**LMCL** *Quarrying Sector Consultant Engineering Geologists and Surveyors*

Tel. +44 (0)1275 543983. www.landandmineralsconsulting.com

SIBELCO

# Bovey Basin Ball Clay Workings

# Environmental Permit Application

# Stability Risk Assessment

March 2025

LMCL

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Director: Adrian Wilkinson

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# Bovey Basin Ball Clay Workings

## Environmental Permit Application Stability Risk Assessment

Site N° : 00934

Project N° : 250129/RSW

Report Date : 1st April 2025

Prepared on behalf of QuarryDesign by:

**R Wilks**
Principal Engineer, UAV Pilot (Geotechnical Specialist) BSc(Hons), CEng, CEnv, MIMMM, MIQ, FIQ

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Checked on behalf of QuarryDesign by:

**M Williams**
Principal Engineering Geologist (Geotechnical Specialist) MGeol(Hons), MSc, MCSM, Eur.Geol, CGeol, FGS, FIQ

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## Author Profiles

***Rupert Wilks*** *(Principal Engineer / UAS Pilot) has an honours degree in Environmental Science at the University of Lancaster, is a Chartered Engineer (CEng) and Chartered Environmentalist (CEnv) with the Institute of Materials, Minerals and Mining (MIMMM) and he is a member of the Institute of Quarrying (MIQ). He has previously been employed by AIG Consulting, Encia Consulting and Stratus Environmental where he has worked in the ground engineering, geotechnical, waste management and contaminated land sectors. More recently he had been involved with the design and management of engineering projects in the waste management sector before joining LMCL in May 2016. Since joining LMCL, Rupert has undertaken designs and geotechnical assessments for many quarries around the UK, undertaking the role of a Geotechnical Specialist in accordance with the Quarries Regulations and also continuing to work on projects relating to the stability of landfill infrastructure. Rupert served an 18 month secondment to Tarmac Northern as a Geologist until March 2019. He also holds a General VLOS Certificate to fly Unmanned Aerial Systems in the Specific Category*

***Land and Minerals Consulting Ltd (LMCL)*** *was formed in 2004 as a geological, geotechnical and surveying consultancy. The Company adopted the trading name* ***QuarryDesign*** *in 2006 to promote its links with the mineral planning consultancy QuarryPlan Ltd. LMCL specialise in the "remote" acquisition of survey, geological and geotechnical data using their various long-range high-accuracy LiDAR scanners and UAV mounted aerial systems. Since 2013, LMCL also trades under the name of* ***DroneSurv*** *(a name more suited to aerial work outside of the quarrying industry).*

*LMCL not only has the expertise to acquire the data; but have the experience, software and hardware to process the data into formats required by a wide range of industry standard surveying, geological modelling, geotechnical analysis and numerical modelling software. With that software, they are able to undertake both the analysis and subsequent designs for excavations, tips and lagoons in both engineering soil materials and rock masses. They also provide Reserve and Resource Statements to The PERC Reporting Standard, Due Diligence for mineral acquisitions and act as Expert Witness.*

*LMCL have undertaken projects for a wide range of industries including surface and underground mining, surface mining and quarrying, mountain and desert cliff surveys, coastal erosion surveys, sink-hole and crown-hole surveys, rock-fall surveys, and slope monitoring surveys. They have worked extensively in the UK and also worked in Ireland, France, Norway, Spain, Portugal, Gibraltar, Bangladesh and Saudi Arabia.*

*Under the QuarryDesign trading name, the Company was awarded Joint Runner-up in the Engineering Initiatives category of the Mineral Planning Association's Health and Safety Awards 2013 for their use of Terrestrial LiDAR and UAV for remote Surveying and Geological / Geotechnical mapping (appended to the end of this document).*

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# 1 INTRODUCTION

## 1.1 Report Context

**Land and Minerals Consulting Limited** (LMCL) was commissioned by **Sibelco Limited** (Sibelco) to prepare a Stability Risk Assessment (SRA) to assist with a waste recovery permit application for the placement of imported inert material as part of the Bovey Basin Ball Clay Workings 'Central Area' restoration.

This report covers the placement of imported inert material as the final subsoil and topsoil layer in Phases 1 and 2 of the restoration of the site. Additional soils will be placed during Phase 3 but that will not be covered in this report.

This SRA has been prepared using guidance from the gov.uk website (https://www.gov.uk/guidance/landfill-operators-environmental-permits/how-to-do-a-stability-risk-assessment-landfill-sites-for-inert-waste-or-deposit-for-recovery-activities) which in turn refers to guidance contained within the **Environment Agency R&D Technical Reports P1-385/TR1 and P1-385/TR2** (hereinafter referred to as 'The Guidance').

### 1.1.1 Outline of the Installation

The Bovey Basin Ball Clay Workings are part of Sibelco's Preston Manor Works complex. The site is located ~2km northwest of Kingsteignton, Devon at Ordnance Survey grid reference 285337E 75335N and is accessed via Lower Preston which runs east from the B3193 main road (Exeter Road).

The Central Area of the Bovey Basin Ball Clay Workings is located on the side of a low hill which rises to the northeast and falls away to the southwest. The site is bounded to the west by the River Teign, ponds, fields and the Village of Preston to the south, Clay Lane to the north and the B3193 to the east.

The Central Area comprises three quarrying areas, several quarry tips and a processing plant as shown on Figure SRA2.

The current ground levels at the site extend from a maximum ground level of ~55m AOD at the top of the Rixey Park Tip in the north of the site down to a lowest quarry floor level of approximately -43mAOD in the base of South Acre Quarry. Original ground levels in the area range from around 6mAOD in the west to around 32mAOD in the east.

Most recently, mineral was being extracted from the northern margin of Whitepit Quary with faces along the entire northern portion of the quarry, progressing in a northerly direction.

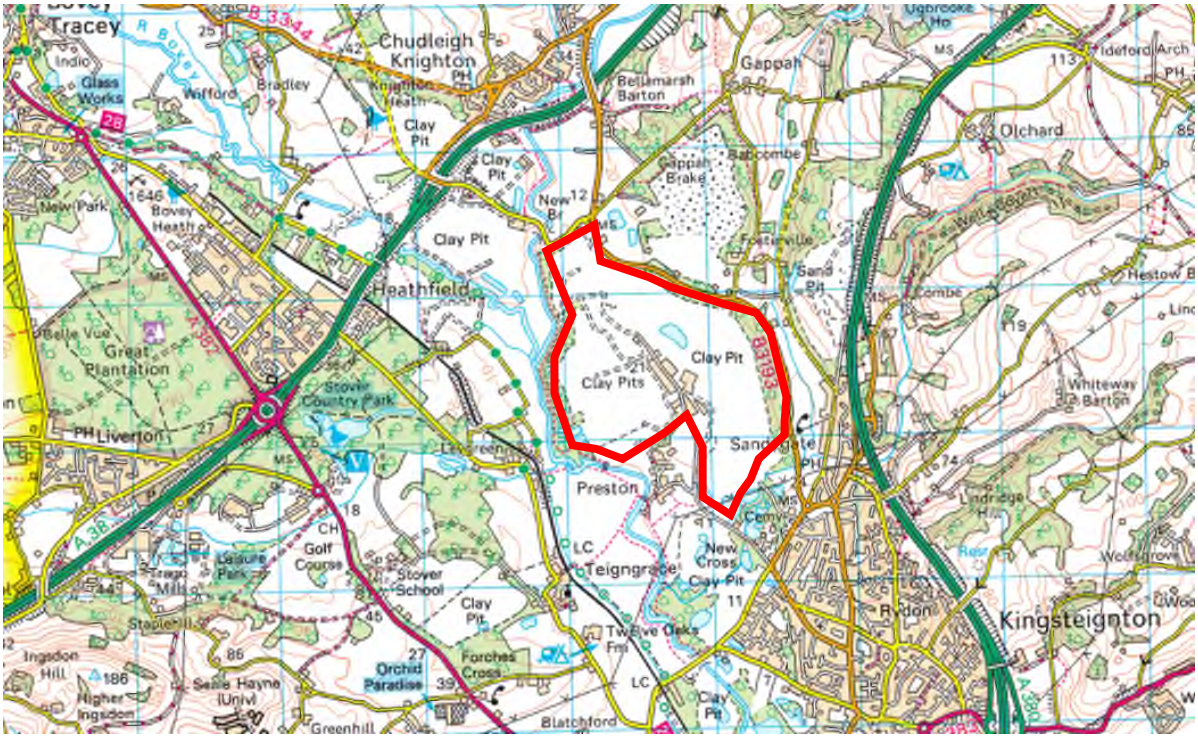



*Figure SRA1: Approximate extent of the Central Area of the Bovey Basin Ball Clay Workings (Based upon map data by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. Licence number 100044692)*

Mineral is won over the duration of a campaign by use of a 12m-reach, 360˚excavator which rips seams of clay in 4m high bench intervals. It is loaded onto dump-trucks and put into dry stores or stockpiles on site until required by customers for specific properties in a final blended product. It is then transported to the Preston Manor Works where it is shredded and blended into final mixes prior to sale to the tiling and pottery industry globally.

Several tips have been formed around the site comprising overburden and excavated material which is out of specification. The main out of specification material is clay. The 'Heathfield Tip, Rixey Park Tip and Whitepit Tip are shown on Figure SRA2 and these tips will form the subgrade for the inert imported restoration material when they reach their final proposed levels.

The proposed Phases 1, 2 and 3 of the waste recovery are indicated on drawings 18876-032, 18876-033, 18876-034 produced by Wardell Armstrong. The Phase 1 and 2 drawings are presented in Appendix SRA1. The areas of the site in which inert material will be imported during Phases 1 and 2 are shown on Figure SRA3.

Drawing 18876-032, indicates that the Phase 1 area comprises existing restored areas with no additional imported material planned. However, it is understood that, in some parts of the Phase 1 area (generally to the east and north east of the Rixey Park Tip) the restoration has not been as successful as hoped and some additional imported inert soils may be required.

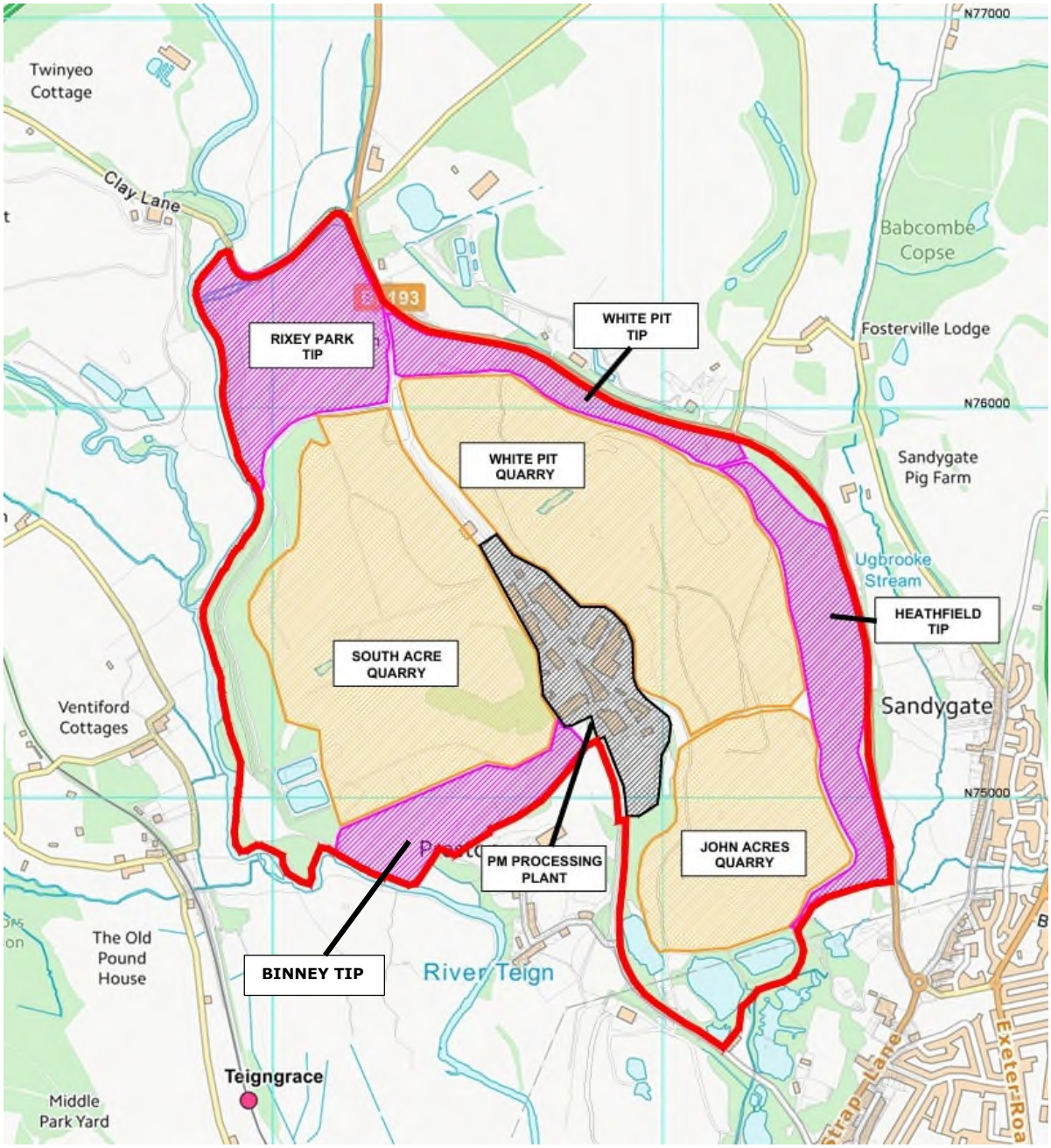



*Figure SRA2: Outline of significant features on the site D03/P28/004 taken from Wardell Armstrong's March 2023 Planning Statement report (ST18876)*

With respect to the Phase 2 area (Drawing 18876-033), this area generally comprises the flanks and top of the Rixey Park Tip. Imported inert material is proposed to be placed in this area in the area shown on Figure SRA3 in red outline.

Therefore, this SRA will concentrate on an assessment of the placement of imported inert soils during Phases 1 and 2 of the restoration, specifically in the Rixey Park Tip area.

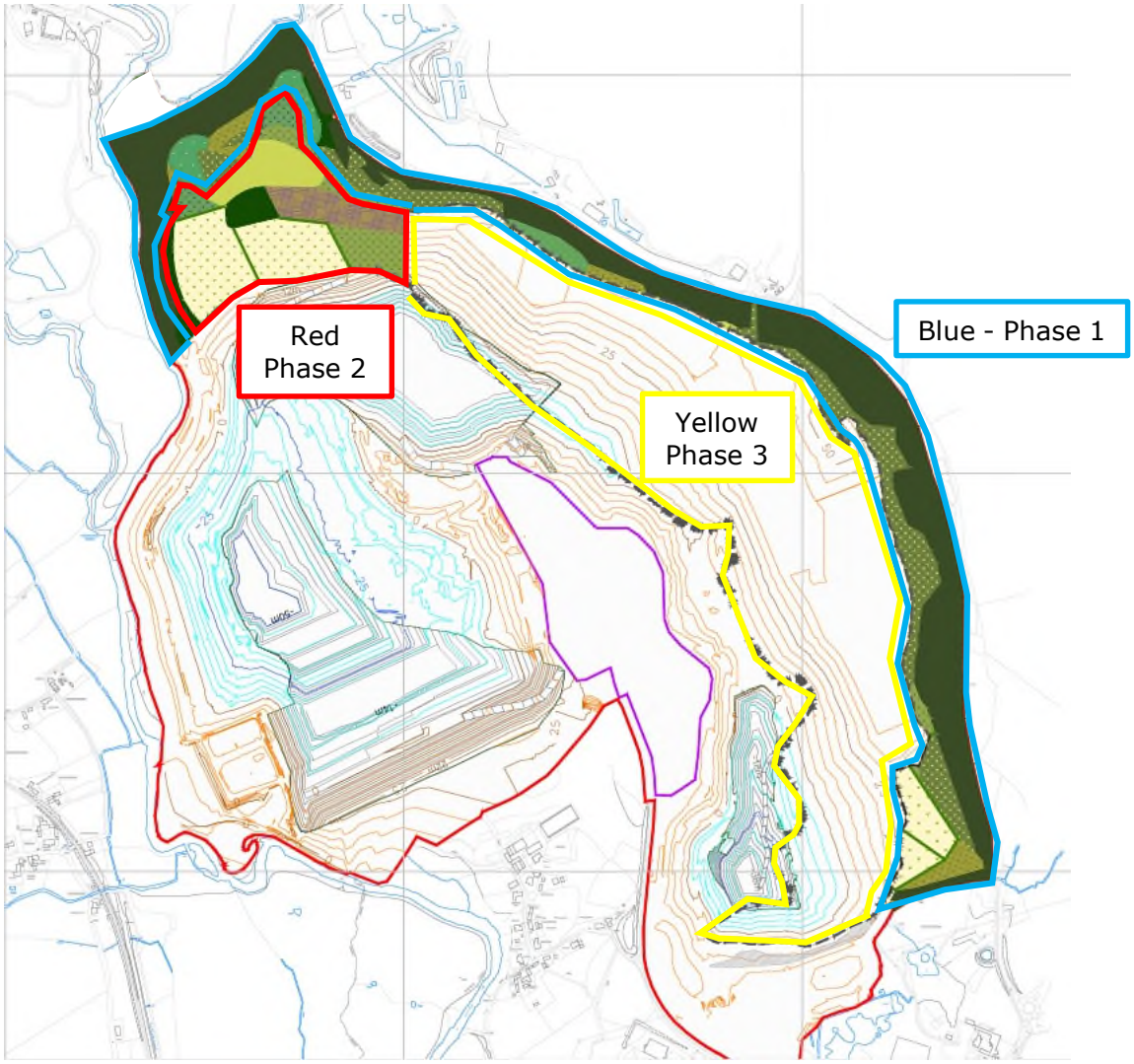



*Figure SRA3: Outline of the locations of the proposed Phases of the waste recovery plan*

### 1.1.2 Summary of Previous Work

This is the first known waste recovery permit for this site, the author is unaware of any previous waste Stability Risk Assessment's (SRA's) which been undertaken for the site.

However, there have been previous reports issued for this site related to the quarrying operations at the site. Key reports are listed in table SRA1.

**Table SRA1: Summary of Historic Information**

| Report Type/Title | Date | Author (Drawing Ref No) | Comments |
|---|---|---|---|
| Geotechnical Assessments for the Southacre Quarry and for the Johnacres Lane and Whitepit Quarries | 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022 | MCG Consultancy Services | Geotechnical Assessment Reports undertaken at 2-year intervals in accordance with in accordance with the quarries regulations 1999.<br><br>Each report details the findings of a walkover assessment of all of the excavations and tips at the site and assesses the suitability of the current excavations and tip designs and designates whether features on site represent significant or non-significant hazards in accordance with the Quarries Regulations (1999). |
| Geotechnical Assessments for Southacre Quarry and for the Johnacres Lane and Whitepit Quarries | 2024 | QuarryDesign | Geotechnical Assessment Report for 2024<br><br>Each report details the findings of a walkover assessment of all of the excavations and tips at the site and assesses the suitability of the current excavations and tip designs and designates whether features on site represent significant or non-significant hazards in accordance with the Quarries Regulations (1999). |

## 1.2 Conceptual Stability Site Model

The following sub-sections present a summary of the natural geological, geosynthetic, or fill materials (including engineered fill and un-engineered infill) used in the model, relating specifically to the components identified on the gov.uk website: (https://www.gov.uk/guidance/landfill-operators-environmental-permits/how-to-do-a-stability-risk-assessment-landfill-sites-for-inert-waste-or-deposit-for-recovery-activities) which in turn refers to guidance contained within the **Environment Agency R&D Technical Reports P1-385/TR1 and P1-385/TR2** (hereinafter referred to as 'The Guidance').

The proposed inert recovery material comprises the upper surface of the restoration only (subsoil and topsoil) therefore there is no specific engineered containment involving a geological barrier or the construction of a sidewall lining system. Following completion of inert infilling the site will be restored with various landscape types.

### 1.2.1 Site History

Extraction of ball clay in this area dates back to the late 17$^{th}$ century, however, extraction in a modern sense did not begin in earnest until the late 1970's. Mining of specific Ball Clay seams using vertical shafts and adits was undertaken up until 1999. From 1999 onwards, only open pit extraction techniques have been used.

Recent history of the site over the previous two years comprises the following activities:

- Material from Binney Tip has been moved and placed in the northern margin of the Whitepit Tip;
- Material has been placed in the central margin of the Whitepit and Heathfield Tip;
- Material has been added to the toe of the Johnacres Lane Internal Tip; and,
- Material has been extracted from Whitepit and from Johnacres Lane Excavation Areas

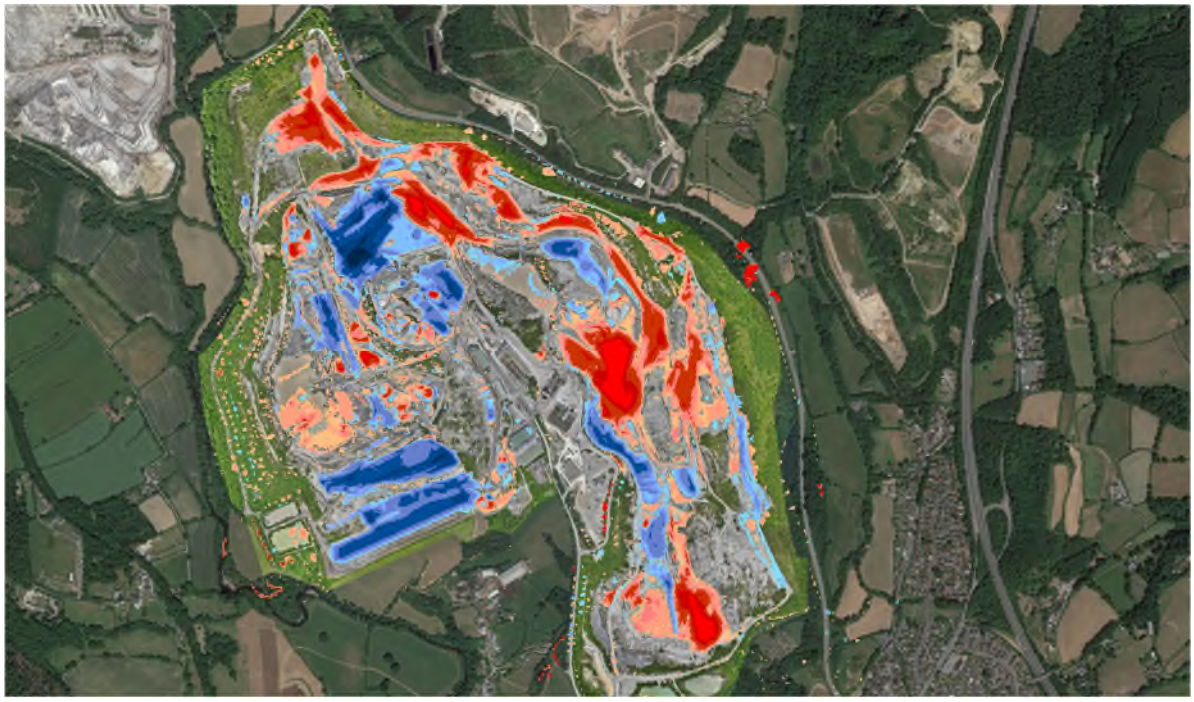


*Figure SRA4: Isopachyte plan showing the difference between the 2022 and 2024 topographic surveys where the blues indicate material has been removed and the orange and red's indicate additional material.*

### 1.2.2 Geology and Ground Conditions

The area is covered by the British Geological Survey, 1:50,000 scale map number 339 'Newton Abbot' (Solid and Drift). Figures SRA5 and SRA6 summarise the geology at the site.

| Geological Unit | | Age | Description | Comment |
|---|---|---|---|---|
| Alluvium | | Quaternary | Silt, sand and gravel | Overburden, superficial deposit |
| Southacre Clay & Lignite Mbr. | | Palaeogene | Clay and lignite | Mineral |
| Abbrook Clay & Sand Mbr. | Ab | | Sand, silt and clay | Main working level |
| Bovey Fm. | | | Sand, silt and clay | |
| Unconformity | | | | |
| Upper Greensand Fm. | | Cretaceous | Sandstone | |
| Unconformity | | | | |
| Crackington Fm. | | Carboniferous | Interbedded mudstone & Sandstone | |
| Ugbrooke Sandstone Fm. | | | Mudstone | |

*Figure SRA5: Geological Succession at the site*

BGS 'bedrock' data for the site indicates that Whitepit, Southacre and Johnacres Quarries are currently extracting Middle to Upper Palaeogene clay, silt and sand material (shaded orange on Figures SRA5 and SRA6) and Upper Palaeogene Clays and Lignite (shaded light brown on Figures SRA5 and SRA6). In some areas, it is overlain by superficial alluvium drift

deposits that are Quaternary in age (light yellow in Figures SRA5 and SRA6). The Bovey Formation is described as:

*'Kaolinitic, sandy and silty clays; silts, lignites and sands deposited in the Bovey Basin, one of three in the NW-SE trending Sticklepath Fault Zone with deposits up to 1200m thick.*

*'The clay formed approximately 56.0 – 33.9Ma (Million years ago) in the Palaeogene Period in an environment dominated by fluvial processes. The Bovey basin is characterised by two main lithofacies; firstly, flood plain clays and sand deposited by meandering rivers; secondly forest swamps with associated temporary shallow lakes creating lignite clays. Braided stream sand and gravels formed mainly from alluvial fans are also present.'*

*'The upper boundary is defined through erosion. The original top of the formation has not been preserved, instead the eroded top forms the land surface underlying modern soil. The lower boundary of the Bovey Formation is defined by the underlying the Aller Gravel and Upper Greensand in the eastern and southern outcrops. Elsewhere, it is unconformable or faulted against Devonian, Carboniferous or Permian aged rock'* (Selwood et al. 1984).

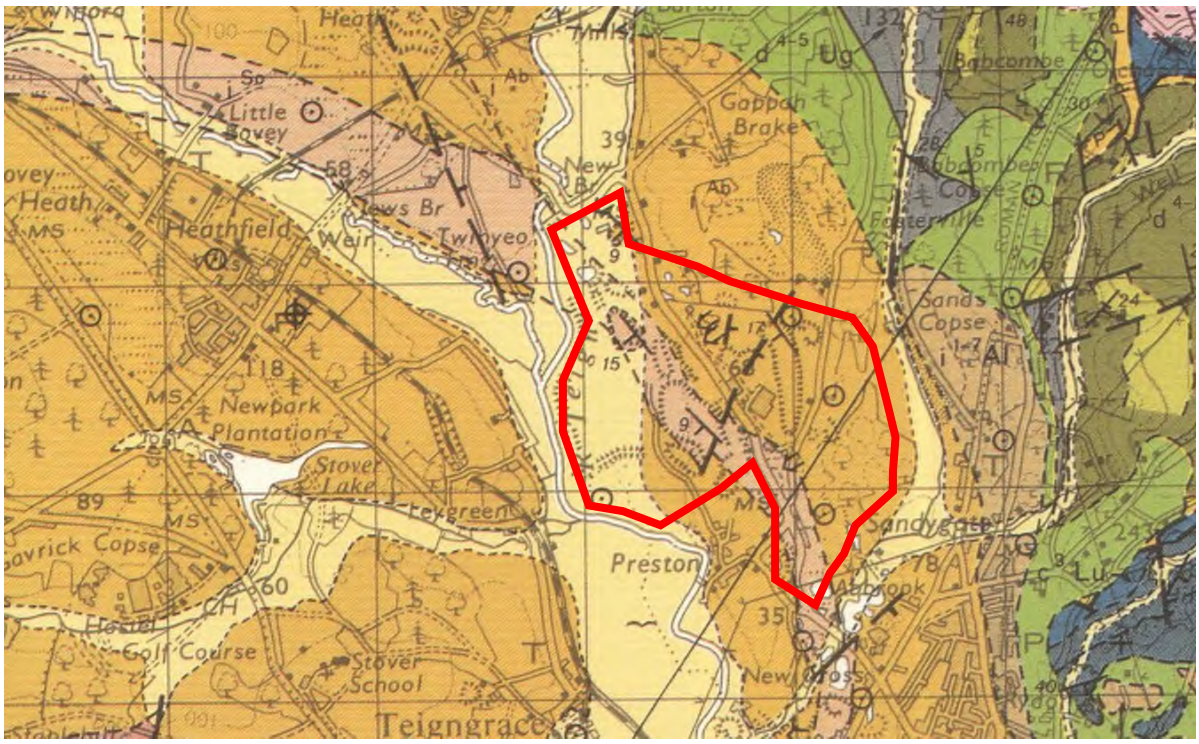



*Figure SRA6: Regional Geology (Solid and Drift), BGS 1:50,000 scale Map Number 339 "Newton Abbot"*

BGS data for the site indicates there is a fault trending NE/SW in the centre of the site (Figure SRA6). It is indicated there is down throw towards the SE. The strata bedding is shown to dip to the south southwest and a dip of 9° is noted.

### 1.2.3 Geotechnical Information

No site-specific testing is available for the Rixey Park Tip material. However, information for the properties and strength of other tips on site is available from a CPT investigation undertaken in 2023. This investigation advanced 12 CPT probes into the Whitepit and Heathfield Tips to help determine tip material properties.

The 2023 CPT report from In-Situ is presented in Appendix SRA2. A plan of the CPT locations is shown in Figure SRA7.

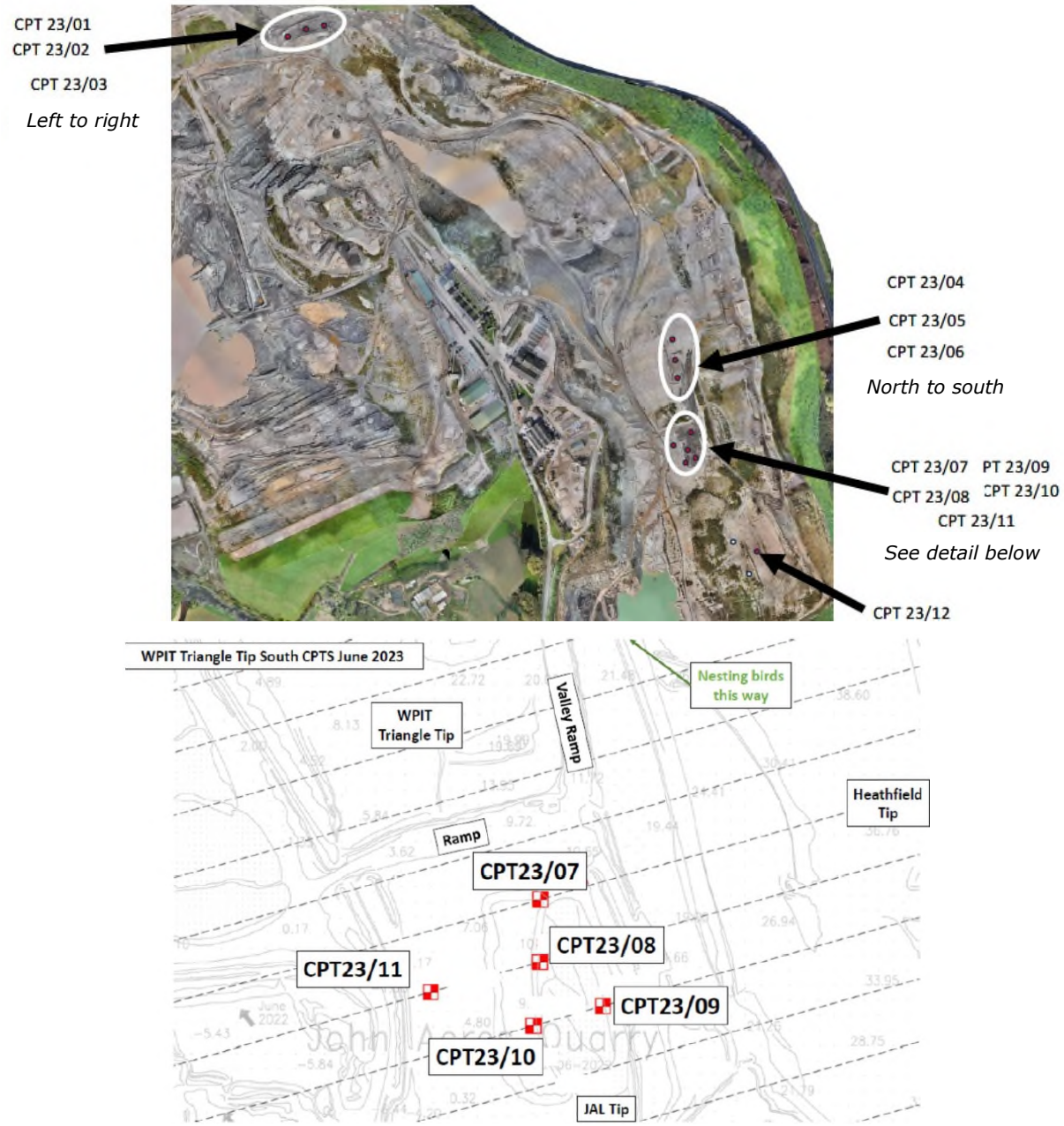



*Figure SRA7: A plan of the CPT locations from the 2023 investigation*

### 1.2.4 Mining Issues

Historical subsurface mining of the Ball Clays has been undertaken in the vicinity of Whitepit, Southacre and Johnacres Quarries. A plan of known mine workings in the area has been passed on by Sibelco and is partially reproduced as Figure SRA8.

The Ball Clay was mined in this area for a period of around 150 years from the mid 1800's up to 1999. Initially vertical shafts with lateral 'drives' were used. These workings extended to maximum depths of around 46m below ground level.

Later on, inclined adits were adopted as the preferred mining method, following a seam of workable ball clay down to greater depths than the vertical shafts. Initially, ash wood frames and, later, steel arched casing was used to support the roof of these adits. Historic photographs indicate a height of the workings of around 1.5 to 2m.

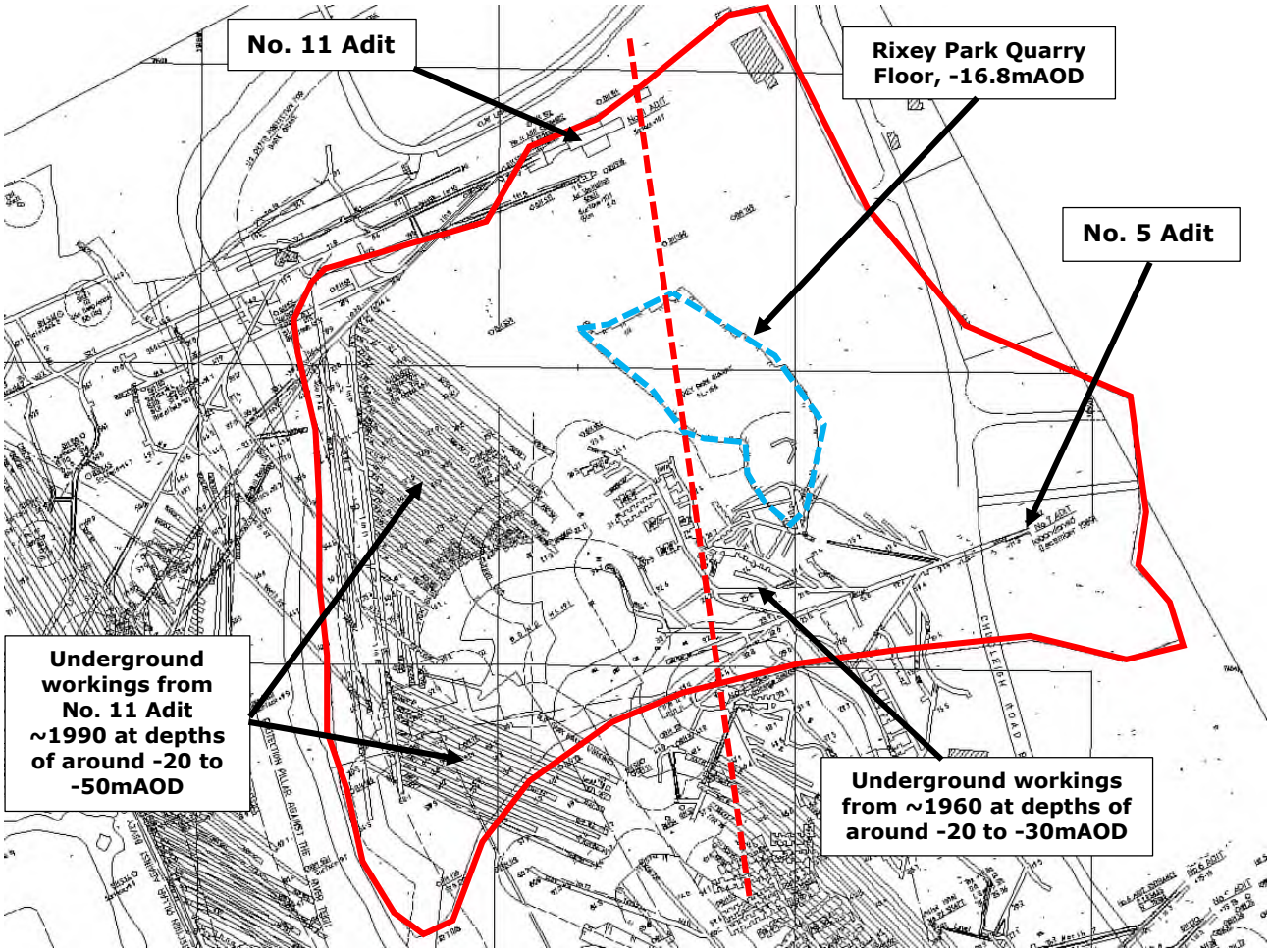



*Figure SRA8: Historic Mine workings underlying the Rixey Park Tip area. Solid Red line is approximate extent of the Rixey Park Tip and the dashed red line is the Model 1 cross section location as shown in Figure SRA9*

Depths of the historic workings below the site are shown on the Rixey Park Mine drawing. The mining plan shows that mineworkings under the Rixey Park Tip area were mined at depths of around -20mAOD to -60mAOD. These depths represent a particular seam of ball clay dipping from east northeast to west southwest.

The Rixey Park tip has been in place for many years. The base of open pit quarrying (shown on the mining plan in Figure SRA8) is -16mAOD and therefore this level has been used for the modelling of the Rixey Park tip on the Plaxis stability models.

The current state of the workings is unknown however, it is considered likely that any historic workings buttressed with wood will have collapsed by now and that more recent historic workings with steel supports may still be open. The closest the workings will be to the imported inert soils will be around 40m depth (See Figure SRA9).

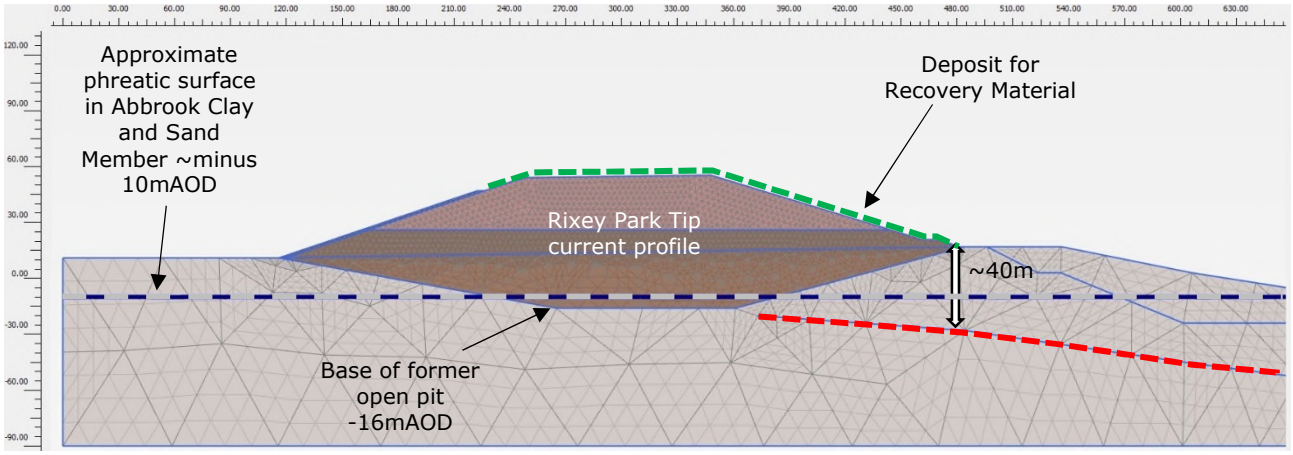



*Figure SRA9: Model 1 showing the indicative depth of the historic mine workings underlying the Rixey Park Tip area of the site. Dashed red line shows approximate depth of the historic workings*

Areas located above or adjacent to historical subsurface mining can be susceptible to the overlying bedrock materials collapsing into the mining void below and forming a 'crownhole'. As such, as part of this report the potential for upward void migration has been assessed using a simplified method set out by Bell et al to help estimate the minimum thickness of material needed to be maintained above the top of the seam (Figure SRA10).

Bell's simplified method assumes that void migration is likely to be arrested by the bulking of broken rock from the failed roof or sidewalls of the workings. Bell's simple methods for determining the likely height of void migration for conical, wedge or rectangular style roof collapses are given below:

For conical-style roof collapse, Dc = 3h/bf

For wedge-style roof collapse, Dc = 2h/bf

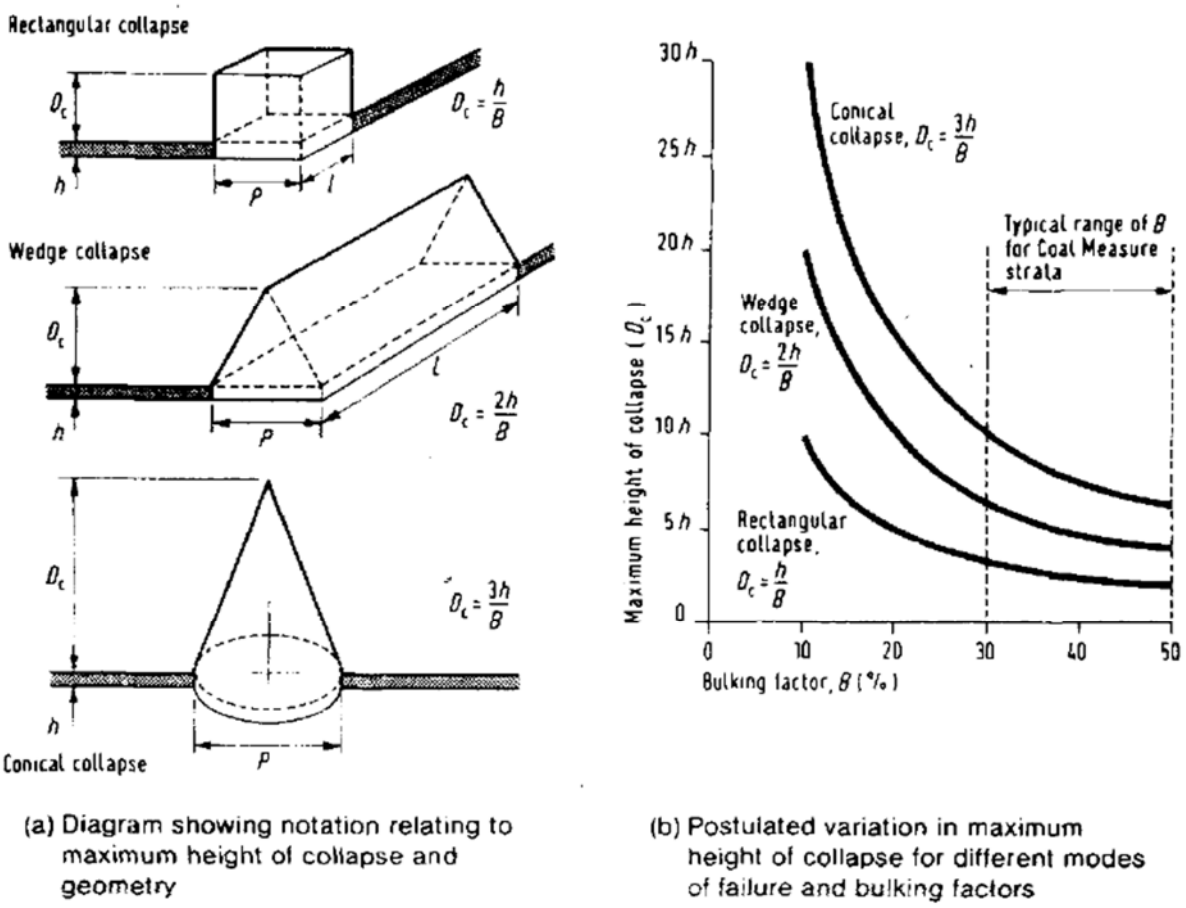
For rectangular roof collapse, Dc = h/bf

Where:

Dc = height of collapse / migration

h = height of the mine opening / adit

bf = bulking factor




(a) Diagram showing notation relating to maximum height of collapse and geometry

(b) Postulated variation in maximum height of collapse for different modes of failure and bulking factors

*Figure SRA10 – Estimation of roof collapse in subsurface mine workings (Bell et al, 1988)*

Bulking factor for the clays has been taken as 30% bulking (i.e. 1.3, from Burt, G et al 2007). The height of working (h) has been taken as 2m. Adopting the above assumptions, the likely maximum void migration above the workings in the ball clay is presented in Table SRA2.

**Table SRA2: Results of Void Migration Estimate (Bell et al 1988)**

| | | |
|---|---|---|
| Void migration depth for Conical Roof Collapse (3h / bf) | 4.6 | m |
| Void migration depth for Wedge Roof Collapse (2h / bf) | 3.1 | m |
| Void migration depth for Rectangular Roof Collapse (1h / bf) | 4.6 | m |
| Conservative void migration depth (6 x deposit thickness) | 12 | m |
| Ultra Conservative void migration depth (10 x deposit thickness) | 20 | m |

Based upon the above, it is considered highly unlikely (Factor of Safety >2) that any of the known mining voids would be able to propagate into the base of the imported inert material.

Surface settlement from any collapsed workings is likely to have been completed considering the significant time period and placement of significant depths of quarry tip material above the workings. Any additional settlement which may occur in the future is not considered likely to affect the imported inert soil materials as there is no engineered lining system at the site which could be compromised by movement stresses.

### 1.2.5 Hydrogeology and Groundwater

Groundwater is known to be present in a shallow aquifer within the Abbrook Clay and Sand Member which is part of the Paleogene Bovey Formation underlying the site. Groundwater is also known to be present in the Aller Gravels which underly the Bovey Formation. These beds are assumed to dip from east northeast to west southwest in the site area. The Conceptual Site Model (CSM) for this application (Drawing 1205.103) shows the general layout of the underlying beds.

Groundwater data from boreholes intersecting shallow aquifer within the Abbrook Clay and Sand Member indicate a phreatic surface which is currently at a level of around -10mAOD in the centre of the Whitepit quarry area (around 500m to the south east of the Rixey Park Tip) (see Figure SRA11). However, groundwater from this aquifer will not necessarily appear at this level on site, if there is sufficient low permeability Bovey Formation strata overlying the sands then this will be a confined aquifer.

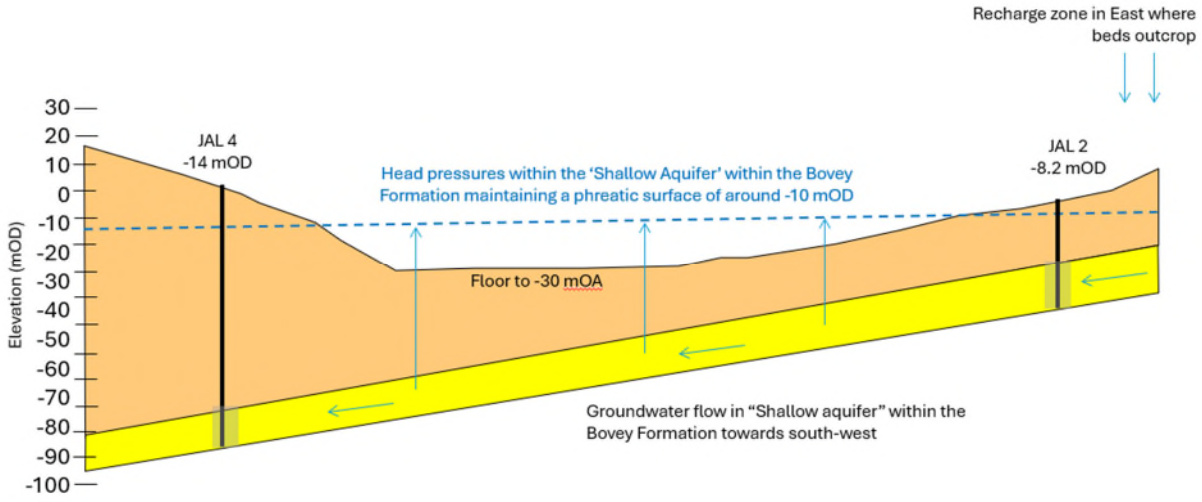



*Figure SRA11 Groundwater conceptual model for the Whitepit area based on groundwater monitoring data from site boreholes – not to scale*.

Groundwater at this site is not considered likely to have an impact on the imported inert soil materials or the underlying slopes of the Rixey Park Tip sub-grade.

### 1.2.6 Subgrade Model

As the proposed imported inert material will be placed as a topsoil and subsoil surface layer above quarry tip material, there is no specific 'basal' or 'sidewall' subgrade. The subgrade for the imported material will comprise quarry tip material which comprises out of specification clay and overburden.

Most of the sub-grade material is already in-situ, the Rixey Park Tip having been constructed up to a level of around 55mAOD by 2024. An exact start date for the tip construction is not

known however, information from Sibelco indicates that the tip stood at around 16m above surrounding ground levels in 2004. This would place the tip at ~26mAOD in 2004.

Some of the sub-grade material is yet to be placed. The proposed model for the final contours of the imported inert material indicates a level of 60mAOD for the tip of the tip. This would require additional sub-grade to be engineered up to a level of 58.8mAOD to allow for the 1.2m of imported material. The proposed final model also includes additional sub-grade material to be placed on the southern flank (see Figure SRA12) and the western flank (see Figure SRA13).

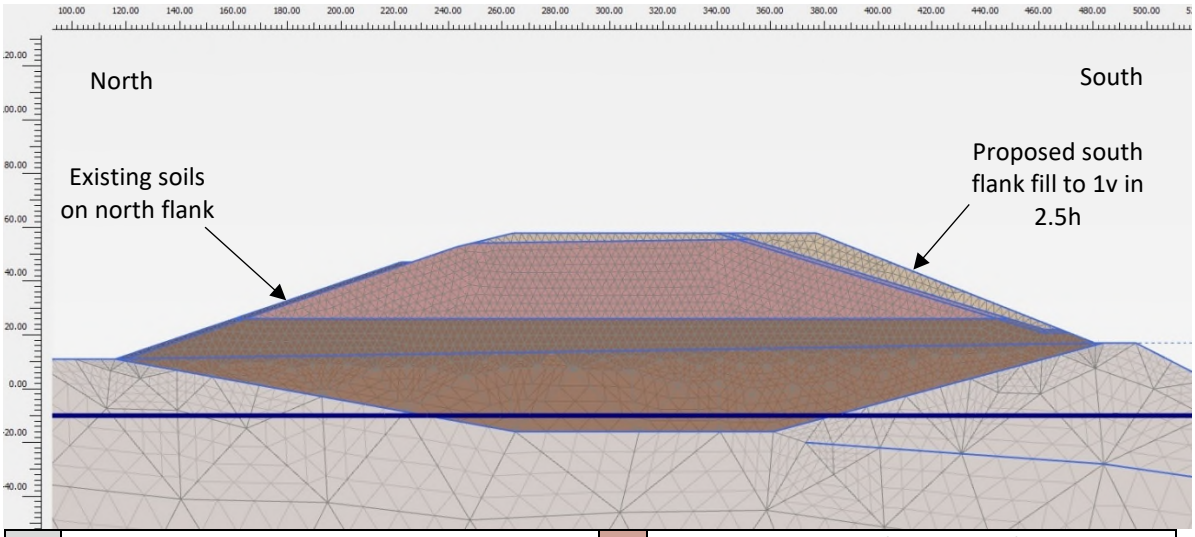



*Figure SRA12: Model 1 cross section, north to south, up to top of sub-grade level. Cross section location on Figure SRA14*

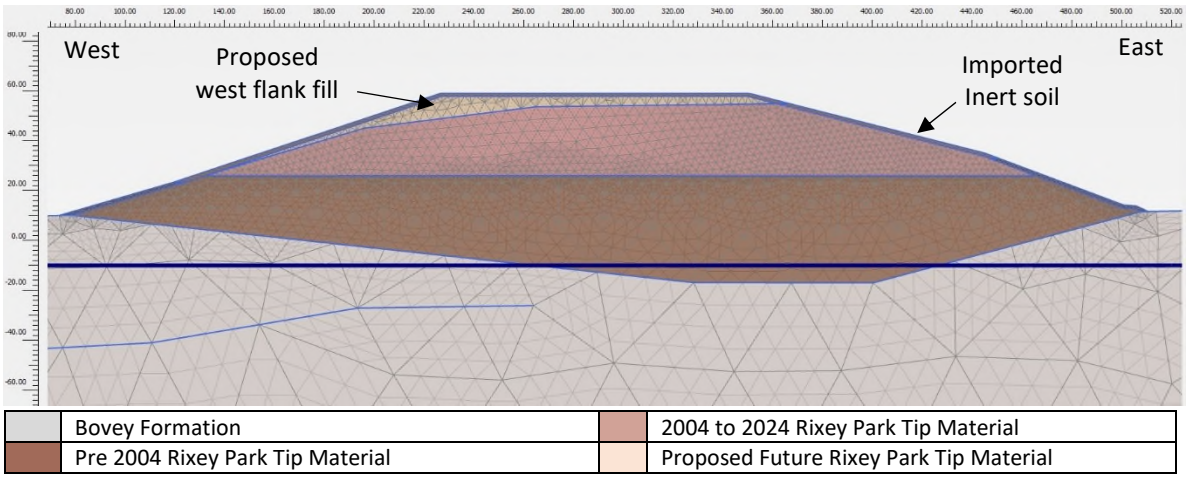



*Figure SRA13: Model 2 cross section, west to east, after imported inert soils placement Cross section location on Figure SRA14*

The steepest gradients of the existing flanks of the Rixey Park Tip and the proposed final model gradients are as follows:

- Northern flank, 50m high (to model at 60mAOD). Current overall slope angle ~1v in 3h – existing soils placed up to 47mAOD - no additional re grading proposed prior to placing the imported inert soils;
- Southern flank, 43m high (to model at 60mAOD). Current overall slope angle ~1v in 3.4h – proposed re-grading to 1v in 2.5h with engineered fill prior to imported inert soil placement;
- Western flank, 50m high (to model at 60mAOD). Current overall slope angle ~1v in 3.9h – soils currently placed to around 23mAOD – proposed re-grading to 1v in 3h with engineered fill prior to imported inert soil placement.
- Eastern flank, 49m high (to model at 60mAOD). Current overall slope angle ~1v in 3.3h comprising a lower steep section with existing soils with a gradient of 1v in 2.8 to 35mAOD and an upper section of 1v in 3.4 above 35mAOD – proposed re-grading of this flank is only above 35mAOD, re-grading the existing subgrade to 1v in 3.8h to create an overall gradient for the flank of 1v in 3.4h prior to imported inert soil placement;

The two cross sections shown in Figures SRA12 and SRA13 have been based on the worst case, highest, steepest flank slopes. The locations of the two Model sections are shown on Figure SRA14.

The sub-grade comprises materials which are considered to be relatively non-compressible.

### 1.2.7 Lining System Model

No basal or side slope lining system is proposed at the site.

### 1.2.8 Waste Mass Model

The site will accept imported inert material comprising subsoils and topsoils.

The maximum possible final waste slope height during Phase 2 would be around 45m (from the lowest top of liner level of 16mAOD to ground level of around 60mAOD). Waste slopes will be modelled with the above worst case slope heights.

Potential final waste slope angles of 1v:2.5h and 1v:3h and 1v in 3.3h will be modelled. These represent the existing profile of the quarry tip and the proposed final profile.

### 1.2.9 Capping System Model

No engineered capping system is proposed for this site.

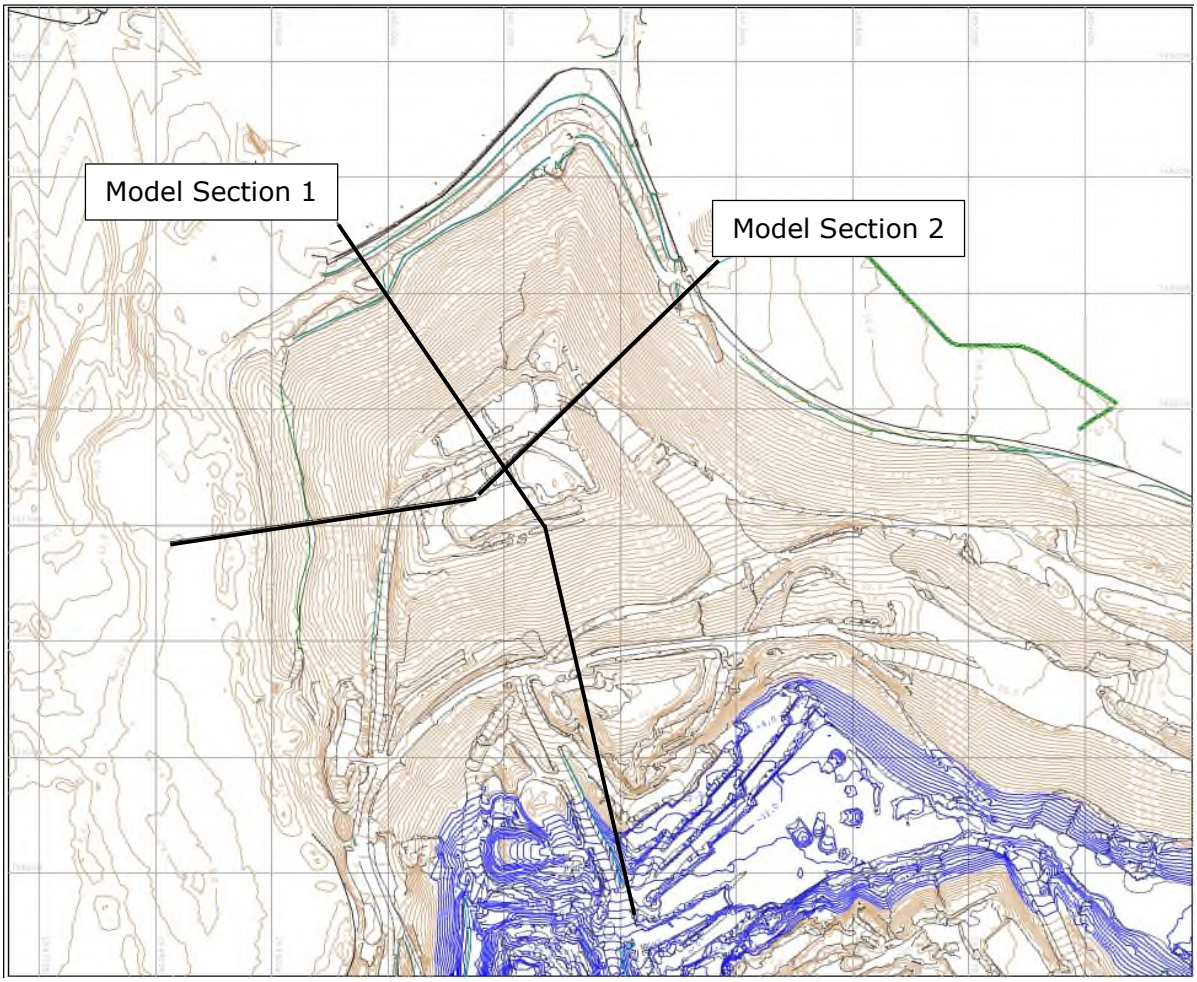



*Figure SRA14: Model cross section locations, 100m grid lines*

# 2 STABILITY RISK ASSESSMENT

The six principal components of the conceptual stability site model have been considered.

## 2.1 Risk Screening

Issues relating to stability and integrity for each principal component have been subject to a preliminary review to determine the need to undertake further detailed geotechnical analyses. The following sections present the results of this screening exercise

### 2.1.1 Subgrade Screening

As the imported recovery material will be topsoil and subsoil and will be placed as a final layer on existing or soon to be constructed quarry tips, there is no real differentiation between a 'Basal' subgrade and 'Side-slope' subgrade so both will be addressed together.

The key considerations for the basal subgrade and the implications for stability and integrity are considered to be as follows:

- **Compressible subgrade:** The subgrade will be either previously placed, or yet to be placed, engineered tip material comprising out of specification clay and overburden. An analysis of the potential strains that could be imposed at any stage of the infilling process will need to be undertaken. This analysis will need to address the construction and waste deposition phases, as well as the situation following waste placement. The values used for the sub-grade materials have been determined from previous work undertaken on the quarries in the area and where engineering values are not available, conservative values will be used.
- **Basal Heave, Groundwater**: The groundwater at the site lies in a confined aquifer with a phreatic surface of around -10mAOD. This depth is around 20m below the lowest level of the imported inert waste materials (around 10mAOD) so basal heave will not affect the sub-grade of this site.
- **Basal Heave, Excess Pore Pressures**: The basal subgrade is cohesive in nature and excess pore pressures could build up due to additional loading of these materials. This will be examined in the Plaxis 2D finite element analysis.
- **Cavities in the Subgrade:** There are not anticipated to be cavities in the subgrade (cohesive tip material). However, there are known to be historic mineworkings within the in-situ Ball Clay strata underlying the tip material. This will be assessed.
- **Filling on Waste:** The Rixey Park Tip material comprises out of specification quarried clay and overburden from the quarrying operations and would not be classified as a waste in the sense of containing any biodegradable material which may need to be taken into account in a stability context. The usual movement, settlement of such of the subgrade tip material will be assessed.

