Geotechnical Investigations and Data Acquisition

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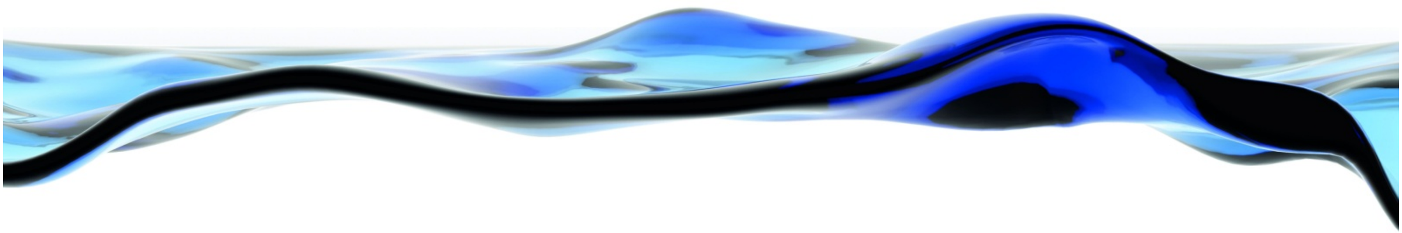

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Executive Summary

As part of the *Project E.1.8 Riverbank Collapse in the Lower River Murray*, both the Universities of Adelaide and Sydney have undertaken geotechnical investigations at 26 different sites along the Lower River Murray, within South Australia (downstream of Lock 1 at Blanchetown to Wellington). The aim of the geotechnical investigations is to add to the existing catalogue of subsurface information and geotechnical data at various sites along the Lower River Murray.

This report contains the summaries of the results of desktop studies, geotechnical in-situ investigations and laboratory testing that were undertaken by both Universities. Additional lithology and stratigraphy data from drillers' logs for sites, where no geotechnical investigations have been carried out, are examined and summarised in this report. The geotechnical investigations and testing performed and described in this report have, in general, confirmed the stratigraphy indicated by the various geological maps relevant to the various locations examined. The investigations and testing have provided additional, relevant data that will be used in the numerical modelling and conclusions drawn in the later phases of this Riverbank Collapse project.

1 Introduction

Riverbank collapse is a natural part of the evolution of rivers. An unprecedented period of dry conditions and low flows between 2005 and 2010 led to more than 162 reported riverbank collapse-related incidents occurring between 2008 and 2010 along the Lower River Murray, in South Australia (downstream of Lock 1 at Blanchetown to Wellington). The most significant collapse event occurred near Long Island Marina, Murray Bridge, on February 4, 2009 when a 60 x 20 m (70,000 m^3) section of riverbank, collapsed into the river, taking with it three unoccupied vehicles and several trees.

As a consequence of this, in September 2009, riverbank collapse was declared a State Hazard under the SA Emergency Management Plan. In January 2013, the Goyder Institute for Water Research approved funding for researchers from the Universities of Adelaide and Sydney to undertake a detailed study to understand better the factors that influence riverbank collapse, which, in turn, will improve management of the River.

The study is subdivided into 6 tasks and this report summarises *Task 3: Geotechnical Investigations and Data Acquisition*. The aim of the geotechnical investigations is to add to the existing catalogue of subsurface information and geotechnical data at various sites along the Lower River Murray. It provides additional and important information on the Lower River Murray riverbank collapse sites and other relevant sites for the development of stability and predictive models.

2 Scope of Work

The scope of the geotechnical investigations includes the following:

- Desktop review of existing geotechnical and geological information;
- Review and summary of previous geotechnical reports by SKM and Coffey Geotechnics;
- Summary of the ground lithology from drillers' logs obtained from the WaterConnect database;
- Testing at 26 sites along the 209 km reach of the Lower River Murray from the towns of Blanchetown (Lock 1) to Wellington;
- Geotechnical sampling and testing, at each site, comprising:
    - Collecting thin-walled push tube samples from the boreholes at various depths;
    - Identification and visual description of the samples including field classification, colour (referenced to a standard colour chart), odour, structure and consistency;
    - Measurement of the field undrained shear strength of fine-grained material by pocket penetrometer tests, at various depths;
    - Cone penetration test with pore-water pressure measurements (CPTu) at each site. The CPTu was performed to a nominal target depth of 20 m or refusal;
- Total soil suction and moisture content testing; and
- Consolidated Undrained (CU) triaxial testing on a range of undisturbed soil samples to determine the variation in strength of the soil profile.

This report summarises the results of these geotechnical investigations. The regions where the site investigation has been undertaken are shown in Figures 1 to 5.

3 Data Sources

The data sources used in this report include the following:

- Geological Survey of South Australia (1962) 1:250,000 Adelaide, Barker and Renmark map-sheets;
- Study into River Bank Collapsing – Lower River Murray Report (SKM, 2010b);
- Past geotechnical investigation report by Coffey for Riverine Recovery Project (Coffey, 2013a, 2013b, 2013c, 2014a, 2014b, 2014c)
- Ground investigation data (as presented in this report) including borehole logs;
- Tests;
    - In-situ tests including cone penetrometer and pocket penetrometer; and
    - Laboratory test results, mainly consolidated undrained (CU) Triaxial testing;
- GIS Database provided by South Australian Government; and
- Drillers' logs from WaterConnect groundwater database (https://www.waterconnect.sa.gov.au).

Figure 1: The scope of the present study (Wellington to Avoca Dell)

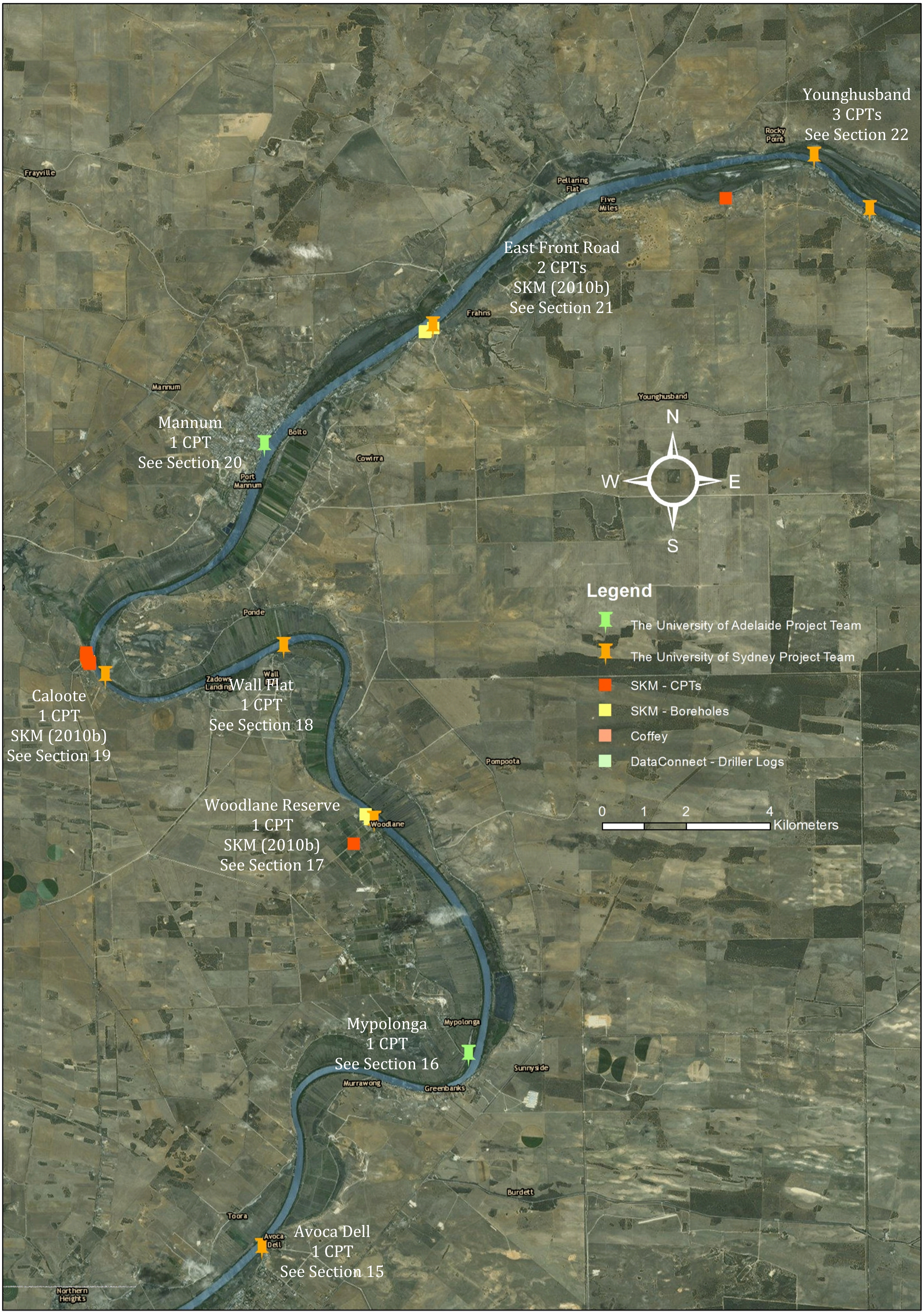

Figure 2: The scope of the present study (Avoca Dell to Younghusband)

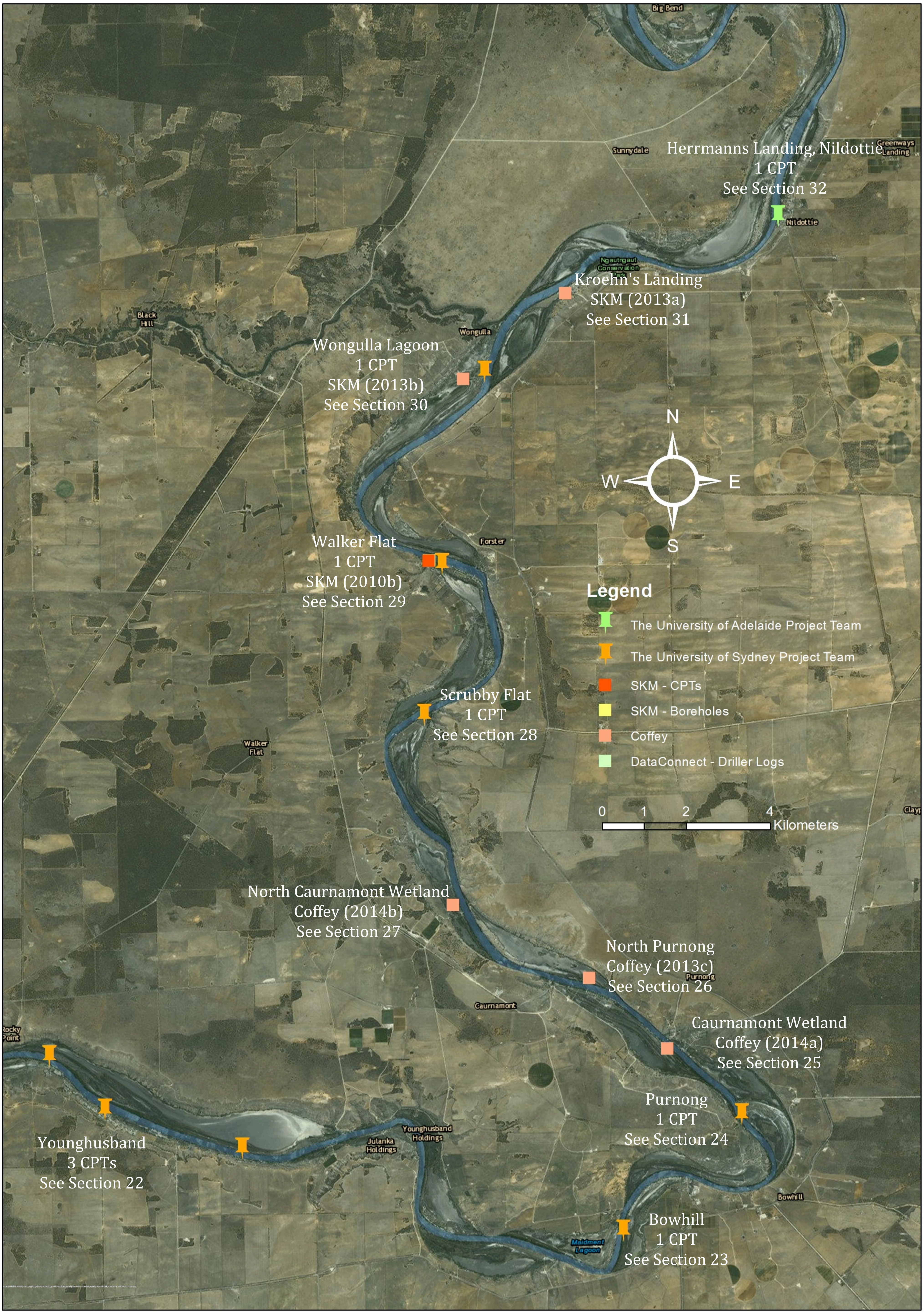

Figure 3: The scope of the present study (Younghusband to Nildottie)

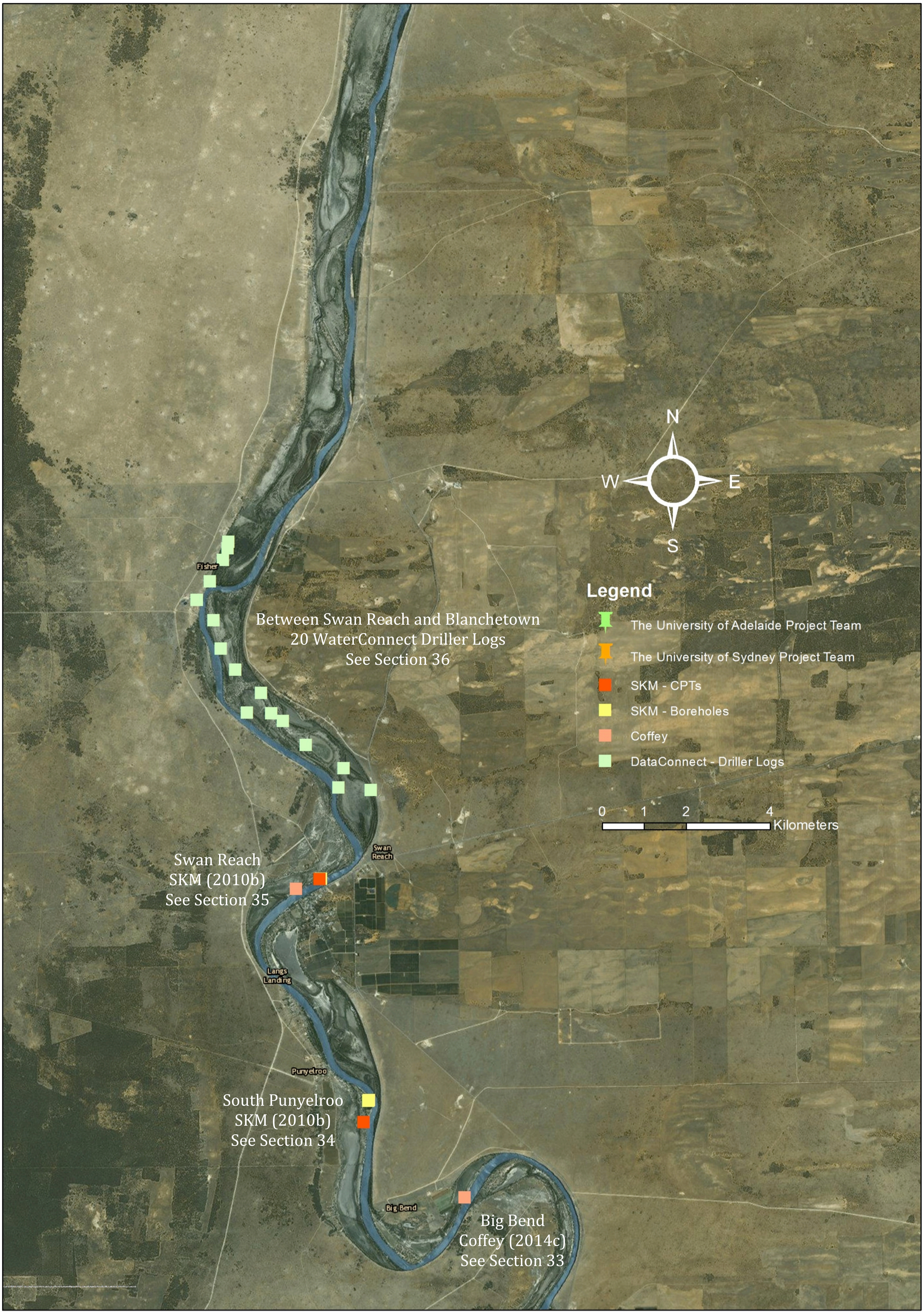

Figure 4: The scope of the present study (Big Bend to regions between Swan Reach and Blanchetown)

Figure 5: The scope of the present study (regions between Swan Reach and Blanchetown)

4 Geotechnical investigations

4.1 Field Investigation

4.1.1 CPTu and Boreholes

The CPTu or piezocone test is a cone penetration test (CPT), which includes the measurement of pore water pressure (u_2) in addition to cone tip resistance (q_c) and sleeve friction (f_s). The addition of pore-water pressure measurement allows more reliable assessment of soil types, shear strength, stiffness and consolidation characteristics. A typical CPTu plot is shown in Figure 6.

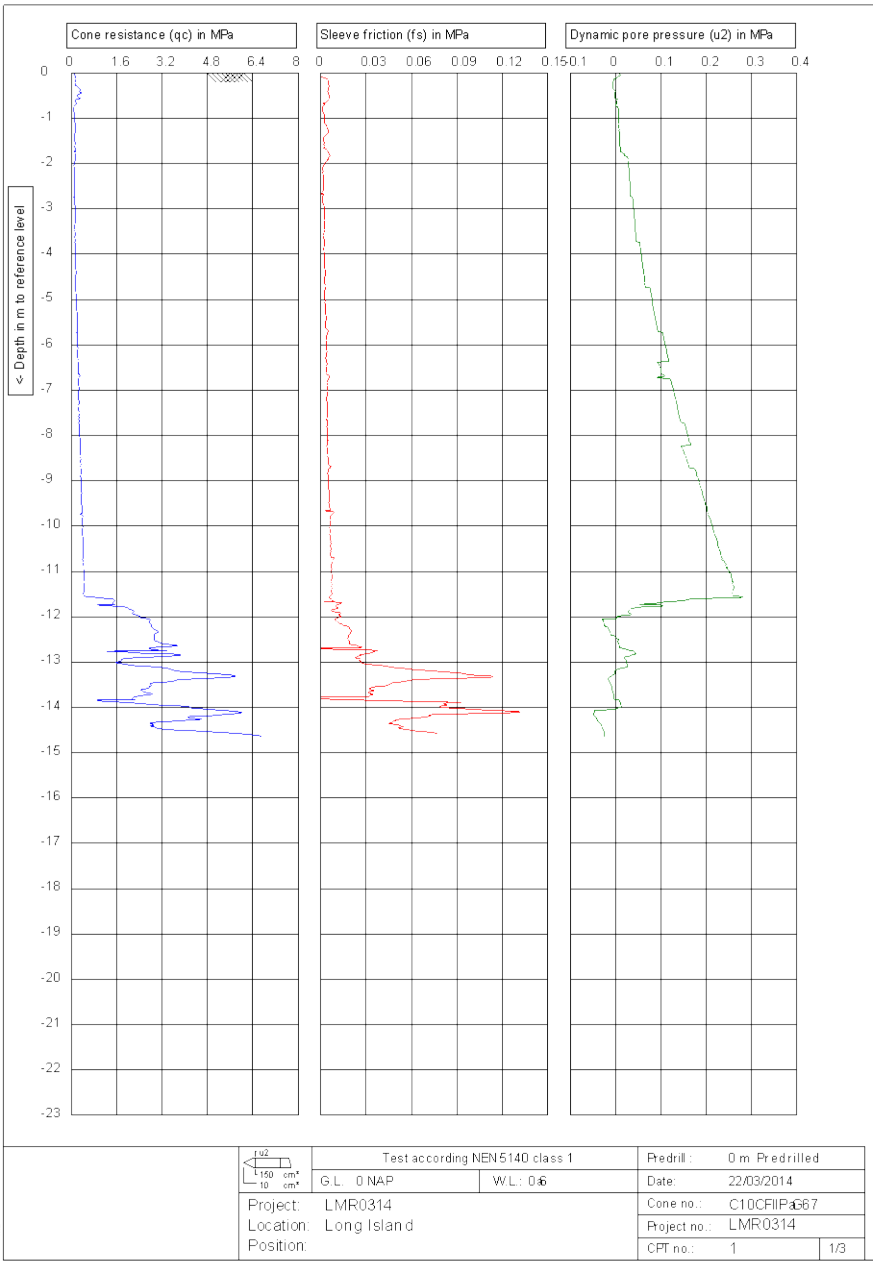

Figure 6: An example of a CPTu plot showing measurements of cone tip resistance (q_c), sleeve friction (f_s) and pore water pressure (u_2)

The values of q_c are typically corrected taking account the effects of cone shape and pore water pressure distribution around the cone. The parameter q_t is the corrected cone tip resistance and it is determined by $q_t = q_c + u_2(1 - a)$, where a is net area ratio of the cone tip, which ranges from 0.6 to 0.8 depending on the cone design. The parameter q_t is then further normalised by taking into account overburden pressure. Therefore the corrected cone resistance $Q_t = (q_t - \sigma_{vo})/\sigma'_{vo}$, where σ_{vo} and σ'_{vo} are total and effective overburden pressures, respectively. The friction ratio, R_f, is typically calculated as $R_f = 100\% \times f_s/(q_t - \sigma_{vo})$. A typical q_t and R_f versus depth plot is shown in Figure 7.

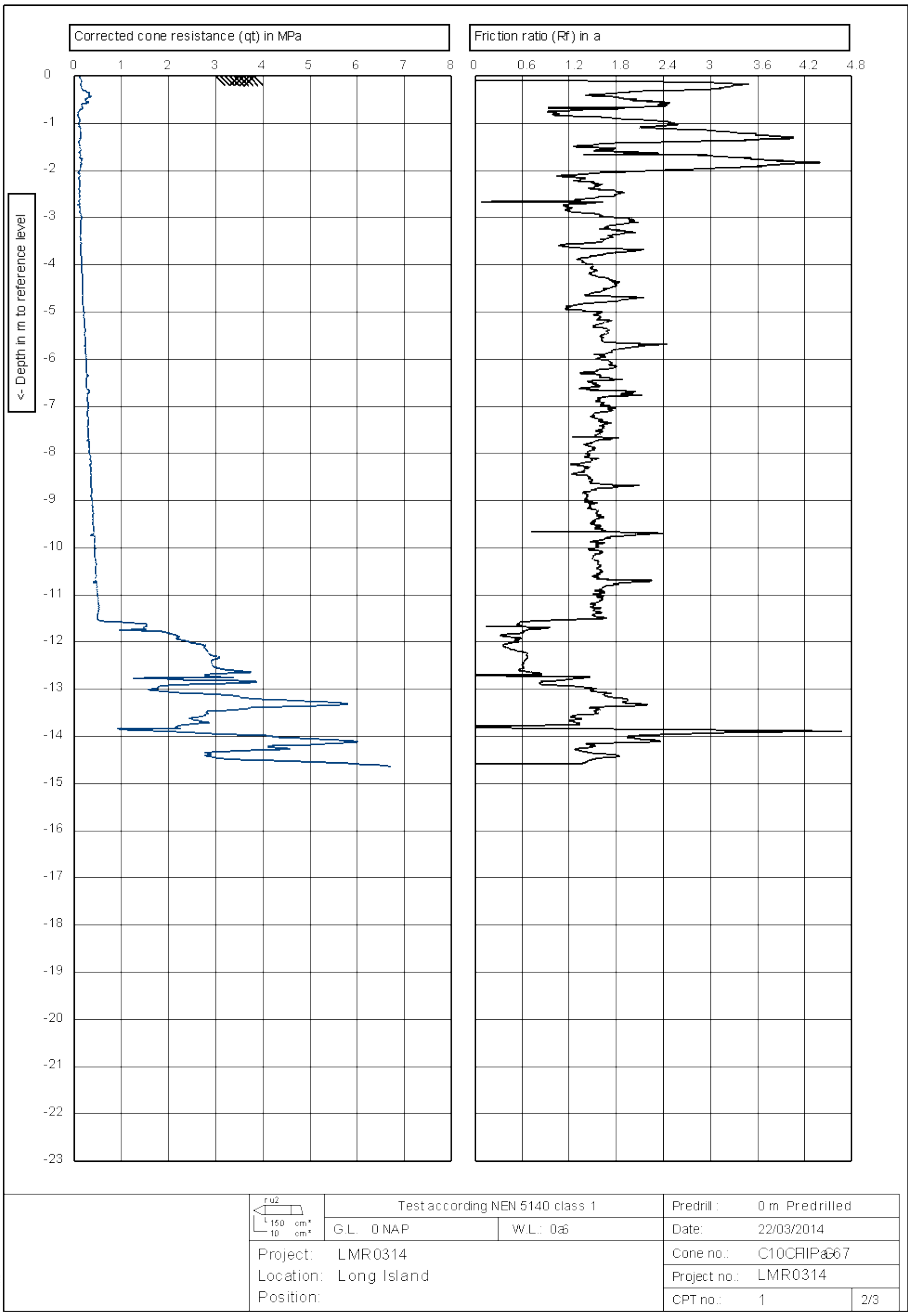

Figure 7: An example of a CPTu plot showing q_t and R_f varying with depth.

Another important parameter for interpreting the CPTu data is, B_q, which is the excess pore water pressure ratio, defined as the ratio of the measured excess pore water pressure to the net cone resistance, and it is calculated as $B_q = (u_2 - u_0)/(q_t - \sigma_{vo})$. Using Q_t, R_f and B_q, the soil type and soil stratigraphy can be determined from the CPT results by using the soil classification chart proposed by Robertson et al. (1986) as shown in Figure 8. An example of the results of such interpretation is shown in Figure 9.

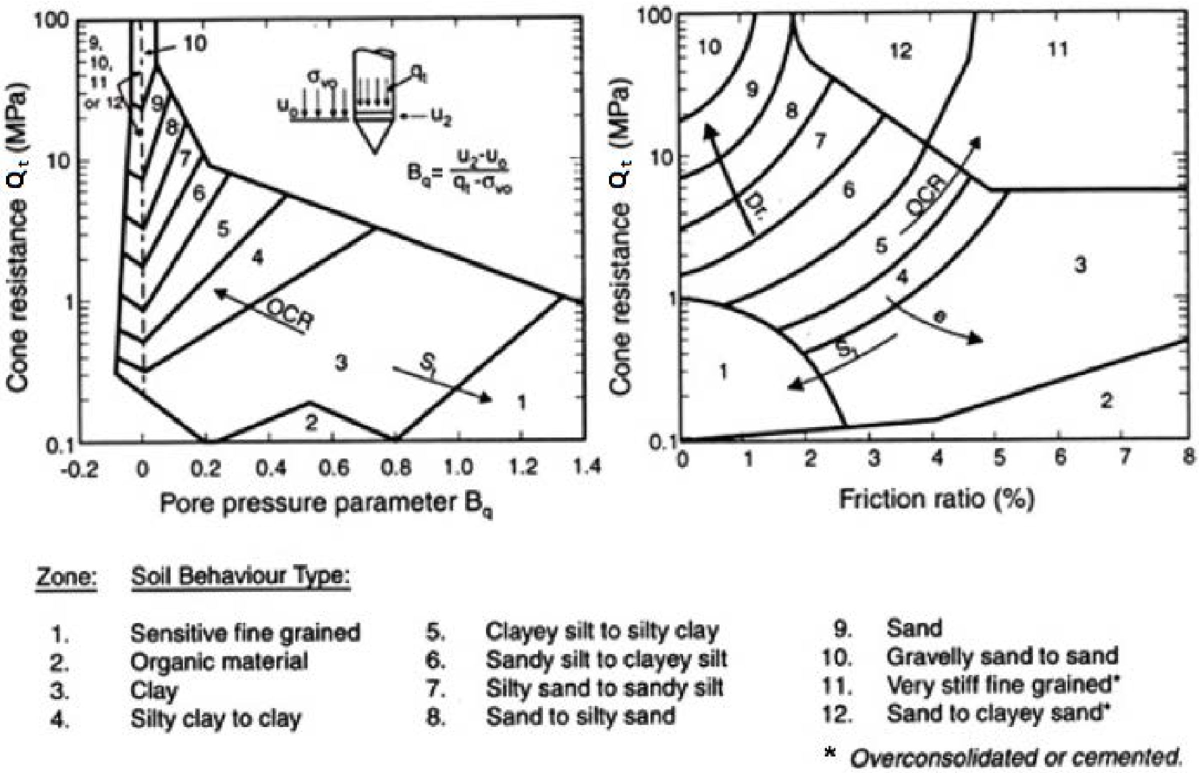

Figure 8: Proposed soil classification chart from CPTu data by Robertson et al. (1986).

The field investigations undertaken by the University of Adelaide team were performed between July 21 and October 15, 2014. The fieldwork comprised two boreholes and 11 onshore CPTu tests, to a maximum depth of 20 m below the existing ground surface level, at 8 nominated sites (Table 2). The boreholes were drilled using a Warman Scout 250 drilling rig. The soil profile encountered in the boreholes was logged and soil samples were obtained to confirm visual classification and for additional laboratory testing.

The University of Sydney team undertook offshore coring and soil sampling within the river channel. The field investigations were performed in three campaigns: (i) April 29 to May 13, 2013; (ii) February 3 to 12, 2014; and (iii) March 19 to 26, 2014. The fieldwork comprised 27 CPTu tests, to refusal or the maximum allowable depth, at 21 different sites (Table 2). Soil samples were collected for additional laboratory testing (mini vane shear testing, particle size analysis). Photographs of the onshore and offshore CPTu testing are presented in Section 41 (this report).

The geotechnical borehole logs are included in the appendices corresponding to each site, and a summary of the borehole details is presented in Table 1. The CPTu results are included in the appendices, and a summary of the test details is presented in Table 2.

Table 1: Borehole details

Borehole No.	Location	Easting [mE]	Northing [mN]	Elevation [m AHD][1]	Final Depth [m below ground level][2]
BH_TR_1	Thiele Reserve	343113	6113907	1.20	17.25
BH_BLR_1	Bells Landing Reserve, Monteith	346648	6106788	1.15	16.6
BH_WR_1	Wellington Reserve	353180	6089003	2.88	20.45

Notes: 1. metres Australian Height Datum; and 2. metres below ground level.

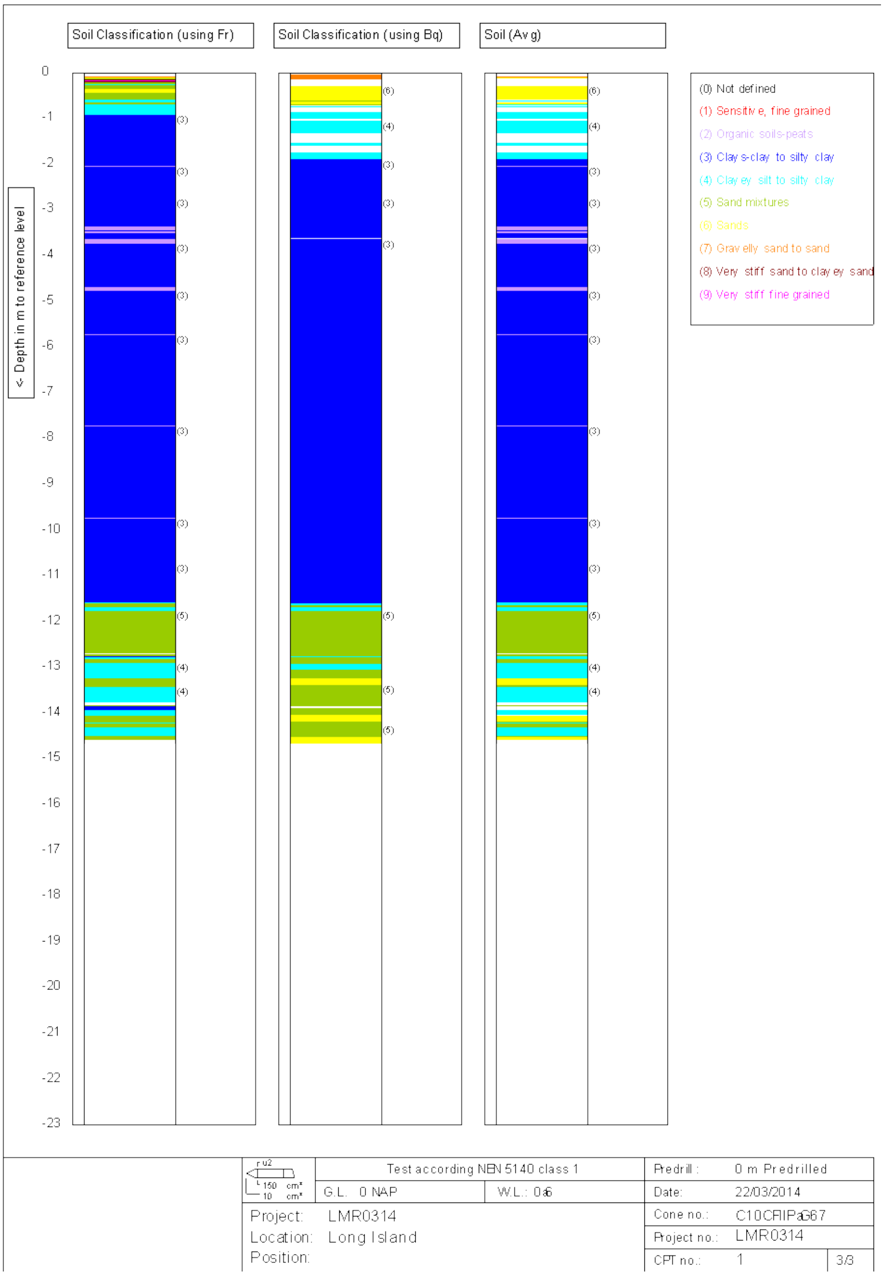

Figure 9: An example of soil profile interpreted from CPTu data.

Two pore water pressure dissipation tests (at the same location but at different depths) were undertaken at Riverglen Marina, Whitesands and the results are shown in **Appendix 5.**

Table 2: CPTu testing details

CPTu No.	Locations	Easting* [mE]	Northing* [mN]
Wellington_ADE_1	Wellington Reserve	-	-
LMR0214_W_1	Wellington	353178	6089048
LMR0214_WE_1	Wellington East Marina	353233	6089803
LMR0214_MVE_1	Murray View Estates, Tailem Bend	357350	6093006
Whitesands_ADE_1~	Riverglen Marina, Whitesands	-	-
LMR0513_TL_1	Whitesands	-	-
LMR0513_WS_1	Whitesands	-	-
LMR0214_RG_2	Riverglen Marina, Whitesands	348214	6104380
Westbrooks_ADE_1	Westbrooks Caravan, Tailem Bend	-	-
Westbrooks_ADE_2	Westbrooks Caravan, Tailem Bend	-	-
Westbrooks_ADE _3	Westbrooks Caravan, Tailem Bend	-	-
Westbrooks_ADE _4	Westbrooks Caravan, Tailem Bend	-	-
LMR0214_WB_1	Westbrooks Caravan, Tailem Bend	354771	6101444
Monteith_ADE_1	Bells Landing Reserve, Monteith	-	-
LMR0214_BR_1	Bells Landing Reserve, Monteith	346634	6106805
LMR0214_LIM_1	Long Island Marina, Murray Bridge	345564	6110662
LMR0214_LIM_2	Long Island Marina, Murray Bridge	345564	6110662
LMR0214_SR_1	Sturt Reserve, Murray Bridge	343532	6112394
LMR0314_LIM_1	Long Island Marina, Murray Bridge	344665	6111528
Thiele_ADE_1	Thiele Reserve, Murray Bridge	-	-
LMR0214_TR_1	Thiele Reserve, Murray Bridge	343129	6113921
LMR0214_AD_1	Avoca Dell	345676	6115810
Mypolonga_ADE_1	Mypolonga	-	-
LMR0214_WR_1	Woodlane Reserve	348350	6125995
LMR0214_WF_1	Wall Flat	346193	6130131
LMR0214_NI_1	Neeta Irrigation Area	341939	6129444
Mannum_ADE_1	Mary Ann Reserve, Mannum	-	-
LMR0513_EFR_1	East Front Road	-	-
LMR0214_EFR_1	East Front Road	349749	6137775
LMR0214_YH_1	Younghusband	363437	6139565
LMR0314_YH_2	Younghusband	360167	6140549
LMR0314_YH_3	Younghusband	358836	6141823
LMR0314_BH_1	Bowhill	372520	6137668
LMR0314_P_1	Purnong	375342	6140438
LMR0314_SF_1	Scrubby Flat	367778	6149959
LMR0314_WF_1	Walker Flat	368198	6153555
LMR0314_WG_1	Wongulla	369210	6158135
Nildottie_ADE_1	Herrmanns Landing, Nildottie	-	-

Note: * Accuracy: ± 8 m; ~ pore water pressure dissipation test; - Not available/measured

4.2 Laboratory Testing

Geotechnical laboratory testing was undertaken on selected samples obtained from the boreholes in the Geotechnical Engineering Laboratory of School of Civil Environmental and Mining Engineering at the University of Adelaide. The tests that were undertaken are summarised in Table 3. Laboratory test results are presented in following sections (4.2.2 and 4.2.3) and appendices (Appendix 27-29).

Table 3: Geotechnical laboratory testing types

Test Description	Applicable Australian Standard
Visual Classification and Moisture Content	AS 1289.2.1.1
4.2.1.1.1.1.1.1.1 Total Soil Suction	4.2.1.1.1.1.1.1.2 AS 1289.2.2.1
Saturated Consolidated Undrained (CU) Triaxial	AS 1289.6.4.2

4.2.2 Total Soil Suction

A total of 24 shallow soil samples were collected at various locations along the Lower River Murray by the University of Sydney team. The cling film wrapped soil samples were then delivered to the School of Civil, Environmental and Mining Engineering for testing. The samples were tested on the June 12, 2013 by staff from the School of Civil, Environmental and Mining Engineering.

Total soil suction was measured using an SMI Transistor Psychrometer. The tests were performed in accordance with the procedure specified in the manual (SMI, 2002).

The average total soil suctions are summarised in Table 4 and Figure 1.

Table 4: Summary of results of total soil suction tests.

Sampling Location	Depth (m)	Soil Suction		Amount Outside Limits of AS 1289.2.2.1 (pF)
		(pF)	(kPa)	
LMR 0513 WS2	0.13	3.70#	492	0.05
	0.73	3.75	552	N/A
	1.15	3.80	619	N/A
	1.19	3.80	619	N/A
Note #: Average of three pF readings: 3.54, 3.69 and 3.81				
LMR 0513 WSF1	0.22	3.95	875	0.02
	0.85	3.90	779	N/A
	1.25	3.85	695	N/A
	1.70	3.90	779	N/A
LMR 0513 RG2A	0.24	3.95	875	N/A
	1.03	3.65	438	N/A
	1.35	3.90	779	N/A
	1.76	3.90	779	N/A
LMR 0513 TL2	0.30	3.65	438	N/A
	0.70	3.75	552	N/A
	1.43	3.90	779	N/A
LMR 0513 WS1	0.27	3.80	619	N/A
LMR 0513 RG1A	0.23	3.95	875	N/A
	0.42	3.75	552	N/A
	0.83	3.80	619	N/A
	1.77	3.80	619	N/A
LMR 0513 RG0A	0.64	3.95	875	N/A
	1.09	3.95	875	N/A
	1.56	3.70	492	N/A
	2.10	3.85	695	N/A

Values of pF are reported in accordance with AS 1289.2.2.1 (Standards Australia 1998). That is, for suctions equal to or less than 3.6 pF, values are given to the nearest 0.1, and greater than 3.6 pF, to the nearest 0.05. Additional sub samples were tested, in accordance with AS 1289.2.2.1, when the test results differed by more than 0.2 pF (for suctions less than or equal to 3.6 pF) or 0.1 pF (for suctions greater than 3.6 pF). When the additional sub samples still differed, these are noted in Table 4.

4.2.3 Saturated Consolidated Undrained (CU) Triaxial Testing

A total of three consolidated undrained (CU) triaxial testis were undertaken by the University of Adelaide team using the GDS Instruments static triaxial testing machine. The U50 (a Selby sampling tube of 50 mm internal diameter) undisturbed soil samples were obtained at Thiele reserve, Murray Bridge East on July 21, 2014 and were tested on various dates (refer to Table 5) by staff of the School of Civil, Environmental and Mining Engineering. The triaxial tests were carried out using the procedures recommended by Head (1998). The samples had nominal dimensions of 50 mm in diameter and 100 mm high. The testing parameters are summarised in Table 5 and the results are given in Table 6. The effective stress versus stain and variation of pore-water pressure versus strain curves for each test are presented in **Appendices 27, 28 and 29**.

