

Earth Science Partnership

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Waterfalls Country Centre – Pontneddfechan, Neath
Proposed Commercial & Leisure Development
Factual Exploratory Investigation

Report Reference: ESP.8715.4014

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Waterfalls Country Centre – Pontneddfechan, Neath Proposed Commercial & Leisure Development Factual Exploratory Investigation

Prepared for:
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Report Reference: **ESP.8715.4014**

Revision	Status	Date	Written by	Checked by	Approved by
0	Final	January 2024	Daniel Thomas BSc (Hons) FGS	H Davies MESci CGeol FGS ROGEP Professional	M Eynon BSc MSc CGeol FGS ROGEP Specialist
0	Draft	December 2023	Daniel Thomas BSc (Hons) FGS	H Davies MESci CGeol FGS ROGEP Professional	M Eynon BSc MSc CGeol FGS ROGEP Specialist
Signature:					
Notes:	- At the request of the Client, this report has been issued as final with the understanding that two further monitoring visits remain to be completed. A revised final report will be issued on completion of the monitoring. - Once issued this document is Uncontrolled, for the latest version and/or to confirm you have authorisation to use it please contact the Earth Science Partnership at enquiries@earthsciencepartnership.com or by telephone at 029 2081 3385. - This document has been optimised for double sided printing and therefore may produce some blank pages when printed single sided.				

Contents

1	Introduction	5
1.1	Background	5
1.2	Objective and Scope of Works.....	5
1.3	Report Format	6
1.4	Limitations of Report	6
2	Site Setting	7
2.1	Site Location and Description	7
2.2	Previous Investigations and Assessments	8
2.3	Geological Setting	8
2.4	Unexploded Ordnance	8
3	Exploratory Investigation	9
3.1	Investigation Points.....	9
3.2	Instrumentation.....	12
3.3	Sampling Strategy	13
3.4	Evidence of Site Contamination Found During Site Works	13
3.5	Geotechnical Laboratory Testing.....	13
3.6	Geo-environmental Laboratory Testing.....	14
4	Summary of Ground Conditions	15
4.1	Geology	15
5	References	16

Figure 1 – Investigation Point Plan

Appendix A	Preliminary UXO Risk Assessment (Zetica, 2022)
Appendix B	Trial Pit Records
Appendix C	Windowless Sample Drillhole Records
Appendix D	Dynamic Probe Records
Appendix E	Results of Soakaway Infiltration Testing
Appendix F	Results of Dynamic Cone Penetrometer (DCP) Testing
Appendix G	Results of Spot Gas and Groundwater Monitoring
Appendix H	Geotechnical Laboratory Test Results
Appendix I	Geo-environmental Laboratory Test Results - Soils

General Notes

1 Introduction

1.1 Background

Andrew Scott Ltd (hereafter known as the Client) have been appointed principal contractors to redevelop the subject site for commercial and leisure purposes. The Earth Science Partnership Ltd (ESP), Consulting Engineers, Geologists and Environmental Scientists, were instructed by Jubb (hereafter known as the designer) acting on behalf of the Client, to undertake an exploratory investigation followed by factual reporting.

It should be noted at this stage that gas/groundwater monitoring is currently on hold awaiting access permission from the landowner. One visit has been completed (see Appendix G), with two further visits remaining.

At the request of the Client, this report has been issued as final with the understanding that two further monitoring visits remain to be completed. A revised final report will be issued on completion of the monitoring.

The designer specified the scope of works for the investigation, as detailed in the Ground Investigation Tender document provided (ref: Waterfalls Country Centre, Glynneath. 13th September 2023) for which this factual report has been completed to fulfil.

Based on the scoping document provided by the designer (Jubb, 2023), the development will comprise *'a new single storey community/visitor hub, a new single storey bunkhouse, and areas car parking and soft landscaping.'*

Based on the above, we understand that the proposed structures would be classified as Geotechnical Category 2 (BS5930:2020).

1.2 Objective and Scope of Works

The objective and scope of works of the investigation was developed by the designer to obtain factual information on the geotechnical character and properties of the ground beneath the site and levels of contamination.

The works were tendered for by ESP, based on the specification provided by the designer and comprised a field reconnaissance visit, the supervision and direction of machine excavated trial pits, windowless sample boreholes, dynamic probing, CBR testing (using dynamic cone penetrometer equipment), soakaway testing, gas and groundwater monitoring, geotechnical and geo-environmental laboratory testing, and factual reporting. This report is the factual presentation of the ground investigation only and no interpretive assessment has been undertaken by ESP.

The contract was awarded based on a competitive tender quotation. The terms of reference for the assessment are as laid down in the revised Earth Science Partnership proposal of 20th September 2023 (ref: ESP.8715.It1 Investigation BoQ.REV1 - Waterfall Country Centre, Pontneddfechan).

The investigation and factual reporting were undertaken in December 2023.

At the request of the Client, this report has been issued as final with the understanding that two further monitoring visits remain to be completed. A revised final report will be issued on completion of the monitoring.

1.3 Report Format

This report is factual only, presenting the findings of the investigation undertaken in line with the scope of works provided by the designer. No other aspects have been considered in this report. This report includes details of the site setting (Section 2), details of the ground investigation undertaken of BS5930:2020 (Section 3), followed by a summary of the ground conditions identified (Section 4). This factual report is issued as a digital version only.

1.4 Limitations of Report

This report represents the factual findings of the scope of works provided by the designer, relating to the proposed development.

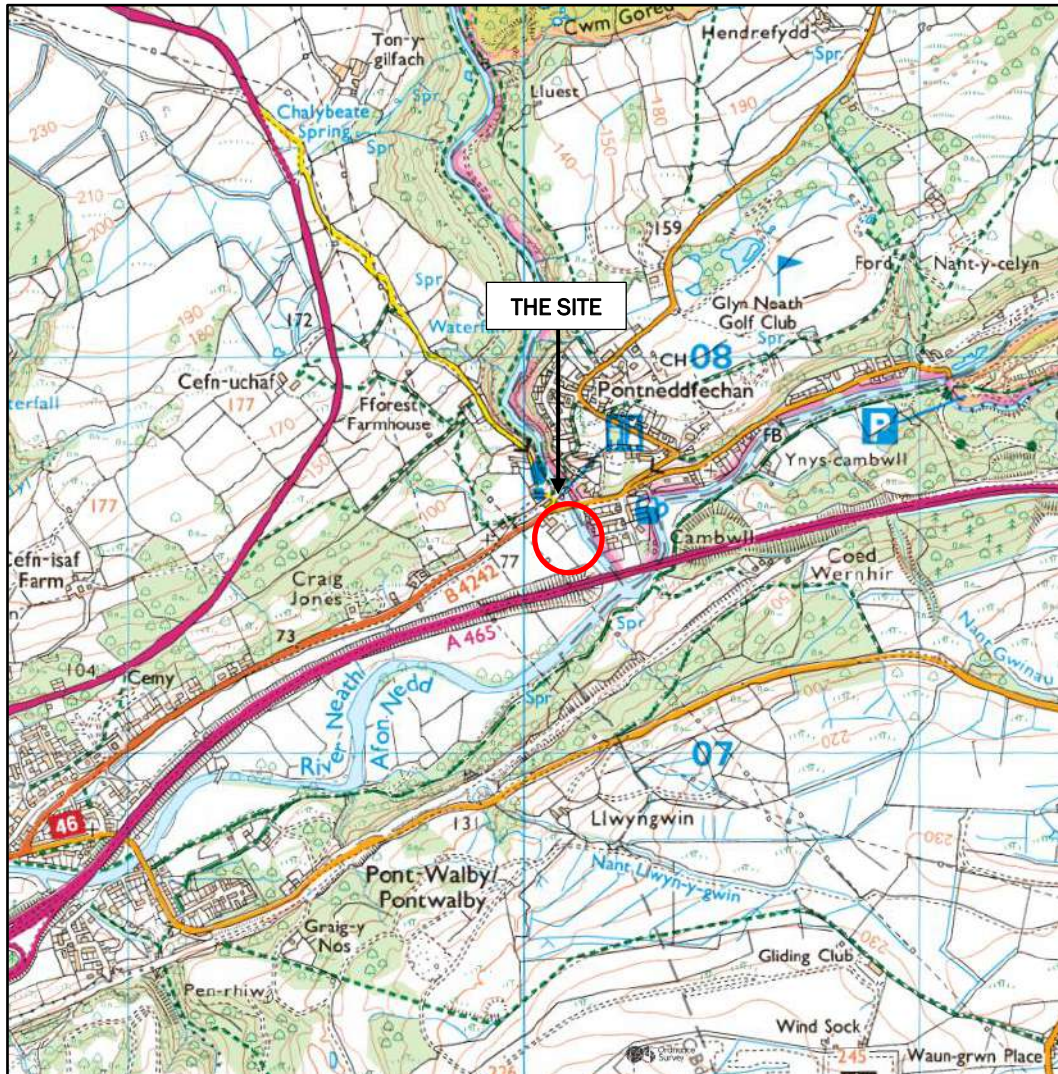
The scope of works did not require any interpretation or assessment of the data and we understand that this is being undertaken by the designer.

2 Site Setting

The site description is largely based on a field reconnaissance and site inspection visit made at the site on 6th December 2023 during generally dry weather.

2.1 Site Location and Description

The site is located within the village of Pontneddfechan within Neath Port Talbot County Borough. The National Grid Reference of the approximate centre of the site is (SN) 290111, 207537 and the nearest postcode is SA11 5NR. A Site Location Plan is presented as Insert 1 below.



Insert 1 - Site Location Plan from Ordnance Survey 1:25,000 scale map.
Reproduced with permission (OS License No.: AL100015788).

The site comprises an irregular shaped parcel of land and currently comprises existing restaurant in the north (to remain), with adjacent farm buildings. The remainder of the site comprises fields to the southeast, as well as additional parcel within the field to the west. The site is largely grass surfaced with an area of grass/gravel noted in the northeast, which appears to be a possible area of filling to create a level platform. Vehicular access to the site is currently gained via a gate in the northeast.

The general topography in the area slopes to the south to the Afon Nedd. The site itself slopes north to south from approximately 79.5m AOD in the northeast to approximately 73/74m AOD in the southeast.

The designer provided ESP with a series of plans/surveys showing the locations of recorded underground services at the site and in the vicinity. These were utilised by ESP to safely locate all investigation points and where required, adjust any proposed positions provided by the designer so as not to damage any existing services.

A Dwr Cymru Welsh Water (DCWW) water main is located beneath the site, trending northeast to southwest. The designer provided a plan showing the surveyed location of the main (after Landmark Surveys Wales, dwg ref: 6765) and marked out the location at the surface in advance of the investigation. The easement on this main is 6.5m either side of the pipe, therefore all investigation were located outside of this zone.

2.2 Previous Investigations and Assessments

We are not aware of any previous geotechnical or geo-environmental investigations or assessments at the site.

2.3 Geological Setting

The published 1:50,000 scale geological map for the area of the site (Sheet 231, available on the website of the British Geological Survey, 2023) indicates the site to be underlain by River Terrace Deposits (sand and gravel) overlying bedrock of the South Wales Lower Coal measures.

Made Ground may also be present in the north/northeast given the historical development in this area.

This geological succession is confirmed in the designer's specification, which also indicates that alluvial deposits may be present in the southeast (Jubb, 2023).

2.4 Unexploded Ordnance

A Preliminary (Pre-Desk Study) UXO Desk Study assessment of risk has been completed by a specialist Ordnance consultant in accordance with CIRIA guidelines (Stone et al, 2009) and is presented in Appendix A (Zetica, 2023).

The assessment concludes that '*a detailed desk study, whilst always prudent, is not considered essential in this instance*'.

3 Exploratory Investigation

The scope of works was provided by the designer (Jubb, 2023). All investigation points were agreed prior to the works with the Client and landowner.

3.1 Investigation Points

3.1.1 Introduction

The main intrusive investigation was undertaken between the 6th and 7th December 2023 in accordance with BS5930:2020. It comprised trial pitting, windowless sample boreholes, dynamic probing, and soakaway infiltration testing.

Prior to the main intrusive works, measurement of the correlated in-situ CBR value using DCP equipment was completed on the 25th October 2023.

Gas and groundwater monitoring is ongoing; however, it is currently on hold awaiting access permission from the landowner. One visit was completed on the 5th January 2024 (see Appendix G), with two further visits remaining.

The exploratory holes were supervised and logged by an engineering geologist in general accordance with BS5930:2020, BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2018, and BS EN ISO 14689:2018, along with published weathering schemes. The investigation point positions are shown on Figure 1, currently in draft pending the surveying of all investigation points (see below).

The ground levels and coordinates of the investigation points are yet to be surveyed (except for the DCP test locations undertaken prior to the recent works).

The investigation points will be surveyed during one of the remaining monitoring visits once access has been granted by the landowner. The ground levels and coordinates will be shown on the investigation point records following surveying with a GEODE GPS (+/- 0.3m AOD).

3.1.2 Investigation Strategy

The investigation strategy was indicated in the designer's specification (Jubb, 2023) and the positions of the investigation points were provided by the designer prior to the works, as per the drawing presented in the specification document (ref: Appendix A - Site Location Plan and Draft Exploratory Hole Location Plan). Where required, positions were altered relative to landowner requests, existing services/obstructions.

Prior to the works, ESP were notified that due a legal agreement between the landowner and the Client, no more than 1m³ soil could be excavated from the ground during the trial pitting. This was not known at the time of the specification being issued (Jubb, 2023) and limited the size/depth of the trial pits constructed during the works.

Due to methods utilised during the trial pitting to mitigate the impact to the site surface (use of tracking mats for the excavator and ply-board for all excavated arisings) and limited time (specification required 1no. day for trial pitting and soakaway testing), not all trial pit positions could be completed. Jubb were present during the trial pitting works and the completed positions were agreed on site.

All exploratory holes were terminated in line with the specification.

3.1.3 Trial Pits

5no. trial pits (TP01 to TP04, including TP03A and TP03B) were excavated across the site on 7th December 2023 23rd November 2019 using a tracked hydraulic excavator. The trial pits were excavated to depths of between 0.5m and 1.25m. The trial pit records are presented as Appendix B, and their positions are shown on Figure 1. All trial pit termination depths were agreed with Jubb on site.

Disturbed samples were collected from the trial pits for laboratory testing as shown on the trial pit records.

On completion, the trial pits were backfilled with arisings in layers compacted with the excavator bucket, and the Topsoil reinstated on the surface. The arisings were left slightly proud of the adjacent surface to allow for future settlement. We understand that the Client will provide any additional reinstatement materials in the future, should the trial pits settle and require infilling.

3.1.4 Windowless Sampling

5no. windowless sample drillholes (WS01 to WS05) were constructed on 6th December 2023 to depths between 1.0m and 1.5m. The borehole records are presented as Appendix C, and their positions are shown on Figure 1.