### 2.1.2 Lining System Screening

No lining system is proposed at the site

### 2.1.3 Waste Mass Screening

The imported recovery material will be topsoil and subsoil and will be placed as a final layer on existing or soon to be constructed engineered, cohesive quarry tip material. The imported inert waste soils will be 1.2m in thickness. Analysis is required in terms of the stability of the waste slopes. The most critical situations will be when the imported inert soils are deposited to full height and this situation will be analysed in more detail for the north, south, west and east slopes of Rixey Park Tip.

The controlling factors that influence the stability of the waste mass are presented below:

- **Stability of Waste Mass**: Temporary waste slopes will exist during the development of the site. However, the maximum temporary waste slope height possible at the site would be 1.2m which will not pose any stability concerns and will not be considered further;
- **Stability of Waste Mass and Subgrade:** It is proposed that analyses should be completed on the final restored slopes to confirm stable long-term gradients. The proposed model of the final contours of Phase 2 will be used for the initial analysis;
- **Stability of Waste and AEGB Lining System**: No lining system is proposed for the site;
- **Integrity of Lining System with Waste**: No lining system is proposed for the site.

### 2.1.4 Capping System Screening

No formal capping system, other than the final soil imported as inert soil cover, is proposed for this site. Therefore, no assessment for a capping system will be undertaken as part of this assessment.

## 2.2 Selection of Appropriate Factors of Safety

The factor of safety is the numerical expression of the degree of confidence that exists for a given set of conditions, against a particular failure mechanism occurring. It is commonly expressed as the ratio of the load or action that would cause failure against the actual load or actions likely to be applied during service. This is readily determined for some types of analysis, for example limit equilibrium slope stability analyses. However, greater consideration must be given to analyses that do not report factors of safety directly. For example, a finite difference analysis of strains within a lining system would not usually indicate overall failure of the model even though the strains could be high enough to indicate a failure of the integrity of the system. In such cases, it is necessary to define an upper limit for shear strains and to express the factor of safety as the ratio of allowable strain to actual strain.

The factor of safety adopted for each component of the model would be related to the consequences of a failure.

BS6031 - Code of Practice for Earthworks (Clause 6.5.1.2 Safety Factors) states that suitable safety factors in a particular case can only be arrived at after careful consideration of all the relevant factors, and the exercise of sound engineering judgement. The factors to be considered include:

- The complexity of the soil conditions;
- The adequacy of the site investigation;
- The certainty with which the design parameters represent the actual in-situ conditions;
- The length of time over which the stability has to be assured;
- The likelihood of unfavourable changes in groundwater regime in the future;
- The likelihood of unfavourable changes in the surface profile in the future;
- The speed of any movement which might take place; and
- The consequences of any failure.

### 2.2.1 Factor of Safety for the Subgrade

A factor of safety of 1.3 is considered appropriate for the engineered cohesive tip material which will provide the sub grade for the imported inert material.

### 2.2.2 Factor of Safety for the Lining System

No lining system is proposed for this site.

### 2.2.3 Factor of Safety for Waste Mass

A minimum factor of safety of 1.3 is considered acceptable for stability, assuming that reasonably conservative values are used.

### 2.2.4 Factor of Safety for Capping System

No capping system proposed.

## 2.3 Justification for Modelling Approach and Software

In order to perform a comprehensive stability risk assessment (SRA), the components of the deposit for recovery system have to be considered not only individually, but also in conjunction with one another, where relevant. Any analytical techniques adopted for such an assessment should adequately represent all the considered scenarios for both the un-confined and confined conditions (where appropriate). The methodology and the software should also achieve the desired output parameters for the assessment. This equates to the determination of factors of safety for stability assessments, or the calculation of strains within liner components, for integrity assessments.

The analytical methods used in this stability risk assessment review include:

- **Finite element analyses** for the determination of **factors of safety** against failure in the mineral components of the basal and side-slope subgrade and imported waste material restoration layer.

### 2.3.1 Finite Element Analyses

The proprietary software **PLAXIS (2D)** has been used for the stability assessment. Plaxis is a two-dimensional finite element programme intended for the analysis of deformation and stability in geotechnical engineering. It is equipped for the simulation of non-linear, time dependent and anisotropic behaviour of soils and rock. In addition, since soil is multi-phase material, special procedures are required to deal with hydrostatic and non-hydrostatic pore pressures in the soil.

A safety analysis in PLAXIS is undertaken by reducing the strength parameters of the soils. This process is termed '**Phi-C reduction**', and is carried out as a separate calculation mode. Phi-C reduction is used when it is required to calculate a factor of safety, for the situation under consideration.

In the Phi-C reduction approach, the strength parameters $\varphi$ and c of the soils (and interface shear strengths) are incrementally reduced until failure of the system occurs. For slopes, the Phi-C reduction approach resembles the method of calculating safety factors as conventionally adopted in traditional slip-circle analyses.

The model used within PLAXIS for these assessments is the Mohr-Coulomb model which considers both the elastic and plastic properties of the soils. The mesh used for all models comprises 15-Node triangles which provide $4^{th}$ order interpolation.

To summarise, assessments have been carried out to assess the future development of this deposit for recovery site for the following design scenarios:

- Stability sub-grade system after construction;
- stability of the sub-grade and inert waste after waste placement; and
- stability of the system after a 5 year waiting period.

## 2.4 Justification for Geotechnical Parameters Selected for Analysis

The parameters selected for material properties take into account the analyses undertaken, and where there was uncertainty, a sensitivity analysis was used to assess the potential for instability due to excessive levels of strain.

The basal/side-slope sub-grade is to be constructed from site sourced out of specification quarry materials (generally cohesive). Therefore, parameters consistent with these materials have been utilised within the analyses. Previous reports for the site, a 2023 CPT investigation on adjacent tips and literature values have been used to inform the chosen parameters.

In terms of inert recovery material parameters, the values for c' and ø' adopted throughout the modelling were 3 to 4 kPa and 23 to 24 degrees, respectively. These have been modelled more conservatively than parameters generally used for non-hazardous waste of 5 kPa and 25 degrees from Jones, D.R.V. and Dixon, N. 2003 (full reference in Section 6) and reflect the cohesive soil/subsoil nature of the proposed import material.

The unit weight of the inert recovery material has been taken as 15kN/m$^3$ to 16kN/m$^3$ based on engineering judgement of the likely main constituents of the waste being soils and sub-soils which will not be subject to engineering compaction.

Further justification and explanation of the chosen parameters is provided in Tables SRA3a and SRA 4a.

## 2.5 Summary of Material Parameters for Finite Element Analyses

**Tables SRA 3** and **4** below summarise effective stress and total stress parameters utilised in the analyses. Cut slopes in cohesive soils are kept stable by pore water suctions and, as these suctions dissipate, stability decreases. Therefore, consideration has been given to both the **long-term – effective stress** (drained) and **short-term – total stress** (un-drained) states for each scenario. In long-term analyses (drained conditions) the materials are reliant on their frictional properties (i.e. $\phi'$) for shear strength, and little from their apparent cohesion (c').

The parameters used in the analyses have been obtained from a combination of published literature and site-specific laboratory testing. Notes on the derivation of the parameters used are presented in **Tables SRA3a** and **SRA4a**.

**Table SRA3: Summary of Effective Stress Material Parameters for Finite Element Analysis**

| Material | Unit Weight | Cohesion with respect to effective stress | Angle of friction with respect to effective stress | Water Permeability (K) | Poisson's Ratio | Young's Modulus |
|---|---|---|---|---|---|---|
| | $kN/m^3$ | $kN/m^2$ | ° | m/s | - | $MN/m^2$ |
| In-situ Bovey Formation | 20 | 23 | 48 | $1x10^{-8}$ | 0.30 | 50 |
| Historic Cohesive Tip Material | 20 | 5 | 25 | $1x10^{-8}$ | 0.30 | 40 |
| 2004 to 2024 Cohesive Tip Material | 19 | 5 | 25 | $1x10^{-8}$ | 0.30 | 30 |
| Proposed Cohesive Tip Material | 18 | 5 | 25 | $1x10^{-8}$ | 0.30 | 10 |
| Historically placed soils | 16 | 4 | 24 | $1x10^{-7}$ | 0.35 | 5 |
| Proposed soils | 15 | 3 | 23 | $1x10^{-7}$ | 0.35 | 3 |

## Table SRA3a: Derivation and Suitability of Parameters in Table SRA3

<table>
<tr><th rowspan="2">Material</th><th>Unit Weight</th><th>Cohesion</th><th>Angle of friction</th><th>Permeability (K)</th><th>Poisson's Ratio</th><th>Young's Modulus</th></tr>
<tr><th>kN/m³</th><th>kN/m²</th><th>°</th><th>m/s</th><th>-</th><th>MN/m²</th></tr>
<tr><td>In-situ Bovey Formation</td><td colspan="3">Values used have been adopted from the previous Geotechnical Assessment Reports undertaken at the site (as listed in Table SRA1).<br>These have been compared against the range of values for Ball Clay provided in 'Reeves, G. M et al (2006)* and are considered conservative.</td><td>Estimated based on previous experience. The clay beds may have a slightly lower permeability but the beds of Lignite will have a higher permeability</td><td rowspan="4">The values of Poisons Ratio for these soils have been derived from engineering judgement and experience. Based on values from Essien, U.E. et al (2014) and Bowles, J. E. (1996). These values are considered to be realistic values.</td><td rowspan="4">Based on Duncan J.M. & Buchignani A. I. (1976) (See Note 1) and checked against Bowles, J. E. (1996) Lower end values for a medium clay</td></tr>
<tr><td>Historic Cohesive Tip Material</td><td colspan="3" rowspan="3">Unit weight of the existing and proposed quarry tip material has been determined from The CPT testing undertaken on similar tip material from Whitepit</td><td rowspan="3">Estimated based on previous experience of a generally cohesive engineered</td></tr>
<tr><td>2004 to 2024 Cohesive Tip Material</td></tr>
<tr><td>Proposed Cohesive Tip Material</td></tr>
<tr><td>Historically placed soils</td><td colspan="6" rowspan="2">The imported inert recovery material will comprise a variety of material sources. The material parameters chosen are considered to be conservative strength parameters for generally cohesive soil forming materials based on engineering judgment and experience.</td></tr>
<tr><td>Proposed Imported Recover Permit Soils</td></tr>
</table>

*Full references in Section 6

Note 1: Parameters for the effective stiffness of the cohesive soils has been derived from the undrained stiffness which has been estimated from **Duncan J.M. & Buchignani A. I. (1976)** (See note 1 in Table SRA4a). Based on the undrained stiffness value, the effective stiffness values have been estimated from the following equation:

$$E_u = \frac{3\,E'}{2(1 + v')}$$

Where E' = Effective Stiffness; $E_u$ is undrained stiffness and v' is the effective poisons ratio (0.35) (*from: Plaxis, Standard Course on Computational Geotechnics June 2015; Dr C Augarde, Duhram University)*

**Table SRA4: Summary of Total Stress Material Parameters for Finite Element Analyses (No Excess Pore Water Pressures)**

| Material | Unit Weight | Cohesion (un-drained shear strength $S_u$) | Permeability (No excess pore water pressures) | Poisson's Ratio | Young's Modulus |
|---|---|---|---|---|---|
| | kN/m³ | kN/m² | m/s | - | MN/m² |
| In-situ Bovey Formation | 20 | 300 | Not applicable to a total stress analysis | 0.495 | 57 |
| Historic Cohesive Tip Material | 20 | 150 | | | 46 |
| 2004 to 2024 Cohesive Tip Material | 19 | 120 | | | 34 |
| Proposed Cohesive Tip Material | 18 | 70 | | | 11 |
| Historically placed soils | 16 | 50 | | | 5.5 |
| Proposed Imported Recover Permit Soils | 15 | 40 | | | 3.3 |

**Table SRA4a: Derivation and suitability of Total Stress Parameters in Table SRA4**

| Material | Unit Weight | Cohesion (un-drained shear strength $S_u$) | Poisson's Ratio | Young's Modulus |
|---|---|---|---|---|
| | kN/m³ | kN/m² | - | MN/m² |
| In-situ Bovey Formation | Realistic figures based on the range of values for Ball Clay provided in **Reeves, G. M et al (2006)** | | Generally, Poisson's ratio is taken as 0.5 for a Total Stress (undrained) assessment. However, the Plaxis model for undrained assessment requires the adoption of a slightly lower value of 0.495 | **Duncan J.M. & Buchignani A. I. (1976)** (See Note 1) |
| Cohesive Tip Material | Values of unit weight and Su derived from **Reeves,2006** and from the site specific CPT testing of the Whitepit tip material. The CPT data indicates increase in Su with depth with shallow values around 70kPa up to 5 to 6m depth and higher values of around 70kpa to 200kPa below this depth | | | |
| Proposed Imported Recover Permit Soils | The imported inert recovery material will comprise a variety of material sources. The parameters chosen are considered to be conservative strength parameters for generally cohesive soil forming materials based on engineering judgment and experience. | | | |

Notes:

1. Information on the undrained stiffness of clays has been sourced from **Duncan J.M. & Buchignani A. I. (1976).** The values used are considered conservative based on a clay of medium plasticity index (31 to 57 Reeves et al) being re-engineered with minimum undrained shear strengths as shown in Table SRA4. A range of stiffnesses for the clays has been modelled.

# 3 ANALYSIS

## 3.1 Introduction

The key areas of the future proposed deposit for recovery which now require analysis have been assessed in the models listed below:

- ***Model 1 (Effective Stress Analysis), Model 1t (Total Stress Analysis)***: The stability of the subgrade system and proposed imported inert material based on a north-south cross section through Rixey Park Tip, assessing the worst case gradients of the existing and proposed northern and southern slopes;
- ***Model 2 (Effective Stress Analysis), Model 2t (Total Stress Analysis)***: The stability of the subgrade system and proposed imported inert material based on an east-west cross section through Rixey Park Tip, assessing the worst case gradients of the existing and proposed western and eastern slopes;

For **Model 1**, north to south cross section, using effective stress analysis, the following stages and timescales will be used:

- **Stage 1**: Initial conditions after quarrying in the Rixey Park Tip area;
- **Stage 2**: Placement of the Rixey Park Tip Material up to 24mAOD, reflecting the approximate ground levels in 2004 – timescale **50 years**;
- **Stage 3**: Placement of materials in the model to achieve the current situation of the Rixey Park Tip and existing placed soils up to the surveyed ground levels in 2024 – timescale **20 years**;
- **Stage 4**: Completion of construction of the sub-grade for the tip based on using the existing south face tip levels and gradient – timescale **1 year**;
- **Stage 5**: Addition of the imported inert waste soils to final levels - timescale **1 year;**
- **Stage 6**: Assessment of factor of safety after a 5 year waiting period - timescale **5 years;**
- **Stage 4a**: Completion of construction of the sub-grade for the tip based on using the proposed final south face gradients of 1v in 2.5h to 1v in 3h – timescale **2 years** (as extra fill required);
- **Stage 5a**: Addition of the imported inert waste soils to final levels based on using the proposed final south face gradients of 1v in 2.5h to 1v in 3h - timescale **1 year.**

For **Model 2**, west to east cross section, using effective stress analysis, the following stages and timescales will be used:

- **Stage 1**: Initial conditions after quarrying in the Rixey Park Tip area;
- **Stage 2**: Placement of the Rixey Park Tip Material up to 24mAOD, reflecting the approximate ground levels in 2004 – timescale **50 years**;

- **Stage 3**: Placement of materials in the model to achieve the current situation of the Rixey Park Tip and existing placed soils up to the surveyed ground levels in 2024 – timescale **20 years**;
- **Stage 4**: Completion of construction of the sub-grade for the tip based on using the existing south face tip levels and gradient – timescale **2 years**;
- **Stage 5**: Addition of the imported inert waste soils to final levels - timescale **1 year;**
- **Stage 6**: Assessment of factor of safety after a 5 year waiting period - timescale **5 years;**

For **Model 1t**, north to south cross section, using total stress analysis, the following stages will be used (no timescales are required for modelling of short term total stress models):

- **Stage 3t**: The current situation of the Rixey Park Tip and existing placed soils up to the surveyed ground levels in 2024;
- **Stage 4t**: Completion of construction of the sub-grade for the tip based on using a proposed final south face gradient of 1v in 3h;
- **Stage 5t**: Addition of the imported inert waste soils to final levels based on using a proposed final south face gradient of 1v in 3h**;**

For **Model 2t**, north to south cross section, using total stress analysis, the following stages will be used (no timescales are required for modelling of short term total stress models):

- **Stage 3t**: The current situation of the Rixey Park Tip and existing placed soils up to the surveyed ground levels in 2024;
- **Stage 4t**: Completion of construction of the sub-grade for the tip based on using the proposed new west face tip overall gradient of 1v in 3.1h (additional fill to be placed) and proposed new east face overall gradient of 1v in 3.3 (existing slope to be re-graded);
- **Stage 5t**: Addition of the imported inert waste soils to final levels based on using the proposed new west face tip overall gradient of 1v in 3.1h (additional fill to be placed) and proposed new east face overall gradient of 1v in 3.3 (existing slope to be re-graded)**;**

Figures in red in the following tables indicate factors of safety below 1.3 for stability.

**Note** that the magnitude of the displacements reported by the Plaxis program on the Phi-c reduction analysis printouts do not relate to any 'real world' values as the model has been taken past its point of failure and these displacements should be ignored.

## 3.2 Model 1: Stability Analyses

A summary of the results from the phi-c reduction runs for Model 1 for the various stages of construction are presented in **Table SRA5** below:

**Table SRA5: Summary of Model 1 Stability Analysis**
**Effective Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of north slope | 1.35 |
| Stage 4 – Subgrade placed up to 58.8mAOD, south face using existing slope gradient | Circular failure of north slope | 1.32 |
| Stage 5 – Final imported inert material height set to 60mAOD, south face using existing slope gradient | Circular failure of north slope | 1.29 |
| Stage 6 – Factor of safety after 5 year waiting period | Circular failure of north slope | 1.36 |
| Stage 4a – Subgrade placed up to 58.8mAOD, south face using proposed steeper 1v in 2.5h gradient | Circular failure of south slope | 1.15 |
| Stage 5a - Final imported inert material height set to 60mAOD, south face using proposed steeper 1v in 2.5h gradient | Circular failure of south slope | 1.06 |

Graphical representations of selected analyses (including failure modes) are shown in Figures SRA15 and SRA16.

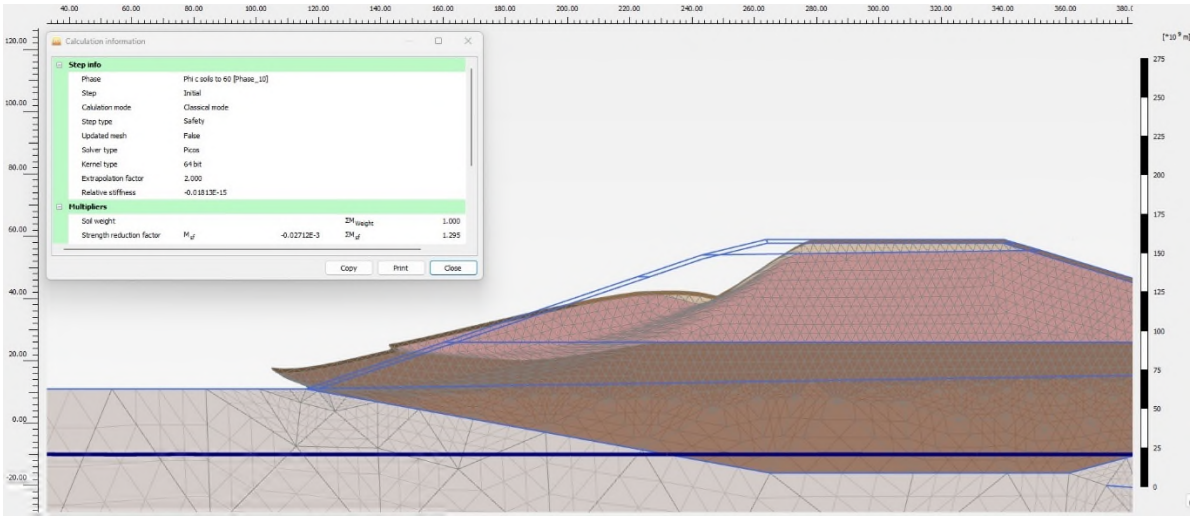



*Figure SRA15: Model 1, Stage 5 failure mode*

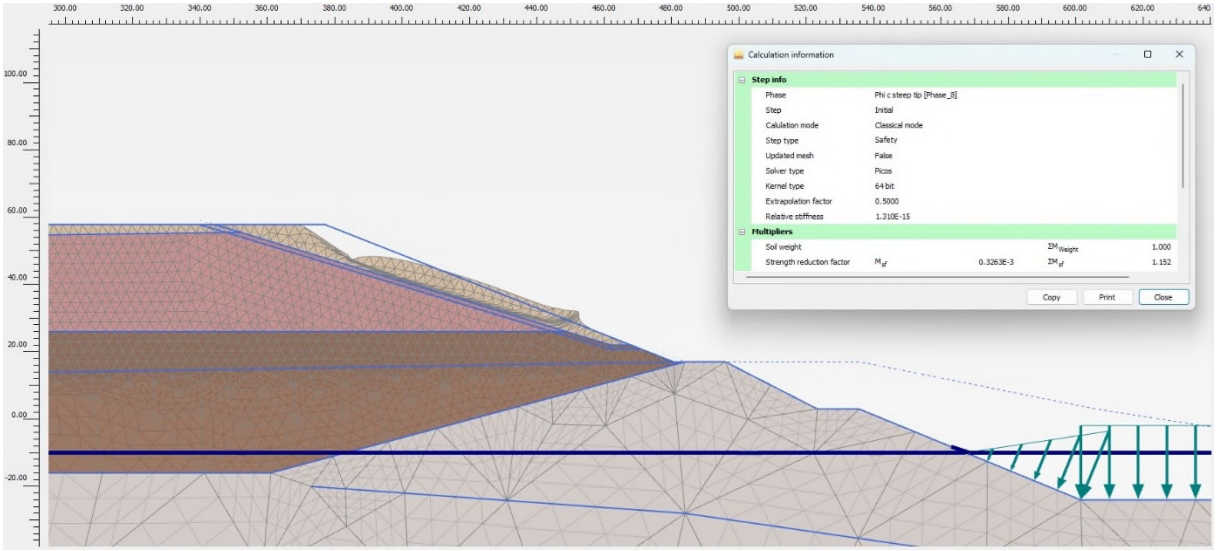



*Figure SRA16: Model 1, Stage 4a failure mode*

## 3.3 Model 1.1 Stability Analyses

As factors of safety were low on some stages for Model 1, Model 1.1 was created where the final deposit for recovery material levels were set to 59mAOD and the gradient of the proposed southern face model was reduced from 1v in 2.5h to 1v in 3h. A summary of the results from the phi-c reduction runs for the various stages of construction are presented in **Table SRA6** below:

**Table SRA6: Summary of Model 1.1 Stability Analysis**
**Effective Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of north slope | 1.35 |
| Stage 4 – Subgrade height set to 57.8mAOD, using existing slope gradient | Circular failure of north slope | 1.32 |
| Stage 5 – Final imported inert material height set to 59mAOD, south face using existing slope gradient | Circular failure of north slope | 1.31 |
| Stage 6 – Factor of safety after 5 year waiting period | Circular failure of north slope | 1.36 |
| Stage 4a – Subgrade height set to 57.8mAOD, south face using revised gradient of 1v in 3h | Circular failure of both north and south slopes | 1.34 |
| Stage 5a - Final imported inert material height set to 59mAOD, south face using revised gradient of 1v in 3h | Circular failure of both north and south slopes | 1.31 |

Graphical representations of selected analyses are presented in Figures SRA17 to SRA19.

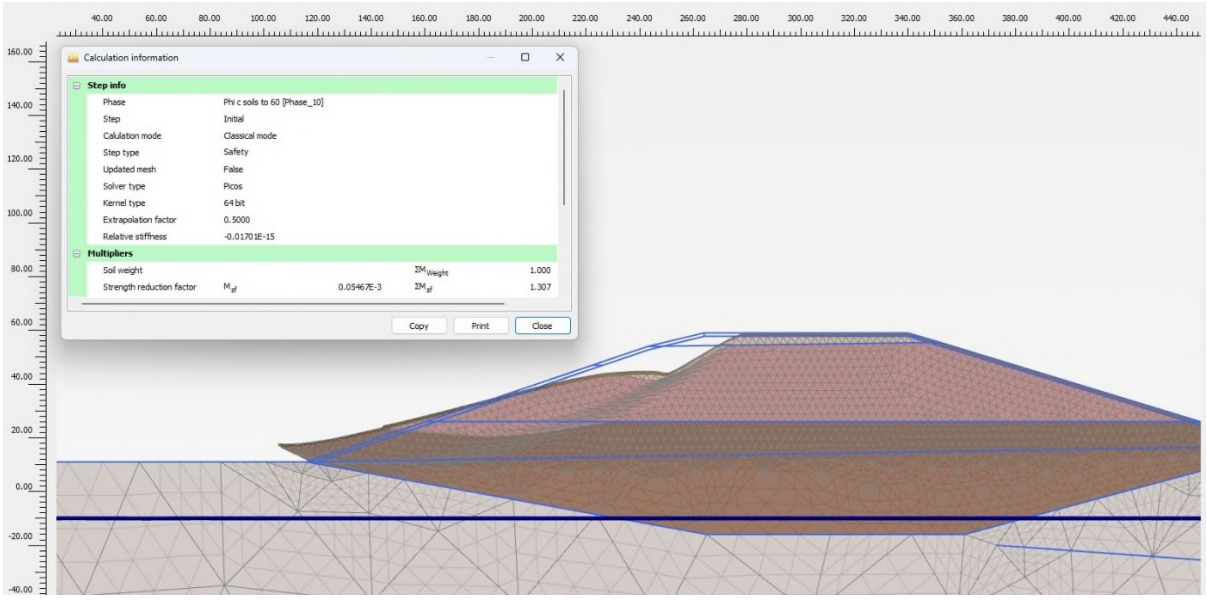


*Figure SRA17: Model 1.1, Stage 5 failure mode*

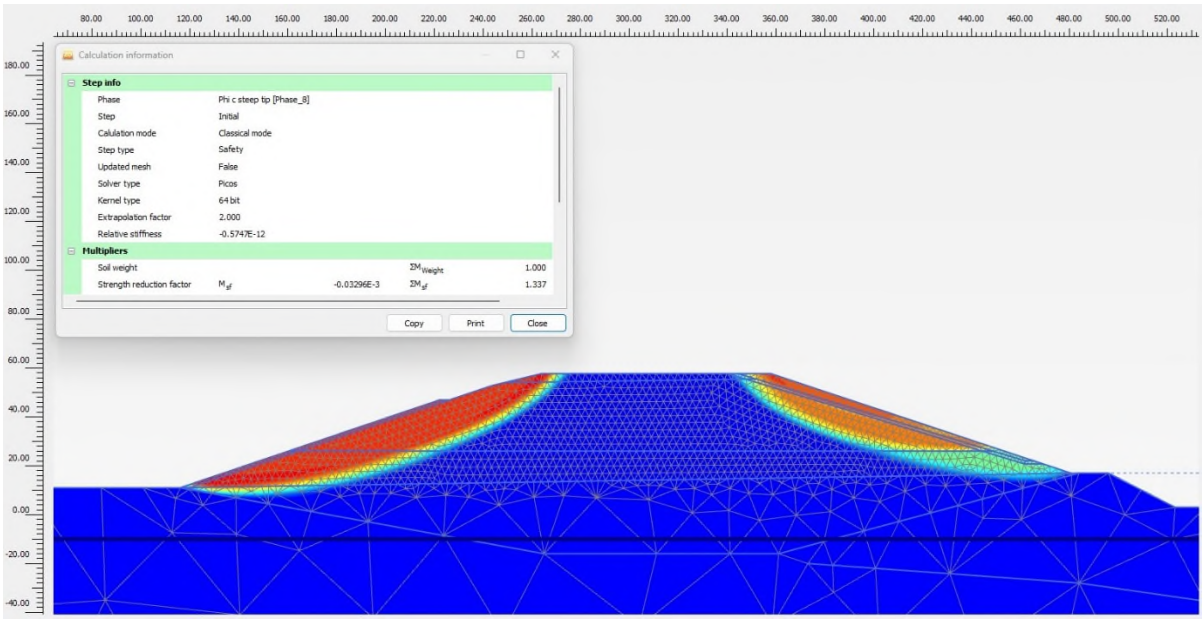



*Figure SRA18: Model 1.1, Stage 4a failure mode*

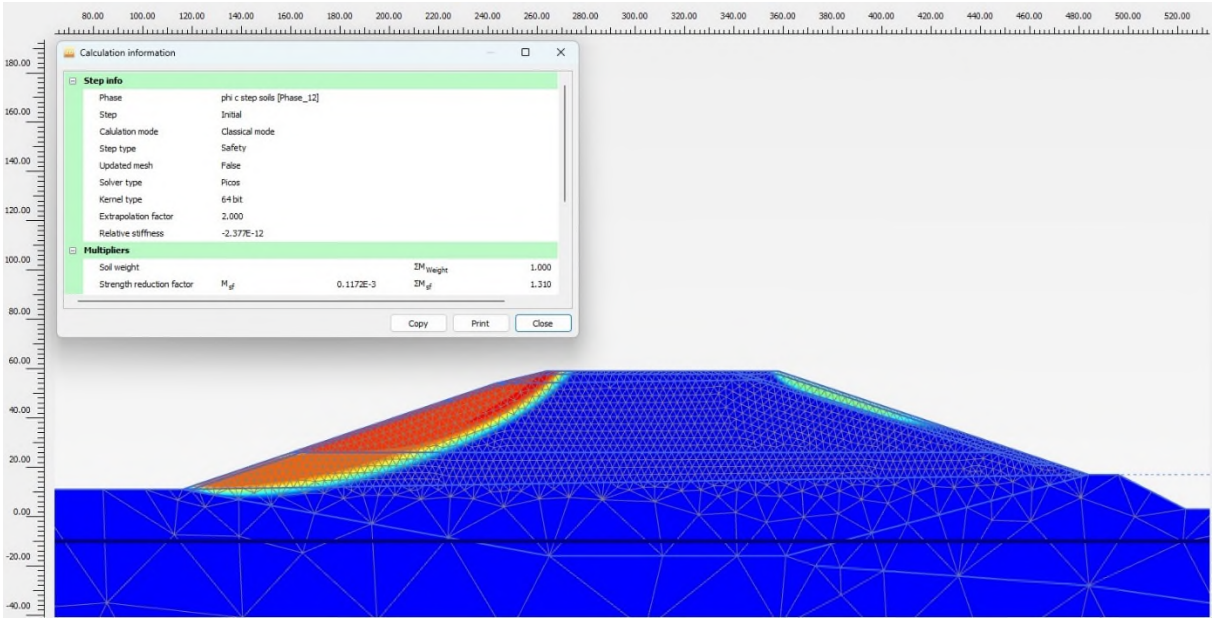



*Figure SRA19: Model 1.1, Stage 5a failure mode*

## 3.4 Model 2: Stability Analyses

A summary of the results from the phi-c reduction runs for Model 2 for the various stages of construction are presented in **Table SRA7**. Model 1.1 had set the final deposit for recovery material height to 59mAOD and was found to be stable, Therefore, Model 2 was also assessed the same highest final level of 59mAOD.

**Table SRA7: Summary of Model 2 Stability Analysis**
**Effective Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of east slope | 1.41 |
| Stage 4 – Subgrade height set at 57.8mAOD, west and east faces using proposed final gradients | Circular failure of west slope | 1.31 |
| Stage 5 – Final imported inert soils set to 59mAOD, west and east faces using proposed final gradients | Circular failure of west slope | 1.32 |

Graphical representations of selected analyses are presented in Figure SRA20.

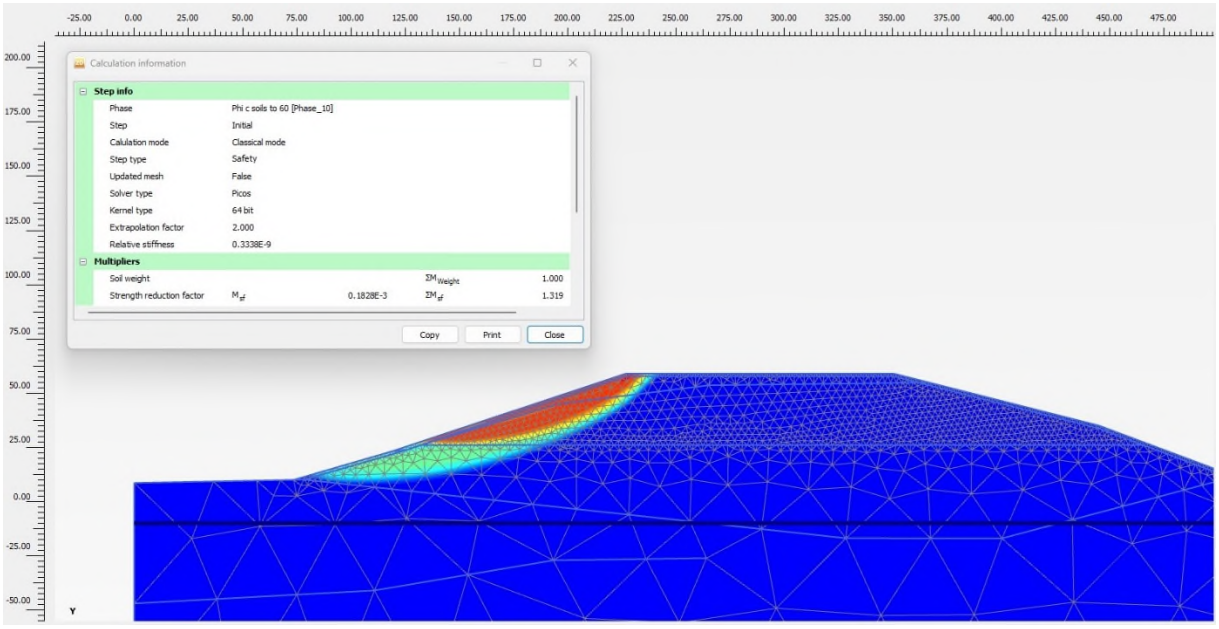



*Figure SRA20: Model 2, Stage 5 failure mode*

## 3.5 Model 1t: Stability Analyses

A summary of the Model 1t results from the phi-c reduction runs for the various stages of the construction are presented in **Table SRA8**. Model 1.1 had set the final deposit for recovery material height to 59mAOD and was found to be stable, Therefore, Model 2 was also assessed the same highest final level of 59mAOD.

**Table SRA8: Summary of Model 1t Stability Analysis**
**Effective Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of north slope | 1.43 |
| Stage 4 – Subgrade height set at 57.8mAOD, using slope gradient | Circular failure of north slope | 1.32 |
| Stage 5 – Final deposit for recovery material height set at 59mAOD, south face using existing slope gradient | Circular failure of north slope | 1.28 |
| Stage 4a – Subgrade height set at 57.8mAOD, south face using revised gradient of 1v in 3h | Circular failure of both north and south slopes | 1.32 |
| Stage 5a - Final deposit for recovery material height set at 59mAOD, south face using revised gradient of 1v in 3h | Circular failure of both north and south slopes | 1.27 |

Graphical representations of selected analyses (including failure modes) are shown in Figure SRA21.

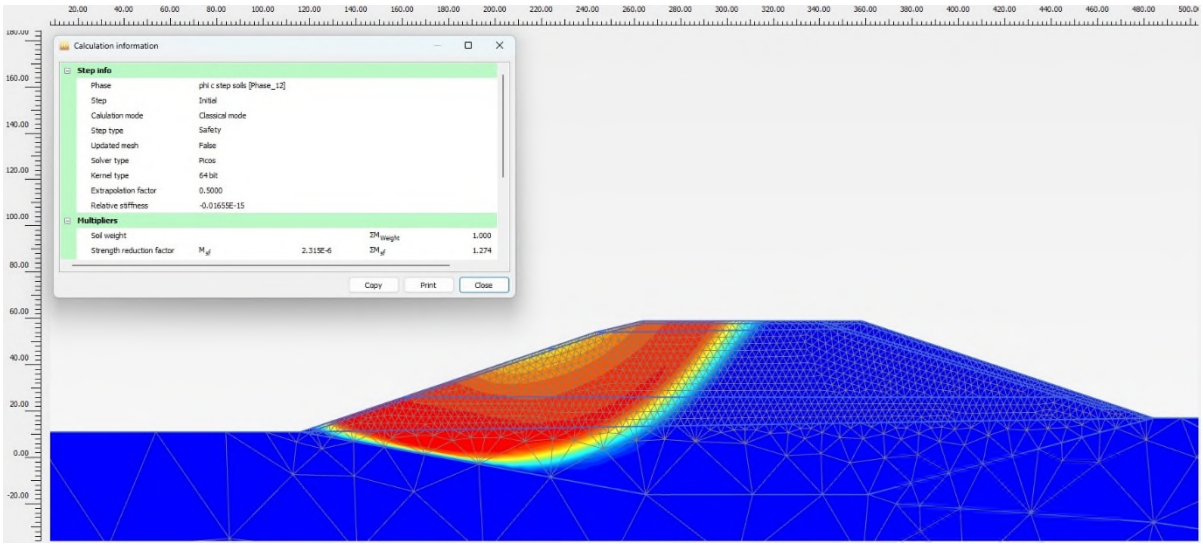



*Figure SRA21: Model 1t, Stage 5a failure mode*

## 3.6 Model 1t.1: Stability Analyses

As factors of safety were low on some stages for Model 1t, Model 1t.1 was created where the final deposit for recovery material level was set to 58mAOD. A summary of the Model 1t.1 results from the phi-c reduction runs for the various stages of the construction are presented in **Table SRA9**.

**Table SRA9: Summary of Model 1t.1 Stability Analysis**
**Effective Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of north slope | 1.43 |
| Stage 4 – Subgrade height set to **56.8mAOD**, using existing southern slope gradient. | Circular failure of north slope | 1.32 |
| Stage 5 – Final deposit for recovery material height set to **58mAOD**, south face using existing slope gradient. | Circular failure of north slope | 1.30 |
| Stage 4a – Subgrade height set to **56.8mAOD**, south face using revised gradient of **1v in 3h**. | Circular failure of both north and south slopes | 1.32 |
| Stage 5a - Final deposit for recovery material height set to **58mAOD**, south face using revised gradient of **1v in 3h** | Circular failure of both north and south slopes | 1.30 |

Graphical representations of selected analyses (including failure modes) are shown in Figure SRA22.

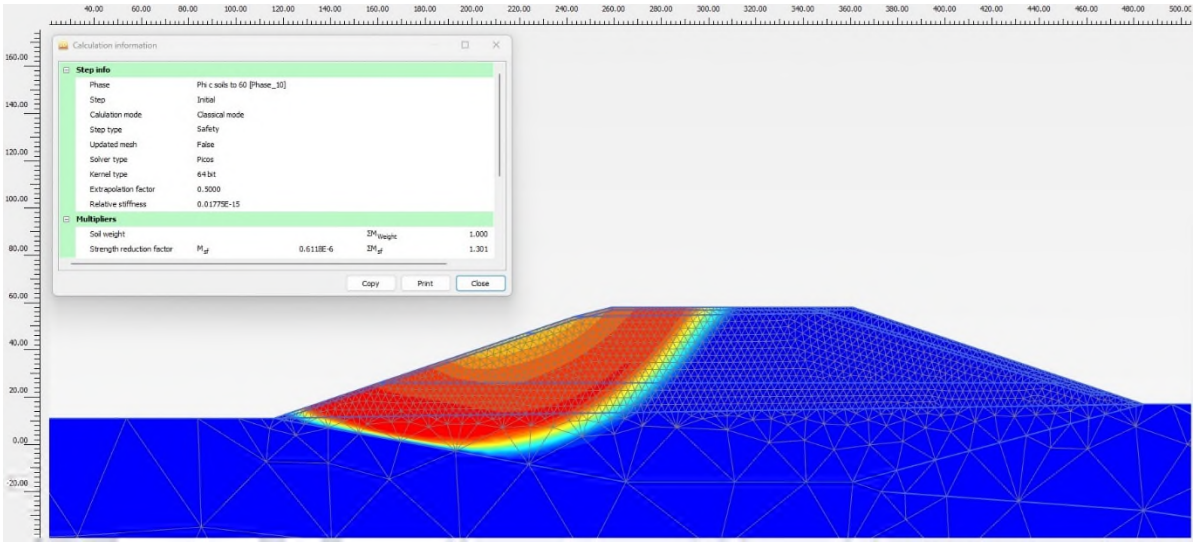



*Figure SRA22: Model 1t.1, Stage 5a failure mode*

## 3.7 Model 2t: Stability Analyses

A summary of the results from the phi-c reduction runs for the various stages of the construction for Model 2t are presented in **Table SRA10**.

**Table SRA10: Summary of Model 2t Stability Analysis**
**Total Stress Parameters (Phi-C reduction)**

| Stage of the construction process modelled | Critical slope identified during analysis | Lowest Factor of Safety |
|---|---|---|
| Stage 3 – Existing situation | Circular failure of east slope | 1.38 |
| Stage 4 – Subgrade height set at 57.8mAOD, west and east faces using proposed final gradients | Circular failure of west slope | 1.37 |
| Stage 5 – Final deposit for recovery material height set to 59mAOD, west and east faces using proposed final gradients | Circular failure of west slope | 1.32 |

Graphical representations of the analyses (including failure modes) are shown in Figure SRA23.

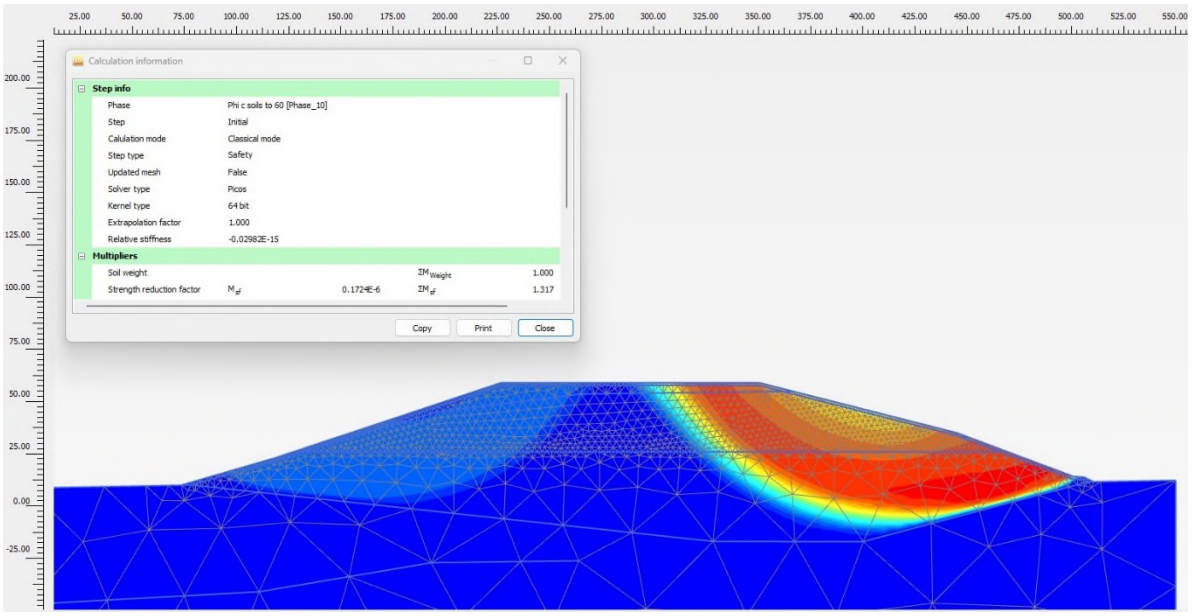



*Figure SRA23: Model 2t, Stage 5 failure mode*

# 4 ASSESSMENT

The assessments outlined above are presented in the order described.

## 4.1 Model 1 and 1.1: Stability Assessment – Effective Stress Analysis

Analysis of Model 1 (with southern flank extended up to a maximum height of 60mAOD at existing gradient) returned a factor of safety just below 1.3 with a predicted fail in the higher, northern slope.

When assessing the placement of steeper sub-grade fill to 1v in 2.5h on the southern flank, failures were predicted in the newly placed fill material with factors of safety of 1.15 after the sub-grade fill and 1.06 after the final soils placement.

Therefore, the model required amendment and Model 1.1 was created with a final height of 59mAOD and a shallower gradient of 1v in 1.3h for the southern flank sub-grade fill. With Model 1.1, factors of safety above 1.3 were returned for all stages of construction.

An analysis of an additional 5 year waiting period after final inert import material placement found that the factor of safety for the system increased from 1.31 to 1.36.

## 4.2 Model 2: Stability Assessment – Effective Stress Analysis

Model 1.1 used a final deposit for recovery material height of 59mAOD and returned adequate factors of safety. Therefore, Model 2 was assessed at the same highest level of 59mAOD.

Model 2 was assessed with the proposed final model gradients for the additional sub-grade fill on the western flank and re-grading of the eastern flank. Analysis found that factors of safety were above 1.3 for all proposed stages of construction based on the 59mAOD final height.

## 4.3 Models 1t and 1t.1: Stability Assessment – Total Stress Analysis

As Model 1.1 used a final deposit for recovery material height of 59mAOD and returned adequate factors of safety. Therefore, Model 1t was assessed at the same highest level of 59mAOD.

Analysis of Model 1t (with southern flank extended up to a height of 59mAOD at existing gradient) found a factor of safety just below 1.3 with a fail of the higher northern slope.

When assessing the placement of steeper sub-grade fill to 1v in 3h on the southern flank, factors of safety of 1.32 for fill and 1.27 for the final soils were predicted by the analysis, slightly less than 1.3.

Therefore, the model required amendment and Model 1t.1 was created with a highest level of 58mAOD. With Model 1t.1, factors of safety equal to or above 1.3 were returned for all stages of construction.

## 4.4 Model 2t Stability Assessment – Total Stress Analysis

As Model 1.1 used a final deposit for recovery material height of 59mAOD and returned adequate factors of safety. Therefore, Model 2t was assessed at the same highest level of 59mAOD.

Model 2t was assessed with the proposed final model gradients for the additional sub-grade fill on the western flank and re-grading of the eastern flank. Analysis found that factors of safety were above 1.3 for all proposed stages of construction based on a final deposit for recovery material level of 59mAOD.

# 5 CONCLUSIONS

## 5.1 General

The above stability risk assessment (SRA) has addressed the stability issues anticipated for the construction of a 1.2m deep final topsoil and subsoil layer from imported inert soils in Phases 1 and 2 of the Bovey Basin Waste Recovery Permit Area.

Specifically, the following scenarios have been investigated for the different possible design options for the construction of the Phase 1 and 2 imported inert recovery material soil layer.

- Construction of Sub-grade to the proposed model and to several different scenarios to obtain favorable factors of safety;
- Construction of the imported inert material soil layer to the proposed model and to several different scenarios to obtain favorable factors of safety.

Analyses have been based on the available site investigation information, conservative materials parameters, and a worst-case interpretation. The conclusions leading into the design are listed in the following sections.

## 5.2 Construction of the Subgrade

The subgrade is proposed to be constructed from suitable site-sourced out-of-specification quarried material. This is generally understood to be cohesive in nature although based on existing site tip records some material may comprise sands.

Analysis has found that the western, eastern and northern flanks of the proposed sub-grade model can be constructed in accordance with the gradients originally proposed. However, for the southern flank, the proposed 1v in 2.5h gradient must be slackened to no steeper than 1v in 3h. In addition, the maximum height that the sub-grade in the Rixey Park Tip should be taken to is 56.8mAOD.

The shorter the time period over which a slope or embankment comprising cohesive materials is constructed the greater the build-up of pore water pressures within the material which can lead to a reduction in the factor of safety for the system. The factors of safety for the heights and gradients of the temporary waste slopes are based on a conservative timing of the placement of the completion of the Rixey Park Tip Phase 1 and 2 sub-grade. Remaining sub-grade placement on Rixey Park Tip should take place over a minimum two year period. Should actual or anticipated tipping rates on site exceed this, then a re-assessment of the waste slope stability will be required**.**

Any future sub-grade placed should be engineered in horizontal layers to achieve a minimum undrained shear strength of 70 kPa (where the sub-grade is cohesive). In order to achieve this, it is recommended that minimum 250mm layers should be used and the layers should be compacted with a minimum 4 passes from a suitable sheepsfoot roller.

New sub-grade should be keyed-in to existing tip material. Any existing tip material which is soft or wet should be removed from the area prior to tipping new material.

Subgrade which has been placed and become soft or wet should either be removed from the work area or left to dry prior to any further tipping. Works areas should be kept free of standing water.

## 5.3 Construction of Imported Inert Recovery Material Soil Layer

The recovery material soil layers are proposed to be constructed from suitable imported soils and subsoils. Th imported material is assumed to comprise clayey sub-soils with sand/gravel and organic topsoil. The topsoil layer is proposed to be ~300mm in thickness with ~900mm of sub-soils.

Analysis has found that the western, eastern and northern flanks of the proposed final imported recovery material model can be constructed in accordance with the gradients originally proposed. However, for the southern flank, the proposed 1v in 2.5h gradient must be slackened to no steeper than 1v in 3h. In addition, the maximum height that the deposit for recovery material in the Phase 2 (Rixey Park Tip) area should be taken to is 58mAOD.

Due to the requirement to retain the quality of the soils, no specific compaction is recommended for soil layer placement other than pushing out the soils with suitable plant such as a dozer or excavator.

## 5.4 Temporary Waste Slopes

As the imported inert material will only be placed 1.2m in depth, no significant temporary waste slopes will be present at the site.

Where imported material is stored prior to placement, soils and subsoils should be stored in stockpiles of no greater than 3m height for topsoil and no greater than 5m height for sub-soils. Side slopes of the stockpiles should be no steeper than 1v in 2h and the piles should be free draining.

## 5.5 Monitoring

During infilling operations, the sub-grade and deposit for recovery material filling areas should be monitored daily by a suitably competent individual. Monitoring should cover examining the crest and toe of any slopes for signs of instability (bulging of the toe or tension cracks at the crest) or signs of any unexpected water discharges from slopes.

After completion of the infilling to final levels, the completed areas should be monitored at least monthly by a suitably competent individual. Monthly aftercare monitoring should cover examining the crest and toe of any slopes for signs of instability (bulging of the toe or tension cracks at the crest) or signs of any unexpected water discharges from slopes.

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# Appendices

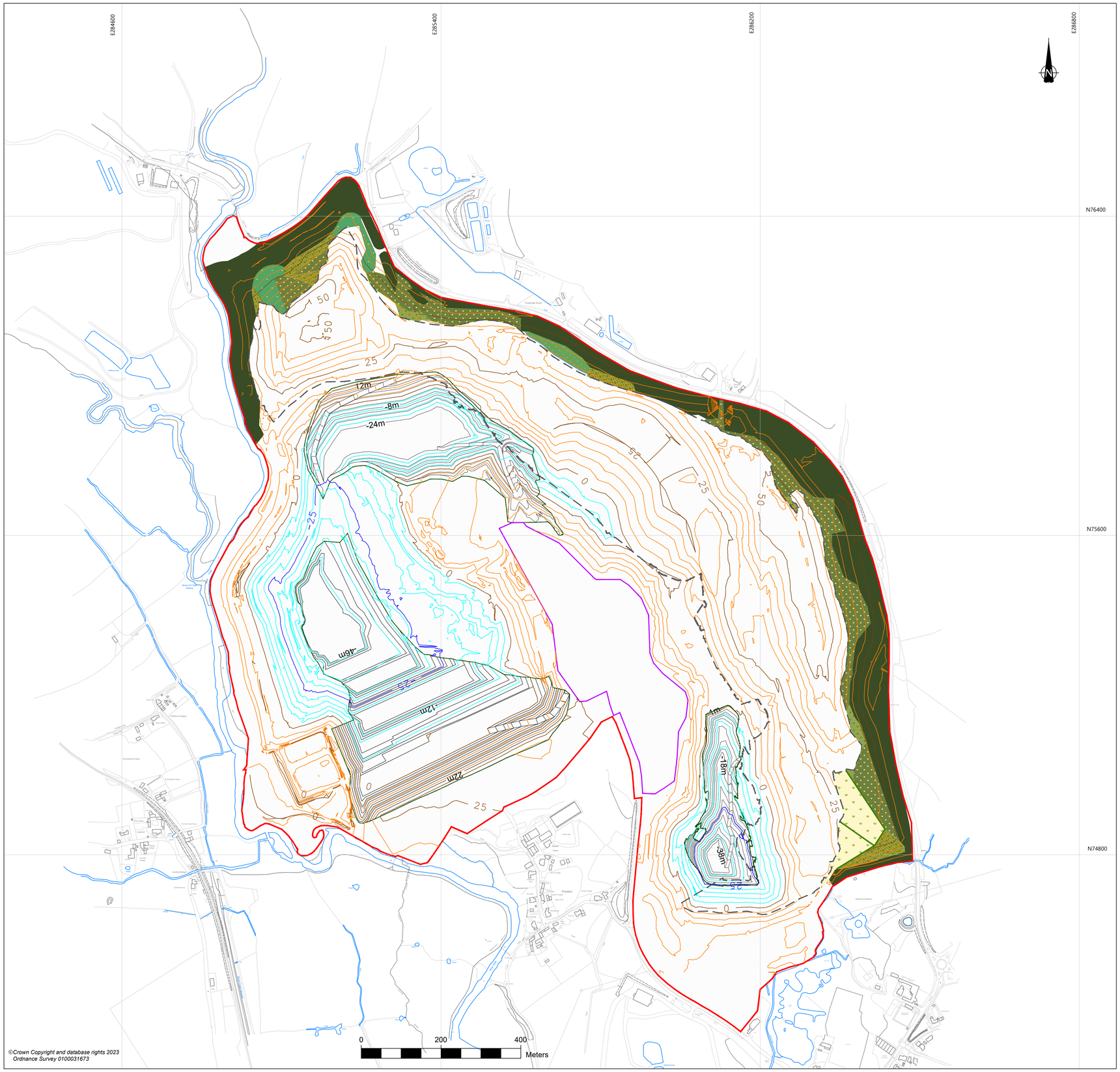
**Appendix SRA1 – Drawings**

**Appendix SRA2 – 2023 InSitu CPT Investigation Report**

# Appendix SRA1

**Drawings**

| | | |
|---|---|---|
| 18876-032 | - | Wardel Armstrong Phase 1 Drawing |
| 18876-033 | - | Wardel Armstrong Phase 2 Drawing |




LEGEND

- PLANNING BOUNDARY
- PRESTON MANOR PROCESSING PLANT
- PHASE 1 EXTRACTION AREA
- ACTIVE PHASE 1 CONTOURS
- CONTOURS WITH POSITIVE VALUES
- CONTOURS WITH NEGATIVE VALUES
- TIPPING FOOTPRINT= 64.354HA (EXTENT OF LANDSCAPE SCHEME= 95.074HA)

EXISTING RETAINED

- NEUTRAL MEADOW (UNIMPROVED)
- NEUTRAL GRASSLAND
- EPHEMERAL / SHORT PERENNIAL
- DENSE SCRUB
- BROADLEAVED WOODLAND

| REVISION | DETAILS | DATE | DRAWN | CHKD | APPD |
|---|---|---|---|---|---|
| B | AREA OF EXTENT OF LANDSCAPE AMENDED | 31/01/23 | EL | MP | SR |
| A | FIRST ISSUE | 20/01/23 | SJB | MP | SR |

CLIENT

SIBELCO UK LIMITED

PROJECT

CENTRAL AREA
CONSOLIDATION APPLICATION

DRAWING TITLE

PHASE 1
PROGRESSIVE RESTORATION PLAN

| ORG No. | REV | SUIT. CODE |
|---|---|---|
| ST18876-032 | B | |

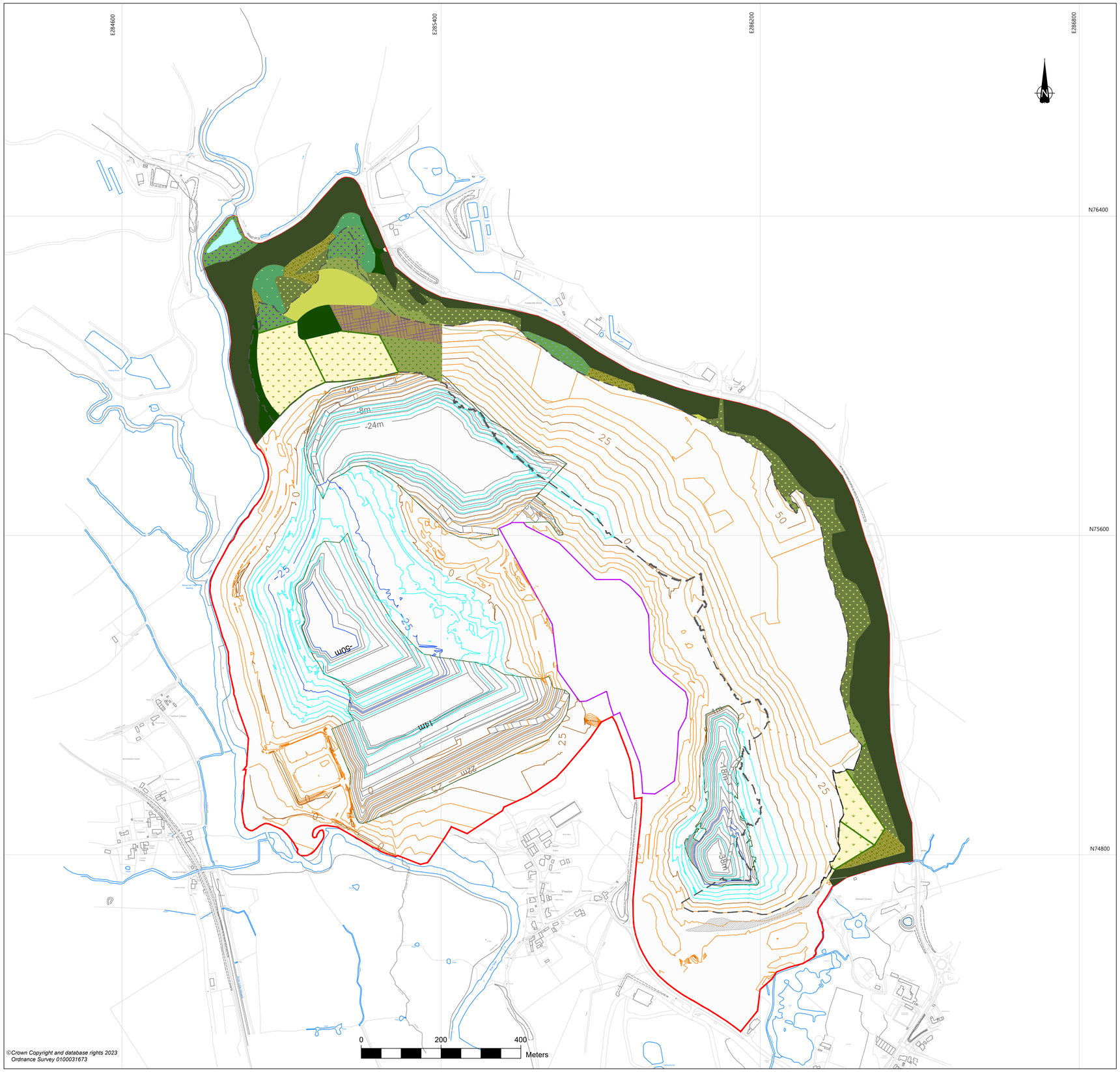
| DRG SIZE | SCALE | DATE |
|---|---|---|
| A1 | 1:5000 | 28/3/2022 |

| DRAWN BY | CHECKED BY | APPROVED BY |
|---|---|---|
| EL | AY | SR |

wardell armstrong



N:\ST\ST18876 - BOVEY BASIN BALL CLAY WORKINGS\03 - DESIGN\AUTOCAD\ST18876-032-A PHASE 1 PROGRESSIVE RESTORATION PLAN.DWG




LEGEND

- PLANNING BOUNDARY
- PRESTON MANOR PROCESSING PLANT
- PHASE 1 EXTRACTION AREA
- ACTIVE PHASE 1 CONTOURS
- CONTOURS WITH POSITIVE VALUES
- CONTOURS WITH NEGATIVE VALUES
- TIPPING FOOTPRINT= 64.354HA (EXTENT OF LANDSCAPE SCHEME= 95.074HA)

EXISTING RETAINED

- NEUTRAL MEADOW (UNIMPROVED)
- NEUTRAL GRASSLAND
- EPHEMERAL / SHORT PERENNIAL
- DENSE SCRUB
- BROADLEAVED WOODLAND

PROPOSED NEW

- NEUTRAL MEADOW - PROPOSED
- NEUTRAL GRASSLAND - PROPOSED
- HEATHLAND - PROPOSED
- BROADLEAVED WOODLAND - PROPOSED
- WOODLAND EDGE - PROPOSED
- ATTENUATION POND - PROPOSED
- NATURAL REGENERATION - PROPOSED

| REVISION | DETAILS | DATE | DRAWN | CHKD | APPD |
|---|---|---|---|---|---|
| B | AREA OF EXTENT OF LANDSCAPE AMENDED | 31/01/23 | EL | MP | SR |
| A | FIRST ISSUE | 25/01/23 | SJB | MP | SR |

CLIENT

SIBELCO UK LIMITED

PROJECT

CENTRAL AREA
CONSOLIDATION APPLICATION

DRAWING TITLE

PHASE 2
PROGRESSIVE RESTORATION PLAN

| | | | |
|---|---|---|---|
| ORG No. ST18876-033 | | REV B | SUIT. CODE |
| DRG SIZE A1 | SCALE 1:5000 | DATE 28/3/2022 | |
| DRAWN BY EL | CHECKED BY AY | APPROVED BY SR | |

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N:\ST\ST18876 - BOVEY BASIN BALL CLAY WORKINGS\03 - DESIGN\AUTOCAD\ST18876-033-A PHASE 2 PROGRESSIVE RESTORATION PLAN.DWG

# Appendix SRA2

## 2023 InSitu CPT Investigation Report

IN SITU
SITE INVESTIGATION

STATIC CONE PENETRATION TEST

# FACTUAL REPORT

CLIENT: Sibelco UK

PROJECT: Whitepit and Heathfield Tips (NE Corner) CPTs June 2023

| | |
|---|---|
| **Project** | **Whitepit and Heathfield Tips (NE Corner) CPTs June 2023** |
| **Project No.** | **1230268** |
| **Client** | **Sibelco UK** |
| **Address** | **Preston Manor Works, Chudleigh Road, Newton Abbot, TQ12 3PR** |

**Attention:** Mr Rory Lynch

Dear Mr Lynch,

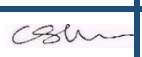
We have pleasure in providing a digital copy of our report and data in AGS format for the above project.

