



University of Reading – Health & Life Science Building

Ground Water Protection Validation Report to discharge condition 17 of Reading Borough Council's Schedule of Conditions.

June 2019

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Revision 1, 26th July 2019 – For submittal.

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1.0 Application of Ground Water Protection Measures

1.1 Application and Validation

This report has been put together to discharge condition 17 of Reading Borough Council's Schedule of Conditions.

The pre-construction information issued to Balfour Beatty at tender stage highlighted the need to prevent surface water from the Health & Life Science site entering the existing surface/ground water system and therefore the Whiteknights Lake on campus. Please see image below.



Throughout the construction period, Balfour Beatty have put into place several measures to ensure our construction activities have not resulted in pollutants entering the campus water courses.

- Spill Kits
- Concrete wash out
- Induction Info
- Site Inspections
- Fuel and Oil Separator

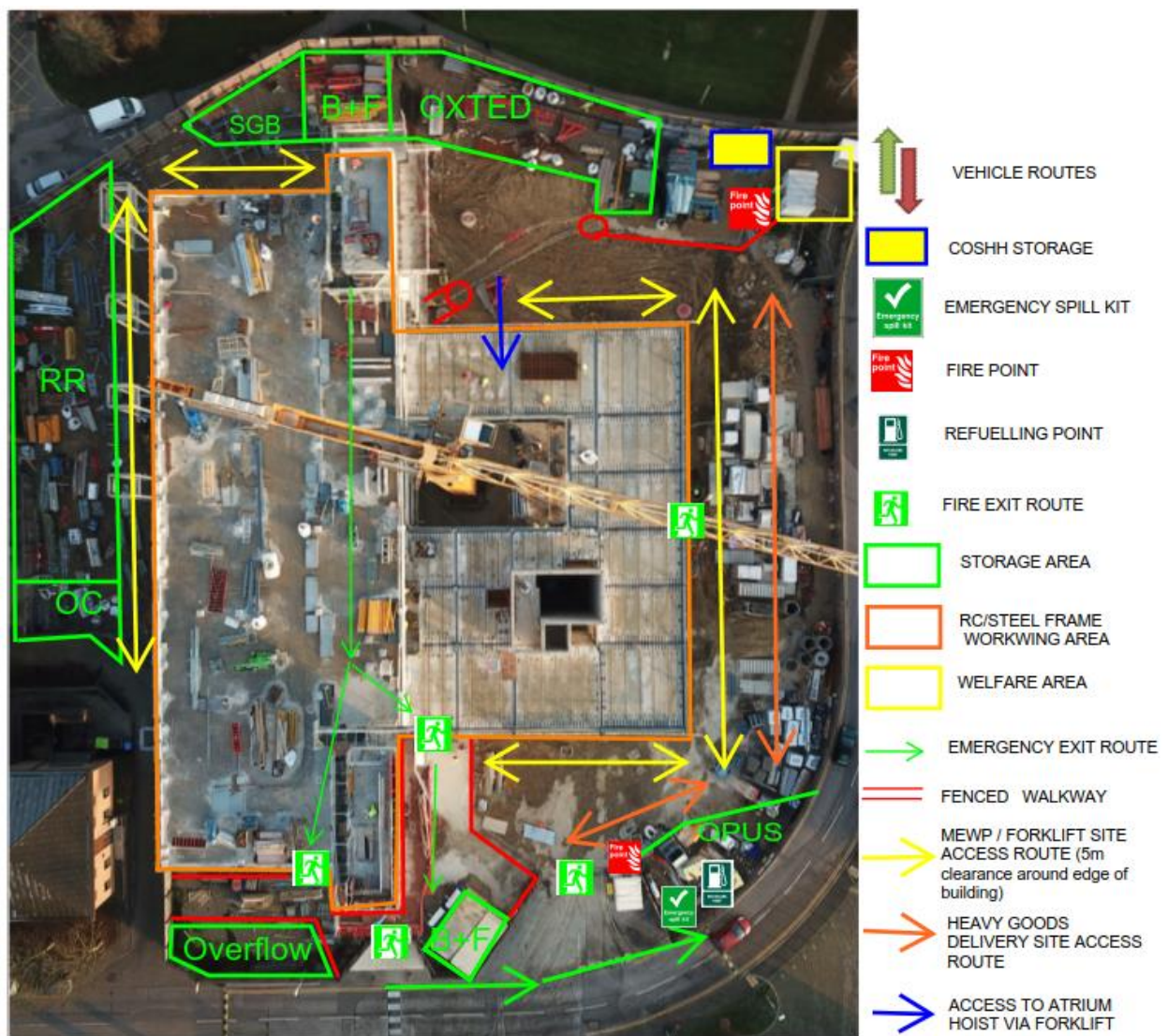
1.2 Spill Kits

Balfour Beatty have employed Wilson James as a logistics provider for the H&LS project. Wilson James operatives have all been briefed on the use of spill kits and regularly undertake practice emergency spill drills.

Please see site logistics plan below for the location of all spill kits within the re-fuelling area.

Additional spill kits are located in both gate houses.

See also *Appendix 1*, showing the Spillage Control Point.





Site re-fuelling area, complete with double bunded fuel tank and spill kit.

1.3 Concrete Wash Out Procedures

Throughout the concrete frame construction at the H&LS building, Balfour Beatty hired the Siltbuster concrete washout system to ensure high pH concrete washout water was treated in the correct manner.

1.4 Induction Information

As part of Balfour Beatty's standard induction process, all operatives are briefed on good environmental practice. The H&LS site induction also includes site specific information to ensure all operatives are aware of the risks involved with allowing contaminants to enter the ground at the University of Reading site. Below is the slide taken from the site induction which is briefed to all operatives before they are allowed to start work on site.

1.5 Site Inspections

Balfour Beatty HSEQ advisor and Environment and Sustainability Specialist also carry out regular site inspections in order to ensure compliance with Balfour Beatty's environmental and sustainability policy and procedures.

ENVIRONMENTAL/COMMUNITY HAZARDS

Balfour Beatty

Master Pollution Incident Plan
Template Form: ENV-TF-0005a

Environment Immediate Action Plan

Pollution Incident Action Plan

- (a) Establish the location / source of the spill / leak and stop further discharge
- (b) Locate your nearest spill kit and prevent further coverage
- (c) Use the absorbent granules and or pads to soak up any spillage
- (d) Clean up the contaminated spill kit and place into a special waste / hazardous waste disposal bag (ensure appropriate PPE is worn at all times)
- (e) Report the Incident to your Line Manager
- (f) In the event that the contaminants have entered the drainage systems the EA should be contacted (03708 506 506)
- (g) In the event of Fuel being discharged into the Drainage System the Emergency Services (Fire) should be notified by dialling 999
- (h) In the event of fuel entering the drainage system everyone operating on site must be evacuated to a designated place of safety.

Foul Drainage
Surface Drainage
Spill Kits
Interceptors

Rivers, Streams, Brooks

Key Contacts

BB Helpline - 0800 121 4444

EA - 03708 506 506

Emergency Services 999 (in the event that fuel is discharged down the drainage system)

Water Provider – Thames Water (UoR)

THINK

- DO NOT PUT ANY CONTAMINATED WASTE INTO THE GENERAL WASTE STREAM
- DO NOT POUR OIL DOWN ANY DRAINAGE SYSTEM

Site operatives are also made aware of the pollution incident plan (included below) which is displayed on site noticeboards.

1.6 Fuel and Oil Separator

At the southern end of the site there is a full retention fuel and oil separator, which prevents hydrocarbons from mixing with surface water. The separator is fitted with an oil probe, automatic closure device and an alarm, which sounds when the oil/fuel level reaches 90% of its storage volume, as required by The Environment Agency's PPG3.

As seen in Appendix 2.

2.0 Geotechnical UoR – Health & Life Science Building Interpretative Report on Ground Investigation

See Appendix 3.

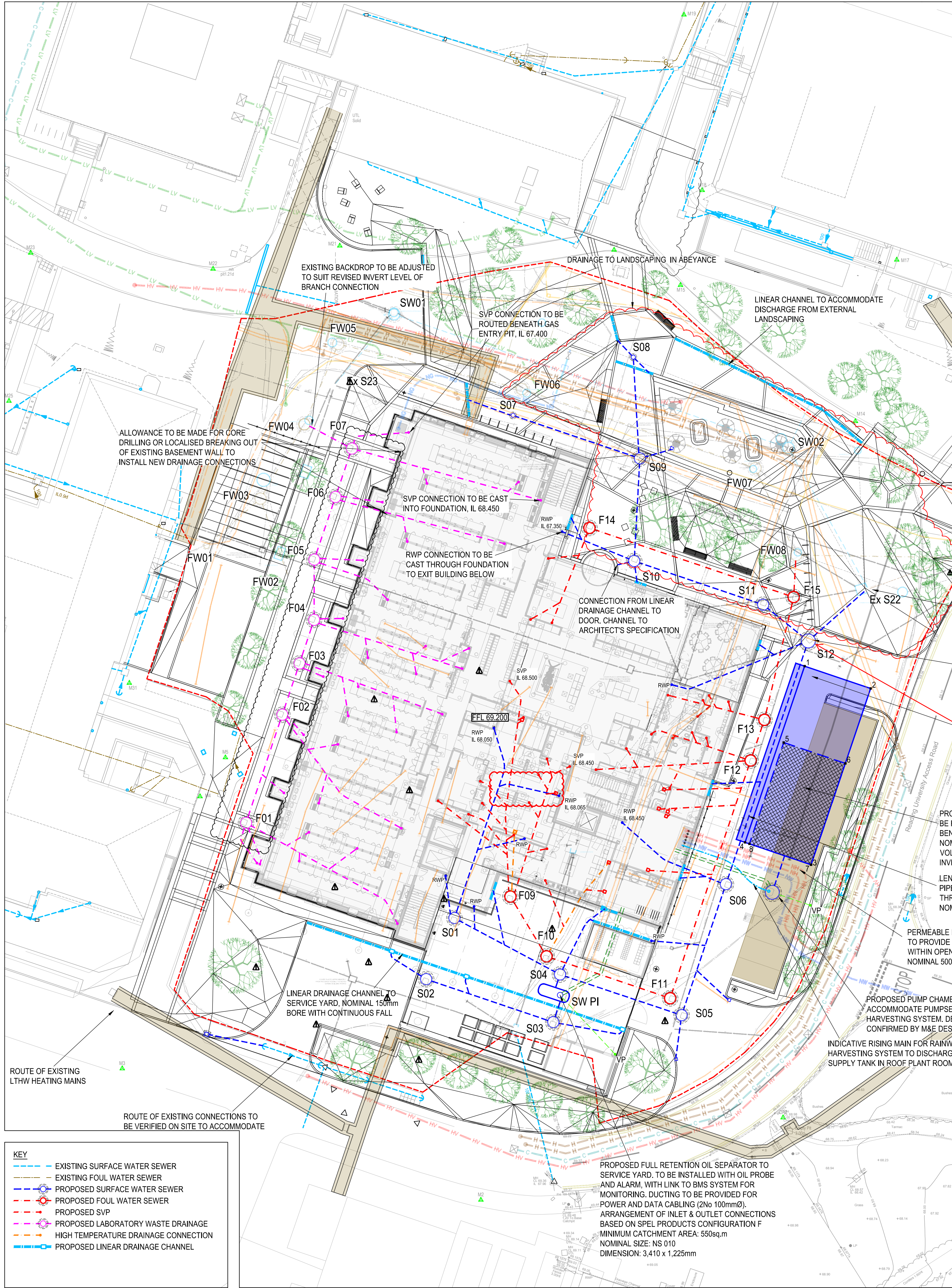
Appendices

Appendix 1. Spillage Control Point

Appendix 2. Fuel and Oil Interceptor

Appendix 3. Ground Investigation Report

APPENDIX 1 – Spillage Control Point



SURFACE WATER MANHOLE SCHEDULE												
Manhole	Cover Level	Manhole Depth	Manhole Size	Cover Size	Cover Type	Pipe Number	Outgoing Invert Level	Pipe Size	Pipe Number	Incoming Invert Level	Pipe Size	Coordinates Easting Northing
RWP	69.200	1.150				1.000	68.050	150				
S01	69.150	1.715	1200	600 x 600	D400	1.001	67.435	225	1.000	67.510	150	473524.028 171493.075
S02	69.120	1.350	1200	600 x 600	D400	2.000	67.770	150				473520.988 171486.510
S03	69.120	1.540	1200	600 x 600	D400	2.001	67.580	150	2.000	67.580	150	473534.662 171481.881
SW PI	69.120	1.630	1200	600 x 600	D400	2.002	67.490	150	2.001	67.540	150	473535.390 171484.790
S04	69.130	1.845	1200	600 x 600	D400	1.002	67.285	225	1.001	67.285	225	473535.381 171487.013
									2.002	67.465	150	
S05	69.000	1.815	1200	600 x 600	D400	1.003	67.185	225	1.002	67.185	225	473548.459 171482.638
S06	69.120	2.300	1200	600 x 600	D400	1.004	66.820	300	1.003	67.065	225	473553.226 171496.719
S07	68.885	1.050	450	600 x 600	C250	3.000	67.835	150				473530.329 171547.115
S08	68.480	0.750	450	600 x 600	C250	4.000	67.730	150				473543.264 171553.377
S09	69.150	1.975	1200	600 x 600	C250	3.001	67.175	225	3.000	67.250	150	473543.970 171542.497
									4.000	67.550	150	
S10	69.175	2.110	1200	600 x 600	C250	3.002	67.065	225	3.001	67.065	225	473543.363 171531.463
S11	68.700	1.785	1200	600 x 600	C250	3.003	66.915	225	3.002	66.915	225	473557.224 171526.770
S12	69.000	2.350	1500	600 x 600	C250	1.005	66.650	150	1.004	66.650	300	473562.079 171522.870
									3.003	66.850	225	
Ex S22	67.940	1.340	Existing	Existing	Existing		Outfall	64.970 ^	1.005	66.600	150	473568.491 171528.519

FOUL WATER MANHOLE SCHEDULE												
Manhole	Cover Level	Manhole Depth	Manhole Size	Cover Size	Cover Type	Pipe Number	Outgoing Invert Level	Pipe Size	Pipe Number	Incoming Invert Level	Pipe Size	Coordinates Easting Northing
SVP	69.200	0.750				1.000	68.450	150				
F01	69.300	1.380	1200	600x600	C250	1.001	67.920	150	1.000	67.920	150	473501.616 171503.312
F02	69.200	1.440	1200	600x600	C250	1.002	67.760	150	1.001	67.760	150	473505.517 171514.941
F03	69.200	1.515	1200	600x600	C250	1.003	67.685	150	1.002	67.685	150	473507.363 171520.445
F04	69.200	1.585	1200	600x600	C250	1.004	67.615	150	1.003	67.615	150	473508.938 171525.139
F05	69.215	1.685	1200	600x600	C250	1.005	67.530	150	1.004	67.530	150	473508.952 171531.612
F06	69.205	1.775	1200	600x600	C250	1.006	67.430	150	1.005	67.430	150	473511.233 171538.349
F07	69.125	1.770	1200	600x600	C250	1.007	67.355	150	1.006	67.355	150	473512.994 171543.552
FW04	68.800	2.230	1200	600x600	C250	Existing	66.570	150	1.007	67.275 ^	150	473507.882 171546.158
SVP	69.200	0.750				3.000	68.500	100				
F09	69.175	1.235	1200	600x600	D400	3.001	67.940	150	3.000	67.990	100	473530.051 171495.393
F10	69.140	1.310	1200	600x600	D400	3.002	67.830	150	3.001	67.830	150	473533.935 171488.959
F11	69.120	1.430	1200	600x600	D400	3.003	67.690	150	3.002	67.690	150	473547.228 171484.459
F12	69.150	1.730	1200	600x600	D400	3.004	67.420	150	3.003	67.420	150	473555.878 171510.009
F13	69.150	1.775	1200	600x600	D400	3.005	67.375	150	3.004	67.375	150	473557.361 171514.390
F14	69.140	1.000	1200	600x600	D400	4.000	68.140	100				473538.549 171535.024
F15	68.780	1.540	1200	600x600	D400	3.006	67.240	150	3.005	67.240	150	473560.509 171527.589
									4.000	67.560	100	
FW08	68.600	2.890	1200	600x600	D400	Existing	65.710	150	3.006	67.015 ^	150	473560.770 171532.100

^ Invert level to top of backdrop
Invert level to be confirmed on-site

Setting Out of Attenuation Tank			
Point Reference	Easting	Northing	Invert Level
Upper Attenuation Tank			
1	473561.691	171520.165	66.750
2	473568.795	171517.760	66.750
3	473562.382	171498.816	66.750
4	473555.278	171501.221	66.750
Lower Attenuation Tank			
5	473559.439	171511.953	66.350
6	473568.069	171509.709	66.350
7	473562.382	171498.816	66.350
8	473555.752	171501.061	66.350

Setting Out of Pumping Chamber			
Point Reference	Easting	Northing	Invert Level
SW PS	473558.209	171495.844	66.650

Spillage control point. All outlets in S12 are bunged. In the event of a spillage, contaminated waste will be pumped from here.

- Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.
- 0mm 50mm 100mm
- GENERAL NOTES:
- DO NOT SCALE DRAWINGS. WORK TO FIGURED DIMENSIONS ONLY.
 - ALL STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, ELECTRICAL, MECHANICAL AND INFRASTRUCTURE DRAWINGS
 - ALL DIMENSIONS IN MM EXCEPT LEVELS WHICH ARE IN METRES.
 - STRUCTURAL ENGINEER TO BE NOTIFIED OF ANY UNFORESEEN STRUCTURES.
 - REFER TO GENERAL NOTES DRAWING No. 80000
 - LOCATION AND ROUTING OF EXISTING SEWERS BASED ON SUBSCAN TOPOGRAPHICAL AND SERVICES SURVEY, REFERENCE 127CS02.
 - EXISTING SERVICES WITHIN DEVELOPMENT PLOT BASED ON SURVEY COMPLETED BY ADIEN, REF 10844-0218-01A DATED MARCH 2018.
 - ROUTING OF SEWERS TO THE SOUTH OF THE BUILDING TO BE CONFIRMED WHERE SURVEY INFORMATION IS INCOMPLETE DUE TO POTENTIAL BLOCKAGES. CAMPUS RECORD DRAWINGS INDICATE ALTERNATIVE ROUTING OF SEWERS WITHIN THE PERIMETER ROADS.
 - CONDITION OF EXISTING SEWERS BASED ON CCTV SURVEY UNDERTAKEN BY SUBSCAN, REFERENCE 9885.
 - INDICATIVE ROUTING OF PROPOSED DRAINAGE SUBJECT TO CONFIRMATION OF LANDSCAPE STRATEGY IN RELATION TO THE EXISTING TREES AND ASSOCIATED ROOT PROTECTION AREAS.
 - CONTRACTOR TO PROVIDE TEMPORARY PROTECTION TO EXISTING DRAINAGE NETWORK TO ENSURE OUTFALL THE WHITEKNIGHTS LAKE IS NOT CONTAMINATED.
 - SURFACE WATER DRAINAGE FROM THE PROPOSED BUILDINGS TO BE LIMITED TO GREENFIELD EQUIVALENT RUNOFF RATE IN ACCORDANCE WITH LOCAL PLANNING POLICY.
 - SURFACE WATER DISCHARGE TO BE LIMITED TO 5.0 l/s IN ACCORDANCE WITH GUIDANCE CONTAINED IN EA/DEFRA PUBLICATION 'RAINFALL RUN-OFF MANAGEMENT FOR DEVELOPMENT'.
 - ATTENUATION SIZING BASED ON ACCOMMODATING ALL FLOWS UP TO THE 1 IN 100 YEAR RETURN PERIOD, PLUS 40% ALLOWANCE FOR CLIMATE CHANGE.
 - PIPE MATERIALS TO BE APPROPRIATE TO ANTICIPATED DISCHARGE TO THE BELOW GROUND DRAINAGE SYSTEMS:
 - SURFACE WATER DRAINAGE - PLASTIC, NITRILE JOINTS
 - FOUL WATER DRAINAGE - CLAY / PLASTIC, SBR JOINTS
 - LABORATORY WASTE DRAINAGE - CLAY / VULCATHENE, EPDM JOINTS
 - AUTOCULVE CONNECTIONS - STAINLESS STEEL, EPDM JOINTS
 - NO ALLOWANCE HAS BEEN INCLUDED FOR SPECIFIC DRAINAGE SYSTEMS FOR CHEMICAL SPILLAGE WITHIN THE SERVICE YARD. IT IS ASSUMED THAT THE SCHOOLS HAVE MANAGEMENT PROTOCOLS ARE IN PLACE REGARDING HANDLING AND TREATMENT OF POTENTIAL SPILLAGES.
 - TRADE EFFLUENT CONSENT MAY BE REQUIRED FOR DISCHARGE OF CHEMICALS TO THE FOUL WATER SEWER NETWORK. IT IS ASSUMED THAT THE EXISTING LABORATORY FACILITIES ACROSS THE CAMPUS HAVE AN EXISTING CONSENT FROM THAMES WATER.
 - ALL BELOW GROUND RAINWATER PIPE CONNECTION TO BE 150mmØ, UNLESS INDICATED OTHERWISE.
 - ALL BELOW GROUND FOUL WATER PIPE CONNECTION TO BE 100mmØ, UNLESS INDICATED OTHERWISE. TYPICAL INVERT LEVEL TO BASE OF STACK TO BE 68.500, UNLESS INDICATED OTHERWISE.

A	C08	23/08/2018	ADDITIONAL SVP AND CONNECTION REMOVED	AB	DM
A	C07	21/08/2018	RAINWATER PIPE LOCATION UPDATED	AB	DM
A	C06	27/07/2018	UPDATES TO LAYOUT TO REFLECT INTERNAL COORDINATION	AB	DM
A	C05	28/06/2018	REVISED AS CLOUDED TO SUIT CHANGE ORDER 04	AB	DM
A	C04	19/06/2018	MANHOLES RELOCATED ALONG WESTERN ELEVATION	AB	DM
A	C03	11/06/2018	INTERNAL DRAINAGE POSITIONS UPDATED. MANHOLES RELOCATED ALONG WESTERN ELEVATION	AB	DM
A	C02	05/06/2018	SETTING OUT TO ATTENUATION TANK ADDED	AB	DM
A	C01	04/04/2018	INTERNAL DRAINAGE UPDATED. MANHOLE COORDINATES ADDED	AB	DM
D4	P01	16/03/2018	ISSUE FOR APPROVAL	AB	DM

STATUS	REV	DATE	DESCRIPTION
CONSULTANT			

REVISOR	REVIEWED BY	CHECKED BY
DAVID MULLKERRIN	DAVID MULLKERRIN	DAVID MULLKERRIN

CLIENT NAME	ORIGINATOR NO
University of Reading	60441574

PROJECT
Health & Life Sciences University of Reading

DRAWING TITLE
PROPOSED MAIN WORKS DRAINAGE GENERAL ARRANGEMENT

SUITABILITY STATUS	As indicated @ A1
PROJECT ORIGINATOR ZONE LEVEL TYPE ROLE CLASS NUMBER	REVISION
1459939-ACM-00-XX-DR-C-ZZZZ-00002	C08

APPENDIX 2 – Fuel and Oil Interceptor

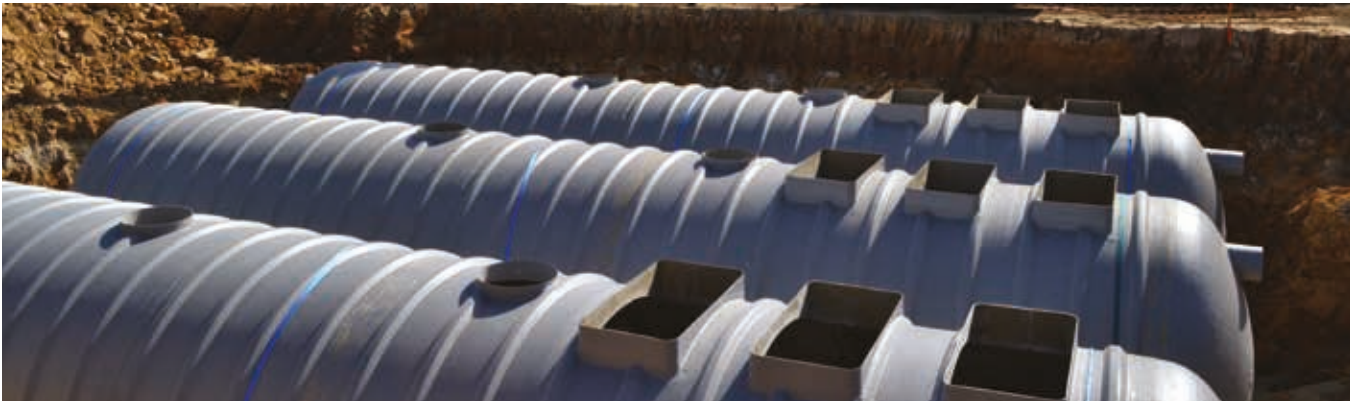


Fuel and Oil Separators



Premier Tech Aqua UK’s range of **Conder Fuel and Oil Separators** are for use with surface water drainage systems and are designed to prevent hydrocarbons (e.g. diesel, petrol, engine oil) from mixing with surface water and entering drainage systems.

Pollution prevention is a critical part of sustainable drainage systems and statutory regulations are in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance.



Compliance
All Premier Tech Aqua UK Conder Fuel and Oil Separators are designed to meet the European standard BSEN-858-1-2.

Under test conditions, the Conder Bypass Separator performed to less than 1 mg/L and in doing so guarantees minimal environmental impact and ensures public safety.

Classes of Separators
There are two classes of separators which are defined by performance.

Class 1
Separators are designed to achieve a concentration of less than 5 mg/L of oil under standard test conditions. These conditions are required for discharges to surface water drains and the water environment.

Class 2*
Separators are designed to achieve a concentration of less than 100 mg/L oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies, such as discharges to the foul sewer.

**Class 2 available in forecourt separators only.*

Separator Alarms
All Fuel and Oil Separators are required by legislation to be fitted with an oil level alarm system with recommendations that the alarm is installed, tested, commissioned and regularly serviced by a qualified technician.

The alarm indicates when the separator is in need of immediate maintenance for it to continue to work effectively. Premier Tech Aqua UK can offer a full technical and service package for a variety of alarm options.

Premier Tech Aqua UK offer a full range of **Fuel and Oil Separators** for a wide variety of uses and applications:

- Bypass Separators
- Forecourt Separators
- Full Retention Separator
- Wash Down and Silt Separators

If you’re unsure of what type of Fuel and Oil Separator you require, please use the chart below to help you identify the most suitable product for your project.

Is there a risk of oil contaminating the drainage from the site?				
YES	YES	YES	YES	NO
Risk of infrequent light contamination and potential for small spills only e.g. car park.	Risk of regular contamination of surface water run off with oil and/or risk of larger spills e.g. vehicle maintenance area, goods vehicle parking or vehicle manoeuvring.	Risk of regular drainage will also contain dissolved oils, detergents or degreasers such as vehicle wash water and trade effluents e.g. industrial sites.	Fuel oils are delivered to and dispensed on site e.g. retail fuel forecourts.	Very low risk of oil contamination e.g. roofwater.
YES	YES	YES	YES	YES
Source control SUDS must be considered and incorporated where suitable.				Separator not required.
IF NOT SUITABLE	Full retention separator with alarm required. Class 1 if discharge to surface water.	Trade effluents must be directed to the foul sewer. It may need to pass through a separator before discharge to sewer to remove.	Full retention forecourt separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Clean water should not be passed through the separator unless the size of the unit is increase accordingly.
By-pass separator with alarm required. Class 1 if discharge to surface water.				
The use of SUDS should be considered at all sites and they should be incorporated where suitable. SUDS can be used to polish the effluent from these separators before it enters the environment.				Source control SUDS should be considered where possible.

Conder Bypass Separators

Premier Tech Aqua UK’s range of Conder Bypass Separators are used to fully treat all flows generated by rainfall rates of up to 6.5 mm/hr. Separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of spillage is small.

Performance

Conder Bypass Separators have been designed to treat all flow rates up to the designed nominal size. Any flow in excess of the nominal size is allowed to bypass the separation chamber, thereby keeping the separated and trapped oil safe.

Typical Applications

- Car parks
- Roadways and major trunk roads
- Light industrial and goods yards

Features and Benefits

- Innovative design
- Compact and easy to handle
- Low installation costs
- Full BSI certification
- Exceeds industry standards
- Easy to service
- Fully tested and verified with a range from CNSB 3 to CNSB 1000 (Class 1)

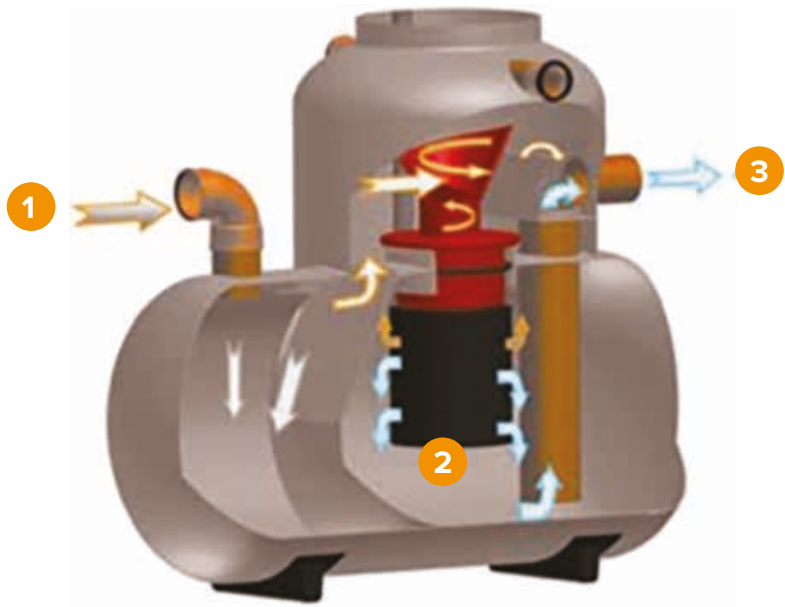
! How it works



During the early part of a rain storm, which is a time of high oil contamination, all the contaminated water flow passes through the sediment collection chamber and enters the separation chamber through a patented oil skimming and filter device.

All the oil then proceeds to the separation chamber where it is separated to the Class 1 standard of 5 mg/L and safely trapped.

As the rainstorm builds up to its maximum and the level of oil contamination reduces significantly, the nominal size flow continues to pass through the separation chamber and any excess flow of virtually clean water is allowed to bypass directly to the outlet.



Specifications

Area Drained (m2)	Tank Code inc. Silt	Length inc. Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)	Access (mm)
1667	CNSB3s/21	1400	300	45	1026	2200	1730	1680	750
2500	CNSB4.5s/21	1785	450	67.5	1026	1875	1270	1220	600
3333	CNSB6s/21	1975	600	90	1026	1875	1270	1220	600
4444	CNSB8s/21	2165	800	120	1026	1875	1270	1220	600
5555	CNSB10s/21	2485	1000	150	1026	1875	1270	1220	600
8333	CNSB15s/21	2670	1500	225	1210	2150	1450	1400	600
11111	CNSB20s/21	3115	2000	300	1210	2150	1450	1400	600
13889	CNSB25s/21	3555	2500	375	1210	2150	1450	1400	600
16667	CNSB30s/21	3470	3000	450	1510	2690	1770	1720	750
22222	CNSB40s/21	4040	4000	600	1510	2690	1770	1720	750
33333	CNSB60s/21	4415	6000	900	1880	3300	2025	1975	2 x 600
44444	CNSB80s/21	5225	8000	1200	1880	3300	2025	1975	2 x 600
55556	CNSB100s/21	6010	10,000	1500	1880	3300	2025	1975	2 x 600

Larger models up to CNSB 1000 are also available.

Note: It is a requirement that you have silt capacity either in your tank or in an upstream catch pit. Specifications for larger models available upon request.

Conder Full Retention Separators

Our range of Conder Full Retention Separators are designed to treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65 mm/hr.

Full Retention Separators are used where there is a risk of regular contamination from oil and a foreseeable risk of significant spillages.

Performance

All Conder Full Retention Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

Typical Applications

- Sites with a high-risk of oil contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops
- Where discharge is to a sensitive environment

Features and Benefits

- All surface water is treated
- Automatic closure device (ACD) fitted as standard



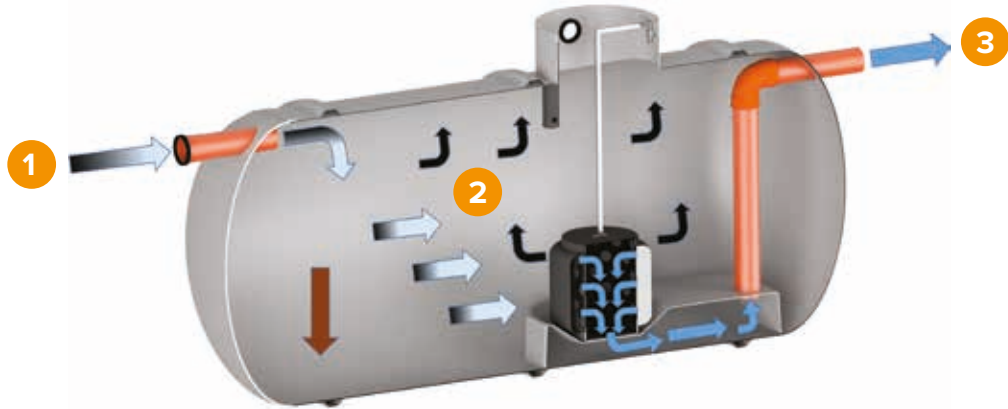
! How it works

- STEP 1
- STEP 2
- STEP 3

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.



Specifications

Area Drained (m²)	Tank Code inc. Silt	Length inc. Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
222	CNS4s/11	2319	400	40	1026	1655	1295	1245
333	CNS6s/11	3414	600	60	1026	1655	1295	1245
444	CNS8s/11	3197	800	80	1210	1855	1480	1430
556	CNS10s/11	3957	1000	100	1210	1855	1480	1430
833	CNS15s/11	3870	1500	150	1510	2180	1780	1730
1111	CNS20s/11	5060	2000	200	1510	2180	1780	1730
1667	CNS30s/11	5369	3000	300	1880	2560	2030	1980
2222	CNS40s/11	7059	4000	400	1880	2560	2030	1980
2778	CNS50s/11	4080	5000	500	2600	3315	2730	2680
3333	CNS60s/11	4805	6000	600	2600	3315	2730	2680
3889	CNS70s/11	5529	7000	700	2600	3315	2730	2680
4444	CNS80s/11	6254	8000	800	2600	3315	2730	2680
5556	CNS100s/11	6751	10,000	1000	2600	3315	2730	2680

Note: It is a requirement that you have silt capacity either in your tank or in an upstream catch pit.

Conder Forecourt Separators

Conder Forecourt Separators have been designed for specific use in petrol filling stations and other similar applications. The size of this separator has been specifically increased in order to retain the possible loss of the contents from one compartment of a road tanker, which could be up to 7,600 litres.

Forecourt Separators are an essential infrastructure requirement for all forecourts to ensure compliance with both health and safety and environmental legislation.

Performance

All Conder Forecourt Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

Typical Applications

- Petrol forecourts
- Refuelling facilities
- Fuel storage depots

Features and Benefits

- All surface water is treated
- Available in Class 1 and Class 2
- Automatic Closure Device (ACD) fitted as standard
- Includes 2000L silt capacity

! How it works

- STEP 1
- STEP 2
- STEP 3

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specifications

Tank Code	Volume (L)	Length (mm)	Diameter (mm)	Height (mm)	Base to Inlet (mm)	Base to Outlet (mm)	Access (mm)
ANO/11*	10,000	4250	1800	2100	1600	1550	750
ANT/12**	10,000	4250	1800	2100	1600	1550	750
LNO/11***	10,000	4250	1800	2100	1600	1550	750

*Class 1 Forecourt Separator suitable for discharging to surface water drains. **Class 2 Forecourt Separator suitable for discharging to foul drains only. ***Class 1 Forecourt Separator suitable for installation in granular materials.

Conder Wash Down and Silt Separators

Our range of Conder Wash Down and Silt Separators are for use in areas such as car washes, pressure wash facilities or other cleaning facilities and must be discharged to the foul water drainage system.

Performance

The Environment Agency requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catch pit for disposal by a licenced waste contractor.

Silt build-up is the primary concern with wash down facilities and so our range of Conder Wash Down and Silt Separators are used to remove the silt and will allow some separation of hydrocarbons. Detergents that are used in wash down areas will break down and disperse hydrocarbons (hindering the separation process). Therefore, it is important to remember the main function of wash down separators is to remove silt.

Typical Applications

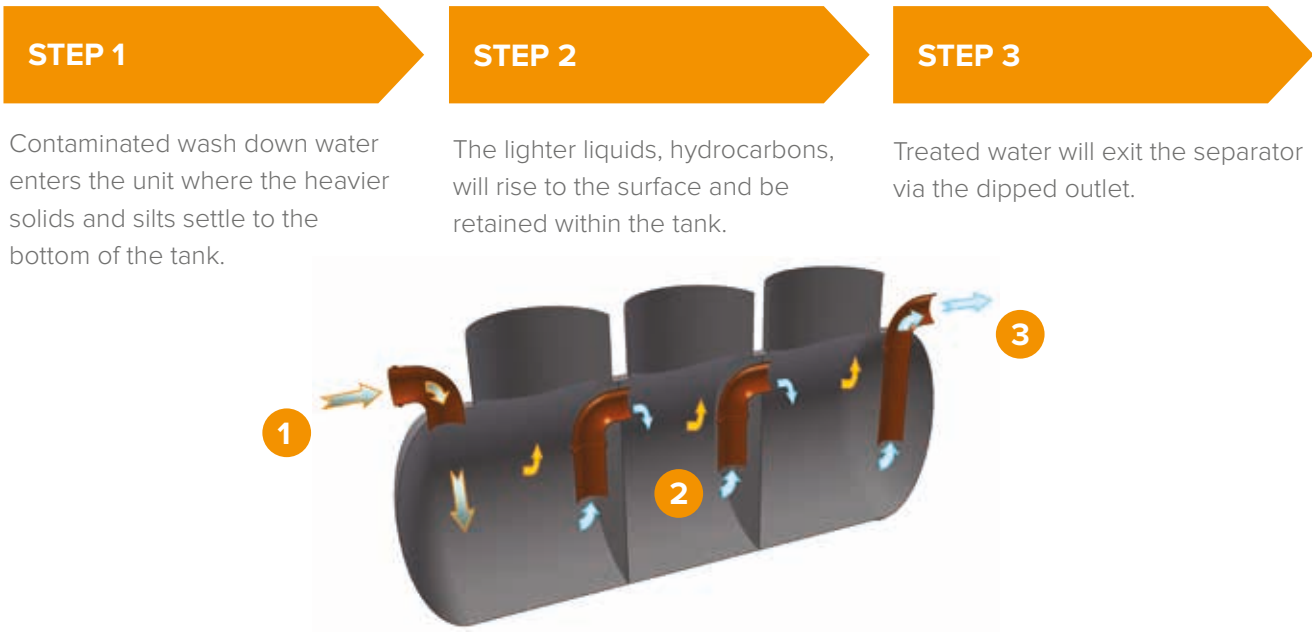
- Car wash facilities
- Tool hire depots
- Pressure washer facilities

Features and Benefits

- Available in 1, 2 and 3 stage options
- Efficient silt and hydrocarbon removal



! How it works



Specifications

Tank Code	Capacity (L)	Silt Storage	Diameter (mm)	Length (mm)	Access Diameter (mm)	Base to Inlet (mm)	Base to Outlet (mm)
CWS2/12	2000	1000	1000	2713	600	1290	1240
CWS3/12	3000	1500	1200	2853	600	1475	1425
CWS4/12	4000	2000	1200	3737	600	1475	1425
CWS6/12	6000	3000	1500	3636	600	1775	1725
CWS8/12	8000	4000	1800	3443	600	2030	1980
CWS10/12	10,000	5000	1800	4250	600	2030	1980

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber Conder Wash Down and Silt Separators are available on request.

Conder FST Silt Trap

Large quantities of silt can be associated with wash down areas. The Conder FST range of silt traps are ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of grated covers from B125 up to E600 to allow installation in all types of vehicle or plant wash down facilities.



Premier Tech Aqua UK Alarm Systems

All separators must be fitted with an alarm to provide visual and audible warning when the level of oil reaches 90% of its storage volume. The alarm system will then be triggered to indicate that the separator is in need of immediate emptying, in order to continue effective operation.



Features and Benefits

- Option for installation at a remote supervisory point
- Audible and visual
- Eliminates unnecessary waste management visits
- Easy installation
- Text message, visual and audible alert alarm systems available

Solar Powered System (Flashing Beacon)

This option requires no mains power supply or any significant cabling or ducting, making it extremely economical for large sites and retro fitting alarms to existing oil separators. A high intensity beacon will flash when a problem is detected.

Solar GSM Alarm

The Solar GSM Alarm sends a status report on your separator to a mobile phone number of your choice. The status of the GSM Alarm can also be tested at any time by simply sending a pre-recorded text message via your directed mobile phone, for additional peace of mind.

Mains Powered System

Mains powered alarm systems are best suited to new build situations or sites where installation of the necessary cabling and ducting is straight forward and economical. The probe located in the separator will, when surrounded by floating hydrocarbons, activate an alarm condition on the remote panel to advise that the unit requires emptying.



Peripherals

Coalescing Filters

The Conder Coalescing Filter is designed to separate residual oil in already separated oil/water and ensures a discharge quality of less than 5 mg/L of oil in water.

Features and Benefits

- Lifting handle for easy removal and cleaning
- Flashing beacons (with option of siren kit)
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

Servicing

The Environmental Agency guidelines stipulate that every 6 months, and in accordance with manufacturer's instructions, experienced personnel should carry out maintenance to both the separator and alarm every 6 months.



Premier Tech Aqua UK is an industry leader in Packaged Water and Wastewater solutions across the UK and Ireland.

Specialists in the design and manufacture of Wastewater, Rainwater Harvesting, Stormwater, Storage and Pump Stations, our innovative ranges are suitable for the industrial, commercial and domestic markets.

As well as an extensive range of products, we can arrange installation through our extensive network of trusted partners.

**For more information or to
arrange a consultation contact:
+44 (0) 8702 64 0004 or visit:
www.premiertechaqua.co.uk to find your
local representative.**

A member of:



Registered with:



Scheme

Warranty

All Premier Tech Aqua UK GRP tanks come with a twenty year warranty and HDPE tanks come with a ten year warranty as standard. Individual product and part warranties are available upon request.

APPENDIX 3 – Ground Investigation Report



UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

INTERPRETATIVE REPORT ON
GROUND INVESTIGATION

Prepared for KNOWLES & SON (OXFORD) LTD

Report Ref: 31710

Geotechnical Engineering Ltd
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UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

INTERPRETATIVE REPORT ON GROUND INVESTIGATION

Prepared for KNOWLES & SON (OXFORD) LTD

Report Ref: 31710

PROJECT: Proposed development

CONSULTANT: AECOM

VOLUME - VERSION	STATUS	ORIGINATOR	CHECKER	APPROVED	DATE
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ORIGINATOR			APPROVER		
					
Jonathan Ind BSc (Hons) MSc FGS Geotechnical Consultant			N Parry BEng MSc CEng MICE MCIHT SiLC Director		

The report is not to be used for contractual or engineering purposes unless this sheet is signed and the report designated "Final".

The report has been prepared for the sole use and reliance by Knowles & Son (Oxford) Ltd. GEL accepts no liability as a result of the use or reliance of this report by any other parties.



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1. INTRODUCTION

It is proposed to replace the existing Engineering Building at the University of Reading with a new purpose-built facility. A new electricity substation is also proposed adjacent to the existing JJ Thomson Building, to the northwest of the Engineering Building. Geotechnical Engineering Limited (GEL) was instructed by Knowles & Son (Oxford) Ltd, acting on behalf of the University of Reading, to carry out an investigation to determine the ground conditions and provide recommendations for foundation design. Contamination testing of soil and water was also undertaken, however this report does not include a full geoenvironmental assessment of the site.

The scope of work and terms and conditions of appointment were defined in correspondence by GEL, reference T23030 dated 2nd February 2016 and subsequent email communication. The investigation was carried out in accordance with the specification provided by the Consultant, being broadly in accordance with the guidance of BS10175:2011+A1:2013 and BS5930:2015.

This report describes the investigation, presents the findings and comments accordingly. The comments given in this report and the opinions expressed assume that ground conditions do not vary beyond the range revealed by this investigation. There may however, be conditions at or adjacent to the site, which have not been disclosed by the investigation and which, therefore, have not been considered in this report. Accordingly, a careful watch should be maintained during any future groundworks and the recommendations of this report reviewed as necessary.

The recommendations given in this report should not be used for any other schemes on or adjacent to this site without further reference to GEL.



2. SITE SETTING

2.1 Site Location and Description

The site is situated at the University of Reading Whiteknights Campus and may be located by its National Grid co-ordinates SU 7352, 7151 or the post code RG6 6UR.

The existing building was roughly T-shaped in plan, comprising a four-storey brick structure at the northern end with a single-storey element extending to the south. The ground level fell gradually from southwest to northeast, up to around 2.5m. The building was bound by a tarmacadam-surfaced car park to the east with the entrance at its southern end. The area to the north and south was mainly surfaced with grass with pedestrian pathways and a number of semi-mature/mature trees. A block-paved pathway was located west of the building. The building was bound by various buried services which are highlighted on Figure 2. Photographs are included in Appendix A.

The site of the proposed substation was located adjacent to a tarmacadam-surfaced access road, south of the existing JJ Thomson Building. The ground level was level and flat, occupying an area of grassed landscaping. A concrete pathway was situated at the northern end, linking to access road to a single-storey brick store with a flat roof. The area to the south was occupied by a skip and two steel storage containers, with a tree positioned beyond.

2.2 Regional Geology

British Geological Survey (BGS) England and Wales (Sheet No. 268 Reading, 1:50,000, published 2000) and the BGS online geology (1:50,000) indicate the site to be underlain by Head deposits, comprising “variably sandy and silty clay with sporadic pebbles”. The Boyn Hill Gravel Member (“sand and gravel”) is shown to the north, east and west of the site and is also likely to be present beneath the Head deposits. The superficial deposits overly the London Clay



Formation, which generally comprises “clay, variably silty, with beds of sand and silt and flint pebble seams; variably glauconitic and shelly”.

BGS boreholes located to the north of the existing library (National Grid co-ordinates SU 73539, 71567) recorded the following ground sequence:

- “Topsoil” to a depth of 0.38m below ground level (bgl);
- “Firm, brown and mottled brown and grey, sandy CLAY with some fine and medium gravel” to 1.68m bgl (Head deposits);
- “Dense to very dense, brown, clayey SAND and GRAVEL” to 4.27m bgl (Boyn Hill Gravel Member);
- “Stiff, brown , silty clay” to 4.57m bgl (London Clay Formation);
- “Stiff, fissured, grey, silty clay” to 6.10m bgl (London Clay Formation).

2.3 Regional Hydrogeology

The Environment Agency’s Groundwater Protection Policy (EA website, 2015) designates that superficial deposits as a Secondary (Undifferentiated) aquifer, meaning that they potentially contain “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers”. The underlying bedrock (London Clay Formation) is classified as unproductive due to low permeability.

The EA website confirms the site to be located approximately 140m southwest of an Inner Zone (Zone 1) Source Protection Zone (SPZ), which is defined as “the 50 day travel time from any point below the water table to the source”.



2.4 Regional Hydrology

There are no surface water features on the site; the nearest relates to Whiteknights Lake, which is located approximately 300m east of the Engineering Building. The River Kennet is situated about 2.2km west of the site.

The EA website indicates the site does not lie within 250m of an Environment Agency fluvial floodplain. The nearest is approximately 1.5km to the west, associated with the River Kennet.

2.5 Radon

The Building Research Establishment (BRE) indicates that no radon protective measures are necessary (BR 211, 2007). It is advised that the local Building Control body is contacted to determine their minimum requirements in respect of radon protection.

3. PROPOSED WORKS

It is proposed to replace the existing Engineering Building at the University of Reading with a new purpose built facility. A new electricity substation is also proposed adjacent to the JJ Thomson Building, to the northwest of the Engineering Building. Exact details of the scheme and foundations loads were unknown at the time of preparing this report. A copy of the scheme drawing, included as part of the Consultants specification, is presented in Appendix B.



4. GROUND INVESTIGATION

4.1 Fieldwork

The fieldwork was carried out in general accordance with BS5930:2015 during the period 31st March to 12th April 2016 and comprised the following:

Existing Engineering Building

- Four cable percussion boreholes.
- In-situ SPT testing and undisturbed sampling (UT100/U100).
- Installation of ground gas and ground water observation wells in each borehole. Post fieldwork monitoring on two occasions.
- Two machine excavated trial pits.
- A single soakaway test in accordance with BRE 365 (2007).
- Three hand dug trial pits to establish existing foundation details.
- Two in-situ Dynamic Cone Penetrometer tests to establish CBR values.

Existing JJ Thomson building

- A single machine excavated trial pit.

The exploratory hole locations were selected by the Consultant and set out by this Company, within the limitations of access, and are shown on Figures 2 and 3. The ground level and co-ordinates at each exploratory hole were established by this Company using GPS techniques.



Boreholes

The boreholes, referenced BH01 to BH04 (Appendix C), were formed using a light cable tool (shell and auger) rig utilising 150mm tools and casing. Initially, an inspection pit was hand excavated at each borehole location to a depth of 1.20m to check for buried services. The boreholes were then advanced using a clay cutter and bailer with the occasional use of a heavy chisel to assist boring.

Representative disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars. Undisturbed samples of 100mm nominal diameter were taken in suitable cohesive soils using an open drive sampler (U100) or a thin walled, open drive sampler (UT100). Samples were wax sealed on site to prevent moisture loss.

Standard penetration tests (SPT) were carried out in general accordance with BS EN ISO 22476-3:2005+A1:2011. A split barrel or a solid cone was used depending upon the materials encountered and the split barrel samples retained in airtight jars. The SPT N value was taken as the number of blows to penetrate the 300mm test drive following a 150mm seating drive. Where low penetration was recorded the seating drive was terminated at 25 blows and the test drive completed after a further 50 blows. Detailed SPT results, together with the energy ratio (E_r), are presented in Appendix C and summarised as uncorrected N values on the borehole logs.

Boreholes were monitored for groundwater ingress as boring proceeded. Water levels were also recorded at the start and finish of each day's work and on completion of the borehole and are presented on the relevant log.

On completion gas/water monitoring standpipes were installed in each borehole. Each installation consisted of a 50mm ID HDPE slotted tube set in a filter response zone of non-calcareous pea gravel. The installation was sealed above and below with a bentonite plug and



accessed via a valve assembly. The installations were protected at the surface by a lockable stopcock cover set in concrete. Installation details are given on the relevant borehole log.

Following completion of the fieldwork, the installations in BH01 to BH04 were monitored on two occasions for gas flow and then tested for methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide using a Gas Data GFM 435 gas analyser. A MiniRAE 2000 PID was used to monitor for Volatile Organic Compounds (VOC's). Atmospheric readings for the three days prior to the monitoring visit were recorded from Weather Underground (www.wunderground.com). The readings are presented in Appendix D together with water level readings.

Trial Pits

The trial pits, referenced TP02 and TP03 (Appendix C), were formed by a wheeled excavator with a 0.60m wide backactor bucket. TP01 was not excavated due to existing trees.

The ground surface at TP02 consisted of hardstanding which required breaking out prior to excavation.

Representative disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars.

Hand vane tests were carried out in suitable cohesive material. The results are presented on the trial pit logs and tabulated in Appendix C.

A soakaway test was carried out in trial pit TP02 in general accordance with BRE 365 (2007). The excavation sides were squared using the excavator bucket and the dimensions recorded within the test section. The trial pit was partially filled with clean water using a dedicated



bowser with a 75mm diameter outlet and the fall in level recorded against time. The test was repeated three times. The results are presented in Appendix C.

Photographs of the trial pit profile and spoil heap were taken and are presented separately.

On completion all trial pits were backfilled with arisings compacted in suitable layers by the excavator bucket. The ground surface at TP02 was reinstated with tarmacadam, whilst the ground surface at TP03 was left slightly proud to accommodate the future inevitable settlement of the backfill.

Foundation Inspection Pits

Three inspection pits, referenced IP01 to IP03 (Appendix C), were hand excavated to uncover the existing foundation bases to the existing building.

Disturbed samples were taken and retained in a combination of plastic tubs, bags and glass jars.

All inspection pits were backfilled with arisings and the surface reinstated.

Foundation sketches and photographs are presented with the inspection pit logs in Appendix C.

Dynamic Cone Penetrometer Tests

Dynamic Cone Penetrometer tests (DCP), referenced DCP01 and DCP02 (Appendix C), were carried out using a CNS Farnell A2465 dynamic cone penetrometer. Probe depths were measured with respect to ground level and the number of blows for the penetration of the



probe was recorded. Equivalent CBR values have been calculated and presented with the results in Appendix C.

Samples for chemical analyses were dispatched daily to ALcontrol, Hawarden, under a Chain of Custody. The remaining samples were brought to this Company's laboratory for testing and storage.

