Intermodal Logistics Park North Ltd

INTERMODAL LOGISTICS PARK NORTH (ILPN)

Intermodal Logistics Park North (ILPN) Strategic Rail Freight Interchange (SRFI)

Project reference TR510001

Preliminary Environmental Information Report (PEIR)

Appendix 15.3: Ground Investigation Report (Land West of Parkside Road) (Part 01 of 02)

October 2025

Planning Act 2008

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

This document forms a part of a Preliminary Environmental Information Report (PEIR) for the Intermodal Logistics Park North (ILPN) project.

A PEIR presents environmental information to assist consultees to form an informed view of the likely significant environmental effects of a proposed development and provide feedback.

This PEIR has been prepared by the project promoter, Intermodal Logistics Park North Ltd. The Proposed Development is described in Chapter 3 of the PEIR and is the subject of a public consultation.

Details of how to respond to the public consultation are provided at the end of Chapter 1 of the PEIR and on the project website:

https://www.tritaxbigbox.co.uk/our-spaces/intermodal-logistics-park-north/

This feedback will be taken into account by Intermodal Logistics Park North Ltd in the preparation of its application for a Development Consent Order for the project.



Phase 2 Site Investigation

Parkside East, St Helens

for

Harworth Estates Property Group Ltd



18 / 07 / 2023



Phase 2 Site Investigation

Parkside East, St Helens

Harworth Estates Property Group Ltd

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1.0 Introduction

1.1 Background

- 1.1.1 RoC Consulting has been appointed by Harworth Estates Property Group Ltd to conduct a Phase 2 Site Investigation across the proposed Parkside East commercial development site, Newton-le-Willows (henceforth known as the site). It is understood that the site is to be redeveloped for commercial use in accordance with AEW architect's drawing (ref: 13063-AEW-XX-XX-DR-A-0005-P8) provided within Appendix A, comprising x4 commercial logistics buildings up to 250m in length with associated areas of external parking, soft landscaping, attenuation ponds and access roads.
- 1.1.2 The following assessment has been completed to support design and planning requirements for the redevelopment of the site and follows on from a desk study relating to the development site, specifically:
 - 1) Phase 1 Desktop Study completed by Wardell Armstrong dated January 2023 (ref: GM12634)
- 1.1.3 It is recommended reference be made to the abovementioned report (s) when reviewing the current assessment.
- 1.1.4 The scope of the report and its assessment has been based around the site redevelopment proposals as outlined in the aforementioned architect's plan. It should be noted that any subsequent revision of the proposed redevelopment or site boundary away from the above-mentioned drawing may result in the full or partial re-interpretation of this report and assessment.

1.2 Terms of Reference

1.2.1 The Phase 2 Site Investigation was carried out following receipt of an instruction from Duncan Seward of Harworth Estates Property Group Ltd.

1.3 Objectives

- 1.3.1 The scope of works has been tailored to meet both planning and design requirements to assist with the site redevelopment. These considerations include:
 - Design a programme of site investigation works to establish ground conditions beneath the site and target any known or suspected sources of contamination (as revealed by the Phase 1 desktop study).
 - 2) Completion of site investigation field works including the formation of 7 rotary cored boreholes, 16 machine excavated trial pits and 14 cone penetration tests (CPT) to establish the site geology, obtain samples for geo-environmental and geotechnical testing, and establish in situ soil strength data, as well as 9 plate load tests to inform road and pavement design.



- 3) Completion of geo-environmental and geotechnical laboratory analysis of soil and rock samples to determine physical and chemical characteristics.
- 4) Completion of a geotechnical assessment of site conditions to inform new building foundation and retaining wall design. The scope of this assessment will also include reference to the findings and result of previous site investigation works.
- 5) Completion of a geo-environmental assessment utilising information provided by both the current and previous phases of site investigation works sufficient in its scope for submission to the relevant statutory authorities.



2.0 Limitations of Study Assessment

- 2.0.1 The report has been produced by RoC Consulting for the client solely for the purposes of a review of information for the above-mentioned site. It may not be used by any person for any other purpose other than that specified without the express written permission of RoC Consulting. Any liability arising out of its use by a third party for purposes not wholly connected with the above shall be the responsibility of that party who shall indemnify RoC Consulting against all claims, costs, damages and losses arising out of such use.
- 2.0.2 This report is written in the context of an agreed scope of work and should not be used in a different context. The report should be read in its entirety. Furthermore, new information, improved practices and changes in legislation may require re-interpretation of this report in whole or in part after its original issue. RoC Consulting reserve the right to alter their conclusions and recommendations in the light of further information that may become available.
- 2.0.3 Ground conditions can change rapidly, especially in areas of made ground, however, it is assumed that the ground conditions observed are typical and representative of the site as a whole. The ground conditions have been determined from a limited number of exploratory holes formed across the property, therefore, only a small percentage of the total area of the property has been investigated. Interpolation between exploratory holes has enabled a general picture of the subsurface conditions to be produced.
- 2.0.4 Conclusions drawn from the ground investigation should be read in this context. RoC Consulting cannot accept responsibility for any situations resulting from locally unforeseen ground conditions occurring between exploratory holes.
- 2.0.5 RoC Consulting has exercised all reasonable due skill, care and diligence when collating the design and subsequent execution of ground investigation works. It should be noted we cannot anticipate the requirements and actions of the regulatory authorities when designing and implementing ground investigation works and, whilst thorough consideration has been given to all geo-environmental and geotechnical concerns; further additional fieldworks or assessment may be required at their request.
- 2.0.6 RoC Consulting cannot confirm that all ground conditions which may be uncovered during the works have been identified, rather this report is intended as an informative for use by experienced professionals and contractors.
- 2.0.7 Whilst the investigation and report has been scoped in accordance with our understanding of typical regulatory authority requirements, we cannot confirm that on submission regulators may require additional in situ testing or investigation.



3.0 Background Information

3.0.1 The overview below outlines the most salient points / considerations, and it is recommended reference be made to the complete findings of previous site investigation reports for additional information / clarification.

3.1 Site Description

- 3.1.1 The site is located circa 2.5km to the east of the town of Newton-Le-Willows on Parkside Road as indicated on drawing 4597-ROC-ZZ-XX-DR-ES-ES101 in Appendix A. The site is occupied by three agricultural fields separated by hedgerows and is centred around National Grid Reference: 360625, 395032 and covers an area of approximately 20ha. A series of live electrified power lines pass through the centre of the site in a roughly southwest to northeast orientation. With the exception of this development no other features of note are present.
- 3.1.2 The site boundaries are formed by an area of woodland to the north beyond which lies the Liverpool and Manchester railway and further commercial and agricultural development. The west of the site is bound by the M6 motorway with further agricultural land and the disused Parkside Colliery. To the east the site is bordered by Parkside Road and further agricultural land and the Kenyon Hall Farm Air Strip. At the time of investigation roadworks for the Parkside Link Road where underway which, when completed, will link Junction 22 of the M6 motorway with the A49. These highway works are designed to take in-bound and out-bound traffic servicing the site away from the local road network. The site is bordered to the south by the M6 motorway, agricultural land and roadworks for the afore-mentioned Parkside Link Road.

3.2 Geological Characteristics

3.2.1 Review of publicly available BGS geological map records indicate the site is underlain by the following:

Drift Geology:

Across most of the site there are no recorded drift deposits. However, limited Devensian Till
Deposits are indicated on British Geological Survey mapping in the east, south, north and
west of the site.

Solid Geology:

- Chester Formation Sandstone: Located across the majority of the site covering mainly the central, eastern and southern portions.
- Kinnerton Sandstone Formation Sandstone: Located in the northwestern portion of the site in a north to south oriented outcrop.
- Manchester Marls Formation Mudstone Occupies a small north to south oriented strip along the site western boundary.
- 3.2.2 The Coal Authority Interactive Map Viewer indicates that the site is located in a Coal Authority reporting area and is located in close proximity to the disused Parkside Colliery (circa 350m to the east of the site). It is not located in or in the vicinity of a Development High Risk Area.



- 3.2.3 A Coal Authority Consultant's Mining report has been obtained and is contained within Appendix F. The report indicates that the site is located in an area of historic coal mining. The shallowest potentially worked coal seam beneath the site is the Crombouk Seam, which is located at a depth of 442m and has a thickness of 1.3m. The seam was last worked in 1966 but it is unknown whether workings are present beneath the site. Workings at this depth do not generally pose a risk of surface movement.
- 3.2.4 The report indicates that there are no probable unrecorded shallow workings, spine roadways at shallow depth or mine entries within 100m.
- 3.2.5 The coal authority has not received a damage notice or claim for any property within 50m of the site boundary (although this would be limited to the farmhouse to the east of the site).
- 3.2.6 Two incidences of mine gas remedial works have been recorded 446 and 494 metres to the southwest. Both relate to the shaft at the nearby Parkside Colliery.
- 3.2.7 There are no proposals for future mining works in the area.
- 3.2.8 Generally, we do not consider there to be a relevant risk to the site from coal mining activity and a coal mining risk assessment is not recommended.
- 3.2.9 The UKHSA UK Maps of Radon have been reviewed to establish the radon potential for the site. The UKHSA maps indicate that the site is located within an area where the maximum radon potential is 1-3% and as such a BGS radon report has been obtained and is contained within Appendix G.
- 3.2.10 The BGS report indicates that the site is located within a radon affected area as above however no radon protective measures are required for the report area.

3.3 Site History and Environmental Characteristics

- 3.3.1 Earliest map records (1849) show the site as agricultural land split into 8 fields bound by hedgerows and trees, records dating from 1892 depict the site with its current field boundaries with the former 8 fields merged to create a north field, a central field and a southern field. The only other changes on site from 1892 to the present day is the installation of overhead electricity pylons (still present today) running north northeast to south southwest through the site depicted on records dating from 1967.
- 3.3.2 Offsite the earliest available historic mapping dated 1849 indicates the site to be occupied by largely undeveloped land similar to the present-day surroundings, a railway junction is present circa 100m to the north, Willows Coppice Wood and area of woodland and marshland is located 100-200m to the west and the Woods Head Delf sandstone open pit is located 120m to the south.
- 3.3.3 Records dating from 1965 depict the construction of the M6 motorway along the southwestern and western boundary of the site and Parkside Colliery has been established circa 300m to the west of the site. Mapping from 1967 indicates that significant railway infrastructure was constructed in the area of Parkside Colliery including a depot consisting of 9 rail tracks, rail sheds and engine rooms. Throughout the late 1980s to mid-1990s Parkside Colliery was decommissioned with associated infrastructure removed. No other significant changes have occurred in the surrounding area in the period from the 1990s to the present day. At the time of writing construction works for the nearby Parkside Link Road were underway to the southeast of the site.



- 3.3.4 The Envirocheck Groundwater Vulnerability Map indicates the drift geology (Devensian Till) where present on site is classified as a Secondary Undifferentiated Aquifer with the underlying Kinnerton Sandstone and Chester Formations Sandstone bedrock classed as a Principal Aquifer. The Manchester Marls bedrock is classified as a Secondary Undifferentiated Aquifer.
- 3.3.5 The site is said to be located within a Source Protection Zone 3 (Total Catchment). There is no groundwater, surface water abstraction points or discharge consents within 1000m of the site.
- 3.3.6 The nearest surface water feature is indicated 400m southwest of the site in the form of a small tributary stream to Newton Brook. There are no surface or groundwater abstraction points; or discharge consents, within 500m of the site.
- 3.3.7 There are no pollution controls, contaminated land register entries or notice or environmental issues record in the vicinity of the site.
- 3.3.8 There are two historic landfill sites located within 500m of the site. However, there are no records as to the operator, category of waste, or size of these sites. The licenses for the sites were in operation between 1955 to 1965. There are no records of any active waste management facilities or recorded waste sites within 500m of the site.
- 3.3.9 The site is not said to be located in an area deemed to be at risk from flooding or extreme flooding events from either land or sea.

3.4 Summary of Previous Phase 1 Desk Study

- 3.4.1 Wardell Armstrong completed a Phase 1 Desk Study for the site in January 2023 (report ref: GM12634). The findings of this report are summarised below.
- 3.4.2 The historic uses of the site indicate a low to moderate risk of contamination, with sources limited to fly tipping noted in woodland areas adjacent to the site, and possible migration of contaminants from the adjacent roadway.
- 3.4.3 A very low risk was assigned to the site relating to ground stability and site investigation works were recommended to investigate the geotechnical properties of the soils and rock present on site.



4.0 Site Investigation Design

General

- 4.0.1 The RoC intrusive investigation was designed and completed to further investigate geo-environmental issues identified during the Phase 1 Desktop Study; as well as provide geotechnical information to facilitate new building foundation and road / pavement design.
- 4.0.2 The site investigation works comprised the formation of 7 rotary cored boreholes to depths between 15.00 20.00 metres below ground level (mbgl), 16 machine excavated trial pits to depths between 1.50 and 2.40mbgl including 9 plate bearing tests at select locations. In addition, 14 CPT tests were undertaken to depths ranging between 1.02 and 2.72mbgl. During a previous phase of work a total of 8 soakaway tests were also undertaken in accordance with BRE 365 at a number of locations across the site.
- 4.0.3 Exploratory hole placement was dictated by the proposed layout and to achieve good coverage across the site in order to develop a ground model and to obtain geotechnical and environmental samples for testing. Installation of groundwater monitoring wells was also completed to support wider baseline assessment.
- 4.0.4 Samples of soil collected during the investigation works are to be analysed for a variety of determinants associated with the pattern of current and historic activity across the site as outlined within the preliminary conceptual site model.
- 4.0.5 Table 4.0 provided below provides location justification for each exploratory hole formed during the site investigation fieldworks. The purposes of this table are to illustrate the targeting of potential sources of contamination during the Phase 2 site investigation works.

Table 4.0: Borehole Locations & Justification

BH/WS ID.	Reason for selection	
Proposed War	ehouse "Unit 04"	
RBH101	Located withing proposed Unit 04 warehouse footprint to establish ground	
CPT101	conditions and engineering properties of soils and bedrock for use in new building foundation design. Where possible, samples of soil and bedrock were	
CPT102	also obtained for geo-environmental and geotechnical analysis	
TP102	Located within external yard areas to support civil engineering design, includes	
TP103	for completion of CBR testing	
Proposed War	ehouse "Unit 03"	
RBH102	Located withing proposed Unit 03 warehouse footprint to establish ground	
RBH103	conditions and engineering properties of soils and bedrock for use in new building foundation design. Where possible, samples of soil and bedrock were	
RBH104	also obtained for geo-environmental and geotechnical analysis	
CPT102		
CPT103		
CPT104		



	1			
CPT105				
TP104				
TP105				
TP107	Located within external yard areas to support civil engineering design, includes			
TP108	for completion of CBR testing			
TP109				
Proposed Ware	ehouse "Unit 02"			
RBH105	Located withing proposed Unit 02 warehouse footprint to establish ground			
CPT106	conditions and engineering properties of soils and bedrock for use in new building foundation design. Where possible, samples of soil and bedrock were			
CPT107	also obtained for geo-environmental and geotechnical analysis			
TP112	Located within external yard areas to support civil engineering design, includes for completion of CBR testing			
Proposed Warehouse "Unit 01"				
RBH106	Located withing proposed Unit 01 warehouse footprint to establish ground			
RBH107	conditions and engineering properties of soils and bedrock for use in new building foundation design. Where possible, samples of soil and bedrock were also obtained for geo-environmental and geotechnical analysis			
CPT108				
CPT109				
CPT110				
TP113				
TP115				
TP114	Located within external yard areas to support civil engineering design, includes			
TP116	for completion of CBR testing			
General Site Coverage				
TP106	General coverage trial pit, located outside proposed development areas to			
TP110	provide wider context and information on site wide ground model			
TP111				
SA101-108	Trial pit soakaway infiltration test, to inform future surface water drainage design			

4.0.6 Exploratory hole locations are shown on RoC Consulting drawings 4597-ROC-ZZ-XX-DR-ES-ES101 (Current Site) and 4597-ROC-ZZ-XX-DR-ES-ES102 (Prop Development) provided within Appendix A.



5.0 Site Investigation Fieldworks

- 5.0.1 Site investigation fieldworks were completed between the 15th and 25th of May 2023 by drilling contractors MT Geoservices, CPT providers Lankelma Ltd and plant hire company Hurt Plant Ltd. Rotary cored boreholes were formed using a Beretta T44, CPT tests were undertaken using a 20.5 tonne track-truck mounted CPT unit and machine excavated trial pits were formed using an 8-tonne tracked excavator.
- 5.0.2 Prior to excavation, our methodology for service avoidance, G5.15, was applied. This methodology includes:
 - Consultation of existing statutory undertakers plans of services
 - Consultation of service drawings provided to us by the client or site operator
 - Completion of location specific GPR clearance where applicable
 - · Opening of nearby service covers
 - · CAT and Genny scanning
 - Excavation of 1.20m hand dug service avoidance pit in advance of borehole drilling
 - Recording of these checks through location specific Permits To Dig.

Records of equipment calibration are presented in Appendix H. Our operatives all hold current qualifications for the use of such equipment.

- 5.0.3 To ensure no new sources of contamination were introduced to underlying soils or bedrock during the formation of each borehole, we have adopted safe drilling techniques for ground investigation in all instances, to ensure no new sources of contamination are introduced or mobilized as a consequence of the works. These methods include but are not limited to:
 - Use of steel casing and vegetable oil as a lubrication medium
 - Formation of impermeable bentonite seals to the tops and bottoms of response zones in installed monitoring wells
 - Cleaning of sampling equipment to reduce cross contamination
 - Dual pipe monitoring wells have not been installed
- 5.0.4 We consider that the employment of these above methods keeps the likelihood of contamination disturbance as low as reasonably practicable, although it is not possible to wholly remove the possibility of such occurrences.
- 5.0.5 Soil and rock core samples were collected for subsequent chemical and geotechnical laboratory analysis. Soil samples used for geotechnical analysis were collected in kg plastic sample tubs, and polythene "bulk" bags. Samples collected for chemical testing were collected in 1kg plastic samples tubs, 258g glass jars and 60g glass gars. Samples were obtained from both made ground and natural strata to assess the overall quality of underlying soils. In situ soil strength was investigated using Standard Penetration Tests (SPT) within superficial deposits as well as to confirm rock head had been reached and in areas of poor rock recovery (<80%).





- 5.0.6 The soil and rock encountered during construction of the boreholes were described and logged by a suitably qualified engineer in accordance with BS 5930: Code of Practice for Site Investigations (the log sheets for which have been provided within Appendix B).
- 5.0.7 A total of 5 ground water monitoring wells were installed within rotary cored boreholes. Installation details are provided within Table 5.0 below, copies of ground water monitoring records are provided within Appendix E.

Table 5.0: Monitoring Well Installations

BH ID	Monitoring well depth	Response zone	Response zone strata
RBH101	10.00m	5.00 to 10.00m	Chester Formation
		(28.30 to 23.30mAOD)	
RBH102	10.00m	5.00 to 10.00m	Chester Formation
		(29.22 to 24.22mAOD)	
RBH104	10.00m	2.00 to 10.00m	Chester Formation
		(34.59 to 26.59mAOD)	and Kinnerton Sandstone Formation
RBH105	10.00m	5.00 to 10.00m	Chester Formation
		(30.63 to 25.63mAOD)	
RBH107	10.00m	5.00 to 10.00m	Kinnerton Sandstone
		(30.28 to 25.28mAOD)	Formation



6.0 Encountered Ground Conditions

6.0.1 The following ground conditions are summarised from the exploratory holes formed during the RoC Consulting site investigation. The following represents an overview of encountered ground conditions, and it is recommended reference be made to the borehole and trial pit log sheets provided within Appendix B for a detailed strata description; all depths shown are given in metres below ground level (mbgl) unless otherwise stated.

6.1 Ground Conditions Overview

Topsoil

- 6.1.1 Soils at the site have been described as Topsoil and/or Made Ground Topsoil where these contain man-made material or overly man-made material. Typically, this material has a depth of 0.20 to 0.60mbgl.
- 6.1.2 These depths and classifications are based on visual descriptions only and do not in themselves indicate that the material is suitable for reuse in soft landscaping areas and should be verified by a landscape architect. We have not undertaken assessment to BS 3882: 2015 Specification for topsoil. However, we consider that this material is likely unsuitable for engineering purposes.

Table 6.1: Topsoil Strata Description

Strata description	Topsoil material was encountered at surface level at all exploratory hole locations and was generally described as a silty fine sand. In a number of locations gravel was present in the topsoil and generally comprised natural lithologies. However, in some location's anthropogenic inclusions such as brick and plastic were noted.		
Max Depth	0.60mbgl Min Depth 0.20mbgl		
Mean Depth	0.40mbgl SPT Range N/A		

Made Ground

6.1.3 Made Ground soils have not been encountered. However, the investigation locations have viewed only a fraction of the site soils, and it remains feasible that Made Ground soils may be present, such as from agricultural activities or associated with the construction of the motorway to the southwestern site boundary.

Devensian Till

6.1.4 Natural soils were reported at the base of made ground deposits at 11 exploratory hole locations as described in the table below. Devensian till deposits were only encountered in the southern, central and western portions of the site and the distribution of these is indicated on the drawing 4597-ROC-ZZ-XX-DR-ES-ES105 presented in Appendix A.



Table 6.2 Devensian Till

Strata Description	slightly sandy, slight 0.20 and 0.90m in deposits were only portions of the site. A total of 5 hand sh Devensian Till deposits arrength ranged from	A total of 5 hand shear vane tests were taken at 5 locations within the Devensian Till deposits between 0.50 and 1.00mbgl. Reported shear strength ranged from 96 to 100kPa with an average of 103kPa. No groundwater strikes were encountered within the Devensian Till		
Max Depth	1.30mbgl	Min Depth	0.60mbgl	
Mean Depth	0.90mbgl	SPT Range	N/A	

Weathered Sandstone (Kinnerton Sandstone Formation and Chester Formation)

- 6.1.5 Weathered sandstone deposits were reported at the base of clay and topsoil deposits at all exploratory hole locations as described in Table 6.3.
- 6.1.6 The Kinnerton Sandstone Formation and Chester Formation are both recorded in geological maps of the site, with the Kinnerton Sandstone Formation underlying the west of the site to depth. Deposits of the Chester Formation are recorded to begin from the centre of the site and deepen to the east, at all points underlain by further deposits of the Kinnerton Sandstone Formation. Both geological units comprise yellow to brown sandstone and are consequently difficult to distinguish. However, BGS records indicate that the Chester Formation is likely to feature deposits of conglomerate and pebbles and may have a generally larger grain size. We have employed our judgement to classify the rock types, but do not consider the distinction to have significant engineering consequences and have grouped both rock types together at various stages of this report.

Table 6.3 Weathered Sandstone (Kinnerton Sandstone Formation and Chester Formation)

Strata Description	Weathered sandstone was generally recovered as a reddish brown / yellowish brown gravelly sand, the gravel encountered was primarily of sandstone. The weathered sandstone was found to become denser and more difficult to excavate with depth until eventually transitioning into intact sandstone. All SPTs undertaken within the weathered sandstone reported N values of 50 and refused within the strata indicating the strata to be very dense. These were generally taken from 1.20mbgl and deposits and the ease of excavation in trial pits at shallower depth indicate it is likely that these soils are medium dense to dense above 1.20mbgl. No groundwater strikes were encountered within the weathered sandstone		
Max Depth	3.00mbgl	Min Depth	0.70mbgl
Mean Depth	1.60mbgl	SPT Range	>50



Sandstone (Chester Formation)

6.1.7 The sandstone of the Chester Formation was generally encountered in the east of the site. In the east of the site this continued to termination while in central parts of the site this is underlain by rock of the Kinnerton Sandstone Formation. A contour plan depicting the depth to bedrock is presented within Appendix A (4597-ROC-ZZ-XX-DR-ES-ES106). The strata are detailed in the table below.

Table 6.4 Sandstone (Chester Formation)

Strata Description	The sandstone of the Chester Formation was generally encountered in the east of the site and comprised a reddish brown to yellowish brown medium to coarse grained sandstone, often conglomeritic and containing gravel of quartzite and mudstone. Sandstone is typically weak, becoming medium strong with depth.		
SPTs	>50		
RQD Range	0 – 100	Average RQD	67

Sandstone (Kinnerton Sandstone Formation and Chester Formation)

6.1.8 The Kinnerton Sandstone Formation was generally encountered in the west of the site where it continues to termination. It also underlies the Chester Formation in all locations where this was penetrated. A contour plan depicting the depth to bedrock is presented within Appendix A (4597-ROC-ZZ-XX-DR-ES-ES106). The strata are detailed in the table below.

Table 6.5 Sandstone (Kinnerton Sandstone Formation)

Strata Description	The Kinnerton Sandstone Formation was generally encountered in the west of the site and beneath the Chester Formation at depth and comprised a reddish brown fine to medium grained sandstone. Sandstone is typically very weak, becoming weak with depth.		
SPTs	>50		
RQD Range	7 - 100	Average RQD	76

6.1.9 A programme of geotechnical testing was completed on soil and rock samples obtained from site investigation works, copies of which are provided within Appendix D.

6.2 Groundwater & Contamination Observations

- 6.2.1 No visual or olfactory evidence of contamination was encountered during site investigation works.
- 6.2.2 No groundwater strikes were encountered during site investigation works due to the drilling methodology preventing accurate detection or measuring of groundwater strikes during the formation of boreholes.





6.2.3 Resting groundwater monitoring results (as revealed from borehole standpipes) indicate a groundwater table within the sandstone bedrock at levels ranging between 23.9 and 28.11mAOD with a mean depth of 26.43mAOD (or 8.48mbgl). Full details of monitoring results have been provided within Appendix E.

Table 6.6 Groundwater Monitoring Information

BH ID	Water Strike Depth	Resting Water Level				
		mbgl	mAOD			
RBH101	None recorded	9.40-9.43	23.90-23.87			
RBH102	None recorded	7.86-7.90	25.95-25.91			
RBH104	None recorded	9.23-9.25	27.36-27.34			
RBH105	None recorded	8.69-8.72	26.94-26.91			
RBH107	None recorded	7.14-7.17	28.14-28.11			

- 6.2.4 It should be noted that, due to the choice of drilling methods, it was not possible to accurately record the depth of groundwater strikes in rotary drilling locations. Assessment of deep groundwater levels is more accurately made based on the resting water levels recorded during monitoring.
- 6.2.5 A drawing showing the variation of groundwater levels across the site, and anticipated direction of flow is presented in Drawing 4597-ROC-ZZ-XX-DR-ES-ES107 presented in Appendix A. This generally indicates a direction of flow from the northwest to the southeast.

6.3 Below Ground Obstructions

6.3.1 No below ground obstructions were encountered during site investigation works, however bedrock was encountered at relatively shallow depths from 0.70 to 3.00mbgl. A contour plan depicting the depth to bedrock is presented within Appendix A (4597-ROC-ZZ-XX-DR-ES-ES106).

6.4 Soakaway Testing

- 6.4.1 Infiltration Testing was undertaken between the 28th and 31st March 2023 in accordance with BRE Digest 365 Soakaway Design. In total eight positions (SA01 to SA08) were identified and coordinated with the proposed masterplan across the site to establish the infiltration rates within the underlying strata. Site works were organised by RoC Consulting with water supply, infiltration testing and subsequent infiltration rate calculations provided by Structural Soils Ltd.
- 6.4.2 Infiltration testing locations at SA01 to SA08 were dug by machine excavated to depths of between 1.40m and 1.50m. The infiltration test depth was then filled with 20mm gravel to prevent collapses during testing and water was poured to fill the pits to a depth of between 0.65m and 0.80m. Depth measurements were made at regular intervals in the monitoring standpipe using an electronic dip tape. In the 3 test locations 3 test cycles were completed while in the remaining 5, only two cycles before it was necessary to backfill excavations.



6.4.3 A summary of the infiltration rate results for SA01 to SA08 is presented in the table below.

Location	Test	Date	Infiltration Rate (m/s)		
SA01	1	29.03.23	1.60x10 ⁻⁵		
SA01	2	29.03.23	1.33x10 ⁻⁵		
SA01	3	29.03.23	8.85x10 ⁻⁶		
SA02	1	29.03.23	7.44x10 ⁻⁶		
SA02	2	29.03.23	5.56x10 ⁻⁶		
SA02	3	30.03.23	4.50x10 ⁻⁶		
SA03	1	30.03.23	8.55x10 ⁻⁶		
SA03	2	30.03.23	7.58x10 ⁻⁶		
SA03	3	not comple	eted due to time constraints		
SA04	1	30.03.23	4.74x10 ⁻⁶		
SA04	2	30.03.23	4.58x10 ⁻⁶		
SA04	3	not comple	eted due to time constraints		
SA05	1	30.03.23	6.58x10 ⁻⁶		
SA05	2	30.03.23	6.76x10 ⁻⁶		
SA05	3	not comple	eted due to time constraints		
SA06	1	31.03.23	9.62x10 ⁻⁶		
SA06	2	31.03.23	1.02x10 ⁻⁵		
SA06	3	not comple	eted due to time constraints		
SA07	1	31.03.23	1.32x10 ⁻⁵		
SA07	2	31.03.23	1.20x10 ⁻⁵		
SA07	3	not comple	eted due to time constraints		
SA08	1	31.03.23	1.37x10 ⁻⁵		
SA08	2	31.03.23	1.20x10 ⁻⁵		
SA08	3	31.03.23	1.60x10 ⁻⁵		

6.5 Plate Load Testing

6.5.1 Plate load testing was undertaken within trial pits formed on site in order to establish CBR values of underlying soils.



6.5.2 Results of plate load test data are presented in Appendix D. The results are summarised in the table below.

Table 6.7 Plate Load Testing Results

Test ID	Method	Strata	Depth		Modulus of Sub- Grade Reaction	
			(m)	(%)	k ₃₀₀ (kN/m ² /m)	k ₇₆₂ (kN/m²/m)
TP102	Plate Bearing (300mm plate)	Gravelly sand	0.60	28.00	228000	100297
TP103	Plate Bearing (300mm plate)	Clay	0.60	3.60	69600	30617
TP105	Plate Bearing (300mm plate)	Clayey sand	0.50	1.60	44000	19356
TP107	Plate Bearing (300mm plate)	Gravelly sand	0.60	1.50	42400	18652
TP108	Plate Bearing (300mm plate)	Sandy clay	0.60	4.30	76800	33784
TP109	Plate Bearing (300mm plate)	Clay	0.60	7.70	107200	47157
TP112	Plate Bearing (300mm plate)	Clay	0.60	2.40	54400	23931
TP114	Plate Bearing (300mm plate)	Gravelly sand	0.60	21.00	192000	84461
TP116	Plate Bearing (300mm plate)	Gravelly sand	0.60	4.1	74400	32729

- 6.5.3 Plate bearing tests were undertaken on Devensian Till or weathered bedrock soils beneath topsoil. As indicated in the results there is a marked variance in CBR values with no clear corelation with depth. Overall, an average CBR value of 8.4% was noted between test locations.
- 6.5.4 However, given the variance it would be prudent to adopt slightly lower values of 5% within granular material and 2.5% within cohesive material, for road and pavement design. This should follow proof rolling and removal of soft spots, and supplementary testing of formation levels should be completed during construction works by contractors to confirm these values are being achieved as a minimum. Where the formation fails the 5% either excavations should be locally extended, or the construction build up adjusted to suit location specific values. It should be noted these values are reflective of site conditions at their current level and do not consider potential impact of site own material being placed in areas of fill as part of wider earthworks process.

6.6 Hand Shear Vane Testing

6.6.1 Hand shear vane was undertaken within clay deposits within trial pits formed on site, in order to establish the shear strength of clay soils. The results of hand shear vane testing are presented below in table 6.8.



Table 6.8 Plate Load Testing Results

	TP101	TP104	TP106	TP109	TP112
Test Depth (m)	1.00	0.60	0.50	0.75	0.60
Shear Strength (kPa)	105	96	100	104	110
BS EN ISO 14688-2:2004 Undrained Strength Classification	High	High	High	High	High

6.7 CPT Testing

- 6.7.1 A total of 14 Cone Penetrometer Tests were undertaken within the footprint of proposed warehouse buildings to supplement data on ground conditions provided by rotary boreholes and machine excavated trial pits. The first 11 of these are designated CPT101-114 and were undertaken remote from other locations. Three additional tests were also undertaken in the locations of TP104, TP111, and TP115.
- 6.7.2 Results of the testing, and methodology for classification is presented within the Lankelma CPT Testing Report contained within Appendix D. As a non-visual, non-sampling investigation technique the results and classifications presented by the report are based on on-board instrumentation and insitu testing.
- 6.7.3 The classifications made by the report are generally considered to be similar to those made by RoC Consulting using other investigation techniques and we have confidence in their accuracy. They generally indicate that Devensian Till soils exhibit shear strength of between 100kPA and 150kPa where present.

Location	Depth of clay (where noted) (mbgl)	Shear strength range (kPA)	Min angle of friction (φ)	Depth of SPT refusal equivalent (50+)
CPT101	-		37	1.2
CPT102	-		38	0.9
CPT103	0.9	50 - 275		1
CPT104	1.2	60 - 280		>1.4
CPT105	-		38	0.7
CPT106	-		38	1.1
CPT107	-		38	1.4
CPT108	-		39	1.3
CPT109	-		38	2.3
CPT110	-		38	0.9
CPT111	-		36	1.4
TP104	0.94	55 - 280		1.2
TP111	-		37	>1.2
TP115	-		38	1.3



7.0 Laboratory Testing

7.0.1 To establish the physical and chemical properties of underlying soils, a programme of laboratory analysis was completed utilising samples obtained during site investigation works. This analysis comprised the testing of soil samples to assist with the estimation of risks posed by contaminated land related concerns.

Chemical Testing

7.0.2 RoC Consulting submitted a total of 23 soil samples to a UKAS accredited testing facility for analysis against a range of determinands synonymous with the site former industrial activity.

Determinands	No. of Tests
Toxic and phytotoxic metals and metalloids	23
Total & Speciated Polycyclic Aromatic Hydrocarbons (PAH),	23
Other inorganic substances (e.g., Sulphate, Cyanide etc)	23
Asbestos ID	2
Water Soluble Sulfate & pH	23
WAC Testing	2

7.0.3 Copies of chemical testing results have been provided within Appendix C.

Geotechnical Testing

7.0.4 A programme of geotechnical laboratory analysis was also completed on disturbed and undisturbed soil samples obtained during site investigation works.

Plasticity Index

7.0.5 A total of 4 soil samples were tested for the determination of plasticity index. The depth range of samples tested varied from 0.50m to 0.60m with a mean depth of 0.58mbgl. The plasticity index range varied between 11% and 38% with a mean value of 20.5%. These results indicate clays to be of a predominantly low plastic nature with a sample from TP108 being of a high plastic nature.

Particle Size Distribution

7.0.6 A total of 5 bulk samples were subject to particle size distribution testing to confirm their principal constituent parts. 4 of these comprise weathered bedrock material and 1 comprises clay of the Devensian Till. Generally, the test results support the soil classifications made in the field.



Point Load Testing

7.0.7 A total of 123 core samples of sandstone were subject to point load testing to provide an indirect measure of compressive strength. Results from these tests indicate that Is(50) values for the sandstone range between 0.02MPa and 0.43MPa.

Uniaxial Compressive Strength Testing

- 7.0.8 A total of 19 rock core samples were subject to UCS testing to confirm their unconfined compressive strength. Samples ranged in depth from 3.26 to 18.78mbgl. Reported UCS values ranged from 13.1MPa to 26.3MPa with a mean value of 20.8MPa. Generally, the results are considered to support the rock descriptions made in the borehole logs.
- 7.0.9 Results from geotechnical laboratory testing have been provided within Appendix D.



8.0 Geo-Environmental Assessment

- 8.0.1 The results from the intrusive Phase 2 ground investigation have been used to complete a refined assessment of risks posed by ground contamination and ground stability issues beneath the site, building on the model and assessment outlined in the Phase 1 Desktop Study. The assessment considers these risks both in terms of the current site arrangement and usage, as well as any potential future development (and associated construction process).
- 8.0.2 The assessment has been collated with reference to various statutory and non-statutory guidance documents relating to land contamination and ground stability. Specifically, the assessment has been conducted in accordance with the Environment Agency Land Contamination Risk Management (LCRM) guidance relating to the "Tier 2 Generic Quantitative Risk assessment" process (revised April 2021).
- 8.0.3 In accordance with this method, a Refined Conceptual Model has been collated for the site based on the results of the desktop review. This model is based around the Source / Pathway / Receptor methodology as outlined in Fig 8.0.

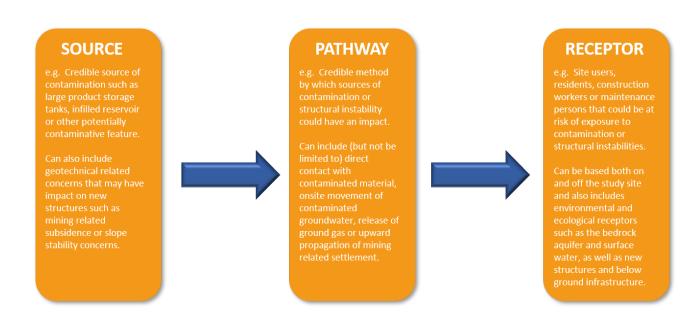


Figure 8.0 Source Pathway Receptor Diagram

8.0.4 Risk assessment is the process of collating known information on a hazard or set hazards in order to establish actual or potential risks to receptors. The receptor may be human health, controlled waters, a sensitive local ecosystem or even construction materials. Receptors can be connected with the hazard under consideration via one or several exposure pathways (e.g., the pathway of direct skin contact and oral exposure).



- 8.0.5 Risks are generally managed by isolating or removing the hazard, isolating the receptor, or by intercepting the exposure pathway. Without the three essential components of a source (hazard), pathway and receptor, there is deemed to be no risk. In other words, the mere presence of a hazard at a site does not mean that there will necessarily be risks.
- 8.0.6 Potential sources of contamination have been identified across the site, where applicable, based on observations and information obtained during the desktop review. These sources are defined based on the results from site investigation fieldworks and subsequent laboratory analysis of samples / monitoring works.
- 8.0.7 The risk assessment has been completed with reference to the guidance outlined within CIRIA 552 "Contaminated land risk assessment. A good practice guide". This risk assessment methodology considers the potential consequence and severity of risks that may be present within soils, and then compares these with the likelihood of occurrence and exposure of said risk. A range of risk classifications are provided within CIRIA 552 further details of which are provided in Table 8.0 below.

Table 8.0 Definition of Risk Class and Consequence

Risk Class	Definition	Example		
Minor	Potential for harm, although not significant, which may result in financial loss to resolve. Ground conditions where the use of PPE would readily mitigate risks posed to human health.	Low level contamination hotspots within made ground / demolition fill materials. Stunted or impeded plant growth due to poor soil quality.		
Mild	Pollution of non-sensitive water resources or damage to crops, plant growth, below ground utilities or structures.	Perched groundwater contamination overlying low permeability aquifer or aggressive sulphate concentrations in soils.		
Medium	Sources of contamination identified on site have the potential to cause both long and short-term health effects on site to residents / users. Alternatively (or in conjunction with) sources of contamination may have the potential to impact surface or groundwater quality or impede vegetation growth.	Elevated concentrations of hydrocarbon contamination reported within topsoil tested within residential gardens as a result of inadequate or incomplete previous remediation works. Movement of contaminated groundwater from leaking below ground storage tank into adjacent surface water course.		
Severe	Sources of contamination pose a credible and acute risk to human health with potential for "Significant Harm" occurring as defined by the Part IIA of the Environmental Protection Act (1990). Alternatively (or in conjunction with risks posed to human health) sources of contamination may pose an immediate risk to controlled water resources or ecosystems.	Grossly contaminated soils are encountered or disturbed during excavation works, causing an immediate release of toxic soil vapour and leachate / contaminated groundwater flow across adjacent land.		



8.0.8 As previously discussed the contaminated land risk assessment model evaluates the severity of risks that may be present within soils / groundwaters in the context of threats posed to identify receptors before deriving the actual risk rating based on the probability of occurrence. Table 8.1 below outlines the range likelihood of risk.

Table 8.1 Probability Assessment

Classification	Definition
High likelihood	A credible pollutant linkage has been identified and it is very likely contaminants will impact identified receptors in both the short or long term (or is already actively doing so). The potential for harm to be caused is thus highly likely.
Likely	Pollutant linkages between the sources of contamination and identified receptors are present and it is considered likely they will become active given the right set of circumstances (e.g., contaminants currently buried below ground that are likely to be exposed or disturbed during construction / excavation works. The circumstances are such that an event is not inevitable, however it is possible in the short term and likely over the longer term.
Low likelihood	A theoretical pollutant linkage has been identified that has the potential to expose receptors to contaminants under the correct circumstances. However, the likelihood of such an event occurring is not a certainty, even in the long term.
Unlikely	There is no / minimal likelihood a pollutant linkage would occur, even over the long term.

8.0.9 The risk assessment process is a combination of probability and consequence, recognising that it may be possible to have a significant source of contamination beneath a site (such as a large below ground chemical storage tank) that may only present a relatively moderate to low risk (owing to the fact it may be contained within a secure concrete bund). Table 8.2 indicates how the actual nature of risk is established with Table 8.3 illustrating how the risk is interpreted in the context of contaminated land risk assessment.

Table 8.2 Risk Definition

		Consequence						
		Severe Medium		Mild	Minor			
	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk			
bility	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk			
Probability	Low Likelihood Moderate Risk		Moderate / Low Risk	Low Risk	Very Low Risk			
	Unlikely	Moderate / Low Risk	Low Risk	Very Lo	w Risk			



Table 8.3 Description of Risks Posed

Risk Definition	Description						
Very High	Active pollutant linkages between a significant source of contamination and identified receptors have been establish and there is a high likelihood of severe harm occurring to said receptors unless immediate investigation and remediation action is not taken.						
High Risk	Harm is likely to arise to receptors from an identified hazard in the short and long term. Urgent investigation of the contaminant issue will be required, and remedial treatment is likely.						
Moderate Risk	The possibility of harm has been identified toward receptors under the right circumstances, although the severity of harm would be relatively mild. Further investigation of identified issues would be prudent and possible need for remedial measures in the long term.						
Low Risk	It is possible harm could arise to a designated receptor from identified hazard, but it is likely (if realised) any harm would be (at worst) mild.						
Very Low Risk	No significant pollutant linkages have been identified and the possibly of harm occurring to receptors is low.						

- 8.0.10 A Preliminary desk-based risk assessment has been completed for the site utilising the current and historical environmental information available (Phase 1 Desktop Study completed by Wardell Armstrong dated January 2023 (ref: GM12634).
- 8.0.11 The Tier 2 risk assessment process can be divided based on the receptor group in question between:
 - 1. Risks posed to human health by soil contamination (both construction persons and future site users).
 - 2. Risks posed to human health by hazardous ground gas ingress (both construction persons and future site users).
 - 3. Risks posed to controlled waters by soil or groundwater contamination (both surface water features and bedrock aquifers).
 - 4. Risks posed to new building construction by aggressive ground conditions (namely elevated sulphate concentrations).
- 8.0.12 It is noted the site is being developed for Commercial use with several warehouses, access roads, car parking, service yards and areas of soft landscaping proposed. All major pathways are considered to be present with the exception of those relating to homegrown vegetable.
- 8.0.13 Appropriate assessments have been completed for each of the above utilising the latest statutory and non-statutory guidance documents; for details of risks posed to human health refer to Section 8.1 (soils) and Section 8.2 (ground gas), for details of risks posed to controlled waters refer to Section 8.3 and risks posed to new structures refer to Section 8.4.



8.1 Assessment of Soil Contamination

- 8.1.1 In order to estimate the risks posed to human health from soil contamination, a quantitative risk assessment has been completed utilising the latest Environment Agency CLEA methodology. The assessment utilises the chemical testing results obtained during the site investigation fieldworks to characterise site conditions and facilitate the completion of the risk assessment process.
- 8.1.2 The assessment is based on the comparison of soil chemical testing results with published Environment Agency Category Four Screening Levels (C4SL's) under the proposed end use scenario to determine the site suitability for use. C4SL values represent the highest acceptable values for contaminants within site soils under the proposed end use and are derived using the Environment Agency CLEA risk assessment methodology. A result in exceedance of a C4SL level may indicate the presence of contaminants within site soils and require further assessment.
- 8.1.3 It is noted only a limited number of C4SL values have been derived by the Environment Agency for use and reference has been made to LQM/CIEH Suitable For Use Values (S4UL's) for a wider range of other contaminants (Heavy Metals, Poly Aromatic Hydrocarbons, TPH, SVOC and VOC's) to increase the depth and robustness of our assessment.
- 8.1.4 Chemical testing results are compared against C4SL and S4UL values for each determinant with any results reported in exceedance of screening criteria identified and their significance reviewed. When determining the significance of any exceedances within the dataset the magnitude and frequency of the exceedance needs to be taken into account, for example, a single exceedance of a screening value may be considered a localised hotspot whereas consistently elevated levels of a substance at multiple locations across the site may indicate a more prevalent contamination issue.
- 8.1.5 In addition to this assessment, an Asbestos Identification test (via the visual inspection method) has been completed on all samples of made ground obtained during the investigation to determine risks posed. Any positive occurrences of Asbestos will be subject to quantification analysis to further assess the extent and significance of risks posed.
- 8.1.6 As required, for each exceedance reference will be made to the Conceptual Site Model to establish the most likely source of contaminants and initial commentary given as to the likely scope of remedial measures. In addition, reference will also be made to the assumptions used to derive generic assessment criteria (C4SL and S4UL values) to determine their comparability with the proposed end use.
- 8.1.7 For the purposes of this assessment we have assumed a "commercial" end use scenario when reviewing chemical testing data against C4SL / S4UL values; a "worst case" Soil Organic Matter content value of 1% has been assumed for the initial assessment.



Summary and Assessment of Risks Posed by Soil Contamination

- 8.1.8 Results from chemical testing analysis indicate that no concentrations of contaminants in excess of Generic Assessment Criteria were encountered on site. Similarly, there was no positive identification of the presence of asbestos. As visual and olfactory evidence of contamination has not been observed, we consider there to be no evidence of the presence of significant sources of contamination.
- 8.1.9 The findings of the above have been used to update the Refined Conceptual Site Model (provided within Section 9.0) as well as inform the scope of any further investigation or remedial works deemed necessary to support the development of the site.

8.2 Ground Gas Risk Assessment

8.2.1 The Preliminary Conceptual Site model did not identify any specific potential sources of ground gas that posed a risk to the site. Intrusive investigations undertaken on site also failed to reveal any potential sources of ground gas. As such it has been deemed unnecessary to assess ground gas risk to the site.

8.3 Controlled Waters

- 8.3.1 It is understood the site is underlain by a Principal Aquifer and is located within an Environment Agency source protection zone 3. The site is not in close proximity to sensitive groundwater abstraction boreholes. The nearest surface water feature is indicated 400m to the southwest of the site and is not considered to be at risk of contaminant migration from the study site. Groundwater monitoring following the site investigation indicates that groundwater is present at the site at depths of between 7.14m and 9.43m during summer months.
- 8.3.2 Given the site long standing operation as agricultural farmland and noting an absence of any sources of soil borne contamination within chemical testing results from ground investigations, we are of the view the risks posed to controlled waters will be low. These risks are further reduced by the results from groundwater level monitoring which indicates the saturated zone of the Sandstone aquifer occurs at depths >6m below ground level. As such we don't not feel the collection of groundwater chemical samples is required to characterise risks posed to the bedrock aquifer.
- 8.3.3 While permeable soils are likely to be present on site and potential pathways may exist, this pathway is only likely to apply in the proposed end use or during the construction process, relating to fuel storage or accidental spillage. During the construction process appropriate control measures and mitigations will be required by contractors to limit the risk of accidental spillage of fuel or chemicals stored on site, this is of particular concern given the fact shallow depth of Sandstone bedrock across the site and likelihood of it being exposed during earthworks operations. We consider this risk to be controllable through good drainage design and site management practices, for example the use of fuel interceptors and environmental regulation of premises.



8.4 Below Ground Utilities and Service Runs

8.4.1 In the absence of the identification of significant sources of contamination, we do not consider there to be a specific risk to below ground utilities requiring assessment, for example, in accordance with the UKWIR methodology. However, if any made ground is encountered during the construction process in or around areas of proposed water supply pipe runs this assessment will need to be revisited and appropriate testing / mitigation measures derived.



9.0 Refined Conceptual Site Model

9.0.1 The Environmental Protection Act Part IIA: 1990, defines contamination as land containing levels of contamination which form a risk to human health, controlled waters or other ecosystems. Therefore, contamination in exceedance of the relevant screening values is considered a source. Table 9.0 assesses and summarises the sources, pathways and receptors that may exist at the site.

Table 9.0: Refined Conceptual Site Model

	Table 9.0		Refined Conceptual Site Model							
	Source	Pathway	Receptor	Severity	Probability	Risk definition	Comments			
			Current Site Uses	Mild	Unlikely	Very Low	The site is current used as agricultural farmland with ground investigation works confirming no sources of contamination are present.			
On Site	Current Ground Conditions	Dermal contact and / or ingestion; inhalation of vapours / dusts	Construction workers	Mild	Low Likelihood	Low	Although construction workers have more potential risks of exposure to contaminants, we consider there is a low likelihood of such an occurrence given current and previous agricultural operations across the site (as is supported by results of current geo-environmental assessment). However, a small-scale residual risk will remain and we recommend that any contamination observed during construction is brought to our attention and managed. Full PPE good hygiene and site practices should be adopted on site.			
			Future Site Users & Ecological receptors	Mild	Low Likelihood	Low	As no sources of soil contamination have been noted on site, and given proposed commercial warehouse redevelopment proposals, we do not consider there to be any risks posed toward future site users.			



	Table 9.0		Refined Conceptual Site Model						
	Source	Pathway	Receptor	Severity	Probability	Risk definition	Comments		
	Current Ground Conditions	Leaching of contaminated soil & leachate into Sandstone Aquifer and SPZ 3	Controlled Waters: Aquifer	Mild	Low Likelihood	Low	As noted in soils testing no sources of contamination have been noted on site; generally, their likelihood across areas of the site are considered to be low given long standing agricultural operations. As such we do not consider the site poses a risk to controlled waters, however exposure pathways will be created during the construction and operational phases of the development that will require due consideration and mitigation.		
On site			Adjacent Sites	Mild	Unlikely	Very Low	Potential sources are limited and have not been proven by site observations or testing.		
O	Ground Gas and radon	Migration / Accumulation	Current Site Users	Mild	Unlikely	Very Low	Significant sources of ground gas were not observed by the Phase 1 assessment and the observations of the fieldwork have confirmed this with no filled ground, organic rich soils or potential sources of on site gas generation noted. As such we do not consider the use of gas protection measures will be required in new building construction. The radon assessment has not identified the need for protection measures.		



Off site		Potential off- site sources	Leaching of contaminated soil onto site	Controlled Waters: Aquifer	Mild	Unlikely	Very Low	Potential offsite sources of contamination were limited and have not been identified through observations or testing.
	J		Ground gas Migration / Accumulation	Construction workers	Mild	Unlikely	Very Low	
				Future Site Users	Mild	Unlikely	Very Low	
				Proposed development	Mild	Unlikely	Very Low	

^{*}Any sources of contamination uncovered during site development works should be brought to the immediate attention of RoC Consulting for consideration and comment.



Soil Contamination Remedial Requirements

- 9.0.2 Re-appraisal and reassessment of the conceptual site model (following completion of investigation works) has failed to reveal any specific sources of contamination that could require specific remedial measures.
- 9.0.3 It is recommended all construction contractors take reasonable precautions to control environmental impacts that may occur as a result of redevelopment works with respect of soil and groundwater quality. These measures should include (and not be limited to):
 - Any sources of contamination uncovered during site development works should be brought to the immediate attention of RoC Consulting for consideration and comment. As required, the findings and recommendations of the current assessment may require amendment to reflect changes in site condition.
 - 2. The operation of plant, refuelling facilities and general basement excavation works should include appropriate provision to reduce the risk of leakage / spillage, particularly into the site groundwater table or exposed natural soils.
 - 3. Appropriate dust mitigation measures should be deployed during basement excavation works, particularly when handling and excavating made ground deposits.
 - 4. All excavated materials stockpiled should be periodically dampened down to control dust release. Similarly, the disposal of any material from site should be completed using covered wagons.

Ground Water Remedial Requirements

- 9.0.4 No sources of soil contamination have been revealed during ground investigation works. Although the site is underlain by predominantly permeable soils and a principal aquifer is located at shallow depth beneath the site due to the lack of any sources of soil contamination it is not considered any risks are posed to controlled water resources.
- 9.0.5 Due consideration and mitigation will be required during the construction and subsequent operational phases of the development to ensure no sources of mobile contamination are introduced into the Sandstone bedrock. Such releases, via accidental spillage and leakage would have the potential to impact water quality within the underlying aquifer and SPZ 3 which will be exacerbated by the shallow depth at which the Sandstone occurs beneath the site and the high likelihood of it being exposed during construction (or left in situ at founding level).

Ground Gas Protection Measures

9.0.6 No significant potential sources of ground gas have been identified and no further assessments are considered to be necessary.





10.0 Preliminary Waste Assessment

10.0.1 Site soils may be considered to comprise waste depending on the circumstances. The Waste Framework Directive (WFD) defines materials as waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not typically considered waste if reused on the site of origin for the purposes of development. Excavation arisings from the development may therefore be classified as waste if surplus to requirements or unsuitable for reuse. A large volume of laws, permitting and regulations govern the management of waste on construction sites, including Environmental Permits, Materials Management Plans and Construction Environmental Management Plans. The below assessment only provides some useful information which may inform future planning.

10.1 Hazardous Waste Assessment

Chemical Assessment

- 10.1.1 A methodology for the classification of waste, and requirement for sampling, is specified in Technical Guidance WM3 (EA, 2021). The level of sampling should be proportionate to the volume of waste and its heterogeneity. The preliminary assessment provided below is indicative based only upon the available sample results and may not be sufficient to adequately classify the waste.
- 10.1.2 Envirolab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool to assess the hazardous properties to support potential off-site disposal of materials in the future. Note that it is ultimately for landfills to confirm what wastes they are able to accept within the constraints of their permit.
- 10.1.3 No samples were found to have hazardous properties based on this assessment. This suggests that if applicable the waste would require disposal at a suitably permitted inert or non-hazardous waste landfill. The results are summarised in the table below and presented in full in Appendix I.

Location	Depth	Strata	Hazardous properties (if present)
TP101	0.40	Topsoil	None
TP101	1.00	Devensian Till	None
TP102	0.50	Topsoil	None
TP104	0.20	Topsoil	None
TP106	0.30	Topsoil	None
TP110	0.30	Topsoil	None
TP111	0.20	Topsoil	None





Location	Depth	Strata	Hazardous properties (if present)
TP113	0.20	Topsoil	None
TP115	0.20	Topsoil	None
TP107	0.30	Topsoil	None
TP114	0.20	Topsoil	None
TP103	0.50	Devensian Till	None
RBH101	0.25	Topsoil	None
TP105	0.60	Chester Formation	None
RBH102	0.70	Chester Formation	None
TP116	0.20	Topsoil	None
TP112	0.40	Devensian Till	None
TP109	0.60	Devensian Till	None
TP108	0.20	Topsoil	None
RBH105	1.00	Chester Formation	None
RBH106	1.00	Chester Formation	None
RBH104	0.20	Devensian Till	None
RBH107	0.30	Topsoil	None

Asbestos Assessment

- 10.1.4 The Environment Agency publication 'Guidance on the classification and assessment of waste WM3 (2018)', requires that within a mixed waste the separately identifiable wastes be assessed separately. For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. This should be disposed of within a hazardous, stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.
- 10.1.5 With reference to WM3 (2018), wastes containing greater than 0.1% free and dispersed asbestos fibres are classified as **hazardous waste** with the code 17 05 03* (soils and stones containing hazardous substances). Where a waste contains identifiable pieces of ACM, then these pieces must be assessed separately.
- 10.1.6 Laboratory testing has not encountered positive identification of asbestos fibres within soils. Based on our desk study no obvious source of Asbestos Containing Materials has been identified and thus the site soils are not considered to be hazardous of the basis of asbestos content.





10.2 WAC Assessment

- 10.2.1 Additionally, a testing regime has been established in 'Waste Sampling and Testing for Disposal to Landfill' (2013) to determine the suitability of soils for disposal. This regime does not supersede the hazardous properties assessment presented above.
- 10.2.2 We have scheduled testing of one sample on this basis, the results of which are presented in Appendix I. The sample has been taken from TP101 at a depth of 0.40m and is considered representative of site topsoil.
- 10.2.3 Comparison of test data with landfill waste acceptance criteria indicates that soils from the site are suitable for disposal at an inert landfill or a site that has a valid exemption from the Environmental Permitting (England and Wales) Regulations 2016 (as amended) registered with the EA.

10.3 Conclusions

- 10.3.1 Based on laboratory testing we consider that soils at the site can be considered to be non-hazardous and are suitable for disposal as inert waste.
- 10.3.2 With reference to the Environment Agency's publications Waste Sampling and Testing for Disposal to Landfill (2013) and Waste acceptance at landfills (2010), naturally occurring soils not likely to be affected by contamination can be classified as inert waste, with a EWC code of 17 05 04. Should any of the naturally deposited soils be suspected to contain contamination (by virtue of visual of olfactory evidence) upon excavation, then such soils should be stockpiled appropriately, and additional testing carried out as considered necessary.
- 10.3.3 The assessment of this report in regard to waste is indicative only and provides useful information to support future management of waste of site, which should be comprehensive and address all other legal and regulatory requirements. Extensive earthworks are anticipated at the site that will require Environmental Permits and Materials Management Plans. Further environmental testing of soils and subsequent treatment and processing may also be required. It may be necessary to consult with the Environment Agency before works commence to verify the proposed works and establish that material can be declassified as waste and reused on site in accordance with the most current guidance and Article 6(1) of the Waste Directive. These applications are the responsibility of the contractor. We can consult on these matters on request.
- 10.3.4 We recommend this report is provided to the selected contractors and landfill facilities to confirm (or otherwise) that waste can be managed and disposed of as above. Please be aware that landfill sites are obligated to undertake in house quality assurance tests and thus may require further WAC testing for any soils encountered as part of this investigation. There is no obligation on any landfill operator to accept waste if they choose not to and waste operators may require additional testing of untested waste soils prior to acceptance at landfill in accordance with the landfill regulations.





11.0 Geotechnical & Foundation Design Assessment

Background Information

- 11.0.1 It is understood that the site is to be redeveloped for commercial use in accordance with AEW architect's drawing (ref: 13063-AEW-XX-XX-DR-A-0005-P8) provided within Appendix A. It is understood the development will include 4 commercial logistics buildings up to 250m in length, with associated areas of external parking, soft landscaping, attenuation ponds and access roads. At the time of writing the design loadings and foundation layouts of the proposed new building are not known.
- 11.0.2 Site investigations indicated that the site soils typically comprise:
 - A covering of topsoil typically 0.40m in thickness
 - Clay soils of the Devensian Till in the southeastern part of the site, with an average depth of 0.90m
 - Weathered sandstone bedrock of the Chester Formation or Kinnerton Sandstone Formation in all locations, underlying either topsoil or the Devensian Till where present
 - In-tact bedrock of the Chester Formation or Kinnerton Sandstone Formation. The depth to bedrock typically varies from 1.55m in the southeast of the site to 2.55m in the northwest of the site.
- 11.0.3 Groundwater monitoring following the site investigation indicates that groundwater is present at the site at depths of between 7.14m and 9.43m during summer months. It is feasible this may rise in the winter.

11.1 New Building Foundation Design

- 11.1.1 The building foundation scheme, including sizes and depths, have not yet been established. It is understood that the preference would be to construct the proposed logistics buildings on traditional mass-filled strip or pad foundations.
- 11.1.2 The proposed cut and fill levels are indicated on drawing 4597-ROC-ZZ-XX-DR-C-0601 P02 presented in Appendix A. From these the following likely foundation depths, supporting strata and depth of overburden can be determined.