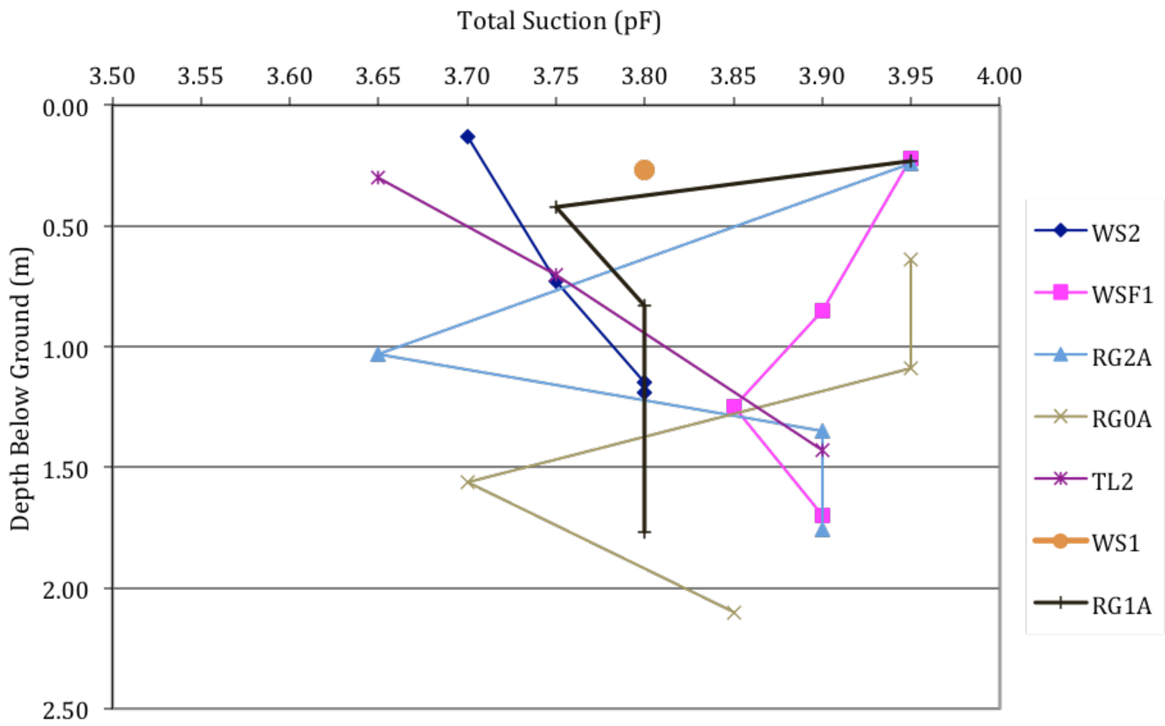

Figure 10: Total soil suction versus depth below ground.

Table 5: Summary of triaxial testing details.

Sampling Locations	Depth (m)	Test Date	Samples Descriptions	Cell Pressure (kPa)	Back Pressure (kPa)
Thiele Reserve	9.8 - 10.25	12/12/15	CH, Silty CLAY, dark grey, with high plasticity fines, traces of fine sands and organics fibre (e.g. vegetation roots), sand contents increase with depth	180	95
	11.15 - 11.6	25/03/15		205	108
	13.65 - 14.1	02/04/15		250	133

Table 6: Summary of triaxial testing results.

Depth (m)	Maximum Deviator Stress (kPa)	Effective Minor Principal Stress, σ'_3 (kPa):	Effective Major Principal Stress, σ'_1 (kPa):	Pore Pressure (kPa)	Cohesion, c' (kPa)	Frictional Angle, ϕ' (°)
9.8 – 10.25	303	85	388	100	0	41
11.15 – 11.6	329	97	426	115		
13.65 – 14.1	475	117	592	173		

All samples were subjected to cell pressures equal to the in situ overburden pressures and back pressures equivalent to the in situ pore-water pressures at the corresponding depths. All stress-strain results showed a clear peak deviator stress followed by post-peak, stress-softening behaviour, suggesting these are all overconsolidated soil samples. The c' and ϕ' were determined from the Mohr circles at failure, as shown in Figure 2, to be 0 kPa and 41° respectively.

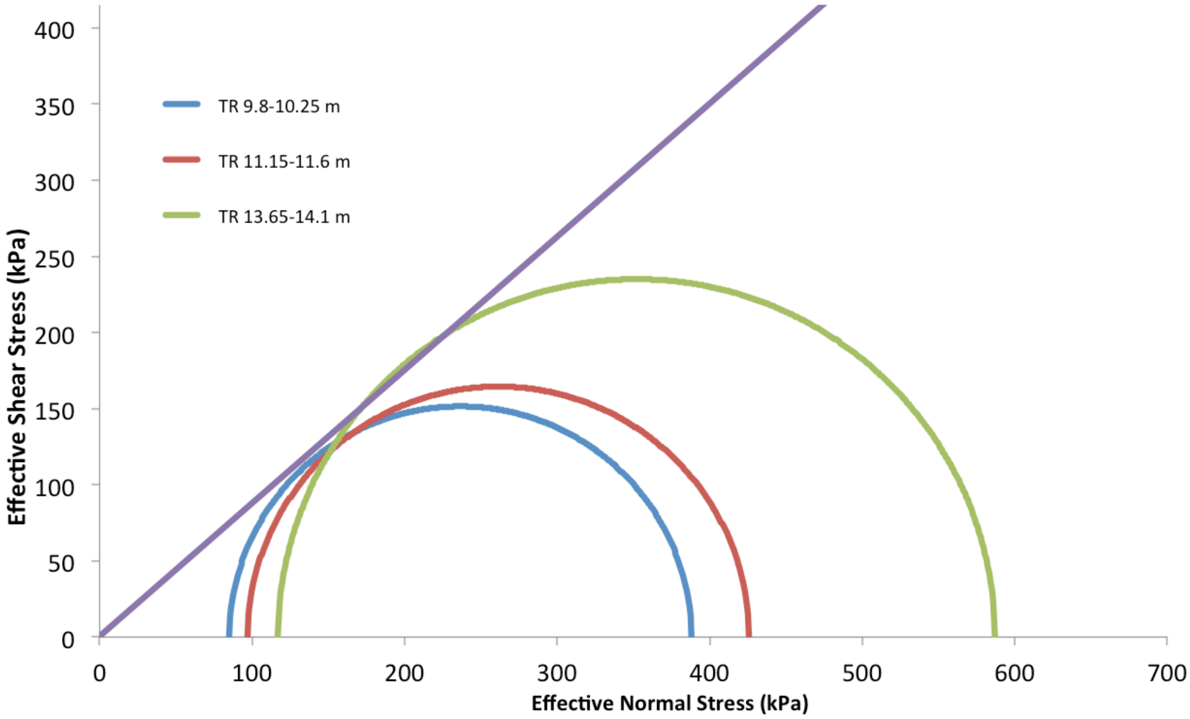

Figure 11: Mohr-circles at failure

5 Overview of geological setting of Lower River Murray and subsurface materials

5.1 Geological setting

The Lower River Murray (LRM) is located at the terminus of the Murray-Darling Basin drainage system which covers 1.073 km^2 or 14% of Australia's landmass. The LMR channel has been structurally controlled through uplift of the Murray Basin since the Pliocene, and the river itself entrenched and incised within the LMR bedrock valley due to a combination of this uplift and glacio-eustatic sea level fluctuations during the Pleistocene (Twidale et al., 1978; Murray-Wallace et al., 2010). The valley is between 3 to 5 kilometres wide and its base reaches approximately 10 m below present-day sea level at Swan Reach and approximately 65 m at Murray Bridge (Twidale et al., 1978). Sands of the Monoman Formation comprise the 'lower valley fill' deposited during late Pleistocene deglaciations and marine transgressions. As the sea level stabilised during the Holocene, alluvial muds of the Coonambidgal Formation were deposited comprising the 'upper valley fill' or 'Soft Clays' referred to in previous geotechnical investigations.

The present-day LMR is a low sinuosity, suspended-load channel with cohesive bank materials, low bed slopes and low stream power (Thoms and Walker, 1989). It terminates at Lakes Alexandrina and Albert before debouching into the Southern Ocean through the Coorong Lagoon and Murray Mouth.

5.2 Subsurface materials

The site investigation confirmed that the riverbanks generally comprises of up to 5 metres of fills overlying soft clay of the Coonambidgal Formation. The soft Coonambidgal clay is underlain by coarser grained alluvial deposits (sands) belonging to the Monoman Formation.

Riverbanks that are located at the toe of a very steep cliff are erosional benches with residual soils from parent materials such as Sandstones or Limestones.

The in-river sediment cores obtained demonstrate the spatial and lateral consistency (or valley-wide extent) of the Soft Clay or Coonambidgal muds sediment, confirming the uniformity observed at depth in the CPTu results and supplementary findings of previous geotechnical investigations by others. The Soft Clay is underlain by stiffer Monoman Sands or near-surface bedrock, with this interface becoming deeper in the stratigraphic profile from Walkers Flat to Riverglen (approx. 10 m below the surface to greater than 20 m). Generally the top 2 to 4 metres of the Soft Clay is overlain by colluvium and fill associated with anthropogenically constructed levees and riverbanks, reflected in the cores and CPTu results.

6 Wellington West

6.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1, 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise fine-grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of the Mannum Formation (To-m). The surface of the higher ground is shown to comprise of recent Pleistocene age, kunkarised dunes and associated sand spread and Kunkar (presently known as calcrete, in sheets) with calcareous bedrock (Qpe).

6.2 Subsurface Condition

A single onshore CPTu has been undertaken by the University of Adelaide team, and the CPTu results showed that the subsurface profile encountered at Wellington West generally comprised fill of Sandy CLAY or Clayey SAND overlying Silty CLAY with a transition typically around 3.5 m depth. The investigation confirmed the expected Quaternary aged Alluvial Flat Deposits, as seen on the Geological Survey of South Australia (1962) Barker map Sheet 1, 54-13 sheet. The Silty CLAY layer consists of dark grey, very soft Silty CLAY with high plasticity fines extending up to 6.5 m deep. Clayey SAND and Sandy CLAY interbeds underlay this layer of Silty CLAY, extending up to the termination depth of approximately 18.75 m. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plots in **Appendix 1**. A summary of the soil profile derived from the CPTu test data is presented in Table 7.

Due to the drilling method employed, it was not possible to determine the elevation of the groundwater table. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 7: Soil profile derived from onshore CPTu test data – Wellington West.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill - Silty/Clayey SAND (SM/SC)	0.0 to 3.5
2	Silty CLAY (CH)	3.5 to 6.5
3	Clayey SAND/Sandy CLAY (SC/CL)	6.5 to 18.75*

* Limit of investigation – refusal

A single offshore CPTu test has been undertaken by the University of Sydney in the vicinity of Wellington West. The CPTu results showed that the riverbed is generally comprised of sandy sediments (SAND or Gravelly SAND), with Silty CLAY and SAND interbedded layers between 0.8 to 2.0 m depth below the sediment. The geotechnical profile encountered during the investigation is summarised in Table 8 and further details are presented on the CPTu plots in **Appendix 1**. The locations of the CPTu soundings are shown in Figure 12.

Table 8: Soil profile derived from offshore CPTu test data – Wellington West.

Layer No.	Soil Type	Depth Below the Ground (m)
1	SAND or Gravelly SAND	0 to 0.8
2	Clayey SAND/Sandy CLAY	0.8 to 2.0
3	SAND or Gravelly SAND	2.0 to 3.6*

* Limit of investigation – refusal

Figure 12: Locations of the CPTu testing near Wellington West (Yellow Label: Wellington_ADE_1; Blue Label: LMR0214_W_1).

7 Wellington East

7.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The surface of the higher ground is shown to comprise recent Pleistocene age kunkarised dunes and associated sand spread and Kunkar (presently known as calcrete, in sheets) with calcareous bedrock (Qpe).

7.2 Subsurface Condition

Two driller logs (WaterConnect's reference no. 6727-3073 and 6727-2074) were found in the vicinity of the floodplain at Wellington East, and the lithology is summarised in Table 9. Further details of the driller logs can be found in **Appendix 2**, and the location of the wells are shown in Figure 13.

Table 9: A summary of lithology of Wellington East obtained from WaterConnect's database.

Layer No.	Soil Type	Elevation AHD (m)	
		Start	End
1	Sandy CLAY or Clayey SAND	1.8	-1.2
2	CLAY	-0.1 to -1.2	-3.2

Figure 13: Locations of the CPTu testing and wells (blue marker: LMR0214_W_1; red markers: WaterConnect)

A single offshore CPTu was undertaken by the University of Sydney team in the vicinity of the Wellington East Marina and the location of the CPTu sounding is shown in Figure 13. The geological units encountered during the investigation, as well as the extent of each geological unit, are summarised in Table 10. Reference should be made to the CPTu plot in **Appendix 2** for more detailed information.

Table 10: Soil profile derived from offshore CPTu test data – Wellington East Marina.

Layer No.	Soil Type	Depth Below the Ground (m)
1	SAND or Gravelly SAND	0 to 1.75
2	Silty CLAY	1.75 to ~26.0*

* Limit of investigation – termination

8 Tailem Bend

8.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age Sandy Limestones of Mannum Formation (To-m).

8.2 Subsurface Condition

Five drillers' logs (WaterConnect's reference no. 6727-2921, 6727-2922, 6727-2923, 6727-2924 and 6727-2925) were found near Tailem Bend. All boreholes were undertaken at higher ground (i.e. cliffs), and hence the elevations (AHD) are not known. A summary of the lithology is presented in Table 11. The locations are shown in Figure 14. Further details of the drillers' logs can be found in **Appendix 3**.

Table 11: A summary of lithology of Tailem Bend West obtained from WaterConnect's database.

Layer No.	Soil Type	Depth Below the Ground (m)	
		Start	End
1a	Fill	0.0	1.8
2a	Sand	1.8	3.5
3a	Clay	3.5	4.3
4a	Limestone	4.3	7.0
1b	Fill	0.0	0.4 to 0.7
2b	Clay or Silt	0.4 to 0.7	1.0 to 1.5
3b	Limestone	1.0 to 1.5	2.0 to 3.0
4b	CLAY	2.0 to 3.0	2.8 to 4.5
5b	Limestone or Sand, Sandstone and Limestone interbedded layers	2.8 to 4.5	4.0 to 6.0
1c	Fill	0.0	0.0 to 0.5
2c	Silt	0.0 to 0.5	1.0 to 1.2
3c	Limestone	1.0 to 1.2	6.5 to 7.0
1d	Fill	0.0	0.5
2d	Calcrete and Clay	0.5	3.0
3d	Sand	3.0	17.0
4d	Siltstone or Limestone	17.0	23.5

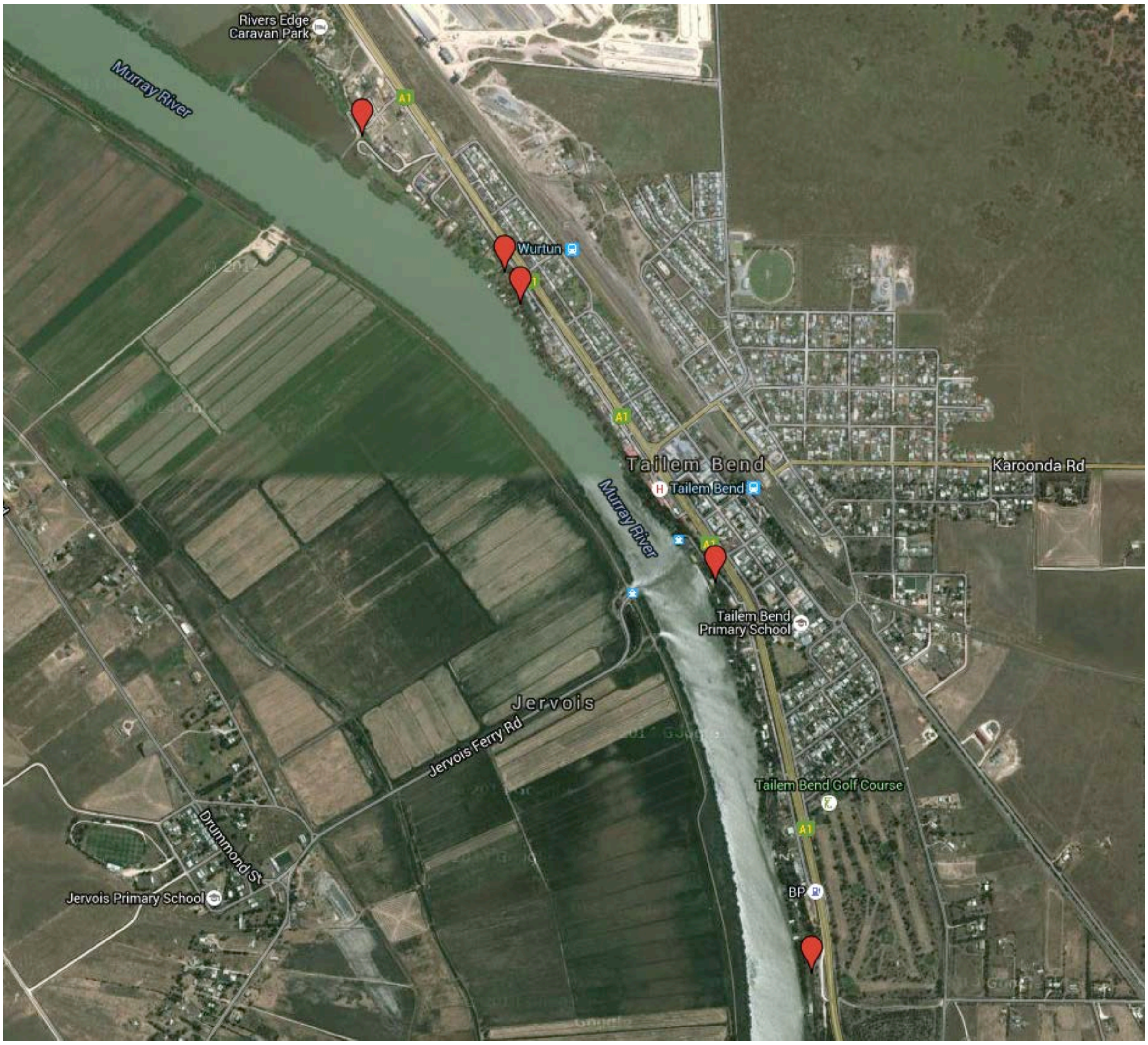

Figure 14: The locations of selected drillers' logs near Tailem Bend

9 Jervois

9.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m).

9.2 Subsurface Condition

A single driller log (WaterConnect's reference no. 6727-3225) was found near Jervois and a summary of the lithology is presented in Table 12. The location is shown in Figure 15.

Table 12: A summary of lithology of Jervois obtained from WaterConnect's database.

Layer No.	Soil Type	Depth Below the Ground (m)	
		Start	End
1	Fill	0	1.35
2	Silty Clay	1.35	2.1
3	Silty Sand	2.1	4.5
4	Silty Clay	4.5	44.0
5	Sand	44	47.5
6	Sandstone	47.5	49.5
7	Silty Clay	49.5	50.0

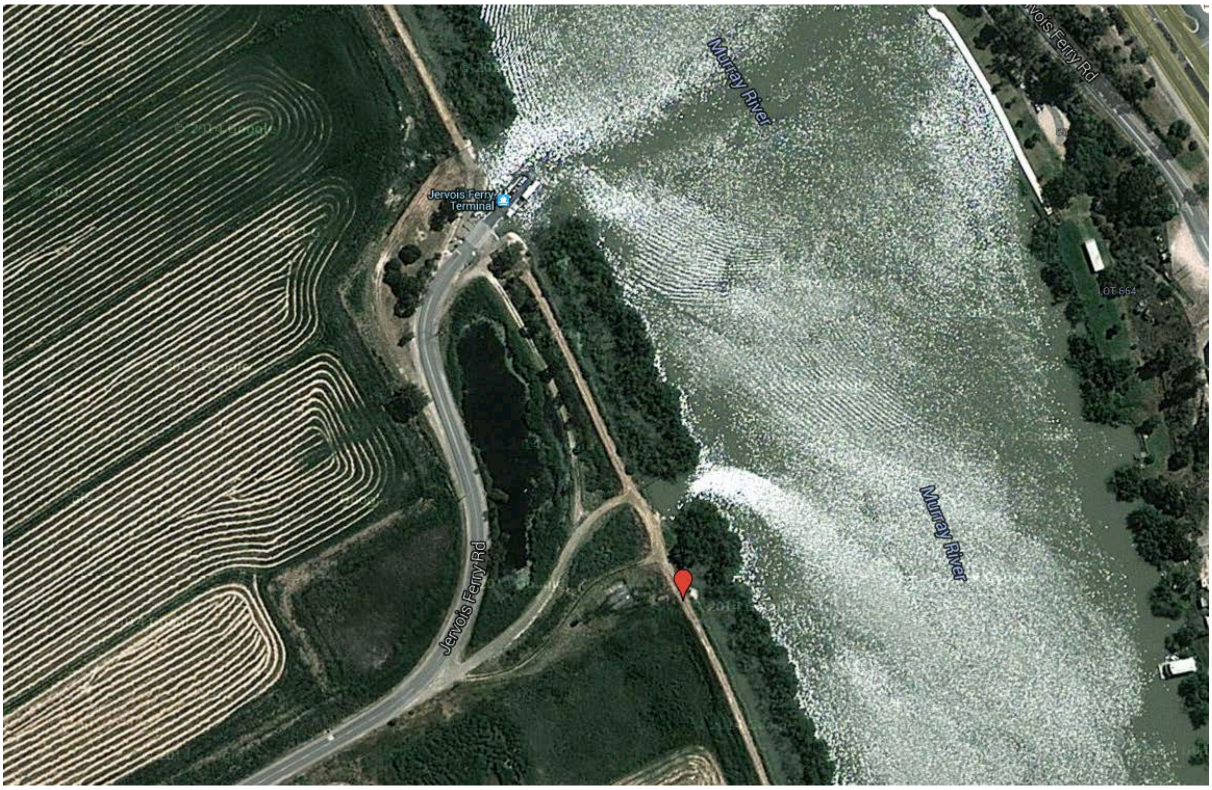

Figure 15: The location of selected driller's log near Jervois

10 Whitesands

10.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m).

10.2 Subsurface Condition

A single onshore CPTu was undertaken by the University of Adelaide, and the CPTu results showed that the subsurface profile encountered at Whitesands generally comprised fill (Sandy CLAY or Clayey SAND) overlying Silty CLAY with a transition typically around 2.0 to 2.5 m depth. The investigation confirmed the expected Quaternary aged Alluvial Flat Deposits, as seen on the Geological Survey of South Australia (1962) Barker map Sheet 1 54-13 sheet. The layers of very soft Silty CLAY with high plasticity fines extended to a depth of ~26 m below ground. Clayey SAND/Sandy CLAY (SC/CL) underlies a Silty CLAY layer, extending to the termination depth of about 29 m. A summary of the geotechnical profile is presented in Table 13, and further details of the subsurface profiles encountered during the investigation are presented on the CPTu plots in **Appendix 5**. Due to the adopted drilling method, it was difficult to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 13: Soil profile derived from onshore CPTu test data – Riverglen Marina, Whitesands

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill	0 to 2.0 – 2.5
2	Silty CLAY	2.0 – 2.5 to 26.0
3	Clayey SAND/Sandy CLAY (SC/CL)	26.0 to >29.0*

* Limit of investigation – termination

Three offshore CPTu tests were undertaken by the University of Sydney team at various locations in the vicinity of Whitesands and Riverglen Marina. The CPTu results showed that the subsurface profile encountered generally comprised sandy sediment (Sandy CLAY or Clayey SAND) overlying Silty CLAY with a transition typically around 0.5 – 1.0 m depth. The layers of very soft Silty CLAY with high plasticity fines extended to a termination depth of ~5.5 – 6.0 m below ground at Whitesands and ~19.25 m at Riverglen Marina. The geotechnical profile encountered during the investigation is summarised in Table 14 and further details are presented in **Appendix 5**. The locations are shown in Figure 16.

Table 14: Soil profile derived from offshore CPTu test data – Whitesands and Riverglen Martina

Layer No.	Soil Type	Depth Below the Ground (m)
1	Sandy CLAY or Clayey SAND	0 to 0.5 – 1.0
2	Silty CLAY	0.5 – 1.0 to 5.5* (Whitesands) – 19.0* (Riverglen Marina)

* Limit of investigation – termination

Figure 16: Locations of the CPTu testing near Whitesands (Yellow Label: Whitesands_ADE_1; Blue Label: LMR0214_RG_2).

11 Westbrooks

11.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m).

11.2 Subsurface Condition

Three onshore CPTu soundings have been undertaken by the University of Adelaide, and the CPTu results showed that the subsurface profile encountered at Westbrooks generally comprised fill (SAND or Gravelly SAND) overlying Silty CLAY with a transition typically around 0.75 to 1.0 m depth, followed by a thin layer of very soft Silty CLAY extending up to a depth of ~1.4 – 1.5 m below ground. Another SAND or Gravelly SAND layer underlies the Silty CLAY layer, extending up to refusal depths of about 1.75 to 4.5 m.

A very stiff substrate is found underneath this layer. A summary of geotechnical profile is presented in Table 15.

Due to the adopted drilling method, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 15: Soil profile derived from onshore CPTu test data – Westbrooks.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: SAND or Gravelly SAND	0 to 0.75 – 1.0
2	Silty CLAY	0.75 – 1.0 to 1.4 – 1.5
3	SAND or Gravelly SAND	1.4 – 1.5 to 1.75 – 4.5*

* Limit of investigation - refusal

The University of Sydney team undertook a single offshore CPTu test near Westbrooks. The CPTu result showed that the similar subsurface profile is encountered with a SAND or Gravelly SAND layer with a very soft and thin layer of Silty CLAY in between (occurs at ~0.4 m depth below sediment surface). A very stiff substrate is found at a shallow depth ~0.45 m. A summary of geotechnical profile obtained from offshore CPTu test is presented in Table 16. Further details of the subsurface profiles encountered during the investigation are presented in **Appendix 6**. The testing locations are shown in Figure 17.

Table 16: Soil profile derived from offshore CPTu test data – Westbrooks.

Layer No.	Soil Type	Depth Below the Ground (m)
1	SAND or Gravelly SAND	0 to 0.4
2	Silty CLAY	0.4 to 0.42
3	SAND or Gravelly SAND	0.42 to 0.45*

* Limit of investigation - refusal

Figure 17: Locations of the CPTu testing near Westbrooks (Yellow Labels: Westbrooks_ADE_1 to _4; Blue Label: LMR0214_WB_1).

12 Bells Landing Reserve, Monteith

12.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m).

12.2 Subsurface Condition

A single onshore CPTu was undertaken by the University of Adelaide, and the CPTu results showed that the subsurface profile encountered at Bell Landing Reserve, Monteith generally comprised fill of Sandy CLAY overlying Silty CLAY with a transition typically around 2.5 m depth. The investigation confirmed the expected Quaternary aged Alluvial Flat Deposits, as seen on the Geological Survey of South Australia (1962) Barker map Sheet 1 54-13 sheet. The layers of dark grey very soft Silty CLAY with high plasticity fines were relatively thick, extending up to 16 m deep. Clayey SAND and Sandy CLAY interbeds underlie the layer of Silty CLAY, extending up to the termination depth of 25 m. It is expected that a deep layer of SAND (Monoman Formation) will be found at greater depth. A summary of the soil profile derived from the onshore CPTu test data is presented in Table 17.

Due to the adopted drilling methods, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 17: Soil profile derived from onshore CPTu test data – Bell Reserve, Monteith.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill - Sandy CLAY	0.0 to 2.5
2	Silty CLAY - CH	2.5 to 16.0
3	Clayey SAND/Sandy CLAY (SC/CL)	16.0 to 25.0

* Limit of investigation - termination

The University of Sydney team undertook a single offshore CPTu test near Bell Landing Reserve. The CPTu results showed that the riverbed is comprised of a SAND or Gravelly SAND layer extending up to a depth of 2 m below the riverbed surface. A soft Silty CLAY or Clayey SILT layer underlies the SAND or Gravelly SAND layer up to termination depth of ~15 m. A summary of the soil profile obtained from offshore CPTu test is presented in Table 18. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 7**. Testing locations are shown in Figure 18.

Table 18: Soil profile derived from offshore CPTu test data – Bell Reserve, Monteith.

Layer No.	Soil Type	Depth Below the Ground (m)
1	SAND or Gravelly SAND	0 to 2.0
2	Silty CLAY/Clayey SILT	2.0 to 15.0*

* Limit of investigation - termination

Figure 18: Locations of the CPTu testing near Monteith (Yellow Label: Monteith_ADE_1; Blue Label: LMR0214_BR_1).

13 Murray Bridge West

13.1 Site Geology

Based on the Geological Survey of South Australia (1962) 1:250,000 Barker map-sheet, the Riverfront Road, Murray Bridge site is located on Quaternary aged Alluvial Flat Deposits, and is in close proximity to the geological boundary with sandy limestone of the Tertiary aged Mannum Formation.

13.2 Subsurface Condition

SKM (2010b) showed that the subsurface profile encountered at Riverfront Road, Murray Bridge generally comprised Silty SAND overlying Silty CLAY with a transition typically around 1.0 m depth. The investigation confirmed the expected Quaternary aged Alluvial Flat Deposits, as seen on the Survey of South Australia (1962) 1:250,000 Barker map sheet.

The layers of dark grey very soft Silty CLAY were relatively thick, extending up to a depth ranging from 11 to more than 20 m deep at two different locations. Pockets of medium dense Sandy CLAY/Clayey SAND underlie this layer of Silty CLAY, extending to the termination depth of 17.5 m. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs in SKM (2010b). A summary of the soil parameters used in SKM (2010b) for the stability assessment is presented in Table 19.

Table 19: Soil parameters for stability assessments – Riverfront Road, Murray Bridge (Modified: SKM 2010b)

Layer No.	Soil Type	Depth Below the Ground (m)	Soil Models	Unit Weight (kN/m^3)	ϕ	c' / s_u (kPa)	Increase Rate for Su
1	Fill: Silty/Clayey SAND (SM/SC)	0.0 to 1.0	Mohr-Coulomb	18 ± 1	28 ± 2	2 ± 2	-
2	Silty CLAY (CH)	1.0 to 11.0 - 20.0	Undrained s_u = f(depth)	16 ± 1	-	10 ± 5	1.25 kPa/m (25 ± 5 max)
3	Clayey SAND/Sandy CLAY (SC/CL)	11.0 to 17.5	Mohr-Coulomb	17 ± 1	30 ± 2	2 ± 2	-

Three offshore CPTu tests were carried out by the University of Sydney team at various locations (Long Island Marina and Sturt Reserve) in the vicinity of Murray Bridge West. The investigation showed that soil profiles similar to SKM (2010b) were derived from the CPTu data, with the exception of one at Sturt Reserve. A summary of the soil profile derived from the offshore CPTu test data is presented in Table 20. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 8**. The testing locations are shown in Figure 19.

Table 20: Soil profile derived from offshore CPTu test data –Murray Bridge West

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty/Clayey SAND	0.0 to 2.0^ – 3.0#
2	Silty CLAY (CH)	2.0^ to ~12.0^ – 16.0^
3	Clayey SAND/Sandy CLAY (SC/CL)	~12.0^ – 16.0^ to 14.5^+ - 16.1^+

Sturt Reserve – limit of the investigation – refusal
^ Long Island Marina
+ Limit of the investigation – refusal

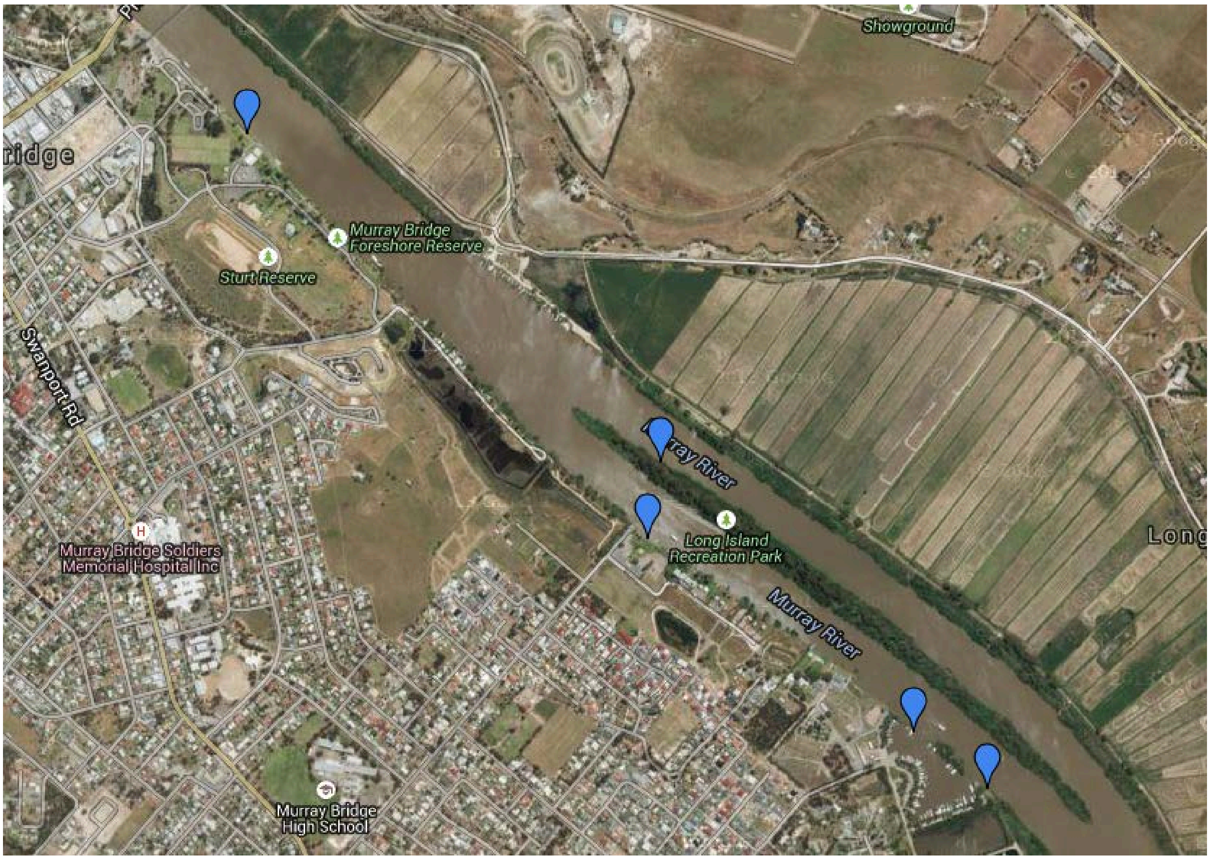

Figure 19: Locations of the offshore CPTu testing near Murray Bridge West and Long Island Marina.

14 Thiele Reserve

14.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m). The surface of the higher ground is shown to consist of recent Pleistocene age kunkarised dunes and associated sand spread and Kunkar (presently known as calcrete, in sheets) with calcareous bedrock (Qpe).

14.2 Subsurface Condition

A single onshore CPTu was undertaken by the University of Adelaide team, and the results showed that the subsurface profile encountered at Thiele Reserve is generally comprised of fill Clayey/Silty SAND, overlying Silty CLAY with a transition occuring at around 2.0 m depth below the ground. The layer of dark grey very soft Silty CLAY with high plasticity fines is relatively thick, extending to a depth of 15.5 m. The investigation confirmed the expected Quaternary aged Alluvial Flat Deposits, as seen on the Geological Survey of South Australia (1962) Barker map Sheet 1 54-13 sheet. A Clayey SAND and Sandy CLAY interbedded layer underlies the Silty CLAY, extending to the refusal depth of 17.0 m. A summary of the soil profile derived from the onshore CPTu test data is presented in Table 21. Note that due to the adopted drilling method, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 21: Soil profile derived from onshore CPTu test data – Thiele Reserve.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: Silty SAND/Clayey SAND	0.0 to 2.0
2	Silty CLAY	2.0 to 15.5
3	Clayey SAND/Sandy CLAY	15.5 to 17.0*

* Limit of investigation - refusal

A single offshore CPTu sounding was undertaken by the University of Sydney team near Thiele Reserve. The CPTu results showed that the riverbed is comprised of a 3 m thick layer of Silty or Clayey SAND at the surface. A soft Silty CLAY layer underlies the sand layer at a depth of ~12.75m, followed by Clayey SAND and Sandy CLAY interbedded layer extending to the refusal depth of ~16.1 m A summary of the soil profile obtained from the offshore CPTu data is presented in Table 22. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 9**. Testing locations are shown in Figure 20.

Table 22: Soil profile derived from offshore CPTu test data – Thiele Reserve.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty SAND/Clayey SAND	0.0 to 3.0
2	Silty CLAY	3.0 to 12.75
3	Clayey SAND/Sandy CLAY	12.75 to 16.1*

* Limit of investigation - refusal

Figure 20: Locations of the CPTu testing near Thiele Reserve (Yellow Label: Thiele_ADE_1; Blue Label: LMR0214_TR_1).

15 Avoca Dell

15.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 54-13 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs the river are comprised of Miocene age sandy Limestones of Mannum Formation (To-m). The surface of the higher ground is shown to comprise of recent Pleistocene age kunkarised dunes and associated sand spread and Kunkar (presently known as calcrete, in sheets) with calcareous bedrock (Qpe).

15.2 Subsurface Condition

A single offshore CPTu test was undertaken by the University of Sydney team near Avoca Dell, and the testing location is shown in Figure 21. The CPTu results showed that the first two metres of the riverbed are comprised of Silty or Clayey SAND, which is underlain by a soft Silty CLAY layer extending to a depth of ~11.5 m. Below the Silty Clay layer is a Clayey SAND and Sandy CLAY interbedded layer extending up to the refusal depth of ~12.1 m. A summary of the soil profile obtained from the offshore CPTu test data is presented in Table 23. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 10**.

Table 23: Soil profile derived from offshore CPTu test data – Avoca Dell.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty SAND/Clayey SAND	0.0 to 2.0
2	Silty CLAY	2.0 to 11.5
3	Clayey SAND/Sandy CLAY	11.5 to 12.1*

* Limit of investigation - Refusal

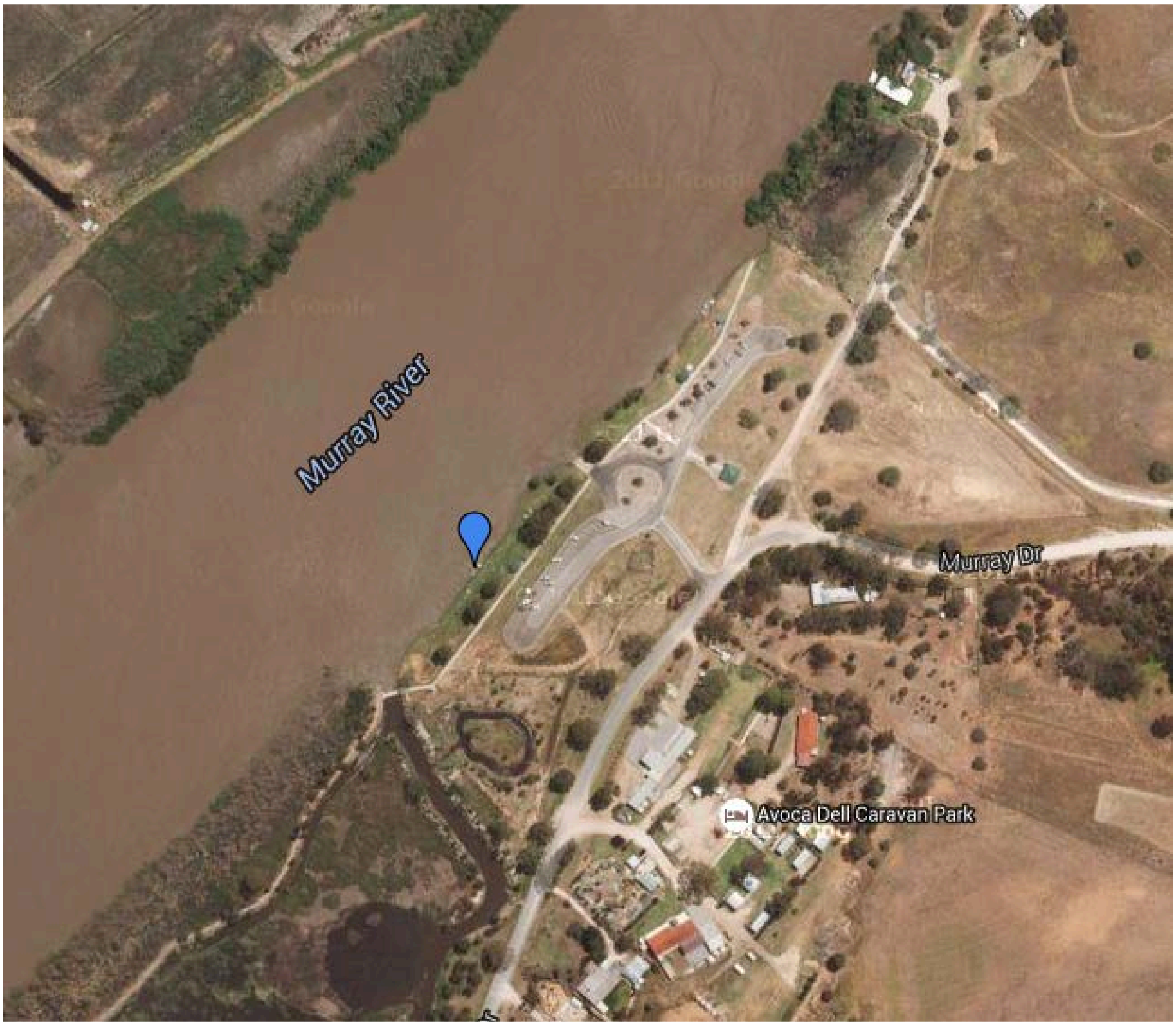

Figure 21: Locations of the offshore CPTu testing near Avoca Dell.