4.2 Logging

The logging of soils was carried out by an Engineering Geologist in general accordance with BS5930:2015. A key to the exploratory hole logs is presented in Appendix B.

Detailed descriptions of the samples are given in the borehole logs, Appendix C, along with details of sampling, in situ testing, groundwater ingress and relevant comments on drilling techniques.

The trial pits and foundation inspection pits were logged in situ to a depth of approximately 1.20m and thereafter from the surface. Detailed descriptions are given in the trial pit logs, Appendix C, along with details of sampling and in situ testing, groundwater ingress and relevant comments on stability.

4.3 Laboratory Testing

A schedule of laboratory tests was prepared by this Company, the following tests being carried out in accordance with BS1377:1990, unless stated otherwise. The number in brackets refers to the test number given in that standard. The results are presented in Appendix E.

The natural water content was determined on sixteen selected samples in accordance with BS EN ISO 17892-1:2014.



Liquid limit, plastic limit and plasticity index tests [Part 2:4.3, 5.3 and 5.4] were carried out on sixteen selected samples. Atterberg line plots have also been presented.

Particle size distributions were determined for five samples by wet sieving [Part 2:9.2]. The fine fractions of two of these samples were further analysed by sedimentation using the pipette method [Part 2:9.4]. The results are presented as grading curves.

The California Bearing Ratio (CBR) test [Part 4:7] was carried out on a single recompacted sample. The results are presented as graphs of force against penetration.

The one-dimensional consolidation properties [Part 5:3] were determined in the oedometer on four 63.5mm diameter by 19mm thick specimens prepared from U100/UT100 samples. The results are presented in tabular form and also as graphs of void ratio versus log (effective pressure).

Unconsolidated undrained triaxial compression tests were carried out under a single cell pressure on fifteen specimens prepared from full diameter U100/UT100 samples [Part 7:8]. A cell pressure equal to the approximate overburden pressure at sample depth was used. Fully saturated, $\phi_u = 0$, conditions were assumed and the undrained cohesion, c_u was taken as half the deviator stress at failure.

Consolidated undrained multistage triaxial compression tests with pore-water pressure measurements [Part 8:4, 5, 6, 7 and Head (1986)] were carried out on two full diameter specimens prepared from U100/UT100 samples.

Hand vane tests were carried out on fifteen undisturbed U100/UT100 samples.



The BRE SD1 (2005) reduced suite; water soluble sulphate, total sulphate and total sulphur, together with pH were determined for ten samples by ALcontrol Laboratories, Hawarden, using in-house methods.

4.4 Chemical Testing

Selected soil samples were despatched to ALcontrol Laboratories under full chain of custody documentation and tested for a suite of contamination as detailed below. The laboratory holds UKAS ISO17025 and MCERTS accreditation for most of the analyses undertaken.

- Arsenic, cadmium, total chromium, lead, mercury, selenium, boron (water soluble), copper, nickel, zinc, speciated polyaromatic hydrocarbons, speciated petroleum hydrocarbons, BTEX, MTBE, speciated phenols, total cyanide, sulphide (acid soluble), sulphate (water soluble) and pH.

Nine soil samples were also screened for asbestos fibres.

The potential risk to groundwater resources was determined by analysis of four groundwater samples taken from standpipes in BH01 to BH04, which were tested for the above suite of contamination together with hardness.

Chemical test results are presented in Appendix F.



5. DISCUSSION AND CONCLUSIONS

5.1 Ground Conditions

The ground conditions revealed by the investigation confirm the strata indicated by the geological records, proving Head deposits over the Boyn Hill Gravel Member. The superficial deposits were underlain by the London Clay Formation. A variable thickness of Made Ground was present above these materials.

Made Ground

Made Ground was recorded to depths of between 0.30m and 1.90m below ground level (bgl) [69.00m and 66.20m OD], with a greater thickness in BH02 and TP03. Below 0.10m of tarmacadam (BH03 and IP02) or block paving (BH04), sub-base comprised very gravelly sand or sandy gravel to a depth of 0.50m bgl, which was further underlain in BH03 by 0.10m of concrete. Within soft landscaping, topsoil comprised dark brown, slightly gravelly, clayey sand or soft/firm, slightly sandy, gravelly clay (including flint and brick). These materials were underlain by very soft, light brown, slightly gravelly, sandy clay (BH02) or dark greenish brown, slightly clayey, gravelly sand, locally with cobbles of brick (TP02, IP01 and IP02). Similar granular material was observed in BH03 to a depth of 1.10m bgl, which may also represent Made Ground. In TP03, the topsoil was underlain by soft, light brown, sandy clay overlying light grey, silty sand. The gravel in these materials comprised flint, brick and concrete.

Head Deposits

With the exception of BH02, the Made Ground was underlain by material which is considered to represent Head deposits. The material comprised soft to firm/firm, locally firm to stiff/stiff, light brown/orangish brown, sandy, locally slightly gravelly clay, where the



gravel was flint. The foundations inspection pits, IP01 to IP03, and TP03 were completed within this material.

Boyn Hill Gravel Member

The Boyn Hill Gravel Member was encountered below depths of between 2.10m and 3.25m bgl [66.40m and 65.85m OD] in BH01 to BH04 and TP02. The material was generally granular in nature, generally comprising light brown slightly clayey, typically very gravelly sand or sandy/very sandy gravel. Towards the base of these deposits, BH01 to BH03 proved beds of stiff/very stiff, slightly sandy/sandy, locally slightly gravelly (flint) clay, between 0.30m and 0.80m thick. The thickness of these deposits ranged between 2.70m and 3.55m, extending to depths of 4.70m and 6.30m bgl [63.40m to 62.30m OD]. TP02 was completed within the granular material at a depth of 2.70m bgl.

London Clay Formation

Underlying the superficial deposits, the London Clay Formation comprised stiff, dark brownish grey, silty clay with rare shell fragments. With increasing depth, the material became locally dark grey in colour with sand sized selenite crystals, gravel sized pockets of fine sand and mica crystals. A very stiff consistency was recorded below depths of around 10.40m to 12.95m bgl. All boreholes were completed at a depth of 18.00m bgl [51.50m to 50.10m OD].

Groundwater

Groundwater was encountered in BH03, within the Boyn Hill Gravel Member, at a depth of 3.50m bgl [65.10m OD], rising to 3.10m bgl [65.50m OD] after a 20 minute monitoring period. Perched water was also encountered in TP02 at the interface of the Made Ground



and underlying Head deposits at a depth of 1.10m bgl [67.40m OD]. The remaining holes remained dry during the short time they remained open.

Post fieldwork monitoring of the observation wells in BH01 to BH04 recorded at depths of between 3.22m and 3.91m bgl (65.62m and 64.28m OD).

5.2 Existing Foundations

Inspection pits, referenced IP01 to IP03 were excavated by hand to establish foundation details of the existing engineering building.

IP01 revealed a concrete foundation, extending 0.30m from the face of the wall, bearing at a depth of 0.90m bgl upon firm to stiff, slightly sandy slightly gravelly clay, which is considered to represent Head deposits.

In IP02, a concrete foundation was uncovered, extending 0.95m from the face of the wall, bearing at a depth of 1.15m bgl upon soft to firm, slightly sandy clay (Head deposits).

A concrete ground beam (?) was revealed in IP03, underlain at a depth of 0.40m bgl by firm to stiff, slightly gravelly, sandy clay (Head deposits).

Sketches are presented with the trial pit logs in Appendix C. Photographs are included in Appendix A.



5.3 Geotechnical Appraisal

Made Ground

No laboratory testing was carried out on the Made Ground.

A single SPT test was carried out within the cohesive Made Ground in BH01, inferring a very soft consistency after the application of a 5kPa correlation factor (Stroud, 1974).

Head Deposits

Index tests indicate the material is typically of intermediate plasticity and possesses a medium volume change potential in response to changes in moisture content (NHBC, 2014).

A high plasticity was indicated for the material from BH04 at 3.15m bgl.

SPT N values of between 11 and 16 were obtained for the Head deposits, indicating a firm/stiff consistency after the application of a 5kPa correlation factor (Stroud, 1974). Hand vane readings of 61kPa and 126kPa infer the clay to firm/stiff.

Consolidation tests carried on samples of the Head deposits from BH01 at 2.80m bgl, BH03 at 2.30m bgl and BH04 at 2.80m bgl provided coefficient of compressibility (m_v) values of between 0.098 and 0.290m²/MN for the pressure range 100kPa to 200kPa (i.e. low to medium compressibility).

CBR values of 4.8% and 7.4% were obtained for the cohesive Head deposits from a recompacted laboratory test on material from BH01 at 0.50m bgl.



A consolidated undrained triaxial test carried out on a sample of the Head Deposits in BH04 at 2.90m bgl provided an angle of shearing resistance (ϕ') of 26.6° and an effective cohesion (c') of 10.1kPa.

Boyn Hill Gravel Member

Index tests indicate the cohesive soils are of high plasticity and possesses a medium volume change potential in response to changes in moisture content (NHBC, 2014).

Particle size distribution tests indicate the granular soils to comprise:

- 1-11% fines (clay/silt), 46-56% sand and 36-52% gravel or
- 9% fines, 72% sand and 19% gravel.

Typically, SPT N values (13 to 46) indicate the granular deposits to be of medium dense/dense relative density. A further N value of 8 infers the basal deposits in BH04 to be loose. Further tests were partially carried out within the underlying London Clay Formation, suggesting a medium dense/dense relative density (N values of 20 to 36).

London Clay Formation

Index tests indicate the London Clay is of high plasticity. Based upon the plasticity indices, this material is considered to be of medium and high volume change potential in response to changes in moisture content (NHBC, 2014).

SPT N values of between 13 and 48 infer the London Clay to be typically stiff, becoming very stiff with increasing depth, after the application of a 5kPa correlation factor (Stroud, 1974).



Triaxial tests yielded undrained cohesion of between 94kPa and 242kPa, indicating the upper weathered part of the London Clay to be stiff, becoming very stiff with increasing depth. Hand vane readings suggest the material to be at least stiff.

A consolidation test carried on a sample of the London Clay from BH04 at 6.5m bgl provided a coefficient of compressibility (m_v) value of $0.096\text{m}^2/\text{MN}$ for the pressure range 200kPa to 400kPa (i.e. low compressibility).

A consolidated undrained triaxial test carried out on a sample of the London Clay in BH03 at 7.15m bgl provided an angle of shearing resistance (ϕ') of 25° and an effective cohesion (c') of 2.6kPa.

5.4 Foundation Considerations

Details of the scheme including foundation loads were unknown at the time of preparing this report. As such, the following comments are of a general nature and should be reviewed when appropriate information becomes available.

The exploratory holes proved a variable thickness of Made Ground, up to 1.90m thick, which is considered an unsuitable bearing stratum. Due to the changeable bearing characteristics and localised absence of the Head deposits, it is generally recommended that foundations bear within underlying natural materials, although it may be locally utilised to support lightly loaded structures.

The Boyn Hill Gravel Member, as encountered between depths of between 2.10m and 3.25m bgl [66.40m and 65.85m OD] would offered an allowable bearing capacity of at least 200kPa, however the depth of excavation through Made Ground and localised groundwater ingress may pose problems for construction and health and safety.



Given the above, it is considered that the most suitable solution is likely to be piles, extending into the London Clay Formation.

Given the potential problems with noise/vibrations during pile driving within proximity to existing buildings and services, continuous flight auger (cfa) or bored piles are likely to be considered the preferred option.

Temporary casing will be required to maintain hole stability within the Made Ground and superficial deposits.

Piles will need to be designed to resist tensional forces that may be caused by rehydration of the clay soils within proximity to existing trees/vegetation and should therefore be designed as tension piles and/or sleeved to accommodate heave.

It will be important that the concrete is poured as soon as the excavation is completed to avoid softening and the potential for groundwater ingress into the base of the shaft.

Based on the undrained shear strength plot in Appendix G, preliminary allowable working loads have been calculated for a single bored cast in-situ pile of given diameter, as presented in Table 5.1 below. The toe depth given is based on piles being installed from an assumed formation level of 69m OD to a level of 53m OD, providing a minimum of 9.3m penetration into the London Clay. An adhesion factor (α) of 0.45, bearing capacity factor (N_c) of 9 and a combined factor of safety of 2.5 have been applied. Skin friction associated with the Made Ground, Head deposits and Boyn Hill Gravel Member has been ignored. An average undrained cohesion of 130kPa has been assumed over the shaft and an undrained shear strength of 180kPa at the pile toe.



Pile length (m)	Allowable Working Load (kN)					
	Pile Diameter					
	300mm	450mm	600mm	750mm	900mm	1200mm
16	250	410	595	800	1030	1555

Table 5.1: Preliminary Pile Working Loads

Once more detail is available with respect to the proposed scheme and loadings, it is recommended that specialist piling contractors should be consulted to advise further on the most suitable pile type, installation method and to provide final design working loads on their chosen system.

Given the presence of shrinkable soils at shallow depth and the potential for shrinkage/heave within the influence zone of existing trees, it is recommended that the ground floor slab is constructed as fully suspended.

5.5 Excavations

Excavations should be within the scope of conventional backhoe excavators. Recourse to hydraulic breakers may be required to break out existing obstructions.

Excavations through the Made Ground are likely to be unstable, even in the short term. If potentially unstable excavations or any excavations deeper than 1.00m are to be entered then the sides should be battered back and/or shoring methods and equipment should be utilised in accordance with relevant Health and Safety legislation.

All excavations should be closely inspected and any loose or soft spots should be removed and replaced with suitably compacted granular material. In order to prevent formation



softening and deterioration it is recommended that all foundations be cast as soon as possible after the excavation or a concrete blinding is placed to protect the formation.

5.6 Buried Concrete

In accordance with the BRE Special Digest 1 (2005) the site is not regarded as brownfield, however the ground is considered to contain sulfides.

The chemical analyses recorded in the investigation fall within the Design Sulfate Class DS-1 for the superficial deposits, based upon the water soluble and groundwater sulphate values. Taking into account mobile groundwater conditions and with alkaline pH values, an ACEC site classification of AC-1 is proposed.

For piled foundations extending into the London Clay Formation, a Design Sulfate Class DS-1 and ACEC site classification of AC-1 is also recommended since the material should not be significantly disturbed.

The total sulphur results indicate that the London Clay Formation possesses a high sulphide content. Any excavated clay should not be reused on site where it could come into contact with, or influence, any buried concrete as it is likely to become sulphate rich upon oxidation.

5.7 Pavement Design

Dynamic Cone Penetrometer (DCP) tests, referenced DCP01 and DCP02, were carried out along the route of a proposed access road. The results suggest a California Bearing Ratio (CBR) value of at least 5% for the Head deposits in DCP01 (with comparison to the ground profile in BH01). Below a depth of around 1.1m bgl, an increase in CBR value was recorded with increasing depth (>16%). Index testing on samples of the near surface Head deposits



(BH01 at 0.50m bgl) suggest the near surface clays should yield a CBR value of approximately 3-4% as per Table 5.1 of the Highways Agency publication IAN 73/06 (2009), based on a plasticity index of 30%. CBR values of 4.8% and 7.4% were obtained for the cohesive Head deposits from a recompacted laboratory test on material from BH01 at 0.50m bgl. A conservative CBR value of 3% is therefore suggested for the Head deposits.

Within the existing car park, DCP02 initially recorded CBR values of at least 32% (probable Made Ground), decreasing below around 0.75m bgl, where CBR values of at least 11% are indicated.

For Made Ground, unless it is removed or suitably proof-rolled/compacted prior to road construction, a CBR value of 2% is recommended, unless in-situ CBR test are carried out closer to the time of construction.

On the basis of classification testing and using TRRL and published data (Croney et al, 1967), the near Head deposits are not considered to be susceptible to frost heave.

5.8 Soakaway Design

Soakaway testing in TP02 recorded negligible infiltration during the test period. Soakaway drainage would therefore not be expected to form a viable solution and alternative forms of drainage should be sought (i.e. drainage to storm water sewers).

5.9 Contamination Considerations

5.9.1 Basis of Assessment - Soils

The concentration of contamination present at a site must be assessed in relation to a recognised system of defining whether a site presents a significant possibility of significant



harm to human health. In the UK, the Department of the Environment Food and Rural Affairs (DEFRA) and the Environment Agency (EA) prepared a method for deriving generic and site-specific assessment criteria to establish actual or potential risk to human health. This comprised the Contaminated Land Exposure Assessment (CLEA) methodology, and the associated DEFRA/EA Soil Guideline Value (SGV) reports.

Further guidance was produced by DEFRA in “Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance (2012)” supporting the use of Generic Assessment Criteria (GACs) as screening tools in generic quantitative human health risk assessment to help assessors decide when land can be excluded from the need for further inspection and assessment, or when further work may be warranted. They may be used to indicate when land is very unlikely to pose a significant possibility of significant harm to human health but they should not be used as direct indicators of whether a significant possibility of significant harm to human health may exist. Furthermore the Category 4 Screening Levels (C4SLs) derived by DEFRA in 2014 will generally be used in place of SGVs and other guidance. In the absence of a suitable C4SL or SGV, risk assessors are advised to identify and select appropriate generic assessment criteria in accordance with established good practice.

The CLEA computer model has been used for this assessment to derive S4ULs and similarly EIC/AGS/CL:AIRE (2010) and Soil Screening Values (SSVs), in lieu of any other available guidance. The basis for assessment of soils is discussed in full in Appendix H.

5.9.2 Basis of Assessment - Water

In the absence of any National Standards relating to groundwater it is recommended by the Environment Agency to compare the results with the general water quality guidelines from the UK, European Union and World Health Organisation. These are published in Appendix A of the publication “Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the Environmental Protection Act 1990” (2002). New



values published in accordance with the Water Framework Directive (2015) may also be relevant in assessment of groundwater.

5.9.3 Basis of Assessment - Ground Gases

Approved Document Part C2 of the Building Regulations (DoE) recommends a tiered risk assessment approach in respect of “methane and other gases” (used to define hazardous soil gases which originate either from waste deposited in landfill sites or are generated naturally). Approved Document C does not include radon (which is dealt with separately) but does include volatile organic compounds (VOC’s). The methodology for the semi-quantitative risk assessment is defined in BS 8485:2015, which provides a framework in line with CLR 11 (2004). For gases not covered by BS8485:2015, a risk assessment basis is considered appropriate with standards taken from occupational exposure limits or other accepted data. Reference should also be made to CIRIA Report C665 (Wilson et al, 2007).

For the determination of the acceptability of volatile vapours (VOCs) in soils, values derived from Soil Gas Acceptance Criteria for the Protection of Indoor Air Quality for a commercial end-use, documented in the New Zealand Guidelines (1999) shall be used. A “trigger” value of 100ppm was used for the determination of acceptability of soils based on the New Zealand Guidelines.

5.9.4 Comparison of Results - Soil

Potential contamination at the site has been compared with the Generic Assessment Criteria (GAC) screening values for a commercial end use. The screening values are defined by C4SLs or SGVs, LQM/CIEH S4ULs (2014), EIC/AGS/CL:AIRE values (2010) and ATRISK SSVs (2011), calculated using the CLEA (2009) computer model. An assumed Soil Organic Matter of 6% SOM (defined by Environment Agency) was used for the SGVs and C4SLs, whilst a worst case, conservative Soil Organic Matter of 1% SOM was used for the S4ULs (where



applicable), EIC/AGS/CL:AIRE and SSVs (defined by Atkins), as closest to conditions on site [measured SOM of between 0.44% and 1.71%].

General Contaminants

When compared to the published GACs for a commercial end use, no exceedances of general contaminants were recorded. As such, these soils are considered unlikely to present a significant possibility of significant harm to human health with respect to the general contaminants in Table 5.2 below.

Contaminant	Concentration ranges with exceedances	GACs (mg/kg)
Arsenic	Range: 7.0 – 18.3mg/kg	640 [•] [°] [#]
Boron	Range: <1.00 – 1.05mg/kg	240,000 [•]
Cadmium	Range: <0.02 – 1.92mg/kg	190 [•] , 410 [°] , 230 [#]
Chromium	Range: 12 – 21.5mg/kg	8,600 [•]
Copper	Range: 4.01 – 12.7mg/kg	68,000 [•]
Cyanide	All less than 1mg/kg	34 [*]
Lead	Range: 11.2 – 36mg/kg	2,300 [°]
Mercury (Methyl)	All less than 0.14mg/kg	410 [#] , 320 [•]
Nickel	Range: 7.39 – 18.1mg/kg	980 [•] , 1,800 [#]
Phenol	All less than 0.18mg/kg	3,200 [#]
Selenium	All less than 1mg/kg	12,000 [•] , 13,000 [#]
Zinc	Range: 17.8 – 139mg/kg	730,000 [•]

[•]GACs derived from Land Quality Management (LQM)/CIEH S4ULs (2014) for commercial end use (6% SOM)

[#]SGVs (2009) for commercial end use (6% SOM)

[°]C4SLs for commercial end use (6% SOM)

^{*}ATRISK (2011) Soil Screening Values (SSVs) for commercial end use (1% SOM)

Exceedances marked in **bold**

Table 5.2: GAC for General Contaminants



Polyaromatic Hydrocarbons (PAHs)

No exceedances of PAHs were recorded above the published GACs for a commercial end use, as shown in Table 5.3 below. On this basis, these soils are considered unlikely to present a significant possibility of significant harm to human health with respect to PAHs.

Contaminant	Concentration ranges with exceedances	GACs (mg/kg)
Acenaphthene	Range: <0.008 – 0.0191mg/kg	84,000 [57] ^{sol}
Acenaphthylene	All less than 0.0433mg/kg	83,000 [86.1] ^{sol}
Anthracene	Range: <0.016 – 0.114mg/kg	520,000
Benzo(a)anthracene	Range: <0.014 – 0.597mg/kg	170
Benzo(a)pyrene	Range: 0.015 – 0.660mg/kg	35, 77 [°]
Benzo(b)fluoranthene	Range: 0.015 – 0.964mg/kg	44
Benzo(ghi)perylene	Range: 0.024 – 0.472mg/kg	3,900
Benzo(k)fluoranthene	Range: <0.014 – 0.297mg/kg	1,200
Chrysene	Range: <0.010 – 0.565mg/kg	350
Dibenzo(ah)anthracene	Range: <0.023 – 0.110mg/kg	3.5
Fluoranthene	Range: 0.017 – 0.979mg/kg	23,000
Fluorene	Range: <0.010 – 0.020mg/kg	63,000 [30.9] ^{sol}
Indeno(123-cd)pyrene	Range: <0.018 – 0.416mg/kg	500
Naphthalene	Range: <0.009 – 0.0116mg/kg	190 [76.4] ^{sol}
Phenanthrene	Range: <0.015 – 0.289mg/kg	22,000
Pyrene	Range: <0.015 – 0.828mg/kg	54,000

GACs derived from Land Quality Management (LQM)/CIEH S4ULs (2014) for commercial end use (1% SOM)

[°]C4SL for commercial land use (1% SOM)

Figure in square brackets [] refer to where GAC presented exceeds the solubility or vapour saturation limit

Exceedances marked in **bold**

Table 5.3: GAC for Polyaromatic Hydrocarbons

Total Petroleum Hydrocarbons (TPHs), BTEX and MTBE

When compared to the published GACs for a commercial end use, no exceedances of TPHs, BTEX or MTBE were recorded, therefore, these soils are considered unlikely to present a



significant possibility of significant harm to human health. The results are shown in Table 5.4 below.

Contaminant	Concentration ranges with exceedances	GACs (mg/kg)
TPH Aliphatic >C ₅ to C ₆	Range: 0.01 – 0.0104mg/kg	3,200 [340] ^{sol}
TPH Aliphatic >C ₆ to C ₈	Range: 0.01 – 0.0253mg/kg	7,800 [144] ^{sol}
TPH Aliphatic >C ₈ to C ₁₀	Range: 0.01 – 5.02mg/kg	2,000 [78] ^{sol}
TPH Aliphatic >C ₁₀ to C ₁₂	Range: 0.01 – 6.68mg/kg	9,700 [48] ^{sol}
TPH Aliphatic >C ₁₂ to C ₁₆	Range: <0.10 – 15.8mg/kg	59,000 [24] ^{sol}
TPH Aliphatic >C ₁₆ to C ₂₁	Range: <0.10 – 39.6mg/kg	1,600,000
TPH Aliphatic >C ₂₁ to C ₃₅	Range: 21.9 – 105mg/kg	1,600,000
TPH Aliphatic >C ₃₅ to C ₄₄	Range: <0.10 – 90mg/kg	1,600,000
TPH Aromatic >C ₅ to C ₇	All less than 0.01mg/kg	26,000 [1,220] ^{sol}
TPH Aromatic >C ₇ to C ₈	All less than 0.01mg/kg	56,000 [869] ^{sol}
TPH Aromatic >C ₈ to C ₁₀	Range: 0.01 – 3.35mg/kg	3,500 [613] ^{vap}
TPH Aromatic >C ₁₀ to C ₁₂	Range: 0.01 – 4.45mg/kg	16,000 [364] ^{sol}
TPH Aromatic >C ₁₂ to C ₁₆	Range: <0.10 – 3.55mg/kg	36,000 [169] ^{sol}
TPH Aromatic >C ₁₆ to C ₂₁	Range: <0.10 – 24.9mg/kg	28,000
TPH Aromatic >C ₂₁ to C ₃₅	Range: 2.57 – 76.7mg/kg	28,000
TPH Aromatic >C ₃₅ to C ₄₄	Range: 0.976 – 127mg/kg	28,000
Benzene	All less than 0.01mg/kg	27, 95 [#] , 98 [°]
Toluene	Range: 0.002 – 0.00234mg/kg	56,000, 4,400 [#]
Ethylbenzene	All less than 0.003mg/kg	5,700, 2,800 [#]
m,p-Xylene	All less than 0.006mg/kg	5,900, 3,200 (p-xylene) [#]
o-Xylene	All less than 0.003mg/kg	6,600, 2,600 [#]
Methyl-tertiary-butyl-ether (MTBE)	All less than 0.005mg/kg	7,900 [*]

GACs derived from Land Quality Management (LQM)/CIEH S4ULs (2014) for a commercial end use (1% SOM)

Figure in square brackets [] refer to where GAC presented exceeds the solubility or vapour saturation limit

[#]SGVs (2009) for commercial end-use (6% SOM)

[°]C4SL for commercial land use (1% SOM)

^{*}GAC derived from EIC/AGS/CL:AIRE GAC for commercial end use (1% SOM)

Table 5.4: GAC for Total Petroleum Hydrocarbons, BTEX and MTBE



Asbestos

Asbestos fibres were not detected in the nine samples of Made Ground tested.

5.9.5 Comparison of Results - Water

The potential risk to groundwater resources was determined by analysis of four water samples obtained from the monitoring standpipes in BH01 to BH04, taken following completion of the fieldwork on 18th April 2016.

The Water Quality Standards (WQS) employed as Tier 1 Water Environment screening criteria are given in Table 5.5 below. The more conservative values of the UK Drinking Water Standards (UK DWS) and Environmental Quality Standards (EA EQS) (Freshwater) have been selected as the primary Tier 1 Screening Values.

The results in Table 5.5 above fall below the published WQS with the exception of the following:

- Selenium in BH04 (26.5µg/l), above the UK DWS (10µg/l) and WFD (7.5µg/l).
- Sulphide in BH04 (1,300 µg/l), above the EA EQS (250µg/l).
- Polyaromatic hydrocarbons in all standpipes (7.89 – 687µg/l), above the UK DWS (0.1µg/l).
- Total petroleum hydrocarbons in all standpipes (977 - 2790µg/l), above the UK DWS (10µg/l).

The results are discussed further in Section 6.2.



Contaminant	Concentrations ranges with exceedances	EA EQS (µg/l)	UK DWS (µg/l)	WFD* (µg/l)
Arsenic	Range: 0.369 – 1.18µg/l	50	10	7.5
Boron	Range: 15.7 – 30.3µg/l	2,000	1,000	750
Cadmium	Range: <0.1 – 0.209µg/l	5	5	3.75
Chromium	Range: 2.76 – 4.66µg/l	250*	50	37.5
Copper	Range: 0.9 – 1.96µg/l	28**	2,000	1,500
Cyanide (total)	All less than 50µg/l	-	50	-
Lead	Range: 0.05 – 0.158µg/l	250*	10	7.5
Mercury	All less than 0.01µg/l	1	1	0.75
Nickel	Range: 4.35 – 30.6µg/l	200**	50	15
Selenium	Range: 1.53 – 26.5µg/l BH04 above the UK DWS	-	10	7.5
Sulphate	Range: 27,500– 99,400µg/l	400,000	250,000	188,000
Sulphide	Range: <100 – 1,300µg/l BH04 above the EA EQS	250		-
Zinc	Range: 2.7 – 14.6µg/l	500*	5,000	-
Phenols	All less than 1µg/l	300	0.5	
Polyaromatic hydrocarbons***	Range: 7.89 – 687µg/l All above the UK DWS	-	0.1	-
Benzo(a)pyrene	Range: 2.17 – 244µg/l All above the UK DWS	-	0.01	0.0075
TPH (total)▲	Range: 977 - 2790µg/l All above the UK DWS	-	10	-
Benzene	All less than 7µg/l	30	1	-
Toluene	All less than 4µg/l	50	-	-
Xylene	All less than 11µg/l	30	-	

* For freshwater, suitable for coarse fish; hardness band CaCO₃ >250mg/l;

** For freshwater, suitable for all fish life; hardness band CaCO₃ >250mg/l;

*** UK DWS for total PAHs relates to the sum of the individual concentrations of benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene and benzo(b)fluoranthene.

▲ Drinking Water Guidance. 1989 Water quality Regulations (superseded).

•WFD – Water Framework Directive drinking water protected areas

Table 5.5: Inorganic and Organic Tier 1 Water Environment Screening Criteria



5.9.6 Comparison of Results - Ground Gases

The observation wells in BH01 to BH04 were monitored on two occasions following completion of the fieldwork to assist in ground gas risk assessment and provide recommendations for gas protective measures, if required. The results are presented in Appendix B and summarised in Table 5.6 below. A preliminary assessment of the results is provided in Section 6.2.

Borehole	Response Zone/Strata (m bgl)	Evidence of Contamination	No. of Monitoring Visits	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Flow (l/hr)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	Volatile Organic Compounds (ppm)	Water Level (m bgl)	Atmospheric Pressure (Mb)
BH01	1.00 – 6.20/ HD & BHG	No	2	0.0- 0.1	2.8- 4.1	9.9-13.0	0.0	0-1	0	1.7-1.8	3.50- 3.91	1003- 1017
BH02	1.00-4.30/ MG, HD & BHG	No	2	0.0	2.1- 5.1	11.2- 17.9	0.0	0-1	0	0.2-1.4	3.22- 3.85	1003- 1010
BH03	1.00 – 6.30/ HD & BHG	No	2	0.0- 0.1	0.2- 5.2	14.0- 19.8	0.0	0-1	0	0.5-0.9	3.25- 3.52	1004- 1019
BH04	1.00 – 6.20/ HD & BHG	No	2	0.0	1.1- 3.0	15.5- 18.8	0.0	0-1	0	0.6-1.7	3.83- 3.91	1003- 1016

Notes: MG – Made Ground; HD – Head deposits; BHG – Boyn Hill Gravel Member

Table 5.6: Summary of Gas Monitoring Data



6. CONTAMINATION RISK ASSESSMENT AND RECOMMENDATIONS

6.1 Qualitative Risk Assessment

6.1.1 General

The assessment of potential sources of contamination were limited to a site walkover and the findings of the ground investigation. Further assessment should be considered, in accordance with the DEFRA and Environment Agency publication CLR 11 (2004), including a Phase 1 desk study of the site to suitably establish the environmental setting.

Notwithstanding the above, chemical analysis of soils fell below the published GACs for a commercial end use. Asbestos fibres were not detected in the samples of Made Ground tested, although this does not prove the absence of asbestos at the site.

Chemical analysis of groundwater in BH01 to BH04 identified exceedances of selenium, sulphide, polycyclic aromatic hydrocarbons and total petroleum hydrocarbons in groundwater beneath the site.

The concentrations of ground gases (based on methane and carbon dioxide) and vapours observed in BH01 to BH04 during post fieldwork monitoring at the site are discussed in Section 6.2 below.



6.1.1 Receptors and Pathways

Human Health

The results of the chemical analysis and asbestos screening indicate the site presents a **LOW** risk to the human health of end-users of the site based on a commercial end use.

Direct human contact could occur during demolition and construction activities proposed for the site, however the potential risk would be deemed to be **LOW** if precautionary measures discussed in Section 7.5 below are adhered to.

Buried Services

Potential receptors would also include buried services (particularly water pipes); further comment is made in Section 6.3.

Controlled Waters

The superficial deposits are designated as a Secondary (Undifferentiated) aquifer, whilst the underlying bedrock (London Clay Formation) is classified as unproductive due to low permeability. The site is located approximately 140m southwest of an Inner Zone (Zone 1) SPZ.

There are no surface water features on the site; the nearest relates to Whiteknights Lake, which is located approximately 300m east of the Engineering Building. The River Kennet is situated about 2.2km west of the site.



The proposed scheme indicates that the majority of the site will be covered by the new building or hardstanding, which will serve to limit potential contamination into the underlying Secondary (Undifferentiated) Aquifer.

Whilst chemical analysis of groundwater in BH01 to BH04 was generally recorded below the WQS, exceedances of selenium, sulphide, polyaromatic hydrocarbons and total petroleum hydrocarbons, above the WQS, indicate that further assessment will be required.

Given the above, the risk to controlled waters is therefore considered to be **LOW to MEDIUM**.

6.2 Gas Protection Measures

The risk posed by gassing sites can be determined from a semi-quantitative assessment of the risk, as proposed by Wilson and Card (1999), following development of the system as detailed in BS8485:2015. The method uses both gas concentrations and borehole flow rates to define a characteristic situation (CS) for a site based on the limiting borehole gas volume-flow or “Gas Screening Value” (GSV) for methane and carbon dioxide. The GSV (litres of gas per hour) can be calculated from the borehole flow rate (litres per hour) and gas concentration (%). The calculation is carried out for both methane and carbon dioxide and the worst case GSV value is generally adopted for comparison with the Classification Situation.

The ground gas observation wells installed in BH01 to BH04 were monitored on two occasions following completion of the fieldwork. The results indicate a maximum concentration of carbon dioxide (CO₂) at 5.2%, up to 0.1% methane and 1ppm carbon monoxide. Hydrogen sulphide was not measured above the limits of detection. Oxygen concentrations varied between 9.9% and 19.8%. No gas flow was detected during the two visits. Given the recorded concentrations of carbon dioxide, it is recommended that at least



two further gas monitoring visits (four in total) are carried out in to provide more robust data for the site. Once the final gas data has been received, the detailed design of protective measures (if any) should be carried out in accordance with BS8485:2015. This design will depend on the type and use of the proposed building.

Based on the maximum recorded concentration of volatile organic compounds to date (up to 1.8ppm), vapour protection measures would not be considered necessary for development at the site.

The BRE indicates radon protective measures are not required in new developments at this site, however it is recommended that the local Building Control body is contacted to establish their minimum requirements for the area.

6.3 Further Work/Remedial Work

Based on the outline scheme, pre-construction remedial action is not considered necessary to protect the human health of future end-users of the site. Further assessment is however recommended to assess the potential risk to controlled waters, which is likely to include a Phase 1 desk study of the site to establish the environmental setting.

Whilst the results to date indicate that ground gas protection measures are not likely to be required, it is recommended that a further two monitoring visits are carried out (four in total) are carried out to provide more robust data for the site.

The concentrations of organic and inorganic contaminants may have an effect on the choice of materials used for underground services. Particularly at risk are drinking water supplies as any deterioration may have a direct effect on water quality and human health. It is therefore recommended that the specification for underground water supply pipes is



agreed with the Water Supply Company where potentially exposed to elevated contaminants.

6.4 Waste Disposal

No assessment has been made within this report with regard to the classification of material for potential offsite disposal. In order to classify materials as non-hazardous and within the Waste Acceptance Criteria (WAC), further testing may be required prior to the dispatch of waste to landfill. We can assist if necessary, with testing usually taking two weeks at the laboratory. Landfill sites may require pre-treatment of waste prior to disposal. Registration of the site may also be required before materials are dispatched. It is recommended that a suitably competent and licensed waste broker be contacted for advice/guidance on how to proceed and to provide a suitable waste classification of the material.

6.5 General Groundworks

Where construction workers are likely to come into contact with potentially contaminated materials during any redevelopment of the site it will be necessary to ensure that a strict personal hygiene regime is observed. Accordingly, skin contact with and possible ingestion of contaminated materials must be avoided. Adequate washing, toilet and first aid facilities should be provided. Construction workers coming into contact with potentially contaminated materials should wear protective clothing including gloves, overalls, boots and eye protection.

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Geotechnical Engineering Limited

LOCATION PLAN



CLIENT KNOWLES & SON (OXFORD) LTD
SITE UNIVERSITY OF READING - HEALTH & LIFE SCIENCES BUILDING
SCALE Approximately 1:50,000

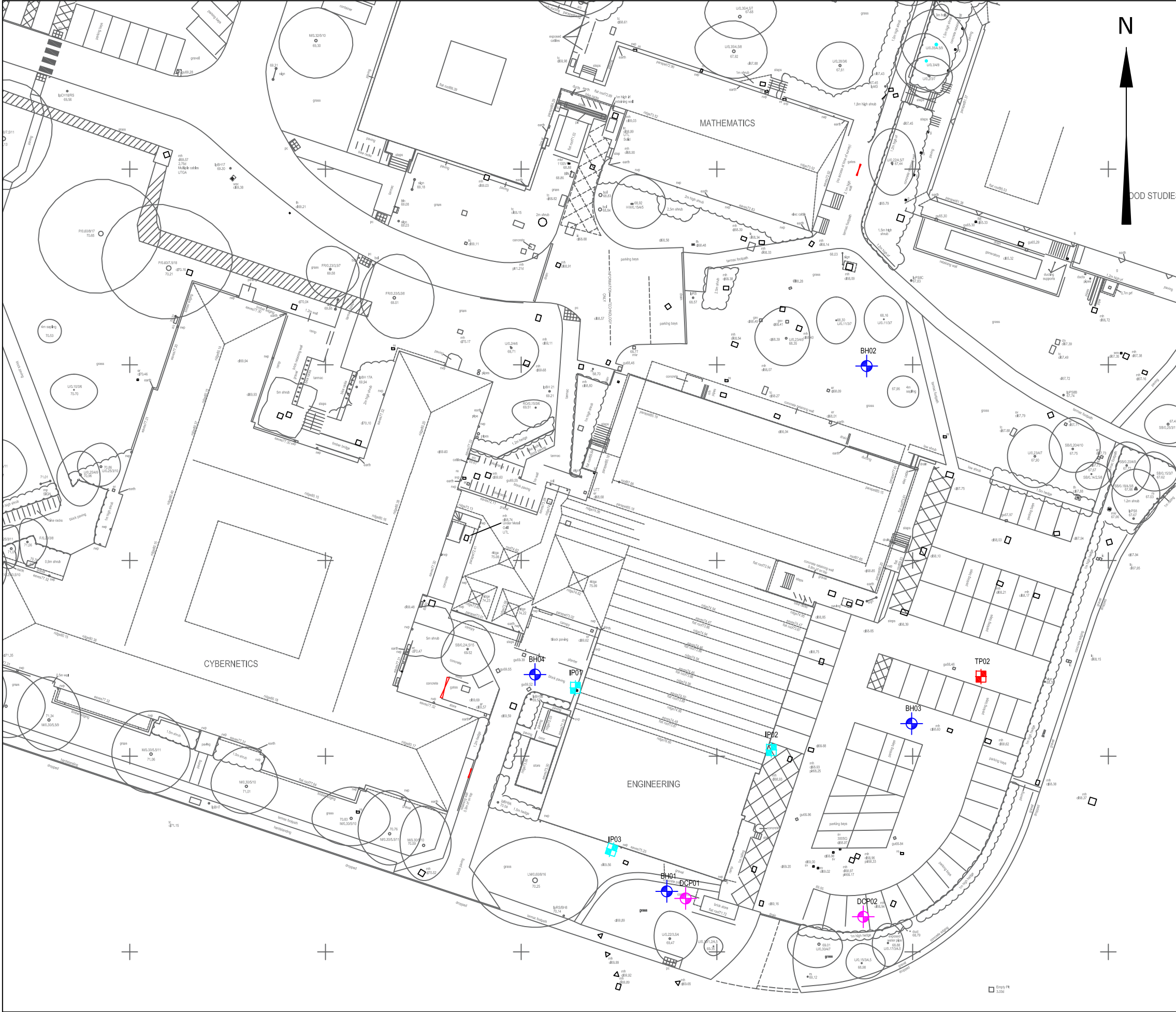
Reproduced from the 2012, 1:50,000 Ordnance Survey Map (Sheet 175 Reading & Windsor) with the permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationary Office, Crown Copyright. Geotechnical Engineering Limited, Gloucester. AL100002447.

CONTRACT

FIGURE

31710

1



Key.



Borehole Location



DCP Location



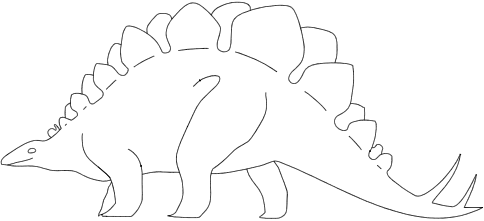
Trial Pit Location



Inspection Pit Location

Notes:

Drawing supplied by client.



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Engineer:

AECOM

Site: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

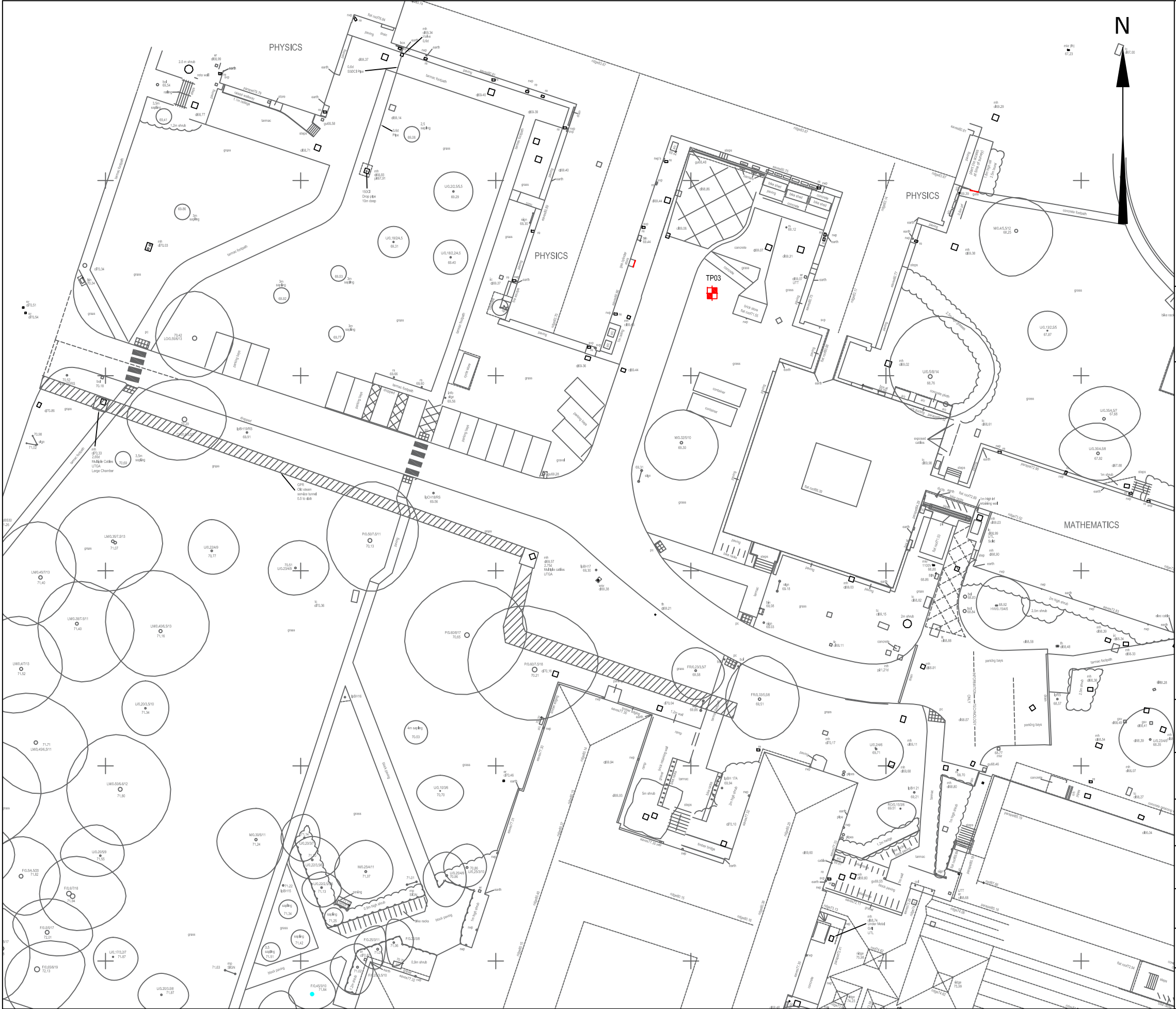
Title:

Exploratory Hole Location Plan

Drawn By:	GJS	Checked By:	JJ	Paper Size:	A3
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Scale:	1:500	Date:	April 2016
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Contract:	31710	Figure:	02
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Key.

- Borehole Location
- DCP Location
- Trial Pit Location
- Inspection Pit Location

Notes:

Drawing supplied by client.

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Engineer:

AECOM

Site: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Title:

Exploratory Hole Location Plan

Drawn By:	GJS	Checked By:	JJ	Paper Size:	A3
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Scale:	1:500	Date:	April 2016
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Contract:	31710	Figure:	03
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APPENDIX A

PHOTOGRAPHS



View of the entrance into Car Park 12, to the south of the existing Engineering Building



View across Car Park 12, looking northwest towards the Engineering Building



View looking west along the southern elevation of the Engineering Building



View looking west along the southern elevation of the Engineering Building



View looking west along the northern elevation of the Engineering Building



View looking southeast towards Car Park 12 from the northeast corner of the Engineering Building



Site of the proposed substation, adjacent to the JJ Thomson Building



Trial pit: TP02 profile



Trial pit: TP02 profile



Trial pit: TP02 profile



Trial pit: TP02 spoil



Trial pit: TP02 spoil



Trial pit: TP02 reinstatement



Trial pit: TP03 profile



Trial pit: TP03 profile



Trial pit: TP03 profile



Trial pit: TP03 spoil



Trial pit: TP03 reinstatement



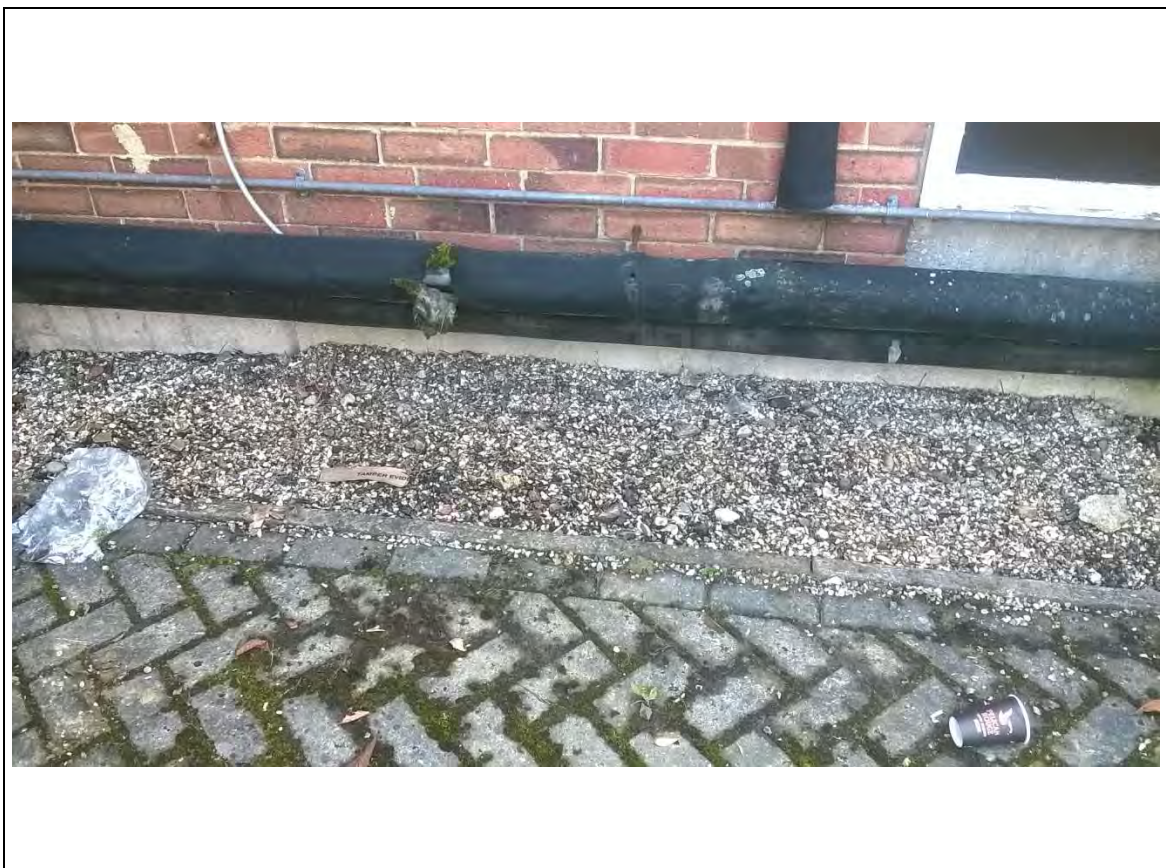
Inspection pit: IP01



Inspection pit: IP01



Inspection pit: IP01 spoil



Inspection pit: IP01 reinstatement



Inspection pit: IP02 profile



Inspection pit: IP02 profile



Inspection pit: IP02 spoil



Inspection pit: IP02 reinstatement



Inspection pit: IP03 profile



Inspection pit: IP03 profile



Inspection pit: IP03 spoil

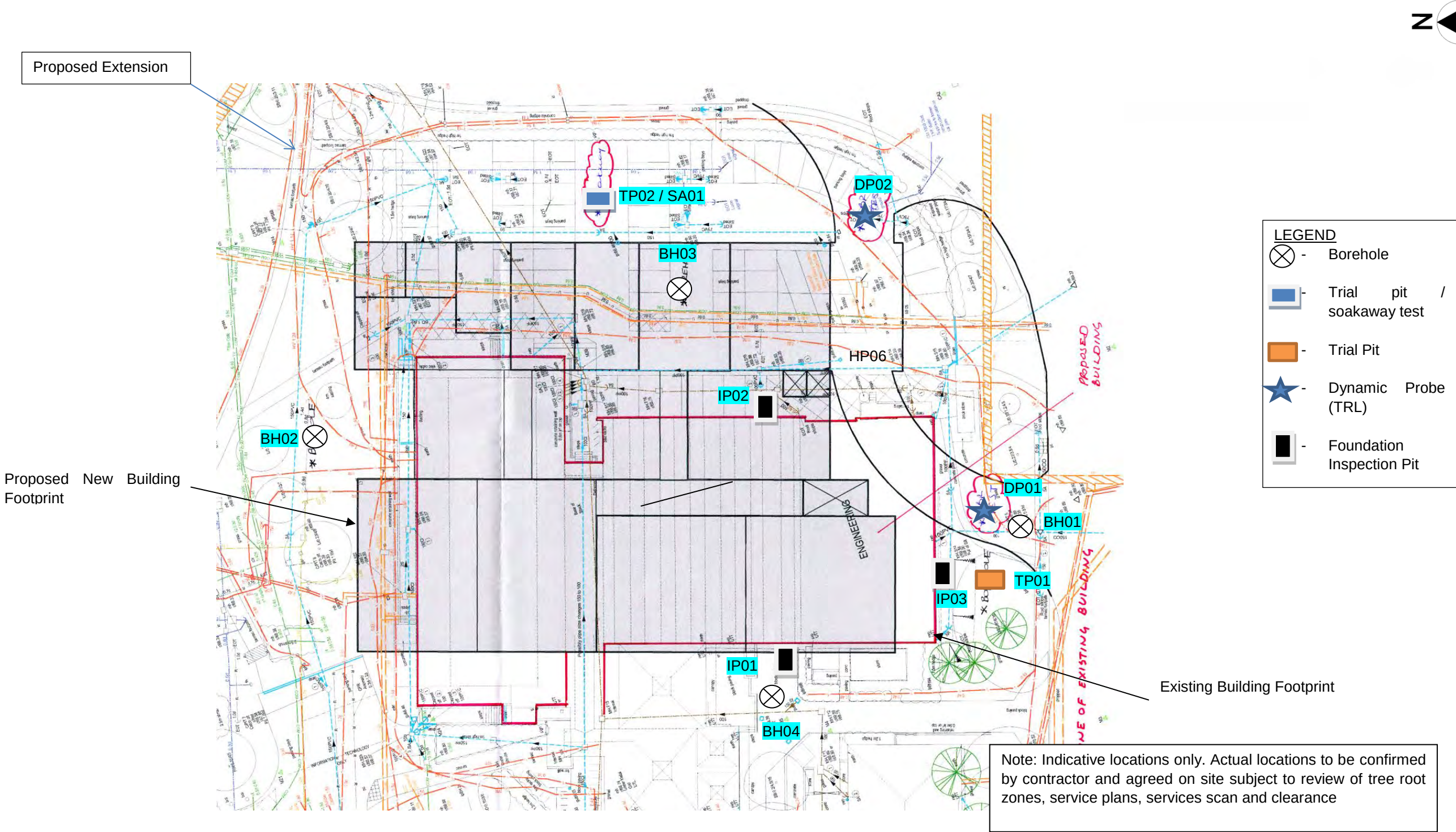


Inspection pit: IP03 reinstatement



APPENDIX B

OUTLINE SCHEME





APPENDIX C

FIELDWORK DATA

KEY TO EXPLORATORY HOLE LOGS



Sample type

D	Small disturbed	U	Undisturbed	X/L	Dynamic	D*/ES	Environmental - soil	Cs	Core subsample (prepared)
B	Bulk disturbed	UT	Undisturbed thin wall	C	Core	EW	Environmental - water	Xs/Ls	Dynamic subsample (prepared)
LB	Large bulk disturbed	P	Piston	W	Water				

Test type

S SPT - Split spoon sampler followed by uncorrected SPT 'N' Value

C SPT - Solid cone followed by uncorrected SPT 'N' Value

(*250 - Where full test drive not completed, linearly extrapolated 'N' value reported, ** - Denotes no effective penetration)

H Hand vane - direct reading in kPa - not corrected for BS1377 (1990). Re* denotes refusal

M Mackintosh probe - number of blows to achieve 100mm penetration

PP Pocket penetrometer - direct reading in kg/sq.cm

Vo Headspace vapour reading, uncorrected peak values in ppm, using a PID (calibrated with Isobutylene, using a 10.6eV bulb)

Sample/core range/l_f

| Dynamic sample

█ Undisturbed sample - open drive including thin wall. Symbol length reflects recovery

x x = Total Core Recovery (TCR) as percentage of core run

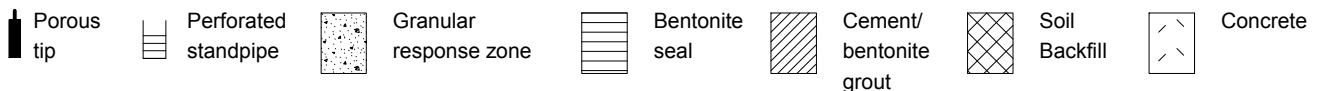
y y = Solid Core Recovery (SCR) as percentage of core run. Assessment of core is based on full diameter.

z z = Rock Quality Designation (RQD). The amount of solid core greater than 100mm expressed as percentage of core run.