Building	Range of current site levels (mAOD)	Finished Floor Level (mAOD)	Cut or fill	Likely Foundation Level (mAOD)	Foundation Strata	Design Thickness of Overburden (non-fill)
Unit 01	c36-32.50	36.00	Om to 3.5m fill	32.00	Weathered Kinnerton Sandstone Formation	0
Unit 02	c 35-36.00	36.25	0.25 to 1.25m fill	34.75	Weathered Chester Formation	0
Unit 03	c 34 -36.50	36.00	0.5m cut to 2.0m fill	33.50	Weathered Chester Formation or Devensian Till	0
Unit 04	c 33-34.00	34.00	0 to 1.0m fill	32.50	Devensian Till	0

11.1.3 With reference to the above table, we would anticipate the following founding depths below finished floor levels within each unit. It is likely strip or pad bases founded within the weathered bedrock will need to be taken down and founded to suitable strata at an appropriate level using lean mix concrete.

Unit 1 = 33.0mAOD or 4.0m below finished floor level

Unit 2 = 34.75mAOD or 1.5m below finished floor level

Unit 3 = 33.5mAOD or 2.5m below finished floor level

Unit 4 = 32.50mAOD or 1.5 below finished floor level

- 11.1.4 Given the range of depths noted further consideration of how foundations can be constructed will be required. In areas of the deepest foundations, potentially the lower concrete foundation elements could be brought up at the time of filling. Alternatively a piled foundation solution could be adopted.
- 11.1.5 BS8004-1986 "Code of practice for Foundations", Section 3.2.8 and National House Building Council (NHBC) Standards, Chapter 4.2 give guidance on minimum foundation depths to account for the volume change potential of soils on site. Clay soils at the site are considered to have low to medium volume change potential. It is therefore recommended that to avoid shrinkage or swelling issues that foundations placed within the clay penetrate a minimum of 0.9 m below the top of the stratum
- 11.1.6 Based on our previous experience of similar commercial developments, a foundation size of up to 1750mm x 1750mm has been assumed. Actual performance will vary with size and depth and the performance of the foundations should be reassessed by the foundation designer once foundation depths, sizes and layouts have been determined. With reference to the anticipated depth of founding stratum vs. proposed site level arrangement, it should be noted that foundations may be required at depths up to 4.0m m in some locations. The precise depth of each foundation should be determined by the foundation designer.





11.1.7 Based on the above, and the observations of the site investigation, in-situ and laboratory testing (as indicated in Sections 6.0 and 7.0), the following design parameters have been adopted for this preliminary assessment.

Parameter	Units	Devensian Till (Clay)	Weathered Bedrock (Dense Sand)	Rationale / Method
Design weight of soils	kN/m ³	18	17	BS8004 Figure 1&2 for soils below the water table, worst case (lowest) values for dense sand and high strength clay respectively
Plasticity	Unitless	Low	-	Atterberg Limits testing
Shear Strength	kN/m ²	103	-	Average of in-situ testing. Conservative in comparison to CPT testing.
Angle of Friction (φ)	Degrees	-	37	Worst case of in-situ CPT testing. According to Peck et. al this would correspond to an SPT N Value of 35.
Shape Factor Nc		7		Skempton et al.
Bearing Capacity Factors Ng and Nq	Unitless		90, 70	Terzaghi's method.
Mv	m²/KN	0.0001		In absence of oedometer testing or insitu SPT testing, adopted published values from Thomlinson for medium compressibility clays
Elasticity modulus Eu	kN/m²	13630		Derived from M _V
Geological factor	Unitless	1.0		Published values for normally consolidated clays

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11.1.8 Correspondingly the following ultimate and safe bearing capacity values have been calculated for each proposed building.

Location	Strata	Safe Bearing Capacity (kPA)*	
Unit 01	Weathered Kinnerton Sandstone Formation	270	
Unit 02	Weathered Chester Formation	270	
Unit 03	Weathered Chester Formation	270	
	Devensian Till	150	
Unit 04	Devensian Till	150	
*Factor of Safety of 3 used for safe bearing capacity. Traditional method without partial factors.			

- 11.1.9 It is anticipated that Units 01 and 02 will be founded on soils of the weathered bedrock and Unit 04 will be founded on soils of the Devensian Till. However, Unit 03 may be founded on a combination of the two soil types. In the case of structures spanning both strata, the worst-case values (for Devensian Till) should be adopted, as indicated above. While settlement is anticipated to be minimal, foundations spanning different strata may undergo differential settlement. The significance of this should be assessed in the light of the final foundation layout and the performance requirements of the structure and slab.
- 11.1.10 The above settlement calculations assume a homogenous soil material beneath the foundations. In reality the stress bulbs of foundations in clay soils would span both cohesive and granular soils and perform somewhere between the two scenarios. However, the above represents a reasonable worst case.
- 11.1.11 It should be noted that the above assessment is based on the currently proposed finished floor levels. Given the range of depths noted further consideration of how foundations can be constructed will be required. In areas of the deepest foundations, potentially the lower concrete foundation elements could be brought up at the time of filling. If foundations are required to be placed within engineered fill, this should be designed and engineered to provide similar safe bearing capacities to the surrounding natural material in order to prevent differential settlement between foundations. Alternatively a piled foundation solution could be adopted. Precise foundation design should be confirmed during detailed design.





11.1.12 Mature trees are present to the site boundaries and a small number of proposed foundation locations may be located with the zone of root influence. A full arboricultural assessment has not been undertaken as part of this investigation and the final details of vegetation planting and removal are not known. The effects of proposed vegetation changes should be accounted for in design in accordance with BS8004-1986 "Code of practice for – Foundations", Section 3.2.8 and National House Building Council (NHBC) Standards, Chapter 4.2. This may lead to a requirement for foundations to be deepened locally.

11.2 Floor Slab Construction

- 11.2.1 It is understood that it is intended for ground floor slabs to be ground bearing, at the levels indicated in the table above. Where these are constructed on natural soils, the values of CBR ratio and Modulus of Subgrade Reaction given in Section 6.5 may be used for design. However, based on the supplied finished floor levels, it is anticipated that the majority of slab spans will be constructed on fill material.
- 11.2.2 Consequently, design of ground floor slabs will require further consideration in tandem with the wider development of an earthworks specification for cut / fill process. Due consideration of the impacts and any treatment of fill material will be required as part of this assessment to allow the use of a ground bearing slab for each unit in accordance with recognised standards and best practices in accordance with EC7. In particular, consideration needs to be given to total and differential settlement gradients across the footprint of the floor slab, particularly where the thickness of engineered or un-engineered fill beneath the slab varies. Depending on the required development loading, consideration may be given to suspended (fully piled) floor slabs.

11.3 Access roads and hardstanding

11.3.1 Extensive access roads and areas of hardstanding are proposed, some of which will be subject to heavy loading by Heavy Goods Vehicles. It is likely that these roads will span a combination of natural soils and fill. Where these are constructed on natural soils, the values of CBR ratio given in Section 6.5 may be used for design. In areas of fill, earthworks should be designed to support the roads and hardstanding areas. The quality of these works should be confirmed through in-situ plate bearing and/or nuclear density testing following completion of the earthworks. Overall, as is the case with internal floor slabs, further consideration and assessment of construction methods will be required as part of the wider earthworks design process.

11.4 Below Ground Obstructions

11.4.1 No below ground obstructions were encountered during site investigation. However, shallow bedrock is present at the site and may increase the difficulty of excavations in some locations.





11.5 General Comments

- 11.5.1 No entry should be permitted into excavations without appropriate risk assessments, shoring and support.
- 11.5.2 Similarly it is not recommended foundation excavations to underlying clay be left open and exposed to the elements as rainwater ingress will damage and reduce its strength (and subsequent bearing capacity). Similarly, no vehicular movements should be permitted within exposed foundation locations.
- 11.5.3 The geotechnical assessment has been collated based on the proposed development type, layout and likely loadings at the time of report publication. It should be noted that future alterations to these proposals or loadings (including alterations in the site layout or new building scale) will require the reinterpretation of the current assessment.





12.0 Aggressive Ground Conditions

- 12.0.1 The hazard of sulphide attack is addressed by reference to procedures described in Building Research Establishment (BRE) Special Digest 1: 2005 'Concrete in Aggressive Ground' to establish a design sulphate class (DS) and the 'aggressive Chemical Environment for Concrete' (ACEC).
- 12.0.2 By the definitions provided the site is considered to comprise a greenfield site and the groundwater mobility is considered to be static.
- 12.0.3 The site is not considered to be in an area of elevated sulphate and sulphide bearing strata (see map on page 18 of SD1). Consequently, pyrite is not considered to be present.
- 12.0.4 Sulphate concentrations range between 24 and <10mg/l with soil pH values ranging between 5.3 and 7.2. Based on the site scenario and laboratory testing the Characteristic pH and Characteristic Sulphate levels have been calculated to determine the DS Class and ACEC Class as presented in the table below.

Geological Unit		Characteristic Sulphate (mg/l)	DS Class	ACEC Class
Natural soils and bedrock	5.45	18.7	DS-1	AC-1s





13.0 Conclusions & Recommendations

13.1General

13.1.1 It is understood the development will include 4 commercial logistics buildings up to 250m in length, with associated areas of external parking, soft landscaping, attenuation ponds and access roads. With the exception of the proposed areas of soft landscaping there are limited potential pathways to receptors.

13.2 Geotechnical

- 13.2.1 Site investigations indicated that the site soils typically comprise:
 - A covering of topsoil typically 0.40m in thickness
 - Clay soils of the Devensian Till in the southeastern part of the site, with an average depth of 0.90m
 - Weathered sandstone bedrock of the Chester Formation or Kinnerton Sandstone Formation in all locations, underlying either topsoil or the Devensian Till where present
 - In-tact bedrock of the Chester Formation or Kinnerton Sandstone Formation. The depth to bedrock typically varies from 1.55m in the southeast of the site to 2.55m in the northwest of the site
- 13.2.2 Groundwater monitoring following the site investigation indicates that groundwater is present at the site at depths of between 7.14m and 9.43m during summer months. It is feasible this may rise in the winter.
- 13.2.3 It is anticipated that the proposed buildings will be constructed on traditional concrete pad foundations. A significant foundation depth (up to 4.0m bgl) may be required to penetrate the proposed depth of fill in some locations given current site levels vs. proposed development platforms. The underlying Devensian Till and sand of the weathered bedrock, are likely to prove suitable to support such foundations.
- 13.2.4 Given the range of depths noted further consideration of how foundations can be constructed will be required. In areas of the deepest foundations, potentially the lower concrete foundation elements could be brought up at the time of filling. If foundations are required to be placed within engineered fill, this should be designed and engineered to provide similar safe bearing capacities to the surrounding natural material in order to prevent differential settlement between foundations. Alternatively a piled foundation solution could be adopted. Precise foundation design should be confirmed during detailed design.
- 13.2.5 In-situ plate bearing testing has been undertaken on natural soils at the site to inform the design of ground bearing slabs, access roads and hardstanding areas. However, in many cases these structures will be constructed on fill material. Consequently, further consideration of the construction and treatment of building floor slabs and external pavement will be required as part of the wider earthwork's design / specification process.





13.2.6 Laboratory testing for aggressive ground conditions indicates that a DS class DS-1 and ACEC Class of AC-1s should be adopted for the site.

13.3 Environmental

- 13.3.1 Chemical assessment of site soils has failed to reveal any sources of soil contamination when compared against a "commercial" end use scenario and consequently no remedial measures are recommended. Due care and attention should be taken at all times when excavating site soils and any suspected sources of contamination identified brought to the immediate attention of RoC Consulting.
- 13.3.2 The Phase 1 Report did not identify any viable pathways to controlled waters and the observations of the intrusive site investigation have not led to revision of this assessment.
- 13.3.3 Laboratory testing indicates Made Ground soils at the site are suitable for disposal at an inert landfill site.
- 13.3.4 No significant sources of ground gas have been identified and consequently gas protection measures are not recommended.
- 13.3.5 Earthworks at the site may require Environmental Permits and Materials Management Plans. Environmental testing of soils and subsequent treatment and processing may also be required. It may be necessary to consult with the Environment Agency before works commence to verify the proposed works and establish that the material can be declassified as waste and reused on site in accordance with the most current guidance and Article 6(1) of the Waste Directive. These applications are the responsibility of the contractor. We can consult on these matters on request.
- 13.3.6 As required, any suspected sources of contamination discovered during the site development (outside those discussed in this report) should be brought to the attention of RoC Consulting and their implications assessed. Depending on the extent and severity, the findings and assessment of the current study may require re-interpretation and a remediation strategy proposed to support the site development.

13.4 Recommendations

- 13.4.1 Copies of the current report, along with the Phase 1 Desktop Study, should be submitted to the local planning authority for consideration and comment. As required, any feedback received from the local authority should be passed back to RoC Consulting for review.
- 13.4.2 As required, any suspected sources of contamination discovered during the site development (outside those discussed in this report) should be brought to the attention of RoC Consulting and their implications assessed. Depending on the extent and severity, the findings and assessment of the current study may require re-interpretation and a remediation strategy proposed to support the sites development.



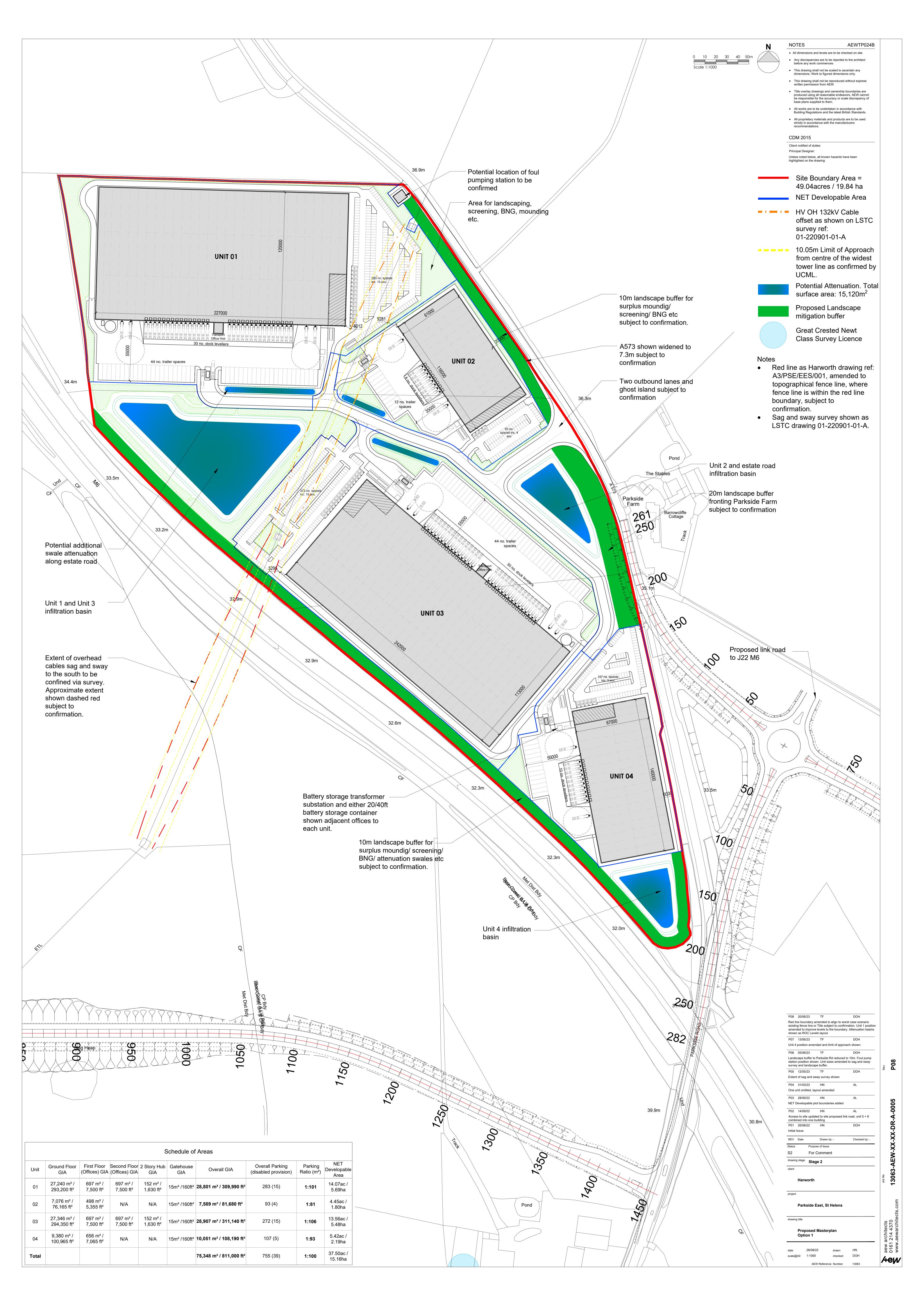


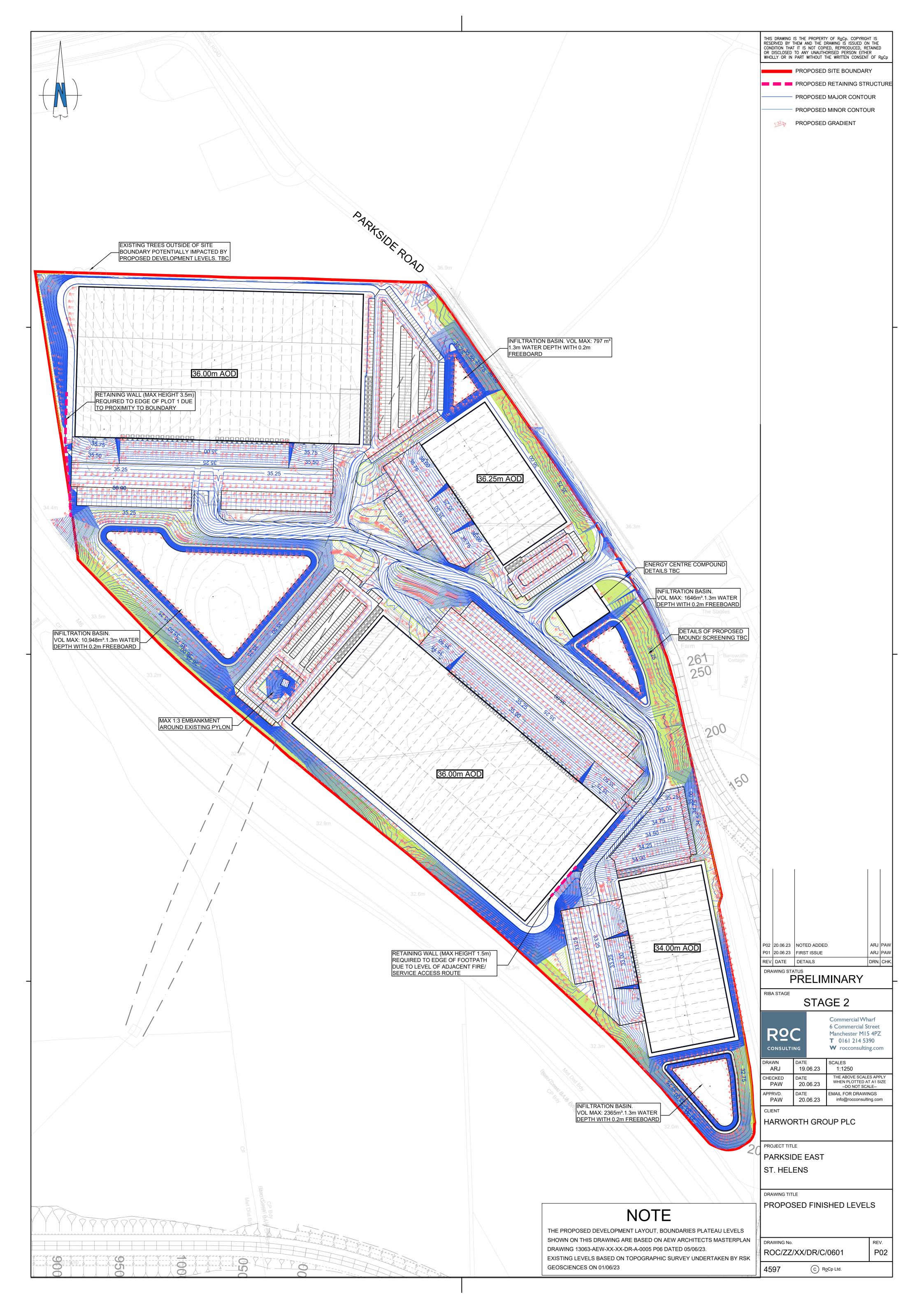
- 13.4.3 Earthworks at the site may require Environmental Permits and Materials Management Plans. Environmental testing of soils and subsequent treatment and processing may also be required. It may be necessary to consult with the Environment Agency before works commence to verify the proposed works and establish that the material can be declassified as waste and re used on site in accordance with the most current guidance and Article 6(1) of the Waste Directive. These applications are the responsibility of the contractor. We can consult on these matters on request.
- 13.4.4 It is noted the current site level arrangement vs. proposed level strategy will require areas of upfilling which will require proper placement to allow for suitable bearing capacity and CBR values to be achieved. As such, it is recommended further consideration and design is completed regarding the construction of building foundations, floor slabs and external pavement as part of the earthworks design and specification process. These designs should be completed with reference to the results of the current Phase 2 Site Investigation report and align with the requirements of Eurocode 7 for earthworks design and construction.
- 13.4.5 It is recommended that on completion of initial design works a suitable earthworks specification is produced in order to enable cut and fill works to be undertaken in order to achieve the performance required by the design. The earthworks specification should be produced by a suitably competent geotechnical engineer in agreement with the foundation designer.

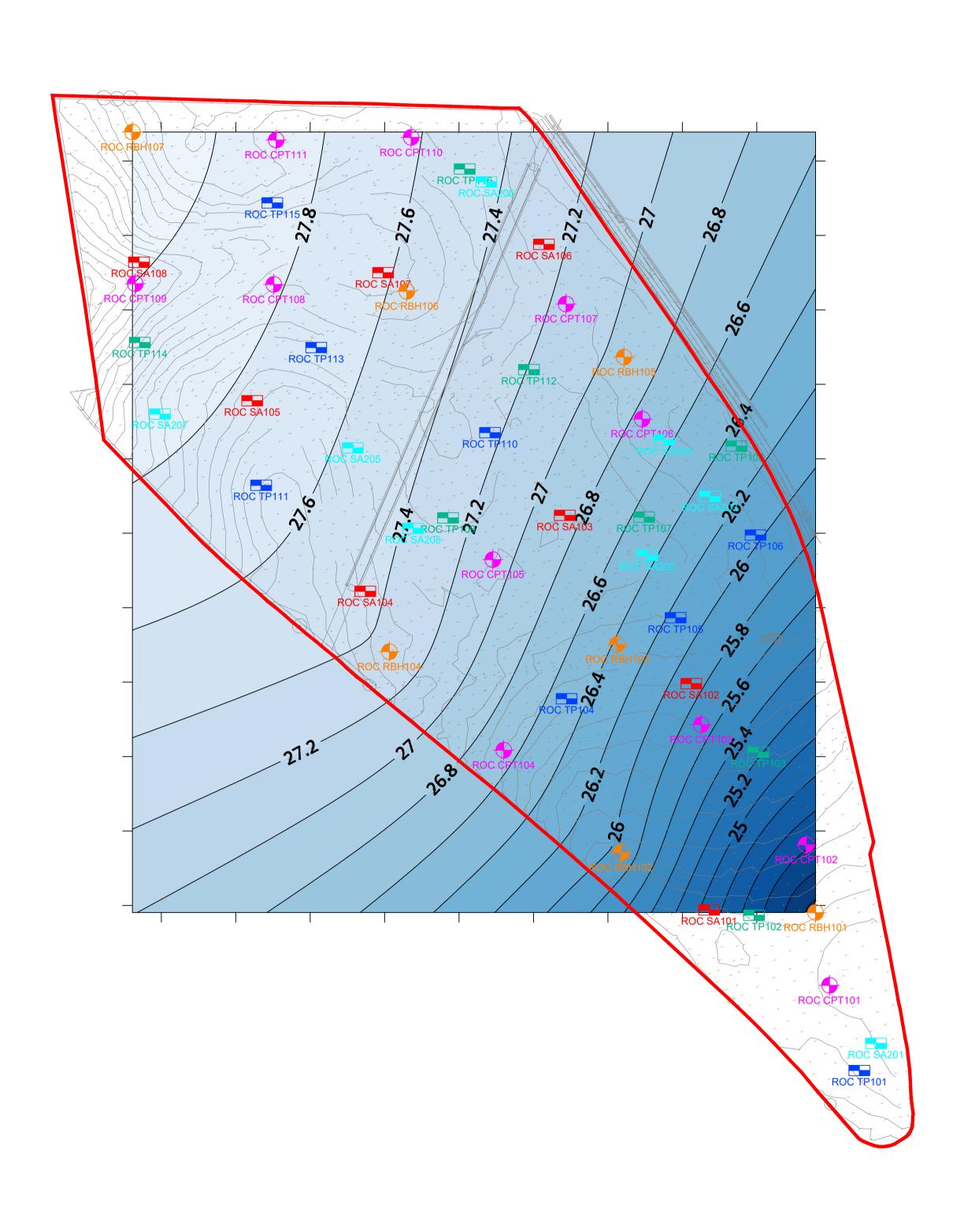
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APPENDIX A – SITE DRAWINGS



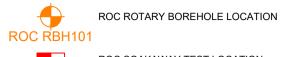


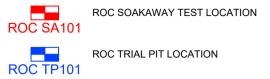


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NOTES

ROC CPT LOCATION







APPROX SITE BOUNDARY

GROUNDWATER DEPTH LEGEND

28.2 28 27.8 27.6 27.4 27.2 27 26.8 26.6 26.4 26.2 26

DRAWING NOTES

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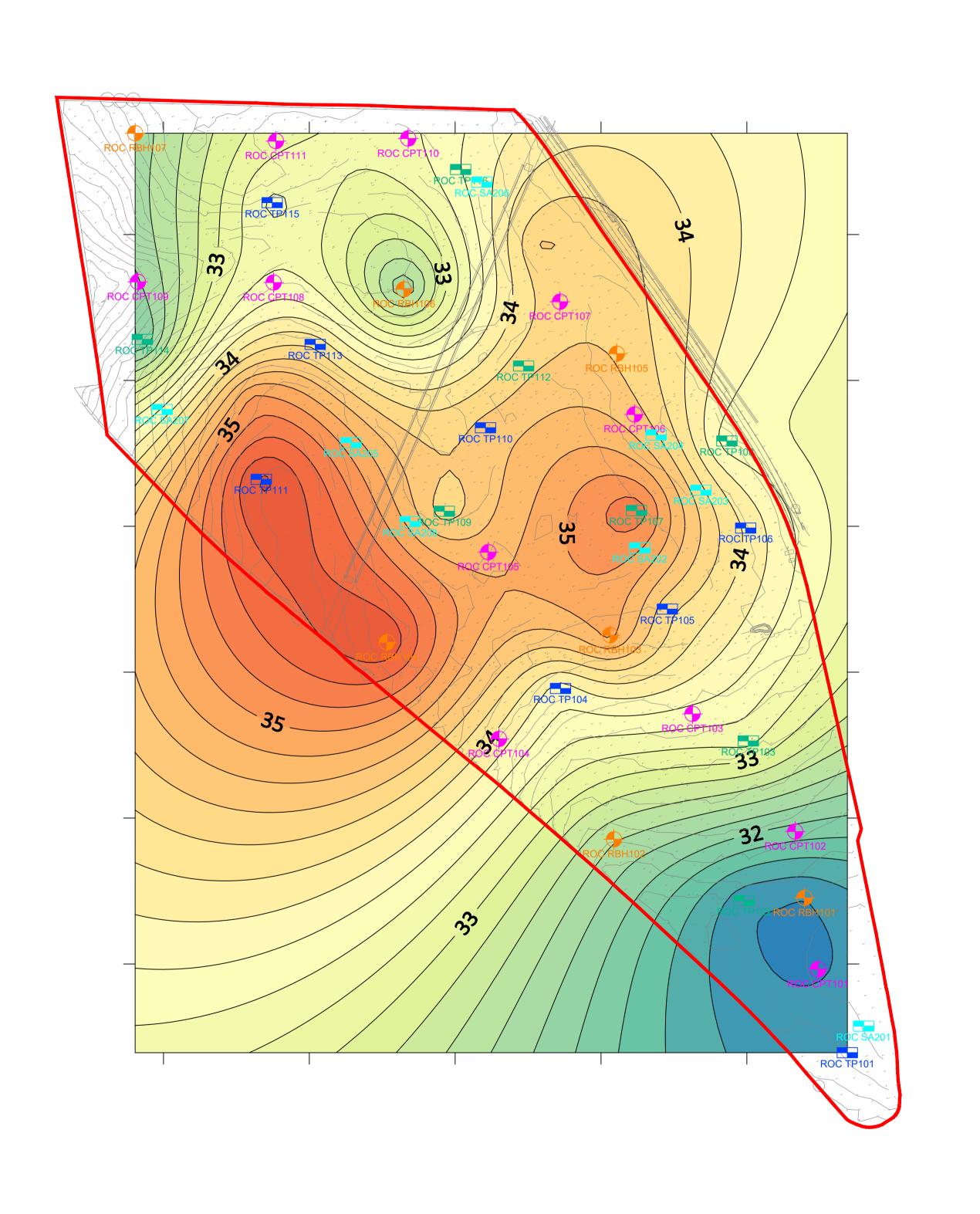
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PROJECT TITLE PARKSIDE EAST

ADDITIONAL SOAKAWAY TEST

LOCATION PLAN 4597-ROC-ZZ-XX-DR-ES-ES107

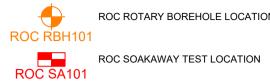


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<u>NOTES</u>



ROC CPT LOCATION



ROC ROTARY BOREHOLE LOCATION

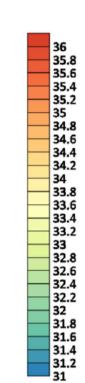


ROC TRIAL PIT LOCATION
ROC TP101



APPROX SITE BOUNDARY

BEDROCK DEPTH LEGEND



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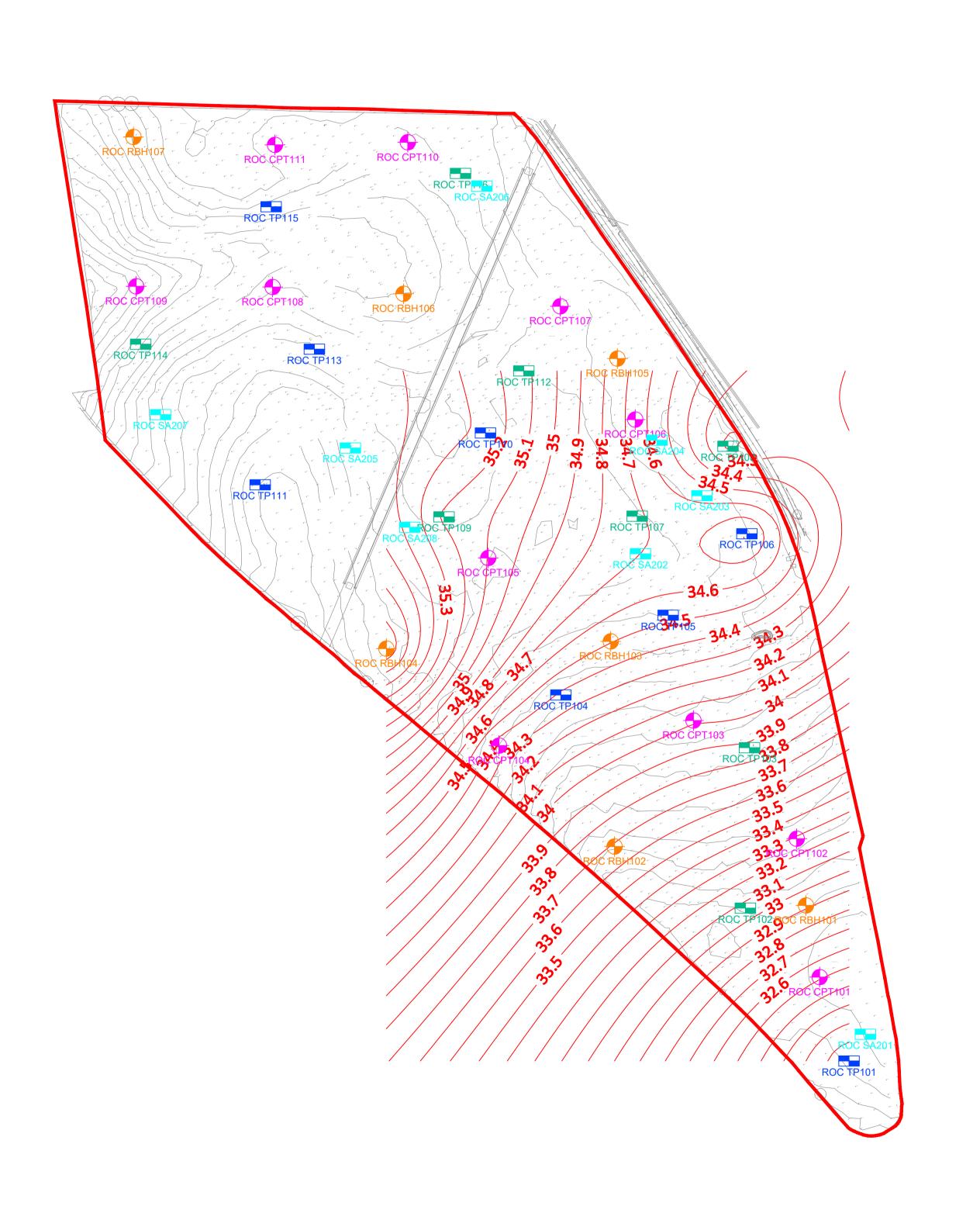
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PROJECT TITLE PARKSIDE EAST

SITE INVESTIGATION BEDROCK CONTOUR PLAN

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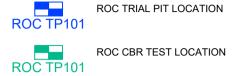
ROC CPT LOCATION



ROC ROTARY BOREHOLE LOCATION



ROC SOAKAWAY TEST LOCATION



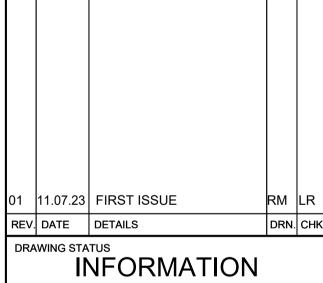
ROC CBR TEST LOCATION

APPROX SITE BOUNDARY

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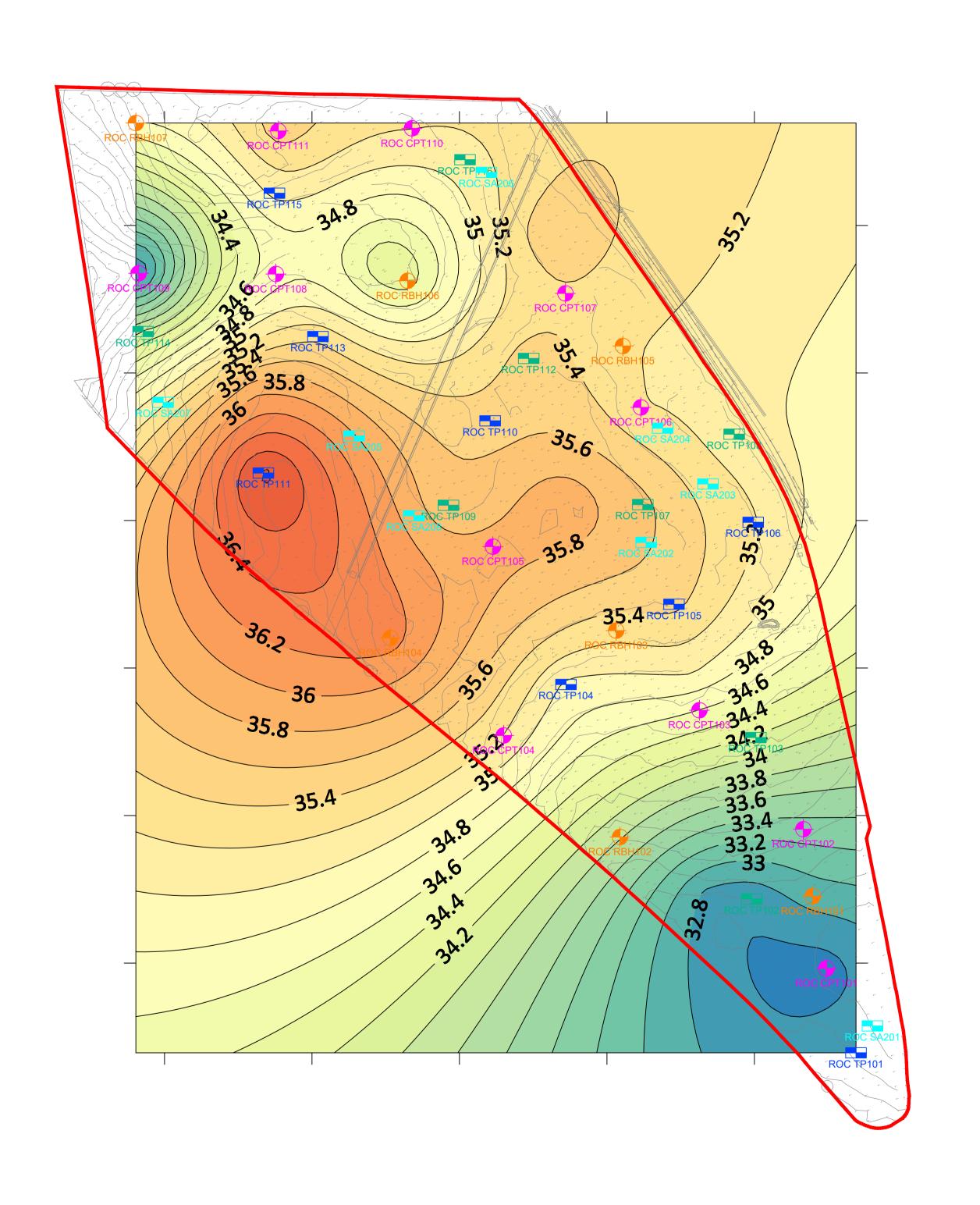
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PROJECT TITLE PARKSIDE EAST

DRAWING No.

SITE INVESTIGATION CLAY EXTENTS PLAN

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NOTES



ROC ROTARY BOREHOLE LOCATION

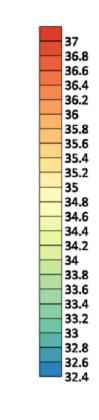


ROC TRIAL PIT LOCATION ROC CBR TEST LOCATION

ROC TP101 OVERHEAD LINE EXCLUSION ZONE

APPROX SITE BOUNDARY

TOPSOIL DEPTH LEGEND



DRAWING NOTES

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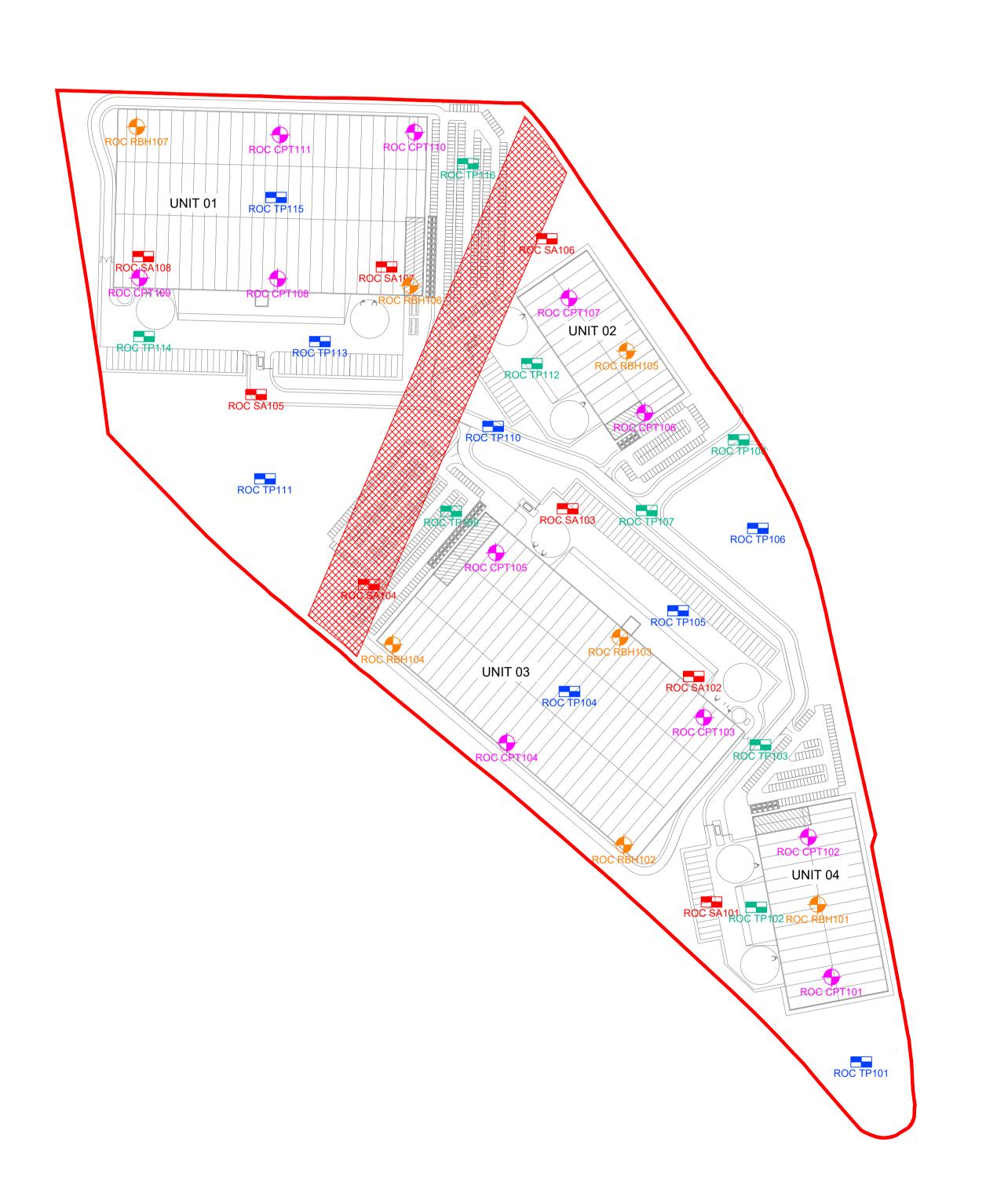
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PROJECT TITLE PARKSIDE EAST

SITE INVESTIGATION

TOPSOIL CONTOUR PLAN DRAWING No.

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NOTES

ES102 DRAWING NOTES



ROC ROTARY BOREHOLE LOCATION







ROC CBR TEST LOCATION
ROC TP101



OVERHEAD LINE EXCLUSION ZONE

APPROX SITE BOUNDARY

_____ ELECTRIC RECORDS --- BT(R) --- TELECOM BT RECORDS _____ WATER RECORDS

- FW(R) - FOUL SEWER RECORDS FOUL SEWER RECORDS (WITH FLOW) — SW(R) — STORM SEWER RECORDS

STORM SEWER RECORDS (WITH FLOW) — CW(R) — COMBINED SEWER RECORDS COMBINED SEWER RECORDS (WITH FLOW) ———— GAS RECORDS

DRAWING NOTES

1) EXPLORATORY HOLE LOCATIONS SHOWN AT APPROXIMATE EXTENTS. 2) PROPOSED DEVELOPMENT ARRANGEMENT TAKEN FROM AEW PROPOSED MASTERPLAN (REF: 13063-AEW-XX-XX-DR-A-0005) AND MAY BE SUBJECT TO AMENDMENT OR REVIEW.

3) BELOW GROUND UTILITY LOCATIONS AND EXTENTS TAKEN FROM RSK GEOSCIENCES SAFEGROUND PLANS (REF: 56427-DB-PARK SIDE-01(00) Sheet 1 of 3 - 3 of 3) BASED ON UTILITY RECORDS AND SHOULD BE CONSIDERED AS APPROXIMATE.

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01	11.05.23	FIRST ISSUE	RM	

DRAWING STATUS INFORMATION

RIBA STAGE



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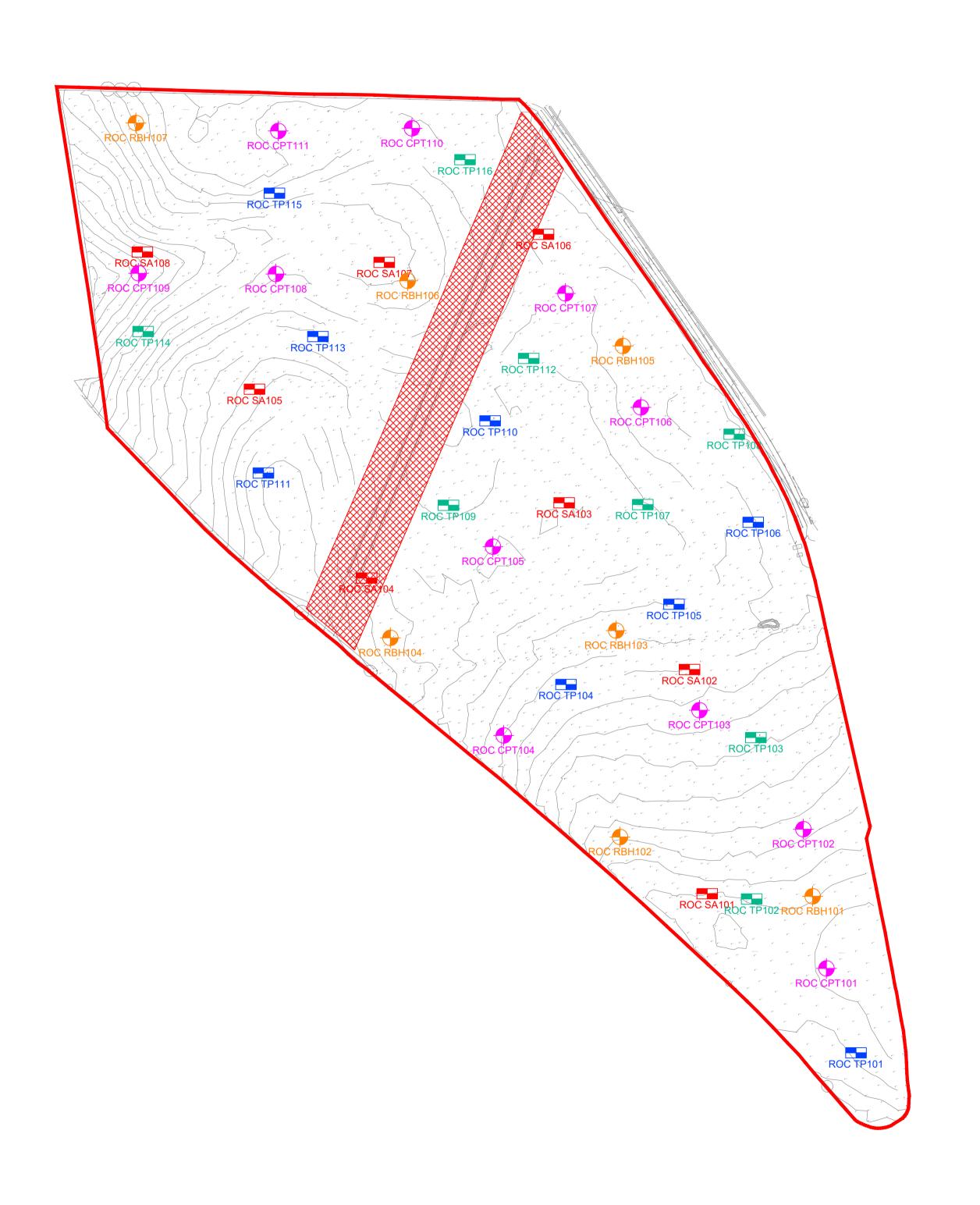
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HARWORTH ESTATE PROPERTY GROUP LTD

PROJECT TITLE PARKSIDE EAST

SITE INVESTIGATION LAYOUT PLAN (PROPOSED)

4597-ROC-ZZ-XX-DR-ES-ES102



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NOTES

ES101 DRAWING NOTES



ROC CPT LOCATION



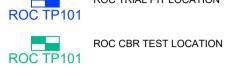
ROC ROTARY BOREHOLE LOCATION



ROC SOAKAWAY TEST LOCATION ROC SA101

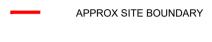


ROC TRIAL PIT LOCATION









_____ ELECTRIC RECORDS _____ WATER RECORDS

— FW(R) — FOUL SEWER RECORDS FOUL SEWER RECORDS (WITH FLOW)

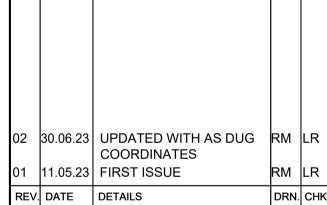
— SW(R) — STORM SEWER RECORDS STORM SEWER RECORDS (WITH FLOW) — CW(R) — COMBINED SEWER RECORDS COMBINED SEWER RECORDS (WITH

FLOW)
GAS RECORDS

DRAWING NOTES

1) EXPLORATORY HOLE LOCATIONS SHOWN AT APPROXIMATE EXTENTS. 2) BELOW GROUND UTILITY LOCATIONS AND EXTENTS TAKEN FROM RSK GEOSCIENCES SAFEGROUND PLANS (REF: 56427-DB-PARK SIDE-01(00) Sheet 1 of 3 - 3 of 3) BASED ON UTILITY RECORDS AND SHOULD BE CONSIDERED AS APPROXIMATE.

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DRAWING STATUS INFORMATION

RIBA STAGE



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CHECKED LR	DATE MAY 23	THE ABOVE SCALES APPL WHEN PLOTTED AT A1 SIZ DO NOT SCALE
APPRVD. LR	DATE MAY 23	EMAIL FOR DRAWINGS info@rocconsulting.com

HARWORTH ESTATE PROPERTY GROUP LTD

PROJECT TITLE PARKSIDE EAST

SITE INVESTIGATION LAYOUT PLAN (EXISTING)

DRAWING No. 4597-ROC-ZZ-XX-DR-ES-ES101



APPENDIX B – EXPLORATORY HOLE LOGSHEETS



roject Name:	: Parkside Ea	ast				Client: F	Harworth					Date: 2	2/05/20	23 - 23/	05/2023	3	
ocation: St. I	Helens					Contrac	tor: MT Ge	eoserv	/ices	3		Co-ords	s: E360	706.26 N	N39492	5.37	
roject No. : 4	597					Crew Na	ame: M.E.	& D.C).			Drilling	Equipm	ent: Bei	retta T4	4	
Borehole N RBH10	umber		e Typ	е		35	Level .57m AoD			Logged			Scale 1:40		Pa	age Numl	
/ell Water	Depth	Туре		orin	g	Diameter Recovery (SPT)	Depth	Lev		Legend		Str		Descript		TICCL 1 OI	Ť
	(m)	/FI	TCR	SCR	RQD	Re ()	(m) 0.30	(m	<u>, </u>		SAND rounde	. Graveled to su	l is fine b angul	ravelly fi to mediu ar of mu	um sub		+
						(50)	0.70	34.8	87		Orang coarse FORM	SAND IATION)	vn sligh (WEAT)	tly claye HERED	CHES	TER	
						-	1.50	34.0	07		coarse FORM	graine IATION)	d SAND	STONE	(CHES	STER	
	1.50 - 3.00		89	60	0						of yello coarse very cl space	owish bus SAND SAND Sosely spoons of the same serving the same serving	rown lar STONE paced o g 0 to 1	minated . Discon ccasion 0 degre ESTER	mediur itinuities ally clos es plan	n to s are sely ar	
	3.00 - 4.50		95	75	0												
							3.94	31.6	63		bandir SAND space	ng medii STONE	um to co Discor intal pla	with yell parse gr ntinuities nar smo TON)	ained s are clo	osely	
	4.50 - 6.00		85	81	29						at 5.12						
											closely to 5.17 to 5 at 5.42	.27. Vei	ry weak			cture	
	6.00 - 7.00		96	83	83		6.15	29.4	42		mediu Discor horizo	m to coa	arse gra s are me nar smo	occasion hined SA edium spoth (CH	NDST(paced	ONE.	
	7.00 - 8.30		101	81	49		7.00	28.9	57		bandir SAND gravel Discor smoot	ng meding STONE is fine to the standard in the	um to co Slightl .o mediu s are me ig 0 to 2	sh brown parse gr y congloum of mo edium sp to degre pRMATIO	rained omerationed udstoned paced p es undi	c, e. olanar	
	I a ·						Т	<u> </u>									1
h Base Diameter	Casing Diam r Depth Base Dia		pth Top	Depth B	hisel	ling Duration	Tool Dep			n and Orient	tation on Orientation	Depth Top	Depth Base		g Flush Colour	Min (%)	Max

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with arisings. Bentonite seal.





Project	Name	: Parkside Ea	st			(Client: I	Harworth				Date: 22/05/20	023 - 23/	05/2023	}	
Locatio	n: St. I	Helens				(Contrac	tor: MT G	eoservice	s		Co-ords: E360	706.26	N39492	5.37	
Project	No. : 4	597				(Crew N	ame: M.E	. & D.O.			Drilling Equipr	nent: Be	retta T4	4	
	hole N RBH10	umber		Typ	е		35	Level .57m AoD	,	Logged RM	Ву	Scale 1:40	!		ge Num heet 2 o	
Well		Depth	Туре		orin	g		Depth	Level	Legend		Stratum	Descrip		neer 2 o	
				TCR	100	86	Diameter Recovery (SPT)				Mediu bandi SANE grave Disco smoo rough Mediu bands SANE Grave Disco space FORM	Stratum um strong redding medium to control of the strong redding to the strong redding medium to control of the strong redding medium to control of the strong redding medium to control of the strong redding medium to medium to medium timuities are of the strong redding the strong redding medium to control of the strong redding to the strong redding th	sh brown coarse grady congle um of medium selection selection selection shows arse grady congle ium of mosely to the (CHES) continuities and grade selection	tion n with grained omeratic udstone paced pees undu ON) n with grined omeratic udstone medium STER es becon ture.	ey ., .lanar ilating ey .,ly ming	9
		14.30 - 15.80		99	99	94	-				at 14.3 spaced	30 to 14.60mbg	il disconi	tinuities	Closely	15 —
Hole Di	iameter	Casing Diame	ter I			 Chise	lling		Inclination	on and Orient	tation		Drillin	g Flush		
Depth Base				oth Top	Depth I		Duration	Tool De	epth Top Depth			n Depth Top Depth Bas		Colour	Min (%)	Max (%)

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with arisings. Bentonite seal.





Projec	t Name	: Parkside Eas	st			C	Client: H	Harworth					Date: 2	2/05/20	23 - 23/	05/2023	3			
Locati	on: St. I	Helens				C	Contrac	tor: MT C	Geo	services	S		Co-ords	s: E3607	706.26 1	N39492	5.37			
Projec	t No. : 4	1597					Crew N	ame: M.E	≣. 8	k D.O.			Drilling	Equipm	ent: Be	retta T4	4			
Bor	ehole N RBH10		Hole F	Typ RC	е		35	Level .57m Ao[D		Logged RM	Ву		Scale 1:40		1	ige Num heet 3 o			
Well	Water	Depth (m)	Type /FI	C	orin	g ROD	Diameter Recovery (SPT)	Depth (m)		Level (m)	Legend		Str	atum D	escrip	tion				
		15.80 - 17.30			100							bands SAND Grave Disco space	im strong mediun DSTONE el is fine i ntinuities d planar MATION)	n to coa . Slightly to medius are clo	rse grai y conglo um of m sely to	ned omeratione ludstone medium).).	17 -		
		17.30 - 18.80		100	98	89							ddish brown weak to medium strong							
		18.80 - 20.30		97	73	33		19.14		16.43		mediu Disco space (KINN	dium to coarse grained SANDSTONE. continuities are very closely to closely aced horizontal planar rough NNERTON SANDSTONE FORMATION) 9.90 to 20.08mbgl destructured sandstone							
								20.30		15.27			9.90 to 20.08mbgl destructured sandstone mudstone							
Hole Depth Bas	Diameter Diamete	Casing Diame		th Top	(Depth 6	Chisel Base	ling Duration	Tool C	Depth		n and Orient Base Inclinatio		Depth Top	Depth Base	Drilling Type	g Flush Colour	Min (%)	24 — Max (%)		
D																				

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with arisings. Bentonite seal.





Projec	t Name:	Parkside E	ast			C	Client: F	Harworth					Date: 2	3/05/20	23 - 24/	05/2023			
Location	on: St. F	lelens				C	Contrac	tor: MT G	Geo:	services	S		Co-ords	s: E360	553.15 l	N394920	0.45		
	t No. : 4					C	Crew Na	ame: M.E	E. &	D.O.			Drilling		ent: Be	retta T4			
Bore	ehole Ni RBH10			e Typ RC	е		36	Level .59m Ao[)		Logged RM	Ву		Scale 1:40			ge Numl heet 1 of		
Well	Water	Depth (m)	Type /FI		orin	g	Diameter Recovery (SPT)	Depth (m)	\neg	Level (m)	Legend		Str	atum D	escript)	1	1001 1 01		
		()		TCR	SCR	KQD	(34)	0.30		36.29 35.79		SAND rounded quartz Stiff of CLAY Extrer coarse	orown slip. Gravel ed to sultite and strangish l (DEVEN mely weater grained MATION)	l is fine to angula sandsto brown g NSIAN Tak reddi	to medic ar of mu ne (TOF ravelly TLL) sh brow	um sub udstone, PSOIL) very sar	ndy	1 -	
	-						1	1.50		35.09									
	_	1.50 - 3.00		79	75	53		1.77		34.82		coarse Discor very c 0 to 10 Very v yellow graine very c smoot 20 deg	ery weak reddish brown medium to harse grained SANDSTONE. scontinuities are extremely closely to any closely spaced planar smooth dipping to 10 degrees (CHESTER FORMATION) bery weak to weak reddish brown with rare allowish brown banding fine to coarse ained SANDSTONE. Discontinuities are any closely to mediumly spaced planar mooth and undulating rough dipping 0 to 0 degrees with occasional dark grey aining (CHESTER FORMATION)						
		3.00 - 4.50		99	93	49							degrees with occasional dark grey						
		4.50 - 6.00		96	92	61													
		6.00 - 7.50		100	94	77		7.50		29.09		at 6.18 banding	t 6.08 to 6.10 clay infill t 6.18 to 6.64mbgl very closely spaced black ding 1 to 10mm in thickness Veak to medium strong reddish brown						
								7.30		∠₹.∪₹		mediu	to medi Im to coa ntinuities	arse gra	ined SA edium s	ANDSTC paced p	NE.	8 -	
	Diameter e Diameter	Casing Diar		oth Top	Depth E	Chisel Base	ling Duration	Tool D	Depth		n and Orient		Depth Top	Depth Base	Drilling Type	g Flush Colour	Min (%)	Max (%)	
Rema			_ 0	-r					,				, , , ,		20.5		(/	\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.	

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 2m to 10m depth. Bentonite seal.





Client: Harworth Project Name: Parkside East Date: 23/05/2023 - 24/05/2023 Location: St. Helens Contractor: MT Geoservices Co-ords: E360553.15 N394920.45 Project No.: 4597 Crew Name: M.E. & D.O. Drilling Equipment: Beretta T44 Borehole Number Hole Type Level Logged By Scale Page Number RBH104 RC 36.59m AoD RM 1:40 Sheet 2 of 2 Coring Depth Type Depth Level Water Well Stratum Description Legend (m) (m) (m) TCR SCR RQD Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Discontinuities are medium spaced planar smooth to rough dipping 0 to 10 degrees 7.50 - 9.00 98 98 (KINNERTON SANDSTONE FORMATION) 9 ..at 9.20 to 9.80mbgl becoming slightly conglomeratic 95 95 9.00 - 10.5095 10 11 100 100 100 10.50 - 11.97 12 12.47 24.12 Weak reddish brown and yellowish brown SANDSTONE. Discontinuities closely to 100 89 11.97 - 13.50 extremely closely spaced planar smooth to rough horizontal (KINNERTON 13 SANDSTONE FORMATION) at 12.47 to 12.64mbgl non intact mudstone 13.33 23.26 at 12.74 to 13.07mbgl becoming medium Medium strong reddish brown medium to coarse grained SANDSTONE. Discontinuities medium spaced planar rough to smooth dipping horizontal with 14 occasional dark grey staining 105 105 105 13.50 - 15.00 (KINNERTON SANDSTONE FORMATION) 15.00 21.59 15 End of Borehole at 15.000m 16 Hole Diameter Casing Diameter Chiselling Inclination and Orientation Drilling Flush Depth Top Depth Base Duration Tool Depth Top Depth Base Inclination Orientation Depth Top Depth Base Min (%) Max (%)

Remarks

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling

3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 2m to 10m depth. Bentonite seal.