A hydraulically powered rig was used to drive plastic lined sampling tubes into the ground, with the soil recovered within the tubes, which are then split to allow sampling and logging. Disturbed samples were obtained throughout the boreholes for identification and laboratory testing purposes, as shown on the borehole records.

At the commencement of each borehole, a square of the grass landscaping was cut, and a service inspection pit excavated by hand to a depth of 1.2m.

Standard Penetration Tests (SPT) were carried out using a solid cone in the boreholes in accordance with BS EN ISO 22476-3 (2005) and BS5930 (2020) to assess the relative density of the coarse-grained soils encountered. As required in BS5930:2020, the SPT N-values shown on the borehole records are the direct, uncorrected results obtained in the field. Depending on the nature of the test undertaken and the soils subjected to testing, field SPT N-values may require correction before using in design.

Due to very dense ground conditions across the site, limited penetration was achieved in the windowless sample boreholes.

On completion, monitoring instrumentation was installed in three boreholes as instructed by Jubb and detailed in Section 3.2. Where no installation was instructed, the boreholes were backfilled with arisings/gravel and the surface Topsoil reinstated.

3.1.5 Dynamic Probing

Dynamic probing (DP) was undertaken from the surface in accordance with BS EN ISO 22476-2 (2005) and BS5930 (2020) at 5no. positions across the (DP1 to DP5) on 6th December 2023, using super-heavy dynamic probing equipment. Each probe position was completed approximately 0.5m from the same numbered windowless sample position (e.g., DP1 was adjacent to WS01). The probing records are presented in Appendix D, and the dynamic probe positions are shown on Figure 1.

A 63kg weight was allowed to drop over a height of 750mm driving a cone and associated rods into the ground. The number of blows required to penetrate successive 100mm intervals are recorded, with the torque on the rods measured at 1m intervals.

It should be noted that dynamic probing is a 'blind' test, in that no indication of the nature of the materials other than their resistance to penetration can be identified from the test. However, the likely soils being tested can be extrapolated from the adjacent windowless sample.

3.1.6 Soakaway Infiltration Testing

The specification allowed for 1no. day for soakaway testing. Due to time constraints, the three positions proposed for soakaway testing could not be completed. Soakaway infiltration tests was undertaken in 2no. selected trial pits across the site (TP02 and TP04). and these were agreed with Jubb on site as their preferred positions.

The results of the infiltration testing, and the calculated infiltration rates, are presented in Appendix E. The positions of the test pits are shown on Figure 1.

At each position, the test pit was excavated to the depth specified on site by the designer. Clean water was added from a large capacity bowser/tanker and the water level monitored as it percolated into the soil.

Sufficient time and water were available to repeat the test (a total of two fills) in test SA01 (TP02). Insufficient time was available to complete a third test in SA01. One fill was completed in test SA02 (TP04), however insufficient time was available to complete any repeat fills.

3.1.7 Dynamic Cone Penetration (DCP) Testing

CBR testing using the TRL approved dynamic cone penetrometer (DCP) was undertaken at 6no. positions (DCP1 to DCP6) on 25th October 2023. The testing was undertaken at positions specified by the designer (Jubb, 2023). The test positions are shown on Figure 1, and test results are presented in Appendix F.

The DCP testing was undertaken from the existing ground surface with no service pit excavated. Appropriate precautions were taken during the testing to ensure the safety of ESP operatives.

The DCP test involves the fall of a fixed weight over a fixed height to force a 20mm diameter, 60° cone into the near surface soils. The depth of penetration for varying numbers of blows is recorded and is then converted to a CBR value using well established empirical correlations (Highways Agency, 2008). In general, the tests were undertaken between the existing ground surface and 0.9m below ground level, thus providing a profile of correlated CBR values within the near-surface soils. No water was added to the soils prior to testing, so they were in their natural condition. The correlated CBR values are also shown on the test result sheets in Appendix F.

3.2 Survey Data – Investigation Points

Table 1: Survey Data – Investigation Points

Investigation Point	Easting	Northing	Ground level (m AOD) ²
DCP-1	290100	207598	79.1
DCP-2	290121	207548	78.1
DCP-3	290177	207480	75.9
DCP-4	290134	207509	77.7
DCP-5	290030	207564	79.0
DCP-6	289730	207527	78.2
WS01/DP01	To Follow		
WS02/DP02			
WS03/DP03			
WS04/DP04			
WS05/DP05			
TP01			
TP02/SA01			
TP03a/TP03b			
TP04/SA02			
Notes: 1. The ground levels and coordinates of the investigation points (boreholes & trial pits) will be surveyed once access is permitted by the landowner for the remaining two monitoring visits. 2. Positions of investigation points shown on Figure 1.			

3.3 Instrumentation

3.3.1 Gas Well Installations

The designer specified the boreholes for monitoring installations to be constructed during the works. A 50mm diameter monitoring well was installed in boreholes in accordance with BS8576:2013 to allow monitoring of hazardous ground gases.

The wells, comprising slotted plastic pipe with a gravel surround (the response zone), bentonite seals above the response zone, and a lockable vandal proof cover, were installed as detailed on the borehole records and summarised in the table below. Wooden fencing was also erected around each installation to ensure the wells were not damaged by livestock and similarly that the livestock were not harmed by the installations.

Table 2: Gas Well Installations

Well ID	Date of Installation	Response Zone depth	Response Zone Stratum
WS01	06/12/23	0.5m – 1.5m	Made Ground & River Terrace Deposits
WS02	06/12/23	0.5m – 1.2m	River Terrace Deposits
WS04	06/12/23	0.5m – 1.5m	River Terrace Deposits
Notes: - Installation specified by Jubb. - Details of each monitoring well are presented on the individual borehole records (Appendix C). - Positions of boreholes shown on Figure 1.			

3.3.2 ‘Spot’ Gas Monitoring

The designer has specified three fortnightly visits for the gas and groundwater monitoring (Jubb, 2023). The first monitoring visit was completed on the 5th January 2024 (see appendix G), however this is now on hold awaiting access permission from the landowner to complete the remaining two visits.

During each visit, Gas Data LMSxi G3.18e portable monitoring equipment is used to measure levels of the following ground gases within the airspace in the wells and the flow rates from the wells:

- Methane - total and percentage of Lower Explosive limit (LEL).
- Carbon dioxide.
- Oxygen.
- Hydrogen sulphide.

The percentage of nitrogen is also calculated by difference. The equipment uses infra-red methane (CH₄) and carbon dioxide (CO₂) detectors, coupled with pressure (barometric and well), temperature and flow sensors. A photo-ionisation detector (PID) with a 10.6eV lamp was used during the monitoring to measure the levels of volatile organic compounds present in the well.

Following measurement of gas levels and flow rates, the well cap is removed, and groundwater levels are measured using a dipmeter from the site surface.

3.4 Sampling Strategy

3.4.1 Soil Sampling

Soil samples were collected from the exploratory holes as per the designer's specification.

Environmental samples (denoted as ES on the exploratory holes records) were collected for possible geo-environmental laboratory testing and generally comprised a plastic tub, an amber glass jar and an amber glass vial. The sample containers provided clean by the testing laboratory appropriate for the proposed testing to be scheduled.

Immediately after collection the samples were placed in sealed cool boxes where they remained during storage and transport to the laboratory. Samples for logging and geotechnical laboratory testing purposes were collected at regular intervals within the exploratory holes.

3.5 Evidence of Site Contamination Found During Site Works

No direct visual/olfactory evidence of contamination was identified in the exploratory holes.

Made Ground was identified in WS01, WS05, TP01, TP03A and TP03B, as detailed on the trial pit and windowless sample borehole records presented in Appendices B and C respectively.

3.6 Geotechnical Laboratory Testing

All geotechnical testing was specified by the designer. Geotechnical laboratory testing was undertaken on samples from the suitable quality classes recovered from the exploratory holes to obtain information on the geotechnical properties on the soils beneath the site.

The following tests were undertaken by a UKAS accredited laboratory on samples selected by ESP in accordance with the methodologies presented in BS1377:1990. The results are presented in Appendix H.

- Natural moisture content.
- Atterberg limits.
- Particle size analysis.
- Compaction Testing.

Samples selected by the designer were also analysed for soil sulphate and pH value in accordance with the analytical methods specified in BRE Special Digest SD1 (BRE, 2005).

The results of the sulphate testing are included with the geo-environmental test results in Appendix I.

3.7 Geo-environmental Laboratory Testing

All geo-environmental testing was specified by the designer.

The geo-environmental analyses were carried out on soil samples selected by the designer by a UKAS accredited testing laboratory with detection limits being generally compatible with the relevant guideline values adopted in the assessment.

The geo-environmental soil test results are presented in Appendix I.

4 Summary of Ground Conditions

The below will be reviewed and revised following receipt of the final laboratory test results and prior to issue of the final report.

4.1 Geology

The exploratory holes have identified the site to be generally underlain by Topsoil overlying River Terrace Deposits. Localised areas of Made Ground have also been identified.

Made Ground: encountered in WS01, WS05, TP01, TP03A and TP03B to a maximum depth of 0.8m below surface level.

WS01 was in the northeast on an area of gravel/grass, likely placed to create an area of hardstanding for vehicles. Fragments of brick were noted within the upper 0.3m, with the soils between 0.3m and 0.8m noted to be likely reworked. Similar soils were noted in WS05 to a depth of 0.7m.

In TP01, reworked Topsoil was identified overlying a possible historic service trench, comprising likely reworked natural soils with occasional fragments of concrete. A black plastic pipe was identified at 0.8m depth, observed to be an old service.

In TP03A and TP03B, located adjacent to the existing track in the southeast identified likely reworked soils (with occasional anthropogenic materials noted) to a depth of 0.5m. A very dense, flat surface was observed at the base of both trial pits, which appeared comprise probable compacted slag.

River Terrace Deposits: encountered across the site to a maximum depth of 1.5m, generally as a light brown, coarse gravel with fractions of silt/clay, sand, and cobbles. The material was noted to generally become coarser (increase in cobble content) with depth.

Limited investigation depth was achieved due to the density of the ground and the limitations on allowed volume of material to be excavated.

4.2 Groundwater

No groundwater was observed within any of the investigation points (windowless sample boreholes or trial pits) to a depth of 1.5m.

During the single monitoring visit completed to date, all the wells were dry. This will be updated in the revised report on completion of the monitoring.

5 References

BRITISH GEOLOGICAL SURVEY (BGS). 2023. Website accessed December 2023.

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BRITISH STANDARDS INSTITUTION (BSI). 2020. Code of Practice for Ground Investigation. BS 5930:2015+A1:2020. HMSO, London.

JUBB. 2023. Waterfalls Country Centre, Glynneath. Ground Engineering Services – Ground Investigation Tender. 13th September 2023. (Jubb, 2023).

ZETICA LTD. 2023. Unexploded Bomb Risk Maps. Website accessed October 2023.

Figure

LEGEND:

- Site Boundary
- ⊕ Windowless Sample/Dynamic Probe
- ⊕ Trial Pit/Soakaway
- Dynamic Cone Penetrometer

NOTES:

Drawing provided by Client. (ref: Pontneddfechan - Topographical Survey 2D).

PROJECT:

**PROPOSED WATERFALLS
COUNTRY CENTRE
PONTNEDDFECHAN, NEATH**

SCALE:

**NOT TO SCALE.
FOR REFERENCE ONLY**

FIGURE :

DRAFT INVESTIGATION POINT PLAN

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Appendix A

Pre-Desk Study Assessment

Site:	Waterfalls Country Centre, Glynneath, Wales
Client:	Earth Science Partnership
Contact:	Hywel Davies
Date:	23 rd October 2023
Pre-WWI Military Activity on or Affecting the Site	None identified.
WWI Military Activity on or Affecting the Site	None identified.
WWI Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities. ■ Industries important to the war effort, including engineering works.
WWI Bombing	None identified on the Site.
Interwar Military Activity on or Affecting the Site	None identified.
WWII Military Activity on or Affecting the Site	None identified.
WWII Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities. ■ Industries important to the war effort, including munitions factories, and engineering and metal works. ■ Military camps and training areas. ■ Anti-invasion defences.
WWII Bombing Decoys (within 5km of Site)	None.
WWII Bombing	During WWII the Site was located in the Rural District (RD) of Neath, close to the RD of Vaynor & Penderyn. Neath RD officially recorded 205No. High Explosive (HE) bombs with a bombing density of 3.9 bombs per 405 hectares (ha). Vaynor & Penderyn RD officially recorded 19No. HE bombs with a bombing density of 0.5 bombs per 405ha. No readily available records have been found to indicate that the Site was bombed.
Post-WWII Military Activity on or Affecting the Site	None identified.
Recommendation	A detailed desk study, whilst always prudent, is not considered essential in this instance.
Further information	For information about Zetica's detailed UXO desk studies and other UXO services, please visit our website: www.zeticauxo.com. Details and downloadable resources covering the most common sources of UXO hazard affecting sites in the UK can be found here. If you have any further queries, please don't hesitate to get in contact with us at uxo@zetica.com or 01993 886 682.

This summary is based on a cursory review of readily available records. Caution is advised if you plan to action work based on this summary.

It should be noted that where a potentially significant source of UXO hazard has been identified on the Site, the requirement for a detailed desk study and risk assessment has been confirmed and no further research will be undertaken at this stage. It is possible that further in-depth research as part of a detailed UXO desk study and risk assessment may identify other potential sources of UXO hazard on the Site.

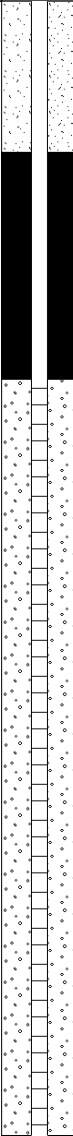
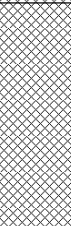
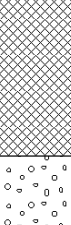
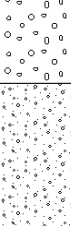
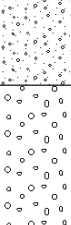
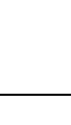
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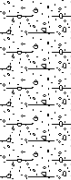
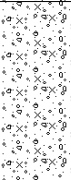
Earth Science Partnership Consulting Engineers Geologists Environmental Scientists				Excavation method/plant: 5T Tracked Excavator.		Shoring/support: None.		TP01		
Project Name: Proposed Waterfalls Country Centre.			Excavation date: 07/12/2023			Plan details: 0.30 Face B Face A Face C 1.50				
Site Location: Pontneddfechan.			Backfill date: 07/12/2023							
Client: Andrew Scott Ltd.			Logged by: SG.							
Project No: 8715			Face Stability: Some spalling throughout.							
Survey details: Ground Level: Easting: Northing: Bearing:			Groundwater observations: No groundwater observed to base.							
Depth		Sample		Test Details		Strata Details				
m	Type	Class	Type	Result	Description	Depth (thickness)	mOD	Legend		
0.10	ES				Grass surface followed by: dark brown slightly sandy gravelly SILT/CLAY. Probable reworked Topsoil. (Probable MADE GROUND).	(0.25)				
0.50	B D				Dark brown sandy very clayey fine to coarse subangular to subrounded GRAVEL with a medium rounded to subrounded cobble content. Occasional gravel sized fragments of concrete noted. Black plastic pipe identified at 0.8m - probable old service. Probable reworked soils. (Probable MADE GROUND).	0.25 (0.65)				
0.80	ES					0.90				
1.00	B ES				Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).	(0.20) 1.10				
					End of Trialpit at 1.100m					
Weather and environmental conditions:										
1. Cold with heavy rain.										
Other comments:										
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records. 2. Trial pit positioned as agreed with Client and landowner. 3. Trial pit terminated in very dense ground. 4. Possible old service identified at 0.8m. 5. Trial pit backfilled with arisings on completion.										