16 Mypolonga

16.1 Site Geology

The Geological Survey of South Australia, Barker Sheet 1 5413 sheet (Zones 5 and 6), indicates that the floodplains are likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along the other side of the river are comprised of Miocene age sandy limestones of Mannum Formation (To-m).

The surface of the higher ground is shown to consist of recent Pleistocene age kunkarised dunes and associated sand spread and Kunkar (presently known as calcrete, in sheets) with calcareous bedrock (Qpe).

16.2 Subsurface Condition

A single onshore CPTu has been undertaken, and the testing location is shown in Figure 22. The result showed that the subsurface profile encountered at Mypolonga generally consists of a Clayey/Silty SAND and Silty Clay interbedded fill layer for the first five metres, overlying Silty CLAY. The layer of dark grey very soft Silty CLAY with high plasticity fines is relatively thick, extending to a depth of 20.1 m with a Clayey SAND and Sandy CLAY interbedded layer occuring at a depth of ~ 9.75 to 12.5 m. Sands were encountered below 20.1 m and the test was terminated at a refusal depth of 20.4 m. A summary of the soil profile derived from the onshore CPTu data is presented in Table 21.

Note that due to the adopted drilling methods, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

A summary of soil profile obtained from onshore CPTu data is presented in Table 24. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 11**.

Table 24: Soil profile derived from onshore CPTu test data – Mypolonga.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Sand and Clay Interbedded	0.0 to 5.0
2	Silty CLAY (CH)	5.0 to 9.75
3	Sand and Clay Interbedded	9.75 to 12.5
4	Silty CLAY (CH)	12.5 to 20.1
5	SAND	20.1 to 20.4*

* Limit of investigation - refusal

Figure 22: Locations of the onshore CPTu testing near Mypolonga.

17 Woodlane Reserve

17.1 Site Geology

The Woodlane Reserve site is mapped on the Geological Survey of South Australia (1969) 1:250,000 Adelaide map sheet as Quaternary grey fluvial silts, sands and gravels (SKM, 2010b).

17.2 Subsurface Condition

SKM (2010b) indicated that the soil profile encountered at Woodlane Reserve confirmed the expected Quaternary aged grey fluvial silts, sands and gravels, as seen in the Geological Survey of South Australia (1969) 1:250,000 Adelaide map sheet. The subsurface profile is generally comprised of Clayey SAND and Silty SAND overlying Silty CLAY, with a transition also occurring around 1.0 m in depth. The dark grey very soft Silty CLAY extended to about 3.0m to 4.0m depth in two boreholes. From this depth, the sand content with trace of gravel increases with depth up to about 7.5 m below the ground level, transitioning from a very soft Sandy CLAY to a medium dense SAND or Gravelly SAND. From 7.5 m below ground level, the silt content increased with depth, transitioning from a soft Sandy SILT or Clayey SILT to firm SILT. Thereafter, alternating silts and sands were observed up to the depth of termination of the boreholes. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs in SKM (2010b).

A summary of the soil parameters used in SKM (2010b) for the stability assessment is presented in Table 25.

Table 25: Soil parameters for stability assessments – Woodlane Reserve (Modified: SKM 2010b)

Layer No.	Soil Type	Depth Below the Ground (m)	Soil Models	Unit Weight (kN/m^3)	ϕ□□□	c' / s_u (kPa)	Increase Rate for s_u
1	Fill: Silty/Clayey SAND (SM/SC)	0.0 to 1.0	Mohr-Columb	17 ± 1	17 ± 1	-	-
2	Silty CLAY (CH)	1.0 to 3.0 - 4.0	Undrained s_u = f(depth)	17 ± 1	-	20 ± 5	-
3	Clayey SAND/Sandy CLAY (SC/CL)	3.0 - 4.0 to 7.5	Mohr-Columb	20 ± 1	20 ± 1	-	-
4	Clayey SAND/Sandy CLAY (SC/CL)	7.5 to 11.5	Mohr-Columb	20 ± 1	20 ± 1	-	-
5	Clayey SAND/Sandy CLAY (SC/CL)	11.5 to >19.5	Mohr-Columb	20 ± 1	20 ± 1	-	-

A single offshore CPTu test was undertaken near Woodlane Reserve by University of Sydney. The testing location is shown in Figure 23. The CPTu result showed that the riverbed is comprised of a 2.5 m thick layer of Silty or Clayey SAND at the top with a thin layer of soft Silty CLAY/Clayey SILT. A soft Silty CLAY layer underlies the sands layer up to depth of ~9 m. A Clayey SAND/Sandy CLAY layer was encountered at the depth of ~9 m to a refusal depth of ~10.8 m. A summary of soil profile obtained from offshore CPTu test data is presented in Table 37. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 12**.

Table 26: Soil profile derived from offshore CPTu test data – Woodlane Reserve.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty/Clayey SAND	0.0 to 2.5
2	Silty CLAY (CH)	2.5 to ~9.0
1	Clayey SAND/Sandy CLAY	9.0 to 10.8*

* Limit of investigation - refusal

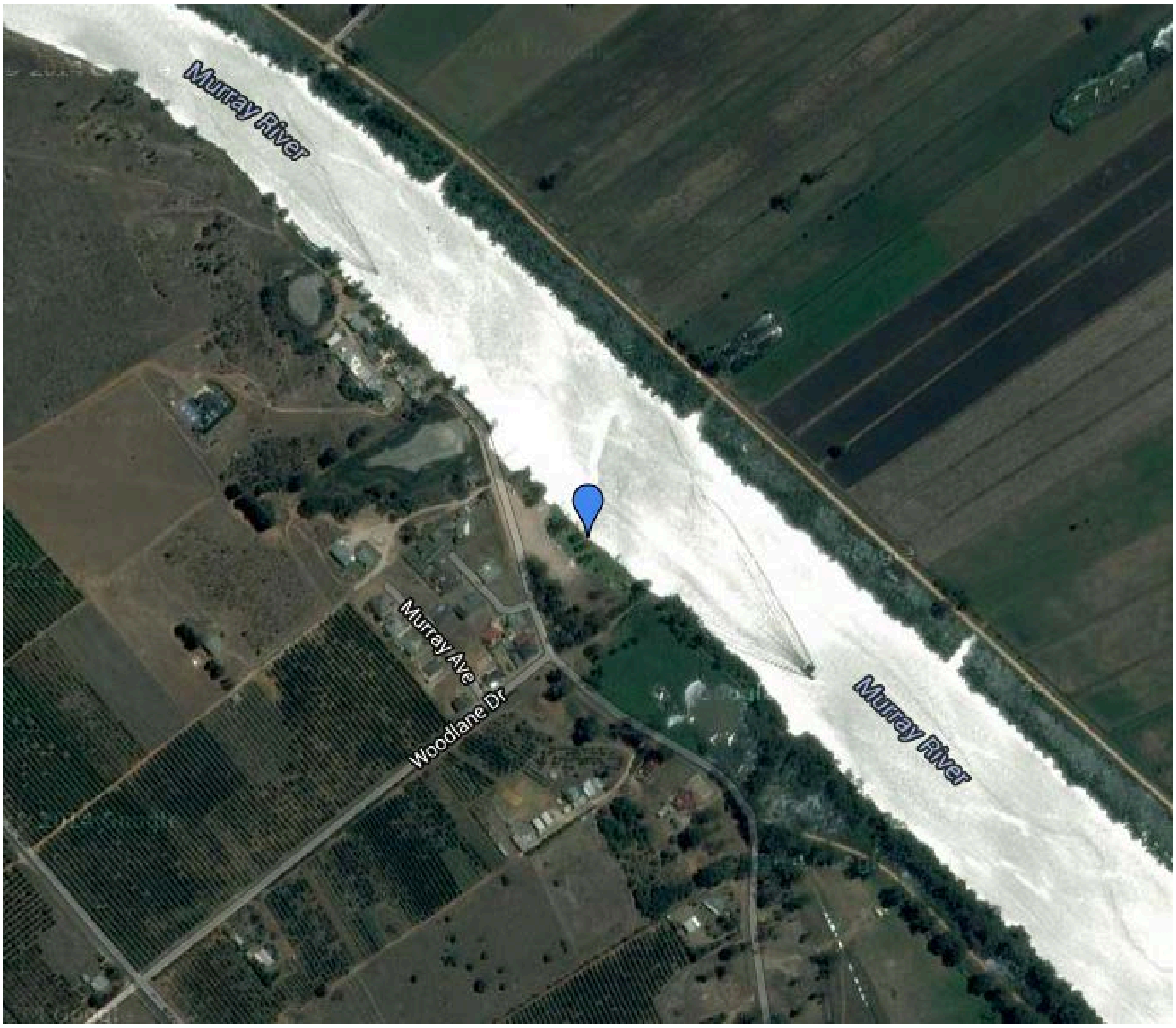

Figure 23: Locations of the offshore CPTu testing near Woodlane Reserve.

18 Wall Flat

18.1 Site Geology

The Geological Survey of South Australia, Renmark Sheet 1 54-10 sheet (Zone 6), indicates that the lower ground at Wall Flat is likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along Wall Flat are comprised of Miocene age limestone and calcrete (Tmm). The surface of the higher ground is shown to comprise of Pleistocene age calcrete (Qca) and Blanchetown Clay (Qph).

18.2 Subsurface Condition

A single offshore CPTu sounding was undertaken near Wall Flat by the University of Sydney team. The testing location is shown in

Figure 24. The CPTu results indicated that the riverbed consists of a 1.75 m thick layer of Silty or Clayey SAND at the surface. A soft Silty CLAY layer underlies the sand layer to a refusal depth of ~14.3 m. A summary of the soil profile obtained from the offshore CPTu data is presented in Table 27. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 13**.

Table 27: Soil profile derived from offshore CPTu test data – Wall Flat.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty SAND/Clayey SAND	0.0 to 1.75
2	Silty CLAY (CH)	1.75 to ~14.3*

* Limit of investigation - refusal

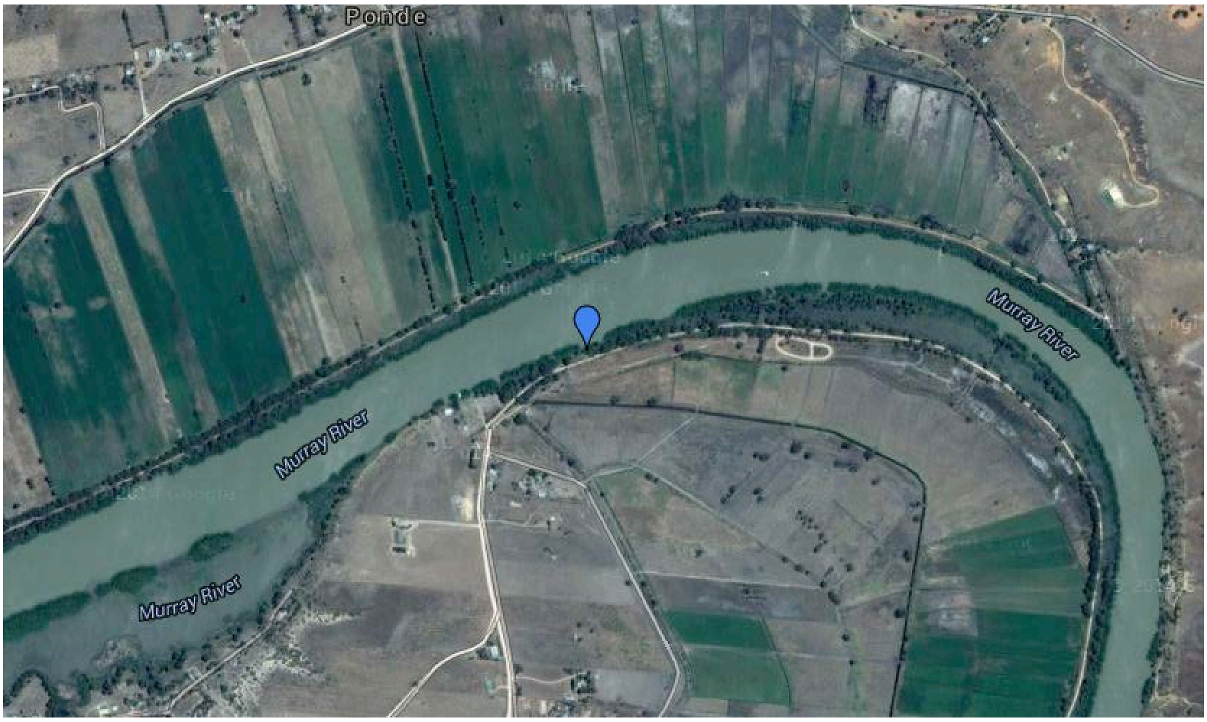

Figure 24: Locations of the offshore CPTu testing near Wall Flat.

19 Caloote

19.1 Site Geology

The Caloote site is mapped on the Geological Survey of South Australia (1969) 1:250,000 Adelaide map sheet as Quaternary grey fluvial silts, sands and gravels. The site is also mapped close to the boundary of the Quaternary Hindmarsh clays and the Tertiary Mannum Formation. The Hindmarsh clays typically consist of grey and red-brown mottled sandy clay and the Mannum Formation typically consists of yellow-brown calcareous sandstone.

19.2 Subsurface Condition

The site investigation undertaken by SKM (2010b) showed that the soil profile encountered at Caloote confirmed the expected Quaternary fluvial silts, sands and gravels as seen in the Geological Survey of South Australia (1969) 1:250,000 Adelaide map sheet.

The subsurface profile consists of Silty/Gravelly SAND underlain by Silty CLAY. The layer of Silty CLAY was typically encountered 1 m to 1.5 m below ground level, and is generally very soft and wet. The thickness of the very soft Silty CLAY layer varies from 3 m to 15 m at the two boreholes. There are also some Sandy Clay/Clayey Sand layers/lenses in the very soft Silty clay layer between 6 to 15 m in depth.

Beneath this layer, the sand content generally increased to the depth of termination, transitioning to a Clayey SAND and Gravelly SAND. At one of the boreholes, the borehole terminated at 4 m, due to refusal on SANDSTONE, confirming the Mannum Formation. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs in SKM (2010b).

A summary of the soil parameters used in SKM (2010b) for the stability assessment is presented in Table 28.

Table 28: Soil parameters for stability assessments – Caloote (Modified: SKM 2010b)

Soil Type	Depth Below the Ground (m)	Soil Models	Unit Weight (kN/m^3)	ϕ	c' / s_u (kPa)	Increase Rate for Su
Fill: Silty/Clayey SAND (SM/SC) (Type - A)	0 to 1.0 - 1.5	Mohr-Coulomb	18 ± 1	28 ± 2	2 ± 2	-
Silty CLAY (CH) (Type - B)	1.0 - 1.5 to 11.0 - 11.5	Undrained Su = f(depth)	16 ± 1	-	10 ± 5	1.07 kPa/m (17 ± 5 max)
Clayey SAND/Sandy CLAY (SC/CL) (Type - C)	11.0 - 11.5 to 13.0 - 13.5	Mohr-Coulomb	17 ± 1	30 ± 2	2 ± 2	-
Silty CLAY (CH) (Type - B)	13.0 - 13.5 to 17.0 - 17.5	Undrained Su = f(depth)	16 ± 1	-	10 ± 5	1.07 kPa/m (17 ± 5 max)
Clayey SAND/Sandy CLAY (SC/CL) (Type - C)	17.0 - 17.5 to >18.5	Mohr-Coulomb	17 ± 1	30 ± 2	2 ± 2	-

A single offshore CPTu test was undertaken near Caloote (Neeta Irrigation Flat) by the University of Sydney team. The testing location is shown in Figure 25. The CPTu results showed that the riverbed consists of a ~2.0 m thick layer of fluvial Silty or Clayey SAND at the surface. A soft Silty CLAY layer underlies the sand layer to a refusal depth of ~12.5 m. The cone tip resistance and sleeve friction increase with depth, which suggests the sand content generally increases to the termination depth, similar to the observation made by SKM (2010b). The CPTu was terminated due to high cone tip resistance encountered at the surface of SANDSTONE. A summary of the soil profile obtained from the offshore CPTu data is presented in Table 29. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 14.**

Table 29: Soil profile derived from offshore CPTu test data – Caloote.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty SAND/Clayey SAND	0.0 to 2.0
2	Silty CLAY (CH)	2.0 to ~12.5*

* Limit of investigation - refusal

Figure 25: Locations of the offshore CPTu testing near Caloote.

20 Mannum

20.1 Site Geology

The Geological Survey of South Australia, Adelaide Sheet 1 54-9 Zones 5 & 6, indicates that the lower ground of Mannum is likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along Mannum are comprised of Miocene age limestone and calcrete (Tmm). The surface of the higher ground is shown to comprise Pleistocene age calcrete (Qca) and Blanchetown Clay (Qph).

20.2 Subsurface Condition

A single onshore CPTu was carried out by the University of Adelaide team, and the testing location is shown in Figure 26. The results indicated that the subsurface profile encountered at Mary Ann Reserve, Mannum, generally comprised of Clayey SAND and Silty SAND overlying Silty CLAY, with a transition occurring at around 2.0 m below ground level. Within the Clayey SAND and Silty SAND layer, tree roots or Gravelly SANDs were encountered at 0.5 m depth, and therefore very high cone tip resistance values were observed.

The very soft Silty CLAY layer extended to about 8.0 m below ground level with sand content increasing with depth, and then transitioning to a medium dense SAND layer, which extended to the refusal depth of 12.1 m. A summary of the soil profile derived from the onshore CPTu data is presented in Table 21.

Note that due to the adopted drilling method, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 15.**

Table 30: Soil profile derived from onshore CPTu test data – Mannum.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: clayey SAND and silty SAND	0.0 to 2.0
2	Silty CLAY	2.0 to 8.0
3	Medium dense SAND	8.0 to 12.1

* Limit of investigation - refusal

Figure 26: Locations of the onshore CPTu testing near Mannum.

21 East Front Road

21.1 Site Geology

The East Front Road site is mapped on the Adelaide map-sheet as an Upper Cambrian to Lower Ordovician Pegmatite dyke, which is likely to be a medium to coarse grained granitic intrusion. Adjacent to this Pegmatite dyke consists the Mannum Formation as well as Quaternary grey fluvial silts, sands and gravels from the Murray River system (SKM, 2010b).

21.2 Subsurface Condition

The site investigation undertaken by SKM (2010b) showed that the soil profile encountered at East Front Road confirmed the expected geology, as shown in the Geological Survey of South Australia (1969) 1:250,000 Adelaide map sheet. The subsurface profile typically consisted of a medium dense Clayey or Sandy GRAVEL (a base/sub-base material for road construction, with thickness about 0.7 to 1.6 m) underlain by a medium dense Silty/Gravelly SAND. Below this layer of Gravelly SAND and Silty SAND, dark brown Silty CLAY was generally encountered. One borehole (No. EF-BH1, refer to SKM 2010b), which was located adjacent to an outcrop of rock material, refused at a relatively shallow depth of 2.0 m below ground level, whilst another borehole (EF-BH2, see SKM 2010b), layers of medium dense to very dense Clayey GRAVEL, Clayey SAND and Gravelly SAND, of varying thickness were encountered. At another borehole (EF-BH-3 in SKM 2010b) a very soft Silty CLAY layer, of about 3.5 to 6.5 m depth, was encountered, underlain by a dense clayey SAND layer. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs in SKM (2010b).

A summary of the soil parameters used for the stability assessment at two different sections (EF1 and EF2) by SKM (2010b) is presented in Table 31 and Table 32.

Table 31: Soil parameters for stability assessments – East Front Road EF1 Section (Modified: SKM 2010b)

Soil Type	Depth Below the Ground (m)	Soil Models	Unit Weight (kN/m^3)	ϕ□□□□	c' / S_u (kPa)	Increase Rate for Su
Fill: Silty/Clayey SAND (SM/SC) and GRAVEL (GM/GC) (Type – A1)	0 to varies	Mohr-Coulomb	20 ± 1	32 ± 2	-	-
Fill: Silty/Clayey SAND (SM/SC) and GRAVEL (GM/GC) (Type – A2)	Varies	Mohr-Coulomb	21 ± 1	35 ± 3	-	-
Silty CLAY (CH) (Type – B)	Varies	Undrained	17 ± 1	-	50 ± 10	
ROCK	Varies	Bedrock (Inpenetrable)	-	-	-	-

Two offshore CPTu soundings were undertaken near East Front Road by the University of Sydney team, and both showed different results. One of the CPTu soundings (LMR0513 EFR) showed that the riverbed is mainly comprised of fluvial Silty CLAY throughout the ~6 m penetration depth. It is noted that very low negative values for sleeve resistance for the first 800 mm of penetration were recorded (possibly due to a zeroing issue prior to testing but this has not significantly affected the results) and the test was terminated when the cone tip resistance approached 1 MPa.

Another CPTu sounding (LMR0514 EFR; testing location is shown in Figure 27) showed that Silty/Clayey SAND layer was encountered within the first 1.6 m of the penetration, followed by a soft Silty CLAY layer extending up to a refusal depth of ~7.5 m. A summary of the soil profile obtained from the offshore CPTu data is presented in Table 33. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plots in **Appendix 16**.

Table 32: Soil parameters for stability assessments – East Front Road EF1(Modified: SKM 2010b)

Soil Type	Depth Below the Ground (m)	Soil Models	Unit Weight (kN/m³)	ϕ	c' / s_u (kPa)	Increase Rate for Su
Fill: Silty/Clayey SAND (SM/SC) and GRAVEL (GM/GC) (Type – A1)	0 to varies	Mohr-Coulomb	20 ± 1	32 ± 2	-	-
Fill: Silty/Clayey SAND (SM/SC) and GRAVEL (GM/GC) (Type – A2)	Varies	Mohr-Coulomb	21 ± 1	35 ± 3	-	-
Silty CLAY (CH) (Type – B1)	Varies	Undrained	17 ± 1	-	17.5 ± 2.5	
Silty CLAY (CH) (Type – B2)	Varies	Undrained	17 ± 1	-	14 ± 2	-
Clayey SAND (SC) (Type – C)	Varies	Undrained	20 ± 1	31 ± 1	-	-
ROCK	Varies	Bedrock (Inpenetrable)	-	-	-	-

Table 33: Soil profile derived from offshore CPTu test data – East Front Road.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty/Clayey SAND (SM/SC)	0.0 to 0.0^ - 1.6
2	Silty CLAY	0.0 – 1.6 to 6.0* - 7.5*

* Limit of investigation - refusal;
^ Geological unit not encountered

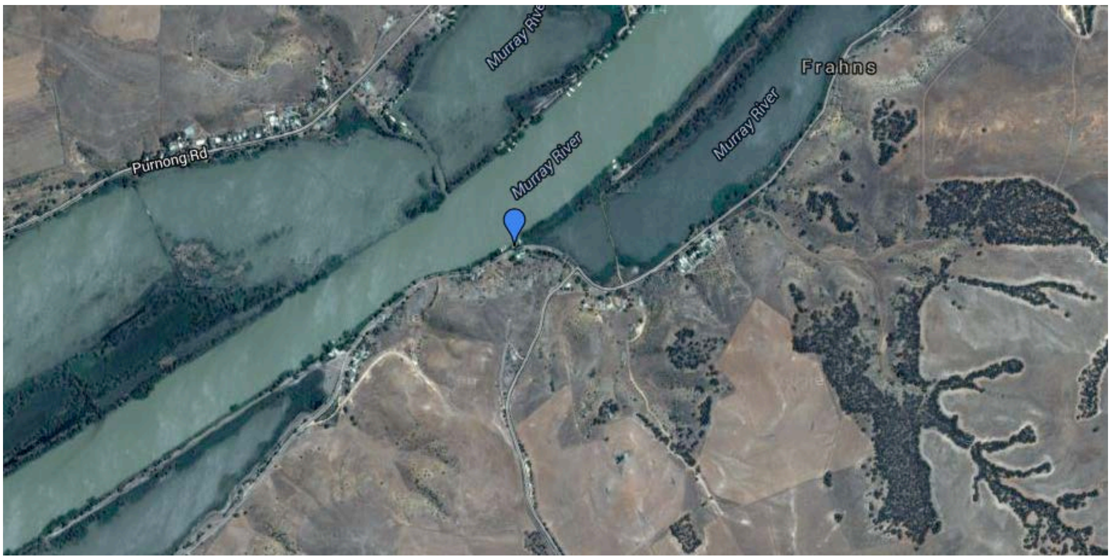

Figure 27 : Testing location of the offshore CPTu near East Front Road

22 Younghusband

22.1 Site Geology

The Geological Survey of South Australia, Renmark Sheet 1 54-10 and Adelaide Sheet 1 54-9, indicates that the lower ground is likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qrc) overlying coarser grained alluvial deposits belonging to the Monoman Formation.

The cliffs along Younghusband are comprised of Miocene age limestone and calcrete (Tmm) and/or Lower Pliocene age Loxton Sand (Tpl). The surface of the higher ground is shown to comprise Pleistocene age calcrete (Qca), Blanchetown Clay (Qph) and Molineaux Sand (Qrm).

22.2 Subsurface Condition

Three offshore CPTu soundings were undertaken by the University of Sydney team at various locations near Younghusband. The locations are shown in Figure 28. The investigation showed that the riverbed is comprised of a ~1.8 to 2.5 m thick layer of fluvial Silty or Clayey SAND at the surface, followed by soft fluvial Silty CLAY extending to ~6.9 to 9.0 m below the sediment surface. Two thin SAND lenses were encountered in one of the CPTu soundings (LMR0314 YH3) at a depth between ~4 to 5 m.

Sand of the Monoman Formation was encountered at ~6.9 – 9 m depth, extending to refusal depths of ~9.0 to 11.2 m. A summary of soil profile obtained from the offshore CPTu data is presented in Table 34. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plots in **Appendix 17**.

Table 34: Soil profile derived from offshore CPTu test data – Younghusband.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fluvial silty or clayey SAND	0.0 to 1.8 – 2.5
2	Silty CLAY	1.8 – 2.5 to 6.9 – 9.0
3	SAND	6.9 – 9.0 to 9.0 – 11.2*

* Limit of investigation - refusal

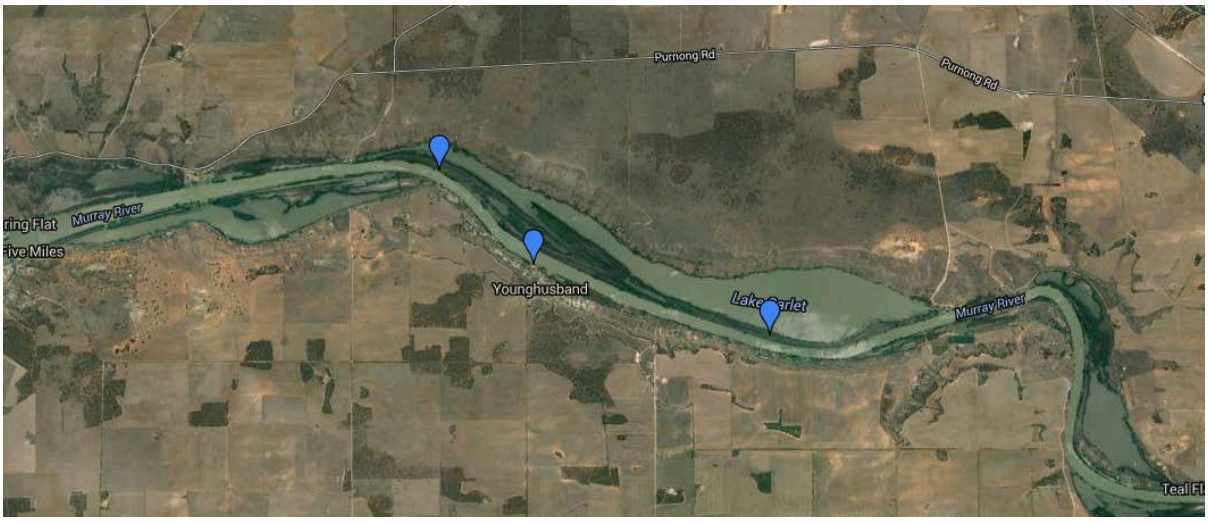

Figure 28 : Testing locations of the offshore CPTu near Younghusband.

23 Bowhill

23.1 Site Geology

The Geological Survey of South Australia, Renmark Sheet 1 54-10 Zone 6, indicates that the lower ground is likely to comprise coarse grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

The cliffs adjacent to Bowhill are comprised of either Miocene age limestone and Calcrete (Tmm, west and south side) or Lower Pliocene age Loxton Sand (Tpl, north and east side).

The surface of the higher ground is shown to comprise Pleistocene age Calcrete (Qca).

23.2 Subsurface Condition

A single offshore CPTu has been undertaken by the University of Sydney team, and the testing location is shown in Figure 29. The results showed that the subsurface profile at Bowhill, is generally comprised of Clayey/Silty SAND layer overlying a Silty CLAY layer, with a transition occurring around ~2.4 m below sediment level.

The Silty CLAY layer extended to the refusal depth of ~13.7 m, and the sand content increases with depth. Within the Silty CLAY layer, very thin sand lenses or pockets of stiff organic material was observed at depths of 3, 9, 12.2 and 12.8 m.

A summary of the soil profile derived from the offshore CPTu data is presented in Table 35. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 18**.

Table 35: Soil profile derived from offshore CPTu test data – Bowhill.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: clayey SAND and silty SAND	0.0 to 2.4
2	Silty CLAY	2.4 to 13.7*

* Limit of investigation - refusal

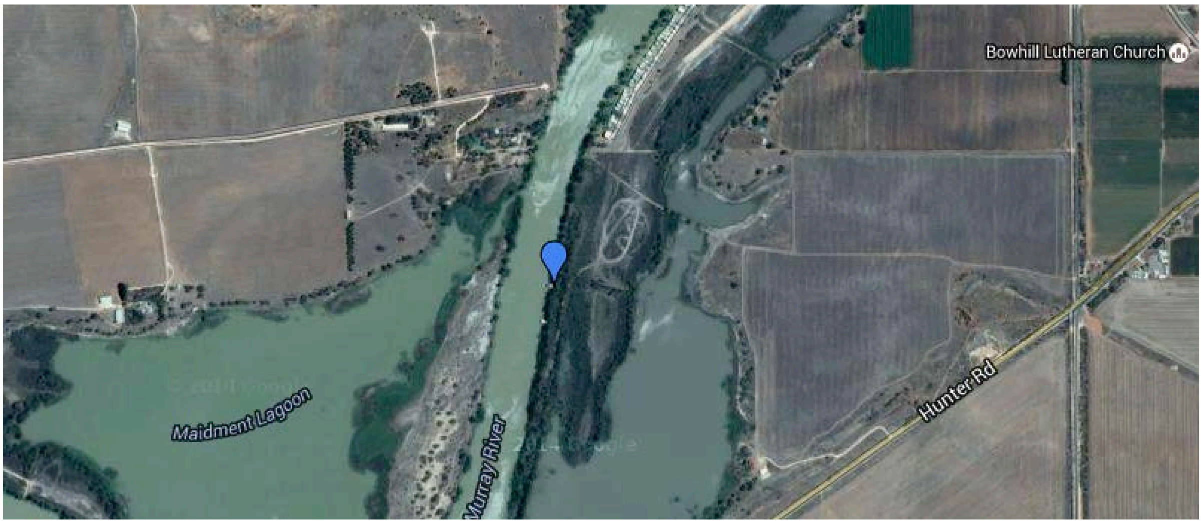

Figure 29 : Testing location of the offshore CPTu near Bowhill.

24 Purnong

24.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

The cliffs are comprised of limestone (Ty) of the Murray Formation. The limestone is a shallow marine deposit of Tertiary Age and is generally of low to medium strength.

The higher ground is shown to comprise Pleistocene age Calcrete (Qca) and/or Blanchetown Clay (Qph).

24.2 Subsurface Condition

A single offshore CPTu has been undertaken by the University of Sydney team, and the testing location is shown in Figure 30. The results showed that the subsurface profile at Purnong generally consist of a Clayey/Silty SAND layer overlying a Silty CLAY layer, with a transition occurring around ~1.5 m below the sediment surface.

The Silty CLAY layer extended to a depth of ~5 m. Within the Silty CLAY layer, very thin sand lenses or pockets of stiff organic material were observed at depths of 3.6 to 3.7 m.

Sand was encountered a depth of 5 m below the sediment surface. A summary of the soil profile derived from the offshore CPTu data is presented in Table 36. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 19**.

Table 36: Soil profile derived from offshore CPTu test data – Purnong.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: clayey SAND and silty SAND	0.0 to 1.5
2	Silty CLAY	1.5 to 5.1*
2	SAND	5 to 5.1*

* Limit of investigation - refusal

Figure 30 : Testing location of the offshore CPTu near Purnong.

25 Caurnamont Wetland

25.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

The river and floodplain deposits were mostly deposited as the sea returned to its present level after the last glaciation (reached present level about 7,500 years ago). They mainly consist of very soft to soft CLAY and Sandy CLAY with lenses and layers of sandier material.

Soft clay extends to at least 30 m below sea level in the Murray Bridge area and at least 20 m below sea level in the Mannum area. In many places, the upper part of the Soft CLAY (e.g. the upper metre or two) below the riverbank is stiffer because of the effects of desiccation.

The cliffs to the south of the lagoon are comprised of limestone (Ty) of the Murray Formation. The limestone is a shallow marine deposit of Tertiary Age and is generally of low to medium strength.

The higher ground is shown to comprise Pleistocene age Calcrete (QPca) overlying Loxton Sand (Tpl). The calcrete is expected to be encountered close to the surface and extend to about 1 m to 2 m depth.

25.2 Subsurface Condition

Coffey (2014a) indicated that the natural subsurface conditions were consistent with the regional geology described in Section 24.1 and consist of soft, normally consolidated, river and floodplain deposits.

The geological units, as well as the extent of each geological unit encountered during the investigation, are summarised in Table 37. Reference should be made to the individual borehole logs given by Coffey (2014a) for more detailed information.

Furthermore, Coffey (2014a) has indicated that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Table 37: Summary of geological units encountered at Caurnamont Wetland - Regulator 189 (Source: Coffey, 2014a)

Description	Depth Below Surface (m)	c_u (kPa)	ϕ' (°)	Unit Weight (kN/m^3)
Soft Riverbank Sand: Fine to medium grained sand, encountered near the surface in isolated areas of the riverbank.	0 up to 1.6	-	-	-
Black Earth Clay: High to Extremely high plasticity, dark grey to black. Typically Stiff to Very Stiff consistency where encountered above the groundwater table reducing to a soft to firm consistency when saturated.	1.6 up to 2.4	15	0	17
Clayey Sand/ Sandy Clay: Light grey sand or sandy clay. Sand particles fine to medium grained, loose consistency.	2.4 –4.2*	15	0	17

* Limit of investigation - refusal

Table 38: Summary of geological units encountered at Caurnamont Wetland - Regulator 193 (Source: Coffey, 2014a)

Description	Depth Below Surface (m)	c_u (kPa)	ϕ' (°)	Unit Weight (kN/m^3)
Fill	0 to 2	-	-	-
Black Earth Clay: High to Extremely high plasticity, dark grey to black. Typically Stiff to Very Stiff consistency where encountered above the groundwater table reducing to a soft to firm consistency when saturated.	2 to 4^	35^	0	18
Green-Grey Clay: Medium plasticity, green-grey, typically normally consolidated with soft to very soft consistency. Some pockets of decomposing plant matter..	4 to 10	15	0	17
Medium dense sand	>10.5	0	34	18

^The firm clay is only present directly below the existing embankment where the soil is slightly over-consolidated due to loading. Outside of this footprint, the soft clay will be present at the surface.

26 North Purnong

26.1 Site Geology

The Geological Survey of South Australia, “Swan Reach” 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

Sands, medium to coarse, and gravel associated with the Monoman Formation (Qam) are expected to underlie the Coonambidgal Formation.

The cliffs are comprised of limestone (Ty) of the Murray Formation. The higher ground is shown to comprise Loxton Sand (Tpl) and Pleistocene age Calcrete (QPca).

26.2 Subsurface Condition

The natural subsurface conditions were consistent with the regional geology described by Geological Survey of South Australia, “Swan Reach” 6828 sheet. The generalised subsurface conditions encountered during the investigation are summarised in Table 39. Reference should be made to the individual borehole logs in Coffey (2013c) for more detailed information.

Table 39: A summary of geotechnical models used for designs at North Purnong (modified: Coffey, 2013c)

Description	Depth Below Surface (m)	c_u (kPa)	ϕ' (°)	Unit Weight (kN/m³)
Topsoil: Silty Clay, high plasticity, dark grey, with some organic content	0 to 0.4			
Silty Clay: High plasticity, grey to green grey, sand pockets, soft to firm consistency	0.4 to 4.0*	20	-	17

* Limit of the investigation

27 North Caurnamont Wetland

27.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac). The river and floodplain deposits were mostly deposited as the sea returned to its present level after the last glaciation (reached present level about 7,500 years ago). They mainly consist of very soft to soft CLAY and Sandy CLAY with lenses and layers of sandier material. Soft clay extends to at least 30 m below sea level in the Murray Bridge area and at least 20 m below sea level in the Mannum area. In many places, the upper part of the soft clay (e.g. the upper metre or two) below the riverbank is stiffer than the underlying soils because of the effects of desiccation). The steeply sloped ground west of the lagoon is shown to consist of limestone (Ty) of the Murray Formation.

The limestone is a shallow marine deposit of Tertiary age and is mainly of low to medium strength Pleistocene age Calcrete (QPca) overlying Loxton Sand (Tpl) is shown to be present in the higher ground west of Fromm Road.

27.2 Subsurface Condition

The site investigation undertaken by Coffey (2014b) showed that the natural subsurface conditions were consistent with the regional geology described in Geological Survey of South Australia, "Swan Reach" 6828 sheet and comprised of soft river and floodplain deposits. The detailed description of the geological units encountered during the investigation and the extent of each geological unit are summarised in Table 40. Reference should be made to the individual borehole logs given by Coffey (2014b) for more detailed information. The geotechnical models that are adopted by Coffey (2014b) are presented in Table 41.

Table 40: Summary of subsurface materials encountered at North Caurnamont Wetland (modified: Coffey, 2014b)

Material Description	Depth Below Surface to Base of Geological Unit (m)				
	BH1 BH2 BH3 and BH6	BH4	BH5	BH7	BH8
Embankment Fill	1.2	-	-	1.0	0.7
Riverbank Sand: Fine to medium grained sand	-	-	0.4	-	-
Black Earth Clay: High plasticity, Typically stiff to very stiff above the groundwater, transition to a soft to firm below groundwater level. At some locations a highly organic clay is present at the base of the unit (around 2.5 to 3.5 mbgs)	3.0 – 3.1	1.3	1.5	3.8	4.0*
Sand / Silty Sand: Light-grey Silty Sand and Sand. Loose to very loose consistency. Fine to medium grained, possibly grading coarser with depth. Encountered at BH7 between 4 and 8 m depth.	-	-	4.2*	8.0 ~#	-
Green-Grey Clay: High plasticity, green-grey, typically normally consolidated with soft to very soft consistency. Highly compressible.	4.2 to 10.95*~	4.0*	-	9.0*	-

* Limit of Investigation
~ Subsurface profile between 4.2 m and 11 m depth inferred by CPT results
# (BH7) Stiff Clay was encount
NM: Not measured

Table 41: A summary of geotechnical models used for designs at North Caurnamont Wetland (modified: Coffey, 2014b)

Soil Type	Depth Below Surface (m)	c_u (kPa)	ϕ (°)	γ (kN/m^3)
Black Earth Clay	0.0 to 1.3	-	-	-
Green-Grey Clay	1.3 to 4.0)	30	-	18
Soft Clay	4 to 10	15	-	17

28 Scrubby Flat

28.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac). Sands, medium to coarse, and gravel associated with the Monoman Formation (Qam) are expected to underly the Coonambidgal Formation.

The higher ground north of the lagoon is shown to comprise Pleistocene age Calcrete (QPca) and limestone (Ty) of the Murray Formation.

