Environmental
Geotechnical
Specialists

GEOTECHNICAL REPORT

job number J3501/16/E-Rev 2	date 27.11.19

site address
24 Stringerhouse Lane
Emley
Huddersfield
HD8 9SU

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GEOTECHNICAL ENVIRONMENTAL

Environmental Geotechnical Specialists

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Environmental Geotechnical Specialists

Report on a Geotechnical Investigation

Location:	24 STRINGERHOUSE LANE Emley, Huddersfield, HD8 9SU
For:	Alyson Makin
Consultants:	Paul Testa Architecture
Report No.	J3501/16/E-Rev 2
Report date:	December 2016

For and on behalf of **Rogers Geotechnical Services Ltd**

Rob Palmer MSc FGS
Graduate Geotechnical Engineer

Steve Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

Report Summary[1]

Item	Comments	Section
Development	Two storey residential building with associated hard standing.	1.
Geology	No superficial geology over Emley Rock.	4.
Strata Conditions	Nominal thickness of topsoil and made ground overlying variable granular and cohesive soils associated with the weathered fraction of the underlying bedrock. NHBC Class – Low to Medium.	5. & 5.1
Groundwater	None recorded.	5.2
Foundation Design	Shallow strip or spread foundations constructed within the natural deposits.	9.1
Ground-floor	Suspended ground-floor slab.	9.3
Pavement Design	Assumed CBR = <2%	9.4
Effect of Sulphates	Concrete Classification DC-1	9.5
Coal Instability	Coal at 11.0m and 12.5m.	10.

[1] This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

1. Introduction

The client proposes to develop the site at 24 Stringerhouse Lane, Emley, Huddersfield by the demolition of the existing barn, replacing it with a two storey building. Consequently, a site investigation has been undertaken in accordance with the instruction from the Client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. Furthermore, rotary probing has been undertaken to identify any coal workings. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

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

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Desk Study

A Coal Risk Assessment has been undertaken by Rogers Geotechnical Services (RGS) and the results were presented as report number J3501/16/EDS in May 2016. This report has been consulted during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 4th November 2016 and between the 15th and 18th of November and included the following:

- Four windowless sample boreholes.
- Four dynamic probes.
- Three open-hole boreholes.
- Three hand excavated foundation pits.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report.

4.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 90mm for the first 1m through 80mm, 70mm and 60mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.2 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes in accordance with the procedure given in BS1377: 1990: Part 9, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

4.3 Rotary Boreholes

Three boreholes were excavated using a track-mounted rotary drilling rig, RGS001, using rotary-open hole techniques with 140mm diameter drag and tricone roller bits. Where necessary, 150mm diameter casing was temporarily installed in 1.5m lengths to support the bore, with a toothed lead section being utilised to assist with reaming. The drill chippings brought to surface in the flush returns were inspected by the driller on a screen which forms part of the re-circulation tanks. The results of this work are provided on the rotary borehole records which are provided in Appendix 4. It should be appreciated that flush was lost generally towards the termination depths of the boreholes, but also at shallower depths.

4.4 Acquisition of Licence

In order to undertake this investigation it was necessary to obtain permission to enter or disturb Coal Authority interests. This was permission was granted on the 14th November as permit reference number 13162, which is presented in Appendix 5 to this report. In accordance with the joint Coal Authority and Health and Safety Executive positioning statement, and under the requirements of the licence, the works were undertaken employing water flush drilling techniques with gas monitoring of the boreholes during the fieldworks.

5. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[2]
Superficial Geology	None recorded	-	-
Solid Geology	Emley Rock	-	Fine-grained flaggy sandstone with mudstone partings.

Topographically, the site is situated on a slope dipping gently to the north-east. Geologically, the site is located on the Emley Rock, a named sandstone member of the Pennine Lower Coal Measures Formation. Furthermore, the Flockton Thick Coal seam is known to outcrop approximately 150m to the west of the site. Dip indicators on the geological map suggest that the solid geology underlying the local area dips approximately 3° degrees to the north-east. However, given the topography of the area, it is not anticipated that the Flockton Thick Coal seam will be observed below the site surface beneath the site. However, the generalised vertical section indicates that the Flockton Thin Coal seam may be present beneath an unknown thickness of the Emley Rock, despite the seam not outcropping to the south-west due to faulting.

6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	Strata Type	Positions Layer Revealed	Groundwater Strikes m below ground level
0.05 - 0.50	Topsoil	WS2, BH1, BH2	None
0.40 - 0.60	Made ground (Granular)	WS2, WS4	None
0.25 - 0.70	Made ground (Cohesive)	WS1, WS3, WS4	None
+1.00 - +1.50	Clayey sandy GRAVEL	WS3, WS4	None
0.80 - +2.00	Silty slightly sandy slightly gravelly CLAY	WS1, WS2, WS3, WS4	None

[2] Sources: British Geological Survey (NERC) Map Sheets 77; Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

10.50 - +12.50	SANDSTONE	BH1, BH2, BH3	None
3.00 - +13.50	MUDSTONE	BH2, BH3	None
13.00	COAL	BH3	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

6.1 General Lithology

It is considered that the clayey sandy gravel and silty slightly sandy slightly gravelly clay represent the weathered fraction of the underlying Emley Rock. In addition, it is considered that the sandstone and mudstone revealed beneath the site are associated with the Emley rock, which is known to comprise fine-grained sandstone with mudstone partings. Furthermore, it is considered that the two coal leaves identified at 11.0m and 12.5m with BH3, both measuring 0.5m in thickness represent the Flockton Thin Coal which was anticipated to be present beneath the Emley Rock.

6.2 Groundwater

No groundwater was observed during this investigation. However, it should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike. Moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

7. Insitu Testing

7.1 Dynamic Penetration Tests

Dynamic penetration tests were undertaken adjacent to the windowless sample borehole positions and a summary of the results is presented below:

Table 3: Summary of Dynamic Penetration Tests

Position	Blows/100mm			Refusal type	Comments
	0 - 2	3 - 10	10+		
	Depth to which blow count range was observed (m)				
DP1	1.5	1.9	2.7	Effective[4]	Weaker results recorded to 1.5m followed by gradual increase until refusal at 2.7m.
DP2	1.0	3.5	11.8	Effective[4]	Weaker results recorded to 1.6m followed by gradual increase until refusal at 2.7m.

[4] 25 blows/100mm.

DP3	0.9	-	2.1	Effective[4]	Weaker results recorded to 0.9m whereupon results increase rapidly. Recordings variable but remain high until refusal.
DP4	1.1m	0.5 1.2	2.3	Effective[4]	Initial strong zone to 0.5m followed by weaker zone to 1.1m. Results rapidly increase and variable high results were recorded until refusal.

