



The Coach House, 11A Underhill Road, Cleadon  
Geotechnical Investigation Report  
S160409  
Mr P Hewitt

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# GEOTECHNICAL INVESTIGATION REPORT




## THE COACH HOUSE, 11A UNDERHILL ROAD, CLEADON

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Revision	Date	Prepared By	Signed
Final	May 2016	A Cutts <i>Senior Engineering Geologist</i>	
		Checked By	
		D Simpson <i>Principal Geotechnical Engineer</i>	
		D Simpson <i>Principal Geotechnical Engineer</i>	

## **1 INTRODUCTION**

### **1.1 Authorisation**

The site investigation described in this report was carried out by Solmek to the instructions of Billingham George and Partners on behalf of Mr P Hewitt, at 11A Underhill Road, Cleadon, South Tyneside. A drawing showing the position of the site is included in Appendix A (Figure 1).

### **1.2 Scope of Works**

A geotechnical investigation was commissioned at the site to determine the local ground conditions for a proposed new residential dwelling incorporating a new access driveway and utilising the existing garden area.

Contamination testing and analysis along with a ground gas risk assessment were outside the scope of this report. In addition no investigation into the history of the site has been undertaken.

The fieldwork and testing was generally carried out according to the recommendations of BS5930: 2015 "Code of Practice for Ground Investigations" and where applicable BS EN 1997-2:2007 with soil descriptions to BS EN 14688-1:2002 where applicable. The information provided in this report is based on the investigation fieldwork, and is subject to the comments and approval of the various regulatory authorities.

There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

## **2 SITE DESCRIPTION AND FIELDWORK**

The site is located at approximate OS Grid Ref 437999,562060 and currently comprises a rectangular parcel of undeveloped land generally comprising an existing soil and grass garden area with occasional bushes and trees. A former driveway lies along the northern boundary surfaced with compacted hardcore and soil. This leads to an area of brick rubble and the outline of a former building with brick present in the footprint. Some areas in the east of site were water logged and water had ponded on the ground surface.

The site was surrounded by high wooden fencing and lies within a residential setting.

No signs of contamination were noted on the site.

### **2.1 Fieldwork**

The fieldwork was carried out on 18<sup>th</sup> April 2016. The extent of the investigation was to provide geotechnical information based on the drilling of three small percussive boreholes (BH1, BH2 and BH3). The boreholes were drilled to depths of 6.00m below ground level (bgl).

In situ hand shear vanes were carried out in the boreholes and on completion the boreholes were backfilled.

Descriptions of the strata encountered in the boreholes together with details of sampling and groundwater are presented in Appendix B of this report. A plan showing the location of the boreholes can be found in Appendix A (Figure 2).

## **3 GROUND CONDITIONS**

A summary of the ground conditions encountered is given below.

### 3.1 Made Ground

Made ground was encountered at all three positions to depths of 0.60mbgl.

BH1 and BH2 comprised a surface cover of slightly sandy gravelly clay with limestone to a depth of 0.20mbgl. In BH3 from ground level and below the clay in BH1 and BH2 was slightly sandy slightly gravelly clay with brick rubble, sandstone and limestone to 0.60mbgl.

### 3.2 Natural Deposits

Natural deposits of stiff consistency slightly sandy medium to high strength clays were proven across the site to depths of between 4.00mbgl in BH2 and 5.00mbgl in BH1 and BH3.

A layer of firm locally soft consistency slightly sandy low and medium strength clay was encountered from 5.00mbgl in BH1 and BH3 to the termination depths of both boreholes at 6.00mbgl. No recovery was recorded in BH2 from 4.00mbgl to 6.00mbgl.

### 3.3 Groundwater

No groundwater was encountered during the fieldwork.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities.

## 4 GEOTECHNICAL TESTING AND ANALYSIS

Samples taken from the boreholes underwent a series of geotechnical tests (BS 1377:1990) to aid foundation design and soil description. In addition, insitu hand shear vanes were undertaken at regular intervals during drilling. The geotechnical results are presented in Appendix C.

### 4.1 Shear Strength and Density

Two samples were subject to quick 38mm undrained triaxial tests at depths of between 0.80 and 1.40mbgl. The tests produced shear strengths of 81kPa (high strength) and 97kPa (high strength). Insitu hand vane readings from the clay within the boreholes at depths of between 1.00 and 4.00mbgl ranged from 47kPa to 90kPa. This is indicative of medium to high strength clay. Below 5.00m the hand vanes were lower and ranged from 29kPa (low strength) to 40kPa (medium strength).