28.2 Subsurface Condition

The offshore CPTu (LMR0314-SF1) undertaken by the University of Sydney team show that the subsurface conditions were consistent with the regional geology described in Geological Survey of South Australia, "Swan Reach" 6828 sheet. The testing location is shown in Figure 31.

The offshore investigation showed that the riverbed is comprised of fluvial Silty or Clayey SAND within the first 1.5 – 2.1 m, underlain by a Clayey SILT or Silty CLAY layer, extending to a depth of ~5.0 m. Clayey SAND/Sandy CLAY was encountered from a depth of ~5.0 to 8.0 m. A summary of soil profile obtained from the offshore CPTu test data is presented in Table 42. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plots in **Appendix 20**.

Figure 31 : Testing location of the offshore CPTu near Scrubby Flat.

Table 42: Soil profile derived from offshore CPTu test data –Scrubby Flat.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Silty/clayey SAND	0.0 to 1.5 – 2.1
2	Clayey/silty CLAY	1.5 – 2.1 to ~5.0
3	SAND	5.0 to 8.0*

* Limit of investigation - refusal

29 Walker Flat

29.1 Site Geology

The Walker Flat site is mapped on the Renmark (1971) map-sheet as Tertiary Mannum Formation, comprising sandy limestones and calcarenite.

29.2 Subsurface Condition

The site investigation conducted by SKM (2010b) indicated that the subsurface profile consists of a topsoil layer of Silty/Clayey GRAVEL, underlain by dry-moist firm Silty CLAY layer. From 3.5 m below ground level, the moisture content increased and the consistency reduced to very soft. From 9.8 m depth, the sand content gradually increased, eventually becoming a Sandy CLAY/Clayey SAND at 10.5 m depth. A summary of the recommended soil parameters by SKM (2010b) used for the stability assessment is presented in Table 43**.**

Table 43: Soil parameters for stability assessments – Walker Flat (Modified: SKM, 2010b)

Description	Depth below the ground (m)	Soil Model	Unit Weight (kN/m^3)	ϕ' (°)	c' / s_u (kPa)	Increase Rate for S_u
Fill: Silty/Clayey SAND (SM/SC) (Type – A)	0 to 1.5	Mohr-Coulomb	19 ± 1	30 ± 2	-	-
Silty CLAY (CH) (Type–B1)	1.5 to	Undrained	19 ± 1	-	70 ± 10	-
Silty CLAY (CH) (Type–B2)			19 ± 1	-	50 ± 10	-
Silty CLAY (CH) (Type–B3)			17 ± 1	-	15 ± 10	-
Silty CLAY (CH) (Type–B4)			17 ± 1	-	15 ± 5	-
Clayey SAND/Sandy CLAY (SC/CL) (Type – C)	>10.5	Mohr-Coulomb	19 ± 1	31 ± 1	-	-

A single offshore CPTu sounding was undertaken near Walker Flat by the University of Sydney team. The testing location is shown in Figure 32. The CPTu results show that the riverbed consists of a ~2.0 m thick layer of fluvial Silty or Clayey SAND at the surface, followed by Silty/Sandy CLAY layer extending to a depth of ~3.9 m. A Clayey SAND and Sandy CLAY interbedded layer was encountered below ~3.9 m, to the refusal depth of ~8.0 m. A summary of the soil profile obtained from the offshore CPTu data is presented in Table 44. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 21**.

Figure 32 : Testing location of the offshore CPTu near Walker Flat.

Table 44: Soil profile derived from offshore CPTu test data – Walker Flat

Layer No.	Soil Type	Depth Below the Ground (m)
1	Gravelly SAND or Silty/Clayey SAND	0.0 to 2.0
2	Silty/Sandy CLAY	2.0 to 3.9
3	Clayey SAND/Sandy CLAY	3.9 to ~8.0*

* Limit of investigation - refusal

30 Wongulla Lagoon

30.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

Sands, medium to coarse, and gravel associated with the Monoman Formation (Qam) are expected to underly the Coonambidgal Formation.

The higher ground north of the lagoon is shown to comprise Pleistocene age Calcrete (QPca) and limestone (Ty) of the Murray Formation.

30.2 Subsurface Condition

The site investigation undertaken by Coffey (2013b) showed that the natural subsurface conditions were consistent with the regional geology described in Section 29.1. The generalised subsurface conditions encountered during the investigation are summarised in Tables 45 and 46, as well as the geotechnical models adopted by Coffey (2013b), are presented in Table 47. Reference should be made to the individual borehole logs given by Coffey (2013b) for more detailed information.

Table 45: Summary of subsurface materials at Wongulla (Source: Coffey, 2013b)

Unit	Material Description	Depth Below Surface (m)			
		BH3	BH4	BH5	BH7
F	Fill: Sandy Gravel, fine to coarse, with Sandy Clay, medium plasticity	0.0 to 0.7	0.0 to 0.6	0.0 to 0.7	0.0 to 0.4
B	Silty Clay: High plasticity, dark grey, grading to grey / green grey clay. Consistency ranges from firm to very soft below the water table. Moisture content well in excess of the plastic limit. Trace pockets of organic material in upper 3m.	0.7 to 6.0*	0.6 to 5.0	0.7 to 2.1*	-
C	Silty Sand / Clayey Sand: Fine grained, pale green grey, non plastic to low plasticity fines, wet	-	5.0 to 6.0*	-	0.4 to 3.0
* Limit of Investigation					

A single offshore CPTu test was undertaken near Wongulla Lagoon by the University of Sydney team and the testing location is shown in Figure 33. The CPTu results showed that the riverbed consists of a ~1.1 m thick layer of fluvial Gravelly SAND or SAND at the top, followed by a Silty/Sandy CLAY or Clayey/Silty SAND layer extending up to a depth of ~3.25 m. Silty CLAY is encountered at a depth between 3.25 and 5.1m. The silty CLAY layer is underlain by SAND, extending up to refusal depth of ~6.5m. A summary of soil profile obtained from offshore CPTu test data is presented in Table 48. Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 22.**

Table 46: Summary of subsurface materials at Wongulla (source: Coffey, 2013b)

Unit	Material Description	Depth Below Surface (m)			
		BH2	BH6	BH1	BH8
A	Topsoil: At BH1, BH2: Silty Clay, medium plasticity, brown, high organic content. At BH6: Silty Sand and Sandy Clay, medium plasticity, fine to medium grained. At BH8: Sand and Gravelly Sand, fine to coarse grained (possible fill)	0.0 to 0.3	0.0 to 0.25	0.0 to 0.25	0.0 to 0.75
B	Silty Clay: High plasticity, dark grey, grading to grey / green grey clay. Consistency ranges from firm to very soft below the water table. Moisture content well in excess of the plastic limit. Trace pockets of organic material in upper 3 m.	0.25 to 4.25*	0.25 to >10 #	0.25 to 4.25*	0.75 to 1.8*
C	Silty Sand / Clayey Sand: Fine grained sand with clayey and silty fines, very soft / very loose collapsible soils.	-	-	-	1.8 to 3.1
D	Sand: Fine to medium grained, grey, some non-plastic fines. Loose density, grading medium dense at 4.7 m (CPT refusal).	-	-	-	3.1 to 5.2

* Limit of Investigation

\# Inferred based on analysis of CPT data

Table 47: A summary of geotechnical models used for designs at Wongulla (source: Coffey, 2013b)

Soil Type	Depth Below Surface (m)	c_u (kPa)	ϕ (°)	γ (kN/m³)
Topsoil: Silty Clay	0.0 to 0.25			-
Silty Clay (high plasticity)	0.25 to 4.25 (could extend > 10m)	18	-	-
Sand	Unknown	-	30	-
Fill: Sandy Gravel	0 to 0.8			-
Soft Clay	0.8 to 2.5	18	-	-
Stiff Clay	2.5 to 3.5	70	-	-
Very Stiff Clay	3.5 to 5	120	-	-

Figure 33 : Locations of the offshore CPTu testing near Wongulla.

Table 48: Soil profile derived from offshore CPTu test data – Wongulla Lagoon.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Gravelly SAND or SAND	0.0 to 1.1
2	Silty/sandy CLAY or Clayey/Silty SAND	1.1 to 3.25
3	Silty CLAY	3.25 to 5.1
4	SAND	5.1 to ~6.5*

* Limit of investigation - refusal

31 Kroehn's Landing

31.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the lower ground is likely to comprise coarse-grained fluvial and finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac).

Sands, medium to coarse, and gravel associated with the Monoman Formation (Qam) are expected to underly the Coonambidgal Formation.

31.2 Subsurface Condition

The site investigation undertaken by Coffey (2013a) showed that the natural subsurface conditions were consistent with the regional geology described in Section 30.1. The generalised subsurface conditions encountered during the investigation are summarised in Table 49 and the geotechnical models adopted by Coffey (2013a) are presented in Table 50. Reference should be made to the individual borehole logs in Coffey (2013a) for more detailed information.

Table 49: Generalised summary of subsurface materials at Kroehn' Landing (source: Coffey, 2013a)

Unit	Material Description	Depth Below Surface (m)	
		BH1 and BH2	BH3 and BH4
Fill	Fill: Consisting of medium to coarse gravels and cobbles up to 350 mm in size in a matrix of sandy clay, medium plasticity, brown, with some fine to medium grained sand.	0 to 0.8–1.1	-
A	Topsoil: Silty clay, grey with rootlets and other plant matter.	-	0 to 0.25
B1	Silty Clay: High plasticity, dark grey to black, high organic content with pockets of decomposed plant matter, odorous; with some bands of silty and clayey sand.	0.8–1.1 to 4.0–4.25	-
B2	Silty Clay: Medium to high plasticity, light grey, green grey	4.0–4.25 to 6.0*–6.75	0.25 to 6.5 – 10*
# C	Sand: Coarse grained sand, medium dense based on CPT data (after Douglas & Olsen, 1981)		
* Limit of Investigation			

Table 50: A summary of geotechnical models used for designs at Kroehn's Landing (Modified: Coffey, 2013a)

Soil Type	Depth Below Surface (m)	c_u (kPa)	ϕ (°)	γ (kN/m^3)
Topsoil: Silty Clay	0.0 to 0.25			
Silty Clay (high plasticity)	0.25 to 1.0	25	-	
Silty Clay (high plasticity)	1.0 to 3.0	40	-	
Silty Clay (high plasticity)	3.0 to 10.0	22	-	
Fill	0.0 to 1.0			
Silty Clay (high plasticity)	1.0 to 2.0	20	-	
Silty Clay (high plasticity)	2.0 to 6.75	25	-	
Sand	6.75 to 7.4	-	32	

32 Herrmanns Landing, Nildottie

32.1 Site Geology

The Geological Survey of South Australia, Renmark Sheet 1 54-10 Zone 6, indicates that the cliffs at Herrmanns Landing consists of limestone and calcarenites (Tmm) of the Mannum Formation. The limestone is a shallow marine deposit of Tertiary age and is mainly of low to medium strength. Pleistocene age Calcrete (Qca) is shown to be present in the high ground where the limestone cliffs are present.

On the other (western) side of river, the floodplain area is likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac) overlying coarser grained alluvial deposits belonging to the Monoman Formation (Qm).

32.2 Subsurface Condition

A single onshore CPTu was undertaken by the University of Adelaide team, and the testing location is shown in Figure 34. The results show that the subsurface profile encountered during the investigation at the lower ground of Herrmanns Landing, Nildottie, consists of Gravelly SAND overlying Silty or Clayey SAND with a transition occurring around 1.2 m below ground level. The Clayey or Silty SAND layer extends to the refusal depth of ~5.6 m. Relief drilling was carried out from a depth of ~5.6 to 6.35 m below the ground surface.

Below the relief drilling depth of ~5.6 to 6.35 m, limestone and calcarenite layers were encountered. At certain depths, negative cone tip resistance and sleeve friction values were recorded. Post-testing diagnosis indicated that the negative values are likely to have been caused by the calcarenite materials adhering to the gap between the sleeve and cone, restricting the sleeve, and also applying a negative force beneath the tip. Therefore, the CPT readings (CPT No. Nildottie_1b) below the depth of 5.6 m are considered unreliable and should be disregarded.

A summary of the soil profile derived from the onshore CPTu data is presented in Table 51. Note that due to the adopted drilling method, it was not possible to determine the elevation of the groundwater. It is assumed that the groundwater level was reflective of the river level and is expected to vary in response to prevailing weather and seasonal conditions.

Further details of the subsurface profiles encountered during the investigation are presented on the CPTu plot in **Appendix 23**.

Table 51: Soil profile derived from onshore CPTu test data – Mannum.

Layer No.	Soil Type	Depth Below the Ground (m)
1	Fill: Gravelly SAND	0.0 to 1.2
2	Silty or clayey SAND	1.2 to 5.6
3	Limestone and Calcarenites	5.6 to 7.55*

* Limit of investigation - refusal

Figure 34 : Location of the onshore CPTu testing at Herrmanns Landing, Nildottie.

33 Big Bend

33.1 Site Geology

The Geological Survey of South Australia, "Swan Reach" 6828 sheet (1:100,000), indicates that the floodplain area is likely to comprise finer grained alluvial deposits associated with the Coonambidgal Formation (Qhac) overlying coarser grained alluvial deposits belonging to the Monoman Formation (Qm).

Across the slightly higher ground, 'Bunyip Sand' is present. The higher ground (>39 m AHD) is shown on the regional geology map to consist of a calcrete capping at the surface, which is probably underlain, at a relatively shallow depth, by the Murray Group Limestone.

33.2 Subsurface Condition

Coffey (2014c) summarised the geological units encountered at this site and are presented in Table 52. The subsurface encountered during the investigation profile is consistent with the expected regional geology and further details are presented on the borehole logs given by Coffey (2014c). The geotechnical parameters that were used for the stability design in Coffey (2014c), are presented in Table 53.

Table 52: Summary of subsurface soil units observed at Big Bend (source: Coffey, 2014c)

Geological Units	Description	Depth range (AHD)
Coonambidgal Formation	Interbedded deposits of silty sand, clayey sand, sandy clay and sand	-1 m to around 3 m
	Soft Clay, organic pockets	<-8m to -1m
Monomon Formation	Sand, fine to coarse grained, low fines content. medium dense to dense.	Top of unit uncertain - Possibly encountered at -6 m at CPT2. Expected to be at least 15 m thick.
Bunyip Sand	Sand, loose to medium dense	> 3 m

Table 53: A summary of geotechnical models used for designs at Big Bend (Modified: Coffey, 2014c)

Soil Type	Depth Below Surface (m) AHD	c_u (kPa)	ϕ (°)	γ (kN/m^3)
Soft Clay	-8.0 to 0.0^	20		17
Sand (Monomon Formation)	Unknown			
Soft Clay	0.0 to -4.6	20		17
Sand	-4.6 to -6.0	-	32	18

^The base of soft clay was not determined

34 South Punyelroo

34.1 Site Geology

South Punyelroo is mapped on the Geological Survey of South Australia (1971) Renmark map- sheet as Quaternary Coonambidgal Formation, comprising fluvial clays, silts and sands; light grey alluvium of the Murray River system.

34.2 Subsurface Condition

The soil profile encountered at South Punyelroo confirmed the expected Quaternary Coonambidgal Formation, as seen on the Geological Survey of South Australia (1971) Renmark map-sheet. The subsurface profile consisted of an upper layer of SAND and Silty SAND, with a thickness about 0.4 to 1.2 m, usually underlain by firm to very soft Silty CLAY. A layer of light green to grey SAND typically underlies this layer around 3.8 to 4.5 m below ground level. The three boreholes conducted at this site were terminated just before 5 m below ground level in medium dense SAND. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs given by SKM (2010b).

Table 54: The summarised geotechnical profile at South Punyelroo (Source: SKM, 2010b).

Description/Type	Soil Model	Unit Weight (kN/m^3)	ϕ' (°)	c' / S_u (kPa)	Increase Rate for S_u
Fill: Silty/Clayey SAND (SM/SC) (Type – A)	Mohr-Coulomb	20 ± 1	30 ± 1	-	-
Silty CLAY (CL) (Type – B1)	Undrained S_u=f(depth)	20 ± 1	-	100 ± 20	-
Silty CLAY (CL) (Type – B2)	Undrained S_u=f(depth)	17 ± 1	-	25 ± 5	-
Clayey SAND/Sandy CLAY (SC/CL) (Type – C)	Mohr-Coulomb	20 ± 1	30 ± 1	-	-

35 Swan Reach

35.1 Site Geology

Most of the lower ground and riverbanks of the Swan Reach area is mapped on the Renmark (1971) map-sheet as Quaternary Coonambidgal Formation, comprising fluvial clays, silts and sands; light grey alluvium of the Murray River system. This unit overlies the coarse-grained riverine sand of the Monoman Formation.

The cliffs near the riverbanks consist of a recent deposit of aeolian quartz sands (Qrp) and Pleistocene age Calcrete (Qca) overlying the Norwest Bend Formation (Tpn, Late Pliocene, Oyster Beds and sandy limestone) and Mannum Formation (Tmm, Miocene, sandy limestone and calcarenites) .

35.2 Subsurface Condition

The site investigation carried out by SKM (2010b) confirmed that soil profile encountered at Swan Reach matched the expected Quaternary Coonambidgal Formation, as seen on the Geological Survey of South Australia (1971) Renmark map sheet. The subsurface profile consisted of a 0.1 m thickness topsoil layer of coarse GRAVEL, underlain by Sandy GRAVEL/Gravelly SAND fill material to around 1.7 m below the ground level. The fill material overlies a dry to moist, firm black Silty CLAY layer (SKM, 2010). From 5 m below ground level, the moisture content increased, the colour changed to a dark grey and the consistency became very soft to 7.5 m depth, where the sand content increased gradually, eventually becoming medium dense SAND. Further details of the subsurface profiles encountered during the investigation are presented on the borehole logs given by SKM (2010b).

A summary of the soil parameters used for the stability assessment is presented in Table 55.

Table 55: The geotechnical profile at Swan Reach (Source: SKM 2010b).

Description	Soil Model	Unit Weight (kN/m^3)	φ' (°)	c' / S_u (kPa)	Increase Rate for S_u
Fill: Silty/Clayey SAND (SM/SC) (Type – A)	Mohr-Coulomb	20 ± 1	30 ± 2	-	-
Silty CLAY (CH) (Type – B1)	Undrained	20 ± 1	-	250	-
Silty CLAY (CH) (Type – B2)	Undrained	20 ± 1	-	50 ± 10	-
Silty CLAY (CH) (Type – B3)	Undrained	18 ± 1	-	18 ± 2	-
Silty CLAY (CH) (Type – B4)	Undrained	18 ± 1	-	12.5 ± 2.5	-
Clayey SAND/Sandy CLAY (SC/CL) (Type – C)	Mohr-Coulomb	20 ± 1	31 ± 1	-	-

36 Between Swan Reach and Blanchetown

36.1 Site Geology

Most of the riverbanks and lower ground between Swan Reach and Blanchetown are mapped on the Renmark Sheet 1 54-10 Zone 6 (Geological Survey of South Australia, 1971), as Quaternary Coonambidgal Formation, comprising fluvial clays, silts and sands; light grey alluvium of the Murray River system. This unit overlies the coarse-grained riverine sand of the Monoman Formation.

The cliffs along the sections between Swan Reach and Blanchetown are comprised of limestone (Tmm) of the Mannum Formation. The limestone is a shallow marine deposit of Tertiary age and is mainly of low to medium strength. The recent aeolian deposit of red-brown quartz sands, as well as Pleistocene age aeolian quartz sand with carbonate silt (Qpo), and Calcrete (Qca) are shown to be present in the high ground where the limestone cliffs are present.

36.2 Subsurface Condition

Twenty drillers' logs (WaterConnect's reference no. 6828-494, 6828-495, 6828-497, 6828-498, 6829-1519, 6829-1544, 6829-1545, 6829-1546, 6829-1547, 6828-930, 6828-951, 6828-952, 6828-953, 6828-955, 6828-956, 6828-958, 6828-957, 6828-959, 6828-960 and 6828-961) were found near Blanchetown. The locations are shown in Figure 35. These records are used to construct five geological profiles that might be found in these locations. A summary of the lithology is presented in Table 57. Further details of the drillers' logs are presented in **Appendix 24**.

Table 56: A summary of lithology between Swan Reach and Blanchetown obtained from WaterConnect's database.

Layer No.	Soil Type	Depth Below the Ground (m)		Elevation AHD (m)	
		Start	End	Start	End
1a	Sand	0.0	0.3 to 1.5		
2a	Limestone	0.3 to 1.5	19.5 to 27.4		
1b	Sandy Clay or Clay	-	-	3.2	-0.8 to -4.0
1c	Silty Clay	-	-	0.0	-4.5
2c	Clayey Sand	-	-	-4.5	-7.0
1d	Clay	-	-	2.3	-0.7
2d	Silty Clay	-	-	-0.7	-3.7
1e	Stiff Clay	-	-	3.2 to 0.8	-2.8 to -5.2
1f	Stiff Clay	-	-	3.7 to 2.7	0.7 to -1.3
2f	Clayey Sand or Sandy Clay	-	-	0.7 to -1.3	-2.3 to -3.3
1g	SAND	-	-	3.4	1.4
2g	Sandy CLAY	-	-	1.4	-2.6

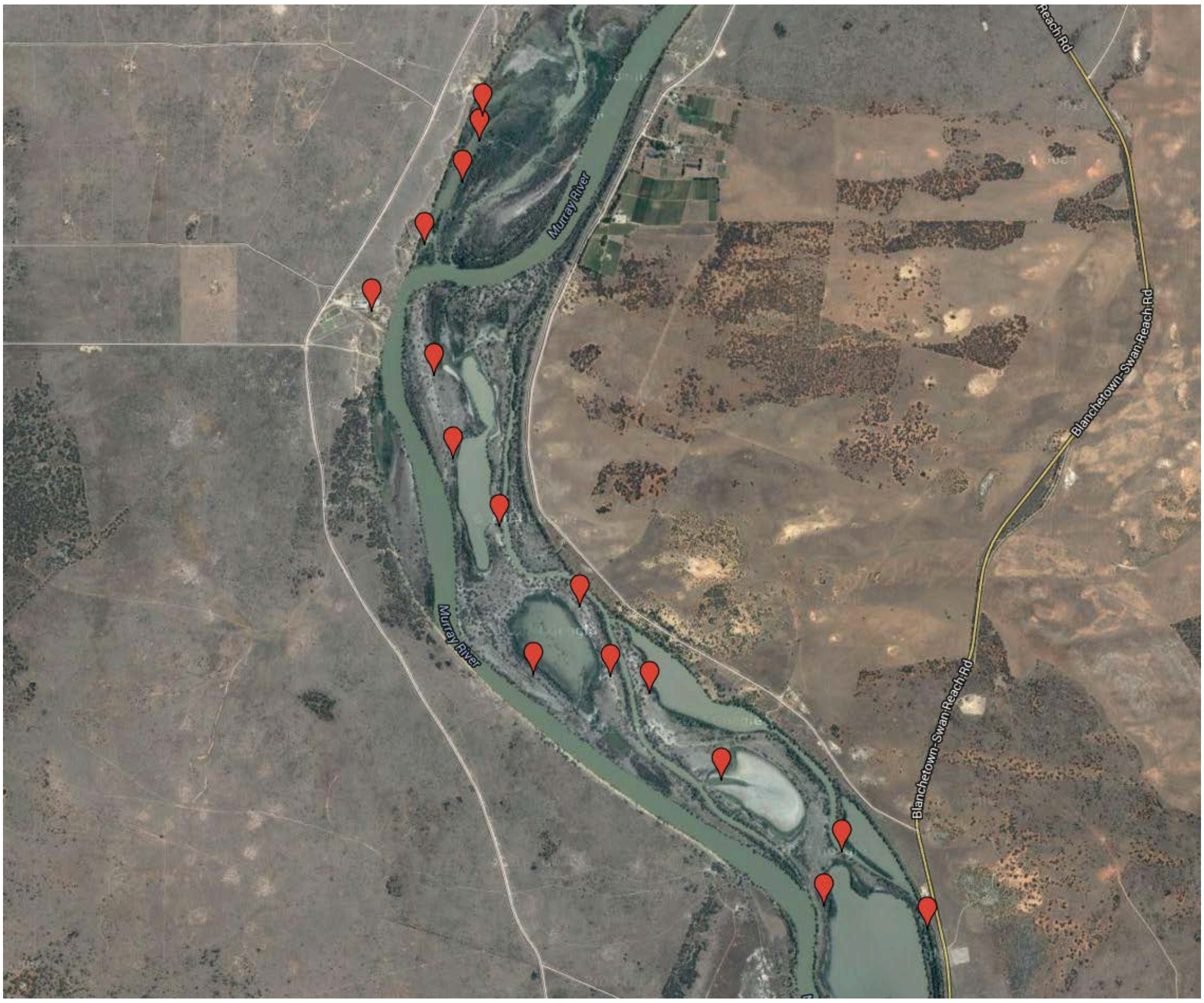

Figure 35 : Locations of the WaterConnect groundwater wells (red labels) – between Swan Reach and Blanchetown.

37 Blanchetown

37.1 Site Geology

Blanchetown East is mapped on the Renmark (Geological Survey of South Australia, 1971) map-sheet as Quaternary Coonambidgal Formation, comprising fluvial clays, silts and sands; light grey alluvium of the Murray River system. This unit overlies the coarse-grained riverine sand of the Monoman Formation.

37.2 Subsurface Condition

Five drillers' logs (WaterConnect's reference no. 6829-1519, 6829-1522, 6829-1520, 6829-1521 and 6829-1568) were found near Blanchetown. A summary of the lithology is presented in Table 57. Further details of the drillers' logs are presented in **Appendix 25**. The locations are shown in Figure 36.

Table 57: A summary of lithology near Blanchetown obtained from WaterConnect's database.

Layer No.	Soil Type	Elevation AHD (m)	
		Start	End
1a	Sandy CLAY	4.7	3.0 to 1.6
2a	CLAY	3.0 to 1.6	-4.2 to -4.8
1b	SAND	1.5	1.0
2b	Sandy Clay or CLAY	1.0	-3.0
1c	Sandy CLAY	4.7	3.2
2c	SAND	3.2	-3.3
1d	Silty CLAY	0.5	-5.6
2d	Sandy CLAY	-5.6	-6.6

Figure 36 : Locations of the WaterConnect groundwater wells (red labels) – Blanchetown.

38 Blanchetown East

38.1 Site Geology

The lower ground and the riverbanks of the Blanchetown East is mapped on the Renmark (Geological Survey of South Australia, 1971) map-sheet as Miodene Coonambidgal Formation, comprising fluvial clays, silts and sands; light grey alluvium of the Murray River system. This unit overlies the coarse-grained riverine sand of the Monoman Formation.

The cliffs presently along Blanchetown East comprise Morgan limestone (Tmm). The limestone is a shallow marine deposit of Tertiary age and is mainly of low to medium strength. Pleistocene age aeolian quartz sand with carbonate silt (Qpo), as well as Calcrete (Qca), are shown to be present in the high ground where the limestone cliffs are present.

38.2 Subsurface Condition

Two drillers' logs (WaterConnect's reference no. 6829-1513 and 6829-1517) were found near Blanchetown East. A summary of the lithology is presented in Table 58. Further details of the drillers' logs are presented in **Appendix 26**. The locations are shown in Figure 37.

Table 58: A summary of lithology near Blanchetown East obtained from WaterConnect's database.

Layer No.	Soil Type	Depth Below the Ground (m)		Elevation AHD (m)	
		Start	End	Start	End
1a	CLAY	-	-	3.6	-0.4
2a	Silty CLAY	-	-	-0.4	-2.4
3a	Sandy CLAY	-	-	-2.4	-4.4
1b	CLAY	0.0	2.0	-	-
2b	Sandy CLAY	2.0	3.0	-	-
2b	Clayey SAND	3.0	4.0	-	-

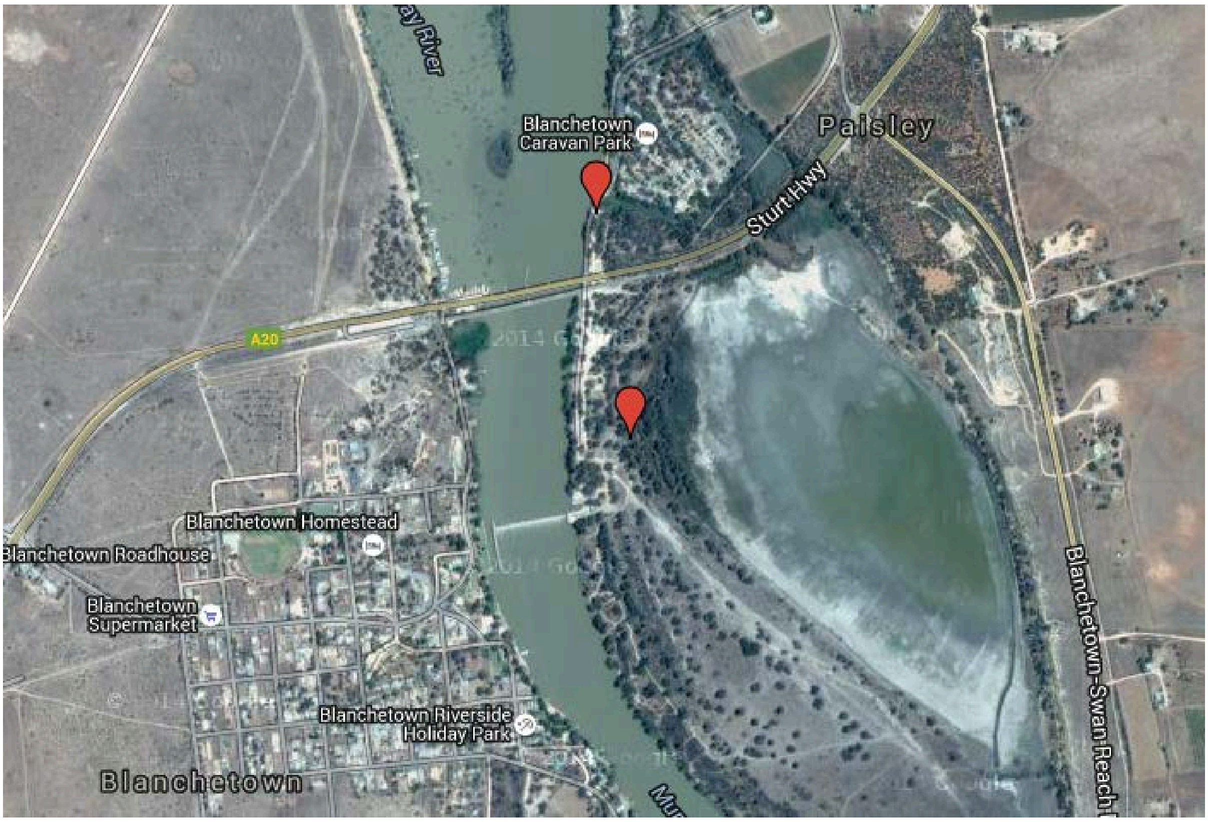

Figure 37 : Locations of the WaterConnect groundwater wells (red labels) – Blanchetown East.

39 Summary and Conclusion

The additional geotechnical investigations and testing performed and described above have, in general, confirmed the stratigraphy indicated by the various geological maps relevant to the various locations examined. The investigations and testing have provided additional, relevant data that will be used in the numerical modelling and conclusions drawn in the later phases of this Riverbank Collapse project.

40 References

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41 Photographs

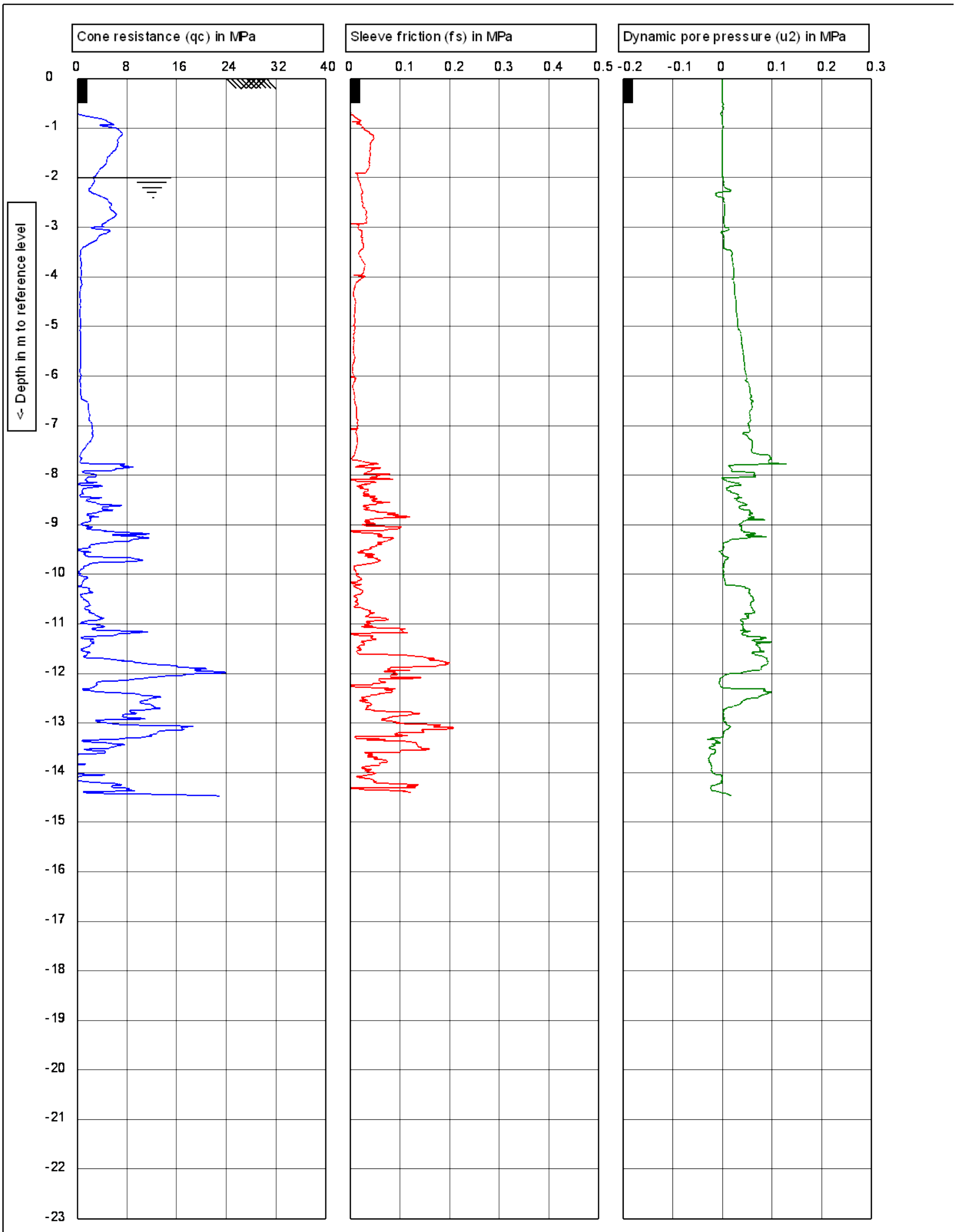
Figure 38: CPTu testing was undertaken at Mannum.

Figure 39: Relief drilling for CPTu testing at Nildottie.

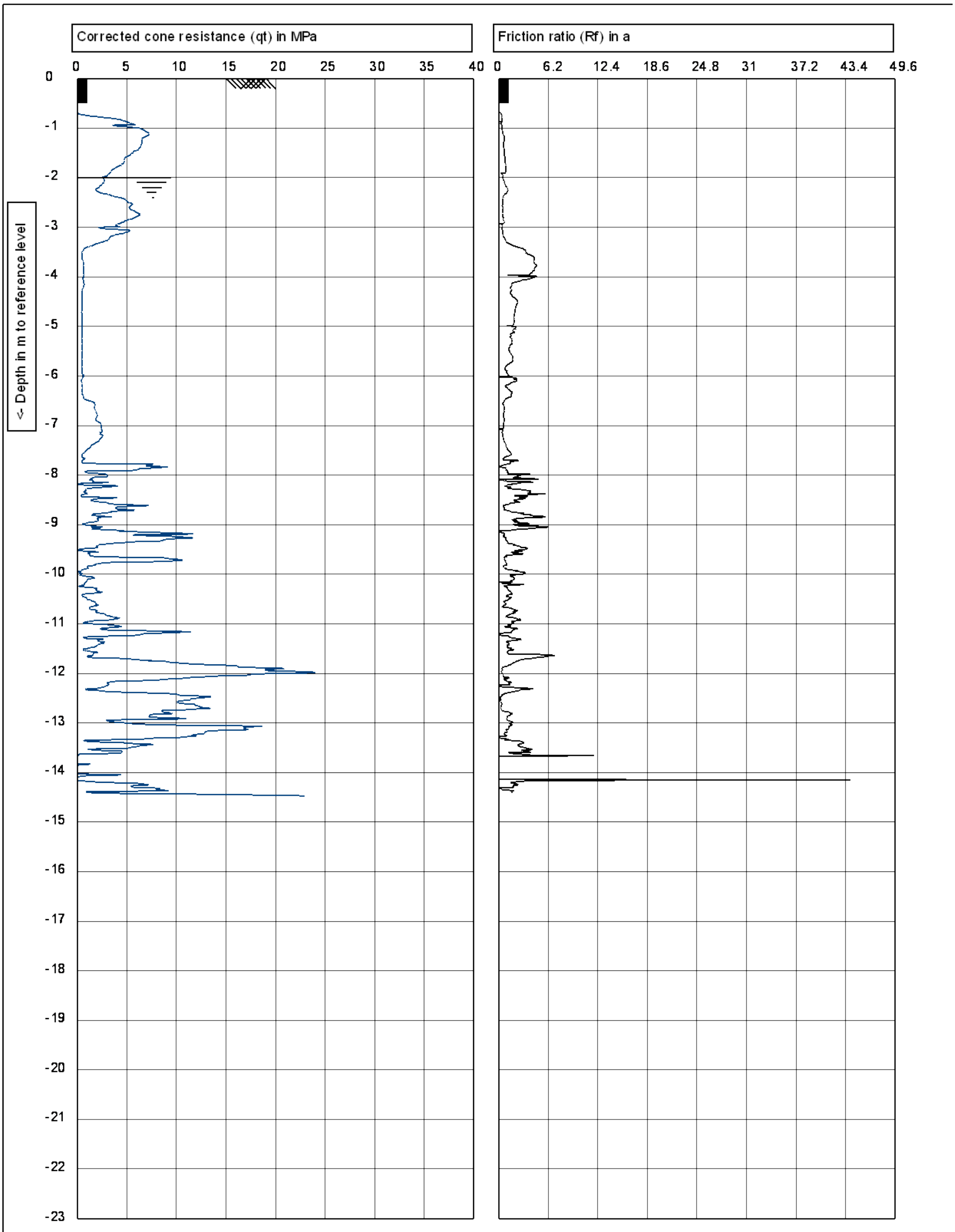
Figure 40: Offshore CPTu setup used in 2013.