8. Laboratory Testing - Geotechnical

The following programme of laboratory testing has been undertaken on samples obtained during this investigation:

- Moisture content determinations — BS 1377: 1990: Pt2: 3.2
- Index properties (1 point) — BS 1377: 1990: Pt2: 4.4, 5.3 & 5.4
- Linear shrinkage — BS 1377: 1990: Pt2: 6.3
- Soluble sulphate content — BS 1377: 1990: Pt3: 5
- pH value — BS 1377: 1990: Pt3: 9

The test results are presented in Appendix 6 and are summarised below:

Table 4: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Moisture content determinations	9	8.5% to 46%		Generally reducing with depth.
Index Properties (1 Point)	4	LL PL PI LS	43 to 58 22 to 27 19 to 31 09 to 12	Clay of intermediate to high plasticity. Consistency index 0.8 to 1.1 NHBC Class - Low to Medium
Soluble sulphate & pH	2	SO_4 pH	19 & <10mg/l 5.6 & 5.8	

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 5: Summary of Geotechnical Properties

Property	Range of values		Comments
Volume change potential (NHBC)	Low to Medium		Silty gravelly CLAY.
Shear strength parameters (at foundation level in cohesive material)	c_u	40kN/m^2	Based on dynamic probes and consistency indices.
Concrete classification	DC1		Natural ground locations (Static water)

9. Discussion of Ground Conditions - Geotechnical

The site is to be developed by the demolition of the existing barn structure, replacing it with a two storey building. It is understood that the proposed ground floor slab will be placed approximately 1m beneath the current ground floor slab. In order for this to be undertaken, material will be excavated and retaining structures will be constructed around the building perimeter.

9.1 Foundations

It cannot be recommended that foundations be constructed directly within the topsoil or made ground revealed at this site. These soils are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading.

The results of this investigation indicate that the weathered fraction of the Emley Rock, comprising silty slightly sandy slightly gravelly clay and clayey sandy gravel, will be revealed from depths ranging between 0.2m and 0.7m. It is considered that these soils will provide a suitable bearing stratum, provided that the foundations are placed within soil generally described as being present in a firm or medium dense insitu condition. It is considered that strip or spread foundations constructed within this material, generally at a minimum depth of say 1.9m, could be designed assuming an allowable increase in stress given in the following table:

Table 6: Allowable increase in stress (Cohesive)

Foundation Type		Strip Footings			Spread Footings		
Foundation Breadth	B (m)	0.6	1.0	1.5	1.0	2.0	3.0
Foundation Depth	D (m)		1.9			1.9	
Allowable increase in stress	(kN/m²)	96	90	86	145	132	125

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 40kN/m^2 at the foundation depths.

Where granular soils are encountered:

Table 7: Allowable increase in stress (Granular)

Foundation Type		Strip Footings		
Foundation Breadth	B (m)	0.3	0.6	>1.0
Foundation Depth	D (m)		1.9	
Allowable increase in stress	(kN/m²)	110	210	320

The allowable increase in stress given above again assumes a factor of safety of 3 against general shear failure, whilst considering an 'SPT' value of 30 at the foundation depths. As these values exceed the results for cohesive soil, the lower values should be employed.

Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately once final trimming has taken place. It should be appreciated that within some areas of the site, for example at borehole position WS3, foundations may be placed at shallower depths where firm and/or medium dense soils were revealed at 1.0m. Furthermore, where possible, it is recommended to place foundations in either cohesive or granular material, as foundations built within a mixture of clay and gravel could lead to differential movement. Therefore, in order to achieve this, foundations may need to be constructed deeper than originally anticipated.

Should any soft or loose material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil. In addition, if the excavations are required to stand open for any period of time then a blinding layer of lean-mix concrete should be placed in the excavation bases. This expedient will reduce softening or loosening of the sub-grade due to the ingress of surface water.

Should seepages of groundwater be encountered it is considered that they could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

The stability of the excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

9.2 Volume Change Potential

It should be appreciated that the cohesive soils revealed at this site possess a low to medium volume change potential under the guidance of the NHBC standards. Therefore, taking the above into account, and the presence of trees at the site, it is will be necessary to ensure that the depths of the foundations are designed in accordance with the Chapter 4.2 of the NHBC standards[5]. The methodology provided in the guidance will require the identification of any trees, still present at, or recently removed from, the site and the distance from the proposed foundations. This may result in foundation depths greater than those given above and the requirement for heave protection to be employed against footings and below the underside of the floors and beams.

9.3 Ground-floors

In light of the made ground and soft near surface soils, it is not recommended that ground bearing ground floor slabs be employed. In this instance it would be necessary to suspend floors between foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth.

[5] NHBC Standards, Chapter 4.2, *Building near trees*

9.4 Retaining Structures

It is understood that as part of the proposed development, retaining walls will be constructed around the building perimeter. From information provided by the client, it is understood that the walls will retain approximately 1.0m of soils.

In order to assist in the design of any retaining structure, the soil parameters, in terms of effective stress for the retained materials, are required. For design and estimating purposes it is considered that the following soils parameters may be utilised.

Table 8: Development specific risk assessment

Description	Angle of Friction ϕ' (°)	Effective Cohesion C' (kN/m²)
Silty gravelly CLAY (PI=28%)	21	0
Well compacted granular backfill	35	0

It is considered that the weathered Emley Rock will provide a suitable bearing stratum for a retaining wall provided that the foundations are placed within soil generally described as being present in a medium dense or firm in-situ condition.

Prior to constructing the wall, the embankment angle should be battered down to an angle of between 25-30°. Once the retaining walls are constructed, the retained area can be filled with well compacted clean granular material (assumed parameters in table above.).

9.5 Access Roads, Drive-ways and Hard-standing

It is considered that any roads or hard-standing at the site could be constructed employing traditional pavement design. A design California Bearing Ratio (CBR) of <2% could be employed in the pavement design[6]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

[6] Table 13/2 Design Manual for Roads and Bridges (1995), HA44/9: Volume 4 Section 1 Part 1, Highways Agency.

9.6 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[7], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[8], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required

10. Discussion of Ground Conditions - Coal Workings

The desk study that was undertaken by Rogers Geotechnical Services estimated that the Flockton Thick Coal seam would be present at <10m depth and beneath the Emley Rock. However, given the ground conditions revealed in this investigation, a revision of the generalised vertical section (GVS) would suggest that the seam present beneath the Emley Rock will be the Flockton Thin Coal seam.

The geological map indicates that the site is located upon the Emley Rock. Given that the GVS indicates that the Flockton Thick seam is stratigraphically younger, and is therefore present above the Emley Rock, it is considered that the Flockton Thick will be present at the surface, or not present at all. Furthermore, the GVS would suggest that the Flockton Thin Coal should be present beneath the Emley Rock, with a seam thickness of up to 1.4m.

