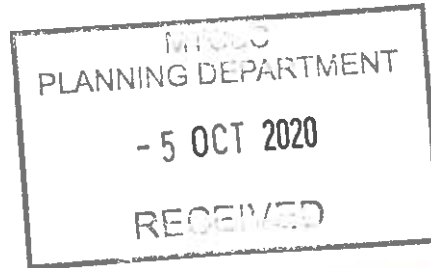


200231



Our Ref: JRW/16193/Report
Your Ref:
Contact: J. Rhys-Williams



Terra Firma (Wales) Ltd.
Consulting Geotechnical & Geo-Environmental Engineers
Site Investigation Contractors

5 Deryn Court, Wharfedale Road,
Pentwyn, Cardiff CF23 7HA
Tel: 029 2073 5354 Fax: 029 2073 5433
Email: info@terrafirmawales.co.uk
www.terrafirmawales.co.uk

28th July 2020

Miss A. Lester
Trebetham
Tydfil Terrace
The Quar
Merthyr Tydfil
CF47 8SY



For the attn. of Miss A. Lester

Dear Amy

GEOTECHNICAL INVESTIGATION: TREBETHAM

We confirm that we have completed the required works and report the following:

1.0 Introduction and Proposed Development

Miss A. Lester is proposing the replacement of a retaining structure and garage at Trebetham, Tydfil Terrace, The Quar, Merthyr Tydfil, CF47 8SY. The site approximately locates at a National Grid Reference 304570, 206985. The proposed site layout is presented in **Drawing 01**.

Terra Firma (Wales) Limited has been commissioned to carry out a geotechnical site investigation.

The main objectives of the geotechnical site investigation were to:

- Determine the type, strength and bearing characteristics of the shallow superficial and underlying solid geology
- Provide engineering foundation recommendations and soil parameters for the proposed development
- Provide recommendations regarding any other geotechnical aspects pertaining to the development

In order to achieve the above objectives, Terra Firma (Wales) Limited carried out a field investigation at the site.

1.1 Limitations and Exceptions of Investigation

The ground investigation was conducted, and this report has been prepared for the sole internal reliance of Miss A. Lester and her design and construction teams. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Terra Firma (Wales) Limited. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill. The report represents the findings and opinions of experienced geotechnical consultants. Terra Firma (Wales) Limited does not provide legal advice and the advice of lawyers may also be required. The subsurface geological profiles are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested.

It was beyond the scope of this investigation to prepare a phase I desk study report or assess the risk to the proposed development from historical coal mining.

2.0 Existing Site Data

2.1 Physical Setting

The development site situates to the front of Trebetham, in the location of the owners terraced garden which incorporates several block retaining wall. A single garage locates at the toe of the retaining structure, at road level. Steps accessing the dwelling cross diagonally up through the terraced garden and retaining structure. Retaining walls were frequently observed to be cracked or leaning indicating ground instability. The approximate height difference between road level and borehole collar depth is between 3.20-3.50m.

2.2 Geology

The 1:50,000 scale geological map (Sheet 249 Newport) shows the site to be underlain by the rocks of the South Wales Lower Coal Measures which is Carboniferous in age. The British Geological Survey Lexicon of Named Rock Units describes this formation as 'grey coal bearing mudstone/siltstone with seatearths and minor sandstones'.

Superficial deposits in the form of Till are shown to overly the solid geology on the site.

2.4 Site History

Publicly available historical maps show Trebetham to have been constructed prior to 1972-1977.

3.0 Field Investigation

3.1 Site Works

A geotechnical site investigation was carried out on the 9th July 2020 and comprised the drilling of three dynamically sampled boreholes and three dynamic probes along the crest of the retaining structure. Access restrictions limited investigation of any other terrace level.

The fieldworks were supervised by Terra Firma (Wales) Ltd. The soils were logged in general accordance with BS 5930:2015.

The boreholes referenced WS01 to WS03 were formed using a lightweight dynamic sampling rig. Dynamic sampling techniques were deployed from surface to produce continuous disturbed samples, recovered in window sampler tube.

Dynamic probe holes referenced WS01 to WS03 were carried out using a lightweight dynamic sampling rig and operated in accordance with the DPH specification BS EN ISO 22476-2:2005+A1:2011. Fixed cones were used.