Figure 41: New offshore CPTu setup in 2014 and 2015

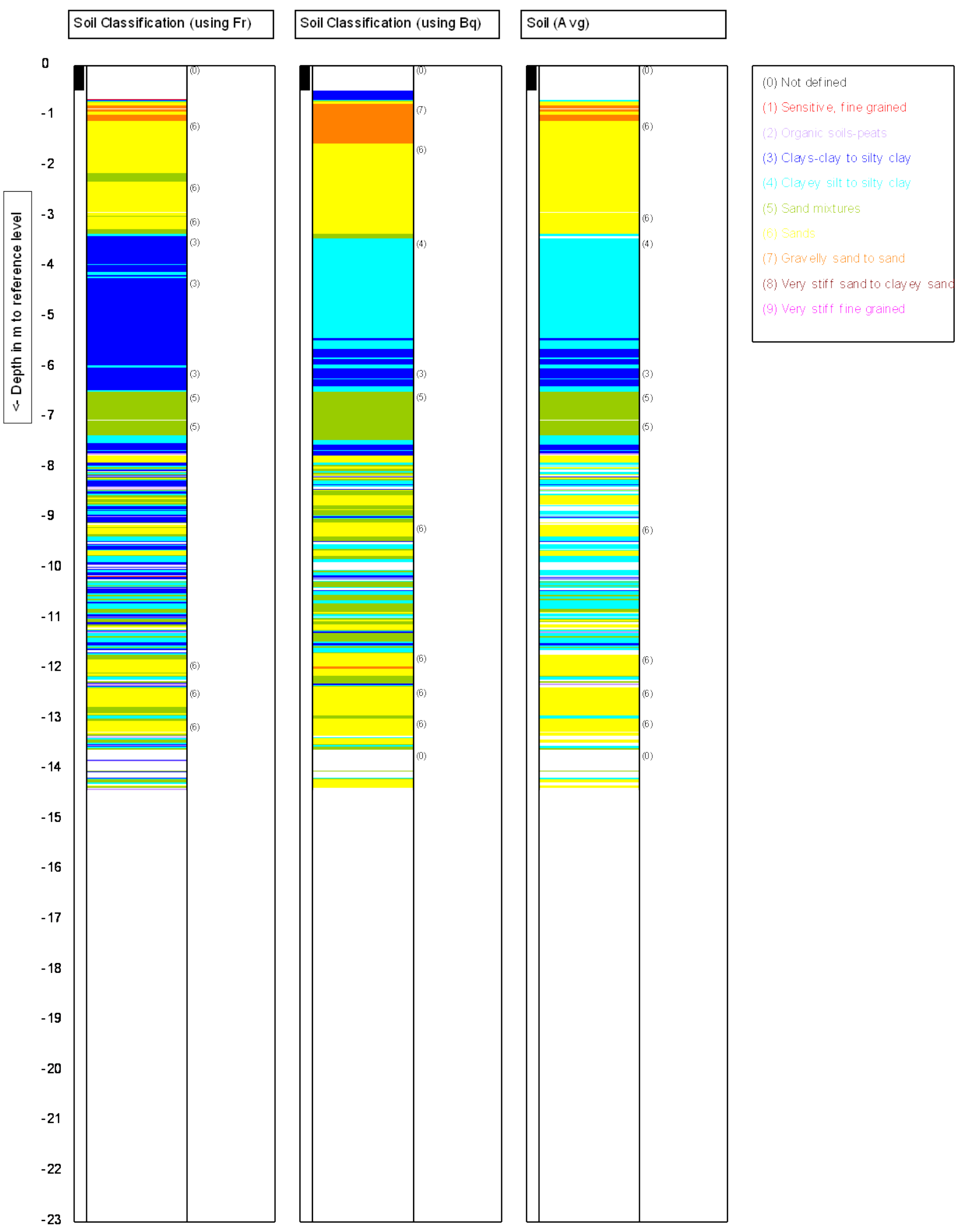
Appendix 1 Wellington West — Cone Penetration Test Results



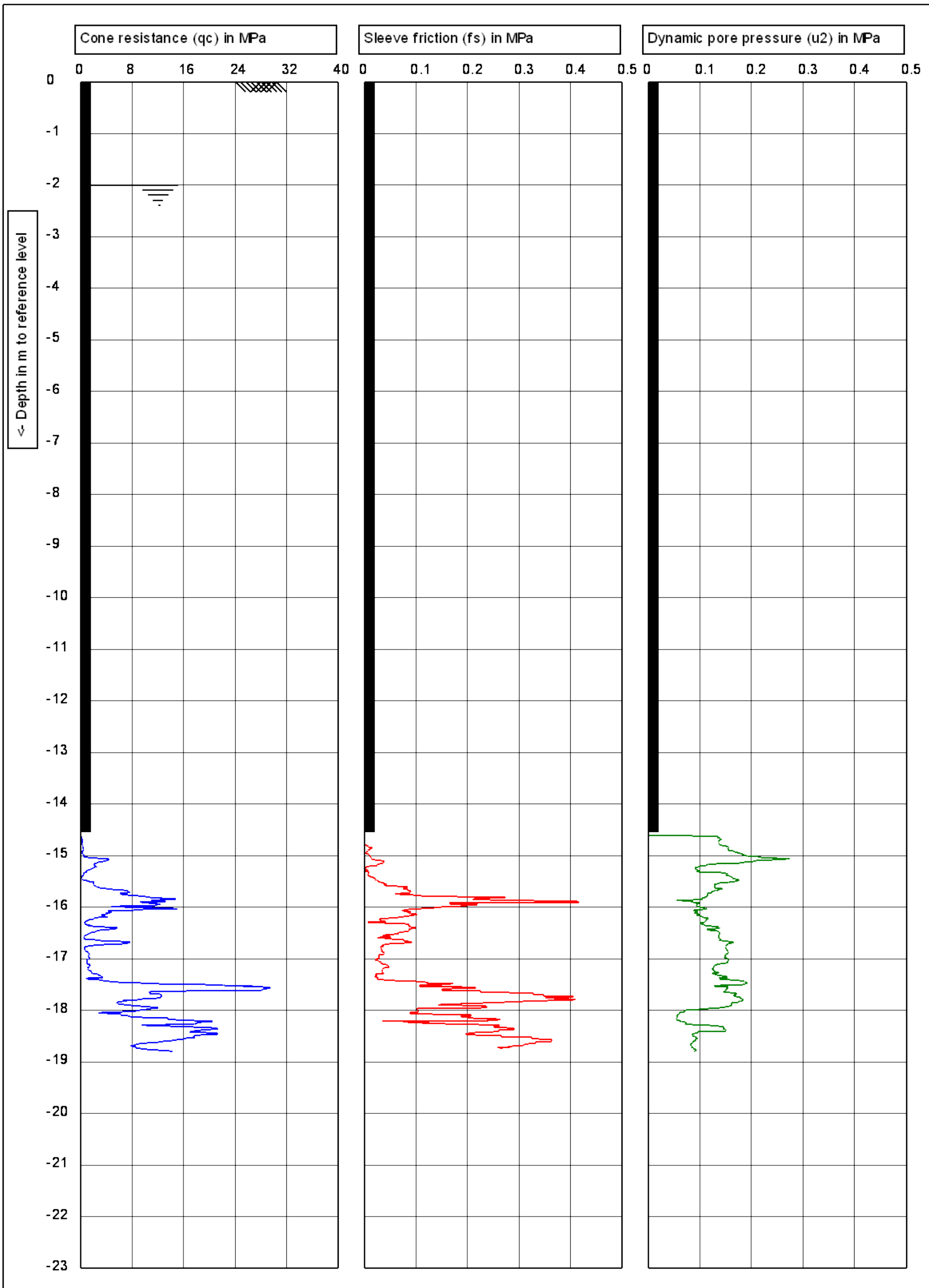
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a2	Date:	24/07/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G65
Location:	Wellington Reserve		Project no.:	Wellington Reserve
Position:			CPT no.:	1 1/3



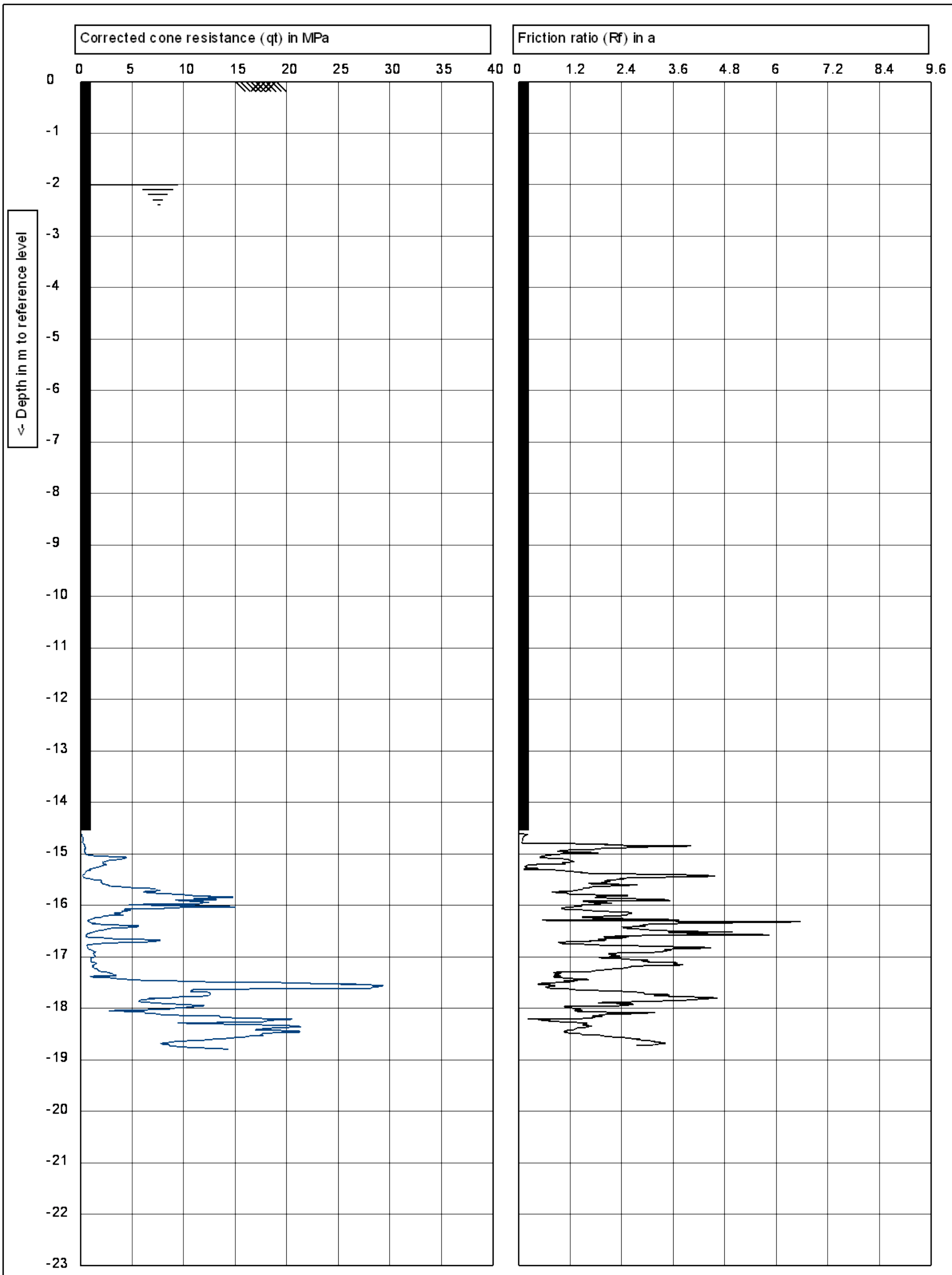
r u2 └150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a2	Date:	24/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G65
Location: Wellington Reserve			Project no.:	Wellington Reserve
Position:			CPT no.:	1 | 2/3



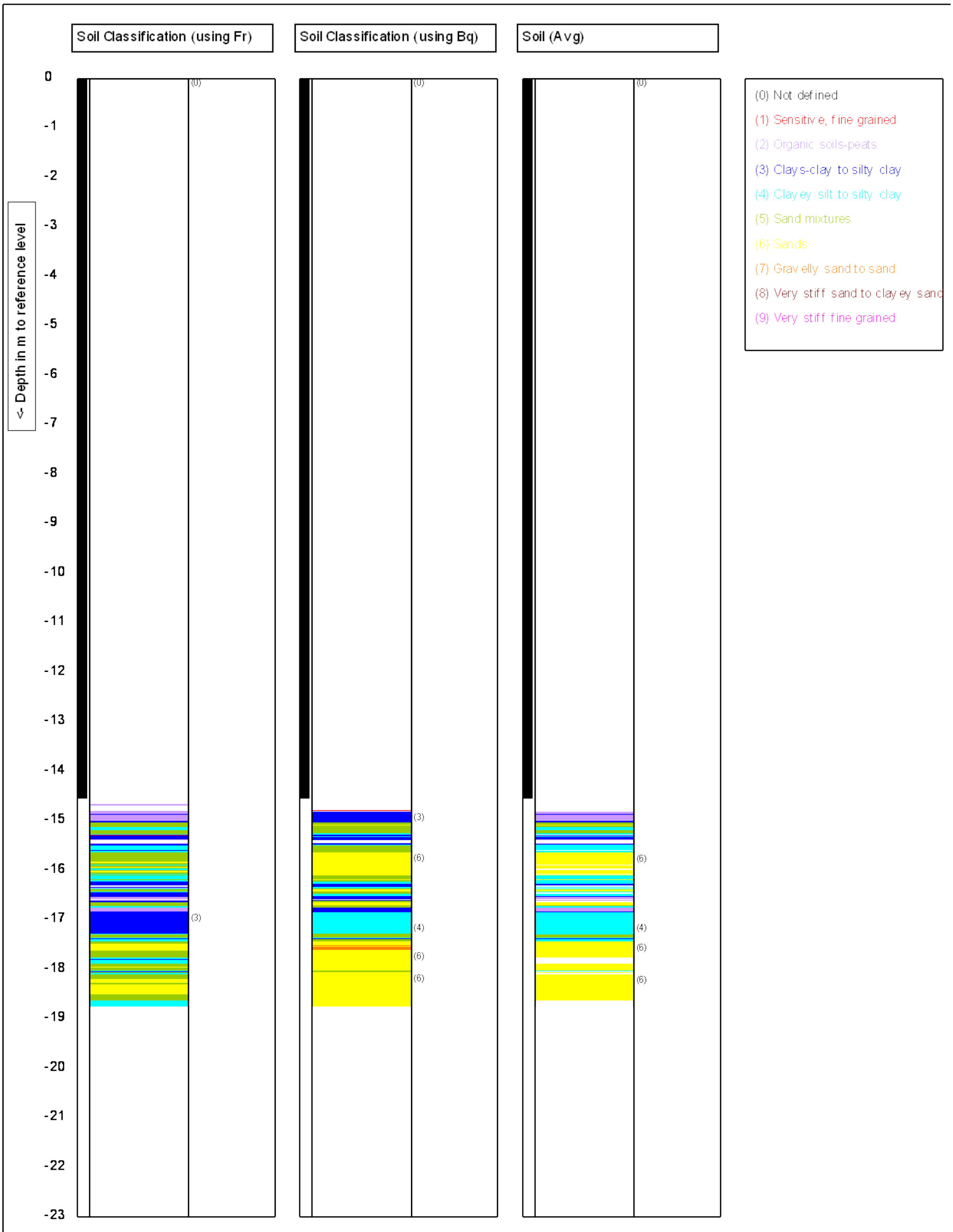
150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill :	0.5 m Predrilled
	G.L. 0 NAP / W.L.: a2	Date:	24/07/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G65
Location: Wellington Reserve		Project no.:	Wellington Reserve
Position:		CPT no.:	1 / 3/3



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	14.6 m Predrilled
	G.L. 0 NAP	W.L.: a2	Date:	24/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G65
Location: Wellington Reserve			Project no.:	Wellington Reserve
Position:			CPT no.:	1b 1/3



150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	14.6 m Predrilled
	G.L. 0 NAP	W.L.: a2	Date:	24/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G65
Location: Wellington Reserve			Project no.:	Wellington Reserve
Position:			CPT no.:	1b 2/3



Test according NEN 5140 class 1		Predrill :	14.6 m Predrilled
G.L. 0 NAP	W.L.: a2	Date:	24/07/2014
Project:	Project E.1.8	Cone no.:	C10CFIIP.G65
Location:	Wellington Reserve	Project no.:	Wellington Reserve
Position:		CPT no.:	1b 3/3

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 1 OF 5

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 20.45 m
LOCATION	: Wellington Reserve, Wellington	BORE DIAMETER	: 150 mm
COORDINATE	X : - Y : -	INCLINATION	: Vertical
DATE STARTED	: 24 July 2014 DATE FINISHED : 24 JULY 2014	RIG MODEL	:
REDUCED LEVEL	: - m	DRILLING CONTRACTOR	: Drilling Solutions
LOGGED BY	: Yien Lik Kuo	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (KPa)	DEPTH (M)
24TH JULY 2014	NIL			0.5									0.5
				1.0									1.0
				1.5									1.5
			24/07/14	2.0									2.0
				2.5									2.5
				3.0									3.0
				3.5									3.5
				4.0									4.0
				4.5									4.5
				5.0									5.0

BORING RESISTANCE:
L : LOW RESISTANCE
M : MEDIUM RESISTANCE
H : HIGH RESISTANCE
R : REFUSAL

SAMPLE CODE:
UN-DISTURBED SAMPLE
DISTURBED SAMPLE
STANDARD PENETRATION TEST (SPT)
PREDRILL

GROUND WATER CONDITION:
WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
D : DRY
M : MOIST
W : WET
<<PL : MUCH LESS THAN PLASTIC LIMIT
<PL : LESS THAN PLASTIC LIMIT
~PL : APPROX. PLASTIC LIMIT
>PL : GREATER THAN PLASTIC LIMIT
>>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
VS : VERY SOFT (0 - 25 kPa)
S : SOFT (25 - 50 kPa)
F : FIRM (50 - 100 kPa)
St : STIFF (100 - 200 kPa)
VSt : VERY STIFF (200 - 400 kPa)
H : HARD (> 400 kPa)
Fb : FRIABLE (unable to test)
VL : VERY LOOSE
L : LOOSE
MD : MEDIUM DENSE
D : DENSE
VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

Reported by:

Signature : ____________________
Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 2 OF 5

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 20.45 m
LOCATION	: Wellington Reserve, Wellington	BORE DIAMETER	: 150 mm
COORDINATE	X : - Y : -	INCLINATION	: Vertical
DATE STARTED	: 24 July 2014 DATE FINISHED : 24 JULY 2014	RIG MODEL	:
REDUCED LEVEL	: - m	DRILLING CONTRACTOR	: Drilling Solutions
LOGGED BY	: Yien Lik Kuo	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
				5.5									5.5
				6.0									6.0
				6.5									6.5
				7.0									7.0
24TH JULY 2014	NIL			7.5			NO SAMPLE RECOVERED						7.5
				8.0									8.0
				8.5									8.5
				9.0									9.0
				9.5									9.5
				10.0									10.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
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- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

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Reported by:

Signature : ______________________

Date : ______________________

ENGINEERING BOREHOLE LOG	BH 1	SHEET : 3 OF 5

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 20.45 m	REDUCED LEVEL	: - m
LOCATION	: Wellington Reserve, Wellington	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 24 July 2014 DATE FINISHED : 24 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (KPa)	DEPTH (M)
24TH JULY 2014	NIL			10.5									5.5
				11.0									6.0
				11.5			NO SAMPLE RECOVERED						6.5
				12.0									7.0
				12.5									7.5
				13.0									8.0
				13.5		SP	SANDS,	W					8.5
				14.0									9.0
				14.5									9.5
				15.0									10.0

BORING RESISTANCE:
L : LOW RESISTANCE
M : MEDIUM RESISTANCE
H : HIGH RESISTANCE
R : REFUSAL

SAMPLE CODE:
UN-DISTURBED SAMPLE
DISTURBED SAMPLE
STANDARD PENETRATION TEST (SPT)
PREDRILL

GROUND WATER CONDITION:
WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
D : DRY
M : MOIST
W : WET
<<PL : MUCH LESS THAN PLASTIC LIMIT
<PL : LESS THAN PLASTIC LIMIT
~PL : APPROX. PLASTIC LIMIT
>PL : GREATER THAN PLASTIC LIMIT
>>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
VS : VERY SOFT (0 - 25 kPa)
S : SOFT (25 - 50 kPa)
F : FIRM (50 - 100 kPa)
St : STIFF (100 - 200 kPa)
VSt : VERY STIFF (200 - 400 kPa)
H : HARD (> 400 kPa)
Fb : FRIABLE (unable to test)
VL : VERY LOOSE
L : LOOSE
MD : MEDIUM DENSE
D : DENSE
VD : VERY DENSE

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Reported by:

Signature : ____________________
Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 4 OF 5

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 20.45 m
LOCATION	: Wellington Reserve, Wellington	BORE DIAMETER	: 150 mm
COORDINATE	X : - Y : -	INCLINATION	: Vertical
DATE STARTED	: 24 July 2014 DATE FINISHED : 24 JULY 2014	RIG MODEL	:
REDUCED LEVEL	: - m	DRILLING CONTRACTOR	: Drilling Solutions
LOGGED BY	: Yien Lik Kuo	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
24TH JULY 2014	NIL			15.5									5.5
				16.0									6.0
				16.5			NO SAMPLE RECOVERED						6.5
				17.0									7.0
				17.5									7.5
				18.0									8.0
				18.5									8.5
				19.0									9.0
				19.5			NO SAMPLE RECOVERED						9.5
				20.0									10.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
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- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

Reported by:

Signature : ____________________

Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 5 OF 5

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 20.45 m	REDUCED LEVEL	: - m
LOCATION	: Wellington Reserve, Wellington	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 24 July 2014 DATE FINISHED : 24 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (KPa)	DEPTH (M)
24TH JULY 2014	NIL				■		NO SAMPLE RECOVERED						
				20.5			Borehole terminated at 20.45 m.						20.5
				21.0									21.0
				21.5									21.5
				22.0									22.0
				22.5									22.5
				23.0									23.0
				23.5									23.5
				24.0									24.0
				24.5									24.5
				25.0									25.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

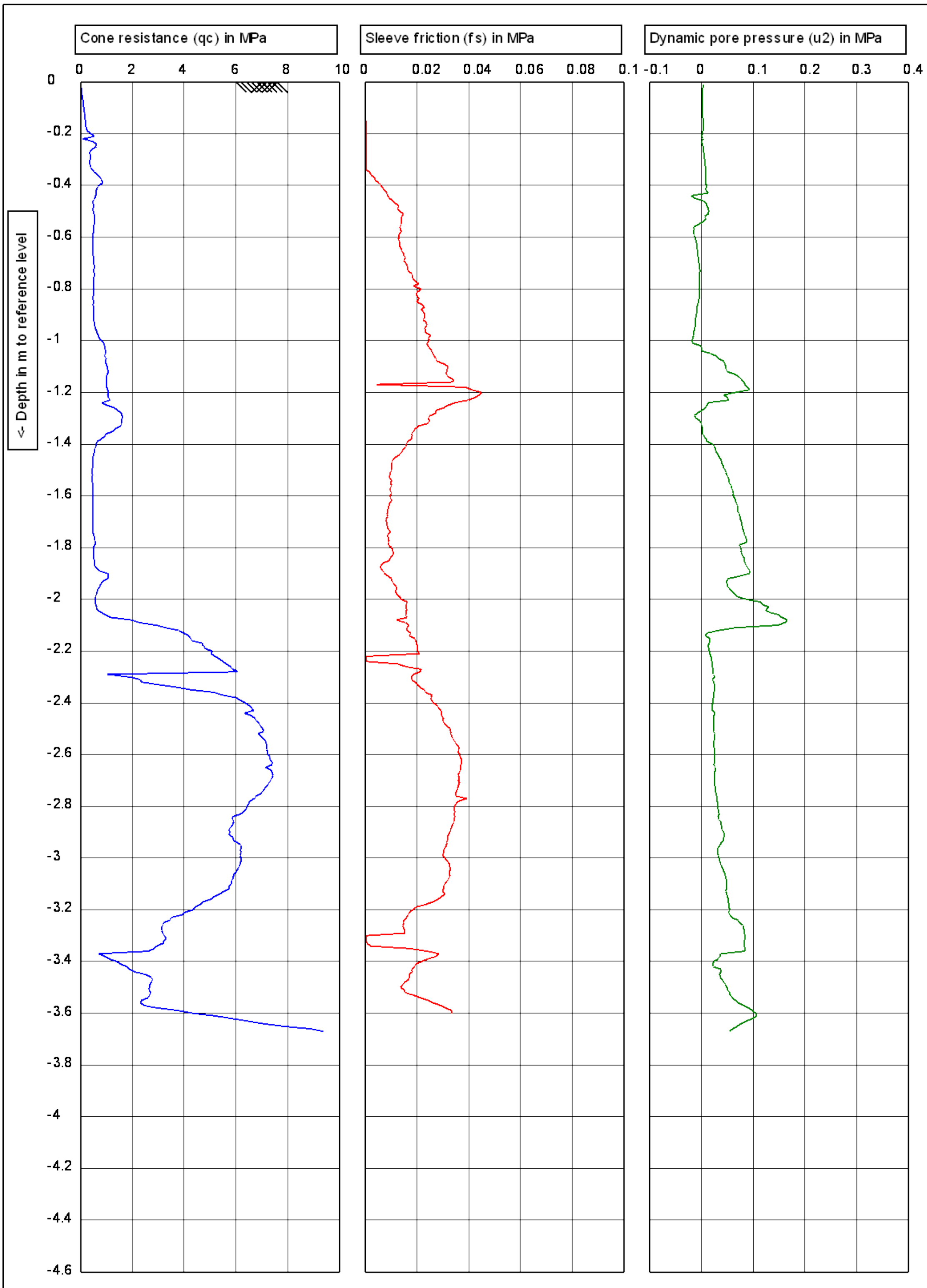
CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

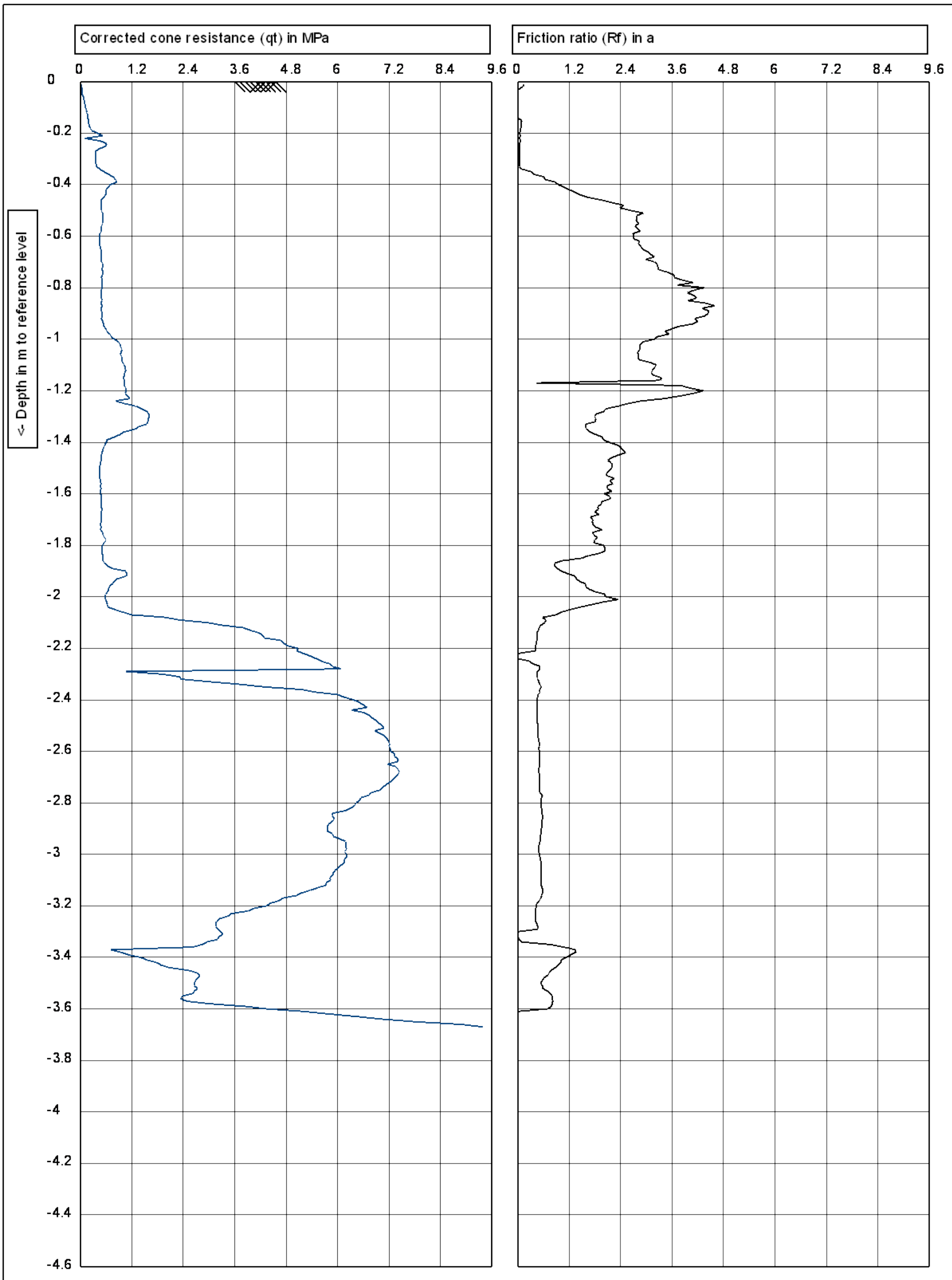
Reported by:

Signature : ____________________

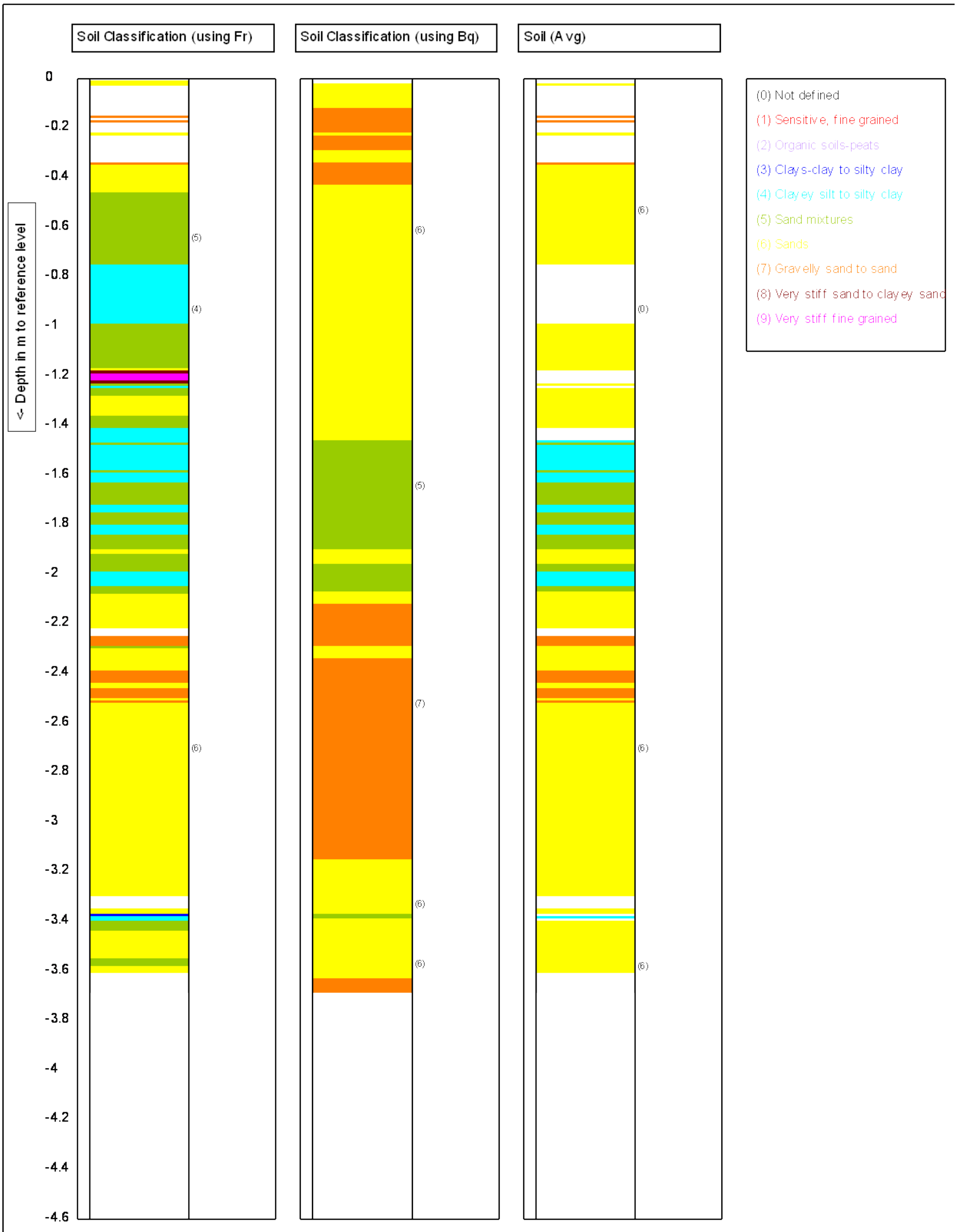
Date : ____________________



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a84	Date:	9/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: WELLINGTON			Project no.:	LMR0214_W
Position:			CPT no.:	1 — 1/3

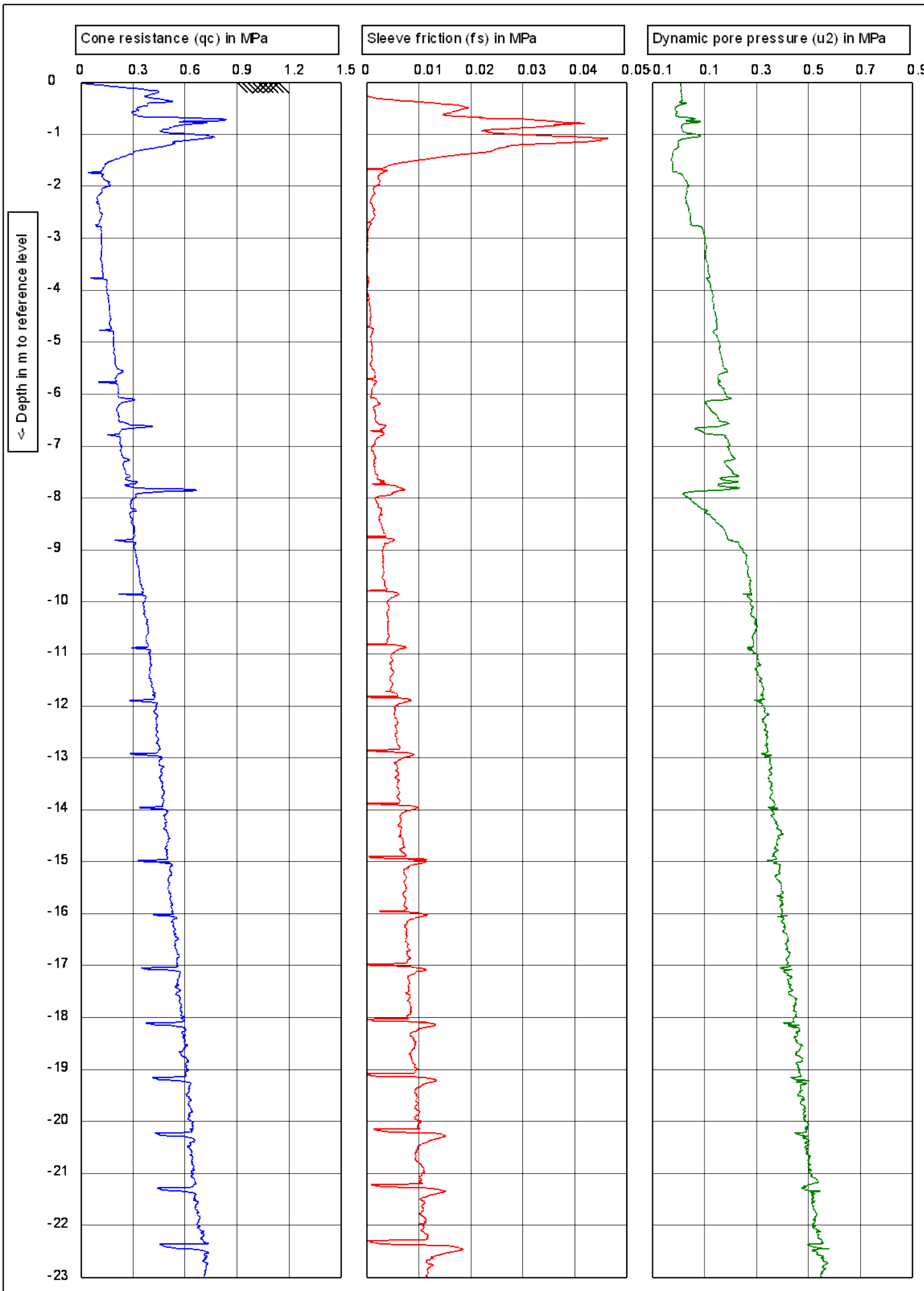


u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0.84	Date:	9/02/2014
Project: LMR0214		Cone no.:	C10CFIIP.G67
Location: WELLINGTON		Project no.:	LMR0214_W
Position:		CPT no.:	1 — 2/3

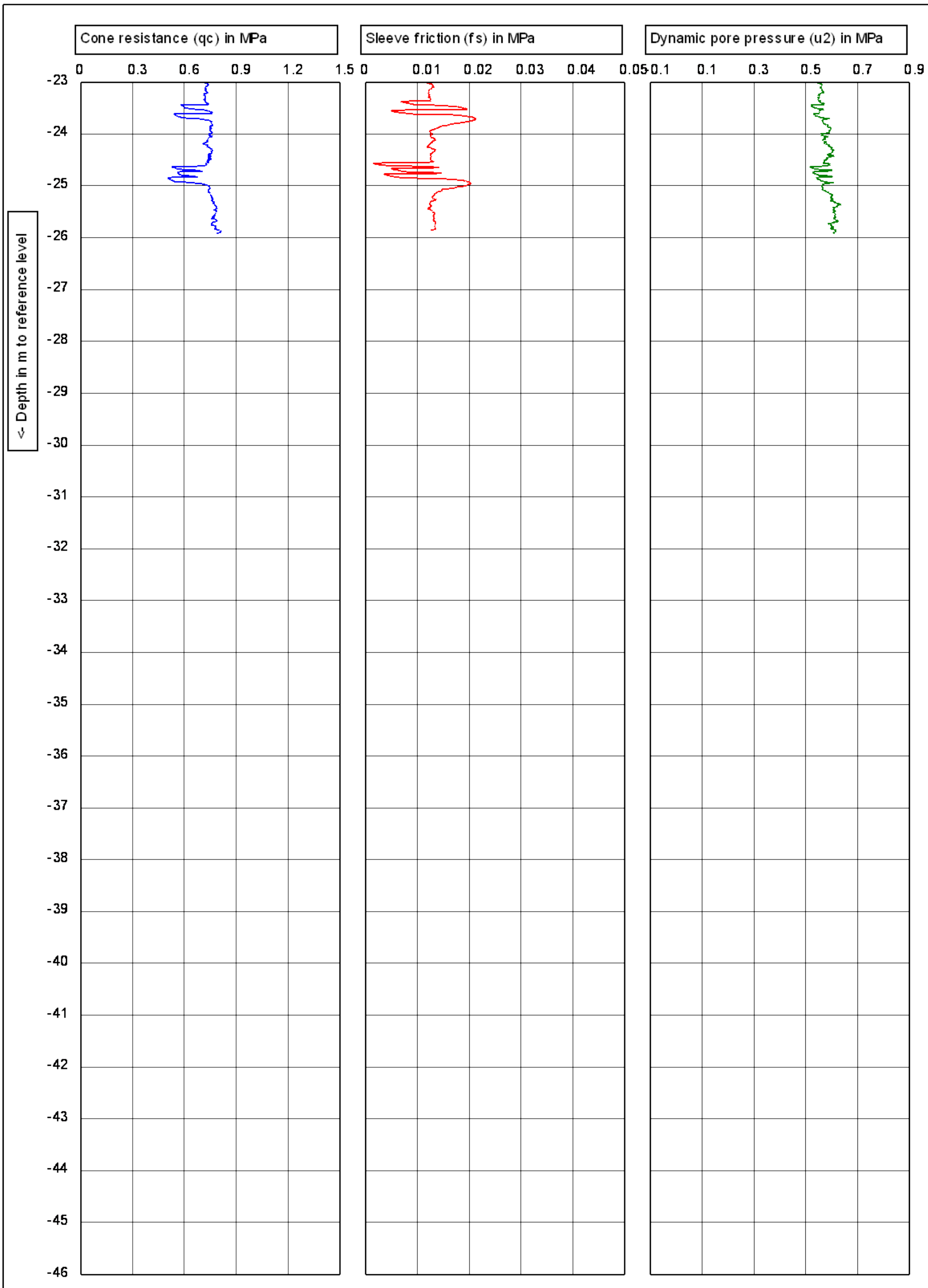


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a84	Date:	9/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: WELLINGTON		Project no.:	LMR0214_W
Position:		CPT no.: 1	3/3

