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17 November 2025

Orchard Grove Development

Kay Road, Horsham Downs

PRELIMINARY GEOTECHNICAL DESKTOP REPORT

Gordon Litt Farms Ltd

Job No. HAM2025-0055AB | Version 3

Hamilton
Level 1 | Block C
401 Grey Street
Hamilton 3216
New Zealand
Ph: +64 7 2820 039
www.cmwgeosciences.com

Version Control

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Job number	HAM2025-0055AB
Prepared by	Peta McGiven, Engineering Geologist
Reviewed by	Dave Sullivan, Principal Geotechnical Engineer CMEngNZ, CPEng
Authorised by	Kori Lentfer, Associate Engineering Geologist CMEngNZ, PEngGeol

Review and Update History

Revision	Date	Comments
A	10 June 2025	Initial draft for internal review
0	16 June 2025	Report issue
1	19 August 2025	Updated following client's comments to proposed development and further work.
2	08 September 2025	Updated following client's comments to proposed development and further work.
3	17 November 2025	Updated following changes to the masterplan.

CONTENTS

Appendices

1.0 INTRODUCTION

1.1 Scope

CMW Geosciences (CMW) was engaged by Gordon Litt Farms Ltd to carry out a geotechnical desktop assessment of a site located at Kay Road, Horsham Downs, to support a fast-track referral application for a proposed residential subdivision.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2025-0055AA, Rev 0 dated 20 May 2025.

This report has been prepared to summarise expected ground conditions and provided preliminary recommendations for possible geohazards, foundation and site-specific geotechnical testing.

2.0 SITE DESCRIPTION

2.1 Site Location

The proposed development (Orchard Grove) is located on Kay Road, Hamilton, as shown in Figure 1. The site comprises an area of approximately 69ha and is currently used for agricultural and horticultural purposes.

The site is bordered by Osborne Road to the west, Reynolds Road to the north, Resolution Drive to the east, and Kay Road and residential/lifestyle blocks to the south.

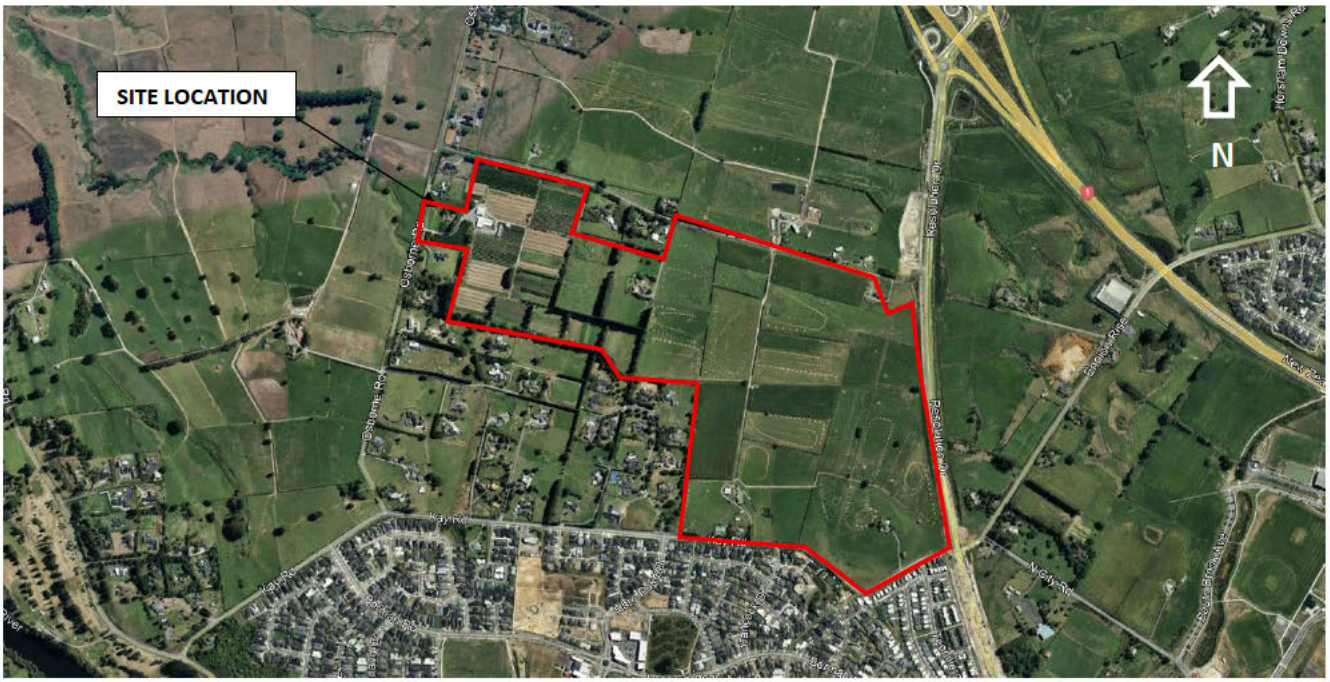

Figure 1: Site Location Plan (Source: Google Earth Pro).

2.2 Landform

The landform is predominantly flat in the central part of the site from the eastern boundary to the north-western corner. Two moderately steep hills are present at the site. One is along Kay Road, which has a gradient of up to 1v:2h sloping to the southeast and one at Renyolds Road with a gradient of up to 1v:5.5h sloping to

the northeast. Existing ground levels ranging from RL44m in the southern corner along Kay Road to RL26m in the gully along the western boundary.

A shallow gully system runs along near western boundary and flows via a culvert beneath Osborne Road. The gully system feeds into the Waikato River, approximately 1.5km west of the proposed subdivision. Farm drains that run through the site also connect to this gully system.

2.3 Proposed Development

The Orchard Grove development is a proposed residential development as shown in Figure 2. The development includes residential lots, a neighbourhood centre, recreational areas, roading and walking and cycling facilities, and associated three waters infrastructure.

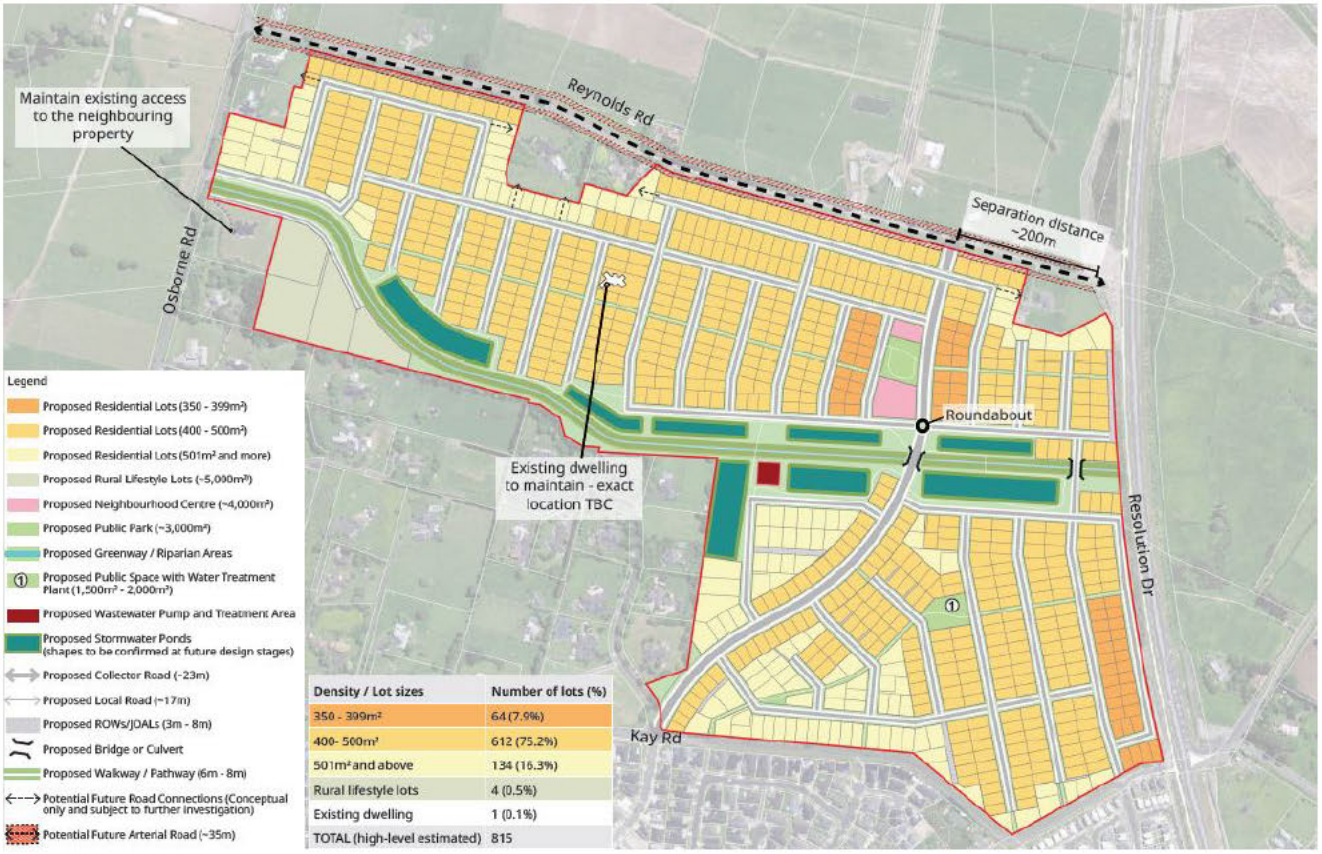

Figure 2: Orchard Grove Masterplan (Source: Barker & Associates).

3.0 CONCEPTUAL GROUND MODEL

3.1 Geology

Published geological maps[1] for the area depict the regional geology as undifferentiated Walton Subgroup alluvium comprising pumiceous sands and silt with thin peat beds. This is overlain by late Pleistocene River deposits of the Hinuera Formation and Piako Subgroup. The Piako Subgroup made up of locally derived gravel,

[1] GNS Geological Map 1:250,000 scale Geological Map No 4 'Waikato'. SW Edbrooke et al.

silt and peat while the Hinuera Formation is made up of pumice cross bedded sand and silt with interbedded peat. This is illustrated in Figure 3 below.

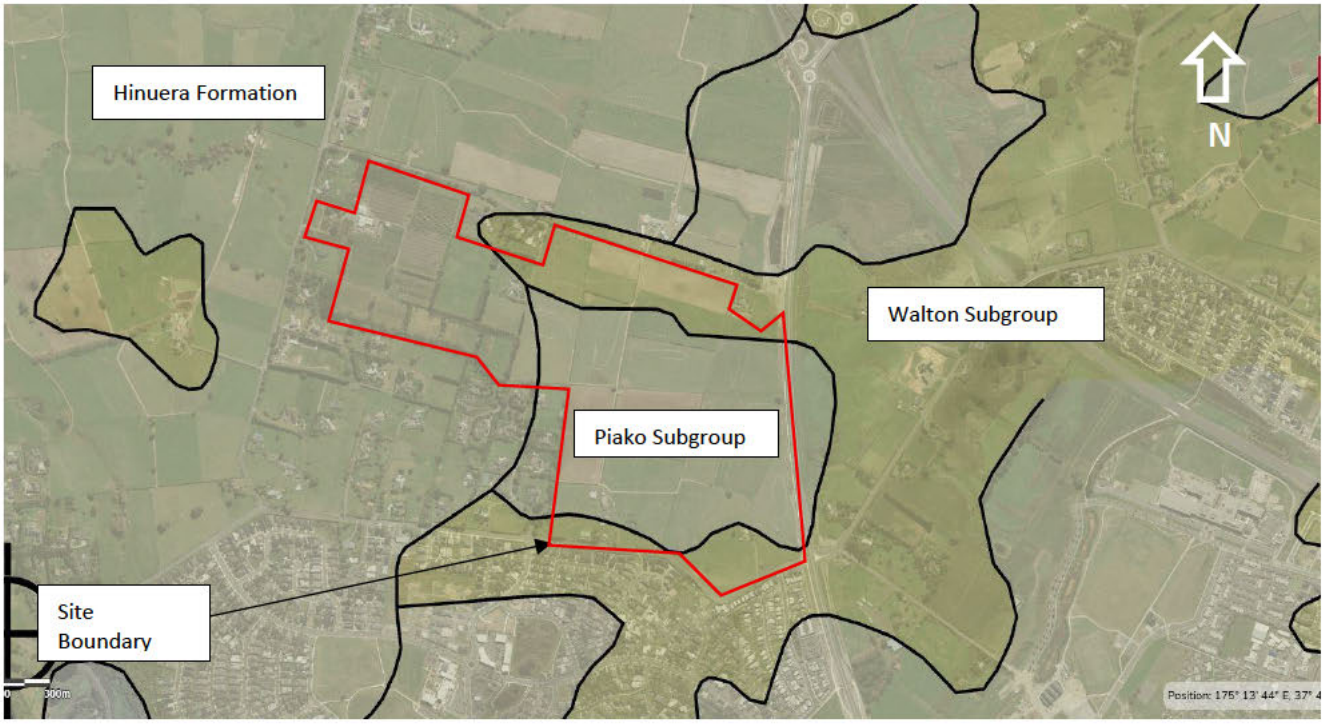

Figure 3: Regional Geology (GNS Geology Map)[1].

3.2 Nearby Geotechnical Data

A review of nearby geotechnical logs from the New Zealand Geotechnical Database (NZGD) confirms the geology present in the published geological maps. Relevant plans and engineering logs are presented in ***Appendix A***.

Several bores are also in or near the site. Eight of these bores have a recorded lithology which have also been attached to ***Appendix A.***

The ground conditions presented in geotechnical data logged by others, can be generalised according to the following units in Table 1. Topsoil had not been recorded in the NZGD logs or the bore logs.

Table 1: Summary of Strata Encountered in Publicly Available Logs.

Unit	Depth to Base of Unit (m)		Assessed Thickness (m)
	Min	Max	
Firm to Stiff SILT with interbedded Organic Silt (Piako Subgoup)*	>1.8		-
Medium Dense to Dense SAND with interbedded SILT (Hinuera Formation)	6.5	9	9
Stiff to Very Stiff CLAY (Hamilton Ash)	1.2	16.5	7
Soft to Firm Clayey SILT (Puketoka Formation)	3.1	3.9	0.5
Dense to Very Dense SAND (Walton Subgroup)*	>20		-
Notes: *Base of units not encountered in limited available investigation logs.			

3.3 Laboratory Test Results

Laboratory testing was conducted in January 2015 along the Hamilton section of the Waikato Expressway. Results[2][3][4] of the laboratory tests provided in ***Appendix B*** are summarised in Table 2.

Table 2: Laboratory Testing from TP_77263.

Test Location	Depth (m bgl)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	MC (%)	OMC (%)	MMDD (t/m²)
TP_77263	1.6 – 4.5	25	75	49	34	15	75.7	37	1.24
Note: Gravel, sand and fines percentages are by weight, LL = liquid limit, PL = plasticity limit, PI = plasticity index, MC = Natural Moisture Content, OMC = Optimum Moisture Content, MMDD = Modified Maximum Dry Density									

3.4 Groundwater

Nearby NZGD data have logged groundwater between 1.7m below ground level (bgl) to 5.5m bgl. Google Street view shows water in the gully on the other side of Osborne Road which had been captured in February 2025.

4.0 DESKTOP FINDINGS

4.1 Historical Photos

Historical photographs dating back to 1941 have been reviewed and are attached in ***Appendix C.*** The historical photographs show that the site has been used for agriculture. In 1963 the orchard had been established in the northwestern corner of the site. In 1979, earthworks along the future Resolution Drive road alignment had begun along the eastern boundary. In an image from 2022 an area of rubbish can be seen in part of the Orchard behind 40B Reynolds Road.

4.2 Regional Hazards

A review of the Waikato Regional Council Natural Hazards Portal[5] was undertaken.

The Hazard Portal addresses potential flooding, coastal hazards, volcanic and seismic hazards.

No river flooding risk had been identified, but the site is part of the Waikato Central Drainage Scheme and has a Waikato Regional Council drain to remove water after a rainfall event. This demonstrates that the site is potentially prone to flooding after a heavy rainfall event.

The nearest active volcanoes are Rotorua and Mayor Island, both of which are approximately 100km away and are currently at alert level 0. Hazard Maps have been presented in ***Appendix D.***

[2] Opus International Consultants Ltd. (*2015*). Plasticity Index for Soils Test Report, Lab Ref No: 15/803/006a. Hamilton.
[3] Opus International Consultants Ltd. (*2015*). Particle Size Analysis (Wet Sieve Method) Test Report, Lab Ref No: 15/803/006. Hamilton.
[4] Opus International Consultants Ltd. (*2015*). Dry Density/Water Content Relationship Standard Compaction, Lab Ref No: 15/803/006. Hamilton.
[5] Waikato Regional Council. Waikato Regional Hazards Portal.
https://waikatoregion.maps.arcgis.com/apps/MapSeries/index.html?appid=f2b48398f93146e8a5cf0aa3fddce92c

4.3 Fault Rupture

This site is not considered to be at risk of fault rupture on the basis that there are no mapped active faults in the area. The GNS Active Fault Database[6] Indicates the nearest active fault is the Kerepehi Fault which is approximately 50km to the east of the site and has a recurrence interval of 2,000 to 3,500 years.

4.4 Liquefaction and Lateral Spread

Liquefaction occurs in loose saturated cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-up, soil grains moving into suspension and temporary loss of strength causing vertical and lateral ground deformation. A liquefaction hazard map from the Waikato Regional Council is presented in ***Appendix D***. The majority of the site is classed as undetermined, and the hills are classed as unlikely.

Based on our local knowledge, the Hinuera Formation and Piako Subgroup deposits are susceptible to liquefaction when below the groundwater table. Free-field liquefaction induced settlement may be significant during a ULS seismic event. The magnitude of liquefaction induced settlement is likely to vary across the site and differential settlement should be anticipated, should there be a large seismic event.

Following the onset of liquefaction, liquefied soils will behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where proposed cut or fill batters are proposed over or within the zone of influence of liquefied soils. The Waikato Regional Council drain/gully and the existing farm drains present as a free face where the risk of lateral spreading must be considered. Lateral spreading will also need to be considered when constructing stormwater basins, as this will create a free face.

The extent and magnitude if lateral spread that may occur during liquefaction is dependent of the groundwater levels present beneath the site and the depth of liquefiable soils. These will need to be assessed once a site investigation has taken place.

4.5 Cyclic Softening

While not liquefiable due to their high plasticity, the fine-grained soils in the Walton Subgroup may be susceptible to some strength loss, during a ULS seismic event. On account of the typically high shear strengths of these soils this is often not a significant geotechnical issue for land development projects.

4.6 Slope Stability

Based on the site topography, it is considered that the site is not generally considered to be at risk of slope instability. Slumping or subsidence has not been observed in the historical photographs, partially around the gully and hill slopes. A site walkover by experienced engineering geologist will be required to confirm slope stability conditions.

The inclusion of high or steep slopes for swales or cuts will need an assessment of slope stability as part of the design process.

4.7 Load Induced Settlement

Given the site geology is predominantly alluvial deposits, there may be localised zones of soft and compressible soils. This is particularly likely within the Piako Subgroup soils. In these instances, significant primary consolidation and long-term secondary creep settlements may occur as a response to the placement

[6] GNS NZ Active Fault Database https://data.gns.cri.nz/af/

of fill and building loads. Site specific geotechnical investigations will need to be carried out to better characterise the soils across the site.

Future reporting will provide advice concerning frequency of site observations during construction to ensure soft areas are appropriately managed.

4.8 Earthworks

Hamilton Ash clays are generally suitable for reuse as engineered fill with moisture conditioning during normal summer conditions. However, the Puketoka Formation and Hinuera Formation silts can be sensitive and may lose strength with they are disturbed and allowed to get wet.

Soft or organic soils near the ground surface may be encountered during excavation particularly within the Piako Subgroup soils.

Geotechnical site investigation a future reporting will provide advice on how to treat soft soils. This may include removal and replacement or ground improvement methods, such as preloading.

Groundwater may be encountered at shallow depth on the low-lying areas. Future reporting may consider underfill subsoil drains or granular drainage blanket layers as mitigation measures.

4.9 Preliminary Foundation Options

Depending on the magnitude of liquefaction induced settlement, engineered foundation solutions may be required. This may include foundation options such as TC2 or TC3 type raft foundations. Deep pile foundations may also be required for larger loads expected in commercial buildings.

Settlement magnitudes can be estimated once the required geotechnical investigation data is available and the earthworks design and building loads are known. Depending on the nature of the proposed development and the finished ground levels, ground improvement of some kind may be required to manage static load induced settlement.

Ground improvement options that could be considered include undercut and reworking of soft ground (static settlement only); temporary surcharge fills (static settlement only), deep soil mixing and/or vibro-stone columns (liquefaction and static settlement). Confirmation of options would require detailed geotechnical investigation and design.

5.0 FURTHER WORK

Based on the assessment presented in this report, there are no unusual features or geotechnical constraints observed for this site that would prevent urban develop from proceeding. We have identified the following additional scope of work that is considered necessary to further assess the risk profile for the scheme and to support a substantive consent application. This additional scope of work is typical for urban development of this scale, and includes the following:

- Geotechnical investigation to inform ground model development, detailed geohazard assessment, selection of geotechnical design parameters, and design and construction recommendations.
- Geotechnical analysis and reporting, suitable to support future project stages including resource consent application, detailed design, and building consent applications (if any).
- Design of ground improvement if necessary to mitigate load or liquefaction induced settlement, or lateral spread.
- Geotechnical completion reporting of subdivision earthworks.

6.0 CLOSURE

This report has been prepared for use by Gordon Litt Farms Ltd in relation to the proposed Orchard Grove development at Kay Road, Horsham Downs project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Gordon Litt Farms Ltd seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

Environmental matters are not covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

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APPENDIX A
NZGD and Bore Logs

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PROJECT:		CHECKED:	DRAWING:
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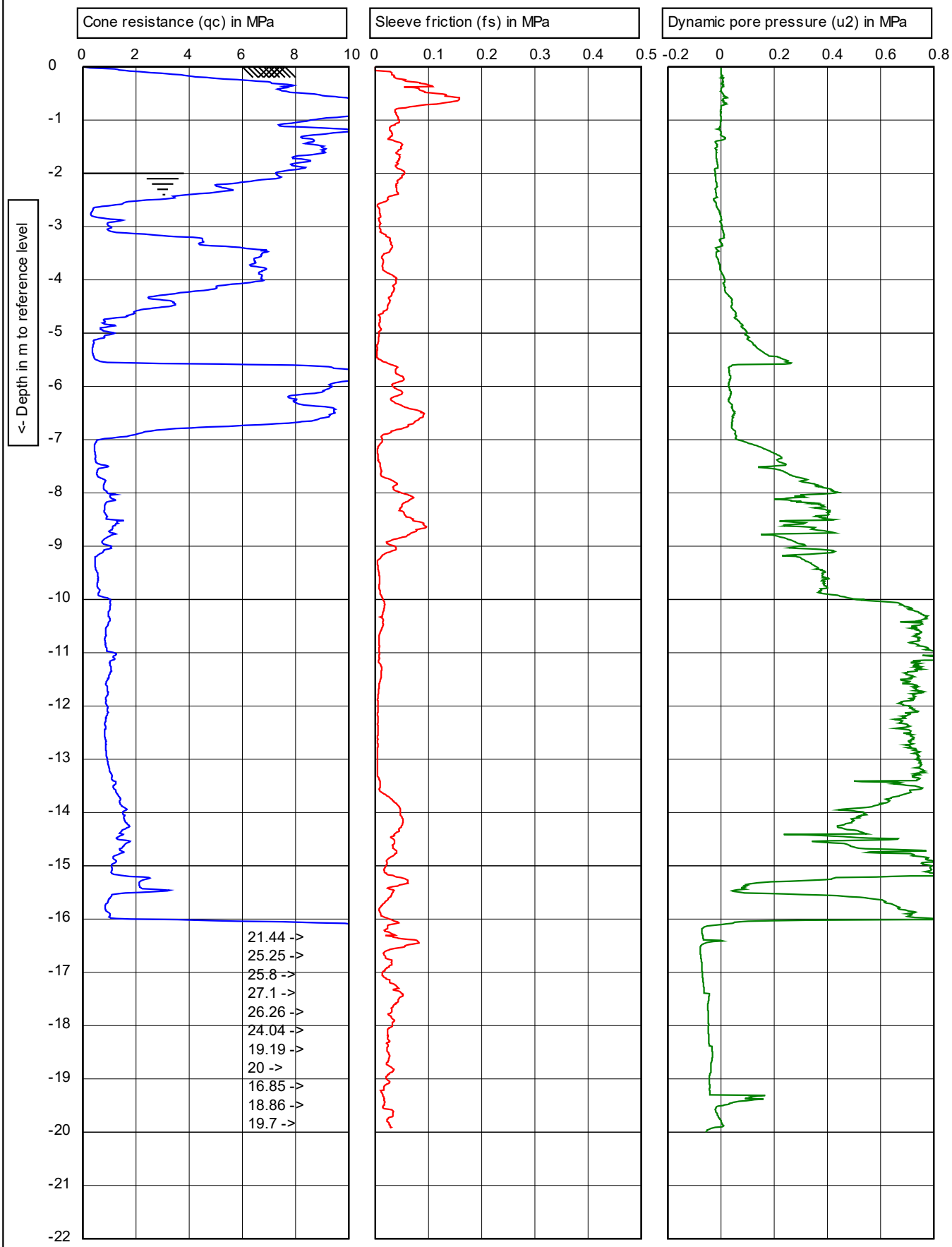

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CPT no.: **01** **1/6**

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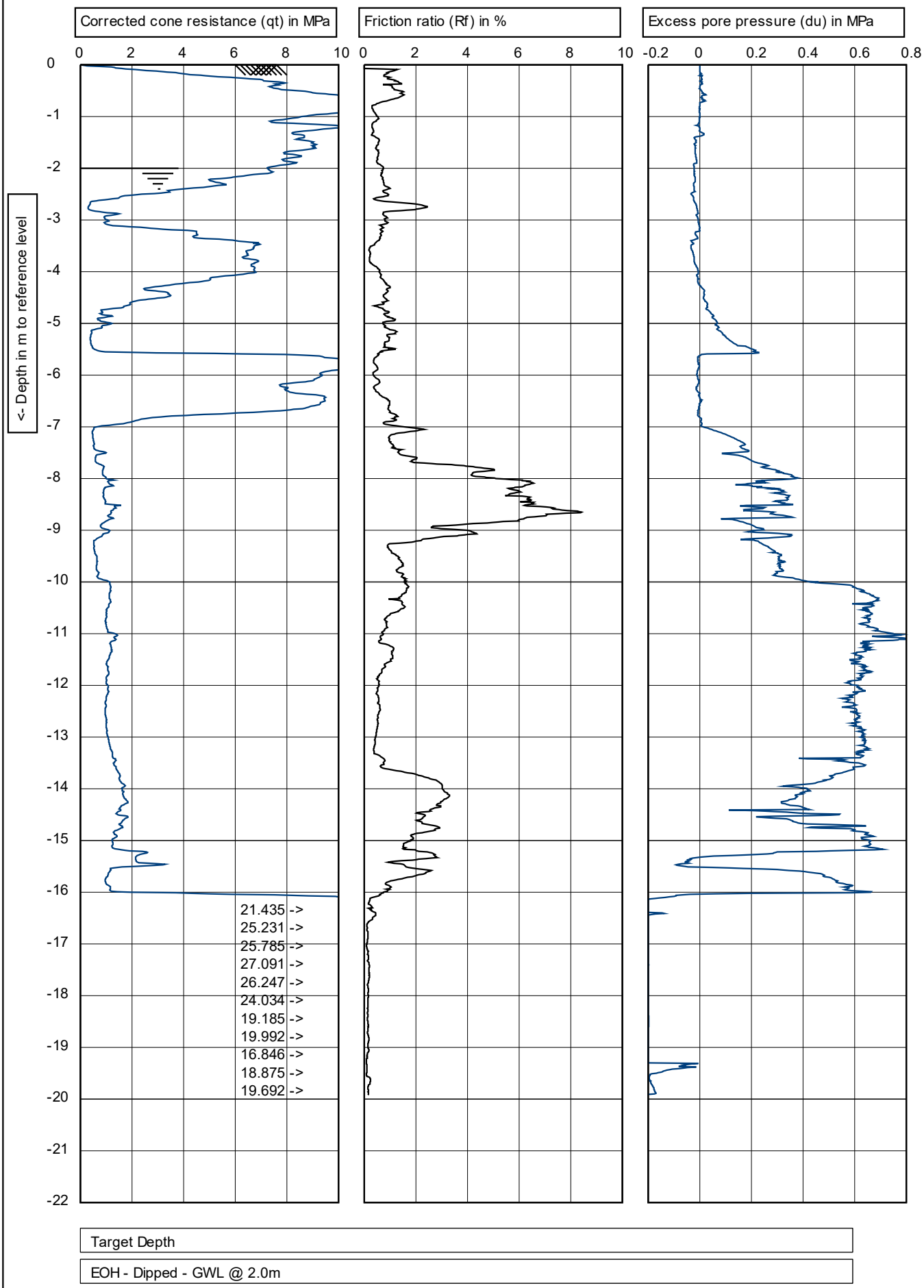