Proje	ct Name	: Parkside Ea	st			C	Client: H	Harworth				Date: 17/05/202	23					
Locat	ion: St. I	Helens				C	Contrac	tor: MT G	eoservice	S	(Co-ords: E3607	'10.80 N	N395118	3.26			
Proje	ct No. : 4	597				C	Crew Na	ame: M.E	. & D.O.			Drilling Equipme	ent: Ber					
Boi	ehole N RBH10			e Typ RC	е		35	Level .63m AoD	,	Logged By RM	Зу	Scale 1:40			ge Numl heet 1 of			
Well	Water	Depth (m)	Type /FI		orin	ig BOD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend		Stratum D	escript		icet i oi			
5 (2) (3) (3) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4					SUR	KQD	(50)	0.40 0.70 1.25	35.23 34.93 34.38		SAND. rounde mudstc Orangi SAND FORM. Reddis SAND. to angu CHEST Extrem coarse	rown slightly grader of the sub-angular of the sub-	o mediuar of sar of chest of the sar of the sa	um sub ndstone n coarse FER n coarse e sub an	and engular ED	1 -		
		2.50 - 4.00		97	87	65		2.50 2.70	33.13 32.93		MUDS (WEAT Extrem brown SANDS to med degree dark gr FORM.	emely weak reddish brown DSTONE recovered as gravel ATHERED CHESTER FORMATION) emely weak reddish brown yellowish on banding medium to coarse grained DSTONE. Discontinuities are closely ediumly spaced dipping 0 to 10 ees planar smooth with occasional grey staining (CHESTER EMATION) 36 to 3.97mbgl yellowish brown fine d sandstone.						
		4.00 - 5.50		97	83	44		4.675.37	30.96		brown SANDS close to degree (CHES	s planar smoot TER FORMATI	grained tinuities d dippir h to rou ON)	l s are ver ng 0 to 1 gh	ту О	5 -		
		5.50 - 7.00		99	94	64					SANDS fine to mudsto mediur to roug	close to closely spaced dipping 0 to 10 degrees planar smooth to rough (CHESTER FORMATION) Very weak reddish brown fine to coarse SANDSTONE. Conglomeratic, gravel is fine to medium rounded of quartzite and mudstone. Discontinuities are closely to mediumly spaced horizontal planar smooth to rough (CHESTER FORMATION) at 6.22mbgl 40 degree fracture						
		7.00 - 8.50		100	98	71				[fr.	ractures	o 7.15mbgl very mbgl sandstone			d	7 8 8		
	Diameter	Casing Diame				Chisel				on and Orientation				Flush				
Depth Ba	se Diamete	r Depth Base Diam	eter Dep	oth Top	Depth I	Base	Duration	Tool De	epth Top Depth	Base Inclination C	Orientation	Depth Top Depth Base	Туре	Colour	Min (%)	Max (%)		

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Projec	t Name	: Parkside Eas	st			C	Client: F	larworth	1					Date: 1	7/05/202	23			
Locati	on: St. I	Helens				C	Contrac	tor: MT	Geose	rvice	s			Co-ords	s: E3607	710.80	N395118	3.26	
Projec	t No. : 4	597				C	Crew Na	ame: M.	E. & D	.0.				Drilling	Equipm	ent: Bei	retta T4		
Bor	ehole N RBH10			Typ RC	е		35	Level .63m Ao	'nD		_	ged RM	Ву		Scale 1:40		1	ge Numl heet 2 of	
Well	Water	Depth (m)	Type /FI		orin	ig Bod	Diameter Recovery (SPT)	Depth (m)	n Le	⊥ evel m)	Lege			Str	atum D	escript		neet 2 oi	
		8.50 - 10.00		91	81	65	-	9.66		5.97			SAND fine to mudst mediu to roug	veak rec STONE mediun one. Dis mly spa gh (CHE	. Conglon roundescontinu ced hori	omerationed of quities are izontal p FORMA	c, grave partzite a e closely planar s TION)	l is and r to mooth	9 -
		10.00 - 11.50		96	96	96							Medium strong And yellowish b medium grained conglomeratic v rounded gravel Discontinuities a dipping 0 to 20 rough with frequ (CHESTER FOI			panding DSTON re fine to artzite ar ediumly es plana ark grey	fine to E. Sligh o mediund muds spaced ar smooth	tly m stone.	10
		11.50 - 13.00		99	99	99							at 11.8 coarse g		45mbgl	sandsto	one is m	edium to	12 -
		13.00 - 14.50		103	103	76		13.45 13.66		2.18 1.97			graine gravel mudst very c horizo Mediu	nely wead SANE is fine to one and lose to one and (CFm strong) marginal mar	OSTONE o mediu I quartzi closely s IESTER g reddis	E. Conglow Im round te. Discopaced paced paced to FORM h browr	lomerati ded of continuiti planar s ATION) n fine to	c, es are mooth	13 -
		14.50 - 15.60		105	105	105	;	15.60	20	0.03			conglo rounde Discor rough FORM at 14.0 coarse g	omeration and of quantinuities dipping MATION To to 14. To 2 to 14. Trained To 14. Grained	g, gravel artzite a s are me 10 to 50 02mbgl 33mbgl s	is fine to and mudediumly degree mudsto sandsto caceous	to mediu distone. spaced es (CHE one band one is mo	planar STER d edium to	
	Diameter se Diamete	Casing Diame r Depth Base Diame		oth Top		Chisel	lling Duration	Tool		_	on and (Base Ind		ation Orientation	Depth Top	Depth Base	Drilling Type	g Flush Colour	Min (%)	16 — Max (%)

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





CON	NSULTING			ı											
Project Na	ame: Parkside E	ast		Client: I	Harworth				Date: 16/05/202	23					
Location:	St. Helens			Contrac	tor: MT G	eoservices	S		Co-ords: E3605	564.86 N	395162	2.48			
Project No	o. : 4597			Crew N	ame: M.E.	. & D.O.			Drilling Equipm	ent: Bere	etta T44	1			
	le Number 3H106	Hole Typ RC	е	34	Level .80m AoD)	Logged RM	Ву	Scale 1:40			ge Numl neet 1 of			
Well Wa	Depth (m)		oring		Depth (m)	Level (m)	Legend		Stratum D	escription					
		TO TORK	SCR RQ	(50)	0.50	34.30		Browr (WEA	orown slightly gr (TOPSOIL) In slightly gravelly THERED KINNE MATION)	y fine to c	coarse	SAND	1		
	2.60 - 4.10	93	62 7	(50)	2.60	32.20	W. 6.1. (2.1.)	reddis are ve smoot brown							
	4.10 - 5.60	93	71 63	3	4.20 4.41	30.60		MUDS FORM Weak stainir SAND space rough discor	Extremely weak reddish brown MUDSTONE (KINNERTON SANDSTONE FORMATION) Weak reddish brown with rare orange staining fine to medium grained SANDSTONE. Discontinuities are closely spaced planar smooth horizontal planar ough. Dark grey spotting present on discontinuities (KINNERTON SANDSTONE FORMATION)						
	5.60 - 7.10	85	55 37	7				discontinuities (KINNERTON SANDSTONE FORMATION)							
	7.10 - 8.60	93	93 65	5									- 8 -		
Hole Diam Depth Base Dia			Chiso Depth Base		Tool De		on and Orient Base Inclinatio		Depth Top Depth Base	Drilling Type	Flush Colour	Min (%)	Max (%)		

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with bentonite pellets.





Projec	t Name	: Parkside Ea	st			c	Client: H	Harworth	1					Date: 1	6/05/202	23			
Location	on: St. I	Helens				C	Contrac	tor: MT	Geo	service	s			Co-ords	s: E3605	564.86 N	N395162	2.48	
Projec	t No. : 4	597				C	Crew N	ame: M.	E. &	D.O.				Drilling	Equipm	ent: Ber	etta T4	1	
Bore	ehole N RBH10			e Typ RC	е		3/	Level .80m Ao	יטי		Lo	gged RM	Ву		Scale 1:40			ge Numl neet 2 of	
Well	Water	Depth (m)	Type /FI		orin	g ROD	Diameter Recovery (SPT)	Depth (m)	-	Level (m)	Leg	gend		Str	ratum D	escript		ieet 2 Oi	3
		8.60 - 10.10		100		77		8.60		26.20			stainir SAND space rough discor FORM Weak bandir mediu horizo FORM at 9.11	ng fine to STONE d planar. Dark g httinuities MATION; reddish ng SANI mly spa ntal (KII MATION; to 9.20	brown y DSTONE ced plar NNERT() mbgl ve	m grainentinuities n horizon ting pre- ERTON vellowisl E. Disconar smo DN SAN retical fra	ed s are clo ntal plar sent on SANDS h brown intinuitie oth to ro IDSTON acture	sely nar TONE ss are ough	9
		10.10 - 11.60		100	100	100							at 10.0 grained						11 -
		11.60 - 13.20		100	100	86		13.10		21.70			at 11.6 gravel is quartzite at 11.8 at 12.1 brown m	rounde and sili 39mbgl 3 17 to 12. audstone	d fine to tstone 30 degre 20mbgl e dipping	coarse e fractu extreme g 70 deg	of muds are ely weak grees	stone, ‹ reddish	12 -
		13.20 - 14.60		98	98	74		13.54	1	21.26			SAND closely degree dark g FORM Weak SAND space with o	STONE y to clos es stain (rey (KIN MATION) reddish (STONE d horizo ccasion:	brown f Discor ded dark NNERTO brown f Discor ontal plan al dark g	tinuities ced dipp reddish DN SAN ine to co tinuities nar smo grey stai	s are ver bing 0 to brown a DSTON oarse gr s are me ooth to re ining.	ry 20 and E rained edium ough	14 -
		14.60 - 16.10		102	102	89							at 15.1 mudston at 15.4 mudston	ne 19 to 15.				า	15 -
Hole 「	Diameter	Casing Diame	eter			Chisel	ling	T		Inclination	on and	l Orient:	ation			Drilling	g Flush		16 -
	Diamete			oth Top			Duration	Tool	Depth				n Orientation	Depth Top	Depth Base	Туре	Colour	Min (%)	Max (%)

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with bentonite pellets.





Project Name	: Parkside Eas	st		Client:	Harworth				Date: 16/0	05/2023				
Location: St.	Helens			Contra	ctor: MT G	Seoservice	S		Co-ords: E	E360564	1.86 N	395162	2.48	
Project No. : 4	4597			Crew N	Name: M.E	. & D.O.			Drilling Ed	quipmen	t: Bere	etta T44	4	
Borehole N		Hole 7			Level		Logged	Ву		Scale			ge Num	
RBH1	Donth	Type			4.80m AoE Depth	Level	RM		1	1:40		Si	heet 3 of	13
Well Water	(m)	/FI T	CR SCR	Diameter Recovery (SPT)	(m)	(m)	Legend		Strati	um Des	cripti	on		
	16.10 - 17.60	5	93 93	79				SANE space with o	reddish br OSTONE. D d horizonta occasional o IERTON S	Discontin al planaı dark gre	uities smoo y stair	are me oth to ro ning.	edium ough	17 -
	17.60 - 19.10	\$	99 82	51	18.46	16.34		graine extrer	emely close to very closely spaced contal planar rough (KINNERTON DSTONE FORMATION)					
	19.10 - 20.60	1	07 104	99	19.10	15.70		SAND Weak SAND to me degre	ned SANDSTONE. Discontinuities are emely close to very closely spaced contal planar rough (KINNERTON DSTONE FORMATION) k reddish brown fine to coarse grained DSTONE. Discontinuities are closely ediumly spaced dipping 0 to 30 ees planar and undulating rough NERTON SANDSTONE FORMATION)					
					20.60	14.20			End of I	Borehole	at 20.0	00m		20 -
					20.00	14.20								-
														21 -
														- - - - -
														23 -
Hole Diameter	Cosing Dis-	tor		'higalling		lo die =4°	on and Orient	totion	I		Drilling	Elizak		24 -
Depth Base Diameter	Casing Diame er Depth Base Diam		Top Depth B	Chiselling Base Duration	Tool D	Pepth Top Depth		_	Depth Top Dep		Type	Colour	Min (%)	Max (%)
												ı		

CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling
 On completion, borehole backfilled with bentonite pellets.





Client: Harworth Project Name: Parkside East Date: 15/05/2023 Co-ords: E360380.55 N395269.43 Location: St. Helens Contractor: MT Geoservices Crew Name: M.E. & D.O. Project No.: 4597 Drilling Equipment: Beretta T44 Borehole Number Hole Type Level Logged By Scale Page Number RBH107 RC 35.28m AoD RM 1:40 Sheet 1 of 2 Depth Type Coring Depth Level Well Water Legend Stratum Description (m) (m) (m) TCR SCR RQD Dark brown slightly gravelly silty SAND. Gravel is fine to coarse rounded of sandstone and quartzite (TOPSOIL) 0.50 34.78 Brown slightly gravelly fine to coarse SAND (KINNERTON SANDSTONE FORMATION) (50) 2 (50)3.00 32.28 3 Very weak reddish brown with yellow banding fine to medium grained SANDSTONE. With dark grey 1mm healed joints. Joints are mediumly spaced planar smooth dipping 0 to 20 degrees with clayey 3.00 - 4.50 100 82 82 contacts. Some joints discoloured to a vellowish brown. (KINNERTON SANDSTONE FORMATION) 4 at 3.00 to 3.27mbgl non intact ...at 4.50 to 6.27mbgl becoming slightly conglomeratic. With fine to medium rounded gravel of sandstone, mudstone and quartzite 4.50 - 6.00 100 100 100 6 6.00 - 7.50 100 97 7.87 27.41 8 Casing Diameter Chiselling Inclination and Orientation Drilling Flush Hole Diameter Depth Top Depth Base Duration Depth Top Depth Base Inclination Orientation Depth Top Depth Base Min (%) Max (%) Tool

Remarks

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling

3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Projec	t Name	: Parkside Eas	st			(Client: I	Harworth					Date: 15/05/2023						
Locati	on: St. I	Helens				C	Contrac	tor: MT (Geose	rvices	3		Co-ords: E360380.55 N395269.43						
_	ct No. : 4					(Crew N	ame: M.E	E. & D	.0.			Drilling Equipment: Beretta T44						
Borehole Number Hole Type RBH107 RC							35	Level .28m Aol	D		Logged RM	Ву	Scale Page Number 1:40 Sheet 2 of 2						
Well	Water	Depth (m)	Type /FI	ype Coring				Depth (m)	Le	- evel m)	Legend		Stratum Description						
		7.50 - 9.00		93	93	73				,		SAND mediu dippin infilled	sh brown fine to medium grained STONE. Joints are closely to mly spaced planar smooth to rough g 0 to 10 degrees. Some joints with clay up to 20mm in thickness ERTON SANDSTONE FORMATION)					9 —	
		9.00 - 10.50		100	100	95												10 -	
		10.50 - 12.00		100	97	80												11 -	
		12.00 - 13.50		100	98	86						at 12.4 black sta					ands of	12	
		13.50 - 15.00		97	89	69						at 14.6			clay inf	iilled frad	cture	14 -	
								15.00	20).28			End	of Boreho	ole at 15.	000m		15	
	Diameter se Diamete	Casing Diame		oth Top		Chisel Base	ling Duration	Tool [n and Orient		Depth Top	Depth Base	Drilling Type	g Flush Colour	Min (%)	Max (%)	

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





<u> </u>																			
Projec	t Name	: Parkside Ea		Client: Harworth								Date: 18/05/2023							
Locati	on: St. I	Helens		C	Contractor: MT Geoservices								Co-ords: E360839.50 N394745.26						
Projec	ct No. : 4	1597		Crew Name: M.E. & D.O.								Drilling Equipment: Beretta T44							
Bor	ehole N			Level Logged By							Scale Page Number								
RBH101			RC .			33				RM		1:40			Sheet 1 of 2		f 2		
Well	Water Depth Type Coring		I g ROD	Diamete Recovel (SPT)	Depti (m)	Depth Lev (m) (m		II edend		Stratum Description									
							(50)	0.40		32.90 32.60			SAND quartz Orang SAND FORM Reddis SAND to ang	. Grave ite and ish brow (WEAT IATION sh brow . Grave ular of	lightly gr I is fine sandsto wn claye THERED) /n grave I is fine sandstor DRMATI	to mediane (TOF) by fine to CHES lly fine to to coars ne (WEA	um of PSOIL) coarse TER cocoarse se sub a	e e ngular	1 -
							(50)	2.10	3	31.20			coarse		ak reddi d SAND)				2
							(50)	3.00	3	30.30			Evtron	nely we	ak thickl	v lamin	ated red	ldich	3 -
		3.00 - 4.50		95	86	27		3.24 4.05		30.06 29.25			brown to coal SAND very cl conglo gravel (CHES	with ra rse gra STONE losely s meration of qual STER F	re yellov ined slig E. Discor paced p c with fin tzite and ORMAT ddish bro	vish bro htly con htinuities lanar sr e to me d mudst ION)	wn band glomera s horizon mooth. S dium ro cone	ds fine atic ntal Slightly	4 —
		4.50 - 6.00		91	86	51		5.59	2	27.71			coarsec conglor rounded Discor spaced degreed Weak and yes mediun Discor 0 to 10 (CHES	e grained SANDSTONE. Slightly omeratic gravel is fine to medium ed of quartzite and mudstone. ntinuities very closely to closely ed undulating rough dipping 0 to 20 es (CHESTER FORMATION) reddish brown with greyish brown ellowish brown banding fine to um grained SANDSTONE. ntinuities are closely spaced dipping 0 degrees occasional clay coating STER FORMATION) reddish brown with greyish brown ng medium to coarse grained			wn pping ing	5	
		6.00 - 7.50		100	94	68		7.18	2	26.12			SANDSTONE. Slightly conglomeratic gravel is fine to medium rounded of mudstone and quartzite. Discontinuities are closely spaced horizontal planar rough (CHESTER FORMATION) Weak reddish brown medium to coarse grained SANDSTONE. Conglomeratic, gravel is fine to coarse sub rounded to rounded of quartzite, mudstone and siltstone. Discontinuities are closely to mediumly spaced horizontal planar rough						7
Hole	Diameter	Casing Diam	eter			 Chisel	ling			nclination	on and	d Orienta	tion			Drillin	g Flush		
Depth Bas				epth Top			Duration	Tool					Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Rotary Core Log

Projec	t Name	: Parkside Eas	st			C	Client: H	Harworth				Date: 1	8/05/20	23			
Locati	on: St. I	Helens				(Contrac	tor: MT G	Seoservice	es		Co-ord	s: E3608	839.50	N39474	5.26	
	t No. : 4					-	Crew N	ame: M.E	. & D.O.			Drilling	Equipm	ent: Be			
Bor	ehole N RBH10		Hole	: Typ RC	е		33	Level .30m AoE	,	Logged RM	Ву		Scale 1:40			ige Numl heet 2 of	
Well	Water	Depth (m)	Type /FI	С	orin		ameter covery SPT)	Depth (m)	Level (m)	Legend		Str	ratum D)escript		neer z oi	
		7.50 - 9.00		99	95	73		9.00	24.30		graine grave round siltsto mediu (CHE	ed SANE I is fine t ed of qu ne. Disc Imly spa STER F	brown IDSTONE to coarse partzite, I continuiti nced hor ORMAT mbgl he	E. Congle sub romudstories are dizontal plant	omerati ounded t ne and closely t olanar ro	c, to	9 —
		9.00 - 10.50		100	98	69					intact zo at 7.50 fractured Mediu mediu Disco space with o	one. O to 7.65 d (3 frac Im stron Im to co Intinuities d horizo ccasion	imbgl lo	cally ver th brown nined SA psely to nar smo grey sta	ry closed and gr NDSTO medium noth to re	ey DNE.	10 -
		10.50 - 12.00		100	99	88		11.06	22.24		yellow SAND fine to mudsi closel undul	vish brow OSTONE o mediur tone and y to med ating rou	g reddis wn medi i. Conglo n roundo d siltstor diumly s ugh (CH	um to comeration ed of quote. Disco paced h	oarse gi c, grave artzite, ontinuiti orizonta	l is es are	11 -
		12.00 - 13.50		95	95	83		12.67	20.63		FORM Mediu mediu Disco space with o (CHE:at 12.2 fine to m siltstone Mediu	MATION; Im stron Im to co- Intinuities Indicated horizon Coasion STER For Eact to 12. Inedium of Imm stron	g reddis arse gra s are clo ontal pla al dark o ORMAT 51mbgl of quartz	h brown hined SA psely to nar smo grey sta ION) conglor tite, muc	n and gr NDSTC medium toth to re ining meratic, dstone a	ONE. ally ough gravel is	12 -
		13.50 - 15.00		99	99	90					coarse Disco space degre	e graine ntinuitie: d plana	wn and on SAND sare closer smooth lating ro	STONE sely to a dipping	:. medium g 0 to 20	nly O	14 -
								15.00	18.30			End	of Boreho				15 -
Hole Depth Bas	Diameter Diamete	Casing Diame or Depth Base Diame		oth Top	Depth I	Chise Base	Iling Duration	Tool D		ion and Orient		Depth Top	Depth Base	Drilling Type	g Flush Colour	Min (%)	Max (%)

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Rotary Core Log

Proje	ct Name	: Parkside Ea	st			C	Client: H	Harworth				Date: 19	9/05/202	23			
Locat	ion: St. I	Helens				C	Contrac	tor: MT C	Geoservice	es		Co-ords	: E3607	708.85 N	N39478	5.43	
Proje	ct No. : 4	1597				(Crew N	ame: M.E	E. & D.O.			Drilling I	Equipm	ent: Ber			
Во	rehole N RBH10			e Typ RC	е		33	Level .81m Aol	n	Logged	I By		Scale 1:40			ge Num heet 1 o	
Well	Water	Depth (m)	Type /FI		orin	ig	Diameter Recovery (SPT)	Depth (m)		Legend		Stra	atum D	escript		neet 1 0	
					JON	RQL	(51)	0.40	33.41		SAND round sands Orang SAND FORM Reddi SAND	orown slip orown slip ed to subtone (TC gish brown orown (WEATI MATION) sh brown orow	is fine to angula PPSOIL In claye HERED In gravel is fine t	o meditar of quality y fine to CHEST ly fine to c coars	um sub artzite a coarse TER co coarse e sub a	nd	1 -
							(50)	1.80	32.01		Extrer coarse	mely wea e grained THERED	RMATION REPORTED TO THE PROPERTY OF THE PROPER	ON) sh brow	n fine to)	2 -
		3.00 - 4.50		83	83	31	- (50)	3.00	30.81		yellow graine congle round Discor space rough	reddish vish brow ed SAND omeratic, ed of qua ntinuities d dipping to smoo ng (CHES	n bandi STONE gravel artzite a are vei g 0 to 20 th with	ing med i. Slightl is fine to nd mud ry close occasio	lium to only o mediuntstone. Iy to clones es plana	ım sely ar	3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 -
		4.50 - 6.00		100	94	55		5.83	27.98		discontir staining	to 4.87r nuity fron	n 4.75 te	o 4.87m	with bla	ack	5 -
		6.00 - 7.50		-100	97	81		6.77 6.98 7.50	27.04 26.83 26.31		yellow graine close rough Weak yellow grey p SAND gravel quartz space	readish rish browed SAND to mediu to smoo reddish rish browe the satches no STONE. I is fine to tite. Discoud horizon STER FC	rn band: STONE m spac th (CHE brown v n bandi nedium Slightly o mediu ontinuiti ntal plar	s mediu Disco ed horiz ester with greing and to coars conglo m of mu ies are in	m to co portinuitie zontal pl FORMA y and occasic se grain omeratic udstone medium	es are lanar (TION) onal ed c, and	7 -
	Diameter se Diamete	Casing Diame		oth Top		Chisel	lling Duration	Tool [ion and Orien	Weak	reddish		nedium	to coars	Min (%)	8 - Max (%)
_	_																

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Rotary Core Log

Projec	t Name	: Parkside Eas	st			(Client: H	Harworth				Date: 1	9/05/20	23			
Locati	on: St. I	Helens				(Contrac	tor: MT G	Seoservice	s		Co-ord	s: E3607	708.85 N	N39478	5.43	
	t No. : 4					(Crew N	ame: M.E	. & D.O.			Drilling	Equipm	ent: Ber			
Bor	ehole N RBH10		Hole	: Typ RC	е		33	Level .81m AoE	,	Logged	Ву		Scale 1:40		1	ge Numl heet 2 of	
Well	Water	Depth (m)	Type /FI		orin	g RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend		Str	ratum D	escript)	1	11001 2 01	
		7.50 - 8.93		100		52		8.30	25.51		graine conglo round very c planai FORM	ed SANE omeration ed of mostosely to r rough to MATION		E. Slightlis fine to be considered to be	ly o mediu ntinuitie: I horizoi STER	ım s are ntal	- - - - - -
		8.90 - 10.50		100	100	91					coarse grave mudsi Disco space occas (CHE: Mediu and ye coarse	e SAND I is fine tone, que ntinuities d planal ional cla STER Form um stron ellowish e graine	ak reddi STONE. to mediu artzite a s are ve r rough t ay film or ORMAT g reddis brown t d SAND c, gravel	Congloum round siltst ry close to smooth contact ION) The brown canding STONE	omeration ded of cone. It to clo the with cts with grandium is Slightl	sely ey n to	9
		10.50 - 12.00		100	97	61					mudsi Disco space 20 de stainir at 10.9 sandstor mudstor	tone, qu ntinuities of planal grees w ng (CHE 93 to 11. ne with v ne bands	artzite a s are clo r rough t ith occas STER F 16mbgl very clos s	nd siltstosely to a sono sional da FORMAT Yellowis sely spa	one. medium th dippii ark grey FION) sh brown ced 20n	nly ng 0 to n n mm thick	11 -
		12.00 - 13.50		95	95	73					grained	micaced	ous SAN	IDSTON	u grey II. IE	ine	13 -
		13.50 - 15.00		97	97	72					շat 14.7	75 to 14.	81mbgl	50 degi	ree fract	ture	14 -
								15.00	18.81			End	of Boreho	ole at 15.0	000m		15
Hole Depth Bas	Diameter Diamete	Casing Diame		th Tor	Depth I	L Chisel	lling Duration	Tool D		on and Orient		Denth To-	Depth Base	Drilling Type	g Flush Colour	Min (%)	Max (%)
John Das	Diamete	, Pohit pass DidMi	orei Deb	ат тор	σσμιι Ι	Juse	JurauUII	1001	орит тор рерп	. Jaso Inciliatio	onentation	Берш юр	Бериі Базе	туре	COIOUI	IVIIII (70)	ividA (70)

1. CAT scanned and hand pit before breaking ground 2. No groundwater strikes were recorded during drilling 3. 50mm diameter gas/groundwater monitoring well complete with raised protective cover installed to 10m depth on completion. Response zone 5m to 10m depth. Bentonite seal.





Projed	t Name:	Parkside Ea	ıst		Clien	nt: Harworth	n			Date: 29/03/202	23 - 31/0	3/2023		
Locati	on: St. F	lelens			Cont	ractor: Hur	t Plant Lt	d		Co-ords: E3607	768.00 N	1394747	.00	
Projec	t No. : 4	597			Crew	/ Name: R.	R.			Equipment: 8 To	onne Ex	cavator		
Loc	cation Nu			ion Type TP		Level 33.25m Ac	,D		ed By R	Scale			ge Numbe	
Well	SA101 Water Strikes	Sample	and In	Situ Testing	,	Depth	Level	Legend	-K	1:25 Stratum De	scription		leet i oi	
	Strikes	Depth (m) Pit Width	Туре			(m) 0.50	(m) 32.75	and Comme	Dense coar angular to a CHESTER	Stratum De I gravelly SAND w I see red gravelly SA I sangular of SANDS FORMATION) End of Borehole	ith roots (Vel is sut ESIDUA	D.L.	1 1 1 1 1 1 1 1 1 1
Pít	Length 1.20	Pit Width 0.60		All faces stable	Sho	oring Used			Kemarks		Date	Kate	Remai	rks

Remarks





Projed	t Name:	Parkside Ea	ıst		Client: I	Harwortl	h			Date: 29/03/202	23 - 31/0	3/2023		
Locati	on: St. F	lelens			Contrac	ctor: Hur	t Plant L	td		Co-ords: E3607	756.00 N	1394899	.00	
Projed	t No. : 4	597			Crew N	lame: R.	R.			Equipment: 8 To	onne Ex			
Loc	cation Nu SA102			ion Type TP	35	Level 5.25m Ad	D D		jed By -R	Scale 1:25			ge Numbe	
Well	Water			Situ Testing	·	Depth	Level	Legend	-11	Stratum De	ecription		leet i oi	
vveii	Strikes	Depth (m)	Туре	Results		(m)	(m)	Legend	Prown grou					
		Depth (m)	Type	Results		0.20	35.05		Dense redo	relly SAND with ro	y medium to angula HESTER	SAND. (r of FORMA		1
	Dime	ensions		<u> </u>		Trench	Support	and Commo	ent			Pumpin	g Data	
Pit	Length 1.20	Pit Width 0.60		Pit Stability All faces stable	Shorin	g Used	,, -		Remarks		Date	Rate	Remai	rks

Remarks





Projec	t Name:	Parkside Ea	ast		Clien	t: Harworth	า			Date: 29/03/202	23 - 31/0	3/2023		
Locati	on: St. F	lelens			Contr	ractor: Hur	t Plant Lt	:d		Co-ords: E3606	671.00 N	1395012	2.00	
	t No. : 4				Crew	Name: R.	R.			Equipment: 8 To	onne Ex			
Loc	ation Nu SA103			ion Type TP		Level 36.24m Ac	ער		ed By .R	Scale 1:25			ge Number neet 1 of 1	
Well	Water Strikes			Situ Testing	,	Depth (m)	Level (m)	Legend	.11	Stratum De	scriptior		ieet i oi	
			,,,			0.30	35.94		Medium de	nse reddish brown arse sub angular _ CHESTER FOR	n gravelly to angula	r of sand	Gravel stone	1 —
						1.30	34.94		Extremely v (CHESTER	veak reddish brow FORMATION) End of Borehold				2 3 4 1 1 1 1 1 1 1 1 1
Pit	Dime Length 1.60	ensions Pit Width 0.60		Pit Stability All faces stable	Shor	Trench ring Used	Support	and Comme	ent Remarks		Date	Pumpir Rate	ig Data Remai	5 —

Remarks





	1										
Project Name: Pa	arkside East		Client: Harworth	n			Date: 29/03/202	23 - 31/0	3/2023		
_ocation: St. Hele	ens		Contractor: Hur	t Plant Lt	d		Co-ords: E3605	37.00 N	l394961	.00	
Project No. : 4597	7		Crew Name: R.	R.			Equipment: 8 To	onne Ex	cavator		
Location Numb SA104	per Lo	cation Type TP	Level 36.59m Ac	oD D		jed By .R	Scale 1:25			ge Numbe neet 1 of 1	
vveii io L		d In Situ Testing	, ' \	Level (m)	Legend		Stratum De	scription	1		
Dimensic Pit Length	ons Pit Width	Pit Stability	1.50	35.09	and Comme	Loose pale fine to coa (RESIDUA	e reddish brown grarse sub angular to a L CHESTER FOR!	avelly SA angular c MATION)	of sandsto	one	1
1.45	0.60	All faces stable									

Remarks





Project Name: Parkside East	Client: Harwortl	h			Date: 29/03/202	23 - 31/0	03/2023		
Location: St. Helens	Contractor: Hur	t Plant L	td		Co-ords: E3604	461.00 N	1395089	.00	
Project No. : 4597	Crew Name: R.	.R.			Equipment: 8 To	onne Ex	cavator		
Location Number Location Type SA105 TP	Level 36.33m Ad	эD		jed By ₋ R	Scale 1:25			ge Number	
Well Water Sample and In Situ Testing	()	Level	Legend		Stratum De	scription			
Strikes Depth (m) Type Results	(m)	(m)		Brown SAN	ID with roots (TOF				
	1.30 1.40	35.93 35.03 34.93		Medium de gravelly SA angular of \$ FORMATIO	nse reddish browr ND. Gravel is fine SANDSTONE (RE	n slightly to coars SIDUAL	e sub and CHESTE	gular to	1 2 3 4 5
Dimensions	Trench	n Support	and Comme	ent			Pumpin	g Data	
Pit Length Pit Width Pit Stability 1.30 0.60 All faces stabl	Shoring Used			Remarks		Date	Rate	Rema	rks

Remarks





Proje	ct Name:	Parkside E	ast		Clien	it: Harworth	า			Date: 29/03/202	23 - 31/0	3/2023		
Locat	ion: St. F	lelens			Cont	ractor: Hur	t Plant Lt	:d		Co-ords: E3606	657.00 N	1395194	.00	
Proje	ct No. : 4	597			Crew	/ Name: R.	R.			Equipment: 8 To	onne Ex			
Lo	cation Nu SA106			ion Type TP		Level 35.82m Ac	D		ed By .R	Scale 1:25			ge Number neet 1 of 1	
Well	Motor	Sample	and In	Situ Testing	3	Depth (m)	Level (m)	Legend		Stratum De	scription		1001 1 01	
Well	Water Strikes	Sample Depth (m)						Legend	Dense oran fine to coars (RESIDUAL	SAND with roots gish red gravelly as sub angular to CHESTER FORI	coarse S/ angular c MATION)	AND. Graf sandste	one	2 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
	Dime	ansione				Transl	Sunnart.	and Comm	ont.		I	Duma':	ng Dote	5 —
Pit	Dime Length 1.30	ensions Pit Width 0.60		Pit Stability All faces stable	Sho	Trench	Support :	and Comme	ent Remarks		Date	Pumpir Rate	ig Data Remai	rks

Remarks





1.50 33.13 End of Borehole at 1.500m	Projec	t Name:	Parksid	e East			Clien	it: Harworth	า			Date: 29/03/202	23 - 31/0	3/2023		
Location Number Location Type 34.63m AoD Loged By Scale Page Number Sheet 1 of 1	_ocati	on: St. F	lelens				Cont	ractor: Hur	t Plant Lt	:d		Co-ords: E3605	549.00 N	1395175	5.00	
Well Water Sample and in Situ Testing Depth (m) Type Results Depth (m) Depth (m) Type Results Depth (m) Depth (m) Type Results Depth (m) Depth (m) Depth (m) Depth (m) Type Results Depth (m)	Projec	t No. : 4	597				Crew	/ Name: R.	R.			Equipment: 8 To	onne Ex	cavator		
Strikes Depth (m) Type Results (m) (m) Legens Stratum Description Out brown SAND (TOPSOIL) Medium dense reddish brown gravelly SAND. Cravel is file to cooles such argular to ampalar of send-stone (RES DUAL CHESTER FORMATION) 1.50 33.13 End of Borehole at 1.500m 2 — Dimensions. Trench Support and Comment. Pumping Dala A— Dimensions. Pumping Dala A— Dimensions. Pumping Dala A— Dimensions. Dimensions. Pumping Dala A— Dimensions. Dimensions. Date Rate Remarks.	Loc			L					oD D							
Demonstors Demonstors Demonstors Part Width Demonstors Tenn's Support and Comment Tenn's Support	Well								Level (m)	Legend		Stratum De	scriptior	1		
Dimensions Trench Support and Comment Pumping Data Pil Lengtin Pit Width Pit Stability Shoring Used Remarks Date Rate Remarks			Бериг	(('')	Турс	Tresuits		0.40	34.23		Medium de	ense reddish browr oarse sub angular	n gravelly to angula	r of sand	Gravel Istone	1 —
Pit Length Pit Width Pit Stability Shoring Used Remarks Date Rate Remarks												End of Borehold	e at 1.500			3
	Pit	Length	Pit \			Pit Stability All faces stable	Sho	Trench ring Used	Support	and Commo	ent Remarks		Date		ng Data Remai	rks

Remarks





Project Name: Parkside East	Client: Harwort	th			Date: 29/03/202	23 - 31/0	03/2023		
Location: St. Helens	Contractor: Hu	ırt Plant L	td		Co-ords: E3603	385.00 N	l395182	.00	
Project No. : 4597	Crew Name: R	R.R.			Equipment: 8 To	onne Ex	cavator		
Location Number Location Type SA108 TP	Level 33.50m A			jed By ₋R	Scale 1:25			ge Number	
Well Water Strikes Depth (m) Type Res	()	Level (m)	Legend		Stratum De	scriptior	1		
Strikes Depth (m) Type Res	0.60	32.90			a slightly gravelly S				-
				Gravel is fir	nse orangish brow ne to coarse subar (RESIDUAL CHES	ngular to	angular c	of	1 —
	1.50	32.00	,		End of Borehold	e at 1.500	lm		-
									2 -
									3
									4
Dimensions Pit Length Pit Width Pit Stability	Shoring Used	h Support	and Comm	ent Remarks		Date	Pumpin Rate	ig Data Rema	5 —
1.50 0.60 All faces stabl									





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360868.91 N394639.17 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 33.20m AoD TP101 ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Туре Depth (m) Results Grass over dark brown very clayey SAND (TOPSOIL) ES 0.40 0.45 32.75 Stiff orange brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse rounded of mudstone and sandstone (DEVENSIAN TILL) 1.00 1.00 HVP=105.0 1.20 32.00 Reddish brown gravelly SAND. Gravel is fine to coarse subangular to angular of sandstone (RESIDUAL CHESTER FORMATION) 1.80 В 1.90 31.30 Reddish brown medium to coarse grained 2.00 31.20 SANDSTONE (CHESTER FORMATION) 2 End of Borehole at 2.000m 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks





Project Name: F	Parkside Eas	st		Client: Harwort	h			Date: 17/05/202	23			
₋ocation: St. He	lens			Contractor: MT	Geoserv	rices		Co-ords: E3607	798.17 N	1394743	3.46	
Project No. : 459	97			Crew Name: A.	M.			Equipment: 8 To	onne Ex	cavator		
Location Num TP102	nber		ion Type TP	Level 33.26m A	oD		ed By RM	Scale 1:25			ge Number neet 1 of 1	
Well Water Strikes	_		Situ Testing Results	(\	Level (m)	Legend		Stratum De	scriptior	ı		
vveii i a	Depth (m) 0.50	ES B		(\		Legend	Yellowish SAND. Gr sandstone FORMATI	er dark brown silty S brown and reddish avel is fine to coars and quartzite (RES	brown gr ee rounde SIDUAL (avelly medical to angion of the street of th	ular of R	3
Dimen	sions			Trencl	h Support	and Comm	ent			Pumpir	ng Data	
Pit Length 3.00	Pit Width 1.00	,	Pit Stability All faces stable	Shoring Used	- 355011		Remarks		Date	Rate	Rema	rks

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Project Name	: Parksid	e Eas	t		Client: Harworth					Date: 18/05/2023				
_ocation: St.	Helens				Contractor: MT Geoservices					Co-ords: E360800.98 N394852.87				
Project No. :	4597				Crew Name: A.M.					Equipment: 8 Tonne Excavator				
Location Number Location Type				Level				jed By	Scale					
TP10 Water	Sam	ple a	TP nd In Situ Testing				Level			1:25 Sheet 1 of Stratum Description			1	
Well Water Strikes	Depth 0.50 0.50	(m)	D ES	Situ Testing		Depth (m) 0.40 1.10 1.30 1.50	Level (m) 34.18 33.88 33.48 33.28 33.08	Legend	Dark brown rounded grading to coarse so (RESIDUAL Reddish broangular GR FORMATIC Red and ye coarse graingravel (CHI	Stratum De a silty fine SAND. If avel of sandstone in brown slightly group se rounded of sand TILL) bown gravelly mediubangular to angular to angular to chester For the sandy fine to the tayen of sandstores.	avelly CL ddstone a um SANI illar of sar MATION) coarse si e (RESIE	to coarsetzite (TO AY. Gravend quartz D. Gravendstone ubangula DUAL CH ated meded as sai	el is zite lis fine dium to ndy	2
3.00		.00		All faces stable		ŭ								

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360672.25 N394888.84 Location: St. Helens Project No.: 4597 Crew Name: A.M. Equipment: 8 Tonne Excavator Location Number Location Type Level Logged By Scale Page Number 35.38m AoD TP104 ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Туре Results Dark brown slightly gravelly clayey SAND. Gravel is fine to medium rounded of mudstone and quartzite (TOPSOIL) 0.20 FS 0.40 34.98 Very stiff orangish brown slightly gravelly CLAY. Gravel is sub rounded to rounded of sandstone, mudstone and quartzite (DEVENSIAN TILL) 0.60 D 0.60 ES 0.60 HVP=96.0 1.00 34.38 Reddish and yellowish brown gravelly medium SAND. Gravel is fine to coarse subangular to angular of sandstone (RESIDUAL CHESTER FORMATION) В 1.20 1.70 33.68 Reddish and yellowish brown extremely weak medium 1.80 33.58 to coarse grained SANDSTONE (CHESTER FORMATION) End of Borehole at 1.800m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Date Shoring Used Rate Remarks 1.00

Remarks





Client: Harworth Date: 18/05/2023 Project Name: Parkside East Co-ords: E360745.48 N394943.25 Location: St. Helens Contractor: MT Geoservices Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Page Number Location Number Location Type Level Logged By Scale 35.75m AoD TP105 TP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Type Results Dark brown silty fine SAND (TOPSOIL) 0.30 35.45 Reddish brown slightly clayey slightly gravelly fine SAND. Gravel is fine to coarse rounded to sub angular of sandstone and quartzite (RESIDUAL CHESTER FORMATION) 0.60 В 0.60 ES 0.90 34.85 Reddish brown and yellowish brown sandy fine to coarse sub angular to angular GRAVEL of sandstone. Occasional sandstone cobbles (RESIDUAL CHESTER FORMATION) 1.50 34.25 Reddish brown medium to coarse grained 1.60 34.15 SANDSTONE recovered as sandy cobbles (CHESTER FORMATION) End of Borehole at 1.600m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading testing undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Co-ords: E360799.20 N394998.80 Location: St. Helens Contractor: MT Geoservices Project No.: 4597 Crew Name: A.M. Equipment: 8 Tonne Excavator Location Number Location Type Level Logged By Scale Page Number 35.57m AoD TP106 ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Results Туре Dark brown slightly clayey silty SAND. Rare fine to medium gravel of sandstone and quartzite (TOPSOIL) 0.30 FS 0.35 35.22 Very stiff orangish brown slightly sandy slightly gravelly CLAY. Gravel is sub angular to rounded of sandstone quartzite and shale (DEVENSIAN TILL) 0.50 D HVP=100.0 0.50 0.75 34.82 Reddish brown interbeded with yellowish brown slightly gravelly medium SAND. Gravel is fine to coarse subangular to angular of sandstone (RESIDUAL CHESTER FORMATION) 1.40 В 1.60 33.97 Very weak thickly laminated yellowish brown, reddish brown and grey medium to coarse grained SANDSTONE. (CHESTER FORMATION) 1.90 33.67 End of Borehole at 1.900m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Date Shoring Used Rate Remarks 1.00

Remarks





Project Name: Parkside East	Client: Harworth	rth		Date: 18/05/2023				
Location: St. Helens	Contractor: MT	T Geoservices	i	Co-ords: E360724.32 N395010.79				
Project No. : 4597	Crew Name: A.I	λ.M.		Equipment: 8 Tonne Excavator				
Location Number Location TP107 TP	• •		Logged By RM	Scale 1:25	1			
Well Water Strikes Depth (m) Type	Results Depth (m)	Level (m)	gend	Stratum Des	cription	1		
Dimensions Pit Length Pit Width Pit	1.70	34.35	is fine to coa (TOPSOIL) Reddish bro SAND. Gras subrounded CHESTER I at 1.20 to coarse of sa cobbles Very weak r SANDSTON frequent sar	slightly silty slightly arse rounded of quarter outside of quarter outside of the same of	brown sl m subar quartziti is angu casiona yellowis sandy gr CHESTE	ightly grangular to e (RESID allar fine all sandstandstandstandstandstandstandstands	to one	1 — — — — — — — — — — — — — — — — — — —
3.50 1.00 All f	idood stable							

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Client: Harworth Date: 18/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360786.30 N395058.49 Location: St. Helens Project No.: 4597 Crew Name: A.M. Equipment: 8 Tonne Excavator Location Number Location Type Level Logged By Scale Page Number 35.47m AoD TP108 ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Туре Results Grass over dark brown silty SAND. Rare brick and plastic fragments (TOPSOIL) 0.20 FS 0.40 35.07 Stiff reddish brown mottled grey slightly sandy CLAY (DEVENISAN TILL) 0.60 D 0.60 1.30 34.17 Yellow and reddish brown gravelly medium SAND. Gravel is fine to coarse subangular to angular of sandstone with rare fine rounded quartzite (RESIDUAL CHESTER FORMATION) 2.00 33.47 2 Reddish brown medium to coarse grained SANDSTONE (CHESTER FORMATION) 33.37 2.10 End of Borehole at 2.100m 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings.





Projec	ct Name:	Parkside	East			Client: Harworth					Date: 18/05/2023				
ocat	ion: St. F	lelens				Contractor: MT Geoservices					Co-ords: E360592.54 N395010.31				
Projec	ct No. : 4	597				Crew Name: A.M.					Equipment: 8 Tonne Excavator				
Location Number Location Type TP109 TP				Level 35.93m AoD				ed By RM	Scale 1:25	•					
Well	Water Strikes	-			Situ Testing		Depth (m)	Level (m)	Legend		Stratum De	scription	1		
		Depth (0 0.20		/pe	Results		0.30 35.63			Grass over dark brown silty SAND. Rare brick and plastic fragments (TOPSOIL) Very stiff orangish brown CLAY. Rare fine to coarse rounded gravel of sandstone and quartzite (DEVENSIAN TILL)				-	
		0.60 0.60 0.60 0.60 0.60	ES	D ES HVP=10 HVP=11		0	0.75	35.18							1 —
							1.65	34.28 34.23		recovered	rown medium grain as sandy gravel ar INE FORMATION) End of Borehol	nd cobble	s (KINNI	ERTON	3
															5 —
			/idth 00	h Pit Stability All faces stable		Trench Shoring Used		Support and Comment Remarks				Date	Pumpir Rate	ng Data Rema	rks

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading testing undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360620.79 N395067.56 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 35.88m AoD **TP110** ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Type Results Dark brown slightly gravelly slightly clayey silty SAND. Gravel is sub angular to rounded of sandstone (TOPSOIL) 0.30 В 0.30 ES 0.40 35.48 Firm light brown slightly gravelly sandy CLAY. Gravel 0.50 D is fine to medium rounded of quartzite and sandstone. 0.50 ES (DEVENSIAN TILL) 0.60 35.28 Reddish brown gravelly fine to medium grained SAND. Gravel is fine to coarse subangular to angular of sandstone (RESIDUAL CHESTER FORMATION) 1.00 В 1.40 34.48 Reddish brown medium to coarse grained SANDSTONE recovered as sandy gravel (CHESTER FORMATION) 1.70 34.18 End of Borehole at 1.700m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360467.04 N395032.19 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 37.25m AoD **TP111** ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Results Depth (m) Type Dark brown slightly clayey slightly gravelly silty SAND. Gravel is fine to medium rounded of sandstone and quartzite. (KINNERTON SANDSTONE FORMATION) 0.20 FS 0.40 36.85 Reddish brown and yellowish brown gravelly SAND. Gravel is fine to coarse subangular to angular of sandstone (KINNERTON SANDSTONE FORMATION) 0.60 В 0.60 ES 1.40 35.85 Reddish brown and yellowish brown medium to coarse grained SANDSTONE recovered as sandy gravel (KINNERTON SANDSTONE FORMATION) 1.70 35.55 End of Borehole at 1.700m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks





Client: Harworth Date: 18/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360646.94 N395109.87 Location: St. Helens Project No.: 4597 Crew Name: A.M. Equipment: 8 Tonne Excavator Location Number Location Type Level Logged By Scale Page Number 35.88m AoD TP112 TP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Type Results Dark brown slightly clayey silty fine SAND (TOPSOIL) 0.40 ES 0.40 35.48 Stiff orangish brown and yellowish brown slightly gravelly sandy CLAY. Gravel is fine to coarse rounded of sandstone, mudstone and quartzite. Rare 0.60 D sandstone and quartzite cobbles (DEVENSIAN TILL) HVP=110.0 0.60 0.75 35.13 Reddish brown and orangish brown gravelly SAND. Gravel is fine to coarse subangular to angular of sandstone (RESIDUAL CHESTER FORMATION) 1.00 В 1.40 34.48 Reddish brown medium to coarse grained SANDSTONE recovered as very gravelly sand with a 1.55 34.33 medium sandstone cobble content (CHESTER FORMATION) End of Borehole at 1.550m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Client: Harworth Date: 17/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360504.03 N395124.70 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 35.75m AoD **TP113** ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Type Results Dark brown slightly gravelly silty SAND. Gravel is fine to medium rounded of sandstone and mudstone (TOPSOIL) 0.20 В 0.20 ES 0.40 35.35 Reddish brown fine to medium gravelly SAND. Gravel is fine to coarse sub angular to angular of sandstone (KINNERTON SANDSTONE FORMATION) 0.70 В 1.60 34.15 Reddish brown and yellowish brown thickly laminated medium grained SANDSTONE. Recovered as sandy 1.80 33.95 tabular angular cobbles (KINNERTON SANDSTONE FORMATION) End of Borehole at 1.800m 2 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks





Client: Harworth Date: 18/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360385.49 N395128.11 Location: St. Helens Project No.: 4597 Crew Name: A.M. Equipment: 8 Tonne Excavator Location Number Location Type Level Logged By Scale Page Number 34.38m AoD **TP114** ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Туре Results Dark brown silty SAND. Rare medium to coarse rounded gravel of quartzite (TOPSOIL) 0.20 FS 0.35 34.02 Orangish brown and yellowish brown slightly gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone and rare mudstone. Occasional sandstone cobbles (KINNERTON SANDSTONE FORMATION) 0.70 В .at 1.00 becoming gravelly 2.00 В 2 2.30 32.08 Yellowish brown fine to coarse grained SANDSTONE 31.98 recovered as sandy gravel with occasional sandstone cobbles (KINNERTON SANDSTONE FORMATION) 2.40 End of Borehole at 2.400m 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings





Project Name: Parkside East Client: Harworth Date: 17/05/2023 Contractor: MT Geoservices Co-ords: E360474.54 N395221.85 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 35.36m AoD TP115 ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Results Depth (m) Type Grass over dark brown slightly clayey silty SAND (TOPSOIL) 0.20 FS 0.30 35.06 Reddish brown gravelly fine to medium SAND. Gravel is fine to coarse angular of sandstone (KINNERTON SANDSTONE FORMATION) В 0.60 ...at 1.50 to 1.90mbgl low sandstone cobble and boulder content 1.80 33.56 Reddish brown and yellowish brown medium to coarse 1.90 33.46 grained SANDSTONE (KINNERTON SANDSTONE FORMATION) 2 End of Borehole at 1.900m 3 5 Dimensions Trench Support and Comment Pumping Data Pit Stability Pit Length Pit Width Shoring Used Date Rate Remarks 1.00

Remarks





Client: Harworth Date: 18/05/2023 Project Name: Parkside East Contractor: MT Geoservices Co-ords: E360603.77 N395244.58 Location: St. Helens Equipment: 8 Tonne Excavator Project No.: 4597 Crew Name: A.M. Location Number Location Type Level Logged By Scale Page Number 35.50m AoD **TP116** ΤP RM 1:25 Sheet 1 of 1 Sample and In Situ Testing Water Depth Level Well Legend Stratum Description Strikes (m) (m) Depth (m) Туре Results Dark brown silty fine SAND. Rare fine to coarse rounded sandstone gravel (TOPSOIL) 0.20 FS 0.40 35.10 Orangish brown and reddish brown slightly gravelly SAND. Rare medium to coarse rounded gravel of quartzite and angular sandstone (RESIDUAL CHESTER FORMATION) 0.60 В 1.70 33.80 Reddish brown medium to coarse grained 1.80 В SANDSTONE recovered as sandy fine to coarse subangular to angular gravel of sandstone (CHESTER 1.90 33.60 FORMATION) End of Borehole at 1.900m 3 5 Dimensions Trench Support and Comment Pumping Data Pit Length Pit Width Pit Stability Shoring Used Date Rate Remarks 1.00

Remarks

1. Location CAT scanned before breaking ground 2. No groundwater strikes were recorded during drilling 3. Plate loading test undertaken at 0.60mbgl 4. On completion Trial Pit backfilled with arisings







TP101



TP101





TP101



TP101



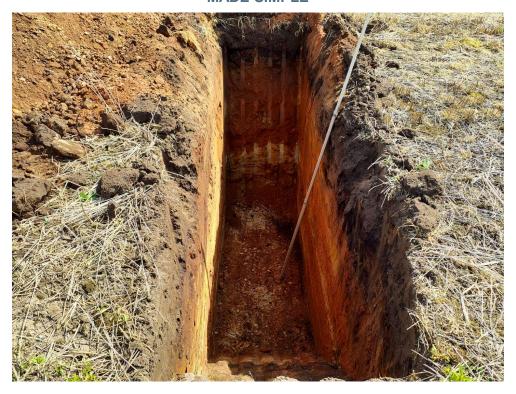


TP101



TP102





TP102



TP102





TP102



TP103





TP103



TP103





TP103



TP103





TP103



TP104





TP104



TP104





TP104



TP104





TP105



TP105





TP105



TP105





TP105



TP106





TP106



TP106





TP106



TP106





TP107



TP107





TP107



TP107





TP107



TP108





TP108



TP108





TP108



TP108





TP109



TP109





TP109



TP109



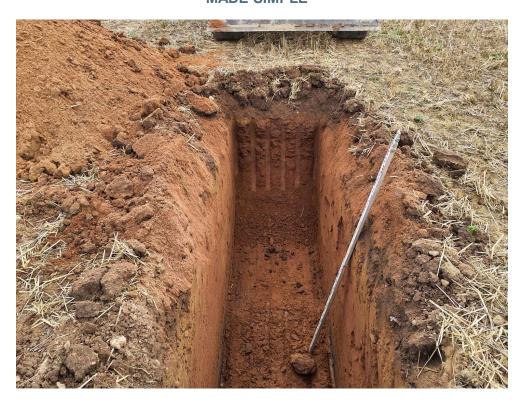


TP109



TP110





TP110



TP110





TP110



TP110





TP111



TP111





TP111



TP111





TP111



TP112





TP112



TP112





TP112



TP112





TP113



TP113





TP113



TP113





TP113



TP114





TP114



TP114





TP114



TP114





TP115



TP115





TP115



TP115





TP115



TP116





TP116



TP116





TP116



TP116



APPENDIX C – CHEMICAL TESTING RESULTS



	23/04902 1	D □□□□30 May, 2023					
	ROCP LIMITED Commercial Wha Castlefield Manchester M15 4PZ	arf 6 Commercial Street					
r	Linden Richardso Parkside East 4597 PO1878 18/05/23 19/05/23 30/05/23	on/Reece McGuinness					
/ // /							

Richard Wong Client Manager







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The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received within the same delivery, will be disposed of after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and Interpretations expressed are outside our scope of accreditation.

The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.

A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

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1	SAND	6	CLAY/LOAM	Α	Contains Stones				
2	LOAM	7	OTHER	В	Contains Construction Rubble				
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	С	Contains visible hydrocarbons				
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal				
5	SAND/CLAY			Е	Contains roots / twigs				

All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase

Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG results have humics mathematically subtracted through instrument calculation.

Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is included in the quantified results but present in the ID for information.

Results greater than 12900uS/cm @ 25°C / 11550uS/cm @ 20°C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.



23/04902

19/05/2023 (am)



Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: ROCP LIMITED, Commercial Wharf 6 Commercial Street, Castlefield,

Project No: Manchester, M15 4PZ **Date Received:**

Cool Box Temperatures (°C): 13.6 **Project:** Parkside East

Clients Project No: 4597

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.





	23/04902/1	23/04902/2	23/04902/3	23/04902/4	23/04902/5	23/04902/6	23/04902/7	23/04902/8	23/04902/9
	TP101 0.40m	TP101 1.00m	TP102 0.50m	TP104 0.20m	TP106 0.30m	TP110 0.30m	TP111 0.20m	TP113 0.20m	TP115 0.20m
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A-T-004s	25/05/2023								25/05/2023
A-T-007s	25/05/2023								25/05/2023
A-T-019s	26/05/2023	26/05/2023	26/05/2023	26/05/2023	26/05/2023	26/05/2023	26/05/2023	26/05/2023	26/05/2023
A-T-022s	26/05/2023								26/05/2023
A-T-024s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-025w	30/05/2023								30/05/2023
A-T-026s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-026w	30/05/2023								30/05/2023
A-T-026w (F)	30/05/2023								30/05/2023
A-T-027s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-030s	30/05/2023								30/05/2023
A-T-031s	27/05/2023	27/05/2023	27/05/2023	27/05/2023	27/05/2023	27/05/2023	27/05/2023	27/05/2023	27/05/2023
A-T-031w	30/05/2023								30/05/2023
A-T-032s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
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A-T-037w	30/05/2023								30/05/2023
A-T-040s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
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A-T-044	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-045	24/05/2023				24/05/2023				
A-T-050s	25/05/2023	25/05/2023	25/05/2023	25/05/2023	25/05/2023	25/05/2023	25/05/2023	25/05/2023	25/05/2023
A-T-050w	30/05/2023								30/05/2023
A-T-ANCs	27/05/2023								27/05/2023
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Calc-no stones	30/05/2023								30/05/2023
Probe (w)	30/05/2023								30/05/2023

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

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Gemma Berrisford Client Manager







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Analytical results reflect the quality of the sample at the time of analysis only.

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A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

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Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
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NAD	No Asbestos Detected
N/A	Not applicable

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Marama	

1	SAND	6	CLAY/LOAM	Α	Contains Stones
2	LOAM	7	OTHER	В	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	С	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5 SAND/CLAY E Contains roots / twigs					
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All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase

Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG results have humics mathematically subtracted through instrument calculation.

Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is included in the quantified results but present in the ID for information.

Results greater than 12900uS/cm @ 25°C / 11550uS/cm @ 20°C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.





Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: ROCP LIMITED, Commercial Wharf 6 Commercial Street, Castlefield,

Manchester, M15 4PZ

Project: Parkside East

Clients Project No: 4597

Project No: 23/05054

Date Received: 24/05/2023 (am)

Cool Box Temperatures (°C): 12.6 & 12.7

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.





	23/05054/1	23/05054/2	23/05054/3	23/05054/4	23/05054/5	23/05054/6	23/05054/7	23/05054/8	23/05054/9	23/05054/10	23/05054/11	23/05054/12
	TP107 0.30m	TP114 0.20m	TP103 0.50m	RBH101 0.25m	TP105 0.60m	RBH102 0.70m	TP116 0.20m	TP112 0.40m	TP109 0.60m	TP108 0.20m	RBH105 1.00m	RBH106 1.00m
	18/05/23	18/05/23	18/05/23	18/05/23	18/05/23	19/05/23	18/05/23	18/05/23	18/05/23	18/05/23	17/05/23	16/05/23
A-T-019s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-024s	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023
A-T-026s	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-027s	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-031s	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-032s	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-040s	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-042sTCN	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023
A-T-044	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023
A-T-050s	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	30/05/2023	31/05/2023	31/05/2023	31/05/2023	31/05/2023
Calc	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023	01/06/2023



	23/05054/13	23/05054/14
	RBH104 0.20m	RBH107 0.30m
D and	23/05/23	15/05/23
A-T-019s	30/05/2023	30/05/2023
A-T-024s	31/05/2023	31/05/2023
A-T-026s	01/06/2023	01/06/2023
A-T-027s	01/06/2023	01/06/2023
A-T-031s	01/06/2023	01/06/2023
A-T-032s	01/06/2023	01/06/2023
A-T-040s	01/06/2023	01/06/2023
A-T-042sTCN	30/05/2023	30/05/2023
A-T-044	01/06/2023	01/06/2023
A-T-050s	31/05/2023	31/05/2023
Calc	01/06/2023	01/06/2023

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.