### 4.2 Atterberg Limit Determinations

Three Atterberg Limit Determination tests were out carried on samples of cohesive material to classify the natural fine grained soils at depths of between 0.80mbgl and 1.60mbgl. The Plasticity Indices were between 37 and 42 with equivalent moisture contents recorded above the corresponding plastic limits. The cohesive material can be assessed as having a **high** shrinkage potential in relation to NHBC Guidance Chapter 4.2.

The liquidity index of these tested samples is given by the numerical difference between the water content and the plastic limit expressed as a percentage ratio of the plasticity index. The Liquidity Indices (0.081 to 0.108) of the samples and in comparison with the table on P52, Foundations of Engineering Geology 3<sup>rd</sup> Edition; T. Waltham, *T & F Books UK*, the samples can be assessed as being within the mid high strength range.

### 4.3 Moisture Contents

Five samples recovered from the boreholes were subject to moisture content tests to determine the moisture at depths of between 0.40 and 1.60mbgl. Moisture levels were between 27% and 39%.

### 4.4 pH and Sulphate Results

Three samples of natural clay from depths of between 0.40mbgl and 1.60mbgl were tested for acidity and

soluble sulphate content to assess whether the material may be potentially aggressive to building fabric. The results of the testing for pH ranged from 8.0 to 8.2 indicating slightly alkaline conditions. The soluble sulphates were between 26 and 73mg/l.

#### **4.5 Foundations**

The proposed dwelling is assumed to be of typical construction and may be founded on the shallow natural clay. Based on plasticity index results, all cohesive soils at the site should be regarded as being of **high** volume change potential. Foundations should therefore be placed at a minimum depth of 1.00m below original or finished ground level, whichever is the lower.

Based on the average shear strength around 1.00mbgl from insitu and laboratory testing (81kN/m<sup>2</sup>) the bearing capacity has been calculated across the site to be 189kN/m<sup>2</sup> within the natural clay using a 0.6m wide strip footing at 1.00mbgl. Providing the safe bearing capacity is not exceeded settlements have been calculated to be less than 25mm.

Foundations near existing or proposed trees should also be deepened and provided with appropriate heave precautions in accordance with current guidance within NHBC Standards Chapter 4.2.

It should be recognised that clay rich soils can deteriorate fairly rapidly on exposure, particularly in periods of wet weather and frost. It would be prudent to protect all exposed soils in foundation excavations with a concrete blinding layer, particularly if they are likely to remain open for extended period of time.

Prior to placing foundation concrete, obvious soft or loose spots should be removed and replaced with suitably recompacted hardcore or lean mix concrete. In addition, all excavations should be inspected to ensure that they fully penetrate areas of disturbed ground.

Sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-1s assuming static groundwater conditions.

#### **4.6 Ground Slabs**

In accordance with NHBC guidelines, ground slabs should be adopted where made ground is less than 0.6m in thickness. At this site made ground is relatively consistent and is generally 0.6m in thickness. Therefore ground slabs may be adopted.

Further advice should be sought from Solmek if unexpected ground conditions are encountered during redevelopment.

#### **4.7 Excavation**

Based on the nature of the ground conditions encountered, excavations should be within the capacity of normal earthworks plant. However, breaking out of possible relict foundations in the south east corner of the site, from the former building, should be allowed for. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97: "Trenching Practice".