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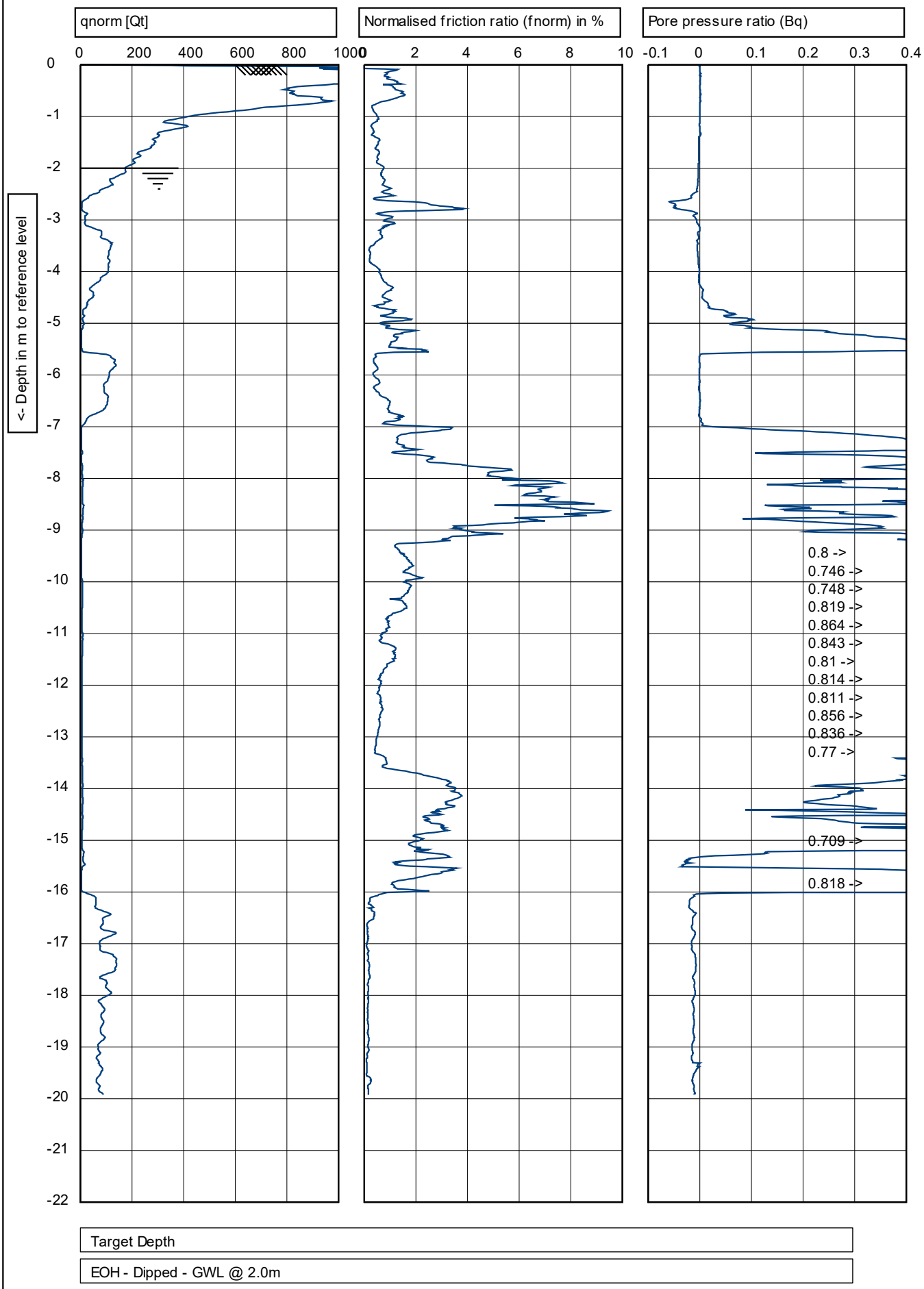

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CPT no.:	**01** **3/6**

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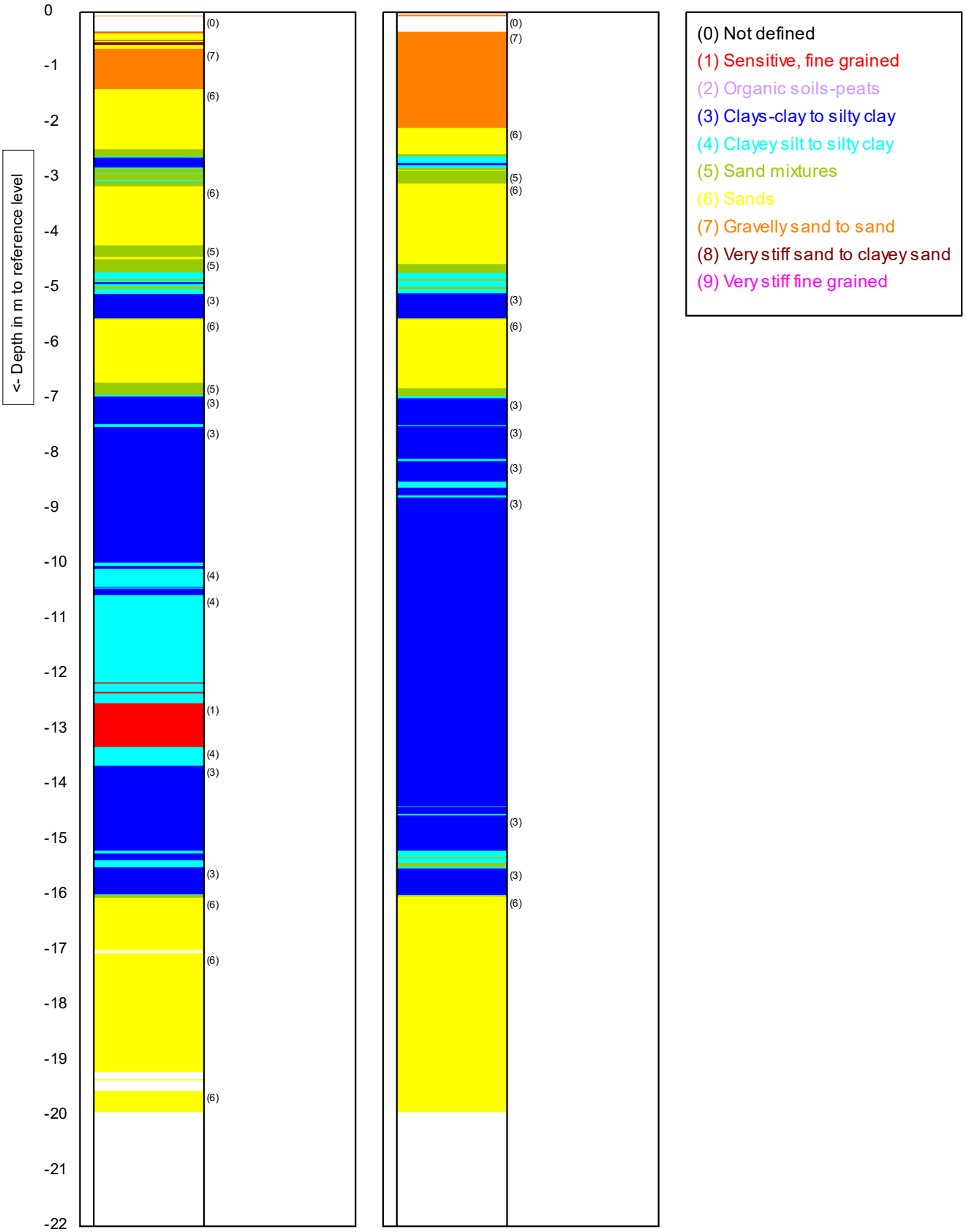
Soil Classification (using Fr)

Soil Classification (using Bq)



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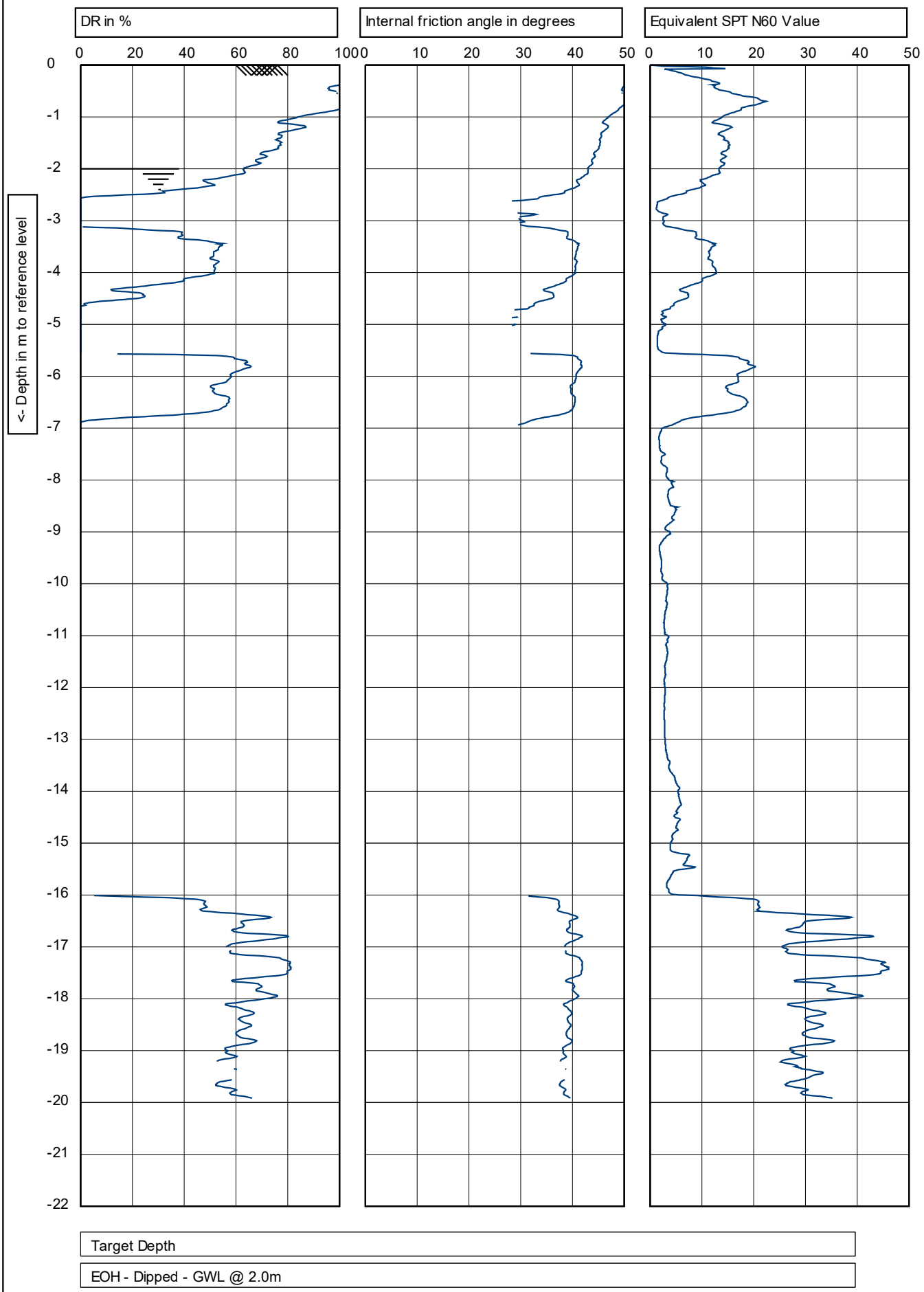

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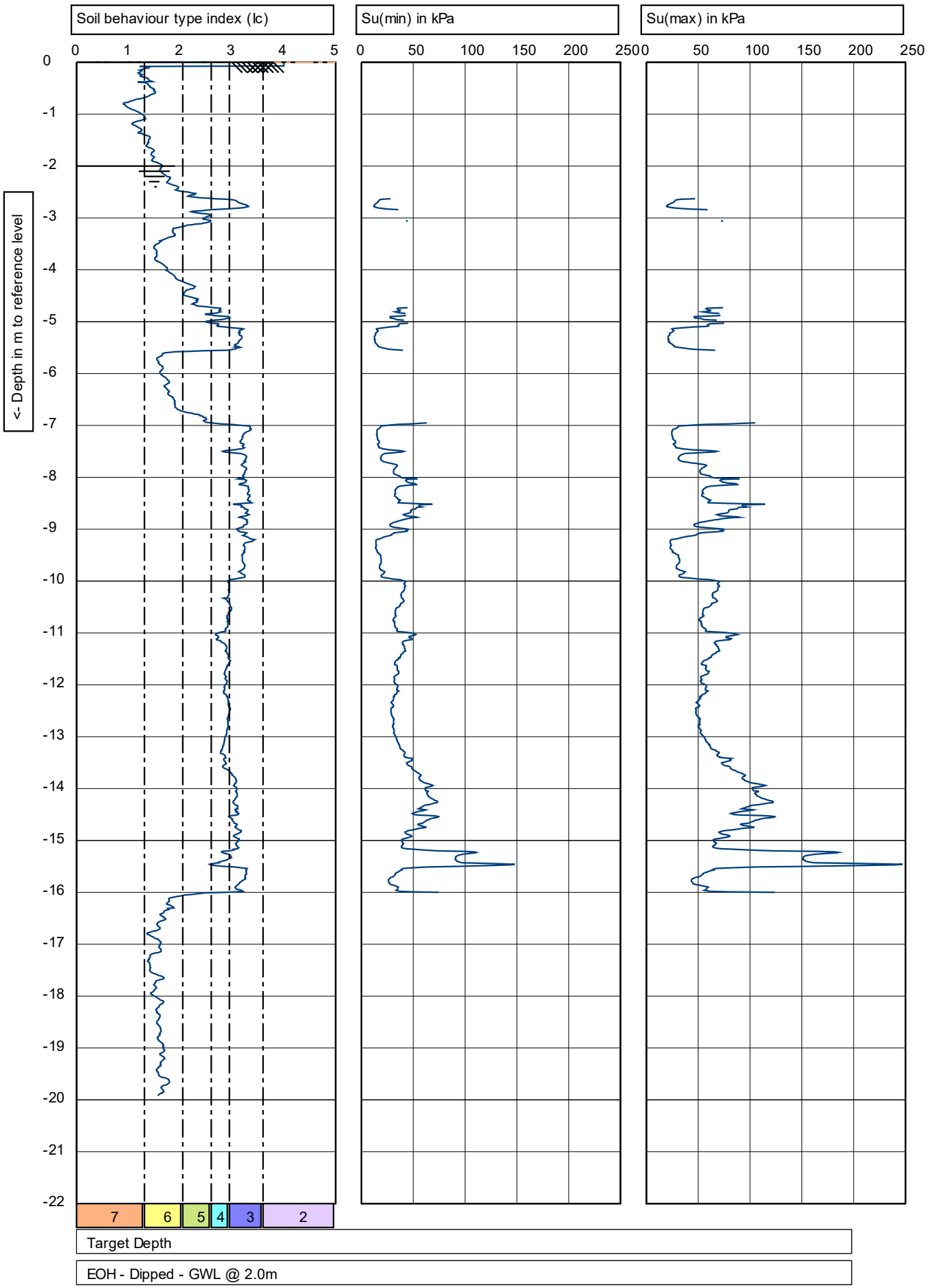

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Position: **1797511, 5823968 NZTM**			CPT no.: **01** **6/6**

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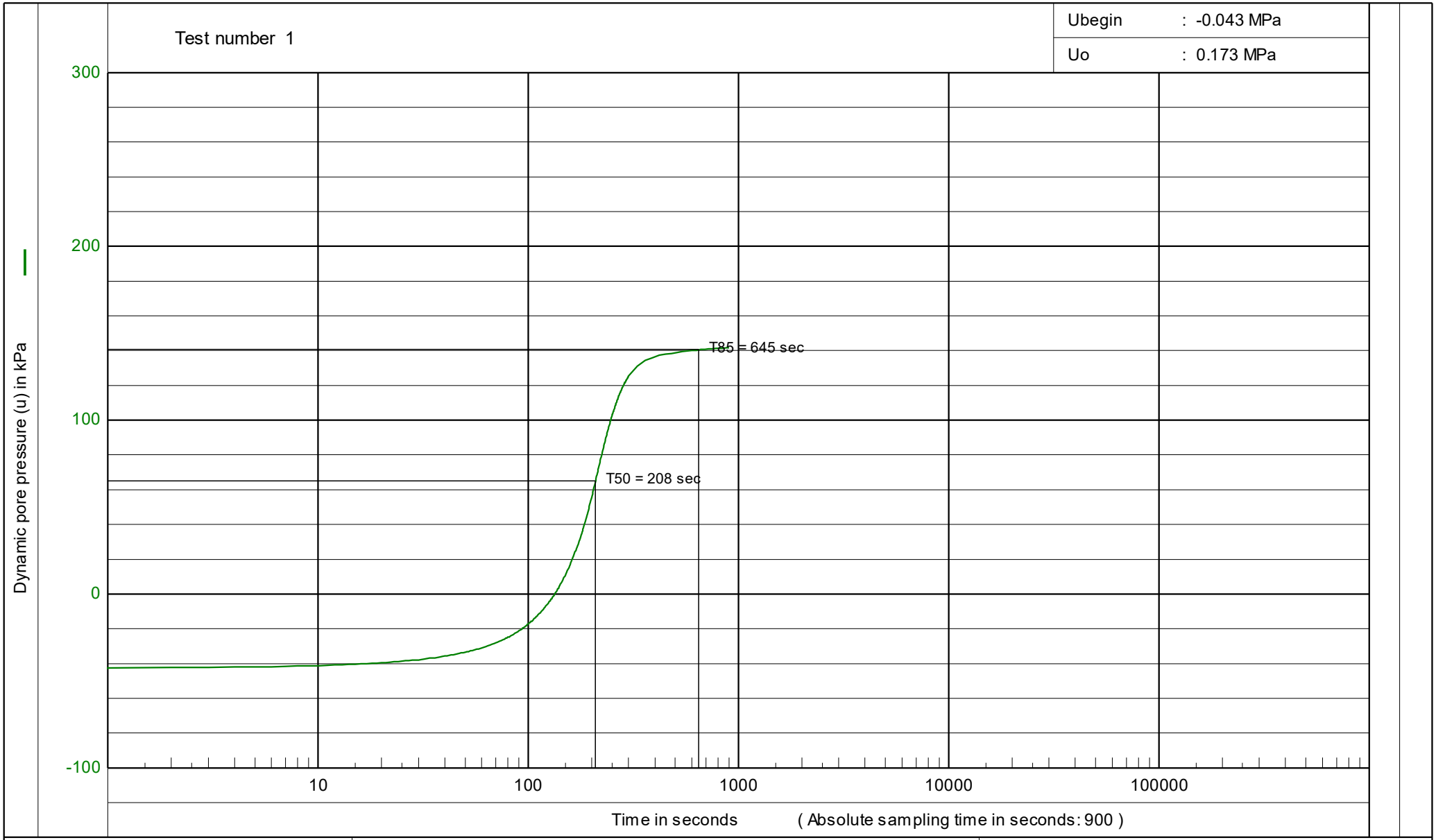

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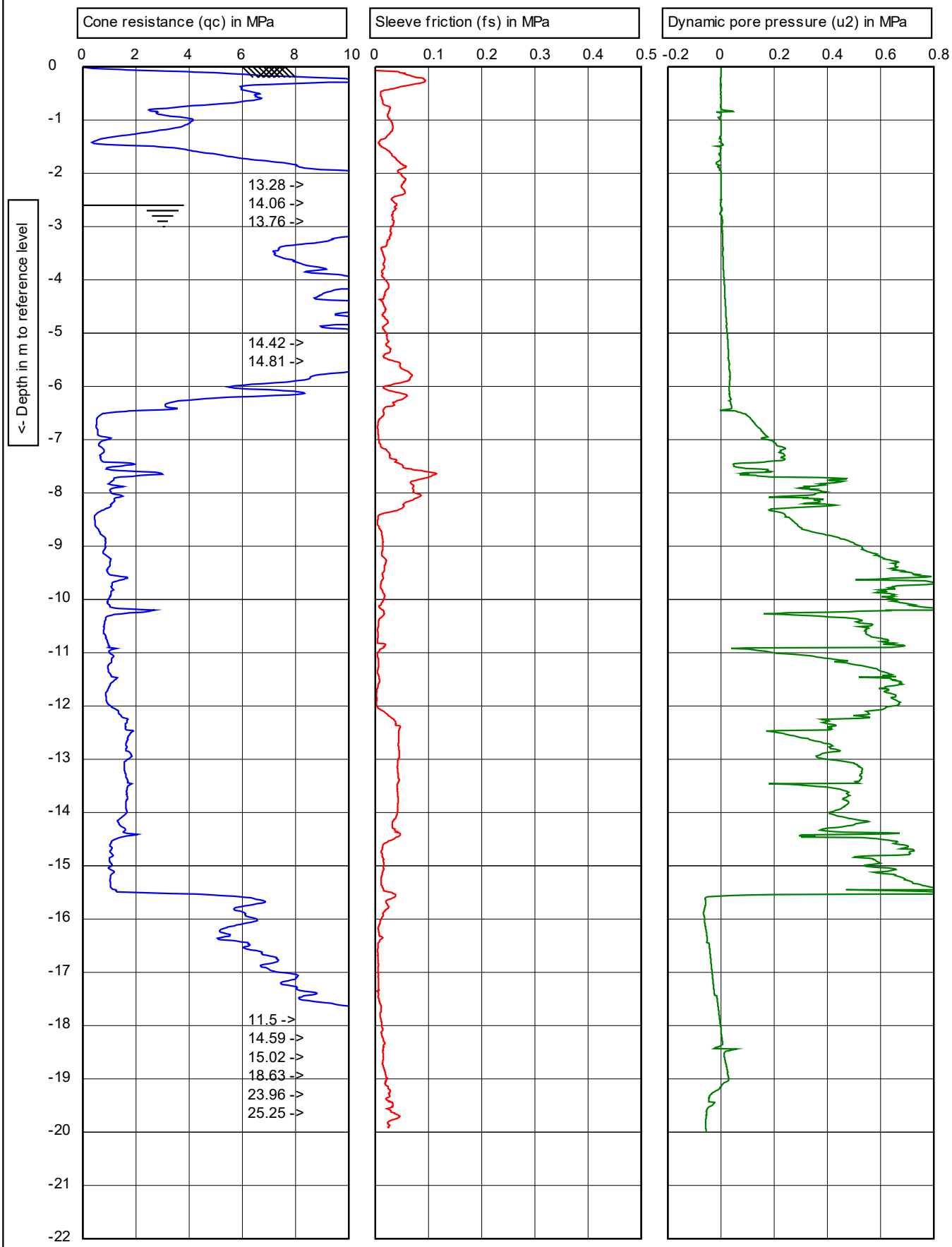

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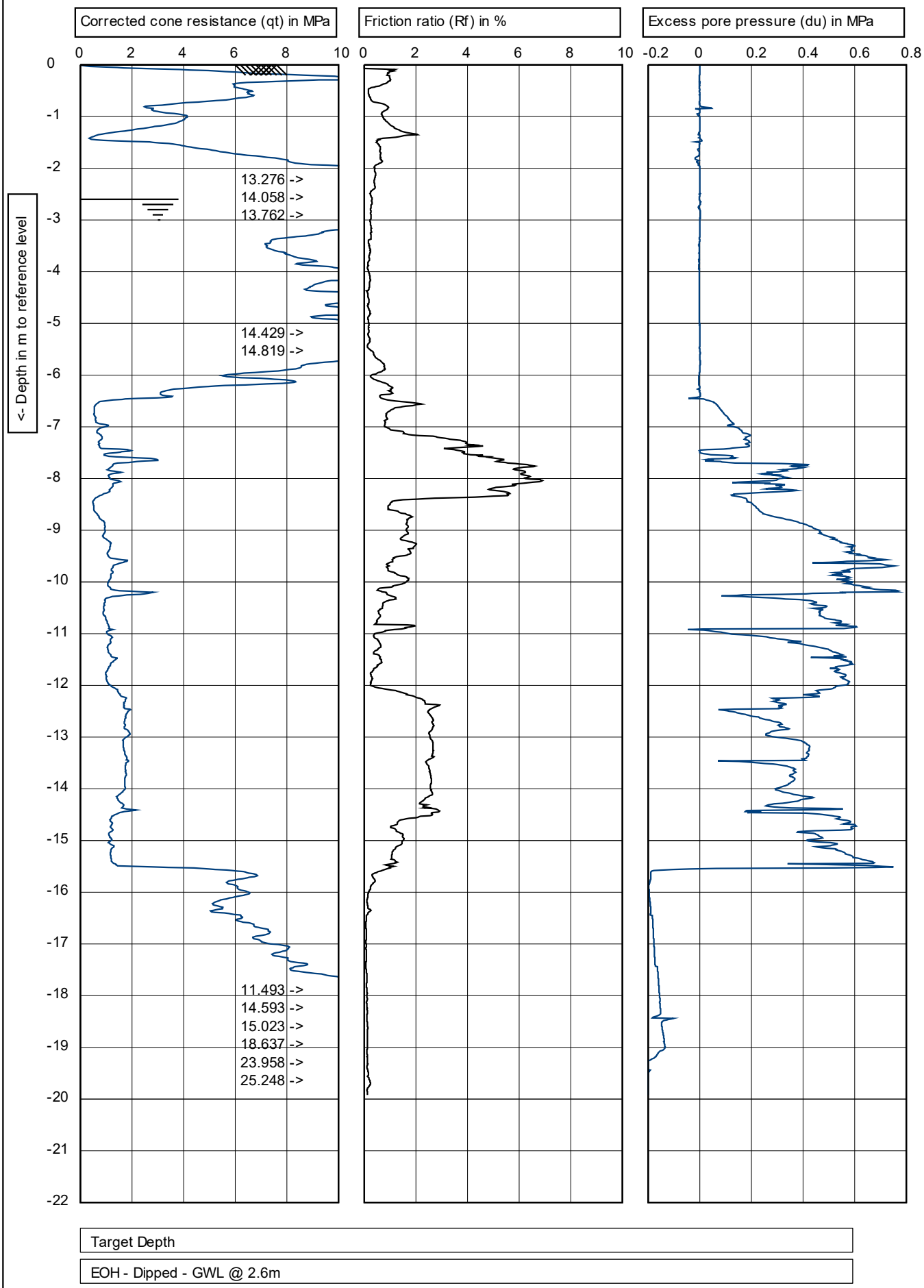