COMPLEX CHALLENGES ... MADE SIMPLE

APPENDIX D – GEOTECHNICAL TESTING RESULTS



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PROJECT:	Warrington
CLIENT:	ROC Consulting

FIELDWORK

CPT rig(s)	20.5-tonne track-truck mounted CPT unit (UK3)
Date fieldwork started	16 th May 2023
Date fieldwork completed	16 th May 2023
Lankelma's representative	Emma Stickland
Client's representative	Reece McGuinness

DOCUMENT CHECKING

Action	Date	Name
Completed	31/05/2023	Christopher Player
Checked	31/05/2023	Joseph Hobbs
Approved	31/05/2023	Joseph Hobbs

Issue	Date	Status
01 01	31/05/2023	Final





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1 INTRODUCTION

At the request of ROC Consulting, a soils investigation was carried out on project Warrington.

Site location:

(In the general region of)

Parkside Road Winwick Warrington WA2 8ST

2 DISCLAIMER

The investigation information, raw data and interpretations provided in this report are for the sole benefit of the Client identified at the front of the report.

Lankelma has exercised reasonable skill and care in the fieldwork and preparation of this report. This report has been completed based on information available to Lankelma at the time of preparation. The measurement and interpreted data in this report do not constitute recommendations for design purposes. An appropriately qualified person must review and interpret the data given in this report, together with any assumptions we have made that affect the data, before using the data for design or recommendation. Lankelma accepts no responsibility for the accuracy or suitability of any assumptions, derived soil parameters, soil classification descriptions or soil layer boundaries contained in this report.

3 COMPLETED WORKS

- 14 nr. cone penetration tests with pore pressure measurement (CPTu)
- Factual report including point data interpretation of selected parameters

Appendix A contains tabulated details of the works completed together with analysis results where applicable.

4 FIELDWORK GENERAL

Fieldwork was performed with a 20.5-tonne track-truck mounted CPT unit (UK3) equipped with a 17.0-tonne capacity hydraulic ram set.

The Client was responsible for the positioning and re-survey of all investigative locations.

The target depth for the investigation was 5 m below ground level. Table 3 details the final test depths and reasons for test termination (*refusal factor*). Where required, each penetration refusal decision was verbally confirmed with the Client's on-site representative.



5 CONE PENETRATION TESTS

Cone penetration testing was carried out in general accordance with BS ISO 22476-1:2012.

Penetrometer measurements included cone tip resistance, friction sleeve resistance and dynamic pore water pressure sampled at a 10 mm resolution.

Penetrometers were calibrated in accordance with ISO 376:2011. The management of calibration records is in accordance with ISO 10012. Copies of all calibration certificates for the cones used are provided in Appendix B.

The penetrometer used was a digital model (down-hole digitisation) with internal measurement of load cell temperature. The temperature data was used for QA during the test and QC during processing. The test operative aimed to keep the rate of temperature change to less than 0.5° /min in low strength soils to maintain acceptable measurement error. The temperature data can be used to assess ground temperature at depths where the cone has paused for more than 10 minutes with an accuracy of ~+- 0.5° .

The piezometer filter element was in the u_2 position and was vacuum saturated in a > 99.9% vacuum under 1000 cSt silicone oil for > 7 days prior to mobilisation. The pore pressure system was vacuum saturated in the disassembled state under 500 cSt glycerine oil (dipropylene glycol or propylene glycol) and assembled under oil prior to each test.

5.1 GLOSSARY OF CPT TERMS AND SYMBOLS

SYMBOLS & ABBREVIATIONS

\Box B_q	Pore pressure ratio. The net pore pressure normalized with respect to the net cone resistance: $B_q = (u_2 - u_0)/(q_t - \sigma_v)$			
Fr	Normalised friction sleeve resistance: $F_r = f_s / (q_{c^-} \sigma_v)$			
fs	Friction sleeve resistance: The total frictional force acting on the friction sleeve, F_s , divided by its surface area A_s : $f_s = F_s/A_s$.			
G	Shear modulus			
g	Gravitational constant: $g = 9.81 \text{ m/s}^2$			
G_0	Small strain shear modulus			
Gs	Specific gravity of solids			
HOC	Heavily overconsolidated			
I _c	Soil Behaviour Type Index : Continuous numerical representation of Robertson (1990) soil behaviour type classification chart.			
LOC	Lightly overconsolidated			
NC	Normally consolidated			
OC	Overconsolidated			
\mathbf{q}_{c}	Cone resistance: The total force acting on the cone Q_c , divided by the projected area of the cone, A_c : $q_c = Q_c/A_c$.			
Q_{t}	Normalised cone resistance (Method 1): $Q_t = (q_c - \sigma_v)/\sigma'v$			
2				





 q_t Corrected tip resistance: The cone tip resistance q_c corrected for pore water

pressure effects on the cone shoulder.

 q_{t-net} Net cone resistance: $q_{t-net} = q_t - \sigma_v$. Where q_t is unavailable q_c is applied.

q_{t1} Normalised cone resistance (Method 2): $q_{t1} = (q_t)/(\sigma'_v)^{0.5}$

R_f Friction ratio: The ratio, expressed as a percentage, of the sleeve friction, f_s,

to the cone resistance, q_c , at a given depth: $R_f = (f_s/q_c) \cdot 100$

SBT or SBTn Soil behaviour type classification

SPT Standard Penetration Test u₀ Equilibrium pore pressure

u₂ Pore pressure: Dynamic pore pressure measured at the shoulder position (u₂)

during penetration and during dissipation tests. $u_2 = \Delta u_2 + u_0$

 $Δu_2$ Excess pore pressure: $Δu_2 = u_2 - u_0$

 V_{s} , V_{p} Shear wave velocity, V_{s} , and pressure wave velocity, V_{p} . Measured with use

of a seismic receiver.

z Depth below ground level: Depth as penetration length without correction for

inclination, or true depth after correction for inclination.

<u>Greek</u>

 γ Unit weight of soil γ_w Unit weight of water

 ρ Volumetric mass density (or specific mass) of soil: $\rho = \gamma/g$

 σ_v Total overburden stress

 σ'_{v} Effective overburden stress

 σ_{atm} , or, P_a Reference atmospheric stress: $\sigma_{atm} = 101.3$ kPa

TERMS

Cone or 'tip': The conical tip of the cone penetrometer.

Friction sleeve: The section of the cone penetrometer upon which the sleeve friction is measured, located behind the cone tip.

Piezocone: A cone penetrometer with a pore pressure sensor (u₂ or u₁)

Seismic cone: A cone penetrometer with a seismic receiver incorporated inside or behind.

Dynamic pore pressure: The pore pressure measured during penetration (u₂ or u₁).

Soil behaviour type, **or** 'SBT': Soil classification scheme or classified soil type according to Robertson (1990, 2016) often abbreviated to SBT or according to normalised cone parameters SBTn.

Rod string: The series of hollow tube push rods that transmit force to the penetrometer.





5.2 CPT DATA REDUCTION AND PRESENTATION

The CPT results are presented in Appendix C. The corrected cone resistance (q_t) , local side friction (f_s) , dynamic pore water pressure (u_2) , friction ratio (R_f) and inclination are all presented against depth and elevation in accordance BS ISO 22476-1:2012. CPT data and the associated derived geotechnical parameters are included in the 4.0 data file provided.

The cone tip and sleeve force measurements were converted to pressure using the nominal dimensions of the penetrometer.

Zero load output values were recorded before and after each test. The set of zero values applied to the measurements (subtracted from the raw output measurement) were those deemed to be obtained at a temperature closest to ground temperature, or the average of the two sets where appropriate.

For tests performed with digital cones, the tip sleeve and pore pressure measurements were corrected for static and transient temperature effects using parameters obtained from the *TEMPERATURE EFFECTS* section of the calibration certificate. For each CPT, the dataset was first grouped into penetration strokes (max 1.2 m) and then locally sub-grouped by tip resistance above and below 2 MPa. For each sub-group of qc < 2 MPa, the slope of the temperature (T) profile with time (t) was determined by regression to obtain the rate of temperature change $\Delta T/\Delta t$. For each recorded value, the static and transient temperature error component (apparent sensor output due to change in temperature) was subtracted from the reading.

For subtraction type cones incorporating traditional temperature compensation wiring in the strain gauge circuit, the residual apparent cone tip resistance ($q_{c:a}$) and sleeve resistance ($f_{s:a}$) due to static and transient temperature effects can be approximated by

```
q_{c:a} = a(\Delta T/\Delta t) + b(\Delta T), f_{s:a} = a(\Delta T/\Delta t) + b(\Delta T) - q_{c:a} and u_a = b(\Delta T)
```

Where $q_{c:a}$ is the apparent tip resistance, $f_{s:a}$ is the apparent sleeve resistance, a is the apparent resistance due to unit transient temperature change $\Delta T/\Delta t$, and b is the change in apparent resistance per unit static temperature change relative to the temperature of the penetrometer at the time of zero load output measurement. Note that for the piezometer sensor only the static temperature component is considered and is only applied to piezometer sensors without temperature compensation circuitry.

Parameter a is established by subjecting the cone to a positive and negative nominal temperature change ($\Delta T \sim +-9^{\circ}$) in water and measuring the apparent output corresponding to the maximum rate of temperature change at the load cells. Parameter b is established by measuring the apparent output after the cone has temperature stabilised.

The temperature corrected tip $(q_{c:c})$, sleeve resistance $(f_{s:c})$ and pore pressure $(u_{:c})$ are then found from





$$q_{c:c} = q_{c:m} - q_{c:a}$$

$$f_{s:c} = f_{s:m} - f_{s:a}$$

$$u_{:c} = u_{:m} - u_{:a}$$

Where subscript ':m', denotes the field measured resistance/pressure as recorded in the raw data files.

Notes:

- 1. Depending on the temperature performance of the individual cone, temperature correction of the sleeve is often not warranted as it does not substantially improve accuracy. This is because for subtraction type cones the errors in the sleeve force largely cancel with errors in the tip force when they have the same sign.
- 2. There is currently no recognised nomenclature for CPT parameters with temperature correction applied during post processing. To avoid confusion the nomenclature is kept unchanged in the logs and AGS data (q_c/q_t , f_s , and u_2) and unless stated otherwise, temperature correction has been applied using the parameters reported in the calibration certificate.

For piezocone tests the total cone resistance (or 'corrected cone resistance') was calculated according to the formula

$$q_t = q_c + u_2 \times (1 - a)$$

Where a is the 'area ratio' and (1- a) is the proportion of cross-sectional area between the cone tip and penetrometer body where pore pressures (positive or negative) can act to add or subtract from the total external axial force on the tip. The difference between measured and corrected values is largest in low strength collapsible soils with large excess pore pressures. The percentage adjustment is described by the curves on the chart below for a = 0.8:

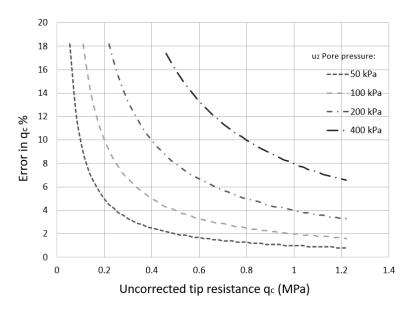


Figure 5-1 Uncorrected tip with measured tip resistance





Penetration length readings were corrected for inclination and sleeve readings were depth corrected for the dimensional offset between cone tip and sleeve during post processing. Rod spikes (artefacts of the pause for push rod addition) were filtered from the cone tip and sleeve data and replaced with an interpolated value. The data was re-sampled from 10 mm resolution to 20 mm to reduce the size of the data set to a more manageable size for end users. A 20 mm resolution is well within the intrinsic influence zone of the cone tip measurement and the loss of meaningful resolution is negligible.

The raw data is presented in Appendix C. For piezocone tests q_t is reported on all logs, and q_c only appears in the digital AGS data.

Geotechnical parameters appropriate for drained and undrained cone penetration conditions were derived for corresponding drained and undrained derived soil behaviour types (SBTs) respectively, however, to account for uncertainty in the SBT correlation with drainage behaviour, all parameters were derived over a range of transitional soils within the range 2.4 < lc < 2.7 (see section 6.3).

In general, the engineering parameters derived for fine grain soils (undrained) are suitable for soils of both silicate and carbonate composition, whereas parameters derived for coarse soils are intended for non-cemented silicate composition.

5.3 IN-SITU STRESS CONDITIONS

An estimate of the equilibrium pore pressure and total and effective vertical stress states is required for derivation of most soil parameters obtained from the CPT and dissipation test.

The total vertical stress with depth was calculated as the sum of the derived soil unit weight above a given depth. See section 5.4 for information on the empirical estimate of soil unit weight.

An arbitrary phreatic surface of 3.00 mBGL was applied in the calculation of effective stress.

Note: The term phreatic surface is used here, however when it is based on piezometer measurements (piezocone) it is assumed that the piezometric level (under hydrostatic conditions) and phreatic surface coincide. The phreatic or piezometric level reported is intended to provide information about pore pressure distribution assumed for calculation purposes and may not represent the true position of the groundwater table or perched water bodies. Complex groundwater pressure distributions will be applied if they are observed from the measurements and are sufficiently well defined.

5.4 SOIL UNIT WEIGHT

The soil unit weight was estimated using the following method proposed by Robertson (2010b).

$$\frac{y}{y_w} = 0.27 \, Log(R_f) + 0.36 \, (Log(q_t/R_f)) + 1.236$$

Throughout pre-drilled zones (inspection pits or drill-out) the soil was assigned a nominal unit weight of 17 kN/m³.





For depths where the friction sleeve resistance measurement was less than zero due to measurement limitations, the friction sleeve resistance input parameter was substituted with a nominal 1.0 kPa resistance for the purpose of obtaining an approximate soil unit weight necessary for estimation of total vertical stress over the entire profile.

5.5 SOIL BEHAVIOUR TYPE

The data have been interpreted using 4 soil behaviour type schemes: Robertson (1990, 2010, 2016) and Schneider et al, 2008. The Robertson (1990) scheme is widely used and forms the bases of the layer analysis whereby the profile is split into zones of common classification. The Robertson (2010 & 2016) and Schneider at all methods are less widely used but can provide better or more relevant classification in many instances. Differences in classification between the Robertson 1990, 2016 and Schneider et all schemes can also help to identify significant structure/cementation (Robertson 2016).

A dedicated soil behaviour type comparison log is provided in Appendix D.

Robertson (1990, 2010)

The soil behaviour type (SBT) was interpreted using the Robertson (1990) classification system based on the normalised cone resistance (Qt) and normalised friction sleeve resistance (Fr) for silicate and organic soils.

While the classification based on normalised parameters is more accurate, particularly for NC soils exceeding 15 m depth, the classification is often significantly in error (artificially granular/drained) at shallow depth (< 1-3 m). The error at shallow depth is associated with the potentially large difference between the estimated vertical effective stress (applied in normalisation) and the unknown horizontal stress influencing penetration resistance.

Robertson (2010) proposed a non-normalised version of the 1990 chart which uses dimensionless cone resistance (q_c /Pa) and friction ratio (Rf). The classification according to this chart can be more reliable at shallow depth.

It should be noted that:

- The SBT classification provides a general soil type and tends to show biased towards the soil fraction that dominates the mechanical behaviour.
- If fine cohesive soils are dry and overconsolidated, the classification tends to shift towards a coarser soil type (or lower I_c index)

While the repeatability and behavioural bias of the SBT is usually beneficial, the classification is not always an appropriate substitute for classification based on particle size and plasticity index tests.



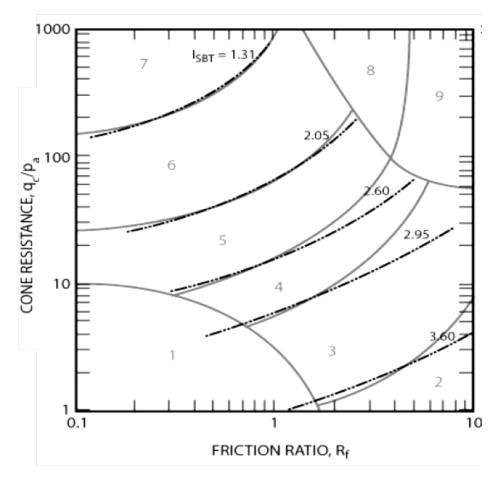


Figure 5-2 Non-normalised SBT chart by Robertson et al. (2010) based on dimensionless cone resistance (qc/Pa) and friction ration, Rf, showing contours of SBT index ISBT (denoted Ic on the test plots). The chart is also applicable to normalised tip (Q_t) and sleeve (F_r) values.

Table 1 Robertson (1990, 2010) soil behaviour type zone descriptions

Zone			
	Sensitive fine-grained	6 Sand	ds - clean sand to silty sand
	Organic soils	7 Grav	elly sand to sand
	Clays – clay to silty clay	8* Very	stiff/dense sand to clayey sand1
	Silt mixtures - clayey silt to silty clay	9* Very	stiff fine grained ¹
	Sand mixtures – silty sand to sandy silt	*Heavily ove	erconsolidated or cemented

¹Note zones 8 and 9 appear as 'Very stiff/dense sand to clayey sand - HOC or cemented' and 'Very stiff fine grained - HOC or cemented' within the soil unit descriptions of plots in Appendix D.

Results are presented in Appendix D.

Robertson 2016

Using the same Q_t - F_r space as above, Robertson (2016) proposed an alternative purely behavioural classification system that places less emphasis on classification according to composition/textural properties and more emphasis on mechanical behaviour - namely the tendency of the soil to dilate or collapse during large strain shear, and sensitivity.



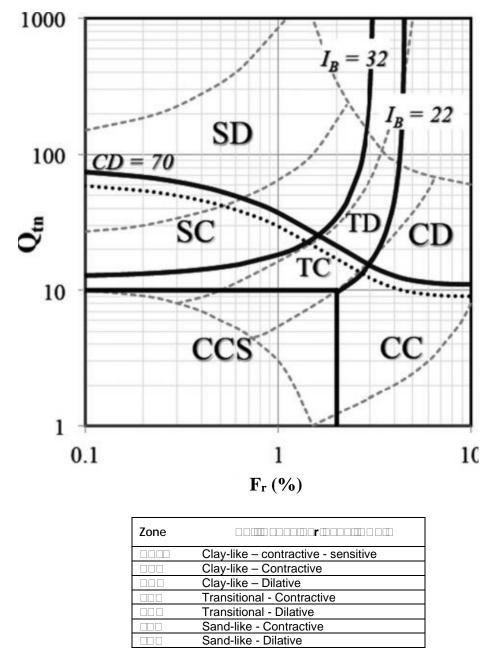


Figure 5-3 Robertson 2016 soil behaviour type classification chart and zone descriptions

Schneider et al. (2008)

Schneider *et al.* (2008) proposed a classification system based on the normalised pore pressure B_q and tip resistance Q_t . This system is particularly useful for soils of very low strength or that exhibit drainage behaviour or u_2 response inconsistent with the SBT derived from tip and sleeve measurements. However, when using this method for onshore CPT data, the u_2 piezometer response should be assessed for possible desaturation. Generally, it is safest to only use this method when the piezometer response is 'spikey' and responding dynamically to changes in tip resistance.

A set of logs showing both the Robertson and Schneider et al. classification results are provided for comparison in Appendix D.



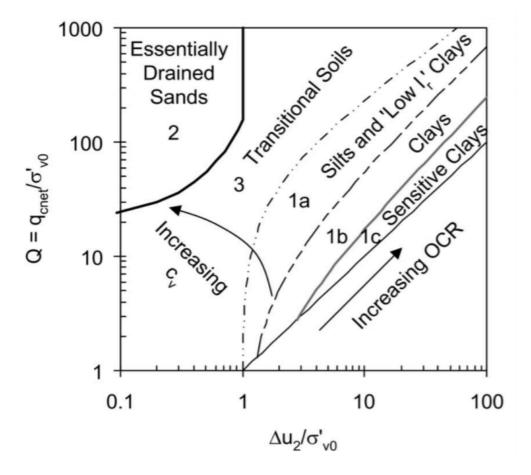


Figure 5-4 Schneider 2008 soil behaviour type classification chart and zone descriptions

Layer Analysis

The layer boundaries are manually interpreted based on broad changes in Robertson 1990 SBT classification or variance with depth. Once layer boundaries are defined, the SBT zones classified within each layer are listed together with the corresponding percentage of data points within the layer (excluding null/filtered data). The modal classification is reported in full, with abbreviated short descriptions for all secondary zones, for example - 'Clays - clay to silty clay [74%]; *Silt mixtures [20%]', where the asterisk represents an abbreviation of the full description 'Silt mixtures - clayey silt to silty clay'. It is important to consider that the classification zone boundaries do not exist in nature and small shifts in the cone response can lead to multiple classifications within layers of relatively uniform behaviour; especially were the layer data plot close to a zone junction and/or has spurious spikes or very thin layers. Therefore, some system is required to limit the number of classified zones that appear within each layer description. The following logic has been used to only retain high % constituent classification values:

Where

C = Minimum % SBT zone classification coverage within the layer description text LT = Layer thickness (m)





For layers having a thickness of less than 1 m, 10% of data at the top and bottom of the layer are excluded to limit the effect of transition zone data (measured resistance influenced by overlying or underlying strata) being included in the classification.

The continuous SBT index I_c should be used to assess the classification distribution and variation not accounted for by the layer description.

5.6 SOIL BEHAVIOUR TYPE INDEX - Ic

The principal trend in soil behaviour type (SBT) variation can be expressed by a continuous index, I_C , proposed by Robertson and Wride (1998) based on a similar index proposed by Jefferies and Davies (1993). The index provides a continuous profile of SBT variation with depth for end-user analysis of soil units and variation within units. The equivalent non-normalised version proposed by Robertson (2010) is provided for comparison.

The basis of I_c and its approximation of the original chart classification zones may be seen from Figure 5-2. The method does not identify zones 1 (*sensitive fine grained*) or zones 8 & 9 (*heavily overconsolidated or cemented*).

Normalised SBT index $I_{\mathcal{C}}$ (Robertson and Wride, 1998):

$$I_c = [(3.47 - \log Q_t)^2 + (\log F_r + 1.22)^2]^{0.5}$$

Non-normalised SBT index I_C (Robertson, 2010):

$$I_c = \left[\left(3.47 - \log \left(\frac{q_c}{\sigma_{atm}} \right) \right)^2 + (\log R_f + 1.22)^2 \right]^{0.5}$$

The normalised version of I_c is generally more accurate, while the non-normalised version is intended for compatibility with the non-normalised Robertson's (2010) SBT chart and may be more accurate at shallow depths in overconsolidated soils.

The results are presented in Appendix D.

5.7 RELATIVE DENSITY

The relative density of sands was calculated based on an empirical relationship proposed by Jamiolkowski *et al.* (2001) based on a large database of undisturbed frozen samples and calibration chamber tests. The expected accuracy may be evaluated from the figures presented below.

$$D_r = 100 \left[0.268 \cdot \ln \left(\frac{q_t / \sigma_{atm}}{\sqrt{\sigma_{vo}' / \sigma_{atm}}} \right) - k \right]$$

k = Compressibility dependant constant can be taken as -0.675 for medium compressibility (applied value in our interpretation), <= 1 for high compressibility and >= 2 for compressible sands.



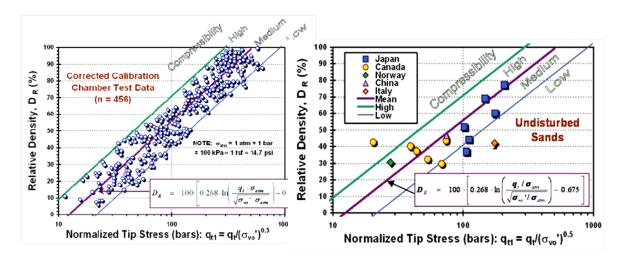


Figure 5-5 Relative density with normalised tip stress and sand compressibility from calibration chamber tests (left) and undisturbed frozen samples (right). Jamiolkowski *et al.* (2001). Reproduced from Mayne (2007).

The results are presented in Appendix F.

5.8 UNDRAINED SHEAR STRENGTH

The undrained shear strength s_u is usually estimated by the bearing capacity method, whereby the net tip resistance is divided by a factor N_k (Lunne *et al*, 1981):

$$s_u = \frac{q_c - \sigma_{v0}}{N_k}$$

Where N_k is an empirical factor which varies with soil type, stress history, structure/fabric, plasticity, and the mode of shear.

Mayne and Peuchen (2018) performed an evaluation of 407 high-quality undrained anisotropically consolidated triaxial compression tests (CAUC) with net tip resistance data pairs, resulting in N_{kt} factors with regression analysis details for five categories of clays shown in Table 2.

Table 2 Summary of CAUC su versus qnet for clays. Reproduced from Mayne and Peuchen (2018).

-		rD			M
Offshore NC-LOC	17	115	0.98	12.32	0.51
Onshore NC-LOC	30	191	0.867	12	0.53
Sensitive NC-LOC	5	43	0.507	10.33	0.84
OC Intact	5	36	0.862	13.57	0.49
OC Fissured	5	22	0.393	22.47	-0.01
All clays	62	407	0.923	13.33	0.55

Alternatively, a variable N_{kt} factor can be estimated for the profile as a function of the pore pressure parameter B_q , applicable for B_q values of > -0.01. The following equation proposed by Mayne and Peuchen is based on the same database evaluation:

$$N_{kt} = 10.5 - 4.6 \cdot \ln(B_q + 0.1)$$

Where the pore pressure parameter B_q is the ratio of excess pore pressure to net tip resistance:



$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{v0}}$$

The N_{kt} estimate has a standard error of 2.4 N_k and correlation coefficient of 0.645.

The estimate based on B_q is presented as ' s_u5 ' on the parameter plots and is only suitable for tests that have a high-quality pore pressure data, often indicated by a positive, repeatable, and dynamic response.

Note: N_{kt} (with subscript 't') indicates a N_k factor that has been established using the corrected tip resistance q_c . N_{kt} can be applied to the uncorrected tip resistance q_c (non-piezocone tests) but results in a slightly lower estimate of s_u depending on the correction magnitude ($q_c - q_t$) in lower strength soils.

Undrained shear strengths corresponding to selected values of N_k are presented on the plots of Appendix D. ' s_u3 ' on the logs (N_k = 15) has been included as a reference for comparison to traditionally applied N_k values of 15 and 20.

The results are presented in Appendix E.

5.9 OVERCONSOLIDATION RATIO

The preconsolidation stress σ_p' was calculated based on the method proposed by Mayne et al (2009):

$$\sigma_p' = k \cdot (q_t - \sigma_{vo})^{m \prime}$$

$$OCR = \sigma_p'/\sigma'_{v0}'$$

Mayne *et al* found that the trend with mean grain size followed a power law through the addition of exponent m' and that its value can be estimated by relation to soil behaviour type index I_c :

$$m' = 1 - \frac{0.28}{1 + \frac{I_c}{2.65}^{25}}$$



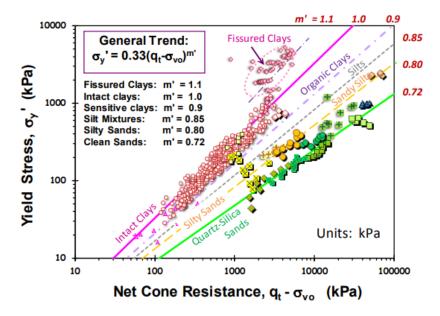


Figure 5-6 Preconsolidation stress with net cone resistance power law, reproduced from Mayne (2014).

An additional set of σ_p' and OCR values were calculated for m'=1.1 to reflect the upper trend for over consolidated fissured clays not captured by the correlation with I_c .

The results are presented in Appendix E.

5.10 SPT N60 VALUES

Equivalent SPT N60 values, defined as the non-normalised SPT blow count over a 30 cm interval, were derived for two correlations.

Method 1 - Jefferies and Davies (1993) cited in Lunne et al. (1997):

$$N_{60} = \frac{q_t}{8.5 \cdot \sigma_{atm} \cdot \left(1 - \frac{I_c}{4.6}\right)}$$

Method 2 - Robertson (2012):

$$\frac{\left(\frac{q_t}{p_a}\right)}{N_{60}} = 10^{(1.268 - 0.2817I_c)}$$

The correlations are intended for clays, silts and sands and not for carbonates or cemented geomaterials.

The results are presented in Appendix F.



5.11 FRICTION ANGLE

Sands

The peak friction angle of granular materials was calculated using the Kulhawy and Mayne (1990) method. The relationship is based on a calibration chamber database from 24 sands of varying mineralogy and is found from:

$$\phi' = 17.6 + 11.0 \cdot \log(q_{t1})$$

Where:

 ϕ' = Peak friction angle (degrees)

 q_{t1} = stress normalised cone resistance:

$$q_{t1} = \left(\frac{q_t}{\sigma_{atm}}\right) / \left(\frac{\sigma_{v0'}}{\sigma_{atm}}\right)^{0.5}$$

The presence of compressible minerals tends to reduce tip resistance resulting in lower estimate of friction angle, while very coarse (sand) or larger grain size tends to increase tip resistance resulting in higher estimate. Increased penetration resistance due to high k_0 conditions also results in an overestimate of friction angle.

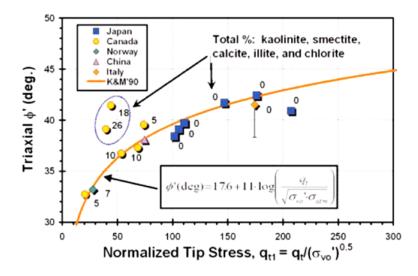


Figure 5-7 Peak triaxial friction angle from undisturbed sands with normalised cone resistance.

Fine grained soils

The effective friction angle for fine grained soils was calculated based on the Senneset et~al. (1988, 1989) method by applying the approximate closed form solution by Mayne & Campanella (2005) as a direct function of the pore pressure parameter Bq and normalised tip resistance Q. The method is applicable where $0.1 < B_q < 1.0$ and $20^\circ < \varphi' < 45^\circ$ and generally appropriate for non-cemented normally consolidated to lightly overconsolidated soils.

$$\Phi' = 29.5^{\circ} B_{q^{0.121}} [0.256 + 0.336 B_q + \log Q]$$



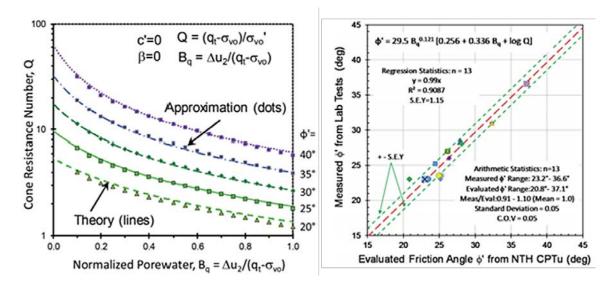


Figure 5-8 [Left] Theoretical curves with function approximation (dots) overlay [Right] calibration data from geotechnical centrifuge tests for a variety of soils. Redrawn from Ouyang & Mayne (2018).

The results are presented in Appendix F.

5.12 COEFFICIENT OF VOLUME CHANGE

Coefficient of volume change m_v defined as the inverse of the constrained modulus M, is evaluated for all soil types using the constrained modulus method proposed by Mayne (2006) cited in Mayne (2007). The value may be used to predict settlement at the end of primary consolidation and is applicable to the present state of vertical effective stress up to the preconsolidation stress for overconsolidated soils.

$$m_v = \frac{1}{M}$$

Where:

$$M = \alpha \cdot (q_t - \sigma_v)$$

$$\alpha = 5$$

An alpha factor of 8.25 reported by Kulhawy & Mayne (1990) for fine grained soils appears to provide a better fit through the data for intact non-organic clays, reducing to around 1 to 2 for organic plastic clays.



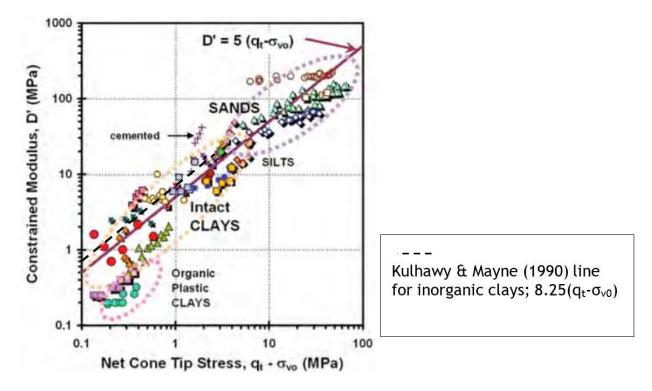


Figure 5-9 Constrained modulus of Mayne (2006). Annotated/redrawn from NCHRP Synthesis 368 (2007).

The results are presented in Appendix E.

5.13 YOUNG'S MODULUS

The secant Young's modulus E' at 25% mobilised shear strength (FOS = 4) was calculated according to the method proposed by Robertson (2009):

$$E' = \alpha (q_t - \sigma_v)$$

Where:

$$\alpha = 0.015(10^{0.55 Ic + 1.68})$$

The method described by Robertson may be adapted to estimate E' for loading at different percentages of mobilised shear strength.

The results are presented in Appendix F.

6 CPT INTERPRETATION NOTES

Provided below is a non-exhaustive set of notes on interpretation of the acquired CPT data with reference to examples within the dataset where appropriate.





DRAINED AND UNDRAINED SOIL BEHAVIOUR

Geotechnical parameters appropriate for drained and undrained cone penetration conditions are derived for drained and undrained soil behaviour types (SBTs) respectively, however, to help mitigate the uncertainty in the SBT correlation with drainage behaviour, all parameters are derived over the Soil Behaviour Type range $2.4 < I_c < 2.7$. For partially drained conditions, error will be introduced within derived parameters.

Piezocone dynamic pore pressure and dissipation tests may be used to identify drainage conditions. Dissipation t_{50} values exceeding 50 seconds indicate undrained penetration behaviour based on the findings of Kim *et al.* (2008).

In partially drained materials the friction sleeve resistance may rise significantly immediately following a pause in penetration due to consolidation and increased effective stress on the friction sleeve.

DYNAMIC PORE PRESSURE u₂ (CPTu)

While the piezo system is saturated before use, testing through unsaturated soils may result in some degree of desaturation leading to a less accurate and more 'sluggish' pore pressure response. Desaturation can also occur during penetration due to suction pressure causing cavitation during dilative shear at the cone shoulder. Dissipation tests that are undertaken following desaturation are likely to have a more pronounced initial rise and the results of analysis may have some degree of error.

If the piezometer system becomes desaturated it may re-saturate at higher excess pressures later in the test as gas dissolves under pressure. The pore pressure response in saturated contractive soils should normally have a dynamic 'peaky' appearance.

The tip resistance in lower strength contractive soils <u>without</u> pore pressure measurement in the u_2 position is likely to be significantly lower (up to 20%, typically ~10%) than the equivalent corrected tip resistance depending on the magnitude of excess pore pressure generated during penetration.

CONE TIP AND SLEEVE OFFSET

The accuracy of the SBT over thin layers and at layer boundaries is sensitive to offset error in the friction ratio often resulting in sharp peaks or troughs at boundaries. The friction ratio is often inaccurate in heavily disturbed soils with a 'blocky' macro fabric. The last ~8 cm of data is also not included in the SBT material description as no friction sleeve measurements are recorded.

FRICTION SLEEVE DATA

There are three common causes of friction sleeve measurement error; 1) unequal pore pressure acting on the sleeve end areas as the sleeve passes though materials of different permeability and hence excess pore pressure Δu_2 , often resulting in a negative/positive spike, 2) Accuracy limitations and temperature effects in very low strength or sensitive soils, and 3) error associated with bending strain that occurs while the cone inclination deviates rapidly. Temperature effects





are generally mitigated by temperature stabilisation during the test and at the time of zero output measurement.

CONE TYPE

The reference cone type has a 10 cm² projected cone tip area and 150 cm² friction sleeve area, however it is common to use a larger 15 cm² cone with a 225 cm² friction sleeve area for improved sensitivity, temperature stability, damage prevention and penetration depth potential due to the higher bending strength. Use of a 15 cm² cone does however require higher penetration force (reaction force) for a given penetration pressure and produces more pronounced transitions zones and thin layer effects due to the larger influence zone.

TRANSITION ZONES AND THIN LAYER EFFECTS

During penetration at the boundary between soils of contrasting stiffness, a transition zone is often evident prior to mobilisation of the true soil stiffness. These should be cautiously ignored in assessment of soil behaviour type and parameter evaluation. Where the stiff layer is thin (<~1 m) mobilised resistance may be significantly less than that of an equivalent thick layer. The effect for thin low stiffness layers is less significant. Procedures for thin-layer effect correction are provided by Robertson and Wride (1998) and Boulanger & DeJong (2018).

GRAVELS

The presence of gravel or larger clasts in a soil is often characterised by short peaks in the CPT tip and sleeve readings, possibly with associate inclinometer 'shake' and/or short sharp reductions in pore water readings due to dilation effects. Frequent gravels in soft or loose soils may generate localised erroneous friction ratio values.





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APPENDICES

Appendix A **SUMMARY TABLES**

Appendix B **GENERAL INFORMATION**

Appendix C **CONE PENETRATION TEST RESULTS**

SOIL BEHAVIOUR TYPE RESULTS Appendix D

Appendix E PARAMETER RESULTS 1 – s_u , m_v , OCR, SBT, I_c

PARAMETER RESULTS 2 – SPT N60, Phi, Dr, E, Ic Appendix F

PENETROMETER TEMPERATURE RESULTS Appendix G

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APPENDIX A SUMMARY TABLES

Table 3 CPT summary

Location ID	Stroke number	Final depth (m)	Cone ID	Piezocone test	Pre-drilled (m)	Pre-drilling details	Rig	Primary refusal factor	Applied zero values: qc, fs, u2	Tip zero drift (kPa)	Sleeve zero drift (subtraction) (kPa)	Piezo zero drift (kPa)	Nr dissipation tests	Raw File Name	Easting (m)	Northing (m)	Elevation (m)	Date	Remarks
ROC CPT 101	1	1.48	S15-CFIPTT.2116	YES			UK3	Lateral support at surface	pre, pre, pre	-10.60	-1.70	-3.90		108325-V1-16052023-UK03-LP91.L11				16/05/2023	
ROC CPT 102	1	1.02	S15-CFIPTT.2116	YES			UK3	Tip load	pre, pre, pre	-15.00	1.80	-0.20		108325-V1-16052023-UK03-LP91.L10				16/05/2023	
ROC CPT 103	1	1.20	S15-CFIPTT.2116	YES			UK3	Tip load	pre, pre, pre	38.40	-2.80	3.20		108325-V1-16052023-UK03-LP91.L08				16/05/2023	
ROC CPT 104	1	1.64	S15-CFIPTT.2116	YES			UK3	Lateral support at surface	pre, pre, pre	-26.20	1.40	0.70		108325-V1-16052023-UK03-LP91.L09				16/05/2023	
ROC CPT 105	1	1.64	S15-CFIPTT.2116	YES			UK3	Tip load	pre, pre, pre	-17.20	0.80	-0.90		108325-V1-16052023-UK03-LP91.L07				16/05/2023	
ROC CPT 106	1	1.34	S15-CFIPTT.2116	YES			UK3	Lateral support at surface	pre, pre, pre	31.00	-1.50	-0.30		108325-V1-16052023-UK03-LP91.L06				16/05/2023	
ROC CPT 107	1	1.96	S15-CFIPTT.2116	YES			UK3	Lateral support at surface	pre, pre, pre	-21.20	-0.20	-2.70		108325-V1-16052023-UK03-LP91.L05				16/05/2023	
ROC CPT 108	1	1.56	S15-CFIPTT.2116	YES			UK3	Lateral support at surface	pre, pre, pre	-0.60	0.20	5.10		108325-V1-16052023-UK03-LP91.L04				16/05/2023	
ROC CPT 109	1	2.72	S15-CFIPTT.2116	YES		П	UK3	Tip load	pre, pre, pre	13.40	0.30	-1.10		108325-V1-16052023-UK03-LP91.L03		П	П	16/05/2023	
ROC CPT 110	1	1.46	S15-CFIPTT.2116	YES		П	UK3	Lateral support at surface	pre, pre, pre	-14.60	-0.90	-8.60		108325-V1-16052023-UK03-LP91.L01		П	П	16/05/2023	
ROC CPT 111	1	1.76	S15-CFIPTT.2116	YES		П	UK3	Lateral support at surface	pre, pre, pre	14.40	-1.10	1.20		108325-V1-16052023-UK03-LP91.L02		П	П	16/05/2023	
ROC TP 104	1	1.52	S15-CFIPTT.2116	YES		П	UK3	Tip load	pre, pre, pre	20.60	-0.40	1.10		108325-V1-16052023-UK03-LP91.L12		П	П	16/05/2023	
ROC TP 111	1	1.30	S15-CFIPTT.2116	YES		П	UK3	Lateral support at surface	pre, pre, pre	-33.00	1.60	1.40		108325-V1-16052023-UK03-LP91.L13		П	П	16/05/2023	
ROC TP 115	1	1.72	S15-CFIPTT.2116	YES		П	UK3	Tip load	pre, pre, pre	35.20	-2.90	-2.00		108325-V1-16052023-UK03-LP91.L14		П	П	16/05/2023	

CPT test plots are presented in Appendix C.





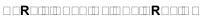
APPENDIX B□ GENERAL INFORMATION

LIST OF FIGURES

Cone calibration certificate: S15-CFIIP.2116

Data sheet: 20.5-tonne track-truck mounted CPT unit (UK3)





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			DD11 IIDDD

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ROOROOOMORMOOO			
AM DSCCHA-100kN Load Cell	66914	0.02%	29/04/2021
AM DSCCHA-5kN Load Cell	61065	0.05%	29/04/2021
Omega MMG750V	502273	0.01%	01/09/2022
Keithley 3706A Multimeter	4067652	10ppm	11/08/2022
LD Solar2-45	168558	0.04°	01/08/2022
ETI Ref Thermometer	D20345255	0.01°C	08/09/2022

The calibration tests were made in the Lankelma force standards machine. The applied forces of which are within an uncertainty of: ± 0.050 % of nominal value from 0.5kN up to 10kN, then 0.02% of nominal from 10kN up to 100kN.

MEASUREMENTS

- 1. The forces applied, and the resulting deflections are given in Tables 1. No corrections for temperature have been applied to these results.
- 2. The cone was loaded to full range 3 times for no less than 1 minute before calibration and after each rotation.
- 3. The cone was calibrated in low and high range using two reference load cells. The low range calibration consisted of a maximum load of 5kN with 4 sets of increasing forces and 2
- sets of decreasing forces. The high range calibration consisted of a maximum load of 100kN with 3 sets of increasing forces and 2 sets of decreasing forces.

 4. The difference in deflection for each applied force with rotation is the relative reproducibility error b, shown as a percentage of the recorded value and in units of pressure MPa. The uncertainty relating to the difference in deflection for increasing forces against degreasing forces is the reversibility uncertainty U_rev, shown as a percentage of the recorded value and in units of pressure MPa.
- 5. For each application of force, the coefficients of a linear and third order equation relating the estimate of the mean deflection as a function of the applied calibration force were calculated. Table 2.
- 6. The combined expanded uncertainty of deflection U for each force is shown as a percentage of the recorded value and in units of pressure MPa.
- 7. The coefficients of a third order equation relating a given applied force to the estimate of the mean deflection were also calculated. The coefficients are given in Table 3.
- 8. In use the forces acting on the sleeve load cell element are a combination of tip resistance and sleeve friction, with the tip resistance from the tip load cell element being subtracted to give the sleeve friction value. The resultant error values for differing tip and sleeve values are shown in Table 4.

 * The combined expanded uncertainties shown are to k=2 with a 95% coverage factor.

The calibration uncertainty is the uncertainty in the force value calculated from the interpolation equation at any deflection.

At each calibration point a combined standard uncertainty uc is calculated from the readings obtained during the calibration.

$$uc = \sum_{i=1}^{8} ui^{2}$$

 $U = k \times uc$

where

11 is the standard uncertainty associated with the applied calibration force

u2 is the standard uncertainty associated with the reproducibility of the calibration results.

u3 is the standard uncertainty associated with the repeatability of the calibration results.

u4 is the standard uncertainty associated with the resolution and noise of the system.

u5 is the standard uncertainty associated with the creep of the instrument. u6 is the standard uncertainty associated with the drift in zero output.

u7 is the standard uncertainty associated with temperature of the instrument.

u8 is the standard uncertainty associated with interpolation best fit of the linear or 3rd order polynomial equation.

	oco comind annorid conocina
Ref LC	Reference load cell with calibration force in kN
cts	Counts. Base digital cone units.
0.1N	Interpolated digital cone units from counts
b	Relative reproducibility error
U_rev	Reversibility uncertainty
Uc	Combined standard uncertainty
Uc_sub	Combined standard uncertainty including sleeve subtraction
U	Combined expanded uncertainty
k=2	95% uncertainty coverage factor

Cone tempreture effect profile:

This section deals with the apparent pressure readings obtained from sensors due to static and transient temperature change. The parameters for post-processing temperature correction are established and the apparent pressures after correction are presented. Depending on the design or temperature performance, correction of the friction sleeve and/or piezometer readings may not be warranted



Dolow componing

					R⊡r⊡d		R□□r□						R⊡r⊡d		R⊞r□	
R	1				□rr□	r b	□rr□r□	U_rev	R	1			□rr□	r <i>b</i>	□rr□r□	J_rev
	□	1□□°	°	°	M		M□□			□*	1□□*		M□□		M□□	
0.100	1.095E+05	1.096E+05	1.117E+05	1.117E+05	0.000	0.65			5.000	5.514E+06	5.513E+06	5.512E+06	0.000	0.01		
0.500	5.506E+05	5.528E+05	5.544E+05	5.519E+05	0.001	0.20			10.000	1.103E+07	1.102E+07	1.102E+07	0.000	0.01		
1.000	1.100E+06	1.102E+06	1.106E+06	1.104E+06	0.001	0.15			15.000	1.653E+07	1.653E+07	1.653E+07	0.000	0.00		
1.500	1.651E+06	1.655E+06	1.656E+06	1.657E+06	0.001	0.09			20.000	2.204E+07	2.204E+07	2.204E+07	0.001	0.00		
2.000	2.204E+06	2.207E+06	2.209E+06	2.208E+06	0.001	0.07			30.000	3.306E+07	3.306E+07	3.306E+07	0.001	0.01		
2.500	2.753E+06	2.757E+06	2.760E+06	2.760E+06	0.001	0.07			40.000	4.406E+07	4.407E+07	4.407E+07	0.001	0.00		
3.000	3.304E+06	3.310E+06	3.313E+06	3.312E+06	0.002	0.08			50.000	5.506E+07	5.507E+07	5.507E+07	0.002	0.00		
3.500	3.856E+06	3.859E+06	3.865E+06	3.865E+06	0.002	0.07			60.000	6.605E+07	6.605E+07	6.606E+07	0.002	0.01		
4.000	4.407E+06	4.410E+06	4.416E+06	4.415E+06	0.002	0.06			80.000	8.800E+07	8.801E+07	8.801E+07	0.002	0.00		
5.000	5.509E+06	5.514E+06	5.520E+06	5.518E+06	0.002	0.06			100.000	1.099E+08	1.099E+08	1.099E+08	0.003	0.00		
4.000	4.417E+06	4.424E+06			0.001	0.05	-0.004	-0.16	80.000	8.801E+07	8.802E+07		0.003	0.01	-0.006	-0.01
3.500	3.866E+06	3.870E+06			0.001	0.04	-0.004	-0.16	60.000	6.607E+07	6.608E+07		0.002	0.01	-0.010	-0.03
3.000	3.313E+06	3.317E+06			0.001	0.04	-0.003	-0.15	50.000	5.509E+07	5.510E+07		0.002	0.00	-0.011	-0.03
2.500	2.762E+06	2.765E+06			0.001	0.04	-0.003	-0.18	40.000	4.409E+07	4.410E+07		0.001	0.00	-0.011	-0.04
2.000	2.209E+06	2.210E+06			0.000	0.00	-0.001	-0.11	30.000	3.309E+07	3.309E+07		0.000	0.00	-0.010	-0.05
1.500	1.656E+06	1.658E+06			0.000	0.03	-0.001	-0.12	20.000	2.206E+07	2.206E+07		0.000	0.00	-0.008	-0.06
1.000	1.105E+06	1.106E+06			0.000	0.05	-0.002	-0.23	15.000	1.655E+07	1.655E+07		0.000	0.00	-0.007	-0.07
0.500	5.521E+05	5.515E+05			0.000	0.04	0.000	-0.01	10.000	1.104E+07	1.104E+07		0.001	0.01	-0.004	-0.07
0.100	1.095E+05	1.099E+05			0.000	0.12	0.000	-0.07	5.000	5.520E+06	5.518E+06		0.000	0.01	-0.002	-0.06

				or one			
Ruruu			r	10	□rd⊞rd		
R				□d□d□			□d□d□
	R			III U			
M			M□□			M□□	
0.067	1000	1003	0.001	1.45	1003	0.001	1.45
0.333	5000	5023	0.003	1.03	5011	0.003	0.77
0.667	10000	10022	0.004	0.64	9996	0.003	0.43
1.000	15000	15037	0.006	0.61	14997	0.003	0.25
1.333	20000	20057	0.009	0.65	20003	0.003	0.22
1.667	25000	25054	0.009	0.57	24986	0.004	0.27
2.000	30000	30076	0.012	0.62	29994	0.005	0.25
2.333	35000	35083	0.014	0.59	34987	0.006	0.24
2.667	40000	40094	0.015	0.56	39985	0.006	0.23
3.333	50000	50123	0.021	0.64	49987	0.012	0.36
2.667	40000	40182	0.025	0.94	40073	0.011	0.42
2.333	35000	35159	0.022	0.93	35063	0.010	0.41
2.000	30000	30133	0.018	0.91	30051	0.008	0.39
1.667	25000	25117	0.016	0.96	25049	0.007	0.44
1.333	20000	20084	0.011	0.86	20030	0.005	0.34
1.000	15000	15061	0.008	0.83	15021	0.003	0.33
0.667	10000	10047	0.006	0.95	10021	0.003	0.49
0.333	5000	5016	0.002	0.65	5004	0.001	0.24
0.067	1000	997	0.000	0.75	997	0.000	0.70

Ruruu			r		□rd⊞rd	r	
R							□d□d□
	R			u U			$\square \square U \square$
M□□□			$M \square \square$			$M \square \square$	
3.333	50000	50107	0.018	0.55	49972	0.012	0.35
6.667	100000	100201	0.031	0.46	99943	0.016	0.24
10.000	150000	150274	0.041	0.41	149909	0.022	0.22
13.333	200000	200355	0.053	0.40	199901	0.026	0.20
20.000	300000	300481	0.072	0.36	299900	0.035	0.17
26.667	400000	400539	0.083	0.31	399906	0.043	0.16
33.333	500000	500523	0.086	0.26	499918	0.051	0.15
40.000	600000	600403	0.080	0.20	599910	0.061	0.15
53.333	800000	799920	0.080	0.15	799925	0.080	0.15
66.667	1000000	999111	0.154	0.23	1000009	0.098	0.15
53.333	800000	800034	0.078	0.15	800040	0.078	0.15
40.000	600000	600632	0.103	0.26	600140	0.062	0.15
33.333	500000	500778	0.115	0.35	500173	0.055	0.16
26.667	400000	400805	0.115	0.43	400172	0.046	0.17
20.000	300000	300735	0.103	0.52	300154	0.037	0.18
13.333	200000	200557	0.078	0.58	200102	0.026	0.19
10.000	150000	150453	0.064	0.64	150088	0.021	0.21
6.667	100000	100322	0.046	0.69	100063	0.016	0.24
3.333	50000	50165	0.025	0.76	50029	0.012	0.35

For a given cone indicated output of D (0.1N units), the corrected applied force

F (in 0.1N units) is calculated from :

 $F = (a3 \times D^3) + (a2 \times D^2) + (a1 \times D) + a0$

a0 = 2.94664 a1 = 0.99709 a2 = 2.97845E-09 a3 = 8.36000E-16 Maximum tip zero drift during the calibration (MPa) = 0.002

Maximum load cell zero drift during the calibration (MPa) = 0.000

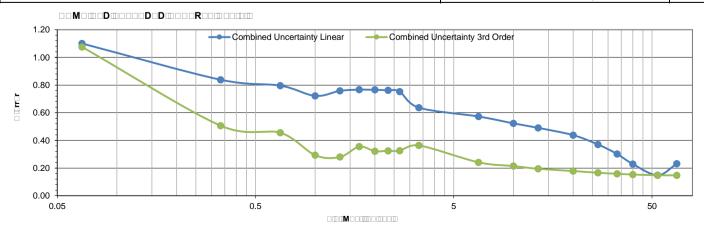
Factor used to convert from counts to 0.1N units = 0.0090895

Maximum tip full scale reading (MPa) = 100.00

Tip resolution (Pa) = 66.7

Tip area (cm²) = 15

Tip area ratio factor = 0.788





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000000**R** || 00000 || **R**0000 || 0

					R⊡r⊡d		R□□r□						R⊡r⊡d		R⊞r□	
R	1				□rr□	r <i>b</i>	□rr□r□	J_rev	R	1			□rr□	r <i>b</i>	□rr□r□	J_rev
	□*	1□-		°						°	1⊡°					
0.100	1.154E+05	1.122E+05	1.159E+05	1.159E+05	0.044	1.01			5.000	5.669E+06	5.690E+06	5.690E+06	0.274	0.12		
0.500	5.690E+05	5.659E+05	5.696E+05	5.698E+05	0.044	0.20			10.000	1.135E+07	1.137E+07	1.137E+07	0.362	80.0		
1.000	1.136E+06	1.139E+06	1.137E+06	1.137E+06	0.034	0.08			15.000	1.702E+07	1.705E+07	1.705E+07	0.402	0.06		
1.500	1.706E+06	1.710E+06	1.706E+06	1.707E+06	0.051	0.08			20.000	2.271E+07	2.274E+07	2.274E+07	0.375	0.04		
2.000	2.273E+06	2.279E+06	2.275E+06	2.277E+06	0.064	0.07			30.000	3.408E+07	3.412E+07	3.412E+07	0.541	0.04		
2.500	2.844E+06	2.850E+06	2.844E+06	2.844E+06	0.082	0.07			40.000	4.544E+07	4.548E+07	4.549E+07	0.551	0.03		
3.000	3.411E+06	3.422E+06	3.412E+06	3.414E+06	0.127	0.10			50.000	5.681E+07	5.684E+07	5.684E+07	0.458	0.02		
3.500	3.981E+06	3.990E+06	3.983E+06	3.984E+06	0.095	0.06			60.000	6.815E+07	6.818E+07	6.819E+07	0.449	0.02		
4.000	4.550E+06	4.562E+06	4.553E+06	4.553E+06	0.139	0.08			80.000	9.081E+07	9.083E+07	9.085E+07	0.524	0.01		
5.000	5.688E+06	5.699E+06	5.689E+06	5.691E+06	0.136	0.06			100.000	1.134E+08	1.134E+08	1.135E+08	0.383	0.01		
4.000	4.557E+06	4.573E+06			0.218	0.12	-0.211	-0.12	80.000	9.079E+07	9.082E+07		0.319	0.01	0.354	0.01
3.500	3.984E+06	4.002E+06			0.244	0.16	-0.173	-0.11	60.000	6.815E+07	6.818E+07		0.351	0.01	-0.040	0.00
3.000	3.416E+06	3.428E+06			0.156	0.12	-0.122	-0.09	50.000	5.681E+07	5.684E+07		0.373	0.02	-0.178	-0.01
2.500	2.845E+06	2.858E+06			0.173	0.16	-0.100	-0.09	40.000	4.547E+07	4.549E+07		0.331	0.02	-0.487	-0.03
2.000	2.275E+06	2.287E+06			0.160	0.18	-0.116	-0.13	30.000	3.410E+07	3.414E+07		0.489	0.04	-0.384	-0.03
1.500	1.704E+06	1.714E+06			0.126	0.19	-0.018	-0.03	20.000	2.274E+07	2.276E+07		0.315	0.04	-0.685	-0.08
1.000	1.135E+06	1.142E+06			0.095	0.22	-0.019	-0.04	15.000	1.706E+07	1.708E+07		0.232	0.04	-0.676	-0.10
0.500	5.654E+05	5.671E+05			0.022	0.10	0.028	0.13	10.000	1.137E+07	1.139E+07		0.314	0.07	-0.404	-0.09
0.100	1.098E+05	1.117E+05			0.026	0.59	0.068	1.55	5.000	5.674E+06	5.692E+06		0.248	0.11	-0.081	-0.04

0000100

RIIIr					□rd⊞rd	r						
R				□d□d□			□d□d□					
	R			<i>U</i>								
	00000100											
4	1000	1009	0.127	2.89	1017	0.178	4.04					
22	5000	5005	0.106	0.48	5005	0.106	0.48					
44	10000	10022	0.212	0.48	10012	0.142	0.32					
66	15000	15038	0.368	0.56	15019	0.224	0.34					
88	20000	20043	0.430	0.49	20014	0.239	0.27					
110	25000	25068	0.645	0.59	25030	0.352	0.32					
132	30000	30080	0.783	0.59	30033	0.440	0.33					
154	35000	35099	0.923	0.60	35042	0.478	0.31					
176	40000	40118	1.116	0.63	40052	0.604	0.34					
220	50000	50137	1.423	0.65	50052	0.883	0.40					
176	40000	40210	1.924	1.09	40144	1.366	0.78					
154	35000	35173	1.618	1.05	35116	1.154	0.75					
132	30000	30142	1.301	0.98	30094	0.904	0.68					
110	25000	25116	1.089	0.99	25077	0.781	0.71					
88	20000	20090	0.870	0.99	20062	0.645	0.73					
66	15000	15052	0.531	0.80	15033	0.394	0.60					
44	10000	10030	0.335	0.76	10021	0.272	0.62					
22	5000	4988	0.125	0.57	4988	0.124	0.56					
4	1000	975	0.227	5.16	983	0.163	3.70					

R□□r□			r		□rd⊞rd		
R				□d□d□			□d□d□
	R						$\square \square U \square$
	00000100						
220	50000	50056	1.023	0.46	49971	0.931	0.42
441	100000	100100	1.436	0.33	99926	1.306	0.15
661	150000	150116	1.711	0.26	149861	1.840	0.14
881	200000	200190	2.301	0.26	199862	1.997	0.11
1322	300000	300435	4.427	0.33	299993	2.215	0.08
1762	400000	400477	4.986	0.28	399973	2.691	0.08
2203	500000	500551	5.778	0.26	500047	3.162	0.07
2643	600000	600488	5.660	0.21	600057	3.716	0.07
3524	800000	800060	4.874	0.14	800040	4.858	0.07
4405	1000000	999220	9.066	0.21	1000032	5.924	0.07
3524	800000	799824	4.940	0.14	799803	5.001	0.07
2643	600000	600425	5.177	0.20	599994	3.578	0.07
2203	500000	500551	5.728	0.26	500046	3.074	0.07
1762	400000	400587	5.735	0.33	400083	2.583	0.07
1322	300000	300519	5.023	0.38	300077	2.191	0.08
881	200000	200408	3.880	0.44	200080	1.618	0.09
661	150000	150335	3.172	0.48	150079	1.360	0.10
441	100000	100217	2.190	0.50	100044	1.128	0.13
220	50000	50056	0.986	0.45	49971	0.893	0.20

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For a given cone indicated output of D ($0.1\mbox{N}$ units), the corrected applied force

F (in 0.1N units) is calculated from:

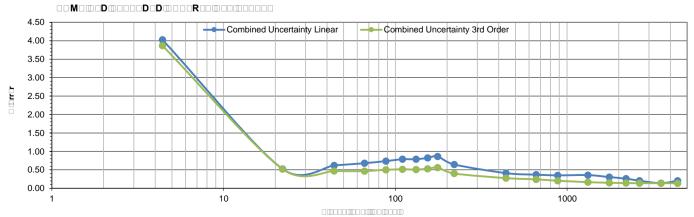
 $F = (a3 \times D^3) + (a2 \times D^2) + (a1 \times D) + a0$

a0 = 9.78589 a1 = 0.99806 a2 = 9.10254E-10 a3 = 1.83912E-15 Maximum sleeve zero drift during the calibration (kPa) =
Maximum load cell zero drift during the calibration (kPa) =
Factor used to convert from counts to 0.1N units =
Physical strength limited maximum sleeve reading (MPa) =
Sleeve resolution (Pa) =

rom counts to 0.1N units = 0.0088081
m sleeve reading (MPa) = 1.333
Sleeve resolution (Pa) = 4.4
Sleeve area (cm²) = 227
Sleeve area ratio factor = -0.001

0.096

0.032





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		Sleeve I	Pa —		—				
		4	22	44	66	110	154	220	661
W	0.07	4.6	0.8	0.6	0.5	0.5	0.5	0.4	0.2
	0.33	5.4	0.9	0.7	0.6	0.5	0.5	0.5	0.2
	0.67	9.1	1.7	1.0	0.8	0.7	0.6	0.5	0.2
	1.00	12.5	2.4	1.4	1.0	0.8	0.7	0.5	0.2
*	1.67	21.4	4.1	2.3	1.6	1.2	1.0	0.7	0.3
	2.33	29.8	5.8	3.1	2.2	1.5	1.2	0.9	0.3
	3.33	34.1	6.7	3.5	2.5	1.7	1.3	1.0	0.3
	10.00	69.0	13.6	7.0	4.8	3.1	2.3	1.7	0.5
	13.33	86.1	17.1	8.7	8.3	3.8	2.8	2.7	0.8

			→ · · · · · · · · · · · · · · · · · · ·						
		4	22	44	66	110	154	220	661
W	0.07	4.4	0.8	0.5	0.4	0.4	0.3	0.2	0.1
	0.33	4.5	0.8	0.5	0.4	0.4	0.3	0.3	0.1
	0.67	6.6	1.2	0.7	0.5	0.4	0.4	0.3	0.2
↓	1.00	7.6	1.4	0.8	0.6	0.5	0.4	0.3	0.2
	1.67	12.8	2.4	1.3	1.0	0.7	0.6	0.4	0.2
	2.33	16.9	3.3	1.7	1.2	0.9	0.7	0.5	0.2
	3.33	21.0	4.1	2.1	1.5	1.0	0.8	0.6	0.2
	10.00	36.2	7.1	3.7	2.5	1.6	1.2	0.9	0.3
	13.33	41.9	8.3	4.2	3.7	1.9	1.4	1.0	0.4

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				R⊡r⊡d		R⊞r	
RⅢR	1			□rr□	r <i>b</i>	□rr□r□	U_rev
	□	1⊡°					
100	2.045E+07	2.044E+07	2.038E+07	0.1	0.10		
200	4.096E+07	4.095E+07	4.098E+07	0.0	0.02		
400	8.188E+07	8.182E+07	8.188E+07	0.1	0.02		
600	1.227E+08	1.227E+08	1.227E+08	0.1	0.01		
800	1.635E+08	1.635E+08	1.636E+08	0.1	0.01		
1000	2.043E+08	2.042E+08	2.043E+08	0.1	0.01		
1500	3.063E+08	3.062E+08	3.062E+08	0.1	0.01		
2000	4.082E+08	4.081E+08	4.082E+08	0.2	0.01		
2500	5.100E+08	5.099E+08	5.099E+08	0.1	0.01		
3000	6.117E+08	6.116E+08	6.116E+08	0.2	0.01		
2500	5.101E+08	5.101E+08		0.0	0.00	-0.4	-0.02
2000	4.084E+08	4.083E+08		0.0	0.00	-0.6	-0.03
1500	3.065E+08	3.065E+08		0.0	0.00	-0.7	-0.04
1000	2.045E+08	2.045E+08		0.0	0.00	-0.5	-0.05
800	1.636E+08	1.636E+08		0.0	0.00	-0.3	-0.04
600	1.228E+08	1.228E+08		0.1	0.01	-0.2	-0.03
400	8.192E+07	8.196E+07		0.1	0.02	-0.3	-0.07
200	4.105E+07	4.107E+07		0.0	0.02	-0.3	-0.15
100	2.051E+07	2.055E+07		0.1	0.07	-0.2	-0.23

R□□r□□□	Rur				□rd⊞rd		
R□□	RⅢ			□d□d□			□d□d□
r							$\square \square U$
100	1000000	1001773	0.460	0.46	997516	0.577	0.58
200	2000000	2009174	1.864	0.93	2001091	0.409	0.20
400	4000000	4014881	3.047	0.76	4000307	0.593	0.15
600	6000000	6018831	3.868	0.64	5999194	0.822	0.14
800	8000000	8020684	4.301	0.54	7997320	1.218	0.15
1000	10000000	10020219	4.298	0.43	9994376	1.782	0.18
1500	15000000	15020728	4.642	0.31	14993559	2.406	0.16
2000	20000000	20019618	4.766	0.24	19997008	2.732	0.14
2500	25000000	25011280	4.007	0.16	24997754	3.331	0.13
3000	30000000	29999421	3.987	0.13	29998158	4.002	0.13
2500	25000000	25018138	4.917	0.20	25004626	3.419	0.14
2000	20000000	20028710	6.366	0.32	20006113	2.917	0.15
1500	15000000	15032670	6.890	0.46	15005505	2.298	0.15
1000	10000000	10028509	5.910	0.59	10002659	1.452	0.15
800	8000000	8026046	5.364	0.67	8002673	1.201	0.15
600	6000000	6021813	4.478	0.75	6002168	0.917	0.15
400	4000000	4019041	3.894	0.97	4004456	1.060	0.26
200	2000000	2013806	2.819	1.41	2005706	1.192	0.60
100	1000000	1006762	1.402	1.40	1002484	0.560	0.56

For a given cone indicated output of D ($0.1\mbox{N}$ units), the corrected applied force

F (in 0.1N units) is calculated from:

 $F = (a3 \times D^3) + (a2 \times D^2) + (a1 \times D) + a0$

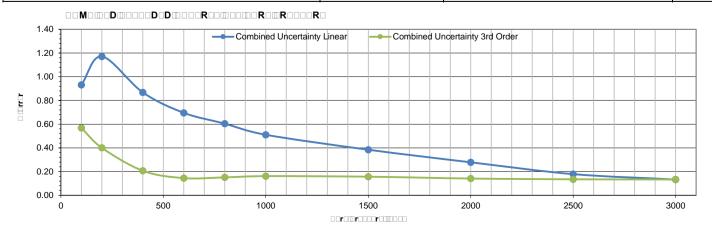
a0 = -66.01639 a1 = 0.99562 a2 = 1.98500E-10 a3 = -1.79257E-18 Maximum PWP zero drift during the calibration (kPa) = 0.04

Maximum reference zero drift during the calibration (kPa) = 0.136

Factor used to convert from counts to 0.1Pa units = 0.0490474

Maximum PWP full scale reading (kPa) = 0.0490474

PWP resolution (Pa) = 0.1





R		
□°C □		
-25	-20027	-20149
0	384	569
25	21001	20795

R		
ి)		
-25	-24.9	-25.3
0	0.0	0.0
25	25.1	24.7

	X inc	Y inc
Factor used to convert from counts to 0.1m° units =	12.1866968	12.2112137
Inclination error (°) =	0.1	0.3

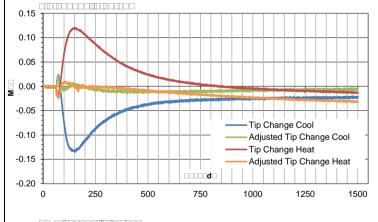
R rd d		
7.13	3056555	3059136
10.36	3113708	3114659
15.26	3196872	3199418
20.28	3286660	3287650
25.14	3371665	3373891

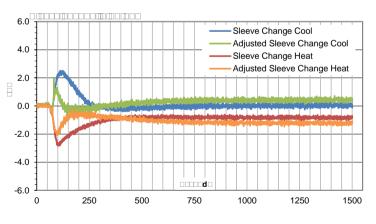
R rd d		
7.13	7.14	7.17
10.36	10.41	10.35
15.26	15.16	15.20
20.28	20.30	20.25
25.14	25.16	25.19

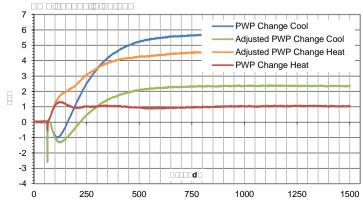
Factor used to convert from counts to 0.00001°C units =	0.572061759	0.572394313
Temperature error (°C) =	0.10	0.06

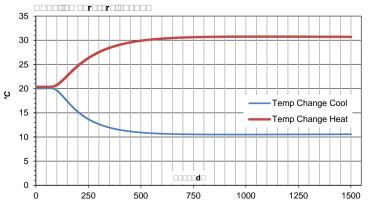
	Cooling	Heating
Start temperature =	20.07	20.37
End temperature =	10.50	30.77
Temperature change =	-9.57	10.40

	Cooling	Heating
Tip maximum rate of change (MPa/(°C/min)) =	0.045	0.044
Tip end change (MPa/°C) =	-0.002	-0.001
Adjusted tip end change (MPa/°C) =	0.000	0.003
Sleeve maximum rate of change (kPa/(°C/min)) =	2.65	2.22
Sleeve end change (kPa/°C) =	-0.01	-0.07
Adjusted sleeve end change (kPa/°C) =	0.03	-0.10
PWP end change (kPa/°C) =	0.59	0.10
Adjusted PWP end change (kPa/°C) =	-0.24	0.45









Page 5 of 5

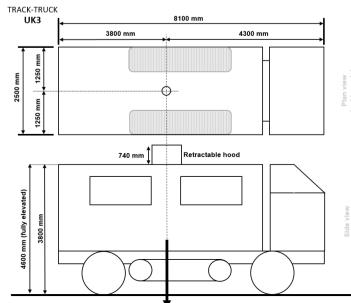


20.5 T 17 T M ----r 86 km/h oracan aarma Steel oracomoca) 3300 mm eranam dana 650 mm Tracks act as jacks ______ 1nr. on each side M a mira a d mara a a a 210 mm M a mraad marma Tracking/pushing - 47 kPa Pulling – 88 kPa _r____r_ M10 degrees M ----r 20 degrees (operator assessed) Testing - 74 dBA Driving - 87 dBA 36/55 push-pull clamp 1.2 m 55 mm

Lankelma's versatile track-truck is suitable for most geotechnical sites. The rig is driven to site as a self-contained HGV with tracks that can be deployed to cope with soft or uneven terrain. Fitted with a chalwyn valve and spark arrestor.

An expected 100m+ of standard CPTu testing can be executed in a day (depending on conditions and access).

Seismic VWP MOSTAP
Pressuremeter Piezometer Shelby
Magnetometer Inclinometer
Video cone
Wing cone
Push-in shear vane



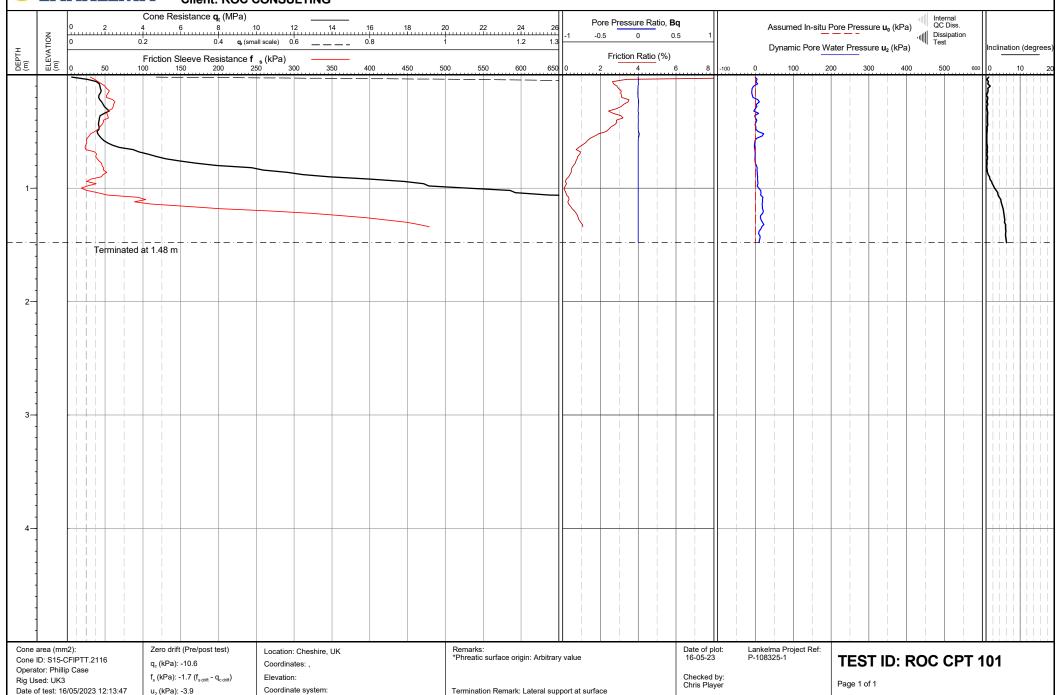


APPENDIX C□ CONE PENETRATION TEST RESULTS

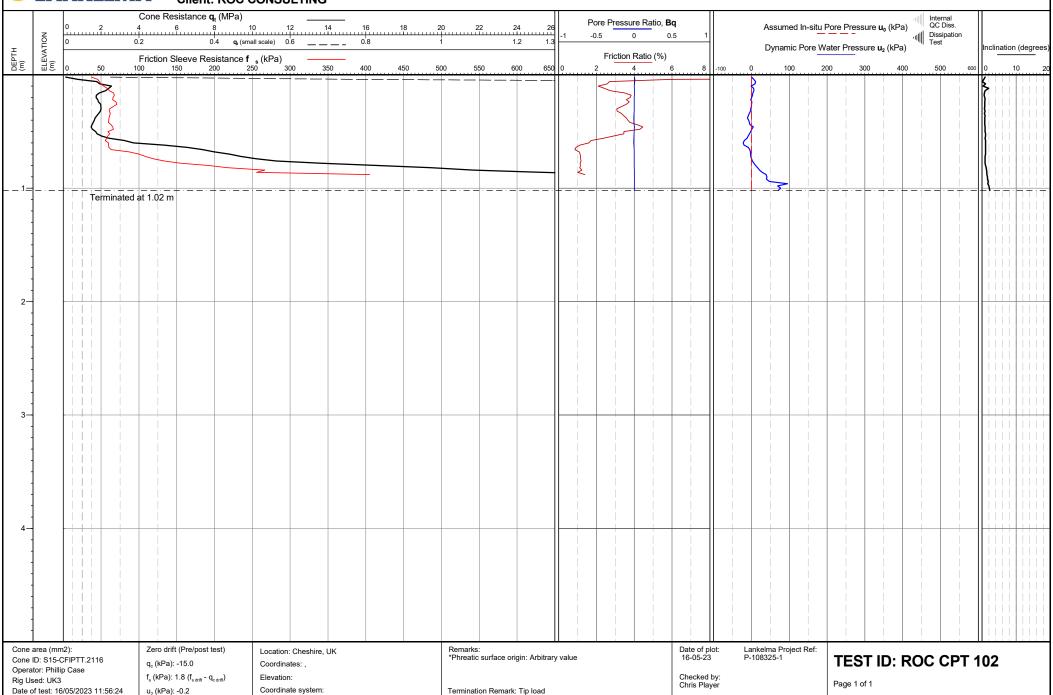
Measured CPT parameters

intermediate parameters $R_{f} \ and \ B_{q}$

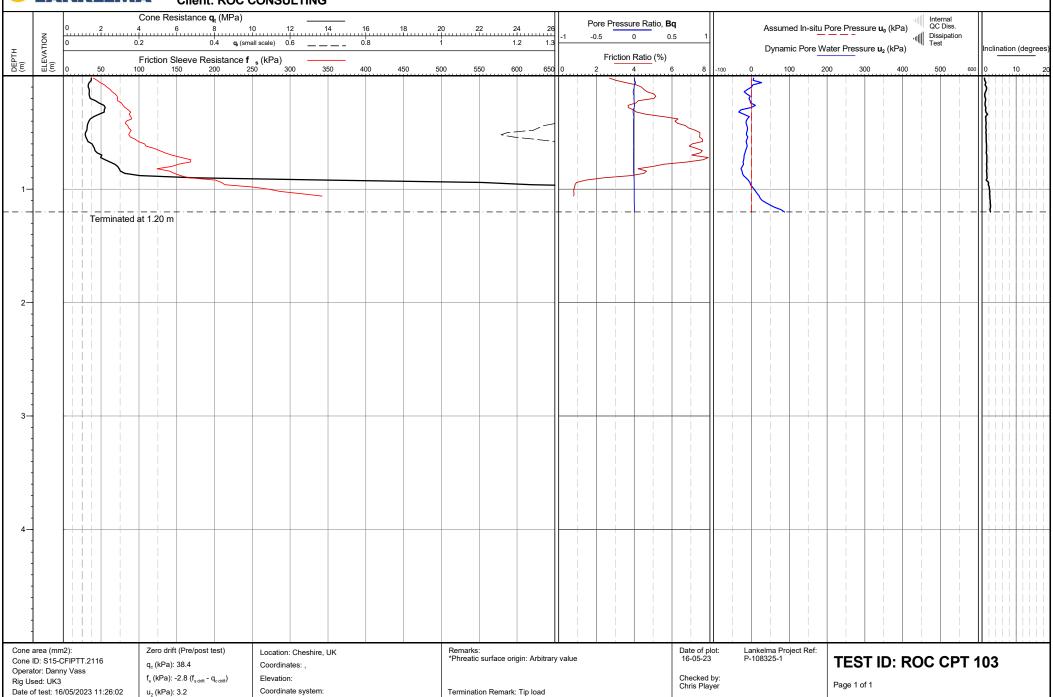




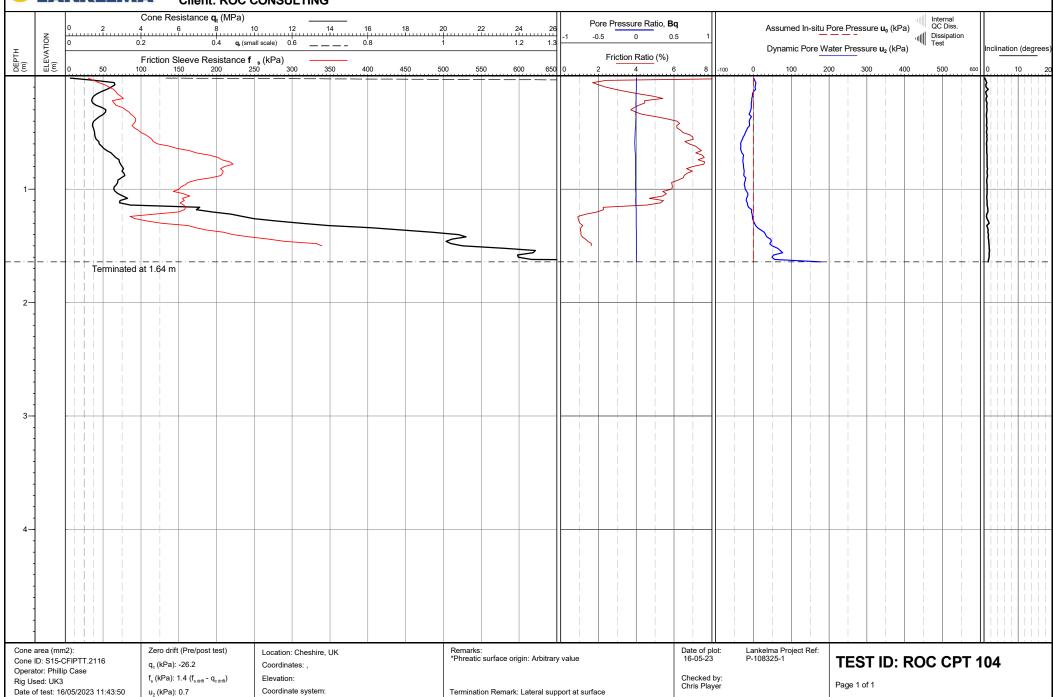




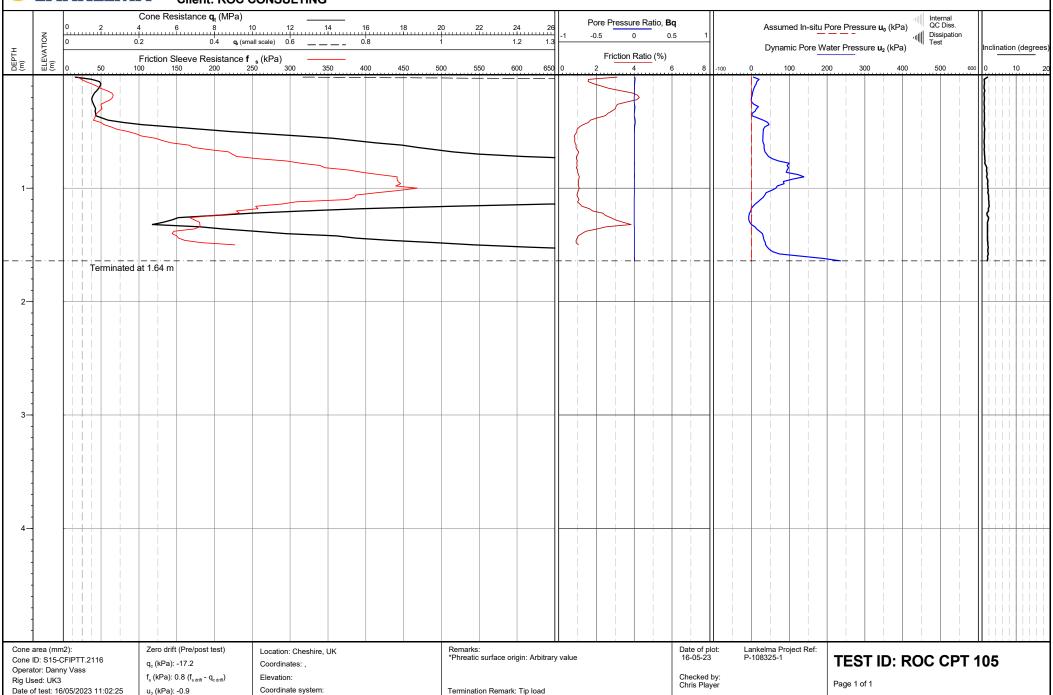




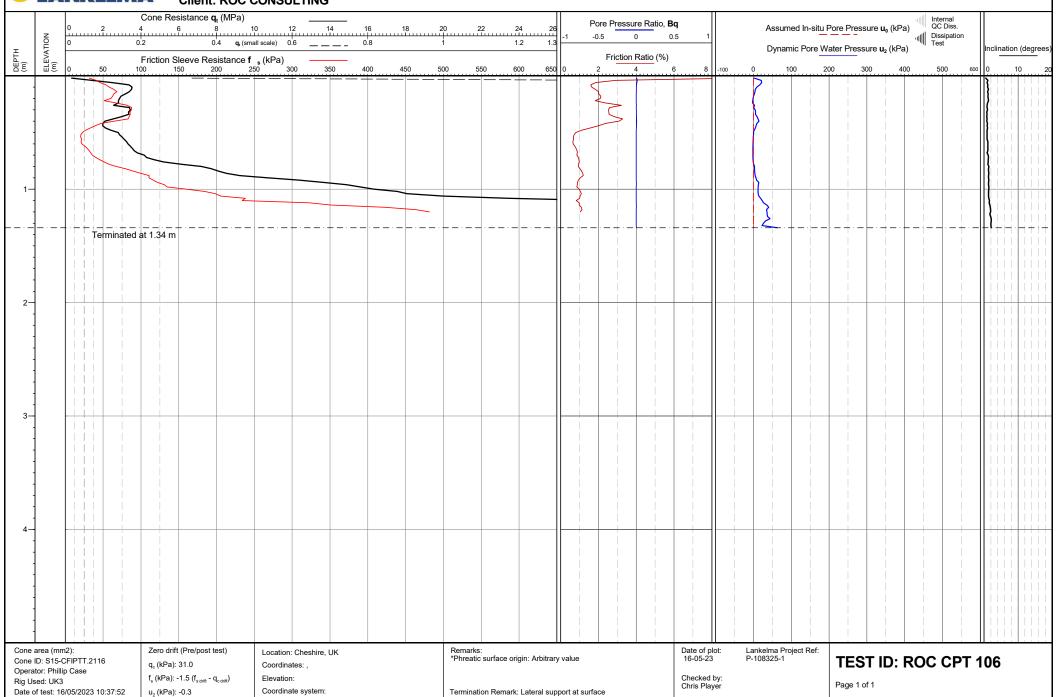




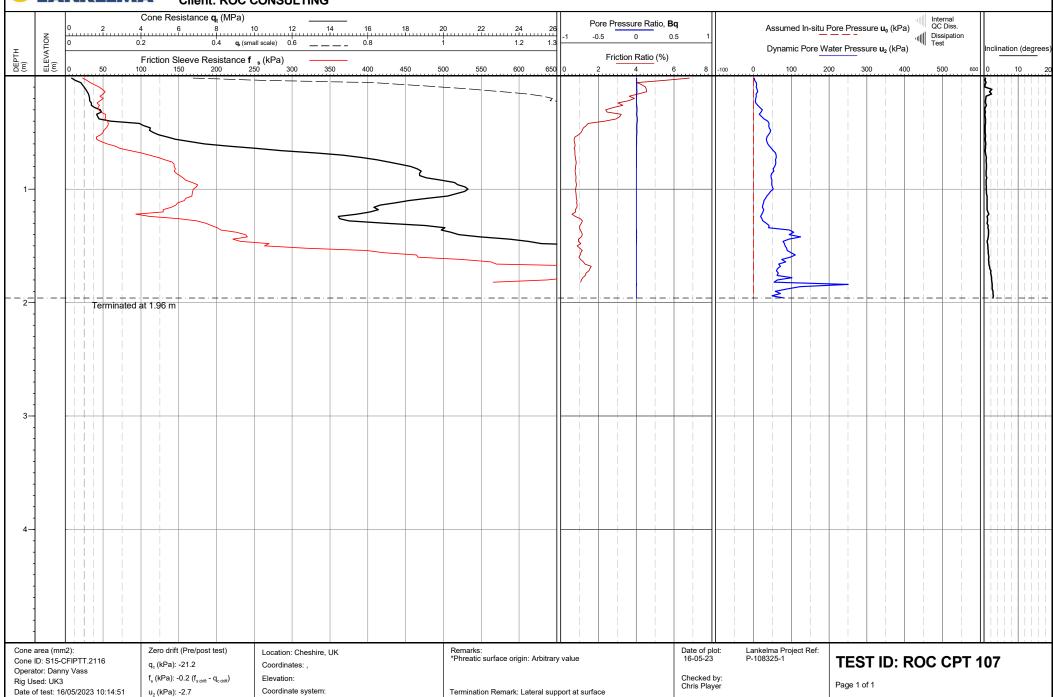




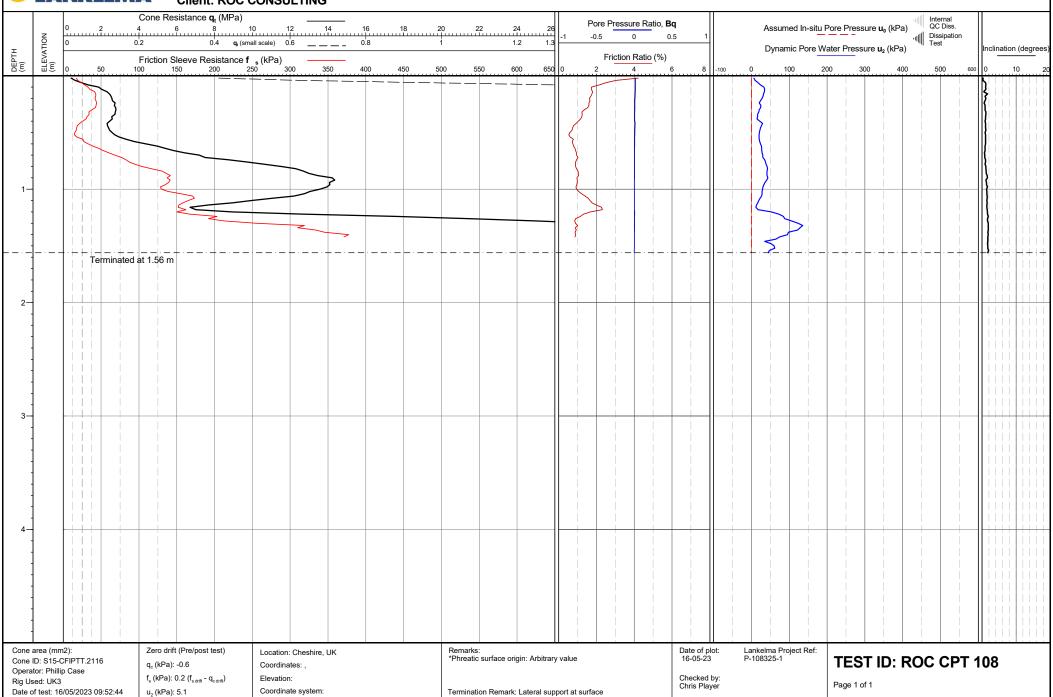




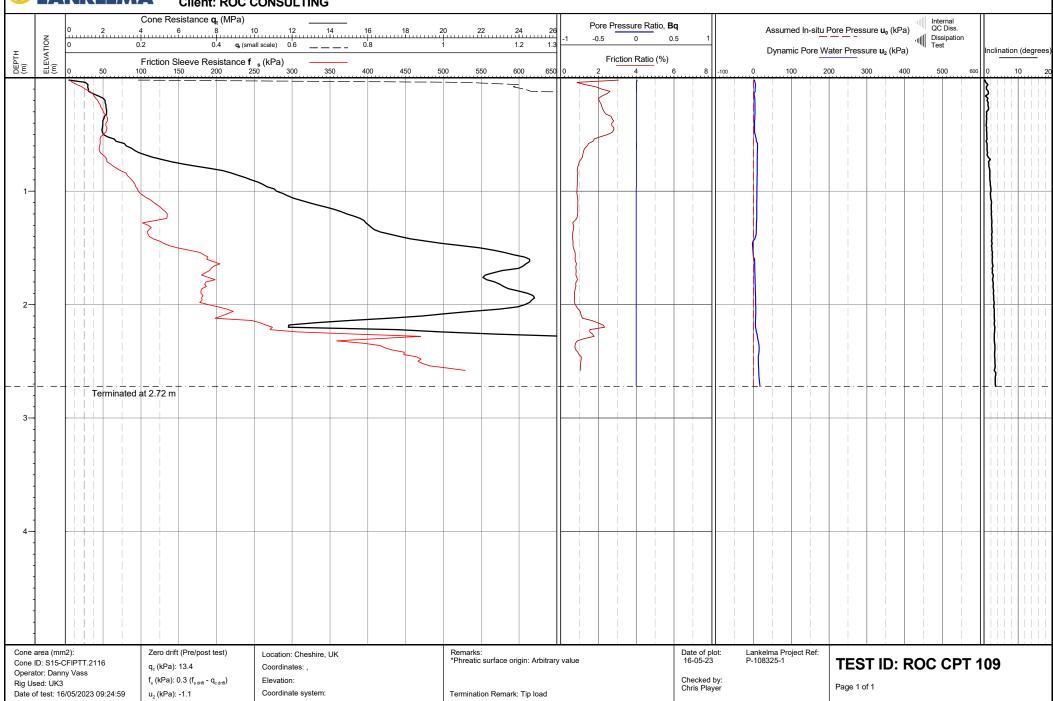




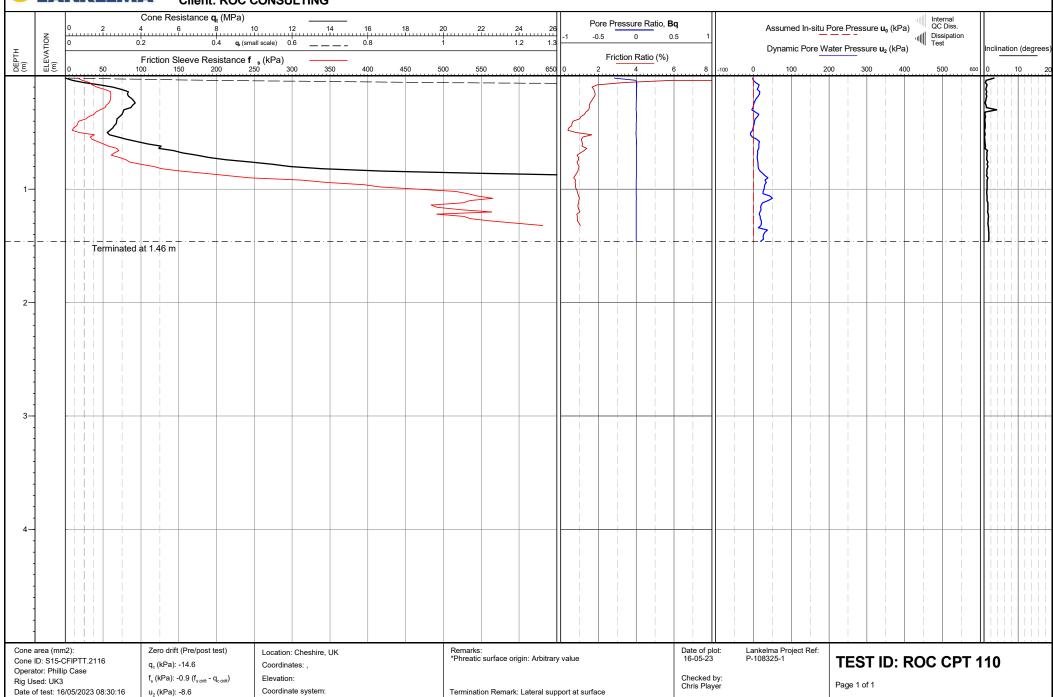




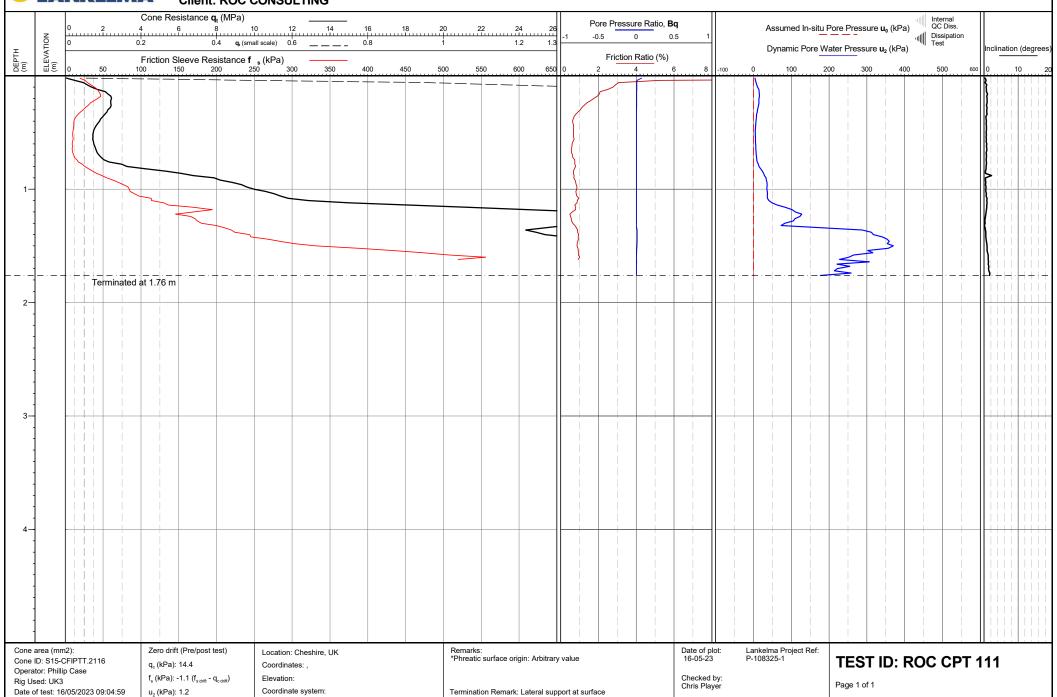




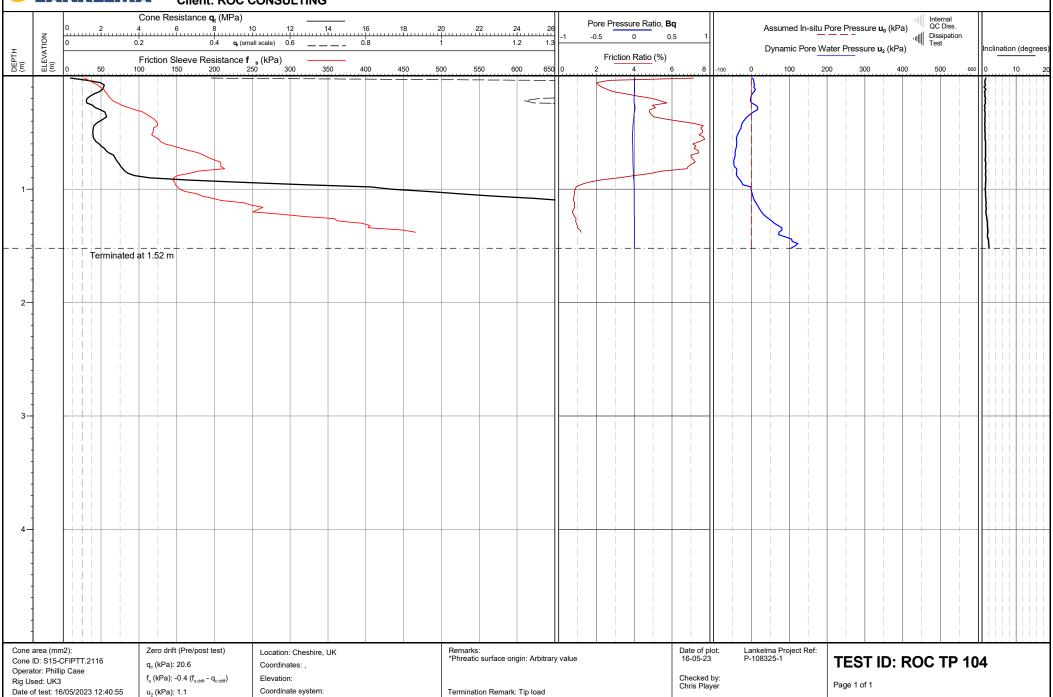




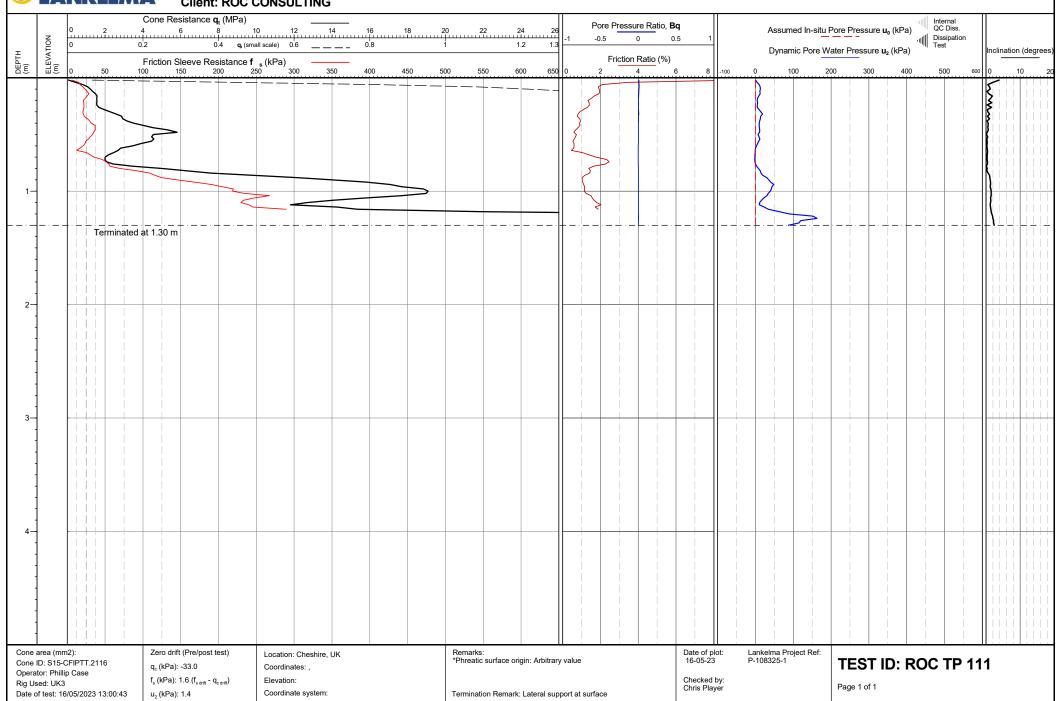




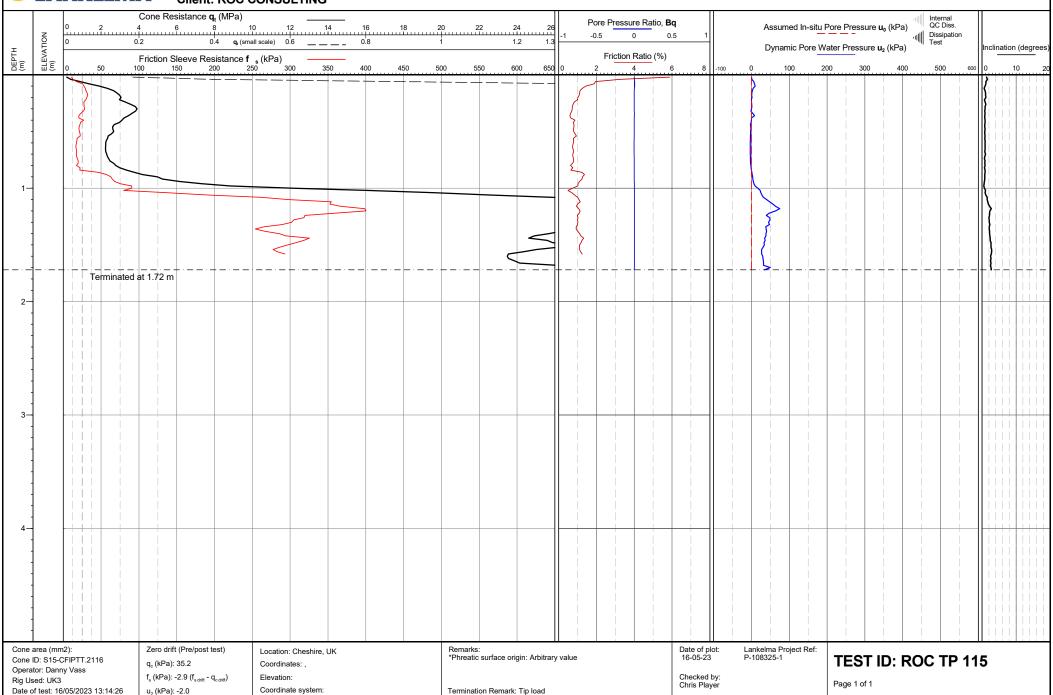
















APPENDIX D□ SOIL BEHAVIOUR TYPE RESULTS

Soil behaviour type (SBT) point data evaluation according to:

Schneider et al (2008)

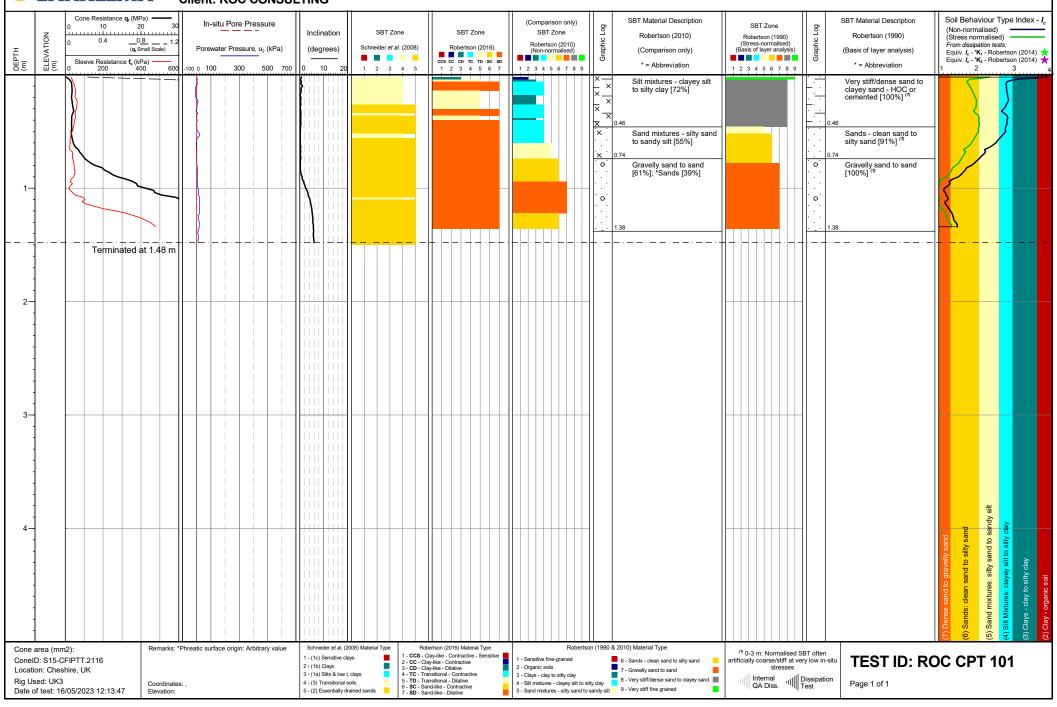
Robertson (2016)

Robertson (2010) with aggregate layer descriptions

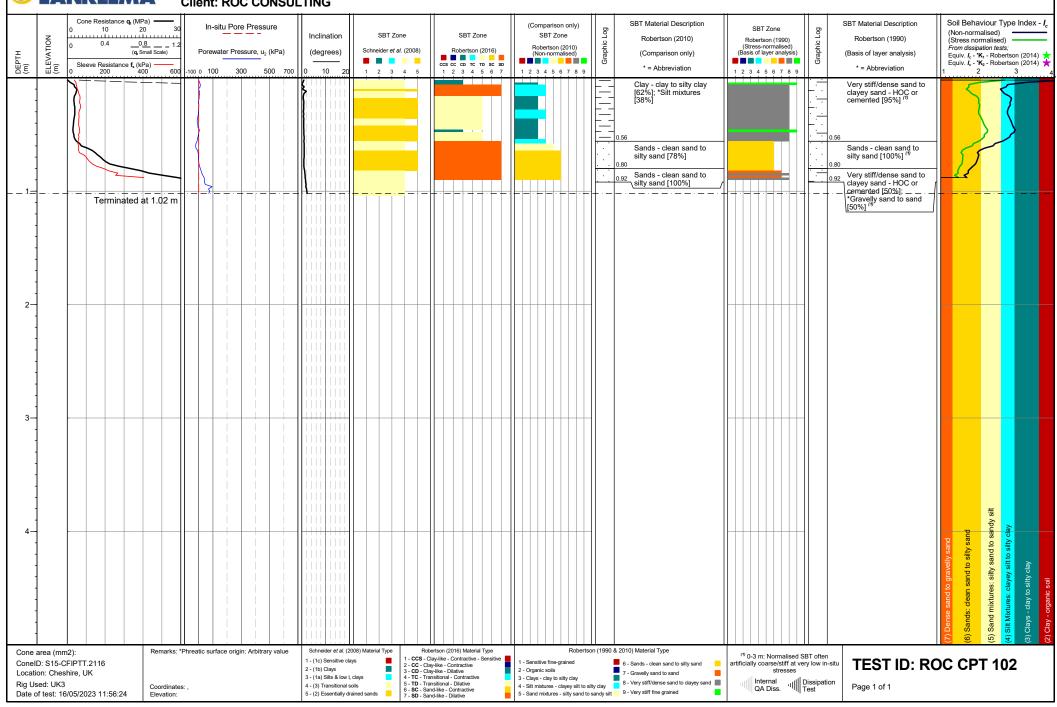
Robertson (1990) with aggregate layer descriptions

П

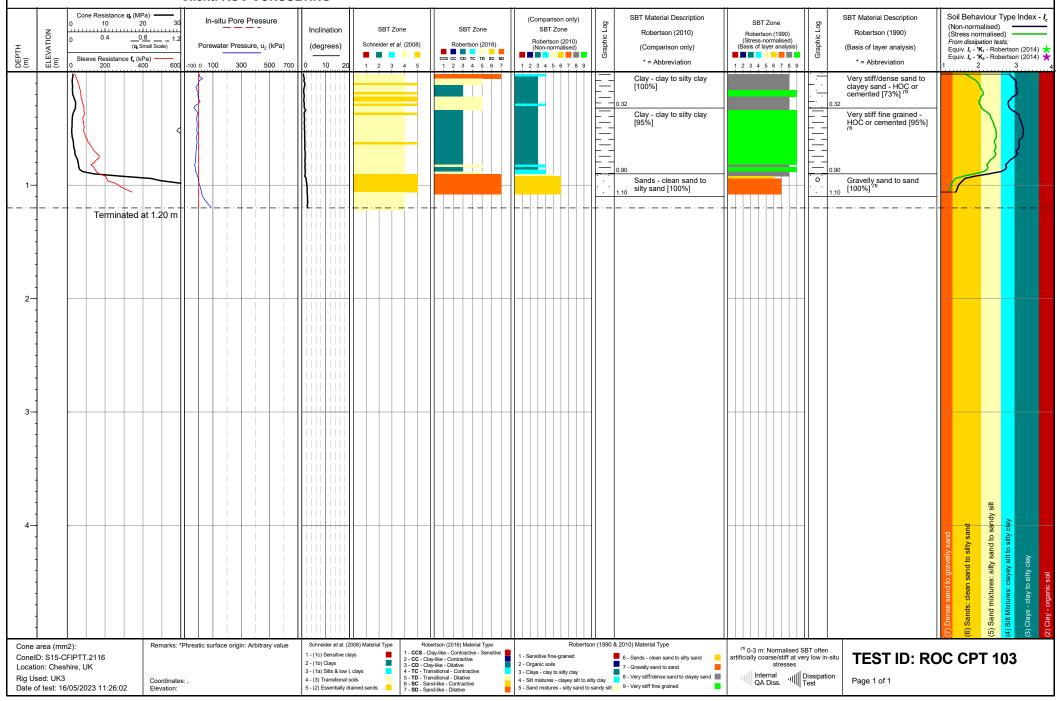
Project: WARRINGTON
Client: ROC CONSULTING



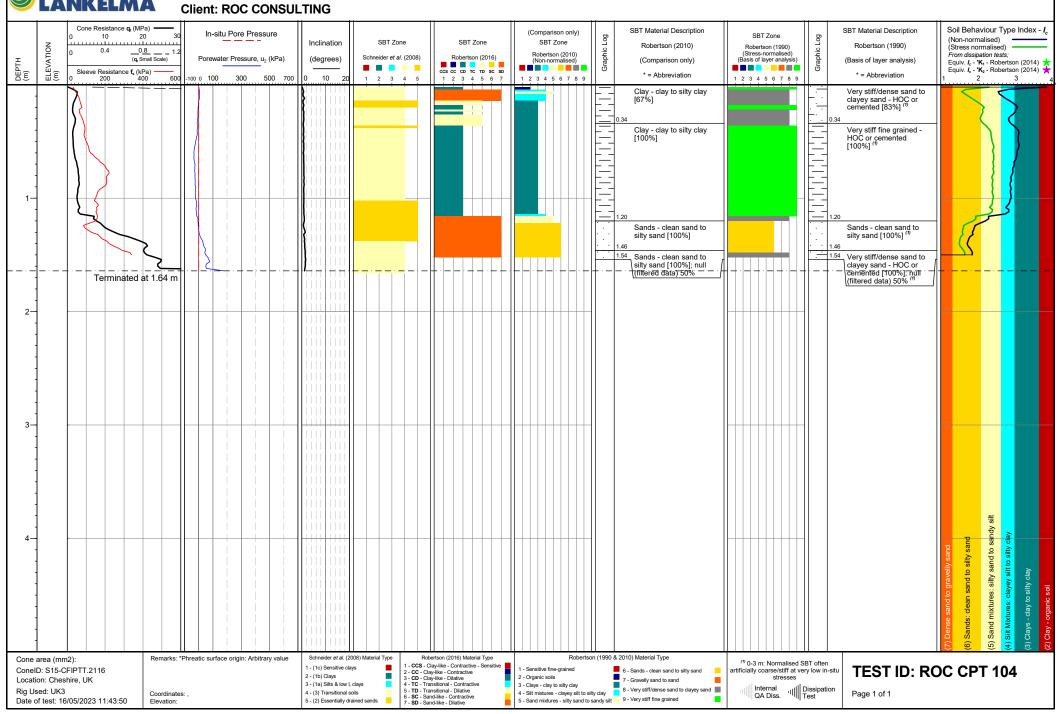
Project: WARRINGTON
Client: ROC CONSULTING



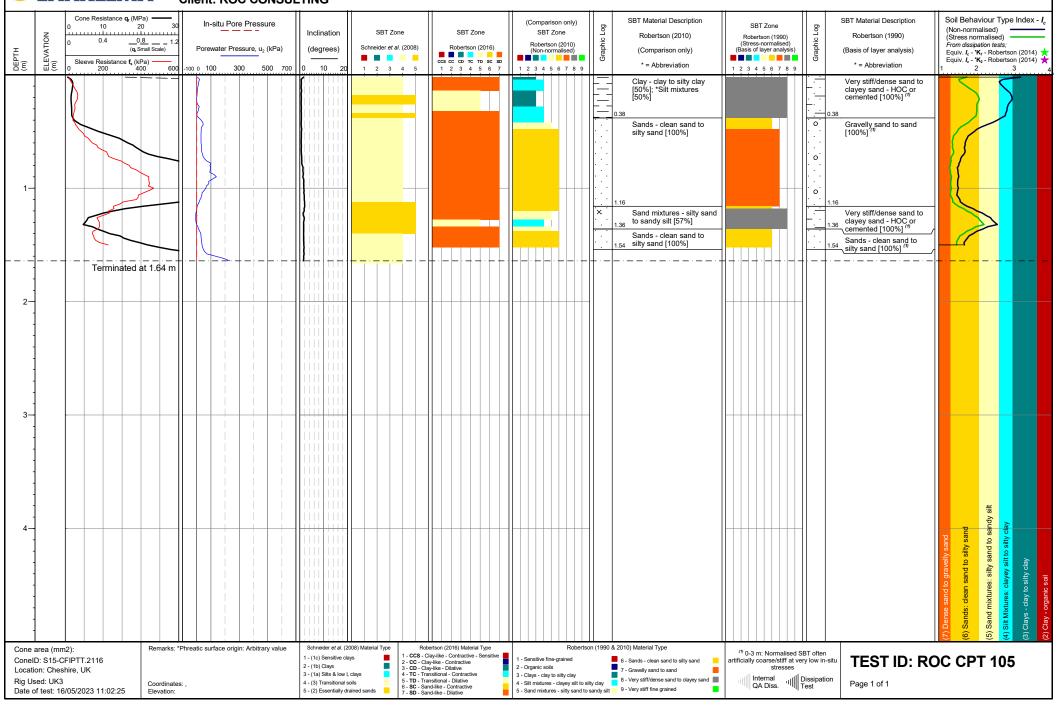
Project: WARRINGTON
Client: ROC CONSULTING



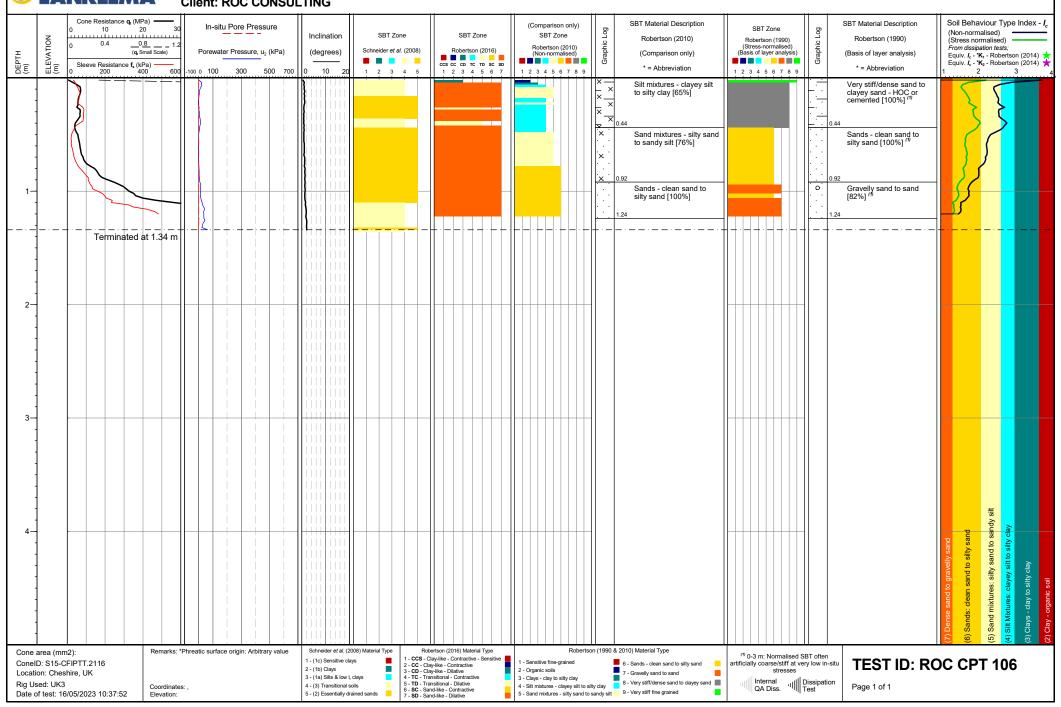
Project: WARRINGTON



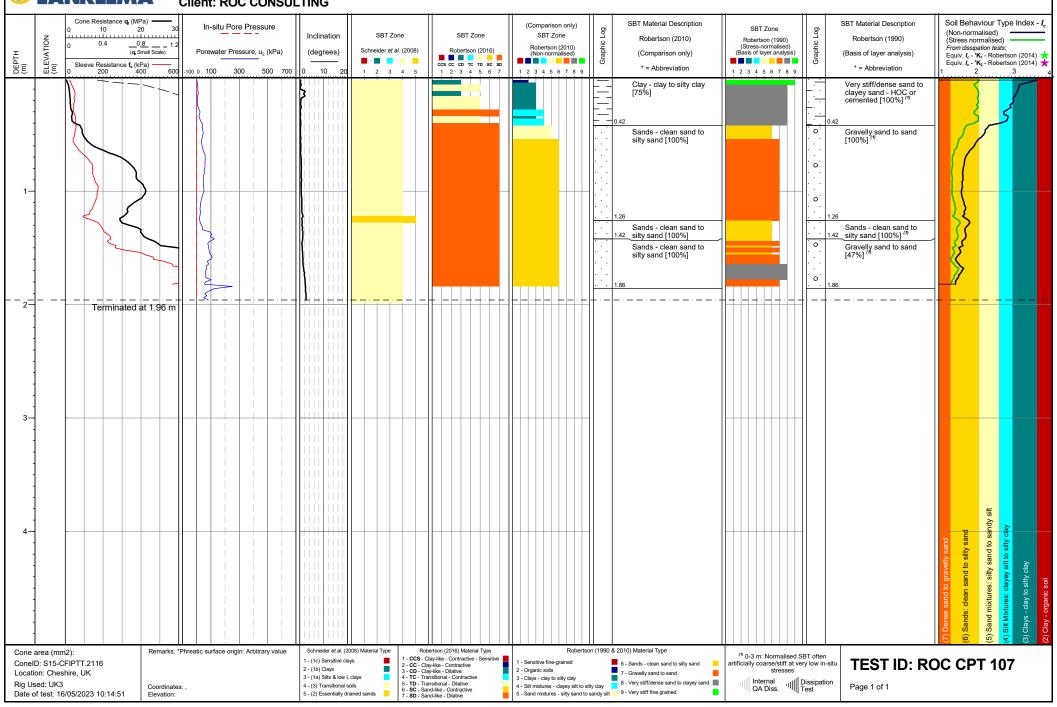
Project: WARRINGTON
Client: ROC CONSULTING