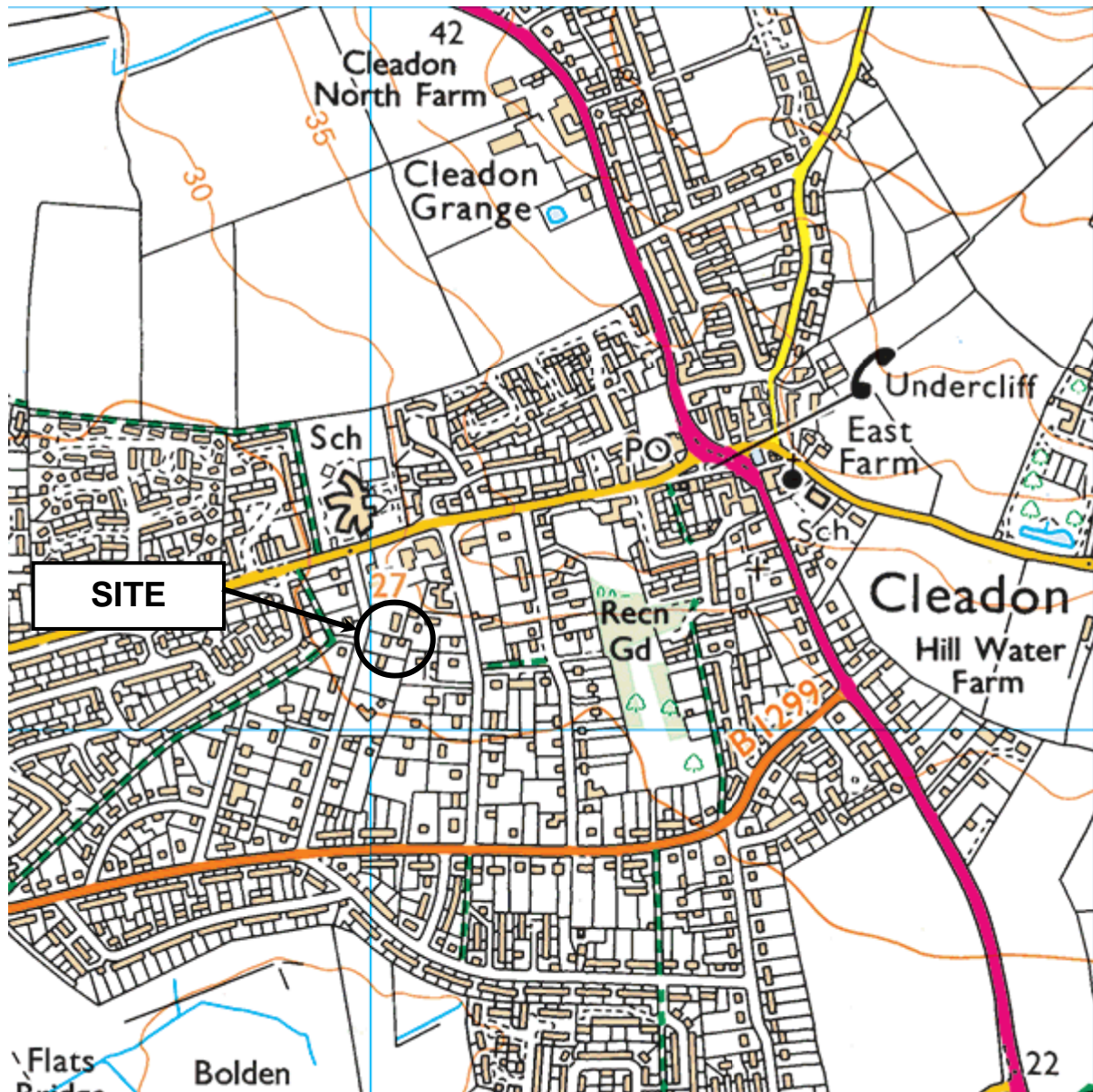
#### **4.8 Groundwater**

No groundwater was encountered during the fieldwork.

It should be noted the rapid rate of advancement of the exploratory holes may mask minor seepages and it should be borne in mind that water levels fluctuate with a number of influences including season, rainfall, dewatering and pumping activities.

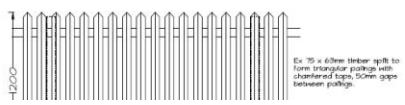
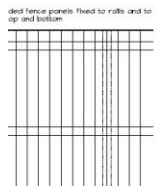
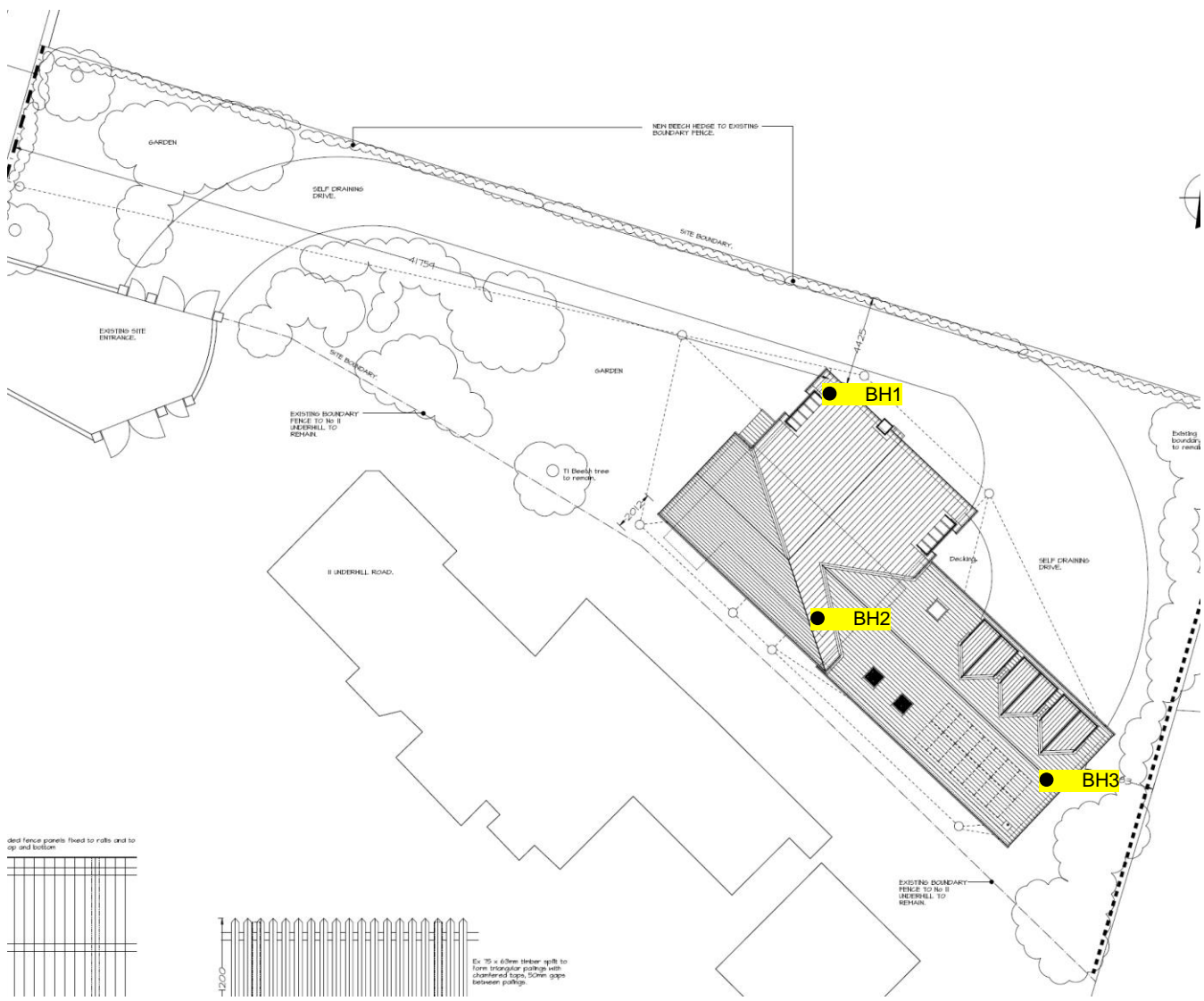
## **SOLMEK**