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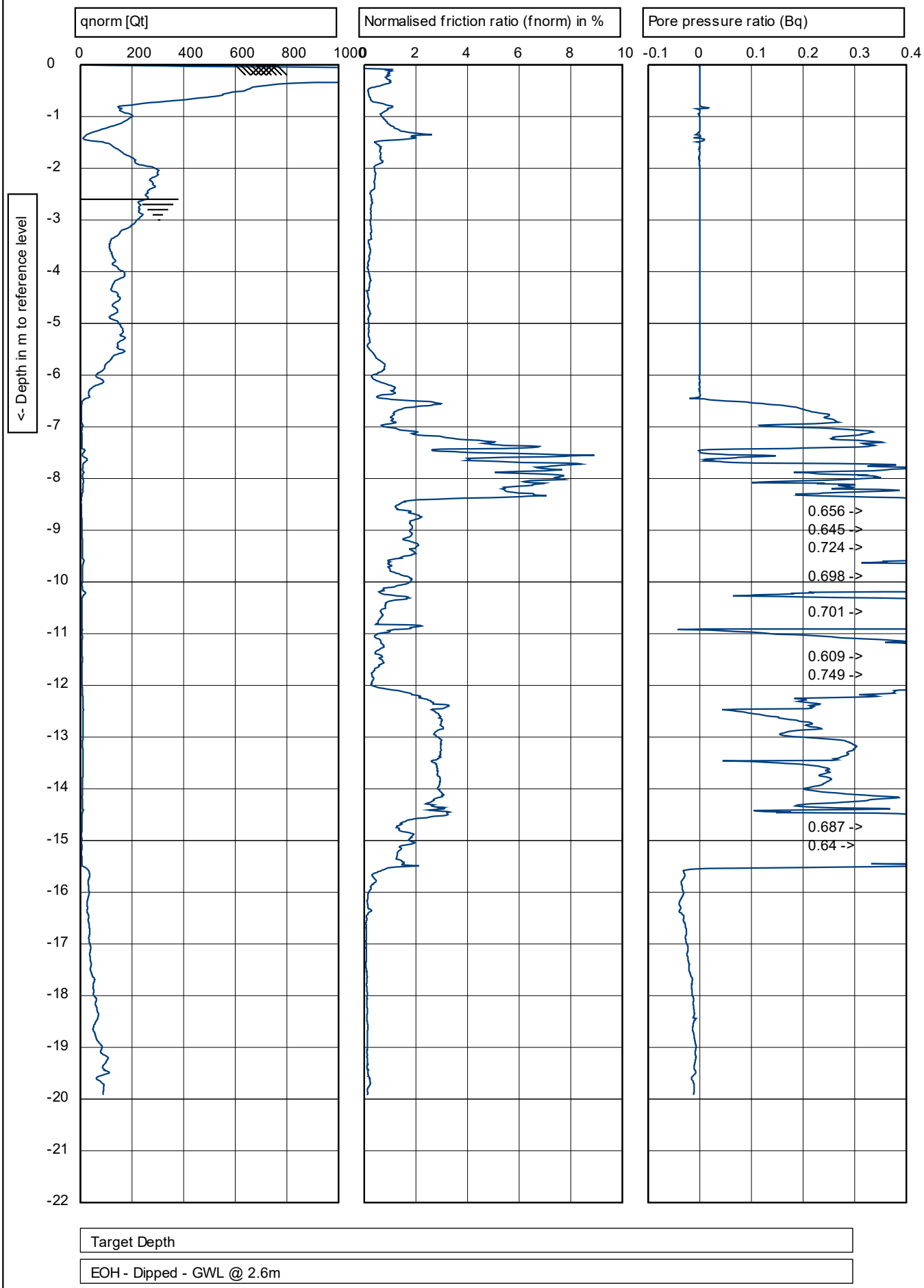

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150 cm²
10 cm²

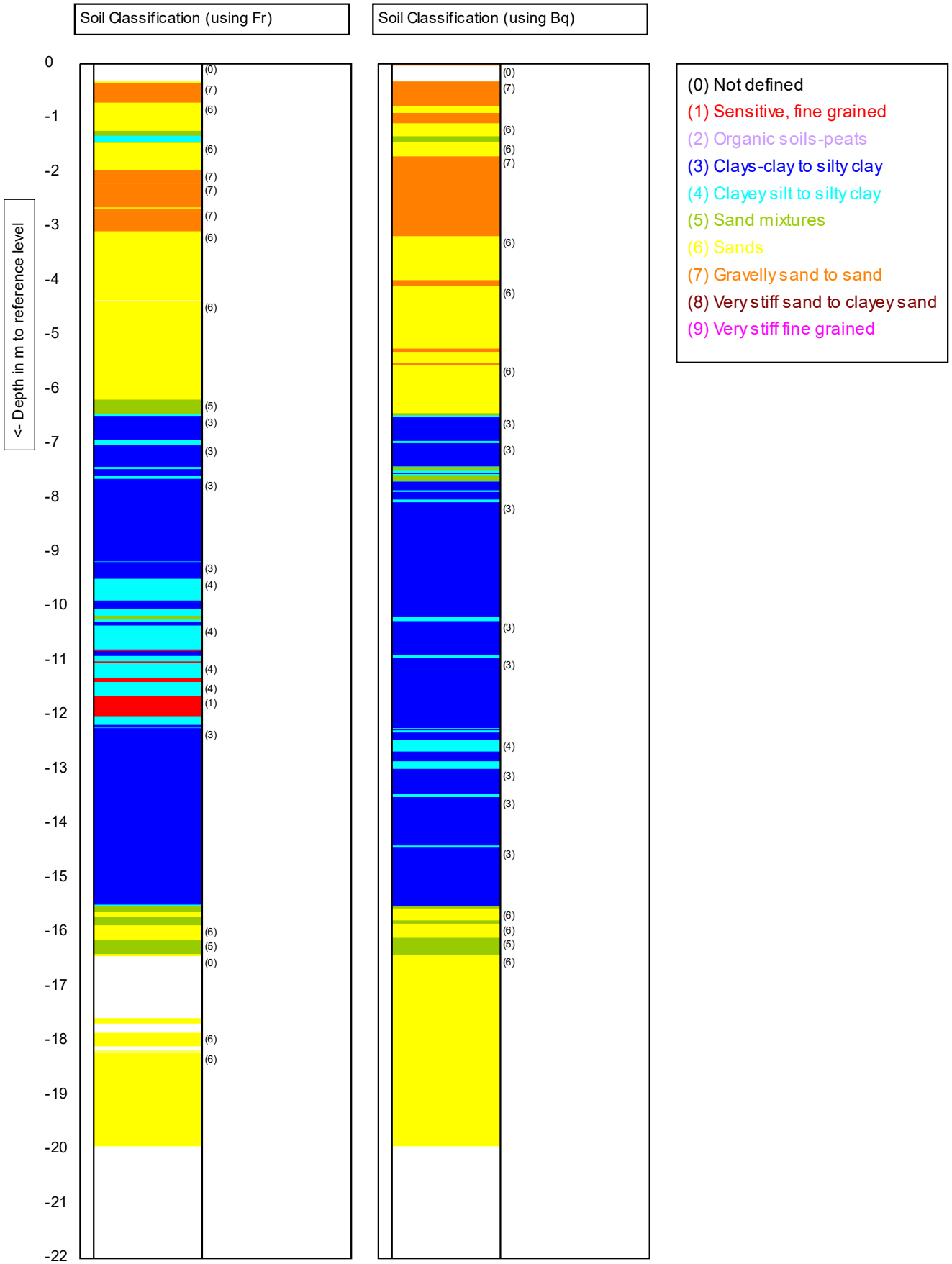
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.60 m**

Project: **40B Reynolds Rd**
Location: **Hamilton (19-0959)**
Position: **1797479, 5823983 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**24/02/2020**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68000.00_HA5601**
CPT no.:	**02** **3/6**

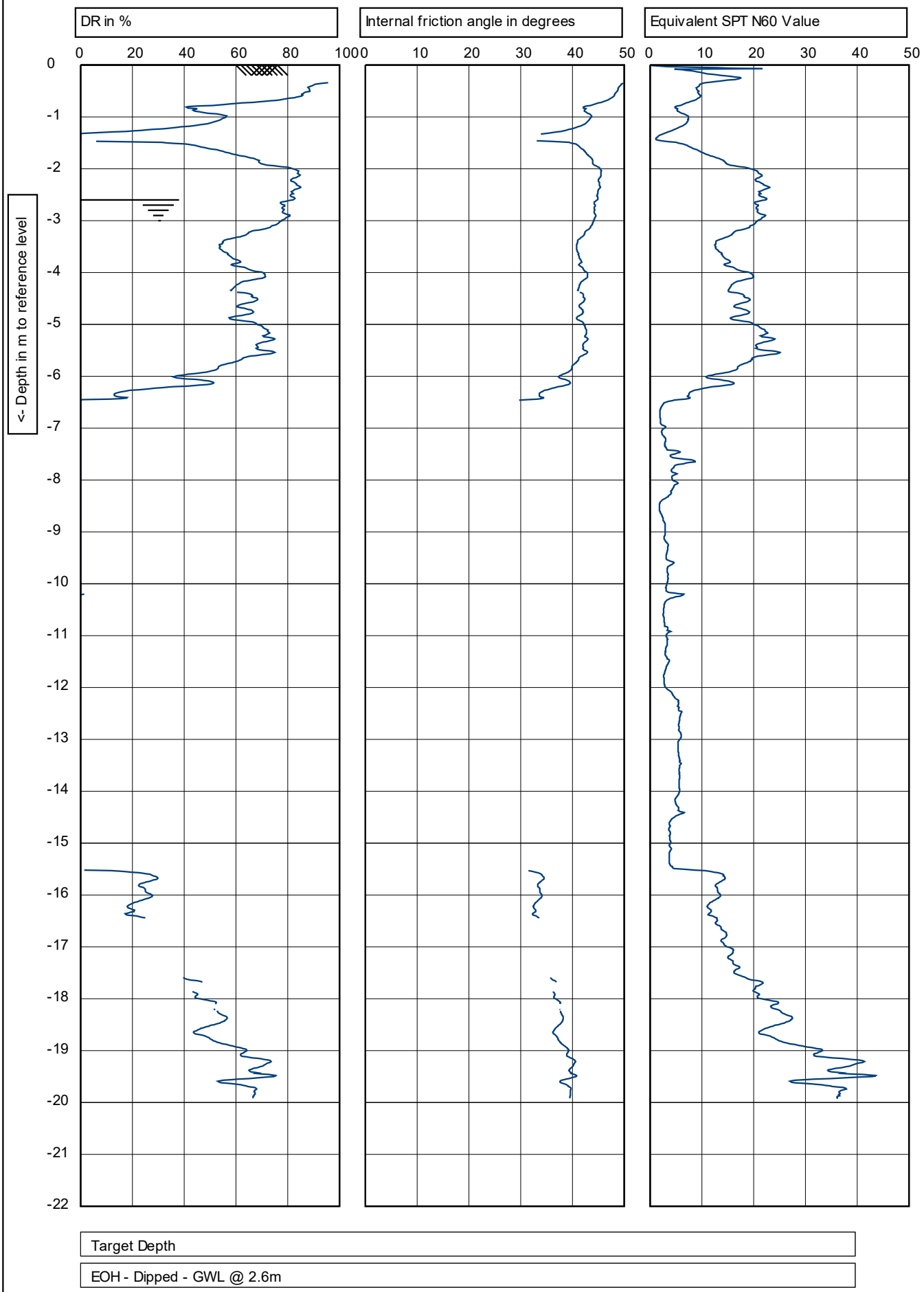
1.47



Graphs on this page are not IANZ accredited

1.47

Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill:	**0.00 m Predrilled**
G.L.: **0.00 m MSL**	W.L.: **-2.60 m**	Date:	**24/02/2020**
Project: **40B Reynolds Rd**		Cone no.:	**C10CFIIP.C15211**
Location: **Hamilton (19-0959)**		Project no.:	**2-68000.00_HA5601**
Position: **1797479, 5823983 NZTM**		CPT no.:	**02** **4/6**



Target Depth

EOH - Dipped - GWL @ 2.6m

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-2.60 m**

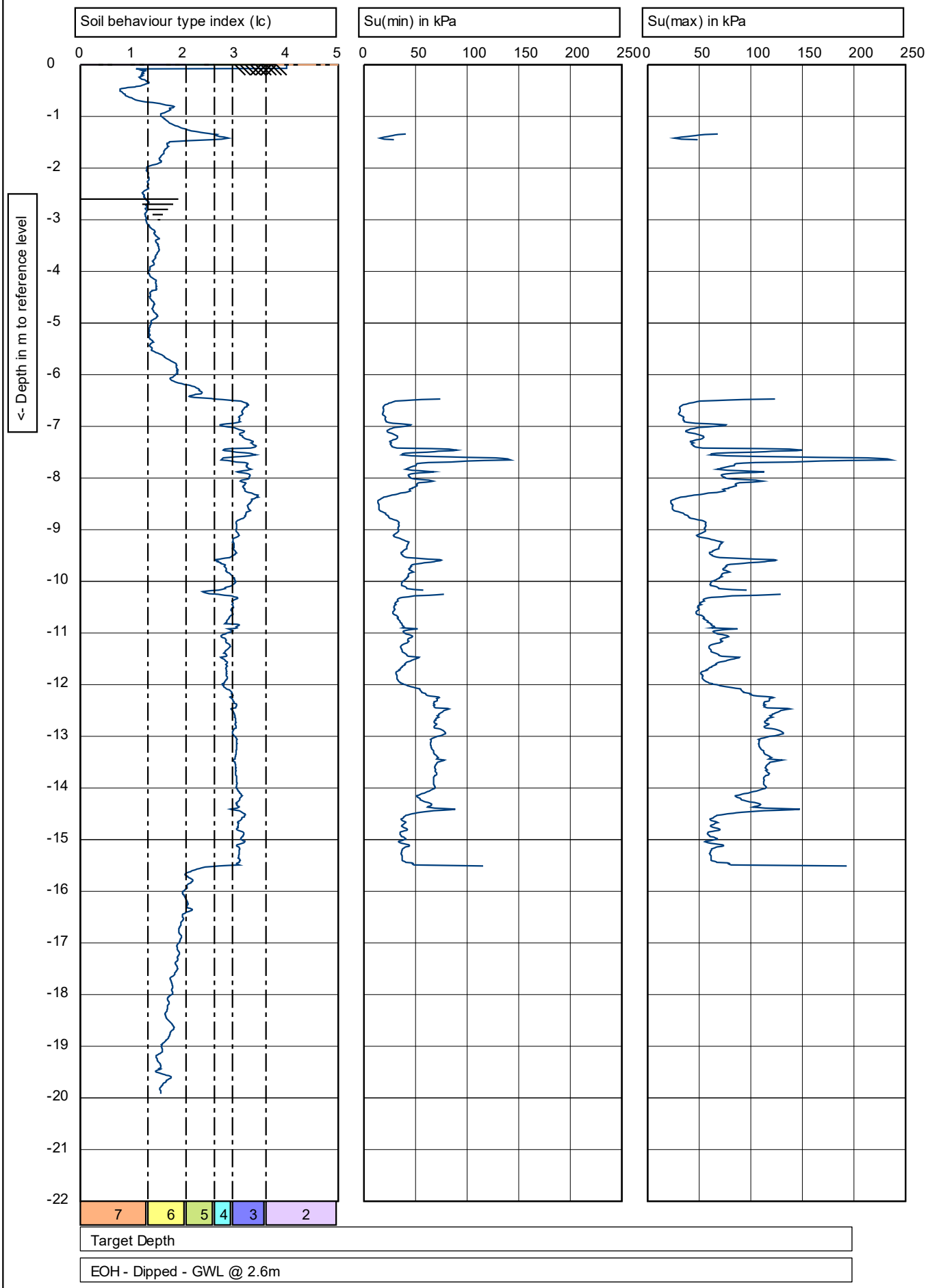
Project: **40B Reynolds Rd**

Location: **Hamilton (19-0959)**

Position: **1797479, 5823983 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**24/02/2020**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68000.00_HA5601**
CPT no.:	**02** **5/6**

1.47



Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.60 m**

Project: **40B Reynolds Rd**

Location: **Hamilton (19-0959)**

Position: **1797479, 5823983 NZTM**

Predrill: **0.00 m Predrilled**

Date: **24/02/2020**

Cone no.: **C10CFIIP.C15211**

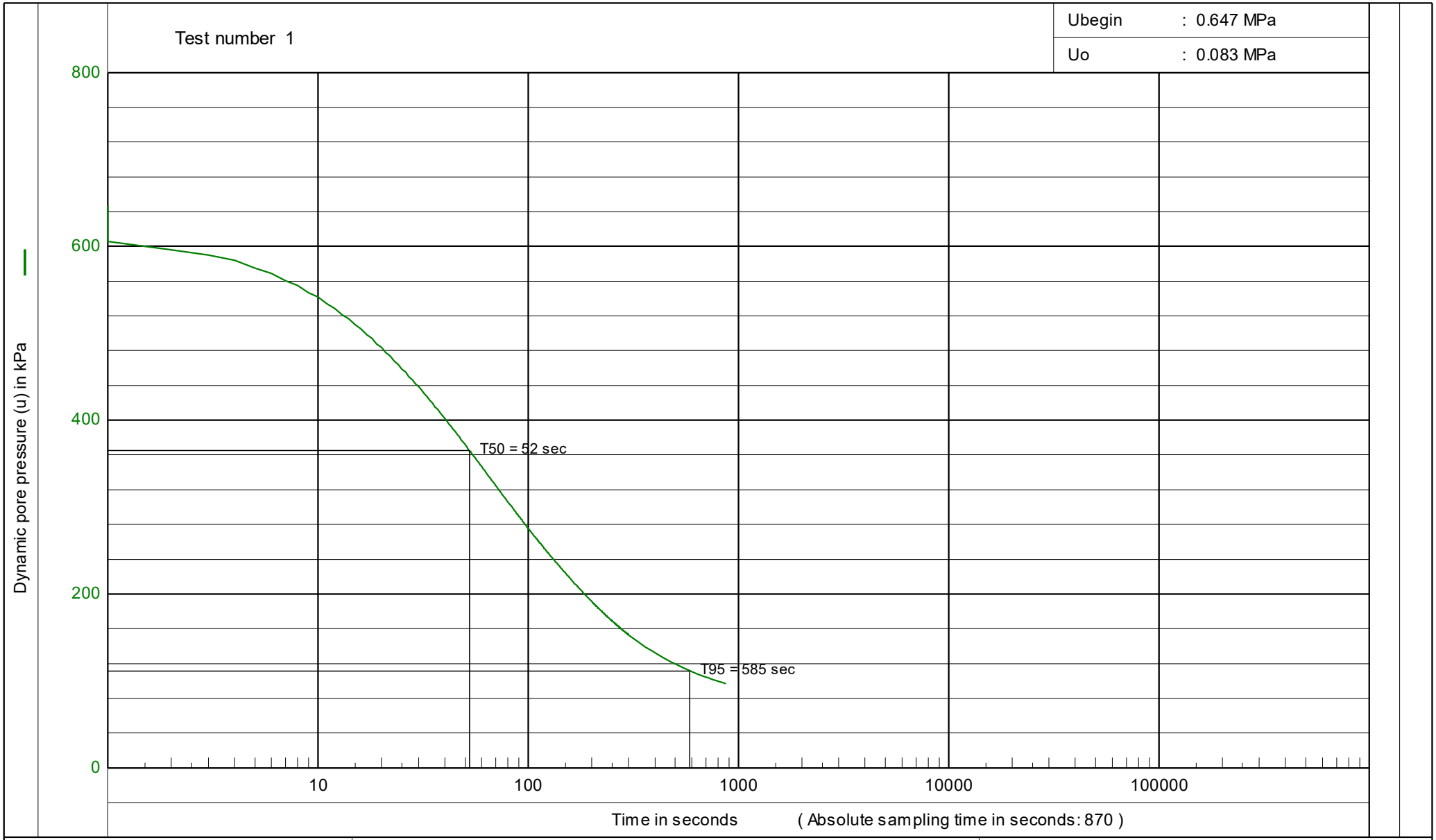
Project no.: **2-68000.00_HA5601**

CPT no.: **02** **6/6**

1.47

Test number 1

Ubegin	:	0.647 MPa
Uo	:	0.083 MPa



wsp

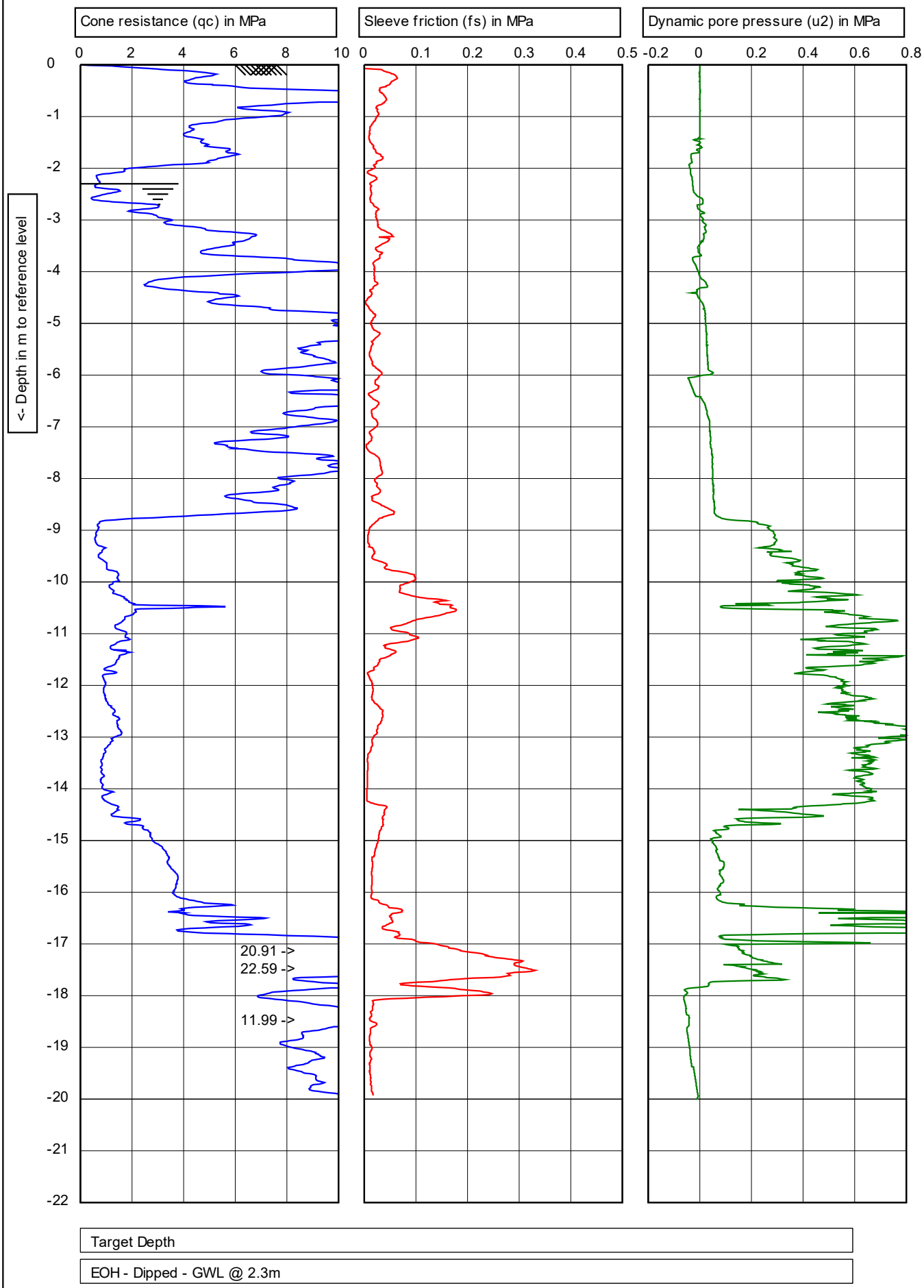
Graphs on this page are not IANZ accredited

Test according ASTM D5778-12 & ISO 22476-1:2012

Project : 40B Reynolds Rd

Location : Hamilton (19-0959)

Date	:	24/02/2020
Project no.	:	2-68000.00_HA5601
CPT no.	:	02
Test depth	:	10.90 [m] - G.L.
Water level	:	-2.60 [m] - G.L.



Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

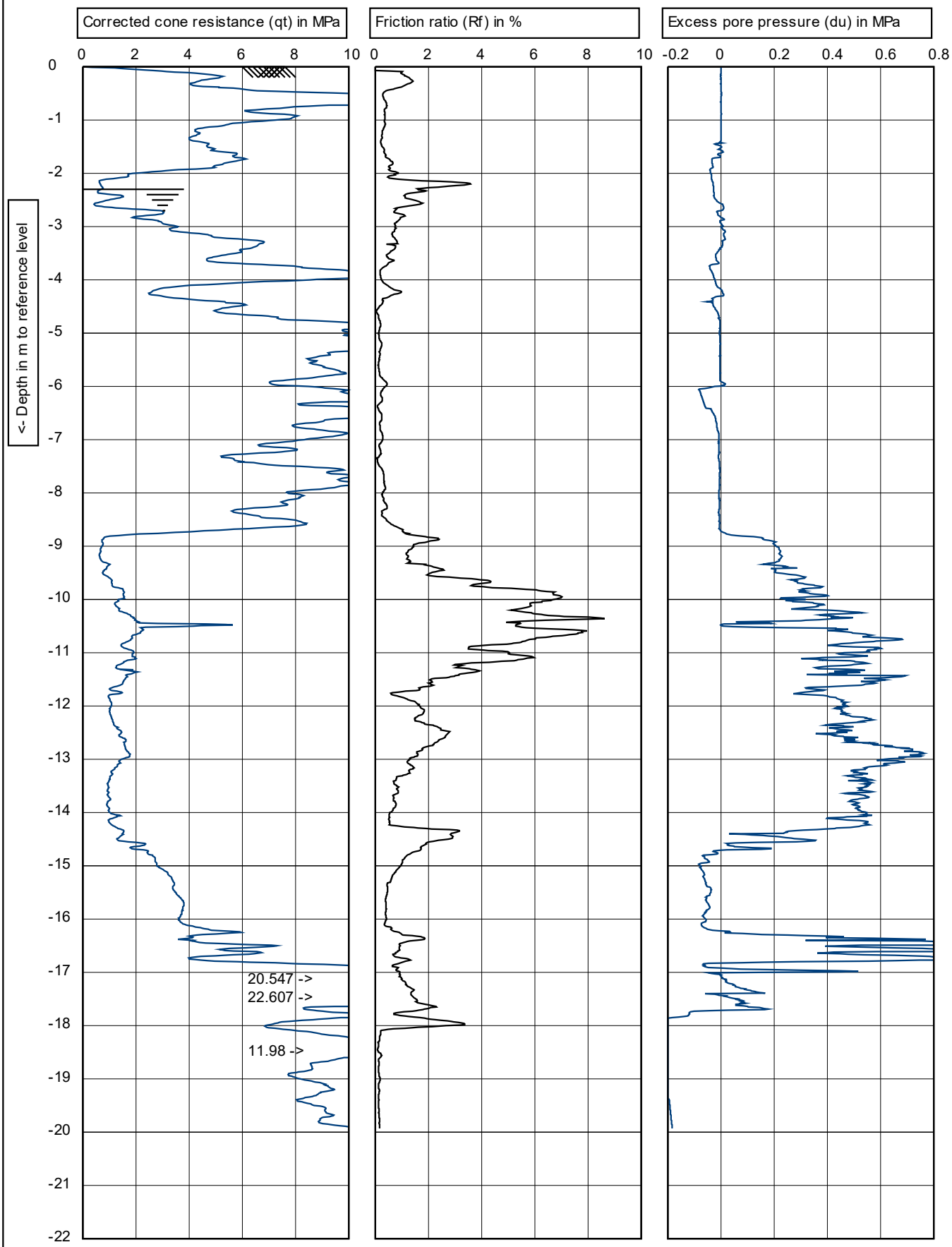
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.30 m**

Project: **40B Reynolds Rd**
Location: **Hamilton (19-0959)**
Position: **1797435, 5823868 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**24/02/2020**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68000.00_HA5601**
CPT no.:	**03**

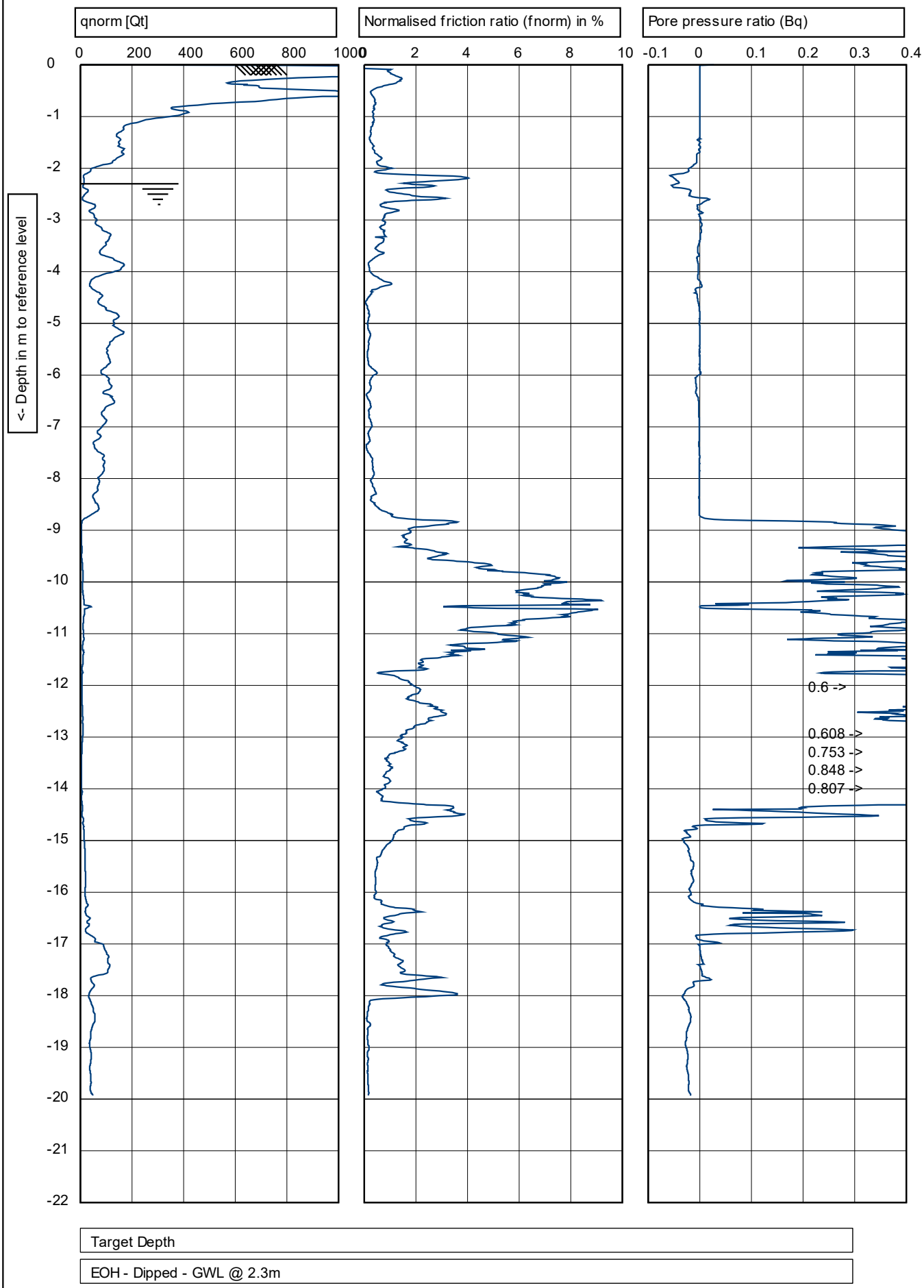
1.47



Graphs on this page are not IANZ accredited

Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill:	**0.00 m Predrilled**
G.L.: **0.00 m MSL**	W.L.: **-2.30 m**	Date:	**24/02/2020**
Project: **40B Reynolds Rd**		Cone no.:	**C10CFIIP.C15211**
Location: **Hamilton (19-0959)**		Project no.:	**2-68000.00_HA5601**
Position: **1797435, 5823868 NZTM**		CPT no.:	**03** **2/6**

1.47



Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

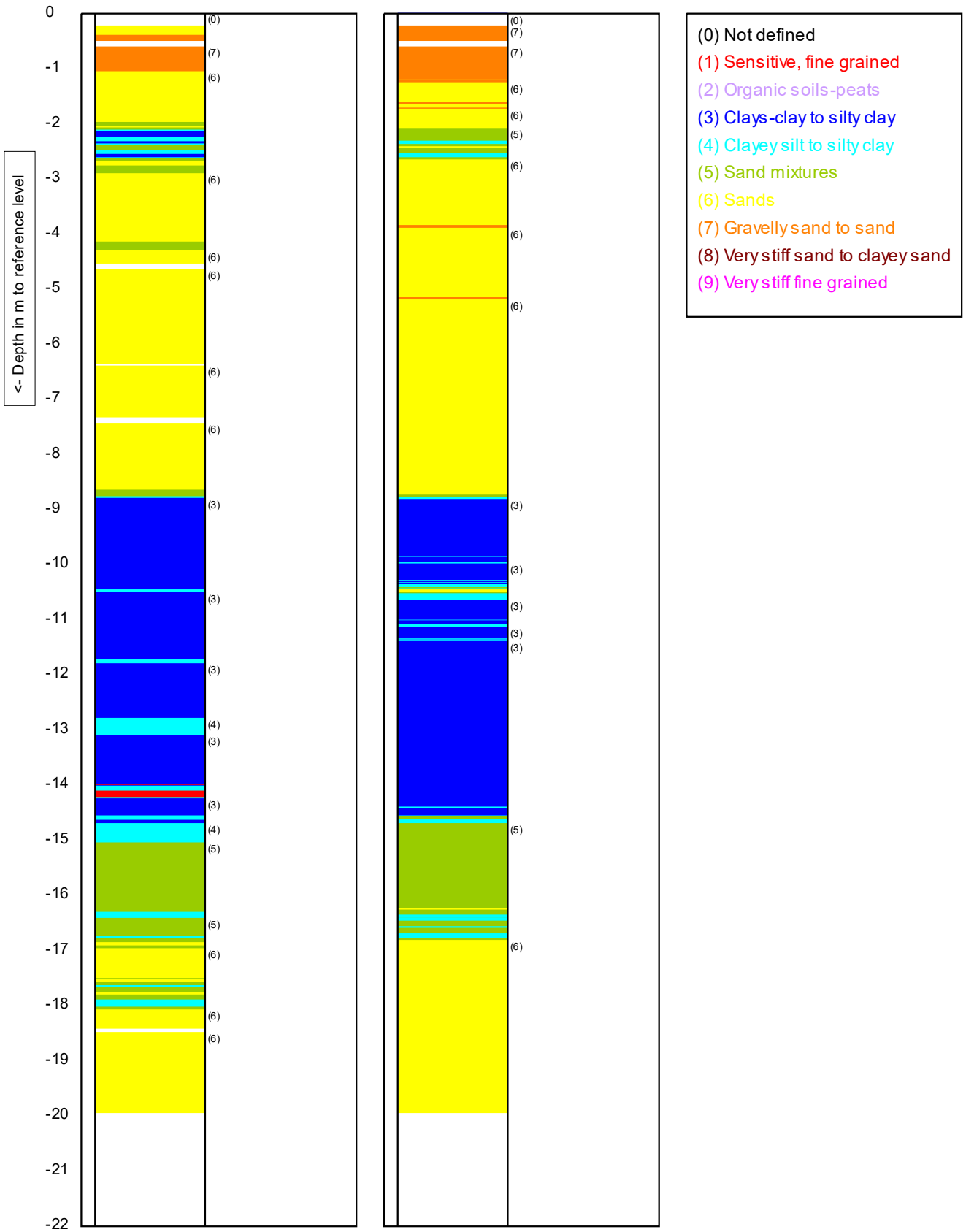
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-2.30 m**

Project: **40B Reynolds Rd**
Location: **Hamilton (19-0959)**
Position: **1797435, 5823868 NZTM**

Predrill: **0.00 m Predrilled**
Date: **24/02/2020**
Cone no.: **C10CFIIP.C15211**
Project no.: **2-68000.00_HA5601**
CPT no.: **03** **3/6**

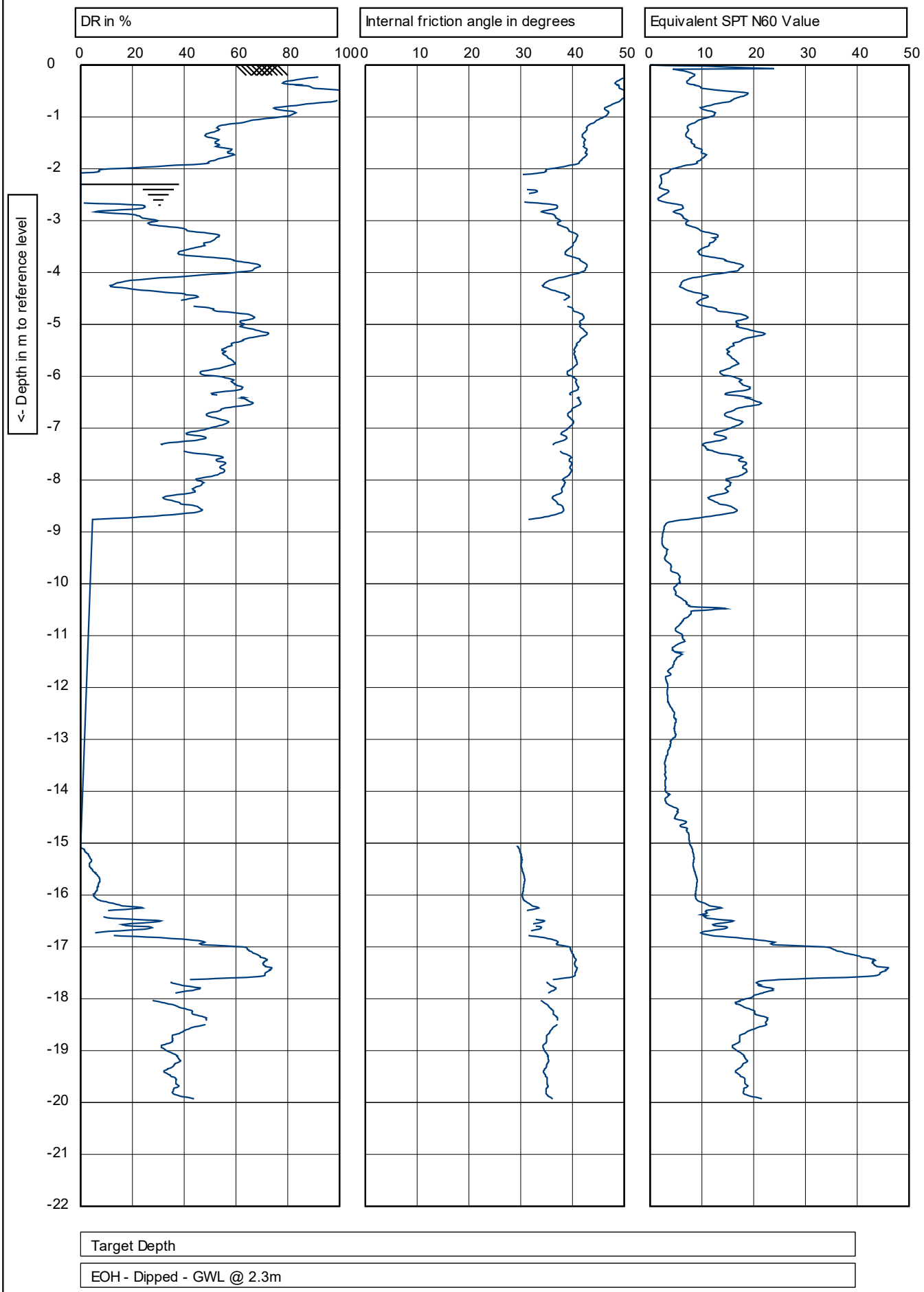
1.47



Graphs on this page are not IANZ accredited

Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill:	**0.00 m Predrilled**
G.L.: **0.00 m MSL**	W.L.: **-2.30 m**	Date:	**24/02/2020**
Project: **40B Reynolds Rd**		Cone no.:	**C10CFIIP.C15211**
Location: **Hamilton (19-0959)**		Project no.:	**2-68000.00_HA5601**
Position: **1797435, 5823868 NZTM**		CPT no.:	**03** **4/6**

1.47



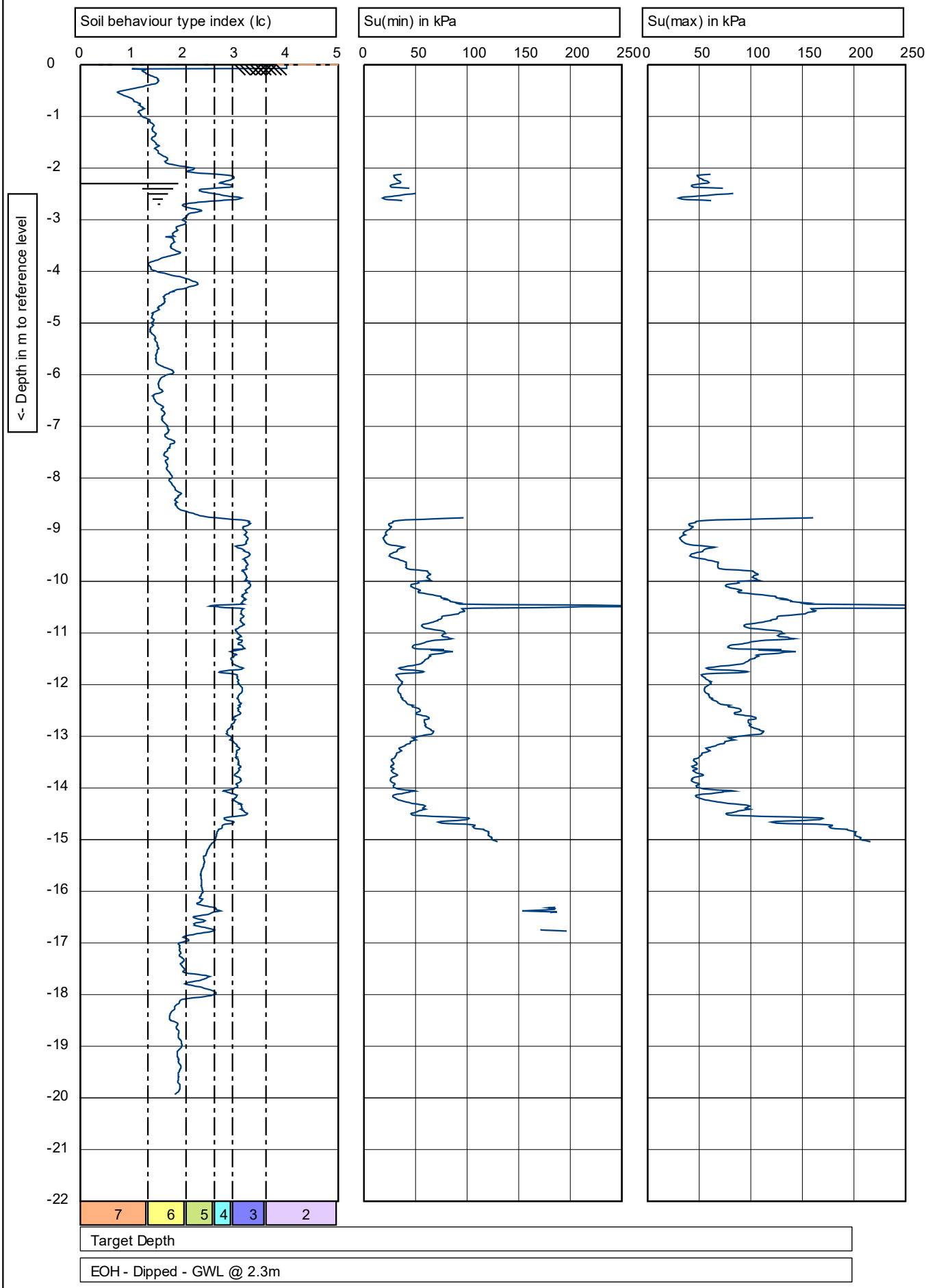
Target Depth

EOH - Dipped - GWL @ 2.3m

Graphs on this page are not IANZ accredited

Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill:	0.00 m Predrilled
G.L.: 0.00 m MSL	W.L.: -2.30 m	Date:	24/02/2020
Project: 40B Reynolds Rd		Cone no.:	C10CFIIP.C15211
Location: Hamilton (19-0959)		Project no.:	2-68000.00_HA5601
Position: 1797435, 5823868 NZTM		CPT no.:	03 5/6

1.47



Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

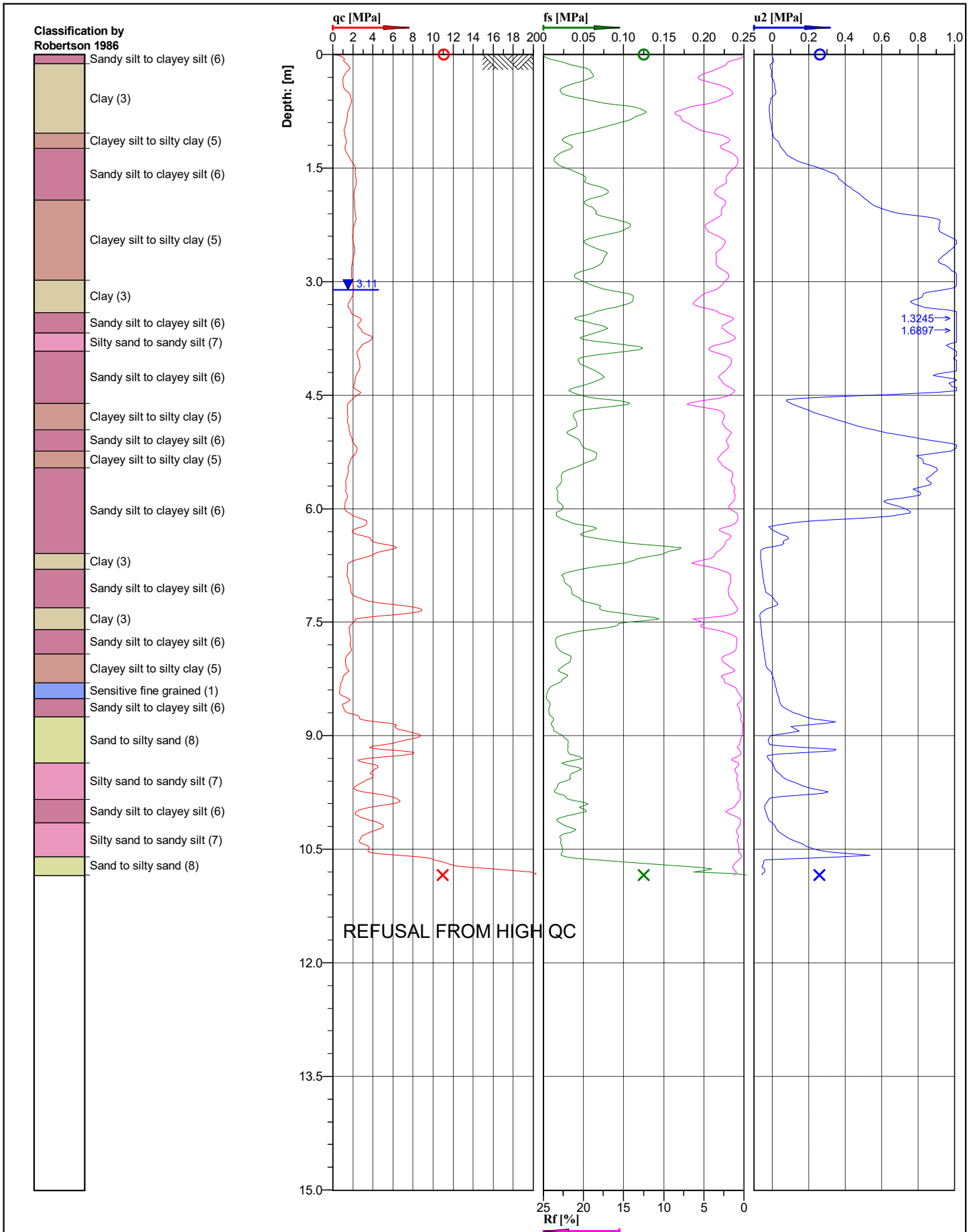
G.L.: **0.00 m MSL** W.L.: **-2.30 m**

Project: **40B Reynolds Rd**
Location: **Hamilton (19-0959)**
Position: **1797435, 5823868 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**24/02/2020**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68000.00_HA5601**
CPT no.:	**03** **6/6**

1.47

NZGD ID: 140595

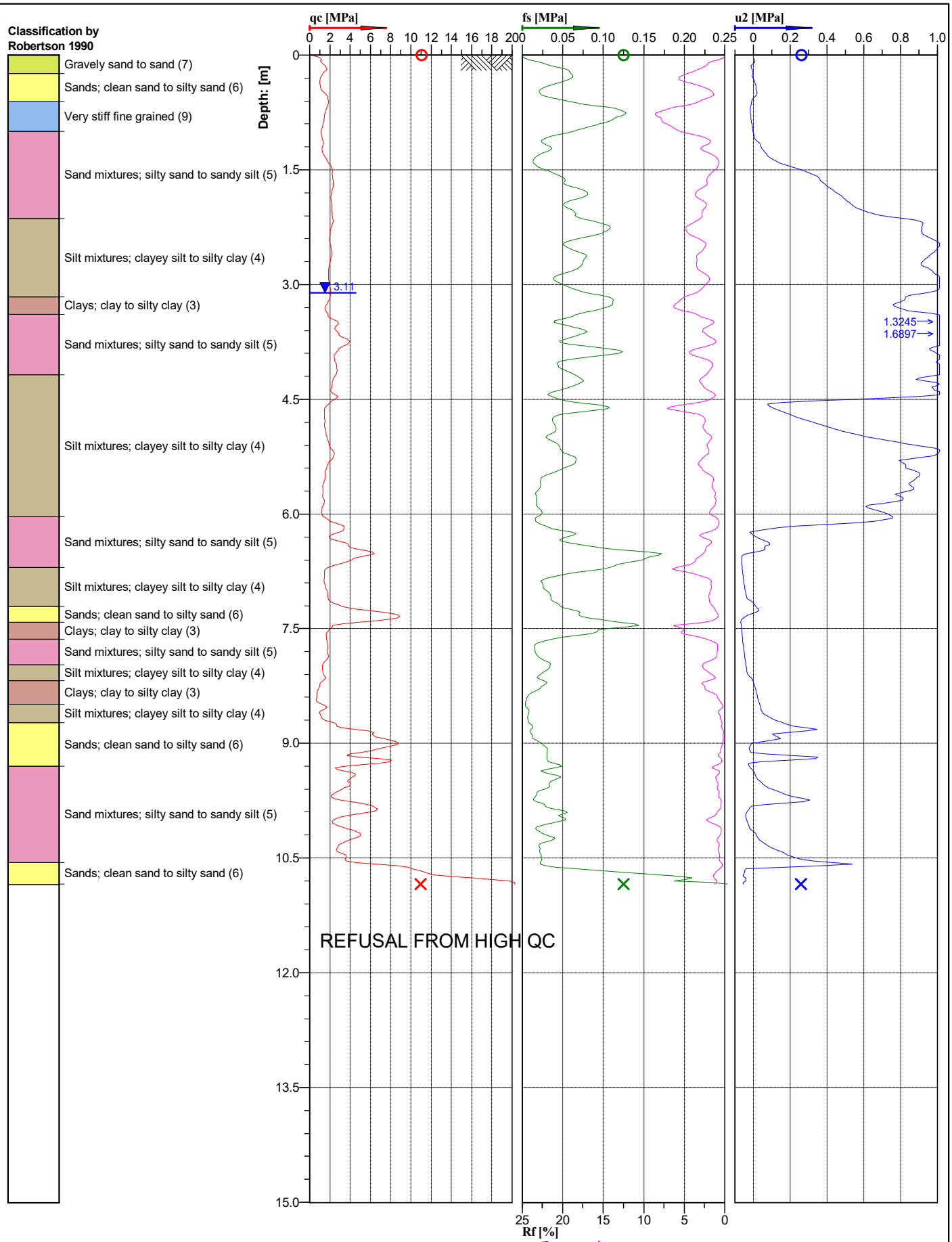


Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 67
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71643, E 175.24098		File: CPT01.cpt	