On completion all exploratory holes were backfilled with arisings.

The borehole and dynamic probe logs are presented in **Annex A**.

The approximate locations of the exploratory holes are given in **Drawing 01**.

3.2 Ground Conditions

The ground conditions encountered during the site investigation are summarised below.

Table 3.1 Summary of Ground Conditions			
Depth from (m)	Depth to (m)	Thickness (m)	Stratum description
GL	1.50/2.50	1.50/2.50	MADE GROUND comprising very soft to soft dark brown or dark brownish grey slightly sandy slightly gravelly silty CLAY . (<i>Thickening to the west</i>)
1.50/2.50	1.50/3.00	0.00/1.00	Soft dark brown or brown slightly sandy slightly gravelly silty CLAY or sandy silty CLAY .
1.50/3.00	>4.00/>5.00	-	Firm brown slightly gravelly sandy/slightly sandy silty CLAY locally firm light brown SILT . (<i>Limited recovery</i>)

Dynamic probe results generally correlate with observed geology boundaries. Therefore, it can be qualitatively inferred that ground conditions beneath the limit of the window sampler (4.0-5.0m) were at least firm or equivalent in strength and consistency to a depth of 5.6-7.0m.

3.3 Groundwater

Groundwater was not recorded, however seepages were noted at the base of the existing retaining structure.

3.4 Stability and Obstructions

Dynamic probe WS03 refused at a depth of 5.60m.

4.0 Engineering Recommendations

4.1 Preparation of Site

Prior to demolition of the existing garage an asbestos survey should be undertaken. Identified asbestos should be removed by a specialist contractor and disposed of at a licensed waste facility.

Areas of vegetation including all roots and topsoil should be stripped and removed from beneath the proposed development site.

Considerable allowances should be made for any temporary/permanent support works to Trebatham and any existing adjacent structure necessary as a result of the proposed works.

Contingencies should be made for the protection/diversion of any underground/overhead services present beneath/above the site brought about as a result of the proposed works.

Any reduced levels should be brought up to the required levels with suitable inert mainly granular materials. Department of Transport (Dtp) type 2 sub-base or similar should be used and should be compacted in layers to the requirements of the Specification for Highway works.

Allowances should also be made for the excavation of any soft spots/areas and their replacement with well compacted imported granular materials.

In accordance with EC Regulation 1272/2008 and Environment Agency Guidance WM3 soils and other materials destined for off-site disposal should be classified on the basis of their hazard phrases prior to disposal. Soils are classified as a mirror entry waste and should be classified on the basis of their specific chemical properties. Terra Firma (Wales) Ltd offer this service if required.

4.1 Foundation Solution

Suitable bearing strata was observed between 1.50-3.00m below drill collar depth, progressively deepening towards the west. The proposed retaining walls and garage should be founded on traditional strip or trench fill foundations within the firm brown silty clay at between 1.50-3.00m depth. As the retaining structure is expected to be circa 3.0m high, bearing strata is likely to be intersected at its base during formation excavation.

For the above founding materials an allowable bearing pressure of 75kN/m² may be used for design purposes.

Foundations must sit at least 200mm within the founding horizon.

One in-situ clay sample was retained during the investigation and submitted for plasticity testing. Laboratory test certificates are presented in **Annex B**. In line with the NHBC (Chapter 4.2), the modified plasticity index was calculated. For design purposes the superficial cohesive deposits should be assumed to have a low volume change potential.

Foundations should be taken down to a minimum depth of 750mm below finished levels when founding in low volume change potential soils.

For the given foundation solutions and bearing pressure, maximum total settlements of 25mm should result with differential movements of the superstructure not exceeding 1:750.

Allowances should be made for the removal of any 'soft spots' and their replacement with well-compacted granular materials. Department of Transport (DoT) Type 2 materials or similar could be used and should be compacted in layers to the specification for Highway Works.

All foundation formations should be inspected by a suitably qualified Engineer before being concreted.

4.2 Excavations and Formations

It is expected that most of the shallow excavations will be possible with normal soil excavating machinery.

Shallow perched water and groundwater flows should be anticipated as water seepage was observed at the base of the existing retaining wall. Any water inflows together with rainwater infiltration should be dealt with by conventional pumping techniques. However, it should be noted that during times of heavy rainfall a higher water table will be encountered.