We hope that you are satisfied with the performance of our staff, equipment and reporting on this project. If you should have any queries about any aspect of the works carried out, please do not hesitate to contact us. We look forward to being of service to you in the future.

Yours faithfully,
**In Situ Site Investigation Limited**

**Darren Ward**
**Director**

**Report Issue**

| Issue | Date | Prepared | Sign | Checked | Sign | Approved | Sign |
|---|---|---|---|---|---|---|---|
| 01 | 21/06/2023 | Chloe Donovan |  | Darren Ward |  | Darren Ward |  |

# Table of Contents

# 1.0 INTRODUCTION

In Situ Site Investigation Limited (In Situ) was engaged in a geotechnical site investigation at Whitepit and Heathfield Tips at the request of Sibelco UK. The site investigation consisted of completing 15 Static Piezocone Penetration Tests (CPTU), to provide information on the soil conditions and derived geotechnical parameters at:

Preston Manor Works,
Chudleigh Road,
Newton Abbot,
TQ12 3PR

All test locations were provided by the client. A site map is included in the end of Appendix A of this report (if provided by the client). The tests were stopped when they reached the target depth as per the client's technical specifications or for other technical reasons, as detailed in the *Project Summary Table* in *Appendix A.1* and on each CPTU log included in Appendix B of this report.

The fieldwork was carried out from 15th June 2023 to 16th June 2023 as per the client's request.

The work on site and the final factual reporting have been undertaken in accordance with the international technical standard *ISO 22476-1:2022(E)*.

# 2.0 FIELDWORK

## 2.1 CONE PENETRATION TESTS

The fieldwork activity is summarised in Table 2.1.

| **Table 2.1 Fieldwork Summary** | |
|---|---|
| **CPT Operator/s** | Andy Chatfield |
| **Date Started** | 15th June 2023 |
| **Date Finished** | 16th June 2023 |
| **In Situ S.I. Project Manager** | Darren Ward |
| **Main Contractor's Site Manager** | Darrin Hewings & Nigel Phil |

### *2.1.1 Rig Information*

Details of CPTU rig used in this project are shown in Table 2.2. Full data sheet for the rig is presented in *Appendix A.2*.

| **Table 2.2 Rig Summary** | |
|---|---|
| **Rig Name** | **Rig Description** |
| CPT017 | 20 Tonne Track Mounted CPT Rig |

### *2.1.2 CPTU Cone*

Details of electric CPTU cone (Type TE2) used in this project conforming to the requirements of Application Class 2 of *ISO 22476-1:2022*, are shown in Table 2.3.

| **Table 2.3 Cone Summary** | | |
|---|---|---|
| **Number** | **Cross-section area** | **Filter position** |
| S15-CFIP.2175 | 15cm$^2$ | $u_2$ |

A full datasheet of the cone used is shown in *Appendix A.3*.

The cone's measured parameters are shown in Table 2.4.

| **Table 2.4 Completed Fieldwork Summary** |
|---|
| 15 CPTU to a maximum depth of 18.64m. Each test measured Cone Resistance, $q_c$, Sleeve Friction, $f_s$, Porewater Pressure in the shoulder position, $u_2$, Inclination in X and Y axes. |
| *Provision of factual report with estimated soil type, derived geotechnical parameters & AGS data* file. |

### 2.1.3 CPTU Cone Calibration

The cone resistance and sleeve friction are recorded by calibrated load cells in the cone. The CPTU load cells and pressure transducers are regularly calibrated in line with *ISO 22476-1:2022(E)* standard by the cone manufacturer. The cone calibration certificate for the cone used at this site are presented in *Appendix A.4*.

### 2.1.4 CPTU Cone Saturation

The pore water pressure is recorded using a calibrated pressure transducer located in the piezocone. To ensure pore water pressure measurements are not affected by the presence of air in the measuring transducer, a de-airing procedure is carried out prior to each test. The cone and filter are saturated using a glycerine fluid with a viscosity of 10,000 CST.

### 2.1.5 Test Procedure

The tests are carried out in accordance with the *International Standard for Electrical Cone and Piezocone Penetration Test ISO 22476-1:2022(E)*.

The final depths of the tests were determined by either completion to the specified test depth or when the maximal safe capacity of the equipment was reached. A schedule of the tests performed is shown in *Appendix A.1*, which has been compiled from the operators' daily progress reports.

The data is transmitted from the digital CPTU through an umbilical cable that runs through the push rods to the data acquisition system. Results are displayed instantaneously on the computer logging screen. The results are recorded on the computer hard disc.

The rate of penetration is kept constant at 20 mm/s ± 5 mm/s except when penetrating very dense or hard strata. Before each test is carried out zero values are taken of the cone to check if it is within calibration. At the end of each test, zero values are taken again to see if there has been any drift during the test. These values are inspected during the post processing stage. This is a quality check on the data and the testing procedure. Individual test zero values are shown on their corresponding test results in *Appendix B*.

### 2.1.6 In Situ Pore Pressure ($u_0$)

The in situ or hydrostatic pore pressure is required for the calculation of several derived parameters included in this report. For this report, the groundwater level is assumed at 0.5m below ground surface, for calculation purposes. The in situ pore pressure, $u_0$ values are presented on the pore pressure plot, on *CPT Log 01,* which is included in *Appendix B*.

## 2.2 POSITIONING

Positioning and surveying of all investigated locations was the responsibility of the client.

# 3.0 CONE PENETRATION MEASURED PARAMETERS

All measured parameters of tests carried with the CPTU cone are shown in *Appendix B* and all the information about data processing and results are given in sections *3.1*, *3.2* and *3.3*.

## 3.1 DATA PROCESSING

The measured parameters, cone end resistance, $q_c$, sleeve friction, $f_s$, porewater pressure measurements with filter in shoulder position, $u_2$ and inclination for *x* and *y* axis, $I_x$, $I_y$, were recorded for every *10 mm* of penetration keeping a constant speed of *20 mm/s ± 5 mm/s*, which may slightly change when the cone is penetrating hard strata.

The measured data from the site works is processed and presented using specialised CPT software. The interpretations on the CPTU results were carried out following the recommendations of *ISO 22476-1:2022(E)*, *Lunne et al. (1997)* and *Robertson (2015)*. Measured parameters, mentioned in *Sections 3.2* and *3.3*, were used to derive all the geotechnical parameters, which are presented in *Chapter 4.0*. The soil behaviour type method used on this report is *Robertson et al. (1986)*, shown in *Figure 3.2*.

### *3.1.1 Zero Measurements*

Before and after each CPTU test, zero measurements are recorded for each channel of the cone. The zero measurements are presented on the logs in *Appendix B*. This is a routine quality check carried out on site.

## 3.2 MEASURED PARAMETERS

### *3.2.1 Cone Resistance ($q_c$)*

Cone resistance, $q_c$, is measured as the total force acting on the cone, divided by the projected area of the cone. The results are presented in *MPa*, on *CPT Log 01*, in *Appendix B*, scale *0-20 MPa* with a minor scale printing on the same graph at *0-4 MPa*.

### *3.2.2 Sleeve Friction ($f_s$)*

Sleeve friction, $f_s$, is measured as the total frictional force acting on the friction sleeve divided by its surface area. The results are presented in *kPa*, on *CPT Log 01*, in *Appendix B*, using a scale of *0-500 kPa*.

### 3.2.3 Porewater pressure ($u_2$)

The pore pressure, $u_2$, is measured during the test. If the material is free draining and saturation is maintained it will normally measure hydrostatic pore pressure. In materials that are not free draining, it will record the total pore pressure (hydrostatic plus any excess pore pressures generated) created by the cone penetration through this material.

The filter element can be mounted in one of three positions. For all tests carried out in this project the filter was mounted in the $u_2$ position (see *Figure 3.1*).

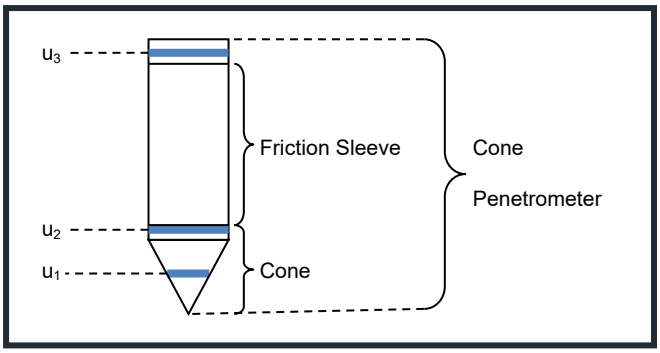



***Figure 3.1:*** *Diagram showing pore pressure filter locations (after Lunne et al., 1997)*

### 3.2.4 Inclination ($I_x$, $I_y$)

The CPT rig was set up to obtain a thrust direction as near as possible to vertical. The CPTU cones have inclinometers incorporated to measure the non-verticality of the test. For test depths less than *15 m*, significant non-verticality is unusual, provided the initial thrust direction is vertical.

## 3.3 ESTIMATED SOIL BEHAVIOUR TYPE

### 3.3.1 Friction Ratio ($R_f$)

The friction ratio, $R_f$ is the ratio between the sleeve friction and the cone resistance (Lunne *et al.,* 1997).

$$Fricton\ Ratio\ (R_f) = \left(\frac{Sleeve\ Friction\ (f_s)}{Cone\ Resistance\ (q_c)}\right) \times 100$$

### 3.3.2 Estimated Soil Behaviour Type (SBT)

The estimation of soil behaviour type, *SBT*, using measurements of cone resistance and sleeve friction is based upon the variations of the friction ratio and cone resistance. The friction

ratio varies depending upon whether the soil is cohesive or granular. The cone resistance varies depending on the strength and densities of the soil.

The interpretation used in this report is *Robertson et al. (1986)*, which is shown in Figure 3.2. The results are presented on *CPT Log 01*, in *Appendix B*.

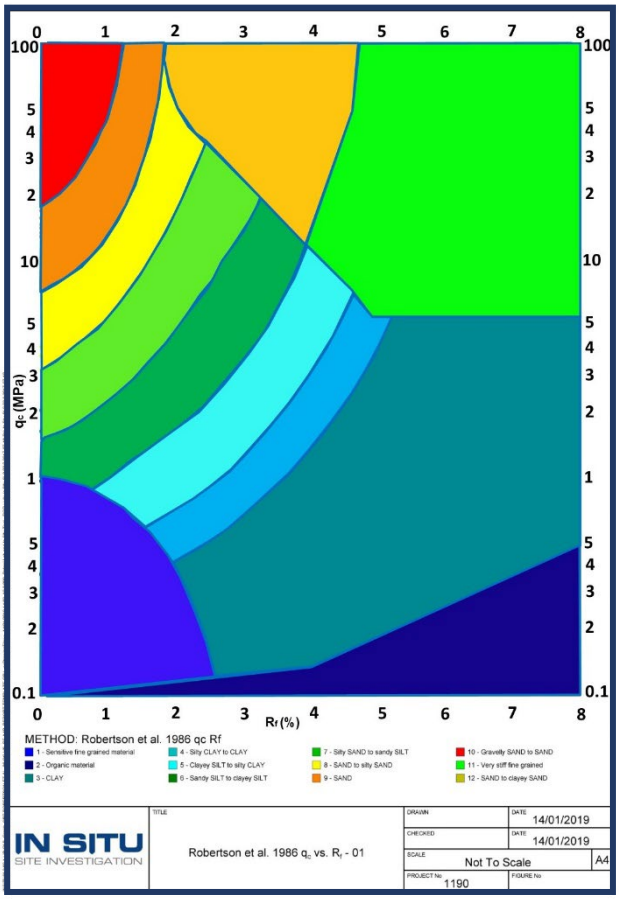



***Figure 3.2:*** *Robertson et al., 1986 soil behaviour type chart.*

### *3.3.3 Pore Pressure Ratio ($B_q$)*

Pore pressure ratio, $B_q$ is the ratio between the measured pore pressure generated during penetration and the corrected cone resistance minus the total overburden stress.

Pore pressure ratio as defined by *Senneset and Janbu (1985)* is defined as:

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

where

| | |
|---|---|
| $u_2$ | is pore pressure measured between the cone and the friction sleeve |
| $u_0$ | is equilibrium pore pressure |
| $\sigma_{vo}$ | is total overburden stress |
| $q_t$ | is cone resistance corrected for unequal end area effects |

## 3.4 APPLIED CORRECTIONS

### 3.4.1 Corrected Cone Resistance ($q_t$)

For each penetration test, the measured cone resistance, $q_c$, can be corrected for the ‘‘unequal area effect’’ due to the influence of the ambient pore water pressure acting on the cone.

The correction has been applied using the following equation by Lunne et *al.,* 1997:

$$q_t = q_c + [u_2.(1 - \alpha)]$$

where

$\alpha$ is the cone area ratio

The cone area ratio used for this project is stated on both the cone calibration certificate and the data footer. This value is geometrically measured.

### 3.4.2 Depth Correction

All tests in the report have been corrected for depth difference caused by inclination. This has been calculated using the method described in *ISO 22476-1:2022*.

To calculate the corrected depth the following formula is used:

$$z = \int_0^l C_{inc} \cdot dl$$

where

*z* is penetration depth, in *m*
*l* is penetration length, in *m*
$C_{inc}$ is correction factor for the effect of the inclination of the CPTU relative to the vertical axis.

The equation for calculating the correction factor for the influence of the inclination for a bi-axial inclinometer is:

$$C_{inc} = \frac{1}{\sqrt{(1 + tan^2\beta_1 + tan^2\beta_2}}$$

where

$\beta_1$ is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees
$\beta_2$ is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle $\beta_1$, in degrees

# 4.0 GEOTECHNICAL DERIVED PARAMETERS

A number of empirical correlations can be used to derive geotechnical parameters from CPTU data. This report includes only the parameters which are described in this chapter. The results of all correlations used to obtain the geotechnical derived parameters are presented on *CPT Log 02* and *CPT Log 03* in *Appendix B*.

**Please, note that each empirical correlation is derived for a certain type of soil, and may not be appropriate for all the soil types encountered on this project.**

## 4.1 SOIL BEHAVIOUR TYPE INDEX ($I_c$)

The soil behaviour type index, $I_c$, was derived by *Jefferies and Davies (1991)*, and was created to simplify the application of CPTU SBT chart shown in *Chapter 3*, *Figure 3.2*. This approach has been modified for use with the *Robertson (1990)* normalised CPT soil classification chart, *Figure 4.1*. The normalised cone parameters $Q_t$ and $F_r$ (for definitions see *Appendix A5* Symbol List) can be combined into one Soil Behaviour Type Index, $I_c$, *(Lunne et al., 1997)*.

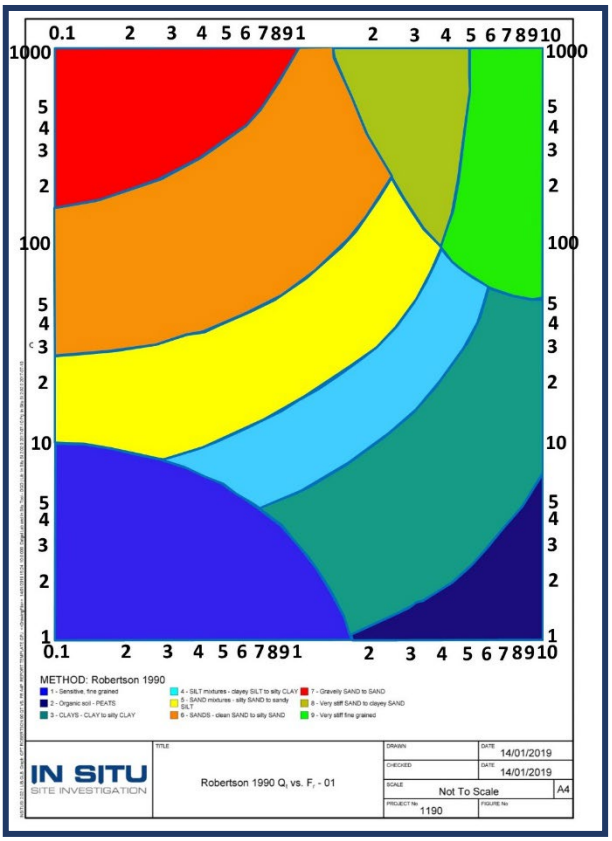



***Figure 4.1:*** *Robertson 1990 soil behaviour type chart.*

The soil behaviour type index, $I_c$, can then be defined using *Robertson (2010)* formula, given below:

$$I_c = ((3.47 - logQ_t)^2 + (logF_r + 1.22)^2)^{0.5}$$

where

$Q_t$ is the normalized cone resistance which represents the simple normalization with a stress exponent (n) of *1.0*, which applies well to clay-like soils

$F_R$ is the normalized friction ratio, in *%*

The boundaries of soil behaviour type are then given in terms of the index, $I_c$, presented in *Table 4.1* below.

The soils behaviour type index does not apply to zones *1*, *8* and *9*. The profiles of $I_c$ provide a simple guide to the continuous variation of soil behaviour type in a given soil profile based on CPTU results, with a reliability greater than *80%* compared with soil samples *(Robertson, 2015).*

| Zone | Soil Behaviour Type | $I_c$ |
|---|---|---|
| 1 | Sensitive fine grained | N/A |
| 2 | Organic Soils – clay | >3.6 |
| 3 | Clays – silty clay to clay | 2.95 – 3.6 |
| 4 | Silt mixtures – clayey silt to silty clay | 2.60 – 2.95 |
| 5 | Sand mixtures – silty sand to sandy silt | 2.05 – 2.6 |
| 6 | Sands – clean sand to silty sand | 1.31 – 2.05 |
| 7 | Gravelly sand to dense sand | <1.31 |
| 8 | Very stiff sand to clayey sand* | N/A |
| 9 | Very stiff fine grained * | N/A |

** Heavily over consolidated or cemented*

***Table 4.1:*** *Normalized CPTU Soil Behaviour Type ($SBT_n$) Index values, $I_c$.(Robertson, 2010)*

## 4.2 N VALUE OF STANDARD PENETRATION TEST (SPT) ($N_{60}$)

The derived *N* value of *SPT, $N_{60}$*, is strongly and directly related to the cone resistance, $q_c$.

In this report the $N_{60}$ value is derived using the following correlations, developed by *Robertson and Wride (1998)*, *Jefferies and Davies (1998)* and Robertson (2012):

1) *Robertson & Wride (1998)*

$$N_{60} = \frac{q_c}{8.5 \cdot p_a \left(1 - \frac{I_C}{4.6}\right)}$$

2) *Jefferies and Davies (1993)*

$$N_{60} = \frac{q_c}{0.85 \cdot \left(1 - \frac{I_C}{4.75}\right)}$$

3) *Robertson (2012)*

$$N_{60} = \frac{\frac{q_c}{p_a}}{10^{1.1268 - 0.2817 I_C}}$$

where

| | |
|---|---|
| $q_c$ | is the cone resistance |
| $p_a$ | is the atmospheric pressure equal to *100 kPa* |
| $I_c$ | is the soil behaviour type index calculated as given in *section 4.1* |

It is suggested that these methods provide a better estimation of the $N_{60}$ value than the actual measured *N*, due to the poor repeatability of SPT test. However, in fine grained soil with high sensitivity these methods may overestimate $N_{60}$ *(Jefferies and Davies, 1991).* The third method suggested by *Robertson (2012)* provides improved estimates of $N_{60}$ for insensitive clays.

## 4.3 RELATIVE DENSITY ($D_r$)

Relative density, $D_r$, is an intermediate parameter for coarse grained soils, widely used to describe sand deposits. All the research on deriving the relative density from CPTU tests results are carried out for ***clean predominantly quartz sands***. The studies have shown that CPTU resistance in granular soils is controlled by sand relative density, in situ effective stresses and compressibility. The more compressible sands tend to give lower penetration resistance for a given relative density then less compressible sands.

In this report relative density is calculated using the methods suggested by *Baldi et al., (1986)*, *Jamiolkowski et al., (2001)* and *Kulhawy and Mayne (1990)* as shown in the equations below:

1) Baldi et al., (1986)

$$D_r = \frac{1}{C_2} \cdot ln\left(\frac{q_c \cdot Wehr}{C_1 \cdot (\sigma'_{v0})^{0.55}}\right) \cdot 100$$

where

$C_1$ is a consolidation coefficient which is *157* for normally consolidated soils and *181* for over consolidated soils

$C_2$ is a consolidation coefficient which is *2.41* for normally consolidated soils and *2.46* for over consolidated soils

Wehr is a correction coefficient for calcareous soils

2) Jamiolkowski et al., (2001)

$$D_r = 100 \cdot \left[0.268 \cdot ln\left(\frac{q_t/\sigma_{atm}}{\sqrt{\sigma'_{v0}/\sigma_{atm}}}\right) + C_1\right]$$

where

$C_1$ is a compressibility coefficient which is *-0.675* for average compressible soils, *≤1.0* for high compressible soils and carbonate or calcareous sands and *≥-2.0* for low compressible soils

$q_t$ is corrected cone resistance

$\sigma_{atm}$ is the atmospheric pressure

3) Kulhawy and Mayne, (1990)

$$D_r = \left[\frac{q_{c1}}{305 \cdot C_1 \cdot OCR^{0.18} \cdot \left(1.2 + 0.05 \cdot log(t/100)\right)}\right]^{0.5} \cdot 100$$

where

$q_{c1}$ is the cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{c1} = \frac{q_c}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

where

$q_c$ is the cone resistance in *kPa*

$\sigma'_{v0}$ is the initial vertical effective stress in *kPa*

$C_1$ is a compressibility coefficient which is *-0.91* for low compressible sands, *1.0* for medium compressible sands and *1.09* for high compressible sands

t is time in years

## 4.4 FRICTION ANGLE (φ')

Friction angle, *φ*', is used to express the shear strength of uncemented, coarse grained soils. In this report friction angle is derived by the correlations of *Mayne and Campanella (2005)*, *Robertson and Campanella (1983)* and *Kulhawy and Mayne (1990)*.

1) Mayne and Campanella, (2005)

$$\varphi' = 29.5^0 \cdot B_q^{0.121} \cdot \left[0.256 + 0.336 \cdot B_q + logQ_t\right]$$

where

$B_q$ is the pore pressure ratio, calculated as in Session 3.3

$Q_t$ is the normalized cone resistance

2) Robertson and Campanella, (1983)

$$\varphi' = \tan^{-1}\left(0.1 + 0.38 \cdot log\left(\frac{q_t}{\sigma'_{v0}}\right)\right)$$

where

$q_c$ is the cone resistance in *kPa*

$\sigma'_{v0}$ is the initial vertical effective stress in *kPa*

3) Kulhawy and Mayne, (1990)

$$\varphi' = 17.6^0 + 11.0^0 \cdot log(q_{t1})$$

where

$q_{t1}$ is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

The method suggested by *Mayne and Campanella (2005)* will not provide reliable results for heavily over consolidated soils, fissured geomaterials and highly cemented or structures clays. This approach gives reliable results when pore pressure is positive and varies $0.1 < B_q < 1.0$. The correlation suggested by *Robertson and Campanella (1983)* estimates the peak friction angle for uncemented, unaged, moderately compressible, predominately quartz sands. For sands of higher compressibility, the method will tend to predict low friction angles. The method suggested by *Kulhawy and Mayne (1990)* is an alternate relationship for clean, rounded, uncemented, quartz sands.

## 4.5 FINES CONTENT (*FC*)

The fines content, *FC*, in this report is estimated using two different methods, one from *Robertson and Wride (1998)* and the other, *Suzuki et al. (1998)* as presented below:

1) Robertson and Wride (1998)

$$I_C < 1.26: FC = 0$$
$$1.26 \leq I_C \leq 3.5: FC(\%) = 1.75I_C^{3.25} - 3.7$$
$$3.5 < I_C: \ FC = 100\%$$

2) Suzuki et al. (1998)

$$FC(\%) = 2.8I_C^{2.6}$$

where

$I_c$ is the soil behaviour type index, calculated as in section 4.1

## 4.6 UNDRAINED SHEAR STRENGTH ($s_u$)

Estimation of undrained shear strength, $s_u$, from CPTU tests using corrected cone resistance is carried out using the following correlation from *Lunne et al. (1981)*:

$$S_u = \frac{(q_t - \sigma_{v0})}{N_{kt}}$$

where

$N_{kt}$ is the empirical cone factor, which varies from *10* (*6* for very soft sensitive fine grained soils) to *20*. In this report 3 values are considered: *15*, *17.5* and *20*. $N_{kt}$ tends to increase with increasing plasticity and decrease with increasing soil sensitivity. It decreases as $B_q$ increases. (*Lunne et al., 1997*)
$\sigma_{vo}$ = total overburden stress.

This report only presents the undrained shear strength data on soils with soil behaviour type index, $I_c$ values greater than *2.60*.

The value of undrained shear strength, $s_u$ to be used in analysis depends on the design problem. In general, the simple shear in the direction of loading often represents the average undrained strength. For larger, moderate to high risk projects, where high quality field and laboratory data may be available, site specific correlations should be developed based on appropriate and reliable values of $s_u$.

## 4.7 SENSITIVITY ($S_t$)

The sensitivity, $S_t$ of clays is defined as the ratio of undisturbed peak undrained shear strength to totally remoulded undrained shear strength.

In this report $S_t$ is calculated using two correlations developed by *Schmertmann (1978)* and *Mayne (2007)*.

1) Schmertmann (1978)

$$S_t = \frac{s_u}{s_{u(rem)}} = \frac{q_t - \sigma_v}{N_{kt}}\left(\frac{1}{f_s}\right)$$

where

$s_{u(rem)}$ is the remoulded undrained shear strength. It can be assumed equal to the sleeve resistance, $f_s$.

2) Mayne (2007)

$$S_t = \frac{0.073 \cdot (q_t - \sigma_{v0})}{f_s}$$

For relatively sensitive clays, $S_t > 10$, the value of $f_s$ can be very low and not very accurate, hence the estimate of sensitivity should be used as a guide only.

## 4.8 SOIL UNIT WEIGHT (γ)

Soil unit weight, $\gamma$ in this report is calculated by using one method for sands, considered under dry conditions and two methods for clays, considered under saturated conditions. These relationships are developed by *Mayne (2007)* and the equations are presented below:

Dry unit weight for sands:

$$\gamma_{dry} = 1.89 \cdot log(q_{t1}) + 11.82$$

Saturated unit weight for clays method 1

$$\gamma_{sat} = 8.32 \cdot log(V_S) - 1.61 \cdot log(z)$$

Saturated unit for clays method 2

$$\gamma_{sat} = 2.60 \cdot log(f_s) + 15 \cdot G_s - 26.5$$

where

$q_{t1}$ is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula:

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

z is the depth

$V_s$ is the shear wave velocity, calculated as $V_S = 118.8 \cdot log\left(f_s\right) + 18.5$

$G_s$ is the specific gravity of solids, typically between *2.40* and *2.90*

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# APPENDIX A

## APPENDIX A1 – Project Summary Sheet

*Piezocone Tests Summary Sheet*

| HOLE ID | Final Depth (m) | Date of Test | Cone Used | Test Remarks |
|---|---|---|---|---|
| CPT2301 | 0.52 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2301A | 0.27 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2301B | 0.42 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2302 | 13.76 | 15/06/2023 | S15-CFIP.2175 | Test refused on sleeve friction. |
| CPT2303 | 18.64 | 15/06/2023 | S15-CFIP.2175 | Test refused on sleeve friction. |
| CPT2304 | 16.99 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2305 | 4.75 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2306 | 13.80 | 15/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2307 | 8.11 | 16/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2308 | 2.19 | 16/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2308A | 9.88 | 16/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2309 | 4.51 | 16/06/2023 | S15-CFIP.2175 | Test refused on sleeve friction. |
| CPT2310 | 12.75 | 16/06/2023 | S15-CFIP.2175 | Test refused on tip resistance. |
| CPT2311 | 9.25 | 16/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |
| CPT2312 | 12.47 | 16/06/2023 | S15-CFIP.2175 | Test refused on total pressure. |

# APPENDIX A2 – CPT Rig Datasheet

## RIGS

### 20 TONNE CPT TRACK MOUNTED RIG (CPT017)

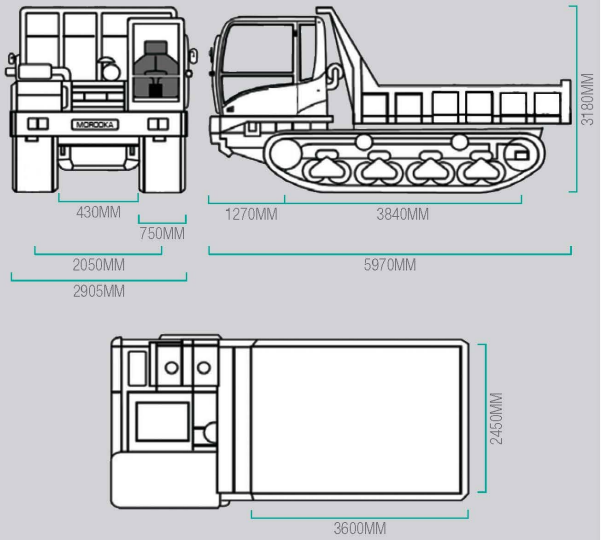
We have a variety of rigs giving us the capacity to meet our clients' needs and specifications for each individual project.

This rubber tracked rig weighs 20 tonnes and is able to push up to a depth of 40 metres, depending on the ground conditions. It has low ground bearing pressure and is ideal for soft, boggy sites which are inaccessible for our wheeled rigs.

### CPT RIG DETAILS

| | |
|---|---|
| DRIVE SYSTEM | RUBBER TRACKED |
| TOTAL WEIGHT | 20 TONNES |
| GROUND BEARING PRESSURE | 35kPA |
| CPT RAM THRUST CAPACITY | 20 TONNES |
| MAXIMUM PENETRATION | 30-40M DEPENDING ON THE GROUND CONDITIONS. |
| PERFORMANCE RATES | 100-150M OF TESTING A DAY, DEPENDING ON ACCESS TO POSITIONS. |
| TYPICAL SITES FOR THIS RIG | SOFT, BOGGY SITES. THE RIG HAS LOW GROUND BEARING PRESSURE. |

### CPT RIG DIMENSIONS





Shrewsbury

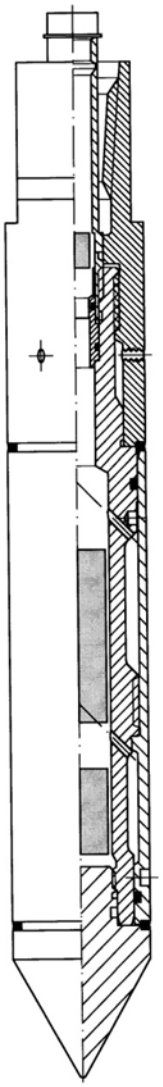
Heading North on our low loader


Falkirk, Scotland

IN SITU SITE INVESTIGATION INSITUSI.COM

## APPENDIX A3 – Cone Datasheet

GeoPoint Systems bv
Rijksstraatweg 22F
2171 AL Sassenheim
Tel. : +31 71 301 92 51
Fax : +31 71 301 92 52
E-mail : info@geopoint.nl
ING bank : 68.23.01.396
Postbank : 5226758
BTW nr. : NL806331677B01



# SPECIFICATIONS S15 SERIES ELECTRICAL CONES

The electronic subtraction cones have been developed to address the durability problems inherent in other cone designs. The unit consists of a single element temperature compensated strain gauge transducer for measuring both cone resistance and local sleeve friction. This design is therefore more robust than a compression type cone. The cone support electronics package is located directly behind the transducer. The precision strain gauge amplifiers and power supply eliminate the effects of cable resistance on the measurements. A standard subtraction cone is capable of measuring simultaneously the following channels: Tip, Local friction, Pore pressure, Temperature and Inclination.

### GENERAL SPECIFICATIONS

| | |
|---|---|
| Cone Tip Section Area | 1,500 mm2 |
| Friction Sleeve Surface | 22,500 mm2 |
| Total Length | 325 mm |
| Weight | 4200 g |
| Power Supply | ± 15 VDC, 100 mA. |
| Output | 0 – 10 VDC* |
| Working Temperature | 0 - 60˚C |
| Storage Temperature | - 40 to + 85˚C |
| Connector | Lemo 10 pins (others on request) |

### TIP RESISTANCE

| | |
|---|---|
| Range | 100/150* kN |
| Accuracy | 0.25 % FS |
| Maximum Load | 150 % of range |
| Cone Area Ratio | 0.75 |

### LOCAL SLEEVE FRICTION

| | |
|---|---|
| Range | 100/150* kN |
| Accuracy | 0.50 % FS |
| Maximum Load | 150 % |
| Sleeve Area Ratio | 1.0 (EA) |

### PORE PRESSURE

| | |
|---|---|
| Range | 1/2/5/10* MPa |
| Accuracy | 0.5 % FS |
| Maximum Load | 150 % of range |

### INCLINATION

| | |
|---|---|
| Range | 25 ˚ (biaxial) |
| Accuracy | < 2 ˚ |

All our equipment complies with the ISSMGE, ASTM, DIN and NEN Standards.

**Other output and voltage ranges available on request. Loadcells may be calibrated for lower ranges.*

## APPENDIX A4 – Cone Calibration Certificate

Eijkelkamp GeoPoint
SoilSolutions

Rijkstraatweg 22F
2171 AL Sassenheim
The Netherlands

T +31 71 301 9251
E info@eijkelkamp-geopoint.com
I eijkelkamp-geopoint.com

# Cone Calibration Certificate

| | | |
|---|---|---|
| Certificate: | **GS-2175-002** | |
| Instrument Type: | Electric Subtraction Cone | |
| Model: | S15-CFIIP | |
| Serial number: | 2175 | |
| Calibration date: | 06-04-2023 | |
| Client: | In Situ | |
| Calibrated by: | R.Wesselink | |
| **Calibration instruments** | | |
| Manufacturer: | Hottinger Baldwin Messtechnik GmbH | |
| NMi certificate | 2461165.00501 | |
| **Calibration conditions** | | |
| Ambient temperature: | 21 | °C |
| Atmospheric pressure: | 1015 | mBar |
| **Cone specifications** | | |
| Cone base area: | 1500 | mm2 |
| Load tip resistance (nom.): | 100 | kN |
| Friction sleeve area: | 22500 | mm2 |
| Load tip + local friction (nom.): | 100 | kN |
| Load friction sleeve (nom.): | 22.5 | kN |
| Load pore pressure (nom.): | 2 | MPa |
| Inclination (nom.): | +/- 20 | ° |
| Temperature compensation (all channels): | 0...+40 | °C |
| Maximum overload capacity (all channels): | 100 | % |
| Cone area ratio (a): | 0.79 | |
| Max. Inaccuracy, relative to measurement value: | 1.0 | % |

| | Tip: | | Sleeve: | | Pore Pressure: | | Inclinometer: | | |
|---|---|---|---|---|---|---|---|---|---|
| | qc in kN | mV | fs in kN | mV | MPa | mV | Degrees | X (mV) | Y (mV) |
| **Zero points:** | | 0241 | | 0237 | | 0315 | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2395 | 2343 |
| | 5 | 0290 | 5 | 0298 | 0.4 | 1519 | -20 | 0423 | 0442 |
| | 10 | 0580 | 10 | 0598 | 0.8 | 3026 | 20 | 4431 | 4270 |
| | 15 | 0868 | 15 | 0896 | 1.2 | 4532 | | | |
| | 20 | 1159 | 20 | 1197 | 1.6 | 6027 | | | |
| | 25 | 1449 | 25 | 1495 | 2 | 7525 | | | |
| | 30 | 1737 | 30 | 1794 | | | | | |
| | 35 | 2025 | 35 | 2093 | | | | | |
| | 40 | 2315 | 40 | 2391 | | | | | |
| | 45 | 2604 | 45 | 2690 | | | | | |
| | 50 | 2893 | 50 | 2988 | | | | | |
| | 75 | 4337 | 75 | 4480 | | | | | |
| | 100 | 5778 | 100 | 5969 | | | | | |

| | |
|---|---|
| Max. eror, abs. qc: | 35 kPa |
| Max. error, abs. fs: | 5 kPa |
| Max. error, abs. u2: | 10 kPa |
| Max. error, abs. I: | 1 ° |

This calibration is compliant with Eijkelkamp GeoPoint SoilSolutions internal quality system, internal calibration procedures and meets the requirements of NEN2649, NEN-EN-ISO 22476-1, NORSOK G-001, ISSMFE and ASTM using calibration equipment traceable to (Inter-)National Standards.

**Approved by:** R. Mosterd
**Date:** 06-04-2023

Eijkelkamp GeoPoint SoilSolutions
V.A.T. NO. NL 8584.21.422.B01
Trade Reg. Arnhem no. 70686149
IBAN NL43 RABO 0326 7904 38
BIC: RABONL2U

## APPENDIX A5 – Symbol List

### *English*

| | |
|---|---|
| a | is area ratio of the cone ($= {}^{A_n}/_{A_c}$) |
| A | is area |
| $A_c$ | is projected area of the cone |
| $A_n$ | is cross sectional area of load cell or shaft |
| $A_s$ | is area of friction sleeve |
| $A_{sb}$ | is bottom end area of friction sleeve |
| $A_{st}$ | is top end area of friction sleeve |
| $B_q$ | is pore pressure parameter ($= {}^{(u_2 - u_0)}/_{(q_t - \sigma_{v0})}$) |
| $c_h$ | is horizontal coefficient of consolidation |
| $c_v$ | is vertical coefficient of consolidation |
| D | is diameter |
| $D_r$ | is relative density ($= \frac{e_{max} - e}{e_{max} - e_{min}} x100\%$) |
| e | is void ratio |
| $e_{max}$ | is maximum void ratio |
| $e_{min}$ | is minimum void ratio |
| E | is Young's modulus |
| $f_s$ | is unit sleeve friction resistance |
| $f_t$ | is sleeve friction corrected for pore pressure effects |
| $F_s$ | is total force acting on friction sleeve |
| $F_R$ | is normalized friction ratio ($= {}^{f_s}/_{(q_t - \sigma_{v0})}$) |
| FoS | is factor of safety |
| FC | is fines content |
| g | is acceleration due to gravity |
| $G_0$ | is initial or maximum shear modulus, shear stiffness |
| $I_c$ | is soil behavior type index |
| $I_r$ | is rigidity index ($= {}^{G}/_{s_u}$) |
| $I_p$ | is plasticity index |
| k | is coefficient of permeability |
| $k_h$ | is coefficient of permeability in horizontal direction |
| $k_v$ | is coefficient of permeability in vertical direction |
| $K_0$ | is coefficient of earth pressure at rest ($= {}^{\sigma'_{h0}}/_{\sigma'_{v0}}$) |
| L | is length |
| $m_v$ | is coefficient of volume change |
| M | is constrained deformation modulus |
| M7.5 | is earthquake magnitude of 7.5 Richter scale |
| N | is number of blows of SPT |
| $N_{60}$ | is SPT energy ratio |
| $N_k$ | is cone factor |
| $N_{ke}$ | is cone factor |
| $N_{kt}$ | is cone factor |
| $N_{\Delta u}$ | is cone factor |
| $p_a$ | is reference stress ($= 100\ kPa$) |
| $q_c$ | is measured cone resistance |
| $q_e$ | is effective cone resistance ($= q_t - u_2$) |
| $q_n$ | is net cone resistance ($= q_t - \sigma_{v0}$) |
| $q_t$ | is corrected cone resistance ($= q_c - (1 - a)u_2$) |
| $Q_c$ | is total force acting on the cone |
| $Q_t$ | is normalized cone resistance ($= {}^{q_t - \sigma_{v0}}/_{\sigma'_{v0}}$) |

| | |
|---|---|
| $R_f$ | is friction ratio ($= \left({}^{f_t}/_{q_t}\right) x100\%$ or alternatively $= \left({}^{f_t}/_{q_t}\right) x100\%$) |
| $s_u$ | is undrained shear strength |
| $s_{ur}$ | is remoulded undrained shear strength |
| $S_t$ | is sensitivity |
| t | is time |
| $t_{50}$ | is time for 50% dissipation of excess pore water pressure |
| $T_{50}$ | is time factor at $U = 50\ \%$ |
| u | is pore water pressure |
| $u_0$ | is in situ pore pressure |
| $u_1$ | is pore pressure measured on the cone |
| $u_2$ | is pore pressure measured behind the cone |
| $u_3$ | is pore pressure measured behind sleeve friction |
| Δu | is excess pore water pressure |
| U | is normalized excess pore pressure |
| $V_s$ | is shear wave velocity |
| z | is depth |

### *Greek*

| | |
|---|---|
| α | is constant |
| α | is cone roughness |
| β | is constant |
| $\beta_1$ | is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees |
| $\beta_2$ | is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle $\beta_1$, in degrees |
| γ | is unit weight of soil |
| $\gamma_w$ | unit weight of water |
| Δ | is change |
| Δu | is excess pore pressure ($= u - u_0$) |
| μ | is Poisson's ratio |
| ρ | is density |
| ψ | is state parameter |
| σ, σ' | is normal stress (total, effective) |
| $\sigma_h$, $\sigma_h$' | is horizontal stress (total, effective) |
| $\sigma_v$, $\sigma_v$' | is horizontal stress (total, effective) |
| $\sigma_{v0}$,$\sigma_{v0}$' | is overburden stress (total, effective) |
| $\tau_{av}$ | is average cyclic shear stress |
| $\tau_{cy}$ | is cyclic shear stress |
| φ' | is effective friction angle |

## APPENDIX A6 – Abbreviations

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| CPTU | Cone Penetration Test with Pore Pressure Measurement (Piezocone Test) |
| CRR | Cyclic Resistance Ratio |
| CSR | Cyclic Stress Ratio |
| GWT | Ground Water Table |
| NC | Normally Consolidated |
| OC | Over consolidated |
| OCR | Over consolidation Ratio |
| PL | Limit Pressure |
| SCPT | Seismic Cone Penetration |
| SDMT | Seismic Dilatometer Marchetti |
| SPT | Standard Penetration Test |
| TC | Technical Committee |

## APPENDIX A7 – Glossary

**CPT**
Cone Penetration Test.

**Cone**
The part of the cone penetrometer on which the end bearing is developed.

**Cone Penetrometer**
The assembly containing the *cone*, *friction sleeve*, any other sensors and measuring systems, as well as the connections to the *push-rods.*

**Cone resistance, $q_c$**
The total force acting on the cone, $Q_c$, divided by the projected area of the cone, $A_c$. $q_c = {Q_c}/{A_c}$

**Corrected cone resistance, $q_t$**
The *cone resistance*, $q_c$ corrected for pore water pressure effects.

**Corrected sleeve friction, $f_t$**
The *sleeve friction* corrected for pore water pressure effects on the ends of the *friction sleeve*.

**Data acquisition system**
The system used to measure and record the measurements made by the *cone penetrometer*.

**Dissipation Test**
A test when the decay of the pore water pressure is monitored during a pause in penetration.

**Filter element**
The porous element inserted into the cone penetrometer to allow transmission of the pore water pressure to the pore pressure sensor, while maintaining the correct profile of the *cone penetrometer*.

**Friction ratio, $R_f$**
The ratio, expressed as a percentage of the *sleeve friction*, $f_s$, to the *cone resistance*, $q_c$, both measured at the same depth.

**Friction reducer**
A local enlargement on the push-rod surface, placed at a distance above the cone penetrometer, and provided to reduce the friction on the *push-rods*.

**Friction sleeve**
The section of the *cone penetrometer* upon which the *sleeve friction* is measured.

**Normalized cone resistance, $Q_c$ or $Q_t$**
The *cone resistance* expressed in a non-dimensional form and taking account of stress changes *in situ*, $Q_c = {(q_c - \sigma_{v0})}/{\sigma'_{v0}}$, or when the *corrected cone resistance* is used $Q_t = {(q_t - \sigma_{v0})}/{\sigma'_{v0}}$. where $\sigma_{v0}$ and $\sigma'_{v0}$ are the total and effective vertical stress respectively.

**Net cone resistance, $q_n$**
The *corrected cone resistance* minus the vertical total stress. $q_n = q_t - \sigma_{v0}$

**Normalized friction ratio, $F_r$**
The *sleeve friction* normalized by the *net cone resistance*.

**Piezocone**
A *cone penetrometer* containing a pore pressure sensor.

**Pore pressure, *u***
The pore pressure generated during penetration and measured by a pore pressure sensor, $u_1$ when measured on the cone, $u_2$ when measured just behind the cone and $u_3$ when measured just behind the friction sleeve.

**Pore pressure ratio, $B_q$**
The *net pore pressure* normalized with respect to the *net cone resistance*.

**Push-rods**
The thick-walled tubes or rods used for advancing the cone penetrometer.

**Rig machine**
The equipment which pushes the cone penetrometer and rods into the ground.

**Sleeve friction, $f_s$**
The total frictional force acting on the *friction sleeve*, $F_s$, divided by its *surface area*, $A_s$. $f_s = {F_s}/{A_s}$

# APPENDIX A8 – Soils Description Tables

## GRANULAR SOILS (Sands and Gravels)

| Description | Relative Density $D_r$ (%) | SPT N value, $N_{SPT}$ |
|---|---|---|
| Very Loose | 0 – 15 | 0 - 4 |
| Loose | 15 – 35 | 4 - 10 |
| Medium Dense | 35 – 65 | 10 - 30 |
| Dense | 65 – 85 | 30 - 50 |
| Very Dense | >85 | >50 |

## COHESIVE SOILS (Clays and Silts)

| Term based on measurement | Undrained Shear Strength Classification, $s_u$ (kPa) |
|---|---|
| Extremely low | <10 |
| Very low | 10 - 20 |
| Low | 20 - 40 |
| Medium | 40 - 75 |
| High | 75 - 150 |
| Very high | 150 - 300 |
| Extremely high | >300 |

# APPENDIX B

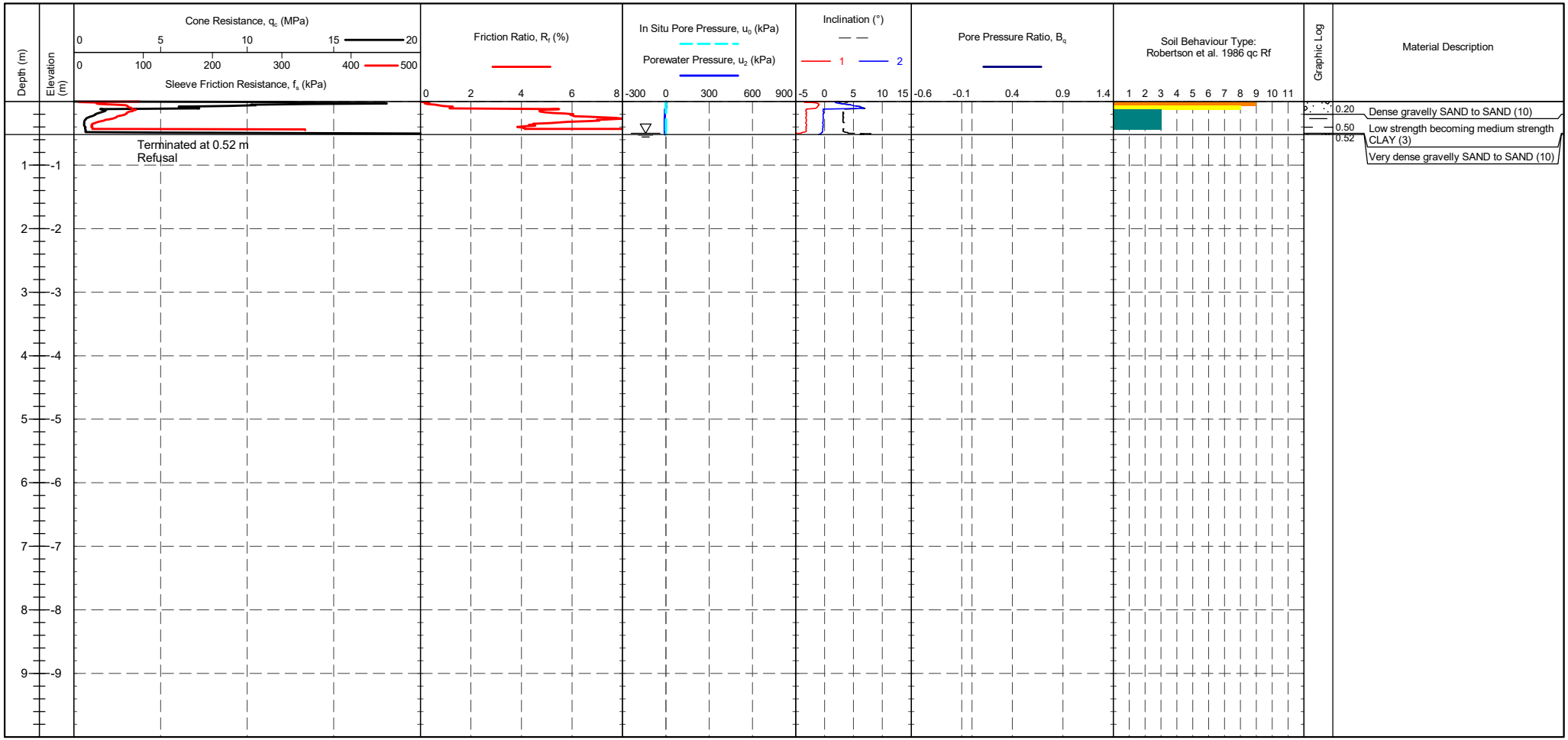
# Cone Penetration Measured Parameters and Geotechnical Derived Parameters

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2301**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 237 mV | 0.023 MPa |
| Sleeve | 228 mV | 229 mV | 0.001 kPa |
| Pore Pressure 2 | 318 mV | 274 mV | -0.012 kPa |
| X-Y Inclinometer | 2479 mV | 2056 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

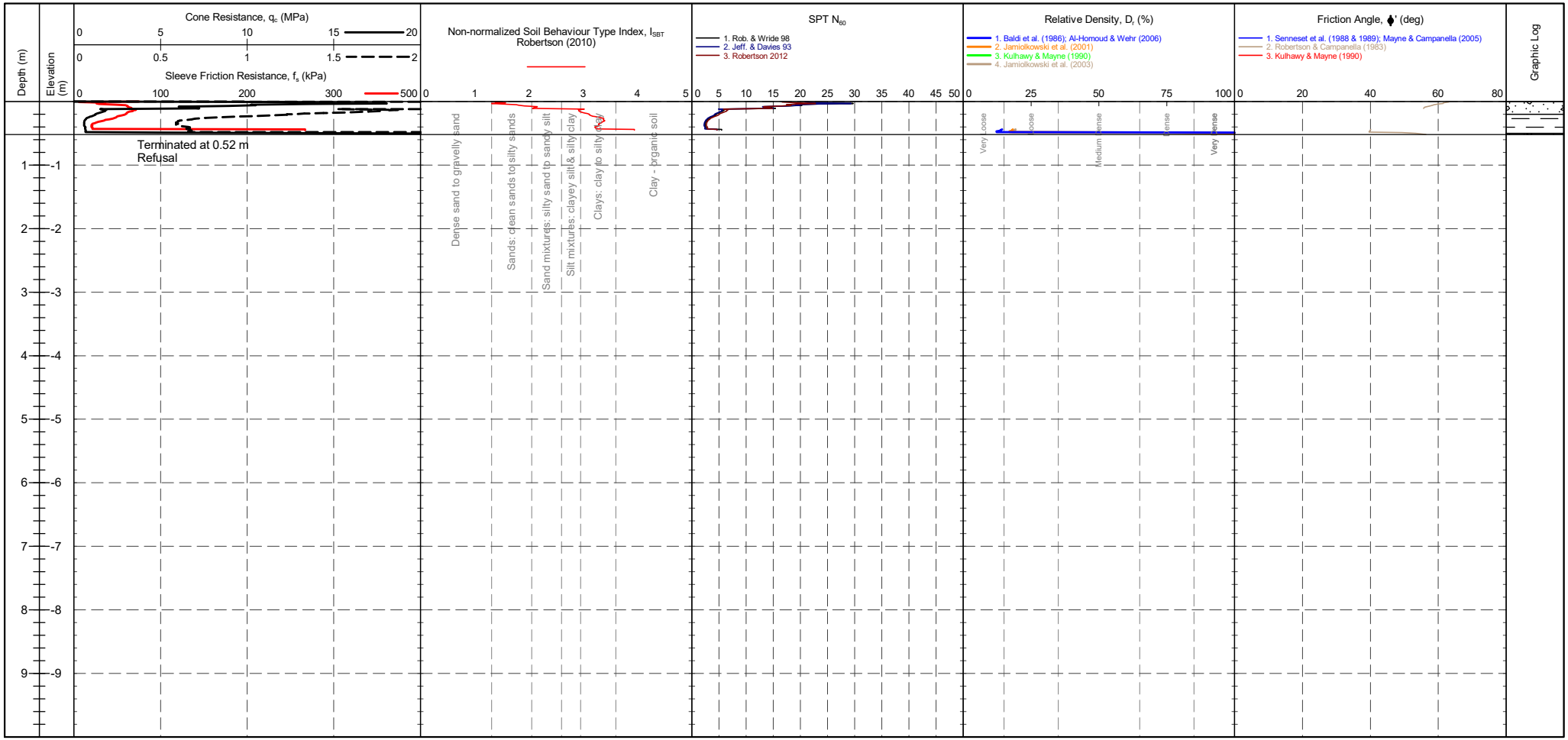
PointID **CPT2301**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 237 mV | 0.023 MPa |
| Sleeve | 228 mV | 229 mV | 0.001 kPa |
| Pore Pressure 2 | 318 mV | 274 mV | -0.012 kPa |
| X-Y Inclinometer | 2479 mV | 2056 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

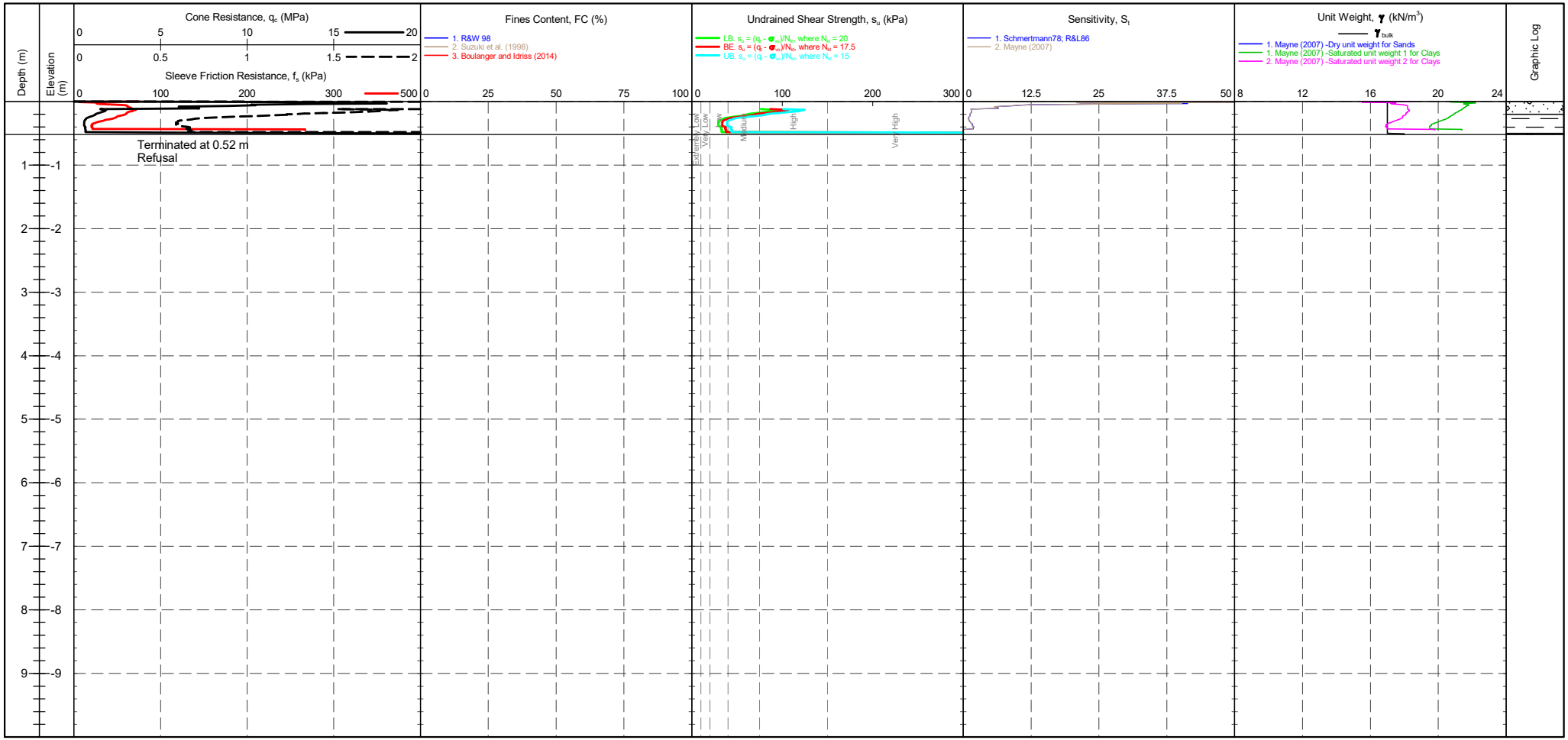
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2301**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



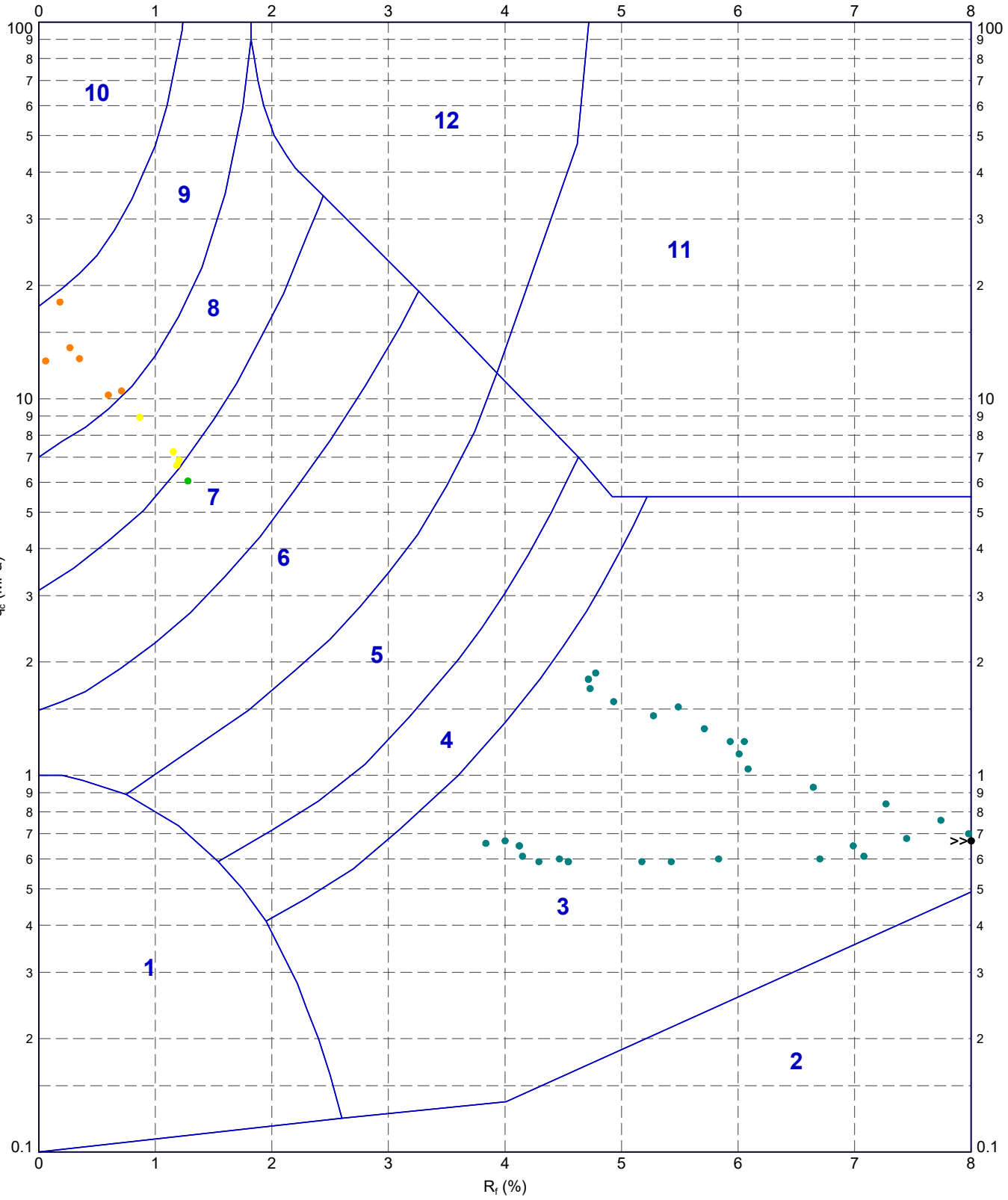

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 235 mV | 237 mV | 0.023 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 228 mV | 229 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 318 mV | 274 mV | -0.012 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2479 mV | 2056 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU
SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2301

| | | |
|---|---|---|
| DRAWN | DATE 20/06/2023 | |
| CHECKED | DATE 20/06/2023 | |
| SCALE Not To Scale | | A4 |
| PROJECT No 1230268 | FIGURE No | |