NZGD ID: 140595

NZGD ID: 140595



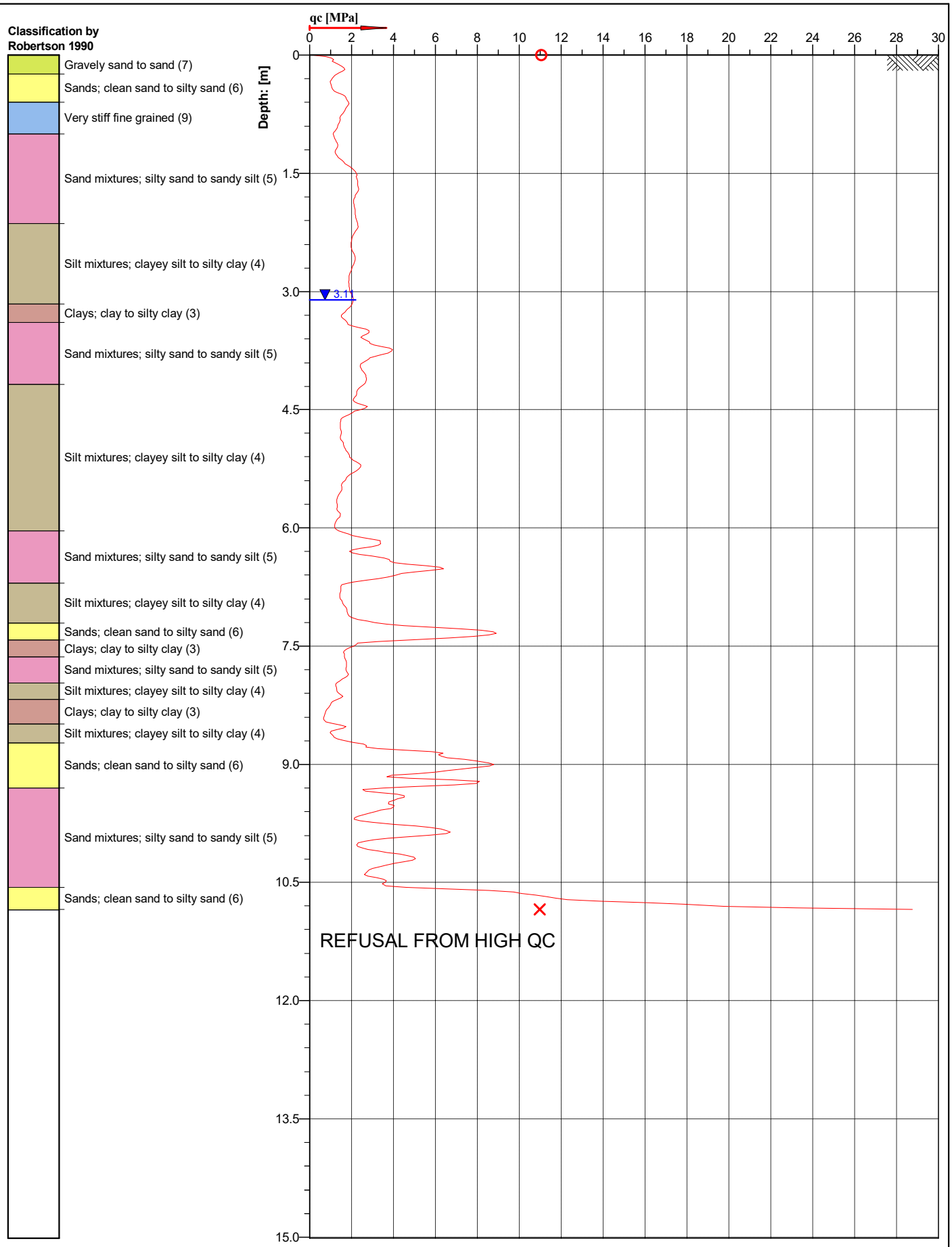
Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 67
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71643, E 175.24098		File: CPT01.cpt	

GEOTECH DRILLING

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

NZGD ID: 140595

NZGD ID: 140595



Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71643, E 175.24098		File: CPT01.cpt	

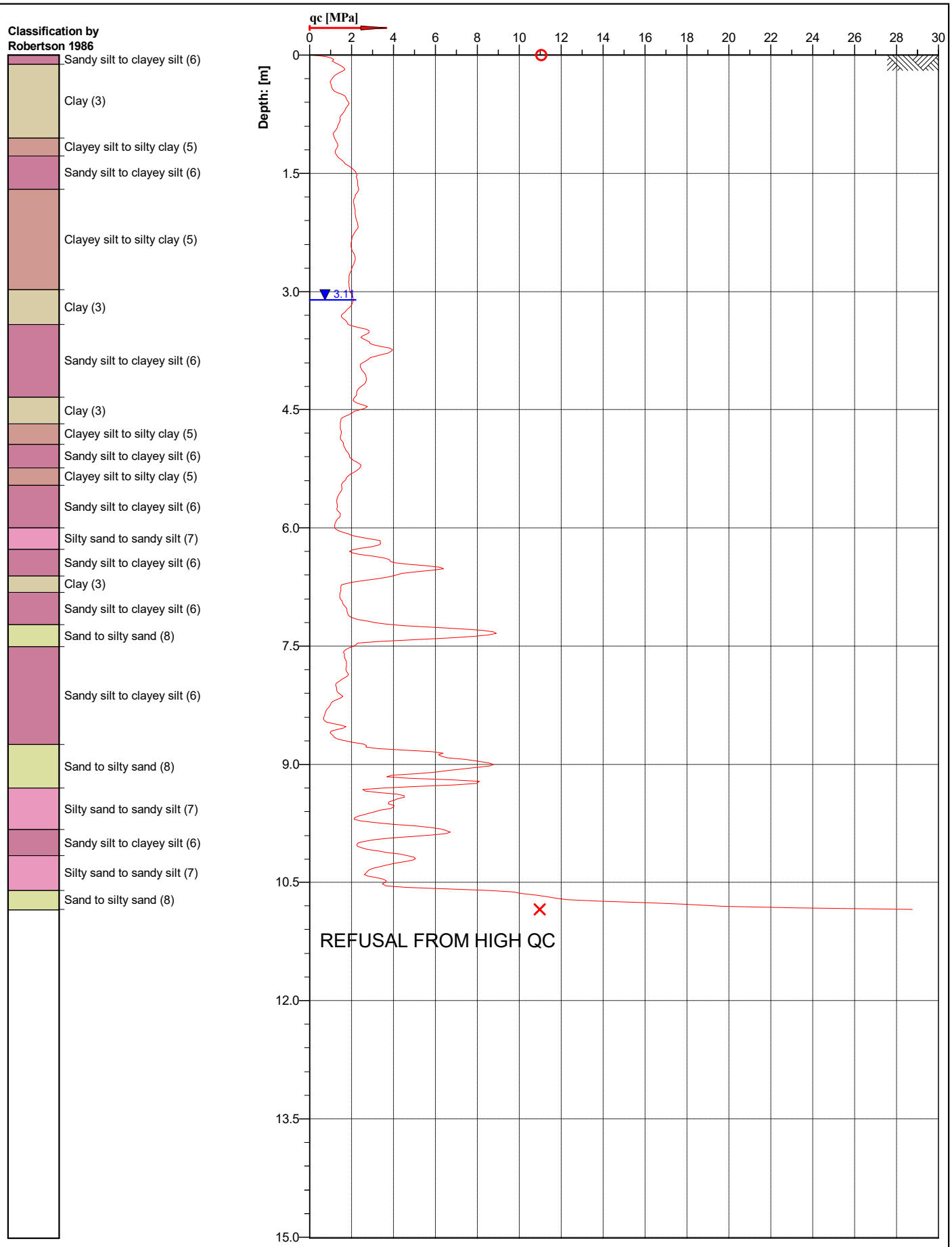
GEOTECH DRILLING

u2

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

NZGD ID: 140595

NZGD ID: 140595



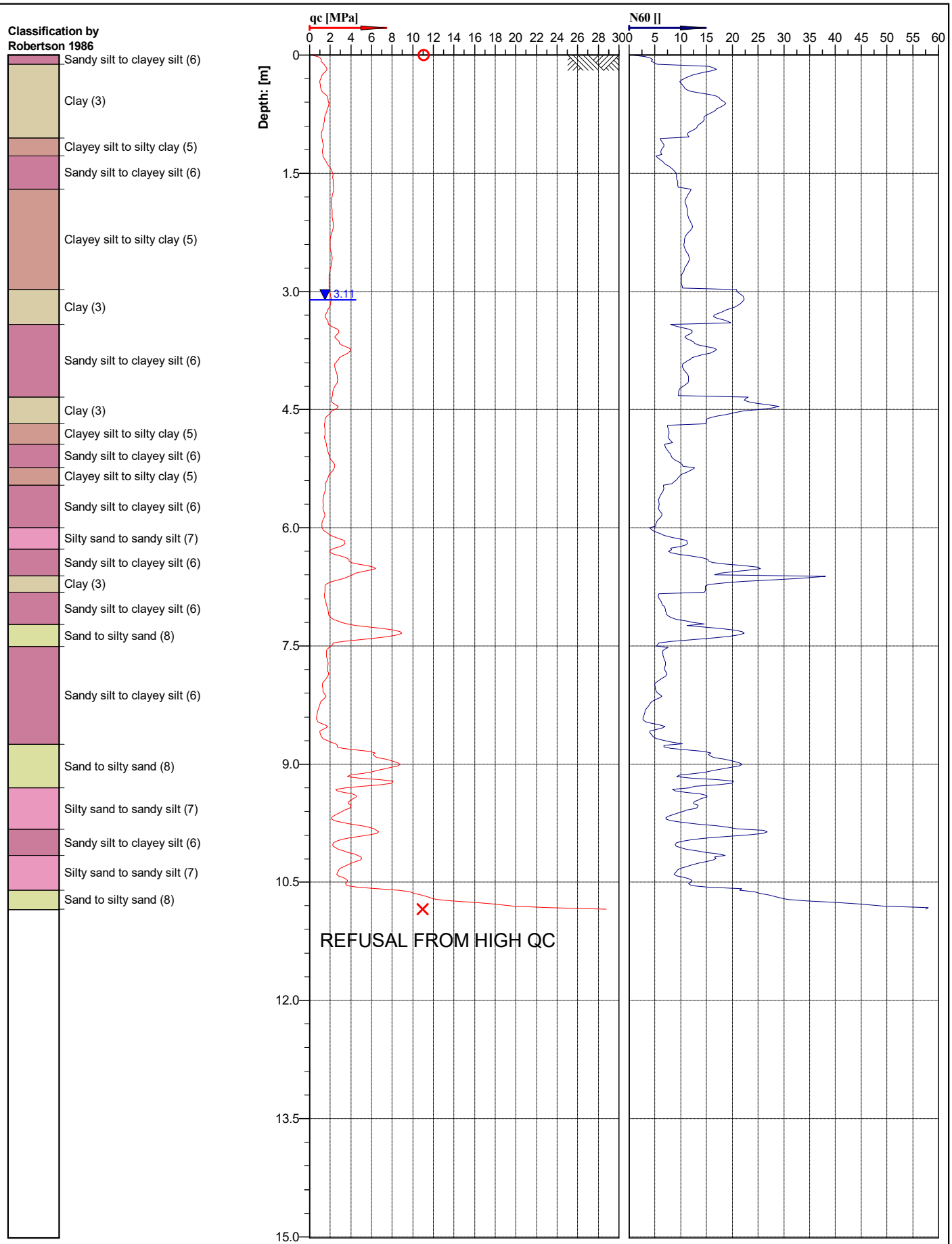
u2

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71643, E 175.24098		File: CPT01.cpt	

NZGD ID: 140595

NZGD ID: 140595

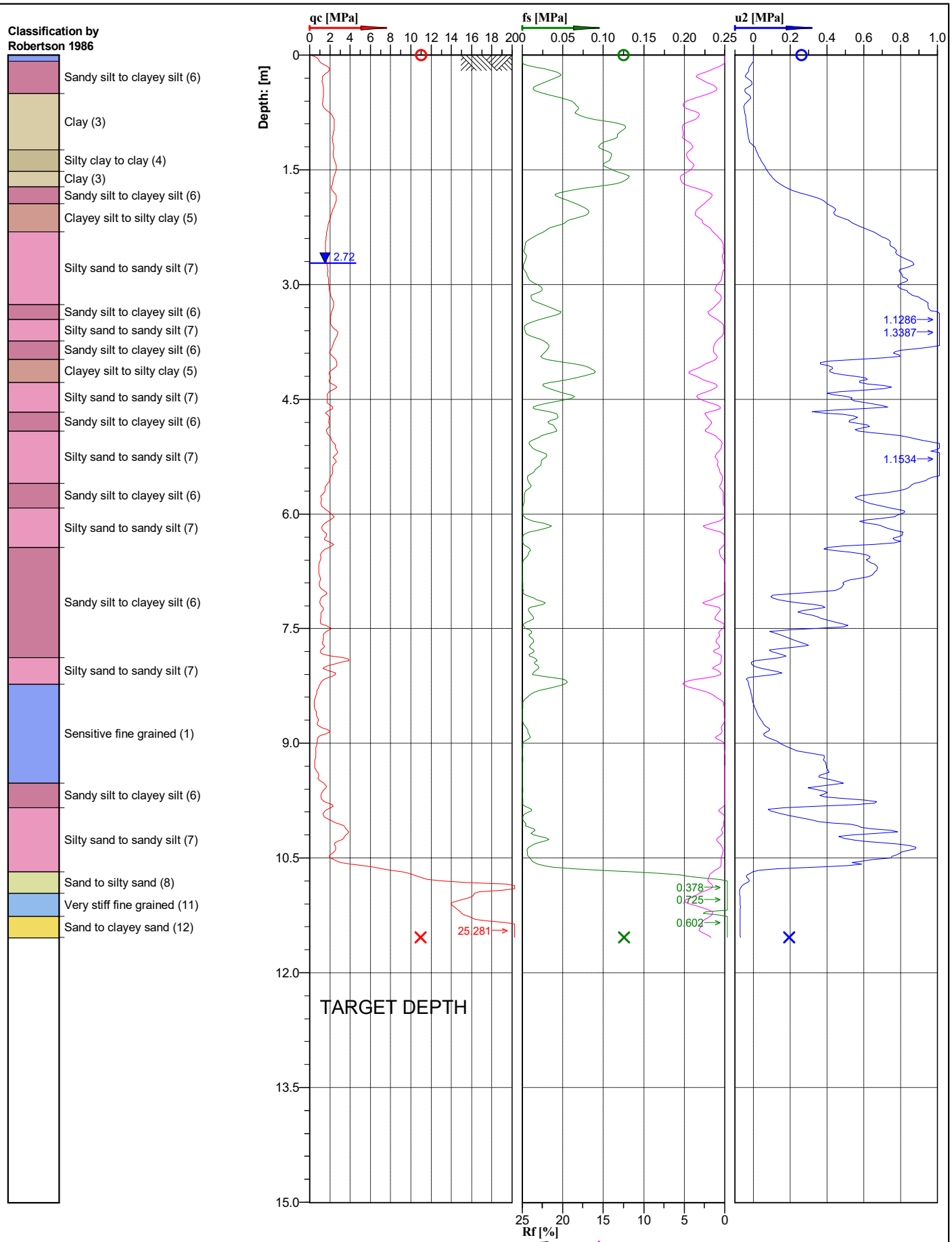


Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71643, E 175.24098		File: CPT01.cpt	

NZGD ID: 140595

NZGD ID: 140596



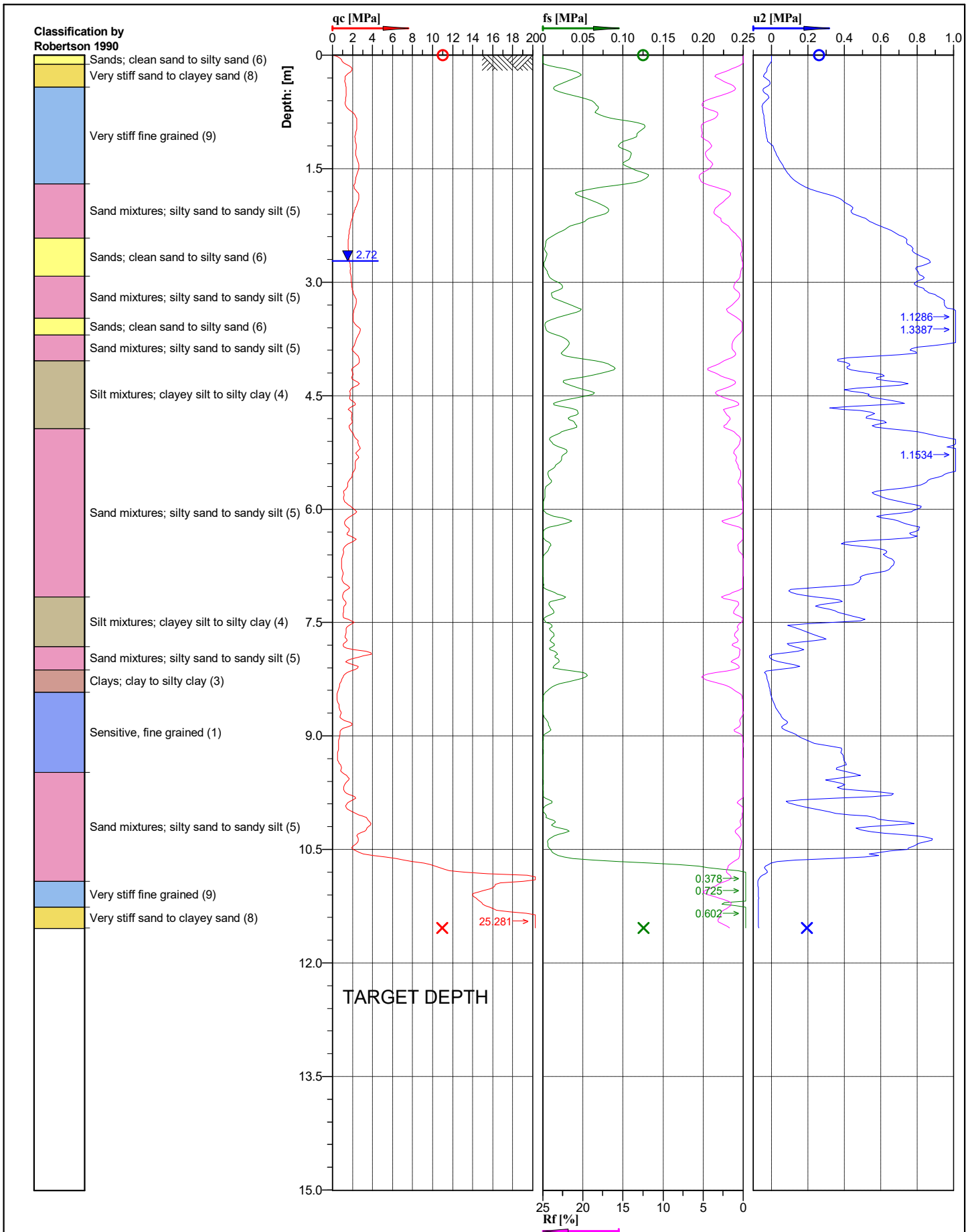
Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 67
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71629, E 175.24124		File: CPT02.cpt	

GEOTECH DRILLING

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

NZGD ID: 140596

NZGD ID: 140596



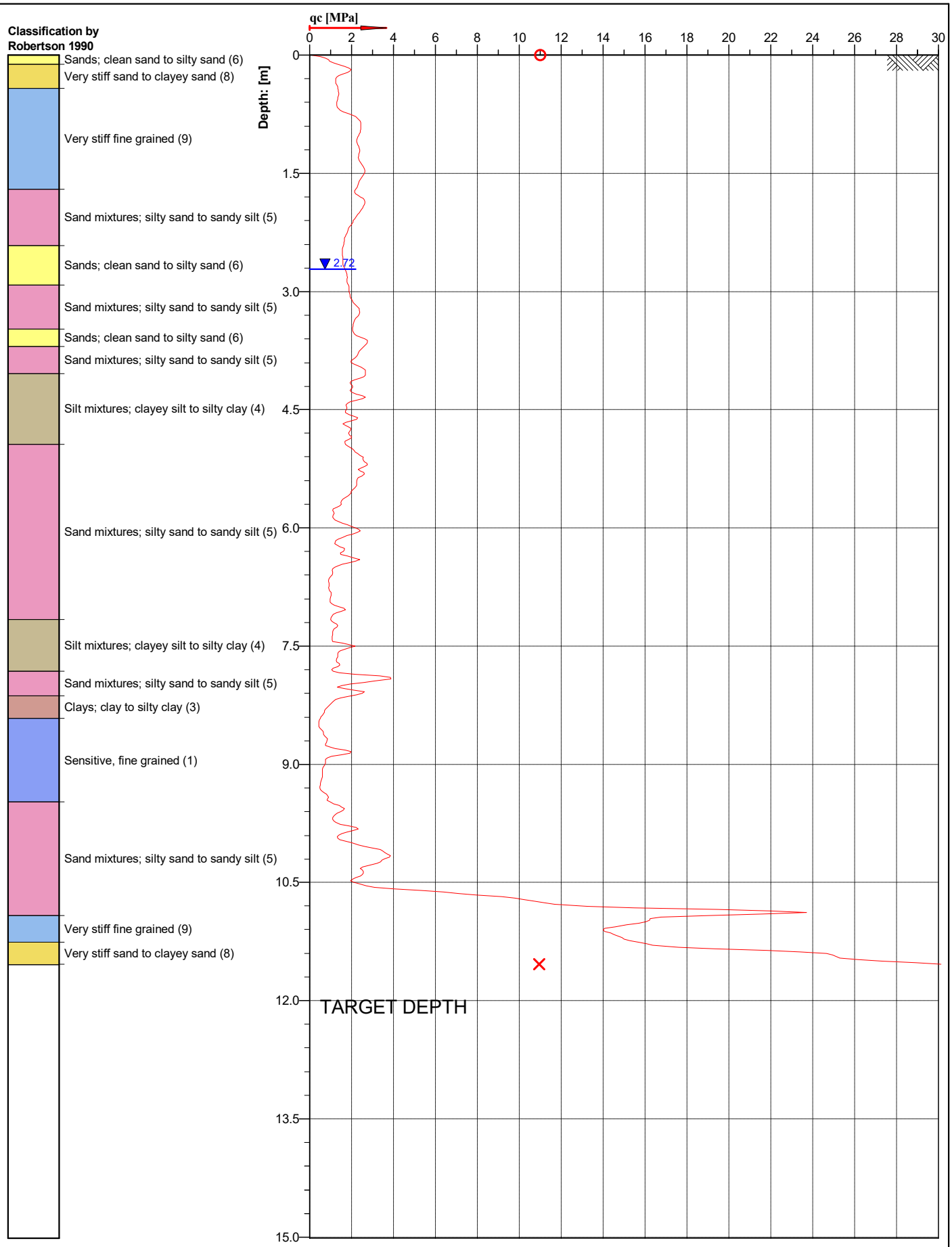
Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 67
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71629, E 175.24124		File: CPT02.cpt	

GEOTECH DRILLING

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

NZGD ID: 140596

NZGD ID: 140596



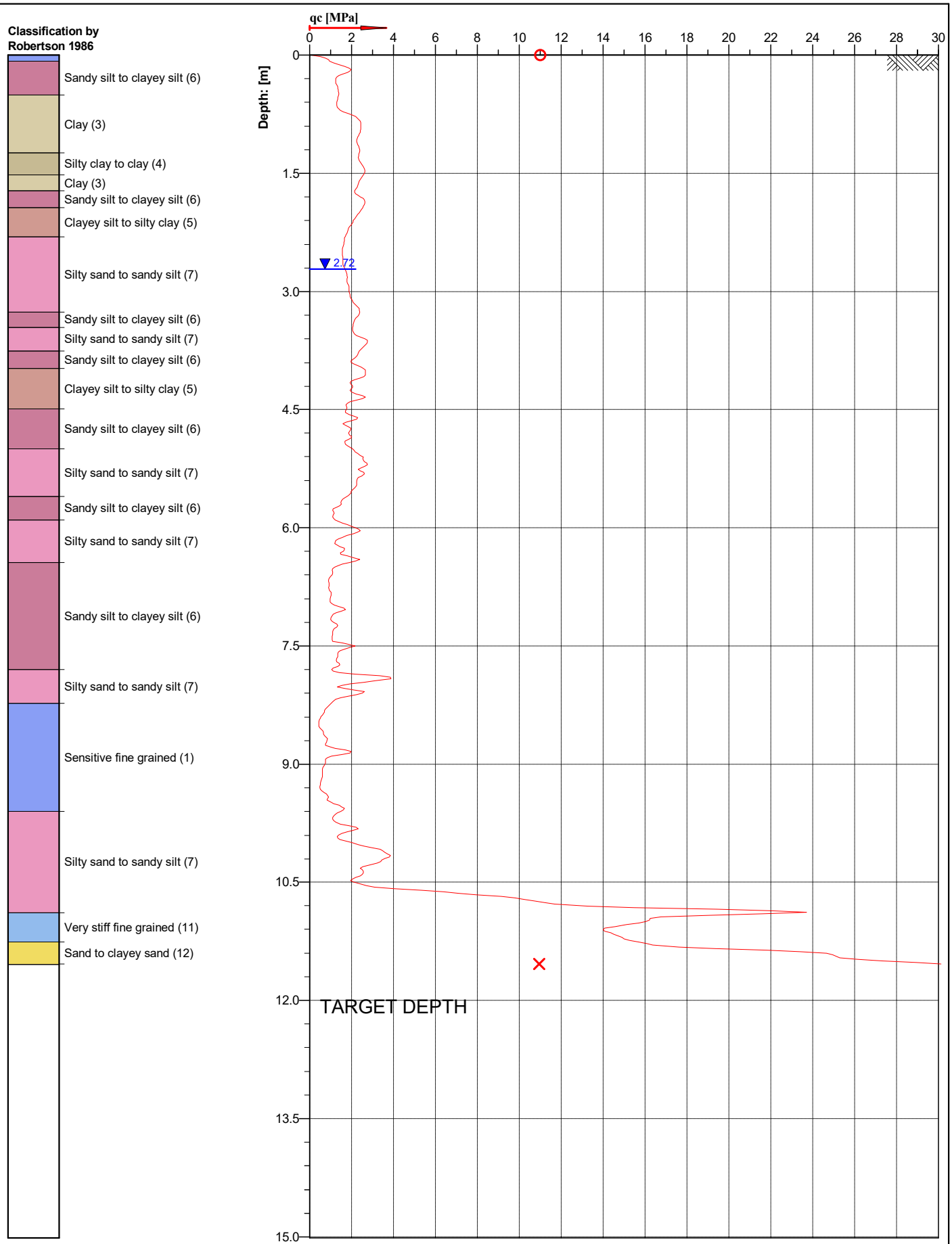
GEOTECH DRILLING

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71629, E 175.24124		File: CPT02.cpt	