Where SPT has been carried out at beginning of core run, disturbed section of core excluded from SCR and RQD assessment.

l_f - fracture spacing - the modal fracture spacing (mm) over the indicated length of core. Where spacing varies significantly, the minimum, mode and maximum values are given. NI = non-intact core NA = not applicable

Instrumentation



Stratum boundaries

----- Estimated boundary -.-.-.-.- Grading boundary

Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930:2015.

Chalk is logged in general accordance with Lord et al (2002) CIRIA C574. Where possible, dynamic samples in chalk have been logged in accordance with CIRIA C574; descriptions and gradings (if presented) should be treated with caution given the potential for sample disturbance.

For rocks the term fracture has been used to identify a mechanical break within the core. Where possible incipient and drilling induced fractures have been excluded from the assessment of fracture state. Where doubt exists, a note has been made in the descriptions. All fractures are considered to be continuous unless otherwise reported.

Made Ground is readily identifiable when, within the material make up, man made constituents are evident. Where Made Ground appears to be reworked natural material the differentiation between in situ natural deposits and Made Ground is much more difficult to ascertain. The interpretation of Made Ground within the logs should therefore be treated with caution.

The descriptors "topsoil" and "tarmacadam" are used as generic terms and do not imply conformation to any particular standard or composition.

Rootlets are defined as being less than 2mm in diameter, roots are defined as in excess of 2mm diameter.

General Comments

The process of drilling and sampling will inevitably lead to disturbance, mixing or loss of material in some soil and rocks.

Indicated water levels are those recorded during the process of drilling or excavating exploratory holes and may not represent standing water levels.

All depths are measured along the axis of the borehole and are related to ground level at the point of entry. All inclinations are measured normal to the axis of the core.

BOREHOLE LOG



BH01

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 2

Start Date 5 April 2016

Easting 473518.6

Scale 1 : 50

End Date 6 April 2016

Northing 171482.7 Ground level 69.50mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
05/04/16 0800hrs	1B	0.20 - 0.40					Grass over soft to firm dark brown slightly sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse flint. (MADE GROUND)	0.50	69.00	
	1ES	0.20 - 0.40								
	2B	0.50 - 0.70					Firm light brown mottled dark orangish brown slightly sandy gravelly CLAY. Gravel is subangular to rounded fine and medium flint. (HEAD DEPOSITS)	0.90	68.60	
	2ES	0.50 - 0.70								
	3B	1.00 - 1.20								
	4D	1.20 - 1.65	1.20	S 13			Firm light brown mottled dark orangish brown slightly gravelly sandy CLAY. Gravel is subangular and rounded fine and medium flint. (HEAD DEPOSITS)			
	5B	2.00 - 2.20								
		2.20 - 2.65	2.20	C 12				2.40	67.10	
	6B	2.30 - 2.50								
	7D	2.80					Firm light orangish brown mottled light grey slightly gravelly sandy CLAY. Gravel is subangular to rounded fine and medium flint. (HEAD DEPOSITS)			
	8U	2.80 - 3.25	2.80					3.25	66.25	
	9D	3.25 - 3.70	3.20	S 16			Medium dense light brown slightly clayey medium and coarse SAND. (BOYN HILL GRAVEL MEMBER)			
								4.00	65.50	
	10B	4.00 - 4.45 4.00 - 4.20	4.00	C 24			Medium dense light brown very sandy subangular and subrounded fine to coarse flint GRAVEL. (BOYN HILL GRAVEL MEMBER)			
								5.00	64.50	
	11B	5.00 - 5.45 5.00 - 5.20	5.00	C 42			Very stiff light brown slightly sandy CLAY. (BOYN HILL GRAVEL MEMBER)			
								5.80	63.70	
	12B	5.80 - 6.00								
		6.00 - 6.45	6.00	C 36			Dense light brown gravelly fine to coarse SAND. Gravel is angular to subrounded fine and medium flint. (BOYN HILL GRAVEL MEMBER)	6.20	63.30	
	13B	6.20 - 6.40								
	14D	6.50								
	15U	6.50 - 6.85	6.50				Stiff dark brownish grey silty CLAY with rare shell fragments (up to 5mm). (LONDON CLAY FORMATION)			
	16D	6.85								
	17D	6.85 - 7.30	6.50	S 24						
	18D	7.50					7.50m: Burrow.			
							Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (150mm) 1.20-18.00m.

CASING: 150mm diam to 7.00m.

BACKFILL: On completion, borehole backfilled with arisings 18.00-8.00m and bentonite pellets 8.00-6.20m. A slotted standpipe (50mm) was installed to 6.20m, granular response zone 6.20-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20- 0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered.

CONTRACT
31710CHECKED
JI

BOREHOLE LOG**BH01**

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 2 of 2

Start Date 5 April 2016

Easting 473518.6

Scale 1 : 50

End Date 6 April 2016

Northing 171482.7 Ground level 69.50mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
05/04/16 1600hrs Dry	19U	8.00 - 8.45	7.00					9.00	60.50	
	20D	8.45								
	21D	8.45 - 8.90	7.00	S 22						
	22D	9.00					Stiff to very stiff dark grey silty CLAY with frequent fine sand sized selenite. (LONDON CLAY FORMATION)			
	23U	9.50 - 9.95	7.00							
	24D	9.95								
	25D	9.95 - 10.40	7.00	S 27						
	26D	10.50								
	27U	11.00 - 11.45	7.00							
	28D	11.45								
06/04/16 0800hrs Dry	29D	11.45 - 11.90	7.00	S 28				15.00	54.50	
	30D	12.00					12.00m: Rare shell fragments (up to 2mm).			
	31U	12.50 - 12.95	7.00							
	32D	12.95					12.95m: Rare mica crystals (up to 5mm).			
	33D	12.95 - 13.40	7.00	S 34			12.95 - 15.00m: Very stiff.			
	34D	13.50								
	35U	14.00 - 14.40	7.00							
	36D	14.40					14.40m: Frequent mica crystals (up to 5mm).			
	37D	14.40 - 14.85	7.00	S 33						
	38D	15.00					Very stiff dark grey silty CLAY with frequent fine and medium gravel sized pockets of light grey fine sand. (LONDON CLAY FORMATION)			
06/04/16 1400hrs Dry	39U	15.50 - 15.95	7.00					18.00	51.50	
	40D	15.95					15.95m: Rare shell fragments (up to 10mm).			
	41D	15.95 - 16.40	7.00	S 48						
	42D	16.50								
	43U	17.00 - 17.45	7.00							
	44D	17.45								
	45D	17.45 - 17.90	7.00	S 39						
							Borehole completed at 18.00m.	{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks							AGS		CONTRACT	CHECKED
Groundwater not encountered.									31710	Jl

BOREHOLE LOG**BH02**

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 2

Start Date 11 April 2016

Easting 473544.1

Scale 1 : 50

End Date 12 April 2016

Northing 171549.8 Ground level 68.10mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
11/04/16 0800hrs	1B 1ES 2B 2ES	0.20 - 0.30 0.20 - 0.30 0.50 - 0.70 0.50 - 0.70				✓	Grass over dark brown mottled light brown slightly gravelly clayey medium and coarse SAND. Gravel is angular and subangular fine and medium brick and flint. (MADE GROUND)	1.00	67.10	
	3B 3ES	1.00 - 1.20 1.00 - 1.20 1.20 - 1.65	1.20	C 2			Very soft light brown slightly gravelly sandy CLAY. Gravel is angular to subrounded fine and medium concrete and flint. (MADE GROUND) 1.00m: Subangular concrete cobble.	1.90	66.20	
	4B 4ES	2.00 - 2.20 2.00 - 2.20 2.20 - 2.65	2.20	C 13			Medium dense light brown slightly clayey very gravelly fine to coarse SAND. Gravel is subangular and subrounded fine to coarse flint. (BOYN HILL GRAVEL MEMBER)	2.70	65.40	
	5B	3.00 - 3.20 3.20 - 3.65	3.20	C 27			Medium dense light orangish brown clayey gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse flint. (BOYN HILL GRAVEL MEMBER)	4.30	63.80	
	6B 7B	4.00 - 4.20 4.20 - 4.65 4.30 - 4.50	4.20	C20			Stiff light brown slightly gravelly sandy CLAY. Gravel is subrounded and rounded fine and medium flint. (BOYN HILL GRAVEL MEMBER)	4.70	63.40	
	8D	5.00 - 5.45	4.50	S 13			Firm dark brownish grey silty CLAY with frequent fine sand sized selenite crystals. (LONDON CLAY FORMATION)			
	9D	6.00								
	10U	6.50 - 6.95	4.50							
	11D 12D	6.95 6.95 - 7.40	4.50	S 20			Stiff dark brownish grey silty CLAY with frequent fine sand sized selenite crystals. (LONDON CLAY FORMATION)	6.95	61.15	
	13D	7.50					7.50m: Subangular claystone cobble.			
							Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (150mm) 1.20-18.00m.

CASING: 150mm diam to 4.50m.

BACKFILL: On completion, borehole backfilled with arisings 18.00-6.30m and bentonite pellets 6.30-4.30m. A slotted standpipe (50mm) was installed to 4.30m, granular response zone 4.30-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20- 0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered.

CONTRACT
31710CHECKED
JL

BOREHOLE LOG

CLIENT KNOWLES & SON (OXFORD) LIMITED

BH02

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 2 of 2

Start Date 11 April 2016

Easting 473544.1

Scale 1 : 50

End Date 12 April 2016

Northing 171549.8 Ground level 68.10mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
11/04/16 1615hrs Dry	14U	8.00 - 8.40	4.50				Stiff to very stiff dark brownish grey silty CLAY with rare shell fragments (up to 2mm). (LONDON CLAY FORMATION)	8.40	59.70	
	15D	8.40								
	16D	8.40 - 8.85	4.50	S 29						
	17D	9.00								
	18U	9.50 - 9.90	4.50							
	19D	9.90								
	20D	9.90 - 10.35	4.50	S 30						
	21D	10.50								
	22U	11.00 - 11.40	4.50					11.40	56.70	
	23D	11.40								
12/04/16 0800hrs Dry	24D	11.40 - 11.85	4.50	S 32			Very stiff dark grey silty CLAY with frequent fine sand sized selenite crystals. (LONDON CLAY FORMATION)			
	25D	12.00								
	26U	12.50 - 12.90	4.50							
	27D	12.90								
	28D	12.90 - 13.35	4.50	S 33						
	29D	13.50						13.50	54.60	
	30U	14.00 - 14.40	4.50							
	31D	14.40								
	32D	14.40 - 14.85	4.50	S 34						
	33D	15.00								
12/04/16 1400hrs Dry	34U	15.50 - 15.95	4.50				15.95m: Frequent shell fragments (10mm).			
	34D	15.95								
	35D	15.95 - 16.40	4.50	S 37						
	36D	16.50								
	37U	17.00 - 17.45	4.50							
	38D	17.45								
	39D	17.45 - 17.90	4.50	S 41				18.00	50.10	
							Borehole completed at 18.00m.	{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks							AGS			
Groundwater not encountered.							CONTRACT			CHECKED
							31710			JL

BOREHOLE LOG

CLIENT KNOWLES & SON (OXFORD) LIMITED

BH03

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 2

Start Date 31 March 2016 Easting 473549.9

Scale 1 : 50

End Date 4 April 2016 Northing 171504.2 Ground level 68.60mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
31/03/16 1200hrs	1B	0.20 - 0.30					MADE GROUND comprising black TARMACADAM.	0.10	68.50	
	1ES	0.20 - 0.30					Light yellowish brown very gravelly medium and coarse SAND. Gravel is subangular and subrounded fine and medium flint and concrete. (MADE GROUND)	0.50 0.60	68.10 68.00	
	2B	0.60 - 0.70					MADE GROUND comprising light grey CONCRETE. (MADE GROUND)	1.10	67.50	
	2ES	0.60 - 0.70								
	3D	1.20					Dark greenish brown very clayey fine and medium SAND. (MADE GROUND?)			
	4D	1.20 - 1.65	1.20	S 11			Firm becoming stiff dark orangish brown mottled light grey sandy CLAY. (HEAD DEPOSITS)			
	3ES	1.50								
	5B	1.80								
	6UT	2.00 - 2.45	2.00							
	7D	2.40								
31/03/16 1600hrs 3.10m	8D	2.40 - 2.85	2.40	S 26				2.75	65.85	
	9B	2.80 - 3.00					Medium dense light orangish brown sandy angular to subrounded fine and medium flint GRAVEL. (BOYN HILL GRAVEL MEMBER)			
01/04/16 0800hrs 3.10m		3.00 - 3.45	3.00	C 28						
	10B	3.80 - 4.00						4.00	64.60	
		4.00 - 4.45	4.00	C 45			Dense light orangish brown very gravelly fine to coarse SAND. Gravel is subangular to rounded fine and medium flint. (BOYN HILL GRAVEL MEMBER)			
	11B	4.80 - 5.00								
		5.00 - 5.45	5.00	C 46						
	12B	5.80 - 6.00								
		6.00 - 6.45	6.00	C 30				6.30	62.30	
	13D	6.30					Stiff light brown mottled dark orangish brown slightly sandy CLAY. (LONDON CLAY FORMATION)	6.60	62.00	
	14B	6.70 - 7.00					Stiff dark brownish grey silty CLAY with rare shell fragments (up to 3mm). (LONDON CLAY FORMATION)			
	15UT	7.00 - 7.45	7.00							
	16D	7.35								
	17D	7.50 - 7.95	7.00	S 21						
Continued Next Page								{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (150mm) 1.20-18.00m.

CASING: 150mm diam to 7.00m.

BACKFILL: On completion, borehole backfilled with bentonite pellets 18.00-6.30m. A slotted standpipe (50mm) was installed to 6.30m, granular response zone 6.30-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20- 0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m)	casing (m)	rose to (m)	time to rise (min)	remarks
3.50	3.50	3.10	20	


CONTRACT
31710
CHECKED
JL

BOREHOLE LOG

CLIENT KNOWLES & SON (OXFORD) LIMITED

BH03

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 2 of 2

Start Date 31 March 2016 Easting 473549.9

Scale 1 : 50

End Date 4 April 2016 Northing 171504.2 Ground level 68.60mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
	18D	8.00					8.00m: Mica crystals (up to 15mm).			
	19UT	8.50 - 8.80	7.00					8.80	59.80	
	20D	8.80								
	21D	9.00 - 9.45	7.00	S 23			Stiff becoming very stiff dark grey silty CLAY with frequent fine sand sized selenite crystals and shell fragments (up to 3mm). (LONDON CLAY FORMATION)			
	22D	9.50								
	23UT	10.00 - 10.45	7.00							
	24D	10.40								
	25D	10.40 - 10.85	7.00	S 34			10.40m: Burrow cast (5mm).			
	26D	11.00								
	27UT	11.50 - 11.95	7.00							
01/04/15 1600hrs Dry	28D	11.95								
	29D	11.95 - 12.40	7.00	S 30						
04/04/16 0800hrs 12.10m	30D	12.50								
	31U	13.00 - 13.45	7.00							
	32D	13.40								
	33D	13.50 - 13.95	7.00	S 34			Very stiff dark grey silty CLAY with frequent fine and medium gravel sized pockets of silty sand. (LONDON CLAY FORMATION)	13.50	55.10	
	34D	14.00								
	35U	14.50 - 14.95	7.00							
	36D	14.90								
	37D	14.90 - 15.35	7.00	S 37			14.90m: Rare shell fragments (up to 3mm).			
	38D	15.50								
	39U	16.00 - 16.45	7.00							
	40D	16.45								
	41D	16.45 - 16.90	7.00	S 36						
	42D	17.00								
04/04/16 1400hrs Dry	43U	17.50 - 17.95	7.00							
	44D	17.95						18.00	50.60	
							Borehole completed at 18.00m.	{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks							AGS	CONTRACT 31710	CHECKED JL	

BOREHOLE LOG



CLIENT KNOWLES & SON (OXFORD) LIMITED

BH04

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 2

Start Date 6 April 2016

Easting 473501.8

Scale 1 : 50

End Date 8 April 2016

Northing 171510.4 Ground level 69.45mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
06/04/16 1400hrs	1B	0.20 - 0.40					MADE GROUND comprising dark grey BLOCK PAVING.	0.10	69.35	
	1ES	0.20 - 0.40					Light greyish brown slightly clayey sandy angular to subrounded fine to coarse concrete and flint GRAVEL.	0.50	68.95	
	2B	0.50 - 0.70					(MADE GROUND)			
06/04/16 1600hrs Dry	2ES	0.50 - 0.70					Soft to firm light brown mottled dark orangish brown slightly sandy gravelly CLAY. Gravel is subangular and subrounded fine and medium flint. (HEAD DEPOSITS)	0.90	68.55	
	3B	0.90 - 1.10								
	3ES	0.90 - 1.10								
07/04/16 0800hrs Dry		1.20 - 1.65	1.20	C 16			Stiff light orangish brown slightly gravelly sandy CLAY. Gravel is subangular and subrounded fine and medium flint. (HEAD DEPOSITS)			
	4B	2.00 - 2.20								
		2.20 - 2.65	2.20	C 12						
	5B	2.40 - 2.70					Firm light orangish brown mottled light grey sandy CLAY. (HEAD DEPOSITS)	2.40	67.05	
	6U	2.70 - 3.15	2.70							
	7D	3.15								
	8D	3.15 - 3.60	3.00	S 31						
	9B	3.50 - 3.70					Dense light brown slightly clayey very gravelly medium and coarse SAND. Gravel is subangular to rounded fine to coarse flint. (BOYN HILL GRAVEL MEMBER)	3.50	65.95	
	10B	4.00 - 4.20								
		4.20 - 4.65	4.20	C 31						
	11B	4.80 - 5.00					Loose light brown very gravelly fine to coarse SAND. Gravel is subangular and subrounded fine and medium flint. (BOYN HILL GRAVEL MEMBER)	4.70	64.75	
		5.00 - 5.45	5.00	C 8						
	12B	6.00 - 6.20								
	13D	6.20								
	14U	6.50 - 6.95	6.50				Stiff dark brownish grey silty CLAY. (LONDON CLAY FORMATION)	6.20	63.25	
	15D	6.95								
	16D	6.95 - 7.40	6.50	S 22						
	17D	7.50					Stiff dark brownish grey silty CLAY with rare shell fragments (up to 2mm). (LONDON CLAY FORMATION)	7.50	61.95	
							Continued Next Page	{8.00}		

EQUIPMENT: Light cable percussive (shell and auger) rig.

METHOD: Hand dug inspection pit 0.00-1.20m. Cable percussion (150mm) 1.20-18.00m.

CASING: 150mm diam to 7.00m.

BACKFILL: On completion, borehole backfilled with arisings 18.00-7.50m and bentonite pellets 7.50-6.20m. A slotted standpipe (50mm) was installed to 6.20m, granular response zone 6.20-1.00m, bentonite seal 1.00-0.20m, concrete and stopcock cover 0.20- 0.00m.

EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

water strike (m) casing (m) rose to (m) time to rise (min) remarks

Groundwater not encountered.

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BOREHOLE LOG

CLIENT KNOWLES & SON (OXFORD) LIMITED

BH04

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 2 of 2

Start Date 6 April 2016

Easting 473501.8

Scale 1 : 50

End Date 8 April 2016

Northing 171510.4 Ground level 69.45mOD

Depth 18.00 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	test type & value	samp. /core range	instru- ment	description	depth (m)	reduced level (m)	legend
07/04/16 1615hrs Dry	18U	8.00 - 8.35	7.00							
	19D	8.35								
	20D	8.50 - 8.95	7.00	S 24						
	21D	9.00						9.00	60.45	
	22U	9.50 - 9.90	7.00							
	23D	9.90								
	24D	9.90 - 10.35	7.00	S 29						
	25D	10.50								
	26U	11.00 - 11.35	7.00							
	27D	11.35								
08/04/16 0800hrs Dry	28D	11.50 - 11.95	7.00	S 29			11.50m: Burrow.			
	29D	12.00								
	30UT	12.50 - 12.90	7.00							
	31D	12.90								
	32D	12.90 - 13.35	7.00	S 31			12.90m: Rare shell fragments (up to 2mm). 12.90 - 13.35m: Very stiff.			
	33D	13.50								
	34UT	14.00 - 14.45	7.00							
	35D	14.45								
	36D	14.45 - 14.90	7.00	S 35				14.45	55.00	
	37D	15.00					Very stiff dark grey silty CLAY with frequent fine and medium sand sized pockets of light grey fine sand and rare shell fragments (up to 2mm). (LONDON CLAY FORMATION)			
08/04/16 1400hrs Dry	38UT	15.50 - 15.90	7.00							
	39D	15.90								
	40D	15.90 - 16.35	7.00	S 36						
	41D	16.50								
	42UT	17.00 - 17.40	7.00							
	43D	17.40								
	44D	17.40 - 17.85	7.00	S 36						
							Borehole completed at 18.00m.	18.00	51.45	
								{18.00}		
water strike (m) casing (m) rose to (m) time to rise (m) remarks							AGS			
Groundwater not encountered.							CONTRACT			CHECKED
							31710			JL

STANDARD PENETRATION TEST

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole no.	borehole depth (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
					blows	pen (mm)	blows	pen (mm)	pen (mm)	pen (mm)			
BH01	1.20	1.65	1.20	Dry	1 2	75 75	2 3 4 4	75 75 75 75			S	13	81
BH01	2.20	2.65	2.20	Dry	1 2	75 75	3 3 3 3	75 75 75 75			C	12	81
BH01	3.25	3.70	3.20	Dry	1 2	75 75	2 4 5 5	75 75 75 75			S	16	81
BH01	4.00	4.45	4.00	3.60	3 4	75 75	6 6 6 6	75 75 75 75			C	24	81
BH01	5.00	5.45	5.00	4.10	3 4	75 75	8 11 11 12	75 75 75 75			C	42	81
BH01	6.00	6.45	6.00	4.90	4 8	75 75	8 6 12 10	75 75 75 75			C	36	81
BH01	6.85	7.30	6.50	6.60	3 4	75 75	5 5 7 7	75 75 75 75			S	24	81
BH01	8.45	8.90	7.00	Dry	2 3	75 75	4 6 6 6	75 75 75 75			S	22	81
BH01	9.95	10.40	7.00	Dry	3 4	75 75	5 6 8 8	75 75 75 75			S	27	81
BH01	11.45	11.90	7.00	Dry	2 5	75 75	5 6 8 9	75 75 75 75			S	28	81
BH01	12.95	13.40	7.00	Dry	5 6	75 75	6 8 10 10	75 75 75 75			S	34	81
BH01	14.40	14.85	7.00	Dry	5 5	75 75	7 8 8 10	75 75 75 75			S	33	81
BH01	15.95	16.40	7.00	Dry	5 6	75 75	8 8 11 21	75 75 75 75			S	48	81
BH01	17.45	17.90	7.00	Dry	6 7	75 75	8 10 10 11	75 75 75 75			S	39	81
BH02	1.20	1.65	1.20	Dry	1 0	75 75	0 1 1 0	75 75 75 75			C	2	81
BH02	2.20	2.65	2.20	Dry	1 2	75 75	2 3 3 5	75 75 75 75			C	13	81
BH02	3.20	3.65	3.20	Dry	1 2	75 75	4 6 8 9	75 75 75 75			C	27	81
BH02	4.20	4.65	4.20	Dry	3 2	75 75	3 4 6 7	75 75 75 75			C	20	81
BH02	5.00	5.45	4.50	Dry	1 2	75 75	2 3 4 4	75 75 75 75			S	13	81
BH02	6.95	7.40	4.50	Dry	2 3	75 75	4 4 6 6	75 75 75 75			S	20	81
BH02	8.40	8.85	4.50	Dry	4 4	75 75	6 7 8 8	75 75 75 75			S	29	81
BH02	9.90	10.35	4.50	Dry	3 4	75 75	5 6 7 12	75 75 75 75			S	30	81
BH02	11.40	11.85	4.50	Dry	4 5	75 75	6 8 8 10	75 75 75 75			S	32	81
BH02	12.90	13.35	4.50	Dry	5 6	75 75	7 8 8 10	75 75 75 75			S	33	81

notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. N values have not been subjected to any correction.
3. Test carried out using split spoon S, solid cone C.
4. Where full test drive not completed, linearly extrapolated N value reported.
5. <1 Denotes hammer self weight penetration (sank under own weight).
6. ** Denotes no effective penetration.

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STANDARD PENETRATION TEST

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole no.	borehole depth (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
					blows	pen (mm)	blows	pen (mm)	pen (mm)	pen (mm)			
BH02	14.40	14.85	4.50	Dry	3 5	75 75	6 8 9 11	75 75 75 75			S	34	81
BH02	15.95	16.40	4.50	Dry	5 6	75 75	8 8 10 11	75 75 75 75			S	37	81
BH02	17.45	17.90	4.50	Dry	4 5	75 75	7 11 10 13	75 75 75 75			S	41	81
BH03	1.20	1.65	1.20	Dry	1 2	75 75	2 3 2 4	75 75 75 75			S	11	81
BH03	2.40	2.85	2.40	Dry	1 3	75 75	3 4 6 13	75 75 75 75			S	26	81
BH03	3.00	3.45	3.00	Dry	2 4	75 75	9 7 6 6	75 75 75 75			C	28	81
BH03	4.00	4.45	4.00	3.10	6 6	75 75	9 11 13 12	75 75 75 75			C	45	81
BH03	5.00	5.45	5.00	3.60	4 8	75 75	9 12 15 10	75 75 75 75			C	46	81
BH03	6.00	6.45	6.00	5.30	2 5	75 75	6 7 8 9	75 75 75 75			C	30	81
BH03	7.50	7.95	7.00	6.20	3 4	75 75	4 5 6 6	75 75 75 75			S	21	81
BH03	9.00	9.45	7.00	Dry	3 4	75 75	5 5 6 7	75 75 75 75			S	23	81
BH03	10.40	10.85	7.00	Dry	4 5	75 75	7 8 8 11	75 75 75 75			S	34	81
BH03	11.95	12.40	7.00	Dry	3 4	75 75	6 7 7 10	75 75 75 75			S	30	81
BH03	13.50	13.95	7.00	Dry	5 9	75 75	7 8 9 10	75 75 75 75			S	34	81
BH03	14.90	15.35	7.00	Dry	4 5	75 75	7 9 10 11	75 75 75 75			S	37	81
BH03	16.45	16.90	7.00	Dry	4 6	75 75	7 9 10 10	75 75 75 75			S	36	81
BH04	1.20	1.65	1.20	Dry	2 2	75 75	4 4 4 4	75 75 75 75			C	16	81
BH04	2.20	2.65	2.20	Dry	1 2	75 75	3 3 3 3	75 75 75 75			C	12	81
BH04	3.15	3.60	3.00	Dry	1 4	75 75	4 8 9 10	75 75 75 75			S	31	81
BH04	4.20	4.65	4.20	4.00	3 4	75 75	6 8 8 9	75 75 75 75			C	31	81
BH04	5.00	5.45	5.00	4.60	3 2	75 75	2 2 2 2	75 75 75 75			C	8	81
BH04	6.95	7.40	6.50	Dry	2 3	75 75	4 6 5 7	75 75 75 75			S	22	81
BH04	8.50	8.95	7.00	Dry	3 4	75 75	4 6 7 7	75 75 75 75			S	24	81
BH04	9.90	10.35	7.00	Dry	4 4	75 75	6 7 7 9	75 75 75 75			S	29	81

notes:

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. N values have not been subjected to any correction.
3. Test carried out using split spoon S, solid cone C.
4. Where full test drive not completed, linearly extrapolated N value reported.
5. <1 Denotes hammer self weight penetration (sank under own weight).
6. ** Denotes no effective penetration.

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SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole no.	borehole depth (m)	bottom depth (m)	casing depth (m)	water level (m)	seating drive		test drive				test type	N	energy ratio (%)
					blows	pen (mm)	blows		pen (mm)				
BH04	11.50	11.95	7.00	Dry	3 5	75 75	5 8 8 8	75 75 75 75		S	29	81	
BH04	12.90	13.35	7.00	Dry	4 4	75 75	6 7 9 9	75 75 75 75		S	31	81	
BH04	14.45	14.90	7.00	Dry	4 5	75 75	7 8 9 11	75 75 75 75		S	35	81	
BH04	15.90	16.35	7.00	Dry	5 7	75 75	7 8 10 11	75 75 75 75		S	36	81	
BH04	17.40	17.85	7.00	Dry	4 6	75 75	7 8 10 11	75 75 75 75		S	36	81	

1. Test carried out in general accordance with BS EN ISO 22476-3:2005 + A1:2011
2. N values have not been subjected to any correction.
3. Test carried out using split spoon S, solid cone C.
4. Where full test drive not completed, linearly extrapolated N value reported.
5. <1 Denotes hammer self weight penetration (sank under own weight).
6. ** Denotes no effective penetration.

CONTRACT
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TRIAL PIT LOG



TP02

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 1

Start Date 4 April 2016

Easting 473558.7

Scale 1 : 25

End Date 4 April 2016

Northing 171510.2 Ground level 68.50mOD

Depth 2.70 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
1.10m: seepage	1B		0.20	MADE GROUND comprising black TARMACADAM.	0.10	68.40	
	1ES		0.20	Light yellowish brown sandy subangular to rounded fine to coarse flint, brick and concrete GRAVEL. (MADE GROUND)	0.35	68.15	
				Dark greenish grey slightly clayey gravelly coarse SAND with a medium subangular brick cobble content. Gravel is angular and subangular fine to coarse brick and flint. (MADE GROUND)			
	2B		0.80				
	2ES		0.80		1.10	67.40	
				Firm to stiff light orangish brown mottled light grey sandy CLAY. (HEAD DEPOSITS)			
	3B	H 92	1.50				
			1.60				
	3ES		1.60		2.10	66.40	
	4B		2.50	Light orangish brown sandy subangular to rounded fine and medium flint GRAVEL. (BOYN HILL GRAVEL MEMBER)			
	4ES		2.50		2.70	65.80	
Damp				Trial pit completed at 2.70m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater seepage encountered at 1.10m.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.70x1.50x2.70m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

TRIAL PIT LOG



TP03

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 1

Start Date 4 April 2016

Easting 473477.7

Scale 1 : 25

End Date 4 April 2016

Northing 171610.6 Ground level 69.15mOD

Depth 2.00 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
Dry	1B		0.20	Grass over soft dark brown slightly gravelly sandy CLAY. Gravel is subangular and subrounded fine to coarse flint. (MADE GROUND)	0.30	68.85	
	1ES		0.20				
				Soft light brown mottled dark orangish brown sandy CLAY. (MADE GROUND)	1.10	68.05	
	2B		0.70				
	2ES		0.70				
		H 28	0.80	Light grey slightly silty fine to coarse SAND. (MADE GROUND)	1.70	67.45	
	3B		1.30				
	3ES		1.30				
	4B	H 61	1.80	Firm light orangish brown mottled light grey sandy CLAY. (HEAD DEPOSITS)	2.00	67.15	
	4ES		1.80				
				Trial pit completed at 2.00m.			

Notes

Trial pit excavated by JCB 3CX mechanical excavator.
Groundwater not encountered.
Trial pit sides remained stable and vertical.
Trial pit dimensions 0.60x1.60x2.00m.
On completion, the trial pit was backfilled with materials arising.

Sketch of Foundation - Not to scale. All dimensions in metres.



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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

Geotechnical Engineering Limited

IN-SITU HAND VANE/POCKET PENETROMETER



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole /trial pit no.	depth (m)	hand vane peak (kPa)	average hand vane peak (kPa)	hand vane remoulded (kPa)	average hand vane remoulded (kPa)	pocket penetrometer (kg/cm ²)	average pocket penetrometer (kPa)*	remarks
TP02	1.50	100 68 108	92	49 45 52	49			
TP03	0.80	30 28 25	28	12 12 10	11			
TP03	1.80	66 57 60	61	42 40 26	36			
general remarks:								
Hand vane test results reported as undrained shear strength. *Average pocket penetrometer results reported as undrained shear strength.							CONTRACT 31710	CHECKED JI

TRIAL PIT LOG



IP01

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 1

Start Date 4 April 2016

Easting 473506.9

Scale 1 : 25

End Date 4 April 2016

Northing 171508.7 Ground level 69.50mOD

Depth 1.00 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
Dry	1B		0.20	Soft dark brown slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. (MADE GROUND)	0.40	69.10	
	1ES		0.20				
	2B		0.60	Dark greenish grey slightly gravelly clayey fine and medium SAND. Gravel is angular and subangular fine and medium flint. (MADE GROUND)	0.90	68.60	
	2ES		0.60				
	3B		0.90- 1.00	Firm to stiff light orangish brown mottled light brown slightly sandy slightly gravelly CLAY. Gravel subangular and subrounded fine and medium flint. (HEAD DEPOSITS)	1.00	68.50	
	3ES		0.90- 1.00				
Trial pit completed at 1.00m.							

Notes

Trial pit excavated by hand.
Groundwater was not encountered.
Trial pit sides remained stable.
On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

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TRIAL PIT DETAIL

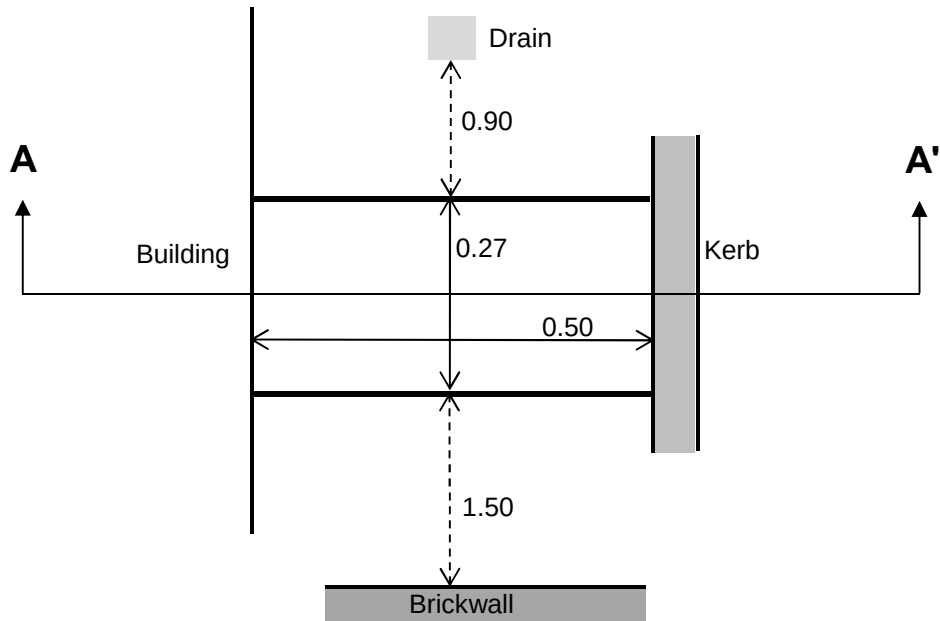
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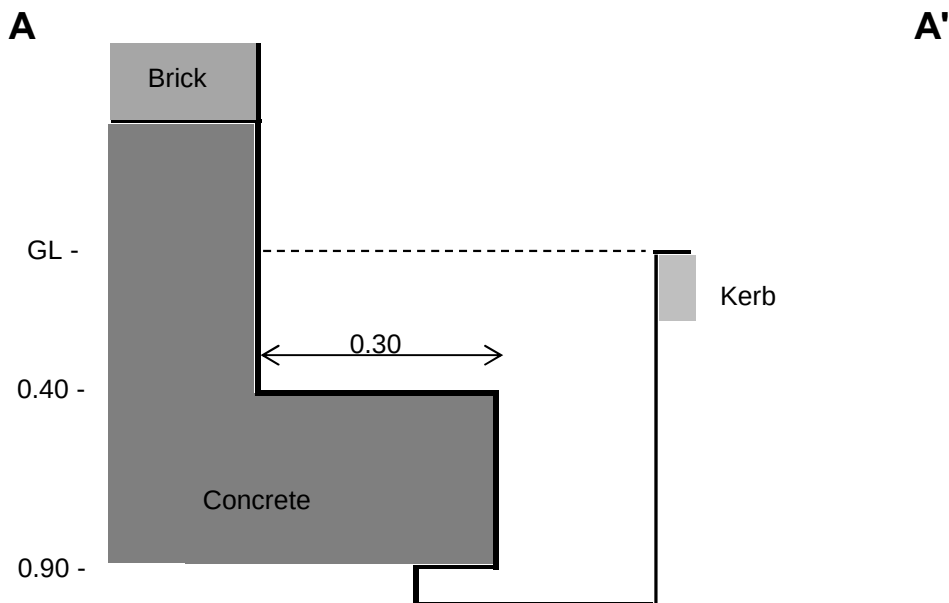


IP01

Plan View



Section A - A'



All measurements in metres.
Not to scale.

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TRIAL PIT LOG**IP02**

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 1

Start Date 4 April 2016

Easting 473532.0

Scale 1 : 25

End Date 4 April 2016

Northing 171500.8 Ground level 68.95mOD

Depth 1.25 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
Dry	1B		0.20	MADE GROUND comprising black TARMACADAM.	0.10	68.85	
	1ES		0.20	Light yellowish brown sandy subangular to rounded fine to coarse flint brick and concrete GRAVEL. (MADE GROUND)	0.35	68.60	
	2B		0.50	Dark greenish grey slightly clayey gravelly coarse SAND with a medium subangular brick cobble content. Gravel is angular and subangular fine to coarse brick and flint. (MADE GROUND)	0.80	68.15	
	2ES		0.50				
				Soft to firm light brown sandy CLAY. (HEAD DEPOSITS)			
	3B		1.00				
	3ES		1.00		1.25	67.70	
				Trial pit completed at 1.25m.			

Notes

Trial pit excavated by hand.
Groundwater was not encountered.
Trial pit sides remained stable.
On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

TRIAL PIT DETAIL

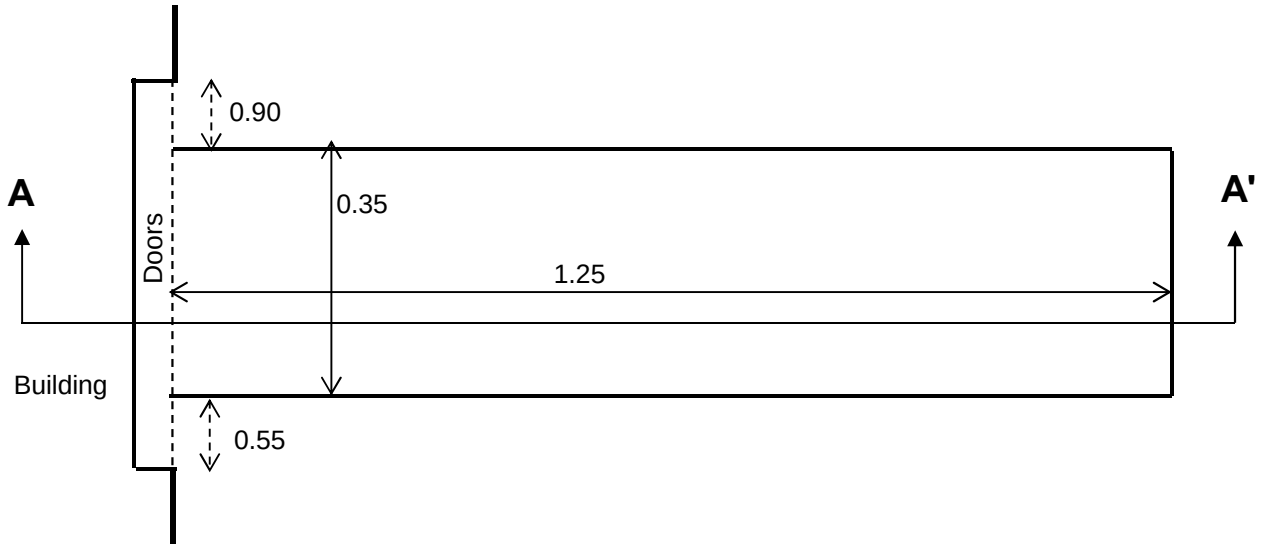
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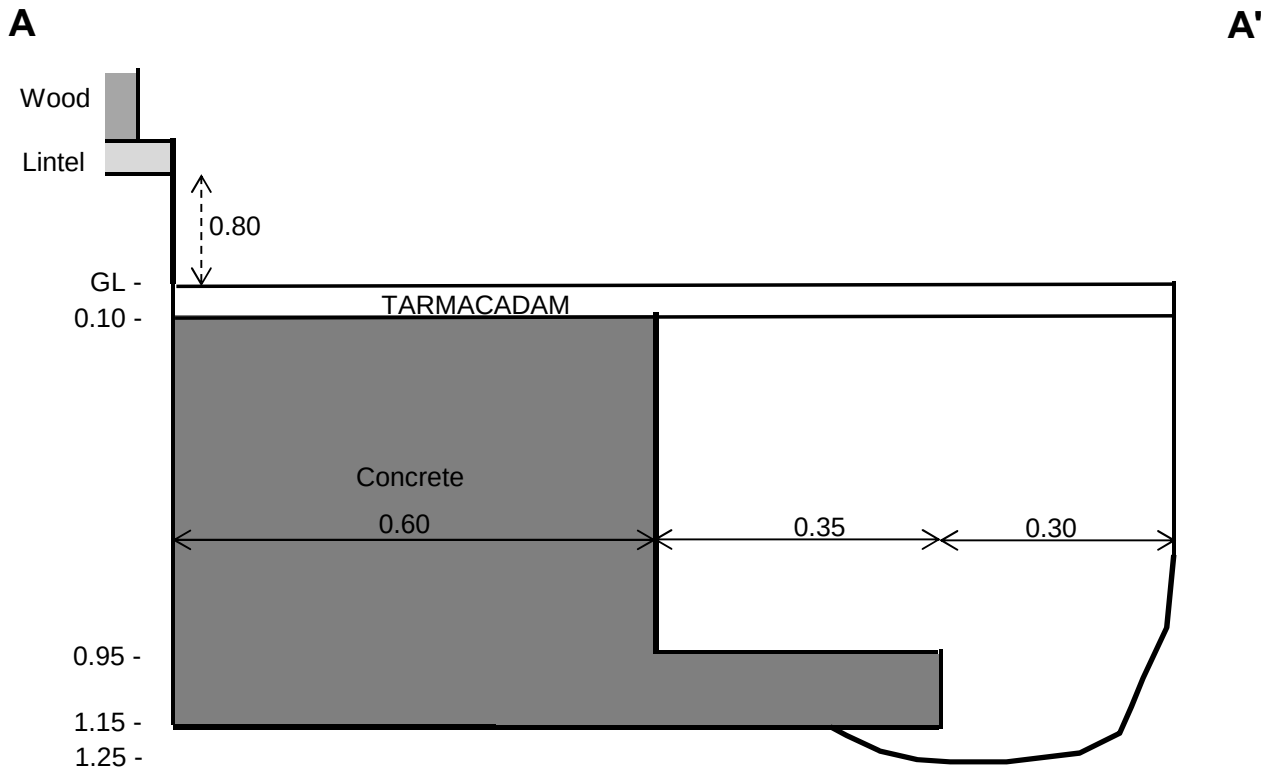


IP02

Plan View



Section A - A'



All measurements in metres.
Not to scale.

CONTRACT
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TRIAL PIT LOG**IP03**

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SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Sheet 1 of 1

Start Date 4 April 2016

Easting 473511.6

Scale 1 : 25

End Date 4 April 2016

Northing 171488.1 Ground level 69.55mOD

Depth 0.60 m

water record	sample/test			description	depth (m)	level (m)	legend
	no/type	result	depth (m)				
Dry	1B		0.20	Grass over dark brown slightly clayey slightly gravelly fine SAND. Gravel is subangular to rounded fine and medium flint. Frequent rootlets. (MADE GROUND)	0.30	69.25	
	1ES		0.20				
	2B		0.50	Firm to stiff light orangish brown mottled light brown slightly gravelly sandy CLAY. Gravel is subangular to rounded fine and medium flint. (HEAD DEPOSITS)	0.60	68.95	
	2ES		0.50				
				Trial pit completed at 0.60m.			

Notes

Trial pit excavated by hand.
 Groundwater was not encountered.
 Trial pit sides remained stable.
 On completion, the trial pit was backfilled and the surface reinstated.

Sketch of Foundation - Not to scale. All dimensions in metres.



CONTRACT

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EXPLORATORY HOLE LOGS SHOULD BE READ IN CONJUNCTION WITH KEY SHEETS

TRIAL PIT DETAIL

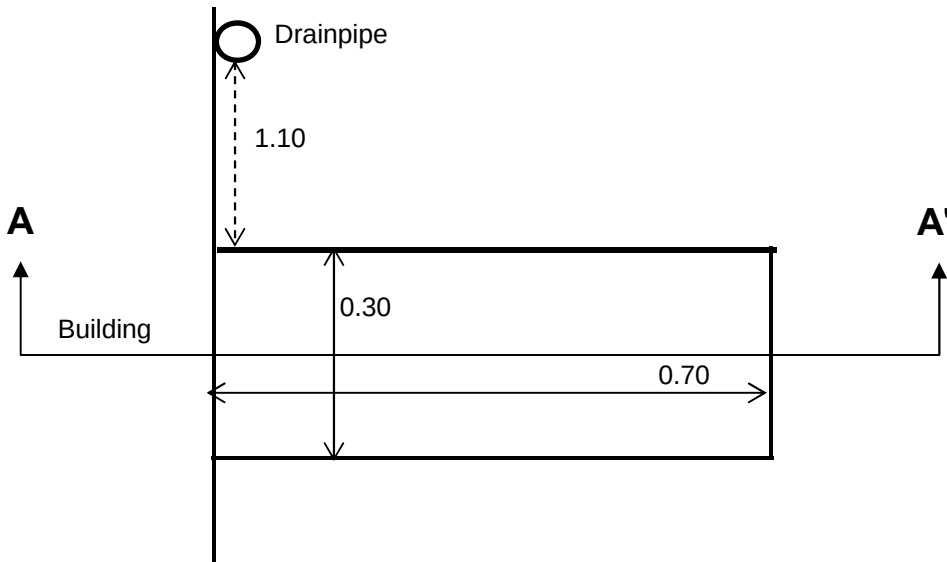
CLIENT KNOWLES AND SON (OXFORD) LTD

SITE UNIVERSITY OF READING HEALTH AND LIFE S

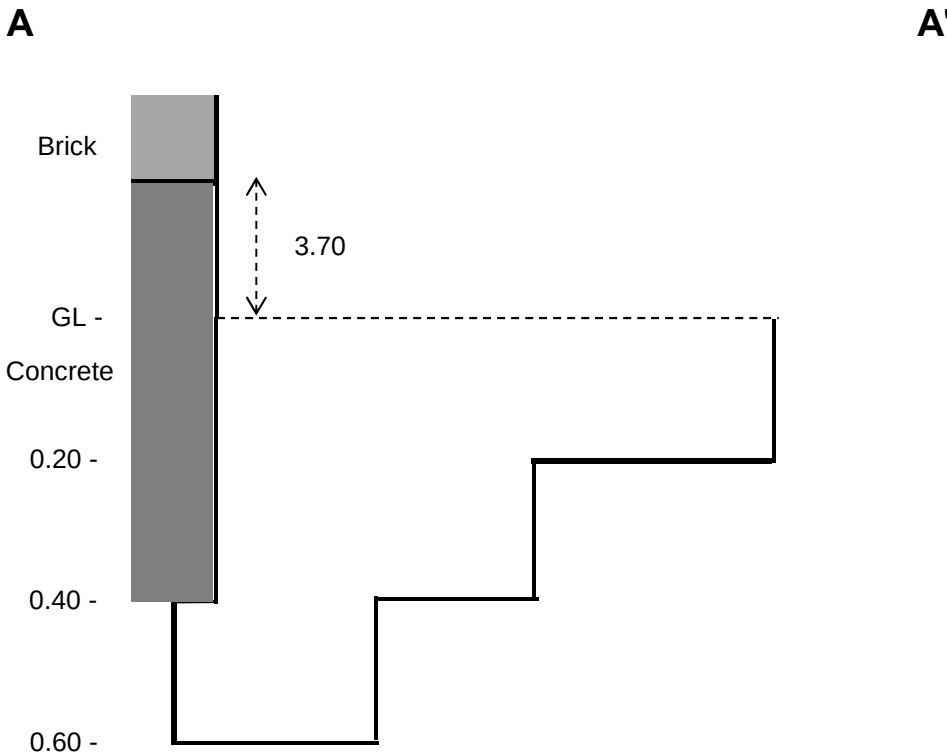


IP03

Plan View



Section A - A'



All measurements in metres.
Not to scale.