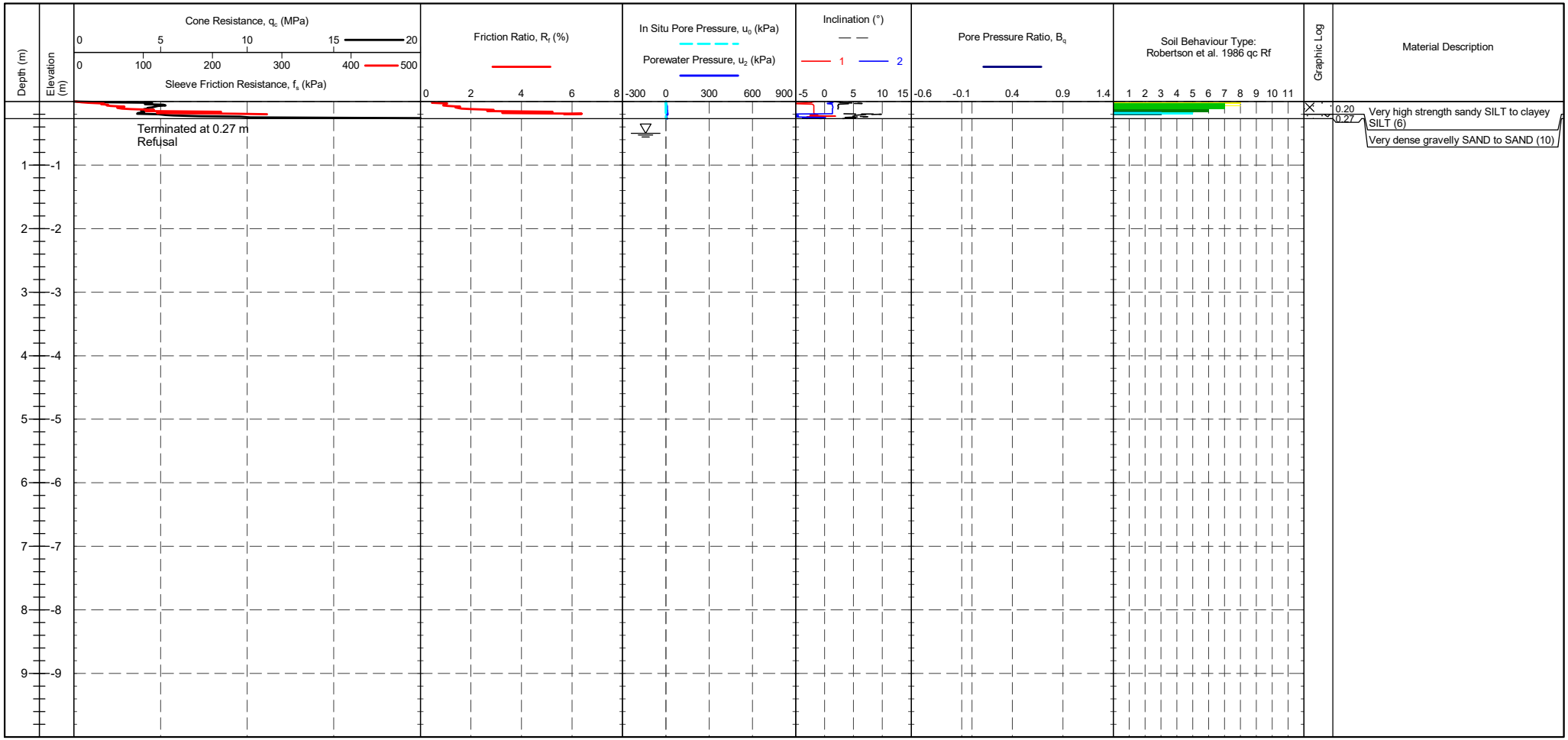
220629-ADVANCED REPORT INSITUSI 2.02.1.LIB - CHLOE.GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF A4P 1230268-WHITEPIT AND HEATHFIELD TIPS.GPJ <<DrawingFile>> 20/06/2023 16:44 10.03.00.09 Datgel Lab and In Situ Tool - DGD | Lib: In Situ SI 2.02.0 2017-07-10 Prj: In Situ SI 2.02.0 2017-07-10

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID **CPT2301A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 228 mV | 223 mV | -0.004 kPa |
| Pore Pressure 2 | 274 mV | 271 mV | -0.001 kPa |
| X-Y Inclinometer | 2218 mV | 2322 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

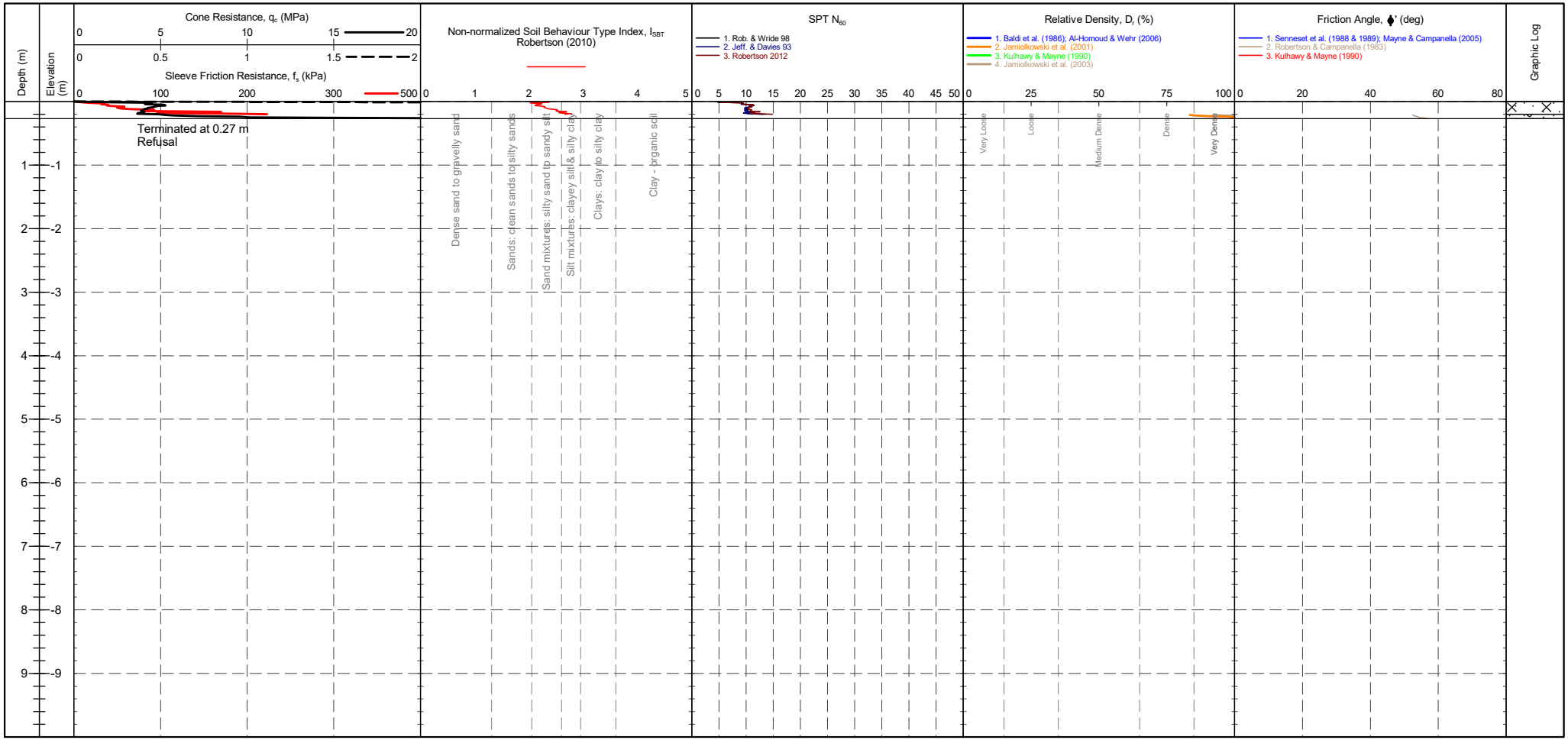
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2301A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | |
|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 236 mV | 234 mV |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 228 mV | 223 mV |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 274 mV | 271 mV |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2218 mV | 2322 mV |

| CPTU ZERO VALUES | | |
|---|---|---|
| Difference | | |
| -0.023 MPa | | |
| -0.004 kPa | | |
| -0.001 kPa | | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

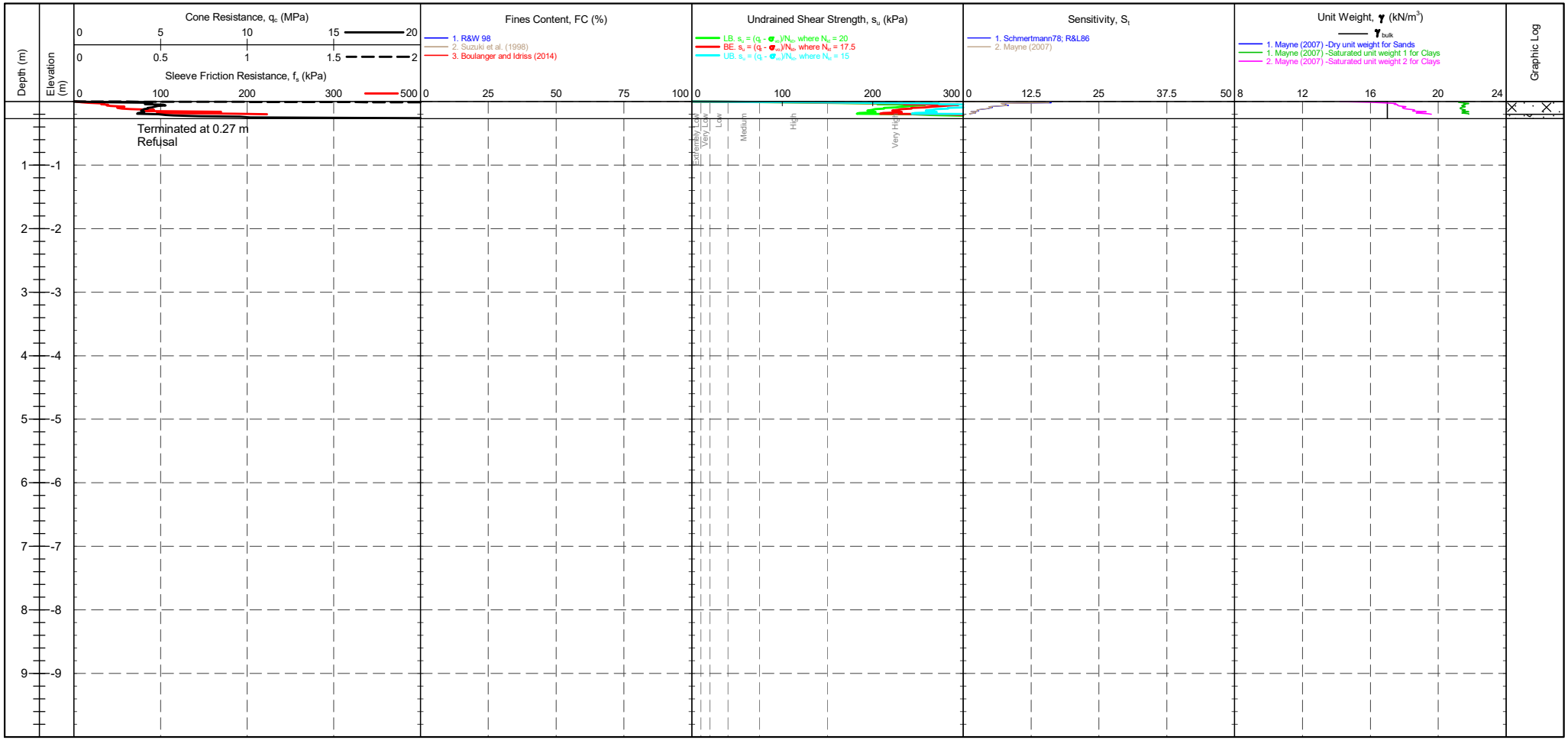
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID: **CPT2301A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



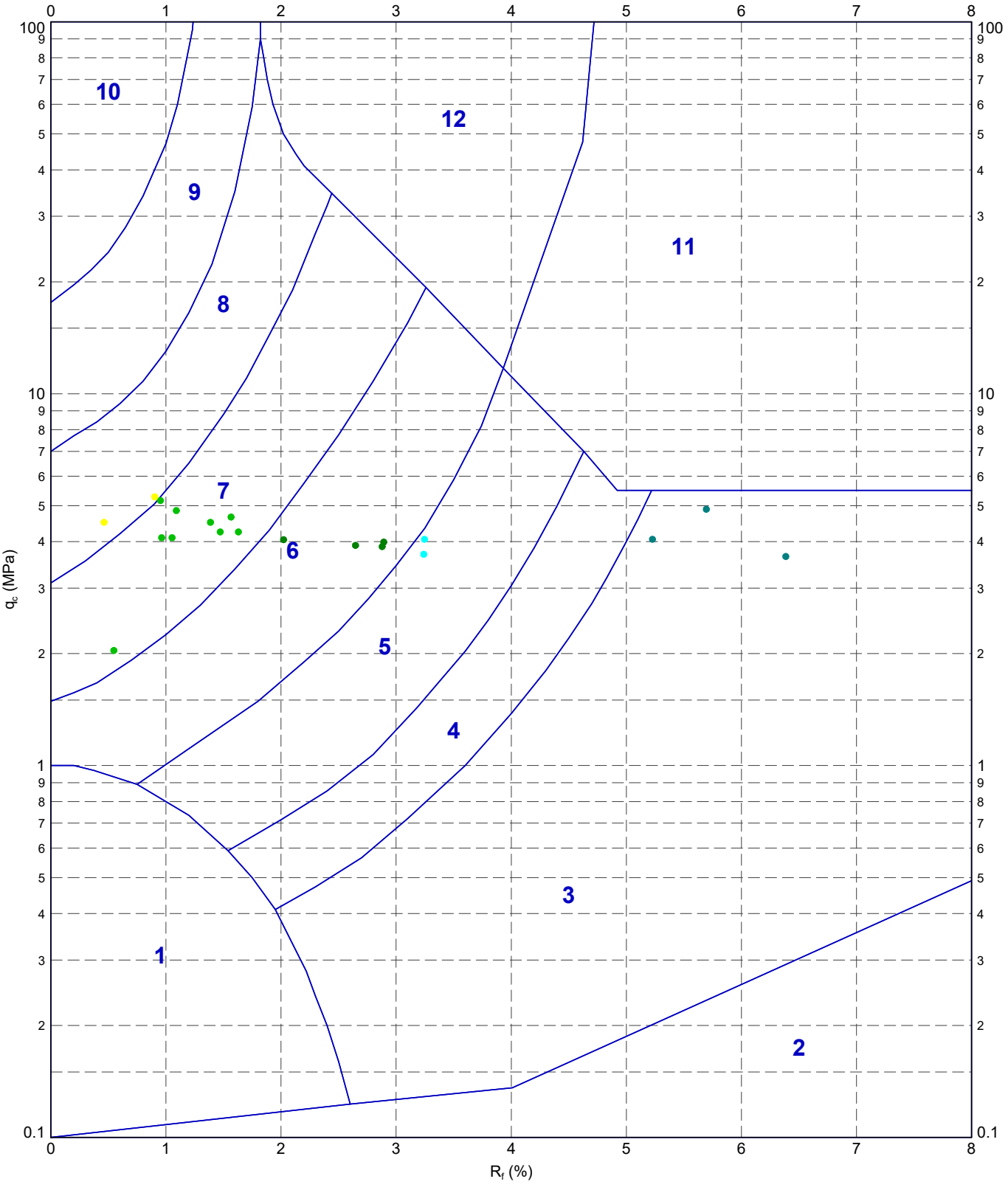

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 236 mV | 234 mV | -0.023 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 228 mV | 223 mV | -0.004 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 274 mV | 271 mV | -0.001 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2218 mV | 2322 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2301A

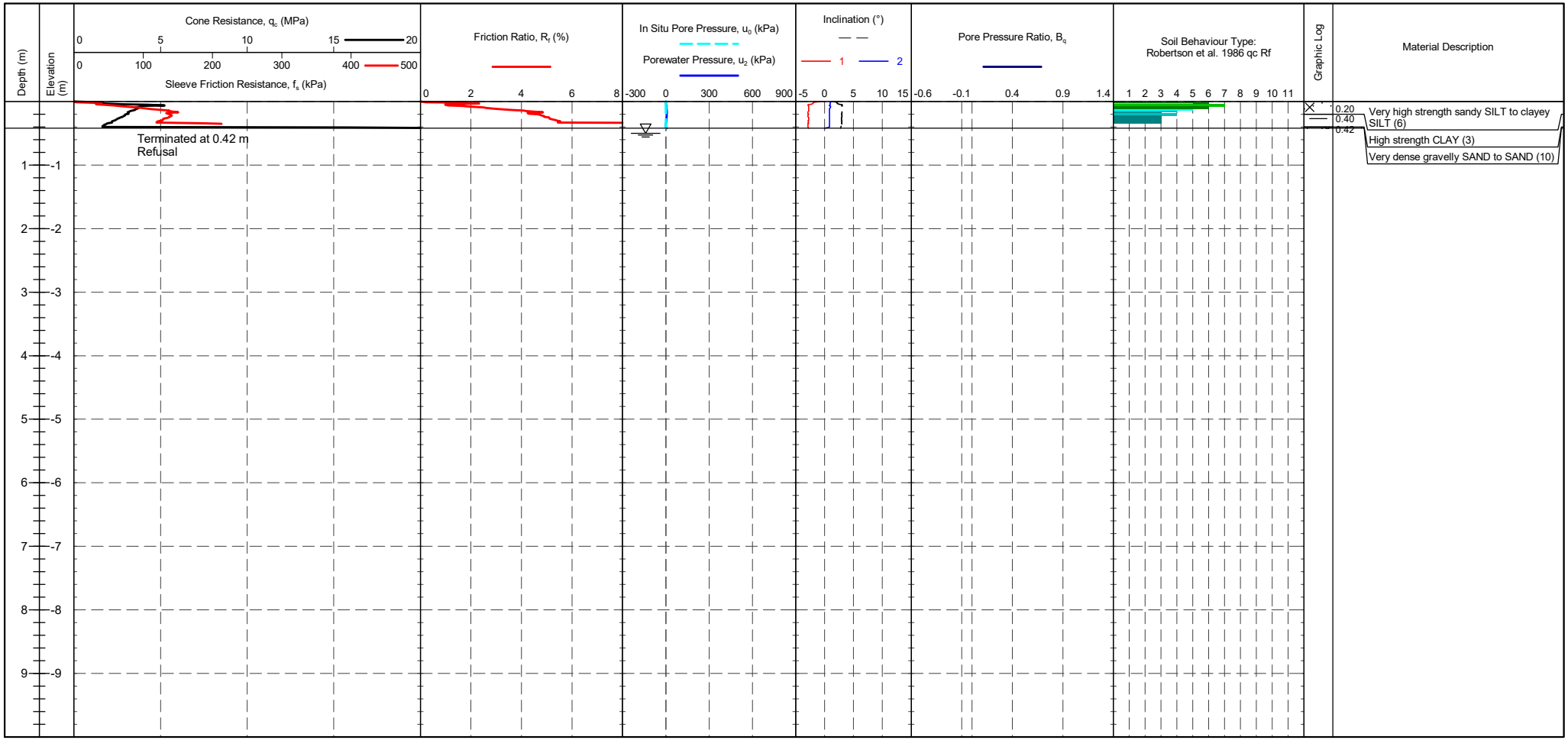
| | | | |
|---|---|---|---|
| DRAWN | | DATE | 20/06/2023 |
| CHECKED | | DATE | 20/06/2023 |
| SCALE | Not To Scale | | A4 |
| PROJECT No | 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2301B**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 236 mV | 0.023 MPa |
| Sleeve | 223 mV | 222 mV | -0.001 kPa |
| Pore Pressure 2 | 273 mV | 274 mV | 0 kPa |
| X-Y Inclinometer | 2318 mV | 2276 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

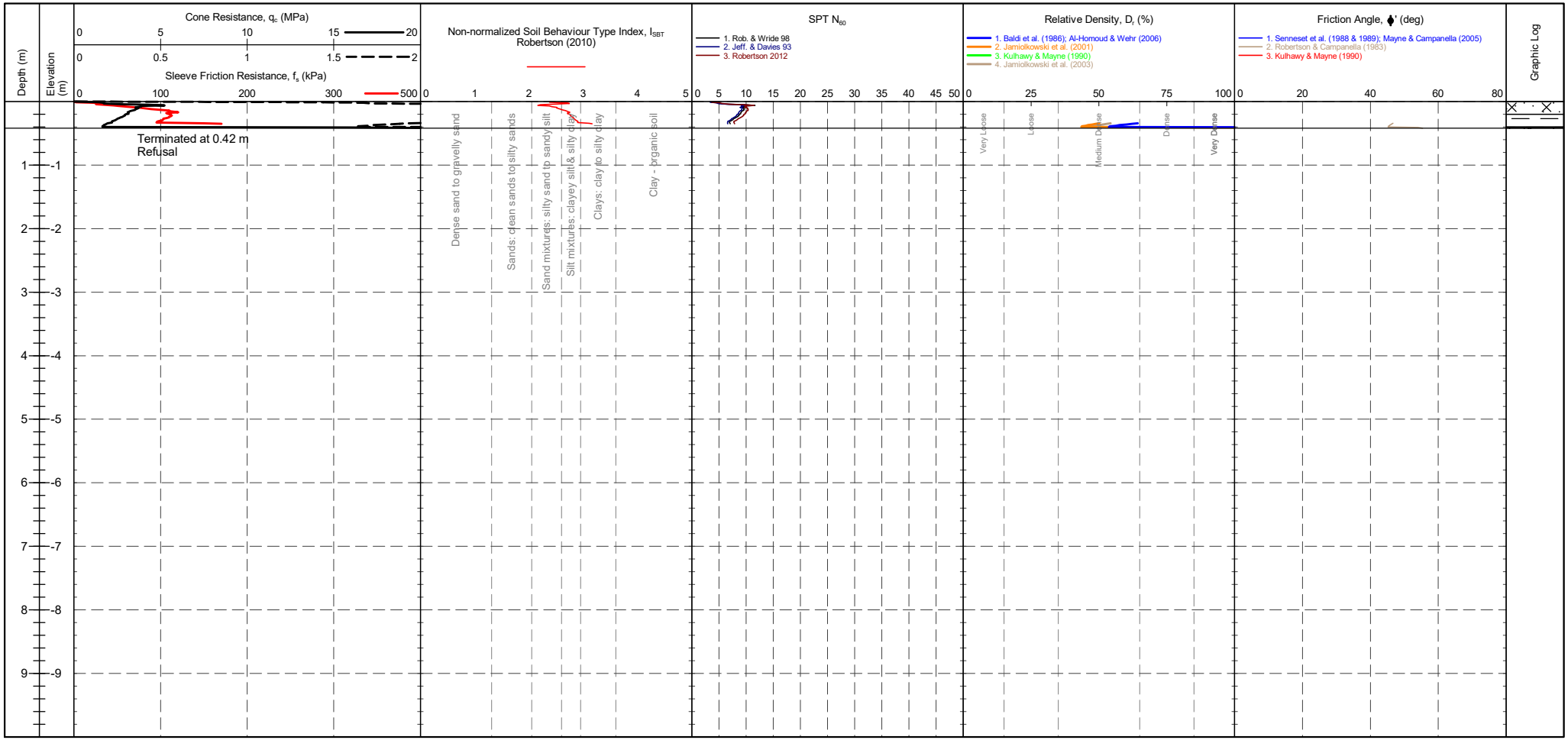
PointID **CPT2301B**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 236 mV | 0.023 MPa |
| Sleeve | 223 mV | 222 mV | -0.001 kPa |
| Pore Pressure 2 | 273 mV | 274 mV | 0 kPa |
| X-Y Inclinometer | 2318 mV | 2276 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

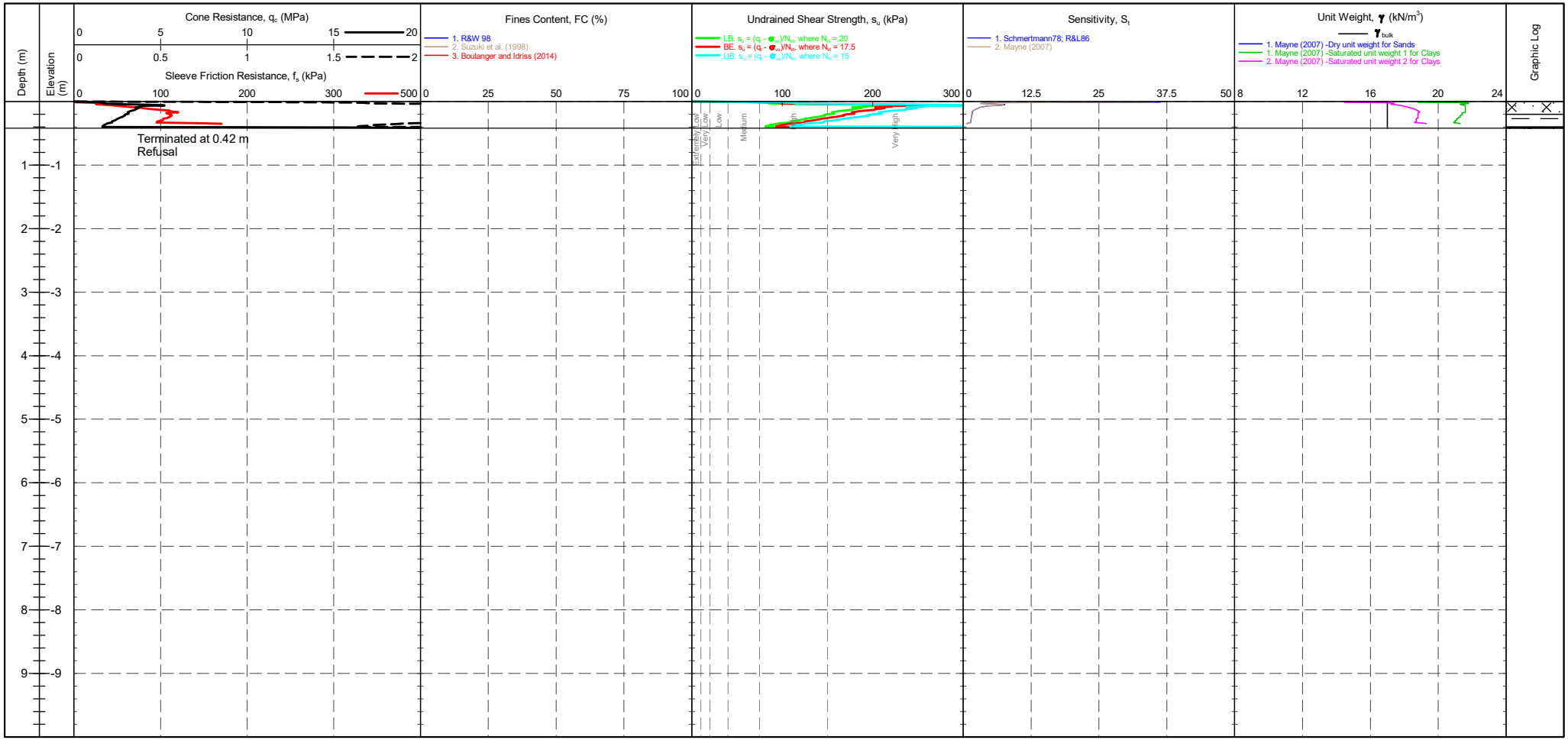
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID: **CPT2301B**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



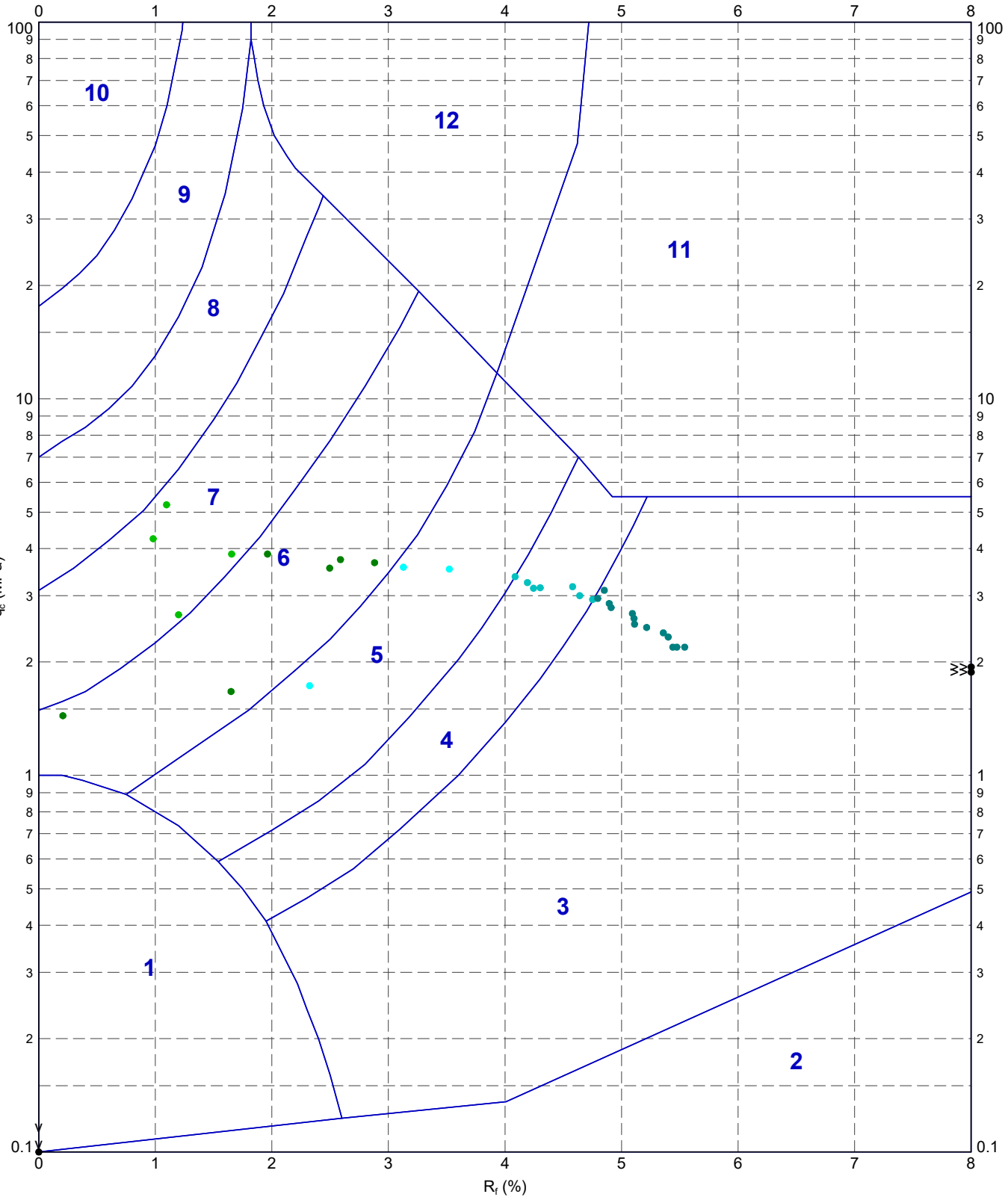

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 236 mV | 0.023 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 223 mV | 222 mV | -0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 273 mV | 274 mV | 0 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2318 mV | 2276 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2301B

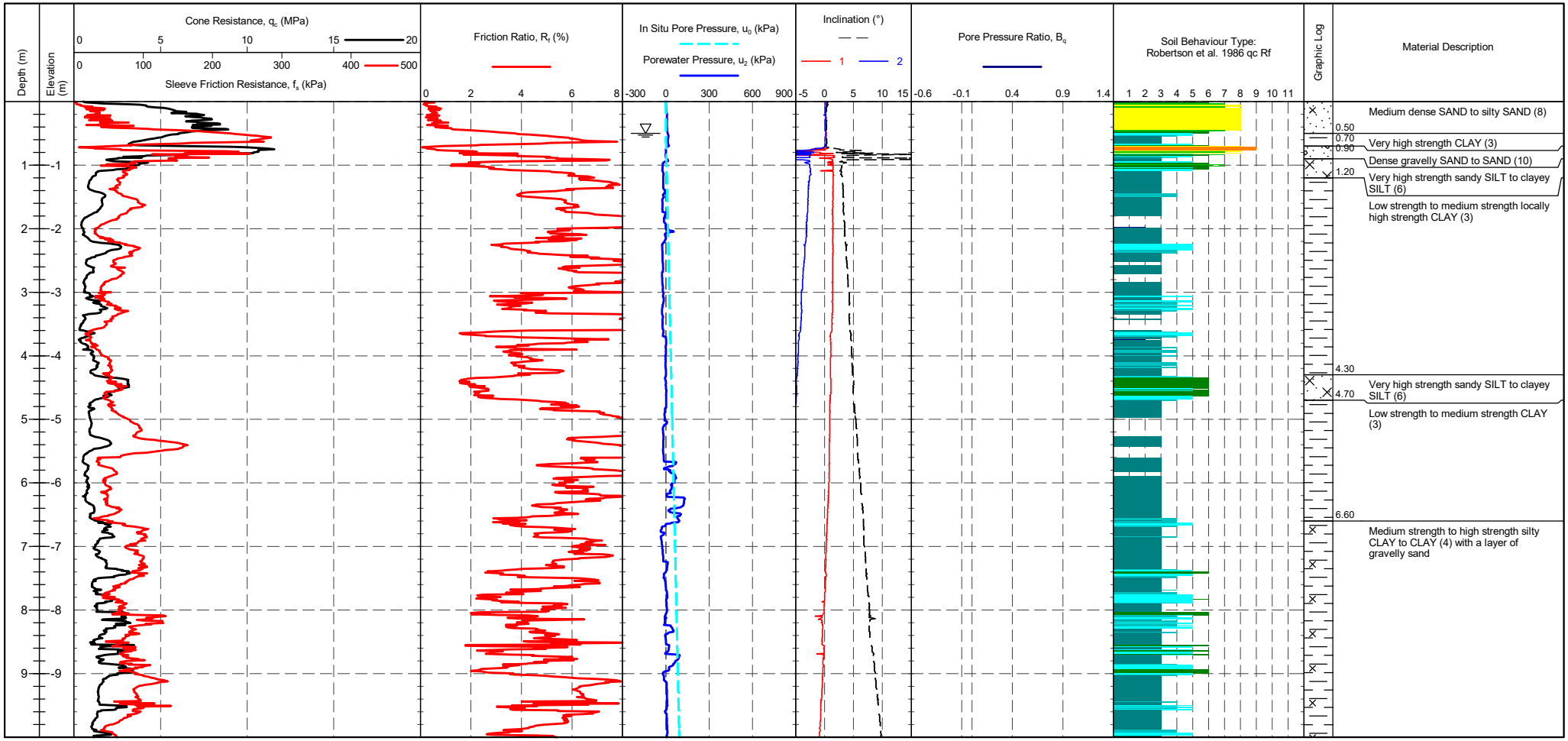
| | | |
|---|---|---|
| DRAWN | DATE 20/06/2023 | |
| CHECKED | DATE 20/06/2023 | |
| SCALE Not To Scale | | A4 |
| PROJECT No 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2302**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 238 mV | 0.035 MPa |
| Sleeve | 229 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| X-Y Inclinometer | 2446 mV | 2449 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

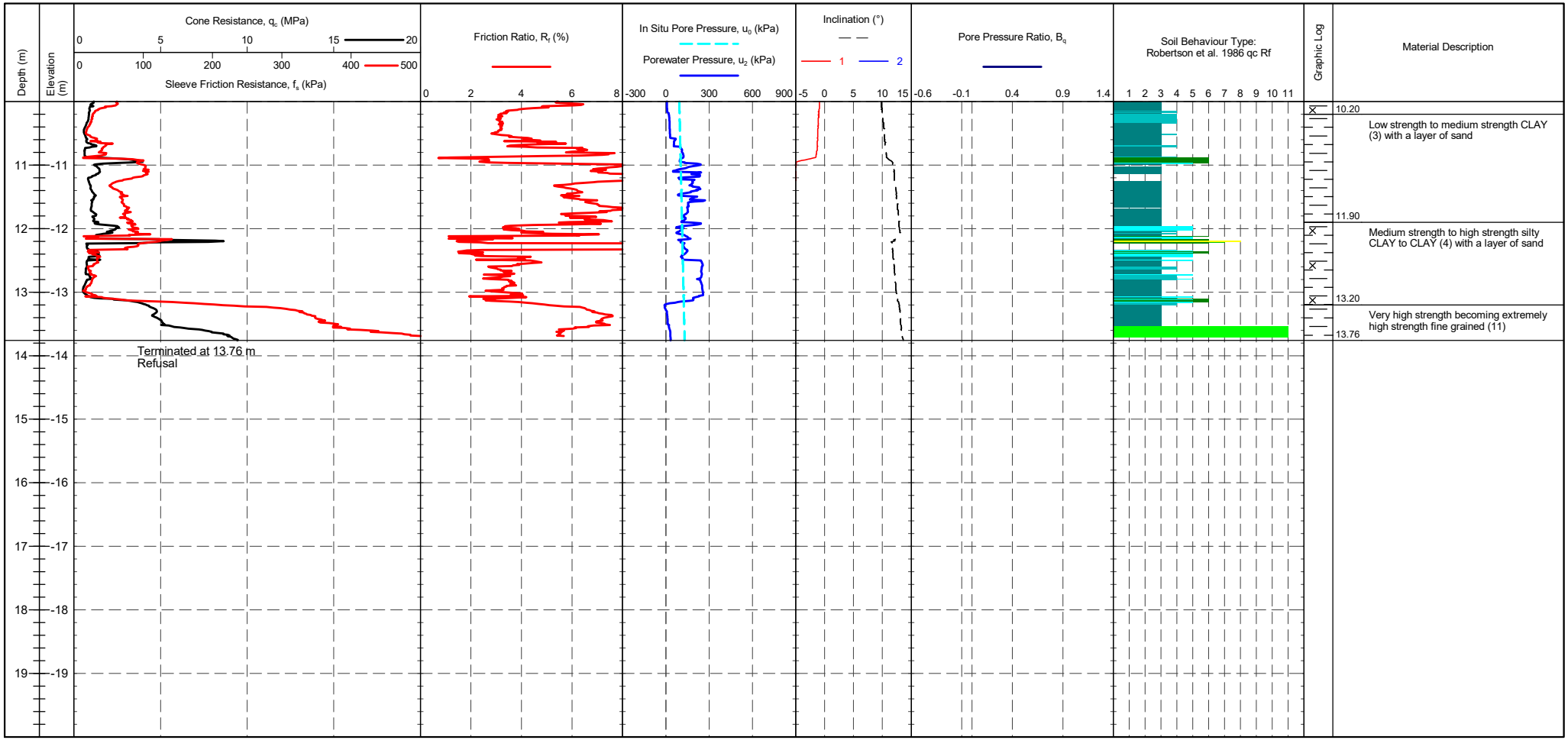
PointID **CPT2302**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 238 mV | 0.035 MPa |
| Sleeve | 229 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| X-Y Inclinometer | 2446 mV | 2449 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

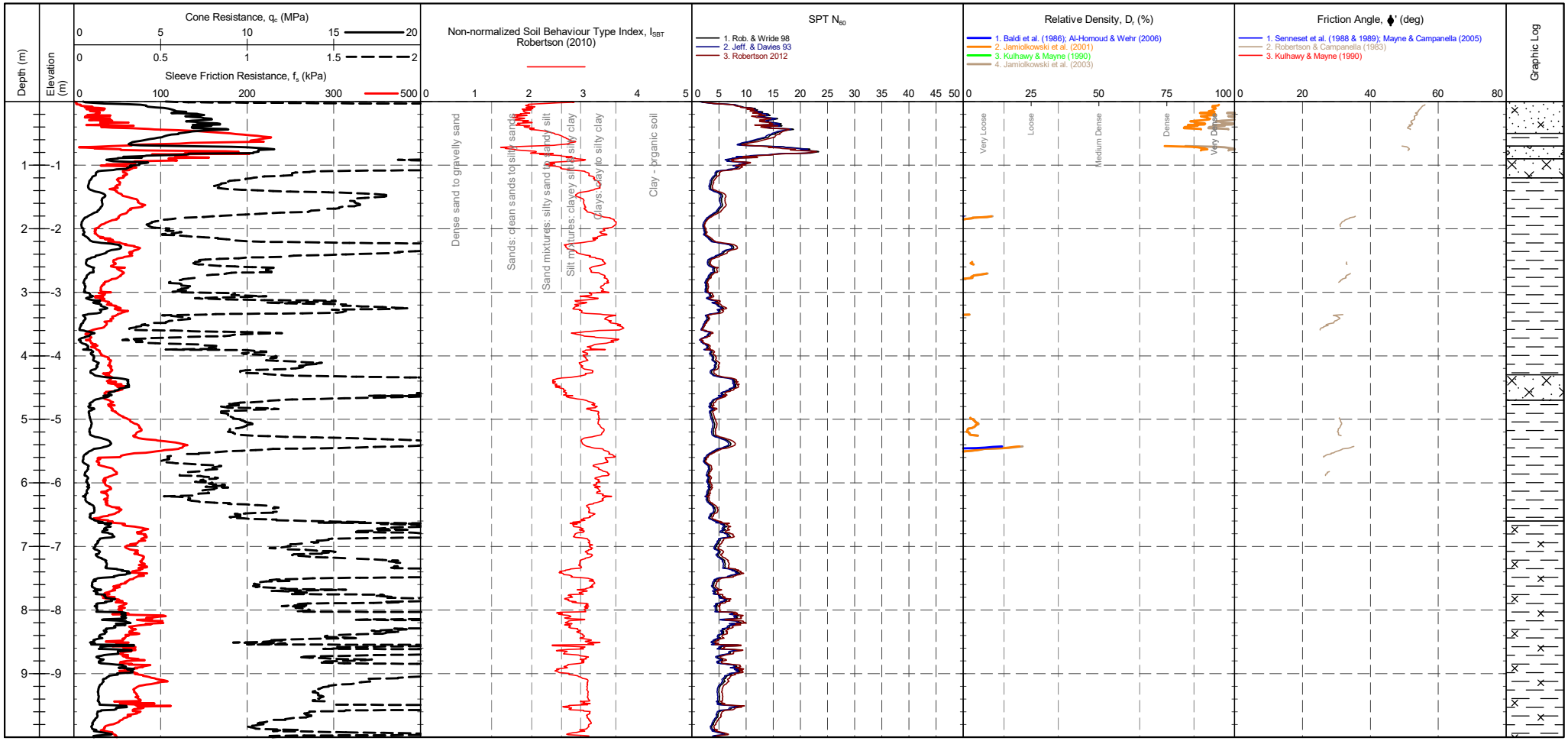
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID: **CPT2302**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 238 mV | 0.035 MPa |
| Sleeve | 229 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| X-Y Inclinometer | 2446 mV | 2449 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

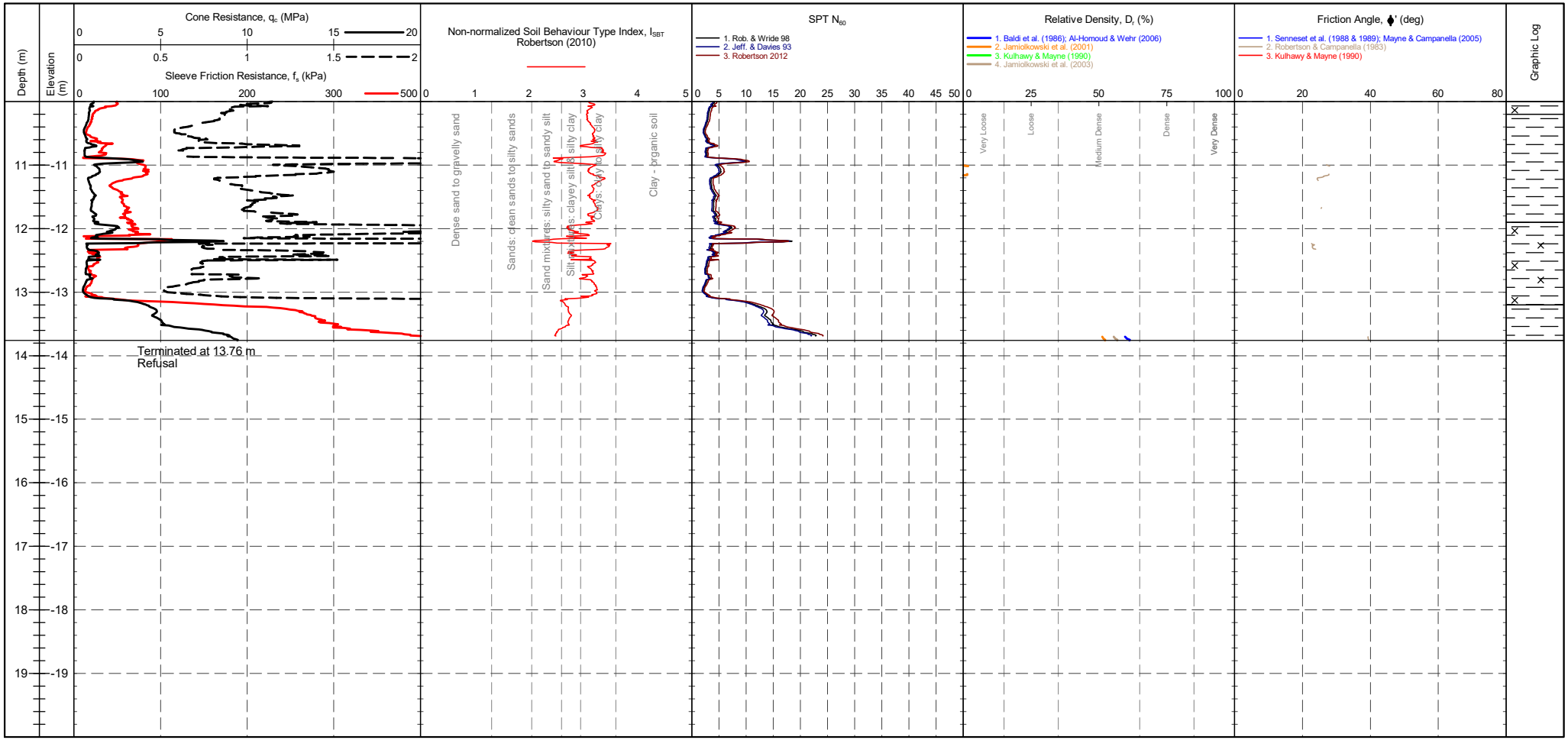
PointID: **CPT2302**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | |
|---|---|
| CONE ID | : S15-CFIP.2175 |
| CONE MODEL | : Subtraction |
| CONE AREA | : 15cm² |
| CONE AREA RATIO | : 0.79 |
| FILTER POSITION | : u2 |
| FILTER TYPE | : HDPE |

| | |
|---|---|
| TEST TYPE | : TE2 |
| APPLICATION CLASS | : 2 |
| RIG | : CPT 017 - Griffen |
| OPERATOR | : AC |
| FRICTION REDUCER | : None |
| WEATHER | : Overcast & Mild |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 238 mV | 0.035 MPa |
| Sleeve | 229 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| X-Y Inclinometer | 2446 mV | 2449 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic |
|---|---|
| Clays | 2.95-3.60 |
| Silt mixtures | 2.60-2.95 |
| Sand mixtures | 2.05-2.60 |
| Sands | 1.31-2.05 |
| Gravelly sand | <1.31 |

| Description | SPT N value, NSPT |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | >50 |

| Description | Relative Density Dr (%) |
|---|---|
| Very Loose | 0 - 15 |
| Loose | 15 - 35 |
| Medium Dense | 35 - 65 |
| Dense | 65 - 85 |
| Very Dense | >85 |

Groundwater Level

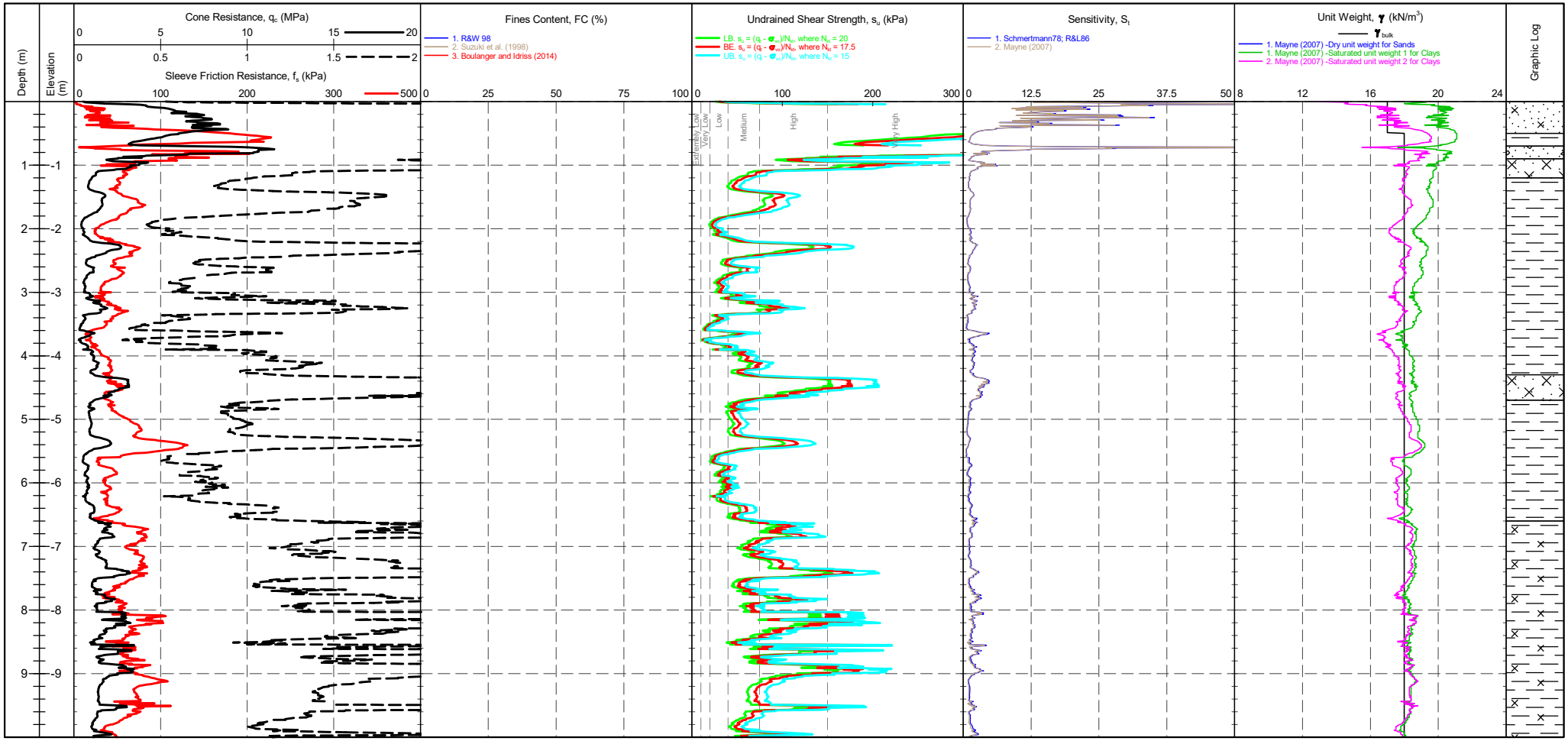
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2302**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 235 mV | 238 mV | 0.035 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 229 mV | 231 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2446 mV | 2449 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

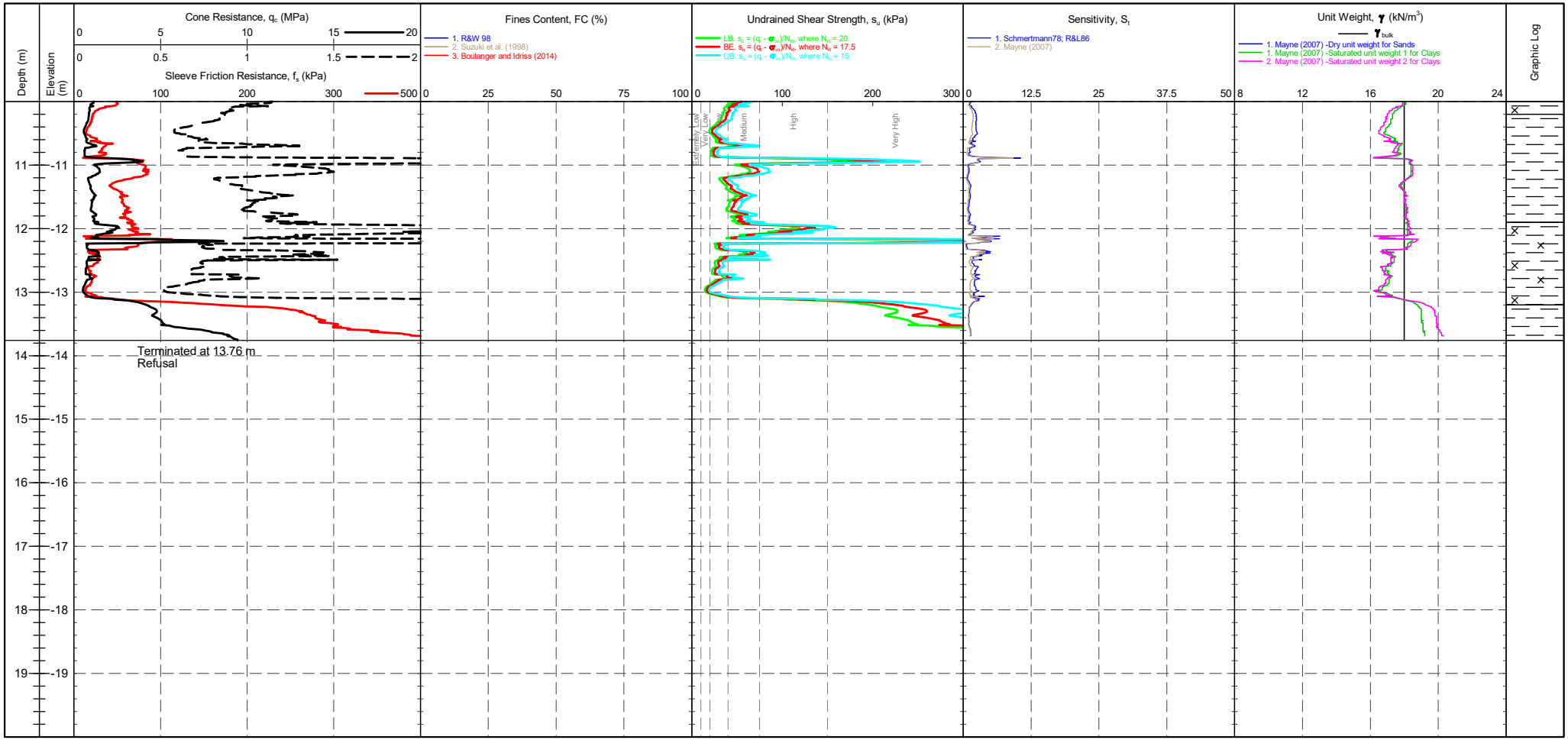
PointID **CPT2302**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

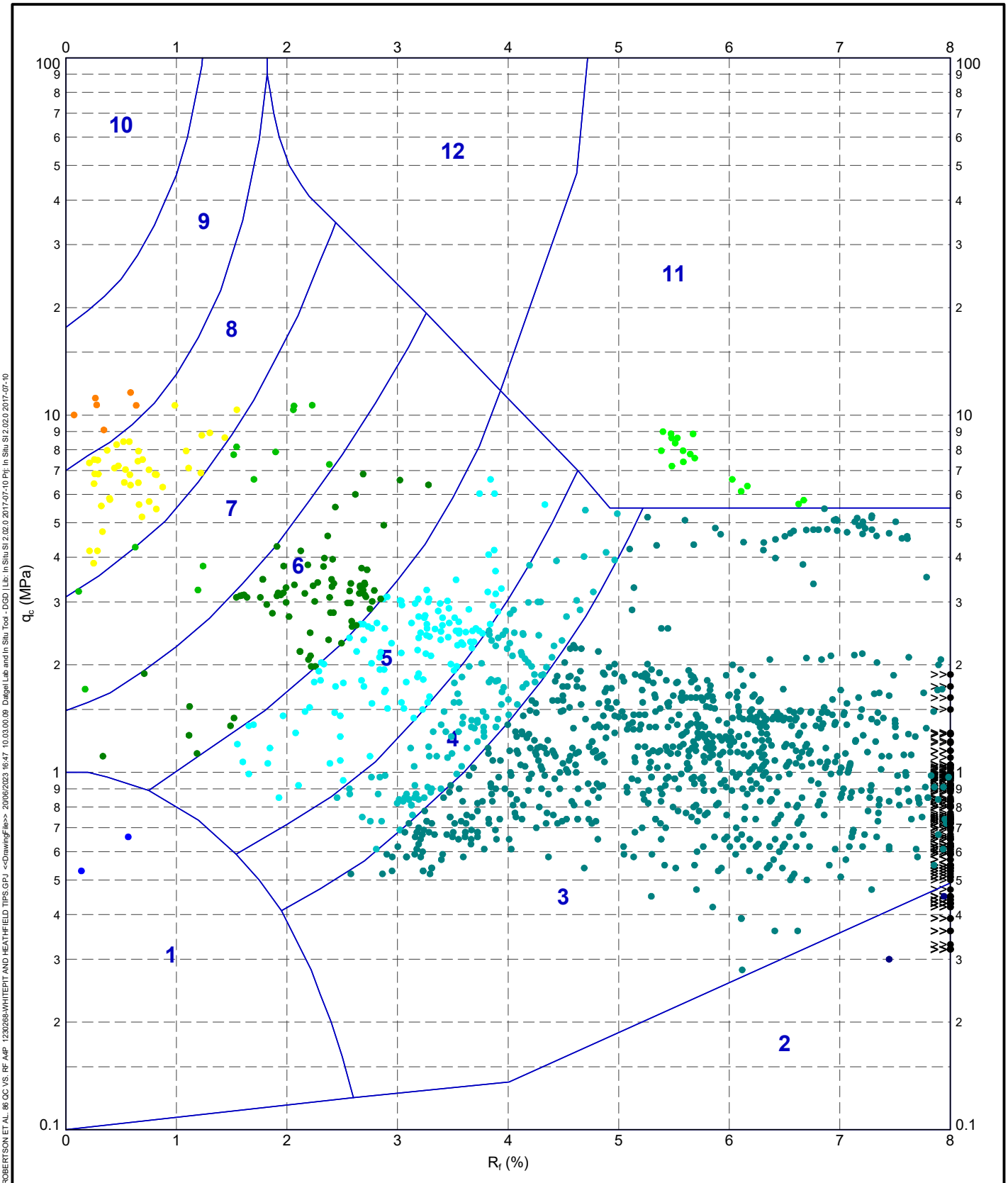
| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 235 mV | 238 mV | 0.035 MPa |
| Sleeve | 229 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 302 mV | 412 mV | 0.029 kPa |
| X-Y Inclinometer | 2446 mV | 2449 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2302