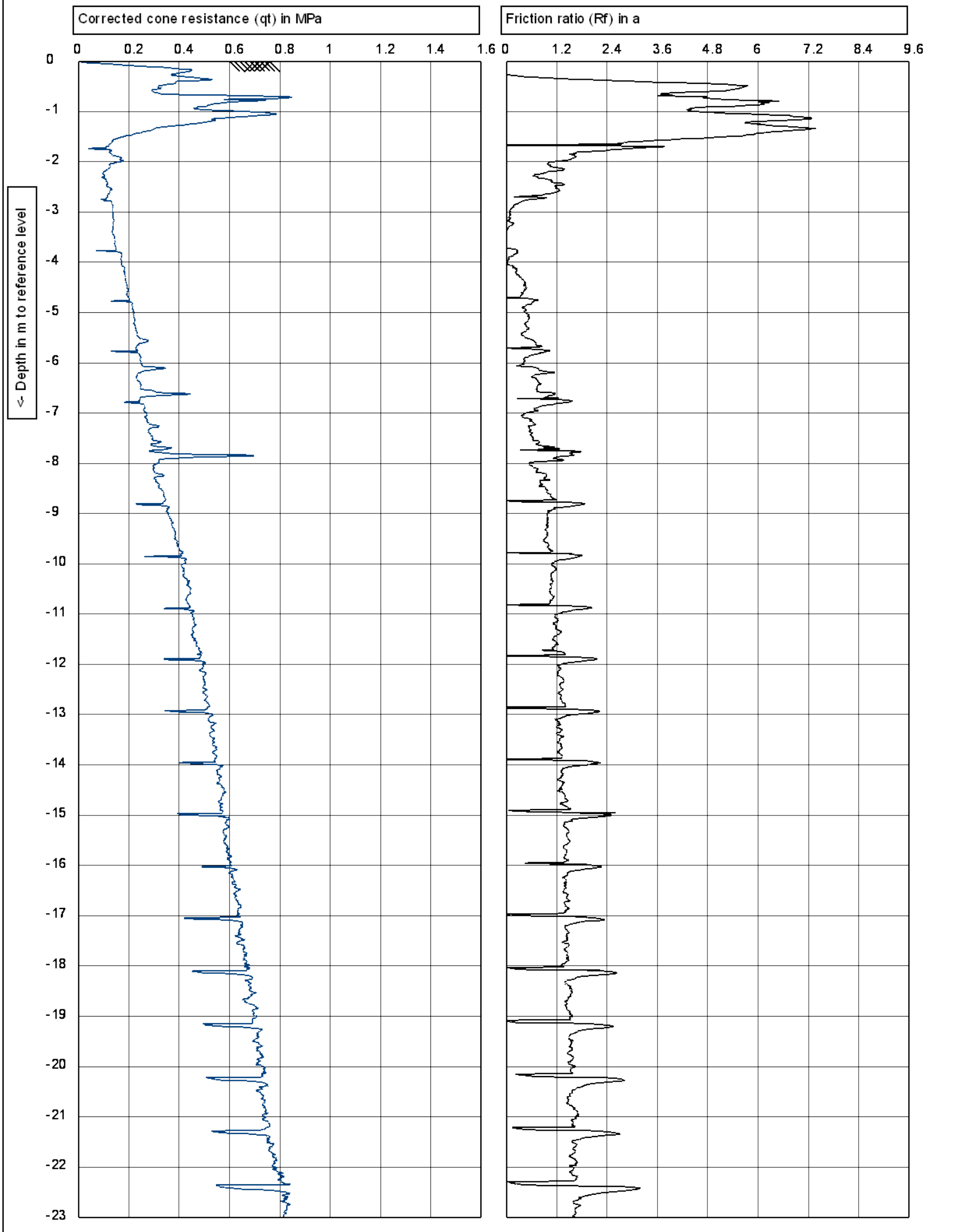
Appendix 2 Wellington East — Cone Penetration Test Results and WaterConnect Data



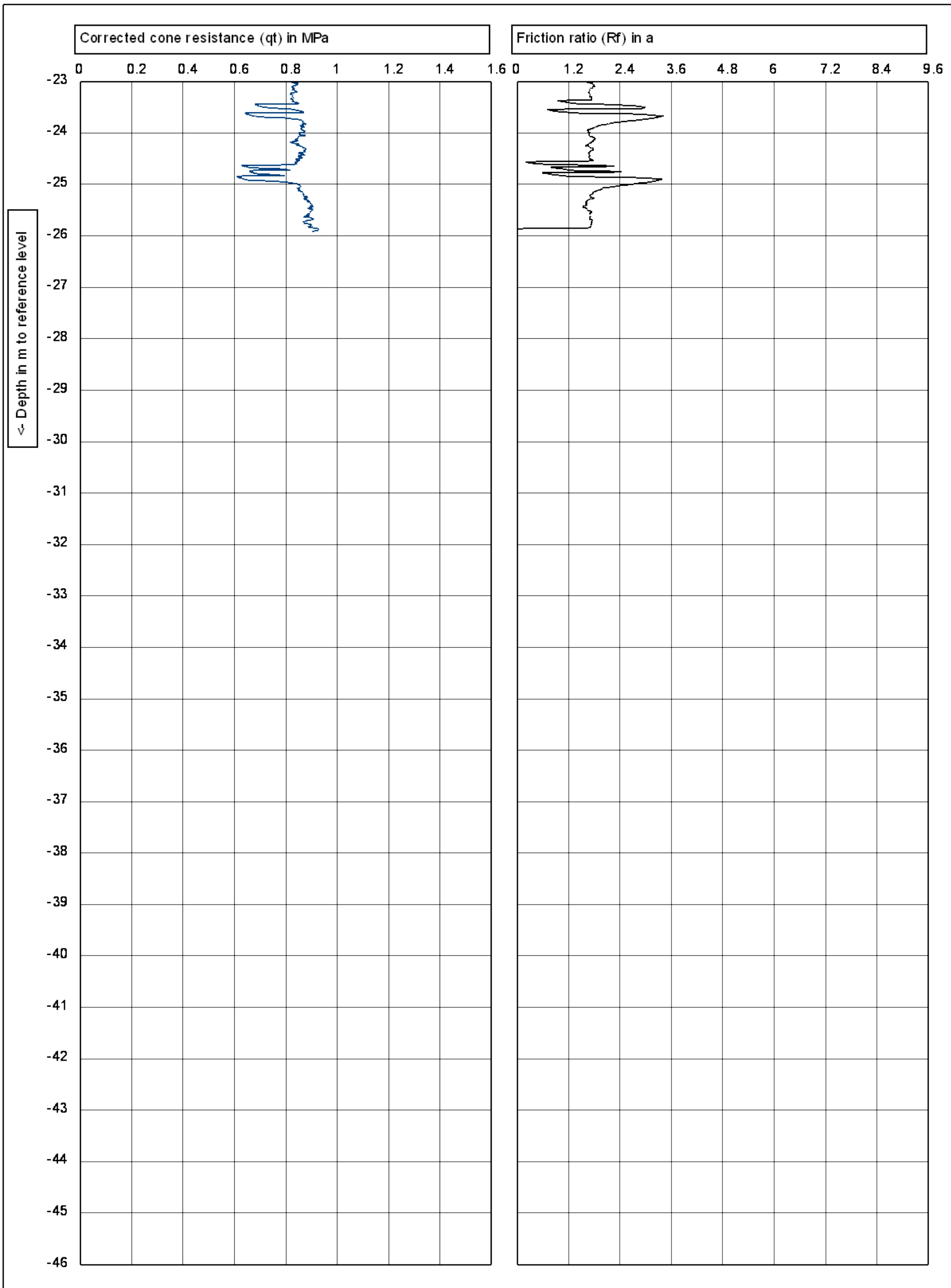
Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0.8	Date:	10/02/2014
Project: LMR0214		Cone no.:	C10CFIIP.G67
Location: WELLINGTON EAST MARINA		Project no.:	LMR0214_WE
Position:		CPT no.:	1 — 1/6



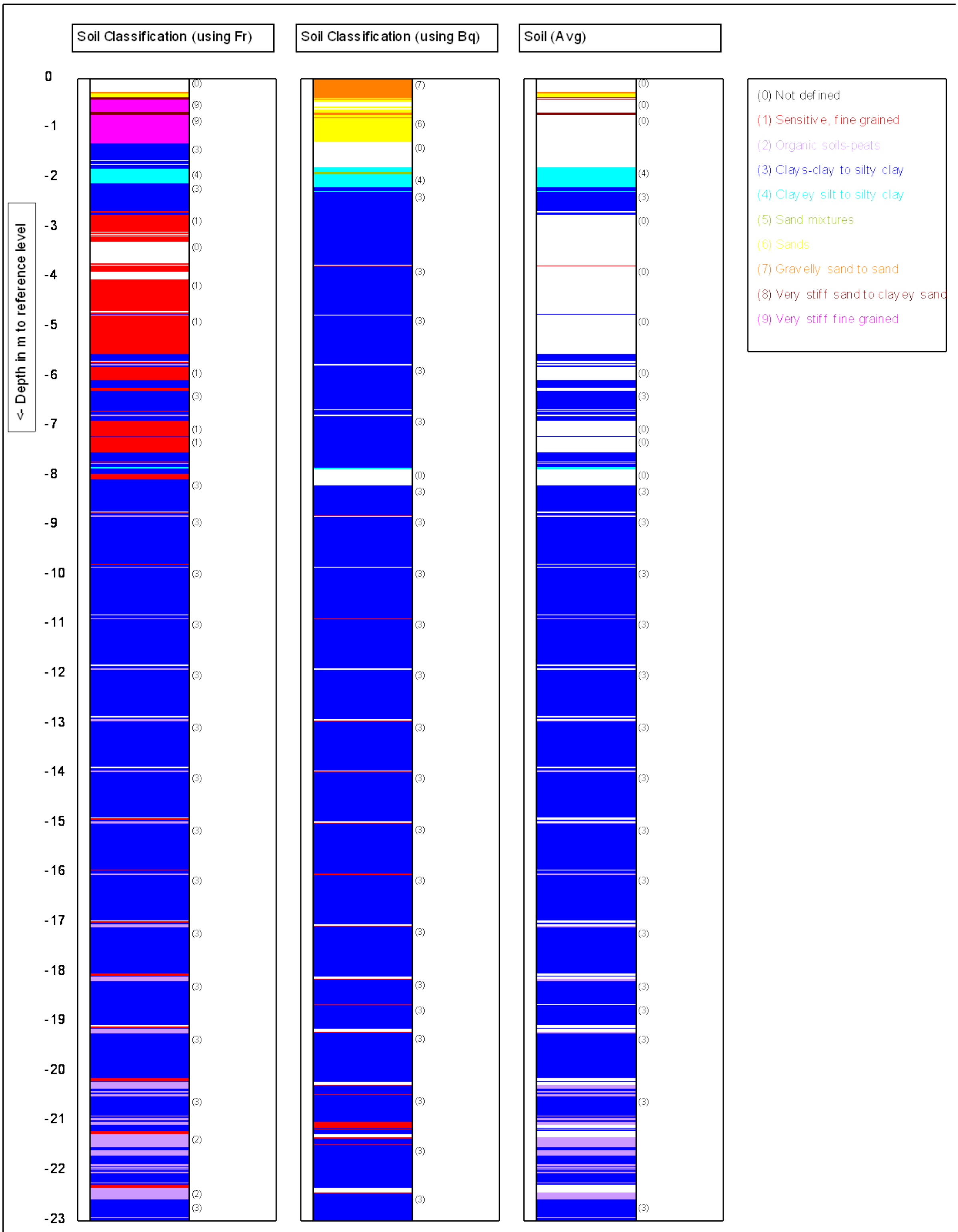
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill : 0 m Predrilled
	G.L. 0 NAP / W.L.: 0.8	Date: 10/02/2014
Project: LMR0214		Cone no.: C10CFIIP.G67
Location: WELLINGTON EAST MARINA		Project no.: LMR0214_WE
Position:		CPT no.: 1 / 2/6



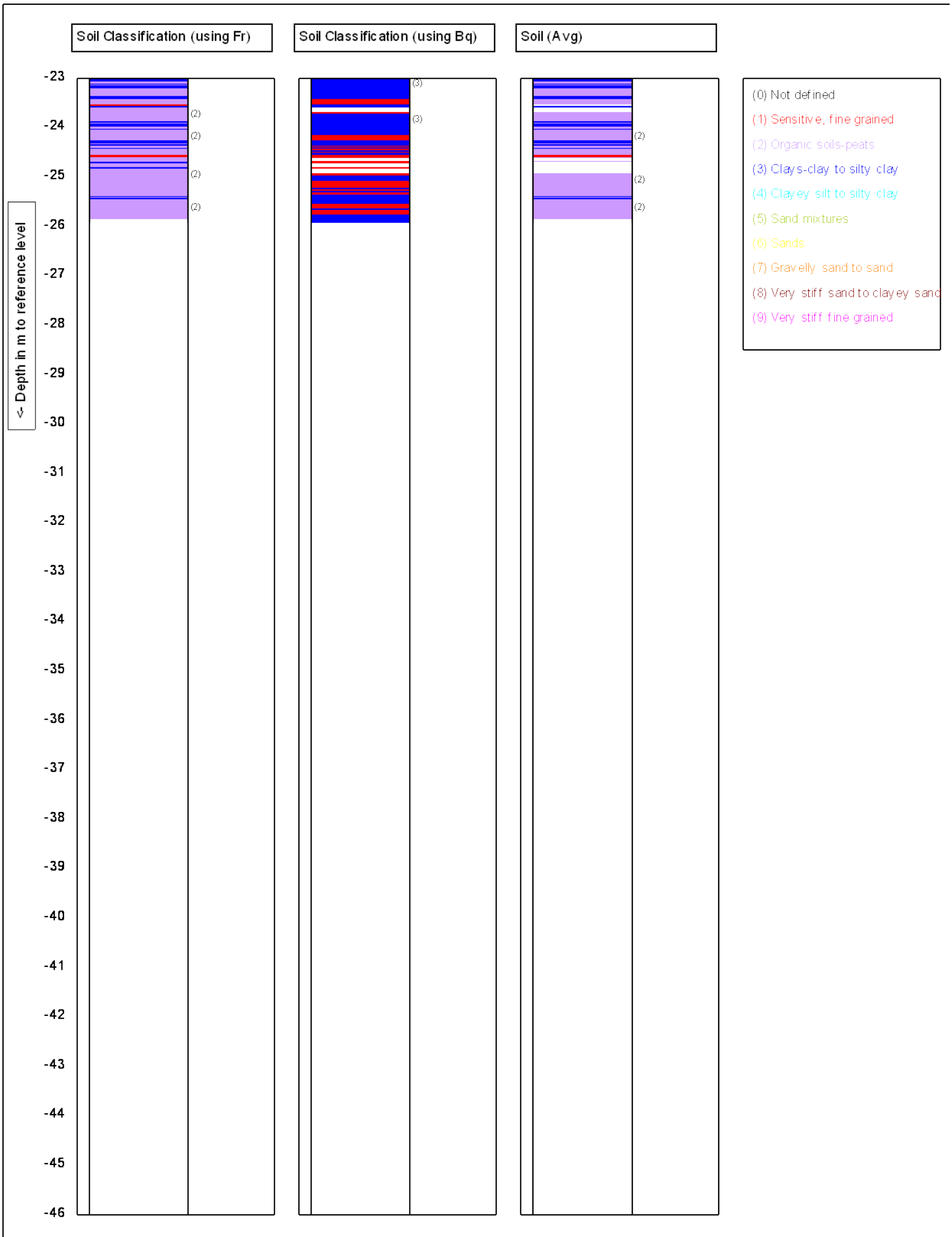
Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0.8	Date:	10/02/2014
Project: LMR0214		Cone no.:	C10CFIIPa.G67
Location: WELLINGTON EAST MARINA		Project no.:	LMR0214_WE
Position:		CPT no.:	1 — 3/6



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a8	Date:	10/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: WELLINGTON EAST MARINA			Project no.:	LMR0214_WE
Position:			CPT no.:	1 4/6



150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: 0a8	Date:	10/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: WELLINGTON EAST MARINA		Project no.:	LMR0214_WE
Position:		CPT no.:	1 5/6

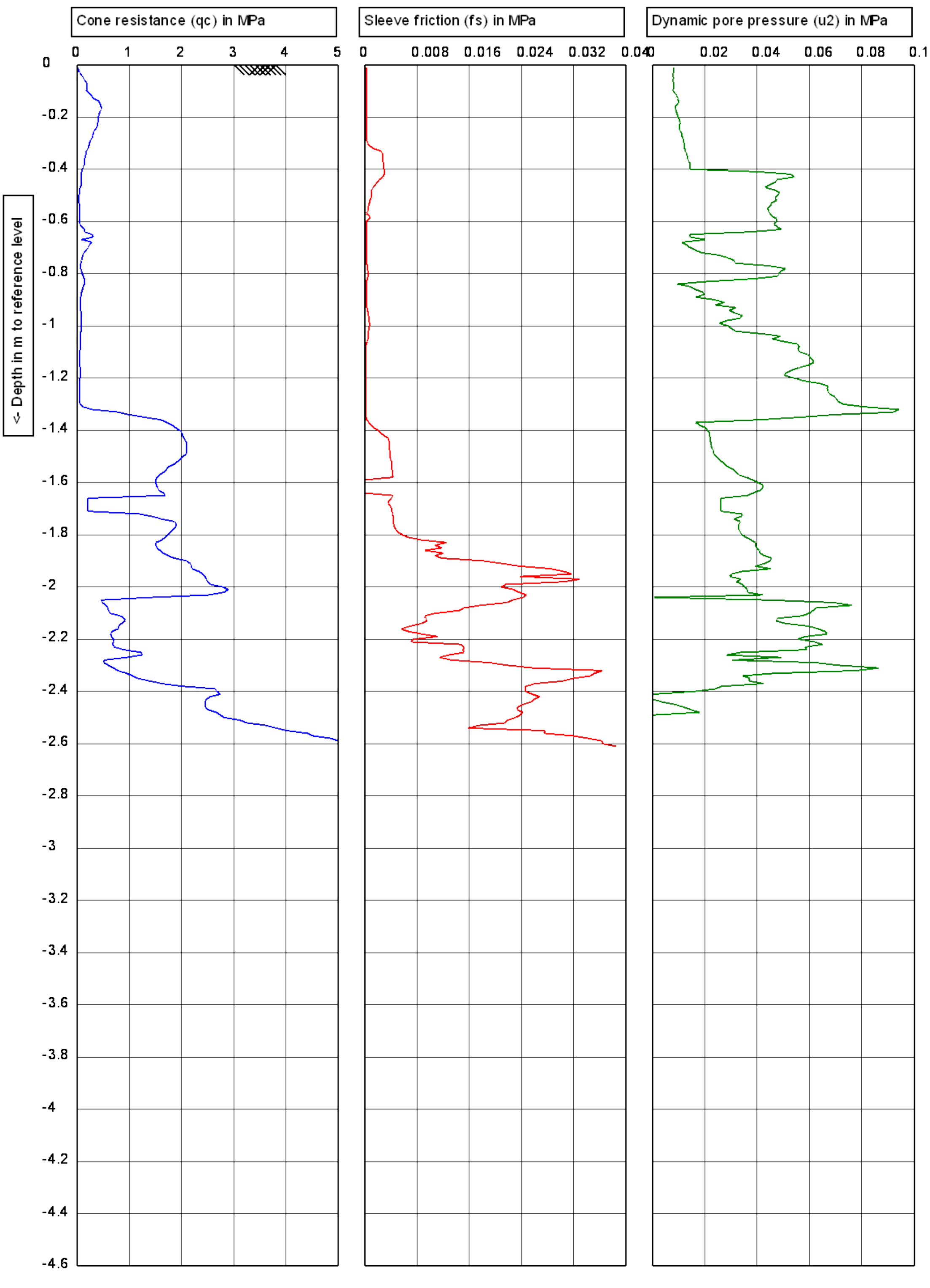


Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a8	Date:	10/02/2014
Project: LMR0214		Cone no.:	C10CFIIPa.G67
Location: WELLINGTON EAST MARINA		Project no.:	LMR0214_WE
Position:		CPT no.:	1 6/6

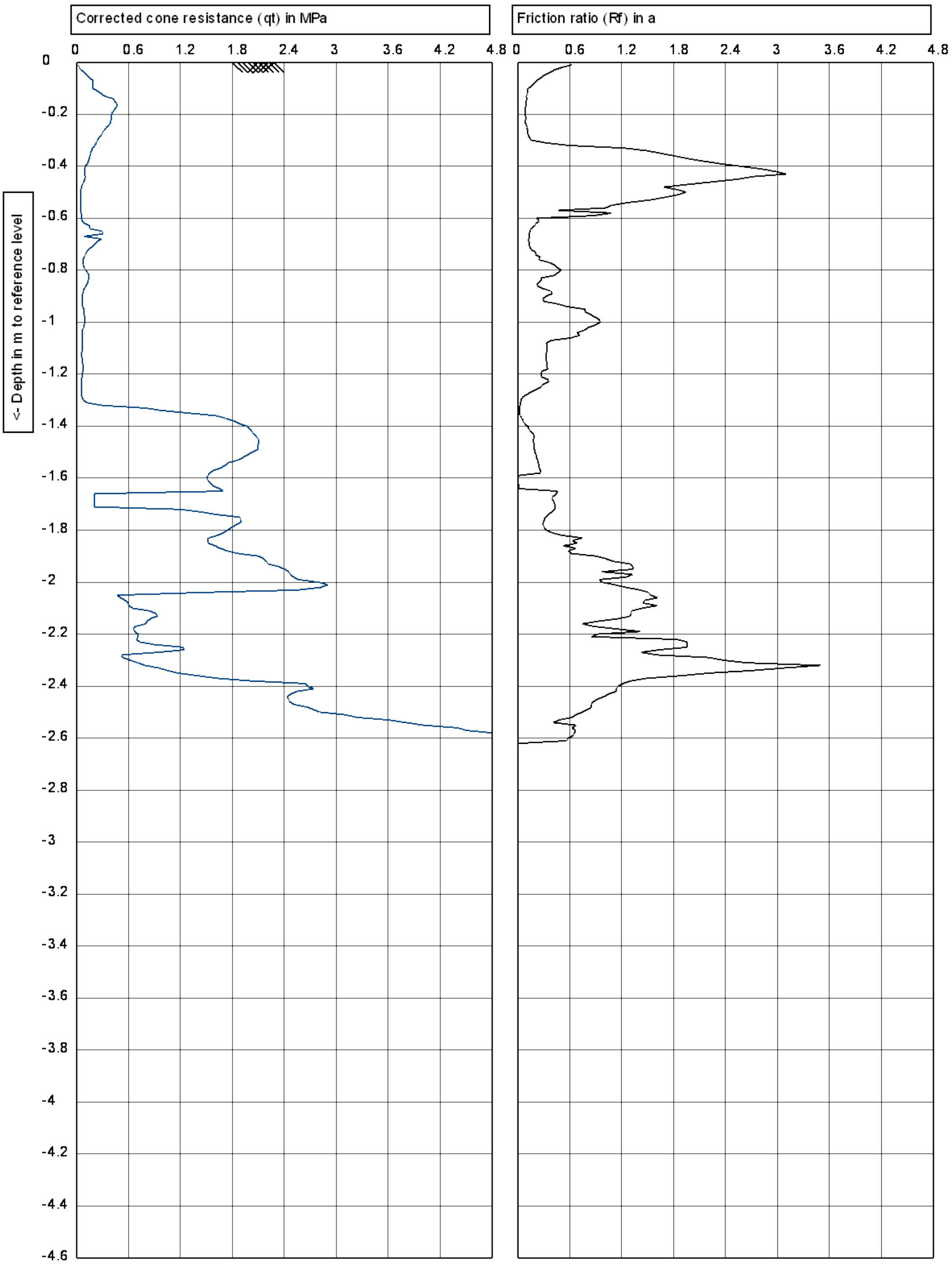
Driller Logs near Wellington East

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6727-3073	0	1	CLYU	SAND	SANDY CLAY grey, sandy clay
6727-3073	1	2	CLYU		CLAY grey clay
6727-3073	2	3	SAND	CLYU	CLAYEY SAND grey clayey sand, medium grained quartz sand
6727-3073	3	4.25	SAND		SAND grey sand, medium grained quartz sand
6727-3073	4.25	5	SAND		ORGANICS dark brown, peats and reeds
6727-3074	0	1	CLYU		CLAY black-grey moderately hard
6727-3074	1	2	CLYU		ORGANICS black-grey, reeds and organics
6727-3074	2	3	CLYU		CLAY grey, soft, plastic clay
6727-3074	3	4	CLYU		CLAY grey, soft, plastic clay

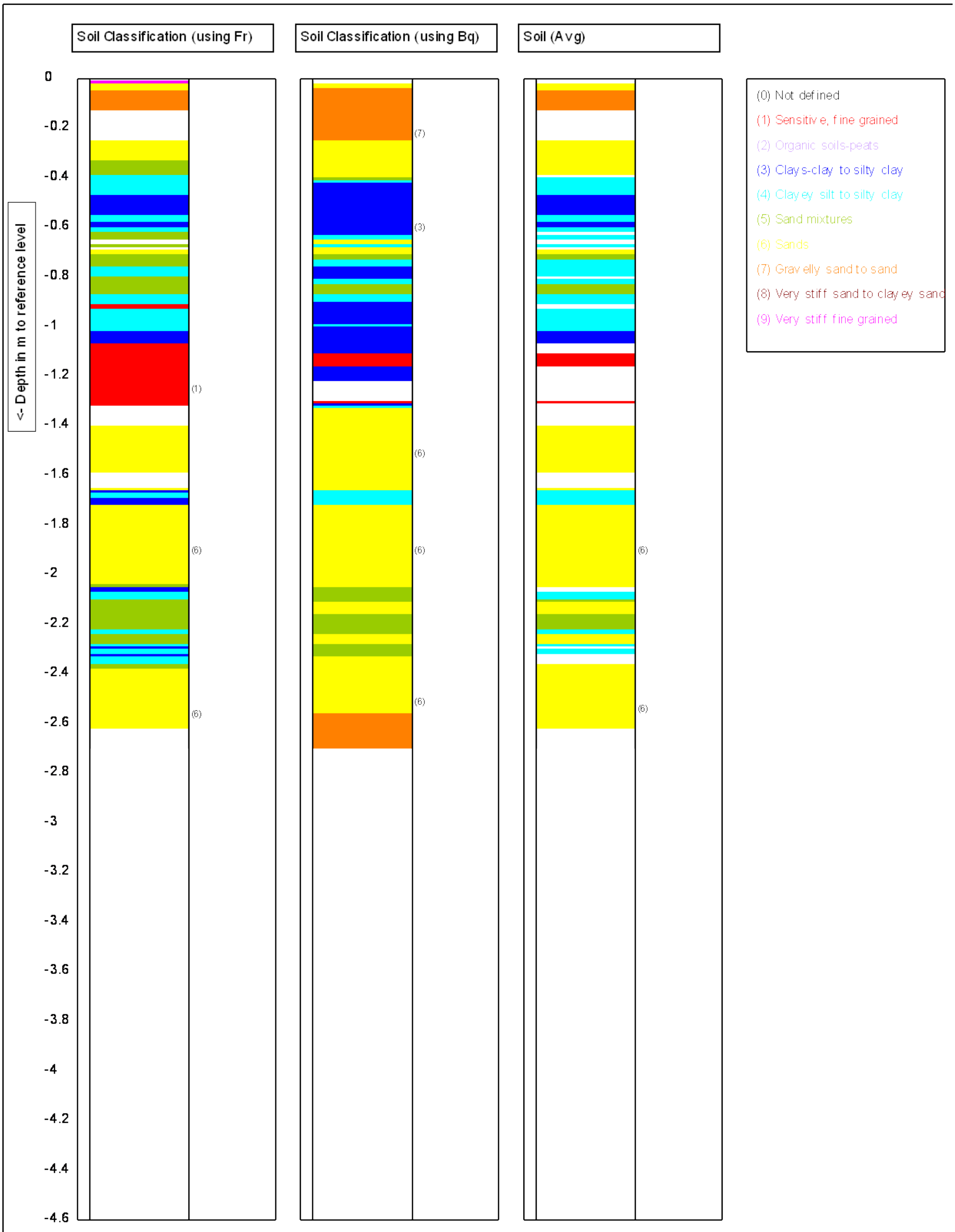
Appendix 3 Tailem Bend West — Cone Penetration Test Results and WaterConnect Data



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a85	Date:	10/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: MURRAY VIEW ESTATES			Project no.:	LMR0214_MVE
Position:			CPT no.:	1 — 1/3



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP / W.L.: 0a85	Date:	10/02/2014
Project:	LMR0214	Cone no.:	C10CFIIPaG67
Location:	MURRAY VIEW ESTATES	Project no.:	LMR0214_MVE
Position:		CPT no.:	1 — 2/3



Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a85	Date:	10/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: MURRAY VIEW ESTATES		Project no.:	LMR0214_MVE
Position:		CPT no.:	1 — 3/3

<u>Driller Logs near Tailem Bend West</u>

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6727-2921	0	1.8	FILL		FILL approx 60% silt, coarse angular calcareous gravel and pebbles (possible rail ballest), poorly sorted, large floaters possibly limestone, difficult for auger
6727-2921	1.8	3.5	SAND		SAND calcareous, clayey sand, medium grained, cream to pale yellow, approx 15% poorly sorted calcareous gravel
6727-2921	3.5	4.3	CLYU		CLAY sandy clay, medium plascitiy, yellow-green, glauconitic horizons, some mottling, medium grained, approx 40% fine sand
6727-2921	4.3	4.5	LMST		LIMESTONE indurated, weathered, cream. Auger refusal
6727-2921	4.5	7	LMST		LIMESTONE green beige, approx 40% calcareous clayey sand, indurated bands of limestone. Limestone highly fractured with minor cavities. End of hole 7 meters
6727-2922	0	0.4	FILL		FILL colluvium, gravelly, silty clayey sand, poorly sorted, transported material from bank behind bore hole, grey to pale grey
6727-2922	0.4	1	CLYU		Sandy CLAY medium plasticity, approx 30% gravel and pebble sized calcareous fragments, large floater possible limestone, pale grey
6727-2922	1	1.2	LMST		LIMESTONE indurated. Auger refusal rig moved 4 times
6727-2922	1.2	3	LMST		LIMESTONE indurated, cream, approx 40% clayey sand as interbeds, clay blocked hammer bit, several cavities present - poor sample returned
6727-2922	3	4.5	CLYU		Sandy CLAY calcareous, cream, medium grained, medium plasticity, clay blocking hammer bit, indurated, thin bands of limestone, cavities present - poor sample return
6727-2922	4.5	6	LMST		lLIMESTONE indurated, approx 30% clayey sand as interbeds, very wet clayey sand flowing into hole, abundant cavities with major cavity at 4.3 metres, eight bags of gravel required to fill cavities in limestone. End of hole 6 metres
6727-2923	0	1.2	SILT		SILT low plasticity, poorly sorted, fine to very coarse with gravel and shell fragments, material possibly from cliffs behind bore hole ie. locally transported, black and carbonaceous
6727-2923	1.2	3	SAND		SAND calcareous, clayey sand, fine to medium grained, high plasticity, cream, moist to wet
6727-2923	3	3.9	SAND		SAND clayey sand, fine to medium grained, high plasticity, cream, calcareous nodules, increasing clay content with depth.
6727-2923	3.9	4	LMST		LIMESTONE weathered, cream. Auger refusal at 4 metres
6727-2923	4	7	LMST		LIMESTONE indurated, cream. Approximately 40% interbeds of clayey sand. End of hole at 7 metres
6727-2924	0	0.5	FILL		FILL poorly sorted gravel, clay, minor organic material, buff
6727-2924	0.5	1	SILT		SILT silty clay, fine to medium grained, calcareous nodules present, poorly sorted, buff-cream
6727-2924	1	3.6	SAND		SAND calcareous, clayey sand, fine to medium grained, high plasticity, wet, cream, very soft

Driller Logs near Tailem Bend West (continue)

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6727-2924	3.6	4	LMST		LIMESTONE weathered, cream approx 40% clayey sand, auger refused at 3.6 metres
6727-2924	4	6	LMST		LIMESTONE cavity in limestone from approx 4 to 6 metres, no sample returned
6727-2924	6	6.5	LMST		LIMESTONE beige cream, approx 40% clayey calcareous sand, very wet, several cavities. End of hole 6.5 metres
6727-2925	0	0.5	FILL		FILL low plasticity silt, clay sand and cobbles, moist, poorly sorted, pale grey
6727-2925	0.5	0.75	FILL		FILL low plasticity silt, clay sand and cobbles, moist, poorly sorted, dark grey
6727-2925	0.75	1.5	SILT		SILT clayey silt, low plasticity, fine grained, yellow to orange
6727-2925	1.5	2	LMST		LIMESTONE approx 40% highly weathered clay, orange yellow
6727-2925	2	2.8	CLYU		CLAY sandy clay, low plasticity, fragments of limestone, buff cream calcareous
6727-2925	2.8	3.3	SAND		SAND clayey sand, low plasticity, wet, buff cream
6727-2925	3.3	3.5	SDST		Calcareous SANDSTONE indurated, medium grained, cream orange. Refused at 3.4 metres
6727-2925	3.5	6.96	LMST		LIMESTONE cream, approx 40% clayey sand, calcareous, cream, wet, numerous cavities

Appendix 4 Jervois— WaterConnect Data

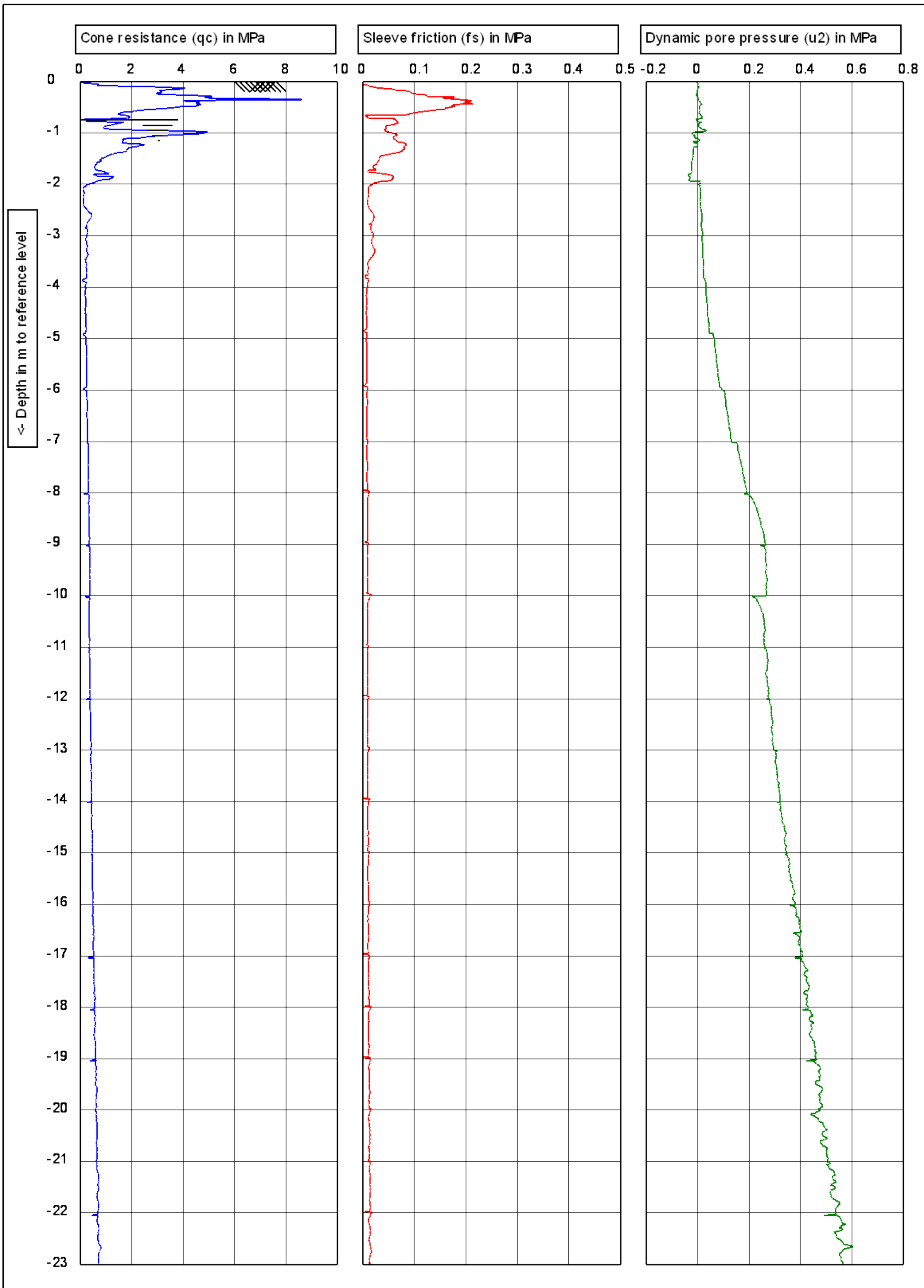
Driller Logs near Jervois

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6727-3225	0	0.45	FILL	CLYU	FILL clayey, sandy, gravel (GC) fine to medium gravel, pale brown, low plasticity, calcareous, fine to medium sand, moist
6727-3225	0.45	1.35	FILL	CLYU	FILL sandy CLAY (CH) high plasticity, grey-brown, red-brown, fine to medium sand, trace of fine to medium calcareous gravels, hard, moisture content <PL
6727-3225	1.35	2.1	CLYU	SILT	Silty CLAY high plasticity, black, light brown, abundant tree roots, firm, moisture content >PL
6727-3225	2.1	4	SAND	SILT	SAND (SP) loose between 2.1 and 3 metres, fine to medium grained, light grey to dark brown, some silt, traces of fine shell fragments, wet
6727-3225	4	4.5	SAND		SAND (SP) fine to medium grained, brown, very loose, wet, non plastic
6727-3225	4.5	5.5	CLYU	SILT	Silty sandy CLAY (CL) medium plasticity, dark grey, fine to medium sand, organic matter, soft, moisture content >>PL pocket penetrometer 30 kPa
6727-3225	5.5	7.4	CLYU	SAND	Peaty CLAY (CH) high plasticity, light grey to dark grey, soft, abundant organic fibres, some fine sand, moisture content >>PL pocket penetrometer 50 kPa
6727-3225	7.4	8.5	CLYU	SILT	Silty CLAY (CH) high plasticity, grey, soft, some organic fibres, moisture content PL pocket pentrometer 30 to 40 kPa.
6727-3225	8.5	10	CLYU	SILT	As above, however very soft to soft, trace of organic fibres, pocket penetrometer 20 to 30 kPa. 9 to 9.5 metres, trace of mica specks, very soft, pocket penetrometer 25 kPa
6727-3225	10	12	CLYU		As above, however, no organic fibres, very soft, pocket penetrometer 20 to 30 kPa, soft to very soft, pocket penetrometer 20 to 30 kPa. Trace of fine sands and mica specks, soft pocket penetrometer 30 to 40 kPa
6727-3225	12	14.5	CLYU	SILT	Silty sandy CLAY (CH) high plasticity, fine sand, micaceous, very soft to soft, moisture content >>PL pocket penetrometer 10 to 30 kPa. Very soft to soft, pocket penetrometer 10 to 30 kPa and 20 to 30 kPa
6727-3225	14.5	17.5	CLYU	SILT	Silty CLAY (CH) high plasticity, grey, very soft to soft, some mica moisture content >>PL pocket penetrometer 30 to 50 kPa. Fine shells, at 15 metres, soft pocket penetrometer 40 to 50 kPa. No shell fragments at 16 metres, soft, pocket penetrometer 40 to 50 kPa
6727-3225	17.5	19	CLYU	SILT	Silty CLAY high plasticity, grey, very soft to soft, some mica, moisture content >>PL pocket penetrometer 20 to 30 kPa. Soft, some fine shell fragments, pocket penetrometer 40 to 50 kPa
6727-3225	19	21	CLYU	SILT	As above, however, firm, pocket penetrometer 60 to 80 kPa, no recovery
6727-3225	21	26	CLYU	SILT	Silty CLAY (CH) high plasticity, dark grey, very soft, some medium to coarse angular limestone fragments, moisture content >>PL timber fragment, no recovery

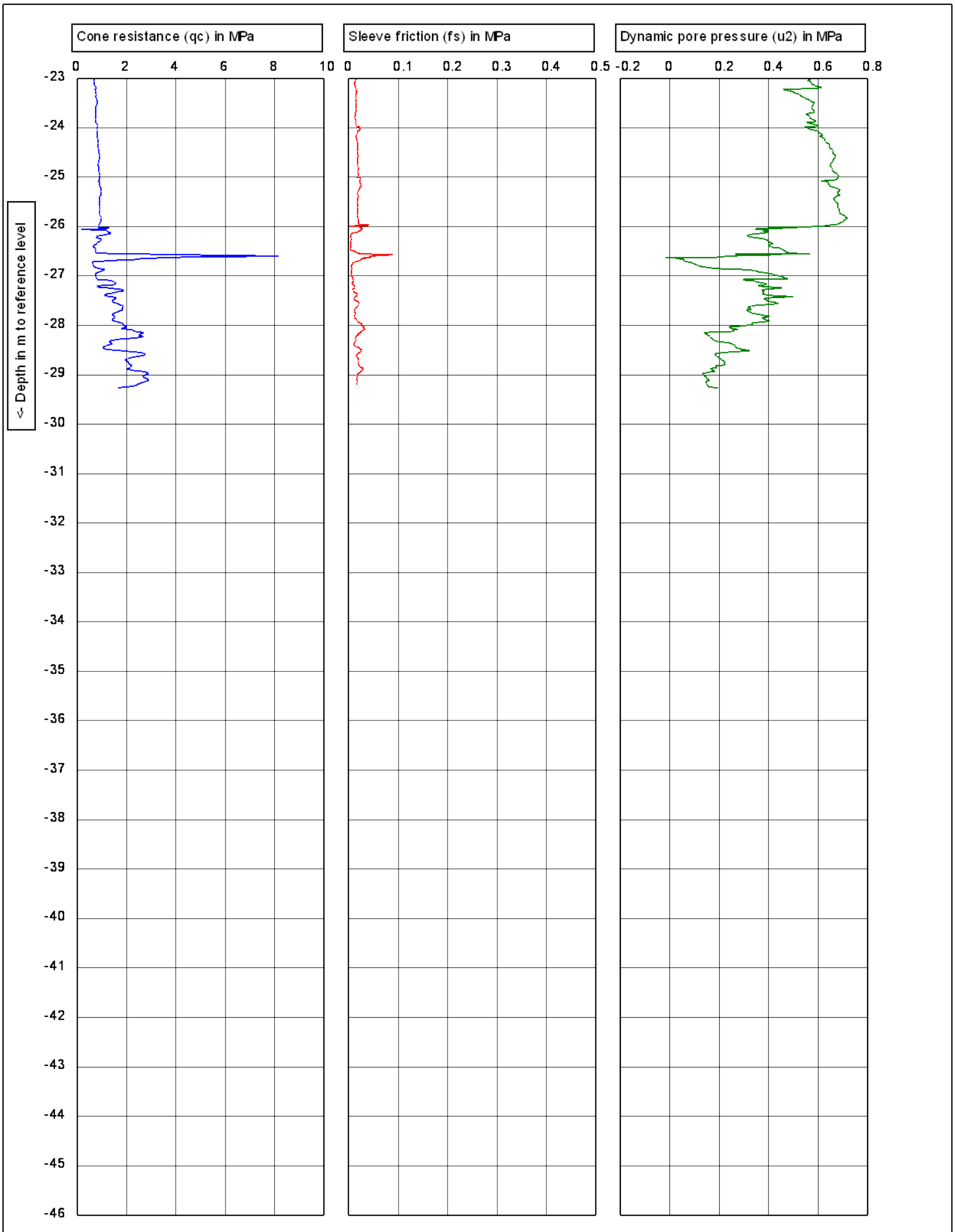
Driller Logs near Jervois (continue)