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DYNAMIC CONE PENETROMETER TESTING

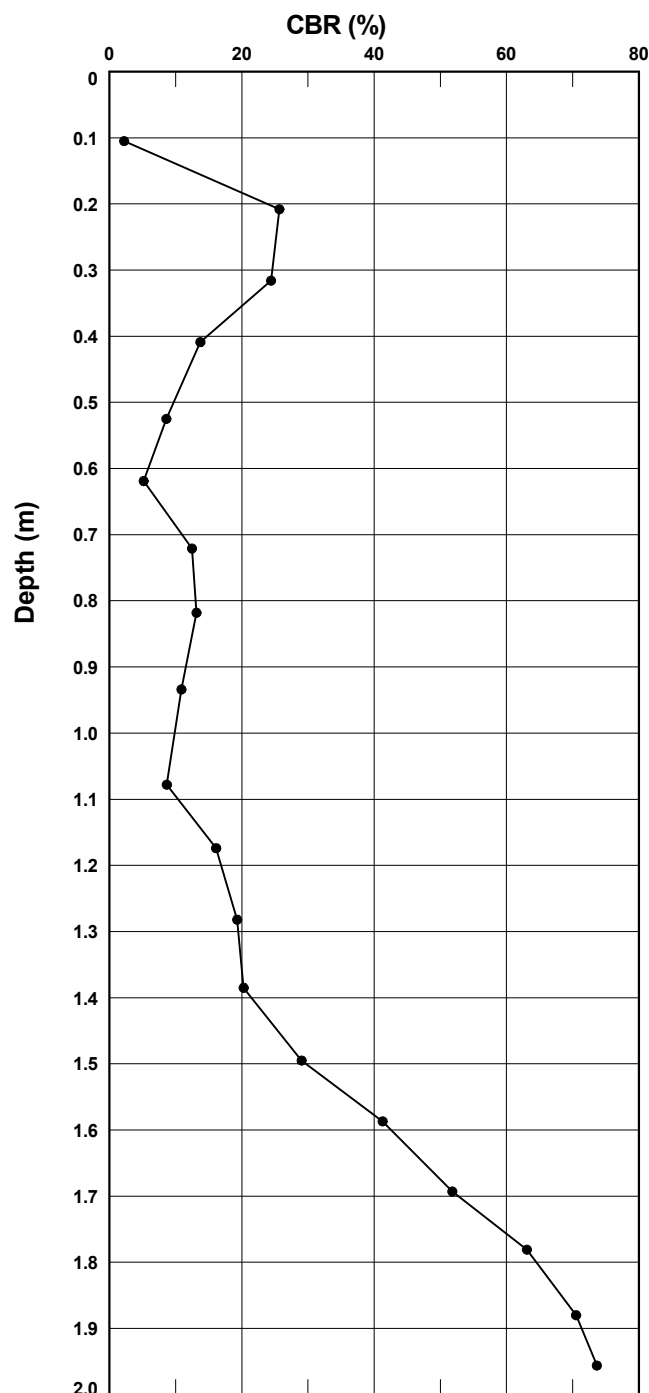


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SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING
DATE	31 March 2016

DCP01

Initial scale reading (mm) 0 Datum bgl (mm) 0

Easting	473521.0
Northing	171481.8
Ground level	69.35mOD

[illegible]

Remarks:

Test carried out in accordance with operating instructions for the dynamic cone penetrometer Model A2465 by CNS Farnell Ltd.
CBR correlation based on the relationship $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057 * \text{Log}_{10}(\text{mm/blow})$ developed by TRL taken from The Highways Agency Interim Advice Note 73/06 - Design Guidance for Road Pavement Foundations (2009)

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DYNAMIC CONE PENETROMETER TESTING



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES

BUILDING

DATE 1 April 2016

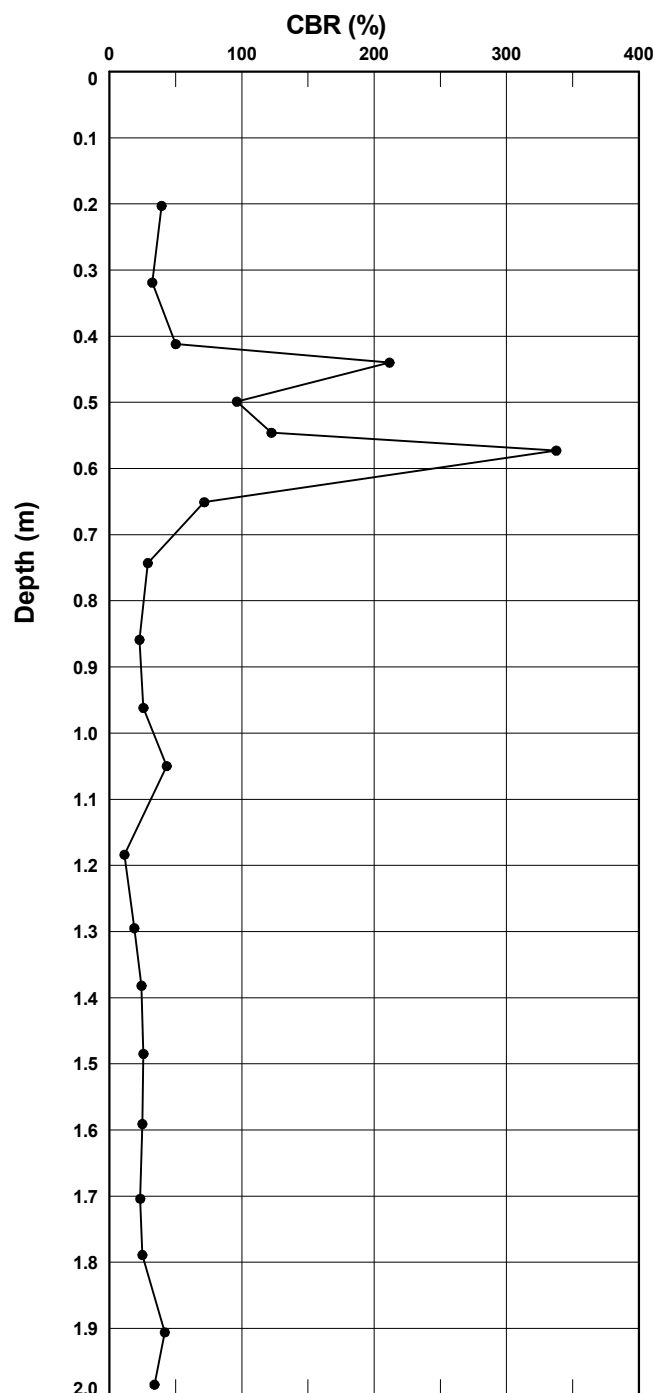
DCP02

Easting 473543.7

Northing 171479.5

Ground level 69.00mOD

Initial scale reading (mm) 0 Datum bgl (mm) 100

[illegible]

Remarks:

Test carried out in accordance with operating instructions for the dynamic cone penetrometer Model A2465 by

CNS Farnell Ltd.

CBR correlation based on the relationship $\text{Log}_{10}(\text{CBR}) = 2.48 - 1.057 * \text{Log}_{10}(\text{mm/blow})$ developed by TRL taken from The Highways Agency Interim Advice Note 73/06 - Design Guidance for Road Pavement Foundations (2009)

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APPENDIX D

GAS MONITORING

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

SITE: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Borehole / trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	15/04/16 12:00:00	1001										10		Weather Underground data (Farnborough): falling barometric pressure, mostly cloudy.
BH01	16/04/16 12:00:00	1005										5		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH01	17/04/16 12:00:00	1016										9		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH01	18/04/16 09:50:00	1017	-0.52								0.0	8		Weather Underground data (Farnborough): rising barometric pressure, partly cloudy.
BH01	18/04/16 09:51:00										0.0			
BH01	18/04/16 09:52:00										0.0			
BH01	18/04/16 09:53:00										0.0			
BH01	18/04/16 09:54:00										0.0			
BH01	18/04/16 09:55:00			3.4	0.0	13.0	0.0	0	0	1.8				
BH01	18/04/16 09:56:00			3.4	0.0	13.0	0.0	0	0	1.8				
BH01	18/04/16 09:57:00			3.4	0.0	13.0	0.0	0	0	1.8				
BH01	18/04/16 09:58:00			3.4	0.0	13.0	0.0	0	0	1.8				
BH01	18/04/16 09:59:00			3.4	0.0	13.0	0.0	0	0	1.8				
BH01	18/04/16 10:00:00			3.4	0.0	13.0	0.0	0	0	1.7				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

SITE: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	18/04/16 10:01:00			3.3	0.0	13.0	0.0	0	0	1.7				
BH01	18/04/16 10:02:00			3.2	0.0	13.0	0.0	0	1	1.7				
BH01	18/04/16 10:03:00			3.1	0.0	13.0	0.0	0	1	1.6				
BH01	18/04/16 10:04:00			3.1	0.0	13.1	0.0	0	1	1.5				
BH01	18/04/16 10:05:00												3.91	
BH01	22/04/16 12:00:00	1021										10		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH01	23/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): steady barometric pressure, mostly cloudy.
BH01	24/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH01	25/04/16 10:00:00	1003	0.38								0.0	9		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH01	25/04/16 10:01:00										0.0			
BH01	25/04/16 10:02:00										0.0			
BH01	25/04/16 10:03:00										0.0			
BH01	25/04/16 10:04:00										0.0			
BH01	25/04/16 10:05:00			2.8	0.1	11.2	2.0	0	0	1.8				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH01	25/04/16 10:06:00			2.8	0.1	11.1	2.0	0	0	1.8				
BH01	25/04/16 10:07:00			2.9	0.1	11.0	2.0	0	0	1.8				
BH01	25/04/16 10:08:00			2.9	0.1	11.0	2.0	0	0	1.8				
BH01	25/04/16 10:09:00			3.2	0.1	10.7	2.0	0	0	1.8				
BH01	25/04/16 10:10:00			3.5	0.1	10.5	2.0	0	0	1.8				
BH01	25/04/16 10:11:00			3.7	0.1	10.3	2.0	0	0	1.8				
BH01	25/04/16 10:12:00			3.9	0.1	10.1	2.0	0	0	1.8				
BH01	25/04/16 10:13:00			4.0	0.1	10.0	2.0	0	0	1.8				
BH01	25/04/16 10:14:00			4.1	0.1	9.9	2.0	0	0	1.8				
BH01	25/04/16 10:15:00												3.50	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	15/04/16 12:00:00	1001										10		Weather Underground data (Farnborough): falling barometric pressure, mostly cloudy.
BH02	16/04/16 12:00:00	1005										5		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH02	17/04/16 12:00:00	1016										9		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH02	18/04/16 11:30:00	1010	-0.51								0.0	8		Weather Underground data (Farnborough): rising barometric pressure, partly cloudy.
BH02	18/04/16 11:31:00										0.0			
BH02	18/04/16 11:32:00										0.0			
BH02	18/04/16 11:33:00										0.0			
BH02	18/04/16 11:34:00										0.0			
BH02	18/04/16 11:35:00			4.3	0.0	11.9	0.0	0	1	1.4				
BH02	18/04/16 11:36:00			4.3	0.0	11.8	0.0	0	0	1.4				
BH02	18/04/16 11:37:00			4.6	0.0	11.6	0.0	0	0	1.3				
BH02	18/04/16 11:38:00			4.8	0.0	11.4	0.0	0	0	1.3				
BH02	18/04/16 11:39:00			5.0	0.0	11.3	0.0	0	0	0.2				
BH02	18/04/16 11:40:00			5.1	0.0	11.2	0.0	0	0	1.1				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

SITE: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	18/04/16 11:41:00			5.1	0.0	11.2	0.0	0	0	1.1				
BH02	18/04/16 11:42:00			5.1	0.0	11.2	0.0	0	0	1.1				
BH02	18/04/16 11:43:00			5.1	0.0	11.2	0.0	0	0	1.1				
BH02	18/04/16 11:44:00			5.0	0.0	11.3	0.0	0	0	1.1				
BH02	18/04/16 11:45:00												3.22	
BH02	22/04/16 12:00:00	1021										10		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH02	23/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): steady barometric pressure, mostly cloudy.
BH02	24/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH02	25/04/16 11:00:00	1003	0.33								0.0	9		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH02	25/04/16 11:01:00										0.0			
BH02	25/04/16 11:02:00										0.0			
BH02	25/04/16 11:03:00										0.0			
BH02	25/04/16 11:04:00										0.0			
BH02	25/04/16 11:05:00			2.2	0.0	17.7	0.0	0	0	0.6				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH02	25/04/16 11:06:00			2.2	0.0	17.7	0.0	0	0	0.6				
BH02	25/04/16 11:07:00			2.2	0.0	17.7	0.0	0	0	0.6				
BH02	25/04/16 11:08:00			2.2	0.0	17.7	0.0	0	0	0.6				
BH02	25/04/16 11:09:00			2.2	0.0	17.8	0.0	0	0	0.6				
BH02	25/04/16 11:10:00			2.1	0.0	17.9	0.0	0	0	0.6				
BH02	25/04/16 11:11:00			2.1	0.0	17.8	0.0	0	0	0.6				
BH02	25/04/16 11:12:00			2.1	0.0	17.8	0.0	0	0	0.6				
BH02	25/04/16 11:13:00			2.2	0.0	17.7	0.0	0	0	0.6				
BH02	25/04/16 11:14:00			2.2	0.0	17.7	0.0	0	0	0.6				
BH02	25/04/16 11:15:00												3.82	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole / trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	15/04/16 12:00:00	1001										10		Weather Underground data (Farnborough): falling barometric pressure, mostly cloudy.
BH03	16/04/16 12:00:00	1005										5		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH03	17/04/16 12:00:00	1016										9		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH03	18/04/16 09:00:00	1019	-0.81								0.0	8		Weather Underground data (Farnborough): rising barometric pressure, partly cloudy.
BH03	18/04/16 09:01:00										0.0			
BH03	18/04/16 09:02:00										0.0			
BH03	18/04/16 09:03:00										0.0			
BH03	18/04/16 09:04:00										0.0			
BH03	18/04/16 09:05:00			0.2	0.0	19.8	0.0	0	0	0.9				
BH03	18/04/16 09:06:00			0.2	0.0	19.9	0.0	0	0	0.8				
BH03	18/04/16 09:07:00			0.3	0.0	19.7	0.0	0	0	0.8				
BH03	18/04/16 09:08:00			0.3	0.0	19.5	0.0	0	0	0.8				
BH03	18/04/16 09:09:00			0.4	0.0	19.2	1.0	0	0	0.8				
BH03	18/04/16 09:10:00			0.5	0.0	18.7	1.0	0	0	0.9				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH03	18/04/16 09:11:00			0.7	0.1	18.2	1.0	0	0	0.9				
BH03	18/04/16 09:12:00			0.9	0.1	17.9	1.0	0	1	0.9				
BH03	18/04/16 09:13:00			0.9	0.1	17.9	1.0	0	1	0.9				
BH03	18/04/16 09:14:00			0.9	0.1	18.0	1.0	0	1	0.9				
BH03	18/04/16 09:15:00												3.52	
BH03	22/04/16 12:00:00	1021										10		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH03	23/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): steady barometric pressure, mostly cloudy.
BH03	24/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH03	25/04/16 10:00:00	1004									0.0	9		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH03	25/04/16 10:01:00										0.0			
BH03	25/04/16 10:02:00										0.0			
BH03	25/04/16 10:03:00										0.0			
BH03	25/04/16 10:04:00										0.0			
BH03	25/04/16 10:05:00			3.4	0.0	16.1	0.0	0	0	0.8				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks	
BH03	25/04/16 10:06:00			3.8	0.1	15.6	1.0	0	0	0.8					
BH03	25/04/16 10:07:00			4.3	0.1	15.0	1.0	0	0	0.7					
BH03	25/04/16 10:08:00			5.0	0.1	14.2	1.0	0	0	0.6					
BH03	25/04/16 10:09:00			5.2	0.1	14.0	1.0	0	0	0.5					
BH03	25/04/16 10:10:00			5.0	0.1	14.3	1.0	0	0	0.5					
BH03	25/04/16 10:11:00			5.0	0.1	14.3	1.0	0	0	0.5					
BH03	25/04/16 10:12:00			4.7	0.1	14.6	1.0	0	0	0.5					
BH03	25/04/16 10:13:00			4.7	0.1	14.7	1.0	0	0	0.5					
BH03	25/04/16 10:14:00			4.7	0.1	14.8	1.0	0	0	0.5					
BH03	25/04/16 10:15:00												3.25		
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.														CONTRACT 31710	CHECKED JI

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	15/04/16 12:00:00	1001										10		Weather Underground data (Farnborough): falling barometric pressure, mostly cloudy.
BH04	16/04/16 12:00:00	1005										5		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH04	17/04/16 12:00:00	1016										9		Weather Underground data (Farnborough): rising barometric pressure, mostly cloudy.
BH04	18/04/16 10:20:00	1016	-0.29								0.0	8		Weather Underground data (Farnborough): rising barometric pressure, partly cloudy.
BH04	18/04/16 10:21:00										0.0			
BH04	18/04/16 10:22:00										0.0			
BH04	18/04/16 10:23:00										0.0			
BH04	18/04/16 10:24:00										0.0			
BH04	18/04/16 10:25:00			1.3	0.0	18.4	0.0	0	1	0.7				
BH04	18/04/16 10:26:00			1.3	0.0	18.5	0.0	0	0	0.7				
BH04	18/04/16 10:27:00			1.3	0.0	18.4	0.0	0	1	0.7				
BH04	18/04/16 10:28:00			1.1	0.0	18.7	0.0	0	0	0.6				
BH04	18/04/16 10:29:00			1.1	0.0	18.8	0.0	0	0	0.6				
BH04	18/04/16 10:30:00			1.3	0.0	18.6	0.0	0	0	0.6				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

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Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (ltr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	18/04/16 10:31:00			1.4	0.0	18.4	0.0	0	0	0.6				
BH04	18/04/16 10:32:00			1.4	0.0	18.5	0.0	0	0	0.6				
BH04	18/04/16 10:33:00			1.6	0.0	18.2	0.0	0	0	0.6				
BH04	18/04/16 10:34:00			1.7	0.0	18.1	0.0	0	0	0.6				
BH04	18/04/16 10:35:00												3.83	
BH04	22/04/16 12:00:00	1021										10		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH04	23/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): steady barometric pressure, mostly cloudy.
BH04	24/04/16 12:00:00	1021										8		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH04	25/04/16 10:40:00	1003	0.68								0.0	9		Weather Underground data (Farnborough): falling barometric pressure, partly cloudy.
BH04	25/04/16 10:41:00										0.0			
BH04	25/04/16 10:42:00										0.0			
BH04	25/04/16 10:43:00										0.0			
BH04	25/04/16 10:44:00										0.0			
BH04	25/04/16 10:45:00			2.6	0.0	16.1	0.0	0	1	1.6				
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl

GAS AND GROUNDWATER LEVELS

CLIENT: KNOWLES & SON (OXFORD) LIMITED

SITE: UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

Borehole /trial pit no.	date and time	barometric pressure (mb)	pressure differentiation (mm H ₂ O)	carbon dioxide (%)	methane (%)	oxygen (%)	LEL (%)	hydrogen sulphide (ppm)	carbon monoxide (ppm)	VOC (ppm)	gas flow (litr/hr)	temperature (°C)	water level (m - bgl)	remarks
BH04	25/04/16 10:46:00			2.7	0.0	16.0	0.0	0	0	1.7				
BH04	25/04/16 10:47:00			2.7	0.0	15.9	0.0	0	0	1.7				
BH04	25/04/16 10:48:00			2.8	0.0	15.8	0.0	0	0	1.6				
BH04	25/04/16 10:49:00			2.9	0.0	15.7	0.0	0	0	1.6				
BH04	25/04/16 10:50:00			3.0	0.0	15.6	0.0	0	0	1.5				
BH04	25/04/16 10:51:00			3.0	0.0	15.5	0.0	0	0	1.4				
BH04	25/04/16 10:52:00			3.0	0.0	15.5	0.0	0	0	1.4				
BH04	25/04/16 10:53:00			3.0	0.0	15.6	0.0	0	0	1.4				
BH04	25/04/16 10:54:00			3.0	0.0	15.6	0.0	0	0	1.4				
BH04	25/04/16 10:55:00												3.91	
remarks # denotes result exceeding capacity of gas monitoring equipment VOC - Photoionisation Detector Mini RAE 2000 measures VOC vapours with 10.6eV lamp calibrated against isobutylene.													CONTRACT 31710	CHECKED Jl



APPENDIX E

LABORATORY TESTING



2718

GEOTECHNICAL ENGINEERING LIMITED



For the attention of Jon Ind

Version No. 1

Page No. 1 of 29

Date of Issue 23/05/2016

TEST REPORT

PROJECT/SITE	University of Reading - Health and Life Sciences Building	Samples received	14/04/2016
GEL REPORT NUMBER	31710	Schedule received	14/04/2016
Your ref/PO:	0	Testing commenced	19/04/2016
Test report refers to	Schedule 1	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	16	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	16	YES
BS1377: Part 2: 1990:9.2, Particle Size Distribution - Wet Sieve	5	YES
BS1377: Part 2: 1990:9.4, Particle Size Distribution - Pipette	2	YES
BS1377: Part 4: 1990:7, California Bearing Ratio (CBR)	1	YES
BS1377: Part 7: 1990:8&9, Undrained Triaxial Compression	15	NO
BS1377: Part 8: 1990: Effective Stress Testing	2	NO
Hand vane (non BS1377)	15	NO
BRE SD1 Reduced Suite: pH, Sulphate - water and acid soluble, sulphur (subcontracted)	10	YES

Remarks This report may not be partially reproduced without written permission from this laboratory.	Approved Signatories: S Robinson (Client Manager) C Andrew (Client Manager) W Jones (Technical Support) J Hanson (Director) N Parry (Director) 
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Doc TR01

Rev No. 14

Revision date 23/10/15

DC:JH

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Sort code: 30-15-99 Bank account: 00072116

LIQUID AND PLASTIC LIMITS**BS.1377 : Part 2 : 1990 : 4 and 5**

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole /trial pit no.	sample		specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
	no./type	depth (m)								
BH01	2B	0.50	0.50	14.4	BXE	40	47	17	30	Brown mottled reddish brown slightly sandy gravelly CLAY
BH01	3B	1.00	1.00	17.0	BXE	19	44	16	28	Reddish brown mottled light grey slightly sandy slightly gravelly CLAY
BH01	5B	2.00	2.00	21.3	BXE	26	42	15	27	Reddish brown slightly sandy slightly gravelly CLAY
BH01	7D	2.80	2.80	26.5	AXE	0	42	17	25	Brown slightly sandy CLAY
BH01	11B	5.00	5.00	29.2	BXE	6	67	28	39	Brown slightly sandy slightly gravelly CLAY
BH01	18D	7.50	7.50	25.9	AXE	0	64	23	41	Grey slightly sandy CLAY
BH02	7B	4.30	4.30	25.9	BXE	18	66	27	39	Brown slightly sandy slightly gravelly CLAY
BH02	9D	6.00	6.00	28.3	AXE	0	62	22	40	Grey slightly sandy CLAY
BH03	5B	1.80	1.80	19.3	BXE	11	42	16	26	Orangish brown mottled greyish brown slightly sandy slightly gravelly CLAY
BH03	16D	7.35	7.35	25.8	AXE	0	64	25	39	Grey slightly sandy CLAY
BH03	27UT	11.50	11.75	25.2	AXE	0	68	26	42	Dark grey slightly sandy CLAY
BH03	40D	16.45	16.45	22.2	BXE	1	56	21	35	Dark grey slightly sandy CLAY with rare shell fragments
BH04	3B	0.90	0.90	12.7	BXE	50	39	16	23	Orangish brown slightly sandy gravelly CLAY
BH04	4B	2.00	2.00	23.7	BXE	22	44	15	29	Orangish brown slightly sandy slightly gravelly CLAY
BH04	7D	3.15	3.15	25.4	AXE	0	59	23	36	Orangish brown mottled grey slightly sandy CLAY
TP03	4B	1.80	1.80	22.3	BXE	12	49	15	34	Brown and grey mottled reddish brown slightly sandy slightly gravelly CLAY

general remarks:

natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014

NP denotes non-plastic

denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892

specimen preparation:

A - as received

B - washed on 0.425mm sieve

C - air dried

D - oven dried (60°C)

E - oven dried (105°C)

F - not known

test method:

X - cone penetrometer (test 4.3)

Y - one point cone penetrometer (test 4.4)

Z - Casagrande apparatus (test 4.5)

CONTRACT

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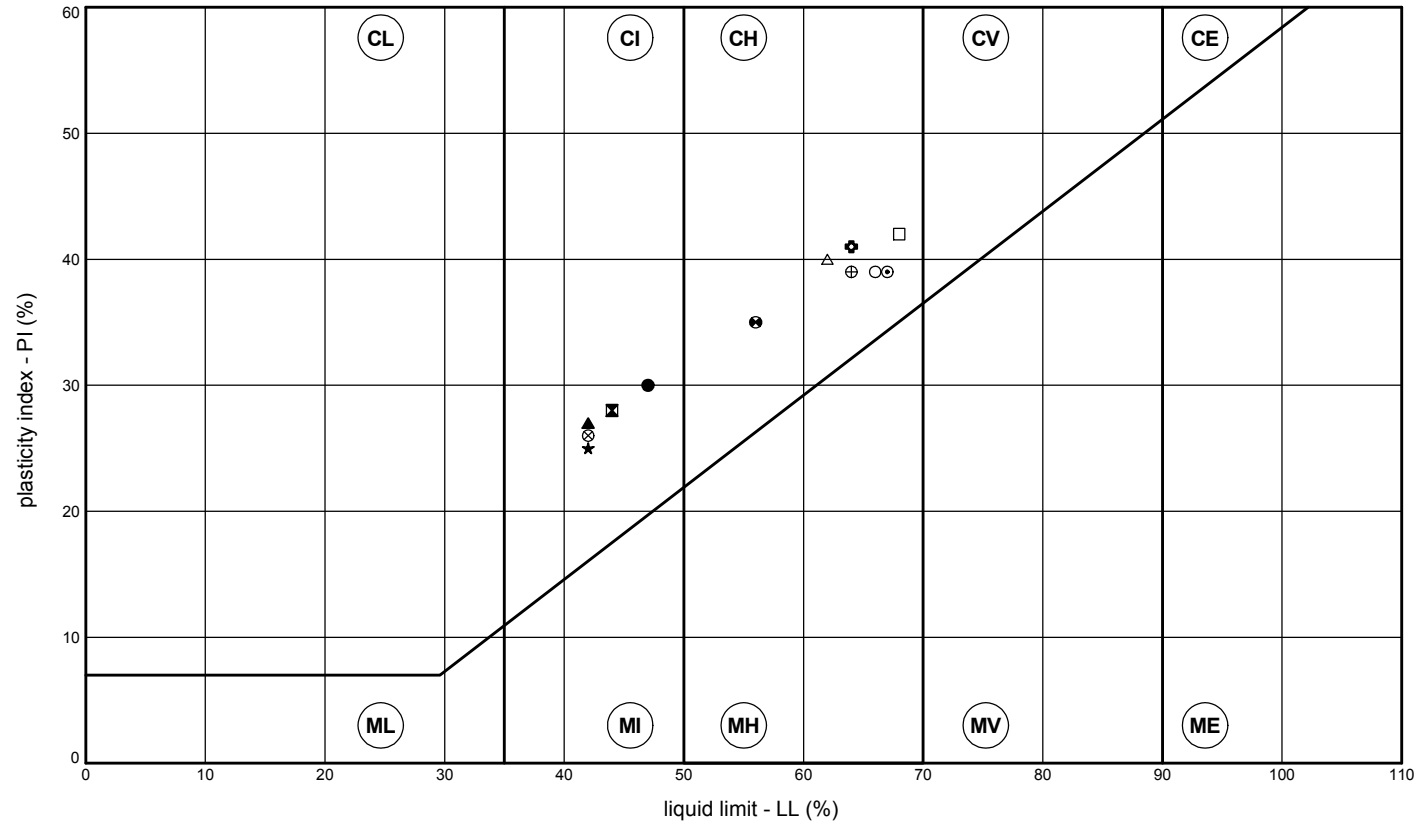
ATTERBERG LINE PLOT



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE

 SCIENCES BUILDING



	BH/TP No.	depth (m)	LL	PL	PI	remarks
●	BH01	0.50	47	17	30	
⊠	BH01	1.00	44	16	28	
▲	BH01	2.00	42	15	27	
★	BH01	2.80	42	17	25	
⊙	BH01	5.00	67	28	39	
⊕	BH01	7.50	64	23	41	
○	BH02	4.30	66	27	39	
△	BH02	6.00	62	22	40	
⊗	BH03	1.80	42	16	26	
⊕	BH03	7.35	64	25	39	
□	BH03	11.75	68	26	42	
⊗	BH03	16.45	56	21	35	

CONTRACT	CHECKED
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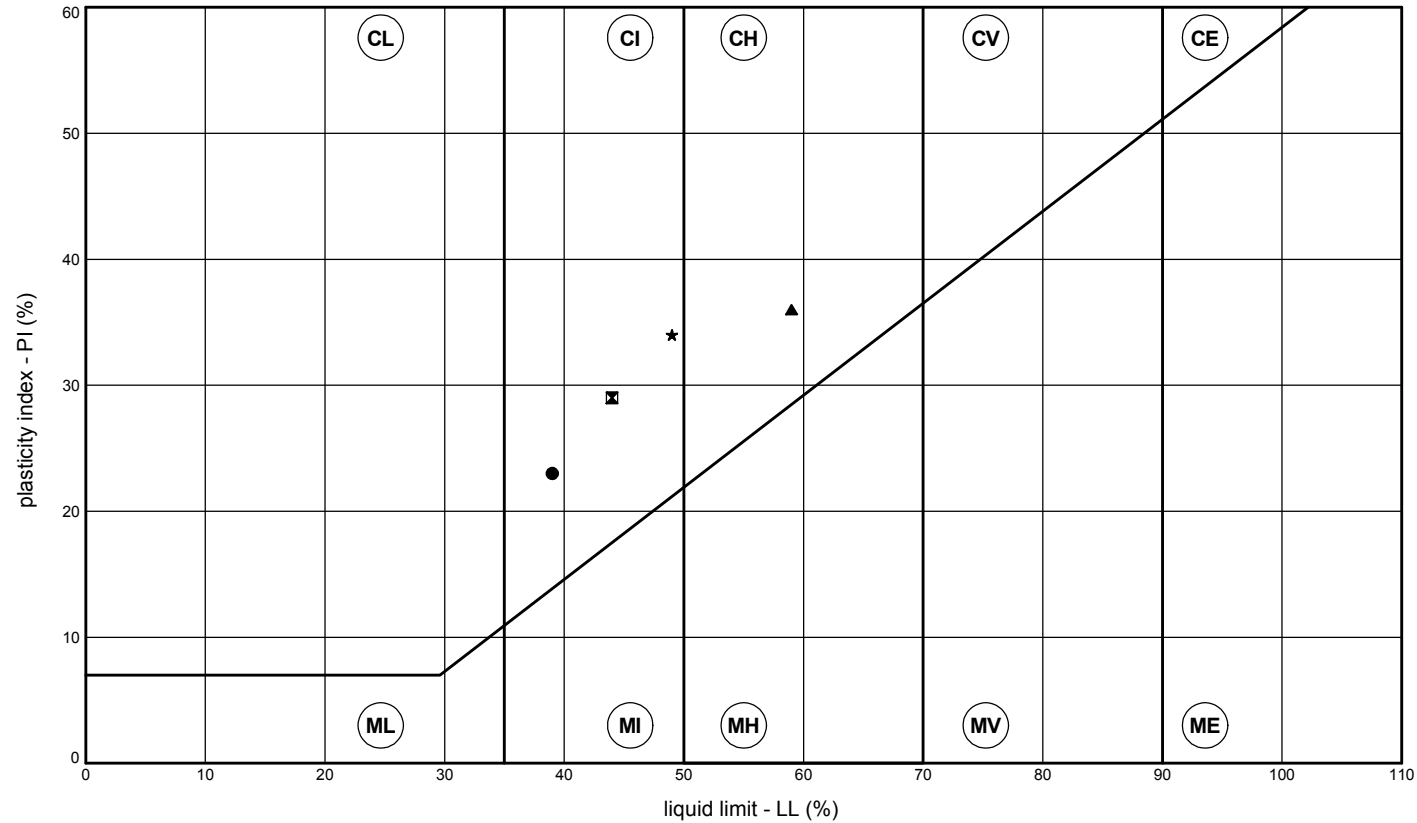
ATTERBERG LINE PLOT



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE

 SCIENCES BUILDING



	BH/TP No.	depth (m)	LL	PL	PI	remarks
●	BH04	0.90	39	16	23	
⊠	BH04	2.00	44	15	29	
▲	BH04	3.15	59	23	36	
★	TP03	1.80	49	15	34	

CONTRACT	CHECKED
31710	CA

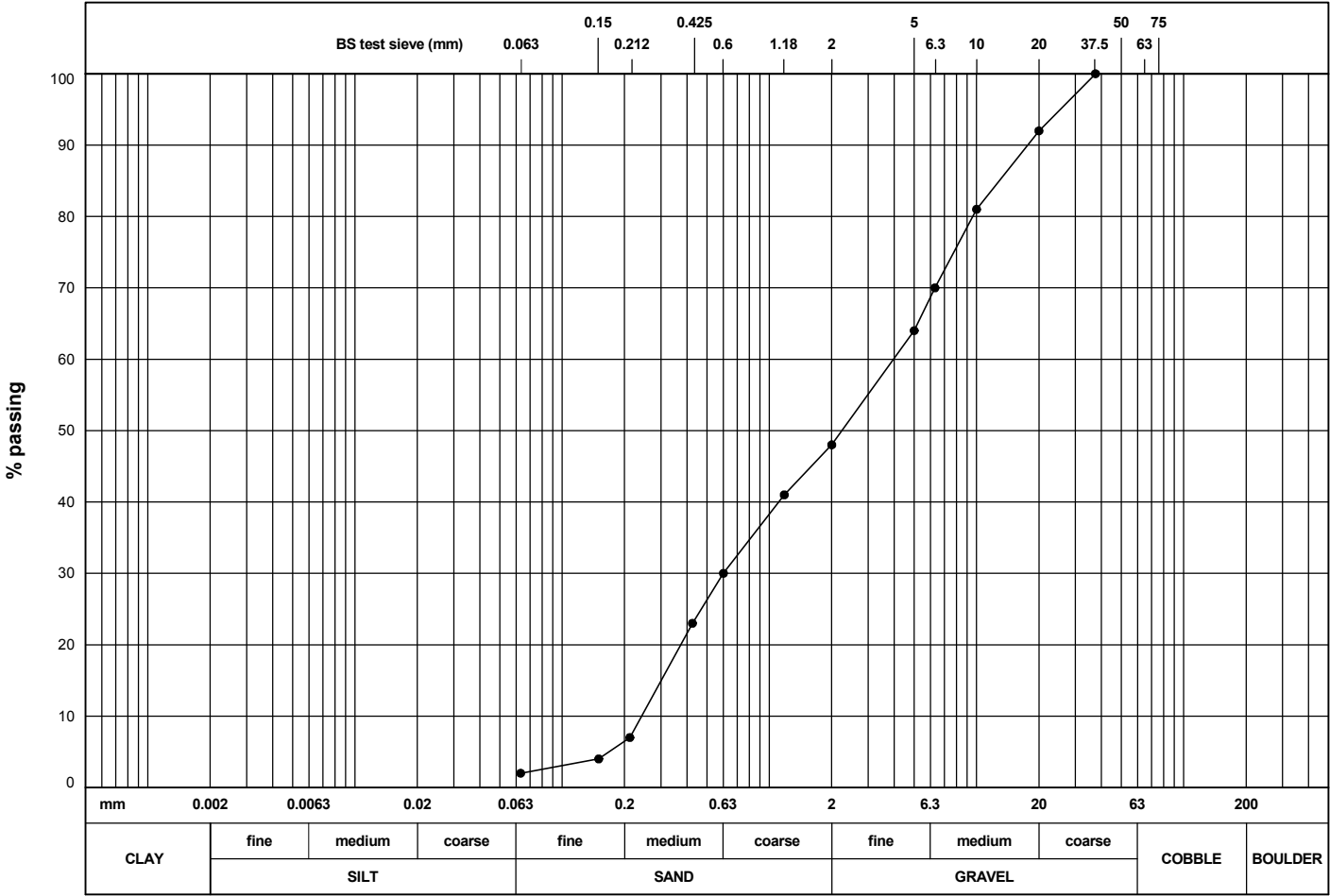
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PARTICLE SIZE DISTRIBUTION



BS.1377 : Part 2 : 1990 : 9

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH01
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	10B
DESCRIPTION	Yellowish brown slightly silty very sandy GRAVEL	SAMPLE DEPTH (m)	4.00
		SPECIMEN DEPTH (m)	4.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
CLAY		150		5	64	20	
SILT	2	75		2	48	6	
SILT & CLAY	46	63		1.18	41	2	
SAND	52	50		0.6	30		
GRAVEL	0	37.5	100	0.425	23		
COBBLE & BOULDER		20	92	0.212	7		
test method(s)	9.2#	10	81	0.15	4		
test method:		6.3	70	0.063	2		
9.2 - wet sieving							
9.3 - dry sieving							
9.4 - sedimentation by pipette							
9.5 - sedimentation by hydrometer							
remarks:	# denotes sample tested is smaller than that which is recommended in accordance with BS1377					CONTRACT	CHECKED
						31710	CA

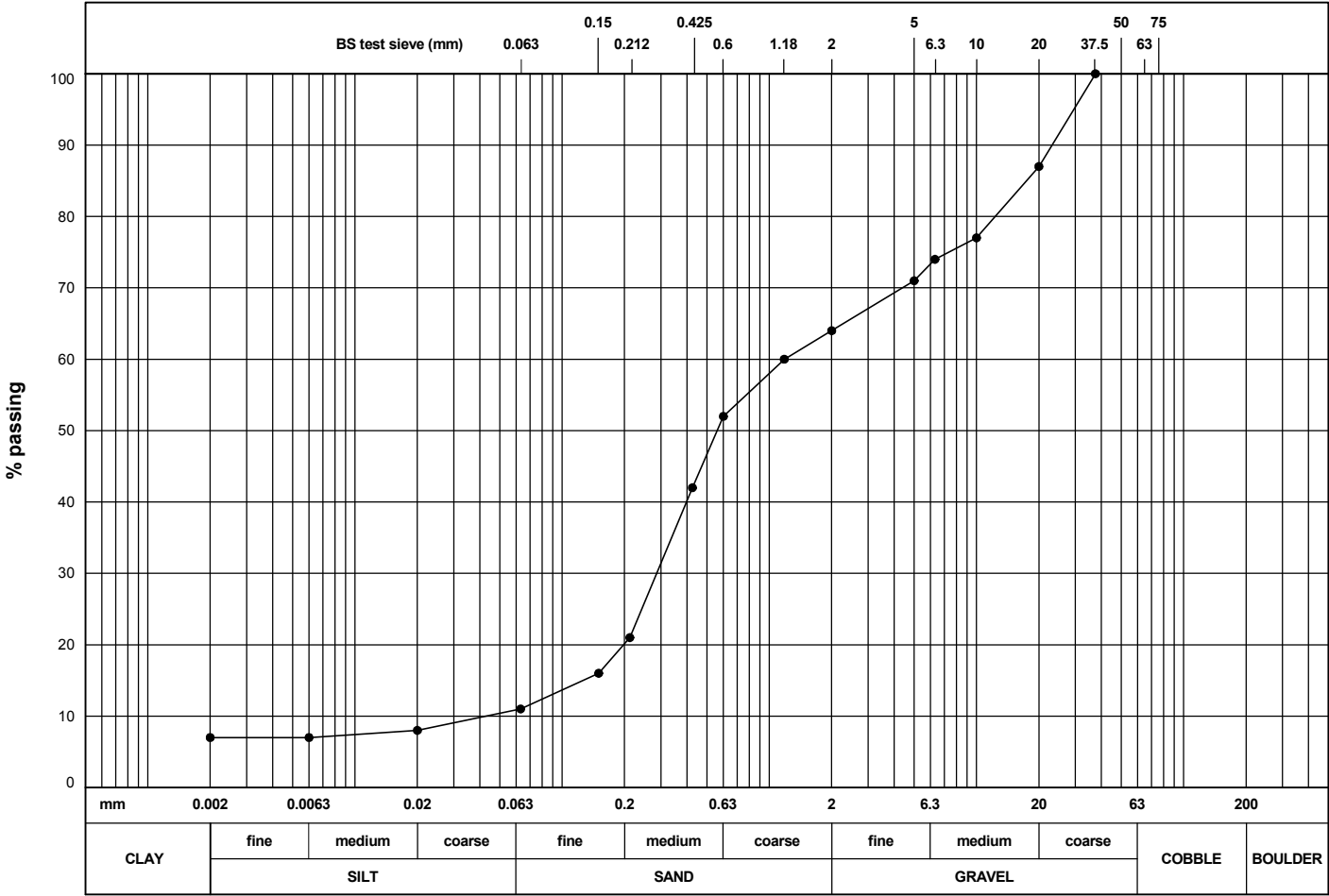
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PARTICLE SIZE DISTRIBUTION



BS.1377 : Part 2 : 1990 : 9

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH02
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	4B
DESCRIPTION	Brown clayey very gravelly SAND	SAMPLE DEPTH (m)	2.00
		SPECIMEN DEPTH (m)	2.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
CLAY	7	150		5	71	20	8
SILT	4	75		2	64	6	7
SILT & CLAY	11	63		1.18	60	2	7
SAND	53	50		0.6	52		
GRAVEL	36	37.5	100	0.425	42		
COBBLE & BOULDER	0	20	87	0.212	21		
test method(s)	9.2# & 9.4	10	77	0.15	16		
test method:		6.3	74	0.063	11		
9.2 - wet sieving							
9.3 - dry sieving							
9.4 - sedimentation by pipette							
9.5 - sedimentation by hydrometer							
remarks:	# denotes sample tested is smaller than that which is recommended in accordance with BS1377					CONTRACT	CHECKED
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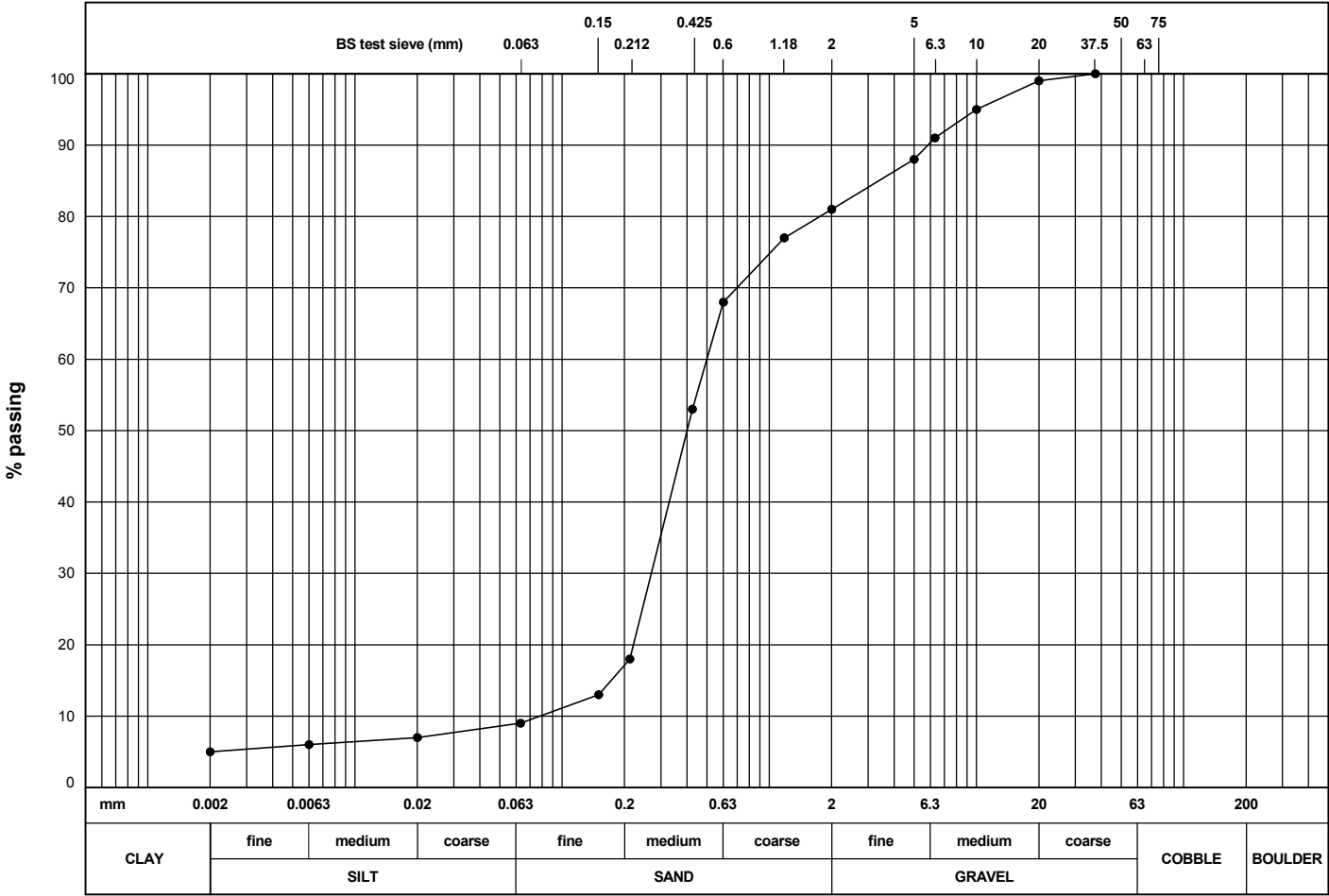
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PARTICLE SIZE DISTRIBUTION



BS.1377 : Part 2 : 1990 : 9

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH02
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	5B
DESCRIPTION	Yellowish brown clayey gravelly SAND	SAMPLE DEPTH (m)	3.00
		SPECIMEN DEPTH (m)	3.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
CLAY	5	150		5	88	20	7
SILT	4	75		2	81	6	6
SILT & CLAY	9	63		1.18	77	2	5
SAND	72	50		0.6	68		
GRAVEL	19	37.5	100	0.425	53		
COBBLE & BOULDER	0	20	99	0.212	18		
test method(s)	9.2 & 9.4	10	95	0.15	13		
test method:		6.3	91	0.063	9		
9.2 - wet sieving							
9.3 - dry sieving							
9.4 - sedimentation by pipette							
9.5 - sedimentation by hydrometer							
remarks:	# denotes sample tested is smaller than that which is recommended in accordance with BS1377					CONTRACT	CHECKED
						31710	CA

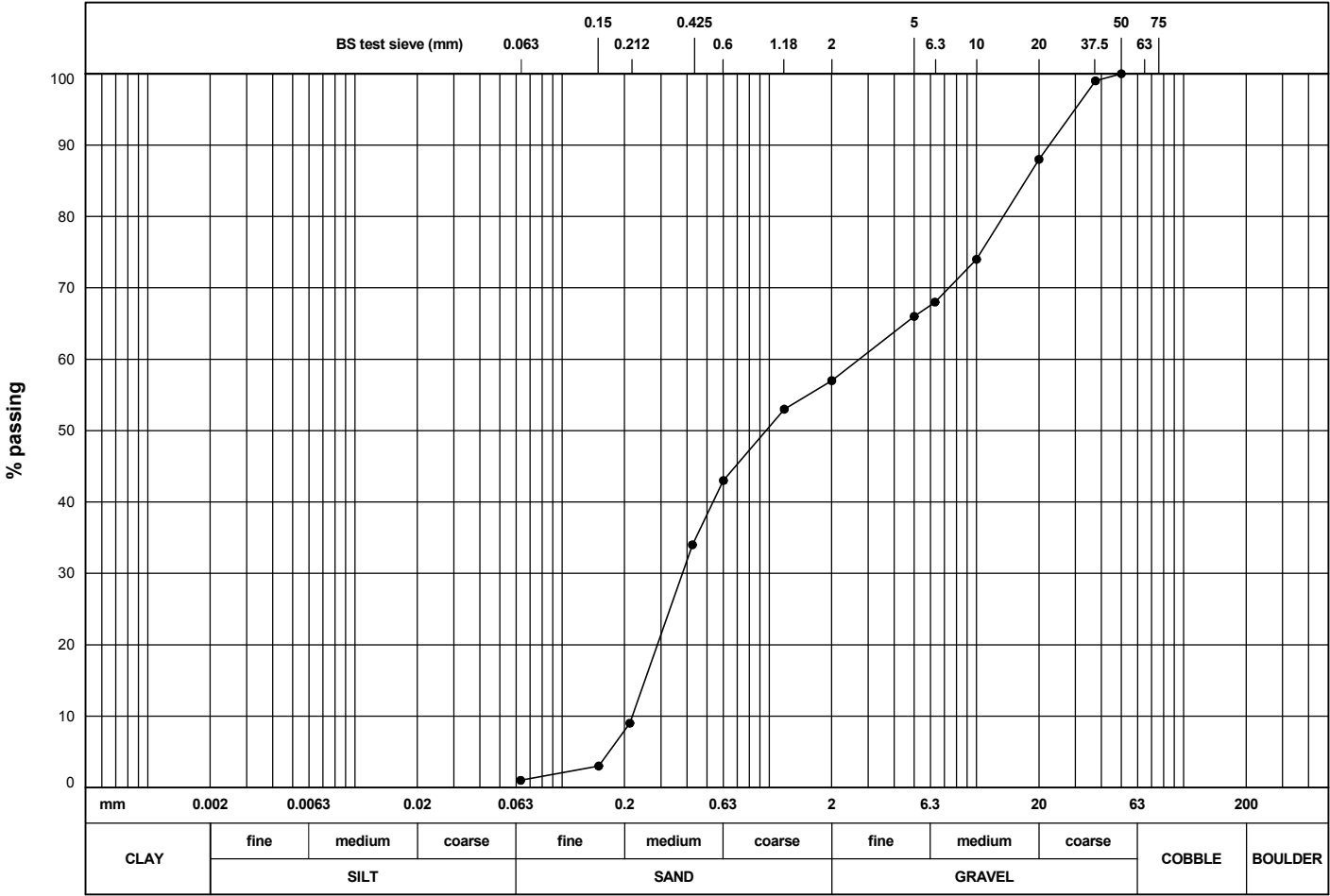
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PARTICLE SIZE DISTRIBUTION



BS.1377 : Part 2 : 1990 : 9

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH03
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	11B
		SAMPLE DEPTH (m)	4.80
DESCRIPTION	Yellowish brown slightly clayey very gravelly SAND	SPECIMEN DEPTH (m)	4.80



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
CLAY		150		5	66	20	
SILT		75		2	57	6	
SILT & CLAY	1	63		1.18	53	2	
SAND	56						
GRAVEL	43						
COBBLE & BOULDER	0						
test method(s)	9.2#	50	100	0.6	43		
		37.5	99	0.425	34		
test method:		20	88	0.212	9		
9.2 - wet sieving		10	74	0.15	3		
9.3 - dry sieving		6.3	68	0.063	1		
9.4 - sedimentation by pipette							
9.5 - sedimentation by hydrometer							
remarks:	# denotes sample tested is smaller than that which is recommended in accordance with BS1377					CONTRACT	CHECKED
						31710	CA

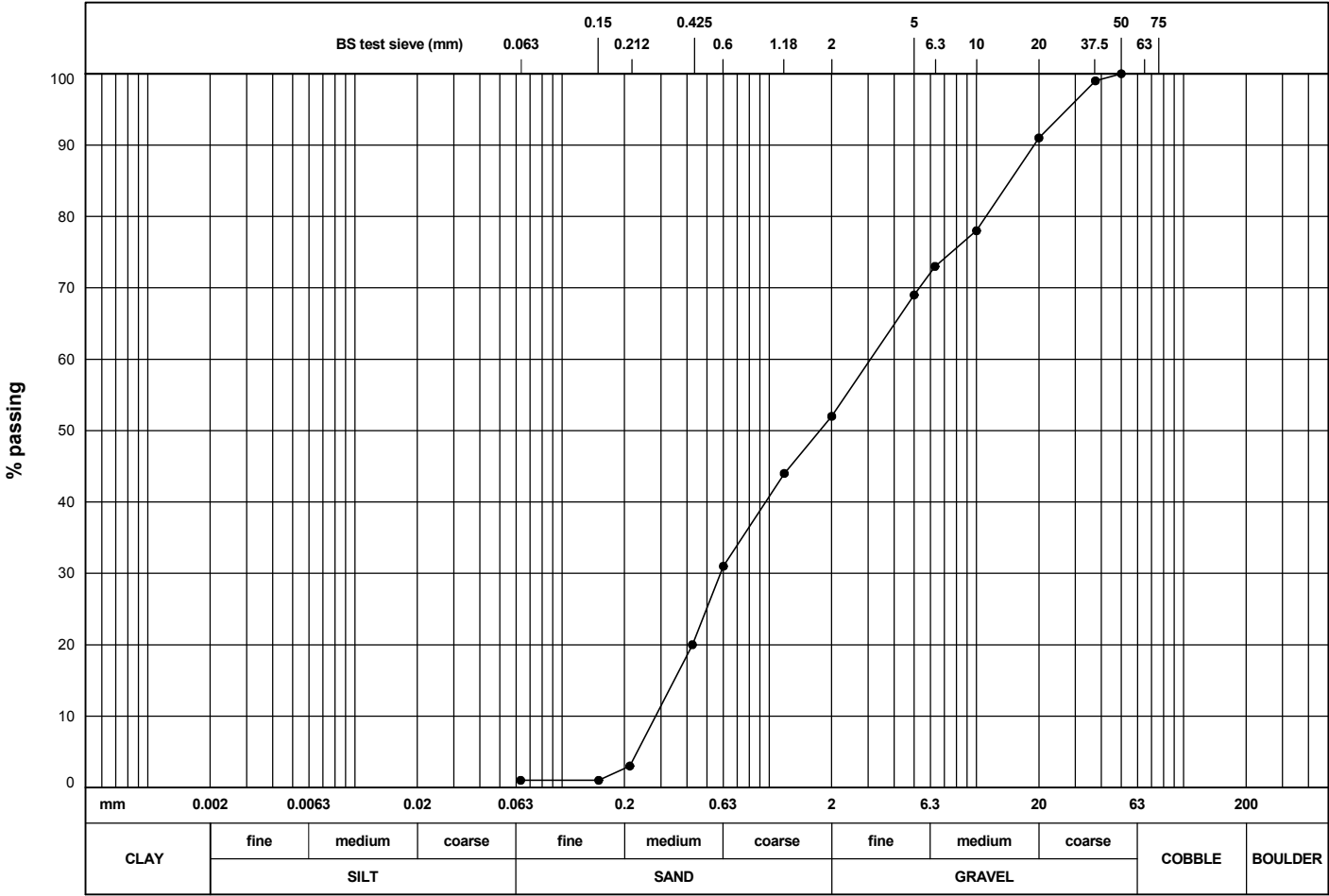
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PARTICLE SIZE DISTRIBUTION



BS.1377 : Part 2 : 1990 : 9

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH04
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	10B
DESCRIPTION	Yellowish brown slightly silty very gravelly SAND	SAMPLE DEPTH (m)	4.00
		SPECIMEN DEPTH (m)	4.00