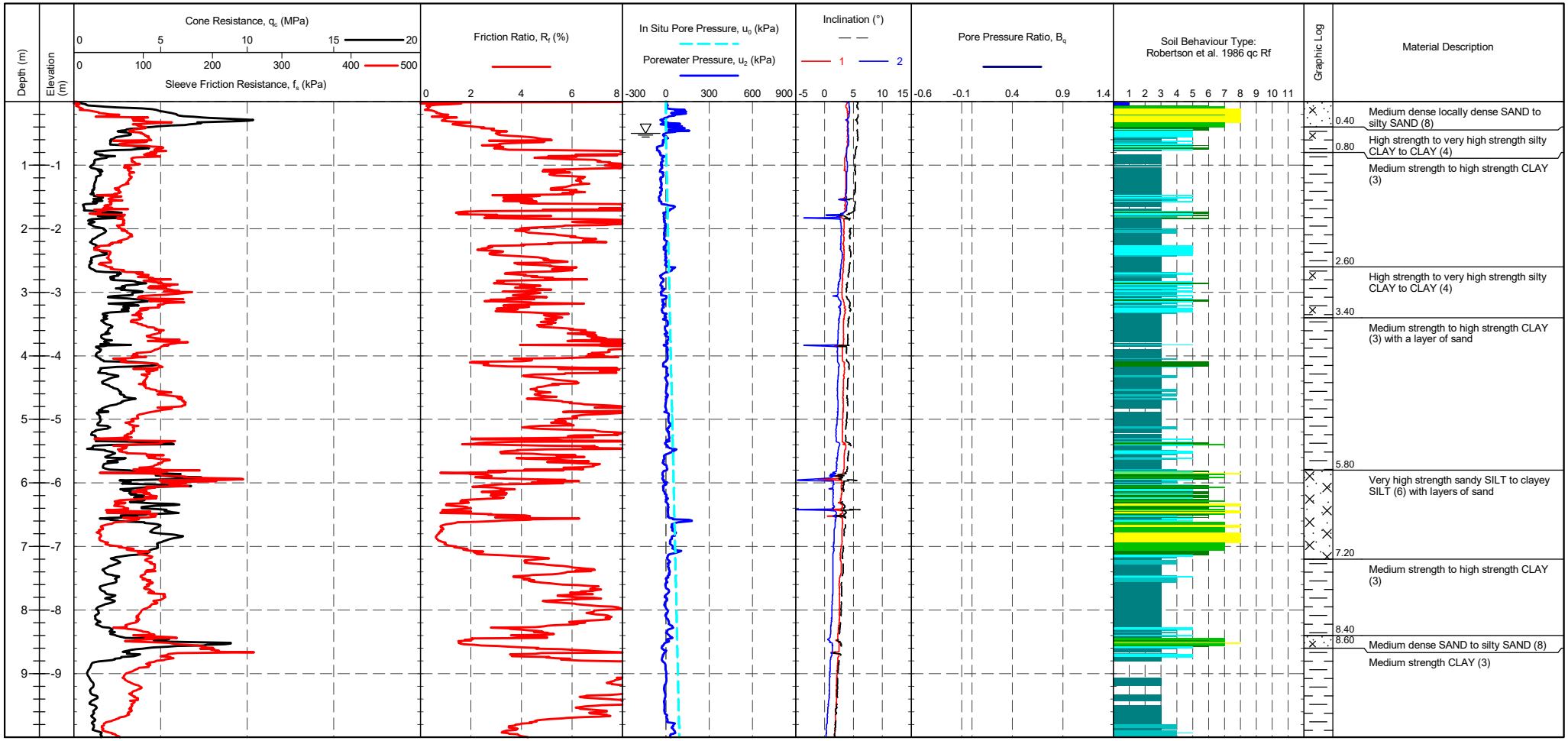
| | | | |
|---|---|---|---|
| DRAWN | | DATE | 20/06/2023 |
| CHECKED | | DATE | 20/06/2023 |
| SCALE | Not To Scale | | A4 |
| PROJECT No | 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2303**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 239 mV | 0.046 MPa |
| Sleeve | 230 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| X-Y Inclinometer | 2824 mV | 2764 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

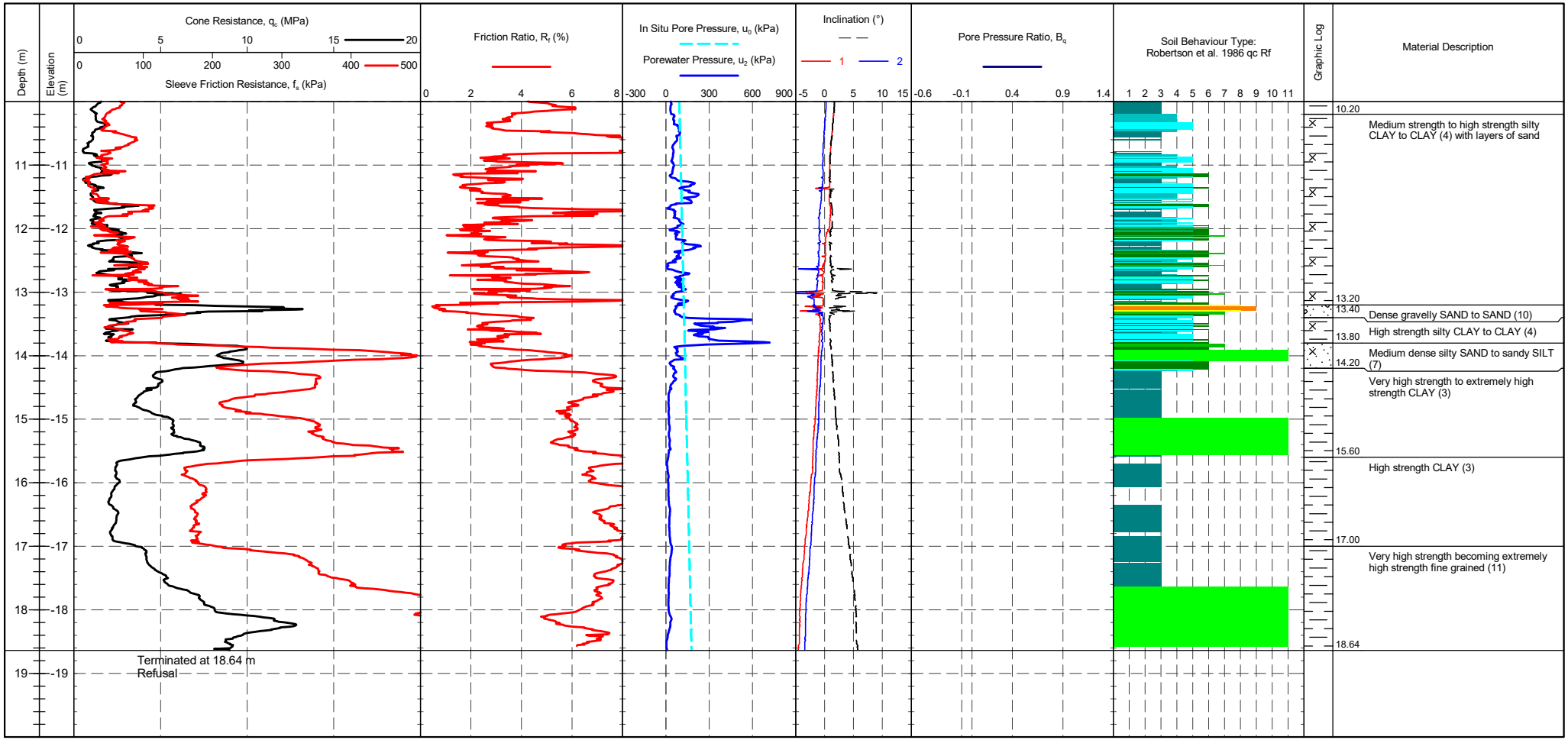
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2303**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 239 mV | 0.046 MPa |
| Sleeve | 230 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| X-Y Inclinometer | 2824 mV | 2764 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

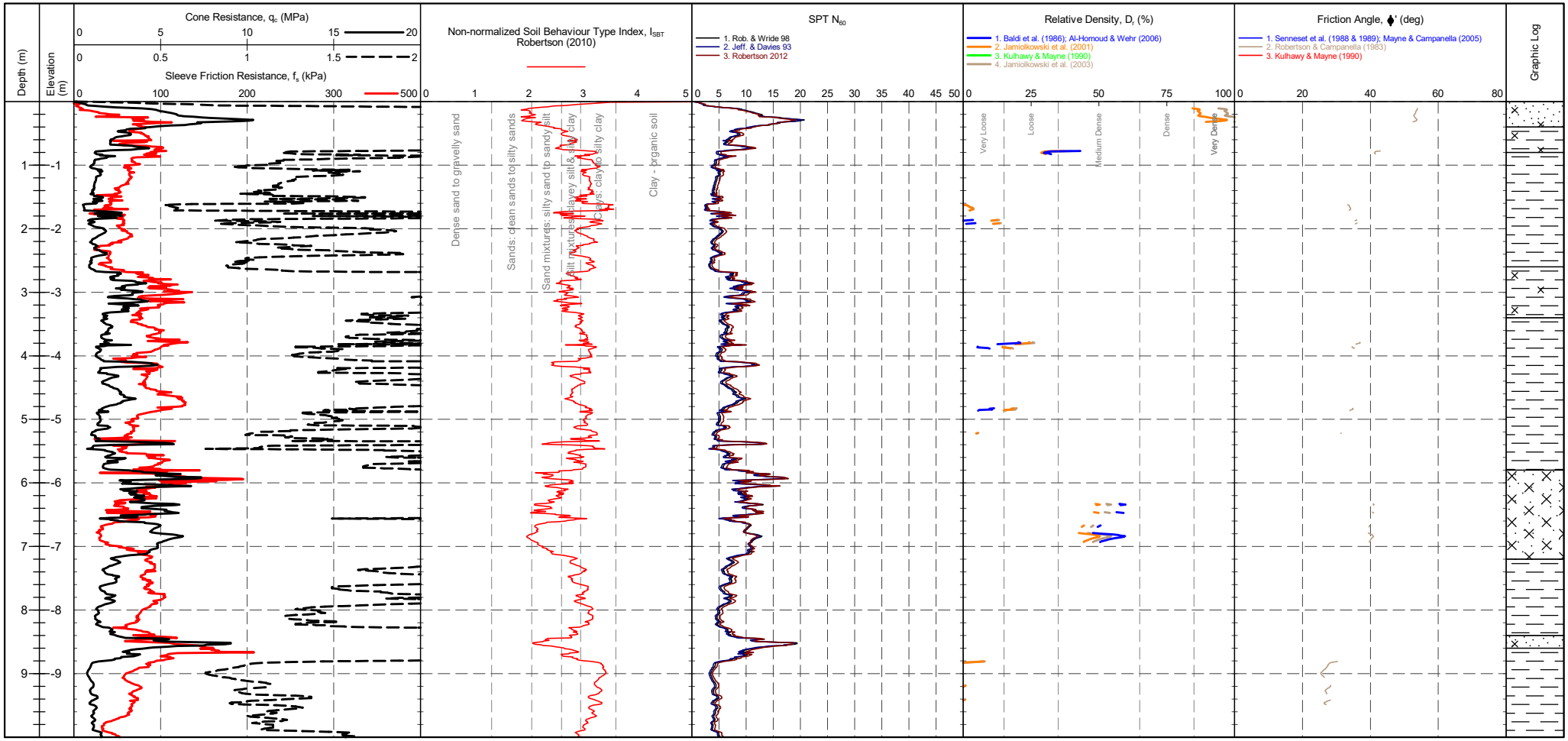
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2303**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 239 mV | 0.046 MPa |
| Sleeve | 230 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| X-Y Inclinometer | 2824 mV | 2764 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

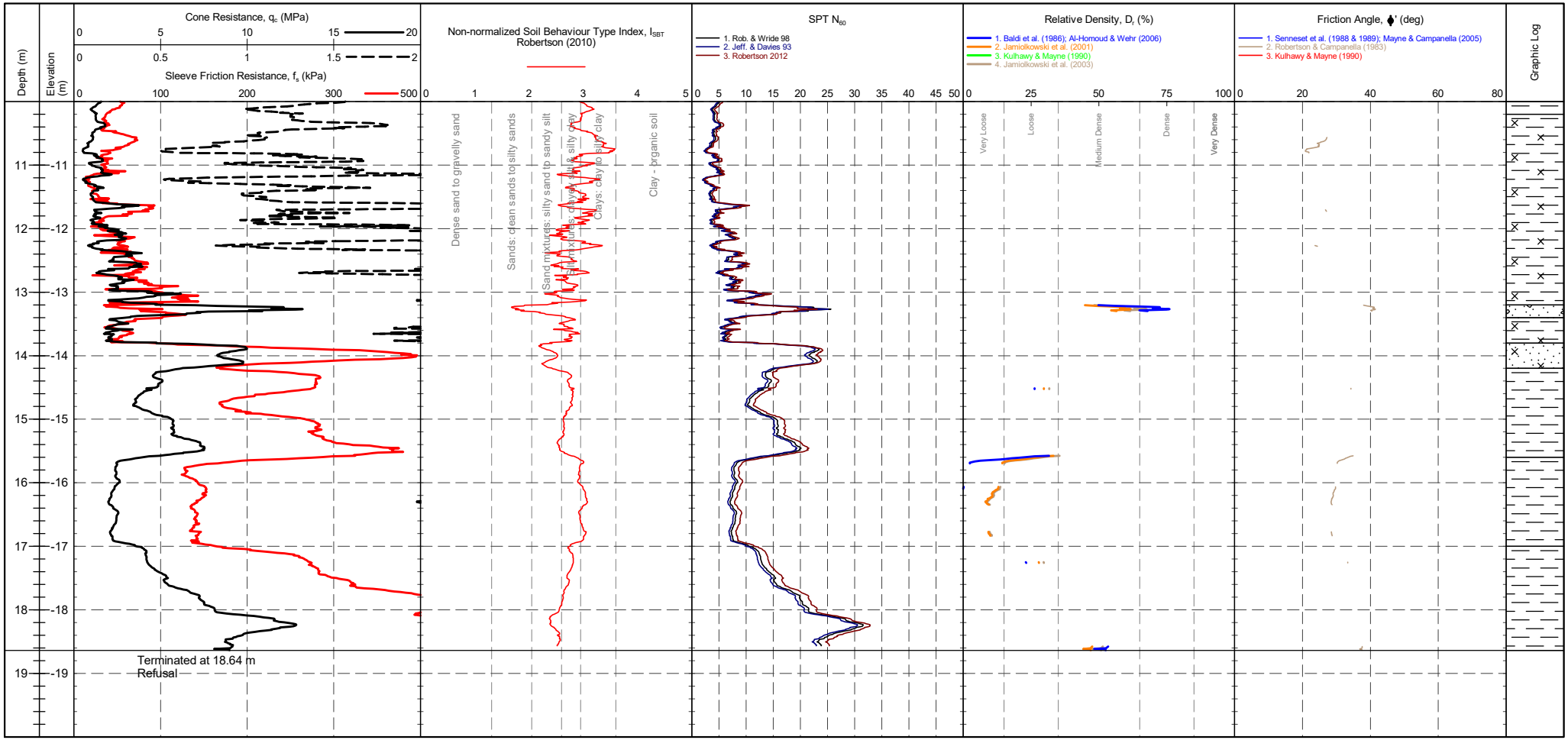
PointID **CPT2303**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 239 mV | 0.046 MPa |
| Sleeve | 230 mV | 231 mV | 0.001 kPa |
| Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| X-Y Inclinometer | 2824 mV | 2764 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

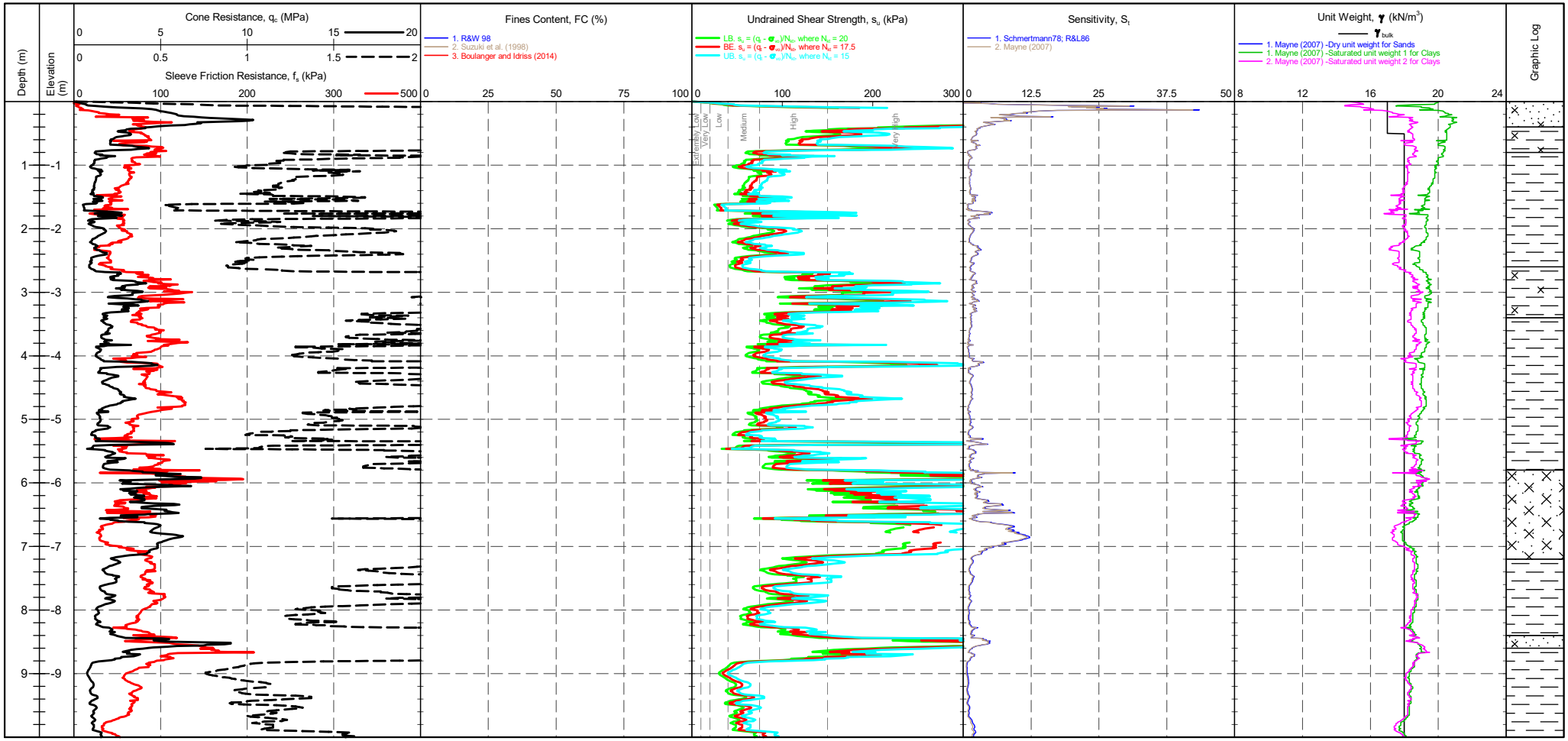
PointID **CPT2303**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 235 mV | 239 mV | 0.046 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 230 mV | 231 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2824 mV | 2764 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

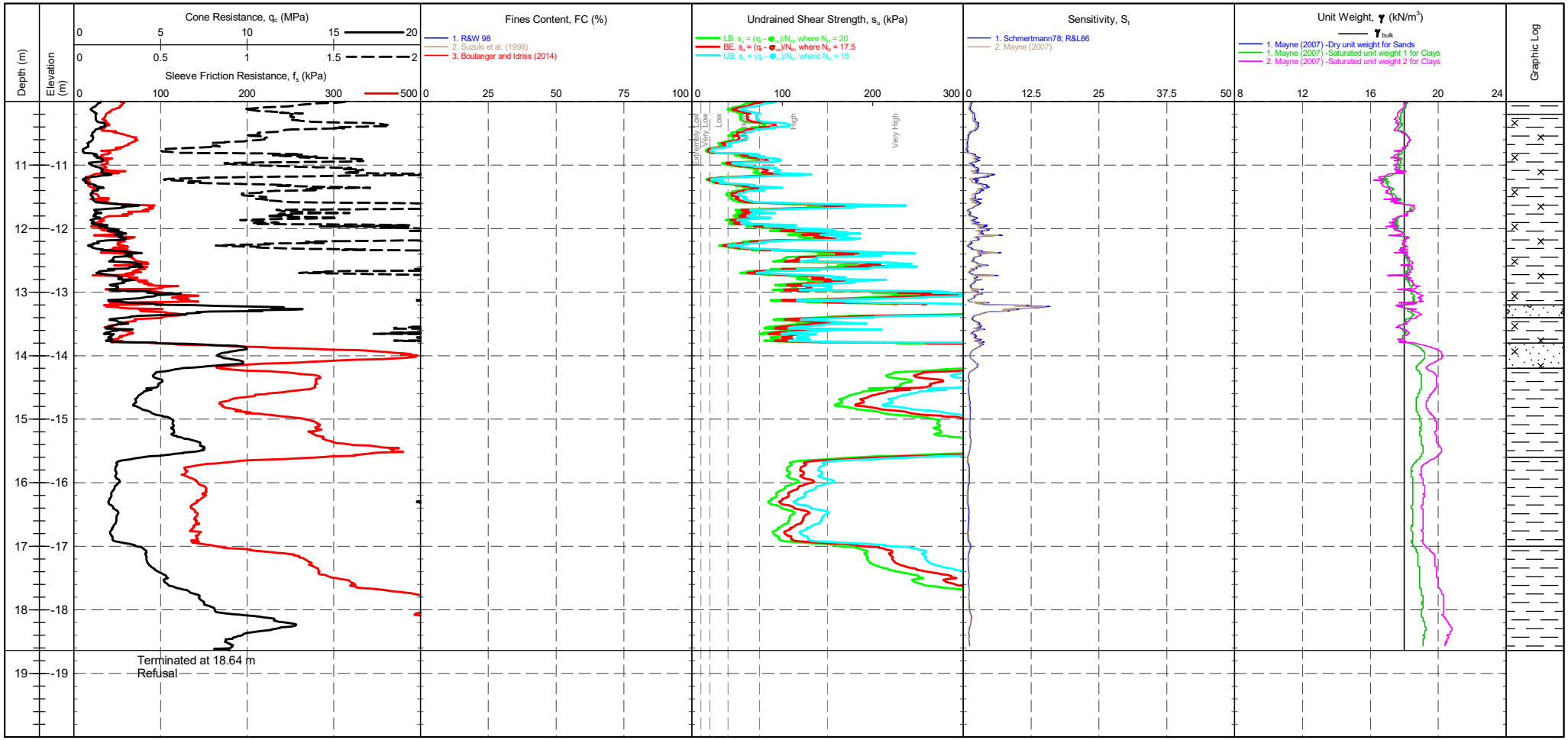
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2303**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



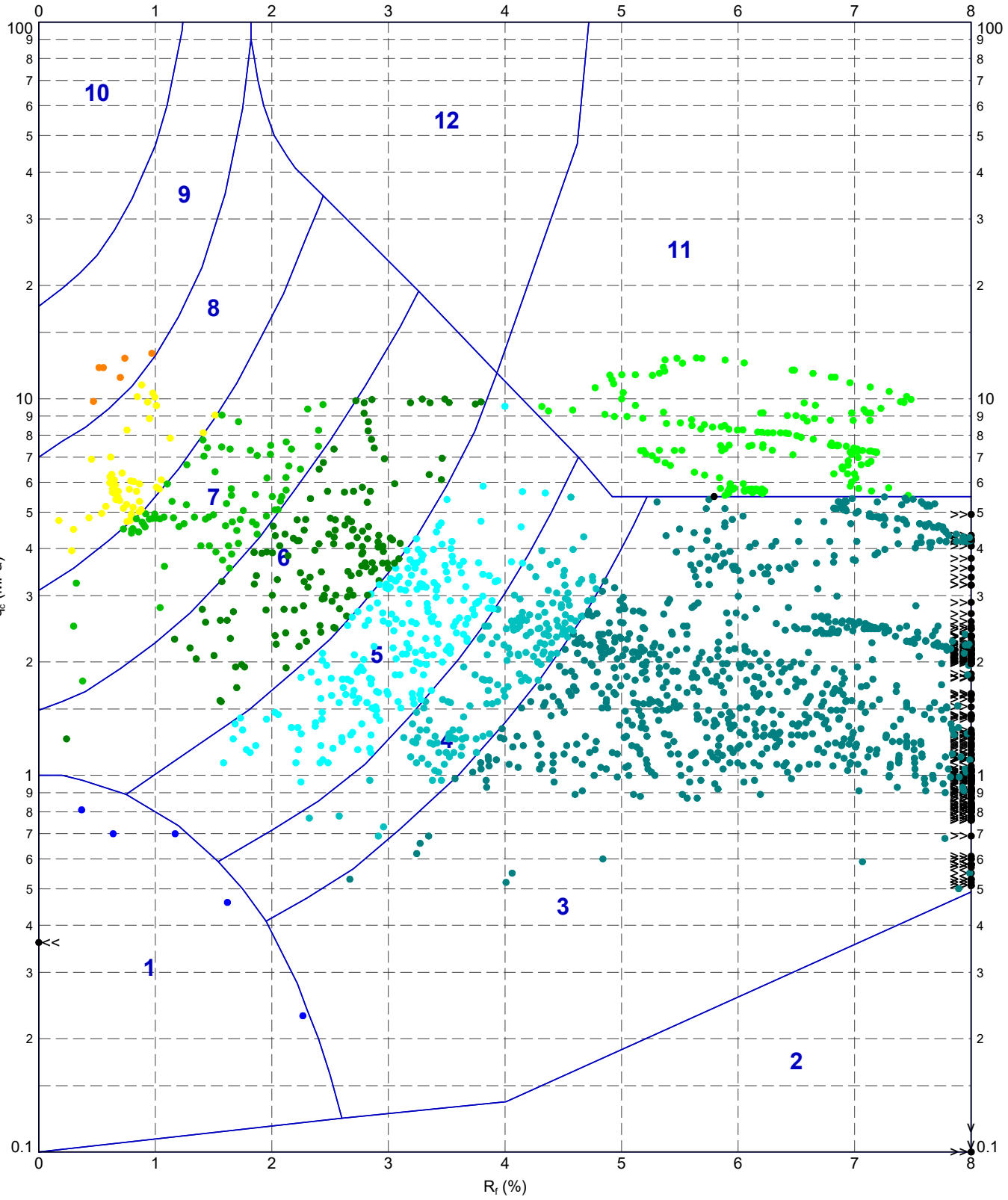

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 235 mV | 239 mV | 0.046 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 230 mV | 231 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 264 mV | 337 mV | 0.019 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2824 mV | 2764 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2303

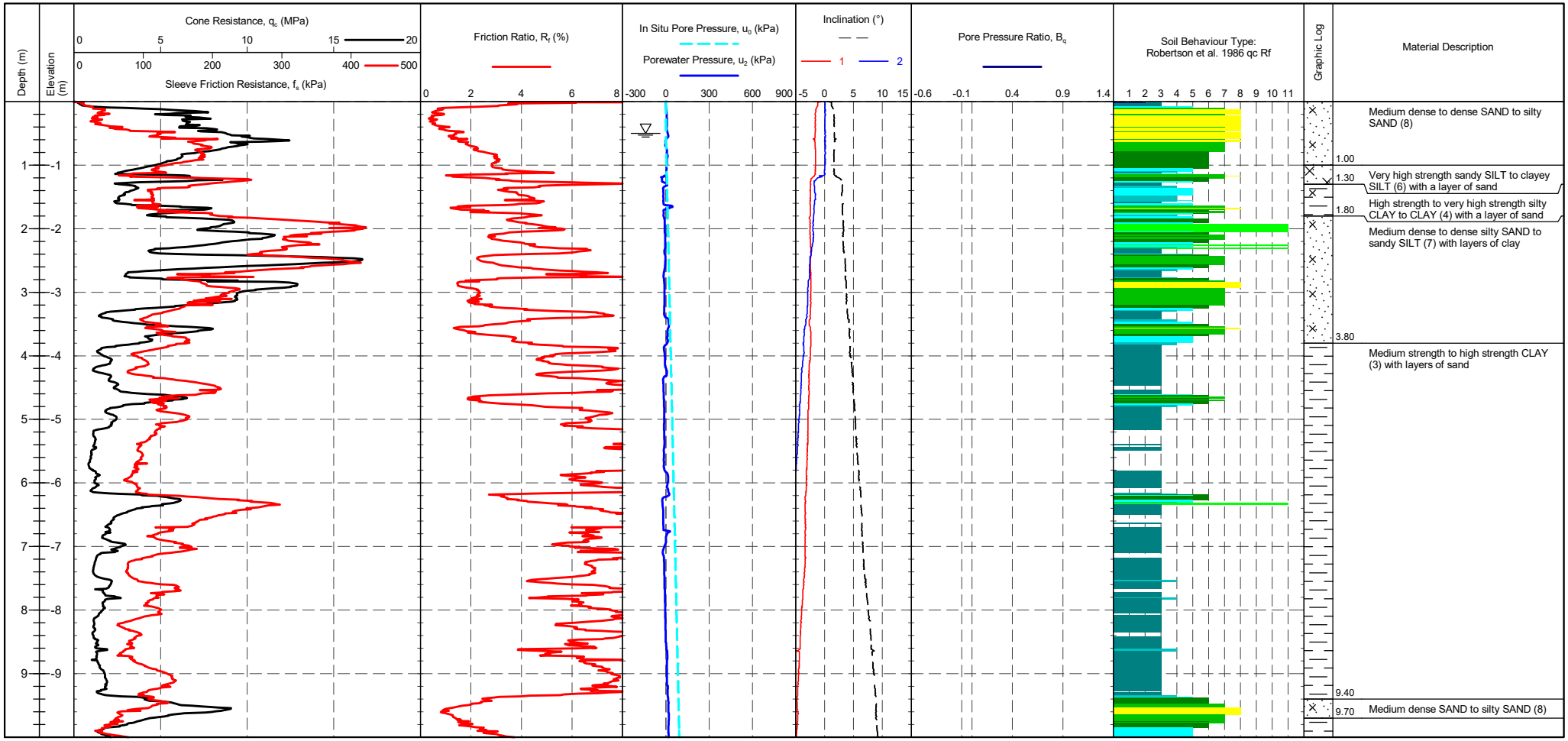
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2304**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 218 mV | 222 mV | 0.003 kPa |
| Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| X-Y Inclinometer | 2346 mV | 2326 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

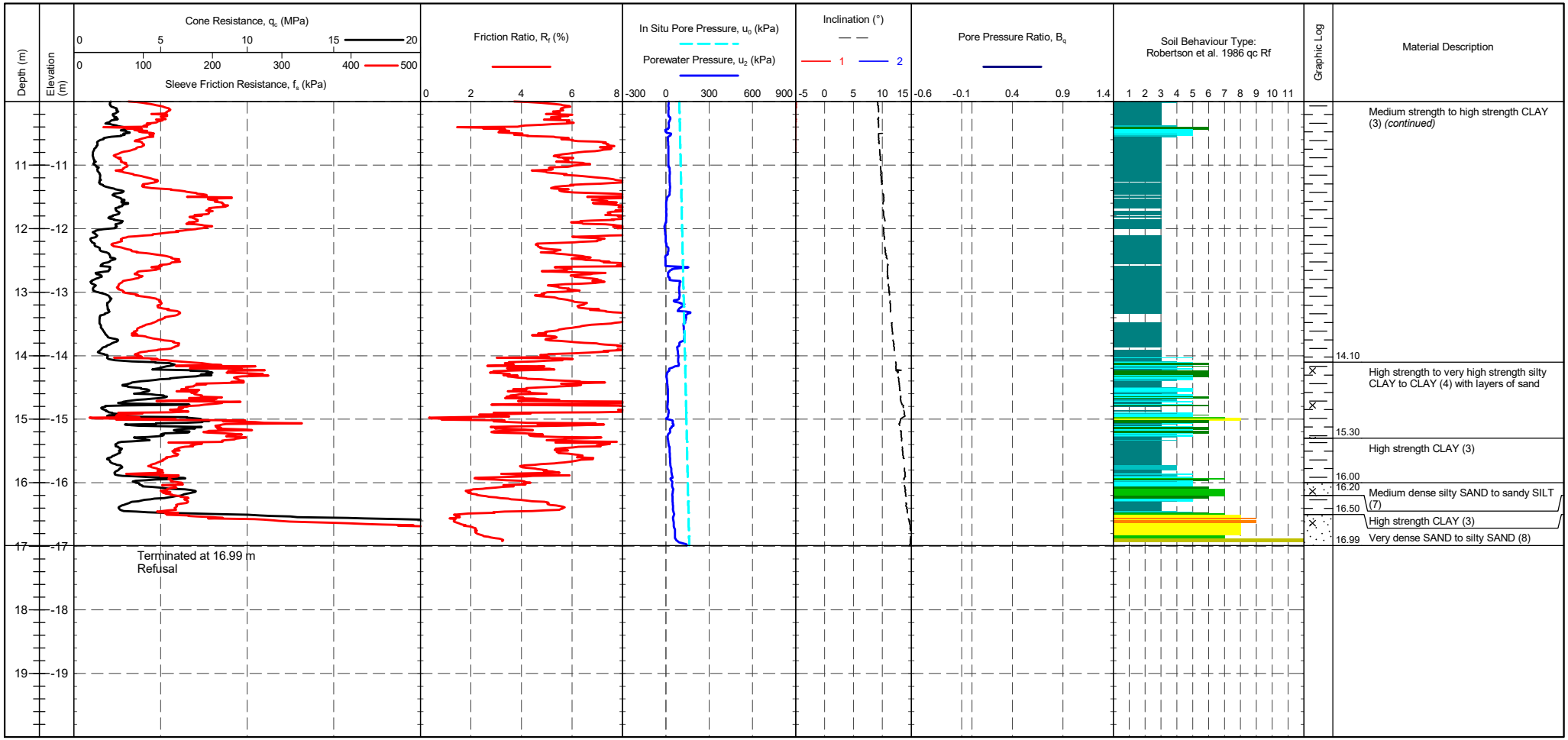
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2304**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 218 mV | 222 mV | 0.003 kPa |
| Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| X-Y Inclinometer | 2346 mV | 2326 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

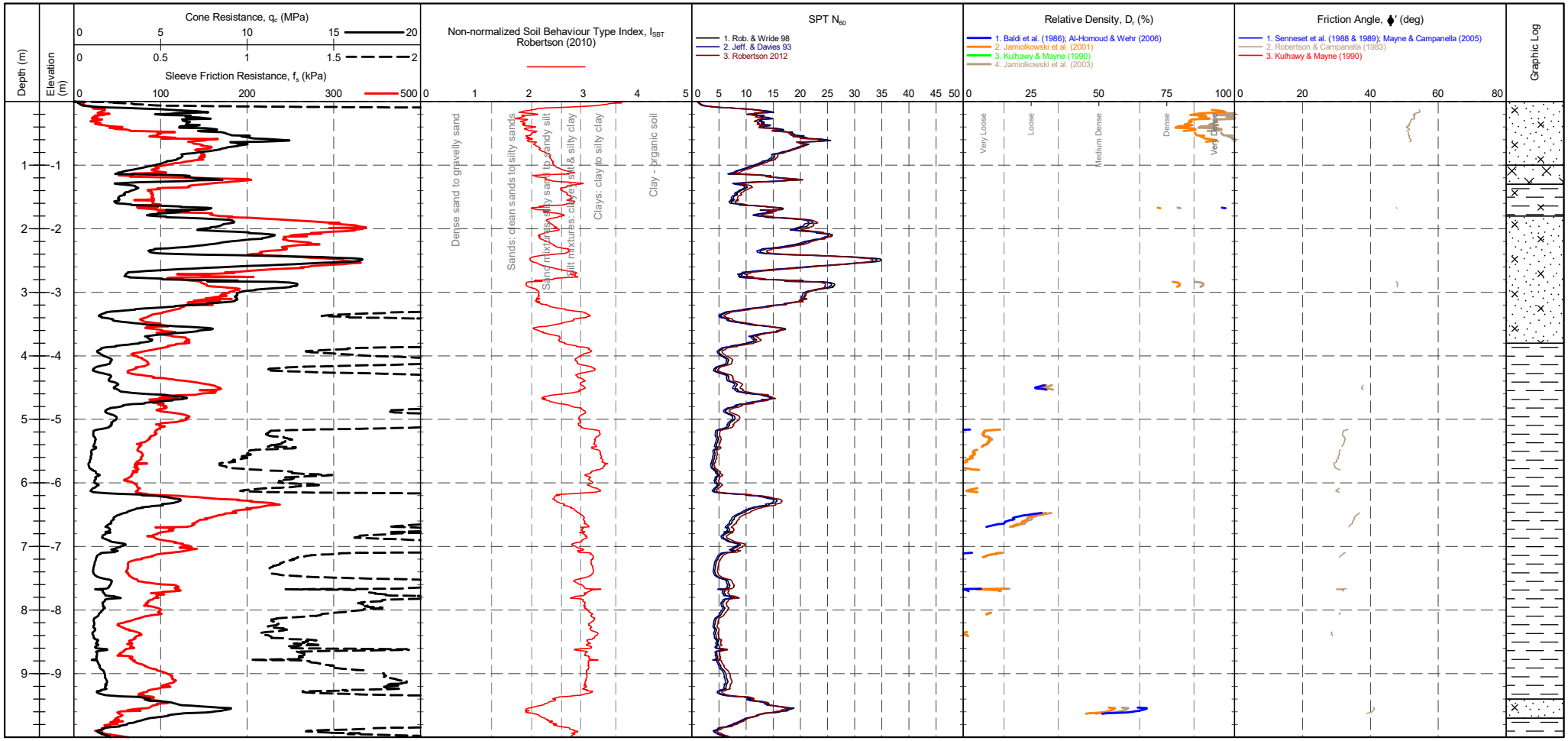
PointID **CPT2304**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 218 mV | 222 mV | 0.003 kPa |
| Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| X-Y Inclinometer | 2346 mV | 2326 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

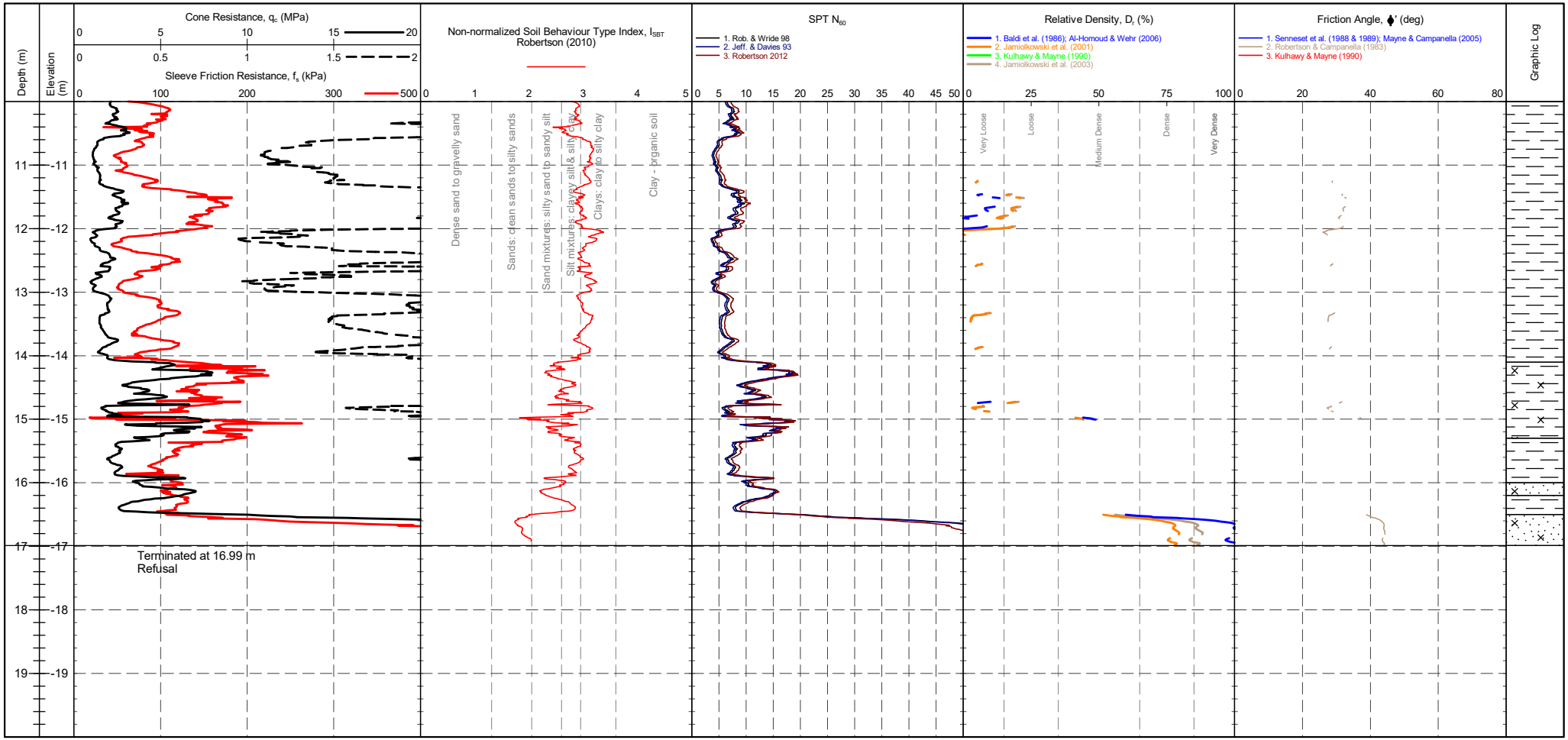
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2304**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco<br>PROJECT : Whitepit and Heathfield Tips<br>LOCATION : Newton Abbot<br>PROJECT No. : 1230268 | EASTING : 0.000 m<br>NORTHING : 0.000 m<br>ELEVATION : 0.000 m OD<br>CHECKED BY : DW<br>TERMINATION REASON : Refusal | Remark:<br>Test refused on total pressure. | SHEET : 2 OF 2<br>STATUS : Final<br>TEST DATE : 15/06/2023<br>PLOT DATE : 20/06/2023<br>METHOD : ISO 22476-1:2022 |




| | | | | | | |
|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | | |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 218 mV | 222 mV | 0.003 kPa |
| Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| X-Y Inclinometer | 2346 mV | 2326 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

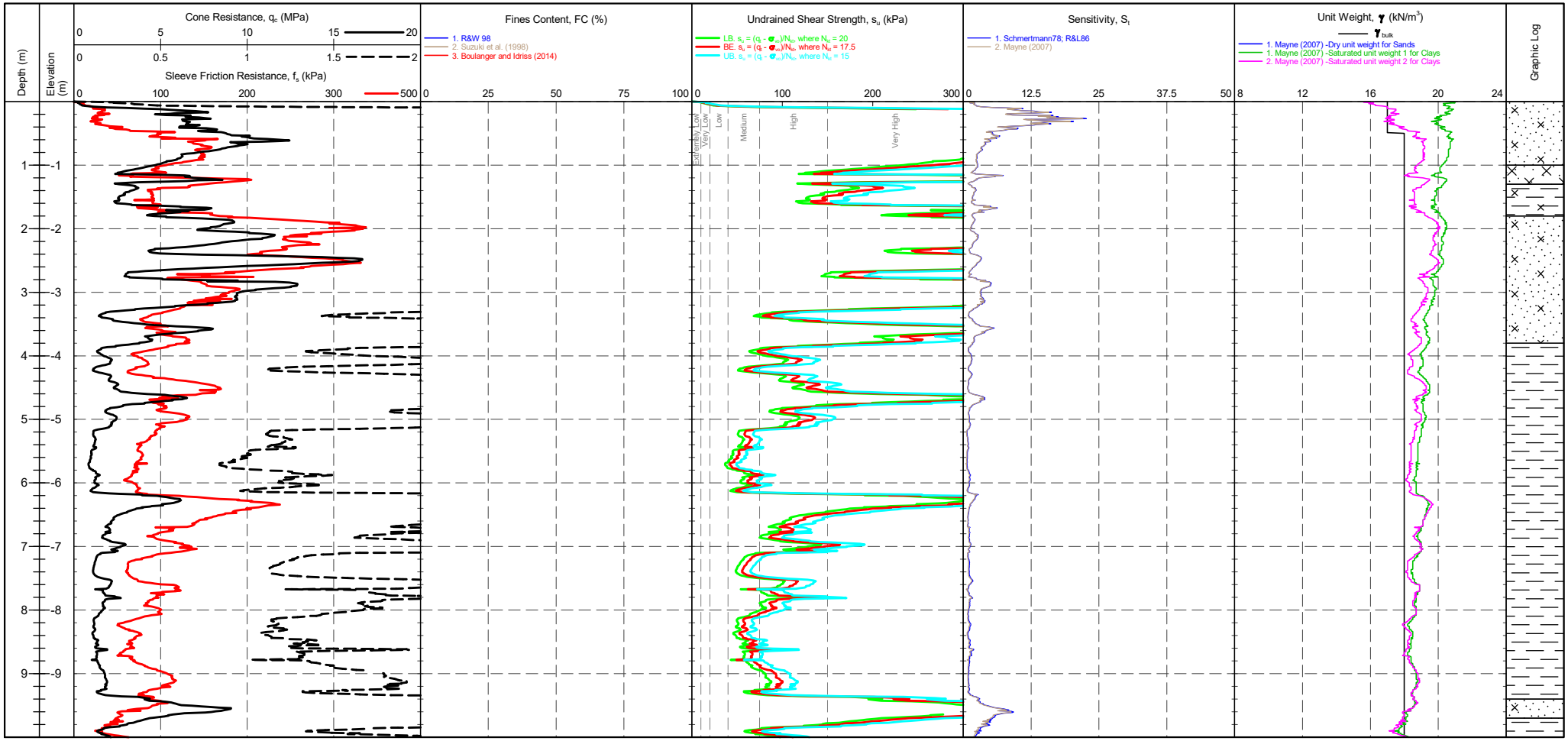
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2304**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 237 mV | 0.035 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 222 mV | 0.003 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2346 mV | 2326 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

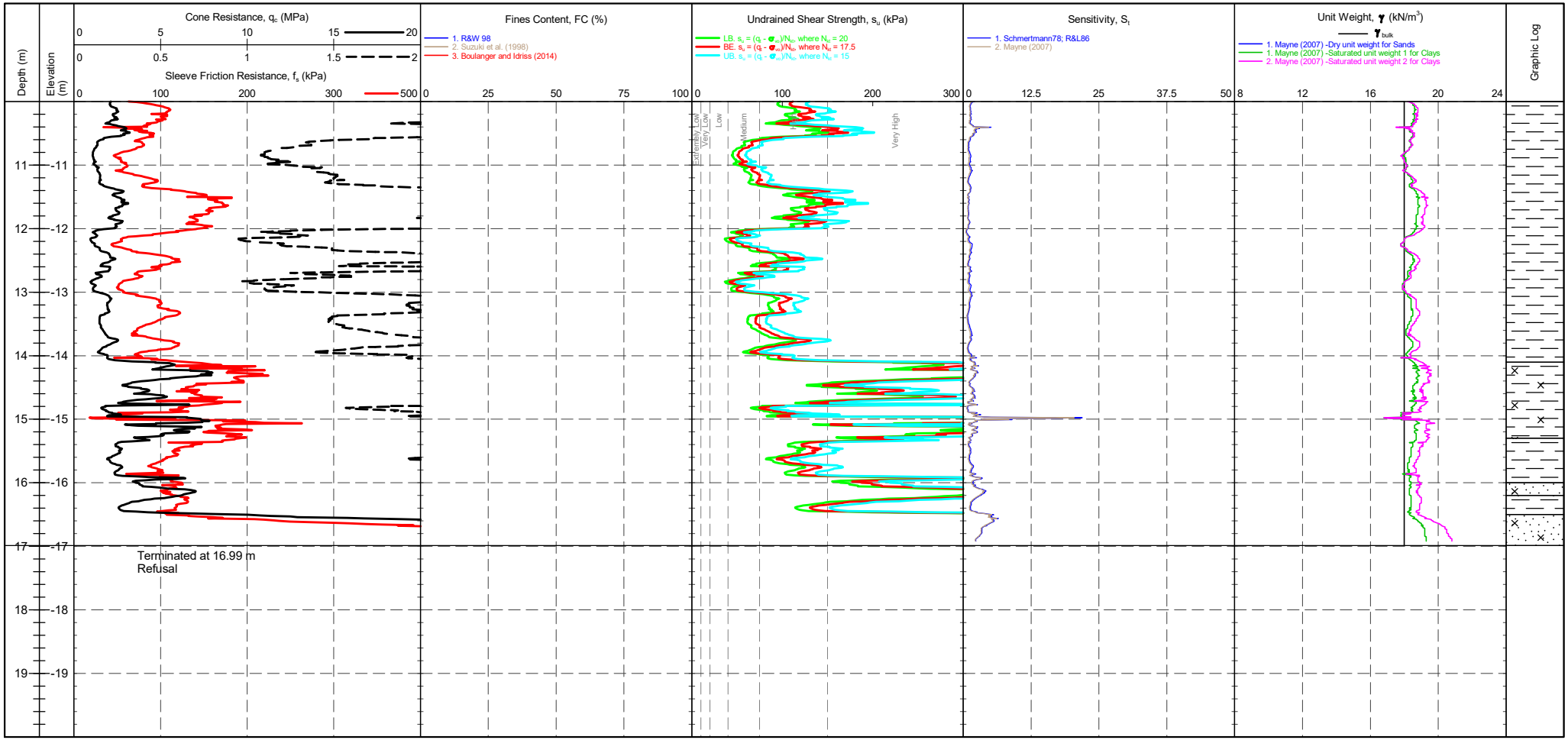
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2304**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



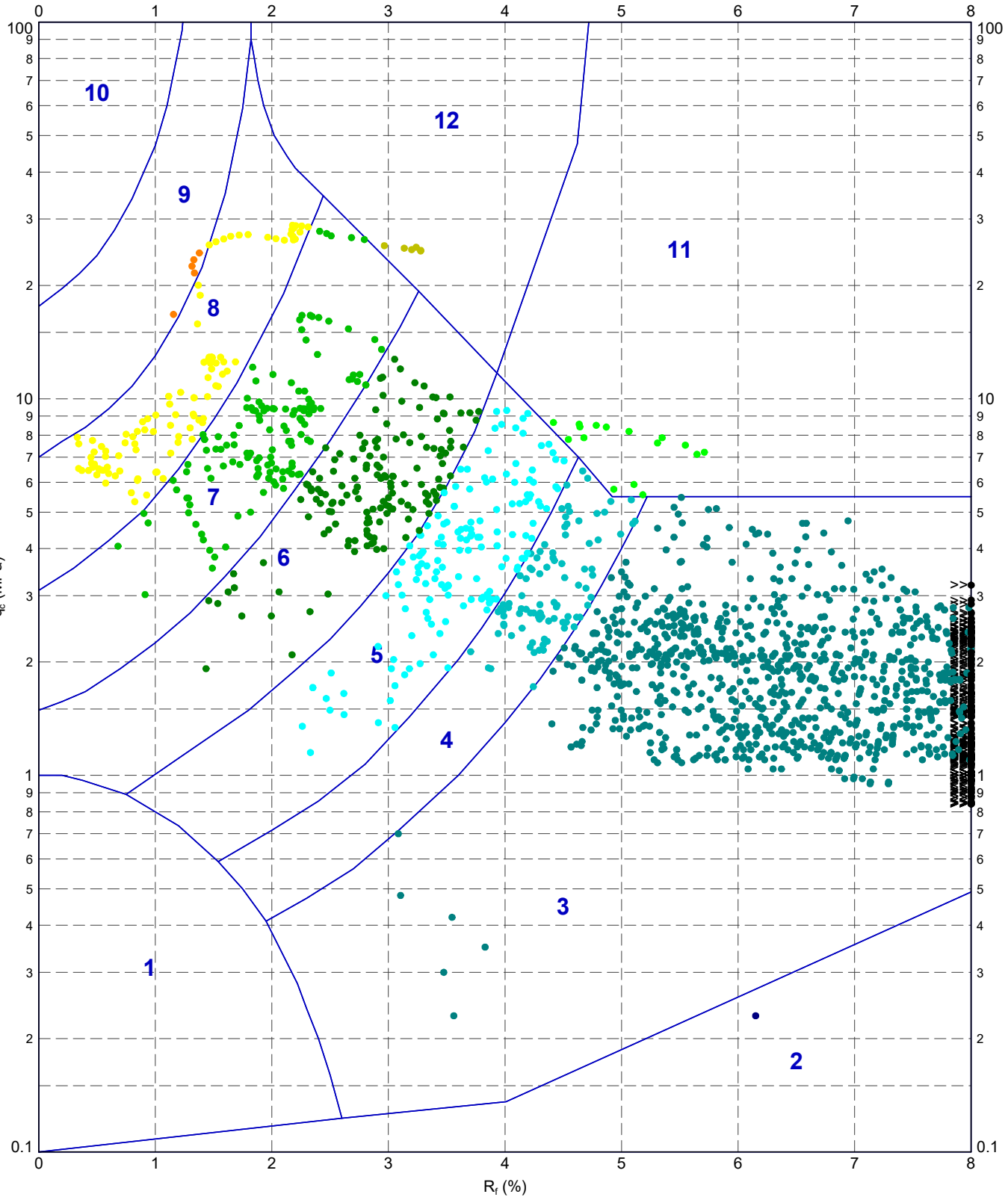

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 237 mV | 0.035 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 222 mV | 0.003 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 238 mV | 440 mV | 0.054 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2346 mV | 2326 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2304

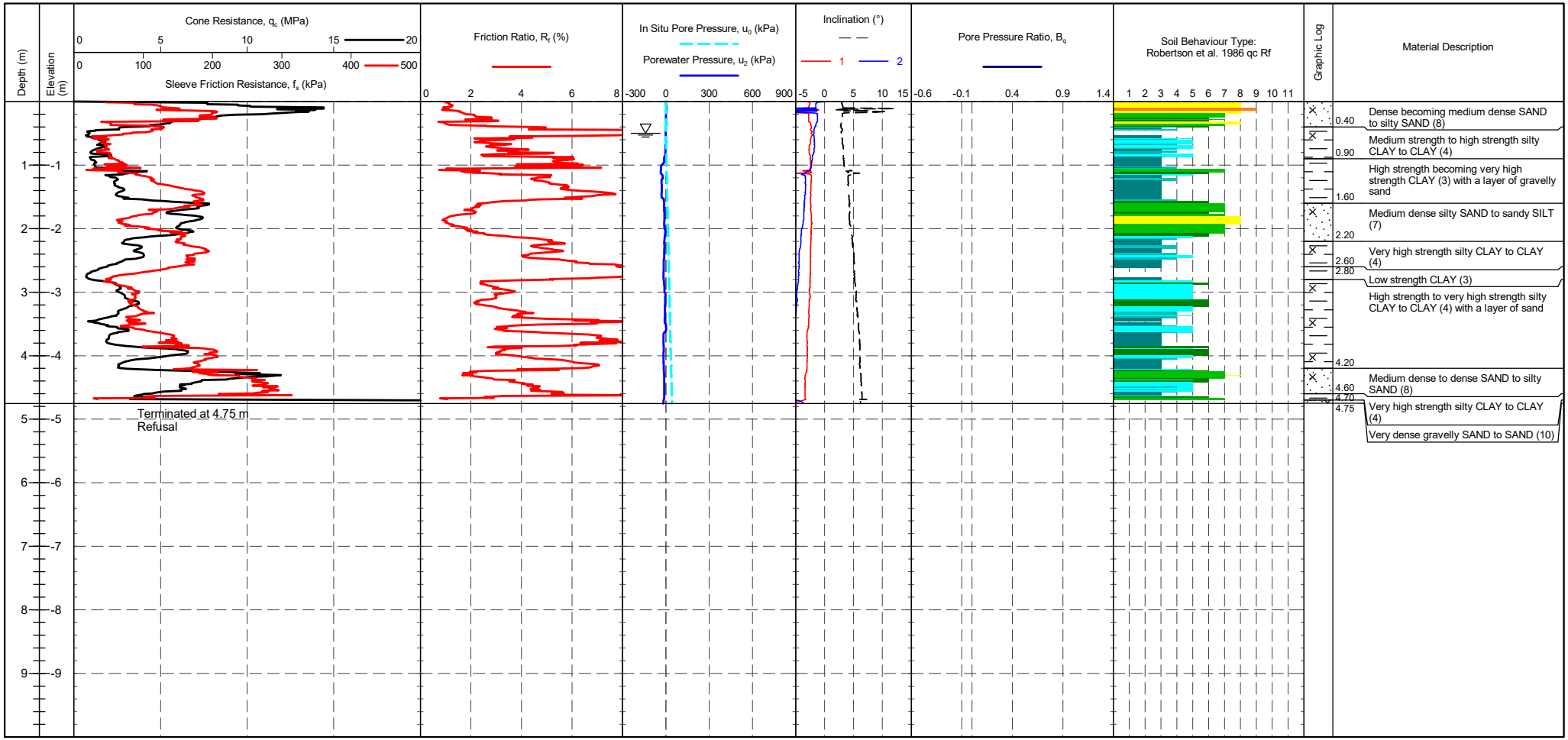
| | | | |
|---|---|---|---|
| DRAWN | | DATE | 20/06/2023 |
| CHECKED | | DATE | 20/06/2023 |
| SCALE | Not To Scale | | A4 |
| PROJECT No | 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID **CPT2305**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 243 mV | 0.115 MPa |
| Sleeve | 219 mV | 256 mV | 0.028 kPa |
| Pore Pressure 2 | 334 mV | 307 mV | -0.007 kPa |
| X-Y Inclinometer | 2074 mV | 2117 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

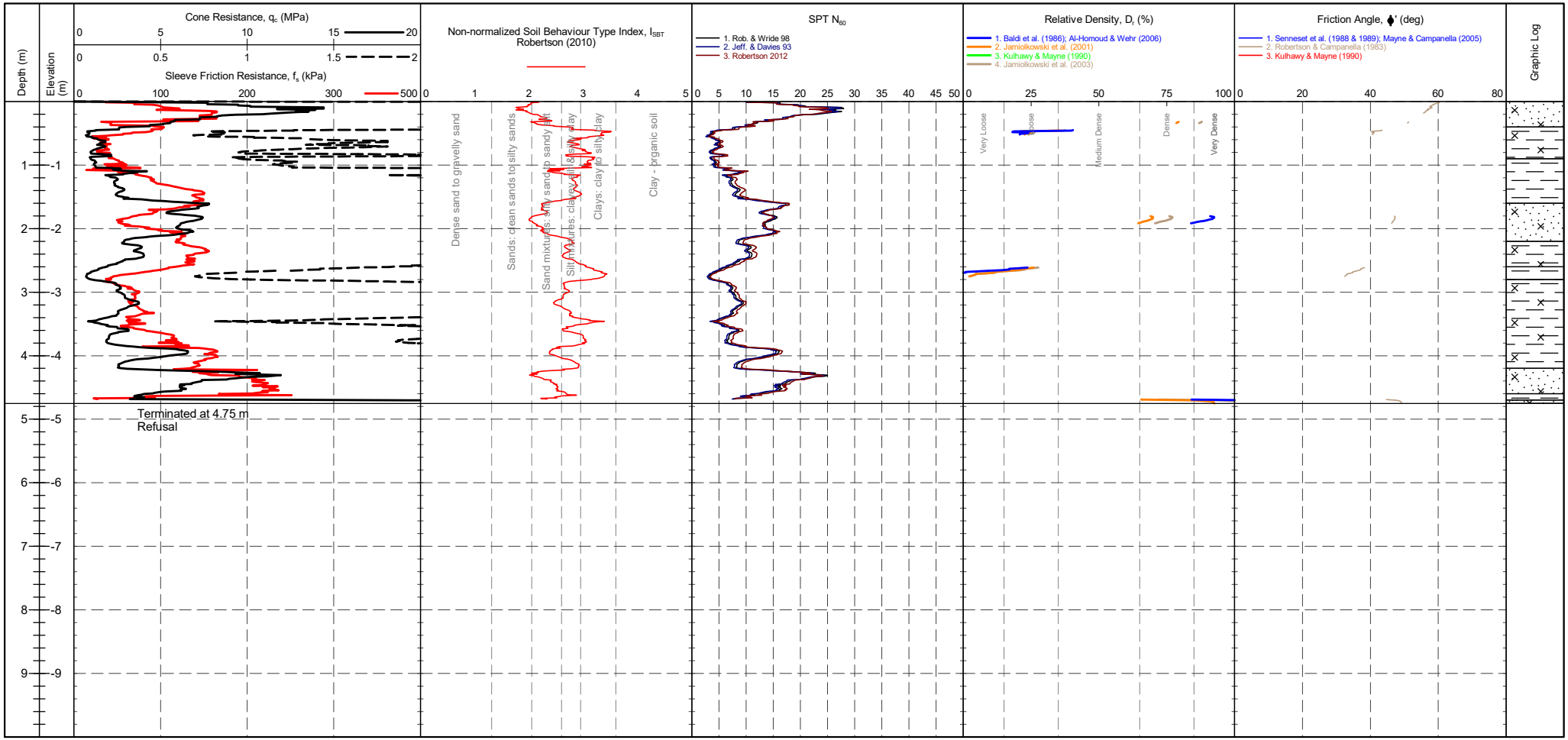
PointID **CPT2305**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 233 mV | 243 mV | 0.115 MPa |
| Sleeve | 219 mV | 256 mV | 0.028 kPa |
| Pore Pressure 2 | 334 mV | 307 mV | -0.007 kPa |
| X-Y Inclinometer | 2074 mV | 2117 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