It should be noted that there are some significant differences between the 1963 version of the BGS map sheet for the area and the contemporary data. In general terms, the most recent data has been given greater credence as it most likely represents a revised understanding of the geological conditions. In this regard, it is apparent that the Joan Coal seam is no longer considered to outcrop at the site, as indicated on the 1963 map. Stratigraphically, this seam is younger than the Emley Rock, the sandstone member which is now indicated to outcrop at the site. Therefore, the Joan Coal seam is not anticipated to be present beneath the site.

In view of the above, and in line with the findings of the coal mining risk assessment, it was stated that 15.4m of competent material would be required above the Flockton Thin Coal seam, assuming a maximum thickness of 1.4m. Moreover, it was anticipated that the Flockton Thick Coal seam would be found at the surface, if present, or not at all.

During drilling, sandstone was proven to depths of between 10.5m and 12.5m. It is considered that this strata is associated with the Emley Rock. It should also be appreciated that coal traces were observed

[7] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*
[8] Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*

within the clays at the near surface. Therefore, this cohesive material may represent the weathered Flockton Thick Coal seam.

Coal was revealed between depths of 11.0m and 11.5m and between 12.5m and 13.0m within borehole BH3. Whilst a 1.0m thick unit of mudstone was revealed between these two coal beds, it is considered that both of the seams collectively represent the Flockton Thin Coal seam. Therefore, if the seam was previously worked, taking into consideration the 1.0m mudstone parting, the Flockton Thin Coal seam is considered to have a thickness of 2.0m as this mudstone would have likely to have been removed if the seam was worked. As a result, at least 22.0m of competent overburden would therefore be required to provide surface stability if this seam has been worked. Whilst the seam was revealed at depths less than 22m, it should be appreciated that the seam was intact and workings were not observed.

Within all positions, flush was lost during drilling which made drilling very slow. Nevertheless, it should be appreciated that resistance was still noted whilst drilling. Therefore, it is considered that no distinctive voids were present beneath the site. However, whilst the loss of flush within the sandstone is considered to have been caused by fractures within the bedrock, it is difficult to determine the reason for the loss of the flush at the termination depth of BH3 within the underlying mudstone. Again, whilst there were no flush returns within this strata, drilling resistance was still noted. Therefore, loss off flush may have been caused by a natural fracture as coal and associated workings were not anticipated to be present directly beneath the Flockton Thin Coal seam. The next coal seam present beneath the Flockton Thin Coal seam on the GVS is the First Brown Metal Coal seam, which, if present, would be observed at a significant depth (i.e. in excess of 30m depth).

Taking all of the above into consideration, it has been determined that the Emley Rock is present directly beneath the site with a thickness of between 10.0m to 12.5m. The Flockton Thin Coal seam was revealed at depths of 11.0m and 12.5m within BH3 and was intact. Due to the difficulties encountered during drilling i.e. lost flush due to fractures in the bedrock, drilling was ceased at depths of 12.0m, 12.5m and 13.5m, with coal only being identified within BH3. In addition, the results of the gas monitoring conducted during the drilling phase suggest that there is a negligible risk of gasses associated with mine workings being present below the proposed development.

10.1 Risk Assessment

In light of the findings of this investigation, the risk to the proposed development is considered with reference to the following ratings and definitions:

Low - The possibility of instability is unlikely therefore no further action is necessary.

Moderate - The possibility of instability is likely and further investigation or remedial action may be required.

High - The possibility of instability is highly likely and further investigation or remedial action will be necessary.

Table 9: Development specific risk assessment			
Item	**Risk of Instability**	**Coal Seam(s) Considered**	**Risk Rating**
1	Shallow coal workings	Flockton Thick Coal	Low
2	Shallow coal workings	Flockton Thin Coal	Moderate

In view of all the information obtained in this investigation, due to the difficulties encountered during drilling from naturally fractured rock, it is uncertain whether or not the Flockton Thin Coal seam has been worked beneath other areas of the site. However, it should be noted that this seam has been identified within close proximity to the development area and the seam was found to be intact and the true thickness recognised.

It should be appreciated that the coal seam is indicated to be overlain by a significant thickness of sandstone which is likely to provide competent overburden. Nonetheless, it is recommended that this report is forwarded to the local authority for consideration to determine whether further drilling is required. If so, the method of drilling will need to be carefully considered.

11. Recommendations

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussions with the Coal Authority should be held to determine if further information is required. The seam was observed to be intact approximately 5m from the development area at position BH3. If additional information is required, and in light of the geological conditions revealed, the method of drilling will need to be reviewed.
- Detailed design of the sub-structure.

12. References

- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes,* B.S.I., London.
- British Standards Institution (2015) BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Geological Survey (NERC) (2019), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units: (*http://www.bgs.ac.uk/lexicon/)*
- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: Concrete in aggressive ground.
  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*
- NHBC Standards, Chapter 4.2, *Building near trees*
- Design Manual for Roads and Bridges (1995), HA44/9: Volume 4 Section 1 Part 1, Highways Agency