The sides of any excavations deeper than 1.20m, or shallower if unstable, should be supported by planking and strutting or other proprietary means.

The sub-formations/formations are likely to be susceptible to loosening, softening and deterioration by exposure to weather (rain, frost and drying conditions), the action of water (flood water or removal of groundwater) and site traffic.

Formations should never be left unprotected and continuously exposed to rain causing degradation, or left exposed/uncovered overnight, unless permitted by a qualified engineer.

Construction plant and other vehicular traffic should not be operated on unprotected formations.

As a minimum the formation/excavation surfaces must be protected by blinding concrete immediately after exposure.

Allowances should be made for the removal of soft spots/areas and their replacement with well compacted granular materials.

Allowances should also be made for special precautions to prevent formation deterioration in addition to the above.

4.3 Retaining Walls

The existing retaining structure is to be replaced as part of the development.

As previously stated, the retaining wall should be founded within firm brown silty clay, taking into account soil plasticity, at a depth of approximately 3.75m below drill collar level (upper garden terrace) or approximately 0.75m below ground level from the existing road level.

The retaining wall structure, backfill and its foundation should not impede on the stability of Trebetham or any adjacent structures. Sufficient distance must be maintained between the two structure foundations to achieve an angle of least 45°

Effective shear parameters for retaining wall design are presented in **Table 4.1**.

Table 4.1 Summary of Ground Conditions			
Stratum description	Bulk Unit Weight (γ) kN/m ³	Effective Cohesion (c') kN/m ²	Effective Angle of Shearing Resistance (ϕ') degrees
MADE GROUND comprising very soft to soft silty CLAY	18	0	15-19
Soft silty CLAY	18	0	19-21
Firm silty CLAY	19	0	25-28

The parameters are based on experience in similar ground conditions.

The materials to be in-filled behind the retaining wall should be placed at or close to its optimum moisture content/maximum dry density and compacted in layers as per the requirements of the Specification for Highway Works. During the earthworks suitable in-situ testing should be carried out to ensure that the compaction process is achieving the required maximum dry density to achieve at least 95% compaction.

The acceptability of the filling works should be verified by appropriate on site testing. A certification report should also be prepared on the earthworks by a suitably qualified Geotechnical Engineer.

Appropriate drainage should be incorporated in the design to prevent the build-up of hydrostatic pressure.

Appropriate cutting and benching of the existing slope should be conducted prior to the replacement of any imported fill to minimise the risk of any slip surfaces forming on the interface between the existing imported materials. The excavations should also be cut in small sections and the wall constructed prior to continuing with the next section.

The excavation works should be carried out in small lengths and the retaining wall constructed prior to continuing with the excavations.

4.4 Protection of Buried Concrete

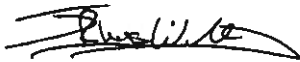
One in-situ soil sample was retained during the investigation and submitted for soil aggressivity testing (BRE SD1 suite). Laboratory test certificates are presented in **Annex B**.

Levels of total sulphate within the in-situ materials measured 0.019% and the pH 8. Water soluble magnesium and sulphate were recorded at <10mg/l.

When the results are compared with Table C2 of BRE Digest 1:2005, it indicates that buried concrete should generally conform to Class AC-1.

We trust that the above is to your satisfaction. However, if you have any queries or require any further information please do not hesitate to contact us.

Yours sincerely
for: Terra Firma (Wales) Ltd



J. Rhys-Williams

enc.

Annex A – Exploratory Hole Logs

Annex B – Geotechnical Testing Results

Drawing 01 – Proposed Site Layout

ANNEX A
Exploratory Hole Logs

Project Name:	Trebetham	Project No:	16193	Co-ords:		Hole Type	WS
Location:	Merthyr Tydfil	Level:		Scale	1:50	Logged By	JRW
Client:	Miss A Lester	Dates:	09/07/2020 -				

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Well	Legend	Stratum Description	
	Depth (m)	Type	Results						
				0.15				Grass over very soft dark greyish brown slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse mudstone and sandstone. (MADE GROUND)	
	1.50	ES		1.50				Very soft dark brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal. (MADE GROUND)	1
								Limited recovery. Recovered as firm brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal.	2
				3.20				Limited recovery. Recovered as firm light brown sandy SILT.	3
				4.00				End of Borehole at 4.000m	4
									5
									6
									7
									8
									9
									10

Remarks: On completion borehole backfilled with materials arising.