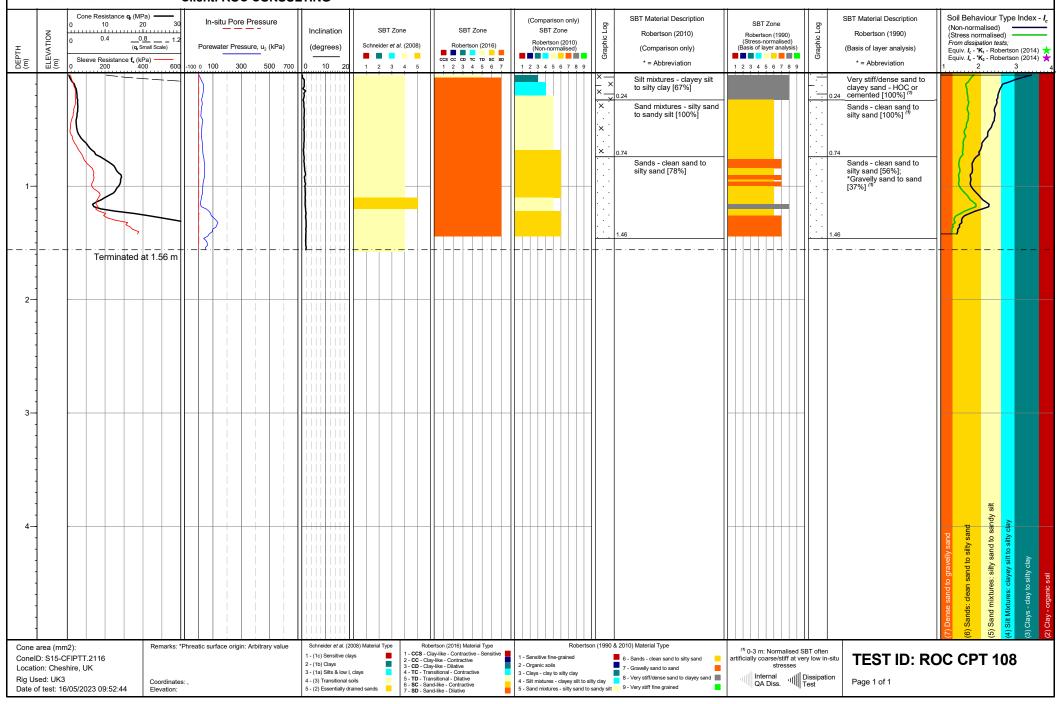
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Client: ROC CONSULTING



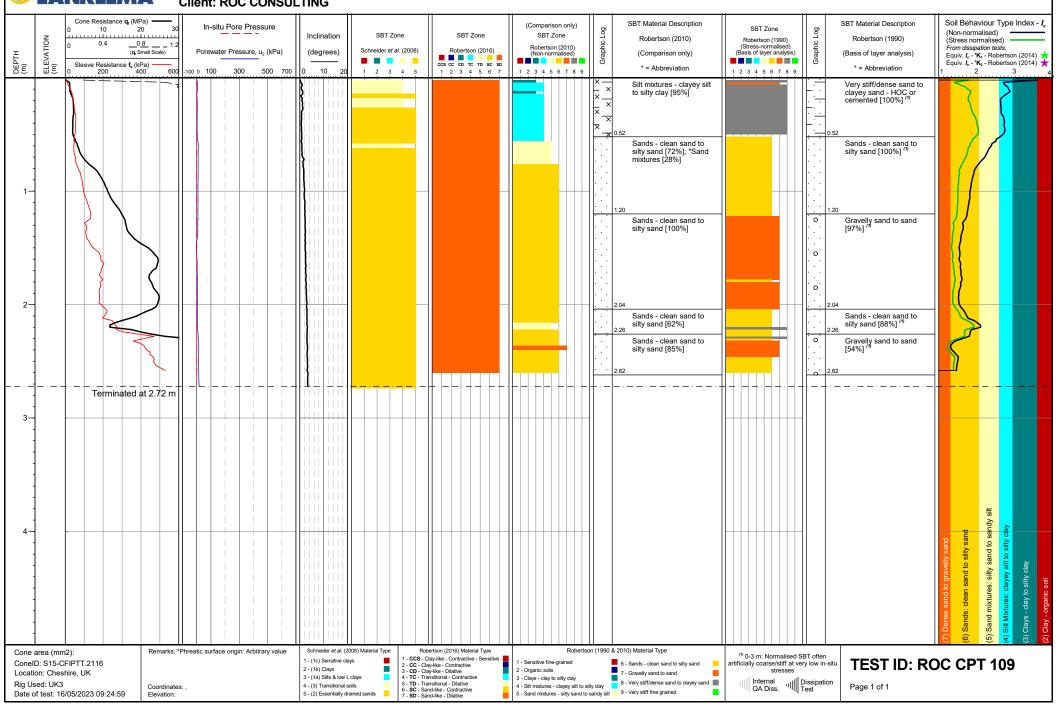
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Client: ROC CONSULTING



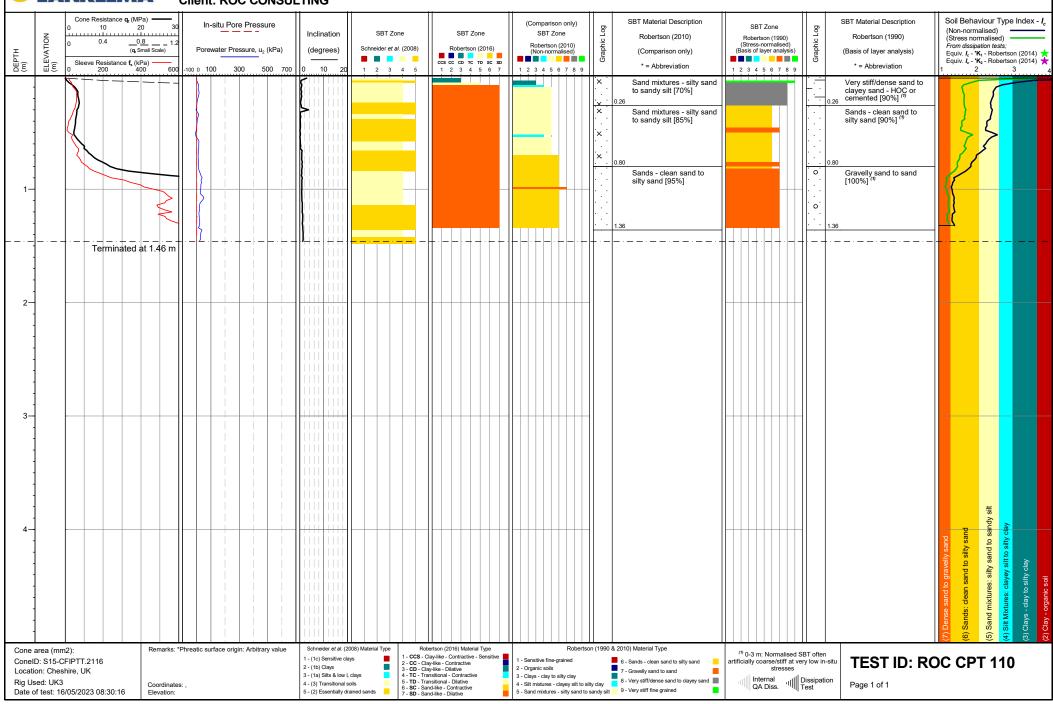
Project: WARRINGTON
Client: ROC CONSULTING



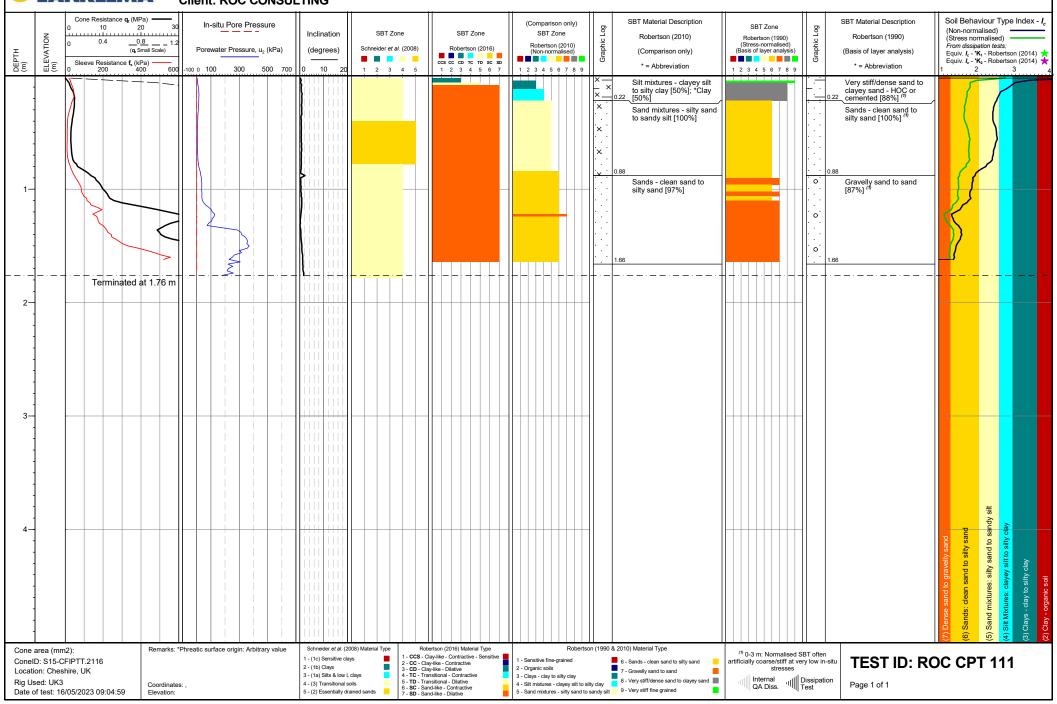
Project: WARRINGTON
Client: ROC CONSULTING



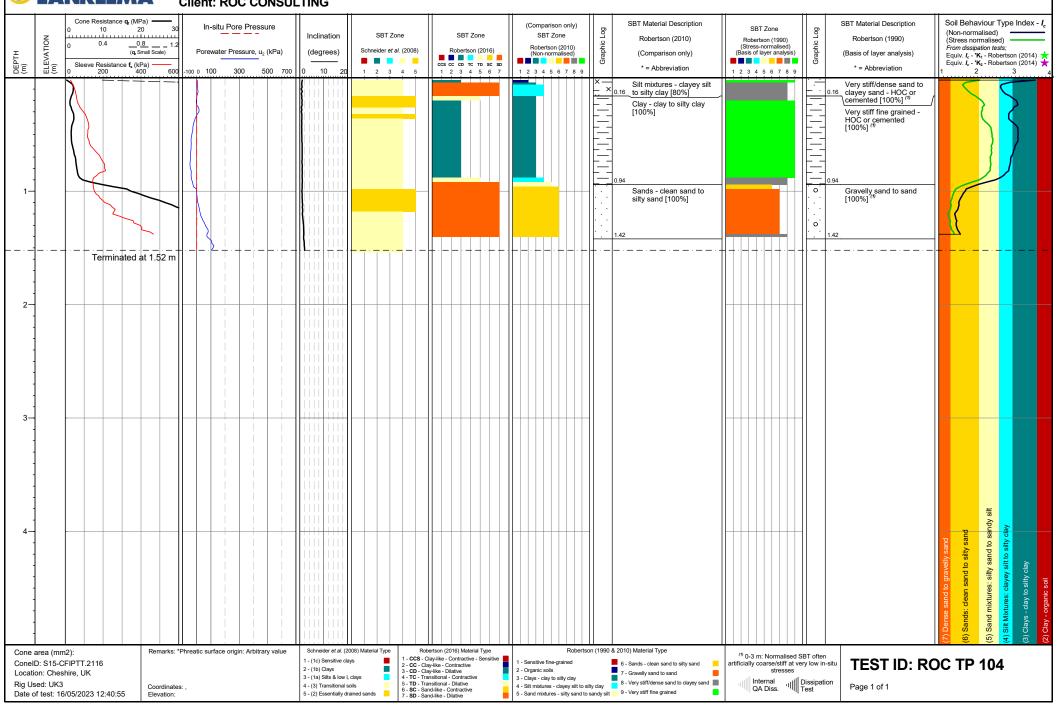
Project: WARRINGTON
Client: ROC CONSULTING



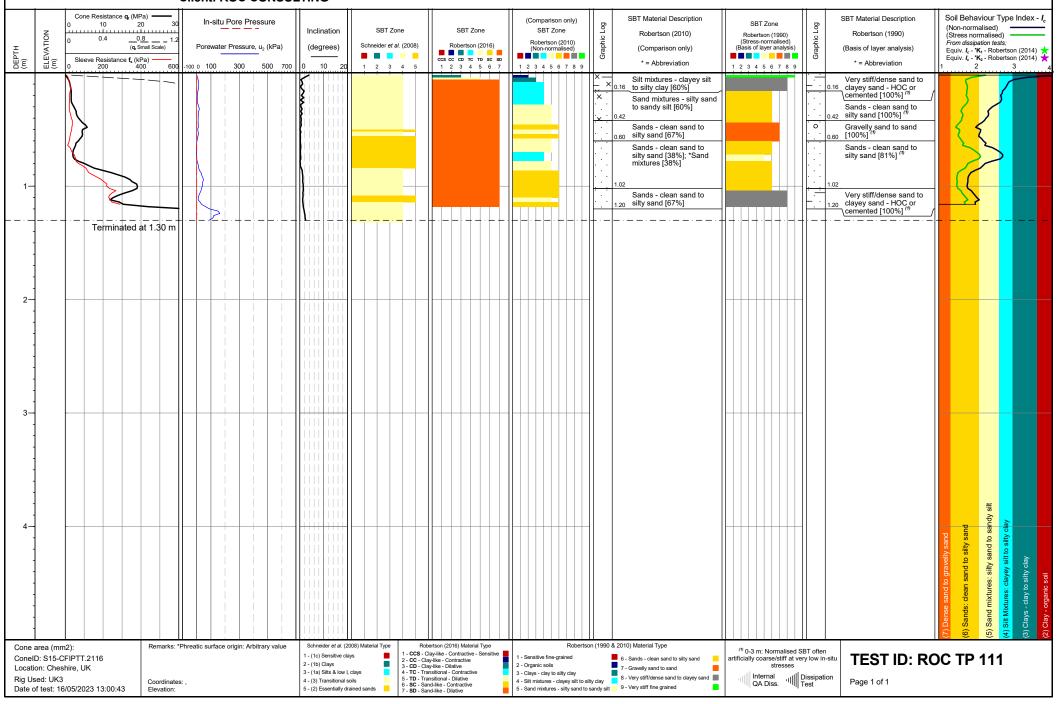
Project: WARRINGTON
Client: ROC CONSULTING



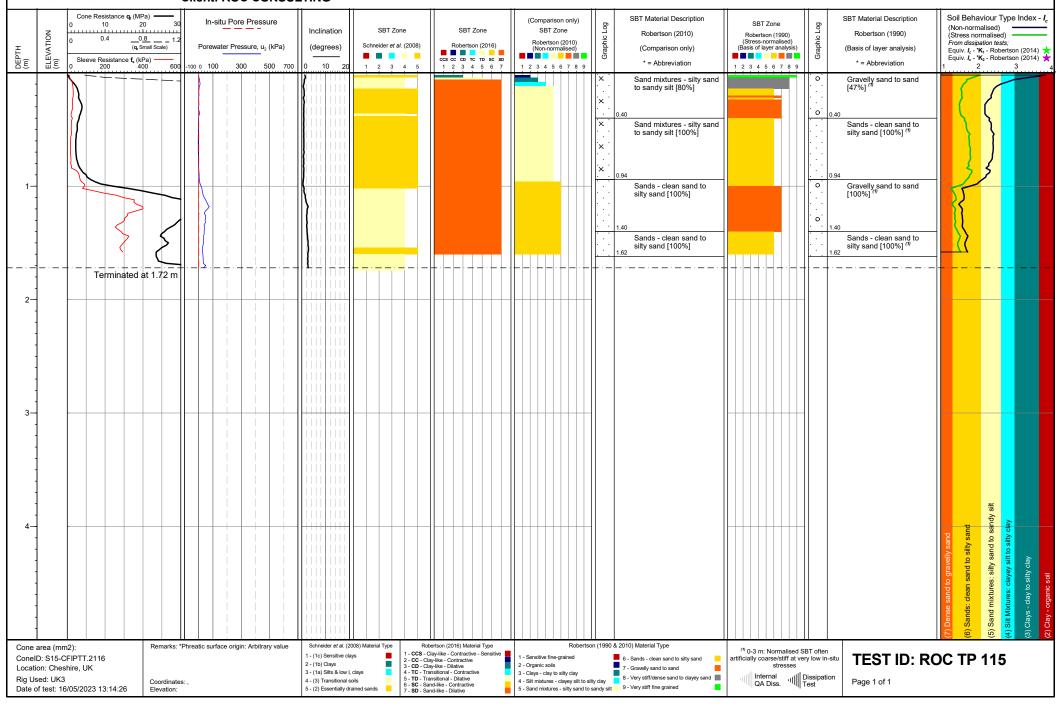
Project: WARRINGTON
Client: ROC CONSULTING



Project: WARRINGTON Client: ROC CONSULTING



Project: WARRINGTON
Client: ROC CONSULTING





$\mbox{\bf APPENDIX E} \mbox{\ } \mbox{\bf PARAMETER RESULTS 1-S}_U, \ M_V, \ OCR, \ SBT, \ I_C$