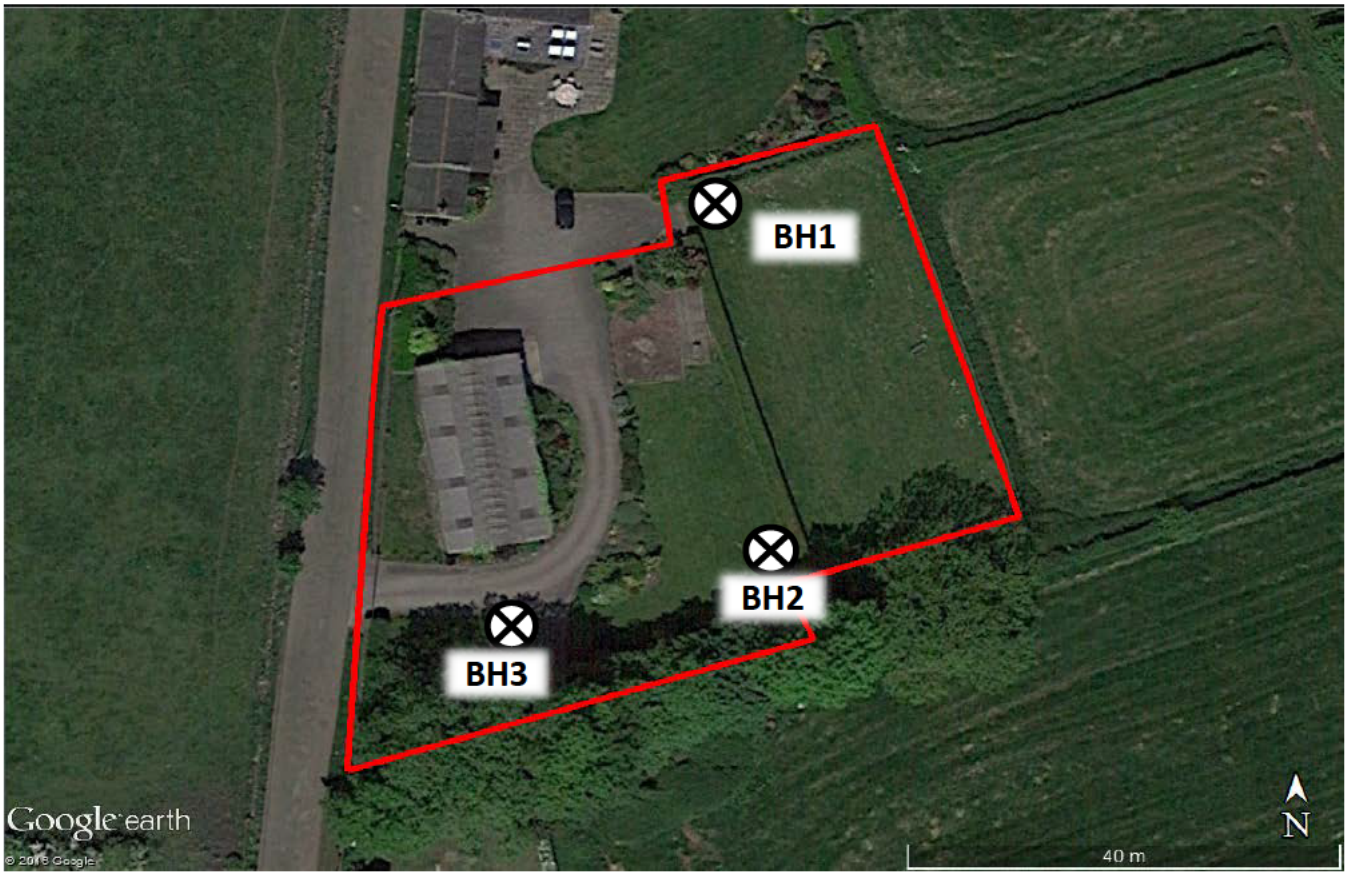
Appendix 1

Site Plan

Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**

Rogers Geotechnical Services Ltd	Site Name: Stringerhouse Lane **Emley**	Job No: **J3501/16/E**



Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan (Rotary)**

Rogers Geotechnical Services Ltd	Site Name: Stringerhouse Lane **Emley**	Job No: **J3501/16/E**

Appendix 2

Windowless Sample Borehole Records

Borehole Log

Borehole No. **WS1**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type WLS
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.20			MADE GROUND (Orangish brown silty gravelly SAND. Gravel is sub-angular fine to coarse of sandstone).
		0.75	D	85	95		0.40			MADE GROUND (Soft to firm dark brown silty slightly gravelly CLAY. Gravel is rounded to sub-angular fine to coarse of sandstone and various lithologies).
		1.20	D	75	80		1.04			Soft to firm thinly laminated orangish brown mottled brownish grey silty slightly gravelly CLAY. Gravel is sub-angular and angular fine to coarse of coal and rare ironstone.
							1.50			Soft to firm grey mottled orange silty slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is sub-angular fine to coarse of sandstone lithorelicts.
							2.00			Medium dense grey and brown clayey sandy sub-angular and tabular fine to coarse GRAVEL of sandstone.
										End of Borehole at 2 00m

Remarks

AGS

Borehole Log

Borehole No. **WS2**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type WLS
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results				
				85	95		0.15			TOPSOIL (Soft dark brown silty slightly gravelly CLAY with occasional rootlets).
							0.35			MADE GROUND (Orangish brown silty very gravelly SAND. Gravel is sub-angular fine to coarse of sandstone and concrete).
		0.80	D				0.60			MADE GROUND (Dark brown gravelly SAND of ash. Gravel is sub-angular fine to medium of clinker and rare brick).
		1.40	D	75	100		1.60			Soft greyish brown mottled orange organic silty slightly gravelly CLAY. Gravel is sub-angular fine to coarse of coal and sandstone.
							2.00			Firm grey mottled orange silty slightly sandy slightly gravelly CLAY. Sand is fine. Gravel is sub-angular fine to coarse of sandstone lithorelicts and rare coal.
										End of Borehole at 2 00m

Remarks

Borehole Log

Borehole No. **WS3**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type WLS
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results				
		0.30	D	85	90		0.25			MADE GROUND (Soft dark brown silty slightly gravelly CLAY. Gravel is sub-angular fine to medium of coal sandstone and rare brick).
		0.70	D				0.80			Soft grey mottled orange silty slightly sandy CLAY. Sand is fine.
							1.00			Dense orangish brown and grey clayey sandy sub-angular and angular fine to coarse GRAVEL of sandstone lithorelicts.
										End of Borehole at 1 00m

Remarks

Borehole Log

Borehole No. **WS4**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type WLS
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results				
				85	100		0.40			MADE GROUND (Black sandy sub-angular and angular fine to coarse GRAVEL of limestone concrete sandstone).
		0.80	D				0.70			MADE GROUND (Dark grey and orange slightly organic silty gravelly CLAY. Gravel is sub-angular and angular fine to coarse of sandstone and coal).
		1.05	D				1.10			Soft grey mottled orange silty slightly gravelly CLAY. Gravel is sub-angular fine to coarse of sandstone and coal).
				75	100		1.50			Dense grey and orange thinly laminated clayey sandy tabular and sub-angular fine to coarse GRAVEL of sandstone lithorelicts.
		1.65	D				1.80			Stiff grey mottled brown friable silty slightly gravelly CLAY. Gravel is tabular fine to coarse of sandstone lithorelicts.
										End of Borehole at 1 80m