Terra Firma (Wales) Limited
5 Deryn Court, Wharfedale Road
Pentwyn, Cardiff
CF23 7HA

Tel: 02920 735354
info@terrafirmawales.co.uk
www.terrafirmawales.co.uk

Borehole No.

WS02

Sheet 1 of 1

Project Name: Trebetham	Project No: 16193	Co-ords:	Hole Type: WS
Location: Merthyr Tydfil		Level:	Scale: 1:50
Client: Miss A Lester		Dates: 09/07/2020 -	Logged By: JRW

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Well	Legend	Stratum Description	
	Depth (m)	Type	Results						
				0.15				Grass over very soft dark greyish brown slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse mudstone and sandstone. (MADE GROUND)	
				1.00				Soft dark brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal. (MADE GROUND)	1
				1.50				Limited recovery. Recovered as soft dark brownish grey slightly sandy slightly gravelly silty CLAY. Gravel is angular fine to coarse sandstone, mudstone, coal and ash. (MADE GROUND)	
				2.50				Soft dark brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal.	2
	3.00	D						Limited recovery. Recovered as firm brown slightly gravelly sandy silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal.	3
				5.00				End of Borehole at 5.000m	5
									6
									7
									8
									9
									10

Remarks: On completion borehole backfilled with materials arising.

Project Name:	Trebetham	Project No:	16193	Co-ords:		Hole Type	WS
Location:	Merthyr Tydfil	Level:		Scale	1:50	Logged By	JRW
Client:	Miss A Lester	Dates:	09/07/2020 -				

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Well	Legend	Stratum Description	
	Depth (m)	Type	Results						
				0.15				Grass over very soft dark brown silty CLAY. (MADE GROUND)	
				1.20				Soft to firm dark brown and brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal. (MADE GROUND)	1
				1.60				Firm dark greyish brown slightly gravelly sandy silty CLAY. Gravel is angular fine to coarse sandstone, mudstone, coal and ash. (MADE GROUND)	
				2.50				Limited recovery. Recovered as soft to firm dark brown mottled brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone, coal and ash. (MADE GROUND)	2
				3.00				Limited recovery. Recovered as soft brown sandy silty CLAY with rare fine and medium sandstone gravel.	
				5.00				Limited recovery. Recovered as firm brown slightly gravelly sandy silty CLAY. Gravel is angular to subrounded fine to coarse sandstone, mudstone and coal.	3
								End of Borehole at 5.000m	4
									5
									6
									7
									8
									9
									10

Remarks: On completion borehole backfilled with materials arising.