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
CLAY		150		5	69	20	
SILT		75		2	52	6	
SILT & CLAY	1	63		1.18	44	2	
SAND	51						
GRAVEL	48						
COBBLE & BOULDER	0						
test method(s)	9.2#	50	100	0.6	31		
		37.5	99	0.425	20		
test method:		20	91	0.212	3		
9.2 - wet sieving		10	78	0.15	1		
9.3 - dry sieving		6.3	73	0.063	1		
9.4 - sedimentation by pipette							
9.5 - sedimentation by hydrometer							
remarks:	# denotes sample tested is smaller than that which is recommended in accordance with BS1377					CONTRACT	CHECKED
						31710	CA

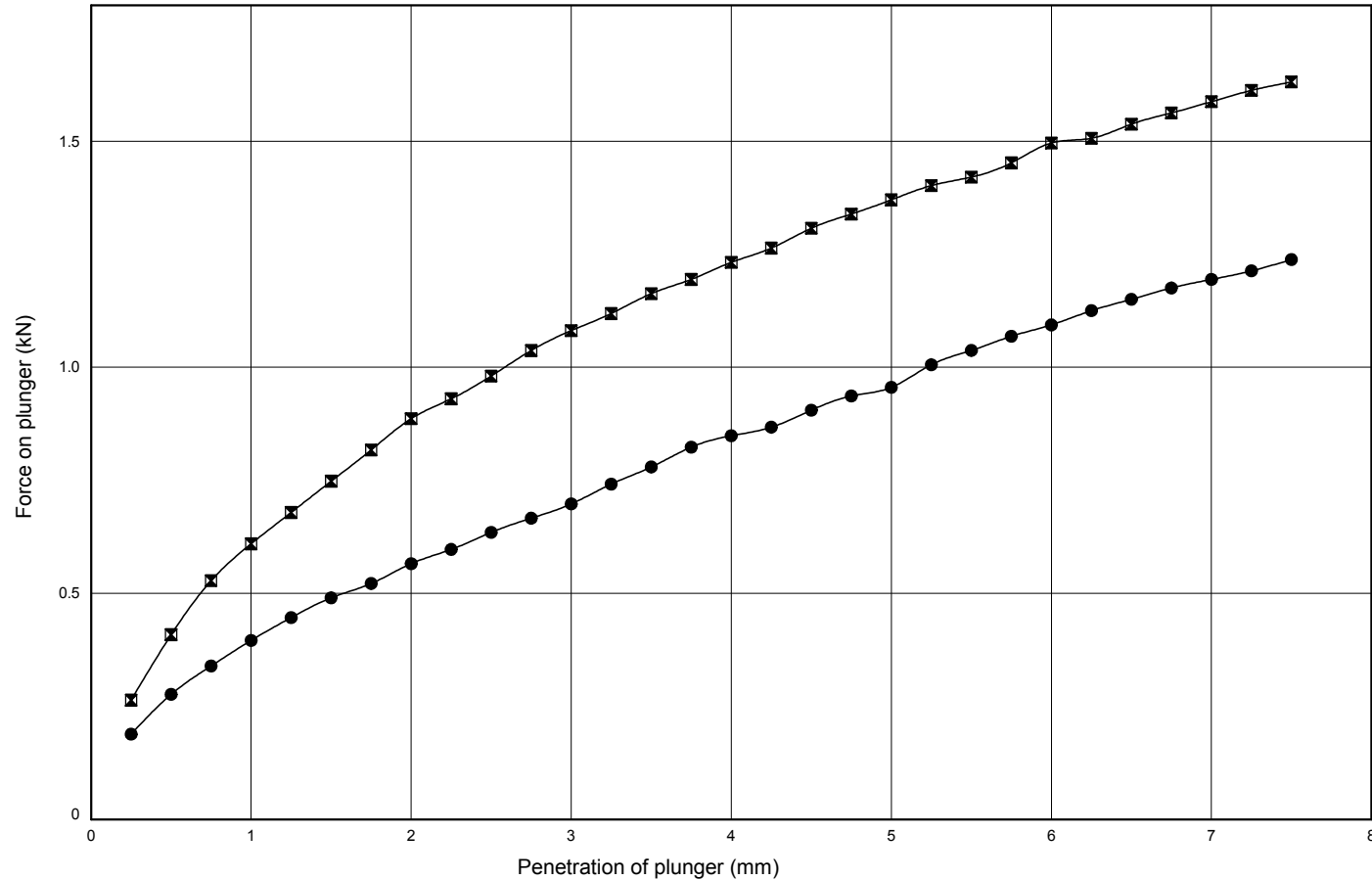
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CALIFORNIA BEARING RATIO



BS.1377 : Part 4 : 1990 : 7

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH01
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	2B
		SAMPLE DEPTH (m)	0.50
DESCRIPTION	Brown mottled reddish brown slightly sandy gravelly CLAY	SPECIMEN DEPTH (m)	0.50



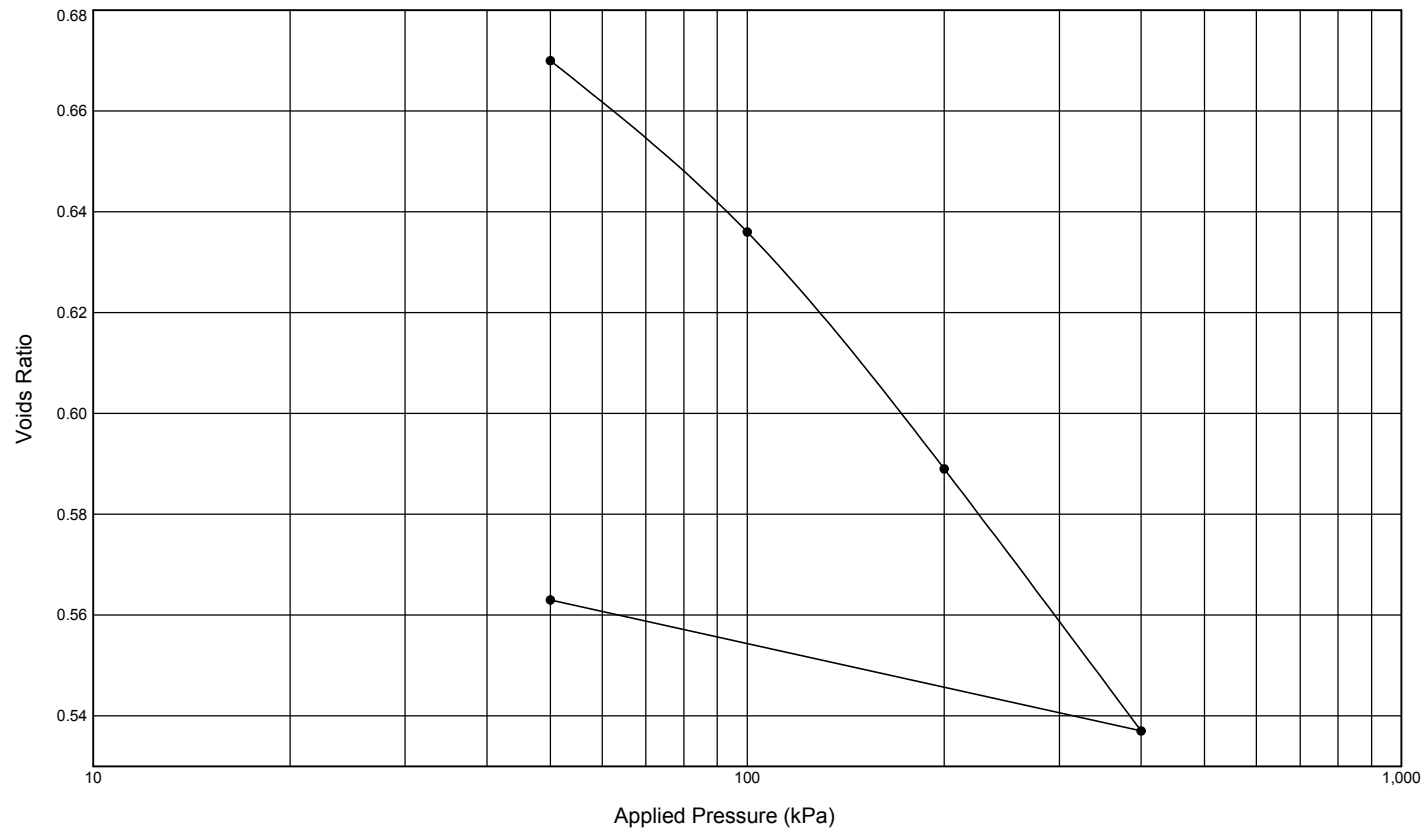
sample preparation:		Dynamic compaction - 2.5Kg rammer	
proportion >20mm removed (%)	4.4	sample condition	Unsoaked
surcharge mass (kg)	10	amount of swell (mm)	N/A
INITIAL CONDITIONS		FINAL CONDITIONS	
moisture content (%)	12	moisture content - top (%)	16
bulk density (Mg/m ³)	2.04	moisture content - base (%)	14
dry density (Mg/m ³)	1.83		
remarks:			
Top Base		CBR value top (%)	4.8
		CBR value base (%)	7.4
		average CBR value (%)	
		CONTRACT	CHECKED
		31710	CA

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES



BS.1377 : Part 5 : 1990 : 3

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH01
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	8U
		SAMPLE DEPTH (m)	2.80
DESCRIPTION	Orangish brown mottled light grey slightly sandy CLAY	SPECIMEN DEPTH (m)	2.80



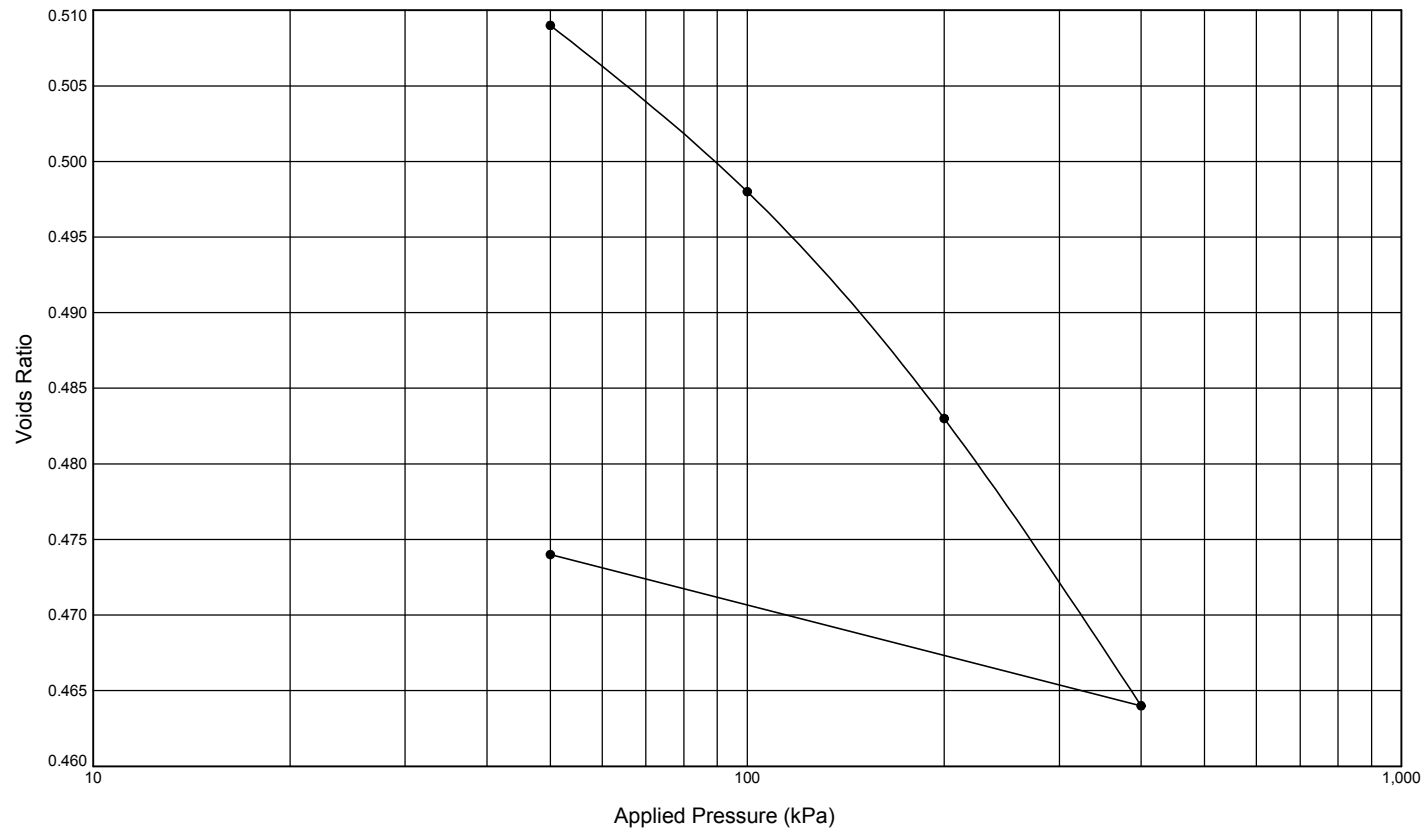
Test and sample details			Test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility (m ² /MN)	consolidation (m ² /year)
specimen diameter	(mm)	63.33				
specimen height	(mm)	18.89				
initial moisture content	(%)	26.8				
final moisture content	(%)	22.8				
initial bulk density	(Mg/m ³)	1.98	50	0.670	0.724	1.4
initial dry density	(Mg/m ³)	1.56	100	0.636	0.408	1.3
initial voids ratio		0.733	200	0.589	0.290	1.5
initial degree of saturation	(%)	99	400	0.537	0.163	1.6
particle density	(Mg/m ³)	#2.70	50	0.563	0.049	
swelling pressure	(kPa)	N/A				
P'o to P'o +100 kPa	(kPa)					
laboratory temperature	(°C)	20 ± 2				
method of time fitting		root time				
remarks: # denotes particle density has been assigned an assumed value.					CONTRACT 31710	CHECKED CA

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES



BS.1377 : Part 5 : 1990 : 3

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH03
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	6UT
		SAMPLE DEPTH (m)	2.00
DESCRIPTION	Orangish brown mottled grey sandy CLAY	SPECIMEN DEPTH (m)	2.30



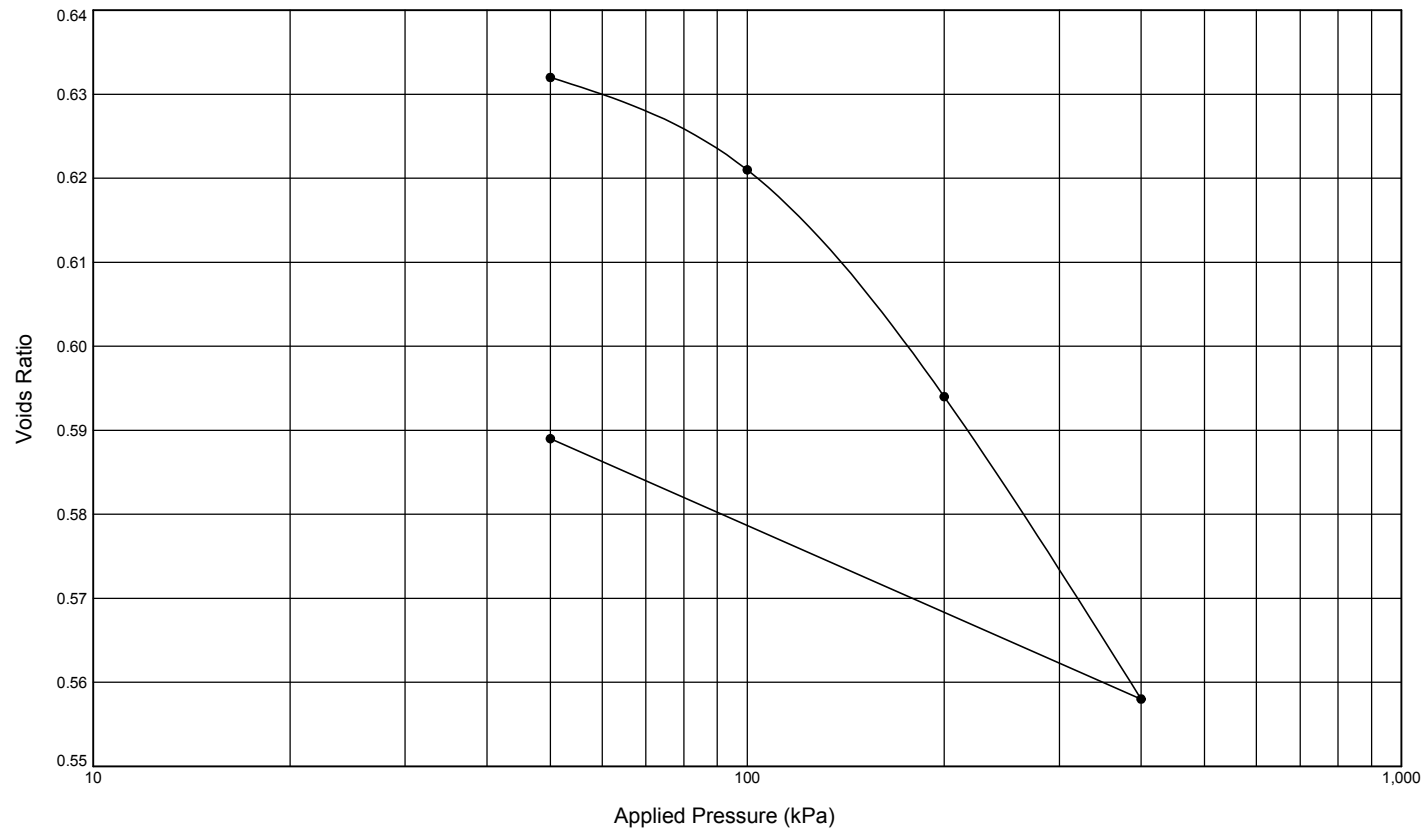
Test and sample details			Test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility (m ² /MN)	consolidation (m ² /year)
specimen diameter	(mm)	63.55				
specimen height	(mm)	18.10				
initial moisture content	(%)	16.6				
final moisture content	(%)	17.4				
initial bulk density	(Mg/m ³)	2.05	50	0.509	0.335	6.8
initial dry density	(Mg/m ³)	1.76	100	0.498	0.147	3.5
initial voids ratio		0.535	200	0.483	0.098	7.8
initial degree of saturation	(%)	84	400	0.464	0.065	3.0
particle density	(Mg/m ³)	#2.70	50	0.474	0.019	
swelling pressure	(kPa)	N/A				
P'o to P'o +100 kPa	(kPa)					
laboratory temperature	(°C)	20 ± 2				
method of time fitting		root time				
remarks: # denotes particle density has been assigned an assumed value.					CONTRACT 31710	CHECKED CA

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES



BS.1377 : Part 5 : 1990 : 3

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH04
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	6U
		SAMPLE DEPTH (m)	2.70
DESCRIPTION	Orange brown slightly sandy slightly gravelly CLAY	SPECIMEN DEPTH (m)	2.80



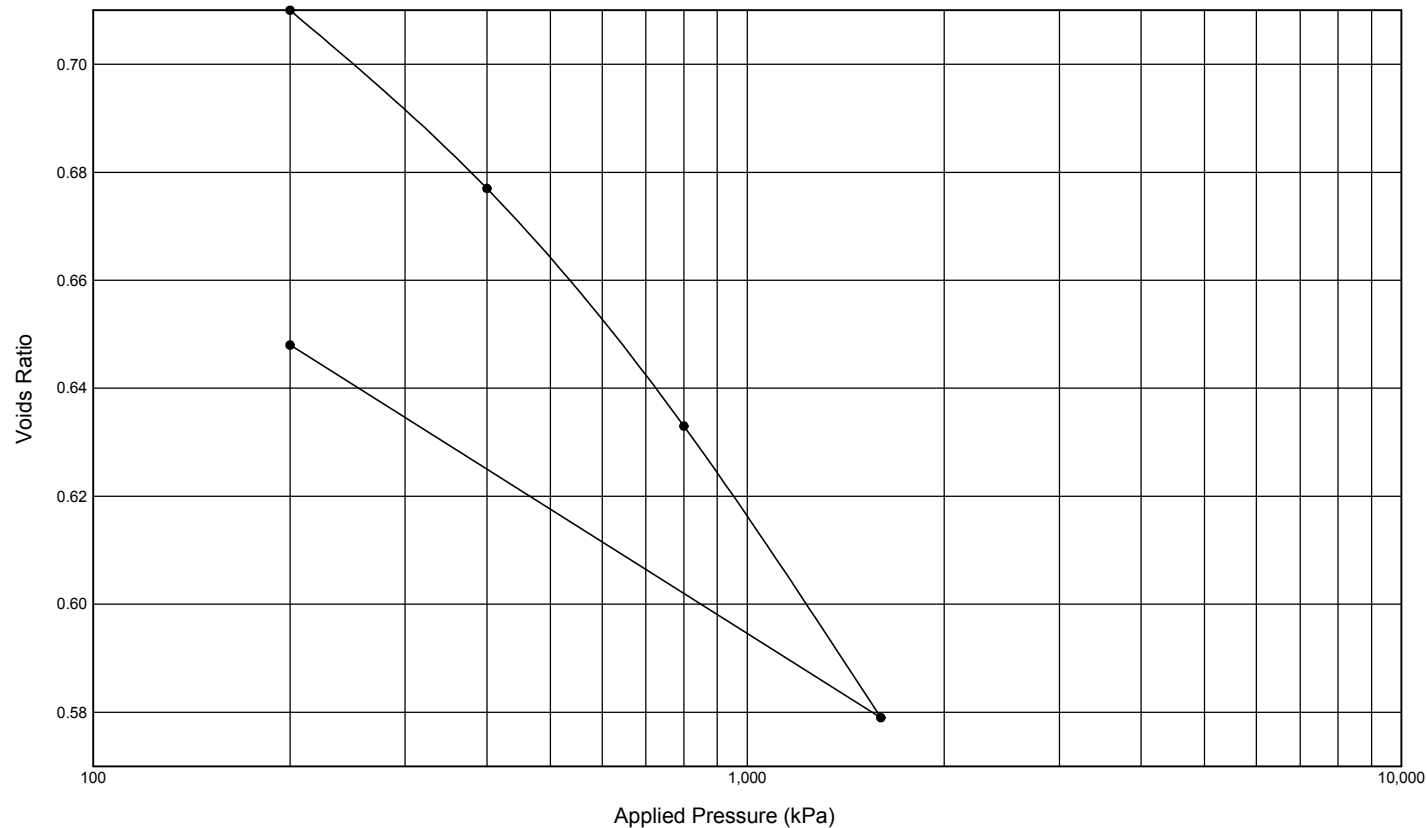
Test and sample details			Test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility (m ² /MN)	consolidation (m ² /year)
specimen diameter	(mm)	63.43				
specimen height	(mm)	19.04				
initial moisture content	(%)	24.1				
final moisture content	(%)	23.8				
initial bulk density	(Mg/m ³)	2.02	50	0.632	0.350	12
initial dry density	(Mg/m ³)	1.63	100	0.621	0.135	1.9
initial voids ratio		0.661	200	0.594	0.165	0.79
initial degree of saturation	(%)	99	400	0.558	0.112	0.59
particle density	(Mg/m ³)	#2.70	50	0.589	0.055	
swelling pressure	(kPa)	N/A				
P'o to P'o +100 kPa	(kPa)					
laboratory temperature	(°C)	20 ± 2				
method of time fitting		root time				
remarks: # denotes particle density has been assigned an assumed value.					CONTRACT 31710	CHECKED CA

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES



BS.1377 : Part 5 : 1990 : 3

CLIENT	KNOWLES & SON (OXFORD) LIMITED	BH/TP No.	BH04
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	14U
		SAMPLE DEPTH (m)	6.50
DESCRIPTION	Grey brown slightly sandy silty CLAY	SPECIMEN DEPTH (m)	6.50



Test and sample details			Test results			
			pressure stage (kPa)	voids ratio	laboratory coefficients of compressibility (m ² /MN)	consolidation (m ² /year)
specimen diameter	(mm)	63.19				
specimen height	(mm)	19.99				
initial moisture content	(%)	26.5				
final moisture content	(%)	25.4				
initial bulk density	(Mg/m ³)	1.91	200	0.710	0.211	2.0
initial dry density	(Mg/m ³)	1.51	400	0.677	0.096	0.41
initial voids ratio		0.785	800	0.633	0.066	0.38
initial degree of saturation	(%)	91	1600	0.579	0.042	0.40
particle density	(Mg/m ³)	#2.70	200	0.648	0.031	
swelling pressure	(kPa)	N/A				
P'o to P'o +100 kPa	(kPa)					
laboratory temperature	(°C)	20 ± 2				
method of time fitting		root time				
remarks: # denotes particle density has been assigned an assumed value.					CONTRACT 31710	CHECKED CA

UNDRAINED TRIAXIAL COMPRESSION**BS.1377 : Part 7 : 1990 : 8 and 9**

CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole /trial pit no.	sample		specimen depth (m)	code	moisture content (%)	density		cell pressure (kPa)	deviator stress (kPa)	failure strain (%)	failure mode	shear strength* (kPa)	description and remarks
	no./ type	depth (m)				bulk (Mg/m ³)	dry (Mg/m ³)						
BH01	15U	6.50	6.55	UU100	25.4	2.04	1.63	135	219	6.8	S	110	Greyish brown slightly sandy silty CLAY
BH01	23U	9.50	9.55	UU100	25.2	2.09	1.67	195	328	8.7	S	164	Greyish brown slightly sandy silty CLAY
BH01	31U	12.50	12.65	UU100	24.4	2.08	1.67	255	234	6.8	S	117	Brown slightly sandy CLAY
BH01	39U	15.50	15.55	UU100	22.4	2.10	1.71	315	470	8.3	S	235	Greyish brown sandy silty CLAY with rare shell fragments
BH02	14U	8.00	8.10	UU100	25.2	2.00	1.60	165	239	7.3	S	120	Dark brownish grey slightly sandy silty CLAY
BH02	22U	11.00	11.05	UU100	23.7	1.99	1.61	225	219	4.3	S	110	Greyish brown slightly sandy silty CLAY
BH02	30U	14.00	14.08	UU100	21.8	2.07	1.70	285	480	7.7	S	240	Brown slightly sandy silty CLAY with rare shell fragments
BH02	37U	17.00	17.23	UU100	22.6	2.04	1.66	345	390	5.8	S	195	Brown mottled grey slightly sandy silty CLAY
BH03	23UT	10.00	10.05	UU100	24.1	2.06	1.66	205	275	5.8	S	138	Dark brown slightly sandy silty CLAY
BH03	31U	13.00	13.05	UU100	25.8	2.04	1.62	265	226	6.3	S	113	Brown slightly sandy silty CLAY
BH03	39U	16.00	16.14	UU100	21.5	2.13	1.75	325	394	6.8	S	197	Brown sandy silty CLAY
BH04	14U	6.50	6.55	UU100	23.7	2.06	1.66	135	217	6.8	S	109	Brown slightly sandy silty CLAY
BH04	22U	9.50	9.55	UU100	25.1	2.07	1.66	195	333	5.8	S	167	Greyish brown slightly sandy silty CLAY
BH04	30UT	12.50	12.55	UU100	25.9	2.00	1.59	255	187	2.9	S	94	Brown slightly sandy silty CLAY with rare shell fragments
BH04	38UT	15.50	15.58	UU100	21.4	2.06	1.70	315	483	5.8	S	242	Brown slightly sandy slightly gravelly silty CLAY

general remarks: * shear strength taken as half deviator stress at failure for each stage.
denotes sample unsuitable to test.

code:
 CD - Consolidated drained M - Multistage 38 - 38mm dia. x 76mm
 CU - Consolidated undrained S - Set of 3 specimens 70 - 69mm dia. x 140mm
 UU - Unconsolidated undrained R - Remoulded 100 - 106mm dia. x 200mm

failure mode:
 B - barrelling (plastic failure) I - intermediate
 S - shear (brittle failure) O - other (see remarks)

membrane correction applied
 sample taken vertically (unless specified)
 rate of strain = 2%/min (unless specified)

membrane thickness:
 38 - 0.2mm 70 - 0.4mm
 106 - 0.4mm

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CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT	KNOWLES & SON (OXFORD) LTD	BH/TP No.	BH03
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	15UT
		SAMPLE DEPTH (m)	7.00-7.45
DESCRIPTION	Grey brown, slightly sandy, slightly gravelly, silty CLAY	SPECIMEN DEPTH (m)	7.15

TYPE OF SPECIMEN	Undisturbed / Vertical
TYPE OF TEST	Single Specimen Multistage
SIDE DRAINS FITTED	Yes
DRAINAGE CONDITIONS	Both ends and radial boundary

		STAGE	1	2	3	
INITIAL CONDITIONS	Length	mm	206.35	204	*	202 *
	Diameter	mm	103.18	102	*	101 *
	Moisture Content	%	25			
	Bulk Density	Mg/m ³	2.00			
	Dry Density	Mg/m ³	1.60			
FINAL CONDITIONS	Moisture Content	%				21
	Bulk Density	Mg/m ³				2.05
	Dry Density	Mg/m ³				1.69
SATURATION (by cell pressure and back pressure increments)	Initial PWP	kPa	-3			
	Saturated PWP	kPa	393			
	Final Cell Pressure	kPa	400			
	B Value		1			
CONSOLIDATION	Cell Pressure	kPa	412.5	485		630
	Back Pressure	kPa	340	340		340
	Initial PWP	kPa	404	430		516
	Final PWP	kPa	340	339		340
	c _v	m ² /yr	0.21	0.18		0.12
	m _v	m ² /MN	0.655	0.284		0.163
	k (calculated value)	m/s	4.3E-11	1.6E-11		6.0E-12
COMPRESSION	Cell Pressure	kPa	412.5	485		630
	Back Pressure	kPa	340	340		340
	σ ₃ '	kPa	72.5	145		290
	Rate of Strain	%/hr	0.062	0.054		0.0365
FAILURE CONDITIONS (based on maximum stress ratio)	Axial Strain (ε)	%	2.7	2.9		6.3
	δu _f	kPa	32	58		113
	σ _{3f} '	kPa	41	87		177
	(σ ₁ ' - σ ₃ ') _f	kPa	71	131		269
	(σ ₁ '/σ ₃ ') _f		2.7	2.5		2.5
FAILURE MODE (also see photo)	EFFECTIVE STRESS PARAMETERS		c' kPa :		φ' deg :	
	INTER		2.6		2 .0	
remarks	* Calculated values		CONTRACT		CHECKED	
			31710		NP	

Geotechnical Engineering Ltd, Centurion House, Olympus Park, Quedgeley, Gloucester, GL2 4NF, Tel - 01452 527743



CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT KNOWLES & SON (OXFORD) LTD

BH/TP No.

BH03

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

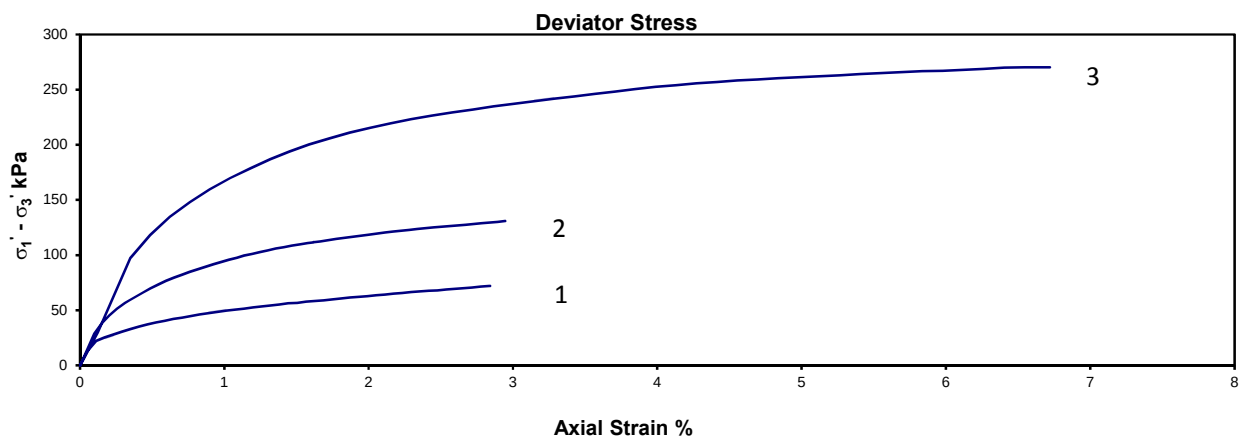
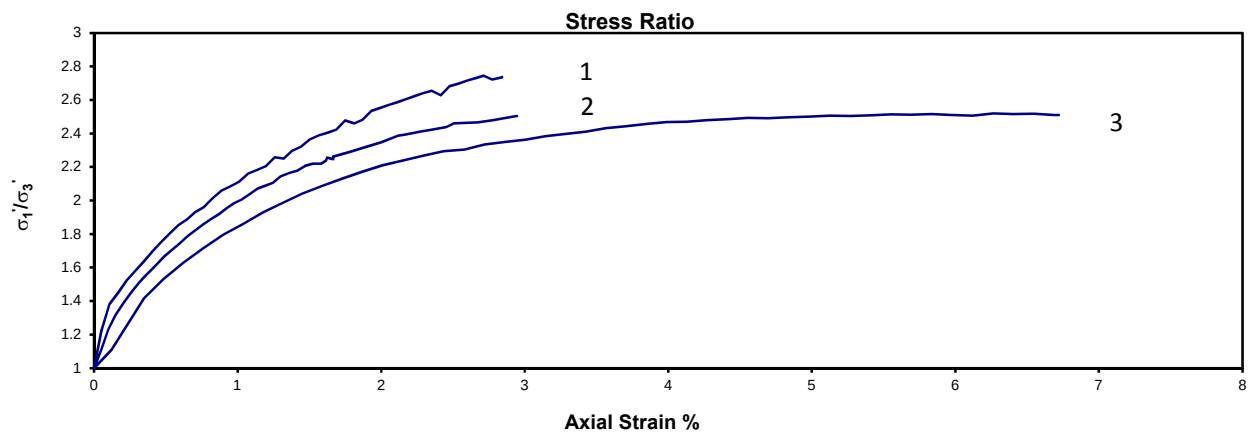
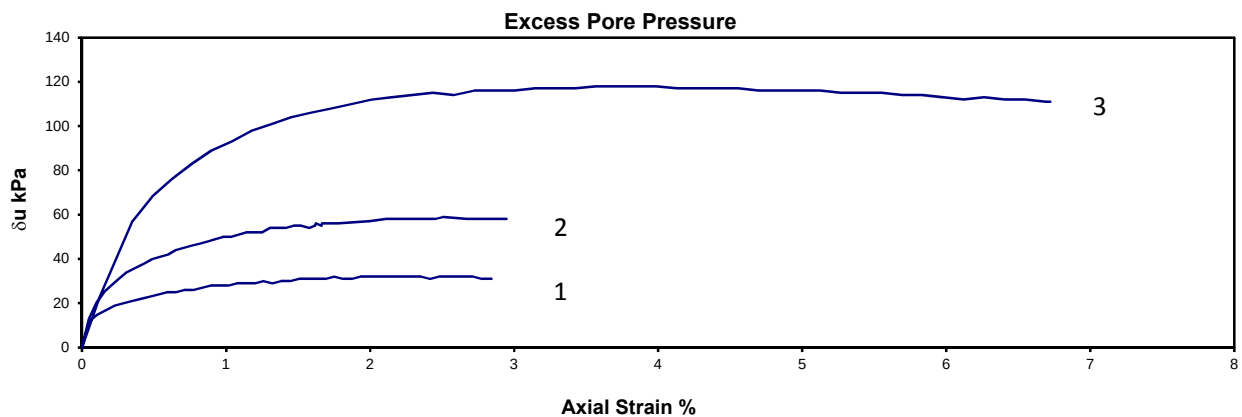
15UT

SAMPLE DEPTH (m)

7.00-7.45

SPECIMEN DEPTH (m)

7.15



remarks

CONTRACT

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NP



CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT KNOWLES & SON (OXFORD) LTD

BH/TP No.

BH03

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

15UT

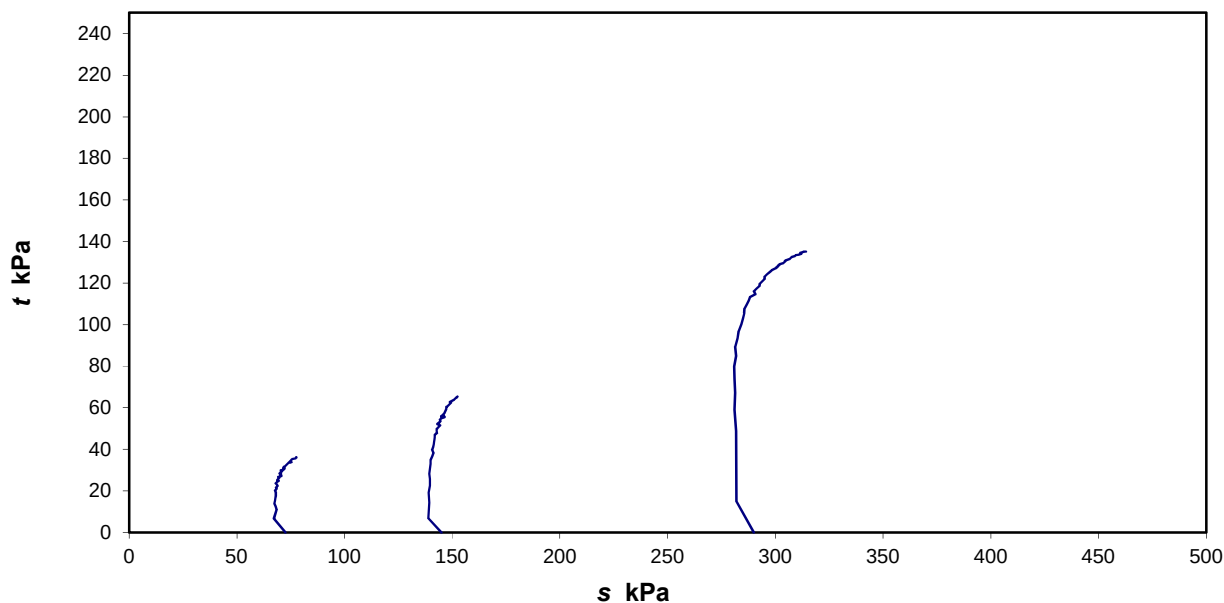
SAMPLE DEPTH (m)

7.00-7.45

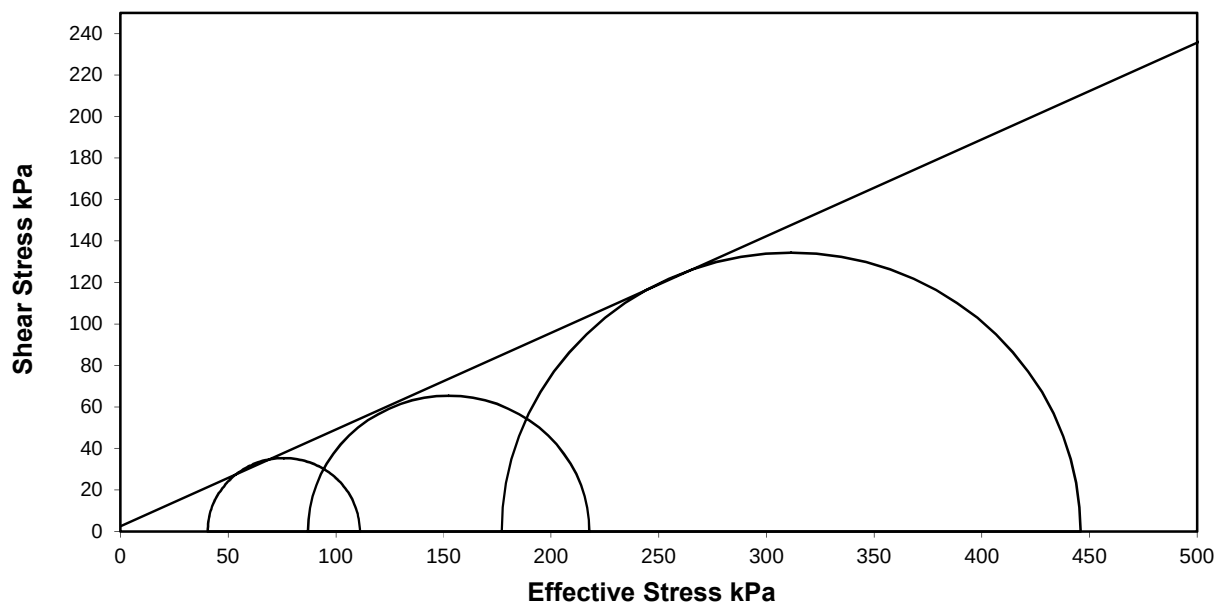
SPECIMEN DEPTH (m)

7.15

Stress Path



Mohr Circles



remarks

CONTRACT

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CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT KNOWLES & SON (OXFORD) LTD

BH/TP No.

BH03

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

15UT

SAMPLE DEPTH (m)

7.00-7.45

SPECIMEN DEPTH (m)

7.15



Failure Mode

INTER

remarks

Please note the photo is intended to show the mode of failure only.

CONTRACT

31710

CHECKED

NP



CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT	KNOWLES AND SON (OXFORD) LTD	BH/TP No.	BH04
SITE	UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING	SAMPLE No./TYPE	6U
DESCRIPTION	Orangish brown mottled light grey, slightly gravelly, sandy CLAY	SAMPLE DEPTH (m)	2.70-3.15
		SPECIMEN DEPTH (m)	2.90

TYPE OF SPECIMEN	Undisturbed / Vertical
TYPE OF TEST	Single Specimen Multistage
SIDE DRAINS FITTED	Yes
DRAINAGE CONDITIONS	Both ends and radial boundary

		STAGE	1	2	3	
INITIAL CONDITIONS	Length	mm	206.45	207	*	206 *
	Diameter	mm	105.23	106	*	105 *
	Moisture Content	%	22			
	Bulk Density	Mg/m ³	2.03			
	Dry Density	Mg/m ³	1.66			
FINAL CONDITIONS	Moisture Content	%				22
	Bulk Density	Mg/m ³				2.04
	Dry Density	Mg/m ³				1.67
SATURATION (by cell pressure and back pressure increments)	Initial PWP	kPa	-3			
	Saturated PWP	kPa	386			
	Final Cell Pressure	kPa	400			
	B Value		1			
CONSOLIDATION	Cell Pressure	kPa	370	400		460
	Back Pressure	kPa	340	340		340
	Initial PWP	kPa	358	367		342
	Final PWP	kPa	338	338		372
	c _v	m ² /yr	0.46	0.41		0.32
	m _v	m ² /MN	0.227	0.254		0.409
	k (calculated value)	m/s	3.3E-11	3.2E-11		4.0E-11
COMPRESSION	Cell Pressure	kPa	370	400		460
	Back Pressure	kPa	340	340		340
	σ ₃ '	kPa	30	60		120
	Rate of Strain	%/hr	0.131	0.116		0.09
FAILURE CONDITIONS (based on maximum stress ratio)	Axial Strain (ε)	%	1.6	1.6		2.7
	δu _f	kPa	11	25		46
	σ _{3f} '	kPa	19	35		74
	(σ ₁ ' - σ ₃ ') _f	kPa	61	94		152
	(σ ₁ '/σ ₃ ') _f		4.2	3.7		3.1
FAILURE MODE (also see photo)	EFFECTIVE STRESS PARAMETERS		c' kPa :		φ' deg :	
	INTER		10.1		26.6	
remarks	* Calculated values		CONTRACT		CHECKED	
			31710		NP	

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CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT KNOWLES AND SON (OXFORD) LTD

BH/TP No.

BH04

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

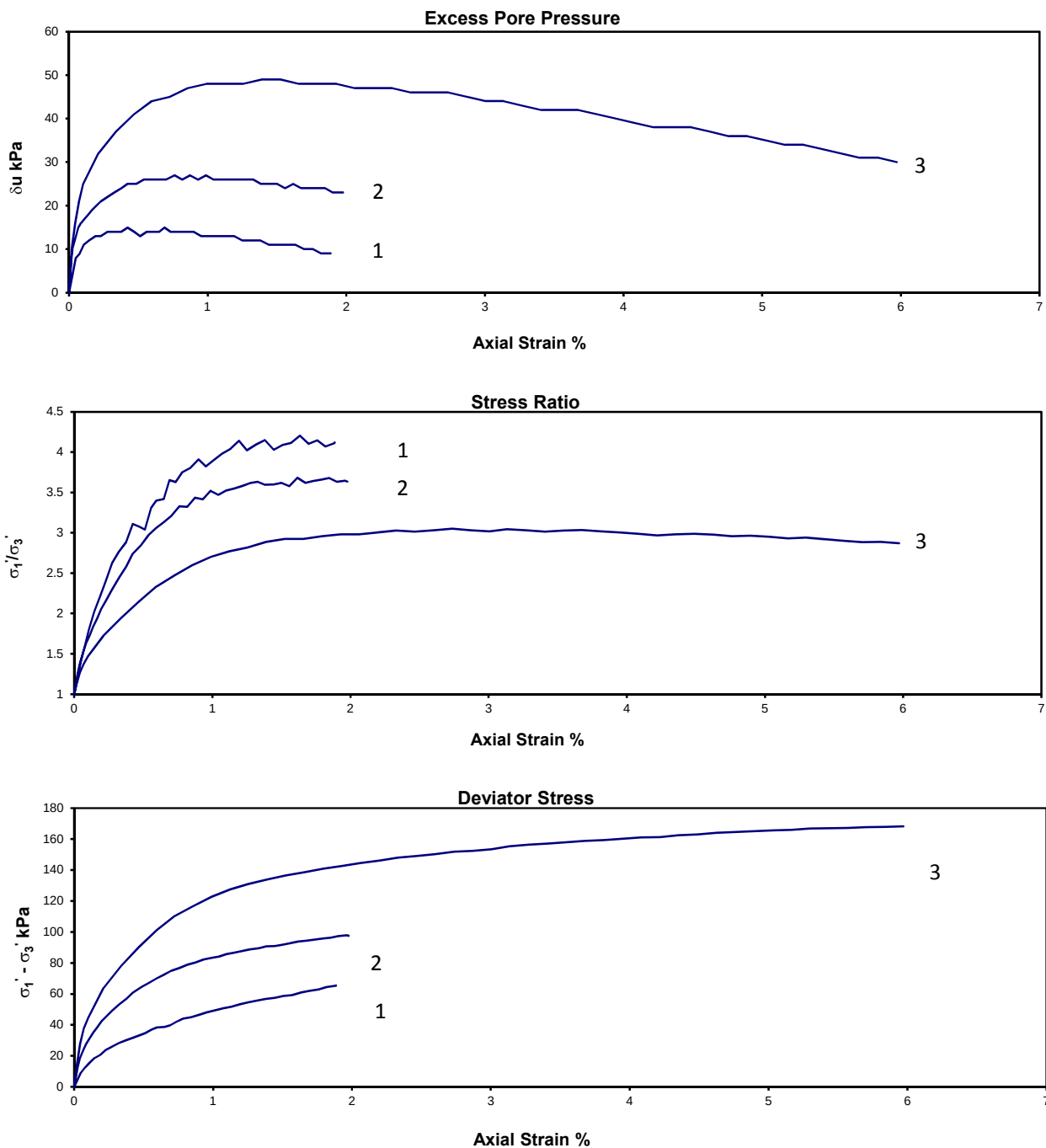
6U

SAMPLE DEPTH (m)

2.70-3.15

SPECIMEN DEPTH (m)

2.90



remarks

CONTRACT

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31710

NP



CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

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CLIENT KNOWLES AND SON (OXFORD) LTD

BH/TP No.

BH04

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

6U

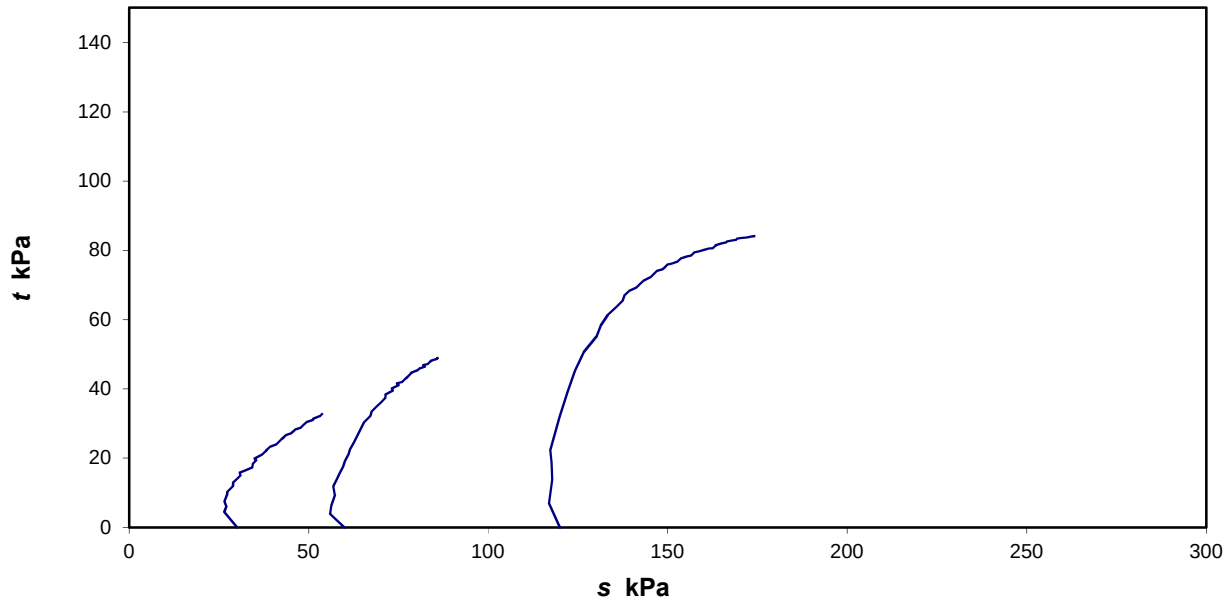
SAMPLE DEPTH (m)

2.70-3.15

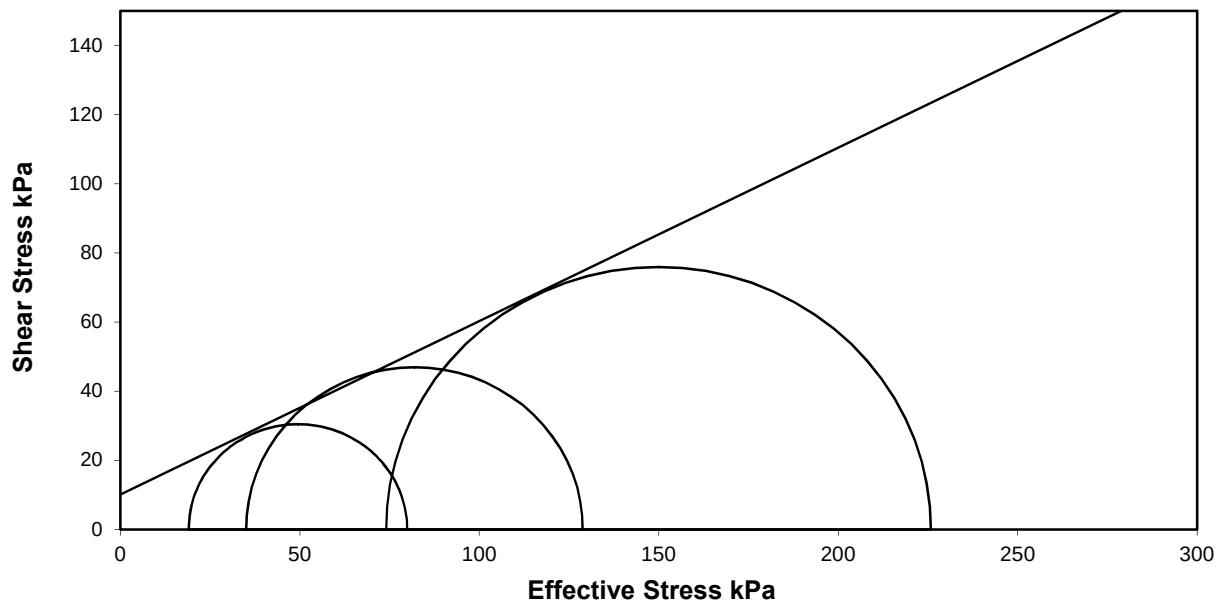
SPECIMEN DEPTH (m)

2.90

Stress Path



Mohr Circles



remarks

CONTRACT

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CONSOLIDATED UNDRAINED TRIAXIAL TEST with PWP

BS1377 : Part 8 : 1990 and "Manual of Soil Laboratory Testing", Volume 3, K.H. Head

CLIENT KNOWLES AND SON (OXFORD) LTD

BH/TP No.

BH04

SITE UNIVERSITY OF READING - HEALTH AND LIFE
SCIENCES BUILDING

SAMPLE No./TYPE

6U

SAMPLE DEPTH (m)

2.70-3.15

SPECIMEN DEPTH (m)

2.90



Failure Mode

INTER

remarks

Please note the photo is intended to show the mode of failure only.