Remarks

Appendix 3

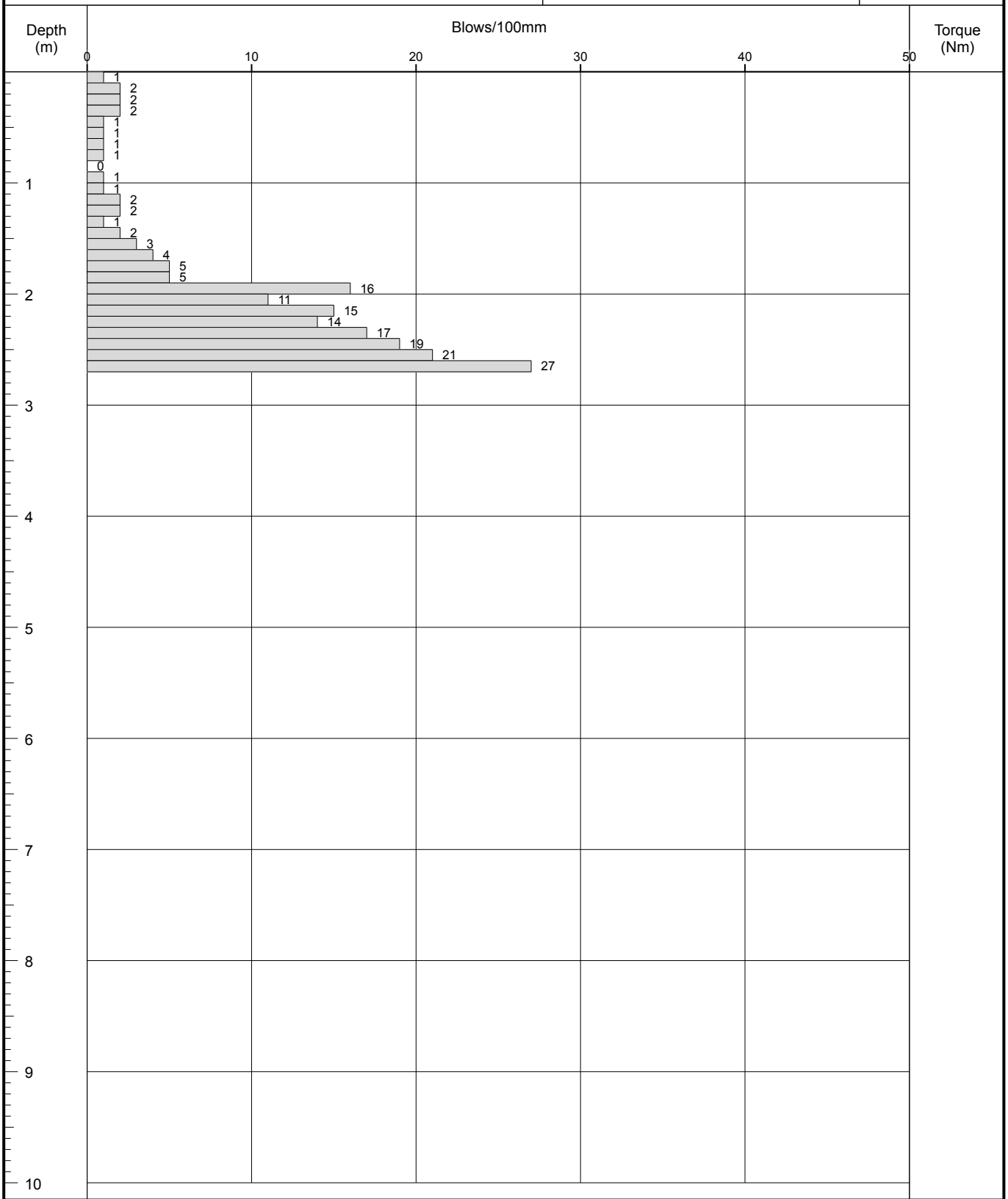
Dynamic Probe Results

Probe Log

Probe No. **DP1**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type DCP
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 04/11/2016	Logged By KW



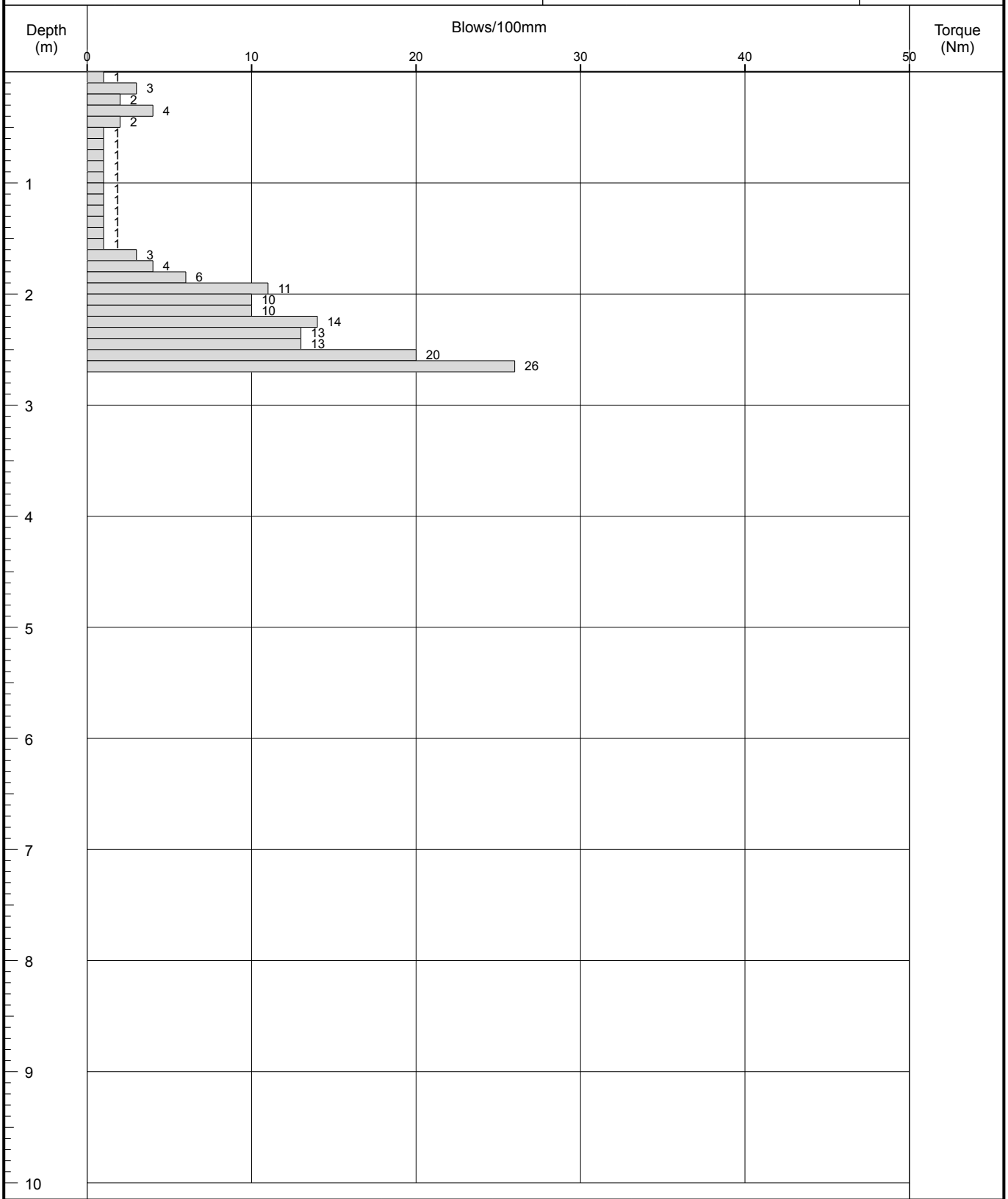
Remarks:
Terminated at 2.60m with 27 blows.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.6m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP2
Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type DCP
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 04/11/2016	Logged By KW



Remarks:
Terminated at 2.60m with 26 blows.