Probe Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: Trebatham

Project No.
16193

Co-ords: -

Hole Type
WS

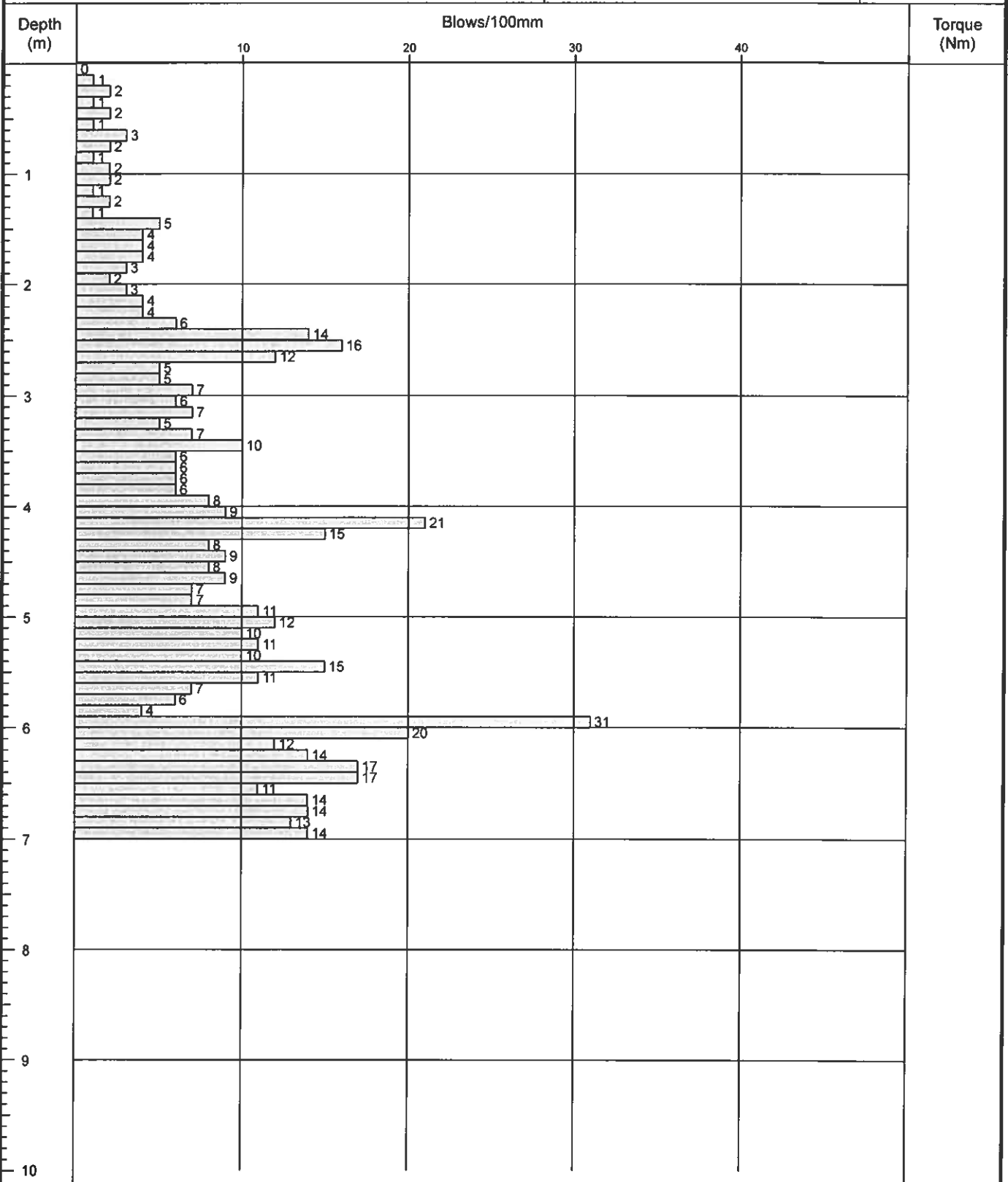
Location: Merthyr Tydfil

Level:

Scale
1:50

Client: Miss A Lester

Dates: 09/07/2020 -

Logged By
JRW


Remarks

On completion borehole backfilled with materials arising.