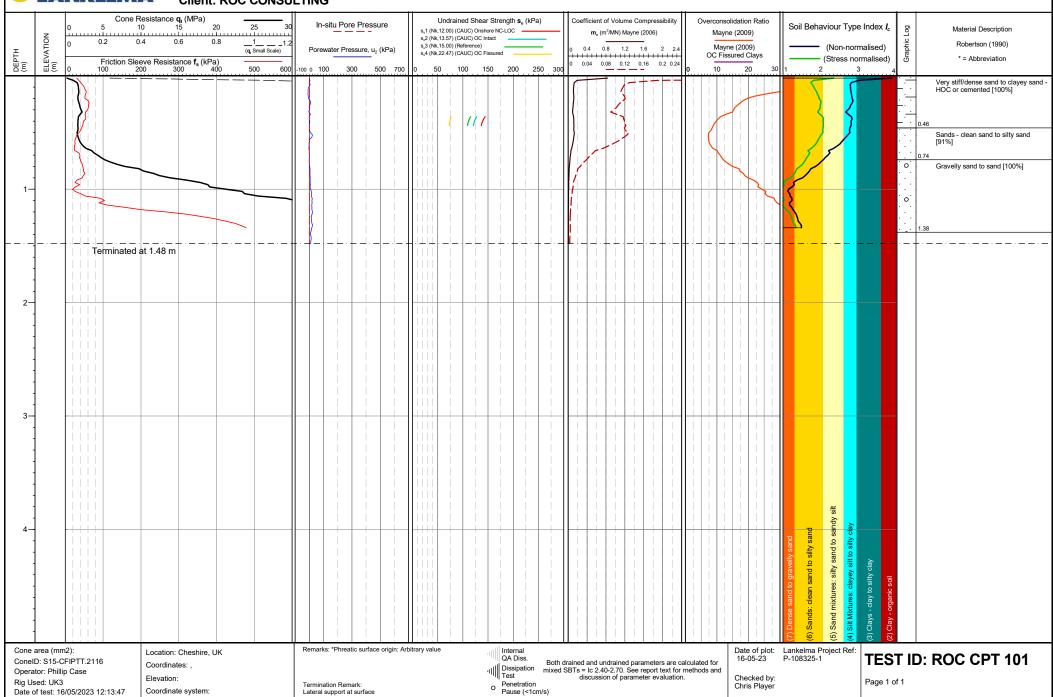
Undrained shear strength

Coefficient of volume change

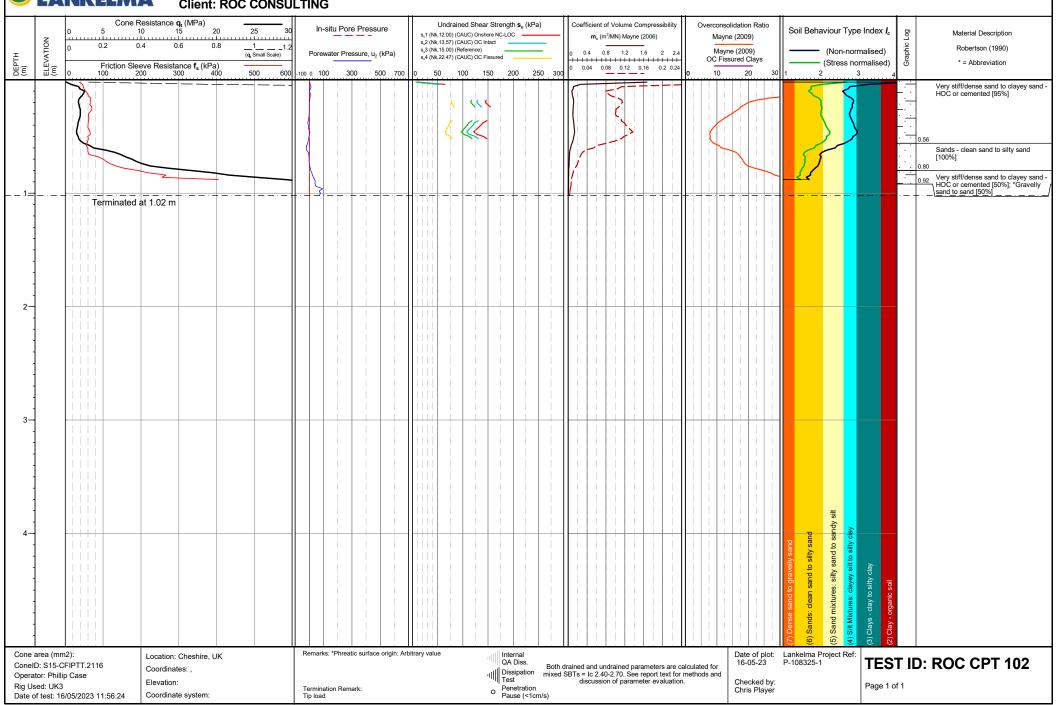
Overconsolidation ratio

Robertson 1990 SBT descriptions & SBT index I_c

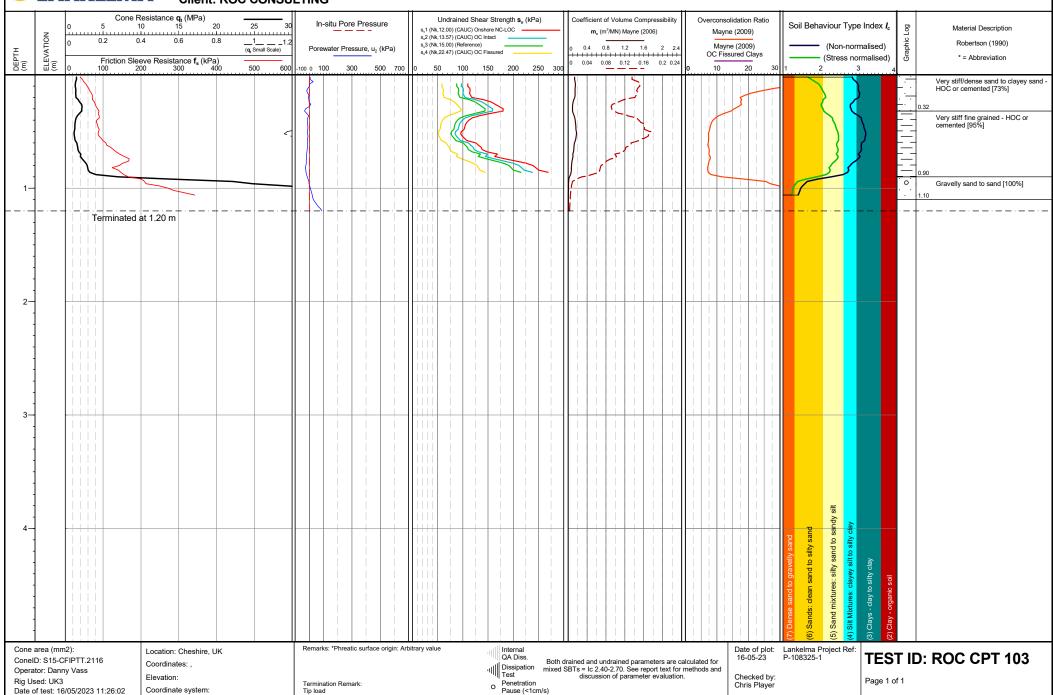




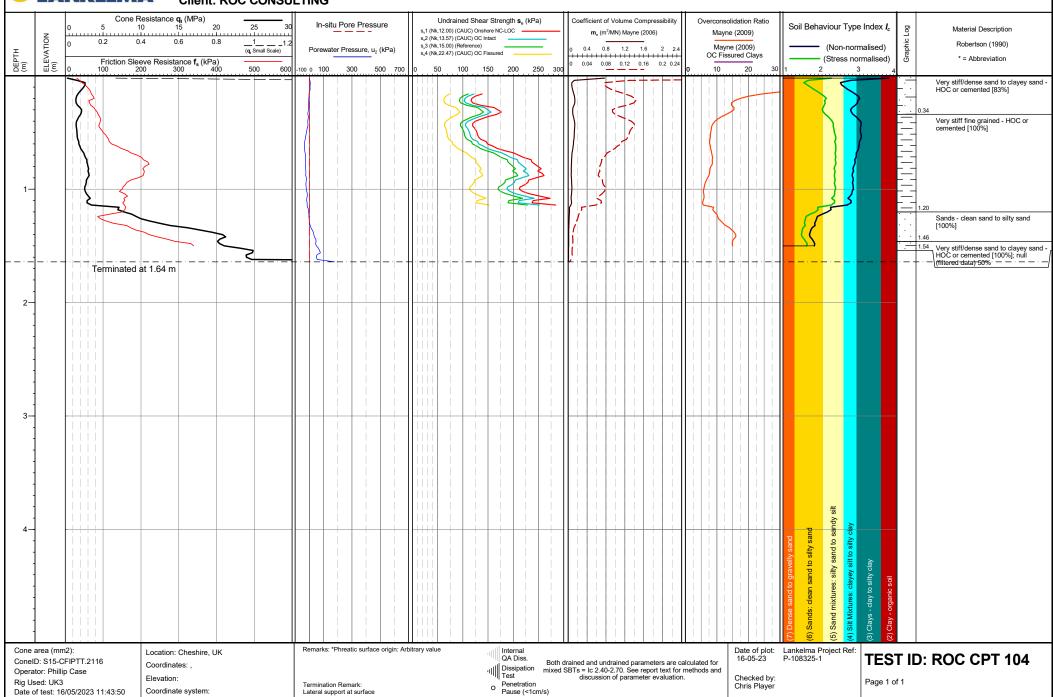




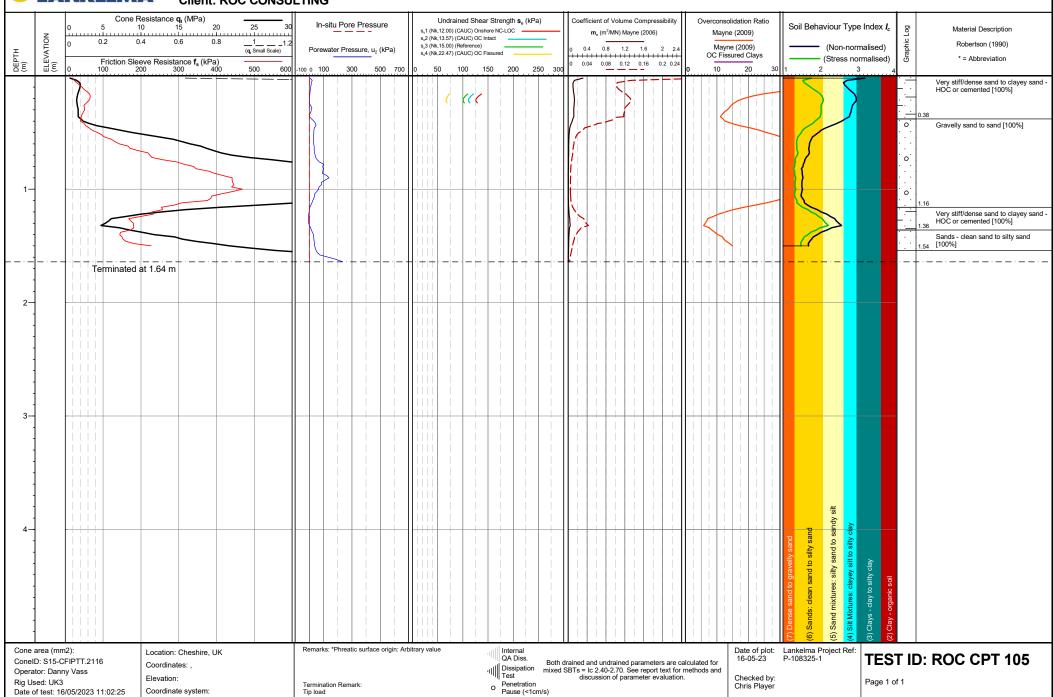




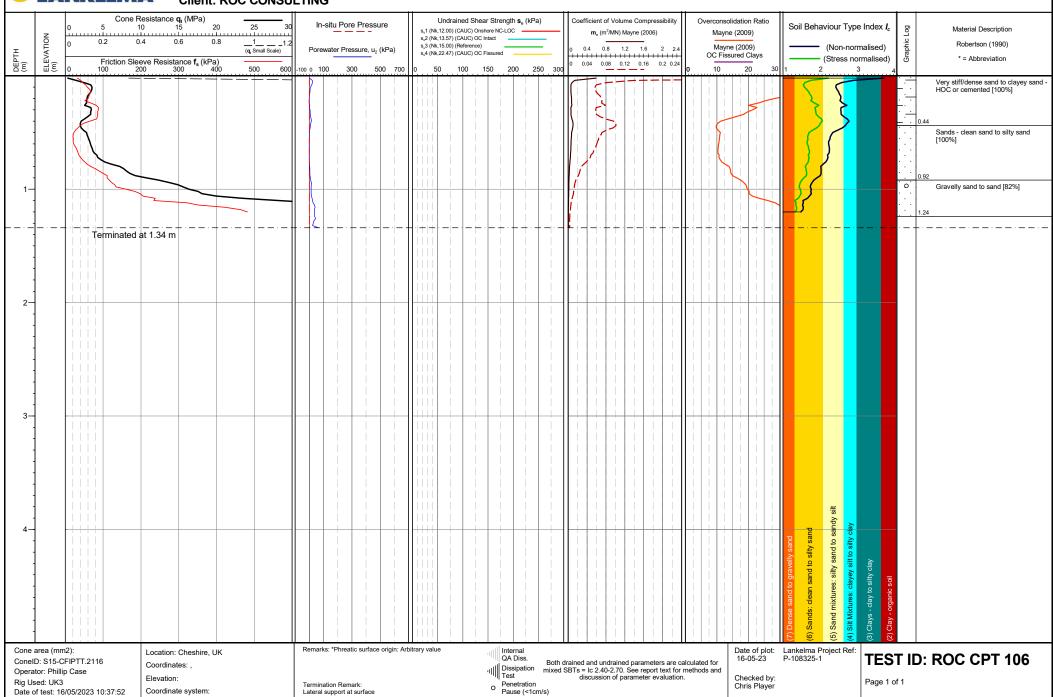




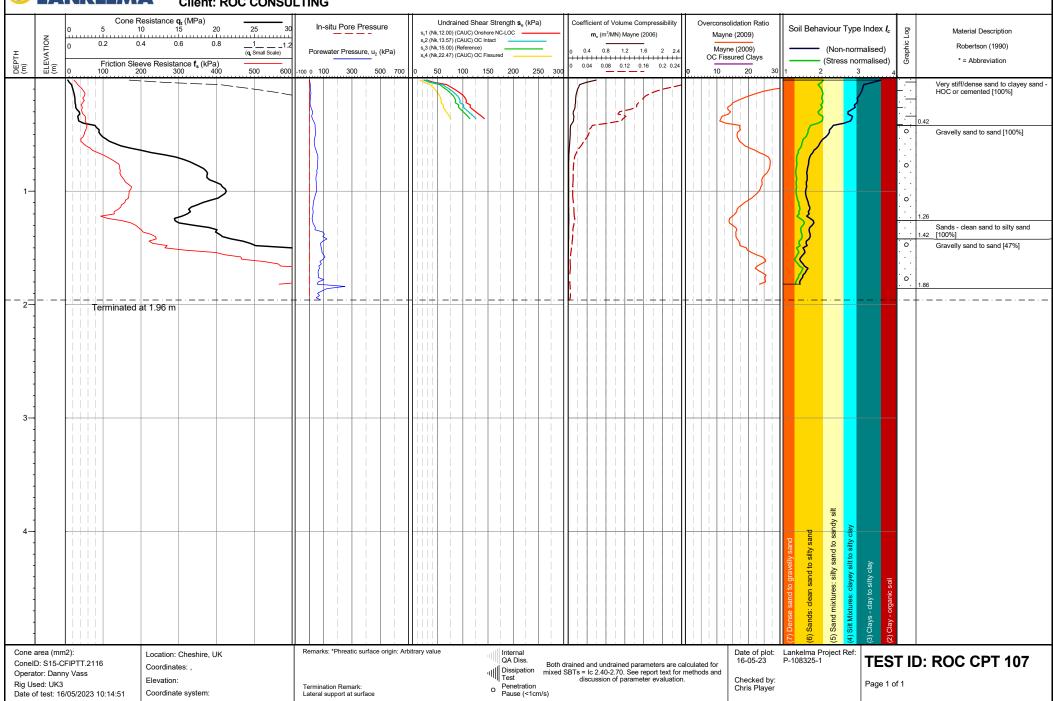




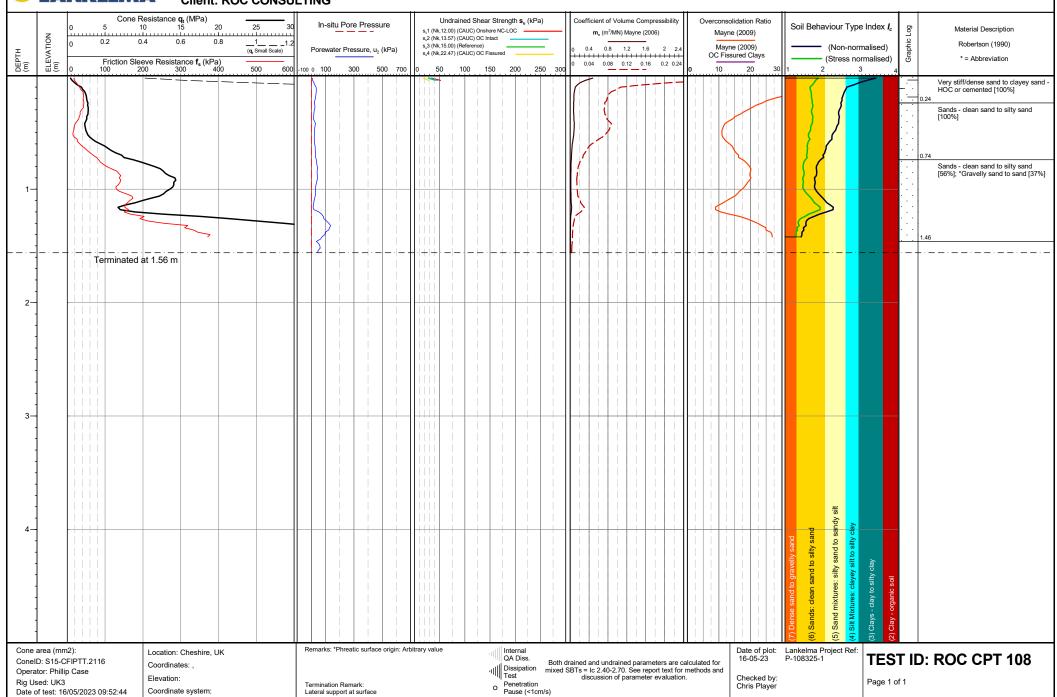




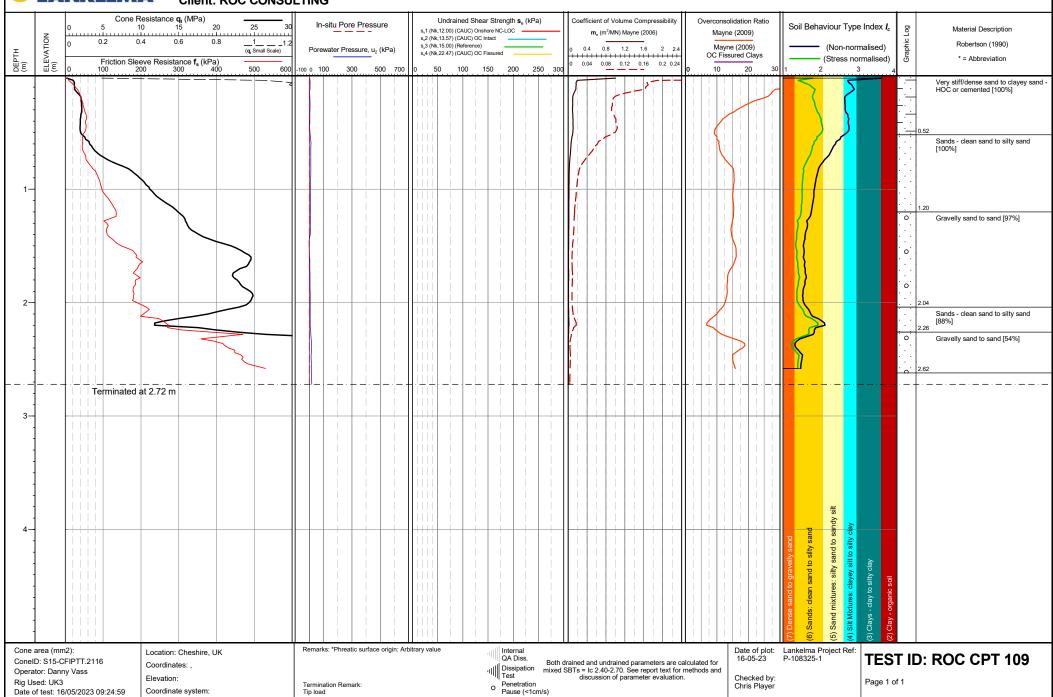




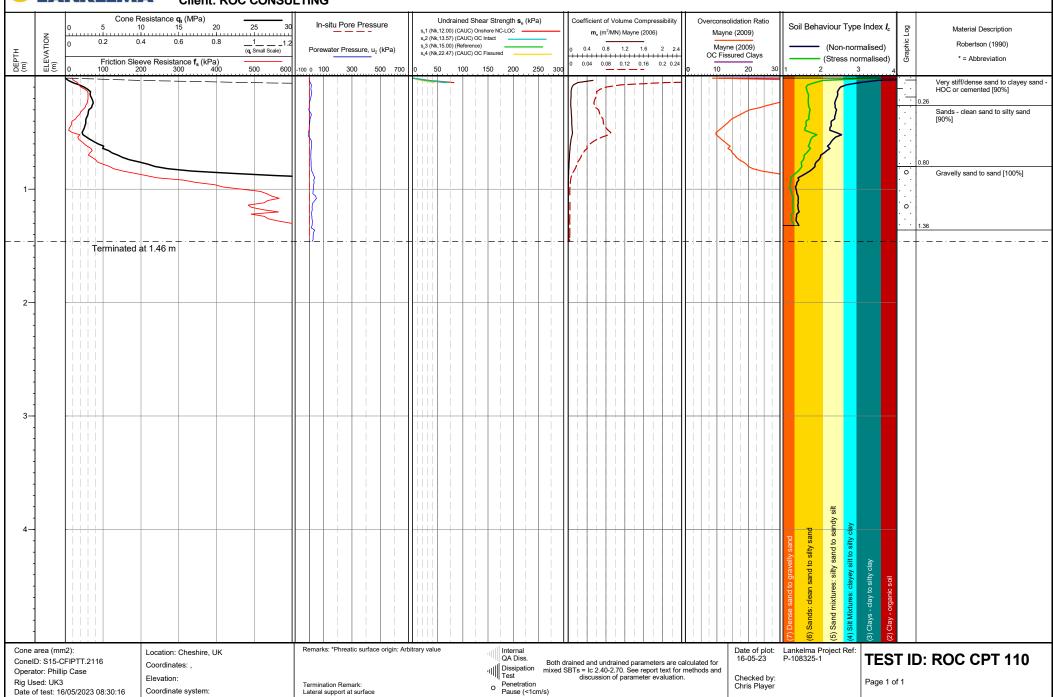




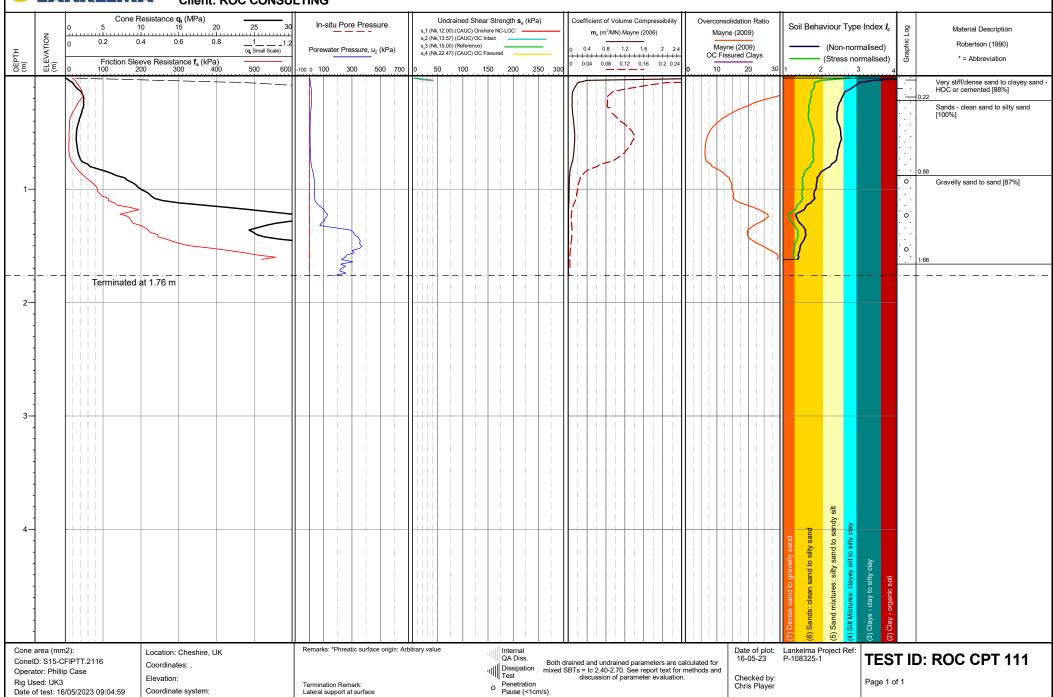




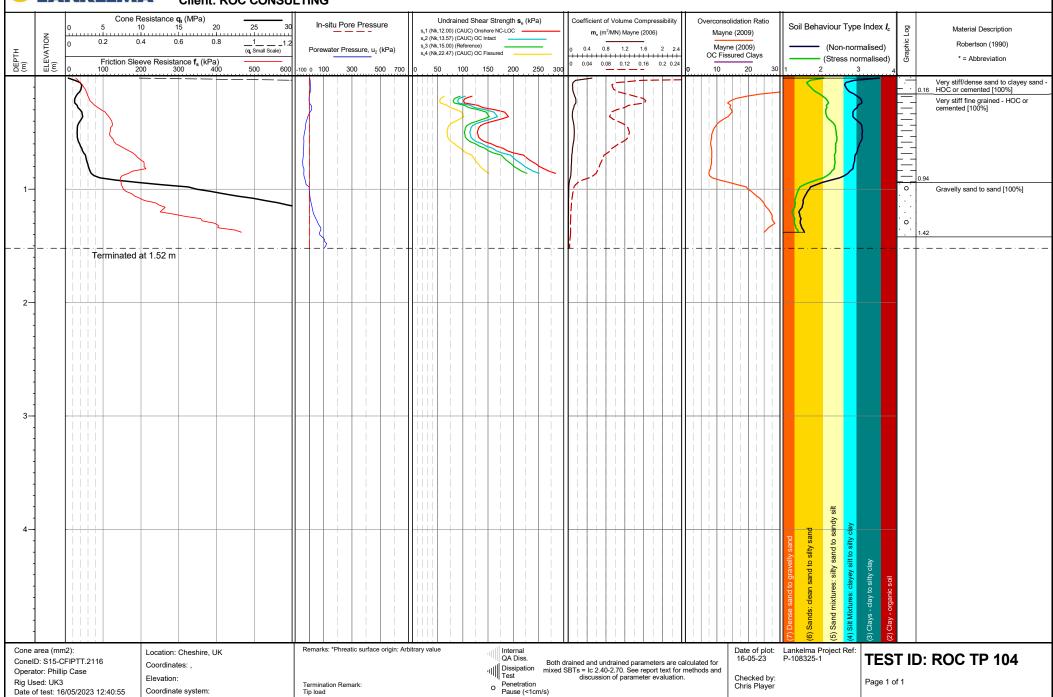




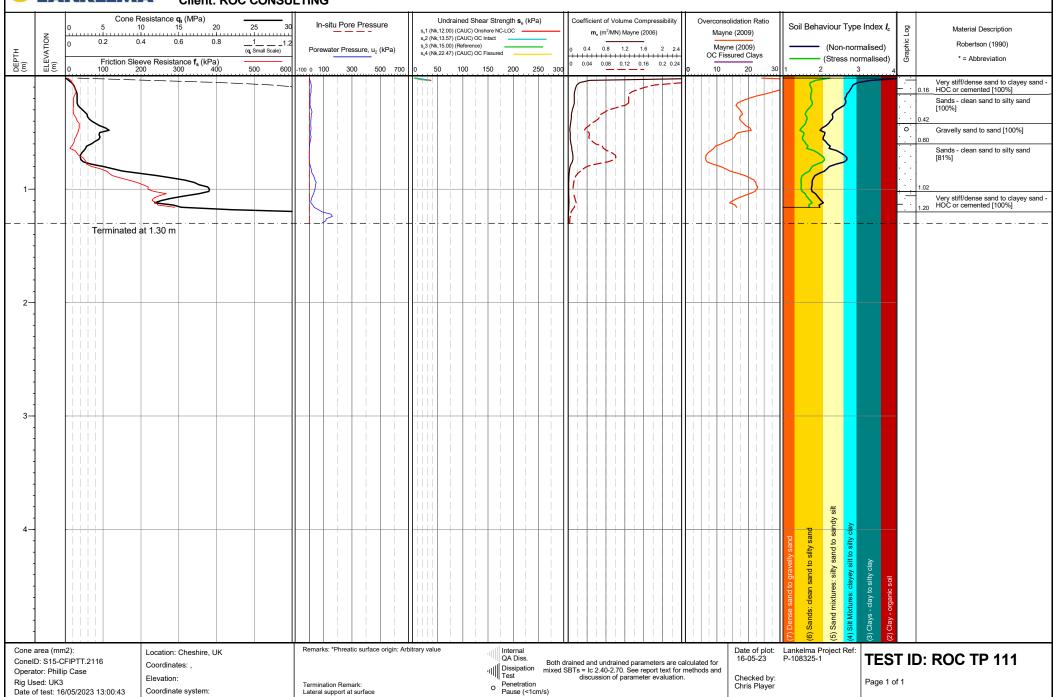




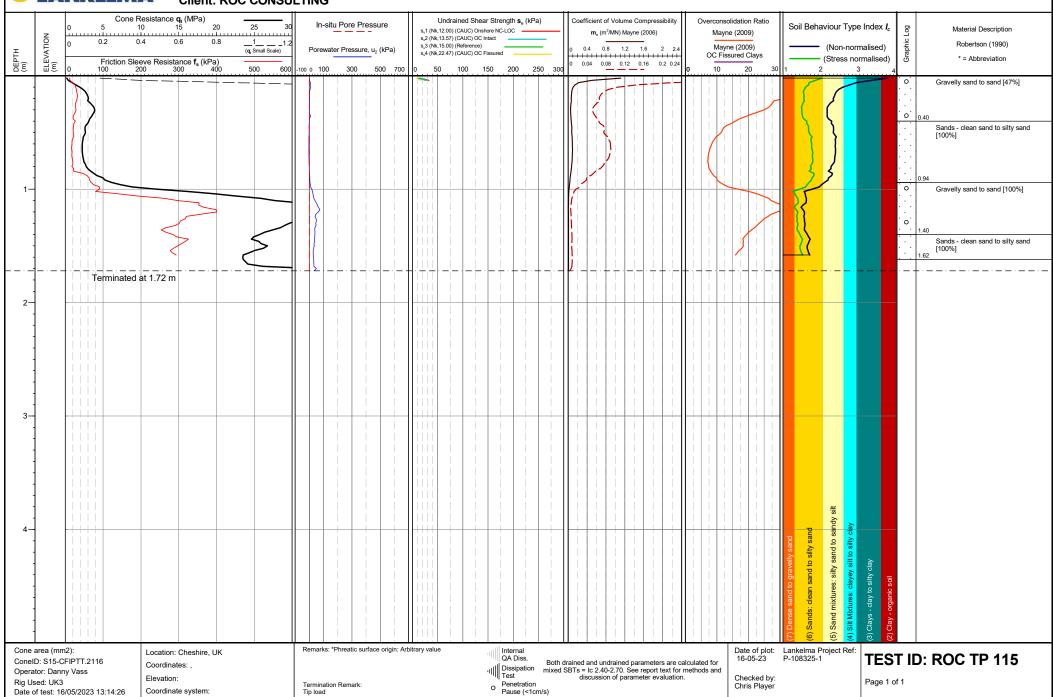














APPENDIX $F \square$ PARAMETER RESULTS 2 - SPT N60, PHI, D_R, E, I_C

Equivalent SPT N60

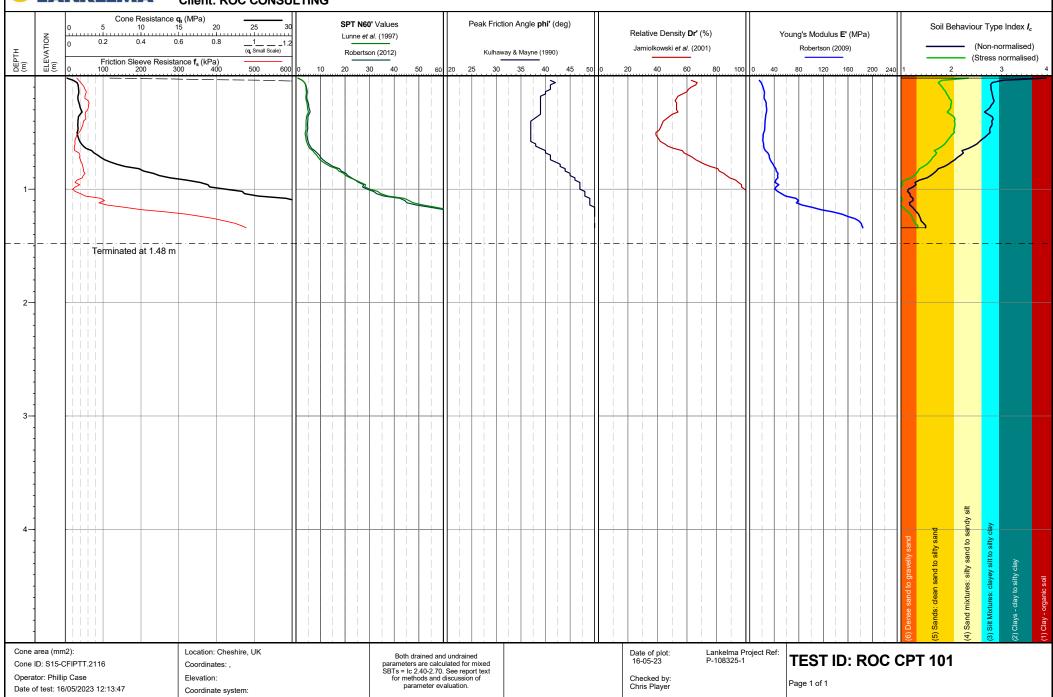
Peak friction angle

Relative density

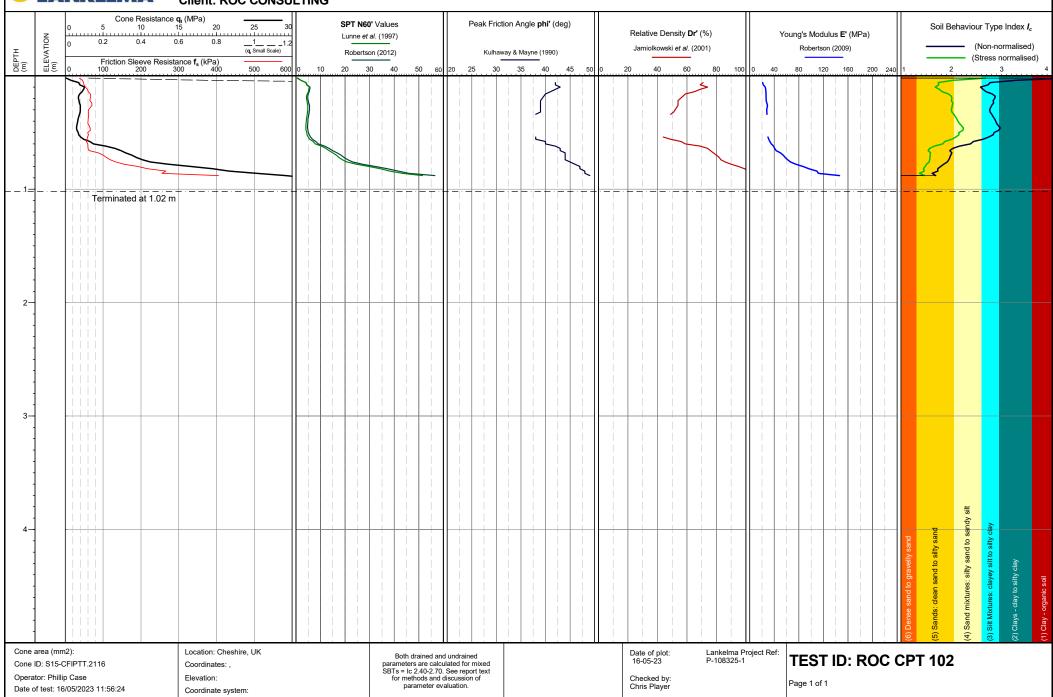
Young's modulus

SBT index I_{c}

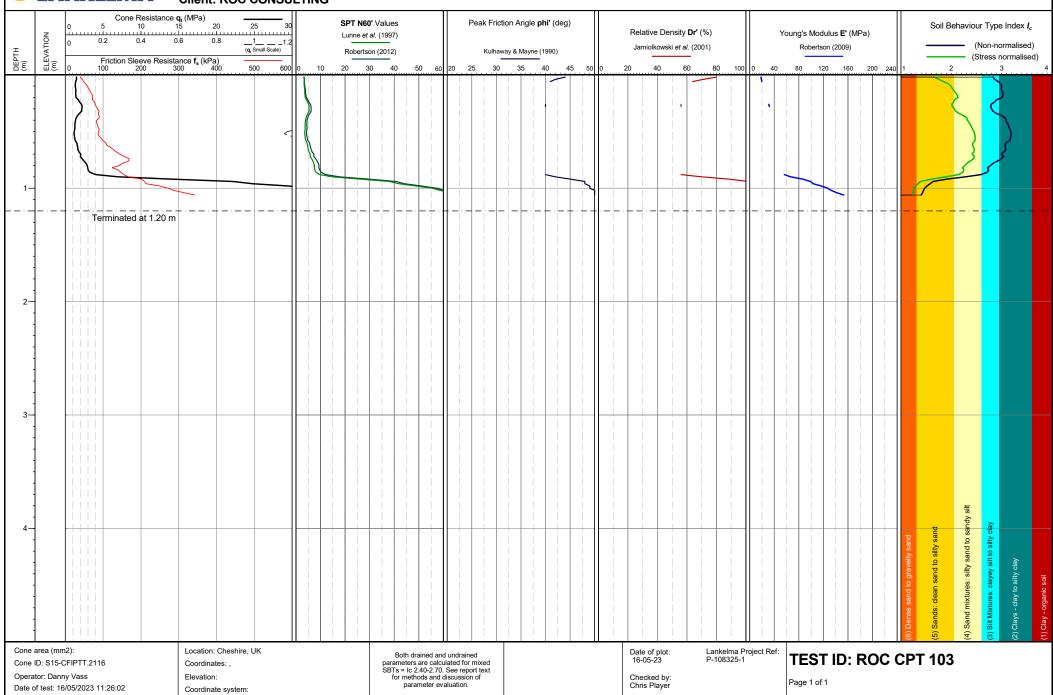




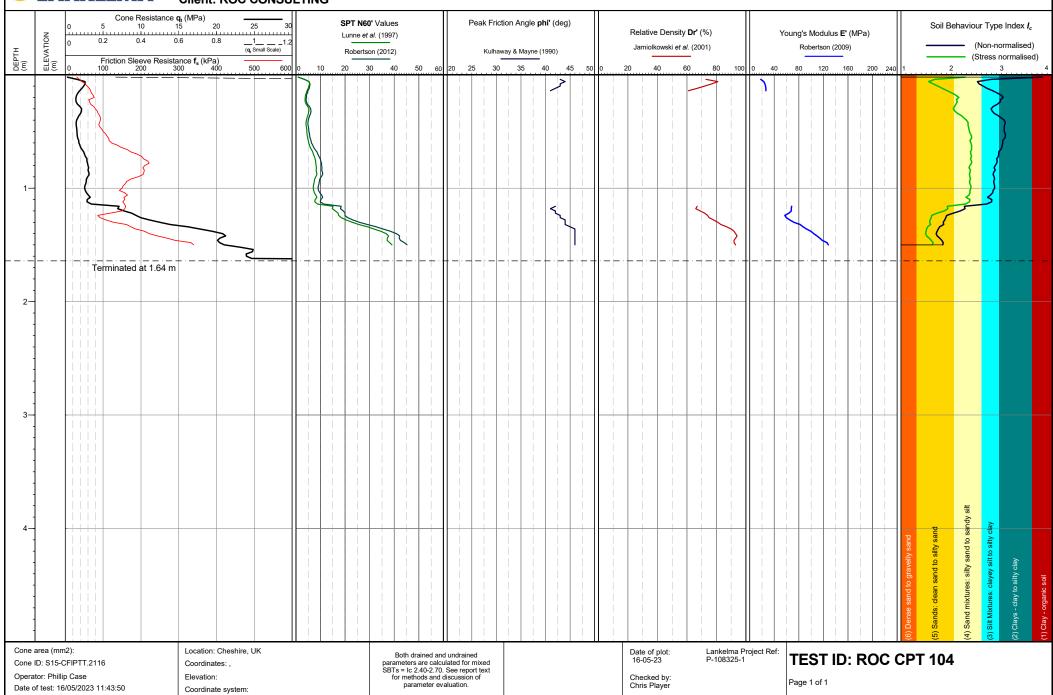




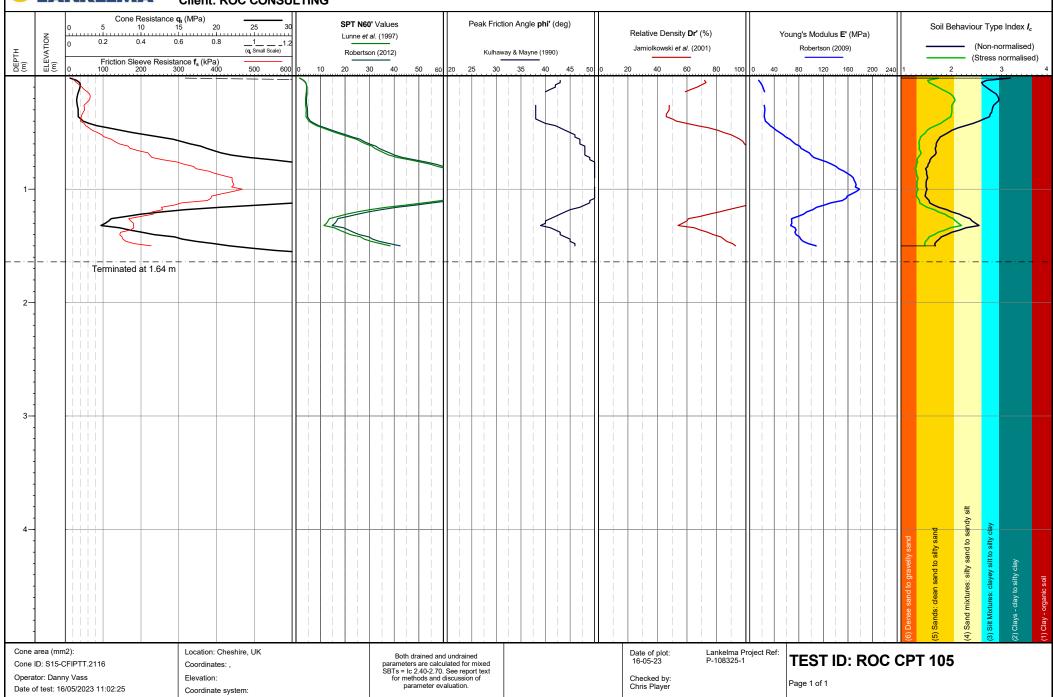




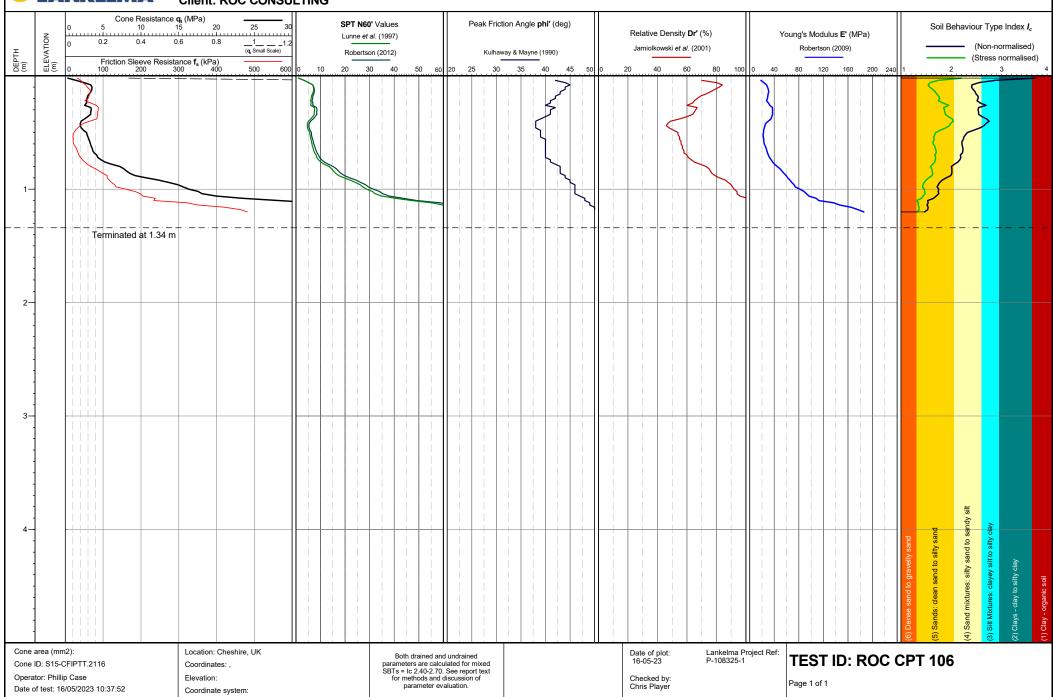




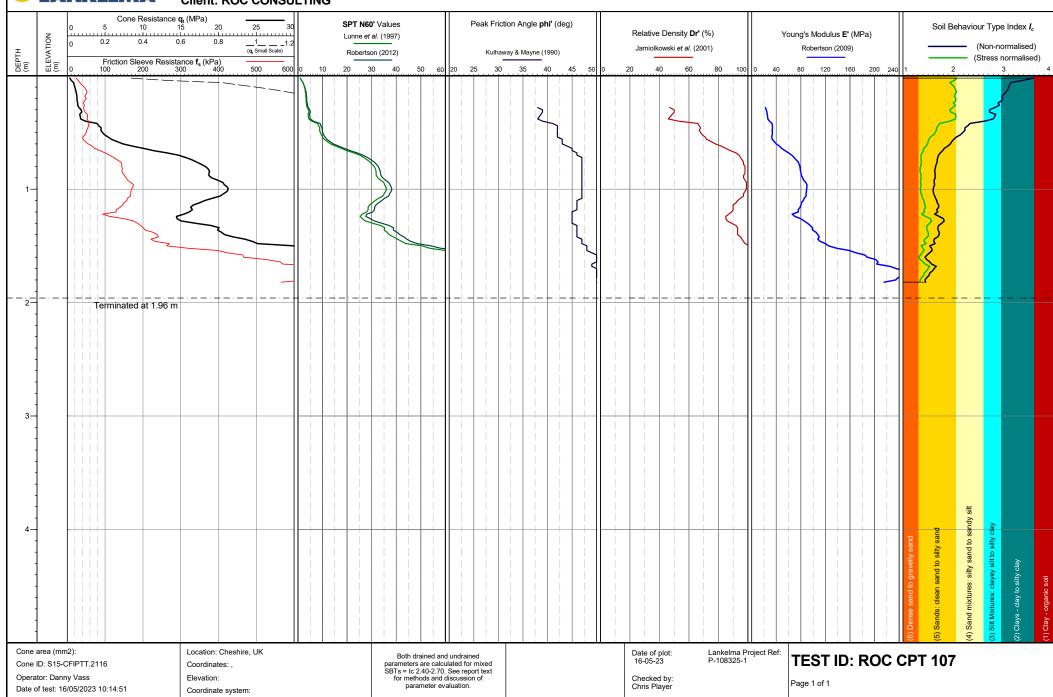




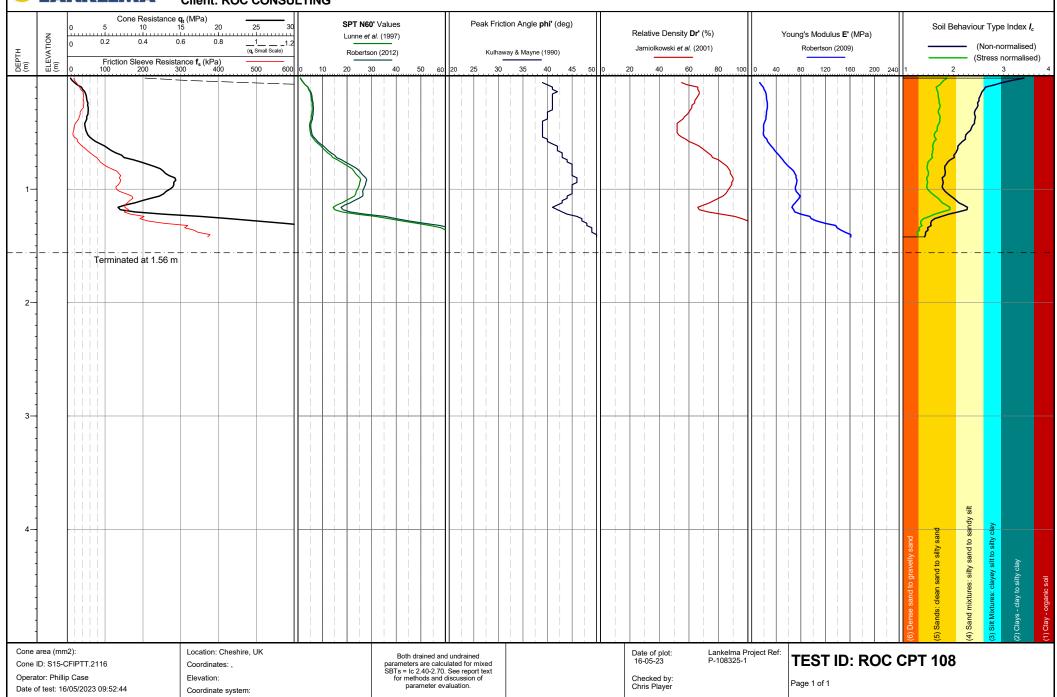




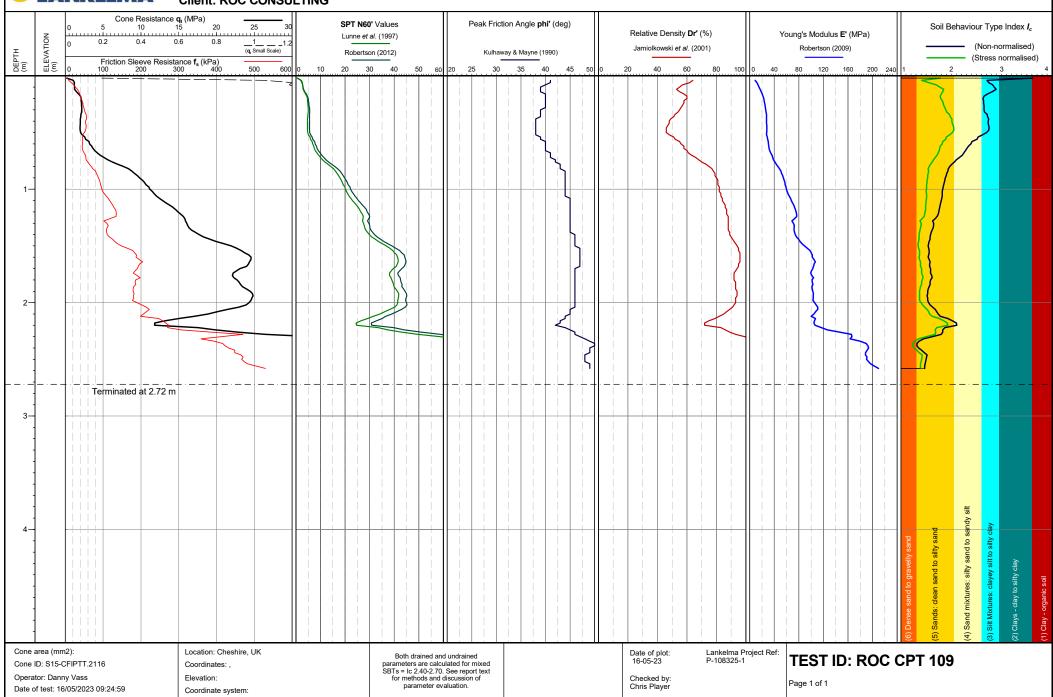




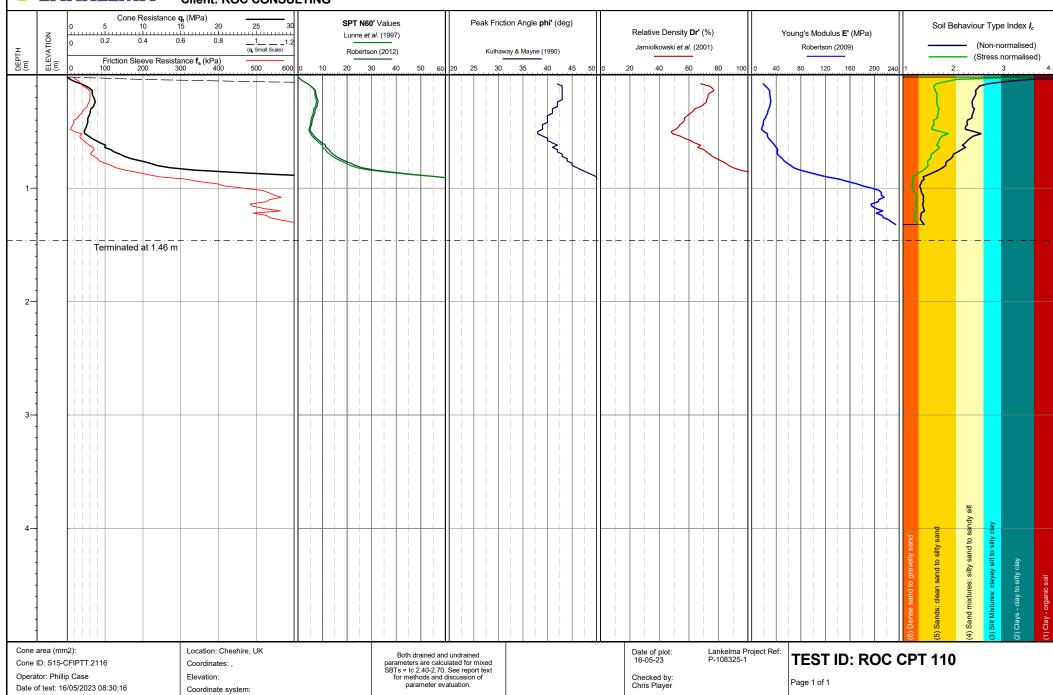




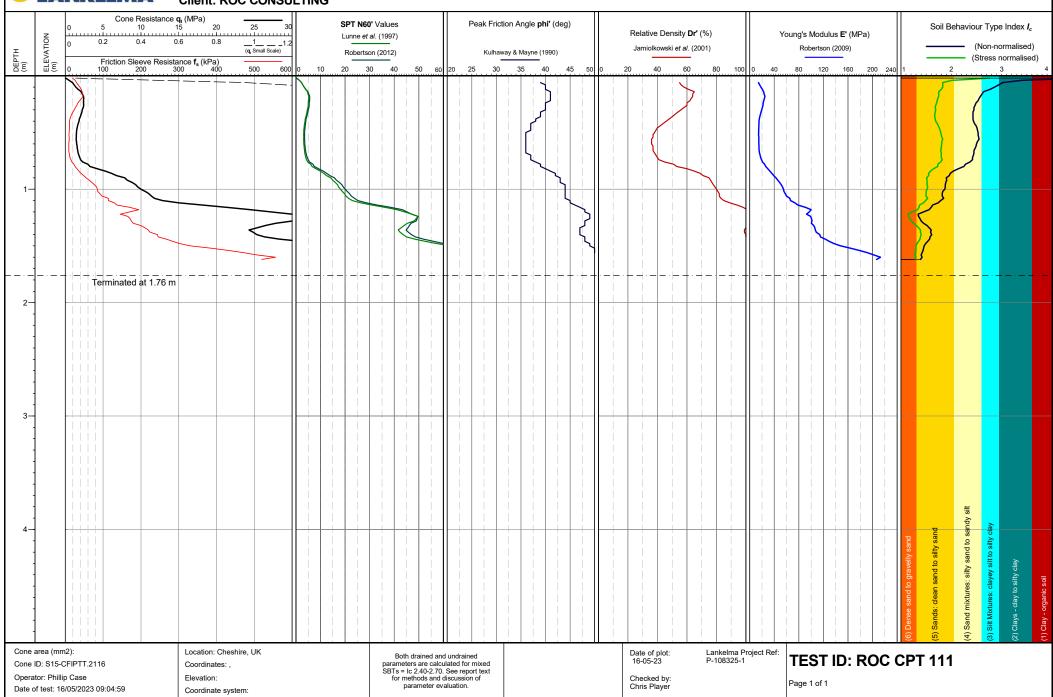




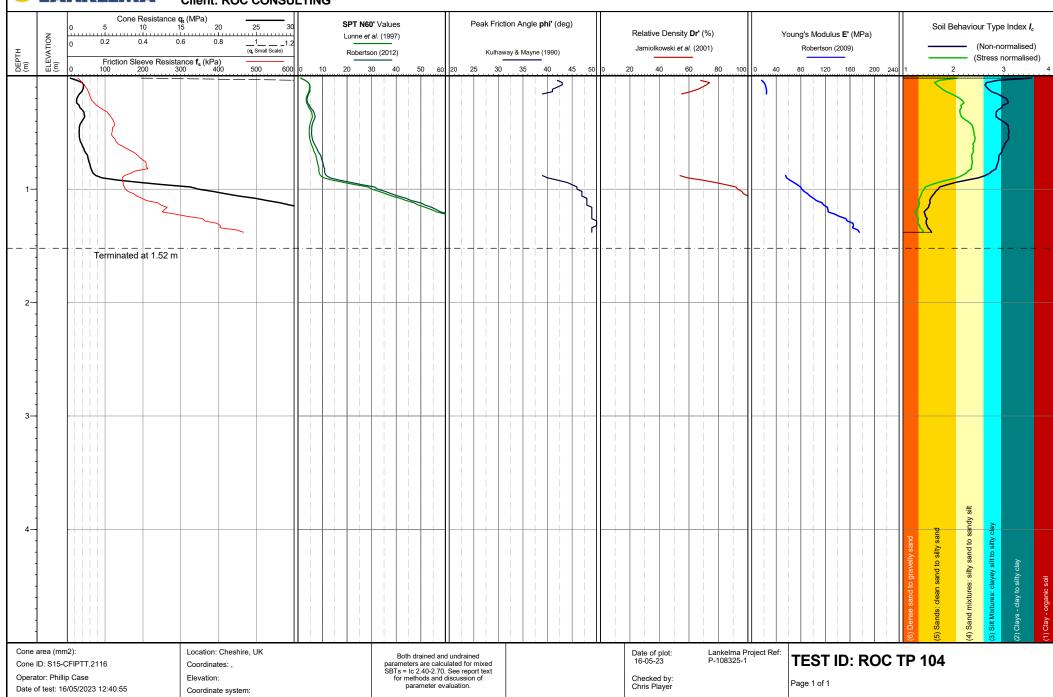




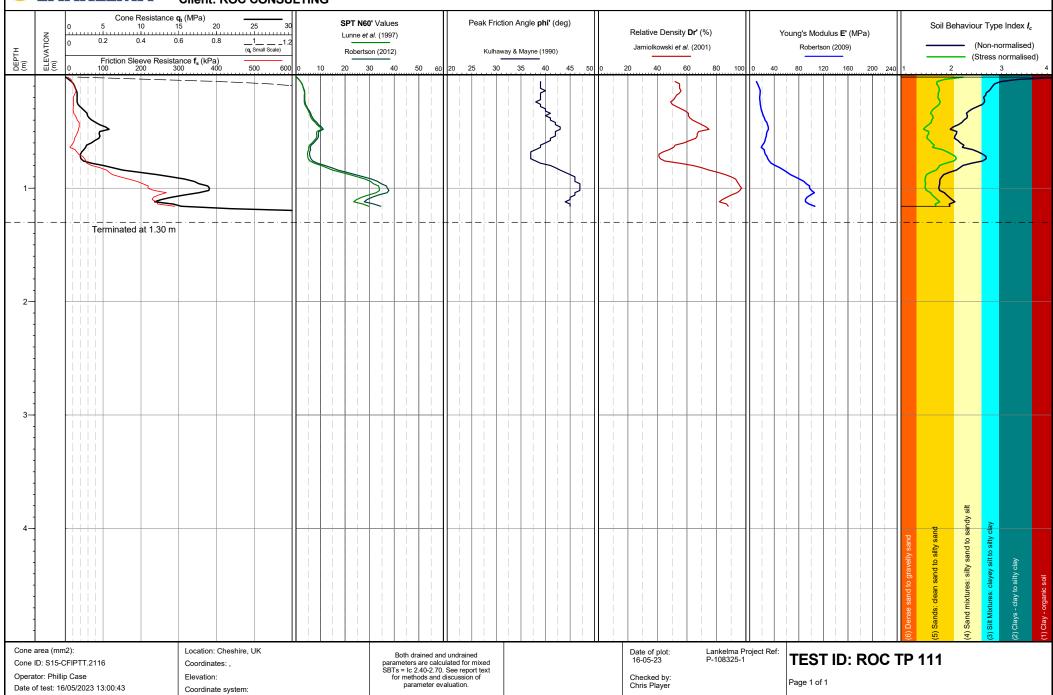




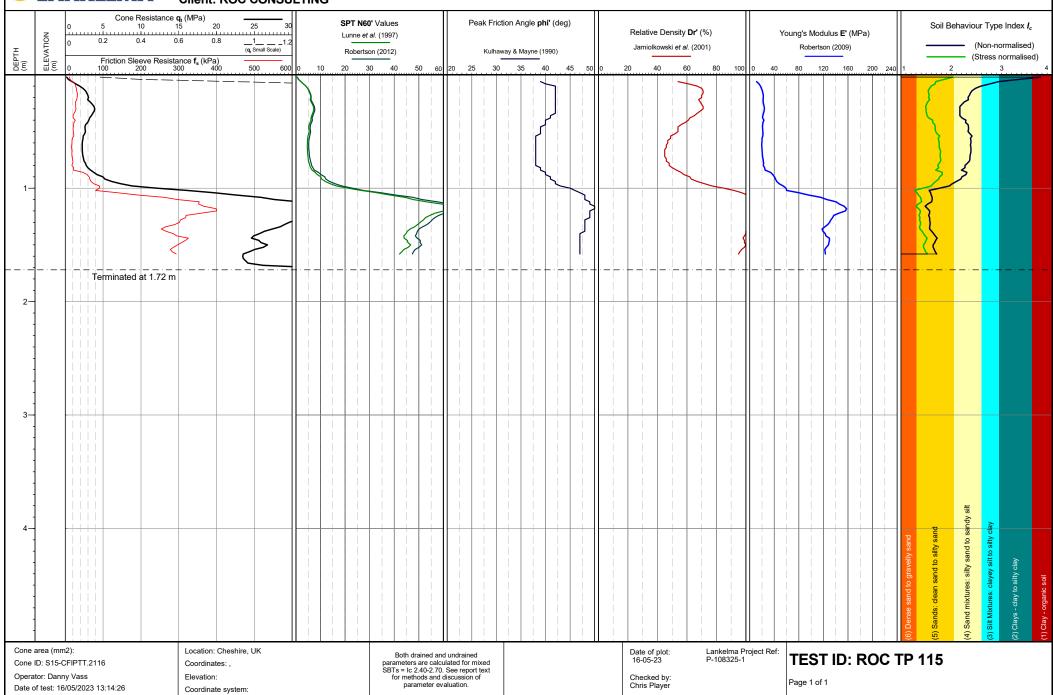
















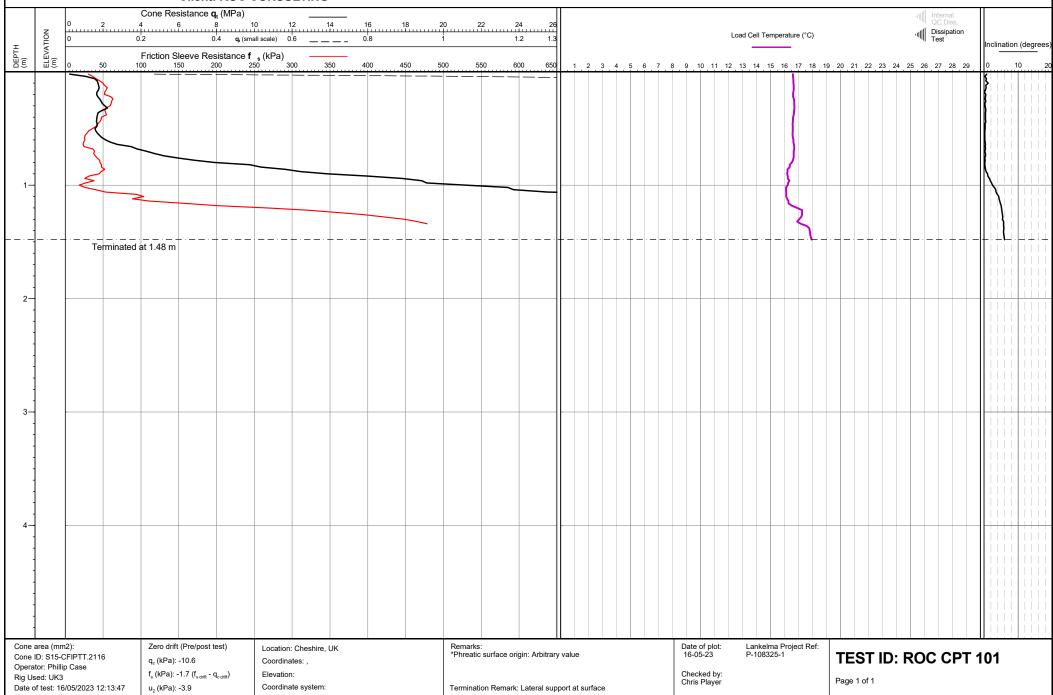
APPENDIX G PENETROMETER TEMPERATURE RESULTS

The temperature values in these logs represent the internal load cell temperature of the penetrometer and are used for QC purposes by comparison to the measured temperature response indicated on the calibration certificate. The CPT results have been corrected for transient and static temperature effects during post processing.

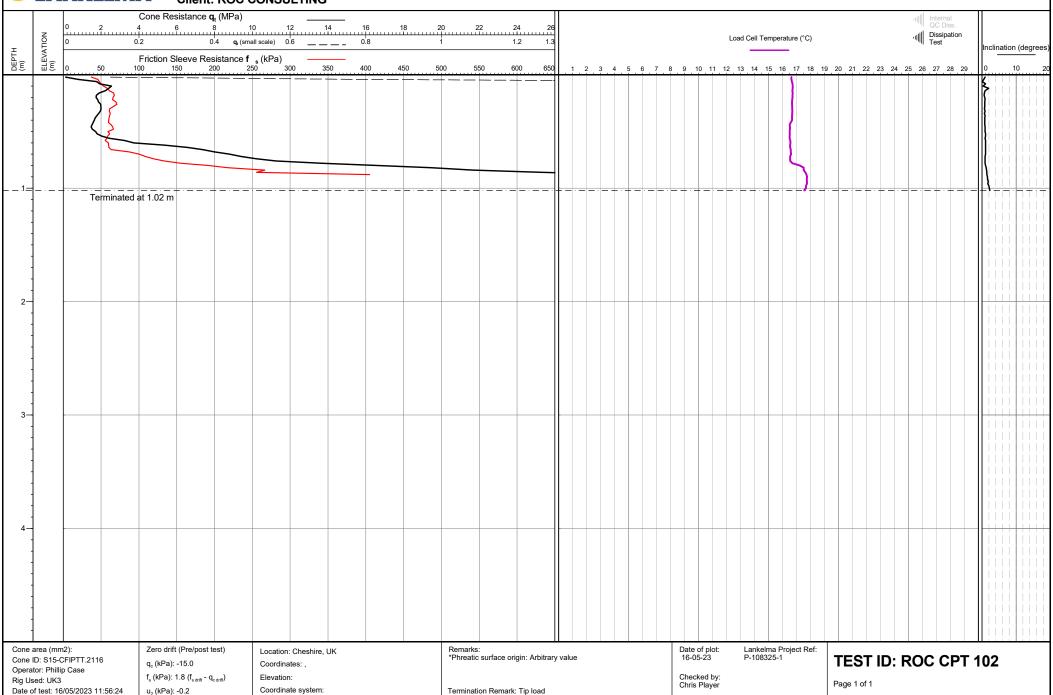
Ground temperature is only represented following a penetration pause of > 11 minutes.

Plots are provided for locations performed with a digital penetrometer measuring internal load cell temperature.

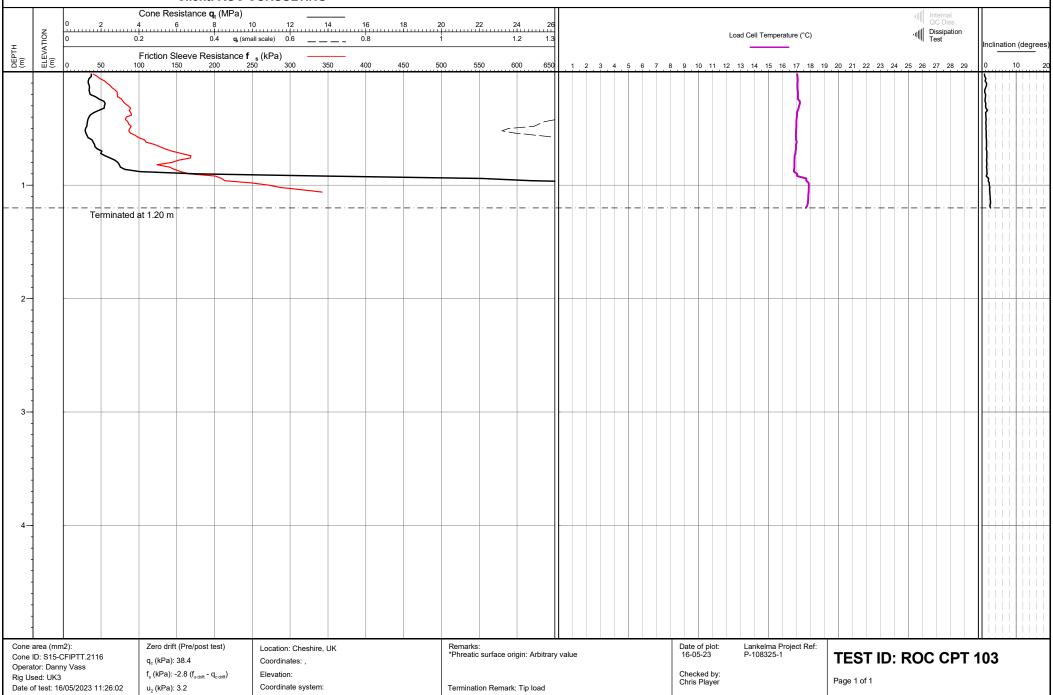




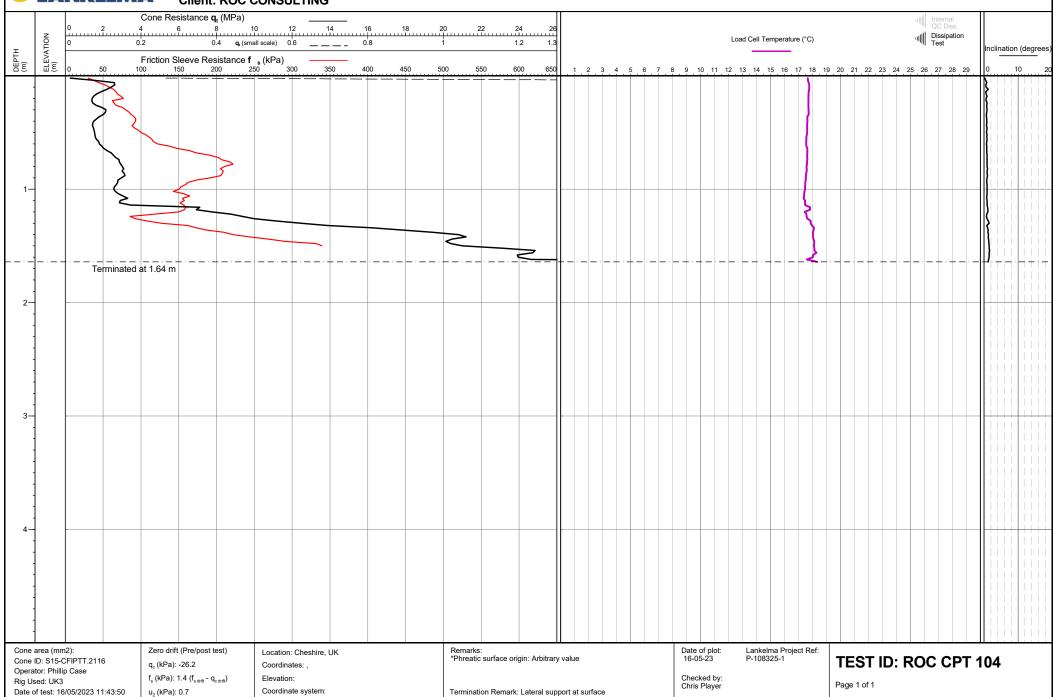




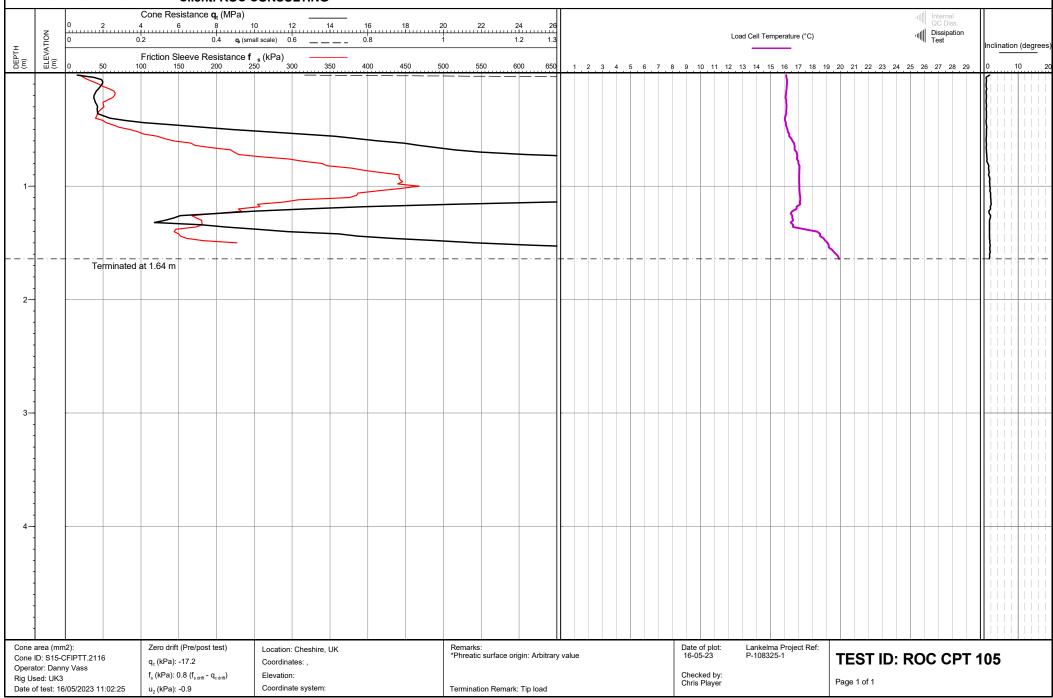




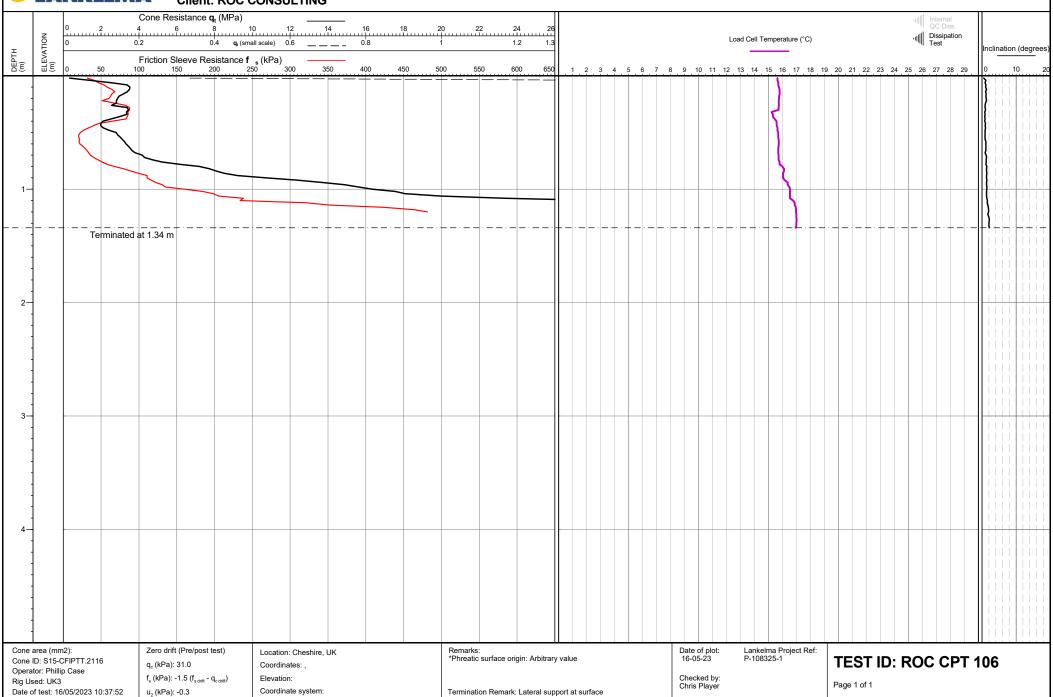




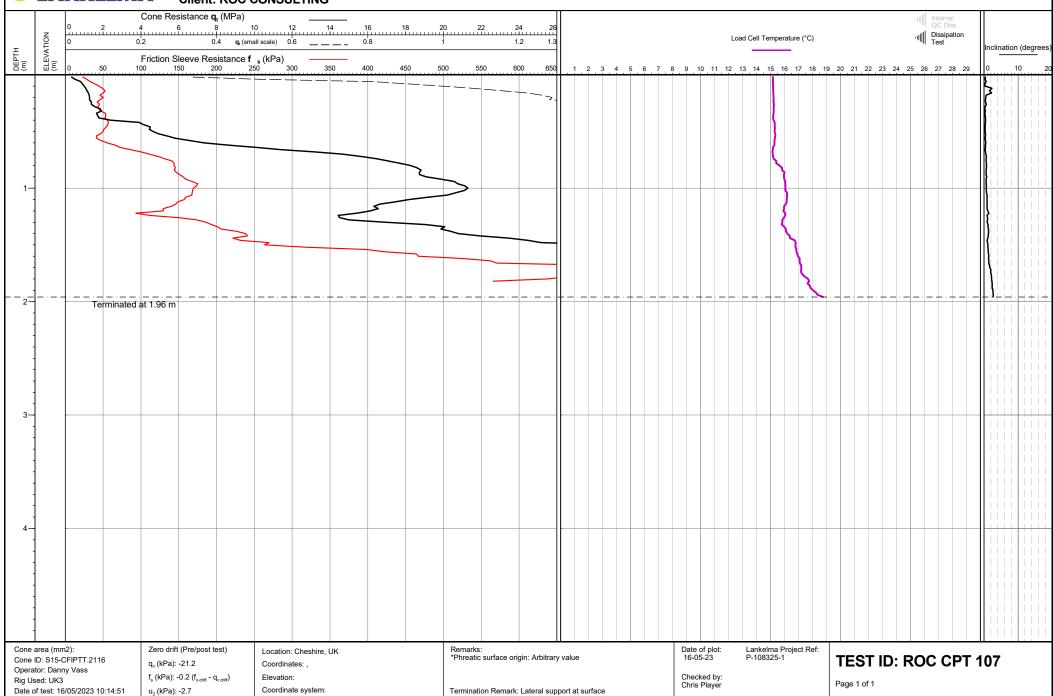




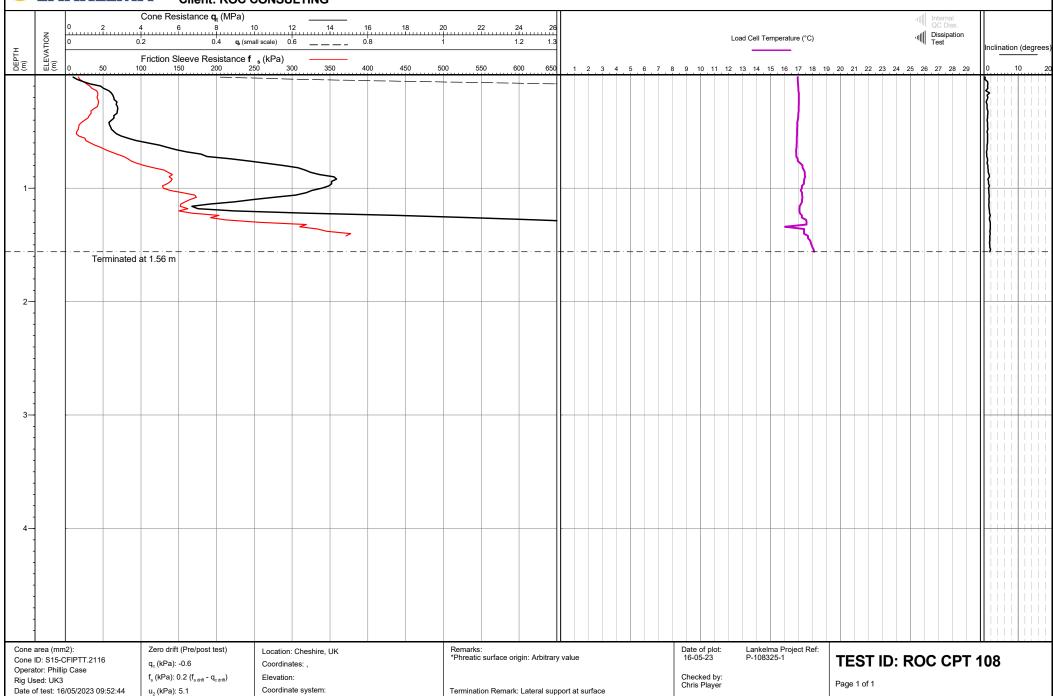




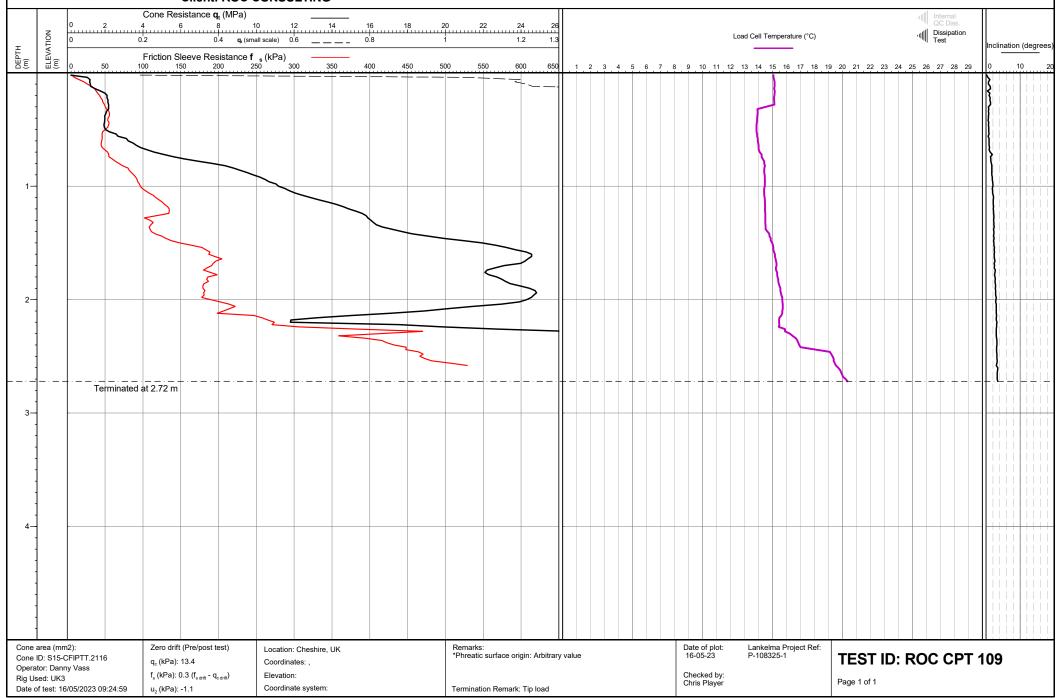




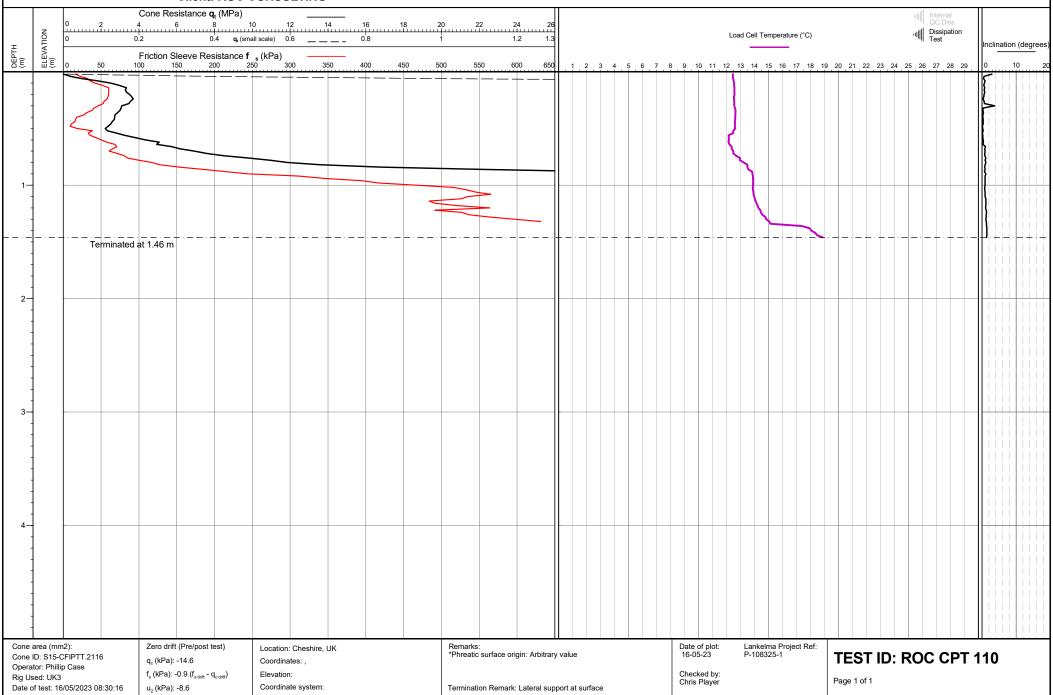




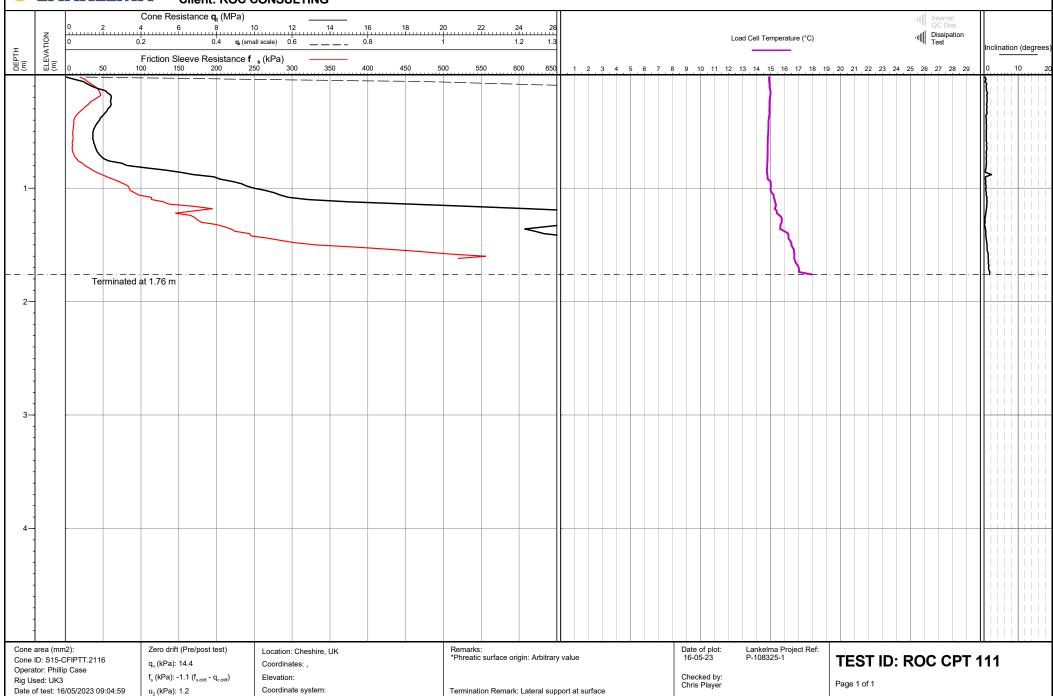




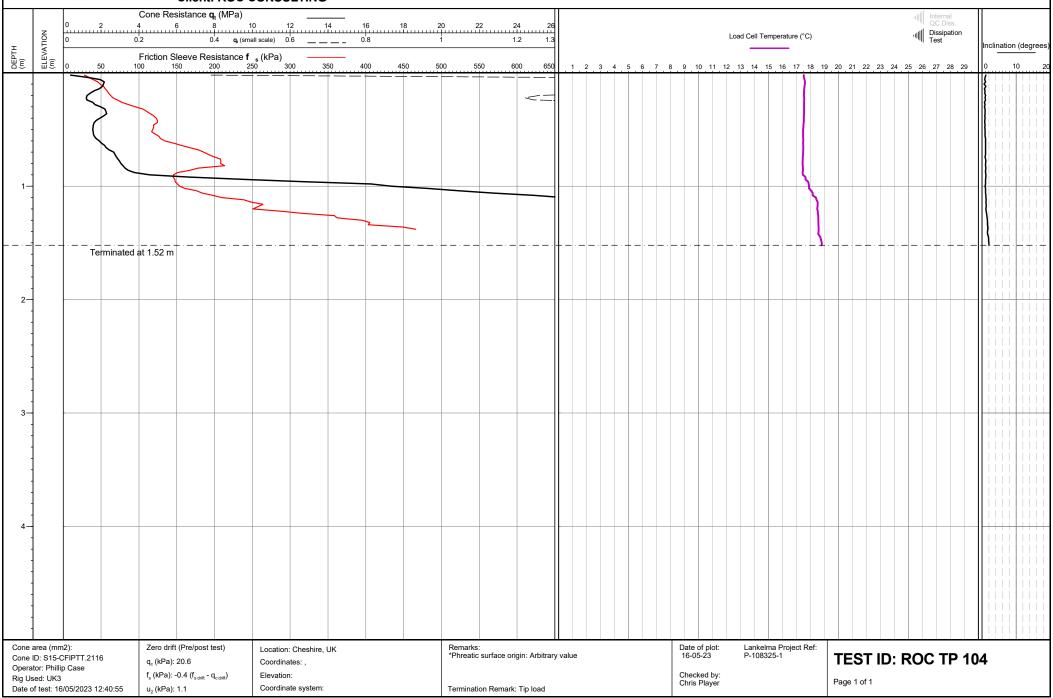




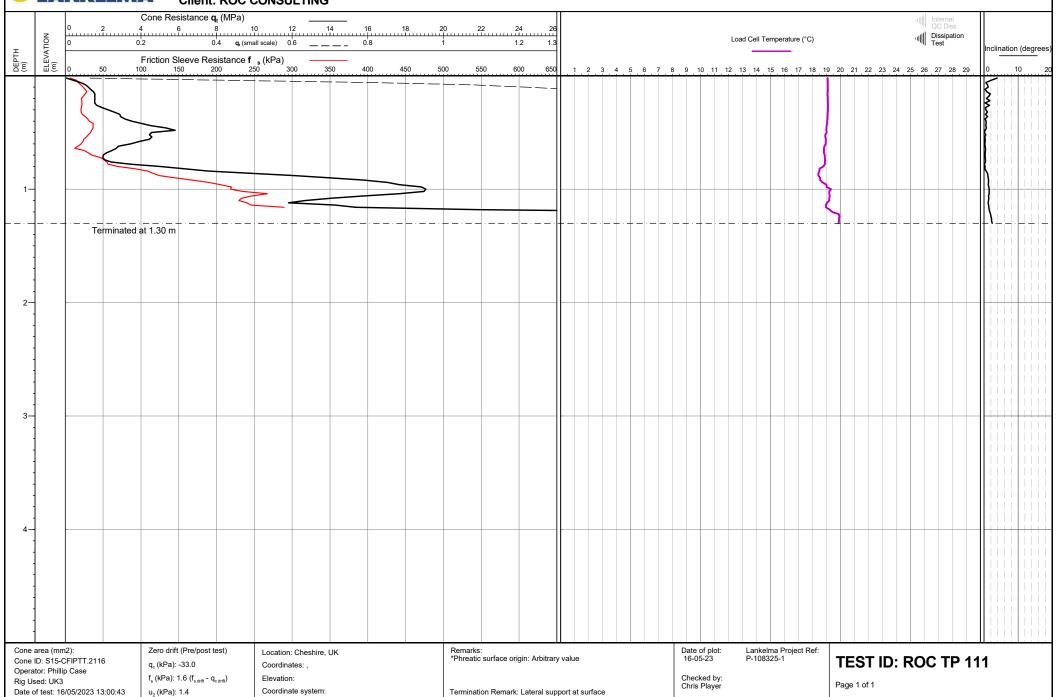




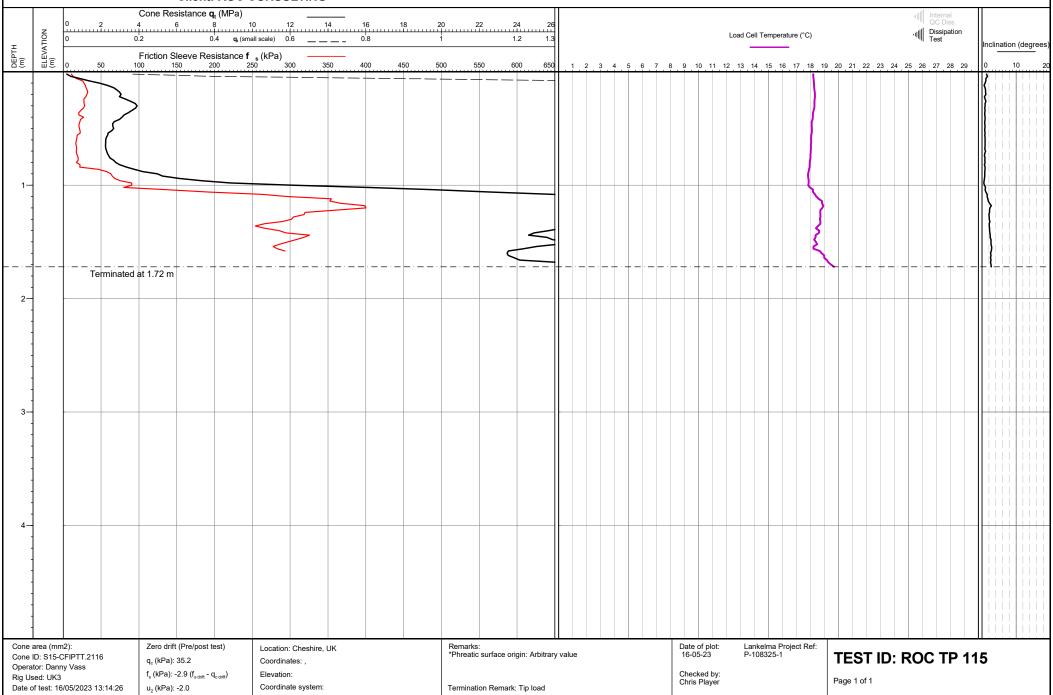














STRUCTURAL SOILS LTD INSITU TESTING REPORT



Report No. 785417R.01(00)

Date 19-May-2023 Contract Parkside East, Warrington

Client ROC Consulting
Address 81-83 Chapel Street

Manchester

Greater Manchester

M3 5DF

For the Attention of Reece McGuinness

Order received	05-May-2023	Client Reference	4597	
Testing Started	18-May-2023	Client Order No.	1871	
Testing Completed	18-May-2023	Instruction Type	Written	

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests

* 9 no. Plate Load Test in occordance with BS1377:Part 9:1990, Clause 4.1

The results represent the ground conditions at the specified locations and depths at the time of testing.

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of. Test were undertaken on samples 'as received' unless otherwise stated.

Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977552255. e-mail matthew.doran@soils.co.uk

GINT_LIBRARY V10_01.GLB LibVersion: v8_07_001 PriVersion: v8_07_1 GrfcText L - LAB VERIFICATION REPORT - V02 - A4P | 785417.GPJ - v10_01. Structural Soils Lid, Branch Office - Castleford: The Potteries, Pottery Street, Castleford, West Yorkshire, WF10 1NJ. Tel: 01977-552255, Fax: 01977-552299, Web: www.soils.co.uk, Email: ask@soils.co.uk, | 19/05/23 - 11:02 | MD3

TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: FINAL

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **19/05/2023 11:00:10**.

Testing reported after this date is not covered by this Verification Certificate.