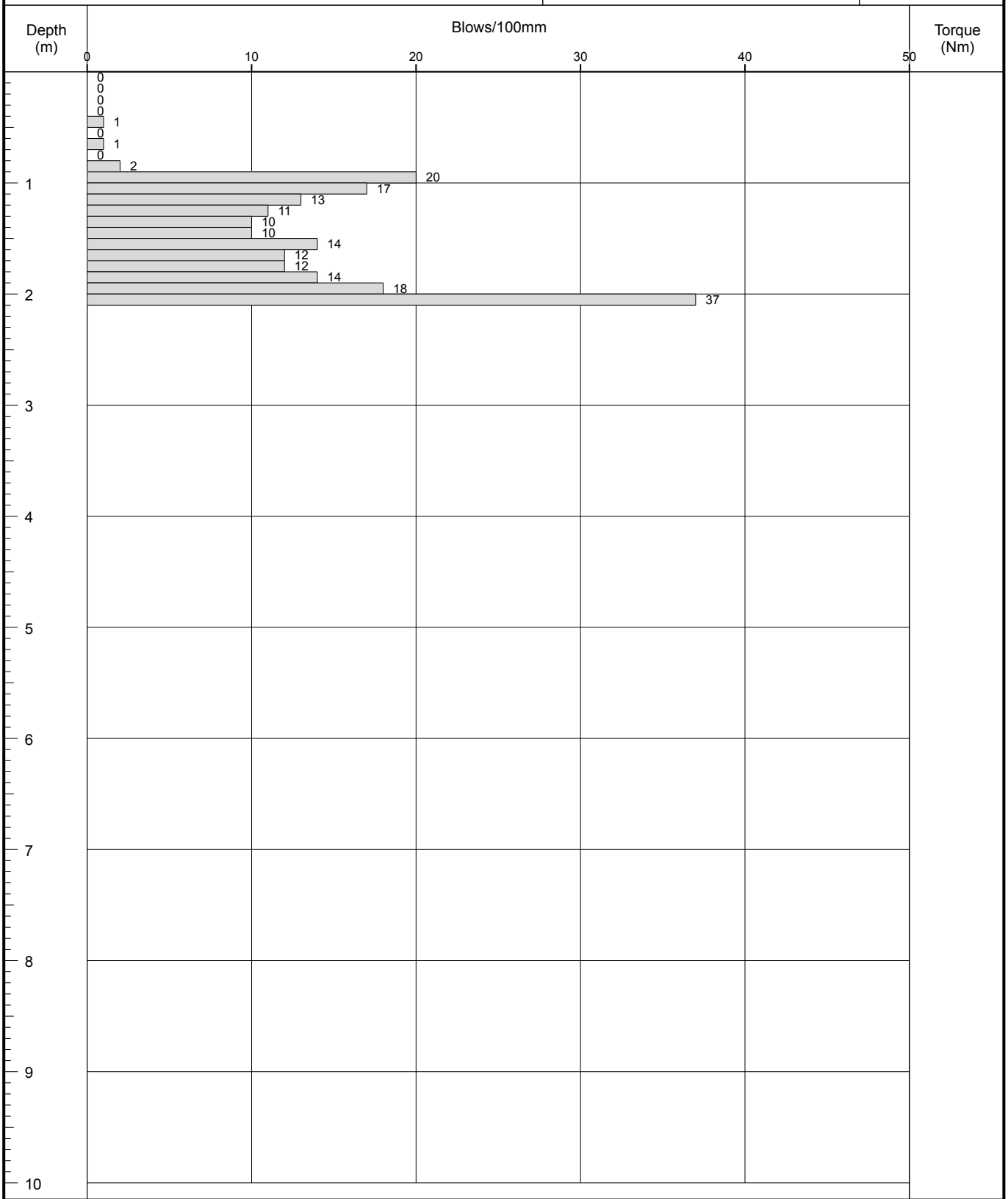
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.6m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP3**

Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type DCP
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 04/11/2016	Logged By KW



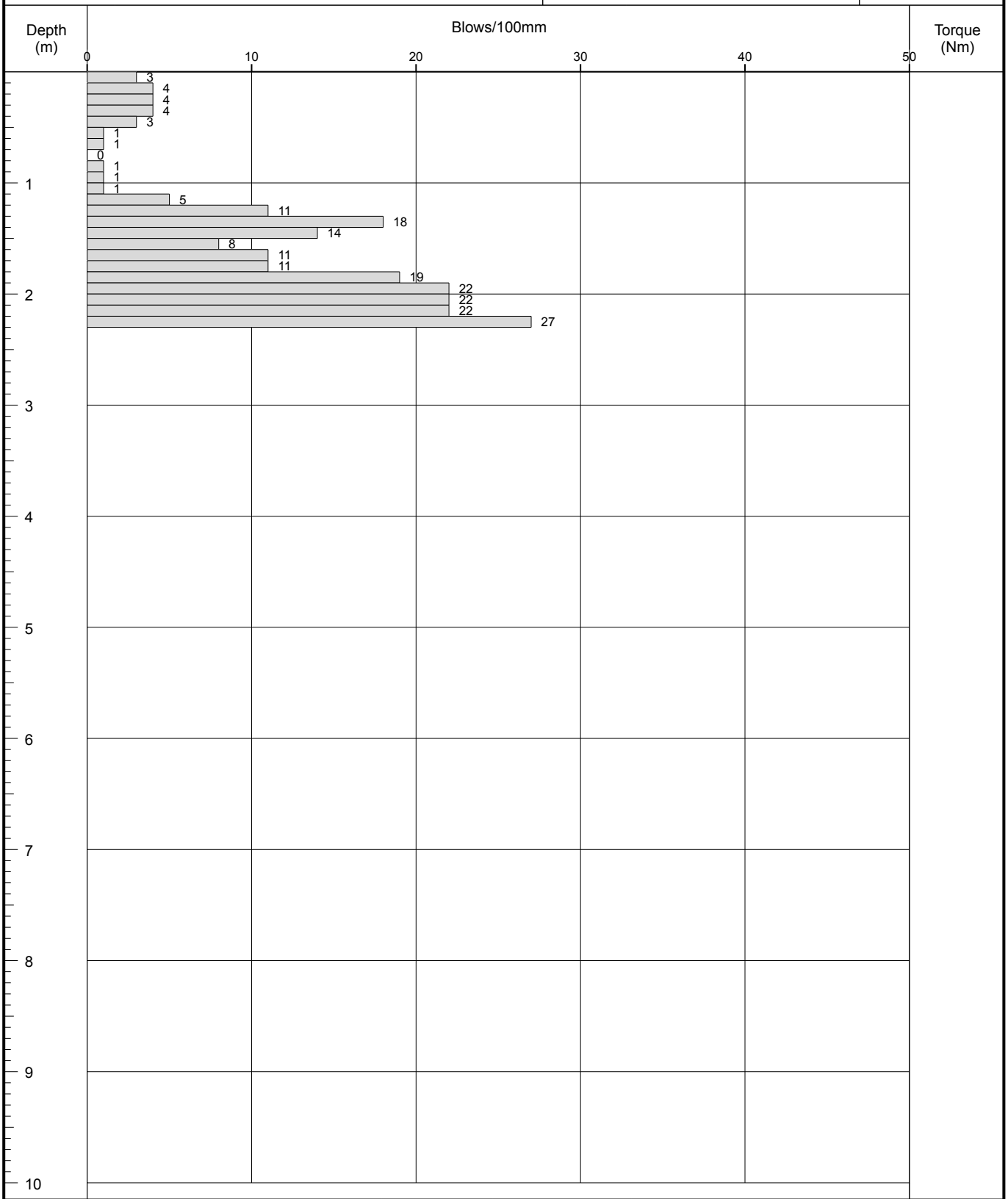
Remarks:
Terminated at 2.00m with 37 blows.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP4
Sheet 1 of 1