## APPENDIX A



<b>Client:</b>	Mr P Hewitt	
<b>Project:</b>	11A Underhill Road, Cleadon	
<b>Title:</b>	Site Location Map	
<b>Drawing No:</b>	Figure 1	Scale: NTS
<b>Date</b>	May 2016	





<b>Title</b>	Borehole Location Plan
<b>Project</b>	11A Underhill Road, Cleadon
<b>Client</b>	Mr P Hewitt
<b>Date</b>	May 2016
<b>Fig No.</b>	Figure 2
<b>Scale</b>	Do Not Scale
<b>Key</b>	
<p><b>Solmek Ltd.</b>          12 Yarm Road          Stockton-on-Tees          TS18 3NA</p> <p>Tel: +44 (0) 1642 607083          Fax: +44 (0) 1642 612355          e-mail: <a href="mailto:south@solmek.com">south@solmek.com</a>  <a href="http://www.solmek.com">www.solmek.com</a></p>	



## APPENDIX B







## APPENDIX C

# Laboratory Report Front Sheet

Site name	Job number
Underhill Rd, Cleadon	S160409

Solmek  
12 Yarm Road,  
Stockton on Tees,  
TS18 3NA  
01642 607083  
lab@solmek.com



## Client details:

Reference: S160409  
Name: Solmek  
Address: 12 Yarm Road,  
Stockton-on-tees,  
TS18 3NA  
  
Telephone: 01642 607083  
Email: acutts@solmek.com  
  
FAO: A Cutts

Date commenced: 29/04/2016

Date reported: 13/05/2016

## Observations and interpretations are outside of the UKAS Accreditation

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

Samples will be held at the laboratory for a period of 8 weeks after the report date. After the 13-07-2016 all samples will be disposed of. Should further testing be required then the office should be informed before the above date.

Signature:	Approved Signatories:
	<input checked="" type="checkbox"/> N Bland (Lab Manager) <input type="checkbox"/> U Mazhar (Assistant Lab Manager) <input type="checkbox"/> I Nicholson (Technical Manager)

# Summary of Classification Tests

Solmek  
 12 Yarm Road,  
 Stockton on Tees,  
 TS18 3NA  
 01642 607083  
 lab@solmek.com



7607

Site name	Job number
Underhill Rd, Cleadon	S160409

Hole	Depth		Type	w %	Oven temp. oc	wa %	Pa %	Pr %	wL %	wP %	IP %	IL	Plasticity class	Preparation method
	Top m	Base m												
BH1	0.80	1.00	B	29	105	29	99	1	62-s	25	37	0.108	CH	Tested after >425µm removed by hand
BH1	1.40	1.60	B	29	105									
BH2	1.40	1.60	B	29	105	29	99	1	67-s	25	42	0.095	CH	Tested after >425µm removed by hand
BH3	0.40	0.60	B	39	105									
BH3	0.80	1.00	B	27	105	28	98	2	62-s	25	37	0.081	CH	Tested after >425µm removed by hand