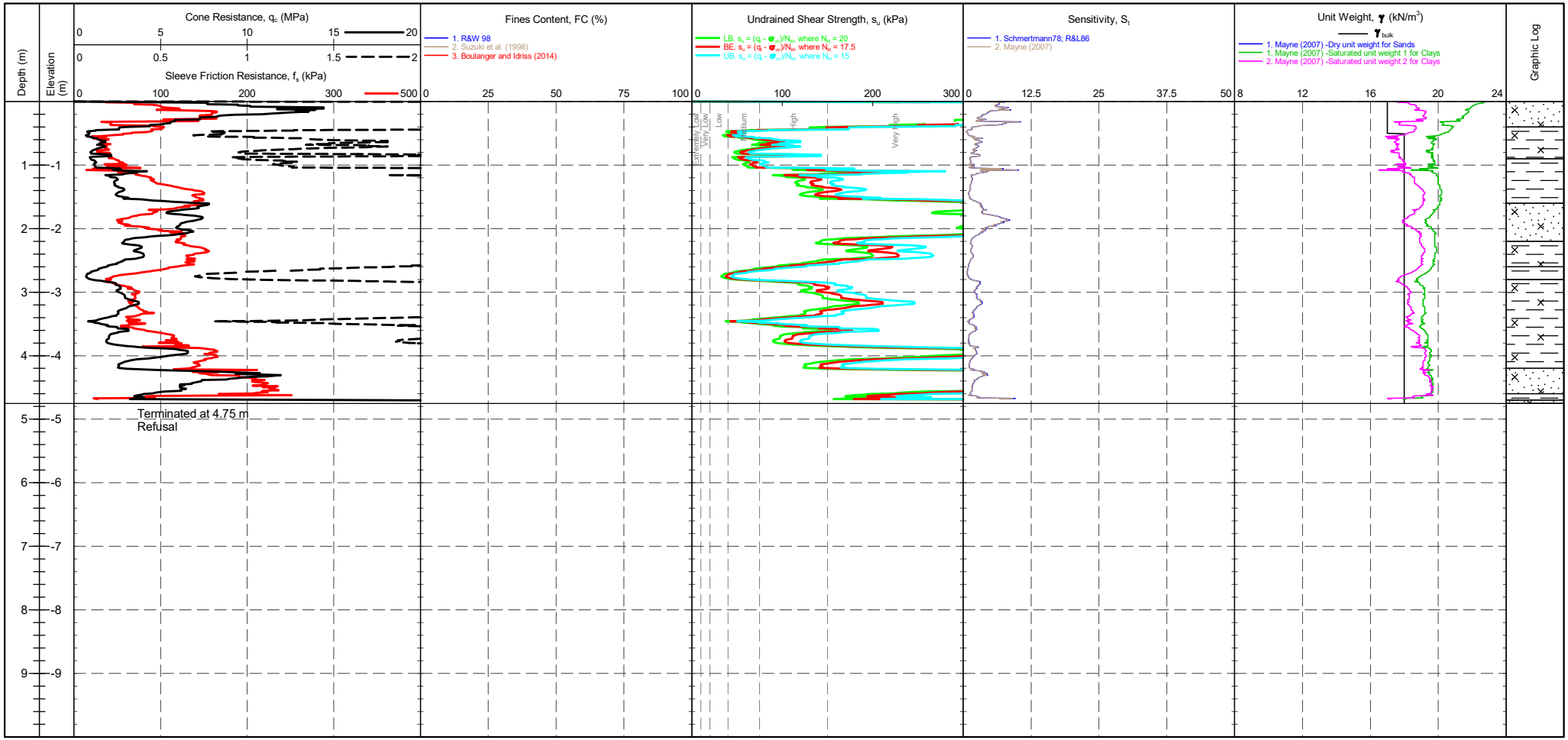
PointID **CPT2305**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 15/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

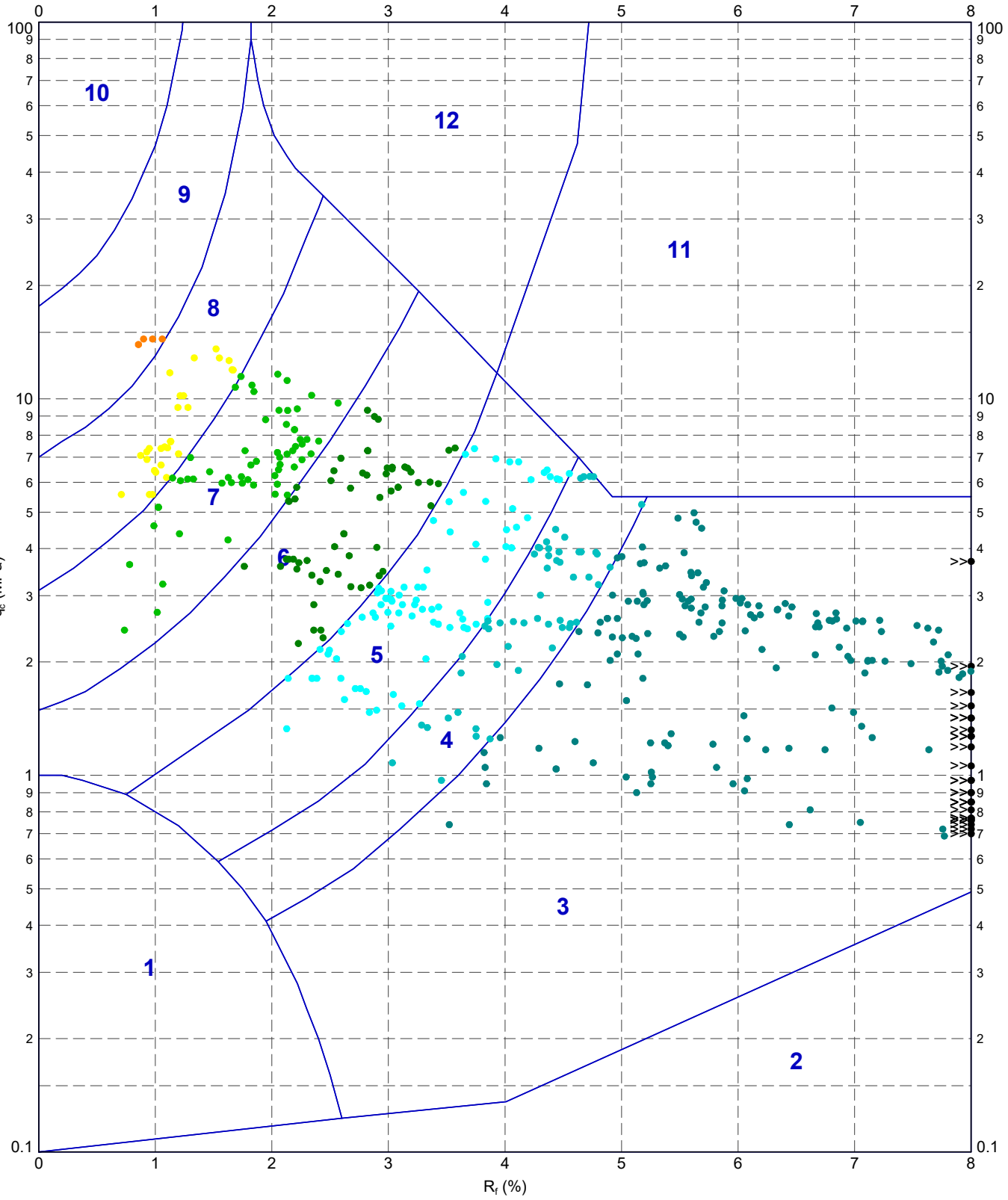
| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 243 mV | 0.115 MPa |
| Sleeve | 219 mV | 256 mV | 0.028 kPa |
| Pore Pressure 2 | 334 mV | 307 mV | -0.007 kPa |
| X-Y Inclinometer | 2074 mV | 2117 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2305

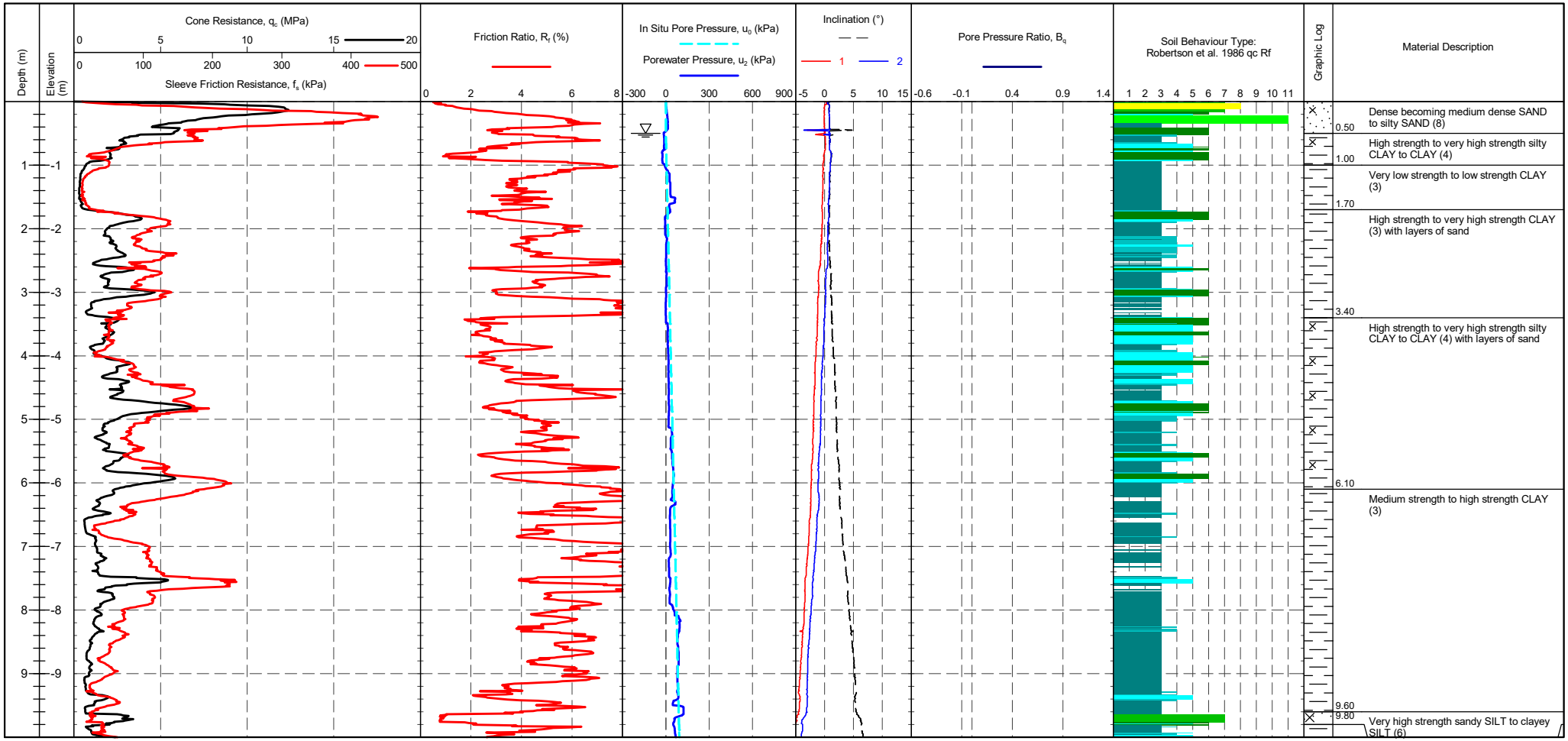
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 242 mV | 0.104 MPa |
| Sleeve | 218 mV | 225 mV | 0.005 kPa |
| Pore Pressure 2 | 280 mV | 449 mV | 0.045 kPa |
| X-Y Inclinometer | 2399 mV | 2459 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

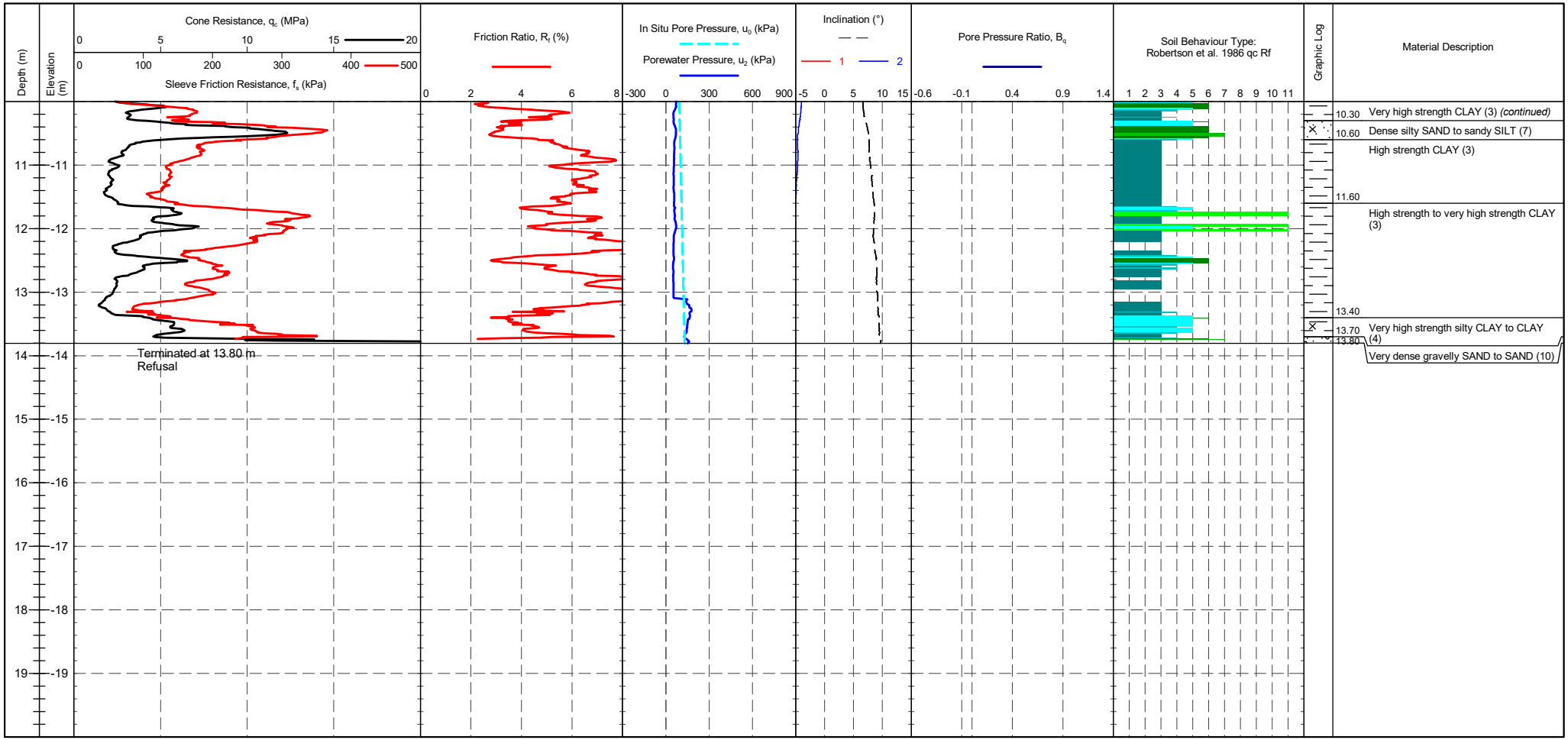
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 242 mV | 0.104 MPa |
| Sleeve | 218 mV | 225 mV | 0.005 kPa |
| Pore Pressure 2 | 280 mV | 449 mV | 0.045 kPa |
| X-Y Inclinometer | 2399 mV | 2459 mV | |

METHOD: Robertson et al. 1986 qc Rf

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8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

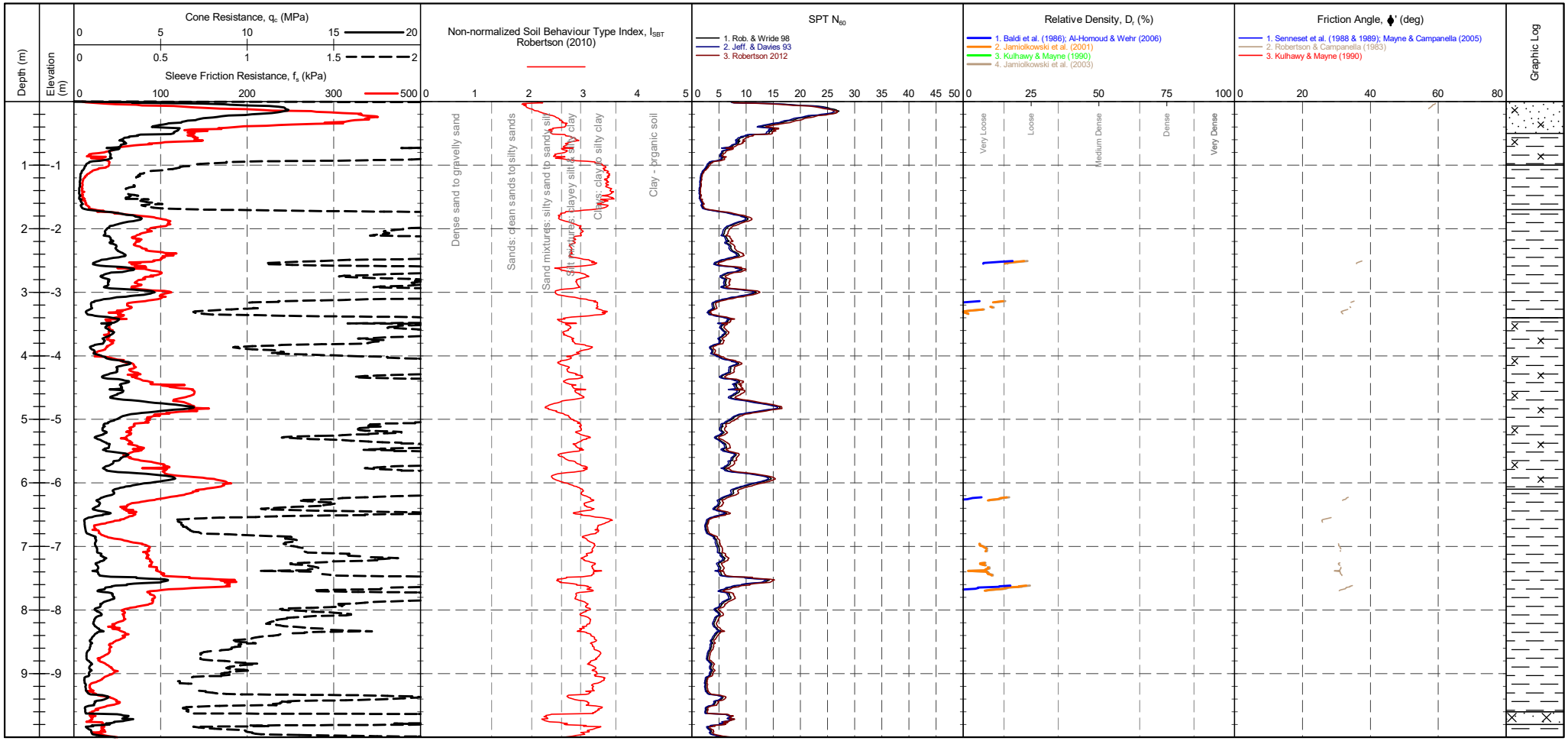
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 233 mV | 242 mV | 0.104 MPa |
| Sleeve | 218 mV | 225 mV | 0.005 kPa |
| Pore Pressure 2 | 280 mV | 449 mV | 0.045 kPa |
| X-Y Inclinometer | 2399 mV | 2459 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

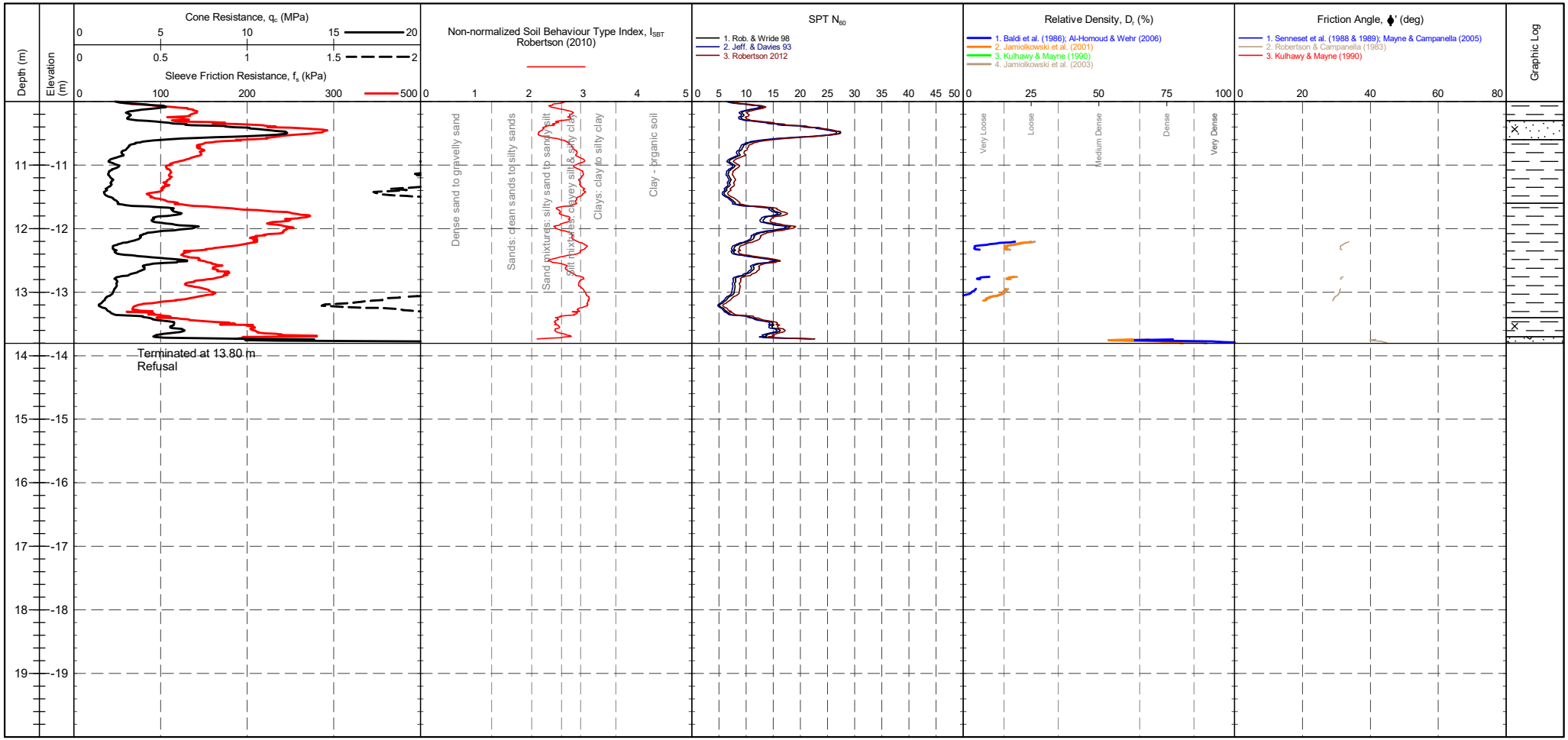
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | |
|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | Tip | 233 mV | 242 mV |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 225 mV |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 280 mV | 449 mV |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2399 mV | 2459 mV |

| Transducer | Difference |
|---|---|
| Tip | 0.104 MPa |
| Sleeve | 0.005 kPa |
| Pore Pressure 2 | 0.045 kPa |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic |
|---|---|
| Clays | 2.95-3.60 |
| Silt mixtures | 2.60-2.95 |
| Sand mixtures | 2.05-2.60 |
| Sands | 1.31-2.05 |
| Gravelly sand | <1.31 |

| Description | SPT N value, NSPT |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | >50 |

| Description | Relative Density Dr (%) |
|---|---|
| Very Loose | 0 - 15 |
| Loose | 15 - 35 |
| Medium Dense | 35 - 65 |
| Dense | 65 - 85 |
| Very Dense | >85 |

Groundwater Level

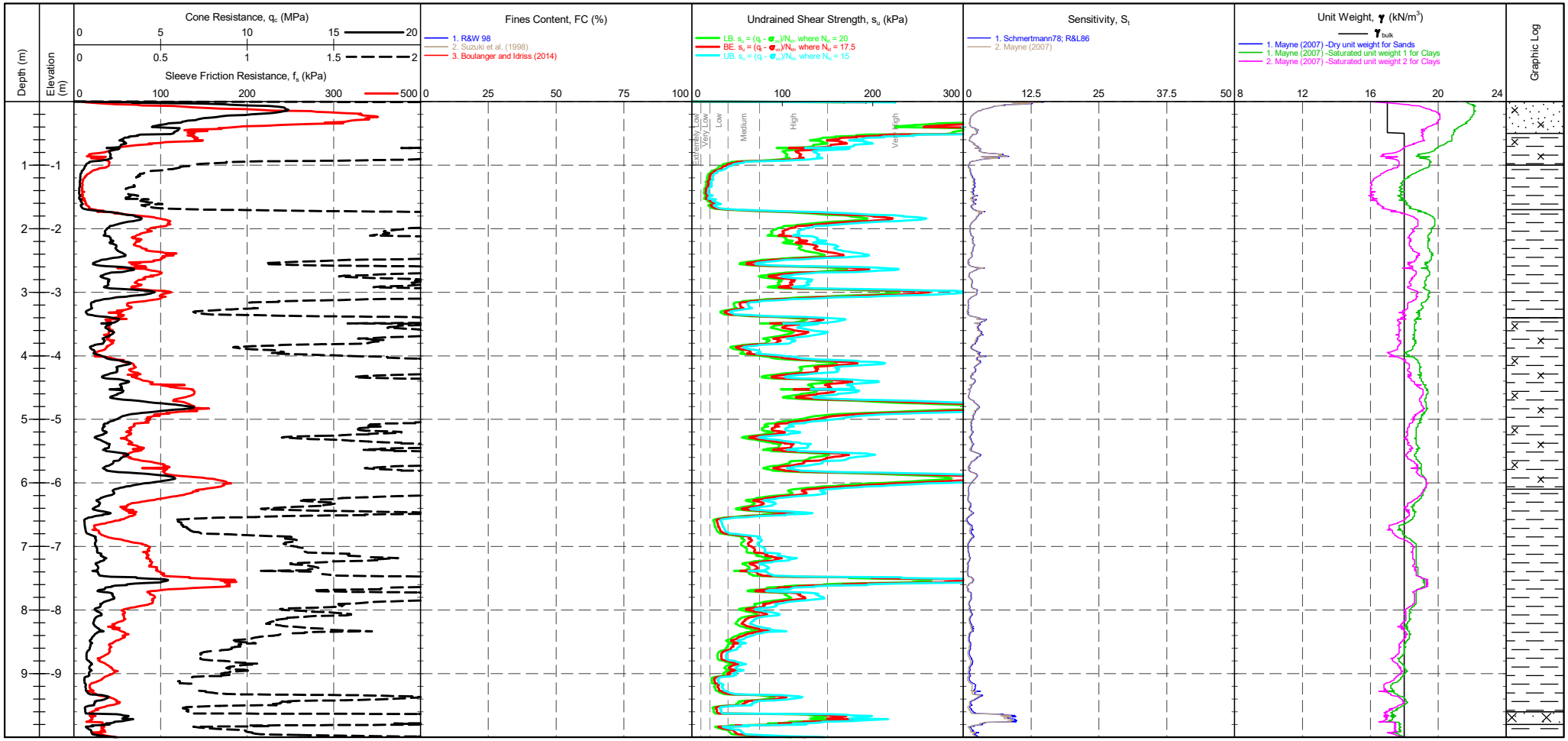
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 233 mV | 242 mV | 0.104 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 225 mV | 0.005 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 280 mV | 449 mV | 0.045 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2399 mV | 2459 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

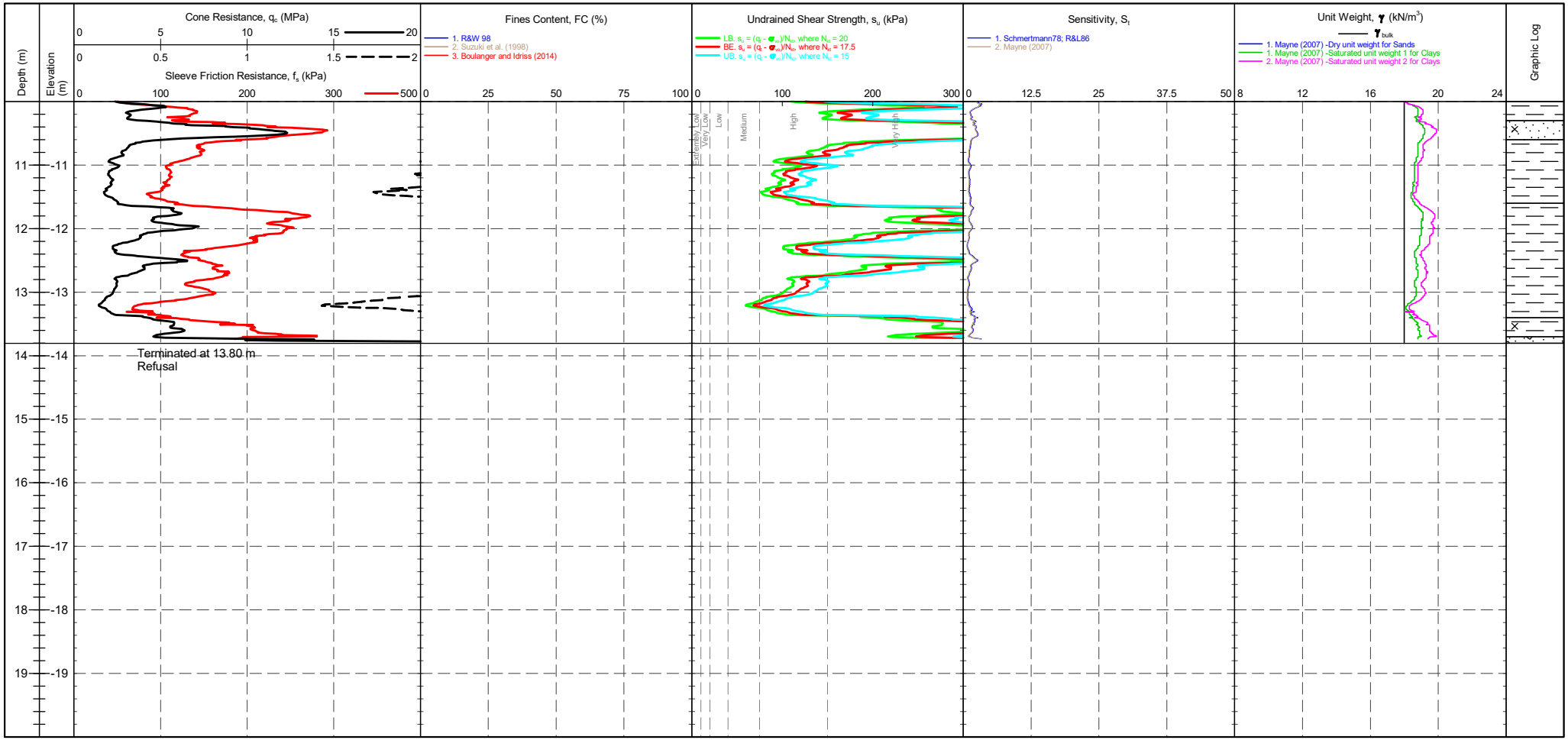
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2306**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 15/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



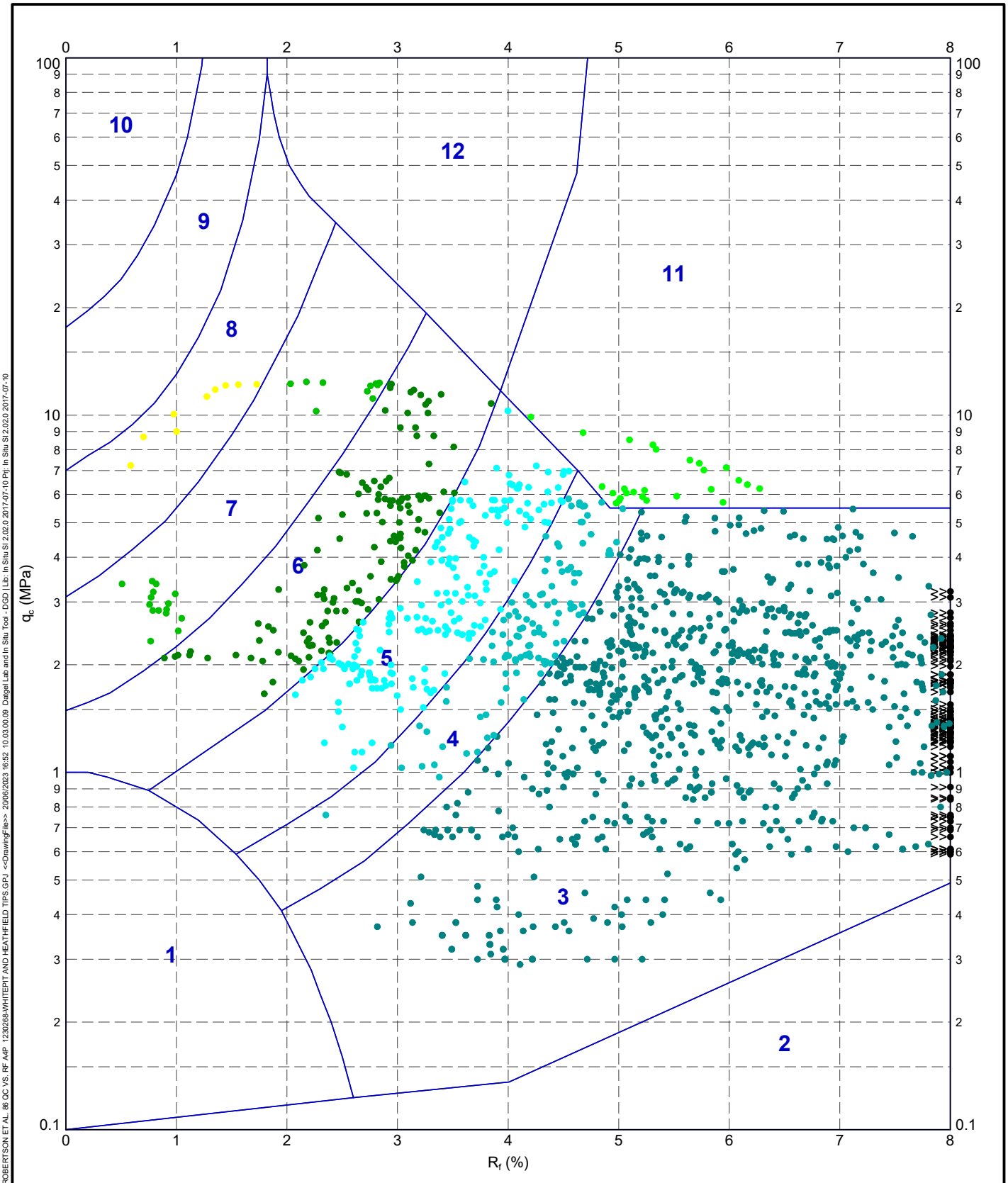

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 233 mV | 242 mV | 0.104 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 225 mV | 0.005 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 280 mV | 449 mV | 0.045 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2399 mV | 2459 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2306

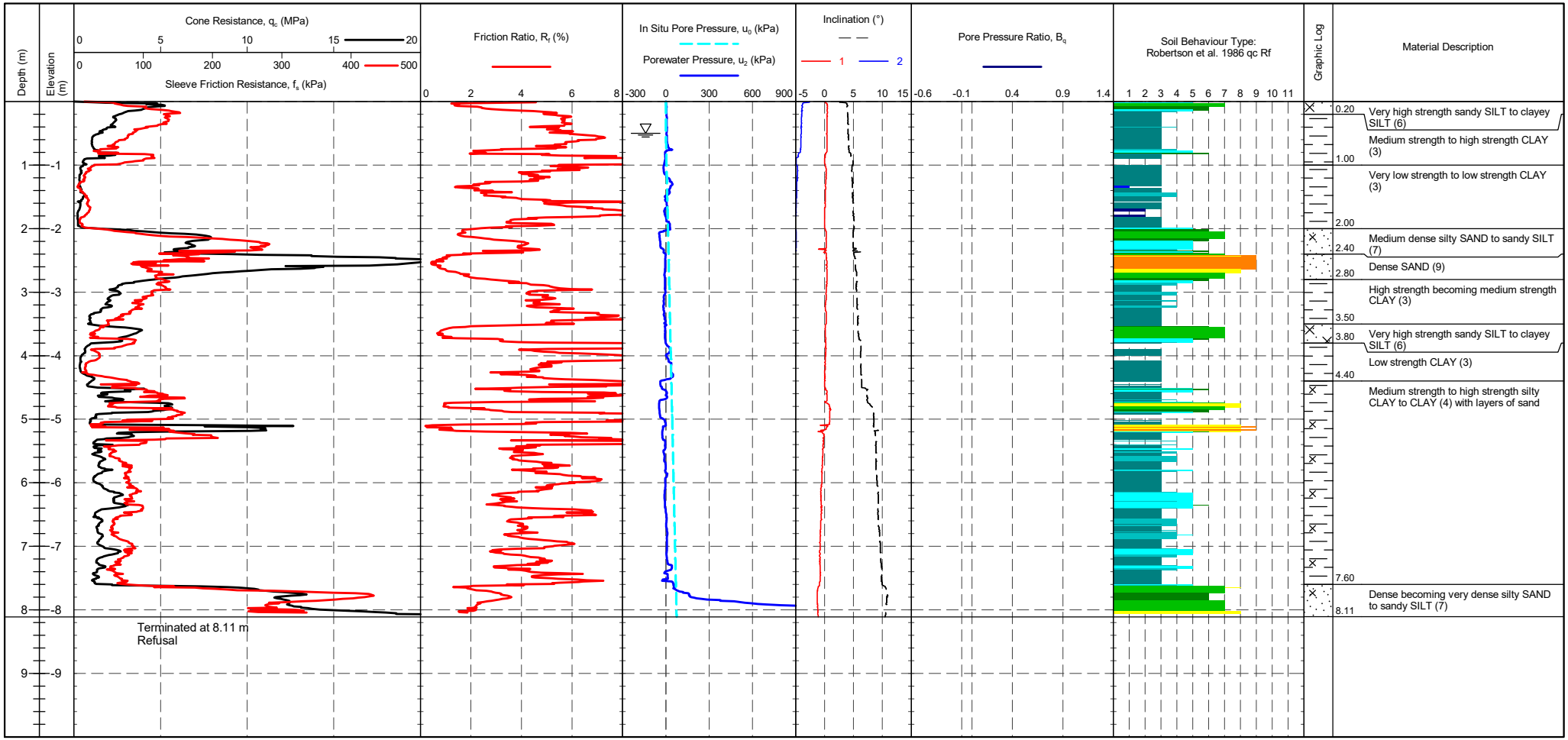
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2307**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 236 mV | 0.035 MPa |
| Sleeve | 217 mV | 218 mV | 0.001 kPa |
| Pore Pressure 2 | 315 mV | 372 mV | 0.015 kPa |
| X-Y Inclinometer | 2413 mV | 2415 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

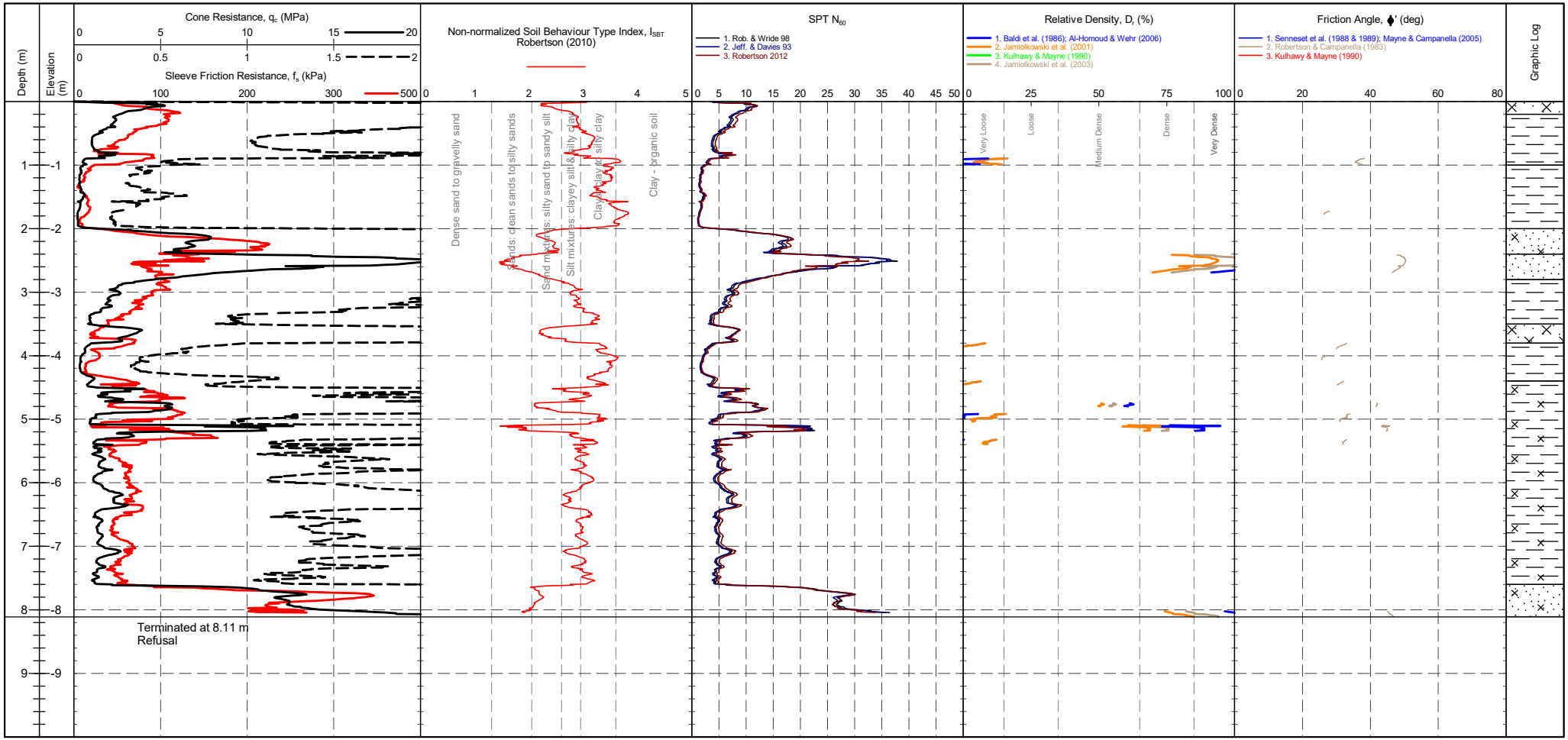
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID: **CPT2307**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 233 mV | 236 mV | 0.035 MPa |
| Sleeve | 217 mV | 218 mV | 0.001 kPa |
| Pore Pressure 2 | 315 mV | 372 mV | 0.015 kPa |
| X-Y Inclinometer | 2413 mV | 2415 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

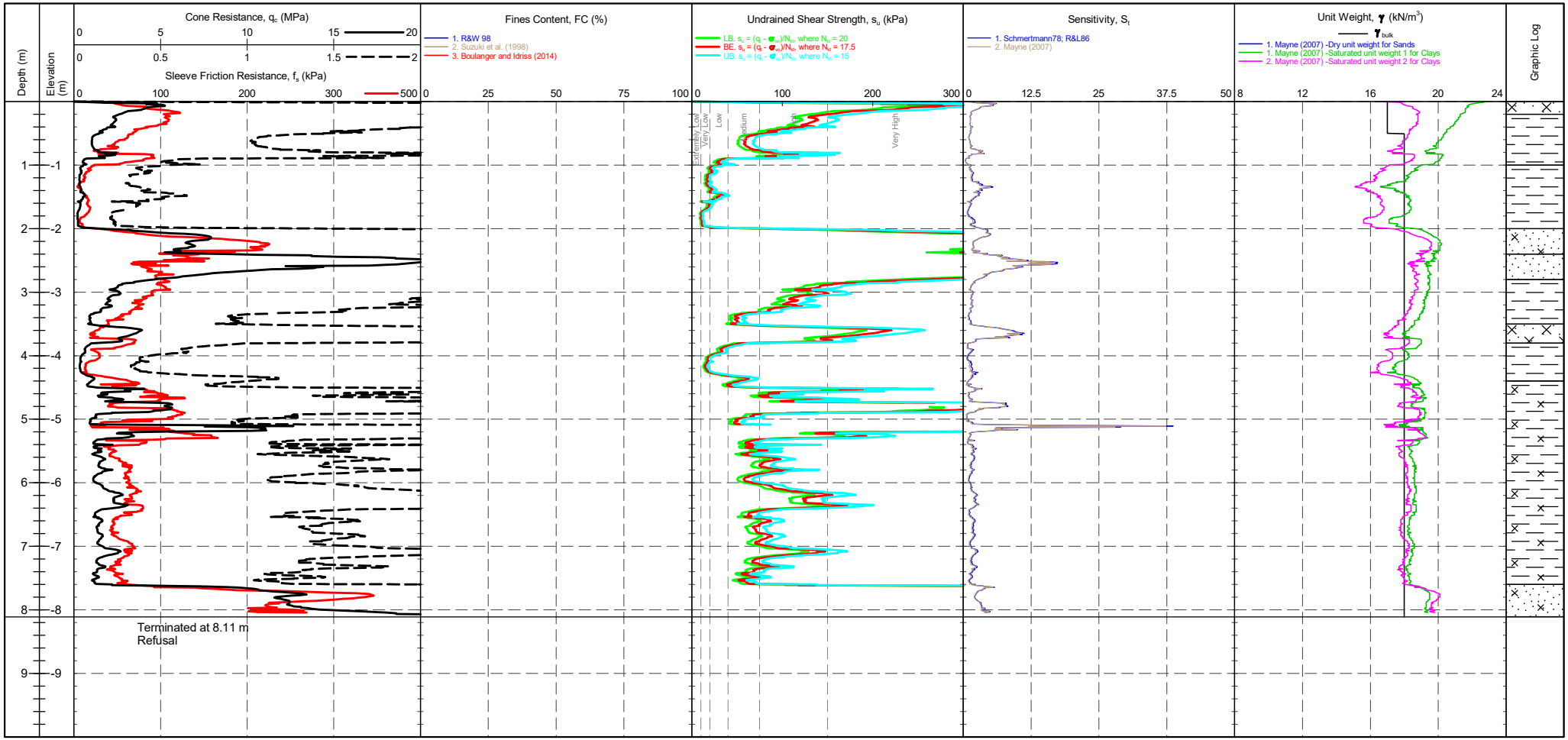
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID: **CPT2307**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



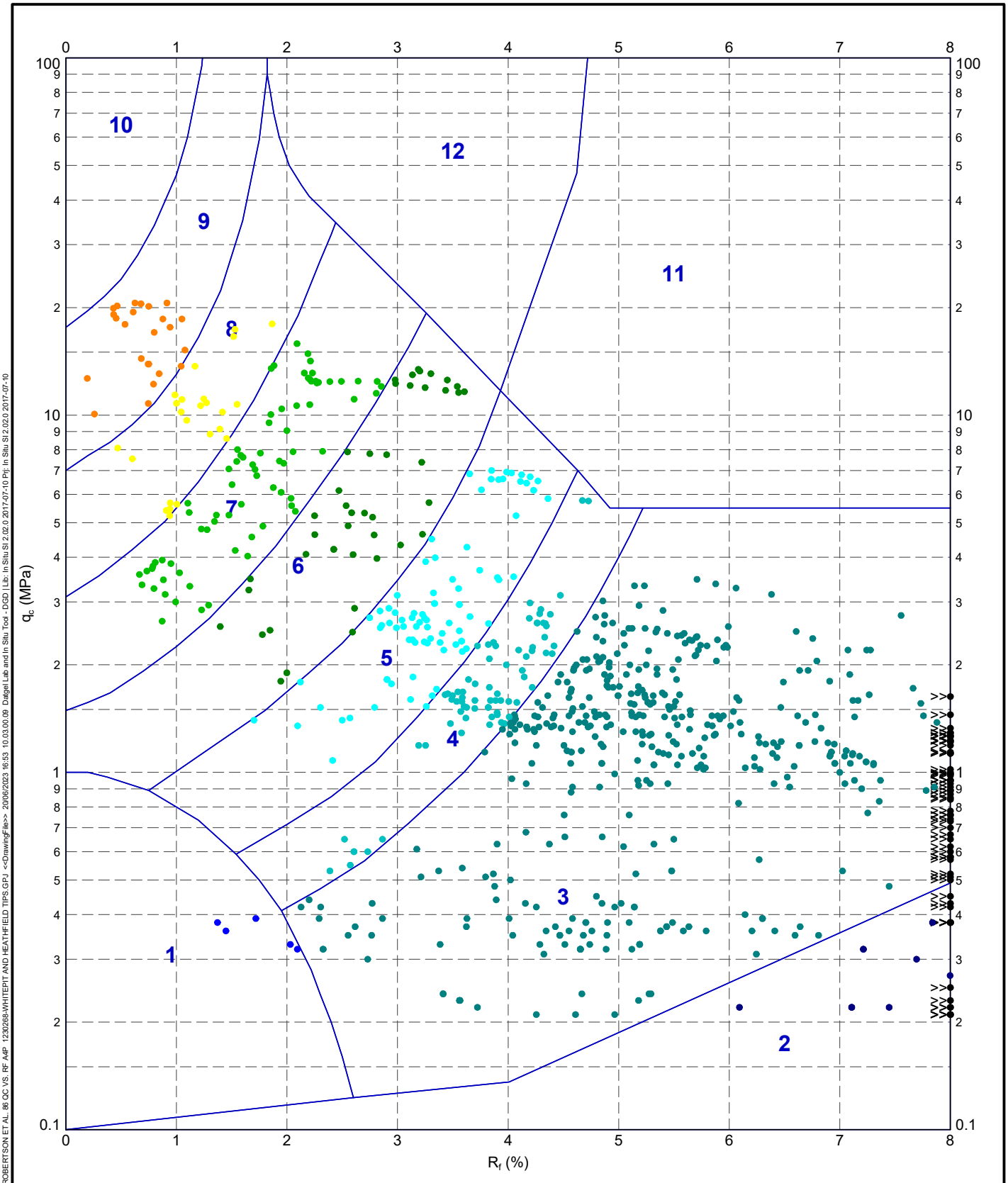

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 233 mV | 236 mV | 0.035 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 217 mV | 218 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 315 mV | 372 mV | 0.015 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2413 mV | 2415 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2307

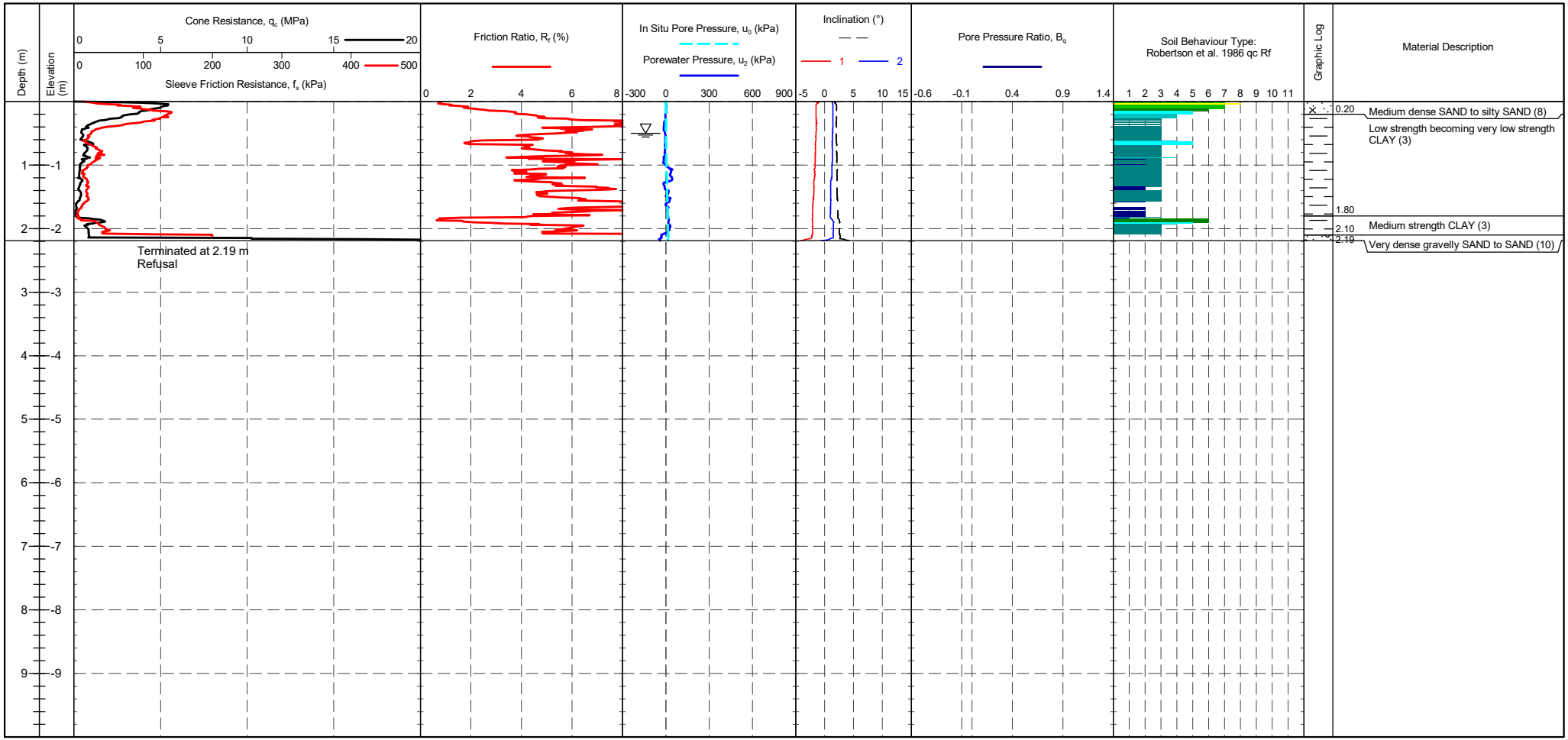
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2308**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | |
|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 | Transducer | Pre | Post / Difference |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen | Tip | 234 mV | 237 mV / 0.035 MPa |
| CONE AREA | : 15cm² | OPERATOR | : AC | Sleeve | 219 mV | 218 mV / -0.001 kPa |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None | Pore Pressure 2 | 305 mV | 301 mV / -0.001 kPa |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2316 mV | 2346 mV |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes | | | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material; 2 - Organic material; 3 - CLAY; 4 - Silty CLAY to CLAY; 5 - Clayey SILT to silty CLAY; 6 - Sandy SILT to clayey SILT; 7 - Silty SAND to sandy SILT; 8 - SAND to silty SAND; 9 - SAND; 10 - Gravelly SAND to SAND; 11 - Very stiff fine grained; 12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

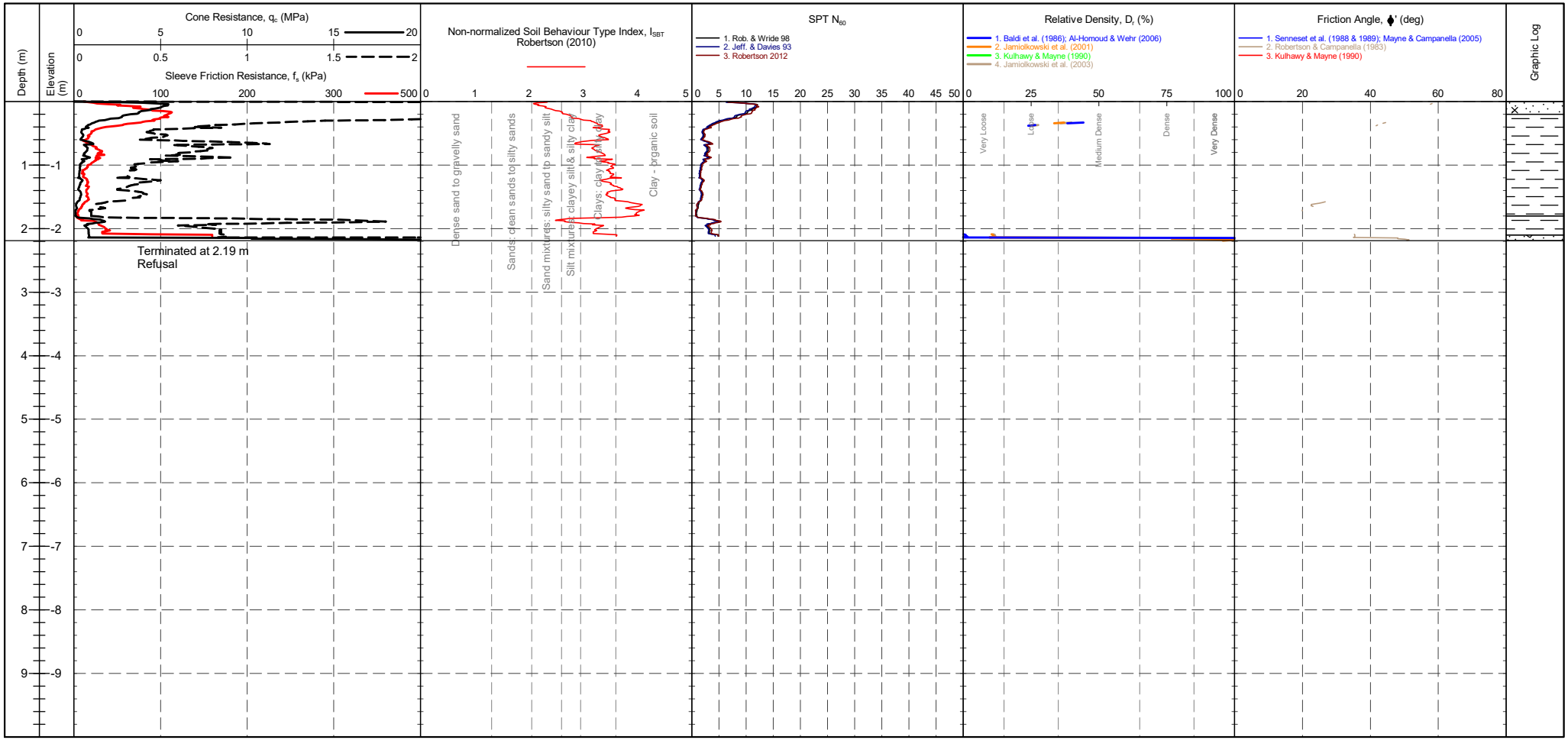
PointID **CPT2308**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 219 mV | 218 mV | -0.001 kPa |
| Pore Pressure 2 | 305 mV | 301 mV | -0.001 kPa |
| X-Y Inclinometer | 2316 mV | 2346 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

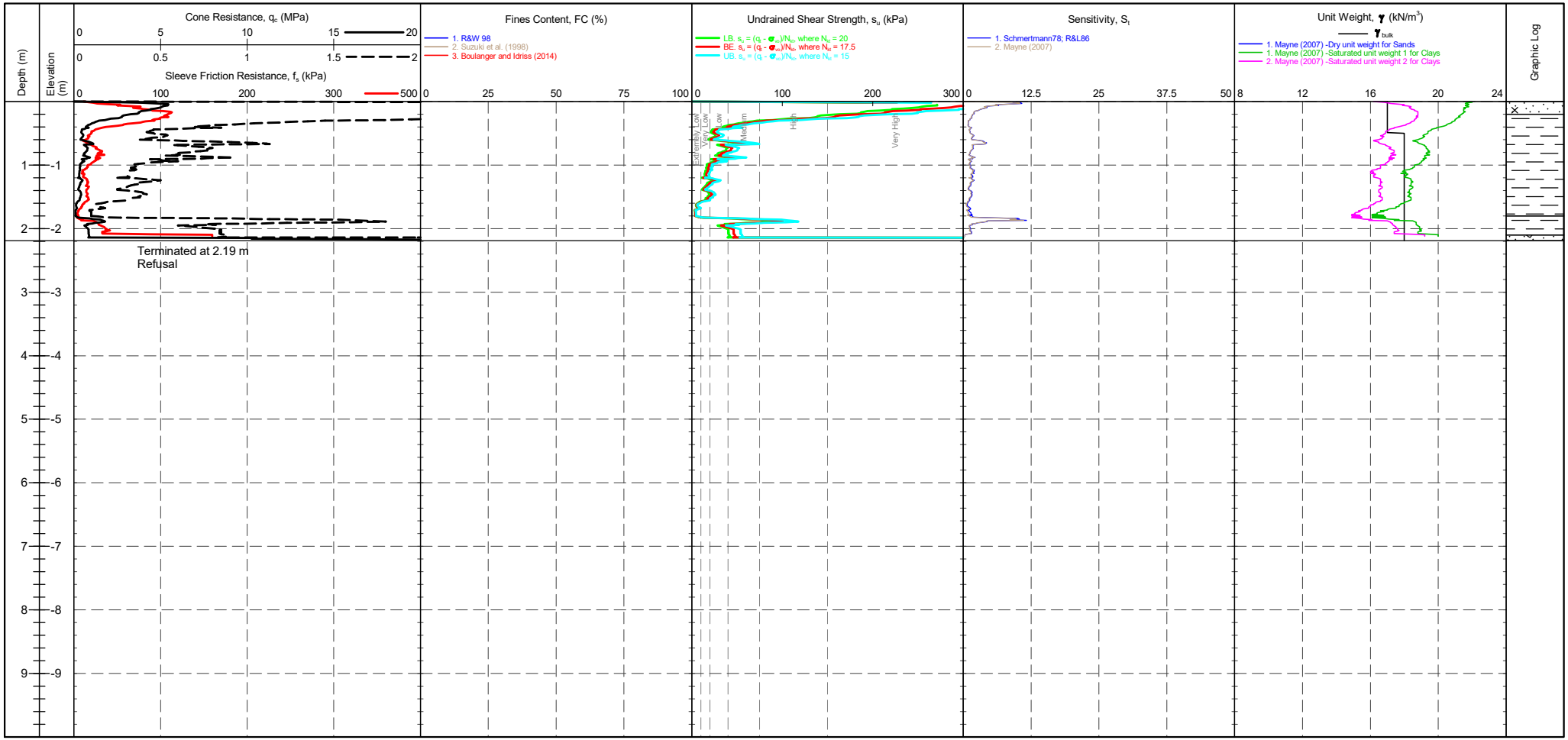
PointID **CPT2308**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