CONTRACT

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NP

Geotechnical Engineering Limited

HAND VANE TEST RESULTS



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole /trial pit no.	sample		specimen depth (m)	Vane Strength (kPa)			description and remarks
	no./type	depth (m)		Top	Bottom	Average	
BH01	19U	8.00	8.00	>130			Dark grey slightly sandy silty CLAY
BH01	19U	8.00	8.20	>130			Dark grey slightly sandy silty CLAY
BH01	19U	8.00	8.45	>130			Dark grey slightly sandy silty CLAY
BH01	27U	11.00	11.00	>130			Dark grey slightly sandy silty CLAY
BH01	27U	11.00	11.21	>130			Dark grey slightly sandy silty CLAY
BH01	27U	11.00	11.45	>130			Dark grey slightly sandy silty CLAY
BH01	35U	14.00	14.00	>130			Dark grey slightly sandy silty CLAY
BH01	35U	14.00	14.20	>130			Dark grey slightly sandy silty CLAY
BH01	35U	14.00	14.40	>130			Dark grey slightly sandy silty CLAY
BH01	43U	17.00	17.00	>130			Dark grey slightly sandy silty CLAY
BH01	43U	17.00	17.25	>130			Dark grey slightly sandy silty CLAY
BH01	43U	17.00	17.45	>130			Dark grey slightly sandy silty CLAY
BH02	18U	9.50	9.50	>130			Dark grey slightly sandy silty CLAY
BH02	18U	9.50	9.70	>130			Dark grey slightly sandy silty CLAY
BH02	18U	9.50	9.90	>130			Dark grey slightly sandy silty CLAY
BH02	26U	12.50	12.50	>130			Dark grey slightly sandy silty CLAY
BH02	26U	12.50	12.70	>130			Dark grey slightly sandy silty CLAY
BH02	26U	12.50	12.90	>130			Dark grey slightly sandy silty CLAY
BH02	34U	15.50	15.50	>130			Dark grey slightly sandy silty CLAY
BH02	34U	15.50	15.73	>130			Dark grey slightly sandy silty CLAY
BH02	34U	15.50	15.95	>130			Dark grey slightly sandy silty CLAY
BH03	6UT	2.00	2.00	99			Brown and light grey slightly sandy slightly gravelly CLAY
BH03	6UT	2.00	2.20	85			Brown and light grey slightly sandy slightly gravelly CLAY
general remarks: Re - Denotes vane test refusal							
						CONTRACT 31710	CHECKED CA

Geotechnical Engineering Limited

HAND VANE TEST RESULTS



CLIENT KNOWLES & SON (OXFORD) LIMITED

SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING

borehole /trial pit no.	sample		specimen depth (m)	Vane Strength (kPa)			description and remarks
	no./type	depth (m)		Top	Bottom	Average	
BH03	6UT	2.00	2.40	126			Brown and light grey slightly sandy slightly gravelly CLAY
BH03	27UT	11.50	11.50	>130			Dark grey slightly sandy silty CLAY
BH03	27UT	11.50	11.72	>130			Dark grey slightly sandy silty CLAY
BH03	27UT	11.50	11.95	>130			Dark grey slightly sandy silty CLAY
BH03	35U	14.50	14.50	>130			Dark grey slightly sandy silty CLAY
BH03	35U	14.50	14.70	>130			Dark grey slightly sandy silty CLAY
BH03	35U	14.50	14.90	>130			Dark grey slightly sandy silty CLAY
BH03	43U	17.50	17.50	>130			Dark grey slightly sandy silty CLAY
BH03	43U	17.50	17.75	>130			Dark grey slightly sandy silty CLAY
BH03	43U	17.50	17.95	>130			Dark grey slightly sandy silty CLAY
BH04	18U	8.00	8.00	112			Dark grey slightly sandy silty CLAY
BH04	18U	8.00	8.17	>130			Dark grey slightly sandy silty CLAY
BH04	18U	8.00	8.35	>130			Dark grey slightly sandy silty CLAY
BH04	26U	11.00	11.00	>130			Dark grey slightly sandy silty CLAY
BH04	26U	11.00	11.15	>130			Dark grey slightly sandy silty CLAY
BH04	26U	11.00	11.25	>130			Dark grey slightly sandy silty CLAY
BH04	34UT	14.00	14.00	>130			Dark grey slightly sandy silty CLAY
BH04	34UT	14.00	14.35	>130			Dark grey slightly sandy silty CLAY
BH04	34UT	14.00	14.45	>130			Dark grey slightly sandy silty CLAY
BH04	42UT	17.00	17.00	>130			Dark grey slightly sandy silty CLAY
BH04	42UT	17.00	17.20	>130			Dark grey slightly sandy silty CLAY
BH04	42UT	17.00	17.40	>130			Dark grey slightly sandy silty CLAY
general remarks: Re - Denotes vane test refusal							
						CONTRACT 31710	CHECKED CA



Final Report

Report No.: 16-08961-1

Initial Date of Issue: 25-Apr-2016

Client Geotechnical Engineering Ltd

Client Address: Centurion House
Olympus Park
Quedgeley
Gloucester
Gloucestershire
GL2 4NF

Contact(s): Claire Andrew

Project 31710 - University Of Reading Health
And Life Sciences

Quotation No.: **Date Received:** 19-Apr-2016

Order No.: 31710 **Date Instructed:** 19-Apr-2016

No. of Samples: 10

Turnaround (Wkdays): 5 **Results Due:** 25-Apr-2016

Date Approved: 25-Apr-2016

Approved By:



Details: Robert Monk, Technical Development
Chemist

Results - Soil

Project: 31710 - University Of Reading Health And Life Sciences

Client: Geotechnical Engineering Ltd	Chemtest Job No.:				16-08961	16-08961	16-08961	16-08961	16-08961	16-08961	16-08961	16-08961
Quotation No.:	Chemtest Sample ID.:				282051	282052	282053	282054	282055	282056	282057	282058
Order No.: 31710	Client Sample Ref.:				TP03	TP03	BH01	BH01	BH01	BH01	BH02	BH02
	Client Sample ID.:				2B	4B	3B	7D	11B	18D	9D	17D
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.7	1.8	1.0	2.8	5.0	7.5	6.0	9.0
	Date Sampled:				15-Apr-2016	15-Apr-2016	15-Apr-2016	15-Apr-2016	15-Apr-2016	15-Apr-2016	15-Apr-2016	15-Apr-2016
Determinand	Accred.	SOP	Units	LOD								
Moisture	N	2030	%	0.020	14	16	14	21	22	20	20	20
pH	U	2010		N/A	8.0	7.9	7.9	7.3	7.1	8.1	8.2	8.3
Sulphate (2:1 Water Soluble) as SO ₄	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.17	0.11	0.10
Total Sulphur	U	2175	%	0.010	0.040	0.020	0.010	0.020	0.010	0.52	0.32	0.51
Sulphate (Acid Soluble)	U	2430	%	0.010	0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.071	0.048	0.047

Project: 31710 - University Of Reading Health And Life Sciences

Client: Geotechnical Engineering Ltd	Chemtest Job No.:				16-08961	16-08961
Quotation No.:	Chemtest Sample ID.:				282059	282060
Order No.: 31710	Client Sample Ref.:				BH02	BH02
	Client Sample ID.:				25D	35D
	Sample Type:				SOIL	SOIL
	Top Depth (m):				12.0	15.95
	Date Sampled:				15-Apr-2016	15-Apr-2016
Determinand	Accred.	SOP	Units	LOD		
Moisture	N	2030	%	0.020	19	16
pH	U	2010		N/A	8.3	8.1
Sulphate (2:1 Water Soluble) as SO ₄	U	2120	g/l	0.010	0.096	0.24
Total Sulphur	U	2175	%	0.010	0.79	0.92
Sulphate (Acid Soluble)	U	2430	%	0.010	0.073	0.068

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 our Coventry 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

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



APPENDIX F

CHEMICAL TESTING



Geotechnical Engineering Ltd
Centurion House
Olympus Park
Quedgeley
Gloucester
Gloucestershire
GL2 4NF

Attention: Jon Ind

CERTIFICATE OF ANALYSIS

Date: 14 April 2016
Customer: H_GEOTECHEN_GLO
Sample Delivery Group (SDG): 160403-9
Your Reference:
Location: University of Reading
Report No: 357003

We received 3 samples on Saturday April 02, 2016 and 2 of these samples were scheduled for analysis which was completed on Thursday April 14, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	160403-9	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	357003
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13194124	BH03	ES	0.20 - 0.30	31/03/2016
13194125	BH03	ES	0.60 - 0.70	31/03/2016
13194126	BH03	ES	1.50	31/03/2016

Only received samples which have had analysis scheduled will be shown on the following pages.



SDG: 160403-9
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		13194124	13194125
	Customer Sample Reference		BH03	BH03
	AGS Reference		ES	ES
	Depth (m)		0.20 - 0.30	0.60 - 0.70
	Container		250g Amber Jar (AL) 1kg TUB	250g Amber Jar (AL) 1kg TUB
Anions by Kone (soil)	All	NDPs: 0 Tests: 2	X	X
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 2	X	X
Boron Water Soluble	All	NDPs: 0 Tests: 2	X	X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 2	X	X
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 1	X	
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 1	X	
GRO by GC-FID (S)	All	NDPs: 0 Tests: 1		X
Metals in solid samples by OES	All	NDPs: 0 Tests: 2	X	X
PAH by GCMS	All	NDPs: 0 Tests: 2	X	X
pH	All	NDPs: 0 Tests: 2	X	X
Phenols Spec MS (S)	All	NDPs: 0 Tests: 2	X	X
Sample description	All	NDPs: 0 Tests: 2	X	X
Total Organic Carbon	All	NDPs: 0 Tests: 2	X	X
Total Sulphate	All	NDPs: 0 Tests: 2	X	X
TPH CWG GC (S)	All	NDPs: 0 Tests: 1	X	



SDG:	160403-9	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	357003
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Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2		
13194124	BH03	0.20 - 0.30	Dark Brown	Sand	0.063 - 2.00 mm	Concrete/Aggre gate	Stones		
13194125	BH03	0.60 - 0.70	Light Brown	Sandy Loam	0.063 - 2.00 mm	Concrete/Aggre gate	Stones		

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Order Number: 31710/JI
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Superseded Report:

13:20:22 14/04/2016

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CERTIFICATE OF ANALYSIS

SDG: 160403-9
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R	BH03					
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.20 - 0.30 Soil/Solid 31/03/2016 02/04/2016 160403-9 13194124 ES					
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-5ö	Sample deviation (see appendix)							
Component	LOD/Units							
GRO Surrogate % recovery**	%	TM089	77					
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	86.9 M					
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<5 #					
Benzene	<10 µg/kg	TM089	<10 M					
Toluene	<2 µg/kg	TM089	<2 M					
Ethylbenzene	<3 µg/kg	TM089	<3 M					
m,p-Xylene	<6 µg/kg	TM089	<6 M					
o-Xylene	<3 µg/kg	TM089	<3 M					
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9					
sum of detected BTEX by GC	<24 µg/kg	TM089	<24					
Aliphatics >C5-C6	<10 µg/kg	TM089	<10					
Aliphatics >C6-C8	<10 µg/kg	TM089	<10					
Aliphatics >C8-C10	<10 µg/kg	TM089	<10					
Aliphatics >C10-C12	<10 µg/kg	TM089	36.3					
Aliphatics >C12-C16	<100 µg/kg	TM173	15800					
Aliphatics >C16-C21	<100 µg/kg	TM173	39600					
Aliphatics >C21-C35	<100 µg/kg	TM173	105000					
Aliphatics >C35-C44	<100 µg/kg	TM173	90000					
Total Aliphatics >C12-C44	<100 µg/kg	TM173	250000					
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10					
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10					
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10					
Aromatics >EC10-EC12	<10 µg/kg	TM089	24.2					
Aromatics >EC12-EC16	<100 µg/kg	TM173	2520					
Aromatics >EC16-EC21	<100 µg/kg	TM173	8050					
Aromatics >EC21-EC35	<100 µg/kg	TM173	76700					
Aromatics >EC35-EC44	<100 µg/kg	TM173	127000					
Aromatics >EC40-EC44	<100 µg/kg	TM173	58100					
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	214000					
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	464000					



SDG:	160403-9	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	357003
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Asbestos Identification - Soil

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH03 ES 0.20 - 0.30 SOLID 31/03/2016 00:00:00 04/04/2016 16:15:35 160403-9 13194124 TM048	05/04/16	Chris Swindells	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	BH03 ES 0.60 - 0.70 SOLID 31/03/2016 00:00:00 08/04/2016 00:37:22 160403-9 13194125 TM048	14/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



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Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
ASB_PREP				
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM072	Modified: US EPA Method 8141A	Determination of Phenols by GC-MS		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM221	Inductively Coupled Plasma - Atomic Emission Spectroscopy. An Atlas of Spectral Information: Winge, Fassel, Peterson and Floyd	Determination of Acid extractable Sulphate in Soils by IRIS Emission Spectrometer		
TM222	In-House Method	Determination of Hot Water Soluble Boron in Soils (10:1 Water:soil) by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



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Client Reference:		Attention:	Jon Ind	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13194124	13194125
Customer Sample Ref.	BH03	BH03
AGS Ref.	ES	ES
Depth	0.20 - 0.30	0.60 - 0.70
Type	SOLID	SOLID
Anions by Kone (soil)	06-Apr-2016	06-Apr-2016
Asbestos ID in Solid Samples	07-Apr-2016	14-Apr-2016
Boron Water Soluble	05-Apr-2016	07-Apr-2016
Cyanide Comp/Free/Total/Thiocyanate	06-Apr-2016	07-Apr-2016
EPH CWG (Aliphatic) GC (S)	06-Apr-2016	
EPH CWG (Aromatic) GC (S)	06-Apr-2016	
GRO by GC-FID (S)	06-Apr-2016	
Metals in solid samples by OES	06-Apr-2016	07-Apr-2016
PAH by GCMS	06-Apr-2016	07-Apr-2016
pH	06-Apr-2016	06-Apr-2016
Phenols Spec MS (S)	08-Apr-2016	08-Apr-2016
Sample description	04-Apr-2016	05-Apr-2016
Total Organic Carbon	06-Apr-2016	08-Apr-2016
Total Sulphate	05-Apr-2016	07-Apr-2016
TPH CWG GC (S)	06-Apr-2016	



SDG: 160403-9
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Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

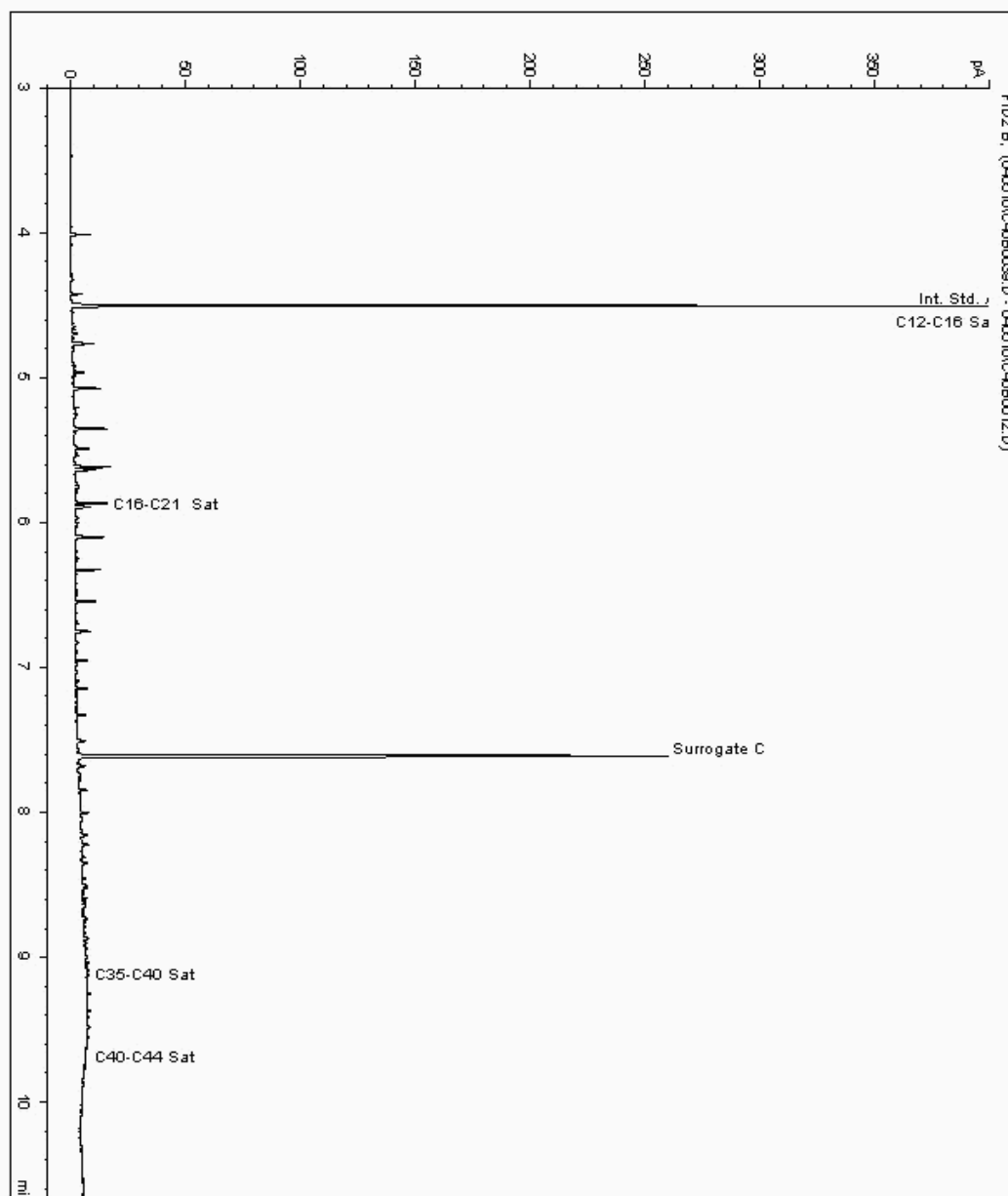
Sample No : 13199465
Sample ID : BH03

Depth : 0.20 - 0.30

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12431279-
Date Acquired : 05/04/2016 22:38:27 PM
Units : ppb
Dilution: BH03[0.20 - 0.30]

->





SDG: 160403-9
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

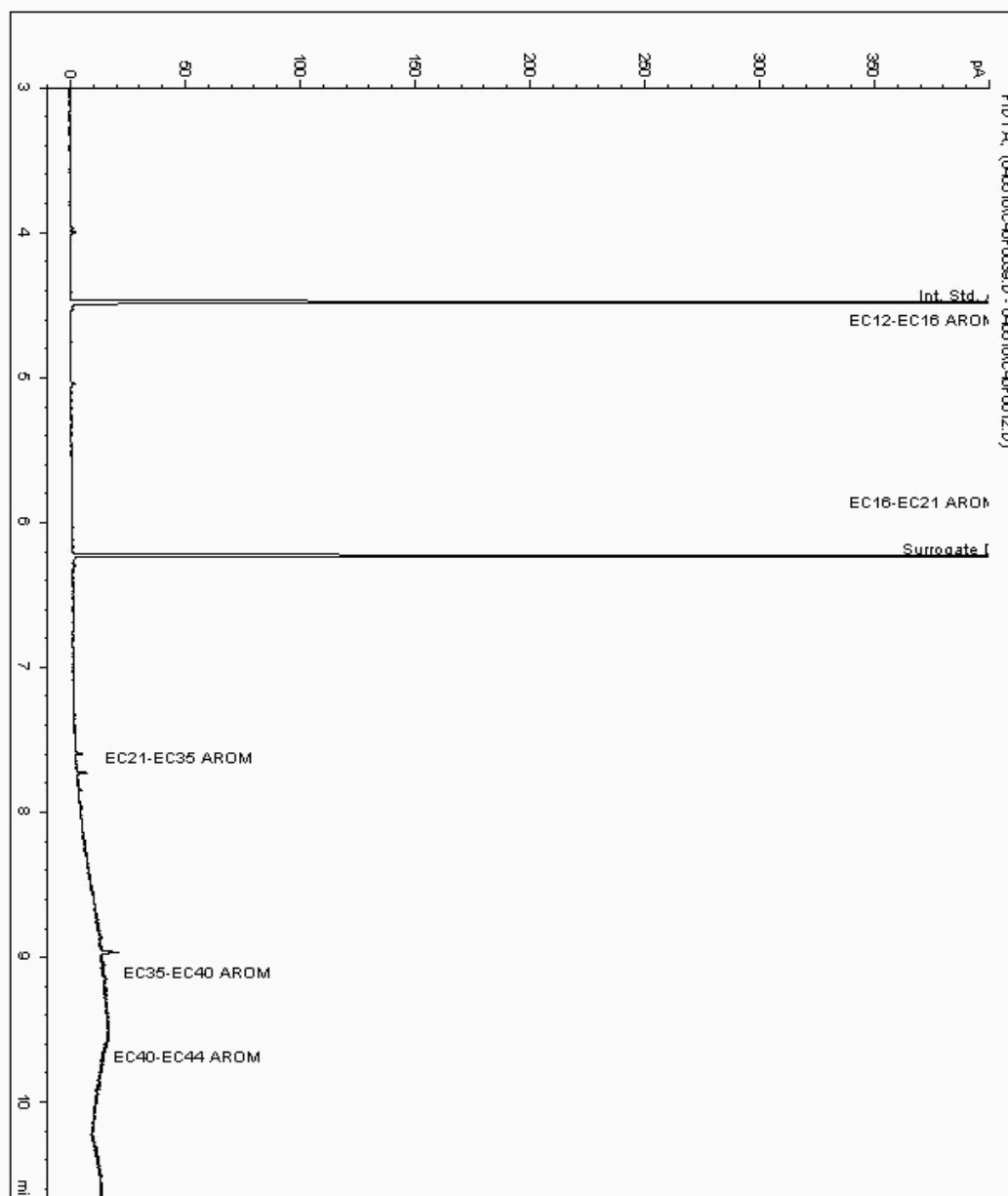
Sample No : 13199465
Sample ID : BH03

Depth : 0.20 - 0.30

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12431280-
Date Acquired : 05/04/2016 22:38:27 PM
Units : ppb
Dilution: BH03[0.20 - 0.30]

->





SDG: 160403-9
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

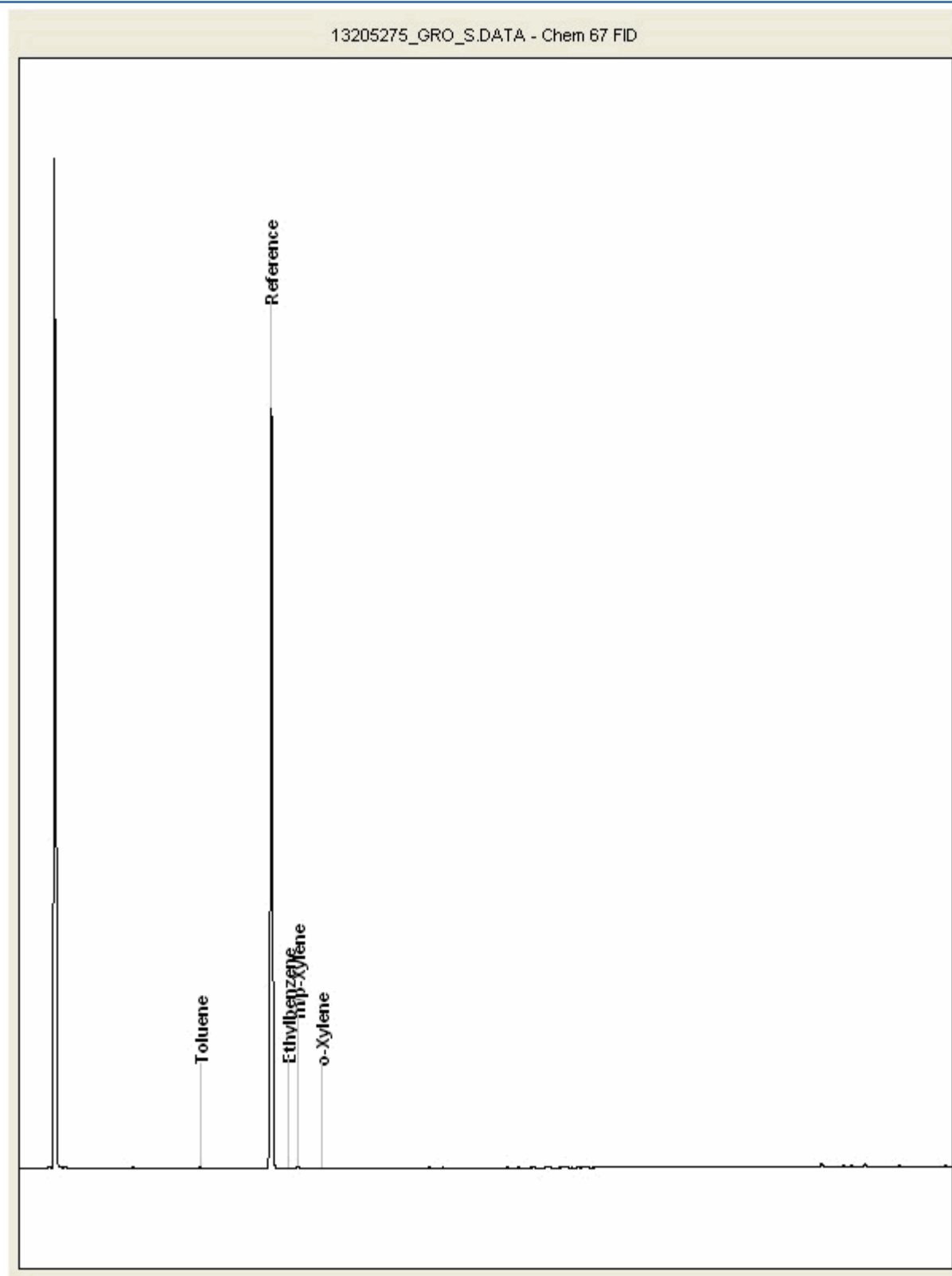
Order Number: 31710/JI
Report Number: 357003
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 13205275
Sample ID : BH03

Depth : 0.20 - 0.30





SDG: 160403-9
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 357003
Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

General

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Almandine	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:
- Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



Geotechnical Engineering Ltd
Centurion House
Olympus Park
Quedgeley
Gloucester
Gloucestershire
GL2 4NF

Attention: Jon Ind

CERTIFICATE OF ANALYSIS

Date: 14 April 2016
Customer: H_GEOTECHEN_GLO
Sample Delivery Group (SDG): 160406-79
Your Reference:
Location: University of Reading
Report No: 356997

We received 18 samples on Wednesday April 06, 2016 and 6 of these samples were scheduled for analysis which was completed on Thursday April 14, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	160406-79	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	356997
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13212264	BH01		0.20 - 0.40	05/04/2016
13212265	BH01		0.50 - 0.70	05/04/2016
13212248	IP01		0.20	04/04/2016
13212249	IP01		0.60	04/04/2016
13212250	IP01		0.90 - 1.00	04/04/2016
13212251	IP02		0.20	04/04/2016
13212252	IP02		0.50	04/04/2016
13212253	IP02		1.00	04/04/2016
13212254	IP03		0.20	04/04/2016
13212255	IP03		0.50	04/04/2016
13212260	TP02		0.20	04/04/2016
13212261	TP02		0.80	04/04/2016
13212262	TP02		1.60	04/04/2016
13212263	TP02		2.50	04/04/2016
13212256	TP03		0.20	04/04/2016
13212257	TP03		0.70	04/04/2016
13212258	TP03		1.30	04/04/2016
13212259	TP03		1.80	04/04/2016

Only received samples which have had analysis scheduled will be shown on the following pages.



SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		Customer Sample Reference		AGS Reference		Depth (m)		Container	
	13212258		TP03				1.30		250g Amber Jar (AL 1kg TUB	
	13212257		TP03				0.70		60g VOC (ALE215) 250g Amber Jar (AL 1kg TUB	
	13212254		IP03				0.20		250g Amber Jar (AL 1kg TUB	
	13212253		IP02				1.00		250g Amber Jar (AL 1kg TUB	
	13212252		IP02				0.50		60g VOC (ALE215) 250g Amber Jar (AL 1kg TUB	
	13212249		IP01				0.60		60g VOC (ALE215) 250g Amber Jar (AL 1kg TUB	
Anions by Kone (soil)	All	NDPs: 0 Tests: 6								
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 5								
Boron Water Soluble	All	NDPs: 0 Tests: 6								
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 6								
Easily Liberated Sulphide	All	NDPs: 0 Tests: 6								
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 3								
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 3								
GRO by GC-FID (S)	All	NDPs: 0 Tests: 3								
Metals in solid samples by OES	All	NDPs: 0 Tests: 6								
PAH by GCMS	All	NDPs: 0 Tests: 6								
pH	All	NDPs: 0 Tests: 6								
Phenols Spec MS (S)	All	NDPs: 0 Tests: 6								
Sample description	All	NDPs: 0 Tests: 6								
Total Organic Carbon	All	NDPs: 0 Tests: 3								
TPH CWG GC (S)	All	NDPs: 0 Tests: 3								



SDG:	160406-79	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	356997
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
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Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
13212249	IP01	0.60	Dark Brown	Sandy Silt Loam	0.063 - 2.00 mm	Stones	None
13212252	IP02	0.50	Dark Brown	Sandy Clay Loam	0.063 - 2.00 mm	Stones	None
13212253	IP02	1.00	Dark Brown	Silty Clay	0.002 - 0.063 mm	Stones	None
13212254	IP03	0.20	Dark Brown	Sandy Silt Loam	0.063 - 2.00 mm	Stones	Vegetation
13212257	TP03	0.70	Dark Brown	Sandy Silt Loam	0.063 - 2.00 mm	Stones	None
13212258	TP03	1.30	Dark Brown	Sandy Loam	0.063 - 2.00 mm	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

SDG:	160406-79	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	356997
Client Reference:		Attention:	Jon Ind	Superseded Report:	

12:11:34 14/04/2016

Order Number: 31710/JL
Report Number: 356997
Superseded Report:

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CERTIFICATE OF ANALYSIS

SDG:	160406-79	Location:	University of Reading	Order Number:	31710/JI
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	356997
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Phenols Spec MS (S)

Results Legend		Customer Sample Reference	IP01	IP02	IP02	IP03	TP03	TP03	
#	ISO17025 accredited.		Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.60	0.50	1.00	0.20	0.70	1.30
M	mCERTS accredited.			Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
aq	Aqueous / settled sample.			04/04/2016	04/04/2016	04/04/2016	04/04/2016	04/04/2016	04/04/2016
diss.filt	Dissolved / filtered sample.								
tot.unfilt	Total / unfiltered sample.								
*	Subcontracted test.								
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery								
(F)	Trigger breach confirmed								
1-5&*\$@	Sample deviation (see appendix)								
Component	LOD/Units	Method							
4-Nitrophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
2,4,6-Trichlorophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
2-Nitrophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
2,4-Dichlorophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
Pentachlorophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
Phenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
4-Chloro-3-methylphenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
2,4-Dimethylphenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
2-Chlorophenol	<1 µg/kg	TM072	<10	<10	<10	<10	<10	<1	
Sum of Detected Phenols	<9 µg/kg	TM072	<90	<90	<90	<90	<90	<9	



CERTIFICATE OF ANALYSIS

SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
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TPH CWG (S)

Results Legend		Customer Sample R	IP01	IP02	TP03			
#	ISO17025 accredited.							
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.60 Soil/Solid 04/04/2016 06/04/2016 160406-79 13212249	0.50 Soil/Solid 04/04/2016 06/04/2016 160406-79 13212252	0.70 Soil/Solid 04/04/2016 06/04/2016 160406-79 13212257			
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-5	@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
GRO Surrogate % recovery**	%	TM089	95	83	88			
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	19500 M	107 M	<44 M			
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<5 #	<5 #	<5 #			
Benzene	<10 µg/kg	TM089	<10 M	<10 M	<10 M			
Toluene	<2 µg/kg	TM089	<2 M	<2 M	2.34 M			
Ethylbenzene	<3 µg/kg	TM089	<3 M	<3 M	<3 M			
m,p-Xylene	<6 µg/kg	TM089	<6 M	<6 M	<6 M			
o-Xylene	<3 µg/kg	TM089	<3 M	<3 M	<3 M			
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9	<9	<9			
sum of detected BTEX by GC	<24 µg/kg	TM089	<24	<24	<24			
Aliphatics >C5-C6	<10 µg/kg	TM089	10.4	10.3	<10			
Aliphatics >C6-C8	<10 µg/kg	TM089	25.3	11.4	<10			
Aliphatics >C8-C10	<10 µg/kg	TM089	5020	23.9	<10			
Aliphatics >C10-C12	<10 µg/kg	TM089	6680	21.7	<10			
Aliphatics >C12-C16	<100 µg/kg	TM173	6070	173	<100			
Aliphatics >C16-C21	<100 µg/kg	TM173	6060	<100	<100			
Aliphatics >C21-C35	<100 µg/kg	TM173	7260	2190	2840			
Aliphatics >C35-C44	<100 µg/kg	TM173	<100	<100	<100			
Total Aliphatics >C12-C44	<100 µg/kg	TM173	19400	2360	2840			
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10	<10	<10			
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10	<10	<10			
Aromatics >EC8-EC10	<10 µg/kg	TM089	3350	23.9	<10			
Aromatics >EC10-EC12	<10 µg/kg	TM089	4450	14.8	<10			
Aromatics >EC12-EC16	<100 µg/kg	TM173	3550	538	<100			
Aromatics >EC16-EC21	<100 µg/kg	TM173	9080	2580	<100			
Aromatics >EC21-EC35	<100 µg/kg	TM173	27900	9850	2570			
Aromatics >EC35-EC44	<100 µg/kg	TM173	6350	3210	976			
Aromatics >EC40-EC44	<100 µg/kg	TM173	1600	1020	<100			
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	46900	16200	3540			
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	85800	18600	6390			



SDG: 160406-79
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Asbestos Identification - Soil

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	IP01 0.60 SOLID 04/04/2016 00:00:00 07/04/2016 13:07:00 160406-79 13212249 TM048	13/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	IP02 0.50 SOLID 04/04/2016 00:00:00 07/04/2016 12:58:28 160406-79 13212252 TM048	13/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	IP03 0.20 SOLID 04/04/2016 00:00:00 07/04/2016 20:51:46 160406-79 13212254 TM048	13/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP03 0.70 SOLID 04/04/2016 00:00:00 07/04/2016 20:58:45 160406-79 13212257 TM048	13/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Received SDG Original Sample Method Number	TP03 1.30 SOLID 04/04/2016 00:00:00 07/04/2016 15:36:45 160406-79 13212258 TM048	13/04/16	Paul Poynton	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected



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Attention: Jon Ind

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Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
ASB_PREP				
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM072	Modified: US EPA Method 8141A	Determination of Phenols by GC-MS		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM180	Sulphide in waters and waste waters 1991 ISBN 01 175 7186 SCA rec. 2007 (unpublished)'	The Determination Of Easily Liberated Sulphide In Soil Samples by Ion Selective Electrode Technique		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM222	In-House Method	Determination of Hot Water Soluble Boron in Soils (10:1 Water:soil) by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



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Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

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Superseded Report:

Test Completion Dates

Lab Sample No(s)	13212249	13212252	13212253	13212254	13212257	13212258
Customer Sample Ref.	IP01	IP02	IP02	IP03	TP03	TP03
AGS Ref.						
Depth	0.60	0.50	1.00	0.20	0.70	1.30
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	13-Apr-2016	12-Apr-2016	12-Apr-2016	13-Apr-2016	13-Apr-2016	12-Apr-2016
Asbestos ID in Solid Samples	13-Apr-2016	13-Apr-2016		13-Apr-2016	13-Apr-2016	13-Apr-2016
Boron Water Soluble	11-Apr-2016	13-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016	13-Apr-2016
Cyanide Comp/Free/Total/Thiocyanate	11-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016
Easily Liberated Sulphide	13-Apr-2016	13-Apr-2016	13-Apr-2016	08-Apr-2016	08-Apr-2016	08-Apr-2016
EPH CWG (Aliphatic) GC (S)	11-Apr-2016	11-Apr-2016			11-Apr-2016	
EPH CWG (Aromatic) GC (S)	11-Apr-2016	11-Apr-2016			11-Apr-2016	
GRO by GC-FID (S)	11-Apr-2016	11-Apr-2016			11-Apr-2016	
Metals in solid samples by OES	12-Apr-2016	12-Apr-2016	11-Apr-2016	12-Apr-2016	12-Apr-2016	12-Apr-2016
PAH by GCMS	11-Apr-2016	11-Apr-2016	12-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016
pH	11-Apr-2016	11-Apr-2016	08-Apr-2016	11-Apr-2016	11-Apr-2016	11-Apr-2016
Phenols Spec MS (S)	14-Apr-2016	14-Apr-2016	14-Apr-2016	14-Apr-2016	14-Apr-2016	14-Apr-2016
Sample description	07-Apr-2016	07-Apr-2016	08-Apr-2016	07-Apr-2016	07-Apr-2016	07-Apr-2016
Total Organic Carbon			13-Apr-2016	13-Apr-2016	13-Apr-2016	
TPH CWG GC (S)	11-Apr-2016	11-Apr-2016			11-Apr-2016	



SDG: 160406-79
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Location: University of Reading
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Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

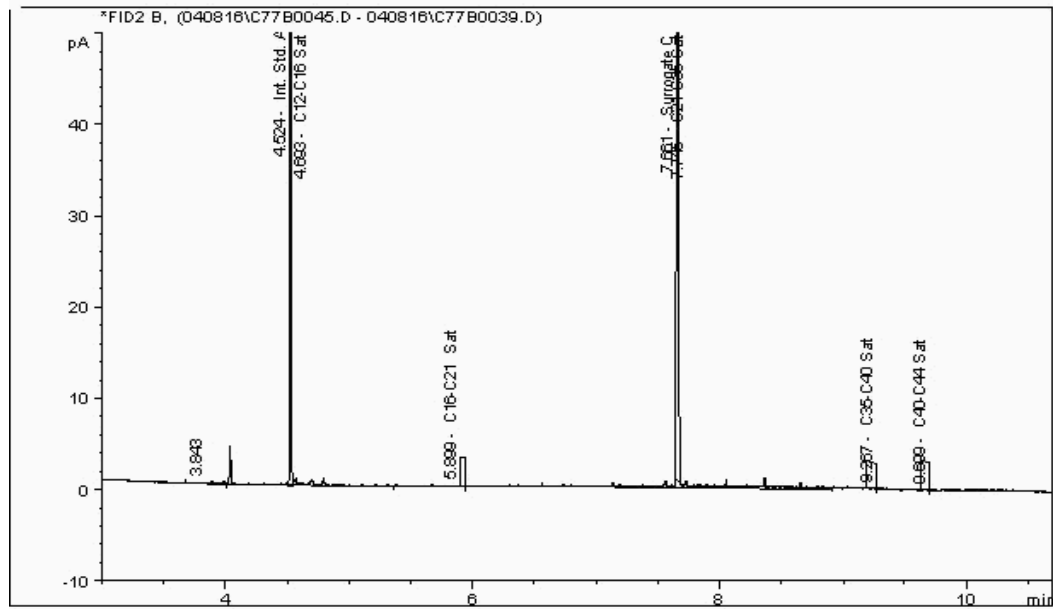
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 13221373
Sample ID : TP03

Depth : 0.70

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443920-
Date Acquired : 08/04/2016 23:46:14 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

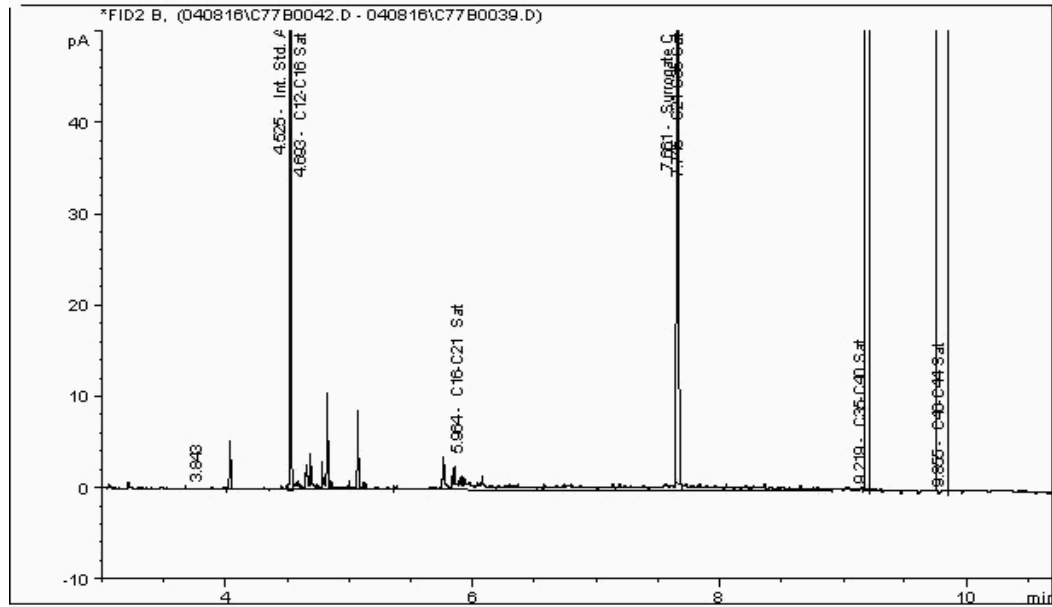
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 13221385
Sample ID : IP01

Depth : 0.60

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443793-
Date Acquired : 08/04/2016 22:53:13 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

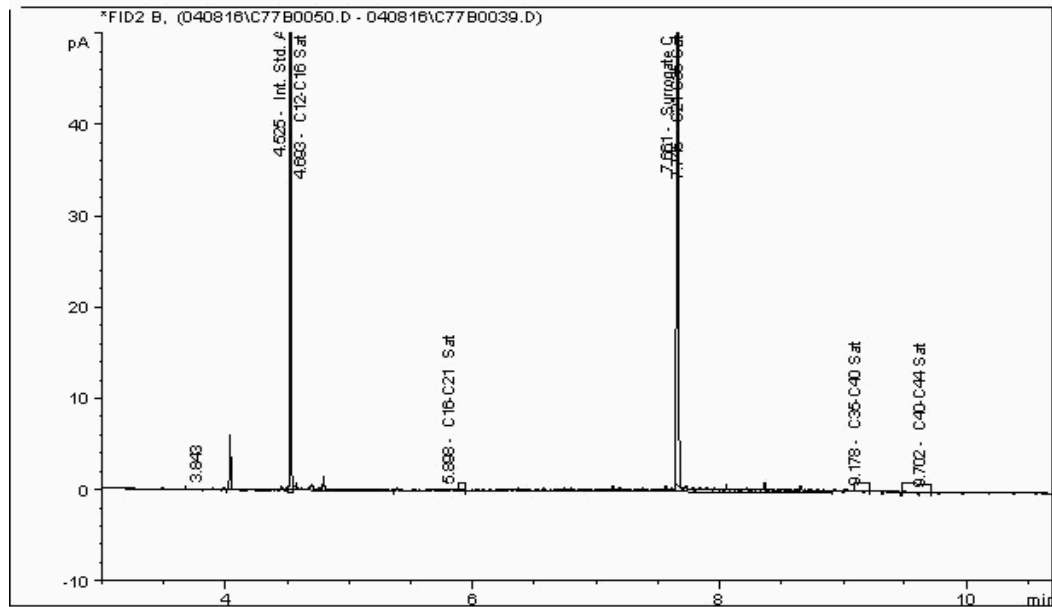
Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 13221420
Sample ID : IP02

Depth : 0.50

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443833-
Date Acquired : 09/04/2016 01:11:33 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

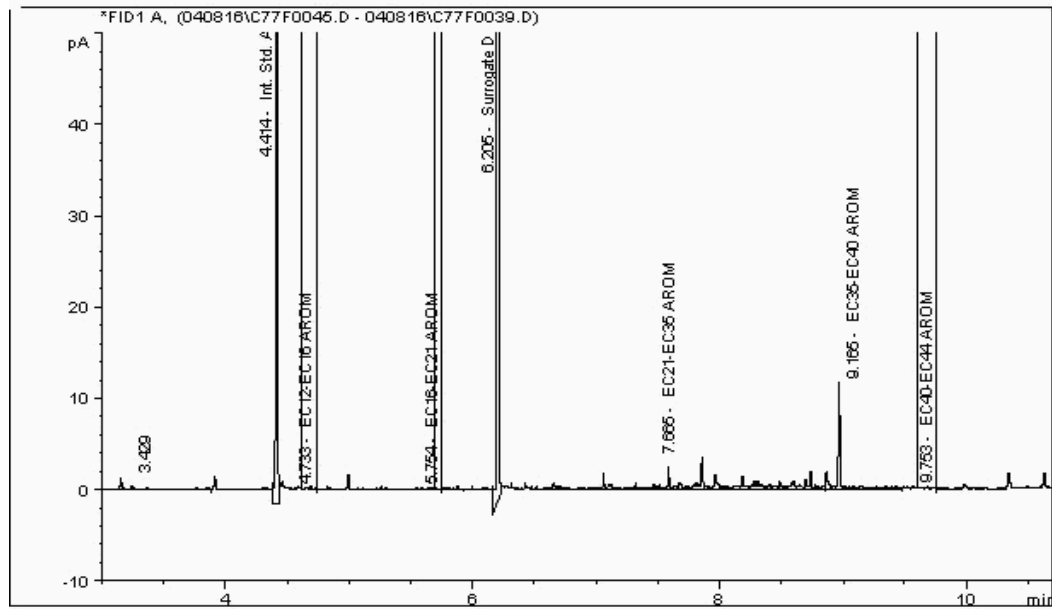
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 13221373
Sample ID : TP03

Depth : 0.70

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443921-
Date Acquired : 08/04/2016 23:46:14 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

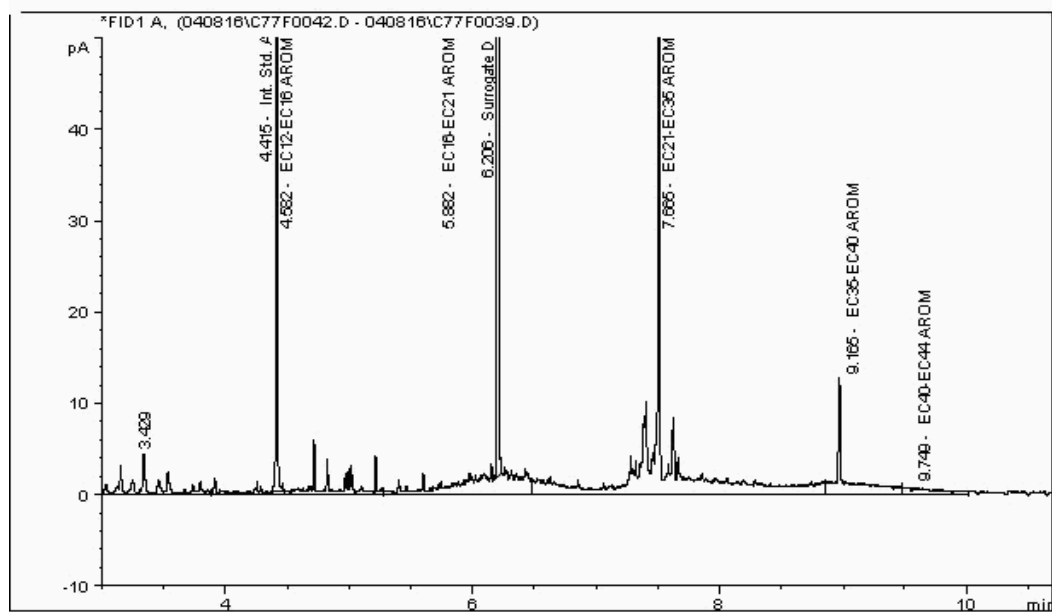
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 13221385
Sample ID : IP01

Depth : 0.60

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443794-
Date Acquired : 08/04/2016 22:53:13 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

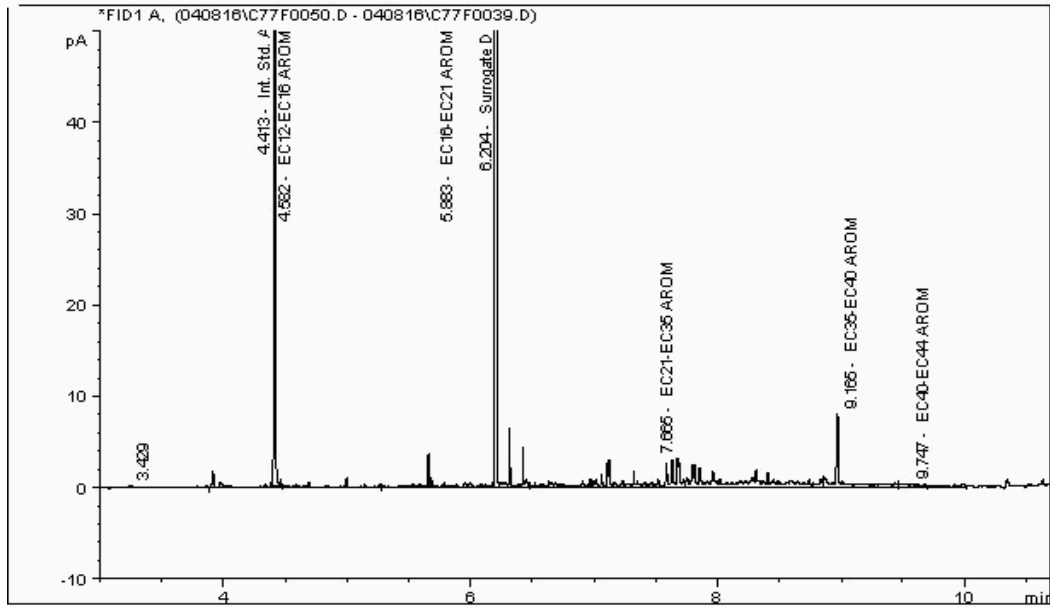
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 13221420
Sample ID : IP02

Depth : 0.50

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12443834-
Date Acquired : 09/04/2016 01:11:33 PM
Units : ppb
Dilution:





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

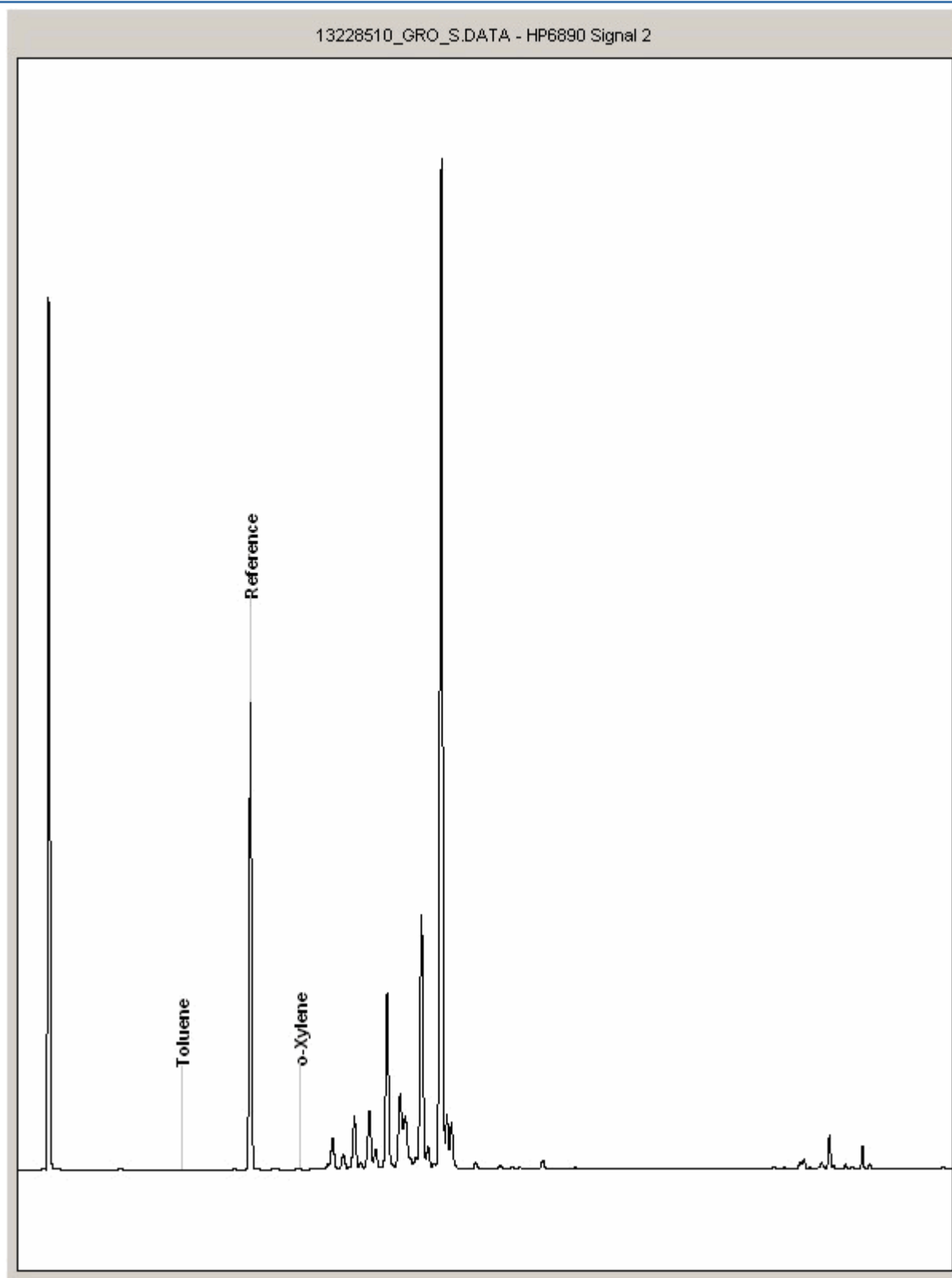
Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 13228510
Sample ID : IP01