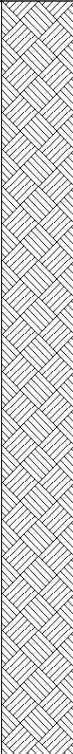
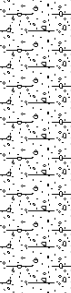
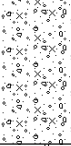
Earth Science Partnership Consulting Engineers Geologists Environmental Scientists				Excavation method/plant: 5T Tracked Excavator.		Shoring/support: None.		TP02			
Project Name: Proposed Waterfalls Country Centre.				Excavation date: 07/12/2023		Groundwater observations: No groundwater observed to base.					
Site Location: Pontneddfechan.				Backfill date: 07/12/2023							
Client: Andrew Scott Ltd.				Logged by: DT.							
Project No: 8715											
Survey details: Ground Level: Easting: Northing: Bearing:				Plan details: 0.30 Face B Face A Face C 1.50		Face Stability: Some spalling throughout.					
Depth m		Sample Type Class		Test Details Type Result		Strata Details Description Depth (thickness) mOD Legend					
0.10		ES				Grass followed by: dark brown very clayey gravelly SAND with a low subrounded cobble content. (TOPSOIL).		0.25			
0.60		ES				Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).		1.00			
1.00		D						1.0			
1.20		B				End of Trialpit at 1.250m		1.25			
								2.0			
								3.0			
Weather and environmental conditions: 1. Cold with heavy rain.											
Other comments: 1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records. 2. Trial pit positioned as agreed with Client and landowner. 3. Trial pit terminated at 1.25m as instructed by Jubb to undertake soakaway test (SA01). 4. Trial pit backfilled with arisings on completion of soakaway test.											

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists				Excavation method/plant: 5T Tracked Excavator.		Shoring/support: None.		TP03A						
Project Name: Proposed Waterfalls Country Centre.				Excavation date: 07/12/2023		Groundwater observations: No groundwater observed to base.								
Site Location: Pontneddfechan.				Backfill date: 07/12/2023										
Client: Andrew Scott Ltd.				Logged by: DT.										
Project No: 8715				Plan details: 0.30 Face B Face A Face C 1.50		Face Stability: Some spalling throughout.								
Survey details: Ground Level: Easting: Northing: Bearing:														
Depth		Sample		Test Details		Strata Details								
m		Type		Class		Type		Result		Description		Depth (thickness)	mOD	Legend
										Grass surface followed by: dark brown very clayey sandy fine to coarse rounded to subrounded and occasionally subangular GRAVEL with a medium rounded to subrounded cobble content. Rare rope and possible fabric noted. Very dense flat surface of probable compacted slag at base. Cannot penetrate with excavator. (MADE GROUND).		(0.50)		
										End of Trialpit at 0.500m		0.50		
												1.0		
												2.0		
												3.0		
Weather and environmental conditions:														
1. Cold with heavy rain.														
Other comments:														
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.														
2. Trial pit positioned as agreed with Client and landowner.														
3. Trial pit terminated at 0.5m as instructed by Jubb on probable compacted slag gravel - no penetration possible.														
4. No samples collected as confirmed by Jubb on site.														
5. Trial pit backfilled with arisings on completion and repositioned to TP03B.														

Appendix C

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists					Project Name: Proposed Waterfalls Country Centre. Site Location: Pontneddfechan. Client: Andrew Scott Ltd. Project No: 8715					Drilling method Equipment Terrier. Ground Level: Easting: Northing:					WS01				
Start date: 06/12/2023 End date: 06/12/2023 Backfill date: 06/12/2023					Driller: SWGT. Logged by: DT. Date logged: 06/12/2023														
Depth		Sample		Test Details		TCR (%)	Water Depth	Casing Depth	Strata Details			Water Strikes/ Standing	Depth		Backfill/ Install- ations				
		Type	Class	Type	Result				Description	Legend	Depth (Thickness)		mOD						
0.20		ES							Gravel/grass surface followed by: dark brown clayey sandy fine to coarse angular GRAVEL. Rare fragments of brick noted. (Probable MADE GROUND).					(0.30)					
									Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a low rounded to subrounded cobble content. Probable reworked River Terrace Deposits. (Probable MADE GROUND).							0.30			
0.60		ES							Grey sandstone COBBLES. (Probable RIVER TERRACE DEPOSITS).						(0.50)				
									Reddish brown sandy rounded to subrounded GRAVEL. (Probable RIVER TERRACE DEPOSITS).						0.80				
0.90		D							Grey sandstone COBBLES. (Probable RIVER TERRACE DEPOSITS).						(0.20)				
									End of Borehole at 1.500m						1.00				
1.20		D							Grey sandstone COBBLES. (Probable RIVER TERRACE DEPOSITS).						(0.30)				
									End of Borehole at 1.500m						1.30				
1.50		D		SPT-C	60 (50 for 125mm/60 for 135mm)				End of Borehole at 1.500m						(0.20)				
									End of Borehole at 1.500m						1.50				
Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter		
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth	
General Remarks																			
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.																			
2. Windowless sample point positioned as agreed with Client and landowner.																			
3. Windowless sample terminated in very dense ground.																			
4. Windowless sample position installed with monitoring well (response zone 0.5m - 1.5m) as instructed by Jubb.																			

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists					Project Name: Proposed Waterfalls Country Centre. Site Location: Pontneddfechan.			Drilling method Equipment Terrier. Ground Level: Easting: Northing:			WS02							
Start date: 06/12/2023 End date: 06/12/2023 Backfill date: 06/12/2023			Driller: SWGT. Logged by: DT. Date logged: 06/12/2023			Client: Andrew Scott Ltd. Project No: 8715												
Depth	Sample		Test Details		TCR (%)	Water Depth	Casing Depth	Strata Details		Water Strikes/ Standing	Depth		Backfill/ Install- ations					
	Type	Class	Type	Result				Description	Legend		Depth (Thickness)	mOD						
0.20	ES							Grass followed by: dark brown very clayey gravelly SAND. (TOPSOIL).			(0.25)							
								Light brown clayey gravelly SAND with a low rounded to subrounded cobble content. Gravel is fine to coarse rounded to subrounded. (Probable RIVER TERRACE DEPOSITS).			0.25							
											(0.45)							
0.60	ES							Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a low to medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).			0.70							
0.70 - 1.20	B										(0.50)							
1.10	D										1							
			SPT-C	50 (25 for 0mm/50 for 0mm)				End of Borehole at 1.200m			1.20							
Progress & Standing Water Levels					Water Strikes					Chiselling			Hole Diameter		Casing Diameter			
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth
General Remarks																		
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.																		
2. Windowless sample point positioned as agreed with Client and landowner.																		
3. Windowless sample terminated in very dense ground.																		
4. Windowless sample position installed with monitoring well (response zone 0.5m - 1.2m) as instructed by Jubba.																		

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists					Project Name: Proposed Waterfalls Country Centre. Site Location: Pontneddfechan. Client: Andrew Scott Ltd. Project No: 8715			Drilling method Equipment Terrier. Ground Level: Easting: Northing:			WS03							
Start date: 06/12/2023 End date: 06/12/2023 Backfill date: 06/12/2023			Driller: SWGT. Logged by: DT. Date logged: 06/12/2023															
Depth	Sample		Test Details		TCR (%)	Water Depth	Casing Depth	Strata Details		Legend	Water Strikes/ Standing	Depth		Backfill/ Install- ations				
	Type	Class	Type	Result				Description	Depth (Thickness)			mOD						
0.10	ES							Grass followed by: dark brown very clayey gravelly SAND. (TOPSOIL).				(0.20)						
0.50	ES						Light brown clayey gravelly SAND with a low rounded to subrounded cobble content. Gravel is fine to coarse rounded to subrounded. (Probable RIVER TERRACE DEPOSITS).				0.20							
	0.70	D					Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a low to medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).				0.60							
							Grey/brown sandstone COBBLES. (Probable RIVER TERRACE DEPOSITS).				0.80							
			SPT-C	50 (25 for 0mm/50 for 0mm)				End of Borehole at 1.000m				(0.20)						
												1.00						
Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth
General Remarks																		
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.																		
2. Windowless sample point positioned as agreed with Client and landowner.																		
3. Windowless sample terminated in very dense ground.																		
4. Windowless sample backfilled with arisings on completion as instructed by Jubb.																		

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists					Project Name: Proposed Waterfalls Country Centre. Site Location: Pontneddfechan. Client: Andrew Scott Ltd. Project No: 8715			Drilling method Equipment Terrier. Ground Level: Easting: Northing:			WS04							
Start date: 06/12/2023 End date: 06/12/2023 Backfill date: 06/12/2023		Driller: SWGT. Logged by: DT. Date logged: 06/12/2023																
Depth	Sample		Test Details		TCR (%)	Water Depth	Casing Depth	Strata Details			Water Strikes/ Standing	Depth		Backfill/ Install- ations				
	Type	Class	Type	Result				Description	Legend	Depth (Thickness)		mOD						
0.10	ES							Grass followed by: dark brown very clayey gravelly SAND with a low subrounded cobble content. (TOPSOIL).			(0.20)							
0.60	ES		SPT-C	21 (10,14/5,5,6,5)				Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a low to medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).			0.20							
1.00	D										(0.90)							
1.40	D		SPT-C	50 (6,10/50 for 260mm)				Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium to high rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).			1.10							
								End of Borehole at 1.500m			1.50							
Progress & Standing Water Levels					Water Strikes					Chiselling			Hole Diameter		Casing Diameter			
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth
General Remarks																		
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.																		
2. Windowless sample point positioned as agreed with Client and landowner.																		
3. Windowless sample terminated in very dense ground.																		
4. Windowless sample position installed with monitoring well (response zone 0.5m - 1.2m) as instructed by Jubb.																		

Earth Science Partnership Consulting Engineers Geologists Environmental Scientists						Project Name: Proposed Waterfalls Country Centre. Site Location: Pontneddfechan.			Drilling method Equipment Terrier. Ground Level: Easting: Northing:			WS05						
Start date: 06/12/2023 End date: 06/12/2023 Backfill date: 06/12/2023			Driller: SWGT. Logged by: DT. Date logged: 06/12/2023			Client: Andrew Scott Ltd. Project No: 8715												
Depth		Sample		Test Details		TCR (%)	Water Depth	Casing Depth	Strata Details		Legend	Water Strikes/ Standing	Depth		Backfill/ Install- ations			
		Type	Class	Type	Result				Description				Strikes/ Standing	Depth (Thickness)		mOD		
0.30		ES							Grass surface followed by: dark brown clayey sandy fine to coarse subrounded to angular GRAVEL. Rare fragments of brick noted. (Probable MADE GROUND).				(0.70)					
0.75		D		SPT-C	50 (25 for 0mm/50 for 0mm)				Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium to high rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS).				0.70 (0.30)					
									End of Borehole at 1.000m				1.00					
Progress & Standing Water Levels					Water Strikes							Chiselling			Hole Diameter		Casing Diameter	
Date	Time	Hole Depth	Casing Depth	Water Depth	Date	Time	Strike Depth	Casing Depth	Elapsed Minutes	Depth to Water	Depth Sealed	Depth Top	Depth Base	Duration	Hole Depth	Hole Diameter	Casing Diameter	Casing Depth
General Remarks																		
1. Grid reference and ground level to be surveyed during monitoring visit and updated on final investigation point records.																		
2. Windowless sample point positioned as agreed with Client and landowner.																		
3. Windowless sample terminated in very dense ground.																		
4. Windowless sample backfilled with arisings on completion as instructed by Jubb.																		

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING UK LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: DART554
Test Date: 25/01/2023
Report Date: 26/01/2023
File Name: AR2812.spt
Test Operator: CM

Instrumented Rod Data

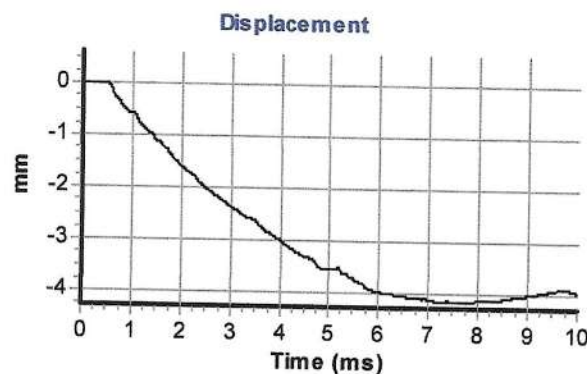
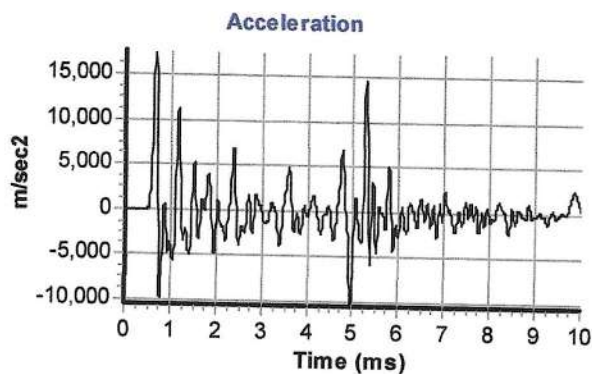
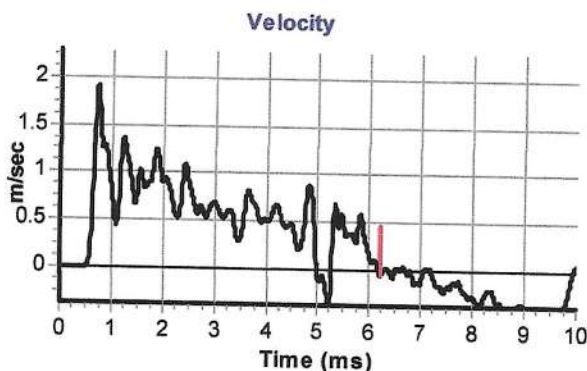
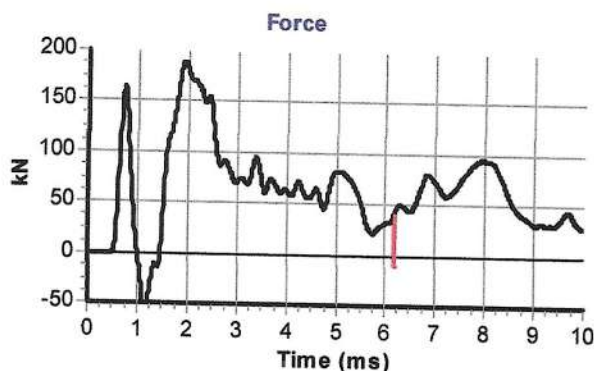
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1:
Accelerometer No.2:

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

SOUTH WALES GROUND TESTING - 83456



Calculations

Area of Rod A (mm^2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 300

Energy Ratio E_r (%):

63

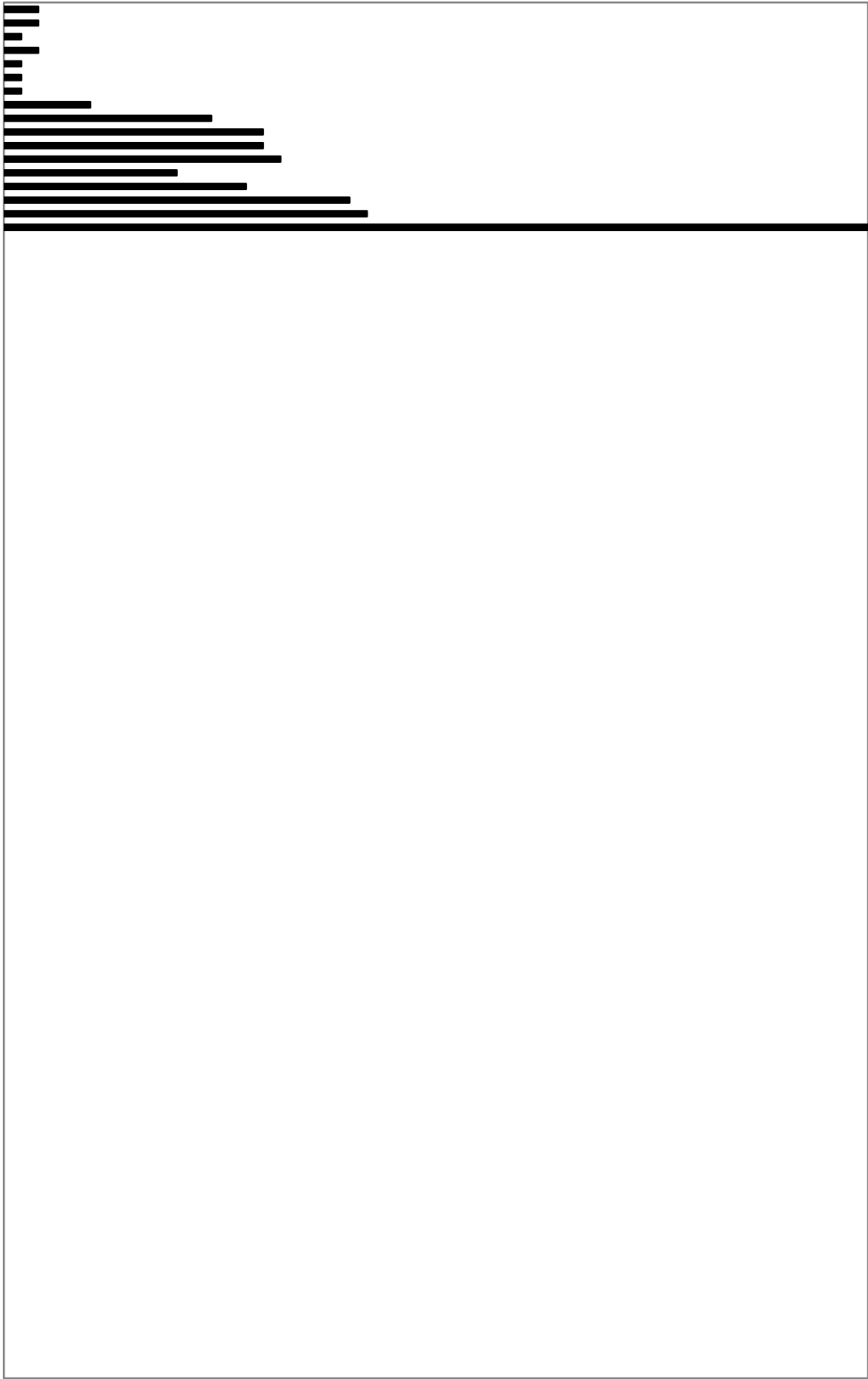
Signed: J.LOCK
Title: FITTER

Appendix D

DYNAMIC PROBE RECORD

Depth(m)	BLOWS (100mm)	DIAGRAM DPSH N100 VALUES	Hammer weight 63kg, drop height 0.75m.	TORQUE (NM)	
	1				
	3				
	4				
	8				
	10				
	50				
1.00					
2.00					
3.00					
4.00					
5.00					
6.00					
7.00					
8.00					
9.00					
10.00					
REMARKS:	Probe hole terminated on hard strata at 0.55m.			PROBE NUMBER: DP 1 DATE: 06.12.23 PAGE 1 of 1	
CONTRACT:	Pontneddfechan				

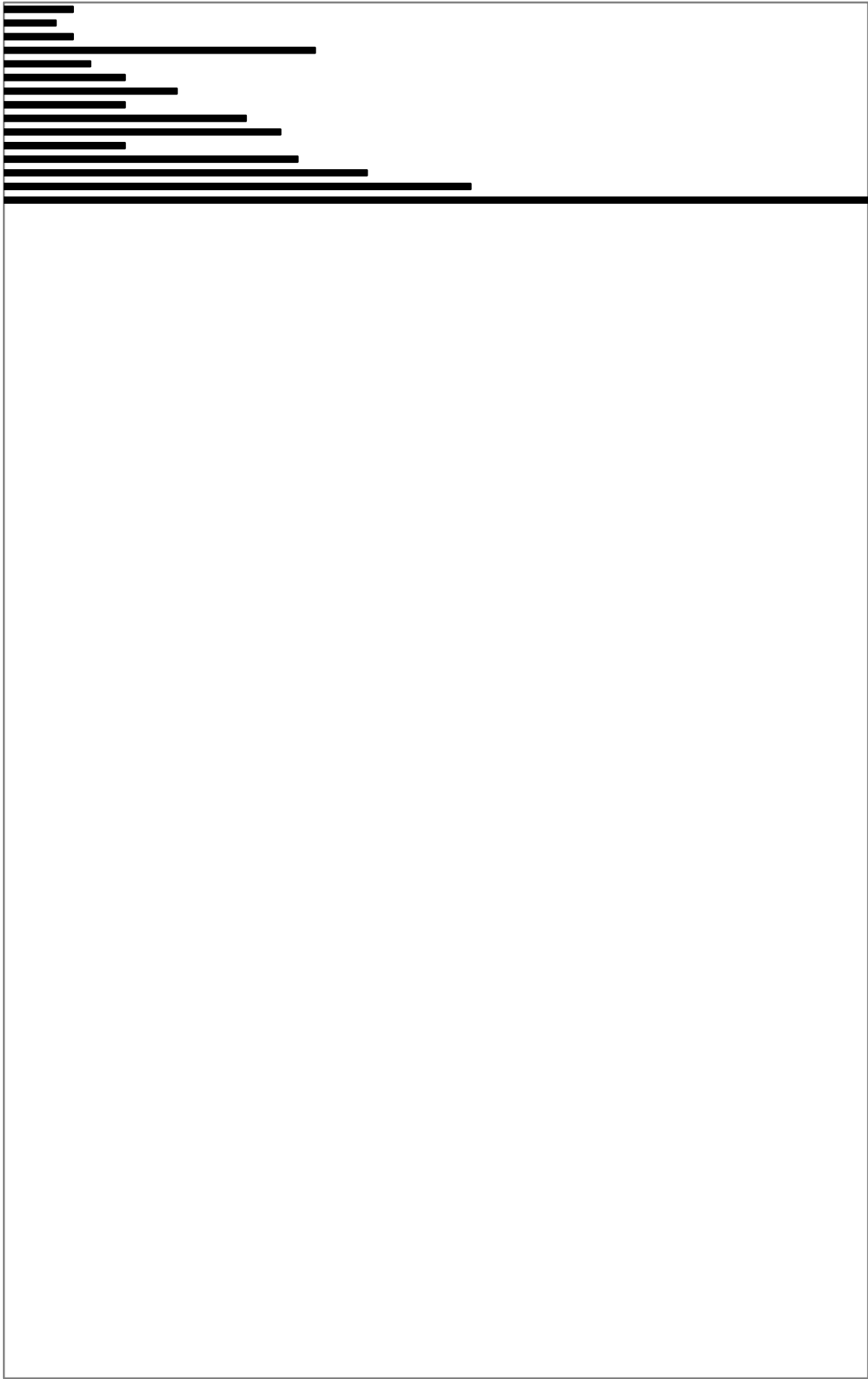
DYNAMIC PROBE RECORD

Depth(m)	BLOWS (100mm)	DIAGRAM DPSH N100 VALUES	Hammer weight 63kg, drop height 0.75m.	TORQUE (NM)				
1.00	2			0				
	2							
	1							
	2							
	1							
	1							
	1							
	1							
	5							
	12							
15								
2.00	15					0		
	16							
	10							
	14							
	20							
	21							
	50							
3.00								
4.00								
5.00								
6.00								
7.00								
8.00								
9.00								
10.00								
REMARKS: Probe hole terminated on hard strata at 1.62m.					PROBE NUMBER: DP 2 DATE: 06.12.23 PAGE 1 of 1			
CONTRACT: Pontneddfechan								

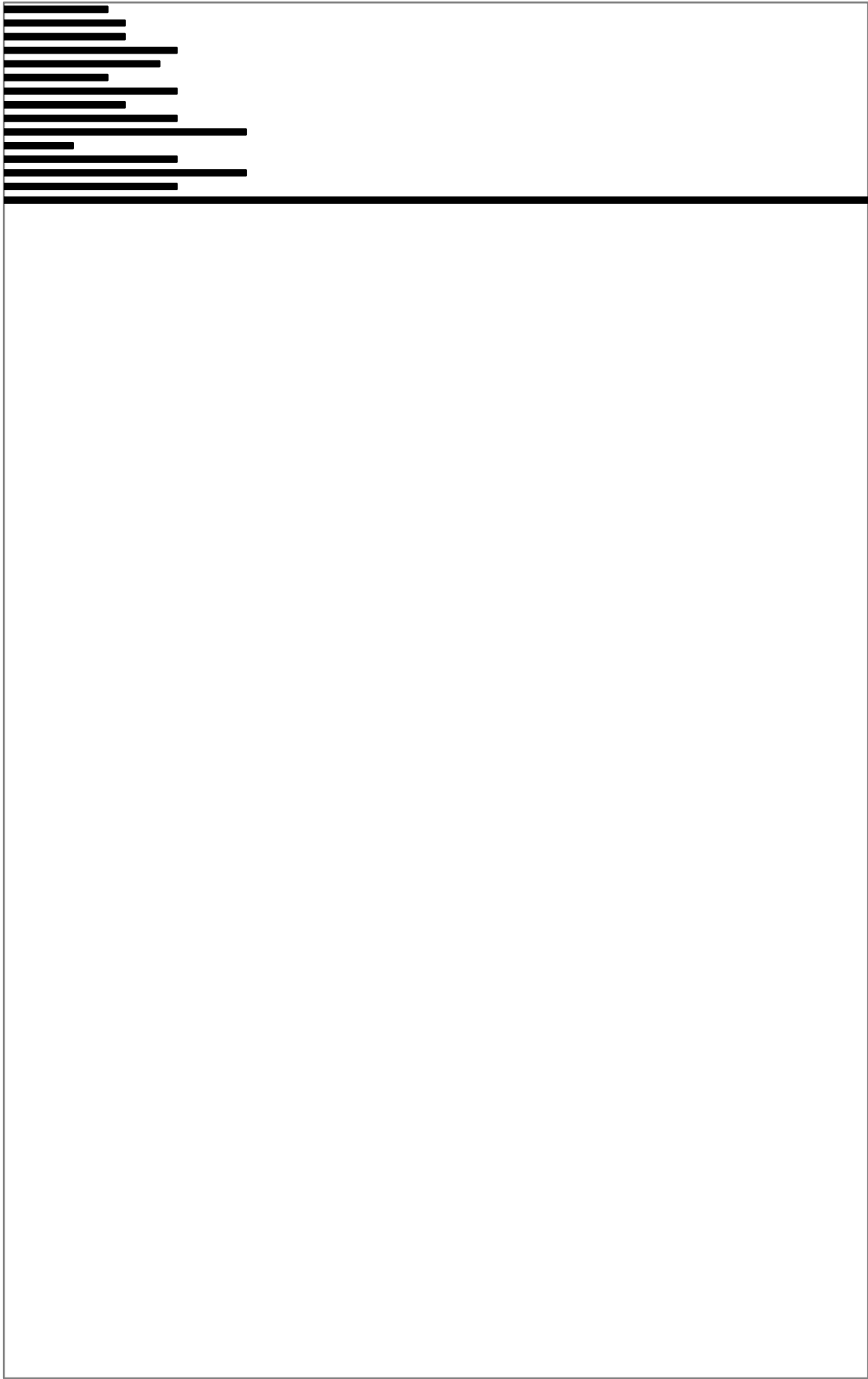
DYNAMIC PROBE RECORD

Depth(m)	BLOWS (100mm)	DIAGRAM DPSH N100 VALUES	Hammer weight 63kg, drop height 0.75m.	TORQUE (NM)	
	1				
	2				
	1				
	1				
	2				
	1				
	2				
	4				
	7				
1.00	10				0
	50				
2.00					
3.00					
4.00					
5.00					
6.00					
7.00					
8.00					
9.00					
10.00					
REMARKS:		Probe hole terminated on hard strata at 1.06m.		 ENGINEERS GEOLOGISTS SCIENTISTS	
CONTRACT:		Pontneddfechan			
		PROBE NUMBER: DP 3 DATE: 06.12.23 PAGE 1 of 1			

DYNAMIC PROBE RECORD

Depth(m)	BLOWS (100mm)	DIAGRAM DPSH N100 VALUES	Hammer weight 63kg, drop height 0.75m.	TORQUE (NM)
1.00	4			12
	3			
	4			
	18			
	5			
	7			
	10			
	7			
	14			
	16			
2.00	7			
	17			
	21			
	27			
	50			
3.00				
4.00				
5.00				
6.00				
7.00				
8.00				
9.00				
10.00				
REMARKS: Probe hole terminated on hard strata at 1.46m.			PROBE NUMBER: DP 4	
CONTRACT: Pontneddfechan			DATE: 06.12.23 PAGE 1 of 1	