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6727-3225	26	27.5	CLYU	SILT	Silty CLAY high plasticity, grey, blue-grey, very soft, moisture content >>PL occasional fine shell fragments
6727-3225	17.5	19	CLYU	SILT	Silty CLAY high plasticity, grey, very soft to soft, some mica, moisture content >>PL pocket penetrometer 20 to 30 kPa. Soft, some fine shell fragments, pocket penetrometer 40 to 50 kPa
6727-3225	19	21	CLYU	SILT	As above, however, firm, pocket penetrometer 60 to 80 kPa, no recovery
6727-3225	21	26	CLYU	SILT	Silty CLAY (CH) high plasticity, dark grey, very soft, some medium to coarse angular limestone fragments, moisture content >>PL timber fragment, no recovery
6727-3225	26	27.5	CLYU	SILT	Silty CLAY high plasticity, grey, blue-grey, very soft, moisture content >>PL occasional fine shell fragments
6727-3225	27.5	35	CLYU	SILT	Silty CLAY high plasticity, mottled grey and green-grey, very soft, moisture content >>PL no recovery
6727-3225	35	41	CLYU	SILT	As above, however, some shell fragments, occasional thick sand partings and fine sand lenses up to 0.1 metres thick
6727-3225	41	44	CLYU	SILT	As above, however, firm sand lenses 10 mm thick at 42.5 metres, pocket penetrometer 90 kPa
6727-3225	44	47.5	SAND		SAND (SP) quartzitic, fine tomedium grained, grey, some mica specks
6727-3225	47	49.5	SDST		SANDSTONE pale grey, pale brown, massive, fine to medium grained some fine to coarse sand sized shell fragments. Moh's hardness = 2
6727-3225	49.5	50	CLYU	SILT	Silty CLAY (CH) high plasticity, dark brown, some grey and orange brown, cemented silty pockets, very soft over stiff, moisture content >> PL over >PL

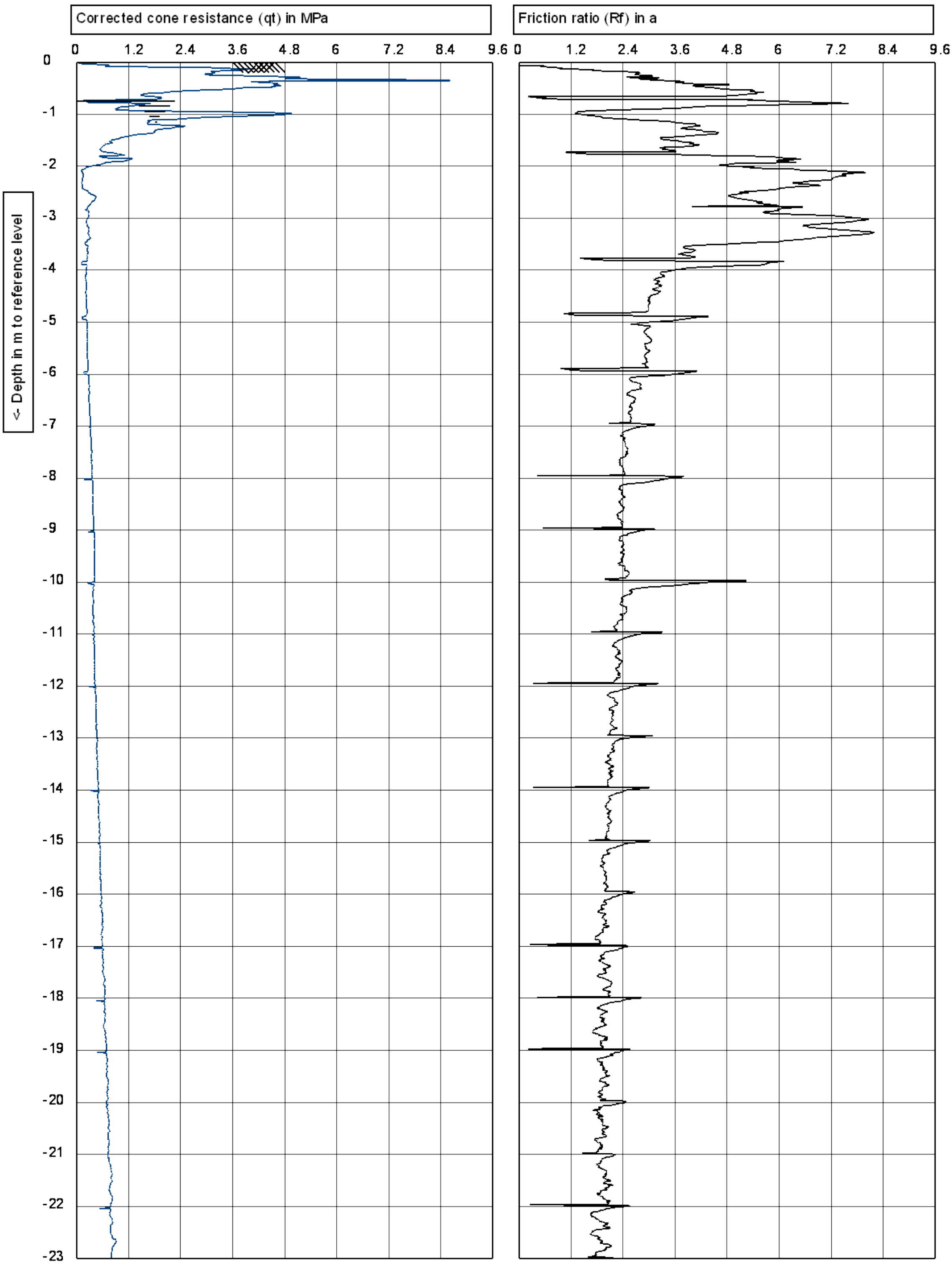
Appendix 5 Whitesands — Cone Penetration Test Results



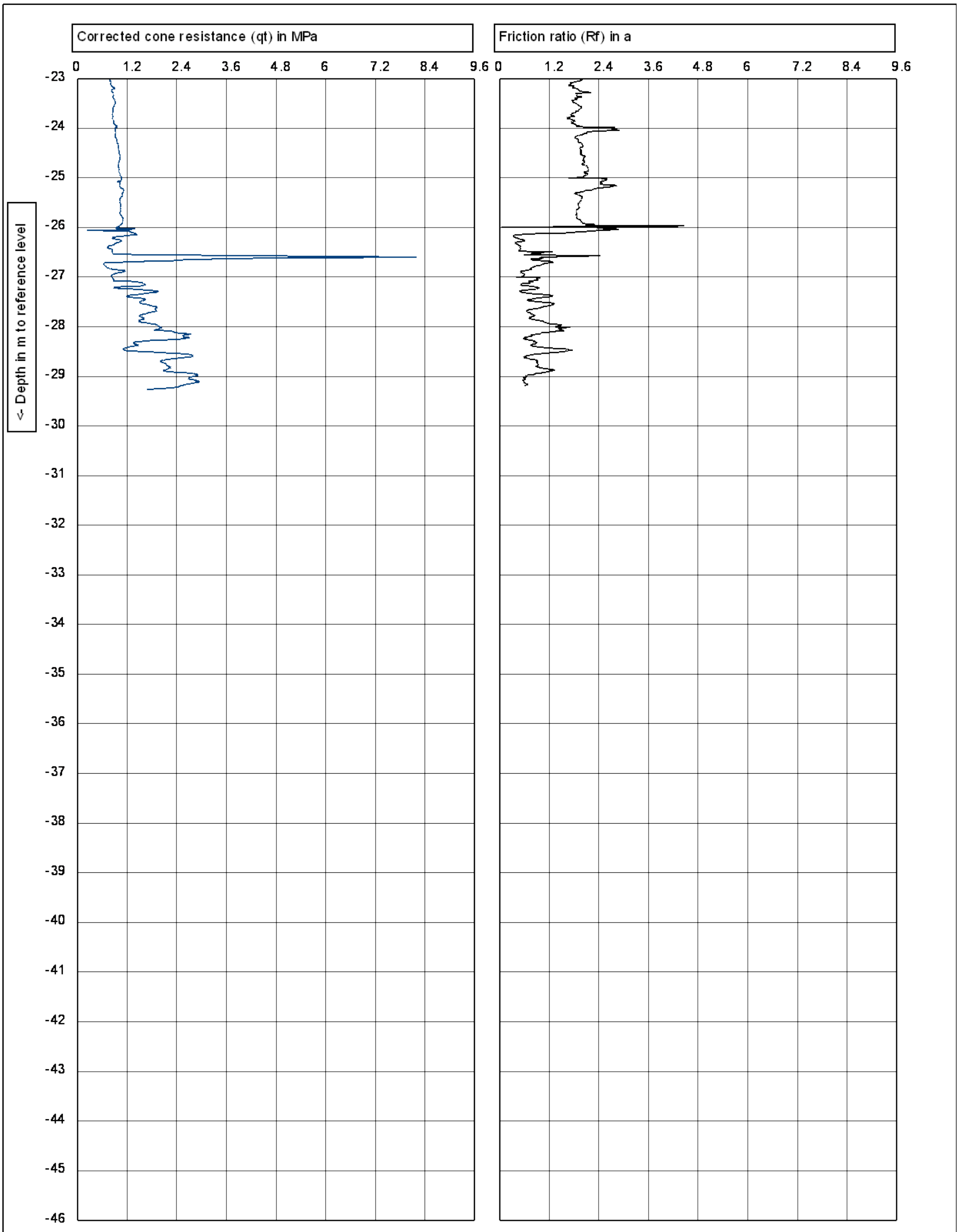
ru2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	15/10/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Whitesands		Project no.:	Whitesands
Position:			CPT no.:	1 1/6



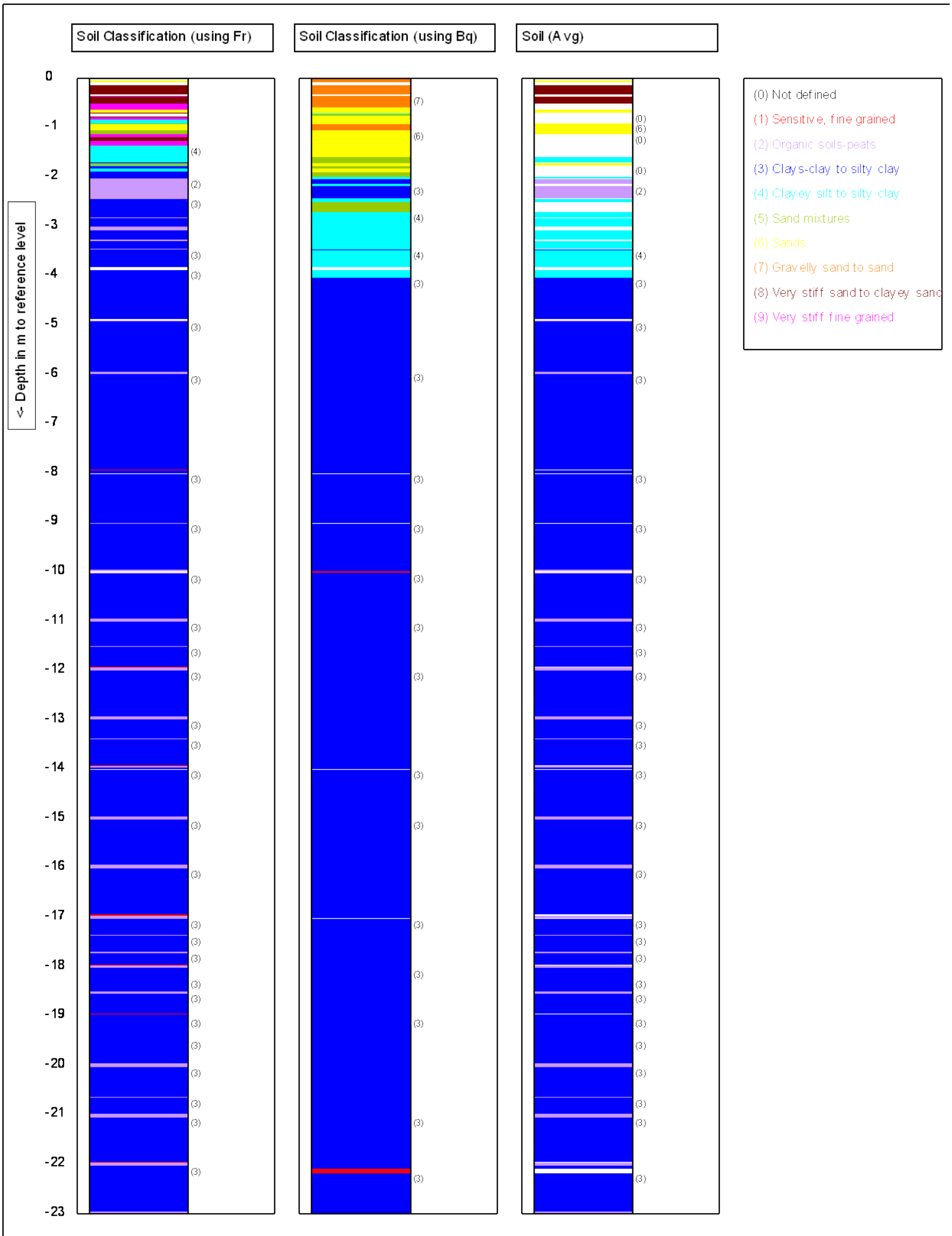
r u2 / 150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP / W.L.: a0.75	Date:	15/10/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Whitesands		Project no.:	Whitesands
Position:		CPT no.:	1 / 2/6



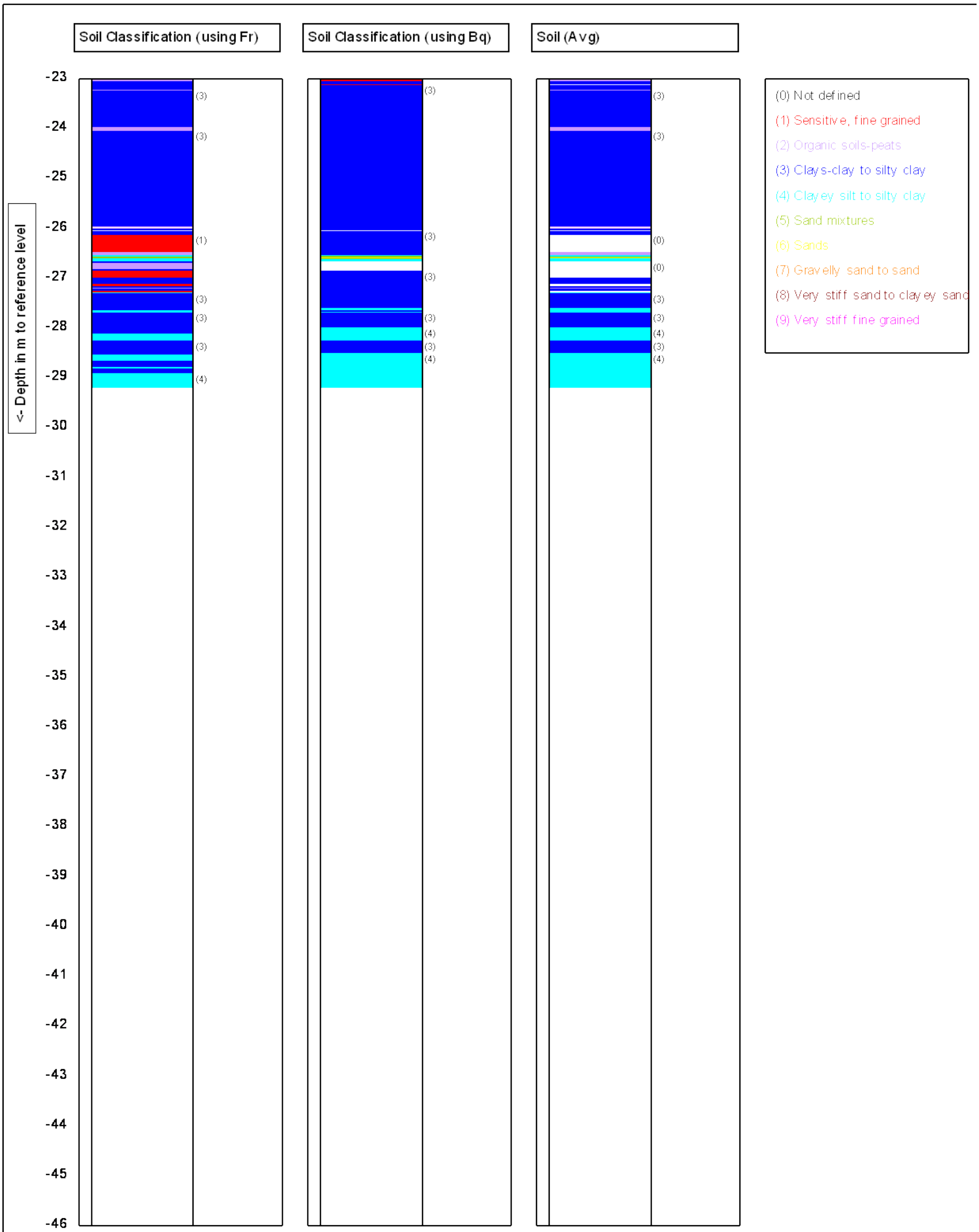
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Whitesands			Project no.:	Whitesands
Position:			CPT no.:	1 — 3/6



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Whitesands			Project no.:	Whitesands
Position:			CPT no.:	1 4/6



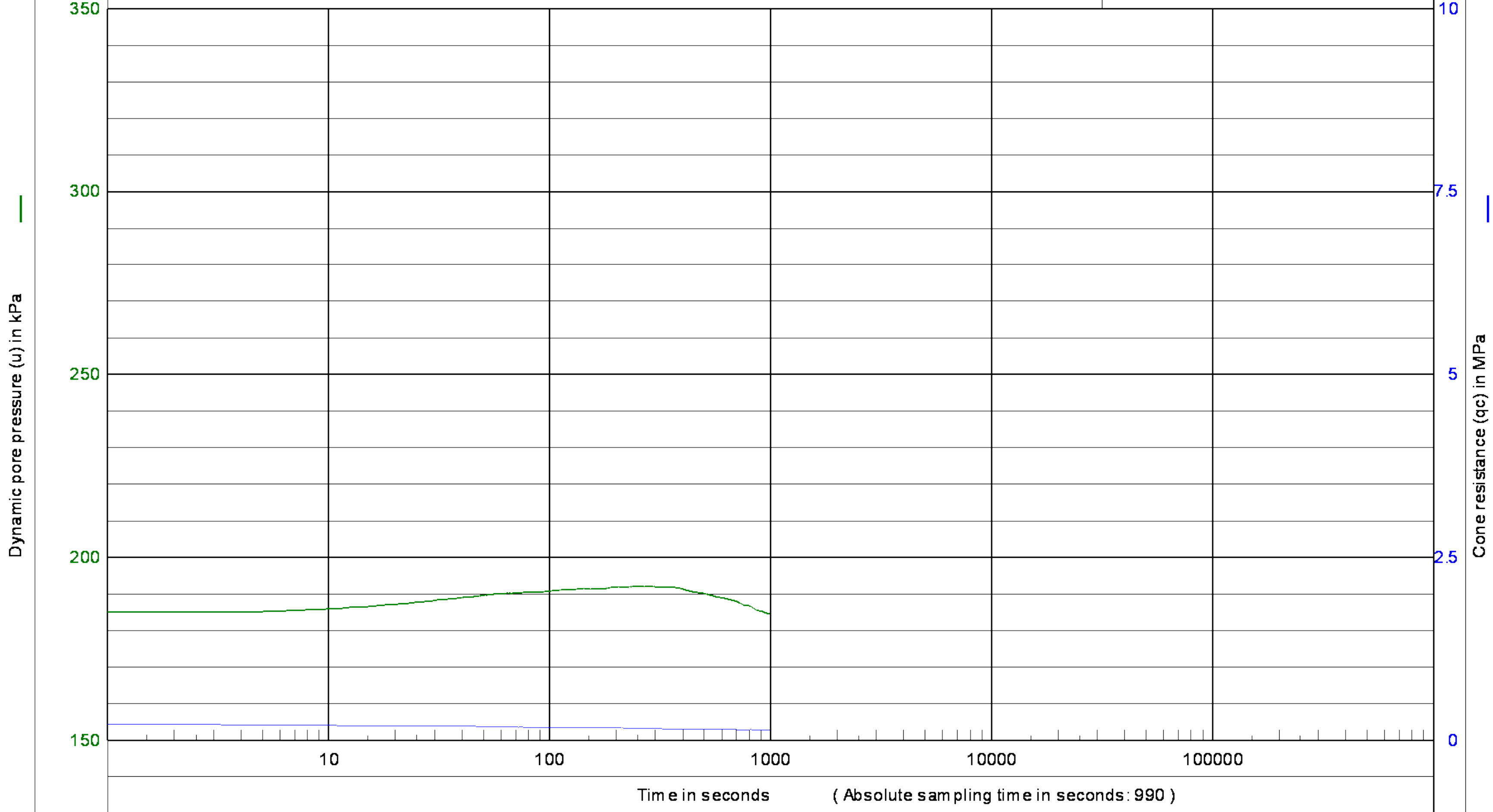
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Whitesands			Project no.:	Whitesands
Position:			CPT no.:	1 5/6



	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Whitesands			Project no.:	Whitesands
Position:			CPT no.:	1 — 6/6

Test number 1

Ubegin	:	0.185 MPa
Uo	:	0.073 MPa

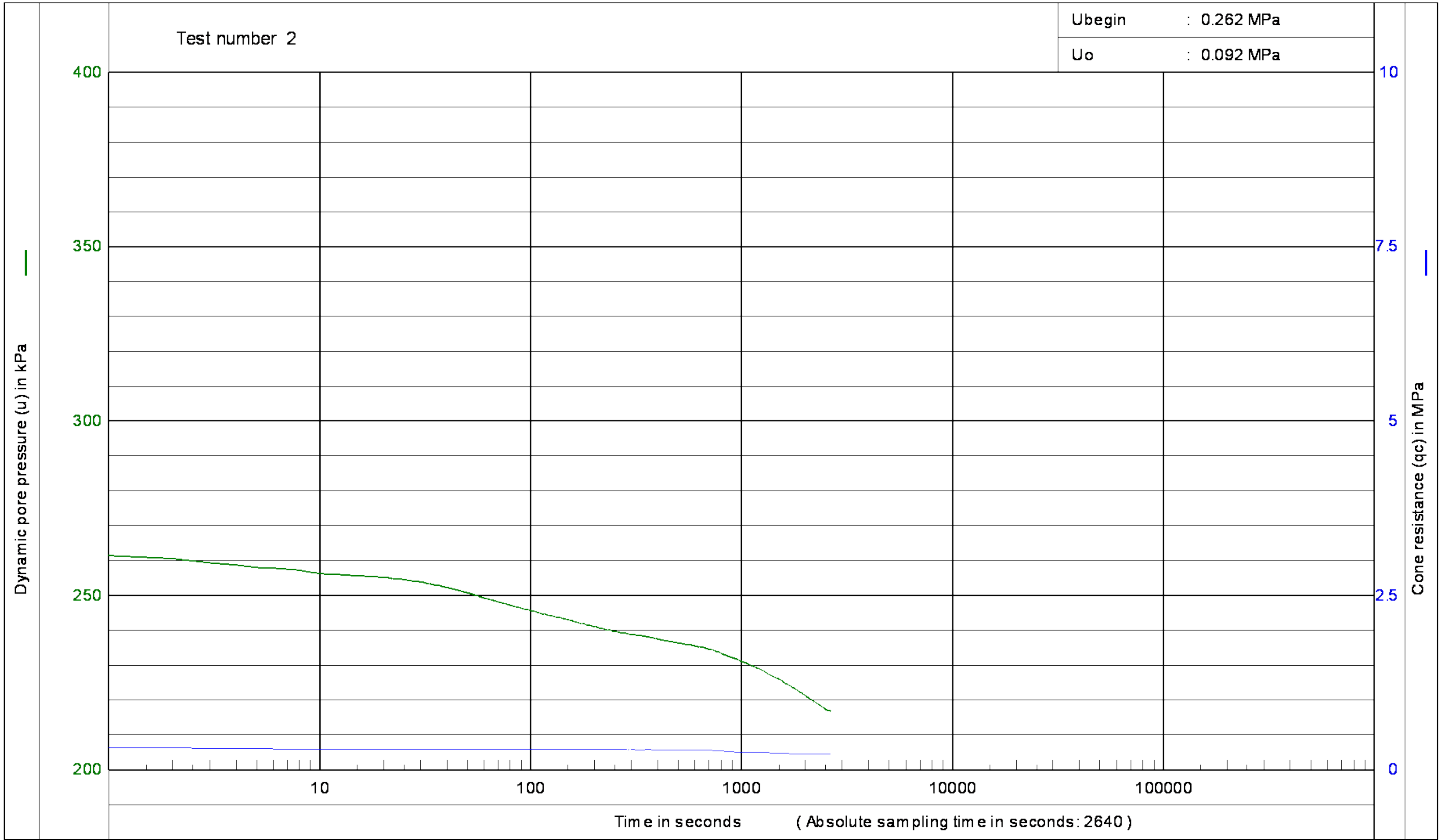


Test according NEN 5140 class 1

Project : Project E.1.8

Location : Whitesands

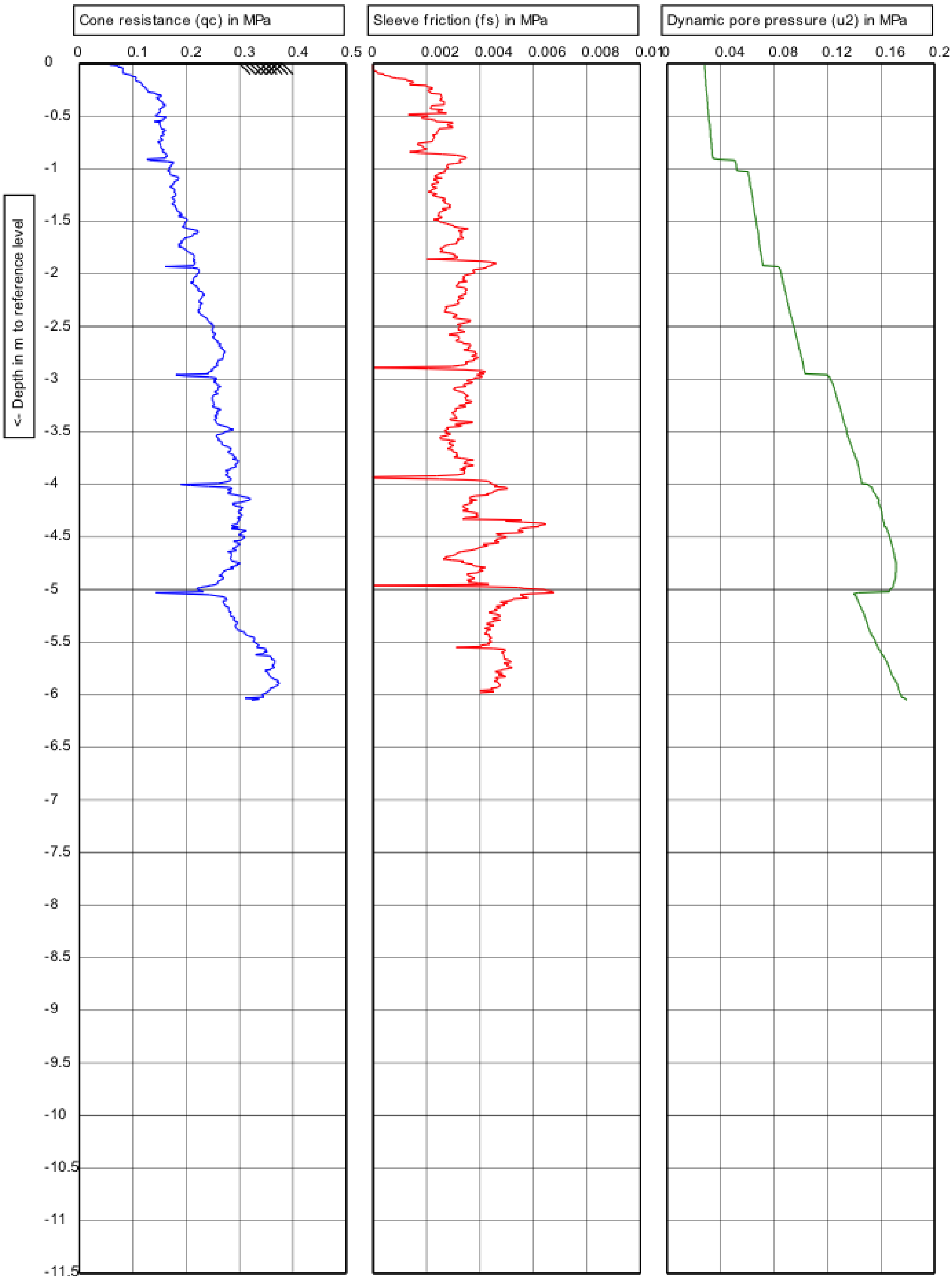
Date	:	15/10/2014	
Project no.	:	Whitesands	
CPT no.	:	1	
Test depth	:	-8.01	[m] - G.L.
Water level	:	-0.75	[m] - G.L.



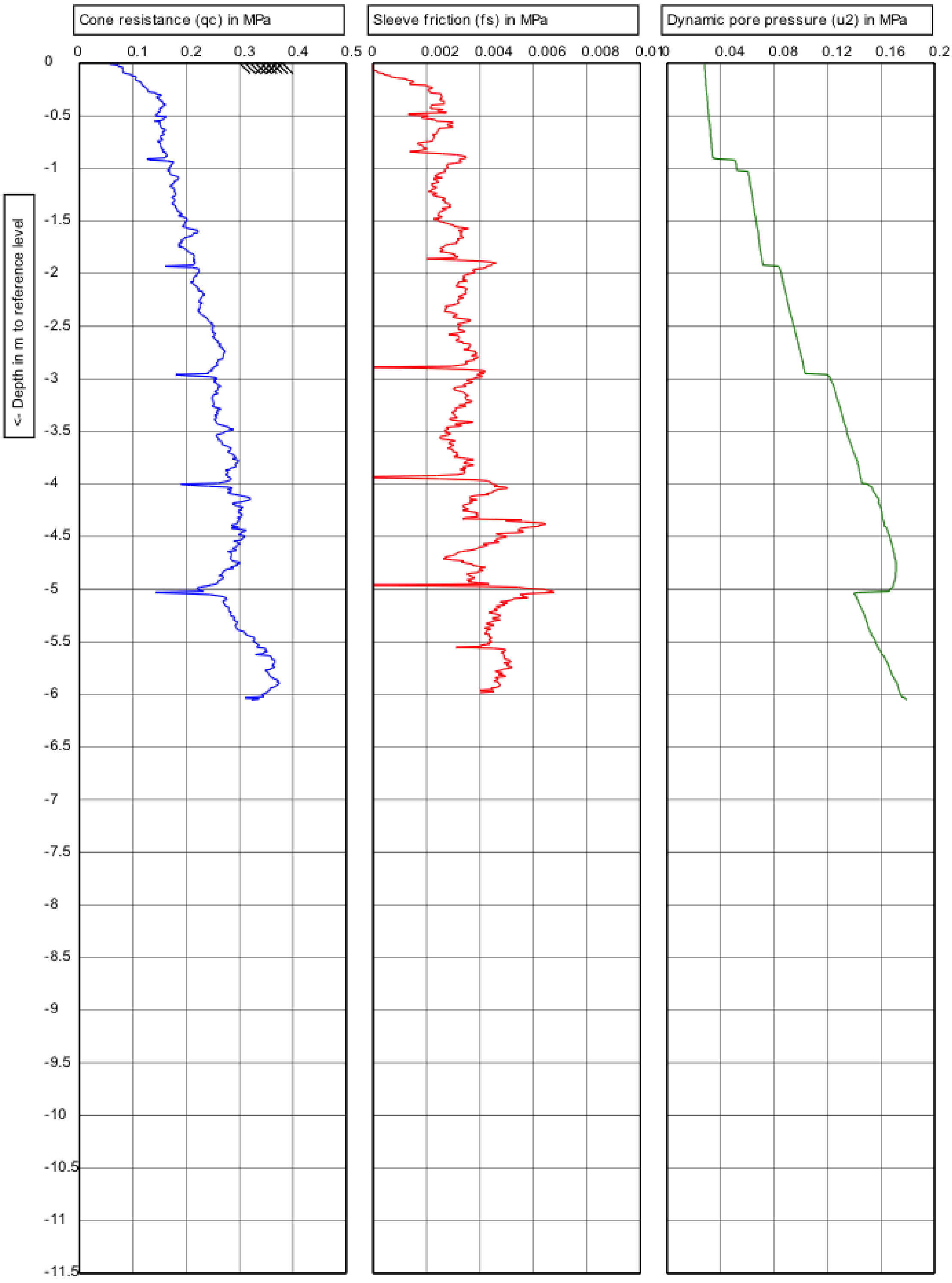
Test according NEN 5140 class 1

Project	: Project E.1.8
Location	: Whitesands

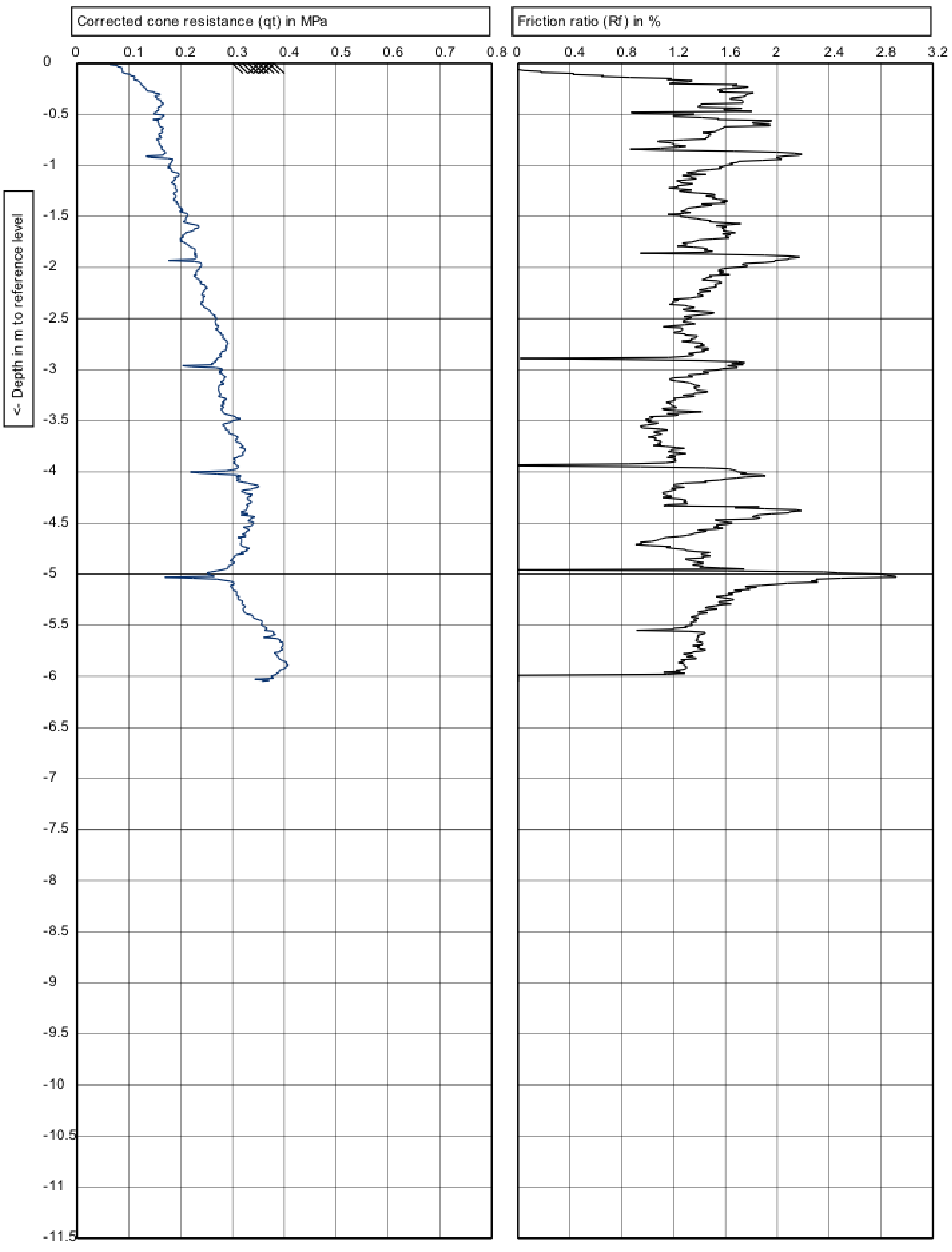
Date	: 15/10/2014	
Project no.	: Whitesands	
CPT no.	: 1	
Test depth	: -10	[m] - G.L.
Water level	: -0.75	[m] - G.L.