All tests found in Solmek UKAS Schedule of Accreditation are tested to standard unless otherwise indicated

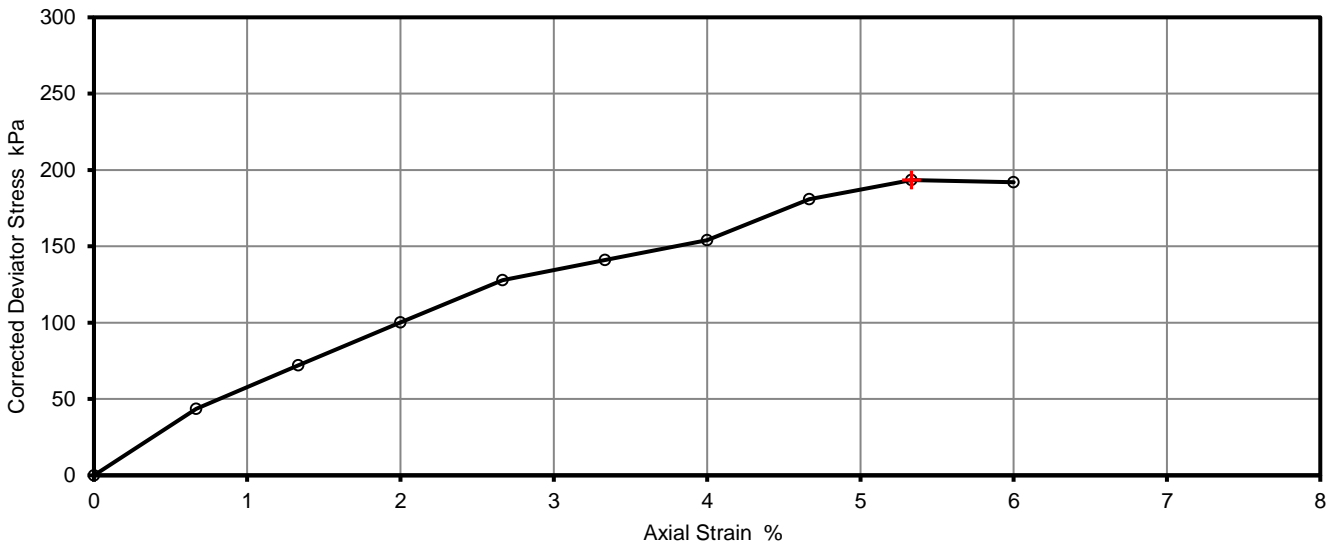
Key	Description	Category	BS Test Code
w	Moisture content		BS 1377:1990 Part 2 Clause 3.2
wa	Equivalent moisture content passing 425µm sieve		BS 1377:1990 Part 2 Clause 3.2
wL	Liquid limit	Single point	-s BS 1377:1990 Part 2 Clause 4.4
		Four point	-f BS 1377:1990 Part 2 Clause 4.3
wP	Plastic limit		BS 1377:1990 Part 2 Clause 5.2
Pa	Percentage passing 425µm sieve		
Pr	Percentage retained 425µm sieve		
IP	Plasticity index		BS 1377:1990 Part 2 Clause 5.4
IL	Liquidity index		BS 1377:1990 Part 2 Clause 5.4
	Suffix indicating test is "Not UKAS Accredited"	*	

Approved by	NB
Approval date	10/05/2016 13:50
Date report generated	
Report Number	