Depth : 0.60





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

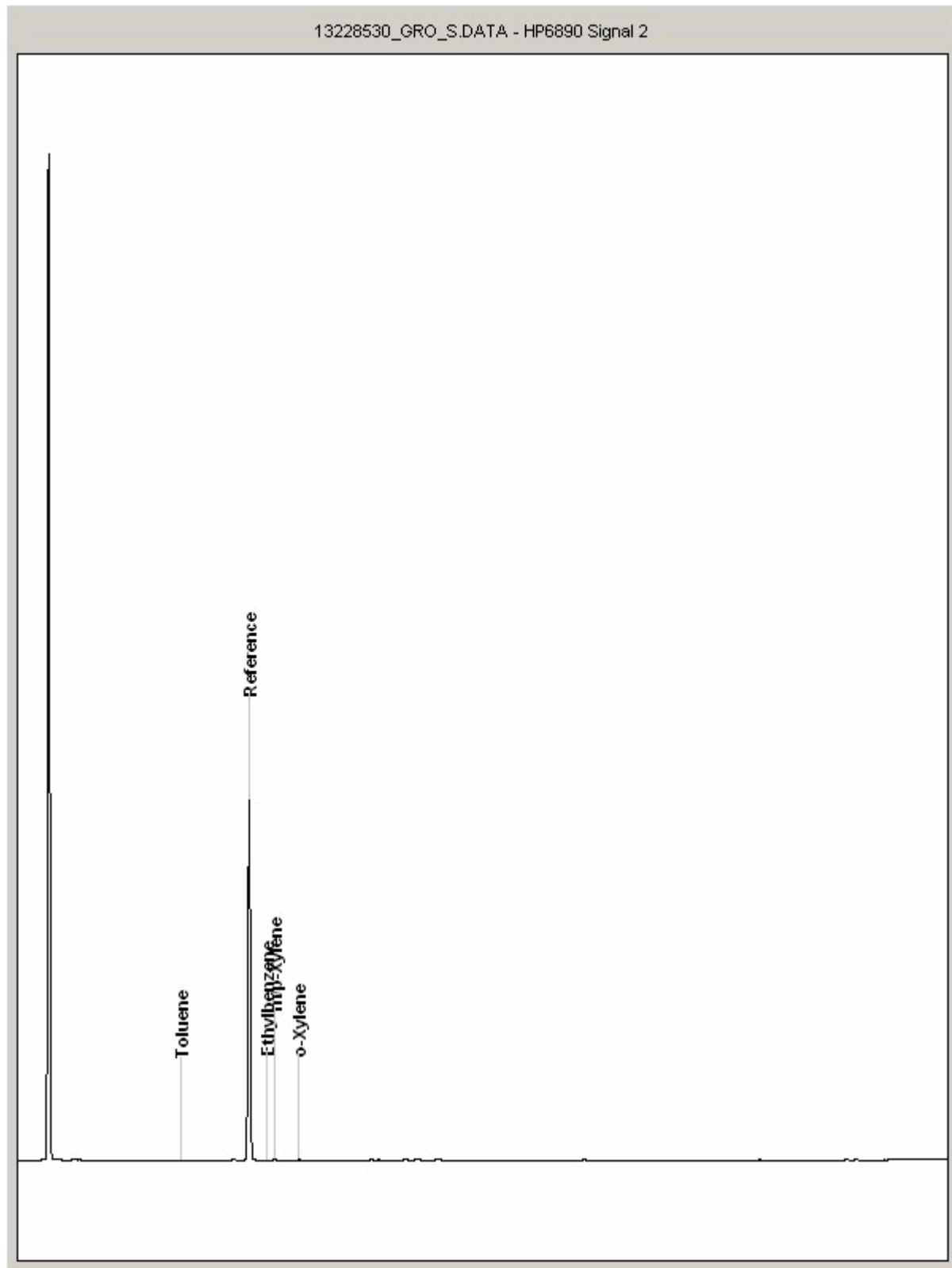
Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 13228530
Sample ID : IP02

Depth : 0.50





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

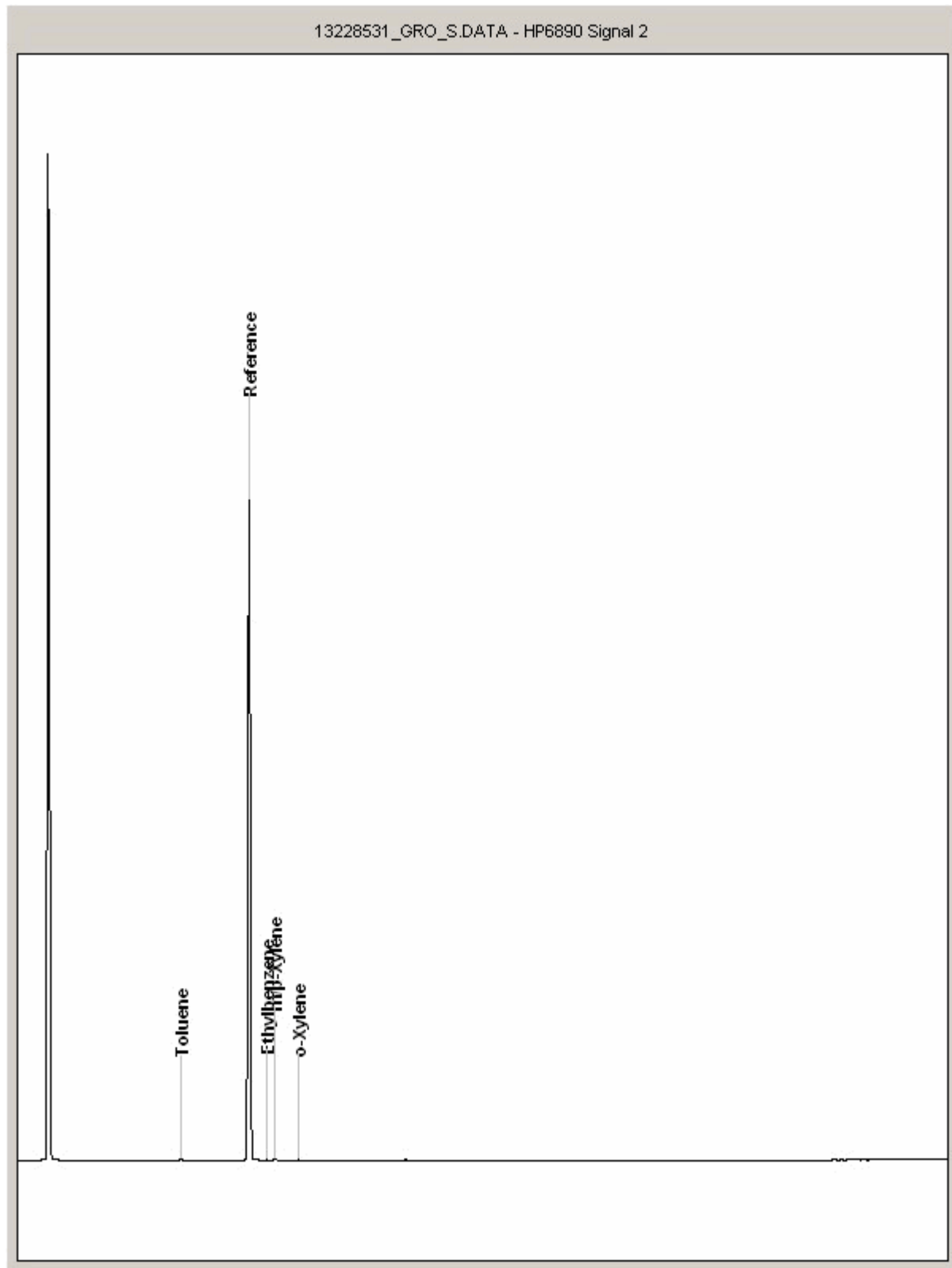
Order Number: 31710/JI
Report Number: 356997
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 13228531
Sample ID : TP03

Depth : 0.70





SDG: 160406-79
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

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Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

General

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Crystalline	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Amosite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



Geotechnical Engineering Ltd
Centurion House
Olympus Park
Quedgeley
Gloucester
Gloucestershire
GL2 4NF

Attention: Jon Ind

CERTIFICATE OF ANALYSIS

Date: 22 April 2016
Customer: H_GEOTECHEN_GLO
Sample Delivery Group (SDG): 160413-30
Your Reference:
Location: University of Reading
Report No: 358159

We received 4 samples on Tuesday April 12, 2016 and 2 of these samples were scheduled for analysis which was completed on Friday April 22, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	160413-30	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358159
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13244493	BH02		0.20 - 0.30	11/04/2016
13244494	BH02		0.50 - 0.70	11/04/2016
13244495	BH02		1.00 - 1.20	11/04/2016
13244496	BH02		2.00 - 2.20	11/04/2016

Only received samples which have had analysis scheduled will be shown on the following pages.



SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

SOLID Results Legend X Test N No Determination Possible	Lab Sample No(s)		13244494	13244495
	Customer Sample Reference		BH02	BH02
	AGS Reference			
	Depth (m)		0.50 - 0.70	1.00 - 1.20
	Container		250g Amber Jar (AL) 1kg TUB	250g Amber Jar (AL) 1kg TUB
Anions by Kone (soil)	All	NDPs: 0 Tests: 2	X	X
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 2	X	X
Boron Water Soluble	All	NDPs: 0 Tests: 2	X	X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 2	X	X
Easily Liberated Sulphide	All	NDPs: 0 Tests: 2	X	X
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 1	X	
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 1	X	
GRO by GC-FID (S)	All	NDPs: 0 Tests: 1		X
Metals in solid samples by OES	All	NDPs: 0 Tests: 2	X	X
PAH by GCMS	All	NDPs: 0 Tests: 2	X	X
pH	All	NDPs: 0 Tests: 2	X	X
Phenols Spec MS (S)	All	NDPs: 0 Tests: 2	X	X
Sample description	All	NDPs: 0 Tests: 2	X	X
TPH CWG GC (S)	All	NDPs: 0 Tests: 1	X	



SDG:	160413-30	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358159
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2		
13244494	BH02	0.50 - 0.70	Dark Brown	Sandy Clay Loam	0.063 - 2.00 mm	Vegetation	Stones		
13244495	BH02	1.00 - 1.20	Dark Brown	Sandy Clay Loam	0.063 - 2.00 mm	Vegetation	Stones		

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Order Number:
Report Number: 358159
Superseded Report:

16:31:25 22/04/2016

Order Number:
Report Number: 358159
Superseded Report:

Page 6 of 15

Order Number:
Report Number: 358159
Superseded Report:

Page 7 of 15



CERTIFICATE OF ANALYSIS

SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

TPH CWG (S)

Results Legend		Customer Sample R	BH02					
#	ISO17025 accredited.							
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-5&*\$@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
GRO Surrogate % recovery**	%	TM089	125					
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089	<44 M					
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089	<5 #					
Benzene	<10 µg/kg	TM089	<10 M					
Toluene	<2 µg/kg	TM089	<2 M					
Ethylbenzene	<3 µg/kg	TM089	<3 M					
m,p-Xylene	<6 µg/kg	TM089	<6 M					
o-Xylene	<3 µg/kg	TM089	<3 M					
sum of detected mpo xylene by GC	<9 µg/kg	TM089	<9					
sum of detected BTEX by GC	<24 µg/kg	TM089	<24					
Aliphatics >C5-C6	<10 µg/kg	TM089	<10					
Aliphatics >C6-C8	<10 µg/kg	TM089	<10					
Aliphatics >C8-C10	<10 µg/kg	TM089	<10					
Aliphatics >C10-C12	<10 µg/kg	TM089	<10					
Aliphatics >C12-C16	<100 µg/kg	TM173	<100					
Aliphatics >C16-C21	<100 µg/kg	TM173	<100					
Aliphatics >C21-C35	<100 µg/kg	TM173	<100					
Aliphatics >C35-C44	<100 µg/kg	TM173	259					
Total Aliphatics >C12-C44	<100 µg/kg	TM173	259					
Aromatics >EC5-EC7	<10 µg/kg	TM089	<10					
Aromatics >EC7-EC8	<10 µg/kg	TM089	<10					
Aromatics >EC8-EC10	<10 µg/kg	TM089	<10					
Aromatics >EC10-EC12	<10 µg/kg	TM089	<10					
Aromatics >EC12-EC16	<100 µg/kg	TM173	1640					
Aromatics >EC16-EC21	<100 µg/kg	TM173	24900					
Aromatics >EC21-EC35	<100 µg/kg	TM173	58300					
Aromatics >EC35-EC44	<100 µg/kg	TM173	22800					
Aromatics >EC40-EC44	<100 µg/kg	TM173	9060					
Total Aromatics >EC12-EC44	<100 µg/kg	TM173	108000					
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173	108000					



SDG:	160413-30	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358159
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Asbestos Identification - Soil

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref.	BH02	21/4/16	Kevin Hughes	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Depth (m)	0.50 - 0.70										
Sample Type	SOLID										
Date Sampled	11/04/2016										
Date Receieved	00:00:00										
SDG	18/04/2016										
Original Sample	10:06:53										
Method Number	160413-30										
	13244494										
	TM048										
Cust. Sample Ref.	BH02	21/4/16	Kevin Hughes	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Depth (m)	1.00 - 1.20										
Sample Type	SOLID										
Date Sampled	11/04/2016										
Date Receieved	00:00:00										
SDG	18/04/2016										
Original Sample	10:12:05										
Method Number	160413-30										
	13244495										
	TM048										



SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
ASB_PREP				
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM072	Modified: US EPA Method 8141A	Determination of Phenols by GC-MS		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM180	Sulphide in waters and waste waters 1991 ISBN 01 175 7186 SCA rec. 2007 (unpublished) ¹	The Determination Of Easily Liberated Sulphide In Soil Samples by Ion Selective Electrode Technique		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM222	In-House Method	Determination of Hot Water Soluble Boron in Soils (10:1 Water:soil) by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG:	160413-30	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358159
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13244494	13244495
Customer Sample Ref.	BH02	BH02
AGS Ref.		
Depth	0.50 - 0.70	1.00 - 1.20
Type	SOLID	SOLID
Anions by Kone (soil)	21-Apr-2016	21-Apr-2016
Asbestos ID in Solid Samples	21-Apr-2016	21-Apr-2016
Boron Water Soluble	20-Apr-2016	19-Apr-2016
Cyanide Comp/Free/Total/Thiocyanate	20-Apr-2016	20-Apr-2016
Easily Liberated Sulphide	21-Apr-2016	21-Apr-2016
EPH CWG (Aliphatic) GC (S)	19-Apr-2016	
EPH CWG (Aromatic) GC (S)	19-Apr-2016	
GRO by GC-FID (S)	19-Apr-2016	
Metals in solid samples by OES	21-Apr-2016	21-Apr-2016
PAH by GCMS	21-Apr-2016	21-Apr-2016
pH	19-Apr-2016	19-Apr-2016
Phenols Spec MS (S)	22-Apr-2016	22-Apr-2016
Sample description	15-Apr-2016	15-Apr-2016
TPH CWG GC (S)	19-Apr-2016	



SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

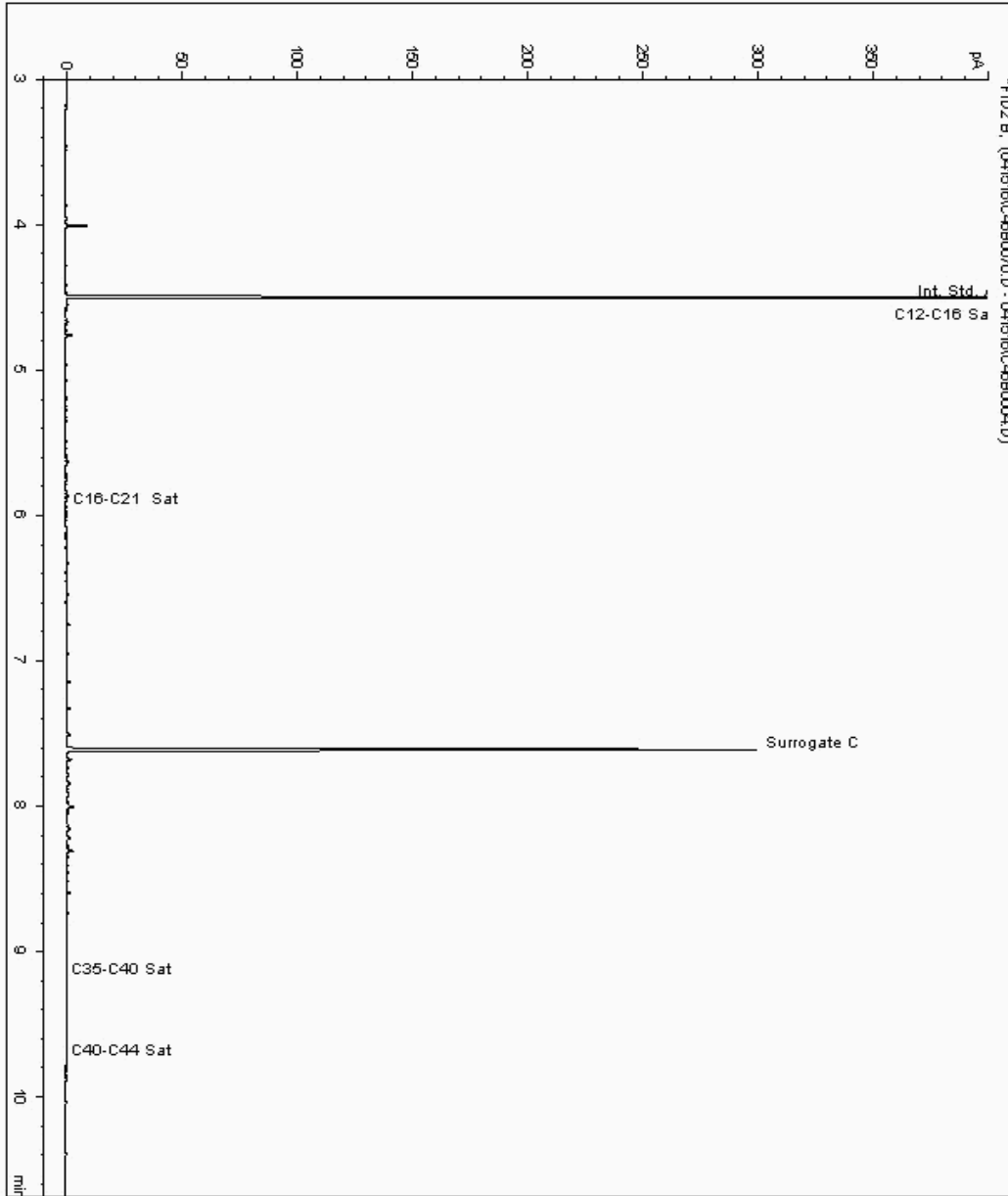
Sample No : 13261412
Sample ID : BH02

Depth : 0.50 - 0.70

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12475048-
Date Acquired : 18/04/2016 18:08:14 PM
Units : ppb
Dilution: BH02[0.50 - 0.70]

->





SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

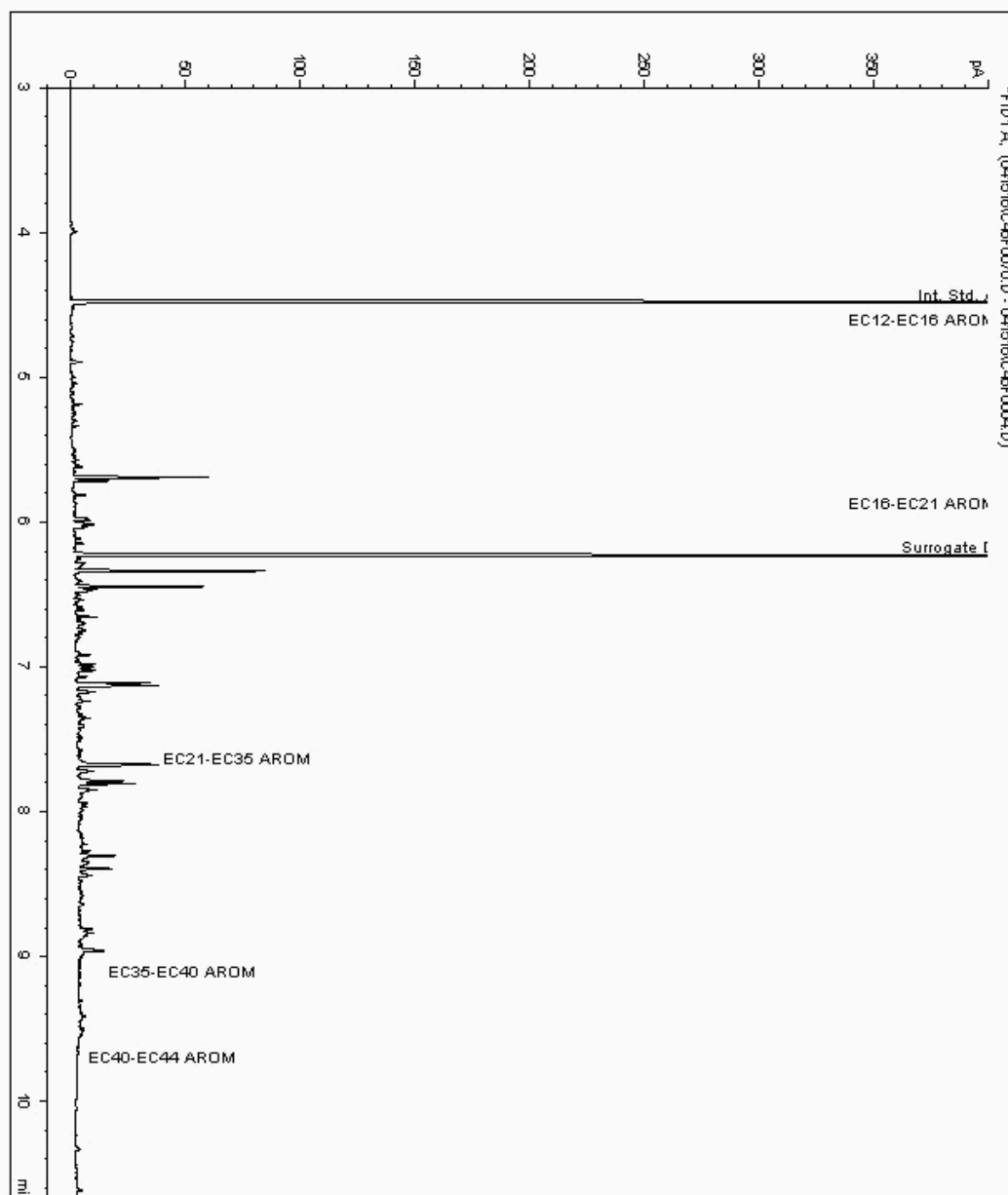
Sample No : 13261412
Sample ID : BH02

Depth : 0.50 - 0.70

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12475049-
Date Acquired : 18/04/2016 18:08:14 PM
Units : ppb
Dilution: BH02[0.50 - 0.70]

->





SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

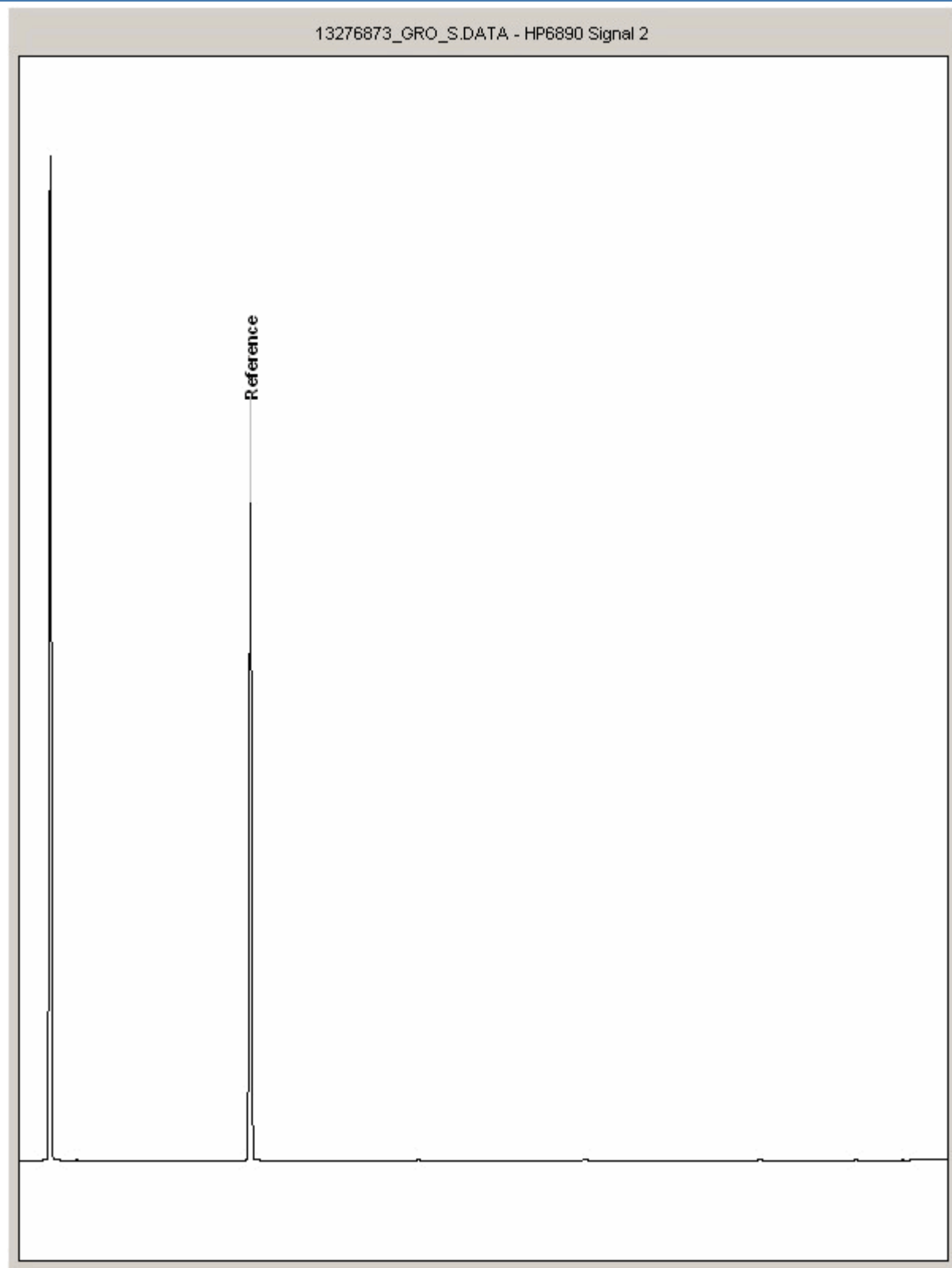
Order Number:
Report Number: 358159
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 13276873
Sample ID : BH02

Depth : 0.50 - 0.70





SDG: 160413-30
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358159
Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

General

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Almandine	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:
- Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



Geotechnical Engineering Ltd
Centurion House
Olympus Park
Quedgeley
Gloucester
Gloucestershire
GL2 4NF

Attention: Jon Ind

CERTIFICATE OF ANALYSIS

Date: 27 April 2016
Customer: H_GEOTECHEN_GLO
Sample Delivery Group (SDG): 160419-67
Your Reference:
Location: University of Reading
Report No: 358783

We received 4 samples on Tuesday April 19, 2016 and 4 of these samples were scheduled for analysis which was completed on Wednesday April 27, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager





SDG:	160419-67	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358783
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13283521	BH01		3.91	18/04/2016
13283523	BH02		3.22	18/04/2016
13283519	BH03		3.52	18/04/2016
13283522	BH04		3.83	18/04/2016

Only received samples which have had analysis scheduled will be shown on the following pages.



SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

LIQUID Results Legend X Test N No Determination Possible	Lab Sample No(s)					
	Customer Sample Reference					
	AGS Reference					
	Depth (m)					
	Container					
			13283521	13283523	13283519	13283522
			BH01	BH02	BH03	BH04
			3.91	3.22	3.52	3.83
			1000ml glass bottle Dissolved Metals Pr Vial (ALE297)	1000ml glass bottle Dissolved Metals Pr Vial (ALE297)	1000ml glass bottle Dissolved Metals Pr Vial (ALE297)	1000ml glass bottle Dissolved Metals Pr Vial (ALE297)
Alkalinity as CaCO3	All	NDPs: 0 Tests: 4	X	X	X	X
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 4	X	X	X	X
Anions by Kone (w)	All	NDPs: 0 Tests: 4	X	X	X	X
COD Unfiltered	All	NDPs: 0 Tests: 4	X	X	X	X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 4	X	X	X	X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4	X	X	X	X
EPH CWG (Aliphatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X	X	X	X
EPH CWG (Aromatic) Aqueous GC (W)	All	NDPs: 0 Tests: 4	X	X	X	X
GRO by GC-FID (W)	All	NDPs: 0 Tests: 4		X	X	X
Mercury Dissolved	All	NDPs: 0 Tests: 4	X	X	X	X
Metals by iCap-OES Unfiltered (W)	All	NDPs: 0 Tests: 2	X	X		
PAH Spec MS - Aqueous (W)	All	NDPs: 0 Tests: 4	X	X	X	X
pH Value	All	NDPs: 0 Tests: 4	X	X	X	X
Phenols by ms (w)	All	NDPs: 0 Tests: 4	X	X	X	X
Sulphide	All	NDPs: 0 Tests: 4	X	X	X	X



SDG:160419-67

Job:H_GEOTECHEN_GLO-236

Client Reference:

Location:University of Reading

Customer:Geotechnical Engineering Ltd

Attention:Jon Ind

Order Number:

Report Number:358783

Superseded Report:

LIQUID

Results Legend

X

Test

N

No Determination Possible

Lab Sample No(s)	13283521	13283523	13283519	13283522
Customer Sample Reference	BH01	BH02	BH03	BH04
AGS Reference				
Depth (m)	3.91	3.22	3.52	3.83
Container	Disolved Metals Pr 1000ml glass bottle Vial (ALE297)	Disolved Metals Pr 1000ml glass bottle Vial (ALE297)	Disolved Metals Pr 1000ml glass bottle Vial (ALE297)	Disolved Metals Pr 1000ml glass bottle Vial (ALE297)
Total Metals by ICP-MS	All	NDPs: 0 Tests: 4		
TPH CWG (W)	All	NDPs: 0 Tests: 4		



CERTIFICATE OF ANALYSIS

SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Results Legend		Customer Sample R						
#	ISO17025 accredited.		BH01	BH02	BH03	BH04		
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	3.91	3.22	3.52	3.83		
aq	Aqueous / settled sample.		Water(GW/SW)	Water(GW/SW)	Water(GW/SW)	Water(GW/SW)		
diss.filt	Dissolved / filtered sample.		18/04/2016	18/04/2016	18/04/2016	18/04/2016		
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery		19/04/2016	19/04/2016	19/04/2016	19/04/2016		
(F)	Trigger breach confirmed		160419-67	160419-67	160419-67	160419-67		
1-58*\$@	Sample deviation (see appendix)		13283521	13283523	13283519	13283522		
Component	LOD/Units	Method						
Alkalinity, Total as CaCO3	<2 mg/l	TM043	347	343	96.9	421		
			#	#	#	#		
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	<0.2	<0.2	<0.2	<0.2		
			#	#	#	#		
Sulphide	<0.01 mg/l	TM101	<0.1	<0.1	1.3	<0.1		
			#	#	#	#		
COD, unfiltered	<7 mg/l	TM107	2450	722	424	1090		
			#	#	#	#		
Arsenic (diss.filt)	<0.12 µg/l	TM152	0.46	0.383	0.369	1.18		
			#	#	#	#		
Boron (diss.filt)	<9.4 µg/l	TM152	17.7	30.3	15.7	22.5		
			#	#	#	#		
Cadmium (diss.filt)	<0.1 µg/l	TM152	0.151	<0.1	0.209	<0.1		
			#	#	#	#		
Chromium (diss.filt)	<0.22 µg/l	TM152	4.22	4.66	2.76	4.47		
			#	#	#	#		
Copper (diss.filt)	<0.85 µg/l	TM152	0.9	1.91	0.946	1.96		
			#	#	#	#		
Lead (diss.filt)	<0.02 µg/l	TM152	0.057	0.158	0.05	0.065		
			#	#	#	#		
Nickel (diss.filt)	<0.15 µg/l	TM152	9.9	5.86	30.6	4.35		
			#	#	#	#		
Selenium (diss.filt)	<0.39 µg/l	TM152	6.92	2.28	1.53	26.5		
			#	#	#	#		
Zinc (diss.filt)	<0.41 µg/l	TM152	8.09	8.74	14.6	2.7		
			#	#	#	#		
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	<0.01	<0.01	<0.01		
			#	#	#	#		
Sulphate	<2 mg/l	TM184	65.7	37.5	59	99.4		
			#	#	#	#		
Chromium (tot.unfilt)	<3 µg/l	TM191	597	410	208	209		
			#	#	#	#		
Phenol	<0.5 µg/l	TM205	<1	<1	<1	<1		
2-methylphenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
3-methylphenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
4-methylphenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2-chlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,4-dimethylphenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
4-chloro-3-methylphenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,6-dichlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
4-Chlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,4-dichlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2-nitrophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,4,6-trichlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,4,5-trichlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
4-nitrophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,3,5,6-tetrachlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		
2,3,4,6-tetrachlorophenol	<0.5 µg/l	TM205	<0.5	<0.5	<0.5	<0.5		

Order Number:
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CERTIFICATE OF ANALYSIS

SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

TPH CWG (W)

Results Legend		Customer Sample R	BH01	BH02	BH03	BH04		
#	ISO17025 accredited.							
M	mCERTS accredited.	Depth (m) Sample Type Date Sampled Sampled Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	3.91 Water(GW/SW) 18/04/2016 19/04/2016 160419-67 13283521	3.22 Water(GW/SW) 18/04/2016 19/04/2016 160419-67 13283523	3.52 Water(GW/SW) 18/04/2016 19/04/2016 160419-67 13283519	3.83 Water(GW/SW) 18/04/2016 19/04/2016 160419-67 13283522		
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted test.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-5	@	Sample deviation (see appendix)							
Component	LOD/Units	Method						
GRO Surrogate % recovery**	%	TM245	93	94	92	90		
GRO >C5-C12	<50 µg/l	TM245	<50	<50	<50	<50		
Methyl tertiary butyl ether (MTBE)	<3 µg/l	TM245	<3	<3	<3	<3		
Benzene	<7 µg/l	TM245	<7	<7	<7	<7		
Toluene	<4 µg/l	TM245	<4	<4	<4	<4		
Ethylbenzene	<5 µg/l	TM245	<5	<5	<5	<5		
m,p-Xylene	<8 µg/l	TM245	<8	<8	<8	<8		
o-Xylene	<3 µg/l	TM245	<3	<3	<3	<3		
Sum of detected Xylenes	<11 µg/l	TM245	<11	<11	<11	<11		
Sum of detected BTEX	<28 µg/l	TM245	<28	<28	<28	<28		
Aliphatics >C5-C6	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C6-C8	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C8-C10	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C10-C12	<10 µg/l	TM245	<10	<10	<10	<10		
Aliphatics >C12-C16 (aq)	<10 µg/l	TM174	12	10	15	<10		
Aliphatics >C16-C21 (aq)	<10 µg/l	TM174	273	110	313	20		
Aliphatics >C21-C35 (aq)	<10 µg/l	TM174	1410	514	1310	141		
Total Aliphatics >C12-C35 (aq)	<10 µg/l	TM174	1700	634	1640	161		
Aromatics >EC5-EC7	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC7-EC8	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC8-EC10	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC10-EC12	<10 µg/l	TM245	<10	<10	<10	<10		
Aromatics >EC12-EC16 (aq)	<10 µg/l	TM174	21	<10	11	19		
Aromatics >EC16-EC21 (aq)	<10 µg/l	TM174	165	58	80	136		
Aromatics >EC21-EC35 (aq)	<10 µg/l	TM174	902	355	453	661		
Total Aromatics >EC12-EC35 (aq)	<10 µg/l	TM174	1090	413	544	816		
Total Aliphatics & Aromatics >C5-35 (aq)	<10 µg/l	TM174	2790	1070	2190	977		



SDG: 160419-67
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Attention: Jon Ind

Order Number:
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Superseded Report:

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample ¹	Surrogate Corrected
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser		
TM101	Method 4500B & C, AWWA/APHA, 20th Ed., 1999	Determination of Sulphide in soil and water samples using the Kone Analyser		
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM174	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID		
TM178	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS in Waters		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM191	Standard Methods for the examination of waters and wastewaters 16th Edition, ALPHA, Washington DC, USA. ISBN 0-87553-131-8.	Determination of Unfiltered Metals in Water Matrices by ICP-MS		
TM205		Determination of Phenols in Waste Waters using Solid Phase Extraction, Acetylation, Gas Chromatography and Mass Selective Detection		
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate		
TM228	US EPA Method 6010B	Determination of Major Cations in Water by iCap 6500 Duo ICP-OES		
TM245	By GC-FID	Determination of GRO by Headspace in waters		
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter		

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.



SDG:	160419-67	Location:	University of Reading	Order Number:	
Job:	H_GEOTECHEN_GLO-236	Customer:	Geotechnical Engineering Ltd	Report Number:	358783
Client Reference:		Attention:	Jon Ind	Superseded Report:	

Test Completion Dates

Lab Sample No(s)	13283521	13283523	13283519	13283522
Customer Sample Ref.	BH01	BH02	BH03	BH04
AGS Ref.				
Depth	3.91	3.22	3.52	3.83
Type	LIQUID	LIQUID	LIQUID	LIQUID

Alkalinity as CaCO3	25-Apr-2016	25-Apr-2016	26-Apr-2016	25-Apr-2016
Ammoniacal Nitrogen	21-Apr-2016	21-Apr-2016	21-Apr-2016	21-Apr-2016
Anions by Kone (w)	21-Apr-2016	21-Apr-2016	21-Apr-2016	21-Apr-2016
COD Unfiltered	23-Apr-2016	21-Apr-2016	22-Apr-2016	22-Apr-2016
Cyanide Comp/Free/Total/Thiocyanate	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016
Dissolved Metals by ICP-MS	25-Apr-2016	25-Apr-2016	25-Apr-2016	25-Apr-2016
EPH CWG (Aliphatic) Aqueous GC (W)	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016
EPH CWG (Aromatic) Aqueous GC (W)	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016
GRO by GC-FID (W)	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016
Mercury Dissolved	21-Apr-2016	21-Apr-2016	21-Apr-2016	21-Apr-2016
Metals by iCap-OES Unfiltered (W)	26-Apr-2016	26-Apr-2016		
PAH Spec MS - Aqueous (W)	25-Apr-2016	22-Apr-2016	25-Apr-2016	22-Apr-2016
pH Value	21-Apr-2016	21-Apr-2016	21-Apr-2016	21-Apr-2016
Phenols by ms (w)	27-Apr-2016	27-Apr-2016	27-Apr-2016	27-Apr-2016
Sulphide	21-Apr-2016	21-Apr-2016	21-Apr-2016	21-Apr-2016
Total Metals by ICP-MS	26-Apr-2016	26-Apr-2016	26-Apr-2016	26-Apr-2016
TPH CWG (W)	22-Apr-2016	22-Apr-2016	22-Apr-2016	22-Apr-2016



SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

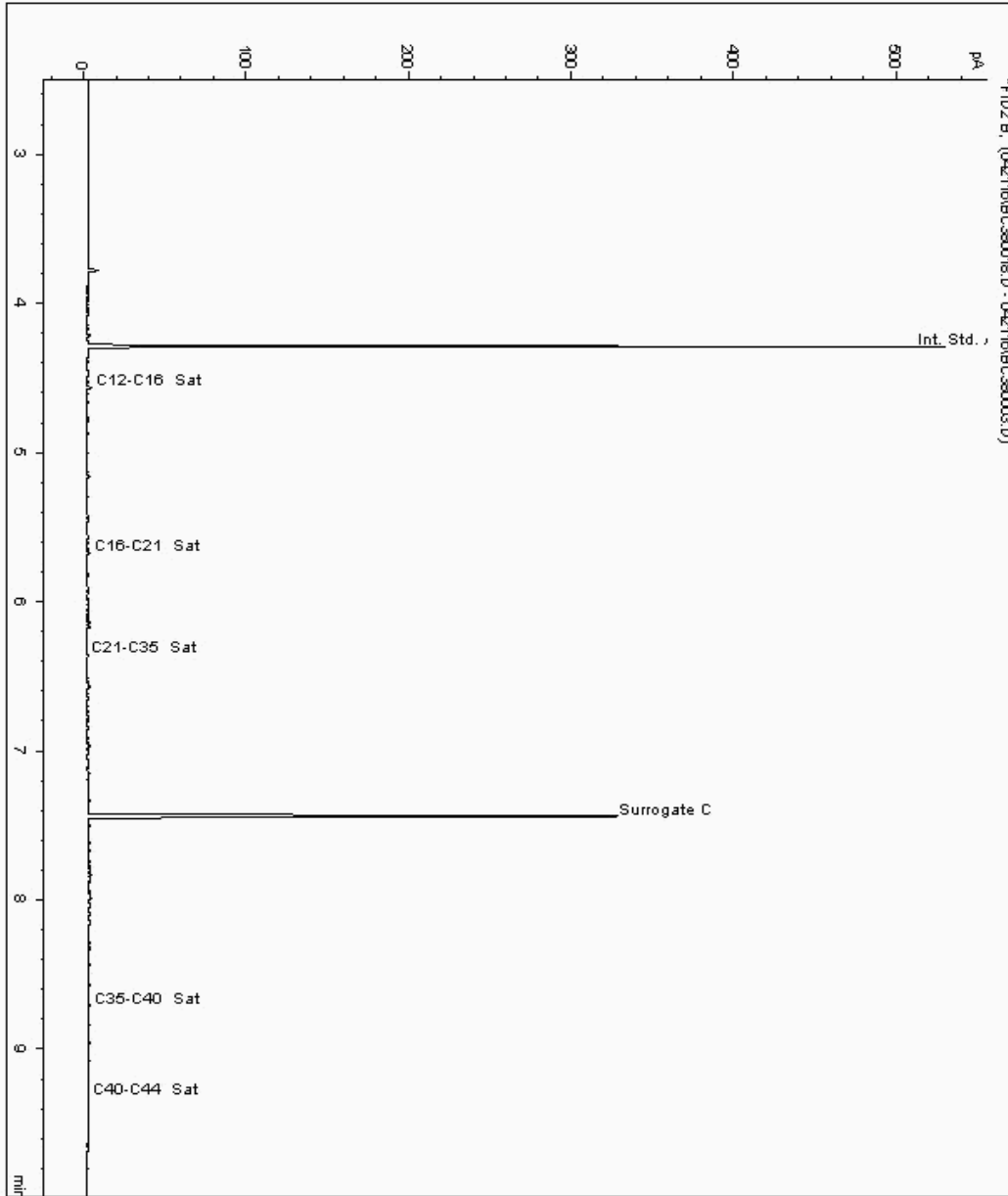
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13288596
Sample ID : BH04

Depth : 3.83

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12507646-
Date Acquired : 21/04/16 20:37:01 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

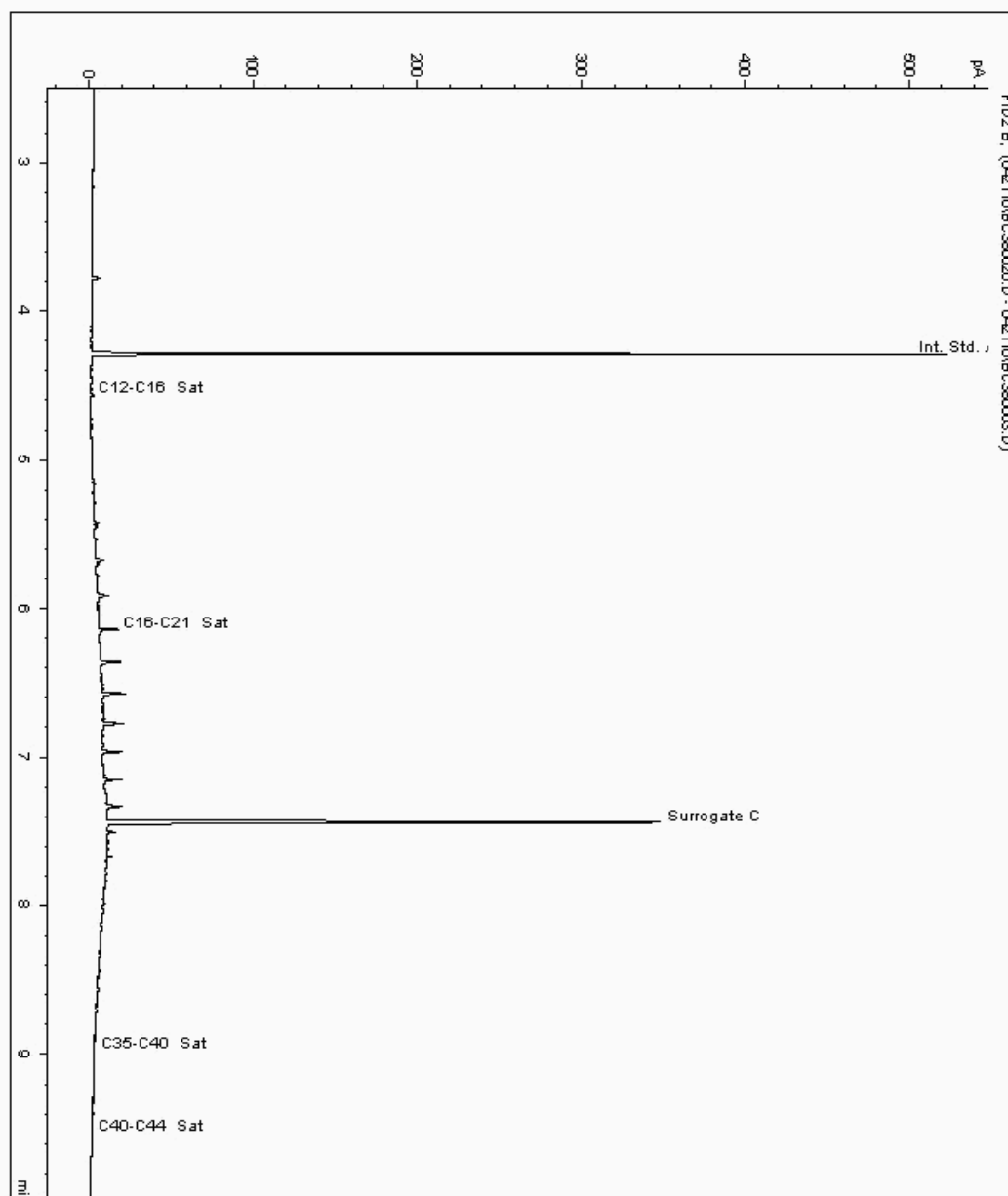
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13288841
Sample ID : BH03

Depth : 3.52

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12507607-
Date Acquired : 21/04/16 21:04:37 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

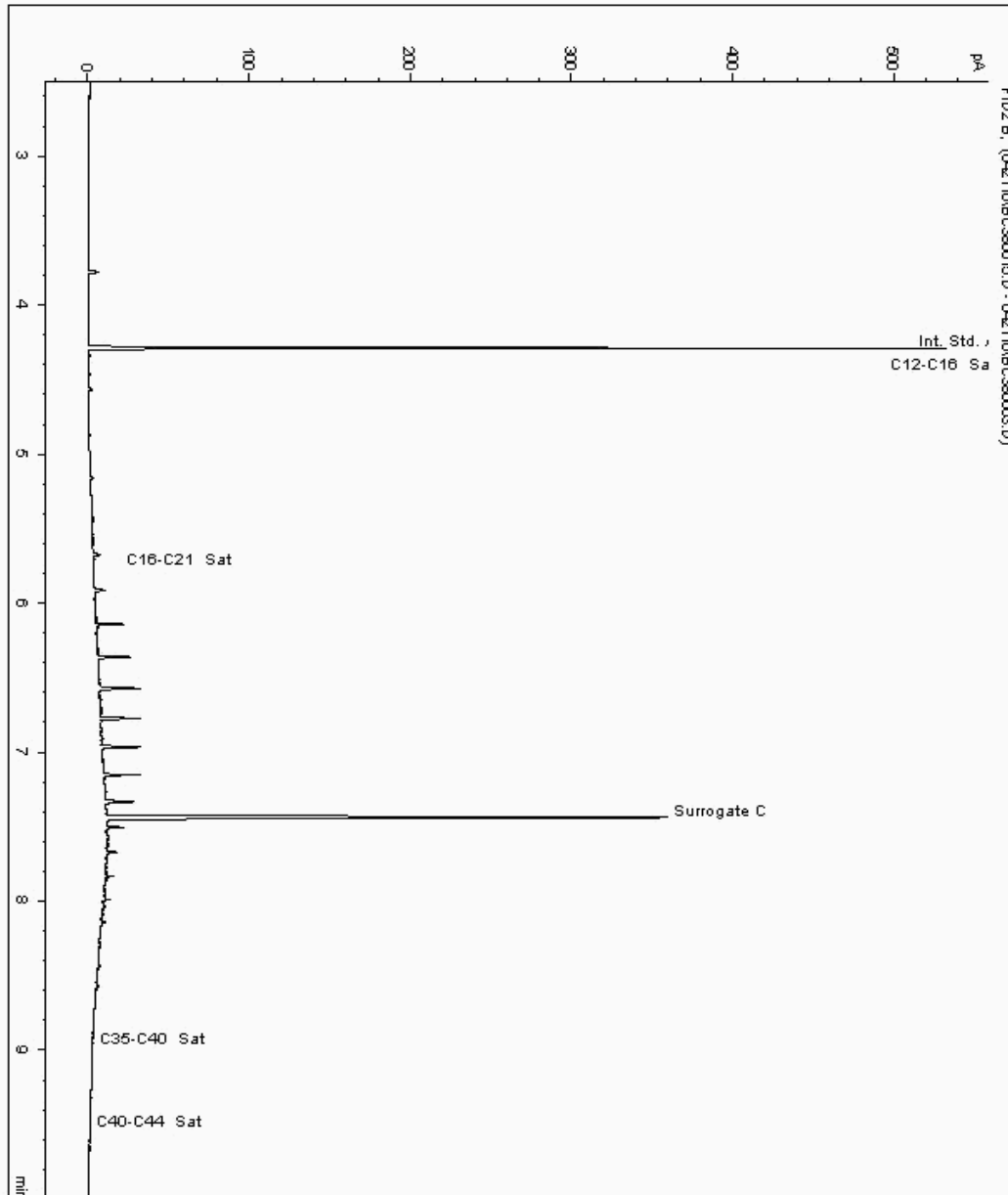
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13288917
Sample ID : BH01

Depth : 3.91

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12507626-
Date Acquired : 21/04/16 19:50:40 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
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Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