1 Day

Approved Signatory

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory 18 Frogmore Road Hemel Hempstead Hertfordshire HP3 9RT Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



STRUCTURAL SOILS LTD

Contract:

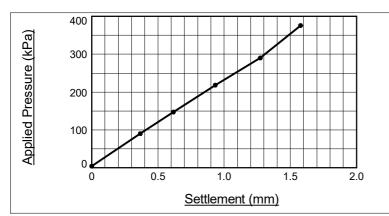
Job No:

Parkside East, Warrington



BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP102 Depth (m): **0.60** Date of Test : 18/05/23



Applied	Average
Pressure	Settlement
(kPa)	(mm)
4	0.000
90	0.367
147	0.617
218	0.933
290	1.273
376	1.577

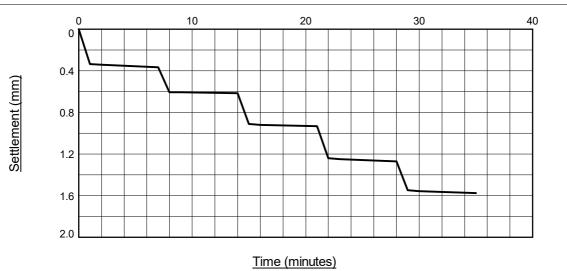


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 376 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 285 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

228000 kN/m²/m 100297 kN/m²/m k₇₆₂: k₃₀₀:

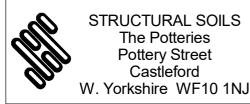
Approximate Equivalent CBR Value (%): 28

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Cloudy Start Temperature: 14°C

End Temperature: 14°C

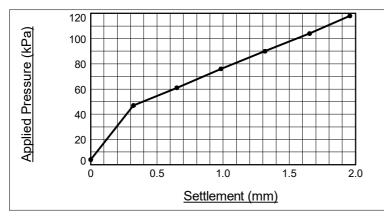


Compiled By		Date
Man	MATTHEW DORAN	19/05/23
Contract	Contract Ref	•

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP103 Depth (m): **0.60** Date of Test : 18/05/23



Applied Pressure (kPa)	Average Settlement (mm)
4 47 61 76 90 104 118	0.000 0.323 0.650 0.983 1.317 1.653 1.957

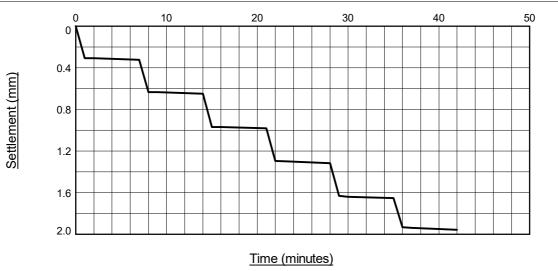


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 118 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 87 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

69600 kN/m²/m 30617 kN/m²/m k₇₆₂: k₃₀₀:

Approximate Equivalent CBR Value (%): 3.6

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Cloudy Start Temperature: 14°C

End Temperature: 14°C

STRUCTURAL SOILS

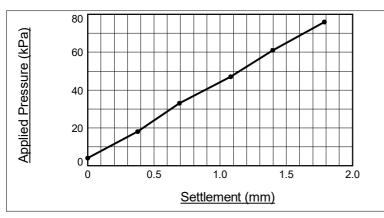
The Potteries Pottery Street Castleford W. Yorkshire WF10 1NJ

Compiled By		Date
Man	MATTHEW DORAN	19/05/23
Contract	Contract Ref:	

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP105 Depth (m): 0.00 Date of Test : 18/05/23



Applied Pressure (kPa)	Average Settlement (mm)
4 18 33 47 61 76	0.000 0.377 0.693 1.080 1.397 1.787

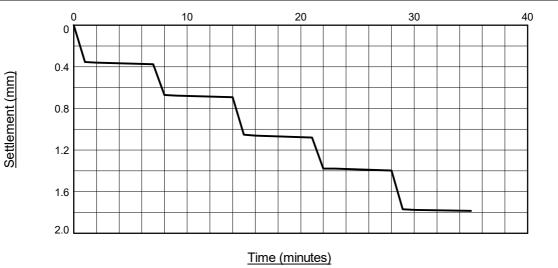


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 76 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 55 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

44000 kN/m²/m 19356 kN/m²/m k₇₆₂: k₃₀₀:

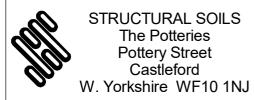
Approximate Equivalent CBR Value (%): 1.6

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Cloudy Start Temperature: 15°C

End Temperature: 15°C

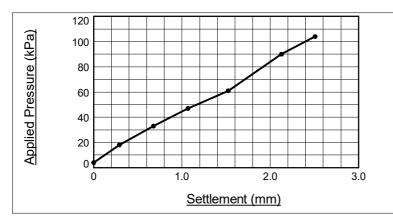


Compiled By		Date
M.Dan	MATTHEW DORAN	19/05/23
Contract	Contract Ref:	,

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP107 18/05/23 Depth (m): 0.60 Date of Test :



Applied Pressure (kPa)	Average Settlement (mm)
4 18 33 47 61 90 104	0.000 0.290 0.677 1.067 1.523 2.127 2.507

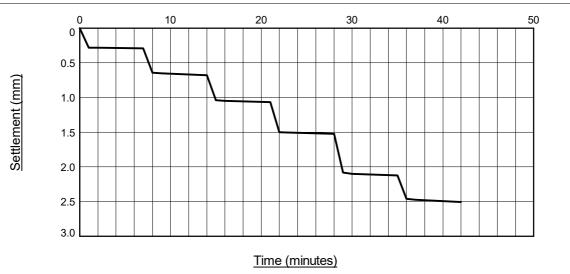


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 104 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 53 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

42400 kN/m²/m 18652 kN/m²/m k₇₆₂: k₃₀₀:

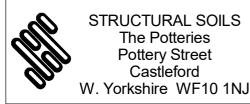
Approximate Equivalent CBR Value (%): 1.5

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 14°C

End Temperature: 15°C

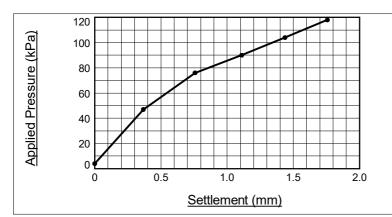


Compiled By		Date
M.Dan	MATTHEW DORAN	19/05/23
Contract	Contract Ref	•

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP108 18/05/23 Depth (m): 0.60 Date of Test:



Applied	Average
Pressure	Settlement
(kPa)	(mm)
4	0.000
47	0.367
76	0.757
90	1.110
104	1.437
118	1.757

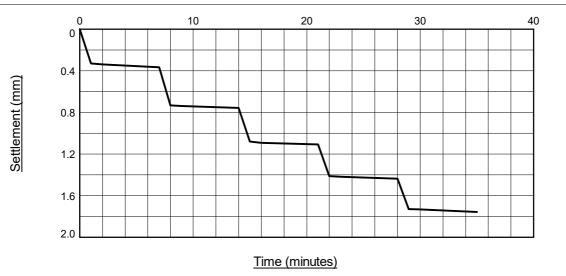


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 118 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 96 kPa Conversion to k_{762} : k₃₀₀ x 0.4399

76800 kN/m²/m 33784 kN/m²/m k₇₆₂: k₃₀₀:

Approximate Equivalent CBR Value (%): 4.3

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 14°C

End Temperature: 14°C



STRUCTURAL SOILS The Potteries Pottery Street Castleford W. Yorkshire WF10 1NJ

	Compiled By
M.Dar	
	•

Date **MATTHEW DORAN** 19/05/23

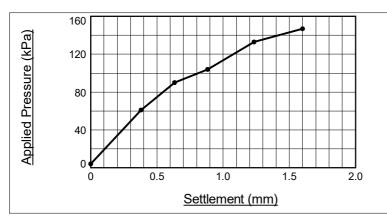
Contract

Parkside East, Warrington

Contract Ref:

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP109 Depth (m): **0.60** Date of Test : 18/05/23



Applied Pressure (kPa)	Average Settlement (mm)
4 61 90 104 133 147	0.000 0.380 0.633 0.883 1.233 1.600

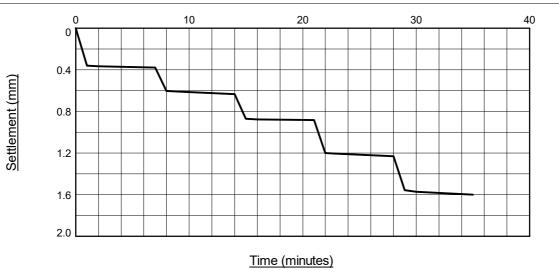


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 147 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 134 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

107200 kN/m²/m 47157 kN/m²/m k₇₆₂: k₃₀₀:

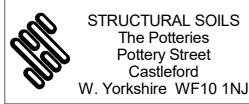
Approximate Equivalent CBR Value (%): 7.7

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 16°C

End Temperature: 16°C

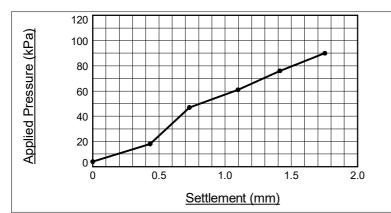


Comp	Date	
Man	MATTHEW DORAN	19/05/23
Contract	Contract Ref	

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP112 Depth (m): **0.60** Date of Test : 18/05/23



Applied Pressure (kPa)	Average Settlement (mm)
4 18 47 61 76 90	0.000 0.433 0.730 1.097 1.413 1.753

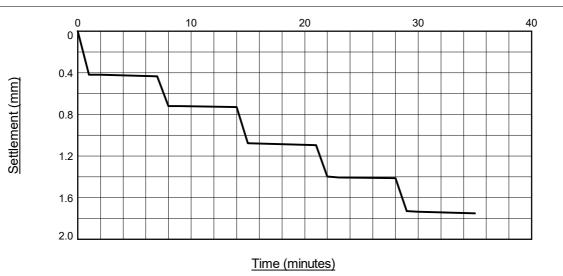


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 90 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 68 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

54400 kN/m²/m 23931 kN/m²/m k₇₆₂: k₃₀₀:

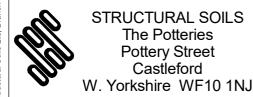
Approximate Equivalent CBR Value (%): 2.4

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 14°C

End Temperature: 14°C

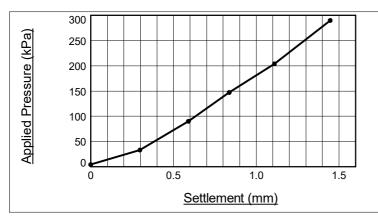


Compiled By				
M.Dan	MATTHEW DORAN	19/05/23		
Contract	Contract Ref	•		

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP114 Depth (m): **0.60** Date of Test : 18/05/23



Applied	Average
Pressure	Settlement
(kPa)	(mm)
4	0.000
33	0.297
90	0.590
147	0.837
204	1.110
290	1.447

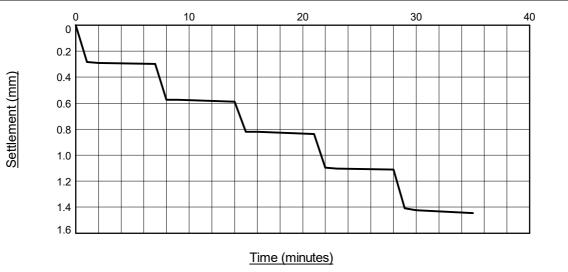


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 290 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 240 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

192000 kN/m²/m 84461 kN/m²/m k₇₆₂: k₃₀₀:

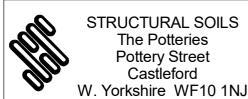
Approximate Equivalent CBR Value (%): 21

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 16°C

End Temperature: 16°C

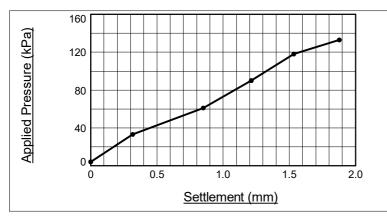


	Compiled By				
Ī	Man	MATTHEW DORAN	19/05/23		
ľ	Contract	Contract Ref:	!		

Parkside East, Warrington

BS1377:Part 9:1990, Clause 4.1

Trial Pit: TP116 Depth (m): **0.60** Date of Test: 18/05/23



Applied Pressure (kPa)	Average Settlement (mm)
4 33 61 90 118 133	0.000 0.317 0.850 1.213 1.533 1.877

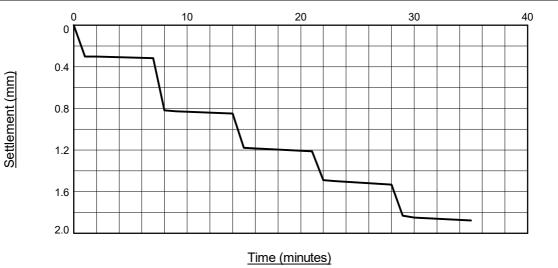


Plate Diameter (mm): 300 Reaction Load: **Tracked Excavator**

Maximum Applied Pressure (kPa): 133 Maximum Applied Deformation (mm):

Modulus of Subgrade Reaction at 1.25mm

Applied Pressure: 93 kPa Conversion to k_{762} : $k_{300} \times 0.4399$

74400 kN/m²/m 32729 kN/m²/m k₇₆₂: k₃₀₀:

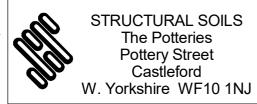
Approximate Equivalent CBR Value (%): 4.1

Calculations derived from section 7.14 of Department of Transport, Interim Advice Note 73/06 (Draft HD25) February 2009 Design Guidance for Road Pavement Foundations

Additional Information

Environmental Conditions at Time of Test: Sunny Start Temperature: 16°C

End Temperature: 16°C



Compiled By				
M.Dan	MATTHEW DORAN	19/05/23		
Contract	Contract Ref	•		

Parkside East, Warrington



LABORATORY REPORT



Contract Number: PSL23/4149

Report Date: 11 July 2023

Client's Reference: 4597

Client Name: ROC Consulting

Spring Lodge, 172 Chester Road

Helsby Cheshire WA6 0AR

For the attention of: Reece McGuiness

Contract Title: Parkside East

Date Received: 1/6/2023

Date Commenced: 1/6/2023

Date Completed: 20/6/2023

Notes: Opinions and Interpretations are outside the UKAS Accreditation

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

Checked and Approved Signatories:

A Watkins R Berriman S Royle

(Director) (Quality Manager) (Laboratory Manager)

L Knight S Eyre T Watkins
(Assistant Laboratory Manager) (Senior Technician) (Senior Technician)

Page 1 of

5 - 7 Hexthorpe Road,

Hexthorpe, Doncaster, DN4 0AR

Tel: 01302 768098

Email: rberriman@prosoils.co.uk awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample	
TP103		D	0.50		Reddish brown very sandy CLAY.	
TP109		D	0.60		Reddish brown very sandy CLAY.	
TP108		D	0.60		Brown slightly gravelly slightly sandy CLAY.	
TP112		D	0.60		Brown slightly gravelly very sandy CLAY.	
TP101		В	1.80		Reddish brown very gravelly silty SAND.	
TP105		В	0.60		Reddish brown slightly gravelly very clayey SAND.	
TP107		В	1.80		eddish brown slightly silty SAND AND GRAVEL.	
TP115		В	1.60		eddish brown slightly gravelly silty SAND.	
TP113		В	0.70		eddish brown gravelly silty SAND.	
TP102		В	0.50		rown slightly sandy slightly silty GRAVEL.	
TP116		В	0.60		eddish brown slightly gravelly very clayey SAND.	
TP114		В	0.70		rown slightly gravelly silty SAND.	
TP110		В	0.30		Brown slightly gravelly very sandy very silty CLAY.	
TP104		В	1.20		Reddish brown slightly gravelly clayey SAND.	





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377: PART 2: 1990)

Hole	Sample	Sampla	Тор	Base	Moisture Content	Linear Shrinkage	Particle Density	Liquid Limit	Plastic Limit	Plasticity Index	Passing .425mm	Remarks
Number	Number	Sample Type	Depth	Depth	%	%	Mg/m ³	%	%	%	%	Kemarks
	- 10-2-2-20	- J P -	m	m	Clause 3.2	Clause 6.5	Clause 8.2	Clause 4.3/4	Clause 5.3	Clause 5.4	, -	
TP103		D	0.50		15			26	15	11	100	Low Plasticity CL
TP109		D	0.60		25			34	17	17	100	Low Plasticity CL
TP108		D	0.60		32			66	28	38	98	High Plasticity CH
TP112		D	0.60		15			32	16	16	98	Low Plasticity CL

SYMBOLS: NP: Non Plastic

*: Liquid Limit and Plastic Limit Wet Sieved.





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

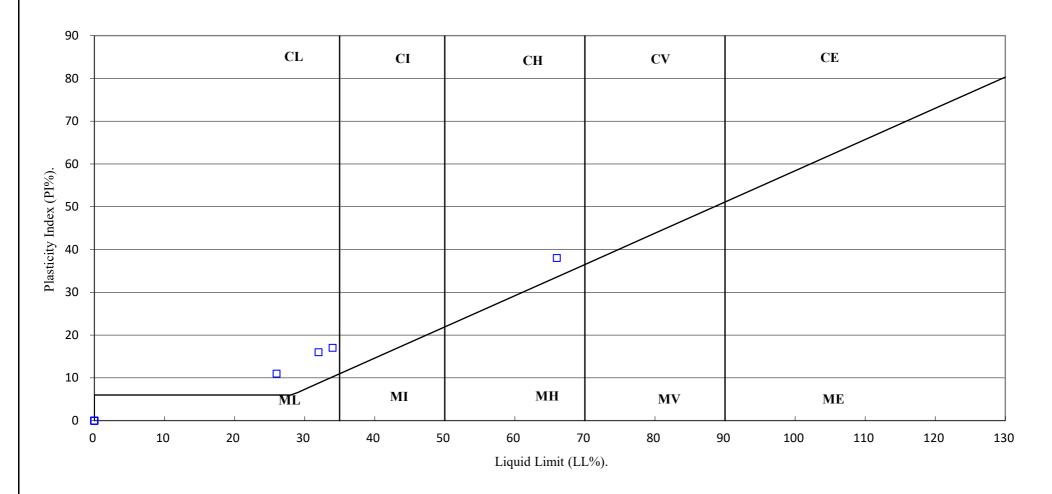
PSLRF006

Issue No.1

Approved By: L Pavey

03/01/2023

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.







Parkside East

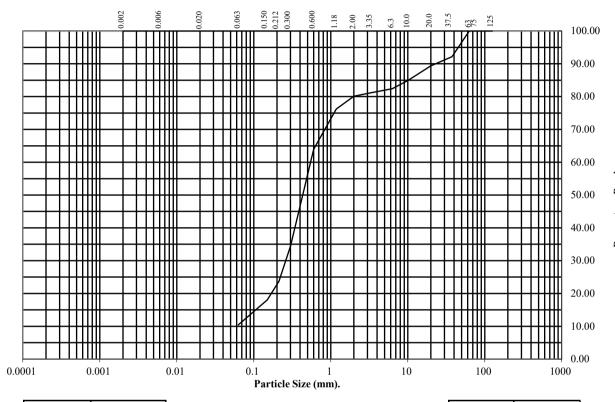
Contract No:
PSL23/4149
Client Ref:
4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP101 Top Depth (m): 1.80

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	92
20	89
10	85
6.3	82
3.35	81
2	80
1.18	76
0.6	64
0.3	34
0.212	24
0.15	18
0.063	10

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 20 70 10

Remarks:

See Summary of Soil Descriptions





Parkside East

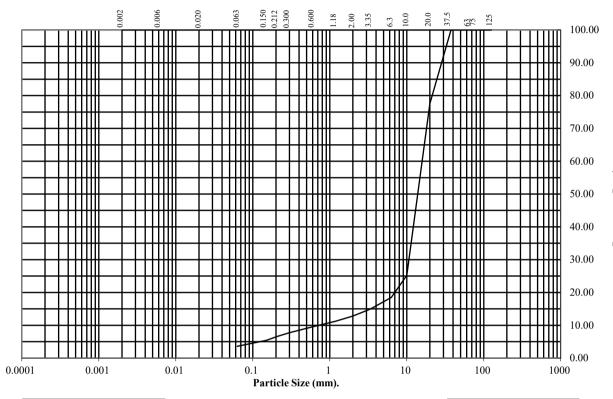
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP102 Top Depth (m): 0.50

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	78
10	25
6.3	18
3.35	15
2	13
1.18	11
0.6	10
0.3	8
0.212	7
0.15	5
0.063	4

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 87 9 4

Remarks:

See Summary of Soil Descriptions





Parkside East

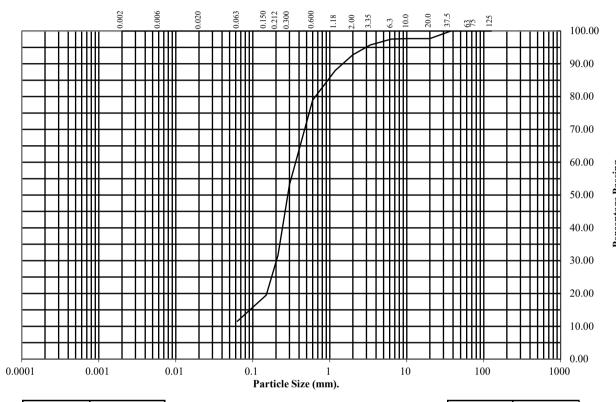
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP104 Top Depth (m): 1.20

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	98
10	98
6.3	98
3.35	96
2	93
1.18	88
0.6	79
0.3	53
0.212	32
0.15	20
0.063	12

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 7 81 12

Remarks:

See Summary of Soil Descriptions





Parkside East

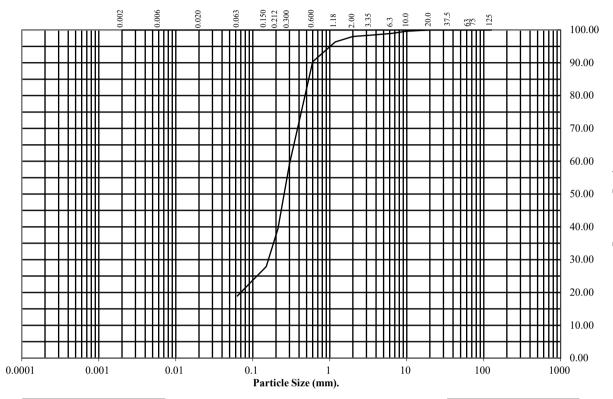
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP105 Top Depth (m): 0.60

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	98
2	98
1.18	96
0.6	90
0.3	59
0.212	39
0.15	28
0.063	19

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 2 79 19

Remarks:

See Summary of Soil Descriptions





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

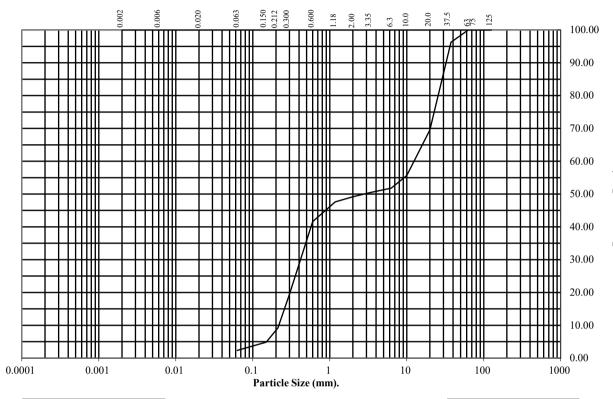
 PSLRF015
 Issue No.1
 Approved by: L Pavey
 03/01/2023

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP107 Top Depth (m): 1.80

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	96
20	70
10	56
6.3	52
3.35	50
2	49
1.18	48
0.6	42
0.3	19
0.212	9
0.15	5
0.063	2

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 51 47 2

Remarks:

See Summary of Soil Descriptions





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

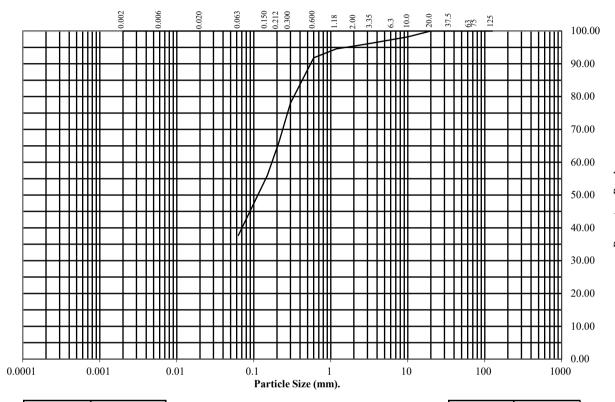
 PSLRF015
 Issue No.1
 Approved by: L Pavey
 03/01/2023

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP110 Top Depth (m): 0.30

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	100
10	98
6.3	97
3.35	96
2	95
1.18	95
0.6	92
0.3	78
0.212	66
0.15	56
0.063	38

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 5 57 38

Remarks:

See Summary of Soil Descriptions





Parkside East

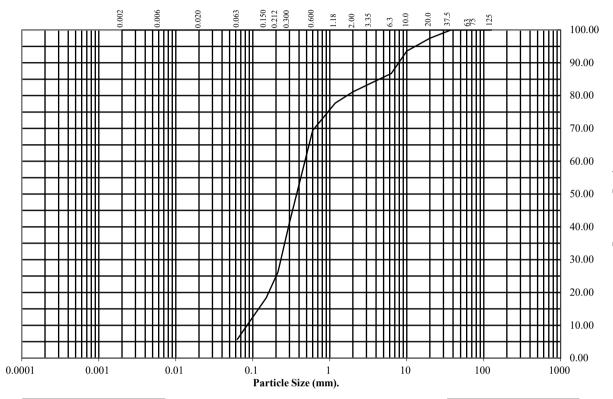
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP113 Top Depth (m): 0.70

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	97
10	94
6.3	87
3.35	84
2	81
1.18	78
0.6	69
0.3	41
0.212	26
0.15	18
0.063	6

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 19 75 6

Remarks:

See Summary of Soil Descriptions





Parkside East

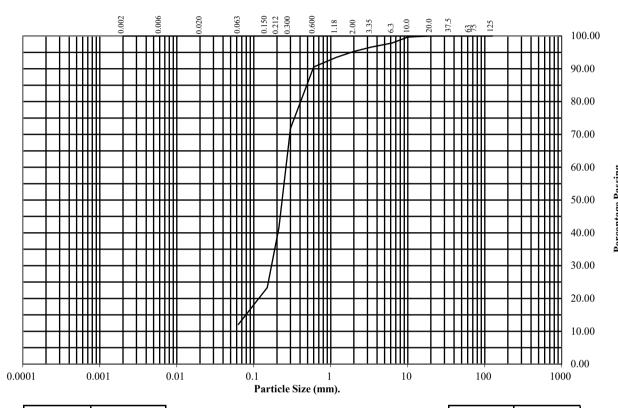
Contract No:
PSL23/4149
Client Ref:
4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP114 Top Depth (m): 0.70

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage						
Sieve (mm)	Passing						
125	100						
75	100						
63	100						
37.5	100						
20	100						
10	100						
6.3	98						
3.35	97						
2	95						
1.18	93						
0.6	91						
0.3	72						
0.212	42						
0.15	23						
0.063	12						

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 5 83 12

	<u>Re</u>	m	a	r	KS	
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See Summary of Soil Descriptions





Parkside East

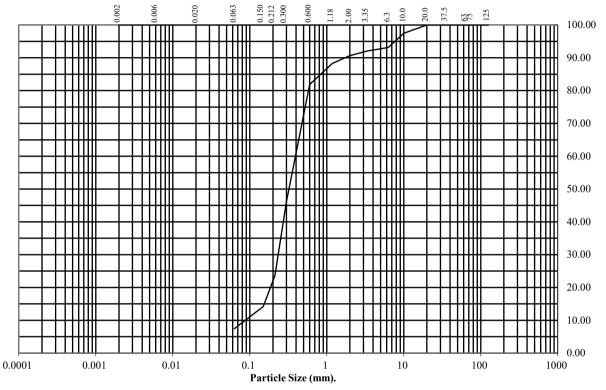
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP115 Top Depth (m): 1.60

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage					
Sieve (mm)	Passing					
125	100					
75	100					
63	100					
37.5	100					
20	100					
10	98					
6.3	93					
3.35	92					
2	91					
1.18	88					
0.6	82					
0.3	46					
0.212	24					
0.15	14					
0.063	7					

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 9 84 7

Remarks:

See Summary of Soil Descriptions





Parkside East

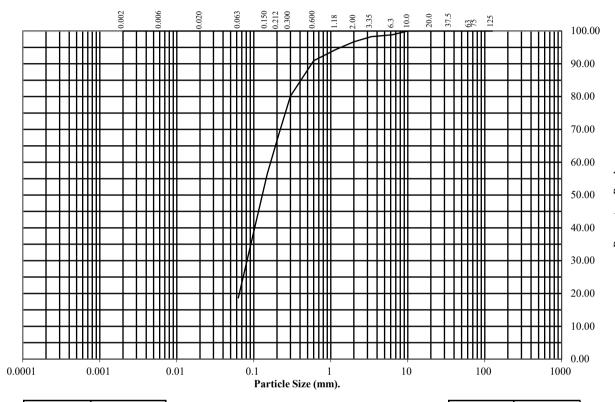
Contract No: PSL23/4149 Client Ref: 4597

BS1377 : Part 2 : 1990 Wet Sieve, Clause 9.2

Hole Number: TP116 Top Depth (m): 0.60

Sample Number: Base Depth(m):

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	98
2	97
1.18	94
0.6	91
0.3	80
0.212	69
0.15	56
0.063	19

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 3 78 19

Remarks:

See Summary of Soil Descriptions





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimei (m		Area	D _e ²	D _e	Failure 1	Load (P)	Is	Corr Fac	I_{s50}	Failure Type	Remarks
Tuniber		KCI	Турс	Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH107	4.37		A	Perp	85	50	4250	5411.27	73.56	-	0.86	0.16	1.190	0.19	Valid	
RBH107	7.54		A	Perp	85	44	3740	4761.92	69.01	-	1.35	0.28	1.156	0.33	Valid	
RBH107	7.23		A	Perp	85	50	4250	5411.27	73.56	1	1.58	0.29	1.190	0.35	Valid	
RBH107	9.22		A	Perp	85	48	4080	5194.82	72.08	-	1.44	0.28	1.179	0.33	Valid	
RBH107	10.95		A	Perp	85	45	3825	4870.14	69.79	ı	0.67	0.14	1.162	0.16	Valid	
RBH107	12.18		A	Perp	85	56	4760	6060.62	77.85	-	0.61	0.10	1.220	0.12	Valid	
RBH106	4.87		A	Perp	85	46	3910	4978.37	70.56	ı	1.40	0.28	1.168	0.33	Valid	
RBH106	2.97		A	Perp	85	40	3400	4329.01	65.80	-	0.94	0.22	1.131	0.25	Valid	
RBH106	5.93		A	Perp	85	46	3910	4978.37	70.56	-	1.50	0.30	1.168	0.35	Valid	
RBH106	3.65		A	Perp	85	38	3230	4112.56	64.13	-	1.01	0.25	1.119	0.27	Valid	
RBH106	4.20		A	Perp	85	35	2975	3787.89	61.55	-	0.24	0.06	1.098	0.07	Valid	
RBH106	13.16		A	Perp	85	47	3995	5086.59	71.32	-	0.97	0.19	1.173	0.22	Valid	
RBH106	19.80		A	Perp	85	38	3230	4112.56	64.13	-	1.24	0.30	1.119	0.34	Valid	
RBH106	16.89		A	Perp	85	46	3910	4978.37	70.56	-	1.67	0.34	1.168	0.39	Valid	
RBH106	12.07		A	Perp	85	47	3995	5086.59	71.32	-	1.08	0.21	1.173	0.25	Valid	
RBH106	9.04		A	Perp	85	44	3740	4761.92	69.01	-	0.92	0.19	1.156	0.22	Valid	
RBH105	2.72		A	Perp	85	38	3230	4112.56	64.13	-	1.06	0.26	1.119	0.29	Valid	
RBH105	4.12		A	Perp	85	41	3485	4437.24	66.61	-	1.27	0.29	1.138	0.33	Valid	
RBH105	5.76		A	Perp	85	46	3910	4978.37	70.56	-	1.80	0.36	1.168	0.42	Valid	
RBH105	7.16		A	Perp	85	44	3740	4761.92	69.01	-	0.94	0.20	1.156	0.23	Valid	
RBH105	8.07		A	Perp	85	48	4080	5194.82	72.08	-	0.86	0.17	1.179	0.20	Valid	
RBH105	9.53		A	Perp	85	46	3910	4978.37	70.56	-	1.20	0.24	1.168	0.28	Valid	

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimei (m	nsions m)	D _e ²	D _e	Failur	e Load	I_s	Corr Fac	I _{s50}	Failure Type	Remarks
rvamber	(111)	KCI	Турс	Par / Perp	L	D		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH107	4.37		D	Par	•	85	7225	85.00	1	0.70	0.097	1.270	0.12	Valid	
RBH107	7.54		D	Par	•	85	7225	85.00	1	0.69	0.096	1.270	0.12	Valid	
RBH107	7.23		D	Par	-	85	7225	85.00	-	1.24	0.172	1.270	0.22	Valid	
RBH107	9.22		D	Par	•	85	7225	85.00	-	1.44	0.199	1.270	0.25	Valid	
RBH107	10.95		D	Par	•	85	7225	85.00	1	0.67	0.093	1.270	0.12	Valid	
RBH107	12.18		D	Par	•	85	7225	85.00	1	0.61	0.084	1.270	0.11	Valid	
RBH106	4.87		D	Par	1	85	7225	85.00	-	1.19	0.165	1.270	0.21	Valid	
RBH106	2.97		D	Par	•	85	7225	85.00	1	0.48	0.066	1.270	0.08	Valid	
RBH106	5.93		D	Par	-	85	7225	85.00	-	1.04	0.144	1.270	0.18	Valid	
RBH106	3.65		D	Par	1	85	7225	85.00	1	0.55	0.076	1.270	0.10	Valid	
RBH106	4.20		D	Par	-	85	7225	85.00	-	0.13	0.018	1.270	0.02	Valid	
RBH106	13.16		D	Par	1	85	7225	85.00	1	0.86	0.119	1.270	0.15	Valid	
RBH106	19.80		D	Par	-	85	7225	85.00	-	0.97	0.134	1.270	0.17	Valid	
RBH106	16.89		D	Par	1	85	7225	85.00	•	1.40	0.194	1.270	0.25	Valid	
RBH106	12.07		D	Par	ı	85	7225	85.00	1	0.68	0.094	1.270	0.12	Valid	
RBH106	9.04		D	Par	•	85	7225	85.00	1	0.66	0.091	1.270	0.12	Valid	
RBH105	2.72		D	Par	ı	85	7225	85.00	1	0.72	0.100	1.270	0.13	Valid	
RBH105	4.12		D	Par	-	85	7225	85.00	-	0.86	0.119	1.270	0.15	Valid	
RBH105	5.76		D	Par	-	85	7225	85.00	-	0.99	0.137	1.270	0.17	Valid	
RBH105	7.16		D	Par	-	85	7225	85.00	-	0.67	0.093	1.270	0.12	Valid	
RBH105	8.07		D	Par	-	85	7225	85.00	-	0.66	0.091	1.270	0.12	Valid	
RBH105	9.53		D	Par	-	85	7225	85.00	-	0.99	0.137	1.270	0.17	Valid	

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimer (m		Area	D _e ²	D _e	Failure 1	Load (P)	Is	Corr Fac	I_{s50}	Failure Type	Remarks
rvaniber		KCI	Турс	Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH105	12.46		A	Perp	85	46	3910	4978.37	70.56	-	0.92	0.18	1.168	0.22	Valid	
RBH105	13.90		A	Perp	85	38	3230	4112.56	64.13	-	1.07	0.26	1.119	0.29	Valid	
RBH105	6.24		A	Perp	85	47	3995	5086.59	71.32	-	1.12	0.22	1.173	0.26	Valid	
RBH105	3.00		A	Perp	85	38	3230	4112.56	64.13	-	0.87	0.21	1.119	0.24	Valid	
RBH101	3.16		A	Perp	85	45	3825	4870.14	69.79	-	1.12	0.23	1.162	0.27	Valid	
RBH101	3.43		A	Perp	85	48	4080	5194.82	72.08	-	1.04	0.20	1.179	0.24	Valid	
RBH101	4.28		A	Perp	85	38	3230	4112.56	64.13	-	0.86	0.21	1.119	0.23	Valid	
RBH101	5.02		A	Perp	85	42	3570	4545.47	67.42	-	1.14	0.25	1.144	0.29	Valid	
RBH101	6.85		A	Perp	85	37	3145	4004.34	63.28	-	0.88	0.22	1.112	0.24	Valid	
RBH101	7.56		A	Perp	85	38	3230	4112.56	64.13	-	0.76	0.18	1.119	0.21	Valid	
RBH101	9.72		A	Perp	85	42	3570	4545.47	67.42	-	1.06	0.23	1.144	0.27	Valid	
RBH101	11.59		A	Perp	85	38	3230	4112.56	64.13	-	0.91	0.22	1.119	0.25	Valid	
RBH101	12.92		A	Perp	85	49	4165	5303.04	72.82	-	0.99	0.19	1.184	0.22	Valid	
RBH101	10.50		A	Perp	85	47	3995	5086.59	71.32	-	1.04	0.20	1.173	0.24	Valid	
RBH102	3.07		A	Perp	85	46	3910	4978.37	70.56	-	1.08	0.22	1.168	0.25	Valid	
RBH102	3.85		A	Perp	85	41	3485	4437.24	66.61	-	0.89	0.20	1.138	0.23	Valid	
RBH102	5.69		A	Perp	85	48	4080	5194.82	72.08	-	1.38	0.27	1.179	0.31	Valid	
RBH102	9.36		A	Perp	85	44	3740	4761.92	69.01	-	1.27	0.27	1.156	0.31	Valid	
RBH102	11.03		A	Perp	85	50	4250	5411.27	73.56	-	1.27	0.23	1.190	0.28	Valid	
RBH102	14.01		A	Perp	85	50	4250	5411.27	73.56	-	1.02	0.19	1.190	0.22	Valid	
RBH102	6.43		A	Perp	85	47	3995	5086.59	71.32	-	1.02	0.20	1.173	0.24	Valid	
RBH103	3.05		A	Perp	85	37	3145	4004.34	63.28	-	0.67	0.17	1.112	0.19	Valid	

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular





Parkside East

4597	
Client Ref:	
PSL23/4149	
Contract No:	

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimei (m		D _e ²	D _e	Failur	e Load	I_s	Corr Fac	I _{s50}	Failure Type	Remarks
rumper	(111)	KCI	Турс	Par / Perp	L	D		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH105	12.46		D	Par	-	85	7225	85.00	-	0.87	0.120	1.270	0.15	Valid	
RBH105	13.90		D	Par	-	85	7225	85.00	-	0.74	0.102	1.270	0.13	Valid	
RBH105	6.24		D	Par	-	85	7225	85.00	-	1.12	0.155	1.270	0.20	Valid	
RBH105	3.00		D	Par	-	85	7225	85.00	-	0.49	0.068	1.270	0.09	Valid	
RBH101	3.16		D	Par	-	85	7225	85.00	-	0.92	0.127	1.270	0.16	Valid	
RBH101	3.43		D	Par	-	85	7225	85.00	-	0.86	0.119	1.270	0.15	Valid	
RBH101	4.28		D	Par	-	85	7225	85.00	-	0.74	0.102	1.270	0.13	Valid	
RBH101	5.02		D	Par	-	85	7225	85.00	-	1.00	0.138	1.270	0.18	Valid	
RBH101	6.85		D	Par	-	85	7225	85.00	-	0.86	0.119	1.270	0.15	Valid	
RBH101	7.56		D	Par	-	85	7225	85.00	-	0.44	0.061	1.270	0.08	Valid	
RBH101	9.72		D	Par	-	85	7225	85.00	-	0.88	0.122	1.270	0.15	Valid	
RBH101	11.59		D	Par	-	85	7225	85.00	-	0.66	0.091	1.270	0.12	Valid	
RBH101	12.92		D	Par	-	85	7225	85.00	-	0.86	0.119	1.270	0.15	Valid	
RBH101	10.50		D	Par	-	85	7225	85.00	-	0.86	0.119	1.270	0.15	Valid	
RBH102	3.07		D	Par	-	85	7225	85.00	-	1.01	0.140	1.270	0.18	Valid	
RBH102	3.85		D	Par	-	85	7225	85.00	-	0.89	0.123	1.270	0.16	Valid	
RBH102	5.69		D	Par	-	85	7225	85.00	-	0.78	0.108	1.270	0.14	Valid	
RBH102	9.36		D	Par	-	85	7225	85.00	-	0.96	0.133	1.270	0.17	Valid	
RBH102	11.03		D	Par	-	85	7225	85.00	-	0.66	0.091	1.270	0.12	Valid	
RBH102	14.01		D	Par	-	85	7225	85.00	-	0.52	0.072	1.270	0.09	Valid	
RBH102	6.43		D	Par	-	85	7225	85.00	-	0.88	0.122	1.270	0.15	Valid	
RBH103	3.05		D	Par	-	85	7225	85.00	-	0.41	0.057	1.270	0.07	Valid	

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimer (m		Area	D _e ²	D _e	Failure 1	Load (P)	Is	Corr Fac	I_{s50}	Failure Type	Remarks
Tulliber		1401	Турс	Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH103	3.32		A	Perp	85	24	2040	2597.41	50.96	-	0.94	0.36	1.009	0.37	Valid	
RBH103	4.19		A	Perp	85	30	2550	3246.76	56.98	-	0.81	0.25	1.061	0.26	Valid	
RBH103	2.10		A	Perp	85	28	2380	3030.31	55.05	-	0.26	0.09	1.044	0.09	Valid	
RBH103	5.58		A	Perp	85	40	3400	4329.01	65.80	-	0.94	0.22	1.131	0.25	Valid	
RBH103	2.48		A	Perp	85	37	3145	4004.34	63.28	-	0.54	0.13	1.112	0.15	Valid	
RBH103	7.50		A	Perp	85	46	3910	4978.37	70.56	ı	2.06	0.41	1.168	0.48	Valid	
RBH103	18.13		A	Perp	85	38	3230	4112.56	64.13	-	1.05	0.26	1.119	0.29	Valid	
RBH103	12.97		A	Perp	85	36	3060	3896.11	62.42	ı	1.24	0.32	1.105	0.35	Valid	
RBH103	4.63		A	Perp	85	44	3740	4761.92	69.01	ı	1.31	0.28	1.156	0.32	Valid	
RBH103	10.25		A	Perp	85	37	3145	4004.34	63.28	ı	1.08	0.27	1.112	0.30	Valid	
RBH104	1.66		I	Perp	34	30	1020	1298.70	36.04	-	0.61	0.47	0.863	0.41	Valid	
RBH104	3.11		A	Perp	85	37	3145	4004.34	63.28	ı	0.81	0.20	1.112	0.22	Valid	
RBH104	4.69		A	Perp	85	48	4080	5194.82	72.08	ı	0.89	0.17	1.179	0.20	Valid	
RBH104	6.18		A	Perp	85	47	3995	5086.59	71.32	-	1.88	0.37	1.173	0.43	Valid	
RBH104	13.09		A	Perp	85	60	5100	6493.52	80.58	-	1.08	0.17	1.240	0.21	Valid	
RBH104	9.56		A	Perp	85	46	3910	4978.37	70.56	-	1.47	0.30	1.168	0.34	Valid	
RBH104	3.43		A	Perp	85	48	4080	5194.82	72.08	-	0.87	0.17	1.179	0.20	Valid	
RBH104	1.77		A	Perp	85	37	3145	4004.34	63.28	-	1.04	0.26	1.112	0.29	Valid	
							-		-		•					

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

ISRM Suggested Methods: 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimer (m		D _e ²	D _e	Failur	e Load	I_s	Corr Fac	I _{s50}	Failure Type	Remarks
rumber	(111)	KCI	Турс	Par / Perp	L	D		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)	Турс	
RBH103	3.32		D	Par	-	85	7225	85.00	-	0.66	0.091	1.270	0.12	Valid	
RBH103	4.19		D	Par	-	85	7225	85.00	-	0.56	0.078	1.270	0.10	Valid	
RBH103	2.10		D	Par	-	85	7225	85.00	ı	0.17	0.024	1.270	0.03	Valid	
RBH103	5.58		D	Par	-	85	7225	85.00	ı	0.83	0.115	1.270	0.15	Valid	
RBH103	2.48		D	Par	-	85	7225	85.00	ı	0.39	0.054	1.270	0.07	Valid	
RBH103	7.50		D	Par	-	85	7225	85.00	ı	1.84	0.255	1.270	0.32	Valid	
RBH103	18.13		D	Par	-	85	7225	85.00	-	0.72	0.100	1.270	0.13	Valid	
RBH103	12.97		D	Par	-	85	7225	85.00	ı	1.00	0.138	1.270	0.18	Valid	
RBH103	4.63		D	Par	-	85	7225	85.00	-	1.06	0.147	1.270	0.19	Valid	
RBH103	10.25		D	Par	-	85	7225	85.00	-	0.92	0.127	1.270	0.16	Valid	
RBH104	3.11		D	Par	-	85	7225	85.00	-	0.44	0.061	1.270	0.08	Valid	
RBH104	4.69		D	Par	-	85	7225	85.00	-	0.66	0.091	1.270	0.12	Valid	
RBH104	6.18		D	Par	-	85	7225	85.00	ı	1.40	0.194	1.270	0.25	Valid	
RBH104	13.09		D	Par	-	85	7225	85.00	-	0.74	0.102	1.270	0.13	Valid	
RBH104	9.56		D	Par	-	85	7225	85.00	ı	1.02	0.141	1.270	0.18	Valid	
RBH104	3.43		D	Par	-	85	7225	85.00	-	0.54	0.075	1.270	0.09	Valid	
RBH104	1.77		D	Par	-	85	7225	85.00	ı	0.21	0.029	1.270	0.04	Valid	

*Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random





Parkside East

Contract No:
PSL23/4149
Client Ref:
4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH107 Top Depth (m): 3.26

Sample Number: - Base Depth (m): 3.89

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions					
Diameter - mm:	85.10				
Height - mm:	225.17				
Water Content - %:	10.4				
Sample Mass - g:	2992.0				
Bulk Density - Mg/m ³ :	2.34				
Dry Density - Mg/m ³ :	2.12				
Height Ratio: * Sample complies with H:D ratio	2.6				
Degree of Saturation - %:	81				
Assumed Specific Gravity for Degree of Saturation:	2.90				

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	14/06/2023
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	1.39
Strain at Failure - kN:	134.86
Unconfined Compressive Strength - Mpa:	23.7
Mode of Failure:	Vertical Shear

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH107 Top Depth (m): 4.94

Sample Number: - Base Depth (m): 5.20

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions					
Diameter - mm:	85.08				
Height - mm:	225.07				
Water Content - %:	10.4				
Sample Mass - g:	2984.0				
Bulk Density - Mg/m ³ :	2.33				
Dry Density - Mg/m ³ :	2.11				
Height Ratio: * Sample complies with H:D ratio	2.6				
Degree of Saturation - %:	81				
Assumed Specific Gravity for Degree of Saturation:	2.90				

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.04			
Strain at Failure - kN:	100.87			
Unconfined Compressive Strength - Mpa:	17.7			
Mode of Failure:	Vertical Shear			

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH107 Top Depth (m): 6.56

Sample Number: - Base Depth (m): 6.91

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.06			
Height - mm:	225.12			
Water Content - %:	10.6			
Sample Mass - g:	2986.0			
Bulk Density - Mg/m ³ :	2.33			
Dry Density - Mg/m ³ :	2.11			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	82			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.49			
Strain at Failure - kN:	143.62			
Unconfined Compressive Strength - Mpa:	25.3			
Mode of Failure:	Vertical Shear			

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH104 Top Depth (m): 11.28

Sample Number: - Base Depth (m): 11.55

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.16			
Height - mm:	225.18			
Water Content - %:	8.7			
Sample Mass - g:	2979.8			
Bulk Density - Mg/m ³ :	2.32			
Dry Density - Mg/m ³ :	2.14			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	71			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.29			
Strain at Failure - kN:	124.62			
Unconfined Compressive Strength - Mpa:	21.9			
Mode of Failure:	Vertical Shear			

Remarks:	-						





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH107 Top Depth (m): 12.80

Sample Number: - Base Depth (m): 13.13

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.11			
Height - mm:	225.08			
Water Content - %:	12.3			
Sample Mass - g:	2994.6			
Bulk Density - Mg/m ³ :	2.34			
Dry Density - Mg/m³:	2.08			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	91			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.35			
Strain at Failure - kN:	130.21			
Unconfined Compressive Strength - Mpa:	22.9			
Mode of Failure:	Vertical Shear			

Remarks: -	





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH101 Top Depth (m): 8.55

Sample Number: - Base Depth (m): 8.80

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.11			
Height - mm:	225.06			
Water Content - %:	12.3			
Sample Mass - g:	2991.2			
Bulk Density - Mg/m ³ :	2.34			
Dry Density - Mg/m ³ :	2.08			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	91			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.29			
Strain at Failure - kN:	125.18			
Unconfined Compressive Strength - Mpa:	22			
Mode of Failure:	Vertical Shear			

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH101 Top Depth (m): 14.41

Sample Number: - Base Depth (m): 14.83

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.17			
Height - mm:	225.10			
Water Content - %:	7.8			
Sample Mass - g:	2987.1			
Bulk Density - Mg/m ³ :	2.33			
Dry Density - Mg/m ³ :	2.16			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	66			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.21			
Strain at Failure - kN:	116.86			
Unconfined Compressive Strength - Mpa:	20.5			
Mode of Failure:	Vertical Shear			

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH102 Top Depth (m): 8.33

Sample Number: - Base Depth (m): 8.73

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.14			
Height - mm:	225.06			
Water Content - %:	8.7			
Sample Mass - g:	2989.8			
Bulk Density - Mg/m ³ :	2.33			
Dry Density - Mg/m ³ :	2.15			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	72			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.02			
Strain at Failure - kN:	98.97			
Unconfined Compressive Strength - Mpa:	17.4			
Mode of Failure:	Vertical Shear			

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number:	RBH103	Top Depth (m):	6.14
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Sample Number: - Base Depth (m): 6.39

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.09			
Height - mm:	225.08			
Water Content - %:	8.8			
Sample Mass - g:	2979.8			
Bulk Density - Mg/m ³ :	2.33			
Dry Density - Mg/m ³ :	2.14			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	72			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	0.99			
Strain at Failure - kN:	96.11			
Unconfined Compressive Strength - Mpa:	16.9			
Mode of Failure:	Vertical Shear			

Remarks:	-		
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Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH103 Top Depth (m): 8.53

Sample Number: - Base Depth (m): 8.99

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.07			
Height - mm:	225.11			
Water Content - %:	9.1			
Sample Mass - g:	2991.6			
Bulk Density - Mg/m ³ :	2.34			
Dry Density - Mg/m ³ :	2.14			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	75			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	0.74			
Strain at Failure - kN:	71.48			
Unconfined Compressive Strength - Mpa:	12.6			
Mode of Failure:	Vertical Shear			

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH103 Top Depth (m): 12.20

Sample Number: - Base Depth (m): 12.62

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.20			
Height - mm:	225.18			
Water Content - %:	12.3			
Sample Mass - g:	2991.2			
Bulk Density - Mg/m ³ :	2.33			
Dry Density - Mg/m ³ :	2.07			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	90			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.29			
Strain at Failure - kN:	125.18			
Unconfined Compressive Strength - Mpa:	22			
Mode of Failure:	Vertical Shear			

Remarks: -	





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH103 Top Depth (m): 15.37

Sample Number: - Base Depth (m): 15.63

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.07			
Height - mm:	225.08			
Water Content - %:	8.6			
Sample Mass - g:	2988.6			
Bulk Density - Mg/m ³ :	2.34			
Dry Density - Mg/m ³ :	2.15			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	72			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result				
Load Frame/Machine:	CM1/Controls			
Date of test:	14/06/2023			
Test Duration - mins:	00:17			
Orientation:	Unknown			
Stress Rate - MPa/s:	1.16			
Strain at Failure - kN:	112.60			
Unconfined Compressive Strength - Mpa:	19.8			
Mode of Failure:	Vertical Shear			

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number:	RBH104	Top Depth (m):	6.96

Sample Number: - Base Depth (m): 7.24

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions				
Diameter - mm:	85.19			
Height - mm:	225.17			
Water Content - %:	9.6			
Sample Mass - g:	2982.7			
Bulk Density - Mg/m ³ :	2.32			
Dry Density - Mg/m ³ :	2.12			
Height Ratio: * Sample complies with H:D ratio	2.6			
Degree of Saturation - %:	76			
Assumed Specific Gravity for Degree of Saturation:	2.90			

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	14/06/2023
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	1.41
Strain at Failure - kN:	136.97
Unconfined Compressive Strength - Mpa:	24
Mode of Failure:	Vertical Shear

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH104 Top Depth (m): 8.20

Sample Number: - Base Depth (m): 8.58

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions		
Diameter - mm:	85.06	
Height - mm:	225.11	
Water Content - %:	10.2	
Sample Mass - g:	2994.8	
Bulk Density - Mg/m ³ :	2.34	
Dry Density - Mg/m ³ :	2.13	
Height Ratio: * Sample complies with H:D ratio	2.6	
Degree of Saturation - %:	81	
Assumed Specific Gravity for Degree of Saturation:	2.90	

Test Result		
Load Frame/Machine:	CM1/Controls	
Date of test:	14/06/2023	
Test Duration - mins:	00:17	
Orientation:	Unknown	
Stress Rate - MPa/s:	0.77	
Strain at Failure - kN:	74.19	
Unconfined Compressive Strength - Mpa:	13.1	
Mode of Failure:	Vertical Shear	

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH105 Top Depth (m): 10.53

Sample Number: - Base Depth (m): 10.82

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions		
Diameter - mm:	85.18	
Height - mm:	225.12	
Water Content - %:	11.8	
Sample Mass - g:	2986.6	
Bulk Density - Mg/m ³ :	2.33	
Dry Density - Mg/m ³ :	2.08	
Height Ratio: * Sample complies with H:D ratio	2.6	
Degree of Saturation - %:	87	
Assumed Specific Gravity for Degree of Saturation:	2.90	

Test Result		
Load Frame/Machine:	CM1/Controls	
Date of test:	14/06/2023	
Test Duration - mins:	00:17	
Orientation:	Unknown	
Stress Rate - MPa/s:	1.55	
Strain at Failure - kN:	149.86	
Unconfined Compressive Strength - Mpa:	26.3	
Mode of Failure:	Vertical Shear	

Remarks: -			





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number:	RBH106	Top Depth (m):	7.83

Sample Number: - Base Depth (m): 8.08

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions		
Diameter - mm:	85.18	
Height - mm:	225.06	
Water Content - %:	9.4	
Sample Mass - g:	2989.0	
Bulk Density - Mg/m ³ :	2.33	
Dry Density - Mg/m ³ :	2.13	
Height Ratio: * Sample complies with H:D ratio	2.6	
Degree of Saturation - %:	76	
Assumed Specific Gravity for Degree of Saturation:	2.90	

Test Result	
Load Frame/Machine:	CM1/Controls
Date of test:	14/06/2023
Test Duration - mins:	00:17
Orientation:	Unknown
Stress Rate - MPa/s:	1.04
Strain at Failure - kN:	100.86
Unconfined Compressive Strength - Mpa:	17.7
Mode of Failure:	Vertical Shear

Remarks:	-		
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Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH106 Top Depth (m): 11.00

Sample Number: - Base Depth (m): 11.42

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions		
Diameter - mm:	85.17	
Height - mm:	225.10	
Water Content - %:	10.0	
Sample Mass - g:	2985.1	
Bulk Density - Mg/m ³ :	2.33	
Dry Density - Mg/m ³ :	2.12	
Height Ratio: * Sample complies with H:D ratio	2.6	
Degree of Saturation - %:	78	
Assumed Specific Gravity for Degree of Saturation:	2.90	

Test Result						
Load Frame/Machine:	CM1/Controls					
Date of test:	14/06/2023					
Test Duration - mins:	00:17					
Orientation:	Unknown					
Stress Rate - MPa/s:	1.00					
Strain at Failure - kN:	96.63					
Unconfined Compressive Strength - Mpa:	17					
Mode of Failure:	Vertical Shear					

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH106 Top Depth (m): 15.15

Sample Number: - Base Depth (m): 15.49

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions						
Diameter - mm:	85.14					
Height - mm:	225.10					
Water Content - %:	11.3					
Sample Mass - g:	2987.8					
Bulk Density - Mg/m ³ :	2.33					
Dry Density - Mg/m ³ :	2.09					
Height Ratio: * Sample complies with H:D ratio	2.6					
Degree of Saturation - %:	85					
Assumed Specific Gravity for Degree of Saturation:	2.90					

Test Result						
Load Frame/Machine:	CM1/Controls					
Date of test:	14/06/2023					
Test Duration - mins:	00:17					
Orientation:	Unknown					
Stress Rate - MPa/s:	1.35					
Strain at Failure - kN:	130.86					
Unconfined Compressive Strength - Mpa:	23					
Mode of Failure:	Vertical Shear					

Remarks:	-						





Parkside East

Contract No: PSL23/4149 Client Ref: 4597

ISRM Suggested Methods - Rock Characterization Testing and Monitoring 1974 - 2006

Borehole Number: RBH106 Top Depth (m): 18.78

Sample Number: - Base Depth (m): 19.15

Sample Type: C Sample Date: -

Storage Condition: Core Box Date of Reciept -

Sample Description: Sandstone

Specimen Details/Conditions						
Diameter - mm:	85.09					
Height - mm:	225.06					
Water Content - %:	12.8					
Sample Mass - g:	2989.6					
Bulk Density - Mg/m ³ :	2.34					
Dry Density - Mg/m ³ :	2.07					
Height Ratio: * Sample complies with H:D ratio	2.6					
Degree of Saturation - %:	92					
Assumed Specific Gravity for Degree of Saturation:	2.90					

Test Result						
Load Frame/Machine:	CM1/Controls					
Date of test:	14/06/2023					
Test Duration - mins:	00:17					
Orientation:	Unknown					
Stress Rate - MPa/s:	1.42					
Strain at Failure - kN:	137.47					
Unconfined Compressive Strength - Mpa:	24.2					
Mode of Failure:	Vertical Shear					

Remarks:	-					





Parkside East

Contract No: PSL23/4149 Client Ref: 4597



Issued:

Certificate Number 23-14139

Client Professional Soils Laboratory Ltd

5/7 Hexthorpe Road

Hexthorpe DN4 0AR

Our Reference 23-14139

Client Reference PSL23/4149

Order No (not supplied)

Contract Title Parkside East

Description 13 Soil samples.

Date Received 15-Jun-23

Date Started 15-Jun-23

Date Completed 22-Jun-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

Kirk Bridgewood General Manager





22-Jun-23



Summary of Chemical Analysis Soil Samples

Our Ref 23-14139 Client Ref PSL23/4149 Contract Title Parkside East

Lab No	2187443	2187444	2187445	2187446	2187447	2187448	2187449	2187450	2187451	2187452	2187453
.Sample ID	TP109	TP101	TP115	TP113	TP104	TP114	RBH107	RBH106	RBH105	RBH101	RBH102
Depth	0.60	1.80	1.60	0.70	1.20	0.70	3.26-3.89	9.04-9.32	2.72-2.90	3.60-3.20	5.12-5.21
Other ID											
Sample Type	D	D	D	D	D	D	D	D	D	D	D
Sampling Date	n/s	n/s	n/s	n/s	n/s						
Sampling Time	n/s	n/s	n/s	n/s	n/s						

Test	Method	LOD	Units											
Inorganics														
рН	DETSC 2008#		рН	7.0	7.1	7.2	6.9	7.0	6.4	5.6	6.3	5.3	6.9	6.9
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	24	12	< 10	< 10	11	< 10	11	12	16	< 10	< 10



Summary of Chemical Analysis Soil Samples

Our Ref 23-14139 Client Ref PSL23/4149 Contract Title Parkside East

Lab No	2187454	2187455
.Sample ID	RBH103	RBH104
Depth	17.30-17.51	1.77-2.00
Other ID		
Sample Type	D	D
Sampling Date	n/s	n/s
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Inorganics					
рН	DETSC 2008#		рН	7.1	7.7
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	< 10	< 10



Information in Support of the Analytical Results

Our Ref 23-14139 Client Ref PSL23/4149 Contract Parkside East

Containers Received & Deviating Samples

Date Inappropriate container for

Lab No	Sample ID	Sampled	Containers Received	Holding time exceeded for tests	tests	
2187443	TP109 0.60 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187444	TP101 1.80 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187445	TP115 1.60 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187446	TP113 0.70 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187447	TP104 1.20 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187448	TP114 0.70 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187449	RBH107 3.26-3.89 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187450	RBH106 9.04-9.32 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187451	RBH105 2.72-2.90 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187452	RBH101 3.60-3.20 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187453	RBH102 5.12-5.21 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187454	RBH103 17.30-17.51 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		
2187455	RBH104 1.77-2.00 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH +		
				Conductivity (7 days)		

Key: P-Plastic T-Tub

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

Soil Analysis Notes

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

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

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

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



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APPENDIX E – WATER MONITORING RESULTS

RºC					Job No:			4597			Site:		Parkside East		
Civ	ril, Structural	& Environme	ental Engine	ers	Date:			26/05/2023			Client:		Harworth		
Con	nmercial Wharf,	6 Commercial	St, MCR, M15	4PZ	Engineer:			RM			Equipment:		Water Dip		
						Prior to monitoring			On day of monitoring			Notes			
Weather Conditions:					DRY			DRY							
Surface G	Surface Ground Conditions:					DRY			DRY						
ВН	Surface Level	Depth to Water (m)	Depth to Base (m)	Well Vol (It)	Temp	рН	Conductiv	ity (us/mg)	Dissolved Oxygen (mg/l)	Head of water (m)	Depth to Water (mAOD)	Depth to Base (mAOD)	Notes		
RBH101	33.3	9.4	10.81	3						1.41	23.9	22.49			
RBH102	33.81	7.86	9.86	4						2	25.95	23.95			
RBH104	36.59	9.23	9.83	1						0.6	27.36	26.76			
RBH105	35.63	8.69	10.17	3						1.48	26.94	25.46			
RBH107	35.28	7.14	11.42	8						4.28	28.14	23.86			
				0						0	0	0			
				0						0	0	0			
				0						0	0	0			
				0						0	0	0			
				0						0	0	0			

RºC					Job No:			4597			Site:		Parkside East	
CONSULTING	ril, Structural	& Environme	ental Engine	ers	Date:			05/07/2023			Client:		Harworth	
Con	nmercial Wharf,	6 Commercial S	St, MCR, M15	4PZ	Engineer:			RM			Equipment:		Water Dip	
					Prior to monitoring			On day of monitoring			Notes			
Weather Conditions:					DRY			DRY						
Surface G	Surface Ground Conditions:					DRY			DRY					
ВН	Surface Level	Depth to Water (m)	Depth to Base (m)	Well Vol	Temp	рН	Conductiv	rity (us/mg)	Dissolved Oxygen (mg/l)	Head of water (m)	Depth to Water (mAOD)	Depth to Base (mAOD)	Notes	
RBH101	33.3	9.43	10.81	3						1.38	23.87	22.49		
RBH102	33.81	7.9	9.86	4						1.96	25.91	23.95		
RBH104	36.59	9.25	9.83	1						0.58	27.34	26.76		
RBH105	35.63	8.72	10.17	3						1.45	26.91	25.46		
RBH107	35.28	7.17	11.42	8						4.25	28.11	23.86		
				0						0	0	0		
				0						0	0	0		
				0						0	0	0		
				0						0	0	0		
				0						0	0	0		



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APPENDIX F – COAL AUTHORITY REPORT