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type DCP
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 04/11/2016	Logged By KW



Remarks:
Terminated at 2.20m with 27 blows.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.2m
Probe Type	DPSH-B		

Appendix 4

Rotary Borehole Records

Borehole Log

Borehole No. **BH1**

Sheet 1 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 15/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.05			TOPSOIL (Operative's notes).
					0.20			MADE GROUND (Gravel sub-base). (Operative's notes).
								Brown CLAY with occasional coal fragments (Operative's notes).
					3.00			Light grey fine SANDSTONE. Slow drilling, good returns. (Operative's notes).
					5.00			Yellow SANDSTONE. Lost flush at 7.0m, 10.0m and 12.0m - fractured ground. Slow drilling, good returns. (Operative's notes).
								7.0m: Lost flush at 7.0m, no returns but drilling resistance - fractured ground.
								Continued on Next Sheet

Remarks

1 hour set up. 1 hour changing equipment. 1 hour repairing pump. Casing to 9.0m.

Borehole Log

Borehole No. **BH1**

Sheet 2 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 15/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								10.0m: Lost flush at 10.0m, no returns but drilling resistance - fractured ground.
								12.0m: Lost flush at 12.0m, no returns but drilling resistance - fractured ground.
					12.50			End of Borehole at 12.50m

11 12 13 14 15 16 17 18 19 20

Remarks

1 hour set up. 1 hour changing equipment. 1 hour repairing pump. Casing to 9.0m.

Borehole Log

Borehole No. **BH2**

Sheet 1 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								TOPSOIL (Operative's notes).
					0.50			Orange brown CLAY with coal fragments (Operative's notes).
					2.50			Grey MUDSTONE. Fast drilling, good returns.
					3.00			Light grey fine SANDSTONE. Slow drilling, good returns. (Operative's notes).
					6.00			Yellow SANDSTONE. Slow drilling, good returns. (Operative's notes).
					9.00			Light grey SANDSTONE. Slow drilling, good returns (Operative's notes).
								Continued on Next Sheet

1 2 3 4 5 6 7 8 9 10

Remarks

1 hour set up. 1 hour recovering casing. Casing to 9.0m.

Borehole Log

Borehole No. **BH2**

Sheet 2 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 16/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								11.5m: Lost flush at 11.50m, no returns but drilling resistance - fractured ground.
					12.00			End of Borehole at 12.00m

Remarks

1 hour set up. 1 hour recovering casing. Casing to 9.0m.

Borehole Log

Borehole No. **BH3**

Sheet 1 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 17/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								CLAY with coal fragments.
					2.00			Grey MUDSTONE. Fast drilling, good returns. (Operative's notes).
					5.50			Light grey fine SANDSTONE. Slow drilling, good returns (Operative's notes).
					8.50			Yellow SANDSTONE. Slow drilling, good returns (Operative's notes).
								Continued on Next Sheet

Remarks

1 hour set up. Casing to 9.0m.

Borehole Log

Borehole No. **BH3**

Sheet 2 of 2

Project Name: Stringer House Lane.	Project No. J3501/16/E	Co-ords:	Hole Type RO
Location: 24 Stringer House Lane, Emley HD8 9SU		Level:	Scale 1:50
Client: Alyson Makin		Dates: 17/11/2016	Logged By DH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					10.50			Dark grey MUDSTONE. Fast drilling, good returns (Operative's notes).
					11.00			COAL. Very fast drilling, good returns (Operative's notes).
					11.50			Dark grey MUDSTONE. Very fast drilling, good returns (Operative's notes).
					12.50			COAL. Very fast drilling, good returns (Operative's notes).
					13.00			Dark grey MUDSTONE. Fast drilling, good returns. *13.0m: Lost flush at 13.0m, no returns but drilling resistance - fractured ground.*
					13.50			End of Borehole at 13.50m

Remarks

1 hour set up. Casing to 9.0m.

Appendix 5

Coal Authority Licence

The Coal Authority

Permit to Enter or Disturb Coal Authority Mining Interests

Permit Reference Number 13162

Name and Address of Permit Holder:

Mrs Allyson Makin
C/o
Paul Testa Architecture
29 Footgate Close
Sheffield
S35 0JA

Site Location:

24 Stringer House Lane
Emley
Huddersfield
HD8 9SU

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by three boreholes to determine presence of shallow coal seams

within the Authority's mining interests at the identified site location for the period of 12 months from the granted date shown below. The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Applicant's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.

Signed: Helen Bennett Granted Date: ***14.11.16***

For and on behalf of The Coal Authority

Nominated Representative: Helen Bennett, Permitting Manager;
The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG
Tel: 01623 637339; E-Mail: permissions@coal.gov.uk

Appendix 6

Laboratory Testing - Geotechnical

Summary of Classification Test Results

Project No.	Project Name
J3501/16/E	Stringer House Lane.

Hole No.	Sample				Soil Description	Density bulk / dry Mg/m3		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
	Ref	Top	Base	Type										
WS1	1	0.75		D	Silty gravelly CLAY.			33.0	78	58 -1pt	27	31		
WS1	2	1.20		D	Silty gravelly CLAY.			8.5						
WS2	1	0.80		D	Silty gravelly CLAY.			39.0						
WS2	2	1.40		D	Silty gravelly CLAY.			28.0	61	54 -1pt	26	28		
WS3	1	0.30		D	Silty gravelly CLAY.			46.0						
WS3	2	0.70		D	Silty gravelly CLAY.			22.0	97	43 -1pt	24	19		
WS4	1	0.80		D	Silty gravelly CLAY.			41.0						
WS4	2	1.05		D	Silty gravelly CLAY.			26.0	98	46 -1pt	22	24		
WS4	3	1.65		D	Silty gravelly CLAY.			11.0						

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

Key			Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer	21/11/2016		
wd - water displacement	cas - Casagrande method	gj - gas jar			sheet
wi - immersion in water	1pt - single point test			Jude	1

Linear Shrinkage - Summary of Results

Project No.	Project Name
J3501/16/E	Stringer House Lane.