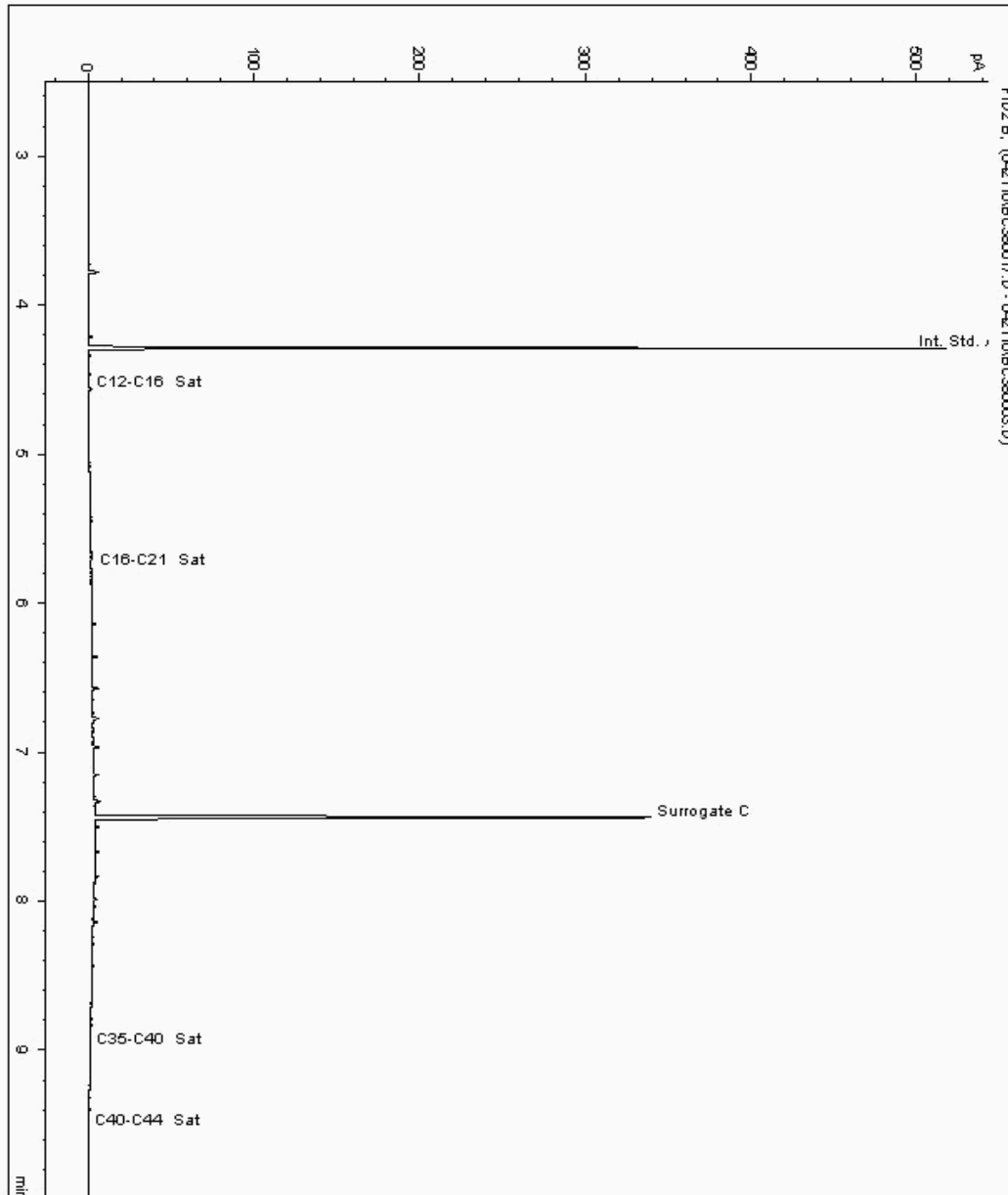
Analysis: EPH CWG (Aliphatic) Aqueous GC (W)

Sample No : 13289152
Sample ID : BH02

Depth : 3.22

Alcontrol/Geochem Analytical Services
Speciated TPH - SATS (C12 - C40)

Sample Identity: 12507666-
Date Acquired : 21/04/16 20:18:29 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

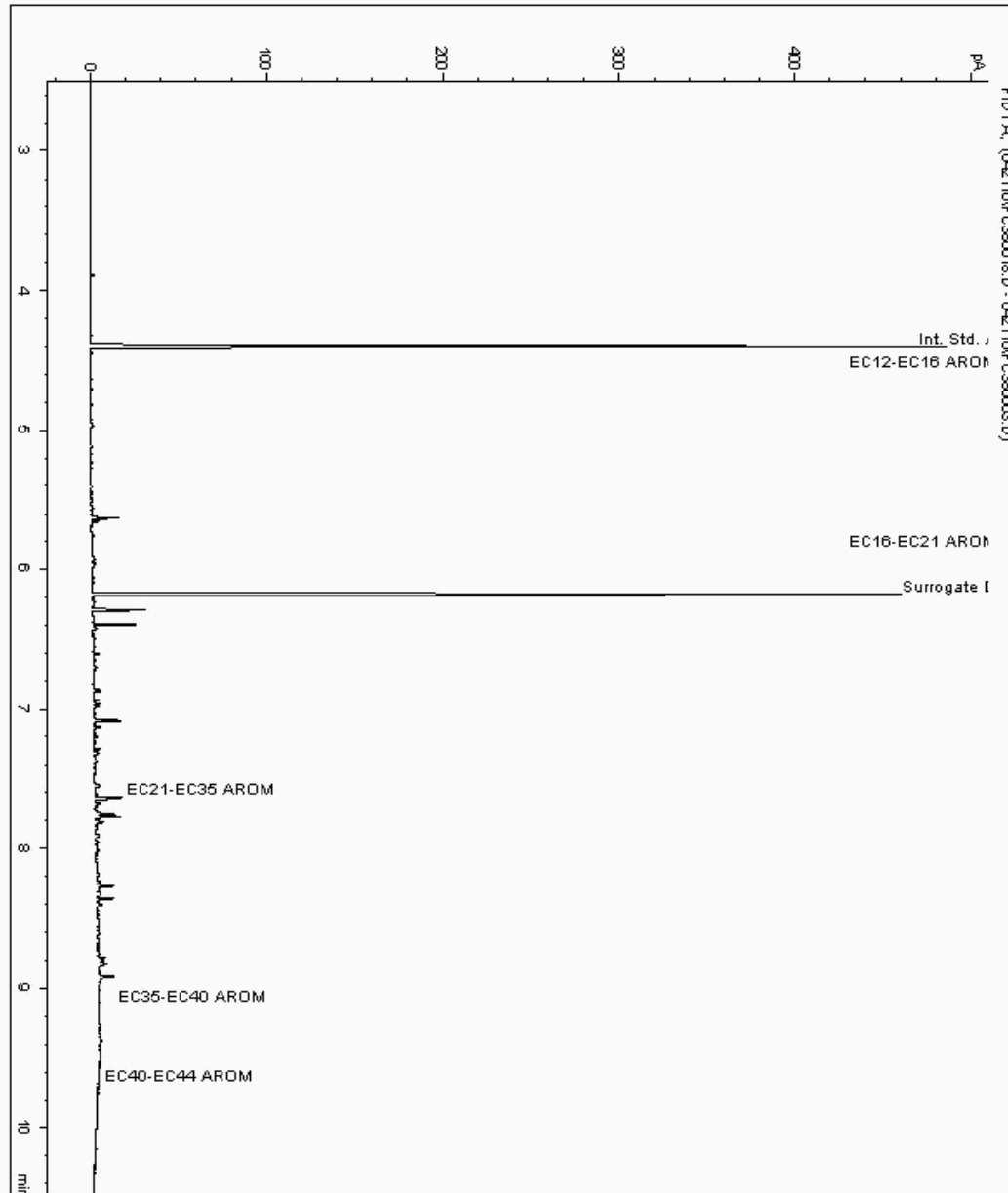
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13288596
Sample ID : BH04

Depth : 3.83

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12507647-
Date Acquired : 21/04/16 20:37:01 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

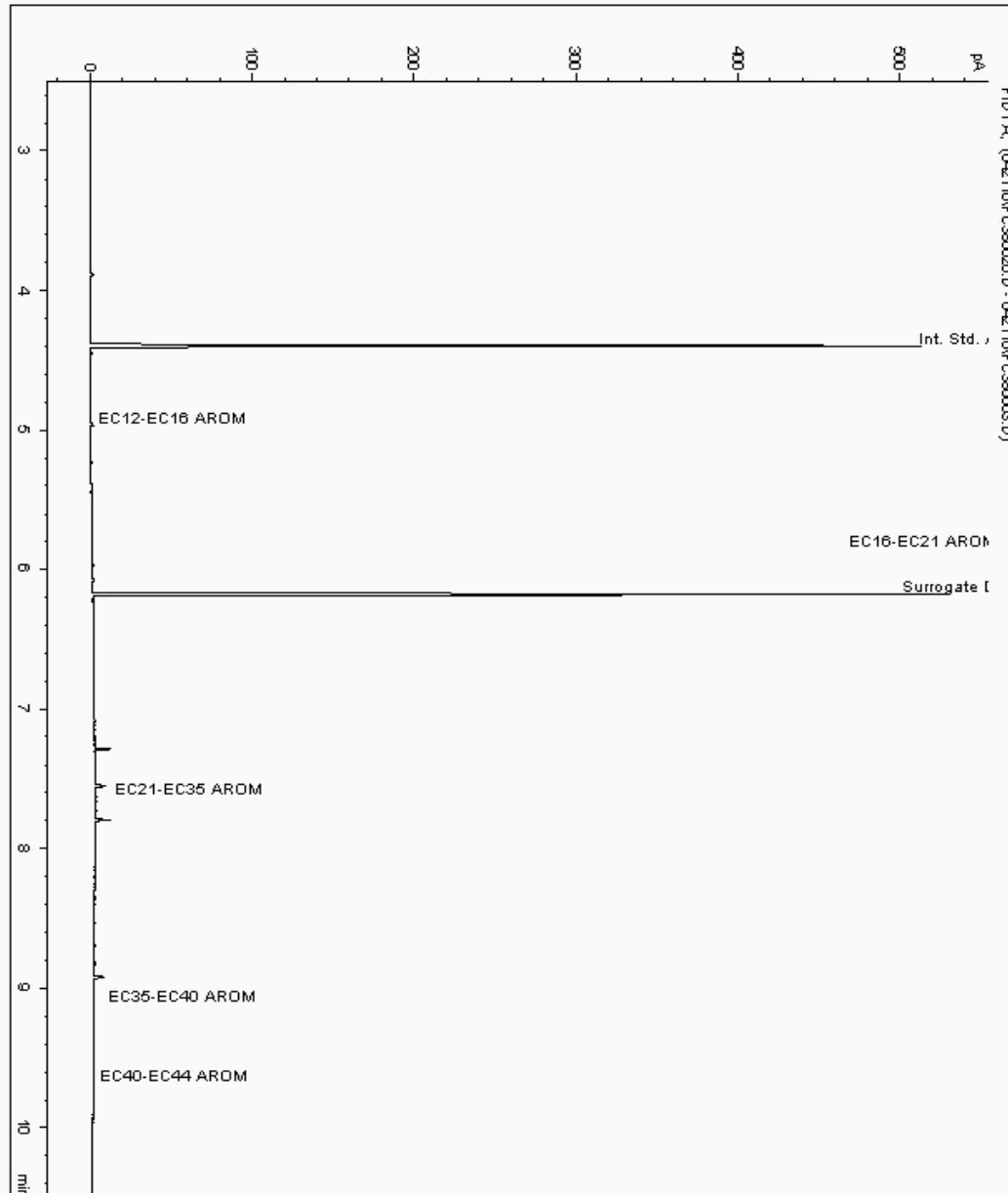
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13288841
Sample ID : BH03

Depth : 3.52

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12507608-
Date Acquired : 21/04/16 21:04:38 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

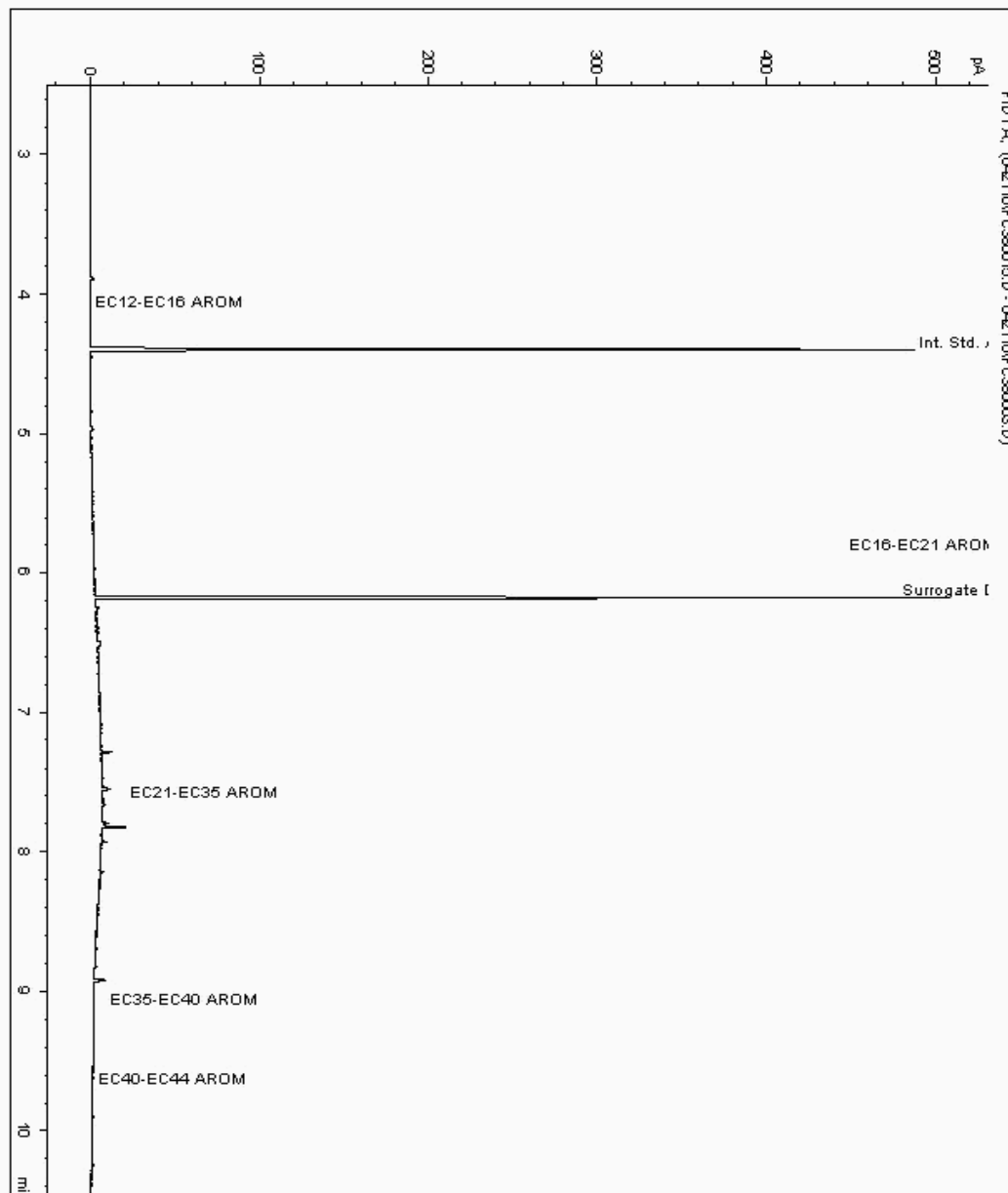
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13288917
Sample ID : BH01

Depth : 3.91

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12507627-
Date Acquired : 21/04/16 19:50:40 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.008





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

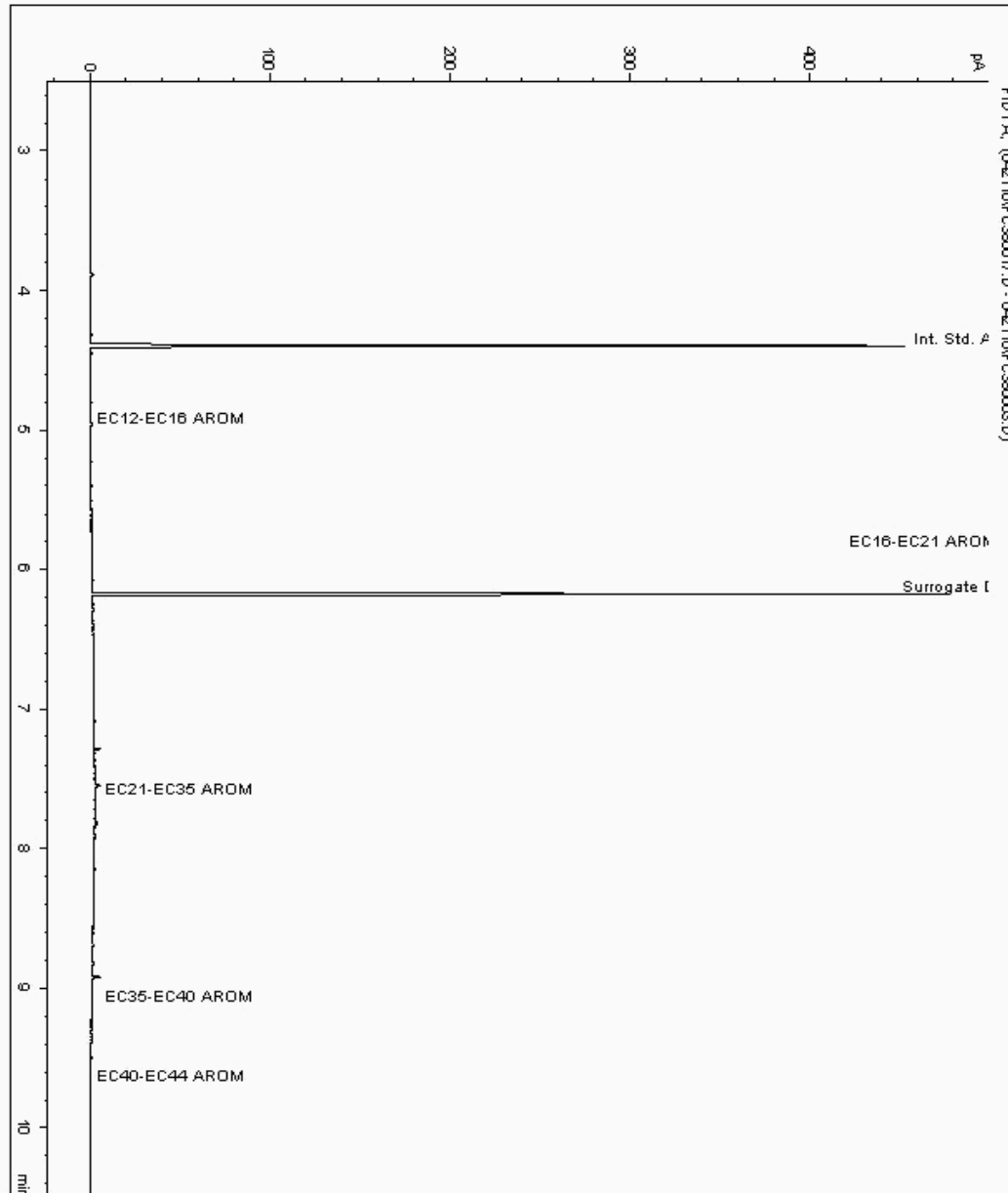
Analysis: EPH CWG (Aromatic) Aqueous GC (W)

Sample No : 13289152
Sample ID : BH02

Depth : 3.22

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 12507667-
Date Acquired : 21/04/16 20:18:29 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 0.009





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

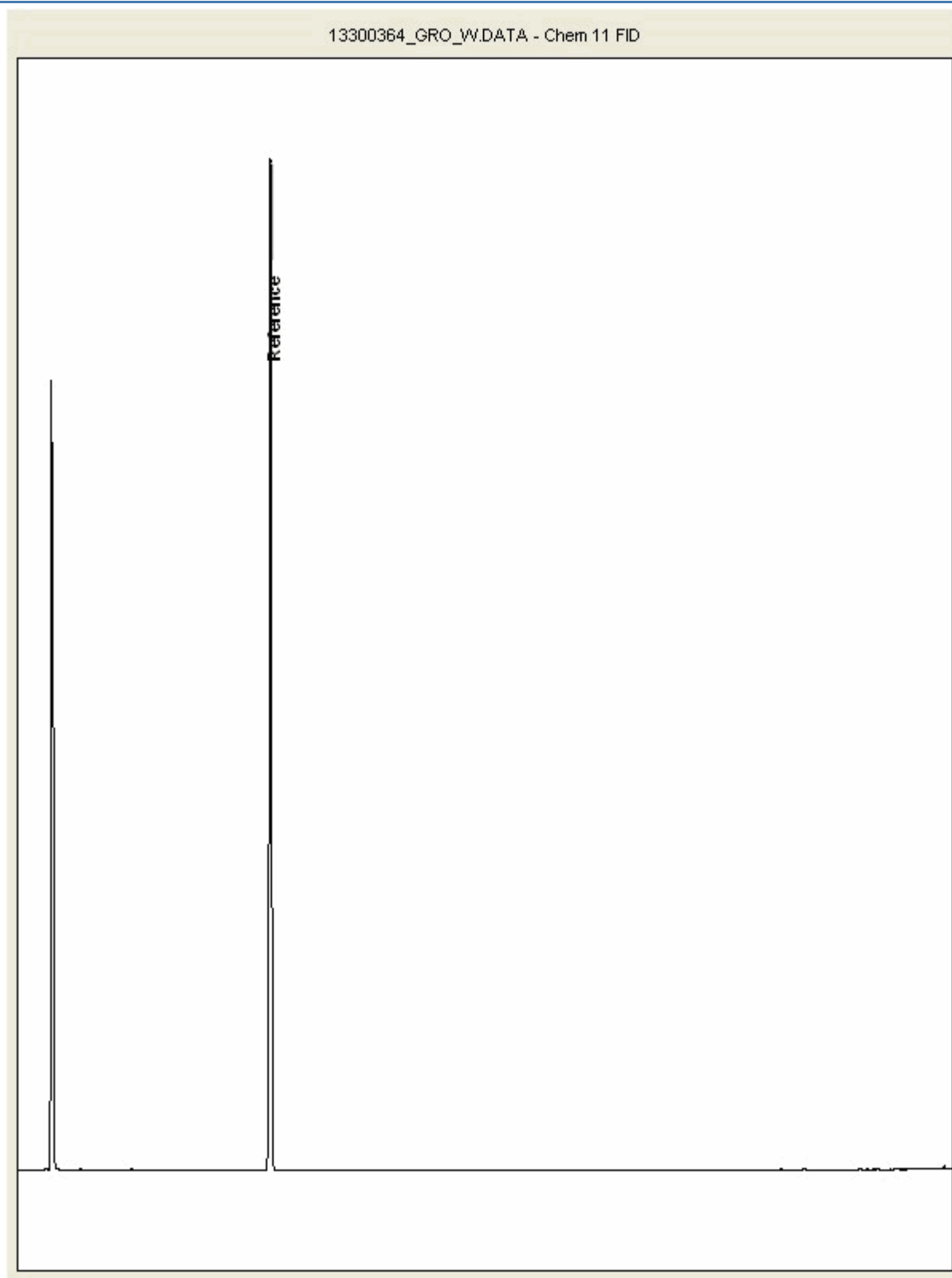
Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13300364
Sample ID : BH02

Depth : 3.22





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

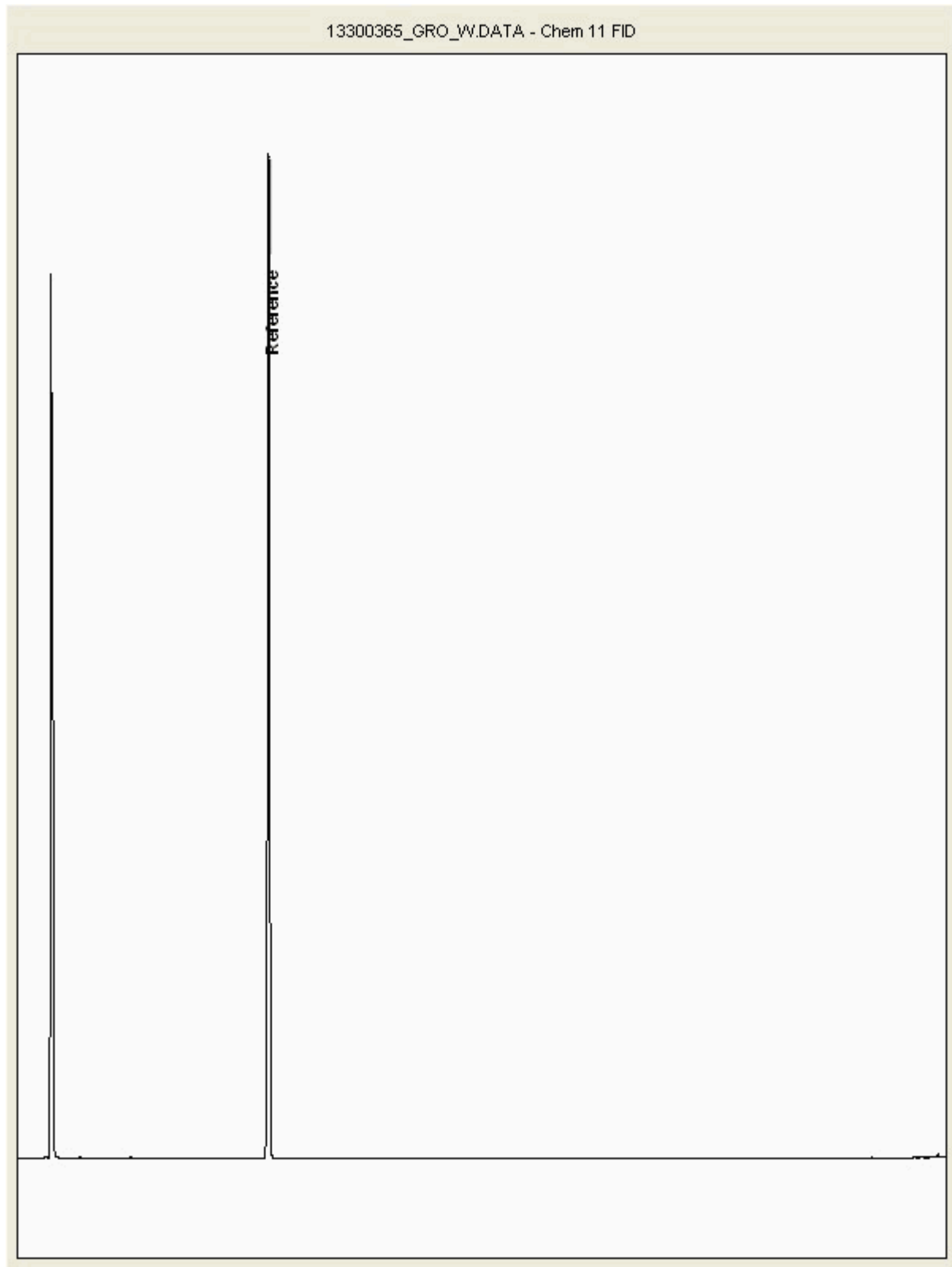
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Report Number: 358783
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13300365
Sample ID : BH04

Depth : 3.83





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

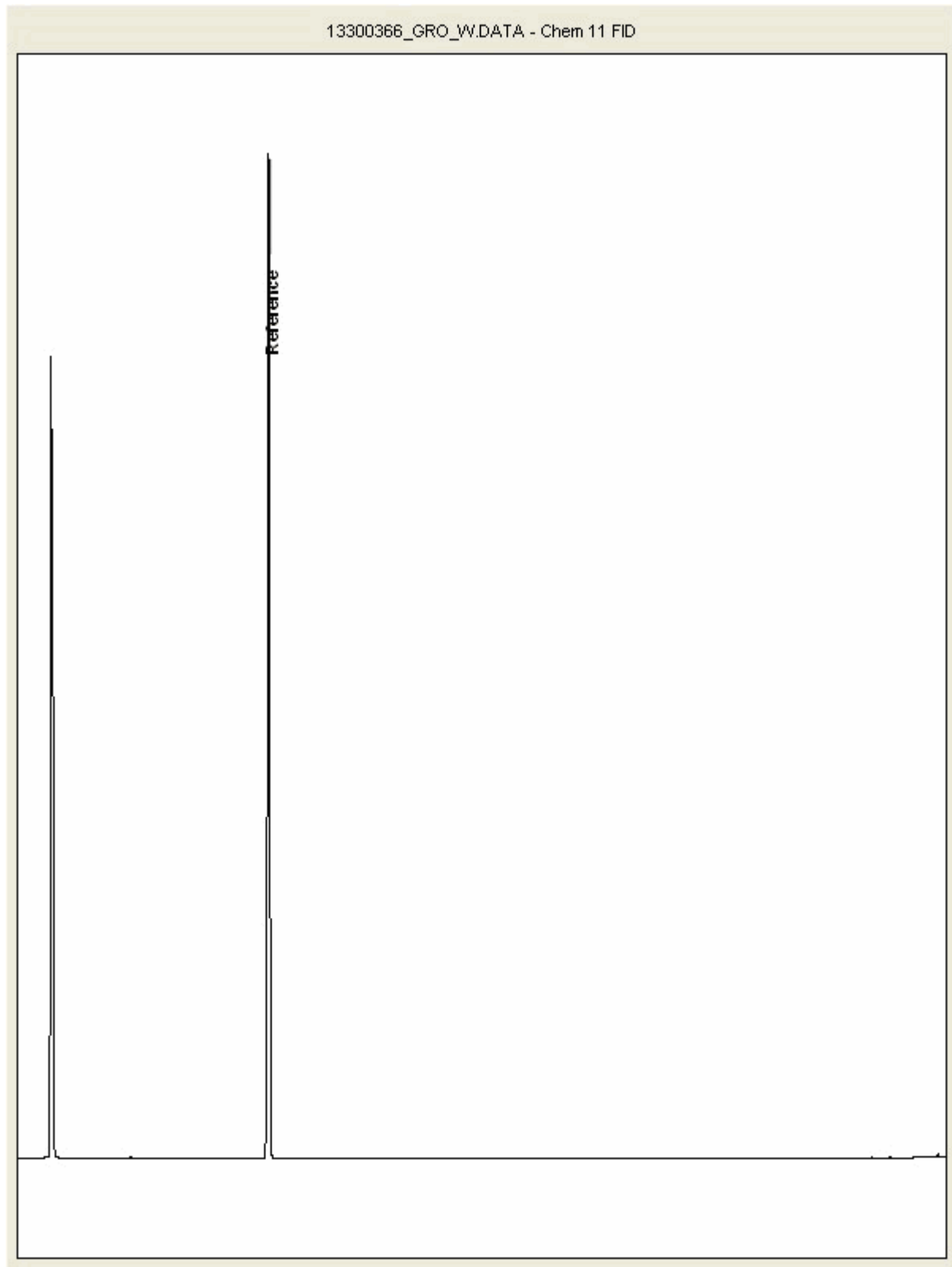
Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13300366
Sample ID : BH01

Depth : 3.91





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

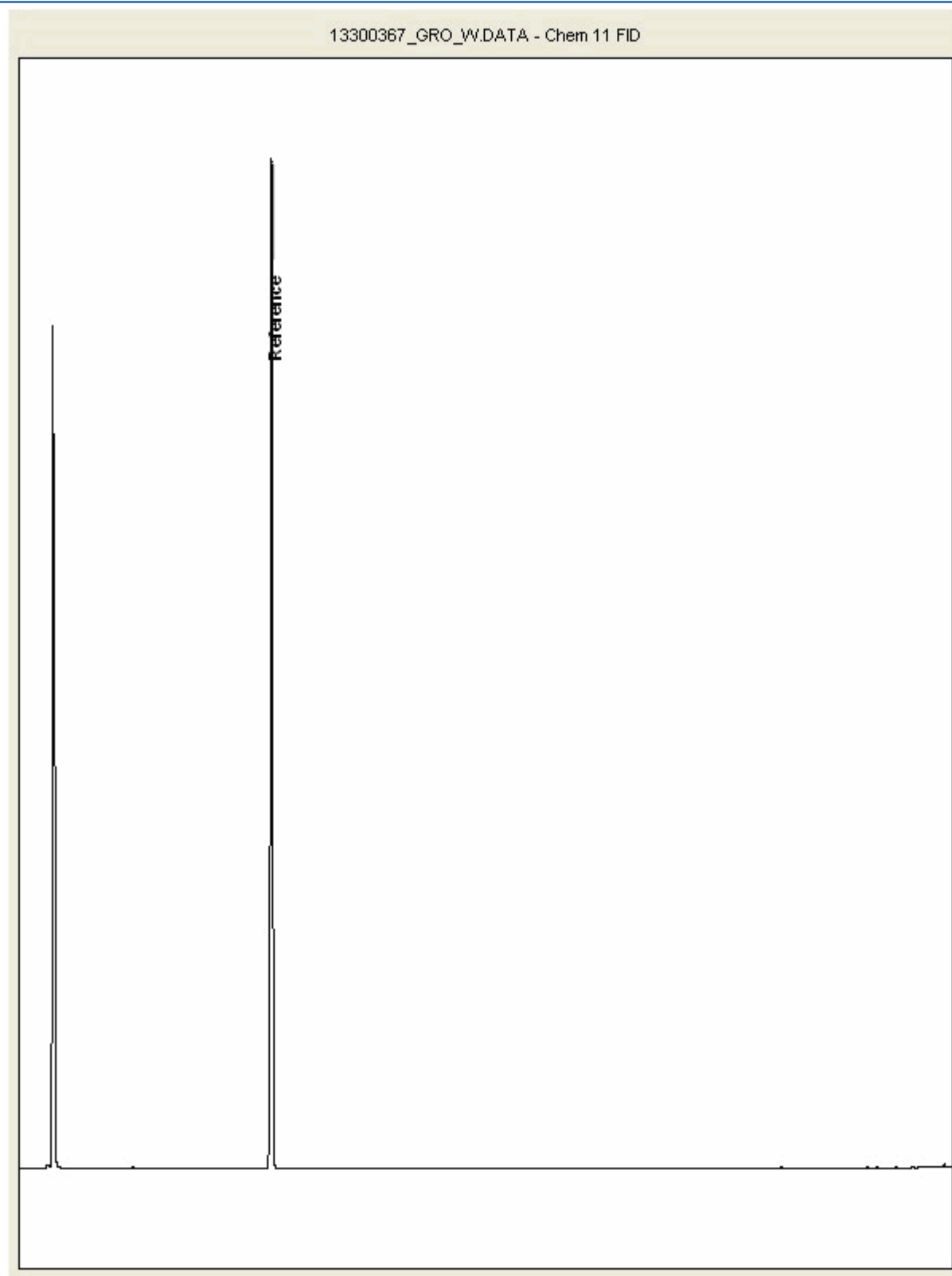
Order Number:
Report Number: 358783
Superseded Report:

Chromatogram

Analysis: GRO by GC-FID (W)

Sample No : 13300367
Sample ID : BH03

Depth : 3.52





SDG: 160419-67
Job: H_GEOTECHEN_GLO-236
Client Reference:

Location: University of Reading
Customer: Geotechnical Engineering Ltd
Attention: Jon Ind

Order Number:
Report Number: 358783
Superseded Report:

Appendix

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethylphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

General

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation was performed
\$	Sampled on date not provided
+	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to sampled on date
&	Sample Holding Time exceeded - Late arrival of instructions.

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Almandine	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than:
- Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.



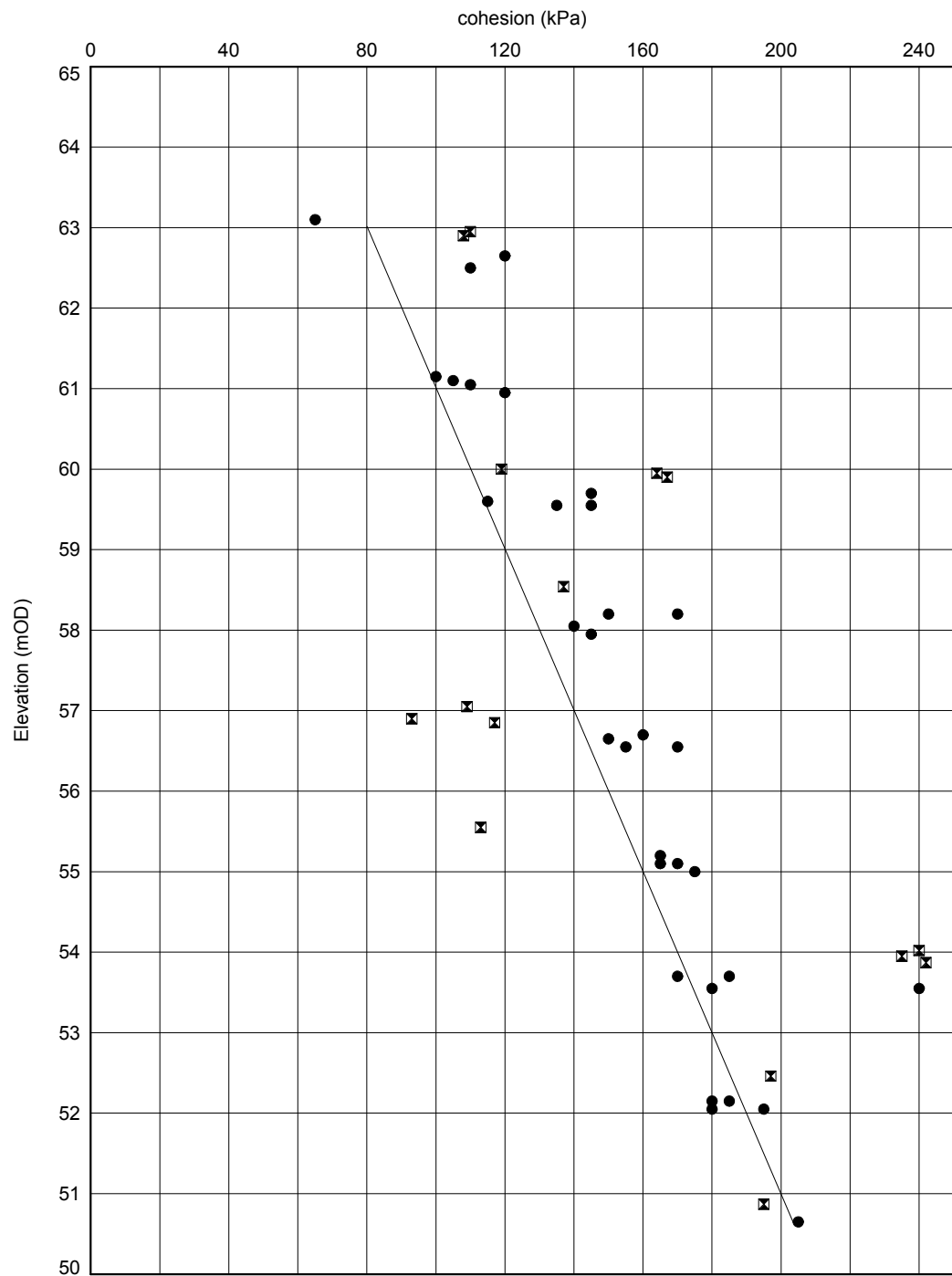
APPENDIX G

GEOTECHNICAL PLOTS

STRENGTH v ELEVATION PLOT (LONDON CLAY FORMATION)



CLIENT KNOWLES & SON (OXFORD) LIMITED
SITE UNIVERSITY OF READING - HEALTH AND LIFE SCIENCES BUILDING



- denotes a cohesion determined from SPT results using a factor of 5kPa (Stroud,1974)
- ⊠ denotes cohesion determined from triaxial test results
- ▲ denotes cohesion determined from hand shear vane test results
- denotes design line

CONTRACT	CHECKED
31710	J1



APPENDIX H

BASIS FOR ASSESSMENT OF SOILS

BASIS FOR ASSESSMENT OF SOILS

The Contaminated Land Exposure Assessment (CLEA) model

The package consists of three main reports (SR2, SR3 and SR4) and supporting toxicology reviews for individual substances. Together, they provide a coherent, consistent approach for assessing risks to human health from contaminated soil.

The development of the CLEA (2009) model was a programme of work supported by DEFRA and the EA. Future publications will include evolution of the CLEA model and individual toxicology reviews.

The three reports (SC050021) are published as part of the SR (Science Report) series of documents and are briefly introduced below.

SR2 Human Health Toxicological Assessment of Contaminants in Soil. This report incorporates the updates to how the toxicity of chemicals in soil are assessed that were introduced in *Guidance on the legal definition of contaminated land* (Defra, 2008b) together with further guidance on chemical risk assessments for soil. The report describes a framework developed by the Environment Agency (in collaboration with the Health Protection Agency and the Food Standards Agency) for the collation and review of toxicological data in order to derive Health Criteria Values (HCVs).

HCVs describe a benchmark level of exposure to a chemical at which, unless stated otherwise, long-term human exposure to chemicals in soil is tolerable or poses a minimal risk. HCVs are derived from available toxicity data. HCVs are used to derive SGVs.

SR3 Updated Technical Background to the CLEA Model. This report incorporates many of the updates to exposure assessment introduced in *Soil Guideline Values: The*

Way Forward (Defra, 2006a) together with other changes. The report describes the technical principles of the Contaminated Land Exposure Assessment (CLEA) model.

The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment, and a generic conceptual model (referred to in this report as generic land use scenarios) for site conditions and human behaviour, to estimate child and adult exposures to soil contaminants for those living, working and/or playing on contaminated sites over long time periods. The CLEA model is used to derive SGVs.

SR4 CLEA Software (Version 1.06) & Handbook (Version 1.05). The software enables assessors to derive assessment criteria (AC) to assist in the evaluation of the risks posed to human health from chronic exposure to chemicals in soil in relation to land use. Assumptions in the CLEA software apply to the derivation of generic assessment criteria (GAC), but also offer a useful starting point for the development of site-specific assessment criteria (SSAC). The introduction of version 1.05 will have only a minor effect on assessment criteria calculated using the CLEA software v1.04.

The accompanying handbook contains further information on using the CLEA software (outside the scope of the CLEA report SR3) for deriving SSAC. The CLEA software version 1.05 handbook is still relevant to version 1.06 and has not been changed. The CLEA software is used to derive SGVs.

The introduction of the new CLEA methodology now means that the SGVs and GACs derived using the old methodology will require updating. The former SGVs have been withdrawn and the Environment Agency have published revised SGV reports and associated TOX reports for the following eleven substances:

- Benzene
- Toluene
- Ethylbenzene
- Xylenes

- Mercury
- Selenium
- Arsenic
- Nickel
- Cadmium
- Phenol
- Dioxins, furans and dioxin-like PCBs

The publication of further SGVs is unlikely as HM Government and DEFRA have produced the document “Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance”. This introduces new Category 4 Screening Levels (C4SLs) where further guidance is proposed.

SGVs are scientifically based generic assessment criteria that can be used to simplify the assessment of human health risks arising from long-term and on-site exposure to chemical contamination in soil. They do not, however, consider risks to construction workers or risks from occupational exposure arising from activities in the work place.

SGVs are a screening tool for the generic quantitative risk assessment of land contamination. They are not (unless clearly stated otherwise) relevant for assessing risks to human health from short-term exposure to chemicals in soil including injury arising from direct bodily contact and do not take account of other types of risks to humans such as explosion or suffocation risks (associated with the build-up of gases such as methane and carbon dioxide) or aesthetic issues such as odour or colour.

SGVs do not take account of other non soil based sources of contamination such as contamination in groundwater, surface waters or drinking waters. They cannot be used to evaluate risks to non-human receptors such as controlled waters, ecosystems, buildings and services, domestic pets or garden plants. Where, for example, phytotoxic

effects are an important consideration in the current or future intended land use further investigation should be undertaken.

SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health. They represent an indicator to a risk assessor of when land is very unlikely to pose a significant possibility of significant harm to human health. Soil concentrations well above this level **may** pose a possibility of *significant harm* to human health. *Significance* is linked to:

- the magnitude of contamination;
- the duration and frequency of exposure;
- other site-specific factors that the enforcing authority may wish to take into account.

SGVs do not represent the threshold at which there is a *significant possibility of significant harm* (SPOSH). Nor do they automatically represent an unacceptable intake in the context of Part 2A of the Environmental Protection Act 1990. However, they are considered to be a useful starting point for such an assessment.

- SGVs can be used as a starting point for evaluating long-term risks to human health from chemicals in soil.
- SGVs can be used as an indication of chemical contamination in soil below which the long-term human health risks are considered to be tolerable or minimal.
- SGVs do not represent the “trigger” for an unacceptable intake.
- Unless specifically stated, SGVs do not cover other types of risk to humans such as fire, suffocation or explosion, or short term and acute exposures.
- SGVs cannot be used to evaluate risks to construction workers or nonhuman receptors.
- SGVs are not explicitly derived to define remediation standards.

Category 4 Screening Levels

The Impact Assessment that accompanied the revised Part 2A Statutory Guidance identified a potential role for new 'Category 4 Screening Levels' (C4SLs) in providing a simple test for deciding when land is suitable for use and definitely not contaminated land. It was envisaged that these new screening levels would allow 'low-risk' land to be dismissed from the need for further risk assessment more quickly and easily and allow regulators to focus efforts on the highest-risk land. The C4SLs were proposed to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels. It is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs.

The Part 2A regime and the planning regime are inter-linked such that the National Planning Policy Framework states that "after development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990" and that "Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner." The Part 2A Statutory Guidance and accompanying Impact Assessment were developed on the basis that Category 4 Screening Levels could be used under the planning regime, as they would be in Part 2A investigations directly. The estimated benefits that were expected to accrue from the changes to the Part 2A Statutory Guidance and specifically from the use of the new Category 4 Screening Levels were based on this assumption. However, policy responsibility for the National Planning Policy Framework and associated Planning Practice Guidance falls to the Department for Communities and Local Government.

The Category 4 Screening Levels consist of estimates of contaminant concentrations in soil that are considered to present an 'acceptable' level of risk, within the context of

Part 2A. The methodology for deriving both the Category 4 Screening Levels is based on CLEA methodology.

Where a valid Soil Guideline Value exists for a contaminant where a Category 4 Screening Level has also been derived, it is anticipated that risk assessors will use the Category 4 Screening Level in line with the Part 2A Statutory Guidance. In the absence of a suitable C4SL, risk assessors should identify and select appropriate generic assessment criteria in accordance with established good practice. It is for the Environment Agency to decide whether or not any of the Soil Guideline Values will be updated in the light of more recent toxicological data or whether any particular Soil Guideline Value should be withdrawn (as has already been the case with the SGV for lead).

LQM/CIEH Suitable for Use (S4UL) values

The “new” LQM/CIEH S4ULs¹ replace the 2nd edition of the LQM/CIEH Generic Assessment Criteria published in 2009. Generic values were developed by Land Quality Management Ltd (LQM) and the Chartered Institute of Environmental Health (CIEH) in 2014 to provide Generic Assessment Criteria (GACs) for a variety of land-uses, using the CLEA 1.06 (2009) model. These values are in accordance with Environment Agency publication SR4 (2009) which states that “You can derive GAC and SSAC using the CLEA software”. The properties used in the model were subject to a peer review process during a workshop in July 2014.

The LQM/CIEH S4ULs are intended for use in assessing the potential risks posed to human health by contaminants in soil and as transparently-derived and cautious “trigger values” above which further assessment of the risks or remedial action may be needed.

In the absence of LQM/CIEH S4ULS values developed by EIC/AGS/CL:AIRE and described below will be used.

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EIC/AGS/CL:AIRE values

The CL:AIRE project involved the collation and review of physico-chemical data, toxicological data and information on background exposure for 44 contaminants sometimes encountered on land affected by contamination in the UK and the derivation of Generic Assessment Criteria (GACs) for 351 of these using the CLEA model (v1.06). The GAC are intended to complement soil guideline values (SGV) produced by the Environment Agency of England and Wales and the 2nd edition GAC produced by LQM and CIEH (Nathanail et al, 2009). All three sets of assessment criteria have been derived in general accordance with the Environment Agency of England and Wales Contaminated Land Exposure Assessment (CLEA) guidance and thus the combined efforts of these three groups have resulted in a useful set of screening criteria for the assessment of risks to human health from soil contamination for more than 120 potentially contaminative substances.

Definition of what EIC/AGS/CL:AIRE GAC are:

- They are scientifically based screening criteria that have been derived using the CLEA model (v1.06) in general accordance with the CLEA framework;
- They can be used as a starting point for evaluating long-term risks to human health from chemicals in soil; and
- They provide an indication of the chemical concentration in soil below which the long-term human health risks for site occupants (for various generic land-use scenarios) are considered to be tolerable or minimal;
- They are screening criteria to determine the need for further investigations and the need for a DQRA.

Definition of what EIC/AGS/CL:AIRE GAC are NOT:

- They do not represent the “trigger” for unacceptable intake, i.e. exceedance of the GAC does not necessarily imply significant possibility of significant harm (SPOSH);

- They do not cover other types of risk to humans such as fire, suffocation or explosion, risks from chemicals in groundwater or ground gas or short term and acute exposures;
- They cannot be used to evaluate risks to construction workers or non-human receptors; and
- They are not explicitly derived to define remediation standards.

CLEA and other Guidance References

CL:AIRE (2010): Soil Generic Assessment Criteria for Human Health Risk Assessment. In association with the Association of Geotechnical and Geoenvironmental Specialists and The Environmental Industries Commission.

CL:AIRE (2013): Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. PS1010 – Final Project Report. Contaminated Land: Applications in Real Environments (CL:AIRE) dated 20th December 2013.

Department for Environment, Food and Rural Affairs (2012). Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance.

Department for Environment, Food and Rural Affairs (2014). SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document. March 2014.

Environment Agency. (2008), Science Report – SC050021/SR7 Compilation of data for priority organic pollutants for derivation of Soil Guideline Values. Science Report. Bristol.

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Environment Agency. (2009), Science Report – SC050021/SR2. Human health toxicological assessment of contaminants in soil. Science Report Final. Bristol: Environment Agency.

Environment Agency. (2009). CLEA software version 1.06. Bristol: Environment Agency.

Environment Agency. (2009). CLEA software (version 1.05) handbook. Science Report SC050021/SR4. Bristol: Environment Agency.

Jeffries, J., (2009). A review of body weight and height data used within the Contaminated Land Exposure Assessment model (CLEA). Project SC050021/ Technical Review 1. Bristol: Environment Agency.

Land Quality Management Ltd (2009): LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment 2nd Edition.

Nathanail, C P, McCaffrey C, Gillett AG, Ogden RC and Nathanail JF (2014) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.

SGV Reports References

Environment Agency. (2009), Science Report - SC050021/Arsenic SGV. Soil Guideline Values for Inorganic Arsenic in Soil.

Environment Agency. (2009), Science Report - SC050021/Mercury SGV. Soil Guideline Values for Mercury in Soil.

Environment Agency. (2009), Science Report - SC050021/Nickel SGV. Soil Guideline Values for Inorganic Nickel in Soil.

Environment Agency. (2009), Science Report - SC050021/Cadmium SGV. Soil Guideline Values for Cadmium in Soil.

Environment Agency. (2009), Science Report - SC050021/Selenium SGV. Soil Guideline Values for Selenium in Soil.

Environment Agency. (2009), Science Report - SC050021/Benzene SGV. Soil Guideline Values for Benzene in Soil.

Environment Agency. (2009), Science Report - SC050021/Toluene SGV. Soil Guideline Values for Toluene in Soil.

Environment Agency. (2009), Science Report - SC050021/Ethylbenzene SGV. Soil Guideline Values for Ethylbenzene in Soil.

Environment Agency. (2009), Science Report - SC050021/Xylenes SGV. Soil Guideline Values for Xylenes in Soil.

Environment Agency. (2009), Science Report - SC050021/Dioxins SGV. Soil Guideline Values for dioxins, furans and dioxin-like PCBs in soil. Bristol: Environment Agency.

Environment Agency. (2009), Science Report - SC050021/Phenol SGV. Soil Guideline Values for Phenol in Soil.

Toxicological reports published under the new approach

Environment Agency. (2009), Science Report - SC050021/TOX1 Contaminants in soil: updated collation of toxicological data and intake values for humans Inorganic Arsenic.

Environment Agency. (2009), Science Report - SC050021//TOX8 Contaminants in soil: updated collation of toxicological data and intake values for humans Nickel.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Mercury.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Selenium.

Environment Agency. (2009), Science Report - SC050021/TOX3 Contaminants in soil: updated collation of toxicological data and intake values for humans. Cadmium

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Benzene.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Toluene.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Ethylbenzene.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Xylene.

Environment Agency. (2009), Science Report - SC050021/ Contaminants in soil: updated collation of toxicological data and intake values for humans Dioxins, furans and dioxin-like PCBs.

Environment Agency. (2009), Science Report - SC050021/ TOX9 Contaminants in soil: updated collation of toxicological data and intake values for humans Cadmium.

Toxicological reports published under the old approach

Environment Agency. (2002), Science Report – R&D Publication/ TOX4 Contaminants in soil: collation of toxicological data and intake values for humans. Chromium.

Environment Agency. (2002), Science Report - R&D Publication / TOX5 Contaminants in soil: collation of toxicological data and intake values for humans. Inorganic Cyanide.

Environment Agency. (2002), Science Report - R&D Publication / TOX6 Contaminants in soil: collation of toxicological data and intake values for humans. Lead.

Environment Agency. (2002), Science Report - R&D Publication / TOX2 Contaminants in soil: collation of toxicological data and intake values for humans. Benzo(a)Pyrene.

Environment Agency. (2003), Science Report - R&D Publication / TOX20 Contaminants in soil: collation of toxicological data and intake values for humans. Naphthalene.

Environment Agency. (2004), Science Report - R&D Publication / TOX22 Contaminants in soil: collation of toxicological data and intake values for humans. 1,2-Dichloroethane.

Environment Agency. (2004), Science Report - R&D Publication / TOX16 Contaminants in soil: collation of toxicological data and intake values for humans. Tetrachloroethane.

Environment Agency. (2004), Science Report - R&D Publication / TOX24 Contaminants in soil: collation of toxicological data and intake values for humans. Trichloroethene.

Environment Agency. (2004), Science Report - R&D Publication / TOX18 Contaminants in soil: collation of toxicological data and intake values for humans. Vinyl Chloride.

Environment Agency. (2004), Science Report - R&D Publication / TOX21 Contaminants in soil: collation of toxicological data and intake values for humans. Carbon Tetrachloride.

Environment Agency. (2004), Science Report - R&D Publication / TOX23 Contaminants in soil: collation of toxicological data and intake values for humans. Tetrachloroethene.

Environment Agency. (2004), Science Report - R&D Publication / TOX25 Contaminants in soil: collation of toxicological data and intake values for humans. 1,1,1-Trichloroethane.