DYNAMIC PROBE RECORD

Depth(m)	BLOWS (100mm)	DIAGRAM DPSH N100 VALUES	Hammer weight 63kg, drop height 0.75m.	TORQUE (NM)
	6			
	7			
	7			
	10			
	9			
	6			
	10			
	7			
	10			
1.00	14			0
	4			
	10			
	14			
	10			
	50			14
2.00				
3.00				
4.00				
5.00				
6.00				
7.00				
8.00				
9.00				
10.00				
REMARKS:		Probe hole terminated on hard strata at 1.44m.		PROBE NUMBER: DP 5
CONTRACT:		Pontneddfechan		DATE: 06.12.23 PAGE 1 of 1

Appendix E

SOAKAWAY INFILTRATION TEST RESULTS

BRE 365 method



Project Name:	PROPOSED WATERFALLS COUNTRY CENTRE
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Project Ref:	8715	Date of Testing:	07.12.23
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Test Location:	SA1 (TP02)	Soil Infiltration Rate	1.47E-04 m/sec
Fill Number:	1		

Test results:

Time (mins)	Water Level (m bgl)
0	0.20
1	0.31
2	0.38
3	0.44
4	0.49
5	0.54
6	0.59
7	0.62
8	0.66
9	0.71
10	0.75
11	0.79
12	0.82
13	0.86
14	0.89
15	0.92
16	0.95
17	1.00
18	1.05

Pit Dimensions (m)

Length	1.50
Width	0.40
Depth	1.25

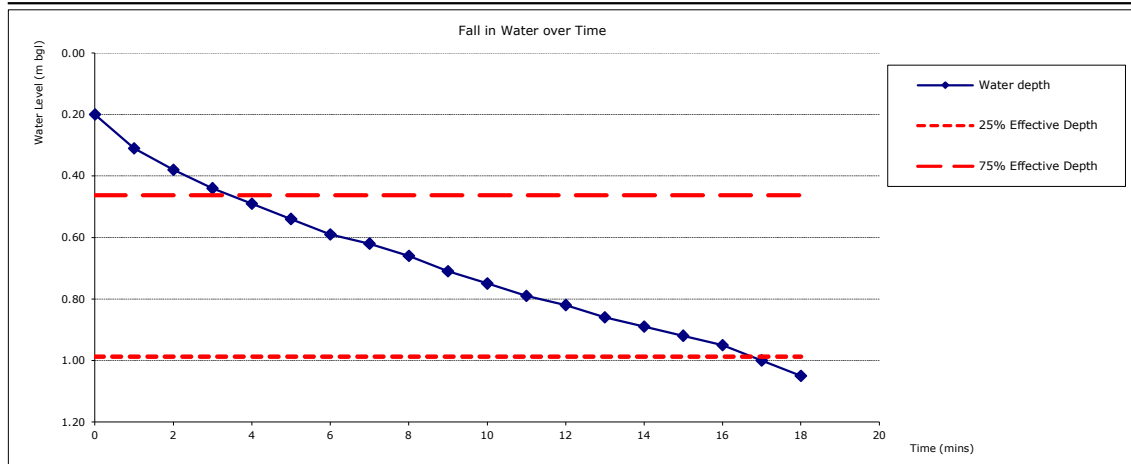
Assumed Invert Level (m bgl)	0.20
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Ground Conditions:

GL - 0.25m	Grass over; dark brown very clayey gravelly SAND with a low subrounded cobble content. (TOPSOIL)
0.25 - 1.25m	Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS)

Remarks:

1. Testing undertaken in general accordance with BRE Digest 365:2007
2. Trial pit was not filled with aggregate for test.
3. Stability of pit sides was poor, base raised to 1.05m.
4. Test depth confirmed on site by Jubb.
5. No groundwater observed to base of excavation.



Soil Infiltration Rate (m/sec)

$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	0.32
α_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	2.595
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	14

Soil Infiltration Rate (m/sec)

$$f = \frac{0.315}{2140.875}$$

$$f \text{ 1.47E-04}$$

SOAKAWAY INFILTRATION TEST RESULTS

BRE 365 method



Project Name:	PROPOSED WATERFALLS COUNTRY CENTRE
---------------	------------------------------------

Project Ref:	8715	Date of Testing:	07.12.23
--------------	------	------------------	----------

Test Location:	SA1 (TP02)	Soil Infiltration Rate	9.47E-05 m/sec
Fill Number:	2		

Test results:

Time (mins)	Water Level (m bgl)
0	0.23
1	0.28
2	0.33
3	0.36
4	0.40
5	0.44
6	0.47
7	0.50
8	0.54
9	0.57
10	0.60
15	0.72
20	0.84
25	0.93
30	1.00
35	1.06
40	1.15
41	1.18
42	1.2

Pit Dimensions (m)

Length	1.50
Width	0.40
Depth	1.20

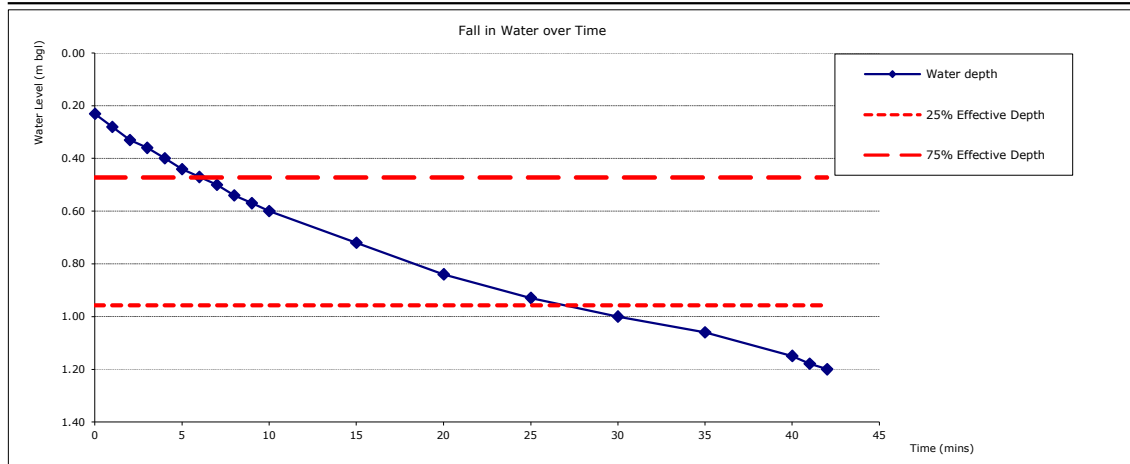
Assumed Invert Level (m bgl)	0.23
------------------------------	------

Ground Conditions:

GL - 0.25m	Grass over; dark brown very clayey gravelly SAND with a low subrounded cobble content. (TOPSOIL)
0.25 - 1.25m	Light brown clayey sandy fine to coarse rounded to subrounded GRAVEL with a medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS)

Remarks:

1. Testing undertaken in general accordance with BRE Digest 365:2007
2. Trial pit was not filled with aggregate for test.
3. Stability of pit sides was poor.
4. Trial Pit reexcavated to 1.2m following Fill 1.
5. Test depth confirmed on site by Jubb.
6. No groundwater observed to base of excavation.



Soil Infiltration Rate (m/sec)

$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	0.29
α_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	2.443
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	21

Soil Infiltration Rate (m/sec)

$$f = \frac{0.291}{3072.945}$$

$$f \text{ 9.47E-05}$$

SOAKAWAY INFILTRATION TEST RESULTS

BRE 365 method



Project Name:	PROPOSED WATERFALLS COUNTRY CENTRE
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Project Ref:	8715	Date of Testing:	07.12.23
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Test Location:	SA2 (TP04)	Soil Infiltration Rate	3.70E-05 m/sec
Fill Number:	1		

Test results:

Time (mins)	Water Level (m bgl)
0	0.26
1	0.30
2	0.34
3	0.36
4	0.39
5	0.41
6	0.43
7	0.45
8	0.47
9	0.48
10	0.50
15	0.54
20	0.59
25	0.63
30	0.68
35	0.71
40	0.75
45	0.79
50	0.83
53	0.86

Pit Dimensions (m)

Length	1.50
Width	0.30
Depth	1.00

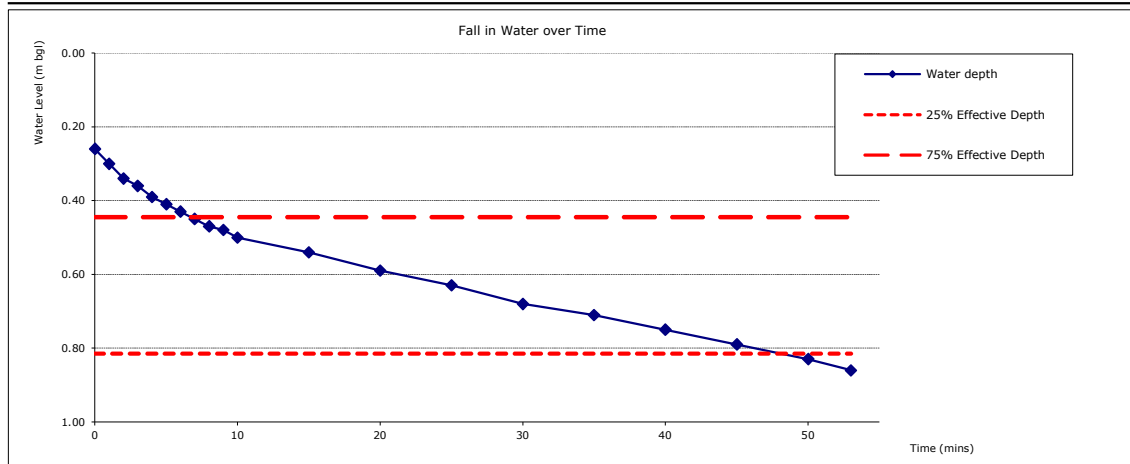
Assumed Invert Level (m bgl)	0.26
------------------------------	------

Ground Conditions:

GL - 0.3m	Grass over; dark brown very clayey gravelly SAND with a low subrounded cobble content. (TOPSOIL)
0.3 - 1.0m	Light brown clayey very sandy fine to coarse rounded to subrounded GRAVEL with a low to medium rounded to subrounded cobble content. (Probable RIVER TERRACE DEPOSITS)

Remarks:

1. Testing undertaken in general accordance with BRE Digest 365:2007
2. Trial pit was not filled with aggregate for test.
3. Stability of pit sides was poor, base risen to 0.89m.
4. Test depth confirmed on site by Jubb.
5. No groundwater observed to base of excavation.



Soil Infiltration Rate (m/sec)

$$f = \frac{V_{p75-25}}{\alpha_{p50} \times t_{p75-25}}$$

V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	0.17
α_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	1.782
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	42

Soil Infiltration Rate (m/sec)

$$f = \frac{0.167}{4504.005}$$

$$f = 3.70E-05$$

Appendix F

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable MG.
Soil condition:	Unsaturated

DCP-1

Blow Count

Depth (m)

— x — Blow count

Depth (m)	Blow Count
0.05	1
0.07	2
0.09	3
0.11	4
0.13	5
0.15	6
0.17	7
0.19	8
0.21	9
0.23	10
0.25	12
0.27	15
0.29	18

DCP-1

Estimated CBR (%)

Depth (m)

Estimated CBR1

Estimated CBR2

Depth (m)	Estimated CBR1 (%)	Estimated CBR2 (%)
0.05	18	18
0.08	22	48
0.10	45	48
0.12	45	48
0.15	45	48
0.18	45	48
0.20	45	48
0.22	45	48
0.25	45	48
0.28	45	48
0.30	45	48
0.32	45	48
0.35	45	48
0.38	45	48
0.40	45	48
0.42	45	48
0.45	45	48
0.48	45	48
0.50	45	48
0.52	45	48
0.55	45	48
0.58	45	48
0.60	45	48

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. MG = Made Ground.
5. Soil type based on nearest available investigation point - approximate only.

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Waterfalls Country Centre, Pontneddfechan, Glynneath
Project No.	8715
Test No.	DCP-2

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

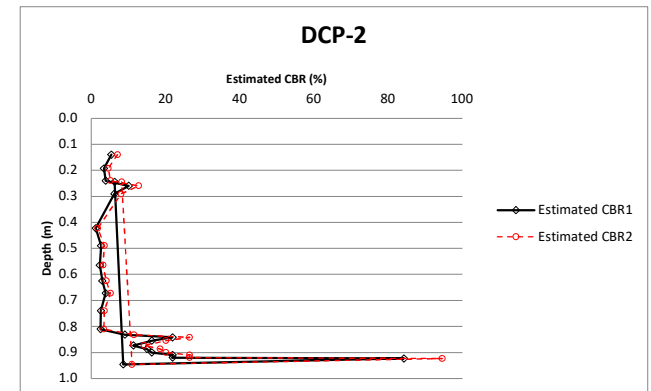
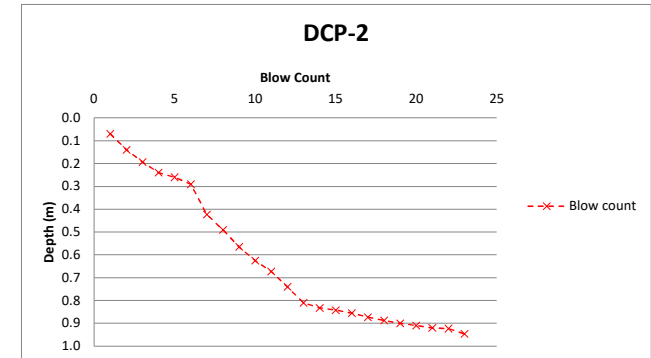
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%) ¹	Estimated CBR2 (%) ²
0	70	0.070			
1	140	0.140	35.0	5	7
2	193	0.193	53.0	3	5
3	240	0.240	47.0	4	5
4	260	0.260	20.0	10	13
5	291	0.291	31.0	6	8
6	423	0.423	132.0	1	2
7	490	0.490	67.0	3	4
8	565	0.565	75.0	2.3	3.1
9	625	0.625	60.0	3	4
10	672	0.672	47.0	4	5
11	740	0.740	68.0	3	3
12	810	0.810	70.0	2.5	3
13	832	0.832	22.0	9.0	11.5
14	842	0.842	10.0	21.9	26.5
15	855	0.855	13.0	16.3	20.1
16	873	0.873	18.0	11.3	14
17	887	0.887	14.0	15	19
18	900	0.900	13.0	16	20
19	910	0.910	10.0	22	26
20	920	0.920	10.0	22	26
21	923	0.923	3.0	84	95
22	946	0.946	23.0	9	11
23	245	0.245	30.5	6	8

Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.



Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

DCP-3a

Blow Count

Depth (m)

— x — Blow count

Depth (m)	Blow Count
0.05	0
0.10	1
0.15	2
0.20	3
0.25	4
0.30	5
0.35	6
0.40	7
0.45	8
0.50	9
0.55	10
0.60	11
0.65	12
0.70	13
0.75	14
0.80	15
0.85	16
0.90	17
0.95	18
1.00	19
1.05	20
1.10	21
1.15	22
1.20	23
1.25	24
1.30	25

DCP-3a

Depth (m)	Estimated CBR1 (%)	Estimated CBR2 (%)
0.20	2	2
0.22	5	5
0.24	10	15
0.26	15	20
0.28	20	25
0.30	25	30
0.32	28	32
0.34	30	30
0.36	30	30
0.38	30	32

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

DCP-3b

Blow Count

Depth (m)

— x — Blow count

Depth (m)	Blow Count
0.0	0
0.1	1
0.2	2
0.3	3
0.4	4
0.5	5
0.6	6
0.7	7
0.8	8
0.9	9
1.0	10

DCP-3b

Depth (m)	Estimated CBR1 (%)	Estimated CBR2 (%)
0.1	3.5	3.5
0.2	3.5	3.5
0.3	3.5	3.5
0.4	3.5	3.5
0.5	3.5	3.5
0.6	3.5	3.5
0.7	3.5	3.5
0.8	3.5	3.5
0.9	3.5	3.5
0.95	10.5	9.5

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

esp
ENGINEERS
GEOLOGISTS
SCIENTISTS

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

DCP-4

Blow Count

Depth (m)

— x — Blow count

Depth (m)	Blow Count
0.0	1
0.1	2
0.2	3
0.3	4
0.4	5
0.5	6
0.6	7
0.7	8
0.8	9
0.9	10
1.0	11

DCP-4

Depth (m)	Estimated CBR1 (%)	Estimated CBR2 (%)
0.1	10	10
0.2	15	15
0.3	20	20
0.4	25	25
0.5	30	30
0.6	35	35
0.7	38	38
0.8	39	39
0.9	40	40
1.0	40	40

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

DCP-5

Depth (m)	Blow Count
0.1	10
0.15	4
0.2	3
0.25	2
0.3	2
0.35	2
0.4	2
0.45	2
0.5	2
0.55	2
0.6	2
0.65	2
0.7	2
0.75	2
0.8	2
0.85	2
0.9	2
0.95	2
1.0	2
1.05	2
1.1	2
1.15	2
1.2	2
1.25	2
1.3	2
1.35	2
1.4	2
1.45	2
1.5	2
1.55	2
1.6	2
1.65	2
1.7	2
1.75	2
1.8	2
1.85	2
1.9	2
1.95	2
2.0	2
2.05	2
2.1	2
2.15	2
2.2	2
2.25	2
2.3	2
2.35	2
2.4	2
2.45	2
2.5	2
2.55	2
2.6	2
2.65	2
2.7	2
2.75	2
2.8	2
2.85	2
2.9	2
2.95	2
3.0	2
3.05	2
3.1	2
3.15	2
3.2	2
3.25	2
3.3	2
3.35	2
3.4	2
3.45	2
3.5	2
3.55	2
3.6	2
3.65	2
3.7	2
3.75	2
3.8	2
3.85	2
3.9	2
3.95	2
4.0	2
4.05	2
4.1	2
4.15	2
4.2	2
4.25	2
4.3	2
4.35	2
4.4	2
4.45	2
4.5	2
4.55	2
4.6	2
4.65	2
4.7	2
4.75	2
4.8	2
4.85	2
4.9	2
4.95	2
5.0	2
5.05	2
5.1	2
5.15	2
5.2	2
5.25	2
5.3	2
5.35	2
5.4	2
5.45	2
5.5	2
5.55	2
5.6	2
5.65	2
5.7	2
5.75	2
5.8	2
5.85	2
5.9	2
5.95	2
6.0	2
6.05	2
6.1	2
6.15	2
6.2	2
6.25	2
6.3	2
6.35	2
6.4	2
6.45	2
6.5	2
6.55	2
6.6	2
6.65	2
6.7	2
6.75	2
6.8	2
6.85	2
6.9	2
6.95	2
7.0	2
7.05	2
7.1	2
7.15	2
7.2	2
7.25	2
7.3	2
7.35	2
7.4	2
7.45	2
7.5	2
7.55	2
7.6	2
7.65	2
7.7	2
7.75	2
7.8	2
7.85	2
7.9	2
7.95	2
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8.25	2
8.3	2
8.35	2
8.4	2
8.45	2
8.5	2
8.55	2
8.6	2
8.65	2
8.7	2
8.75	2
8.8	2
8.85	2
8.9	2
8.95	2
9.0	2
9.05	2
9.1	2
9.15	2
9.2	2
9.25	2
9.3	2
9.35	2
9.4	2
9.45	2
9.5	2
9.55	2
9.6	2
9.65	2
9.7	2
9.75	2
9.8	2
9.85	2
9.9	2
9.95	2
10.0	2
10.05	2
10.1	2
10.15	2
10.2	2
10.25	2
10.3	2
10.35	2
10.4	2
10.45	2
10.5	2
10.55	2
10.6	2
10.65	2
10.7	2
10.75	2
10.8	2
10.85	2
10.9	2
10.95	2
11.0	2
11.05	2
11.1	2
11.15	2
11.2	2
11.25	2
11.3	2
11.35	2
11.4	2
11.45	2
11.5	2
11.55	2
11.6	2
11.65	2
11.7	2
11.75	2
11.8	2
11.85	2
11.9	2
11.95	2
12.0	2
12.05	2
12.1	2
12.15	2
12.2	2
12.25	2
12.3	2
12.35	2
12.4	2
12.45	2
12.5	2
12.55	2
12.6	2
12.65	2
12.7	2
12.75	2
12.8	2
12.85	2
12.9	2
12.95	2
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13.1	2
13.15	2
13.2	2
13.25	2
13.3	2
13.35	2
13.4	2
13.45	2
13.5	2
13.55	2
13.6	2
13.65	2
13.7	2
13.75	2
13.8	2
13.85	2
13.9	2
13.95	2
14.0	2

Figure 10 is a line graph titled "Comparison of Estimated CBR and Estimated CBR2". The x-axis is labeled "Estimated CBR (%)" and ranges from 0 to 350 in increments of 50. The y-axis is labeled "Depth (m)" and ranges from 0.0 to 0.3 in increments of 0.1. There are two data series: "Estimated CBR1" represented by a solid black line with diamond markers, and "Estimated CBR2" represented by a dashed red line with circle markers. Both series show a sharp increase in CBR value as depth increases from 0.0 to 0.15m, then level off around 300% CBR for depths greater than 0.2m.

Depth (m)	Estimated CBR1 (%)	Estimated CBR2 (%)
0.0	~10	~10
0.05	~20	~20
0.1	~30	~30
0.15	~30	~30
0.2	~300	~300
0.25	~300	~300
0.3	~300	~300

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.

RESULTS OF DYNAMIC CONE PENETROMETER (DCP) TESTING

Project:	Waterfalls Country Centre, Pontneddfechan, Glynneath
Project No.	8715
Test No.	DCP-6

Date of Test:	25-Oct-23
Operator:	JA/TM
Soil type^{4, 5}:	Probable TS overlying RTD
Soil condition:	Unsaturated

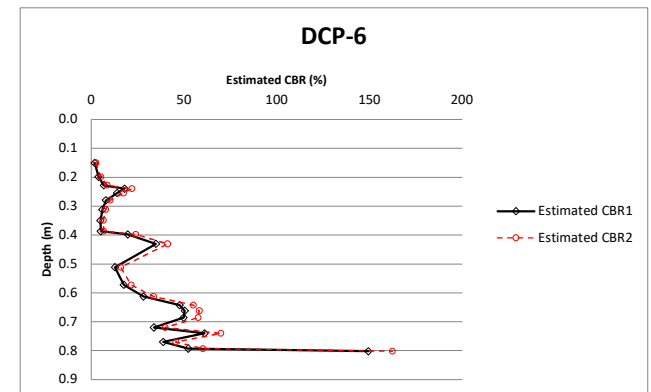
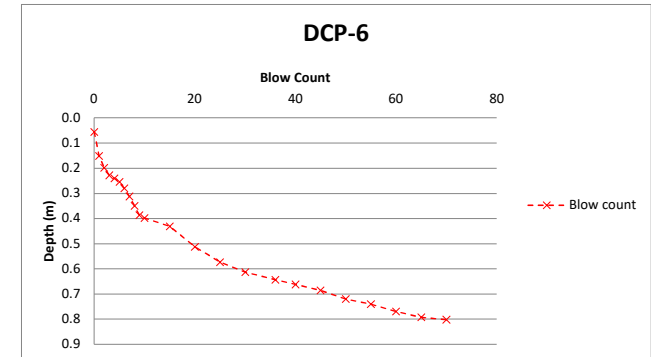
Blow count	Penetration (mm)	Penetration (m)	Penetration Index (DPI) mm/blow	Estimated CBR1 (%) ¹	Estimated CBR2 (%) ²
0	56	0.056			
1	151	0.151	95.0	2	2
2	199	0.199	48.0	4	5
3	228	0.228	29.0	7	9
4	240	0.240	12.0	18	22
5	255	0.255	15.0	14	17
6	280	0.280	25.0	8	10
7	312	0.312	32.0	6	8
8	350	0.350	38.0	4.9	6.5
9	387	0.387	37.0	5	7
10	398	0.398	11.0	20	24
15	431	0.431	6.6	35	41
20	512	0.512	16.2	12.7	16
25	573	0.573	12.2	17.5	21.5
30	613	0.613	8.0	28.1	33.5
36	643	0.643	5.0	47.6	55.1
40	662	0.662	4.8	50.4	58
45	686	0.686	4.8	50	58
50	720	0.720	6.8	34	40
55	740	0.740	4.0	61	70
60	770	0.770	6.0	39	45
65	793	0.793	4.6	52	60
70	802	0.802	1.8	149	162

Notes:

1. CBR calculated based on Webster et al, 1992.
2. CBR calculated based on DMRB, 2008.
3. CBR values less than 2.5% highlighted in red and bold. Soils unsuitable in pavements.
4. TS = Topsoil RTD = River Terrace Deposits
5. Soil type based on nearest available investigation point - approximate only.

Reference:

- Webster S, Grau R and Williams T. 1992. Description and Application of Dual Mass Dynamic Cone Penetrometer. Dept of Army Waterways Equipment Station, Instruction rpt GL-92-3.
- Highways Agency, 2008. Design Manual for Roads and Bridges (DMRB), Data for Pavement Assessment. HD29/08.



Appendix G
(Visit 1 only. Visits 2 & 3 awaiting access permission)

Waterfalls Country Centre
Pontneddfechan, Glynneath
Results of Hazardous Gas and Groundwater Monitoring
(Spot Monitoring)
Project Ref. 8715

Monitoring Event

1

Date:	05/01/2024	Atmospheric Pressure (start):	995 mb	Trend:	Falling
Time:	10:30	Atmospheric Pressure (end):	994 mb		
Engineer:	TM	Site Status:	Farmland		
Weather:	Cold, fog	Ground Conditions:	Damp		
Instrument:	Gas Data LMSxi G3.18e meter	Next Calibration Due Date:	02/08/2024		
Instrument:	Phoccheck 2000+ PID	Next Calibration Due Date:	06/09/2024		

Well ID:	WS01	Well dia.(mm):	50	Date installed:	06/12/2023	Response stratum:		Made Ground/Probable River Terrace Deposits		
		Well depth (m):	1.54			Groundwater depth (m):		Dry		
Monitored Variables	dP (Pa)	LEL (%)	N ₂ (%)	CO ₂ (%)	CH ₄ (%)	O ₂ (%)	H ₂ S (ppm)	Flow (L/hr)	PID (ppm)	
Immediate Reading	0.0	0.0	80.3	0.0	0.0	19.7	0.0	0.0	0.2	
After 30 Seconds	0.0	0.0	81.0	0.7	0.0	18.3	0.0	0.0	0.2	
After 1 Minute	0.0	0.0	81.1	0.7	0.0	18.2	0.0	0.0	0.1	
After 2 Minutes	0.0	0.0	81.2	0.7	0.0	18.1	0.0	0.0	0.0	
After 3 Minutes	0.0	0.0	81.2	0.7	0.0	18.1	0.0	0.0	0.0	
After 4 Minutes	0.0	0.0	81.2	0.7	0.0	18.1	0.0	0.0	0.0	
After 5 Minutes	0.0	0.0	81.2	0.7	0.0	18.1	0.0	0.0	0.0	
Steady State	0.0	0.0	81.2	0.7	0.0	18.1	0.0	0.0	0.0	
min	0.0	0.0	80.3	0.0	0.0	18.1	0.0	0.0	0.0	
max	0.0	0.0	81.2	0.7	0.0	19.7	0.0	0.0	0.2	
Borehole Hazardous Gas Flow Rates Q _{hg} (max gas conc)					Methane:	0 L/hr	Carbon Dioxide	0.00 L/hr		
Borehole Hazardous Gas Flow Rates Q _{hg} (steady state gas conc)					Methane:	0.00 L/hr	Carbon Dioxide	0 L/hr		
Comments:										

Well ID:	WS02	Well dia.(mm):	50	Date installed:	06/12/2023	Response stratum:		Probable River Terrace Deposits		
		Well depth (m):	1.04			Groundwater depth (m):		Dry		
Monitored Variables		dP (Pa)	LEL (%)	N ₂ (%)	CO ₂ (%)	CH ₄ (%)	O ₂ (%)	H ₂ S (ppm)	Flow (L/hr)	PID (ppm)
Immediate Reading		0.0	0.0	80.5	0.0	0.0	19.5	0.0	0.0	0.1
After 30 Seconds		0.0	0.0	81.4	2.0	0.0	16.6	0.0	0.0	0.1
After 1 Minute		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
After 2 Minutes		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
After 3 Minutes		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
After 4 Minutes		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
After 5 Minutes		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
Steady State		0.0	0.0	81.5	2.0	0.0	16.5	0.0	0.0	0.0
min		0.0	0.0	80.5	0.0	0.0	16.5	0.0	0.0	0.0
max		0.0	0.0	81.5	2.0	0.0	19.5	0.0	0.0	0.1
Borehole Hazardous Gas Flow Rates Q _{hg} (max gas conc)					Methane:	0 L/hr		Carbon Dioxide	0.00 L/hr	
Borehole Hazardous Gas Flow Rates Q _{hg} (steady state gas conc)					Methane:	0.00 L/hr		Carbon Dioxide	0 L/hr	
Comments:										