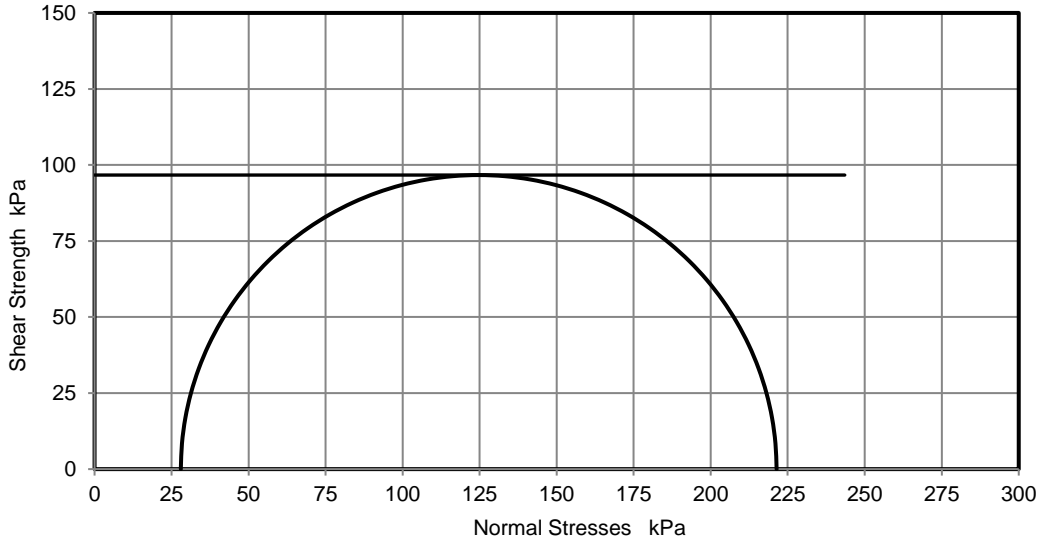
<b>Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen</b>			Job Ref	S160409	
			Borehole/Pit No.	BH1	
Site Name	Underhill Rd, Cleadon		Sample No.		
Soil Description			Depth	1.40	
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	stiff, brown mottled grey, s/g, CLAY		KeyLAB ID	SLMK2016051028	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		Date of test	12/05/2016	

Test Number	1	
Length	75.0	mm
Diameter	38.0	mm
Bulk Density	1.99	Mg/m3
Moisture Content	28.1	%
Dry Density	1.55	Mg/m3
Rate of Strain	1.0	%/min
Cell Pressure	28	kPa
At failure	5.3	%
Axial Strain	193	kPa
Deviator Stress, ( $\sigma_1 - \sigma_3$ ) <sub>f</sub>	97	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)$ <sub>f</sub>
Undrained Shear Strength, $c_u$		
Mode of Failure	Plastic	

**Deviator Stress v Axial Strain**



**Mohr Circles**



Deviator stress corrected for area change and membrane effects

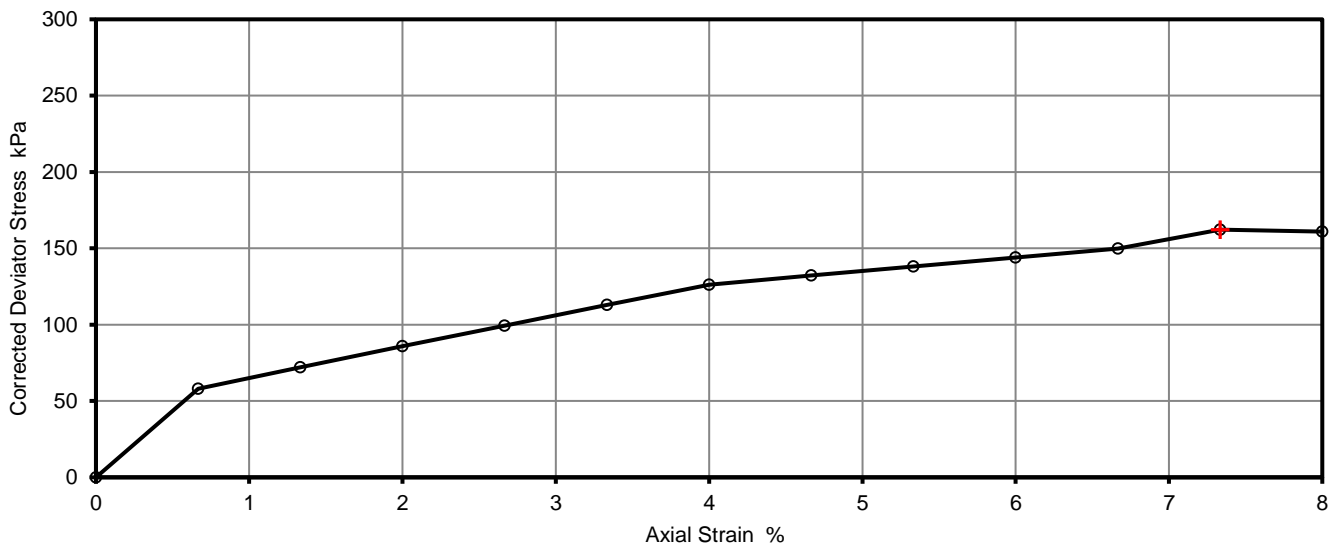
Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.