NZGD ID: 140596

NZGD ID: 140596

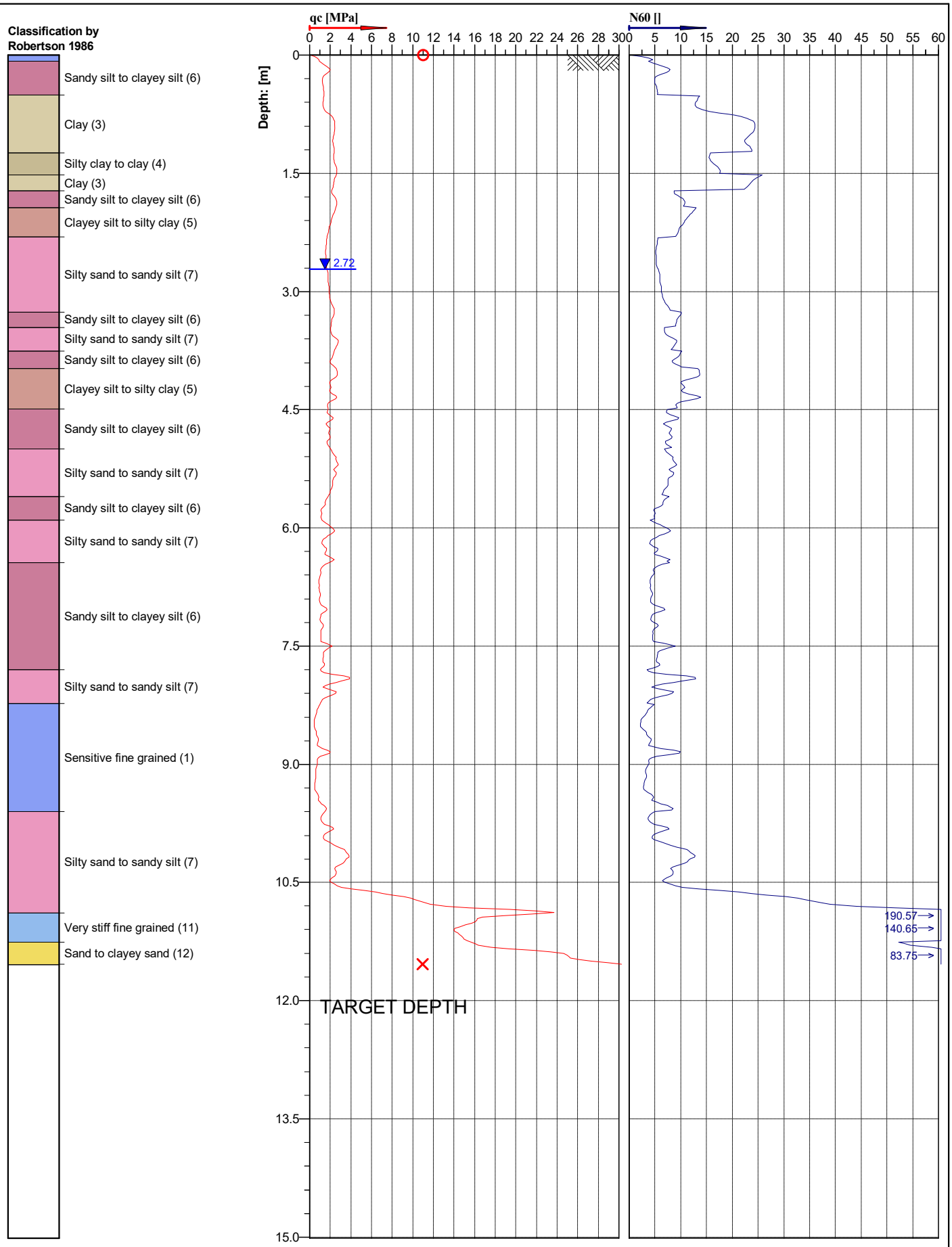


Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71629, E 175.24124		File: CPT02.cpt	

NZGD ID: 140596

NZGD ID: 140596



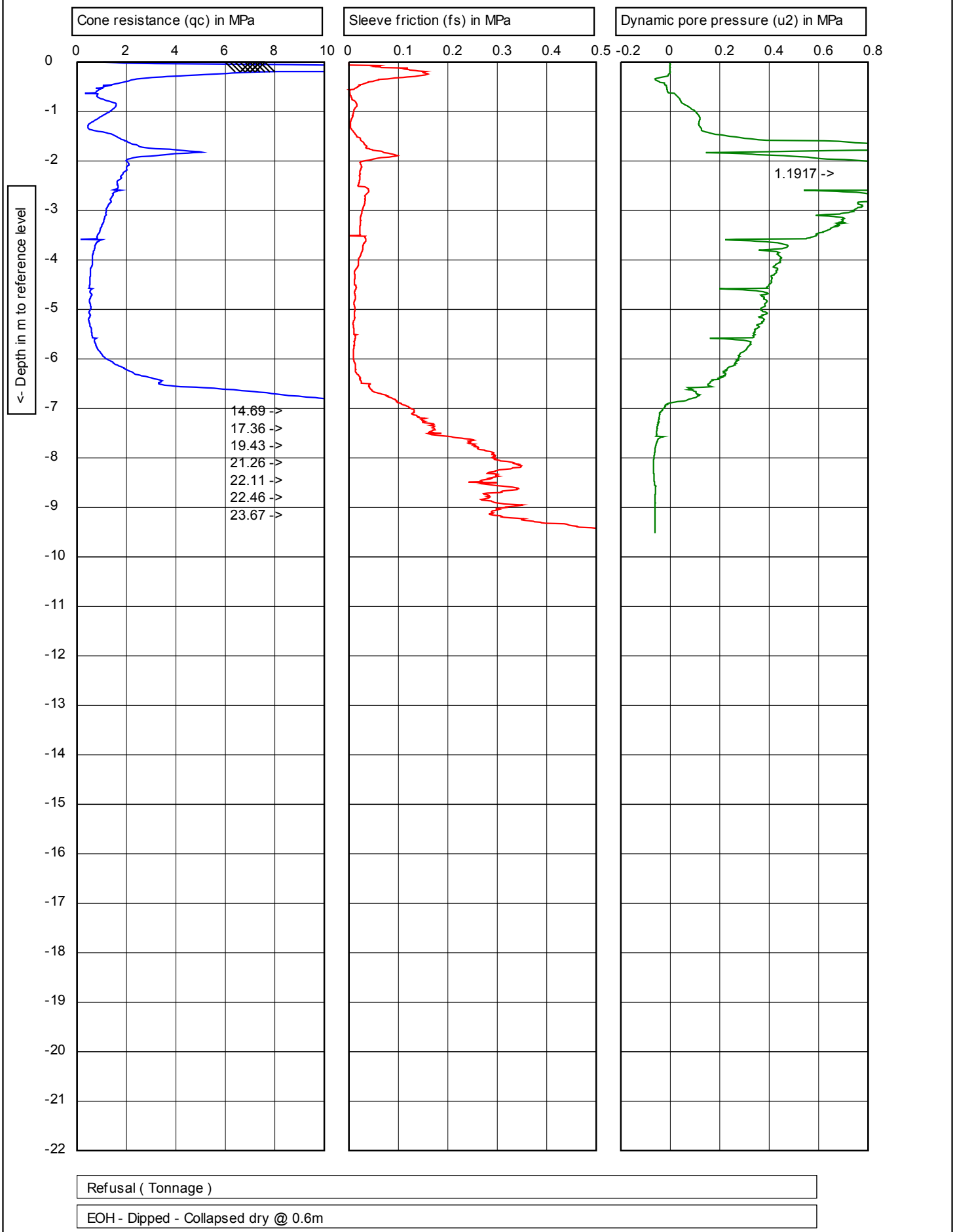
Location: HAMILTON	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: KIRK ROBERTS	Date: 18/12/2018	Scale: 1 : 65
Project: 11 OAKTREE LANE - FLAGSTAFF		Page: 1/1	Fig.:
S 37.71629, E 175.24124		File: CPT02.cpt	

GEOTECH DRILLING

Cone No: 4696
Tip area [cm2]: 10
Sleeve area [cm2]: 150

NZGD ID: 140596

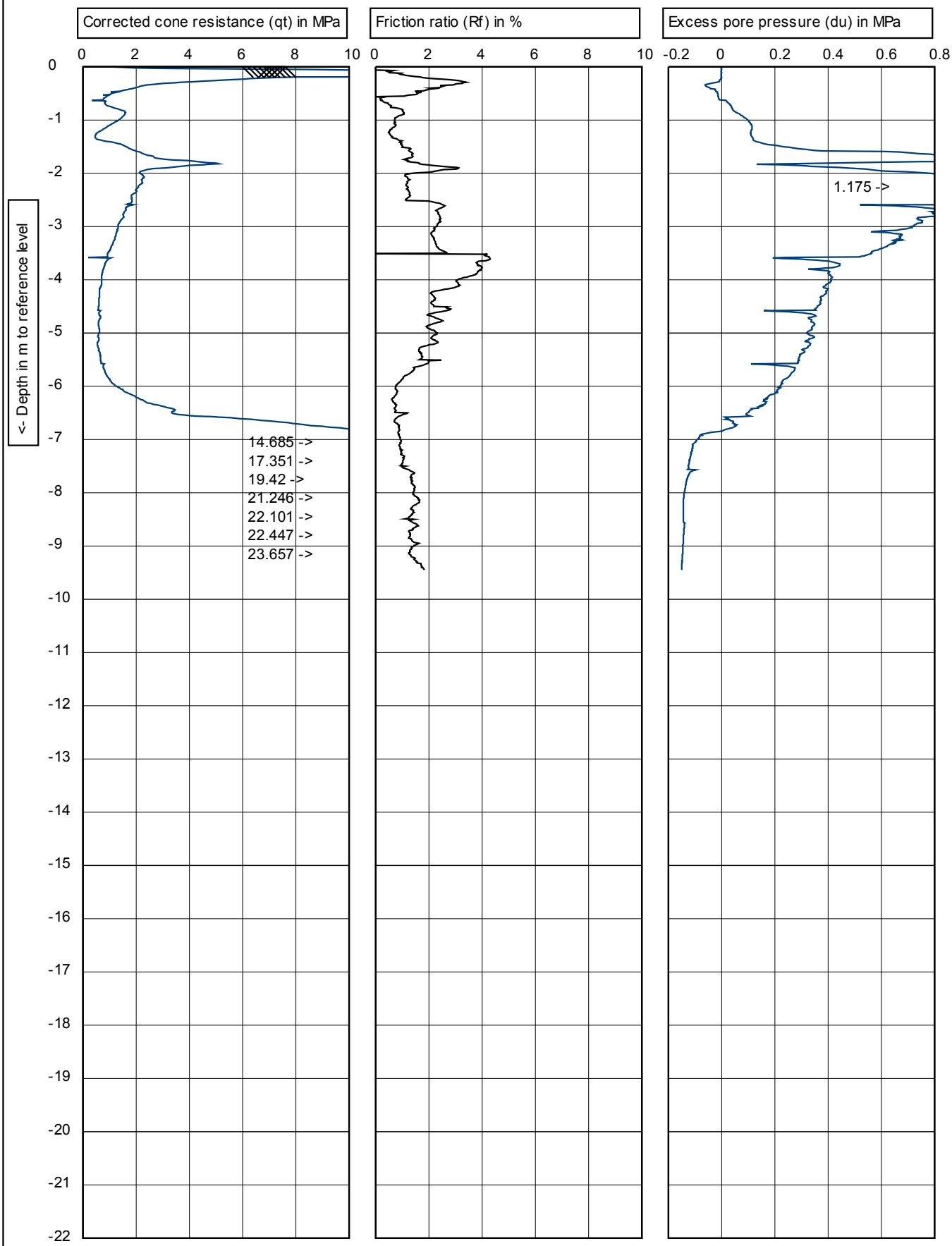
NZGD ID: 73321



r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL — W.L.: **-0.6**	Date:	**12/8/2014**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Kay Rd**	Project no.:	**231695.00_027**
Position:	**1798409, 5823310 NZTM**	CPT no.:	**728** — **1/6**

1.40

NZGD ID: 73321



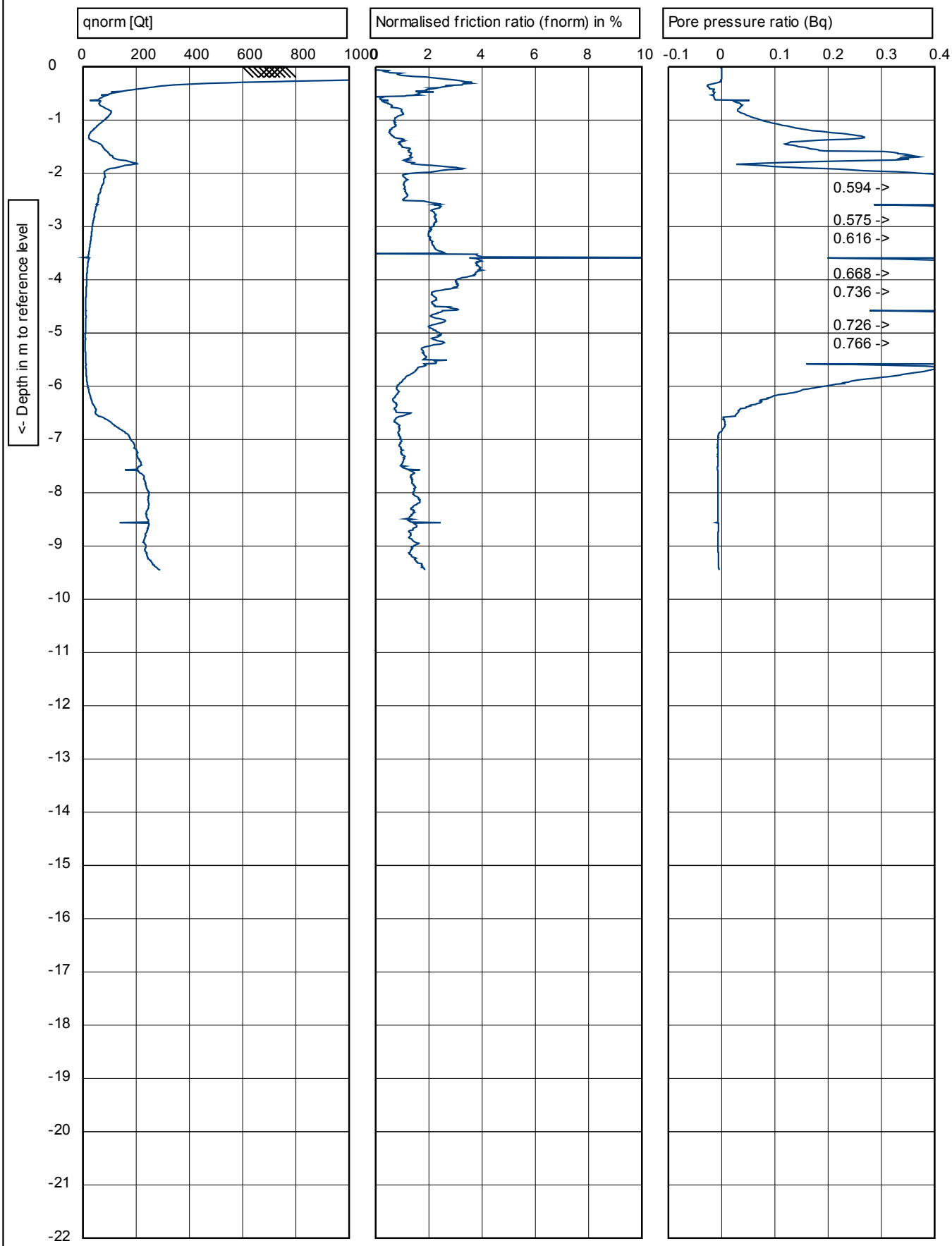
OPUS

Graphs on this page are not IANZ accredited

1.40

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-0.6**	Date:	**12/8/2014**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Kay Rd**	Project no.:	**231695.00_027**
Position:	**1798409, 5823310 NZTM**	CPT no.:	**728** **2/6**

NZGD ID: 73321



OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.6**

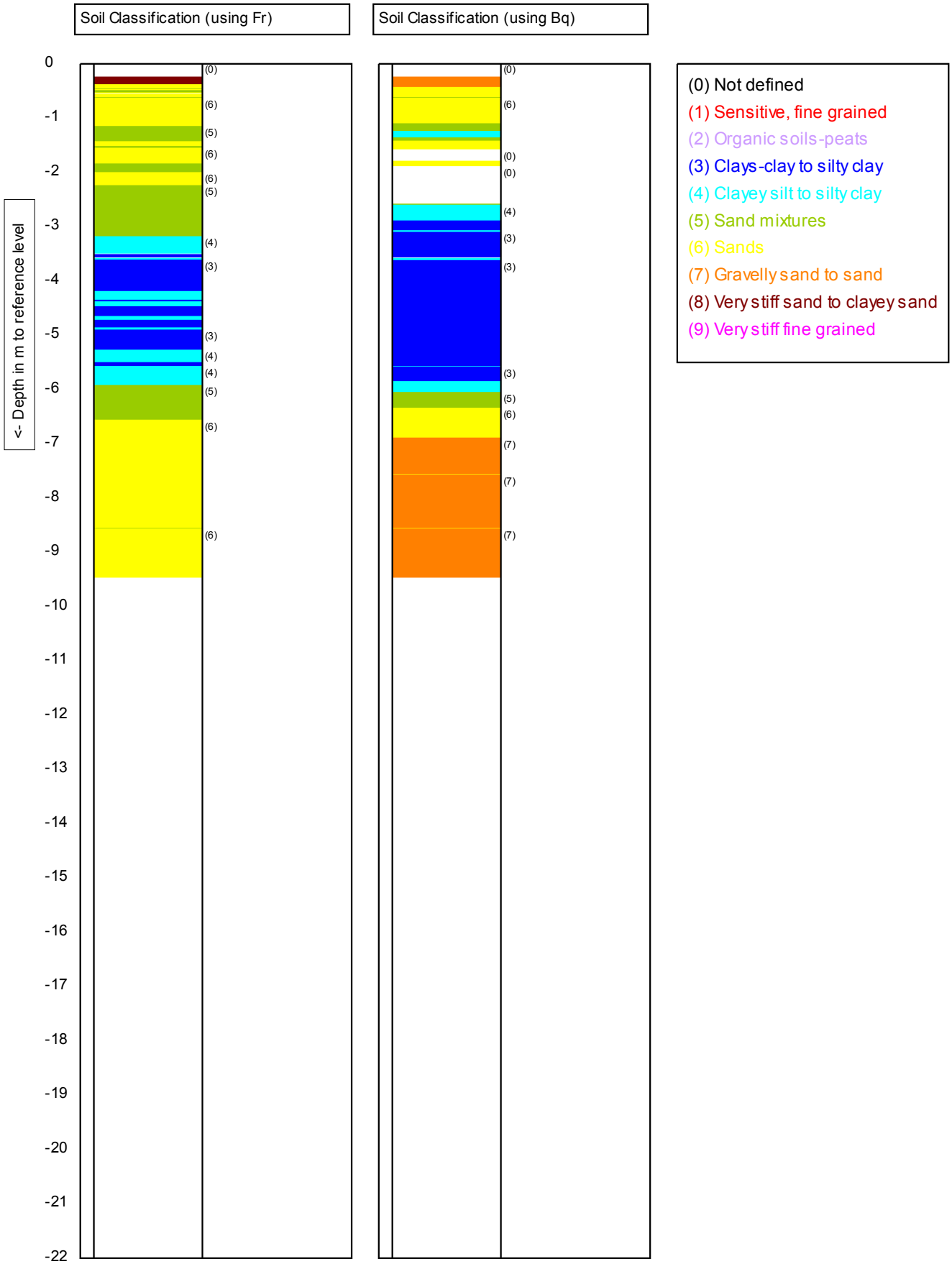
Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798409, 5823310 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**728** 3/6

NZGD ID: 73321



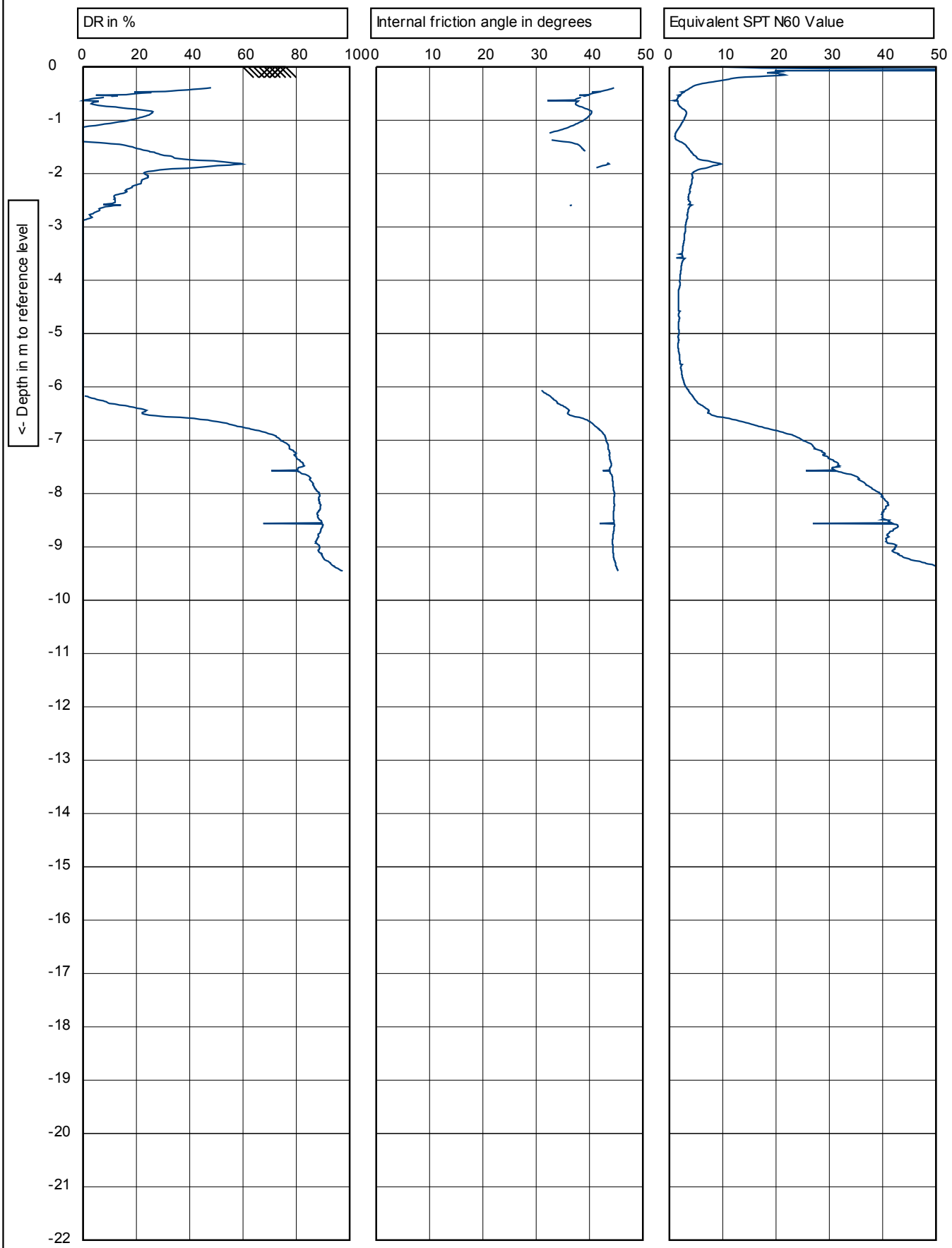
OPUS

Graphs on this page are not IANZ accredited

1.40

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-0.6**	Date:	**12/8/2014**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Kay Rd**	Project no.:	**231695.00_027**
Position:	**1798409, 5823310 NZTM**	CPT no.:	**728** 4/6

NZGD ID: 73321



Refusal (Tonnage)

EOH - Dipped - Collapsed dry @ 0.6m

OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.6**

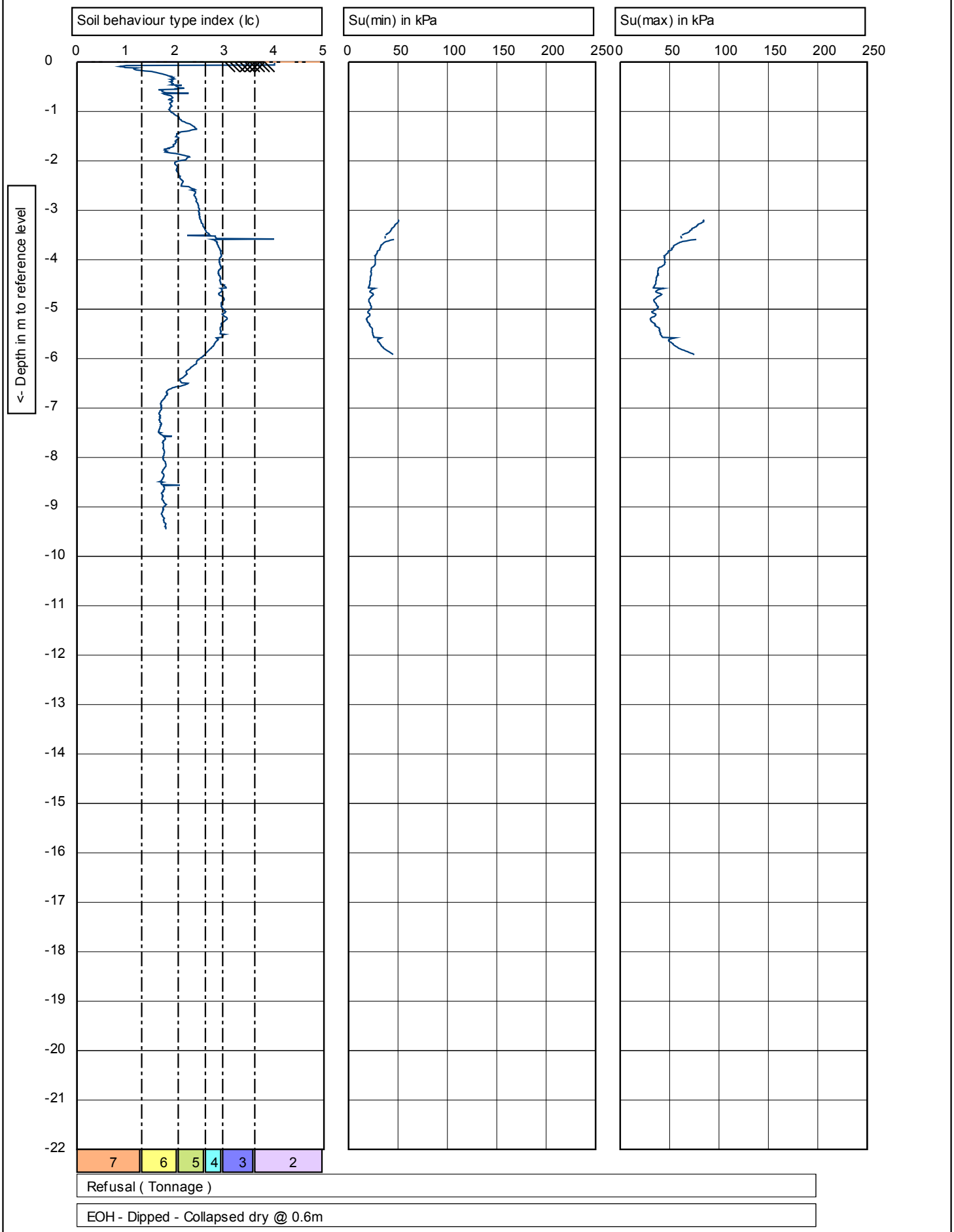
Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798409, 5823310 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**728** **5/6**