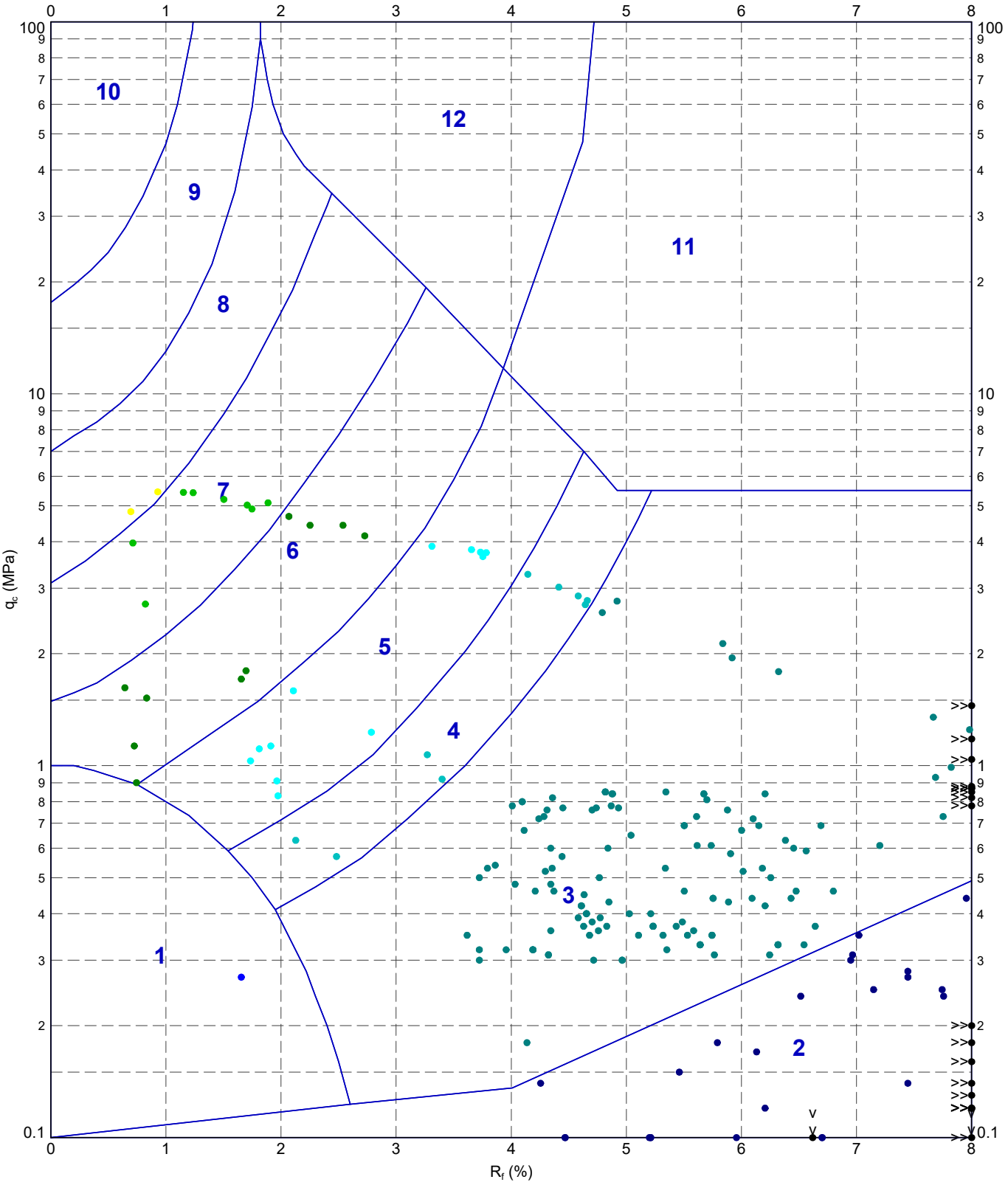
| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 237 mV | 0.035 MPa |
| Sleeve | 219 mV | 218 mV | -0.001 kPa |
| Pore Pressure 2 | 305 mV | 301 mV | -0.001 kPa |
| X-Y Inclinometer | 2316 mV | 2346 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2308

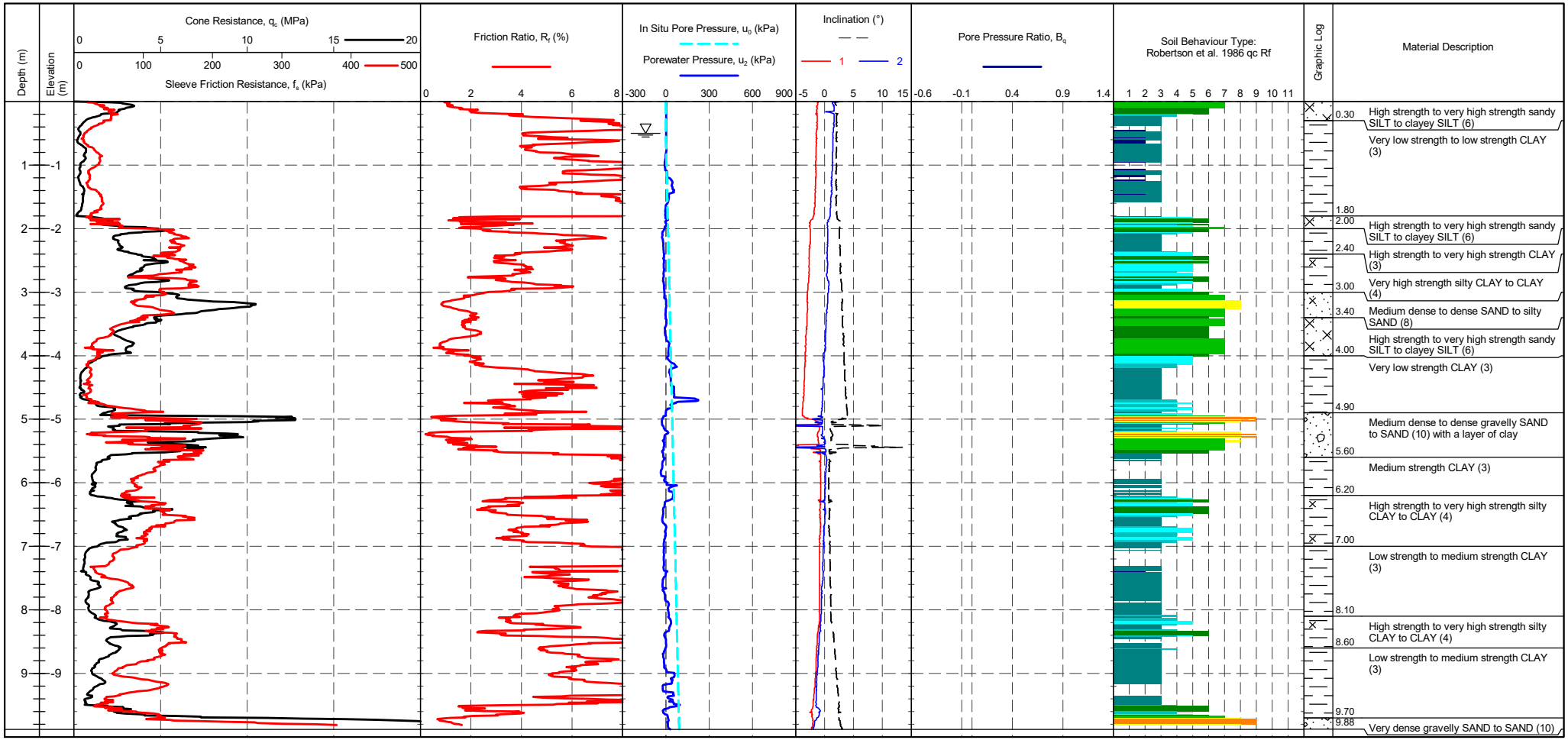
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID **CPT2308A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 217 mV | 217 mV | 0 kPa |
| Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| X-Y Inclinometer | 2287 mV | 2266 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

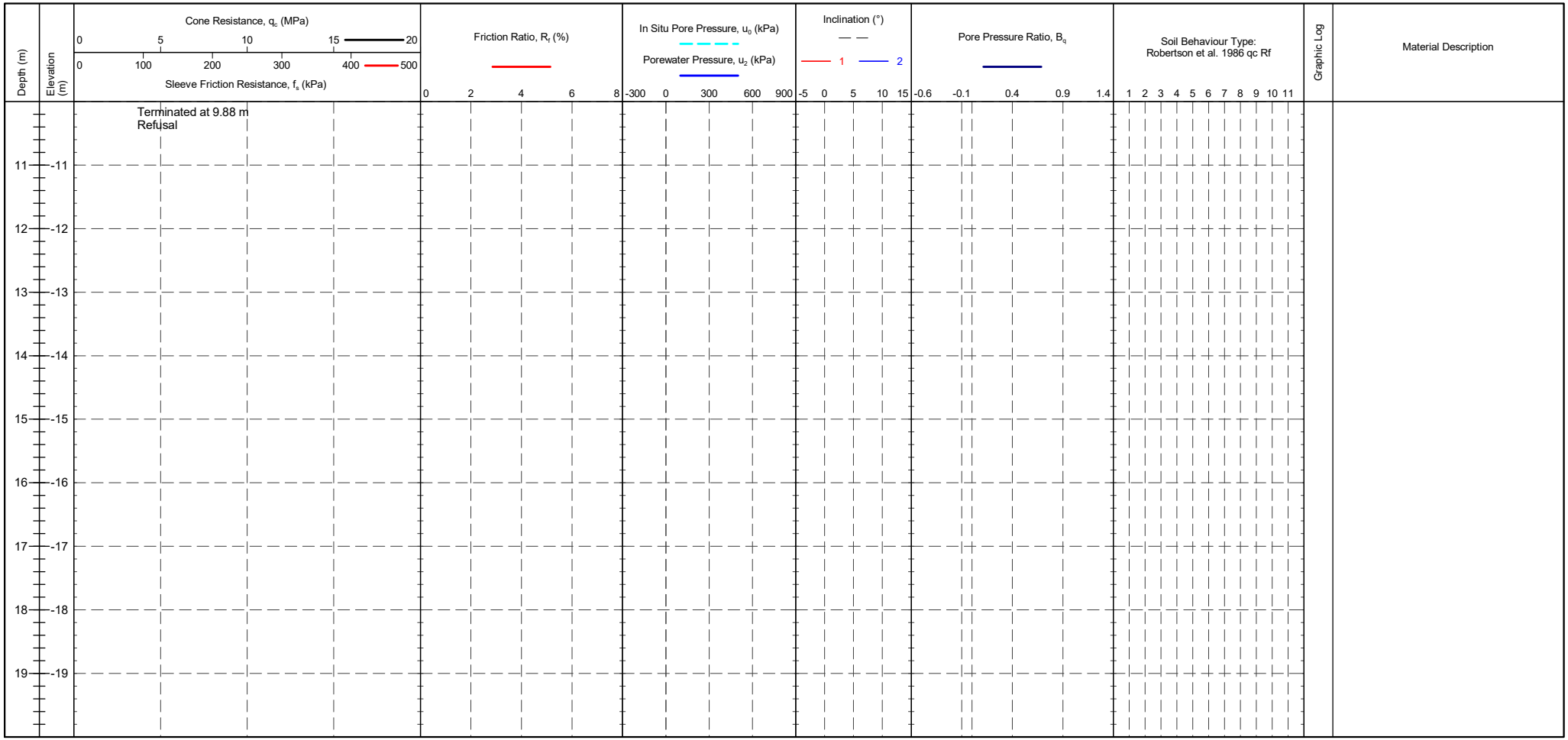
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2308A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 217 mV | 217 mV | 0 kPa |
| Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| X-Y Inclinometer | 2287 mV | 2266 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

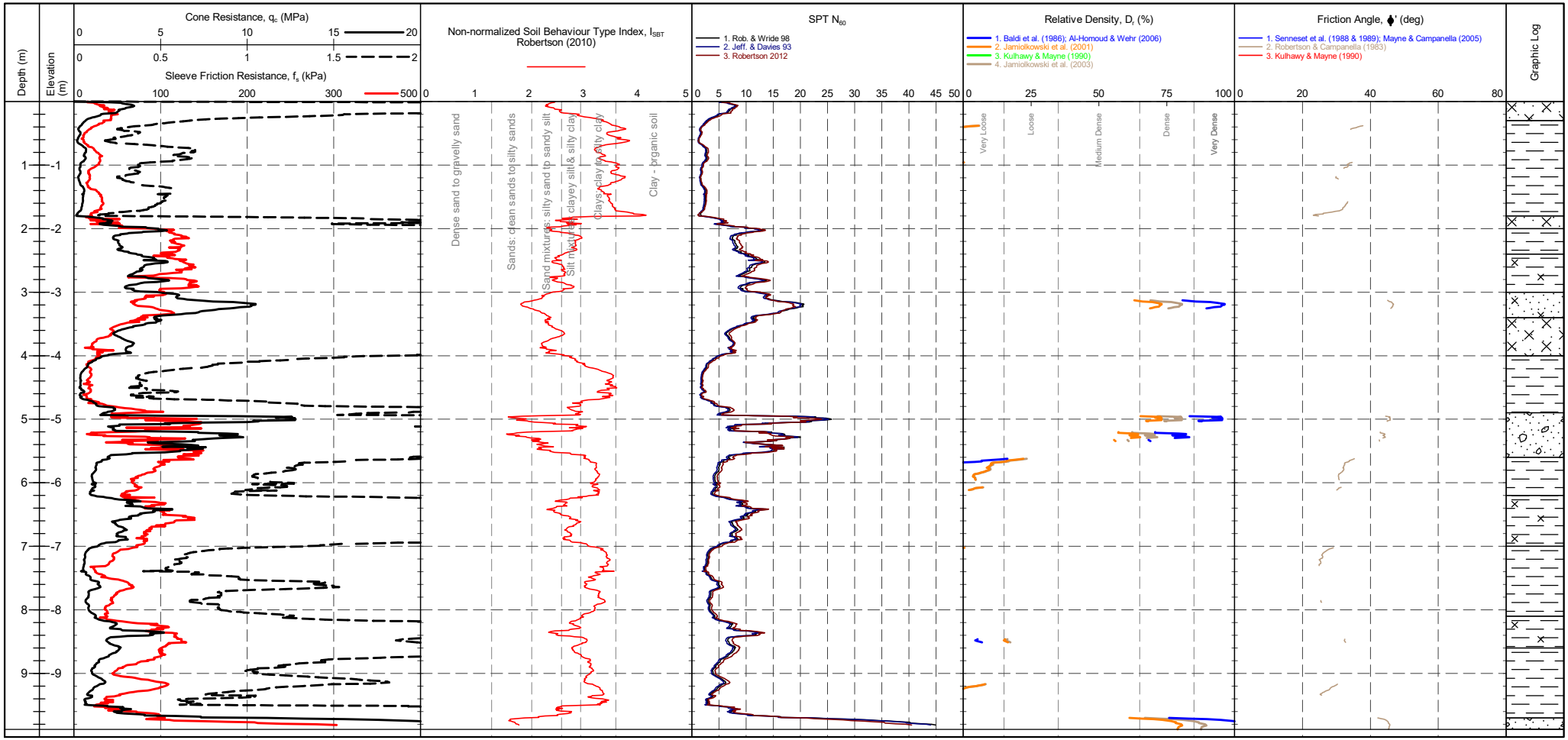
PointID: **CPT2308A**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 217 mV | 217 mV | 0 kPa |
| Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| X-Y Inclinometer | 2287 mV | 2266 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

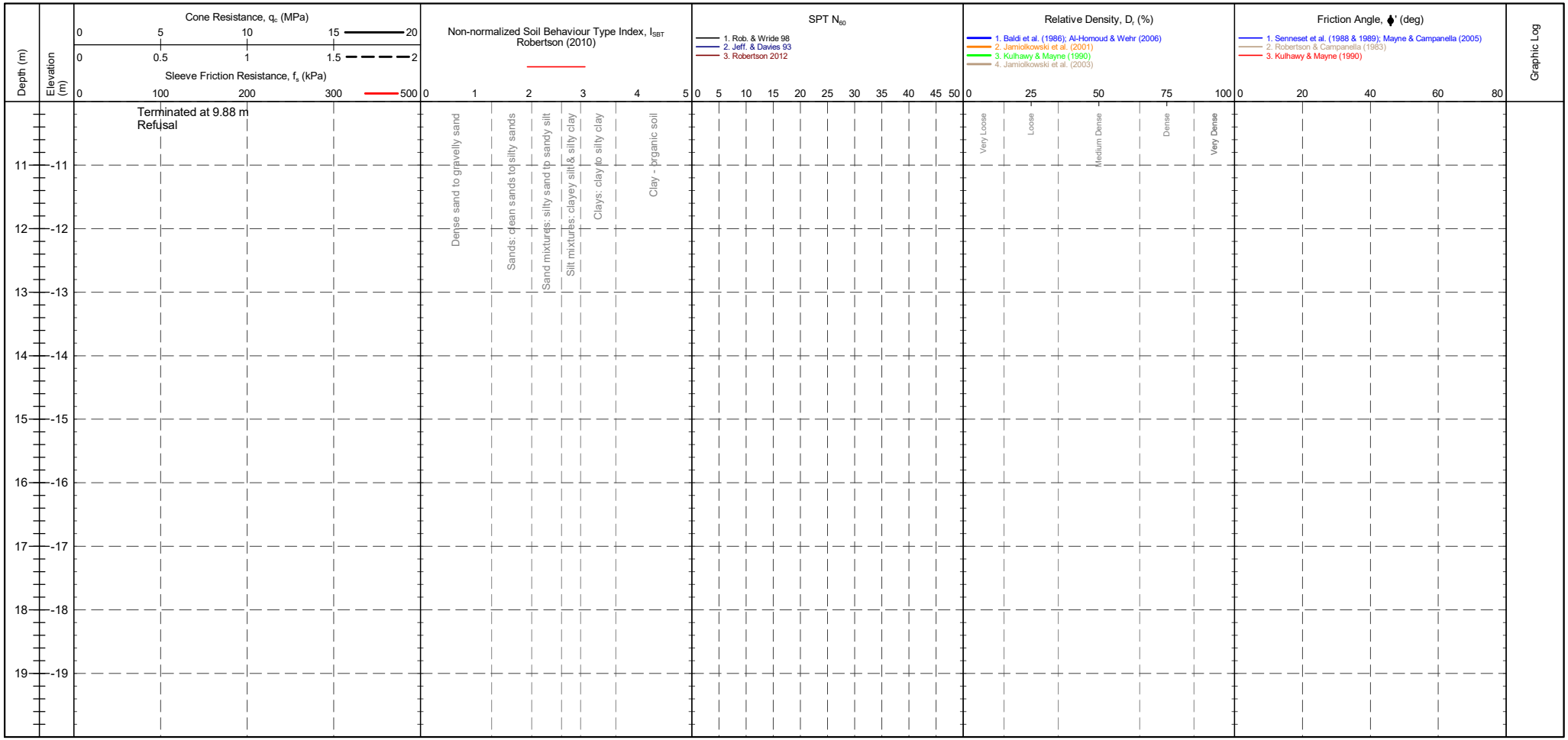
PointID: **CPT2308A**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | |
|---|---|
| CONE ID | : S15-CFIP.2175 |
| CONE MODEL | : Subtraction |
| CONE AREA | : 15cm² |
| CONE AREA RATIO | : 0.79 |
| FILTER POSITION | : u2 |
| FILTER TYPE | : HDPE |

| | |
|---|---|
| TEST TYPE | : TE2 |
| APPLICATION CLASS | : 2 |
| RIG | : CPT 017 - Griffen |
| OPERATOR | : AC |
| FRICTION REDUCER | : None |
| WEATHER | : Overcast & Mild |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 217 mV | 217 mV | 0 kPa |
| Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| X-Y Inclinometer | 2287 mV | 2266 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

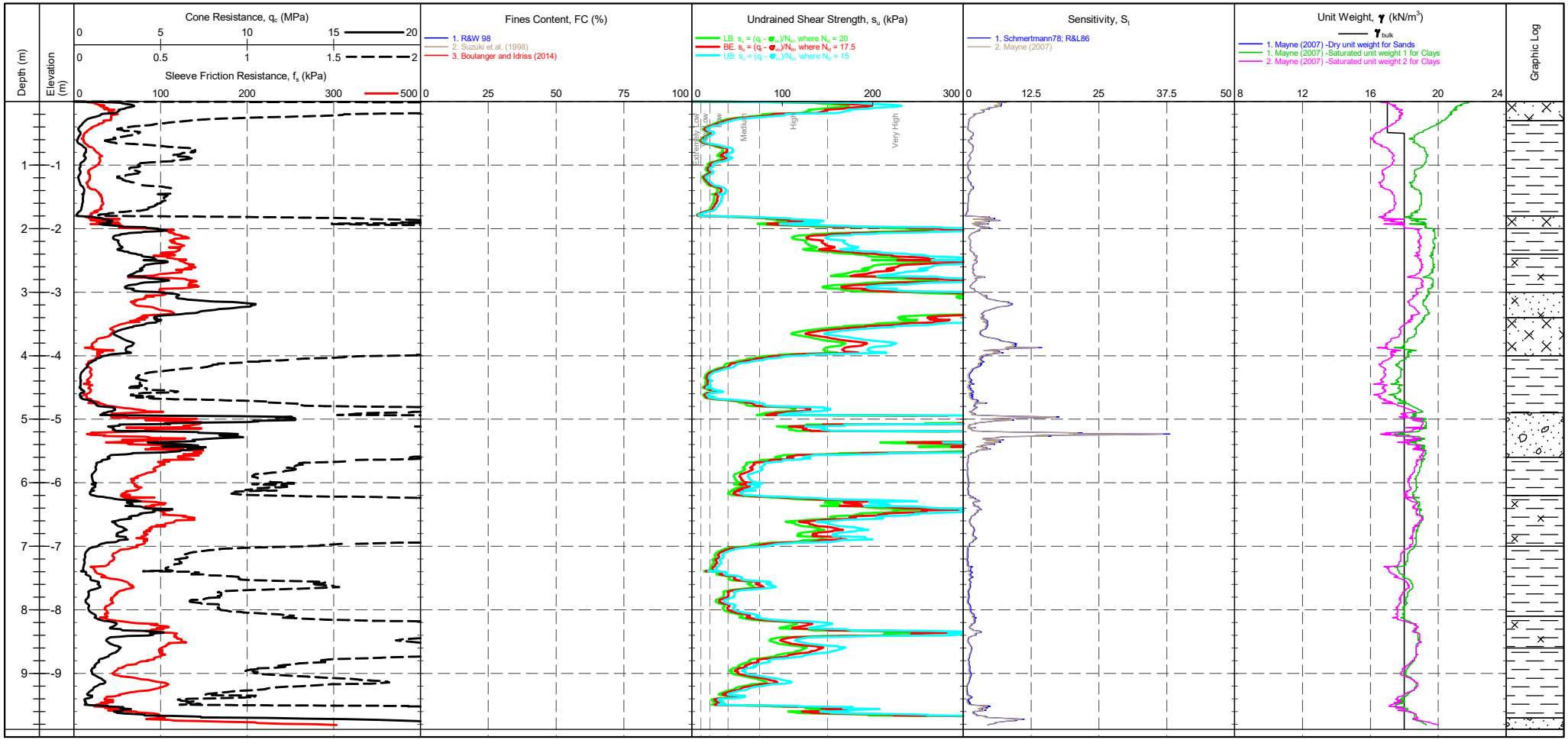
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2308A**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 236 mV | 234 mV | -0.023 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 217 mV | 217 mV | 0 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2287 mV | 2266 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

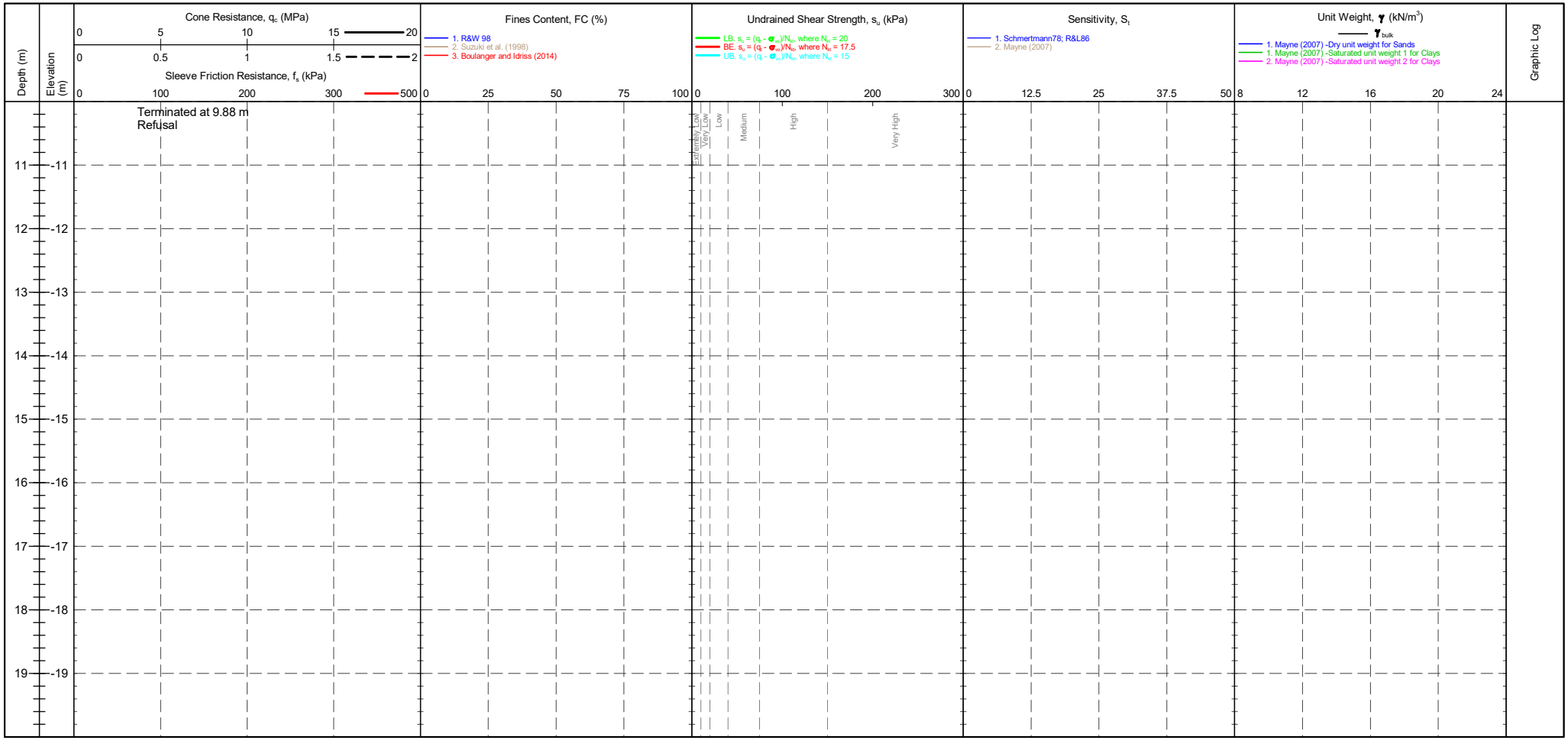
PointID: **CPT2308A**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | |
|---|---|
| CONE ID | : S15-CFIP.2175 |
| CONE MODEL | : Subtraction |
| CONE AREA | : 15cm$^2$ |
| CONE AREA RATIO | : 0.79 |
| FILTER POSITION | : u2 |
| FILTER TYPE | : HDPE |

| | |
|---|---|
| TEST TYPE | : TE2 |
| APPLICATION CLASS | : 2 |
| RIG | : CPT 017 - Griffen |
| OPERATOR | : AC |
| FRICTION REDUCER | : None |
| WEATHER | : Overcast & Mild |

CPTU ZERO VALUES

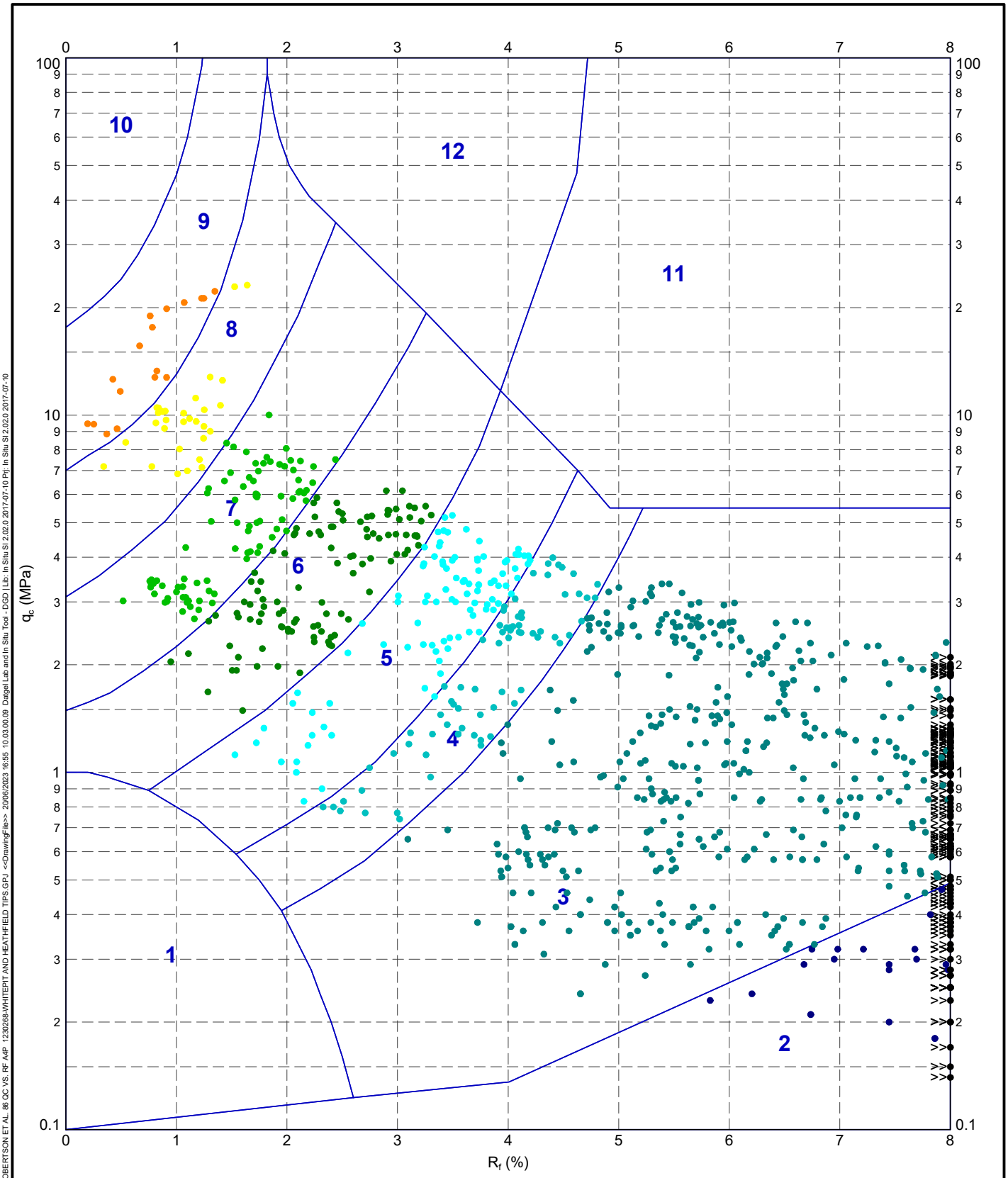
| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 236 mV | 234 mV | -0.023 MPa |
| Sleeve | 217 mV | 217 mV | 0 kPa |
| Pore Pressure 2 | 293 mV | 379 mV | 0.023 kPa |
| X-Y Inclinometer | 2287 mV | 2266 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) |
|---|---|
| Extremely low strength | <10 |
| Very low strength | 10-20 |
| Low strength | 20-40 |
| Medium strength | 40-75 |
| High strength | 75-150 |
| Very high strength | 150-300 |
| Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2308A

| | | |
|---|---|---|
| DRAWN | DATE 20/06/2023 | |
| CHECKED | DATE 20/06/2023 | |
| SCALE Not To Scale | | A4 |
| PROJECT No 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

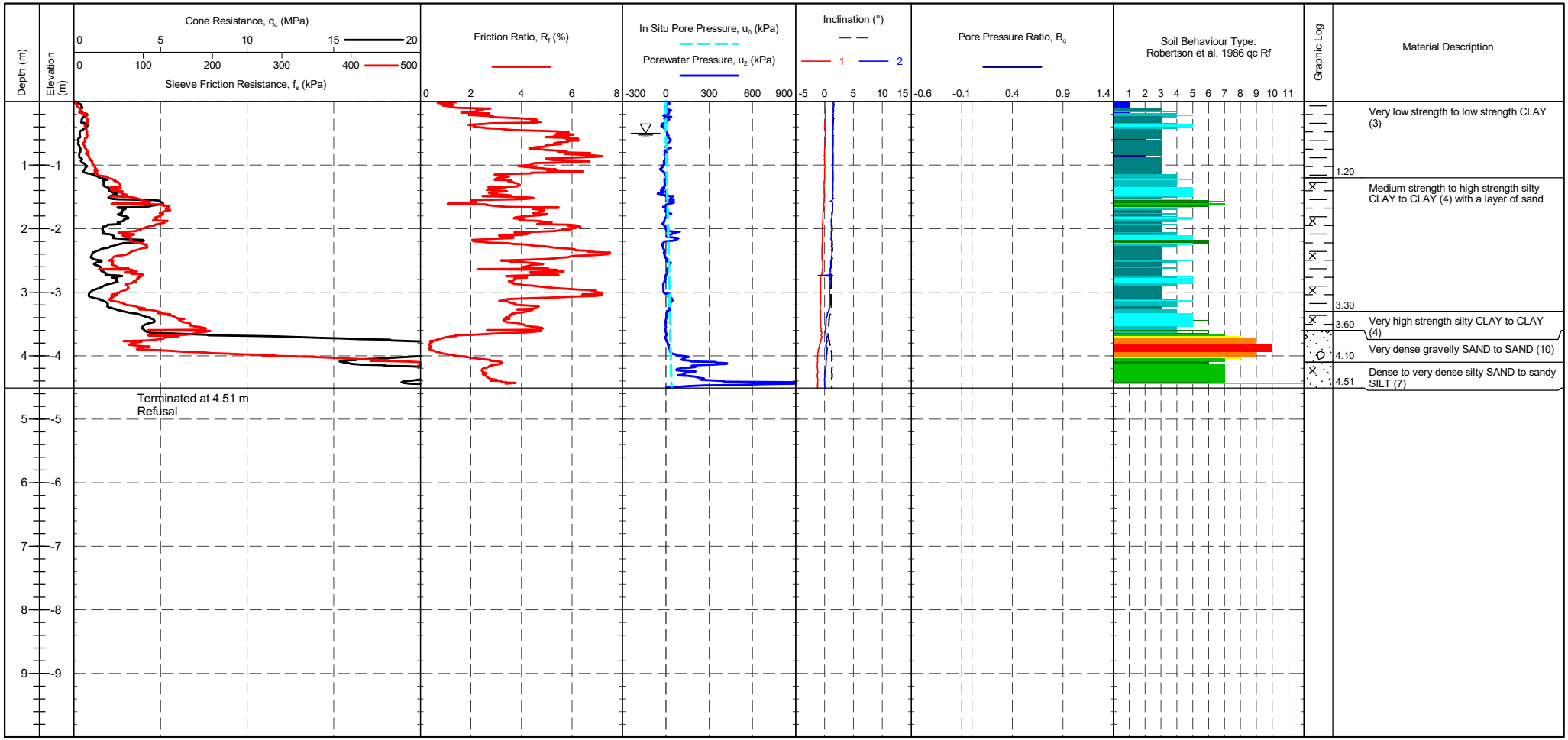
PointID **CPT2309**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 234 mV | -0.012 MPa |
| Sleeve | 220 mV | 218 mV | -0.001 kPa |
| Pore Pressure 2 | 278 mV | 276 mV | -0.001 kPa |
| X-Y Inclinometer | 2382 mV | 2406 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

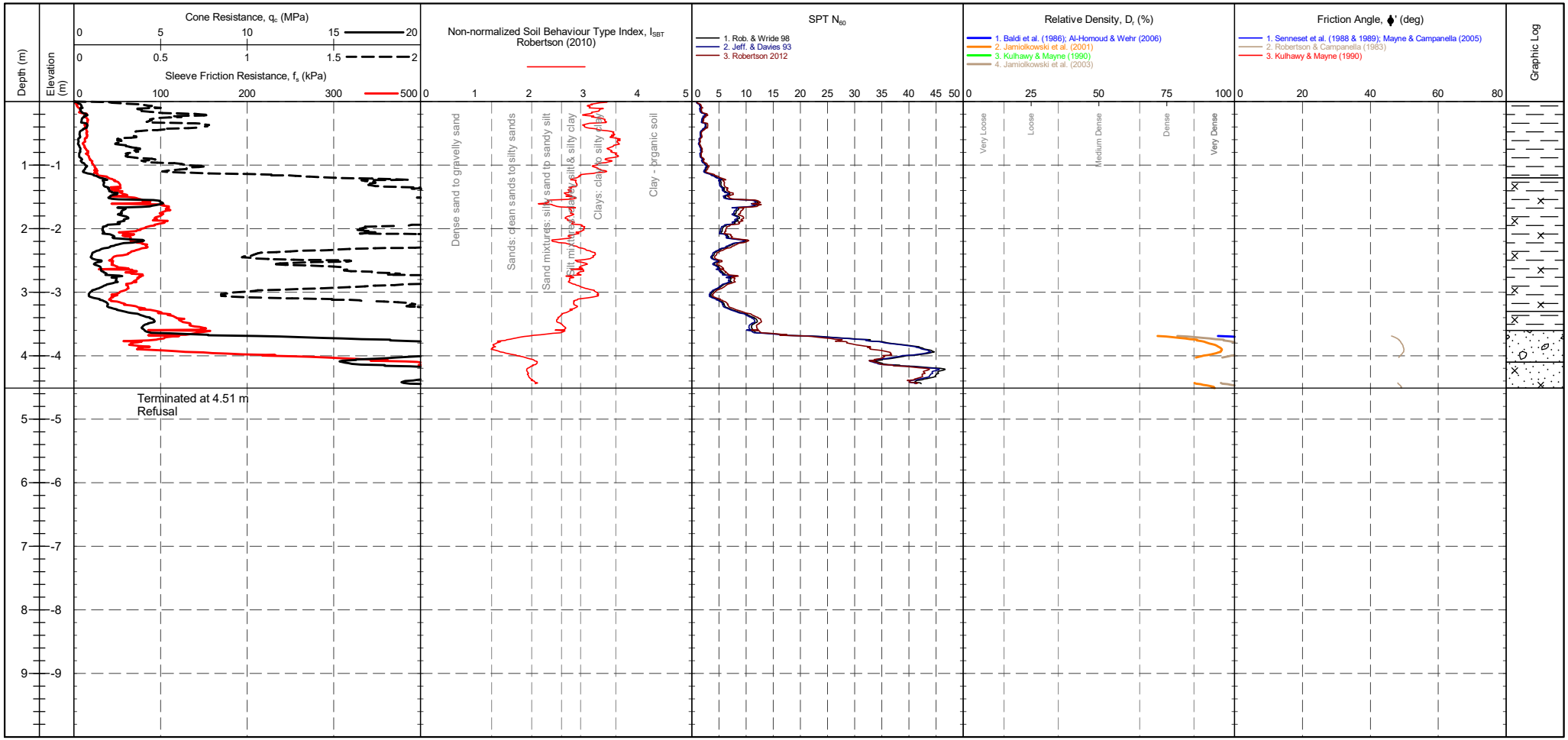
PointID **CPT2309**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on sleeve friction.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 235 mV | 234 mV | -0.012 MPa |
| Sleeve | 220 mV | 218 mV | -0.001 kPa |
| Pore Pressure 2 | 278 mV | 276 mV | -0.001 kPa |
| X-Y Inclinometer | 2382 mV | 2406 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic |
|---|---|
| Clays | 2.95-3.60 |
| Silt mixtures | 2.60-2.95 |
| Sand mixtures | 2.05-2.60 |
| Sands | 1.31-2.05 |
| Gravelly sand | <1.31 |

| Description | SPT N value, NSPT |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | >50 |

| Description | Relative Density Dr (%) |
|---|---|
| Very Loose | 0 - 15 |
| Loose | 15 - 35 |
| Medium Dense | 35 - 65 |
| Dense | 65 - 85 |
| Very Dense | >85 |

Groundwater Level

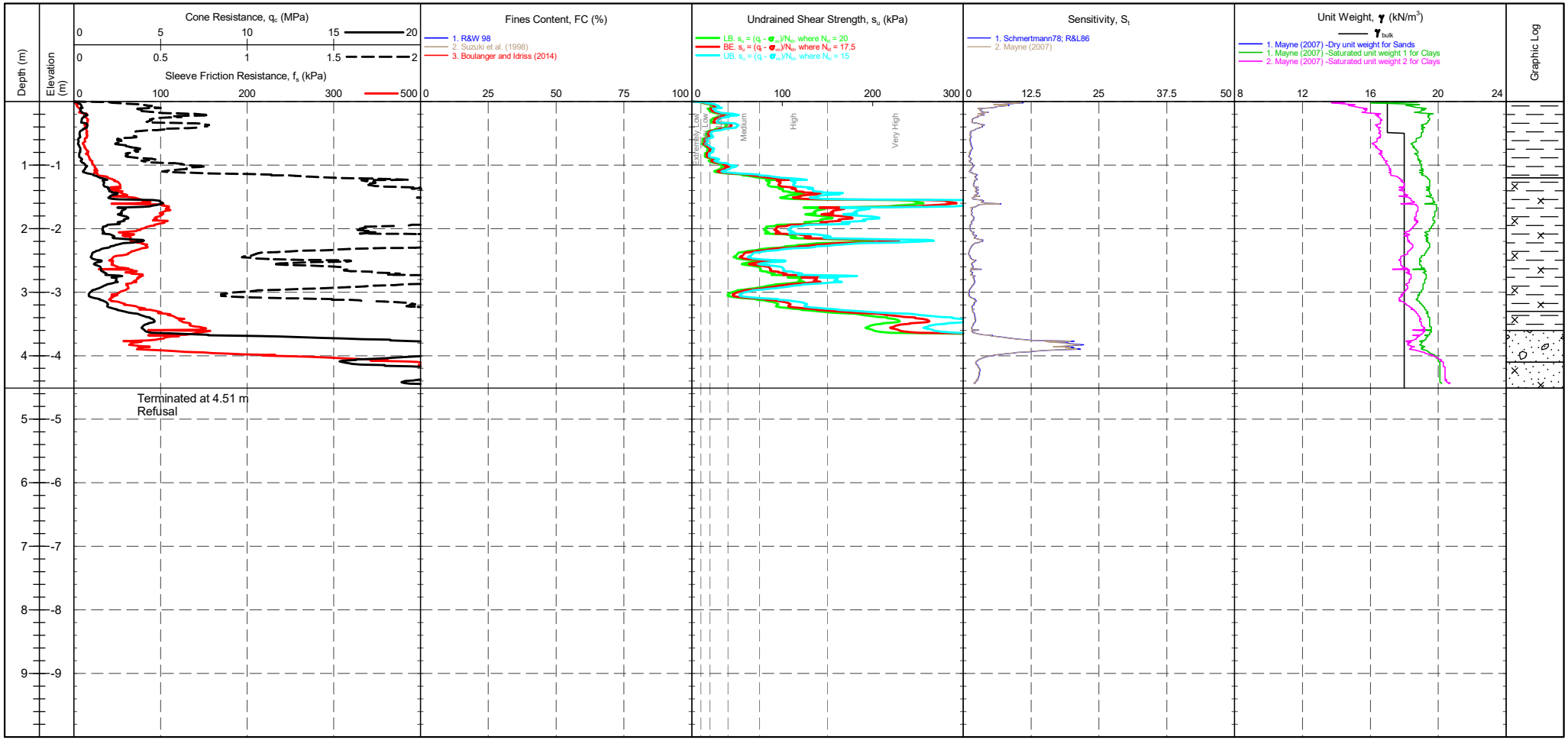
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID: **CPT2309**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on sleeve friction. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



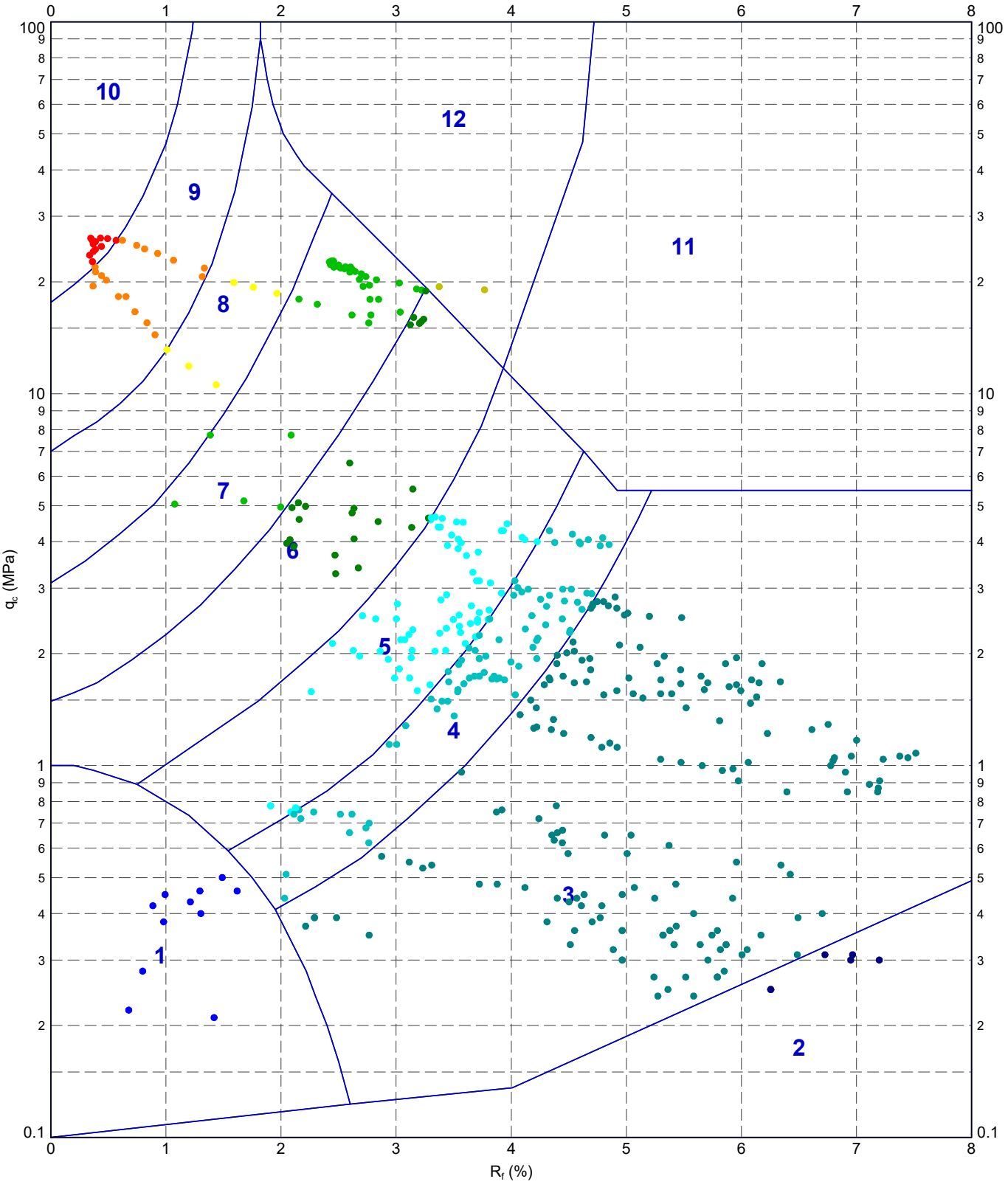

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 235 mV | 234 mV | -0.012 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 220 mV | 218 mV | -0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 278 mV | 276 mV | -0.001 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2382 mV | 2406 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2309

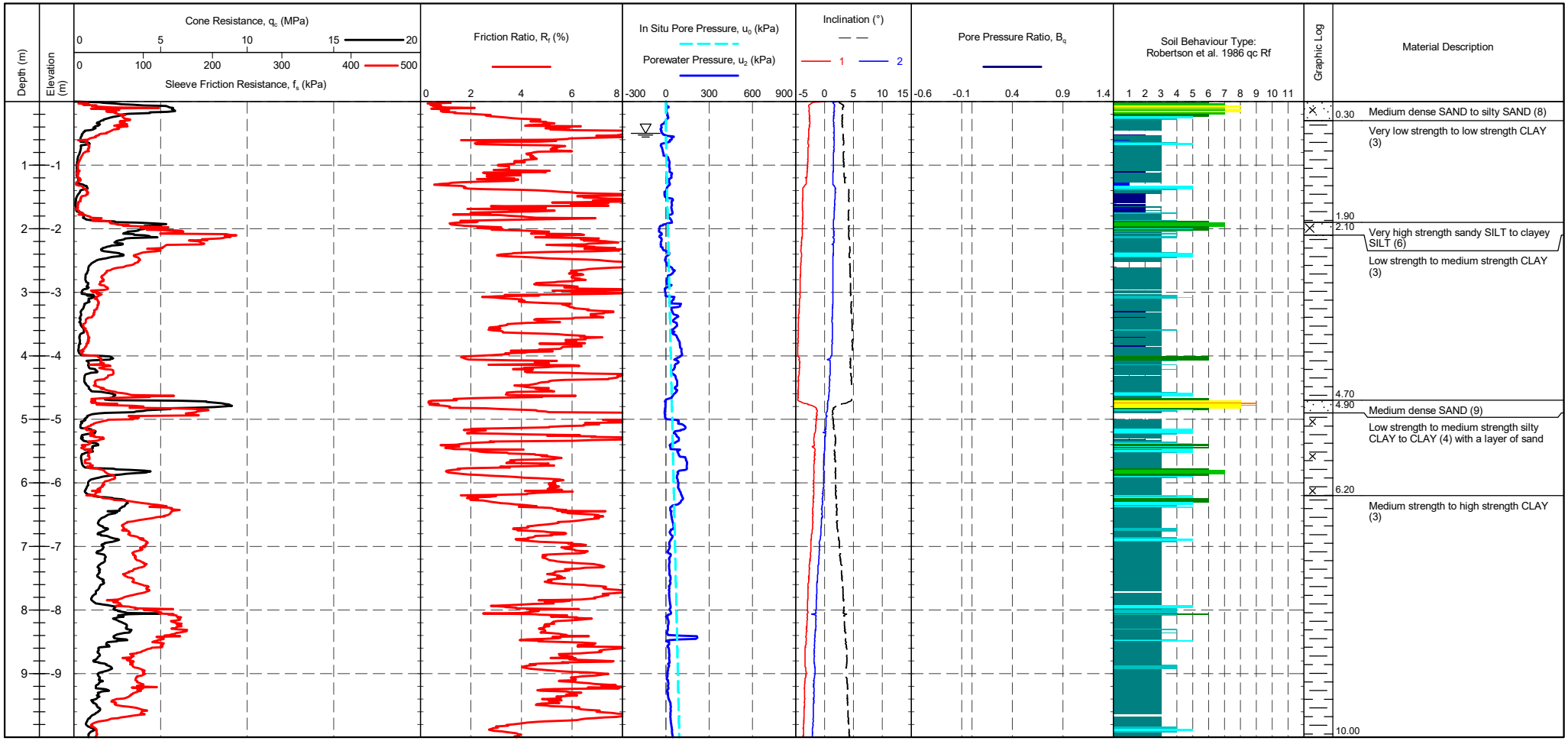
| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2310**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on tip resistance. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 234 mV | 0 MPa |
| Sleeve | 218 mV | 218 mV | 0 kPa |
| Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| X-Y Inclinometer | 2419 mV | 2175 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

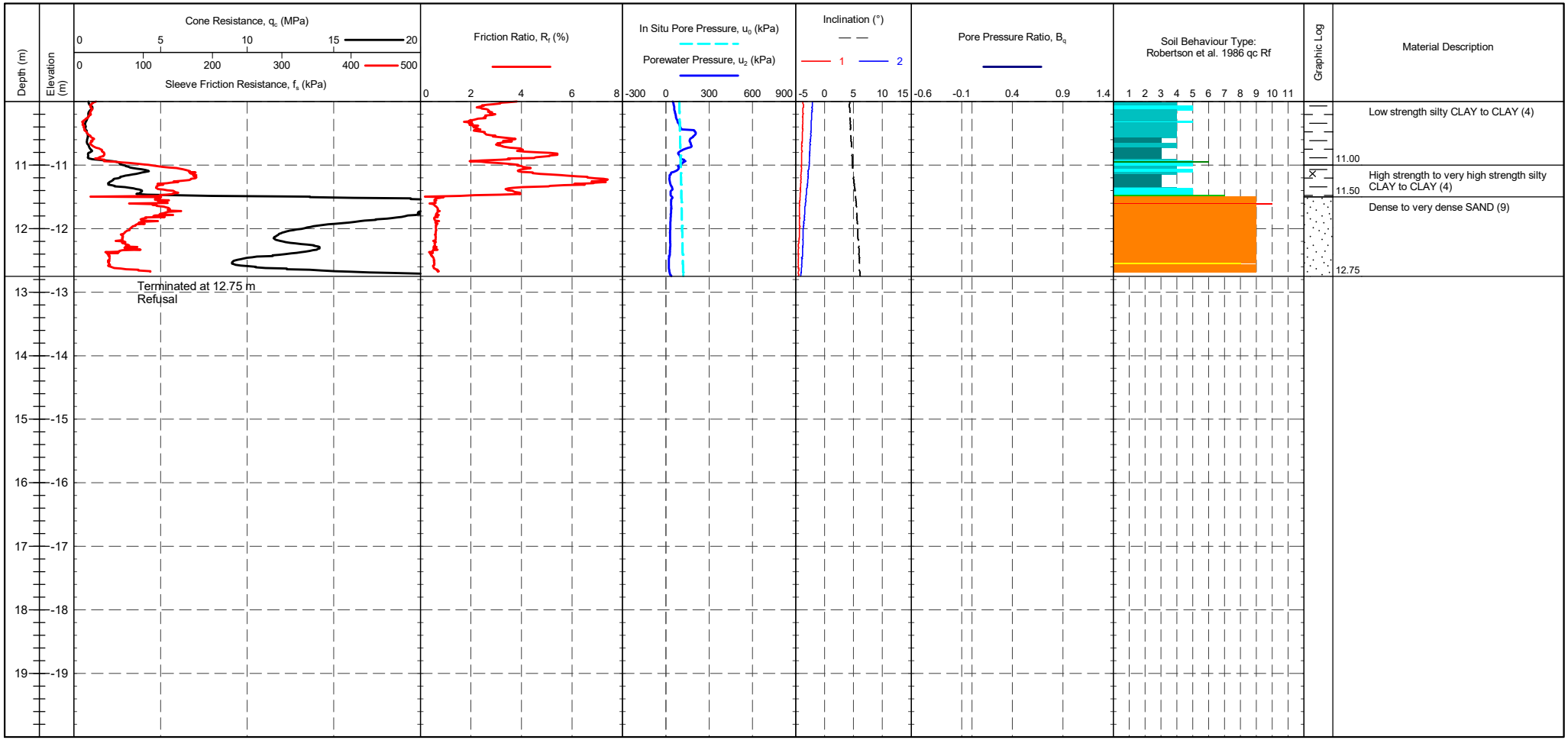
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2310**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on tip resistance. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 234 mV | 0 MPa |
| Sleeve | 218 mV | 218 mV | 0 kPa |
| Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| X-Y Inclinometer | 2419 mV | 2175 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

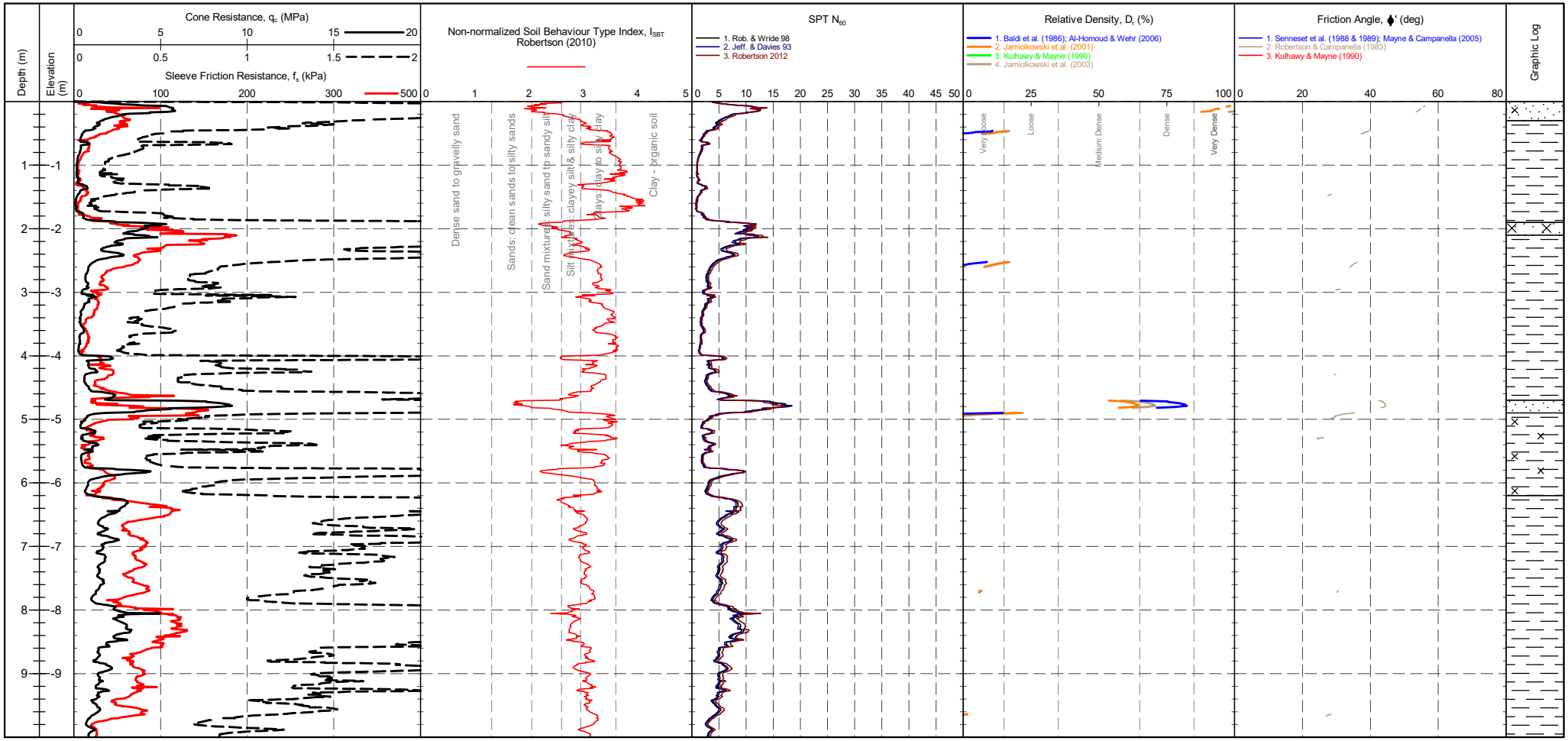
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2310**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on tip resistance. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 234 mV | 0 MPa |
| Sleeve | 218 mV | 218 mV | 0 kPa |
| Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| X-Y Inclinometer | 2419 mV | 2175 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

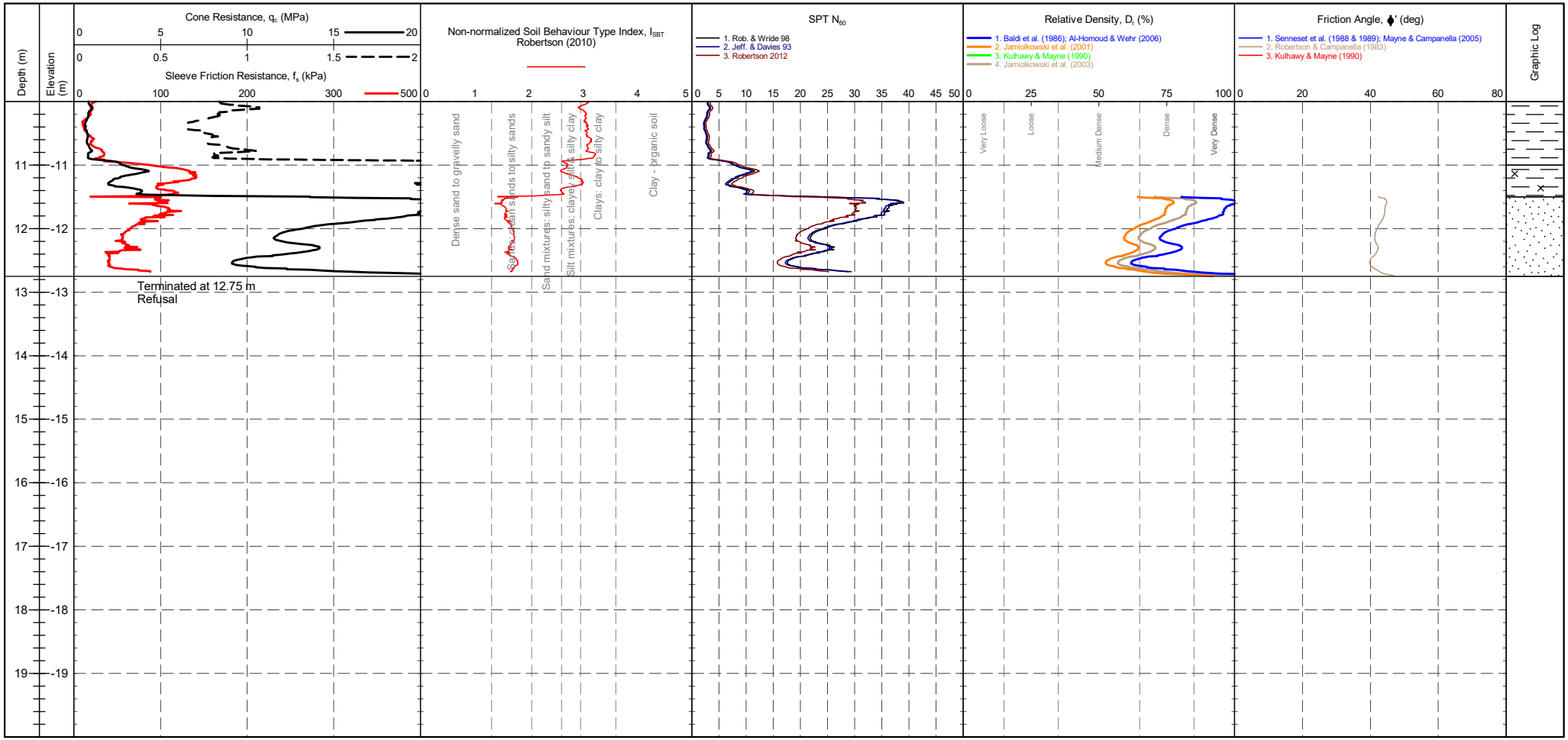
PointID: **CPT2310**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on tip resistance.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | |
|---|---|
| CONE ID | : S15-CFIP.2175 |
| CONE MODEL | : Subtraction |
| CONE AREA | : 15cm² |
| CONE AREA RATIO | : 0.79 |
| FILTER POSITION | : u2 |
| FILTER TYPE | : HDPE |

| | |
|---|---|
| TEST TYPE | : TE2 |
| APPLICATION CLASS | : 2 |
| RIG | : CPT 017 - Griffen |
| OPERATOR | : AC |
| FRICTION REDUCER | : None |
| WEATHER | : Overcast & Mild |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 234 mV | 0 MPa |
| Sleeve | 218 mV | 218 mV | 0 kPa |
| Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| X-Y Inclinometer | 2419 mV | 2175 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