Fall Height 500

Hammer Wt 50

Probe Type DPH

Cone Base Diameter

Final Depth 7.00

Log Scale 1:50

Probe Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: Trebetham

Project No.
16193

Co-ords: -

Hole Type
WS

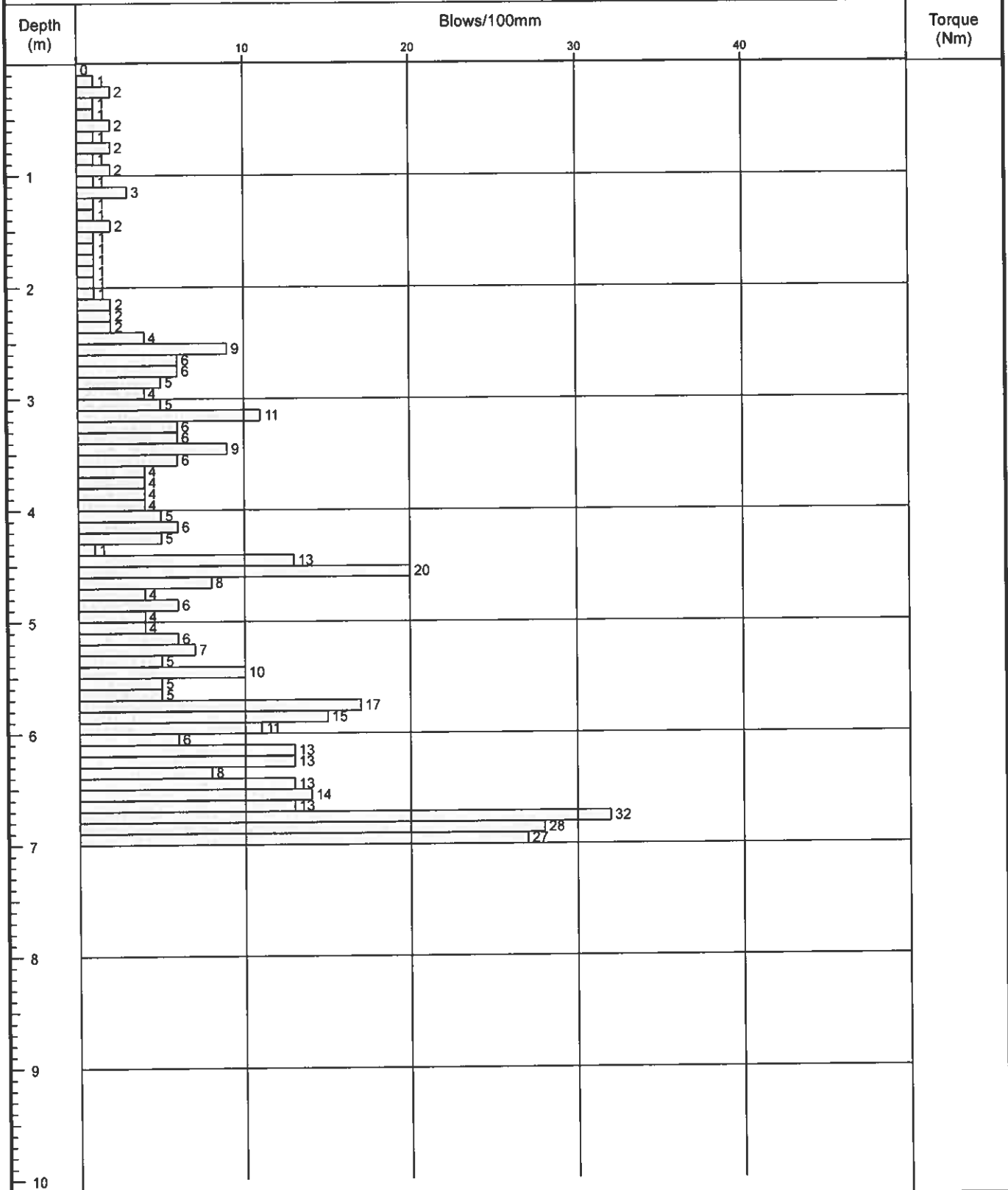
Location: Merthyr Tydfil

Level:

Scale
1:50

Client: Miss A Lester

Dates: 09/07/2020 -

Logged By
JRW


Remarks

On completion borehole backfilled with materials arising.