Hole No.	Sample				Soil Description	Material <425µm %	Preparation	Linear Shrinkage %	Remarks
	Ref	Top	Base	Type					
WS1	1	0.75		D	Silty gravelly CLAY.	78	Specimen prepared from natural material	9	
WS2	2	1.40		D	Silty gravelly CLAY.	61	Specimen prepared from natural material	12	
WS3	2	0.70		D	Silty gravelly CLAY.	97	Specimen prepared from natural material	9	
WS4	2	1.05		D	Silty gravelly CLAY.	98	Specimen prepared from natural material	12	

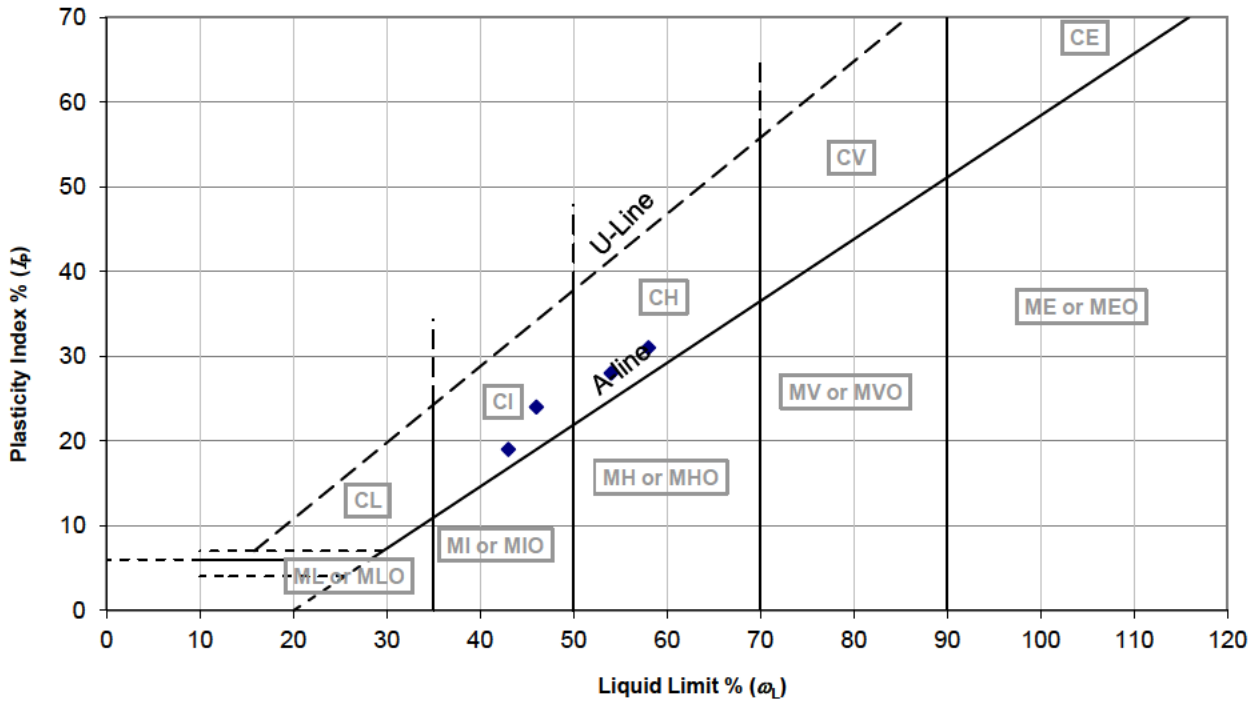
Notes

Tests performed in accordance with BS 1377 : Part 2 : 1990, clause 6 5 unless annotated otherwise

Date Printed	Approved By	Table
21/11/2016	Jude	2
		sheet 1

Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Interpretation of Moisture Content, Liquid and Plastic Limits**	**J3501/16/E**
Project Name: Stringer House Lane.	**B.S 1377: Part 2: 1990: 3.2, 4 and 5**	Fig. 3 / Sheet. 1
Location: Stringer House Lane. Emley.		Input By: CJN / Date: 21.11.16
Client: Alyson Makin		Check By: CJN / Date: 21.11.16

Location	Depth (m)	Moisture Content (w) (%)	Liquid Limit (wL) (%)	Plastic Limit (wP) (%)	Plasticity Index (IP) (%)	Retained by 425mm (%)	Modified (w) (w') (%)	Modified (IP) (IP') (%)	Liquidity/ Consistency (IL) (%)	Liquidity/ Consistency (IC) (%)	Casagrande Class	N.H.B.C Class (%)
WS1	0.75	33	58	27	31	22	42	24	0.2	0.8	C H	MEDIUM
WS2	1.40	28	54	26	28	39	46	17	0.1	0.9	C H	LOW
WS3	0.70	22	43	24	19	3	23	18	-0.1	1.1	C I	LOW
WS4	1.05	26	46	22	24	2	27	24	0.2	0.8	C I	MEDIUM



Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.:	16-28158-1
Initial Date of Issue:	24-Nov-2016
Client	Rogers Geotechnical Services Ltd
Client Address:	Unit 4, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Rob Palmer
Project	J3501/16/E Stringerhouse Lane, Emley

Quotation No.:		**Date Received:**	18-Nov-2016
Order No.:	1116-61	**Date Instructed:**	18-Nov-2016
No. of Samples:	2		
Turnaround (Wkdays):	5	**Results Due:**	24-Nov-2016
Date Approved:	24-Nov-2016		
Approved By:			

Details:	Robert Monk, Technical Development Chemist

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3501/16/E Stringerhouse Lane, Emley

Client: Rogers Geotechnical Services Ltd			**Chemtest Job No.:**		16-28158	16-28158
Quotation No.:			**Chemtest Sample ID.:**		379995	379996
Order No.: 1116-61			Client Sample Ref.:		WS01	WS02
			Client Sample ID.:		C1	C2
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.9	1.6
			Date Sampled:		16-Nov-2016	16-Nov-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
pH	M	2010		N/A	5.6	5.8
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.019	< 0.010
Moisture	N	2030	%	0.020	24	16
Soil Colour	N	2040		N/A	Brown	Brown
Other Material	N	2040		N/A	NONE	Stones
Soil Texture	N	2040		N/A	Clay	Clay

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

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