NZGD ID: 73321



OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.6**

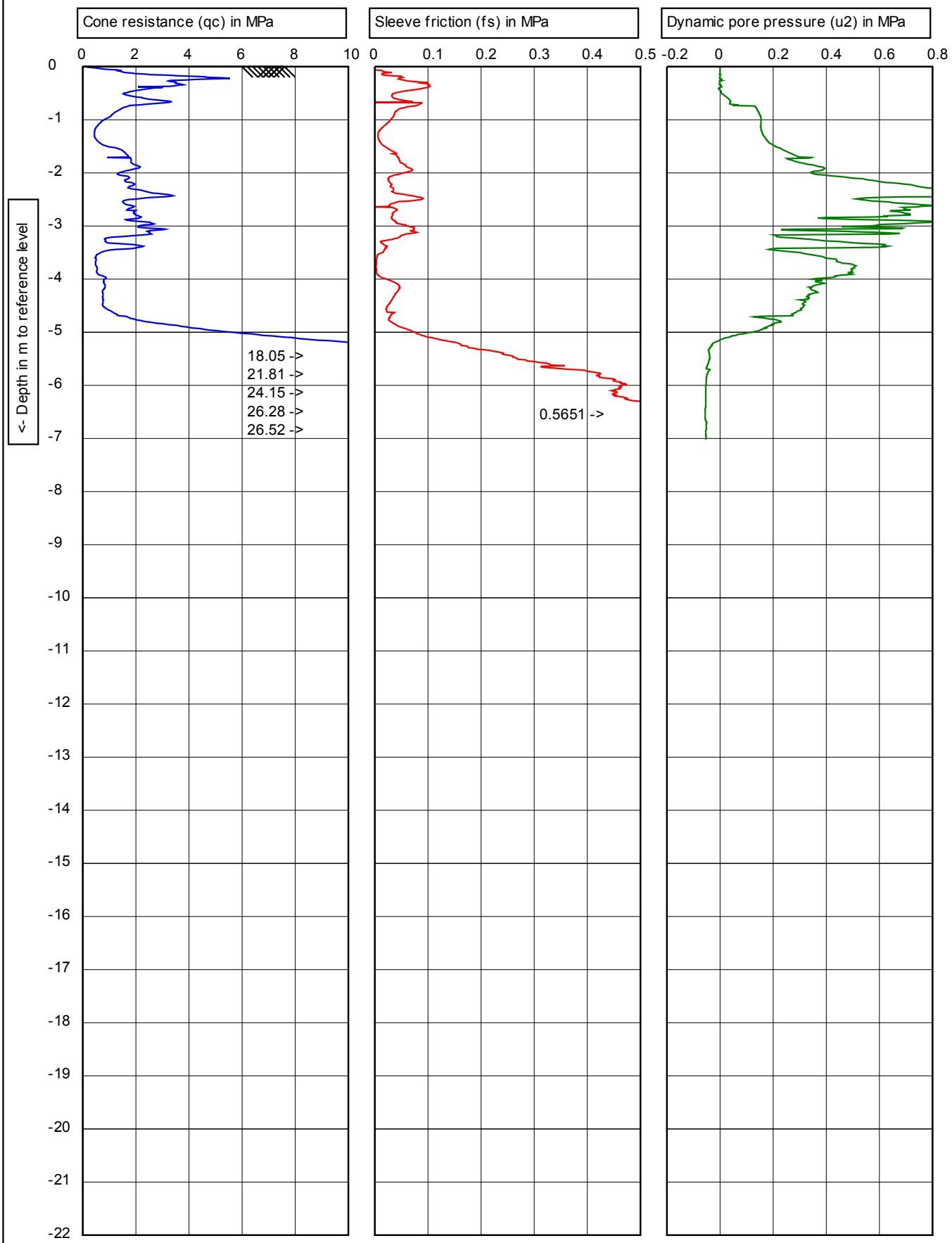
Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798409, 5823310 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**728** 6/6

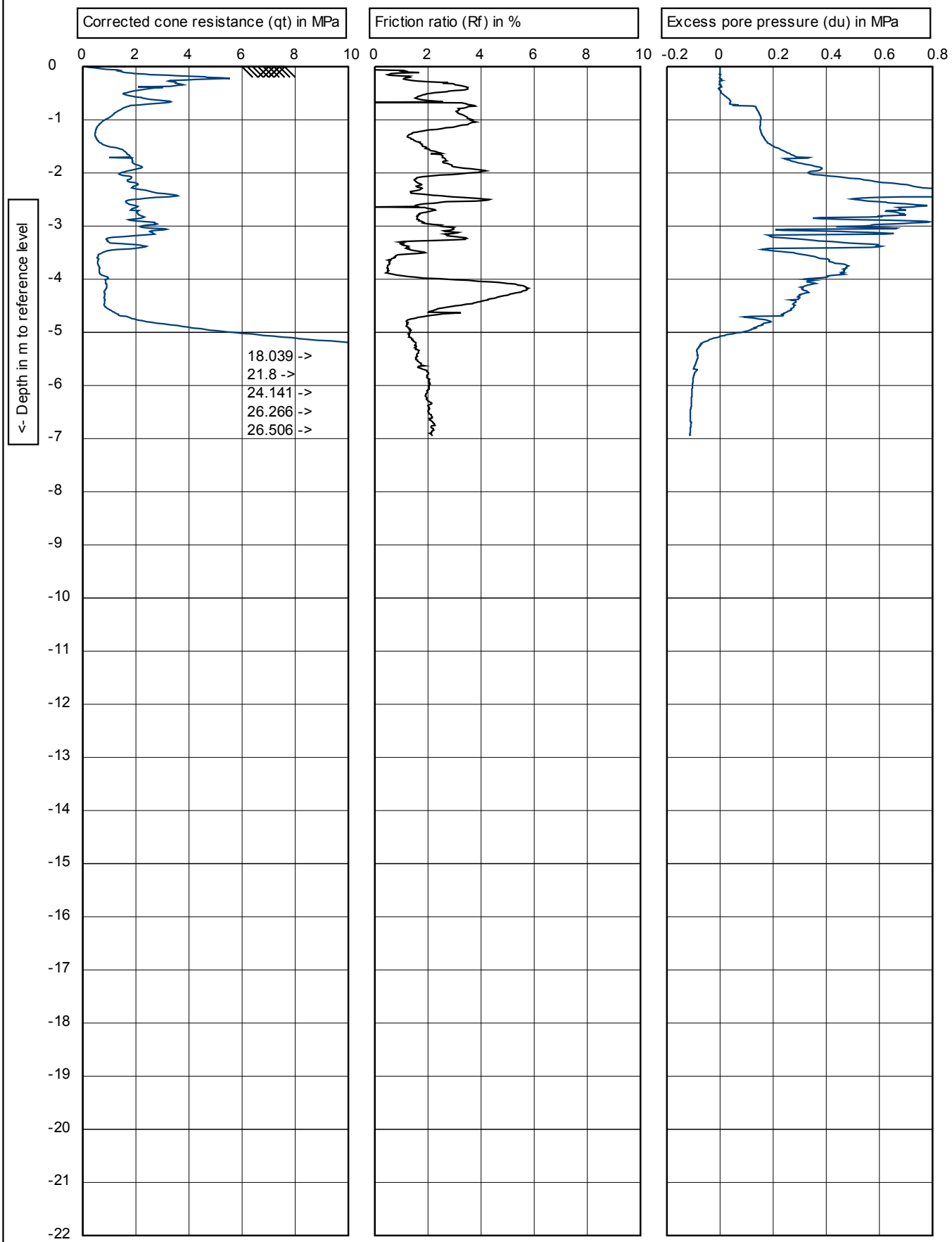
NZGD ID: 73321



r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-0.9**	Date:	**12/8/2014**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Kay Rd**	Project no.:	**231695.00_027**
Position:	**1798415, 5823254 NZTM**	CPT no.:	**729** 1/6

1.40

NZGD ID: 73322



OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.9**

Project: **Waikato Expressway:Hamilton Sect.**

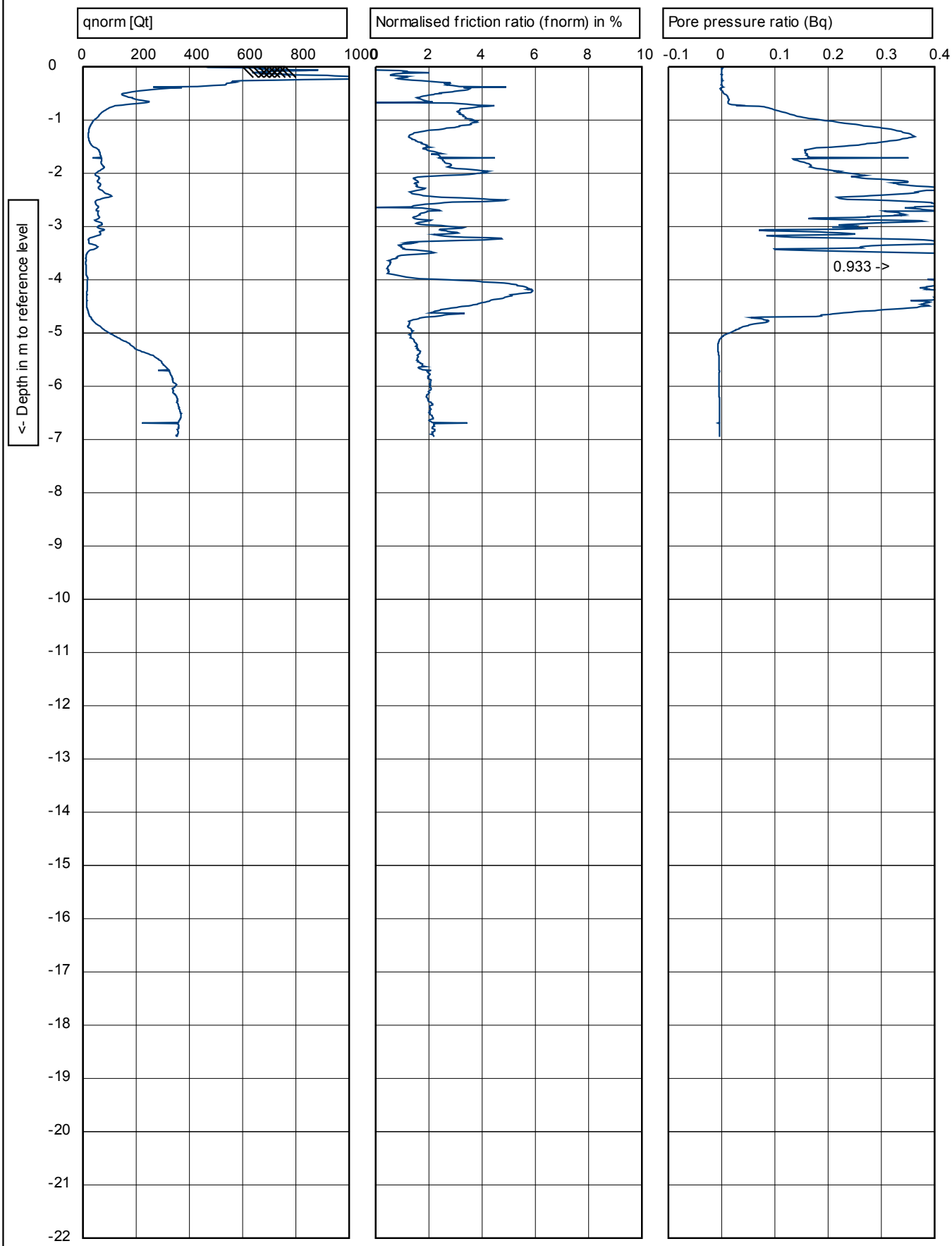
Location: **Kay Rd**

Position: **1798415, 5823254 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**729**

NZGD ID: 73322

NZGD ID: 73322



Refusal (Tonnage)

EOH - Dipped - Collapsed dry @ 0.9m

OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.9**

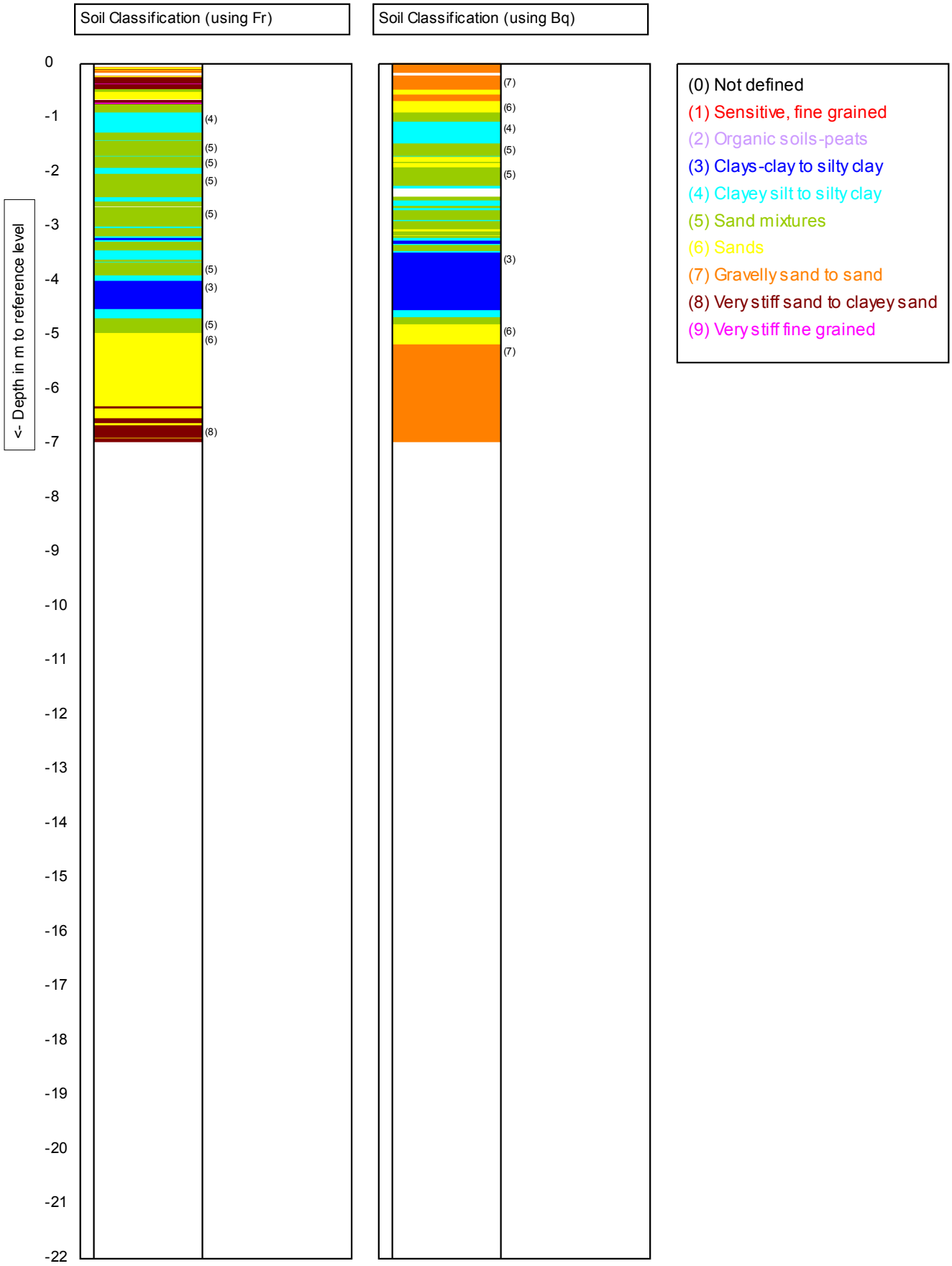
Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798415, 5823254 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**729** **3/6**

NZGD ID: 73322

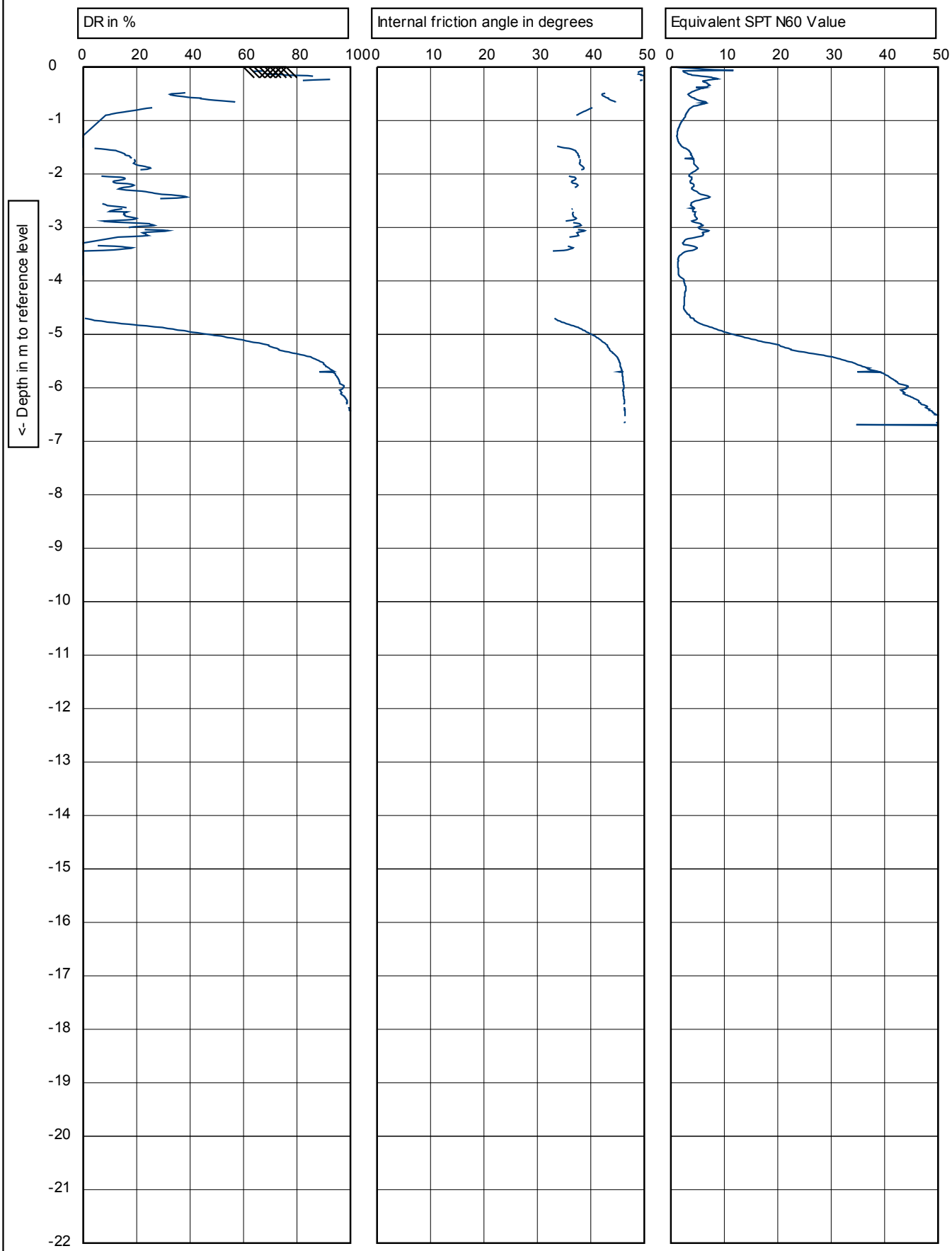


OPUS

Graphs on this page are not IANZ accredited

1.40

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-0.9**	Date:	**12/8/2014**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Kay Rd**	Project no.:	**231695.00_027**
Position:	**1798415, 5823254 NZTM**	CPT no.:	**729** 4/6



Refusal (Tonnage)

EOH - Dipped - Collapsed dry @ 0.9m

OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

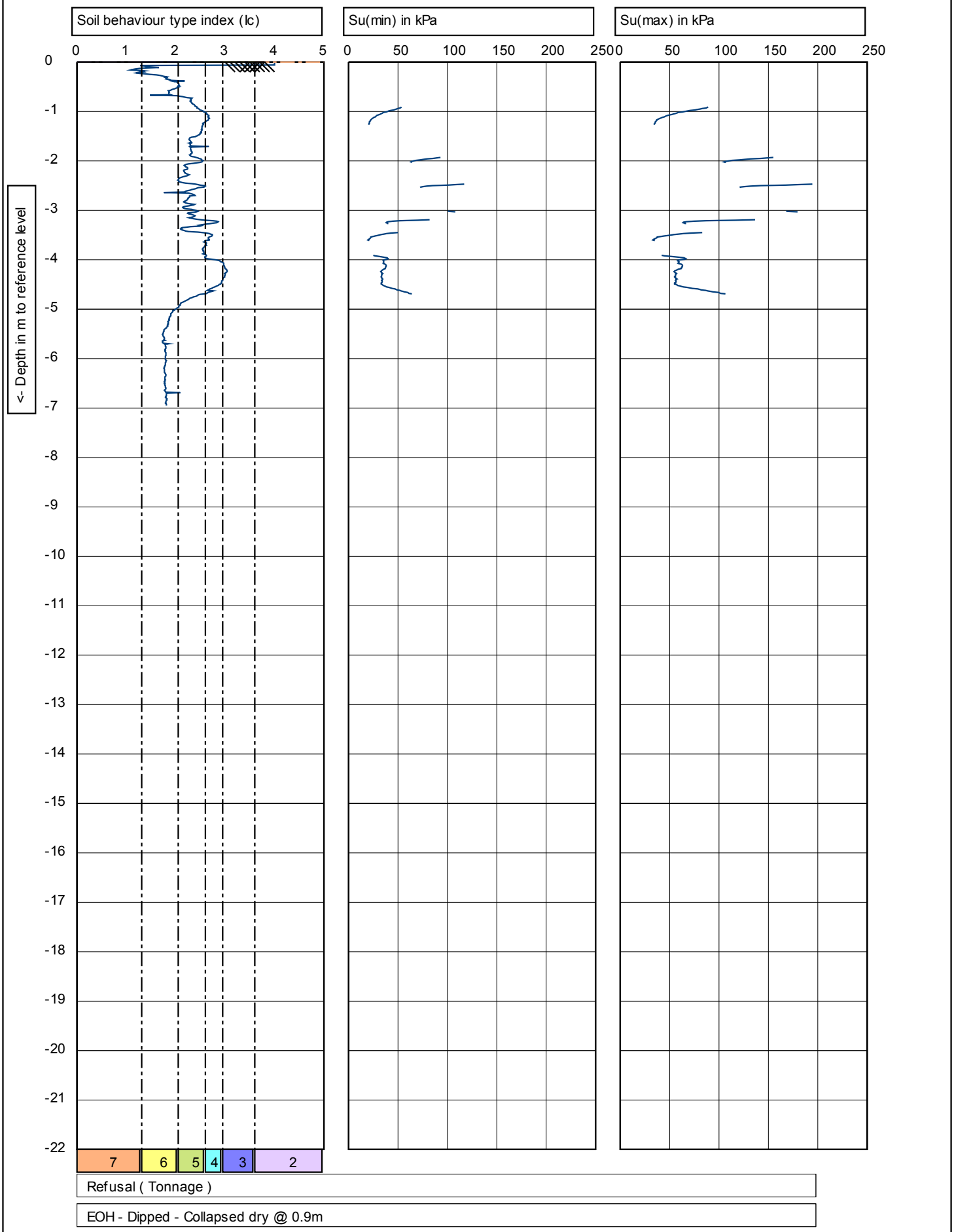
G.L. 0 MSL | W.L.: **-0.9**

Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798415, 5823254 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**729** **5/6**



OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-0.9**

Project: **Waikato Expressway:Hamilton Sect.**

Location: **Kay Rd**

Position: **1798415, 5823254 NZTM**

Predrill :	**0 m Predrilled**
Date:	**12/8/2014**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**729** 6/6

NZGD ID: 73322

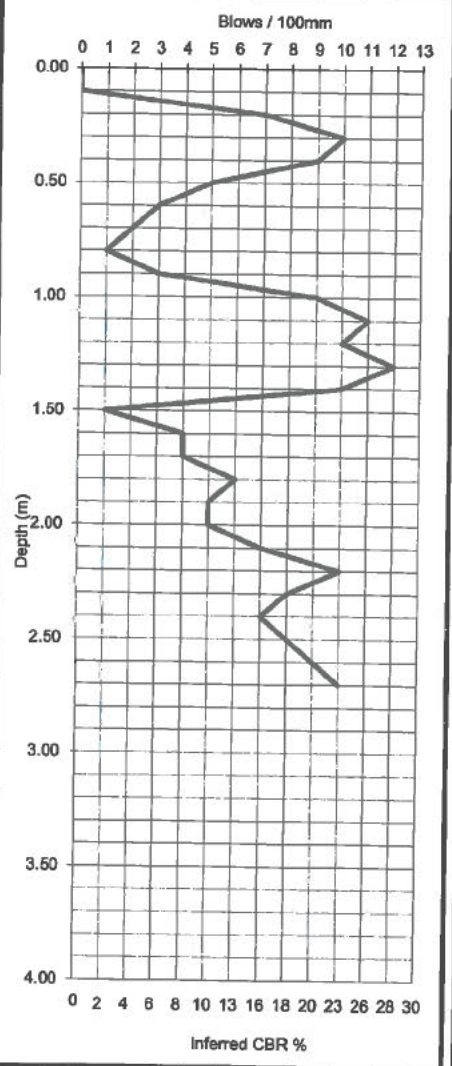
TEST PIT / SCALA PENETROMETER TEST REPORT

OPUS

Project :	**Waikato Expressway - Hamilton Section**
Location :	**Resolution Drive Extension**
Client :	**NZ Transport Agency**
Sampled by :	**E J West**
Test number :	**TP 728**
Shear vane number :	**DR 398**
Shear vane correction :	**Refer to Calibration Sheet**
Coordinates (NZTM) :	**N 5823311**
	E 1798407
Water level (m) :	**Not encountered**

Project No :	**2-31695.00**
Lab Ref No :	**15/802/002**
Client Ref No :	**TP 728**

Scala Penetrometer



Test Results

Depth (m)	Shear Strength (kPa)	Sample Details	Soil Description
0.00			AP65. Fresh angular silty SAND GRAVEL, dense, dry, non plastic.
0.20	Refusal		Clayey SILT, orange brown, hard, moist, highly plastic.
0.40	118/34		SILT, some Clay, orange brown / orange white / red, firm, moist, moderately plastic.
0.80	118/38	Bulk	SILT, some Clay, light yellowish brown, firm, moist, moderately plastic.
1.60	17/3		Clayey SILT, light yellowish brown,
1.80	Refusal	Bulk	soft, saturated, moderately plastic.
4.50		Bulk	Water weeping into hole.
6.00			*End of Pit.*

Test Methods

Determination of Penetration Resistance of a Soil, NZS 4402 : 1988, Test 6.5.2	Field Descriptions of Soils and Rocks by
Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001	NZ Geotechnical Society Dec 2005
Inferred CBR values taken from Austroads Pavement Design Manual 2004	Inferred CBR values are not IANZ accredited

Date tested : 28/01/15
Date reported : 03/02/15

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 03/02/15

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Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Opus International Consultants Ltd
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre, Hamilton 3240, New

Telephone +64 7 856 2870
Facsimile +64 7 856 2873
Website www.opus.co.nz

NZGD ID: 77263

OPUS

Waikato Expressway – Hamilton Section

Project No: 2-31695.00
Lab Ref No: 15/802/003

Pit Photo

Test Pit

TP 728

Page 1 of 1

NZGD ID: 77263

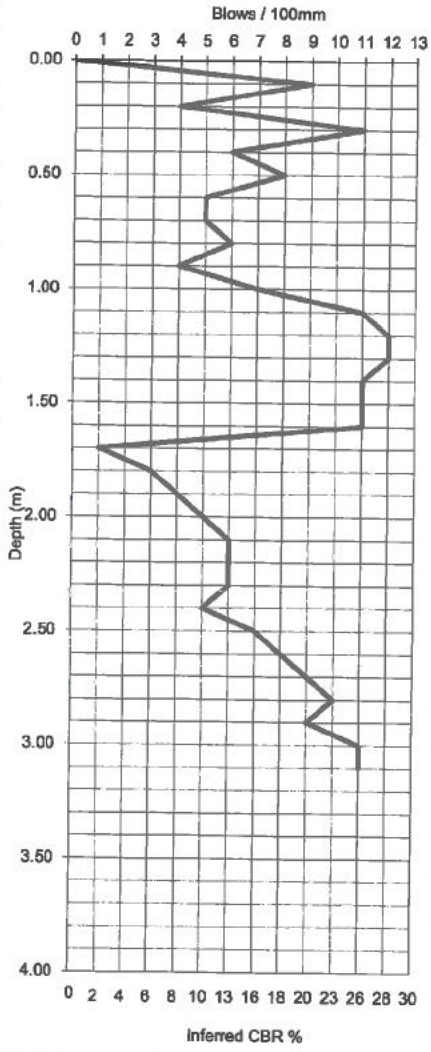
TEST PIT / SCALA PENETROMETER TEST REPORT

OPUS

Project :	**Waikato Expressway - Hamilton Section**
Location :	**Resolution Drive Extension**
Client :	**NZ Transport Agency**
Sampled by :	**E J West**
Test number :	**TP 729**
Shear vane number :	**DR 398**
Shear Vane correction :	**Refer to Calibration Sheet**
Coordinates (NZTM) :	**N 5823256**
	E 1798417
Water level (m):	**5.5**

Project No :	**2-31695.00**
Lab Ref No :	**15/802/002**
Client Ref No :	**TP 729**

Scala Penetrometer



Test Results

Depth (m)	Shear Strength (kPa)	Sample Details	Soil Description
0.00			AP65. Fresh angular silty sandy GRAVEL, dense, dry, non plastic.
1.50	Refusal		Clayey SILT, orange brown / red / white mottled, firm, moist, highly plastic. Fill.
3.50			Fine to medium SAND, minor fine Gravel, yellowish brown, firm, moist, highly plastic. Fill.
0.50	184/56		Clayey SILT, orange / brown, stiff, moist, highly plastic. Fill.
0.70	151/22		SILT, trace Clay, orange / yellowish brown, soft, moist, slightly plastic.
0.80	79/22		Clayey SILT, reddish grey, firm, moist, highly plastic.
1.20	112/19	Bulk	SILT, some Clay and medium Sand, light yellowish grey, firm, moist, highly plastic.
3.10		Bulk	Silty medium SAND, minor Clay, yellowish white / orange mottled, medium dense, wet, non plastic.
4.00		Bulk	Fine pumiceous SAND, yellowish white, medium dense, saturated, non plastic.
5.10		Bulk	Fine pumiceous SAND, light brown, medium dense, saturated, non plastic.
5.50			*End of Pit. Water level.*

Test Methods	
Determination of Penetration Resistance of a Soil, NZS 4402 : 1988, Test 6.5.2	Field Descriptions of Soils and Rocks by
Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001	NZ Geotechnical Society Dec 2005
Inferred CBR values taken from Austroads Pavement Design Manual 2004	Inferred CBR values are not IANZ accredited

Date tested : 28/01/15
Date reported : 03/02/15

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 03/02/15

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Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Opus International Consultants Ltd
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre, Hamilton 3240, New

Telephone +64 7 856 2870
Facsimile +64 7 856 2873
Website www.opus.co.nz

NZGD ID: 77264

OPUS

Waikato Expressway – Hamilton Section

Project No: 2-31695.00
Lab Ref No: 15/802/003

Pit Photo

Test Pit

TP 729

Page 1 of 1

NZGD ID: 77264

AECOM

LOG OF TEST PIT

INSPECTION PIT IDENTIFICATION: **TP04**

Client: Hamilton City Council
Project: Resolution Drive Borman to WEX
Project number: 60316742

Co-ordinates
Orientation -90° Elevation
Location Hamilton North
Feature 800m chainage from Borman Rd.