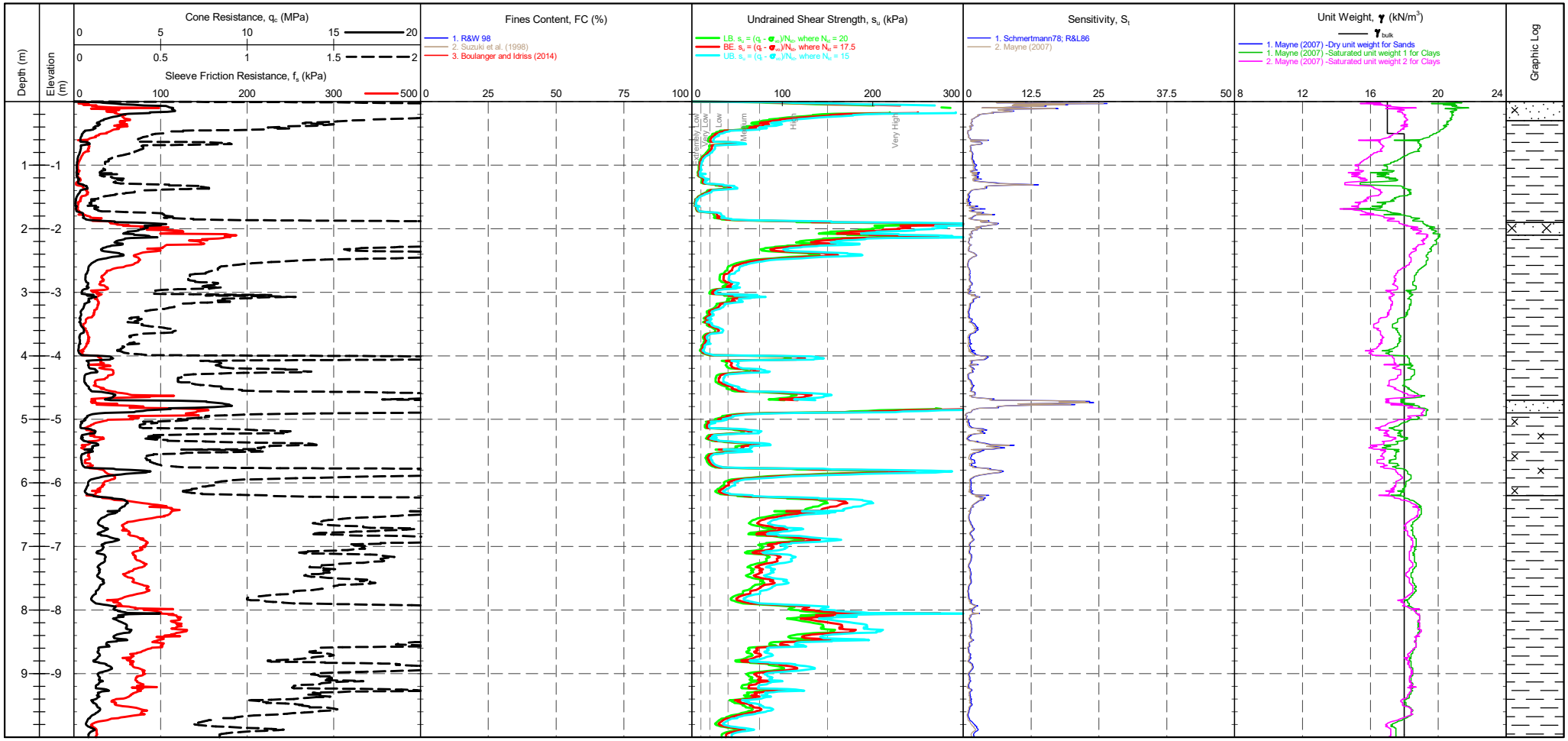
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2310**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco<br>PROJECT : Whitepit and Heathfield Tips<br>LOCATION : Newton Abbot<br>PROJECT No. : 1230268 | EASTING : 0.000 m<br>NORTHING : 0.000 m<br>ELEVATION : 0.000 m OD<br>CHECKED BY : DW<br>TERMINATION REASON : Refusal | Remark:<br>Test refused on tip resistance. | SHEET : 1 OF 2<br>STATUS : Final<br>TEST DATE : 16/06/2023<br>PLOT DATE : 20/06/2023<br>METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 234 mV | 0 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 218 mV | 218 mV | 0 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 2419 mV | 2175 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

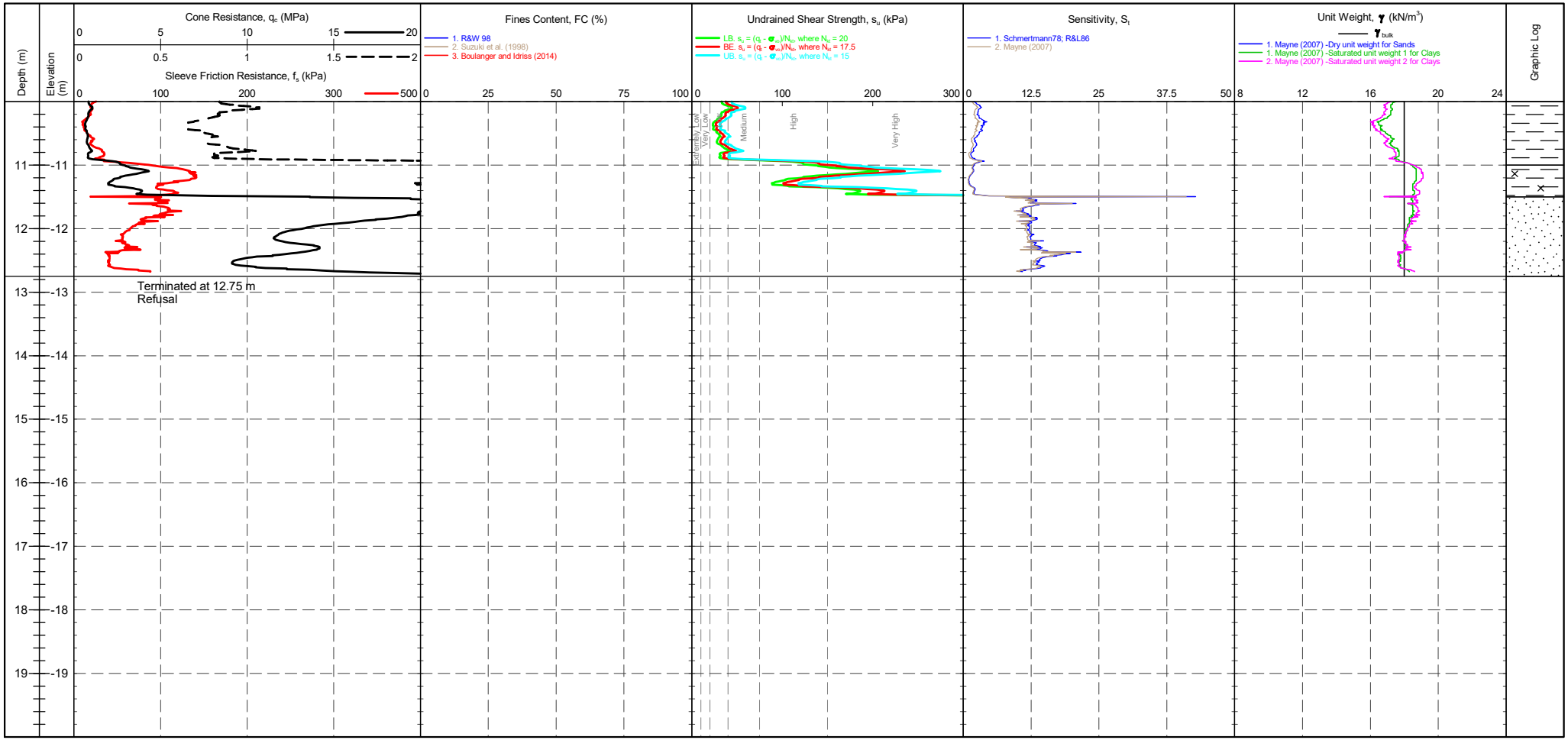
PointID **CPT2310**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on tip resistance.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

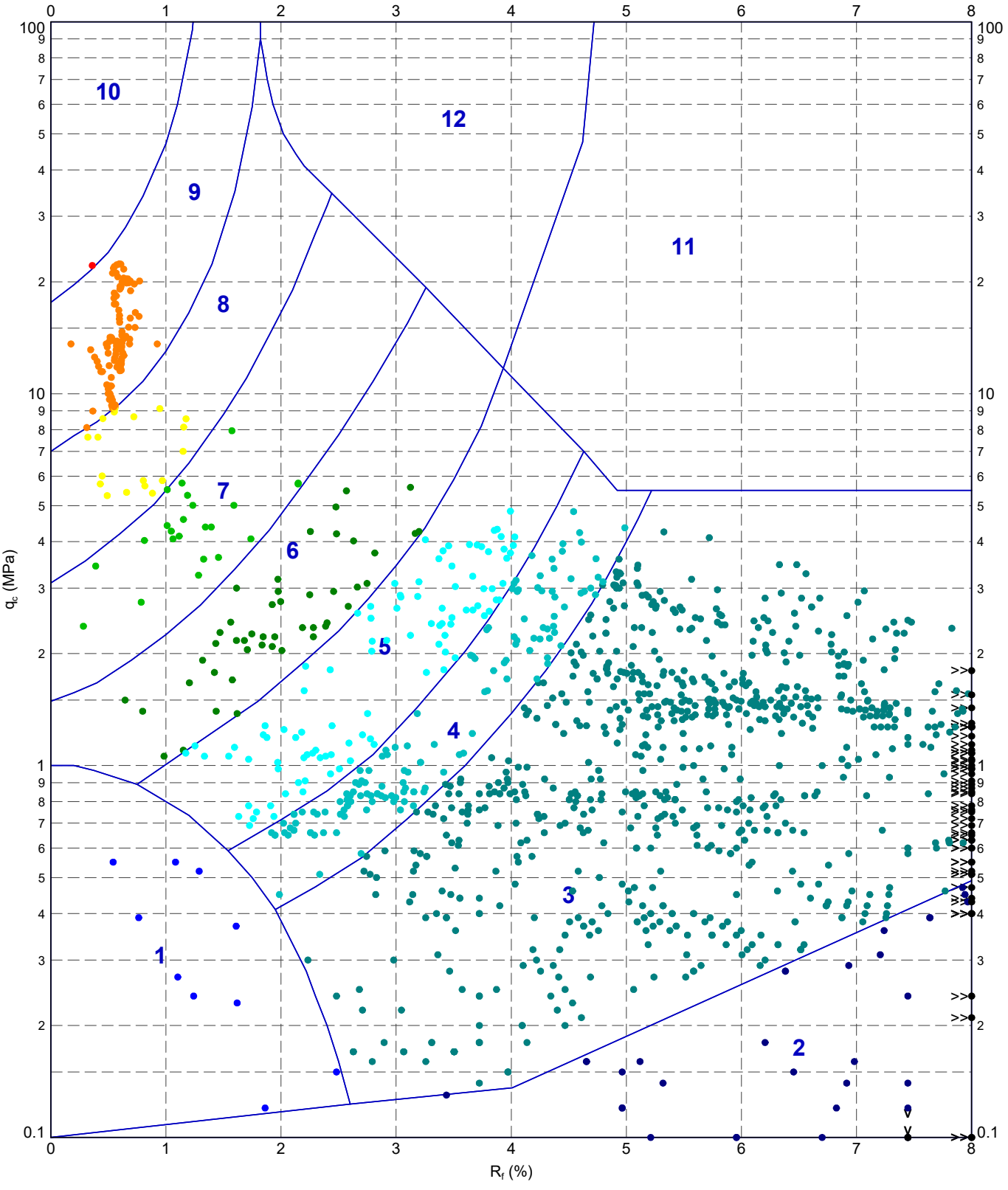
| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 234 mV | 0 MPa |
| Sleeve | 218 mV | 218 mV | 0 kPa |
| Pore Pressure 2 | 277 mV | 312 mV | 0.009 kPa |
| X-Y Inclinometer | 2419 mV | 2175 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2310

| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

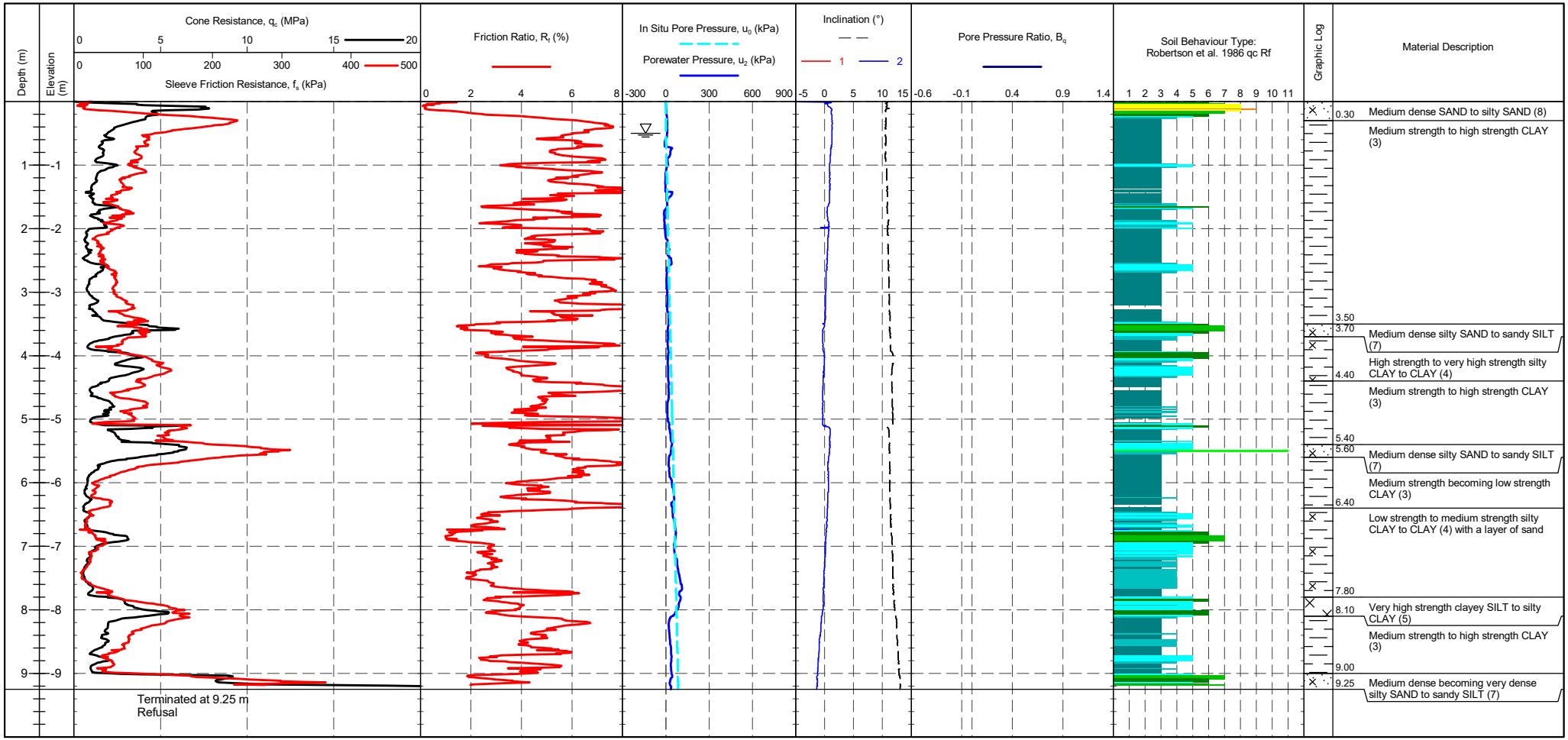
PointID: **CPT2311**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 238 mV | 0.046 MPa |
| Sleeve | 216 mV | 219 mV | 0.002 kPa |
| Pore Pressure 2 | 320 mV | 358 mV | 0.01 kPa |
| X-Y Inclinometer | 1652 mV | 1340 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

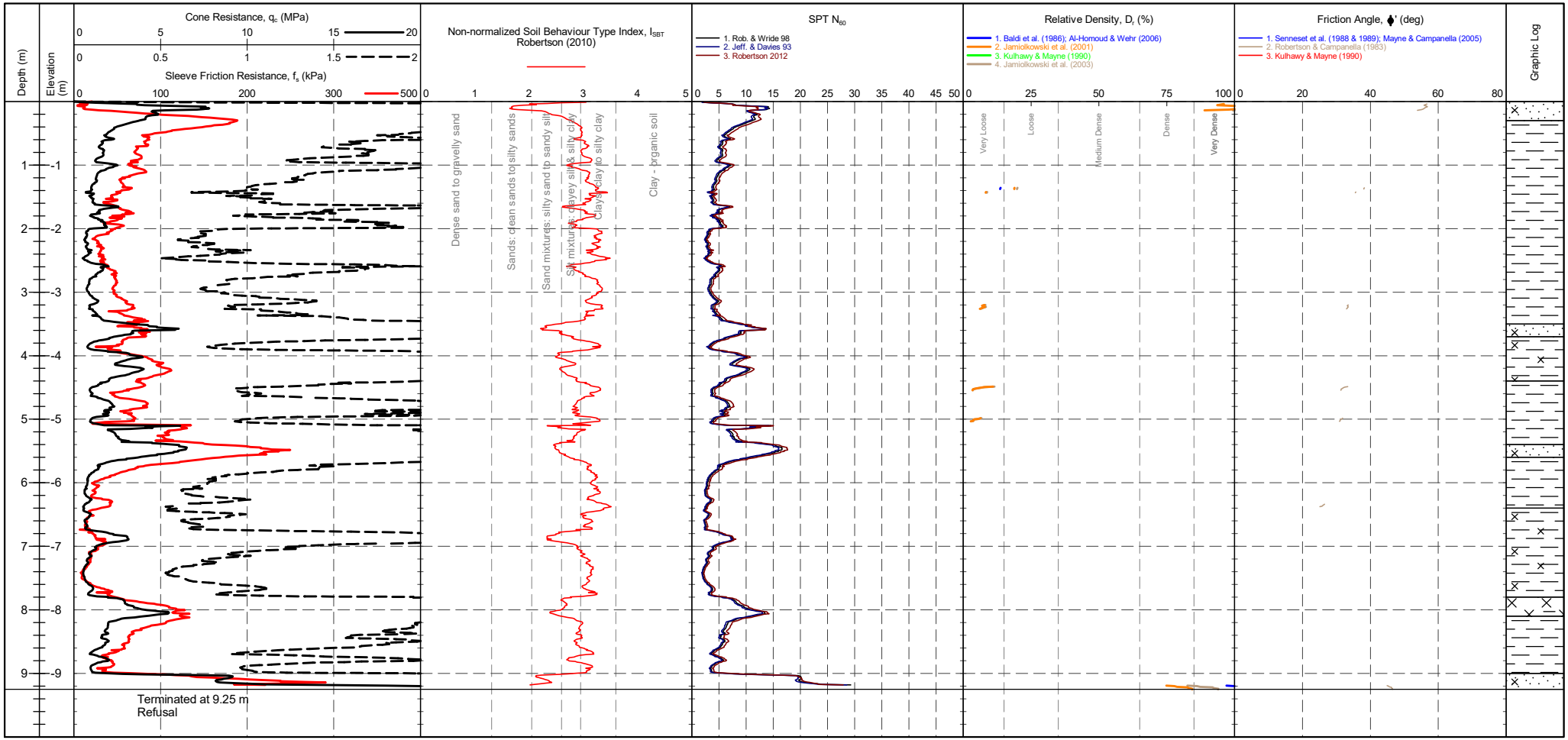
PointID **CPT2311**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | Tip | 234 mV | 238 mV | 0.046 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 216 mV | 219 mV | 0.002 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 320 mV | 358 mV | 0.01 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 1652 mV | 1340 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

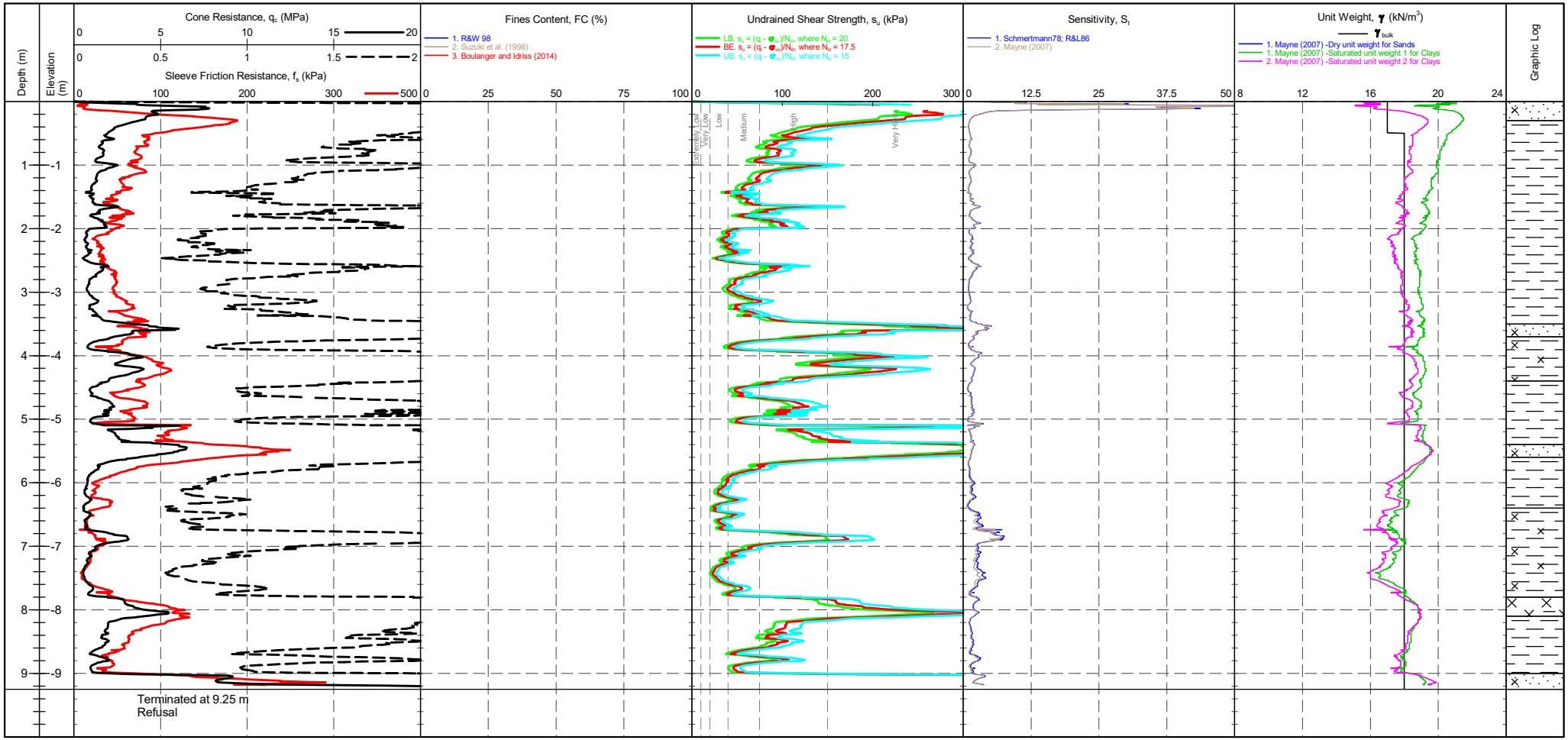
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2311**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 1 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |



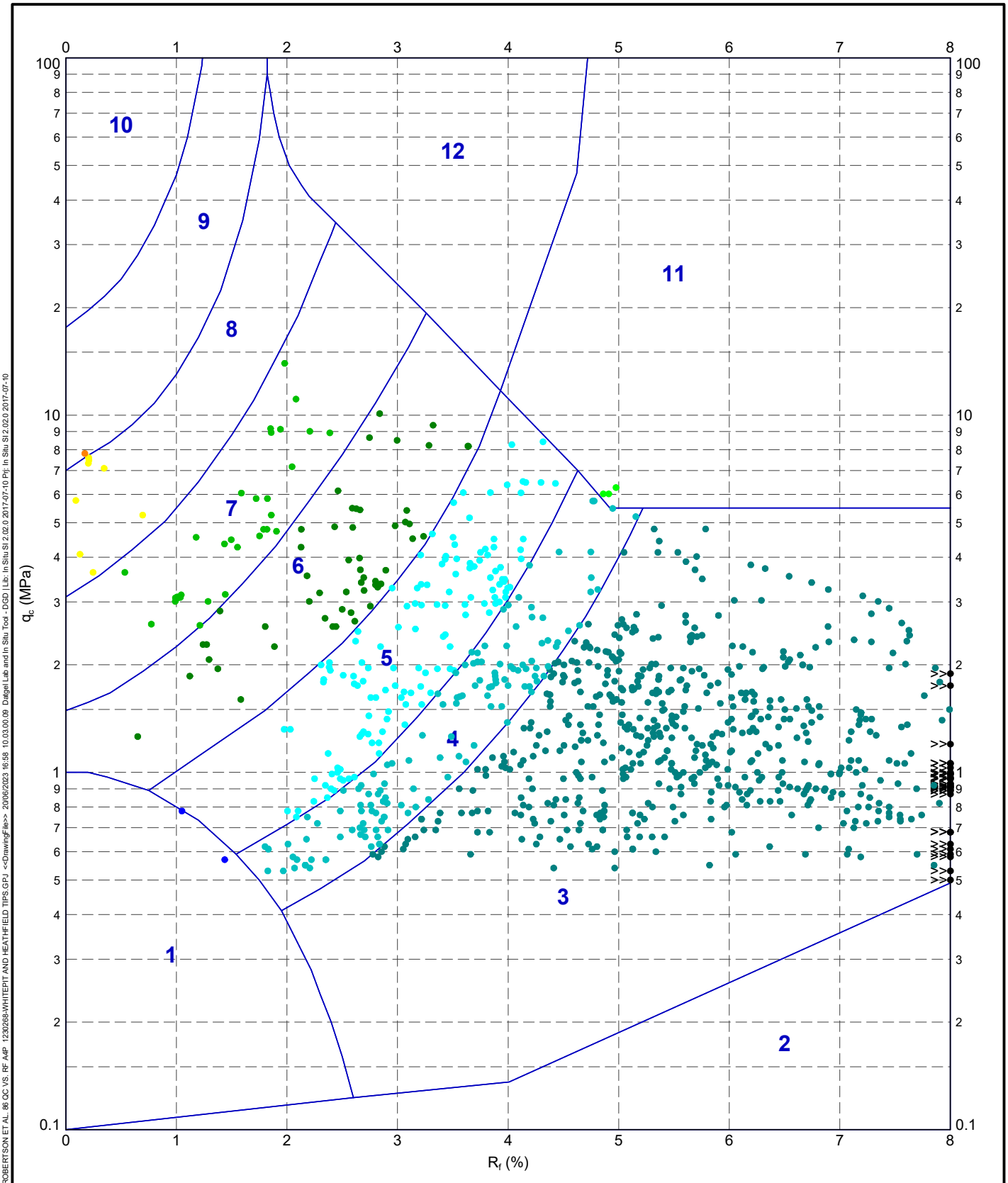

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 238 mV | 0.046 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 216 mV | 219 mV | 0.002 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 320 mV | 358 mV | 0.01 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 1652 mV | 1340 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

| | | | |
|---|---|---|---|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2311

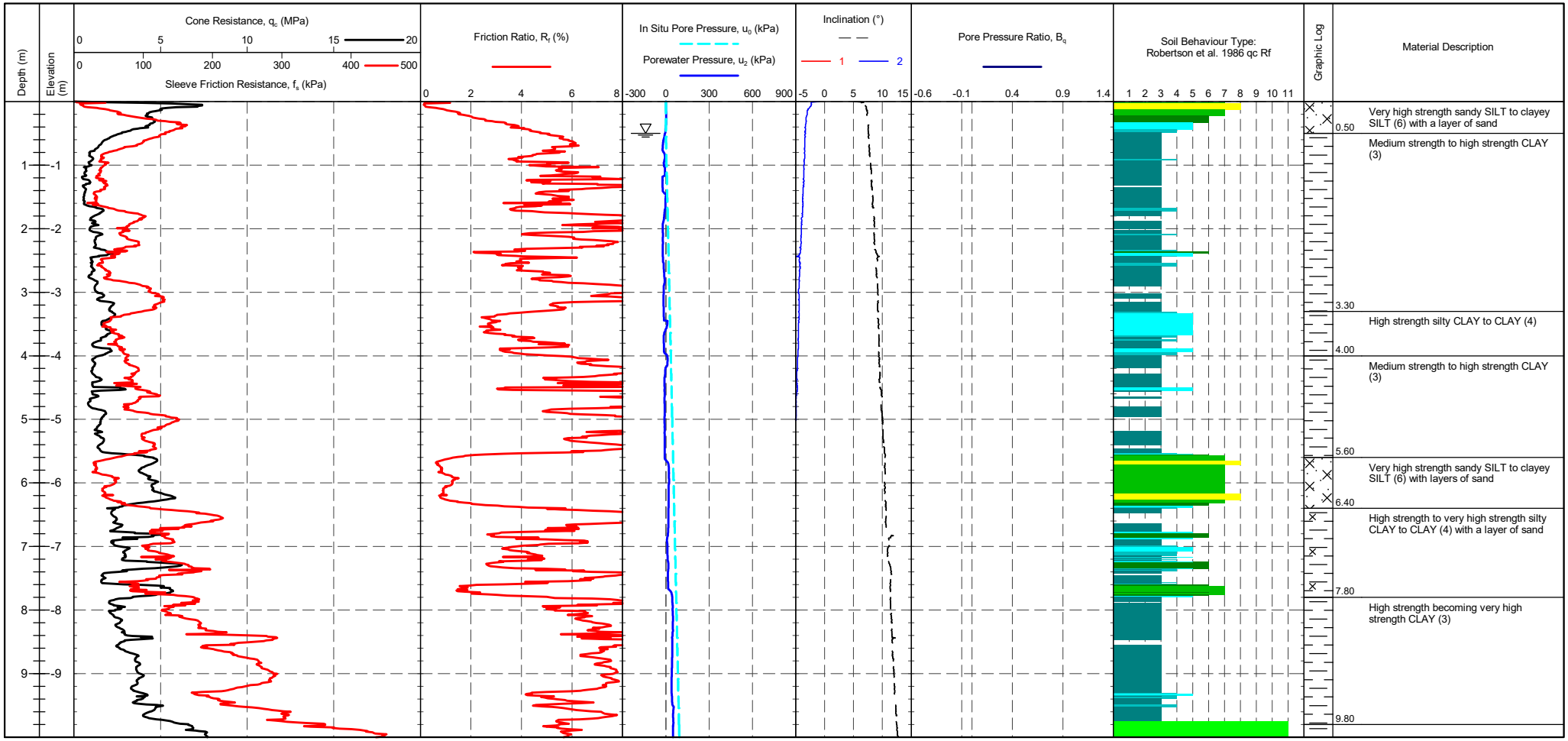
| | | | |
|---|---|---|---|
| DRAWN | | DATE | 20/06/2023 |
| CHECKED | | DATE | 20/06/2023 |
| SCALE | Not To Scale | | A4 |
| PROJECT No | 1230268 | FIGURE No | |

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2312**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | |
|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen |
| CONE AREA | : 15cm² | OPERATOR | : AC |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes |

CPTU ZERO VALUES

| Transducer | Pre | Post | Difference |
|---|---|---|---|
| Tip | 234 mV | 235 mV | 0.012 MPa |
| Sleeve | 215 mV | 216 mV | 0.001 kPa |
| Pore Pressure 2 | 278 mV | 382 mV | 0.028 kPa |
| X-Y Inclinometer | 1889 mV | 1979 mV | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

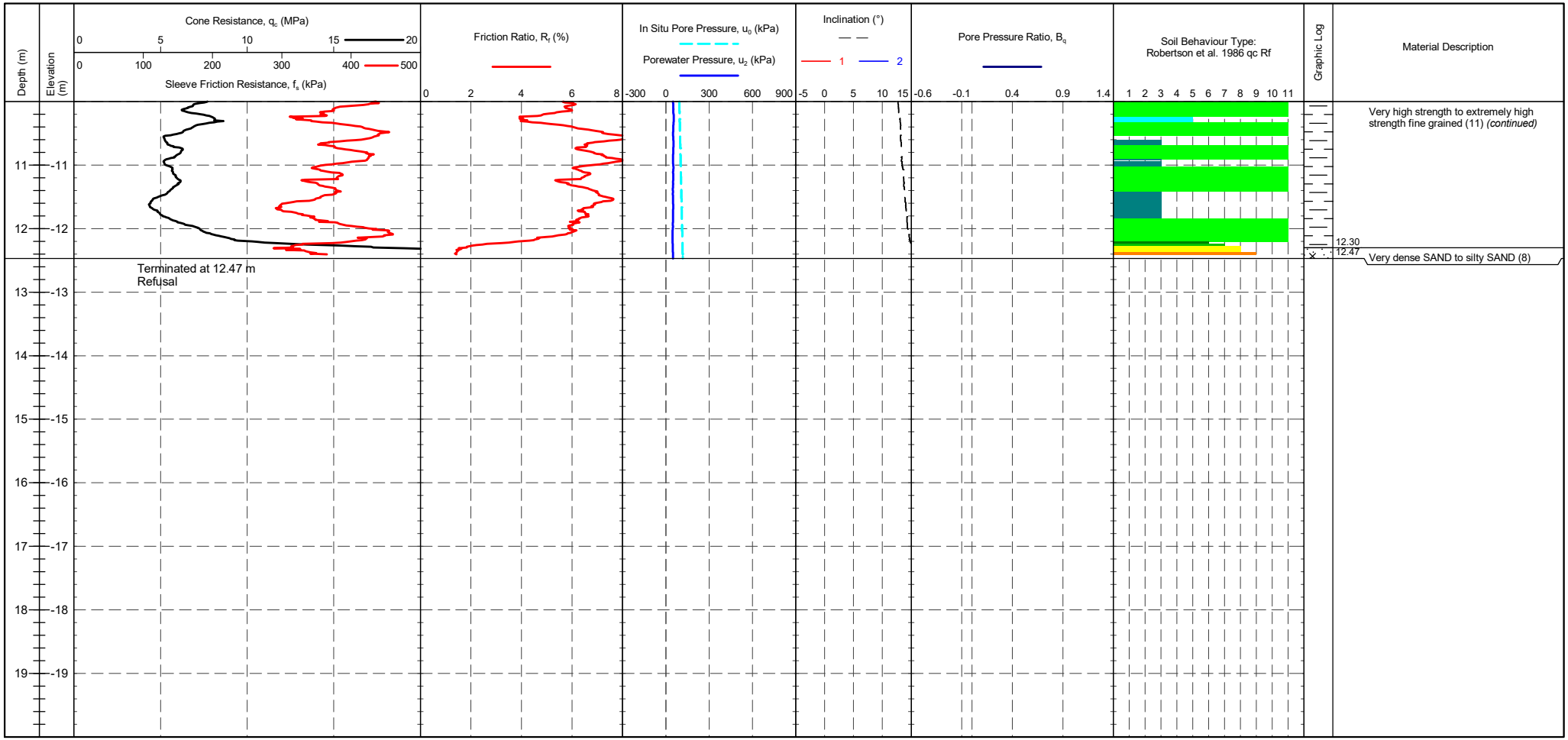
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 01

PointID: **CPT2312**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | CPTU ZERO VALUES | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | Transducer | Pre | Post | Difference |
| CALIBRATION DATE | : 05/12/2022 | APPLICATION CLASS | : 2 | Tip | 234 mV | 235 mV | 0.012 MPa |
| CONE MODEL | : Subtraction | RIG | : CPT 017 - Griffen | Sleeve | 215 mV | 216 mV | 0.001 kPa |
| CONE AREA | : 15cm$^2$ | OPERATOR | : AC | Pore Pressure 2 | 278 mV | 382 mV | 0.028 kPa |
| CONE AREA RATIO | : 0.79 | FRICTION REDUCER | : None | X-Y Inclinometer | 1889 mV | 1979 mV | |
| FILTER POSITION | : u2 | WEATHER | : Overcast & Mild | | | | |
| FILTER TYPE | : HDPE | GROUNDWATER DEPTH | : Assumed for calculation purposes | | | | |

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level

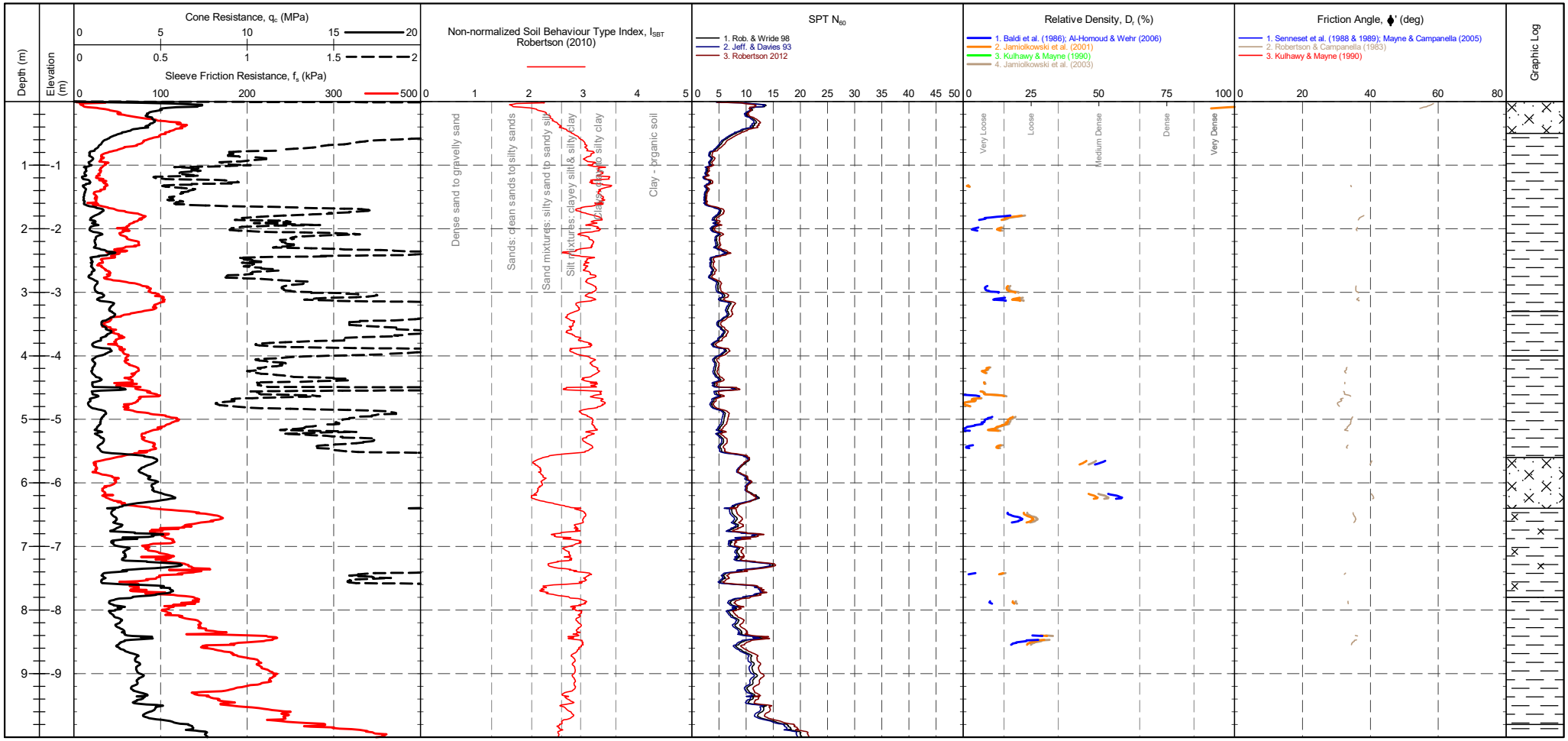
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID **CPT2312**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco<br>PROJECT : Whitepit and Heathfield Tips<br>LOCATION : Newton Abbot<br>PROJECT No. : 1230268 | EASTING : 0.000 m<br>NORTHING : 0.000 m<br>ELEVATION : 0.000 m OD<br>CHECKED BY : DW<br>TERMINATION REASON : Refusal | Remark:<br>Test refused on total pressure. | SHEET : 1 OF 2<br>STATUS : Final<br>TEST DATE : 16/06/2023<br>PLOT DATE : 20/06/2023<br>METHOD : ISO 22476-1:2022 |




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
| Tip | 234 mV | 235 mV | 0.012 MPa |
| Sleeve | 215 mV | 216 mV | 0.001 kPa |
| Pore Pressure 2 | 278 mV | 382 mV | 0.028 kPa |
| X-Y Inclinometer | 1889 mV | 1979 mV | |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic | Description | SPT N value, NSPT | Description | Relative Density Dr (%) |
|---|---|---|---|---|---|
| Clays | 2.95-3.60 | Very Loose | 0 - 4 | Very Loose | 0 - 15 |
| Silt mixtures | 2.60-2.95 | Loose | 4 - 10 | Loose | 15 - 35 |
| Sand mixtures | 2.05-2.60 | Medium Dense | 10 - 30 | Medium Dense | 35 - 65 |
| Sands | 1.31-2.05 | Dense | 30 - 50 | Dense | 65 - 85 |
| Gravelly sand | <1.31 | Very Dense | >50 | Very Dense | >85 |

Groundwater Level

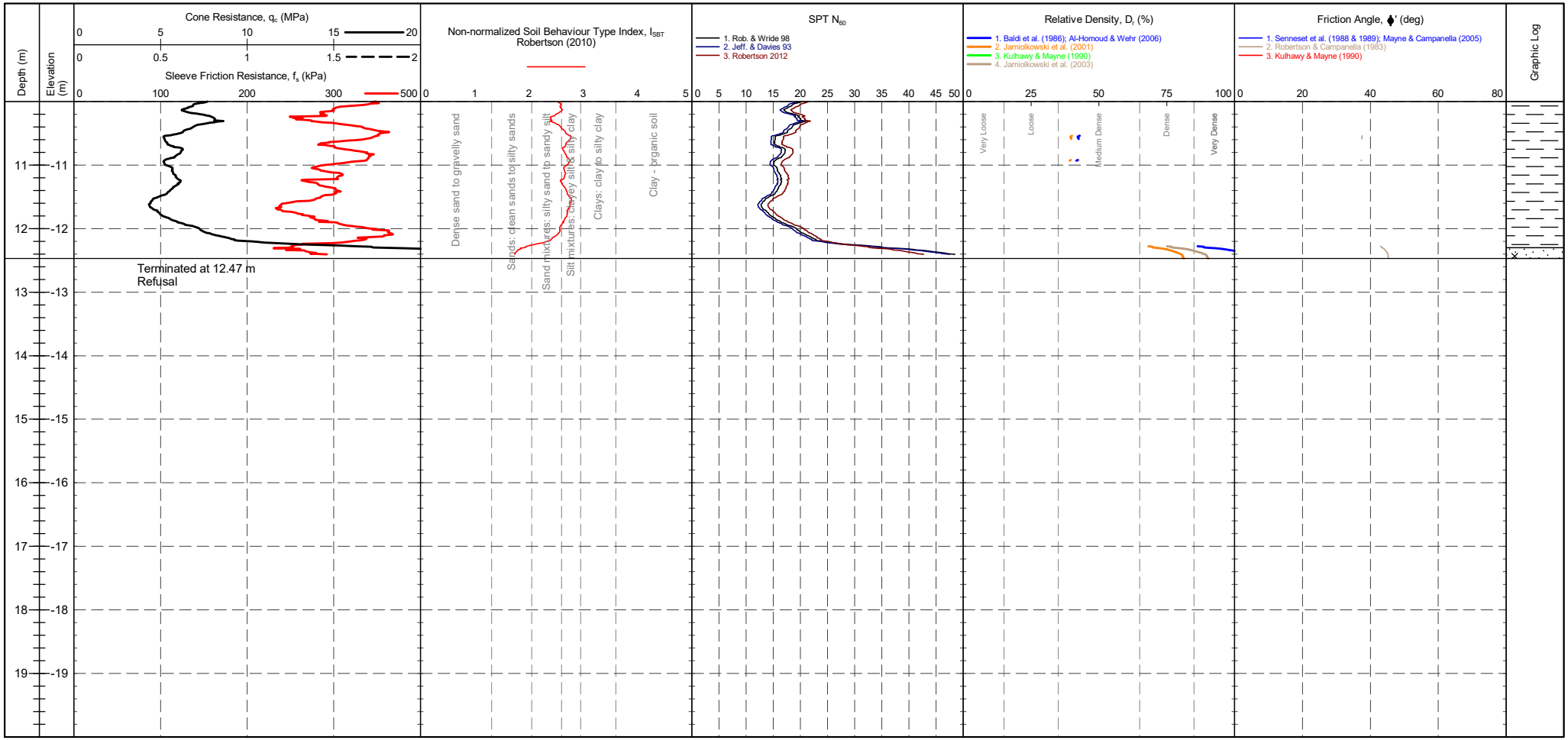
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 02

PointID: **CPT2312**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 2 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | |
|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post |
| CONE AREA | : 15cm² | RIG | : CPT 017 - Griffen | Tip | 234 mV | 235 mV |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 215 mV | 216 mV |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 278 mV | 382 mV |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 1889 mV | 1979 mV |

| Difference |
|---|
| 0.012 MPa |
| 0.001 kPa |
| 0.028 kPa |

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

| Description | SBT Index, Ic |
|---|---|
| Clays | 2.95-3.60 |
| Silt mixtures | 2.60-2.95 |
| Sand mixtures | 2.05-2.60 |
| Sands | 1.31-2.05 |
| Gravelly sand | <1.31 |

| Description | SPT N value, NSPT |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | >50 |

| Description | Relative Density Dr (%) |
|---|---|
| Very Loose | 0 - 15 |
| Loose | 15 - 35 |
| Medium Dense | 35 - 65 |
| Dense | 65 - 85 |
| Very Dense | >85 |

Groundwater Level

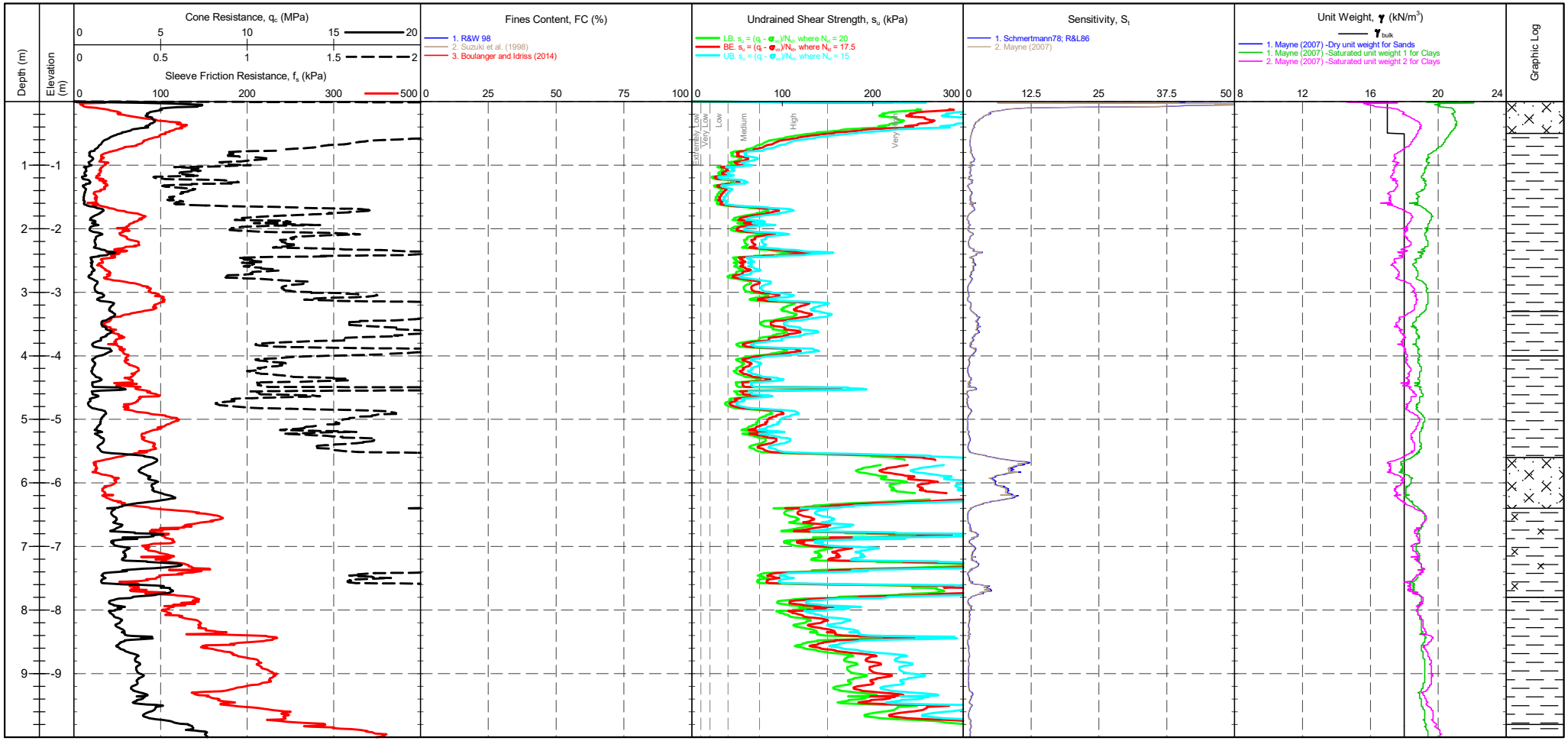
Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

PointID **CPT2312**

| | | | |
|---|---|---|---|
| CLIENT : Sibelco | EASTING : 0.000 m | Remark: | SHEET : 1 OF 2 |
| PROJECT : Whitepit and Heathfield Tips | NORTHING : 0.000 m | Test refused on total pressure. | STATUS : Final |
| LOCATION : Newton Abbot | ELEVATION : 0.000 m OD | | TEST DATE : 16/06/2023 |
| PROJECT No. : 1230268 | CHECKED BY : DW | | PLOT DATE : 20/06/2023 |
| | TERMINATION REASON : Refusal | | METHOD : ISO 22476-1:2022 |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | CPTU ZERO VALUES | | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | Transducer | Pre | Post | Difference |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | Tip | 234 mV | 235 mV | 0.012 MPa |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | Sleeve | 215 mV | 216 mV | 0.001 kPa |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | Pore Pressure 2 | 278 mV | 382 mV | 0.028 kPa |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | X-Y Inclinometer | 1889 mV | 1979 mV | |

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

| Term based on measurement | su (kPa) | Term based on measurement | su (kPa) |
|---|---|---|---|
| Extremely low strength | <10 | Medium strength | 40-75 |
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test

IN SITU SITE INVESTIGATION Working with: SIBELCO

# CPT LOG 03

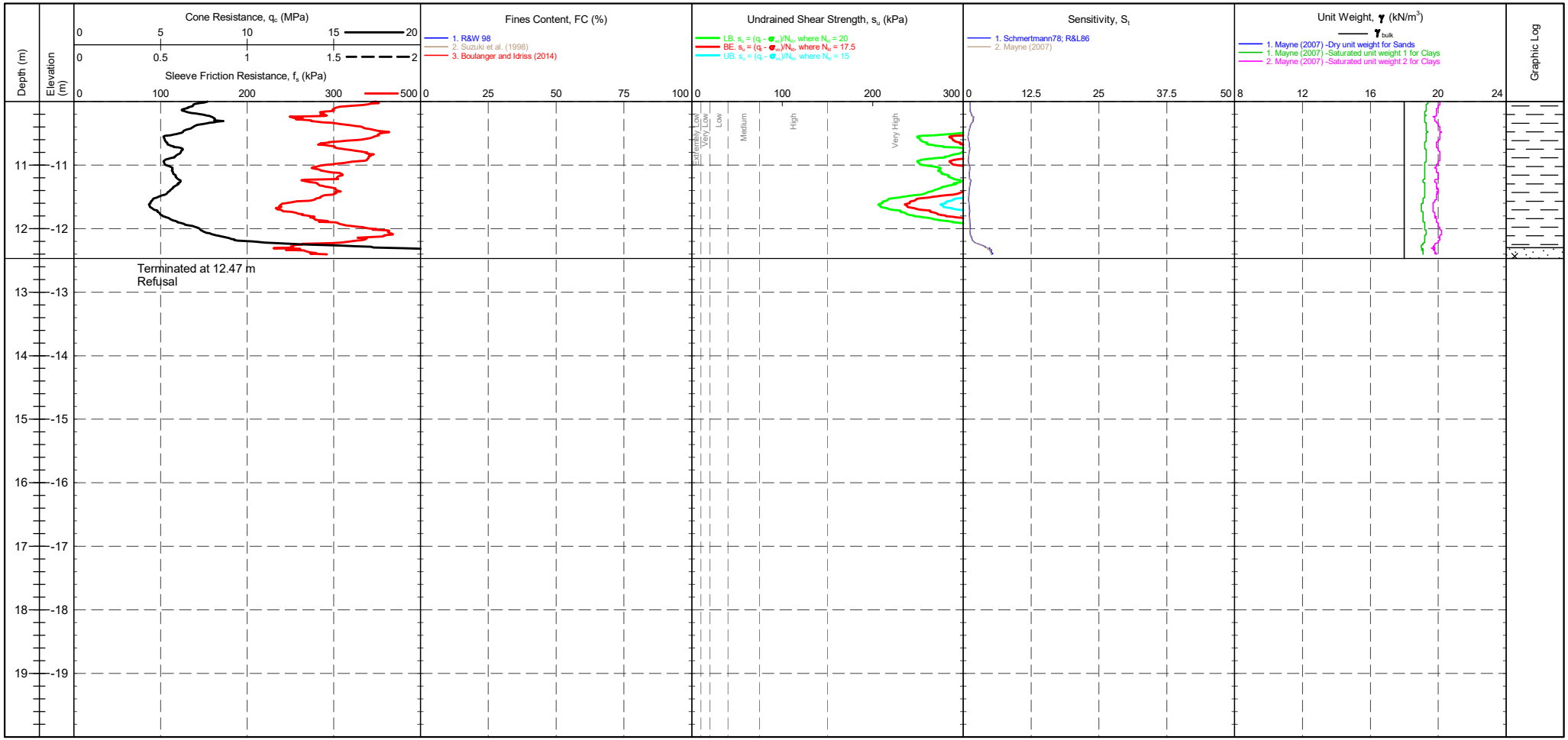
PointID **CPT2312**

CLIENT : Sibelco
PROJECT : Whitepit and Heathfield Tips
LOCATION : Newton Abbot
PROJECT No. : 1230268

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 16/06/2023
PLOT DATE : 20/06/2023
METHOD : ISO 22476-1:2022




| | | | | | |
|---|---|---|---|---|---|
| CONE ID | : S15-CFIP.2175 | TEST TYPE | : TE2 | | |
| CONE MODEL | : Subtraction | APPLICATION CLASS | : 2 | | |
| CONE AREA | : 15cm$^2$ | RIG | : CPT 017 - Griffen | | |
| CONE AREA RATIO | : 0.79 | OPERATOR | : AC | | |
| FILTER POSITION | : u2 | FRICTION REDUCER | : None | | |
| FILTER TYPE | : HDPE | WEATHER | : Overcast & Mild | | |

CPTU ZERO VALUES

| | Pre | Post | Difference |
|---|---|---|---|
| Transducer | | | |
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| Sleeve | 215 mV | 216 mV | 0.001 kPa |
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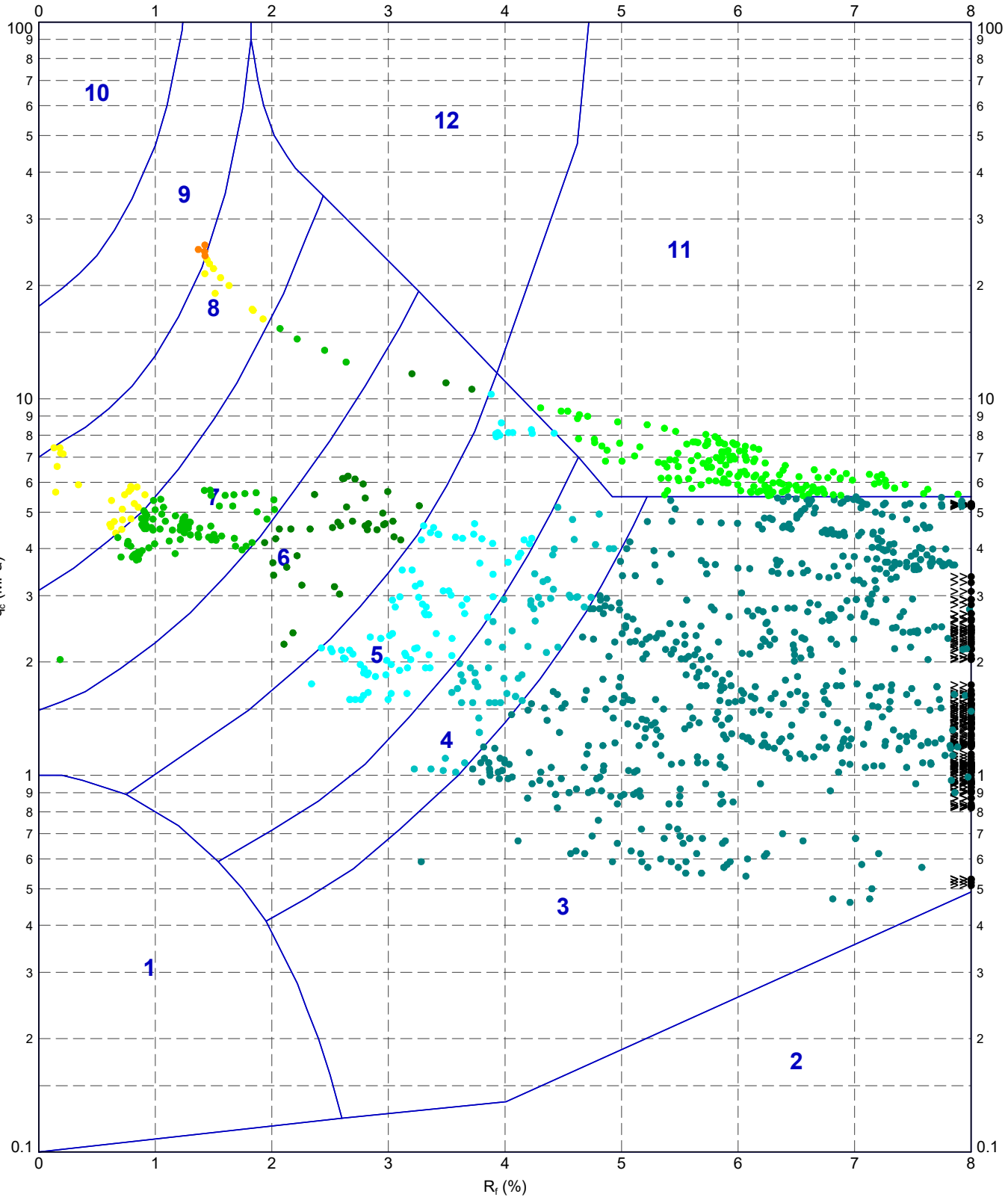
| Very low strength | 10-20 | High strength | 75-150 |
| Low strength | 20-40 | Very high strength | 150-300 |
| | | Extremely high strength | >300 |

Groundwater Level

Dissipation Test




METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material
- 2 - Organic material
- 3 - CLAY
- 4 - Silty CLAY to CLAY
- 5 - Clayey SILT to silty CLAY
- 6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT
- 8 - SAND to silty SAND
- 9 - SAND
- 10 - Gravelly SAND to SAND
- 11 - Very stiff fine grained
- 12 - SAND to clayey SAND

IN SITU SITE INVESTIGATION

TITLE

Sibelco
Newton Abbot
Whitepit and Heathfield Tips
Robertson et al. 1986 $q_c$ vs. $R_f$ - CPT2312

| | |
|---|---|
| DRAWN | DATE 20/06/2023 |
| CHECKED | DATE 20/06/2023 |
| SCALE Not To Scale | A4 |
| PROJECT No 1230268 | FIGURE No |

*IN SITU SITE INVESTIGATION*

Unit 23 Hastings Innovation Centre,
Highfield Drive
St. Leonards on Sea, East Sussex,
TN38 9UH, U.K.

Company No.: 6339499
VAT No.: 922 3561 41