Fall Height 500

Hammer Wt 50

Probe Type DPH

Cone Base Diameter

Final Depth 7.00

Log Scale 1:50

Probe Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: Trebetham

Project No.
16193

Co-ords: -

Hole Type
WS

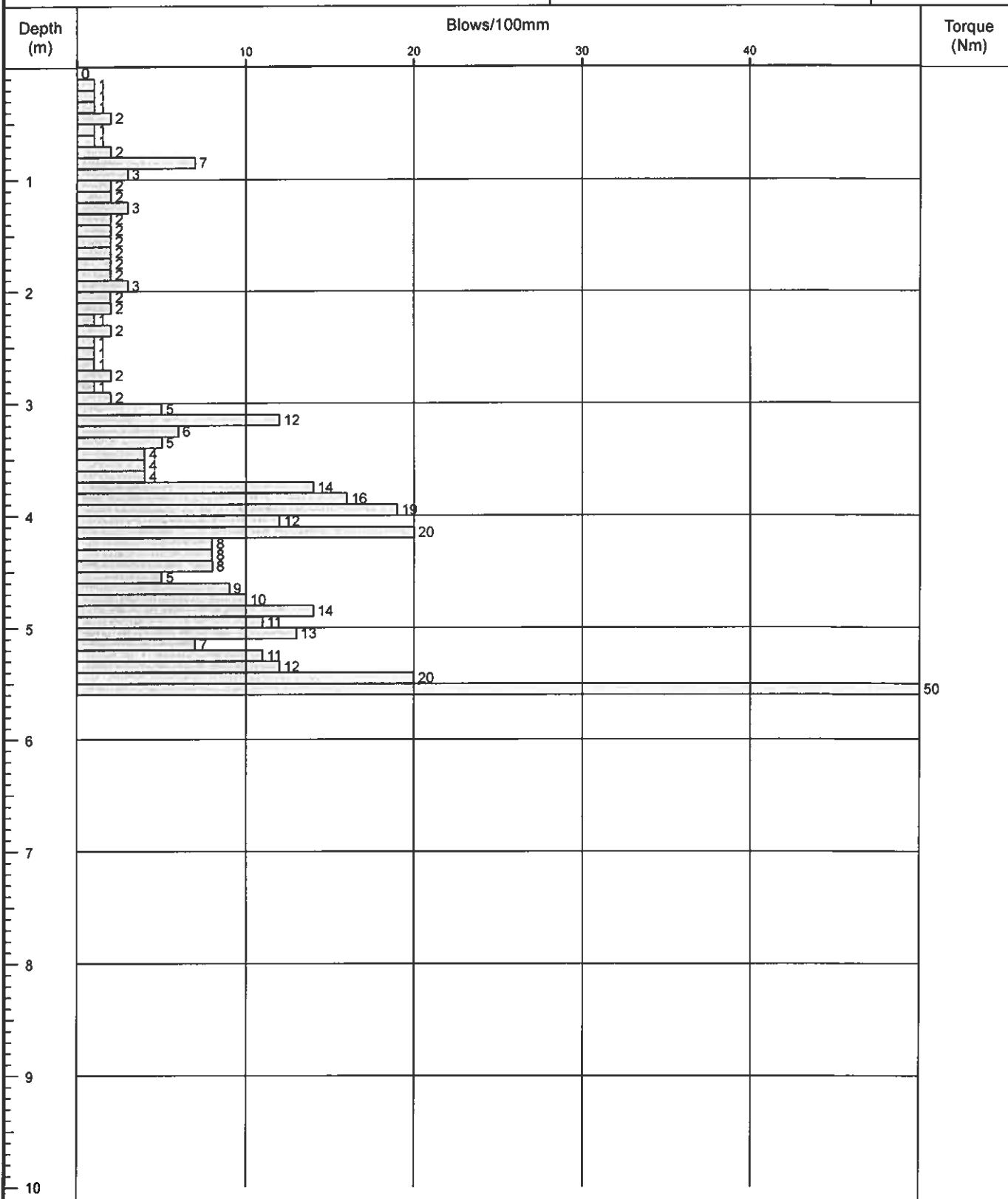
Location: Merthyr Tydfil

Level:

Scale
1:50

Client: Miss A Lester

Dates: 09/07/2020 -

Logged By
JRW


Remarks

On completion borehole backfilled with materials arising.

Fall Height 500

Hammer Wt 50

Probe Type DPH

Cone Base Diameter

Final Depth 5.60

Log Scale 1:50

ANNEX B
Geotechnical Testing Results

TEST REPORT
LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX
BS EN ISO 17892-12:2018 Clauses 5.3/5.5/6.5