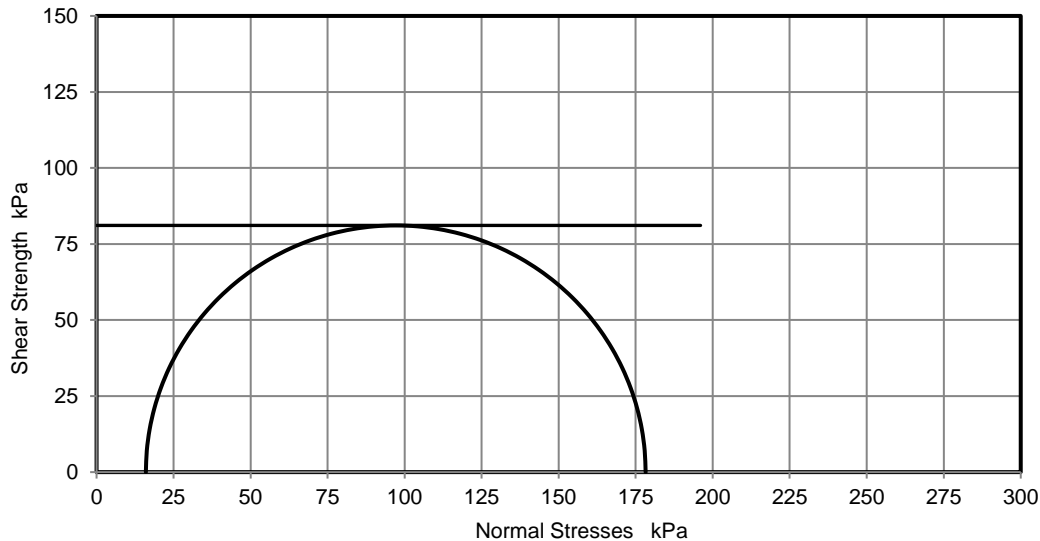
<b>Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen</b>			Job Ref	S160409	
			Borehole/Pit No.	BH3	
Site Name	Underhill Rd, Cleadon		Sample No.		
Soil Description			Depth	0.80	
Specimen Reference		Specimen Depth	m	Sample Type	B
Specimen Description	greyish brown, slightly sandy, slightly gravelly CLAY		KeyLAB ID	SLMK2016051031	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		Date of test	12/05/2016	

Test Number	1	
Length	75.0	mm
Diameter	38.0	mm
Bulk Density	1.98	Mg/m <sup>3</sup>
Moisture Content	27.5	%
Dry Density	1.55	Mg/m <sup>3</sup>
Rate of Strain	1.0	%/min
Cell Pressure	16	kPa
At failure	7.3	%
Axial Strain	162	kPa
Deviator Stress, ( $\sigma_1 - \sigma_3$ ) <sub>f</sub>	81	kPa
Undrained Shear Strength, $c_u$		$\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Mode of Failure	Plastic	

**Deviator Stress v Axial Strain**



**Mohr Circles**



Deviator stress corrected for area change and membrane effects

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



## Certificate of Analysis

Certificate Number 16-65092

09-May-16

*Client* SOLMEK  
12 Yarm Road  
Stockton On Tees  
Cleveland  
TS18 3NA

*Our Reference* 16-65092

*Client Reference* S160409

*Order No* (not supplied)

*Contract Title* Underhill Rd, Cleadon

*Description* 3 Soil samples.

*Date Received* 02-May-16

*Date Started* 02-May-16

*Date Completed* 09-May-16

*Test Procedures* Identified by prefix DETSn (details on request).

*Notes* Opinions and interpretations are outside the scope of UKAS accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

*Approved By*

A handwritten signature in black ink, appearing to read "Rob Brown".

Rob Brown  
Business Manager



## Summary of Chemical Analysis Soil Samples

Our Ref 16-65092

Client Ref S160409

Contract Title Underhill Rd, Cleadon

<b>Lab No</b>	980298	980299	980300
<b>Sample ID</b>	BH1	BH2	BH3
<b>Depth</b>	0.80-1.00	1.40-1.60	0.40-0.60
<b>Other ID</b>			
<b>Sample Type</b>	B	B	B
<b>Sampling Date</b>	n/s	n/s	n/s
<b>Sampling Time</b>	n/s	n/s	n/s

Test	Method	LOD	Units			
<b>Inorganics</b>						
pH	DETSC 2008#			8.2	8.1	8.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	73	45	26

## Information in Support of the Analytical Results

Our Ref 16-65092  
Client Ref S160409  
Contract Underhill Rd, Cleadon

### Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
980298	BH1 0.80-1.00 SOIL		PT 1L		
980299	BH2 1.40-1.60 SOIL		PT 1L		
980300	BH3 0.40-0.60 SOIL		PT 1L		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

### Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

### Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

## APPENDIX D

These conditions accompany our tender and supercede any previous conditions issued. Solmek will prepare a report solely for the use of the Client (the party invoiced) and its agent(s). No reliance should be placed on the contents of this report, in whole or in part by 3<sup>rd</sup> parties. The report, its content and format and associated data are copyright, and the property of Solmek. Photocopying of part or all of the contents, transfer or reproduction of any kind is forbidden without written permission from Solmek. A charge may be levied against such approval, the same to be made at the discretion of Solmek. Solmek was a trading name of Hymas Geoenvironmental Ltd.