Depth	GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, Rock Name, Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc))	Test Records	Sampling	Dynamic Cone Penetrometer (Blows per 100 mm)	SOIL PROPERTIES (Subordinate MAJOR minor; colour; structure, Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc) Depth Related Remarks / DEFECT DESCRIPTION (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, Continuity, Roughness, Infilling, etc.)	Graphic Log	Instrumentation
0.2	FILL — 0m: Fill.				0m: Silty GRAVEL; brown. Moist; gravel, coarse, angular.		
0.4	0.3m: Buried topsoil.			4	0.3m: Organic SILT; black and orange. 'Hard'; moist; slightly plastic.		
0.6	0.5m: Reworked weathered volcanic ash.			3	0.5m: Silty CLAY; light brown. 'Hard'; moist; slightly plastic.		
0.8				4			
1.0				6			
1.2				6			
1.4				6			
1.6				7	1.5m: Sample taken.		
1.8				8	TP04 terminated at 1.6m Target Depth		
2.0							
2.2							
2.4							
2.6							
2.8							

For explanation of symbols and observations, see key sheet

FLUID DEPTHS DURING DRILLING

Date Time	Drilled Depth (m)	Casing Depth (m)	Fluid Depth (m)

Hand Held Shear Vane

Vane shear strength per NZGS guideline

Length
Width
Stability Stable
Excavation Method
Orientation B

Remarks
No groundwater encountered.

Started 8/04/2014
Finished 8/04/2014
Date logged
Logged DK
Checked DMM

Page 1 of 1

25/06/2014

NZGD ID: 77415

AECOM

LOG OF TEST PIT

INSPECTION PIT IDENTIFICATION: **TP05**

Client: Hamilton City Council
Project: Resolution Drive Borman to WEX
Project number: 60316742

Co-ordinates
Orientation -90° Elevation
Location Hamilton North
Feature TP1

Depth	GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, Rock Name, Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc))	Test Records	Sampling	Dynamic Cone Penetrometer (Blows per 100 mm)	SOIL PROPERTIES (Subordinate MAJOR minor; colour; structure, Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description, minor fraction description etc) Depth Related Remarks / DEFECT DESCRIPTION (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, Continuity, Roughness, Infilling, etc.)	Graphic Log	Instrumentation
0.2	FILL: 0m: Fill.				0m: Silty GRAVEL; brown. Moist; gravel, coarse, angular.		
0.4	0.3m: Reworked weathered volcanic ash.			7	0.3m: Silty CLAY; dark greyish brown. 'Stiff'; moist; highly plastic.		
0.6				4			
0.8				4	0.6m: Silty CLAY; orange. 'Firm to stiff'; moist; highly plastic.		
1.0				4			
1.2				4			
1.4				7	1.3m: 'Firm'; saturated.		1.8 ▽
1.6				9			
1.8				9	TP05 terminated at 1.8m Target Depth		
2.0							
2.2							
2.4							
2.6							
2.8							

For explanation of symbols and observations, see key sheet

FLUID DEPTHS DURING DRILLING

Date Time	Drilled Depth (m)	Casing Depth (m)	Fluid Depth (m)
08/04/2014 00:00	1.80	-	1.3

Hand Held Shear Vane

Vane shear strength per NZGS guideline

Length
Width
Stability Stable
Excavation Method
Orientation B

Remarks

Started 8/04/2014
Finished 8/04/2014
Date logged
Logged DK
Checked DMM

25/06/2014

NZGD ID: 77416

AECOM

LOG OF TEST PIT

INSPECTION PIT IDENTIFICATION **TP06**

Client Hamilton City Council
Project Resolution Drive Borman to WEX
Project number 60316742

Co-ordinates
Orientation -90° Elevation
Location Hamilton North
Feature 400m chainage from Ky Rd.

Depth	GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, Rock Name, Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc))	Test Records	Sampling	Dynamic Cone Penetrometer (Blows per 100 mm)	SOIL PROPERTIES (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc) Depth Related Remarks / DEFECT DESCRIPTION (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, Continuity, Roughness, Infilling, etc.)	Graphic Log	Instrumentation
0.2	FILL: 0m: Fill.				0m: Silty GRAVEL; brown. Moist; gravel, coarse, angular.		
0.4	REWORKED ASH: 0.3m: Reworked weathered volcanic ash.			15	0.3m: Silty CLAY; brownish orange. 'Very stiff'; moist; low plasticity.		
0.6				8			
0.8				6			
1.0				6	0.8m: Clay, some silt; brwonish orange. 'Very stiff'; moist; high plasticity.		
1.2				5			
1.4				7			
1.6				6	TP06 terminated at 1.6m Target Depth		
1.8				9			
2.0							
2.2							
2.4							
2.6							
2.8							

For explanation of symbols and observations, see key sheet

FLUID DEPTHS DURING DRILLING

Date Time	Drilled Depth (m)	Casing Depth (m)	Fluid Depth (m)

Hand Held Shear Vane

Vane shear strength per NZGS guideline

Length
Width
Stability Stable
Excavation Method
Orientation B

Remarks
No groundwater encountered.

Started 8/04/2014
Finished 8/04/2014
Date logged
Logged DK
Checked DMM

Page 1 of 1

25/06/2014

NZGD ID: 77417

AECOM

LOG OF TEST PIT

INSPECTION PIT IDENTIFICATION: **TP07**

Client: Hamilton City Council
Project: Resolution Drive Borman to WEX
Project number: 60316742

Co-ordinates
Orientation -90° Elevation
Location Hamilton North
Feature 600m chainage from Kay Rd.

Depth	GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, Rock Name, Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc))	Test Records	Sampling	Dynamic Cone Penetrometer (Blows per 100 mm)	SOIL PROPERTIES (Subordinate MAJOR minor; colour; structure. Strength; moisture condition; grading, bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc) Depth Related Remarks / DEFECT DESCRIPTION (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, Continuity, Roughness, Infilling, etc.)	Graphic Log	Instrumentation
0.2	FILL: 0m: Fill.				0m: Silty GRAVEL; brown. Moist; gravel, coarse, angular.		
0.4							
0.6	HINUERA FORMATION: 0.5m: Lacustrine mud, silt and sand with interbedded peat.			7	0.5m: Silty CLAY; brown. 'Very stiff'; moist; slightly plastic.		
0.8				6			
1.0				5	0.8m: Organic SILT; dark brownish grey. Moist; slightly plastic; breaks apart easily.		
1.2				7			
1.4				7			
1.6				8	1.2m: SILT; grey. 'Firm to stiff'; moist; slightly plastic.		
1.8				9			
2.0				7	TP07 terminated at 1.5m Target Depth		
2.2							
2.4							
2.6							
2.8							

For explanation of symbols and observations, see key sheet

FLUID DEPTHS DURING DRILLING

Date Time	Drilled Depth (m)	Casing Depth (m)	Fluid Depth (m)

Hand Held Shear Vane

Vane shear strength per NZGS guideline

Length
Width
Stability Stable
Excavation Method
Orientation B

Remarks
No groundwater encountered.

Started 8/04/2014
Finished 8/04/2014
Date logged

Logged DK
Checked DMM

Page 1 of 1

25/06/2014

AECOM

LOG OF TEST PIT

INSPECTION PIT IDENTIFICATION: **TP08**

Client: Hamilton City Council
Project: Resolution Drive Borman to WEX
Project number: 60316742

Co-ordinates
Orientation -90° Elevation
Location Hamilton North
Feature 800m chainage from Kay Rd.

Depth	GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, Rock Name, Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc))	Test Records	Sampling	Dynamic Cone Penetrometer (Blows per 100 mm)	SOIL PROPERTIES (Subordinate MAJOR minor; colour; structure, Strength; moisture condition; grading; bedding; plasticity; sensitivity; major fraction description; subordinate fraction description; minor fraction description etc) Depth Related Remarks / DEFECT DESCRIPTION (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, Continuity, Roughness, Infilling, etc.)	Graphic Log	Instrumentation
0.2	FILL: 0m: Fill.				0m: Silty GRAVEL; brown. Moist; gravel, coarse, angular.		
0.4							
0.6	HINUERA FORMATION: 0.5m: Lacustrine mud, silt and sand.			2	0.5m: SILT, minor gravel; dark brown. 'Firm to stiff'; wet; high plasticity.		
0.8				2			
1.0				3	0.8m: Silty CLAY; light brown. 'Firm to stiff'; wet; high plasticity.		
1.2				2			
1.4				3			
1.6				3			
1.8				3	1.7m: Seepage into pit.		1.8 ▽
2.0				3	TP08 terminated at 1.8m Target Depth		
2.2							
2.4							
2.6							
2.8							

For explanation of symbols and observations, see key sheet

FLUID DEPTHS DURING DRILLING

Date Time	Drilled Depth (m)	Casing Depth (m)	Fluid Depth (m)
08/04/2014 00:00	1.80	-	1.7

Hand Held Shear Vane

Vane shear strength per NZGS guideline

Length
Width
Stability Stable
Excavation Method
Orientation B

Remarks

Started 8/04/2014
Finished 8/04/2014
Date logged
Logged DK
Checked DMM

25/06/2014

NZGD ID: 77419

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APPENDIX B
Laboratory Testing

PLASTICITY INDEX FOR SOILS TEST REPORT

OPUS

Project :	**Waikato Expressway Hamilton Section**
Location :	**See Below**
Client :	**NZ Transport Agency**
Contractor :	**Opus Hamilton**
Sampled by :	**Opus Hamilton**
Date received :	**January 2015**
Sampling method :	**See Below**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/006a**
Client Ref No :	

Test Results

General Location:	Lake Rd off ramp	Osborne Road Cut		Resolution Drive Ext.	Ruakura Rd Relocation
Sampling method:	Bulk Sample	Bulk Sample	Bulk Sample	Bulk Sample	Bulk Sample
Soil Fraction Tested:	Whole Soil	-425um	-425um	-425um	-425um
Sample Location :	**TP711**	**TP715**	**TP715**	**TP728**	**TP742**
Depth (m) :	1.8 - 2.7	3.1 - 4.1	4.1 - 6.0	1.6 - 4.5	0.2 - 0.7
Liquid Limit :	63	50	53	49	54
Plastic Limit :	40	34	34	34	29
Plasticity Index :	**23**	**16**	**19**	**15**	**25**
Natural Water Content (%):	**59.0**	**51.3**	**35.7**	**75.7**	**24.4**

Sample Description (as logged): **TP711 1.8-2.7m :** SILT, trace clay.
TP715 3.1-4.1m : SILT, minor clay.
TP715 4.1-6.0m : H/W medium to coarse SAND.
TP728 1.6-4.5m : Clayey SILT.
TP742 0.2-0.7m : SILT, trace clay.

Test Methods		Notes
Water Content	NZS 4402 : 1986, Test 2.1	Soil Fraction Tested as shown
Liquid Limit	NZS 4402 : 1986, Test 2.2	1. Unable to form groove and/or sample slipping in bowl.
Plastic Limit	NZS 4402 : 1986, Test 2.3	2. Unable to roll to specified dimensions.(Sandy sample)
Plasticity Index	NZS 4402 : 1986, Test 2.4	3. **N.P.** denotes **Non Plastic**
		4. Where applicable the sample was rubbed through the 425um sieve.

Date tested : 16-20/03/15
Date reported : 23/03/15

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 23/03/15

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Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

t: +64 7 856 2870
f: +64 7 856 2873
w: www.opus.co.nz

NZGD ID: 77263

PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

OPUS

Project : **Waikato Expressway**
Location : **Hamilton Section**
Client : **OPUS Hamilton**

BH/TP/Sample ID: **TP728** Depth: 1.6 metres
Sampled by : **Opus Hamilton** Date: 2015
Date received : **5/03/15**
Sampling method : **Bulk**
Sample condition : **As Received**
Sample description : **Sandy CLAY/SILT**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **76.0 %**

Project No: 2-31695.00
Lab Ref No: 15/803/006
Client Ref:

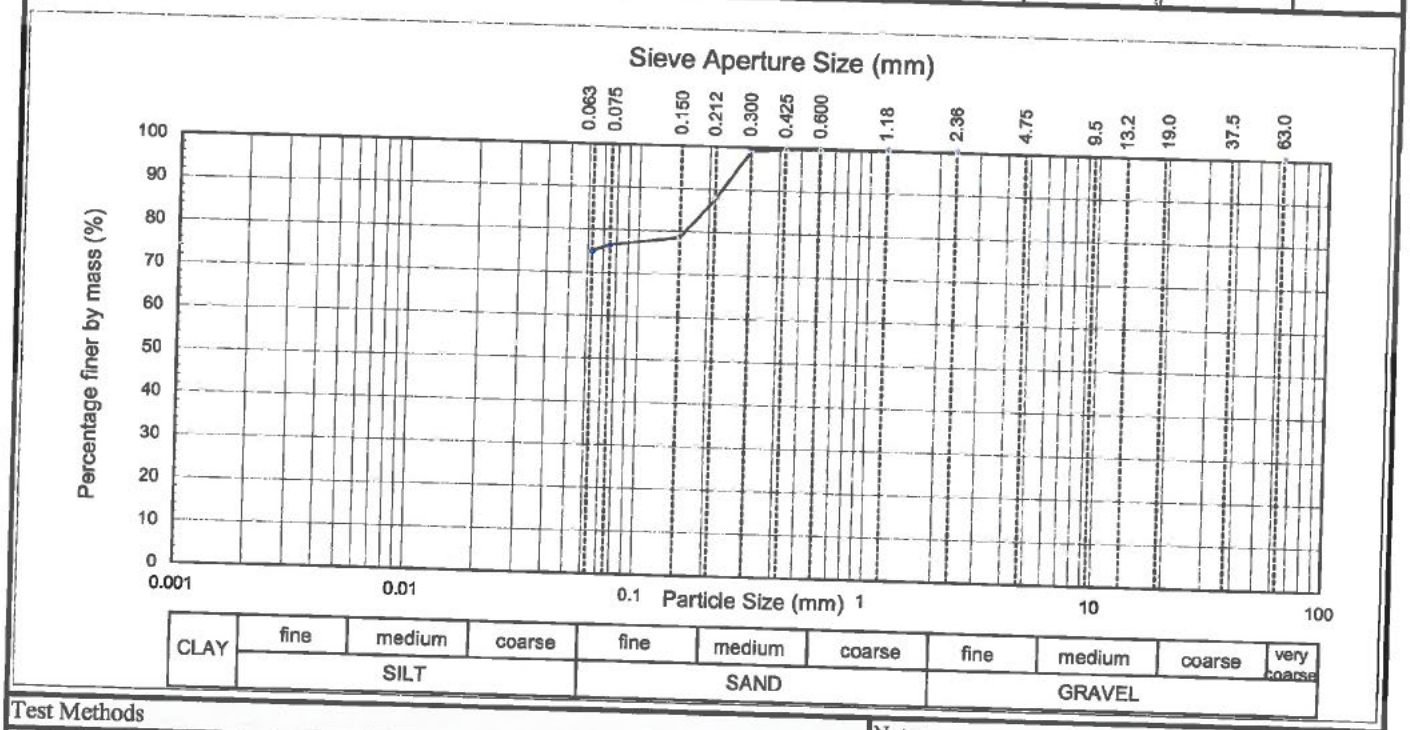
Sieve Analysis

Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99
37.5	--	2.36	100	0.212	88
19.0	--	1.18	100	0.150	79
13.2	--	0.600	100	0.075	76
9.5	--	0.425	100	0.063	75

Note: "--" denotes sieve not used and/or hydrometer analysis not tested

Hydrometer Analysis

Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--
--	--	--	--
--	--		



Test Methods
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)
Water Content: NZS 4402: 1986 Test 2.1

Notes
Fraction Passing finest sieve is by difference

Date Tested: 28/04/15
Date Reported: 30/04/15

Sampling is not covered by IANZ Accreditation

IANZ ACCREDITED LABORATORY
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

IANZ Approved Signatory
Designation : Senior Civil Engineering Technician
Date : 30/04/15

csf 2100 (12/06/13)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001
Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand
t: +64 7 856 2870
f: +64 7 856 2873
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TEST REPORT

Project :	**Waikato Expressway- Hamilton Section**
Location :	**Hamilton**
Client :	**NZ Transport Agency**
Contractor :	**N/A**
Sampled by :	**Opus**
Date sampled :	**Various**
Sampling method :	**Testpit**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/006a**
Client Ref No :	**5G3HL**

Test Results

Sample Location	Depth (m)	Water Content (%)
TP742	0.2-0.7	23.9
TP711	1.8-2.7	61.1
TP715	4.1-6.0	36.3
TP715	3.1-4.1	51.1
TP752	0.4-1.4	43.3
TP777	2.6-5.0	24.7
TP728	1.8	76.3

Test Methods		Notes
Water Content	NZS 4402 : 1986 Test 2.1	

Date tested : 9-13/03/15
Date reported : 16/03/15

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
This report may only be reproduced in full

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 16/03/15

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Opus International Consultants Ltd
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre,
Hamilton 3240, New Zealand

Telephone +64 7 856 2870
Facsimile +64 7 856 2873
Website www.opus.co.nz

NZGD ID: 77263

DRY DENSITY / WATER CONTENT RELATIONSHIP
STANDARD COMPACTION

OPUS

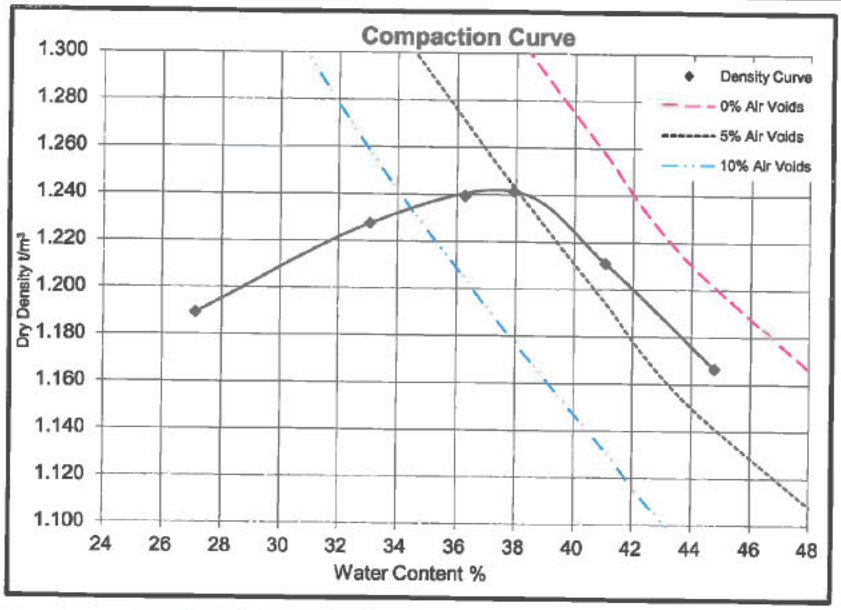
Project :	**Waikato Expressway- Hamilton Section**
Location :	**Hamilton**
Client :	**NZ Transport Agency**
Contractor :	**N/A**
Sampled by :	**J West (Opus)**
Date sampled :	**28/01/15**
Sampling method :	**Testpit**
Sample description :	**SILT, some fine to medium sand; light brown.**
Sample condition :	**As received**
Solid density :	**2.60 t/m³ (Assumed)**
Source:	**TP728, 1.8m**

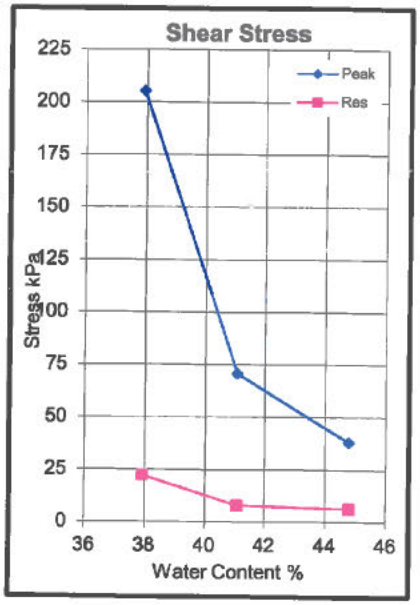
Project No :	**2-31695.00**
Lab Ref No :	**15/803/006**
Client Ref No :	**TP728, 1.8m**

Test Results

Maximum dry density	1.24	t/m³	Natural water content	76.3 %
Optimum water content	37	%	Fraction tested	Passing 19mm

Sample ID		-850	-750	-700	-650	-600	-550	Nat
Bulk density	t/m³	1.512	1.633	1.689	1.712	1.708	1.689	-
Water content	%	27.1	33.1	36.3	37.9	41.1	44.8	76.3
Dry density	t/m³	1.189	1.227	1.239	1.241	1.211	1.166	-
Sample condition		Hard Dry-moist	Hard Moist	Hard Moist-wet	V. Stiff Wet	Stiff Wet	Firm Wet	
Peak stress	kPa	Refusal	Refusal	>207	205	71	38	-
Remoulded stress	kPa	-	-	-	22	8	6	-





Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 (Standard)	
Shear Strength using a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001	

Date tested : 18/03/15
Date reported : 23/03/15

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
This report may only be reproduced in full

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 23/03/15

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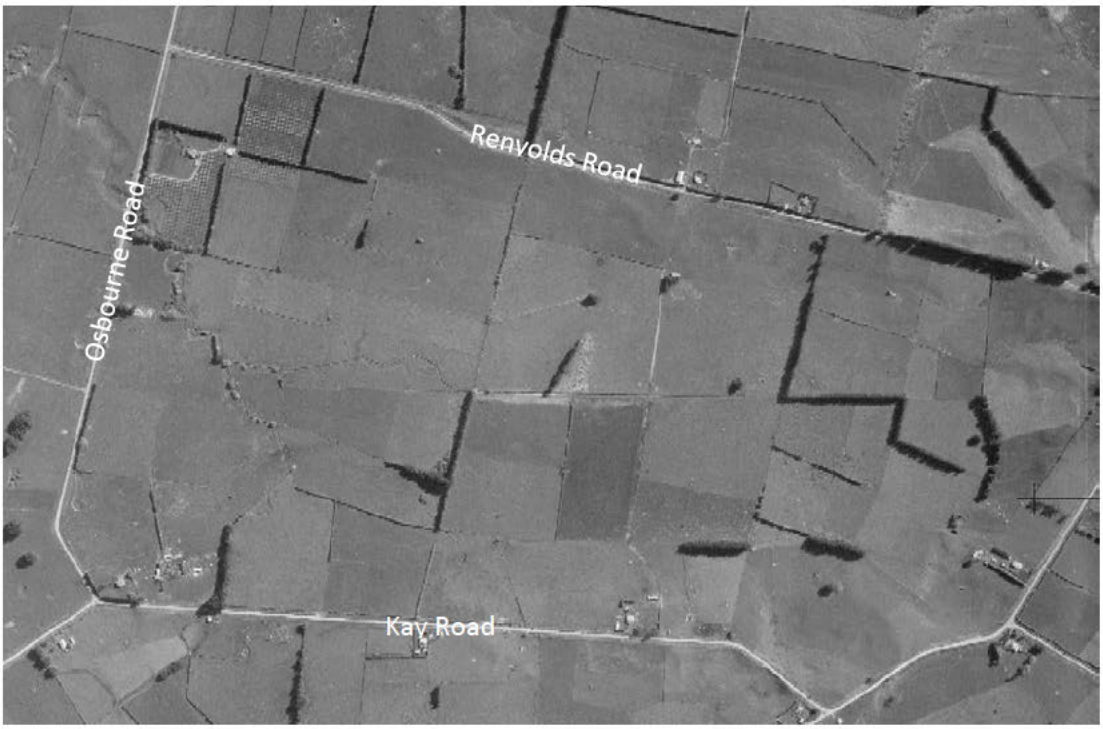
APPENDIX C
Histoical Photographs

Date and source	Key Features
1941 Retrolens	 • No photographs available for the eastern part of site. • Gully present under Osbourne Road into the proposed site. • Area appears to be used for agricultural purposes (pasture).

1952 Retrolens	 • Orchard present in the west in the corner of Osbourne and Reynolds Road.
1979 Retrolens	 • Construction of a road along the eastern boundary has begun. • Orchard has expanded into nearby paddocks. • Hedgerows within the farm have been removed.

1991 Retrolens	 • Orchard has expanded further, and hedgerows have been planted.
2022 Google Earth	 • Potential uncontrolled fill located behind 40B Reynolds Road (Circled in red).

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APPENDIX D
WRC Hazard Maps

Hamilton

Level 1 | Block C
401 Grey Street
Hamilton 3216
New Zealand

Ph: +64 7 2820 039

www.cmwgeosciences.com