Well ID:	WS04	Well dia.(mm):	50	Date installed:	06/12/2023	Response stratum:		Probable River Terrace Deposits		
		Well depth (m):	1.57			Groundwater depth (m):		Dry		
Monitored Variables		dP (Pa)	LEL (%)	N ₂ (%)	CO ₂ (%)	CH ₄ (%)	O ₂ (%)	H ₂ S (ppm)	Flow (L/hr)	PID (ppm)
Immediate Reading		0.0	0.0	80.3	0.0	0.0	19.7	0.0	0.0	0.0
After 30 Seconds		0.0	0.0	80.7	0.7	0.0	18.6	0.0	0.0	0.0
After 1 Minute		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
After 2 Minutes		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
After 3 Minutes		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
After 4 Minutes		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
After 5 Minutes		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
Steady State		0.0	0.0	80.9	0.7	0.0	18.4	0.0	0.0	0.0
min		0.0	0.0	80.3	0.0	0.0	18.4	0.0	0.0	0.0
max		0.0	0.0	80.9	0.7	0.0	19.7	0.0	0.0	0.0
Borehole Hazardous Gas Flow Rates Q _{hg} (max gas conc)					Methane:	0 L/hr		Carbon Dioxide	0.00 L/hr	
Borehole Hazardous Gas Flow Rates Q _{hg} (steady state gas conc)					Methane:	0.00 L/hr		Carbon Dioxide	0 L/hr	

Key:

dP - differential pressure (well-atmosphere)

LEL - Lower Explosive Limit (methane)

N₂ - nitrogen

CO₂ - carbon dioxide

CH₄ - methane

O₂ - oxygen

H₂S - Hydrogen sulphide

PID - measure of volatile organic compounds

Appendix H



Laboratory Report



Contract Number: 70214

Client Ref: **8715**
Client PO: **12070**

Date Received: **14-12-2023**
Date Completed: **09-01-2024**
Report Date: **09-01-2024**

Client: **Earth Science Partnership**

This report has been checked and approved by:

Contract Title: **Waterfalls Country Centre, Pontneddfechan**
For the attention of: **Daniel Thomas**

Brendan Evans
Office Administrator

Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	2
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	2
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	5
Dry Den/MC (2.5kg Rammer Method 1 litre mould/CBR Mould) BS 1377:1990 - Part 4 : 3.4 - * UKAS	1
Disposal of samples for job	1

Notes: Observations and Interpretations are outside the UKAS Accreditation

* - denotes test included in laboratory scope of accreditation

- denotes test carried out by approved contractor

@ - denotes non accredited tests

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 test report/certificate shall not be reproduced except in full, without the approval of GEO Site & Testing Services Ltd. Any opinions or interpretations stated - within this report/certificate are excluded from the laboratories UKAS accreditation.

Approved Signatories:

Brendan Evans (Office Administrator) - Darren Bourne (Quality Senior Technician) - Paul Evans (Director)
Richard John (Quality/Technical Manager) - Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager)
Wayne Honey (Human Resources/ Health and Safety Manager)

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

Page 3 of 9



PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number 70214

Borehole/Pit No. TP01

Project Name Waterfalls Country Centre, Pontneddfechan

Sample No.

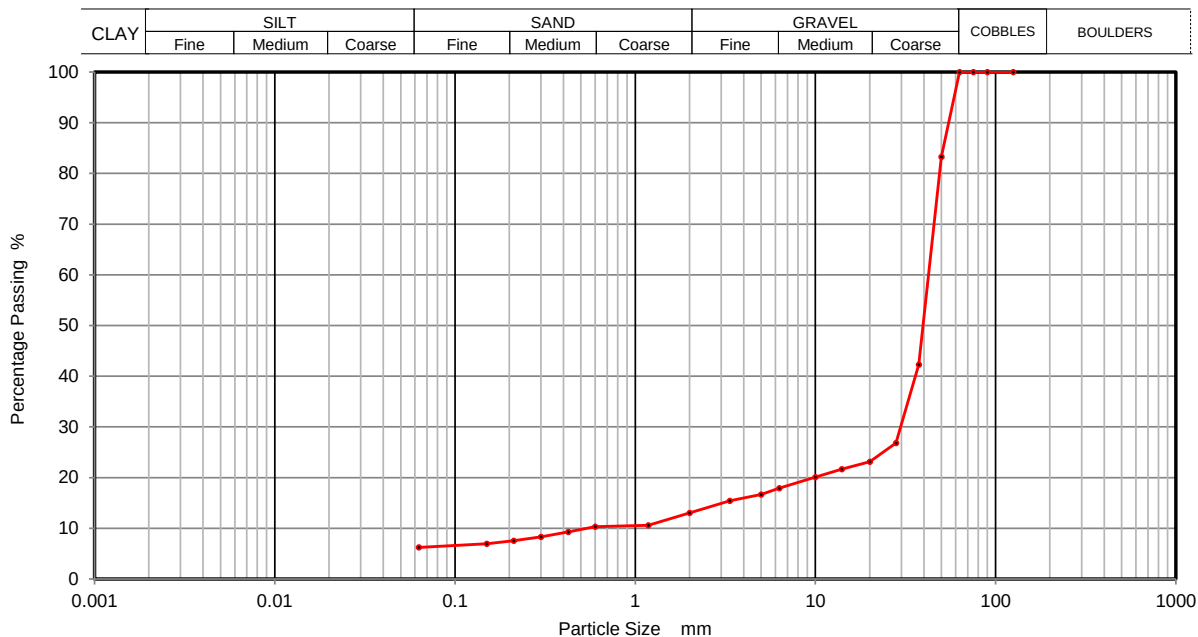
Soil Description Brown silty/clayey fine to coarse sandy fine to coarse GRAVEL

Depth Top 1.00

Depth Base

Date Tested 08/01/2024

Sample Type B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	83		
37.5	42		
28	27		
20	23		
14	22		
10	20		
6.3	18		
5	17		
3.35	15		
2	13		
1.18	11		
0.6	10		
0.425	9		
0.3	8		
0.212	8		
0.15	7		
0.063	6		

Sample Proportions	% dry mass
Cobbles	0
Gravel	87
Sand	7
Silt and Clay	6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator

David Edwards



2788

**PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2**

Contract Number 70214

Borehole/Pit No. TP02

Project Name Waterfalls Country Centre, Pontneddfechan

Sample No.

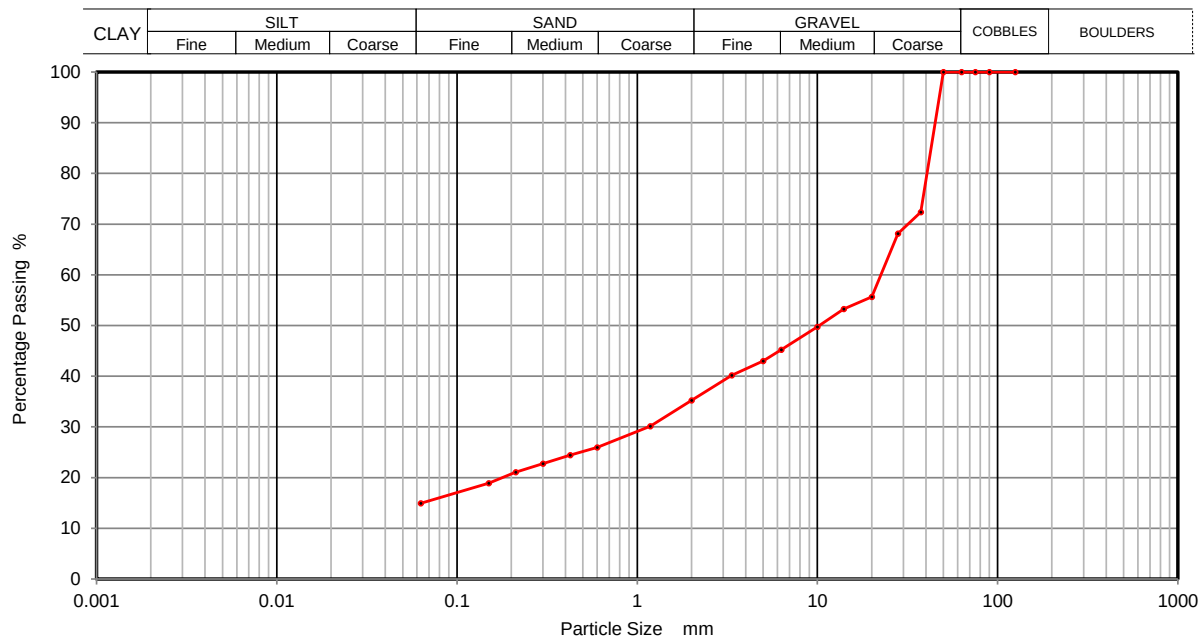
Soil Description Brown silty/clayey fine to coarse sandy fine to coarse GRAVEL

Depth Top 1.20

Depth Base

Date Tested 08/01/2024

Sample Type B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	72		
28	68		
20	56		
14	53		
10	50		
6.3	45		
5	43		
3.35	40		
2	35		
1.18	30		
0.6	26		
0.425	24		
0.3	23		
0.212	21		
0.15	19		
0.063	15		

Sample Proportions	% dry mass
Cobbles	0
Gravel	65
Sand	20
Silt and Clay	15

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator

David Edwards

**PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2**

Contract Number 70214

Borehole/Pit No. WS01

Project Name Waterfalls Country Centre, Pontneddfechan

Sample No.

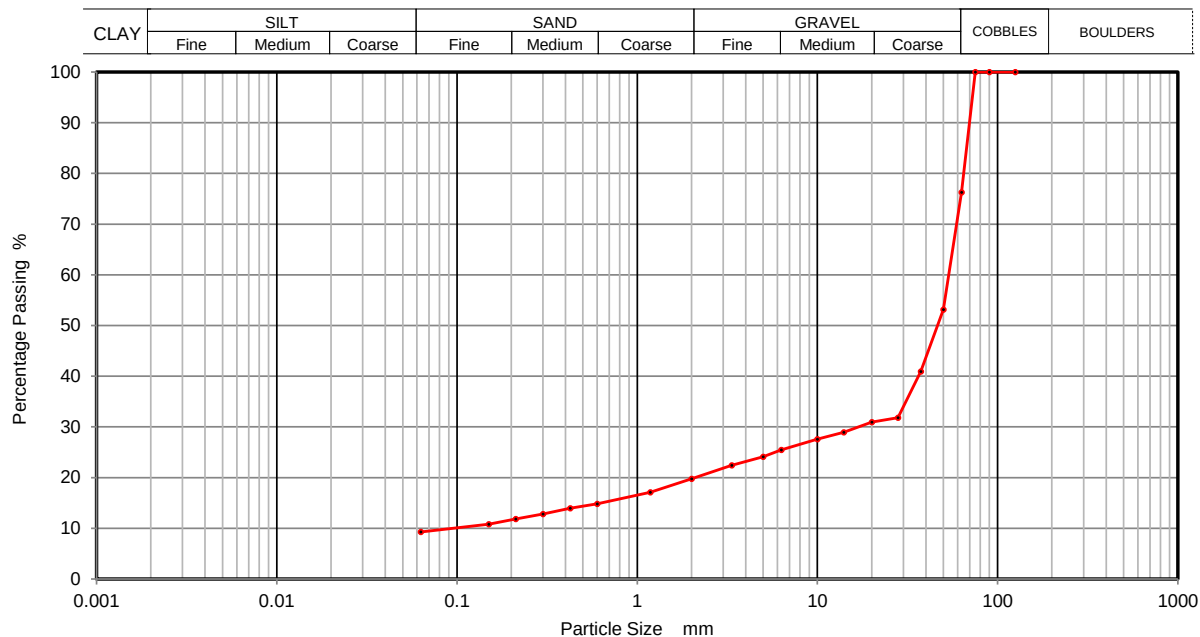
Soil Description Brown silty/clayey fine to coarse sandy fine to coarse GRAVEL (with cobbles)

Depth Top 0.30

Depth Base 0.80

Date Tested 08/01/2024

Sample Type B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	76		
50	53		
37.5	41		
28	32		
20	31		
14	29		
10	28		
6.3	25		
5	24		
3.35	22		
2	20		
1.18	17		
0.6	15		
0.425	14		
0.3	13		
0.212	12		
0.15	11		
0.063	9		

Sample Proportions	% dry mass
Cobbles	24
Gravel	56
Sand	11
Silt and Clay	9

Remarks
Preparation and testing in accordance with BS1377 unless noted below

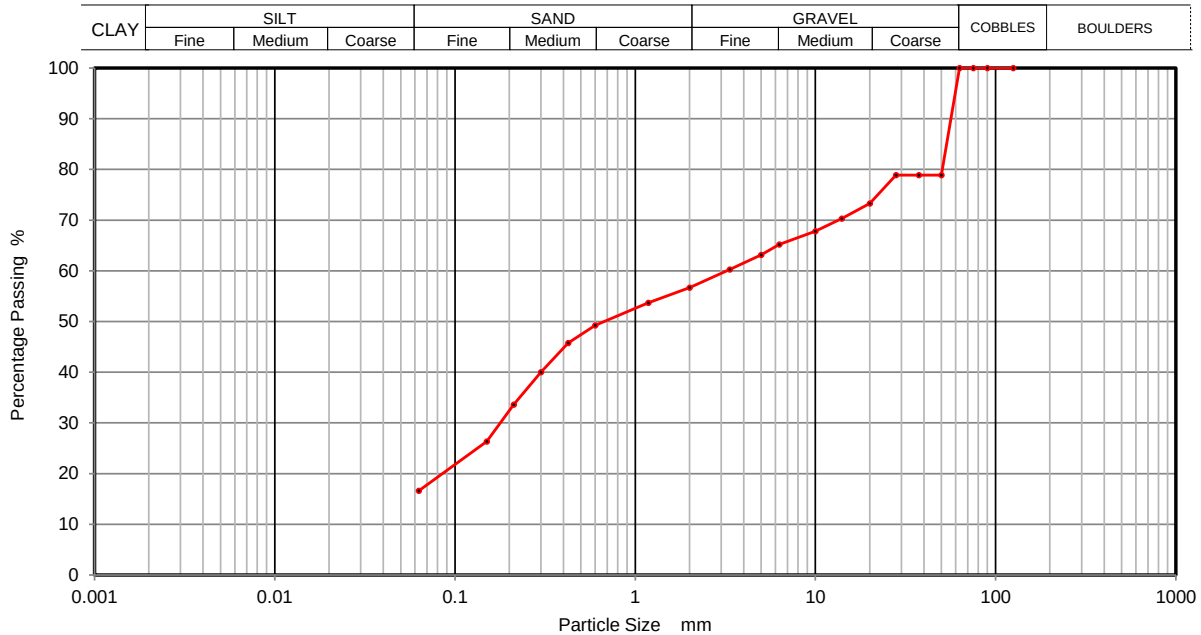
Operator

David Edwards



**PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2**

		Contract Number	70214
		Borehole/Pit No.	WS02
Project Name	Waterfalls Country Centre, Pontneddfechan		Sample No.
Soil Description	Brown silty/clayey fine to coarse sandy fine to coarse GRAVEL	Depth Top	0.70
		Depth Base	1.20
Date Tested	08/01/2024	Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	79		
37.5	79		
28	79		
20	73		
14	70		
10	68		
6.3	65		
5	63		
3.35	60		
2	57		
1.18	54		
0.6	49		
0.425	46		
0.3	40		
0.212	34		
0.15	26		
0.063	17		