Solmek cannot be held liable and do not warrant, or otherwise guarantee the validity of information provided by third parties and subsequently used in our reports. Solmek are not responsible for the action negligent of otherwise of subcontractors or third parties.

Site investigation is a process of sampling. The scope and size of an investigation may be considered proportional to levels of confidence regarding the ground and groundwater conditions. The exploratory holes undertaken investigate only a small volume of the ground in relation to the overall size of the site, and can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions as encountered within each of the exploratory holes. There may be different ground conditions elsewhere on the site which have not been identified by this investigation and which therefore have not been taken into account in this report. Reports are generally subject to the comments of the local authority and Environment Agency. The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that mobile contamination, ground gas levels and groundwater levels may vary owing to seasonal, tidal and/or weather related effects. Solmek cannot be held liable for any unrecorded or unforeseen obstructions between exploratory boreholes and trial pits. This includes instances where previous structures on the site (buried man made structures) or the presence of boulder clay (cobbles and/or boulder obstructions) have been anticipated. All types of piling operations should make allowance for obstructions within the construction budget to accommodate this. Unrecorded ancient mining may occur anywhere where seams that have been worked and influence the rock and soil above. Dissolution cavities can occur where gypsum or chalk is present. Rotary drilling is the recommended technique to prove the integrity of the rock.

Where the scope of the investigation is limited via access to information, time constraints, equipment limitations, testing, interpretation or by the client or his agents budgetary constraints, elements not set out in the proposal and excluded from the report are deemed to be omitted from the scope of the investigation.

Desk studies are generally prepared in accordance with RICS guidelines. Environmental site investigations are generally undertaken as 'exploratory investigations' in accordance with the definitions provided in paragraph 5.4 of BS 10175:2001 in order to confirm the conceptual assumptions. You are advised to familiarize yourself with the typical scope of such an investigation. No pumping of water will be undertaken unless a licence or facilities/equipment have been arranged by others.

Where the type, number or/and depth of exploratory hole is specified by others, Solmek cannot and will not be responsible for any subsequent shortfall or inadequacy in data, and any consequent shortfall in interpretation of environmental and geotechnical aspects which may be required at a later date in order to facilitate the design of permanent or temporary works.

All information acquired by Solmek in the course of investigation is the property of Solmek, and, only also becomes the joint property of the Client only on the complete settlement of all invoices relating to the project. Solmek reserve the right to use the information in commercial tendering and marketing, unless the Client expressly wishes otherwise in writing. The quoted rates do not include VAT, and payment terms are 30 days from dispatch of invoice from our offices. Quotes are subject to a site visit.

We have allowed for 1 mobilisation and normal working hours unless otherwise stated. The scope of the investigation may be reviewed following the desk study and/or fieldwork. The presence or otherwise of Japanese Knotweed or other invasive plants can be difficult to identify especially during winter months. If Japanese Knotweed or other invasive species are suspect, it should be confirmed by an ecologist. We have not allowed for acquiring services information, and cannot be responsible for damage to underground services or pipes not shown to us or not clearly shown on plans. Costs incurred will be passed on to you, and in commissioning Solmek you understand and accept that you/your agent have a contractual relationship with Solmek & you accept this. Our rates assume unobstructed, reasonably level and firm access to the exploratory positions and adequate clear working areas and headroom. We have priced on the basis that you or your client have the necessary permissions, wayleaves and approvals to access land. All boreholes and pits are backfilled with arisings except where gas monitoring pipes are installed with stopcock covers. Solmek are not responsible for any uneven surfaces as a result of siteworks and rutting and backfilled excavations may require re-levelling and/or making good by others after fieldwork is complete, and Solmek has not allowed for this. No price has been provided or requested for a return visit to remove pipework and covers. Hourly rates apply to consultancy only and do not include expenses unless otherwise shown. If warranties are required, legal costs incurred will be passed on to you assuming Solmek agree to complete such warranties, modified or otherwise and you understand and agree to pay all costs.

We reserve the right to pursue full payment of the invoice prior to release of any information including reports. We advise you/your client that we may elect to pursue our statutory rights under late payment legislation, and will apply 8% to the base rate for unreasonably late payments. Solmek are exempt from the CIS Scheme. Solmek offer to undertake work only in strict accordance with conditions covered by our current insurances, which are available for inspection. Solmek are not responsible for acts, negligent or otherwise of subcontractors and as a matter of policy cannot indemnify any other parties. Professional indemnity Insurance is limited to ten times the invoice net total except where stated otherwise by Solmek. Solmek give notice that consequential loss as a direct or indirect result of Solmek's activities or omission of the same are excluded.