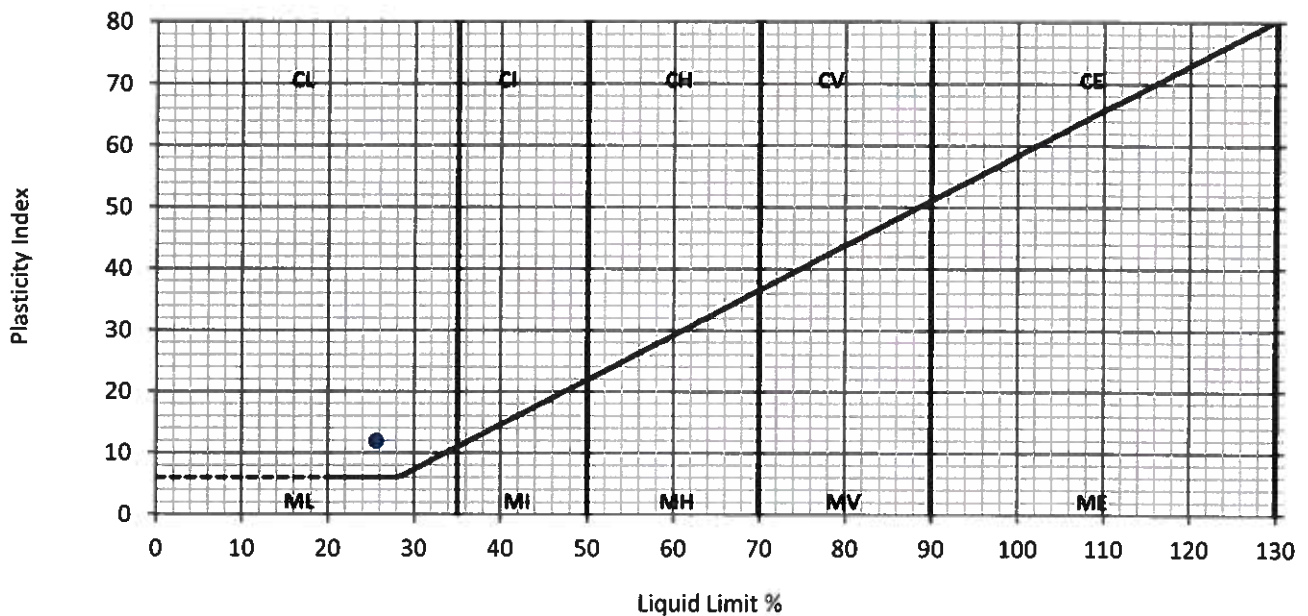
Project No: D20211 Project Name: 16193 ATS Sample No: 20908	Client: Terra Firma Address: Deryn Court 5 Wharfdale Road Cardiff CF23 7HA
--	--

Site Ref / Hole ID: WS02 Sample No: Sampling Certificate Received: No Location in Works: N/A Date Sampled: Unknown Sampled By: Client Date Received: 13 July 2020	Depth (m): 3.00 Sample Type: Disturbed Material Description: Brownish grey gravelly CLAY Material Source: Unknown Material Supplier: Unknown Specification: ISO 17892 Date Tested: 17 July 2020
--	--

Test Results

Liquid Limit	26	%
Plastic Limit	14	%
Plasticity Index	12	%

Preparation:	4.2.4 Sieved Specimen
Proportion retained on 425µm sieve:	32 %



Remarks:

QA Ref.

EN ISO
17892-
12:2018:E



Apex Testing Solutions

Sturmi Way, Village Farm Industrial Est, Pyle
 Bridgend, CF33 6BZ
 Tel: 01656 746762 Fax: 01656 749096



7771

Approver

L Davis

Date

17/07/2020

Fig.

ATT

L Davis, Quality Manager



2183

Final Report

Report No.:	20-18068-1		
Initial Date of Issue:	20-Jul-2020		
Client	Terra Firma (Wales) Ltd		
Client Address:	5 Deryn Court Wharfedale Road Pentwyn Cardiff CF23 7HA		
Contact(s):	james@terrafirmawales.co.uk		
Project	Merthyr		
Quotation No.:		Date Received:	15-Jul-2020
Order No.:	16193/JRW	Date Instructed:	15-Jul-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	21-Jul-2020
Date Approved:	20-Jul-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: Merthyr

Client: Terra Firma (Wales) Ltd	Chemtest Job No.:			20-18068
Quotation No.:	Chemtest Sample ID.:			1031732
	Client Sample ID.:			1
	Sample Location:			WS01
	Sample Type:			SOIL
	Top Depth (m):			1.5
	Date Sampled:			13-Jul-2020
	Time Sampled:			12:00
Determinand	Accred.	SOP	Units	LOD
Moisture	N	2030	%	0.020
pH	U	2010		4.0
Magnesium (Water Soluble)	N	2120	g/l	0.010
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010
Total Sulphur	U	2175	%	0.010
Chloride (Water Soluble)	U	2220	g/l	0.010
Nitrate (Water Soluble)	N	2220	g/l	0.010
Ammonium (Water Soluble)	U	2120	g/l	0.01
Sulphate (Acid Soluble)	U	2430	%	0.010

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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurement by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by 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
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

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

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

Charges may apply to extended sample storage

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

customerservices@chemtest.com

DRAWINGS



Scale: Not to scale

KEY

Borehole Location