Sample Proportions	% dry mass
Cobbles	0
Gravel	43
Sand	40
Silt and Clay	17

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Operator
David Edwards



**Dry Density / Moisture Content Relationship
BS 1377:Part 4:1990**

Contract Number 70214

Borehole / Pit No TP04

Project Name Waterfalls Country Centre, Pontneddfechan

Sample No

Date Tested 08/01/2024

Depth Top 0.90

Compaction Method 2.5 Kg Rammer

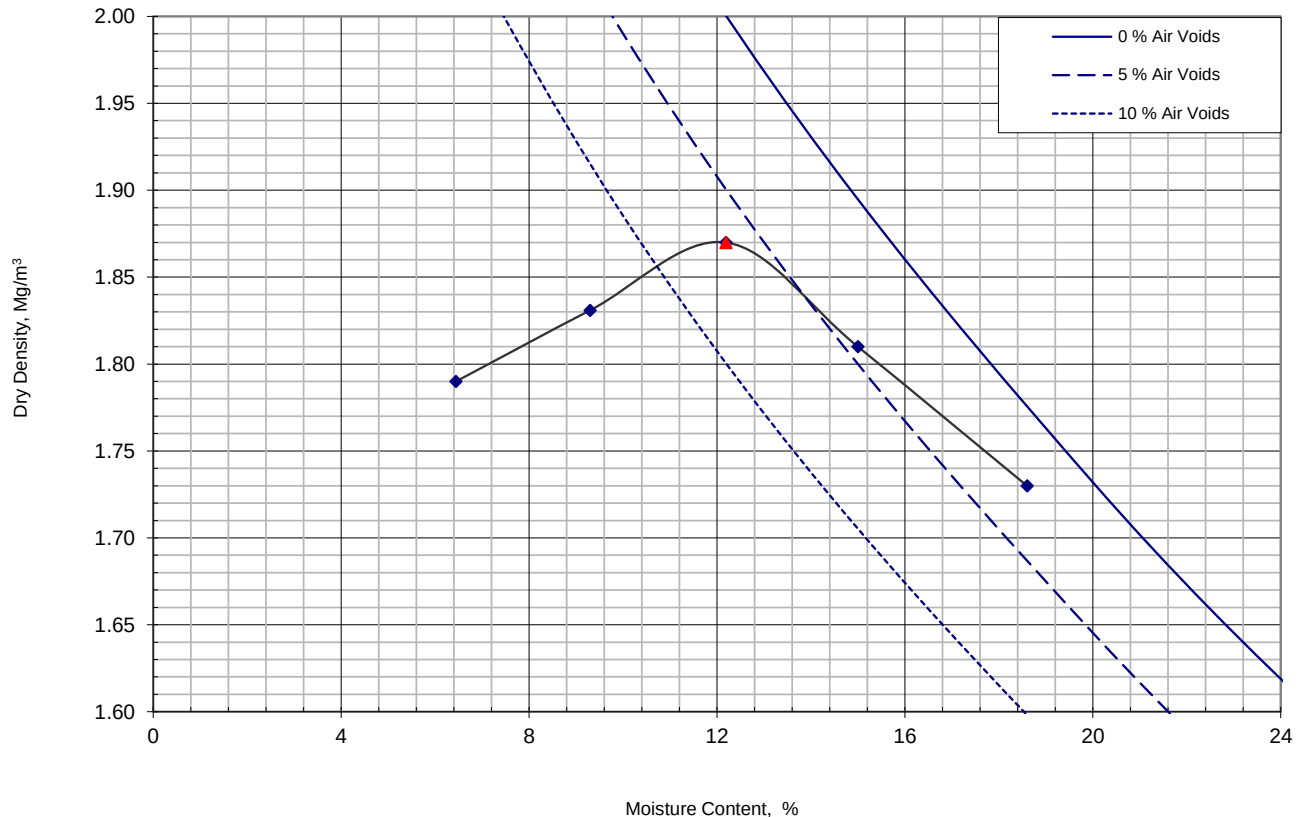
Depth Base

Compaction Clause BS1377:Part 4:1990, Clause 3.3

Sample Type B

Sample Description Brown fine to coarse gravelly silty/clayey fine to coarse SAND

Single or Separate Sample Used Single



Compaction Point	1	2	3	4	5							
Moisture Content	6.4	9.3	12	15	19							
Bulk Density	1.91	2.00	2.10	2.08	2.05							
Dry Density	1.79	1.83	1.87	1.81	1.73							

Initial Moisture Content	19	%
Maximum Dry Density	1.87	Mg/m3
Optimum Moisture Content	12	%
Particle Density	2.65 Assumed	Mg/m3
Material Retained 37.5mm	0	%
Material Retained 20mm	1	%

Operator

Conor

Appendix I



Certificate of Analysis

Certificate Number 23-29403

Issued: 21-Dec-23

Client Earth Science Partnership
33 Cardiff Road
Taffs Well
Cardiff
CF15 7RB

Our Reference 23-29403

Client Reference 8715

Order No 12069

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Description 10 Soil samples.

Date Received 13-Dec-23

Date Started 13-Dec-23

Date Completed 21-Dec-23

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

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 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. 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 "K. Bridgewood".

Kirk Bridgewood
General Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 23-29403

Client Ref 8715

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Lab No	2276685	2276686	2276687	2276688	2276689	2276690
Sample ID	WS01	WS01	WS02	WS03	WS04	WS04
Depth	0.60	0.90	0.60	0.10	0.10	0.60
Other ID						
Sample Type	ES	D	ES	ES	ES	ES
Sampling Date	06/12/2023	06/12/2023	06/12/2023	06/12/2023	06/12/2023	06/12/2023
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	15		9.4	56	31	
Beryllium	DETSC 2301#	0.2	mg/kg	0.6		0.3	0.4	0.4	
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	< 0.2		< 0.2	0.2	< 0.2	
Cadmium	DETSC 2301#	0.1	mg/kg	0.2		< 0.1	1.3	0.9	
Chromium	DETSC 2301#	0.15	mg/kg	18		11	14	11	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0		< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg	27		20	41	33	
Lead	DETSC 2301#	0.3	mg/kg	28		38	180	46	
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05		< 0.05	0.09	< 0.05	
Nickel	DETSC 2301#	1	mg/kg	23		13	14	11	
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5		< 0.5	< 0.5	< 0.5	
Vanadium	DETSC 2301#	0.8	mg/kg	27		14	26	23	
Zinc	DETSC 2301#	1	mg/kg	81		56	89	92	
Inorganics									
pH	DETSC 2008#		pH	7.5	7.4	6.7	5.2	6.8	6.5
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.3		0.2	0.6	0.4	
Organic matter	DETSC 2002#	0.1	%	2.3		1.9	4.0	3.5	
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	37	12				13
Sulphur as S, Total	DETSC 2320	0.01	%	0.03	0.01				0.02
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.07	0.03				0.06
Petroleum Hydrocarbons									
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10		< 10	< 10	58	
PAHs									
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	0.04	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04		< 0.03	0.03	0.06	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Chrysene	DETSC 3303	0.03	mg/kg	0.03		< 0.03	0.03	0.09	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.05		< 0.03	0.04	0.20	
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	0.10	
Pyrene	DETSC 3303#	0.03	mg/kg	0.03		< 0.03	0.04	0.15	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.15		< 0.10	< 0.10	0.63	



Summary of Chemical Analysis Soil Samples

Our Ref 23-29403

Client Ref 8715

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Lab No	2276685	2276686	2276687	2276688	2276689	2276690
Sample ID	WS01	WS01	WS02	WS03	WS04	WS04
Depth	0.60	0.90	0.60	0.10	0.10	0.60
Other ID						
Sample Type	ES	D	ES	ES	ES	ES
Sampling Date	06/12/2023	06/12/2023	06/12/2023	06/12/2023	06/12/2023	06/12/2023
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units
Phenols			
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg

Summary of Chemical Analysis

Soil Samples

Our Ref 23-29403

Client Ref 8715

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Lab No	2276691	2276692	2276693	2276694
Sample ID	WS05	WS05	TP04	TP04
Depth	0.30	0.75	0.20	0.70
Other ID				
Sample Type	ES	D	ES	D
Sampling Date	06/12/2023	06/12/2023	07/12/2023	07/12/2023
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	4.9		26	
Beryllium	DETSC 2301#	0.2	mg/kg	1.3		0.8	
Boron, Water Soluble (2.5:1)	DETSC 2311#	0.2	mg/kg	0.2		< 0.2	
Cadmium	DETSC 2301#	0.1	mg/kg	0.1		0.5	
Chromium	DETSC 2301#	0.15	mg/kg	16		13	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0		< 1.0	
Copper	DETSC 2301#	0.2	mg/kg	15		32	
Lead	DETSC 2301#	0.3	mg/kg	19		27	
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05		< 0.05	
Nickel	DETSC 2301#	1	mg/kg	6.5		23	
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5		< 0.5	
Vanadium	DETSC 2301#	0.8	mg/kg	40		19	
Zinc	DETSC 2301#	1	mg/kg	52		93	
Inorganics							
pH	DETSC 2008#		pH	8.5	7.2	6.5	6.4
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.1		0.2	
Organic matter	DETSC 2002#	0.1	%	2.1		1.8	
Sulphate Aqueous Extract as SO ₄ (2:1)	DETSC 2076#	10	mg/l		12		< 10
Sulphur as S, Total	DETSC 2320	0.01	%		0.02		< 0.01
Sulphate as SO ₄ , Total	DETSC 2321#	0.01	%		0.05		0.03
Petroleum Hydrocarbons							
EPH (C10-C40)	DETSC 3311#	10	mg/kg	33		22	
PAHs							
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05		< 0.03	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Chrysene	DETSC 3303	0.03	mg/kg	0.07		< 0.03	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.10		< 0.03	
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.05		< 0.03	
Pyrene	DETSC 3303#	0.03	mg/kg	0.08		0.04	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.35		< 0.10	



Summary of Chemical Analysis Soil Samples

Our Ref 23-29403

Client Ref 8715

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Lab No	2276691	2276692	2276693	2276694
Sample ID	WS05	WS05	TP04	TP04
Depth	0.30	0.75	0.20	0.70
Other ID				
Sample Type	ES	D	ES	D
Sampling Date	06/12/2023	06/12/2023	07/12/2023	07/12/2023
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units
Phenols			
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg

Summary of Asbestos Analysis

Soil Samples

Our Ref 23-29403

Client Ref 8715

Contract Title WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2276685	WS01 0.60	SOIL	NAD	none	Josh Best
2276687	WS02 0.60	SOIL	NAD	none	Josh Best
2276688	WS03 0.10	SOIL	NAD	none	Josh Best
2276689	WS04 0.10	SOIL	NAD	none	Josh Best
2276691	WS05 0.30	SOIL	NAD	none	Josh Best
2276693	TP04 0.20	SOIL	NAD	none	Josh Best

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 23-29403
 Client Ref 8715
 Contract WATERFALLS COUNTY CENTRE, PONTNEDDFECHAN

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2276685	WS01 0.60 SOIL	06/12/23	GJ 250ml, GJ 60ml, PT 1L		
2276686	WS01 0.90 SOIL	06/12/23	PT 1L		
2276687	WS02 0.60 SOIL	06/12/23	GJ 60ml, GB 1L, PT 1L		
2276688	WS03 0.10 SOIL	06/12/23	GJ 60ml, GB 1L, PT 1L		
2276689	WS04 0.10 SOIL	06/12/23	GJ 60ml, PT 1L		
2276690	WS04 0.60 SOIL	06/12/23	GJ 60ml, GB 1L, PT 1L		
2276691	WS05 0.30 SOIL	06/12/23	GJ 60ml, GB 1L, PT 1L		
2276692	WS05 0.75 SOIL	06/12/23	PT 1L		
2276693	TP04 0.20 SOIL	07/12/23	GB 1L, PT 1L		
2276694	TP04 0.70 SOIL	07/12/23	PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub B-Bottle

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

End of Report

General Notes

GENERAL NOTES

1. Earth Science Partnership (ESP) believes that providing information about limitations is essential to help clients identify and therefore manage their risks. These risks can be mitigated through further investigation or research, but they cannot be eliminated. This report may not be used for any purpose other than that for which it was commissioned.
2. This report includes available factual data for the site as obtained only from the sources described in the text. The data are related to the site on the basis of the site location and boundary information provided by the client. The findings and opinions conveyed in this assessment are based on the information obtained from a variety of sources as detailed in the report, which ESP believe are reliable. Nevertheless, ESP cannot and does not guarantee the authenticity or reliability of the information it has relied on. It is possible that the assessment failed to indicate the existence of further sources of information on the site. Assuming such sources do exist, their information could not have been considered in the formulation of the opinions and findings in this report. It should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
3. In preparing this report it has been assumed that all past and present occupants of the site have provided all relevant and other information, especially relating to known or potential hazards. This report is not required to identify insufficiencies or mistakes in the information provided by the user/owner or from any other source, but has sought to compensate for these where obvious in the light of other information.
4. Reports are normally prepared and written in the context of a stated purpose, and should not, therefore be used in a different context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission.
5. The opinions presented in this report are based on the findings derived from a site inspection, investigations and a review of historical and other records. The report details any indicators that may suggest that hazardous substances exist at the site at levels likely to warrant mitigation. Not finding such indicators does not mean that hazardous substances do not exist at the site. The most recent site inspection was undertaken as detailed within the report. Circumstances on sites are subject to change and certain indicators of the presence of hazardous substances that may have been latent at the time of this inspection may subsequently have become observable.
6. The work carried out for the assessment can only investigate a small portion of the subsurface conditions. Certain indicators or evidence of hazardous substances may have been outside the limited portion of the subsurface investigated, latent at the time of the work or only partially intercepted by the works, and thus their full significance could not be appreciated. In this regard, groundwater levels are particularly susceptible to variation and it should be noted that groundwater levels are subject to diurnal, seasonal, and climatic changes and are solely dependent on the time the ground investigation was carried out and the weather before and during the investigation.
7. Accordingly, it is possible that the assessment failed to indicate the presence or significance of hazardous substances. Assuming such substances exist, their presence could not have been considered in the formulation of the report's findings and opinions. The conclusions resulting from this study and contained in this report are not necessarily indicative of future conditions or operating practices at or adjacent to the site. Where differing ground conditions or suspect materials are encountered during future site works, additional specialist advice should be sought to assess whether the new information will materially affect the recommendations currently provided herein and whether further consideration is required. Any limiting factors should be assessed by an appropriately qualified specialist.
8. The assessment was prepared for the sole internal use and reliance of the Client. The report shall not be relied upon by or transferred to other parties without the express written authorisation of the Earth Science Partnership. If an unauthorised party comes into possession of the report, they rely on it at their peril and the authors owe them no duty of care and skill.
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