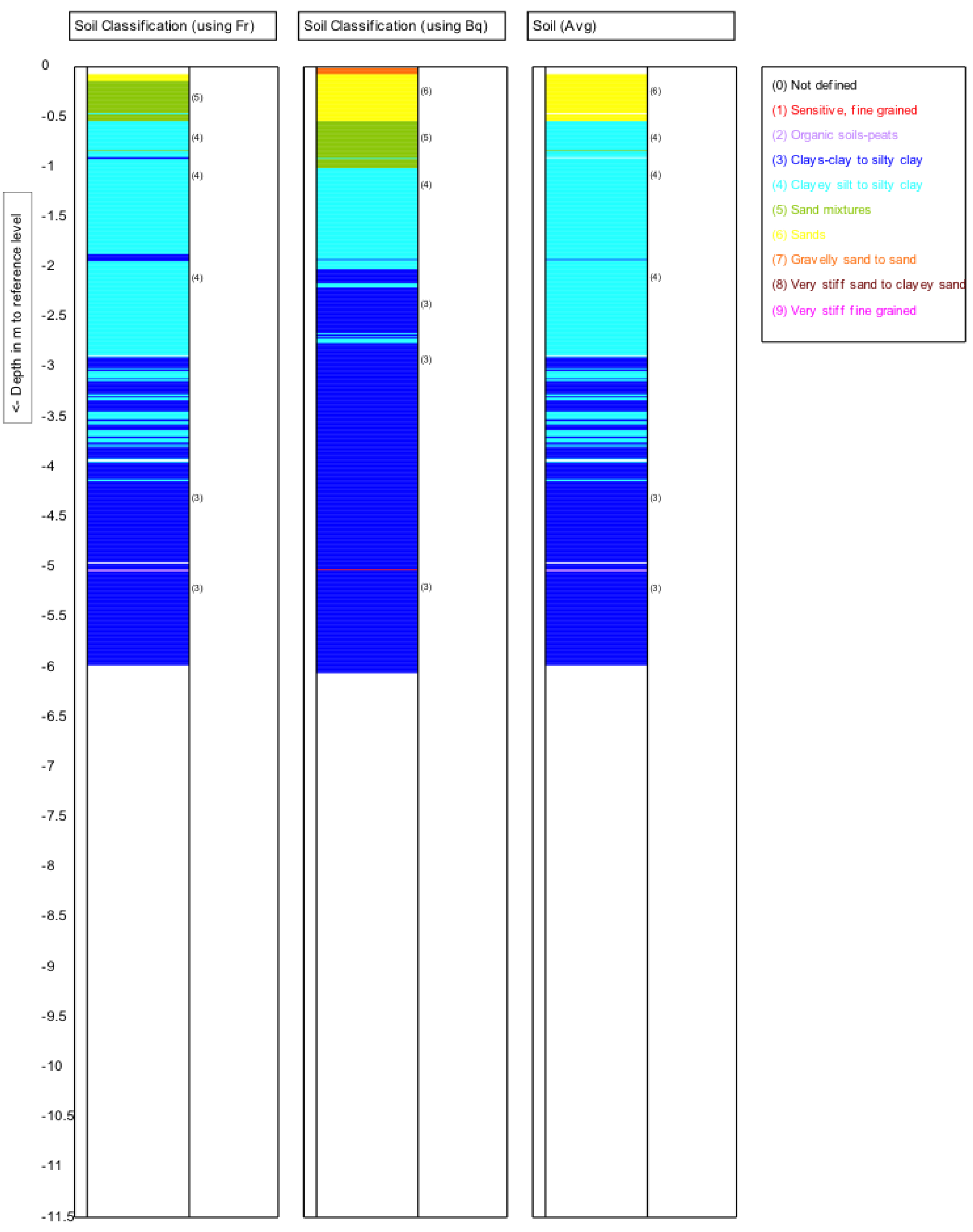
u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
	G.L. 0 NAP W.L.: **2.83**	Date:	**8/05/2013**
	Project: **LMR0513 - White Sands Failure**	Cone no.:	**C10CFIIP.G67**
	Location: **Whitesands**	Project no.:	**LMR0513-TL**
	Position:	CPT no.:	**1** 1/3



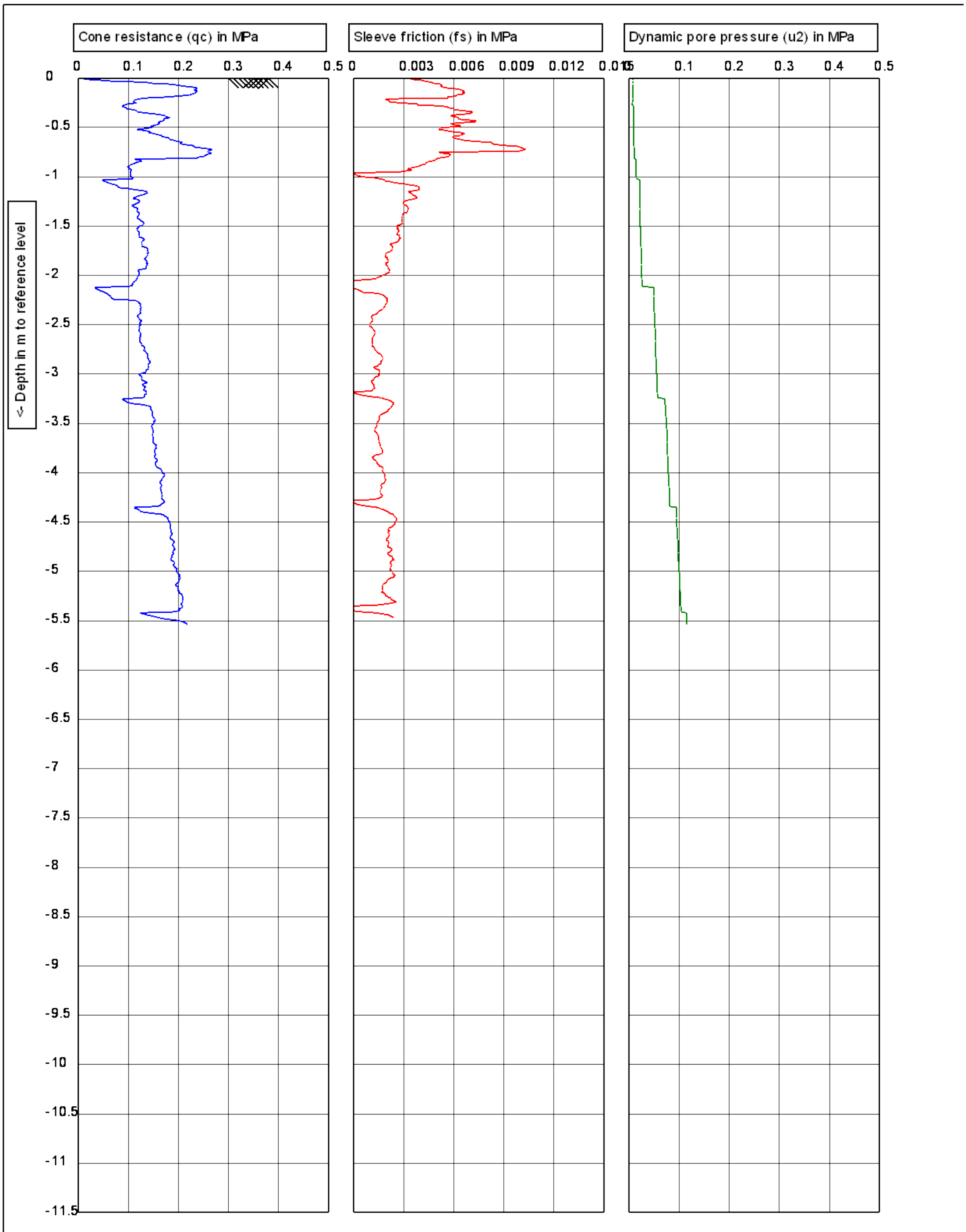
u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
G.L. 0 NAP	W.L.: **2.83**	Date:	**8/05/2013**
Project: **LMR0513 - White Sands Failure**		Cone no.:	**C10CFIIP.G67**
Location: **Whitesands**		Project no.:	**LMR0513-TL**
Position:		CPT no.:	**1** 1/3



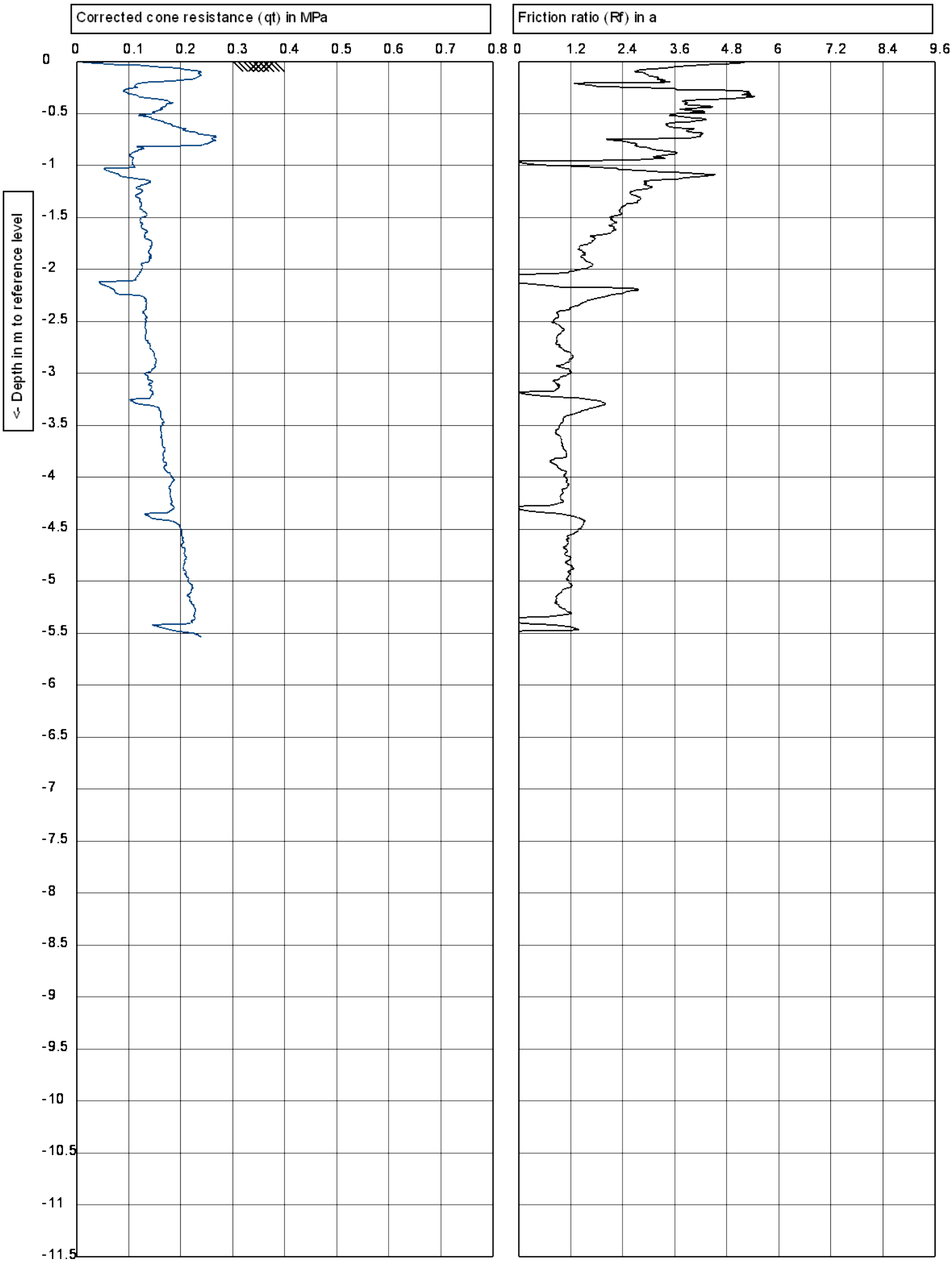
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
	G.L. 0 NAP	W.L.: **2.83**	Date:	**8/05/2013**
Project:	**LMR0513 - White Sands Failure**		Cone no.:	**C10CFIIP.G67**
Location:	**Whitesands**		Project no.:	**LMR0513-TL**
Position:			CPT no.:	**1** 2/3



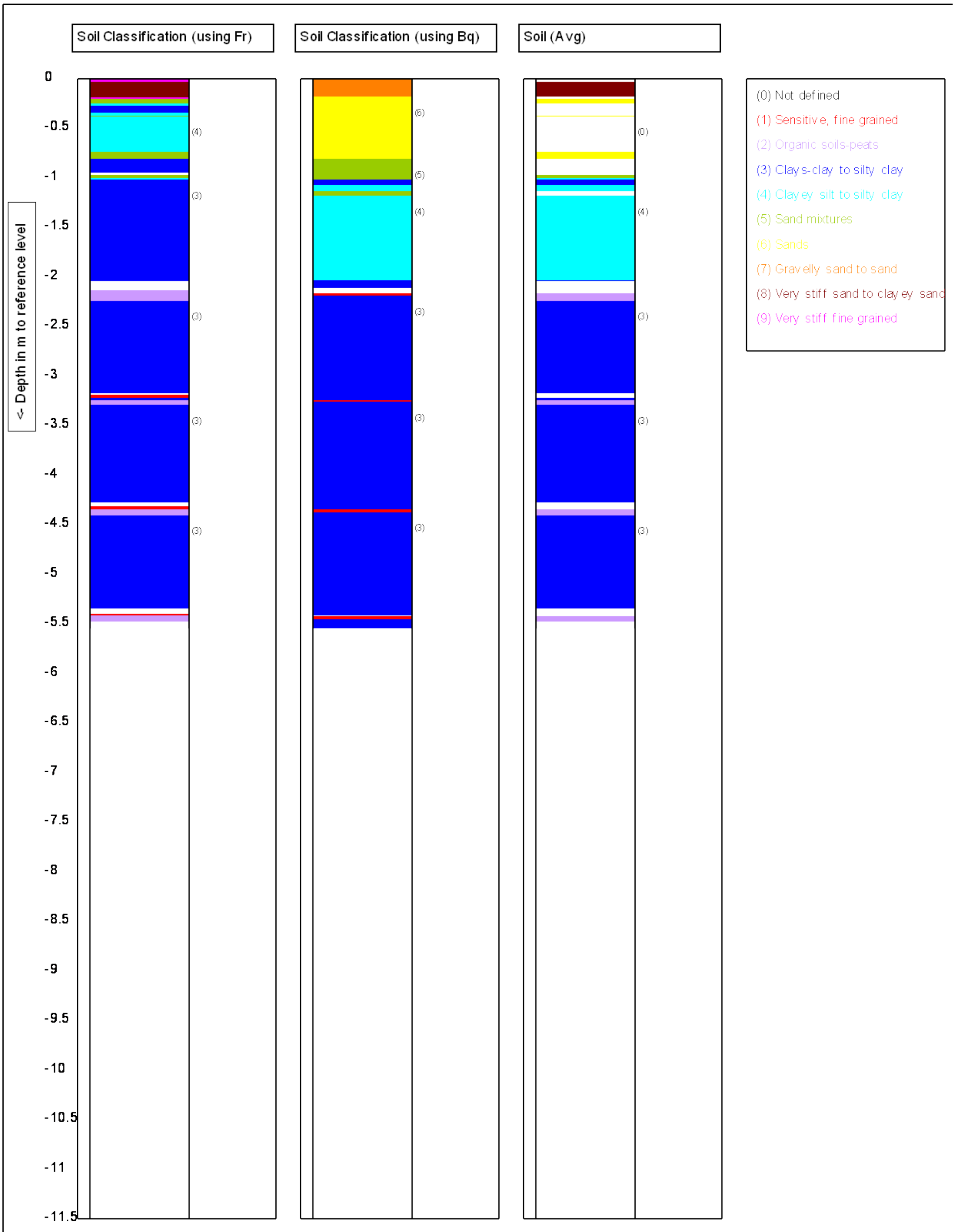
Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
G.L. 0 NAP	W.L.: **2.83**	Date:	**8/05/2013**
Project:	**LMR0513 - White Sands Failure**	Cone no.:	**C10CFIIP.G67**
Location:	**Whitesands**	Project no.:	**LMR0513-TL**
Position:		CPT no.:	**1** 3/3



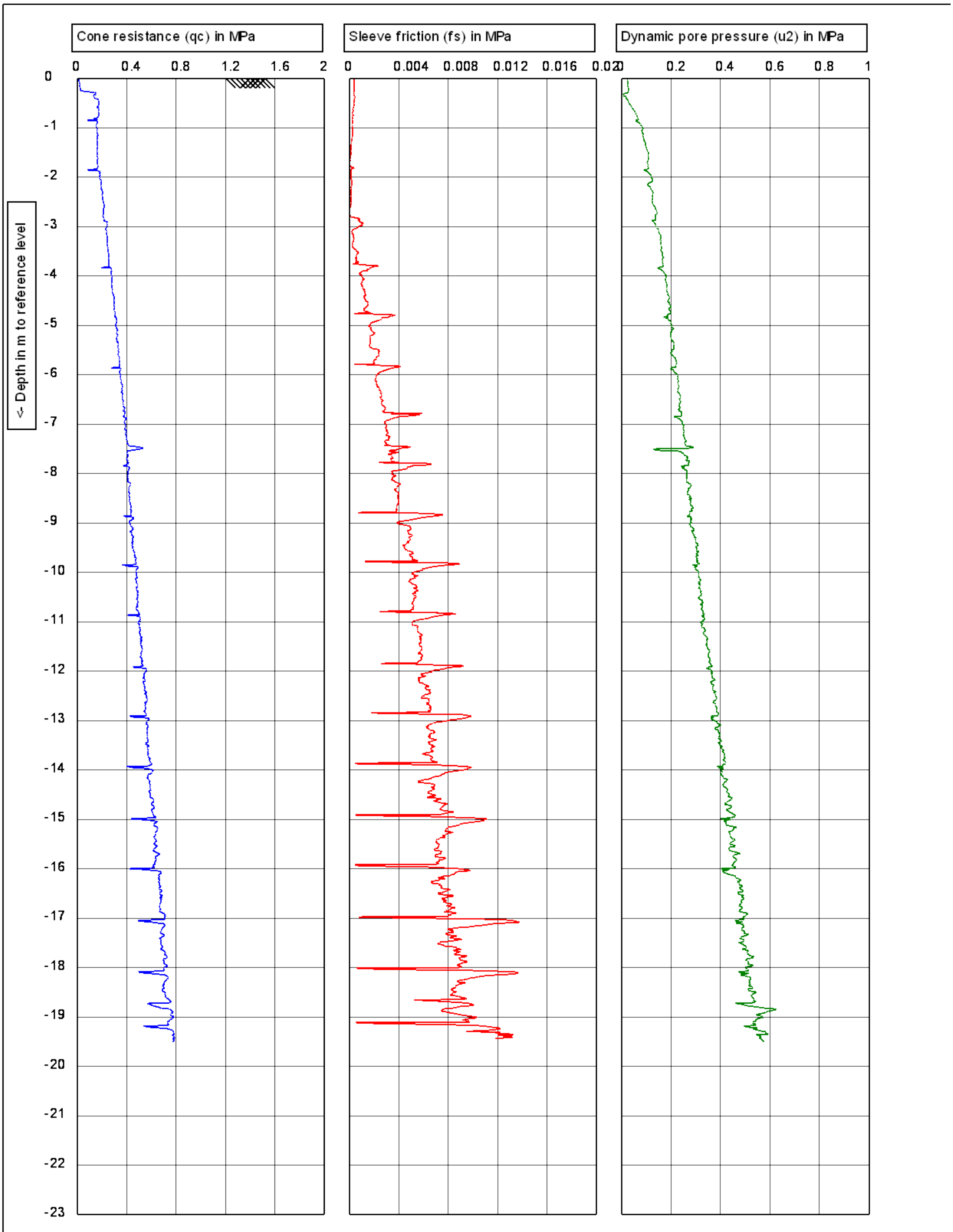
Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0.59	Date:	3/05/2013
Project: LMR0513 a White Sands		Cone no.:	C10CFIIP.G67
Location: WS		Project no.:	LMR0513aWS
Position:		CPT no.:	1 · 1/3



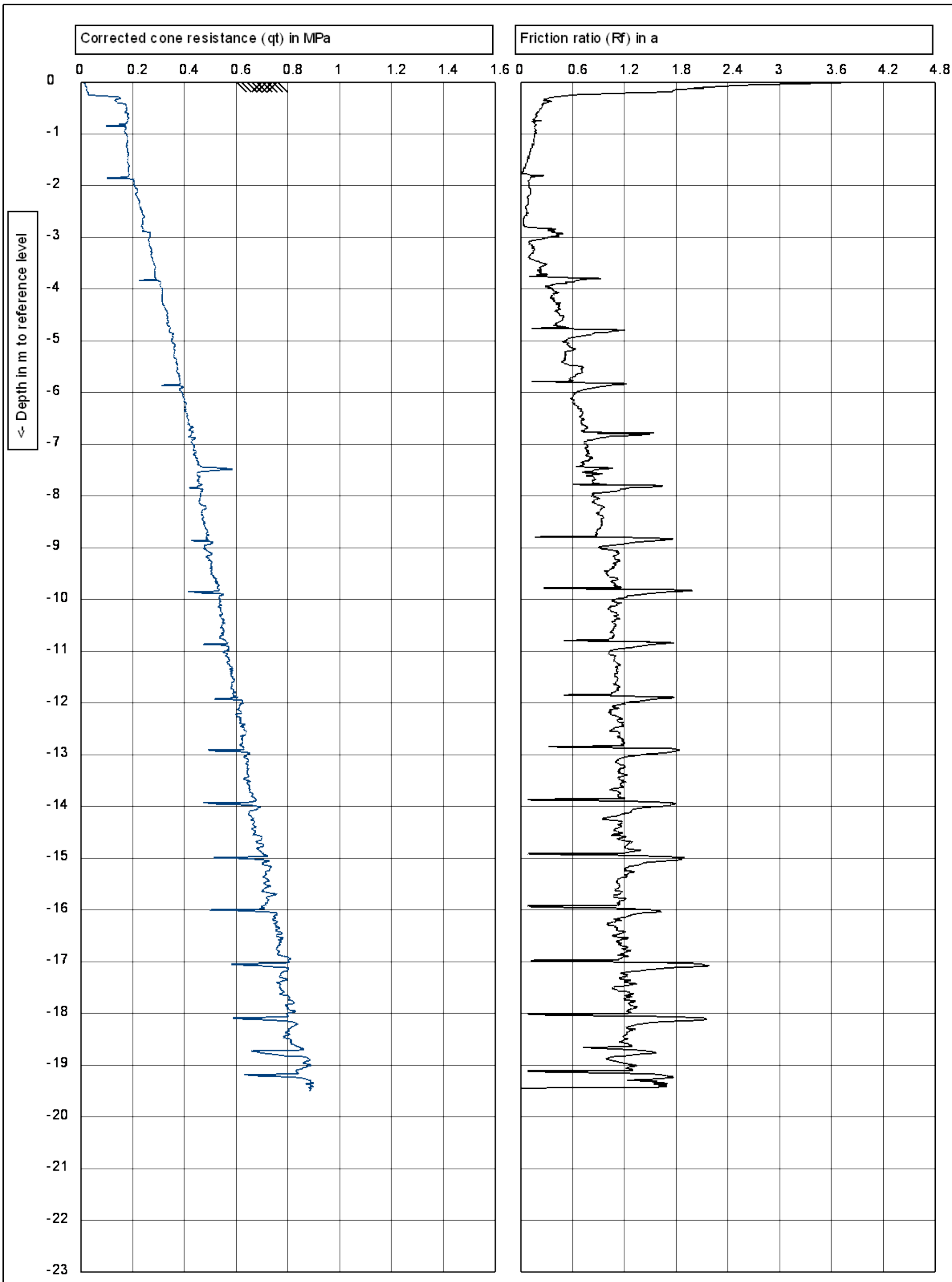
	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
150 cm² 10 cm²	G.L. 0 NAP	W.L.: 0.59	Date:	3/05/2013
Project: LMR0513 aWhite Sands			Cone no.:	C10CFIIP.G67
Location: WS			Project no.:	LMR0513aWS
Position:			CPT no.:	1 2/3



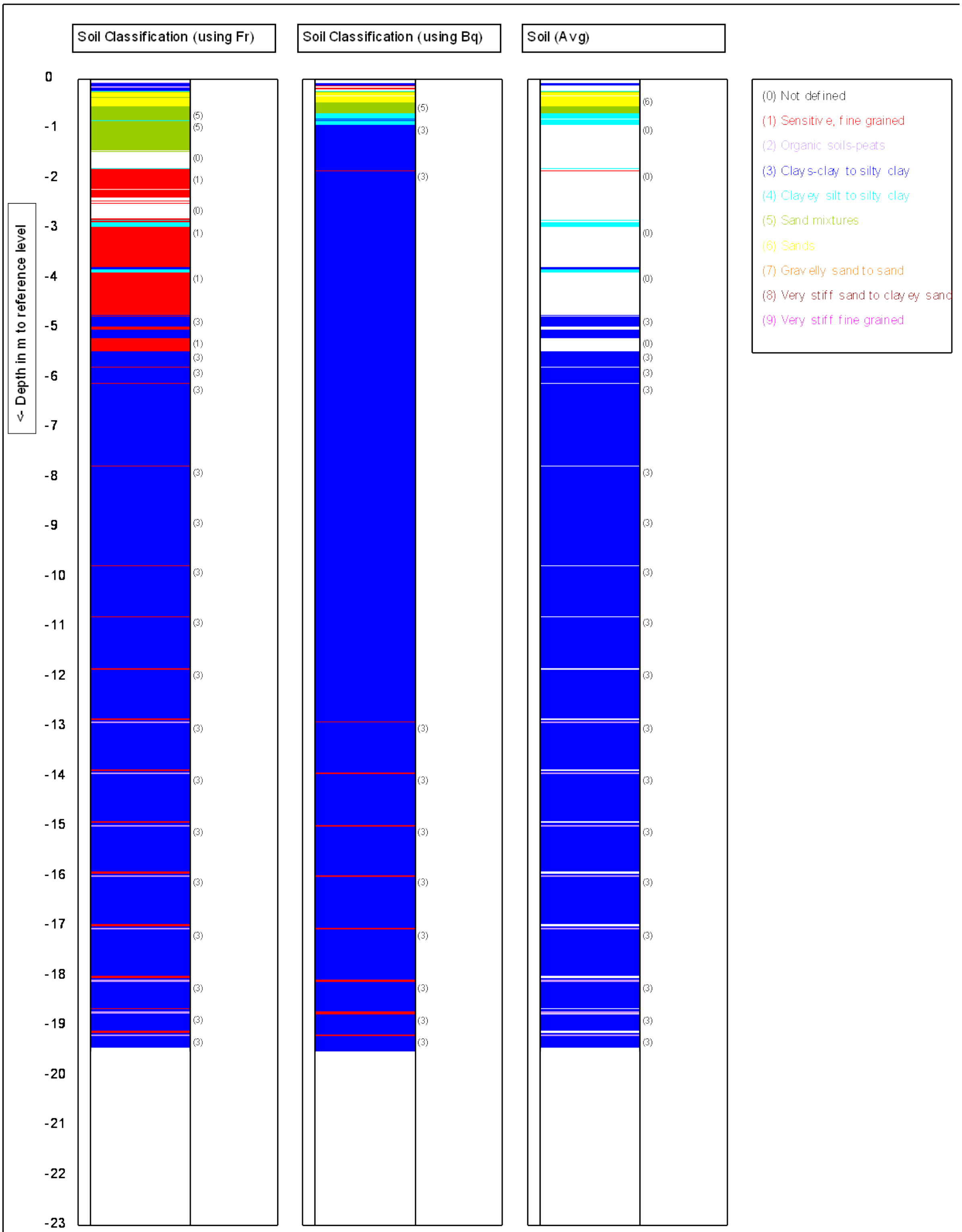
Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP / W.L.: 0.59	Date:	3/05/2013
Project: LMR0513 aWhite Sands	Cone no.:	C10CFIIP.G67
Location: WS	Project no.:	LMR0513aWS
Position:	CPT no.:	1 — 3/3



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled	
	G.L. 0 NAP	W.L.: 1a7	Date:	11/02/2014	
Project: LMR0214			Cone no.:	C10CFIIPaG67	
Location: RIVERGLEN MARINA			Project no.:	LMR0214_RG	
Position:			CPT no.:	2	1/3

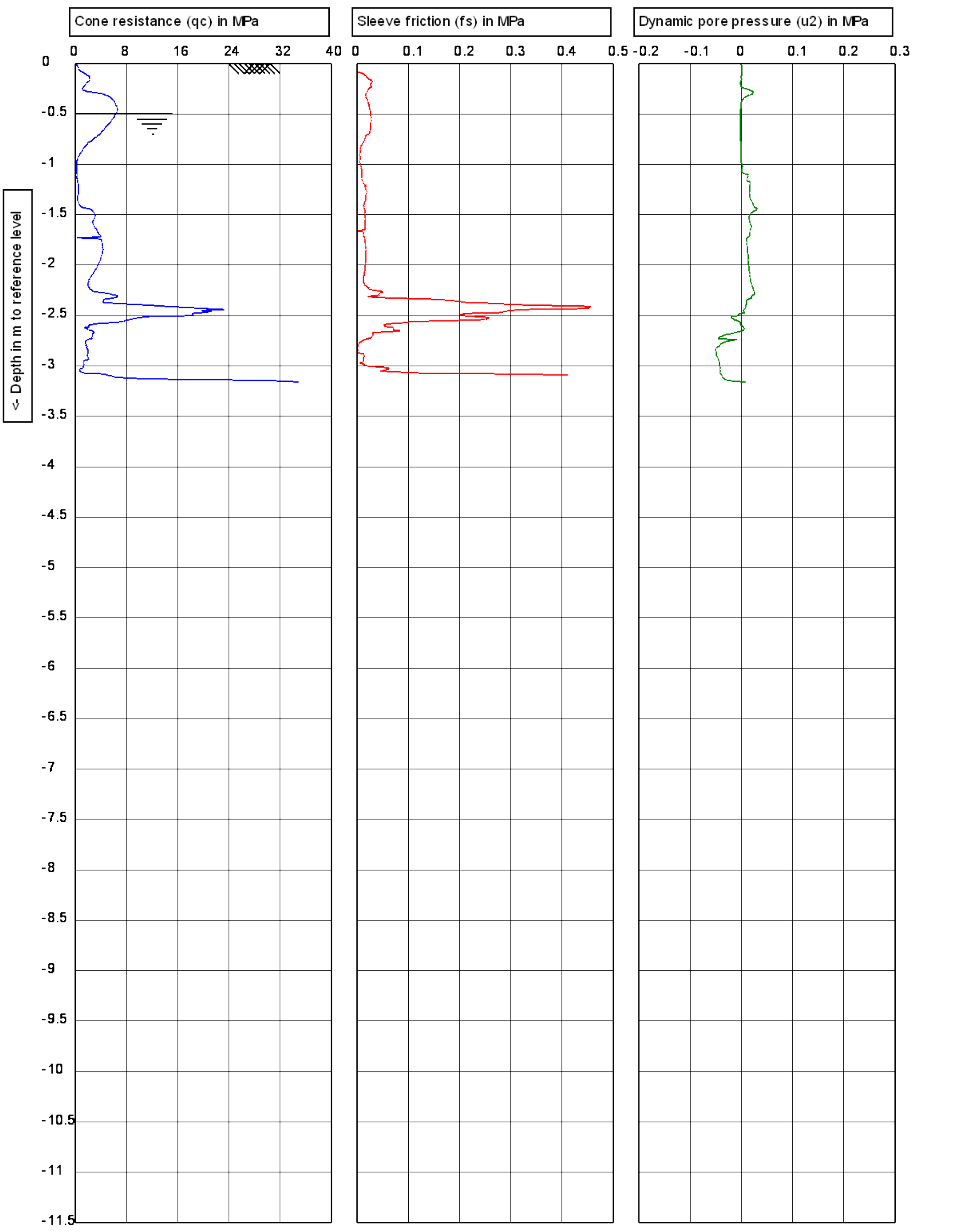


u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a7	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: RIVERGLEN MARINA			Project no.:	LMR0214_RG
Position:			CPT no.:	2 — 2/3

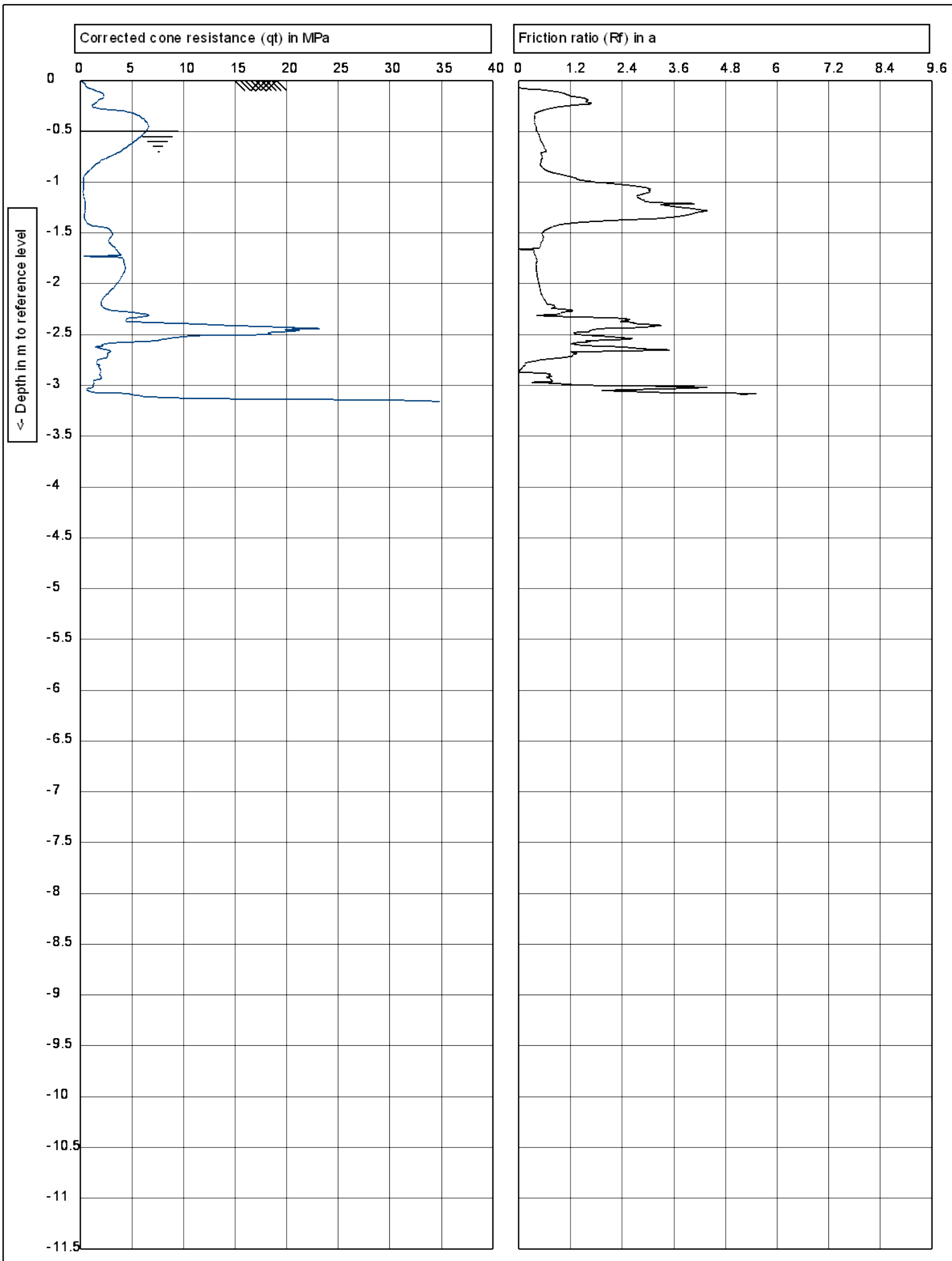


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a7	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPa367
Location: RIVERGLEN MARINA			Project no.:	LMR0214_RG
Position:			CPT no.:	2 — 3/3

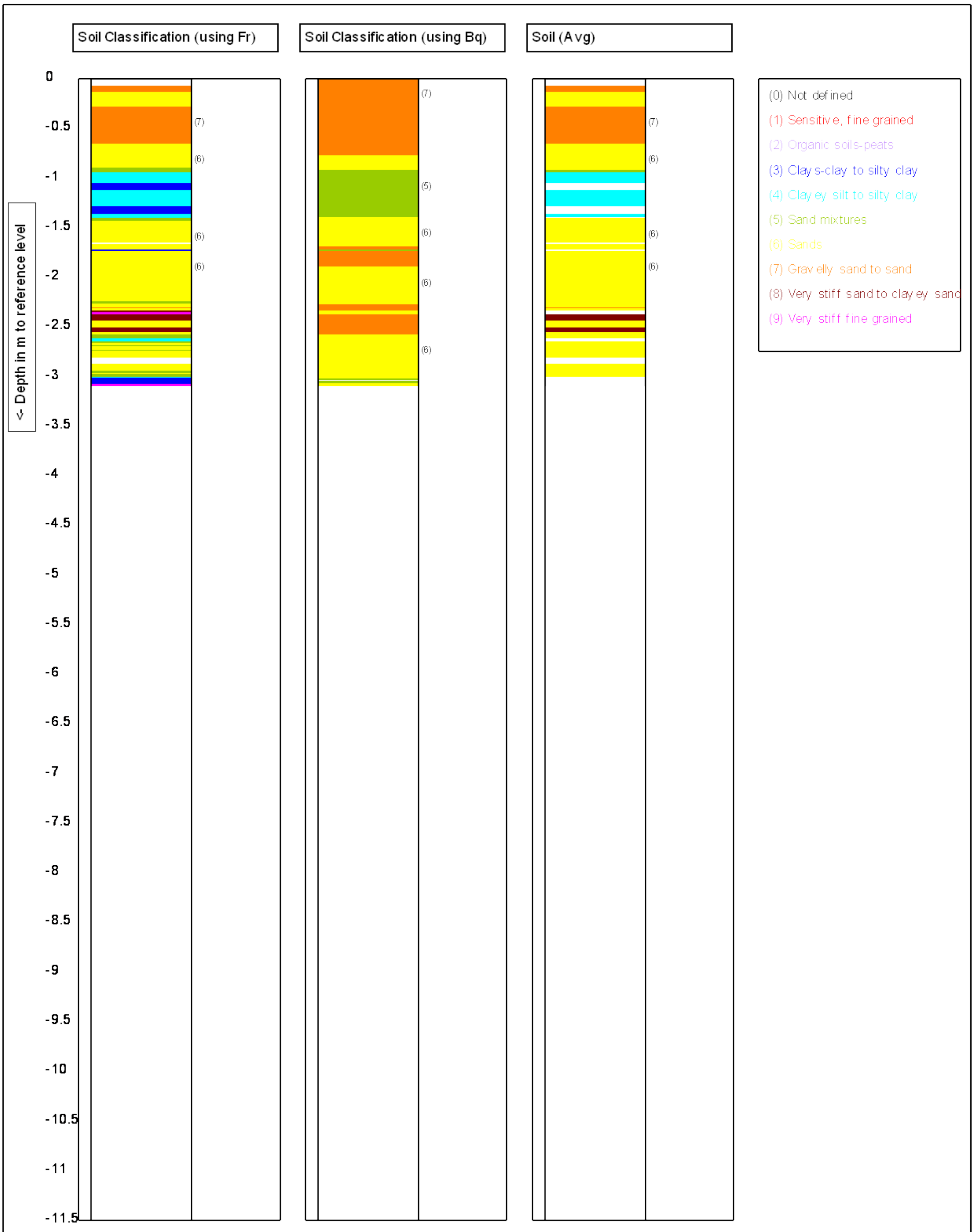
Appendix 6 Westbrooks — Cone Penetration Test Results



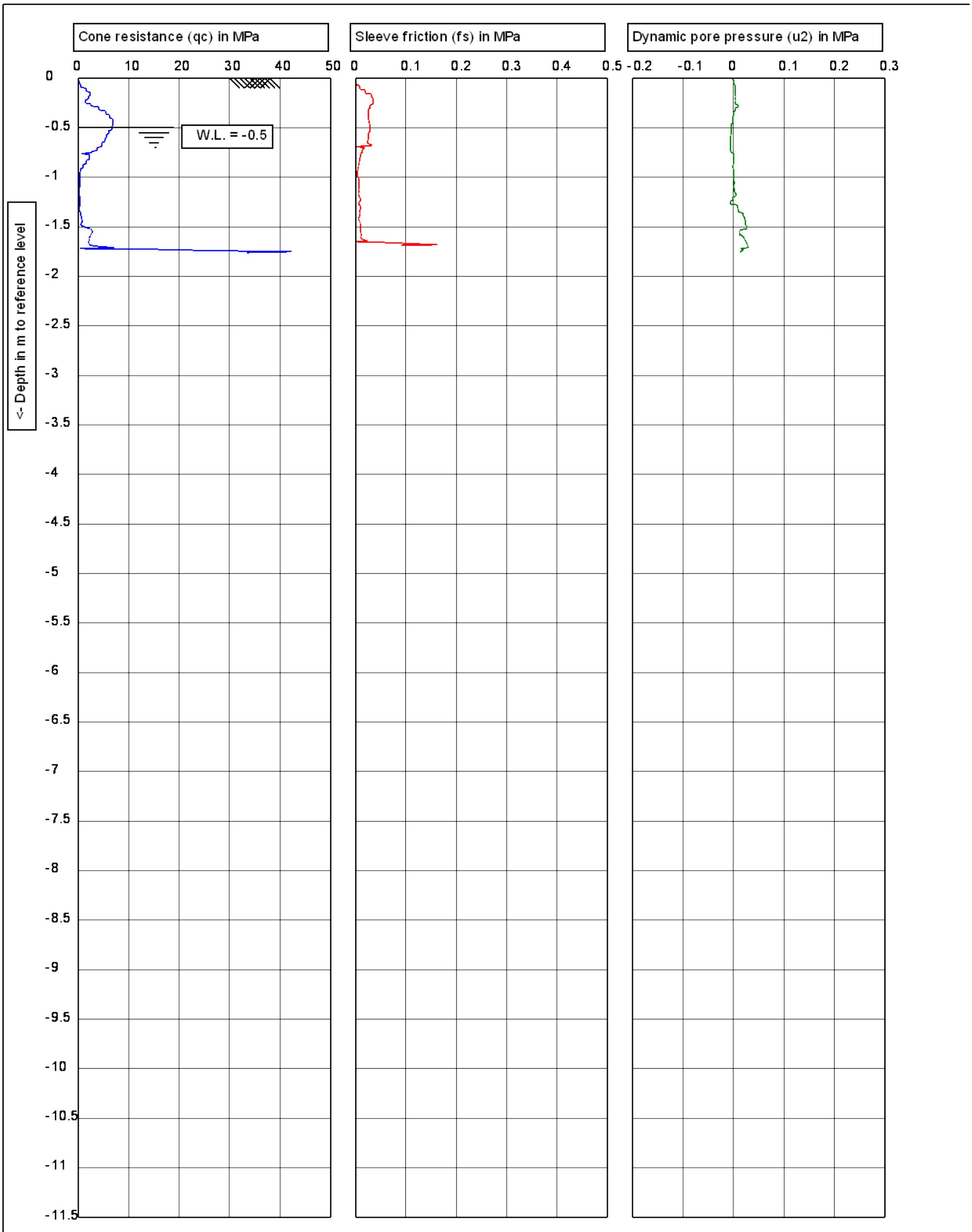
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: -0.5	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Westbrooks			Project no.:	Westbrooks
Position:			CPT no.:	1 1/3



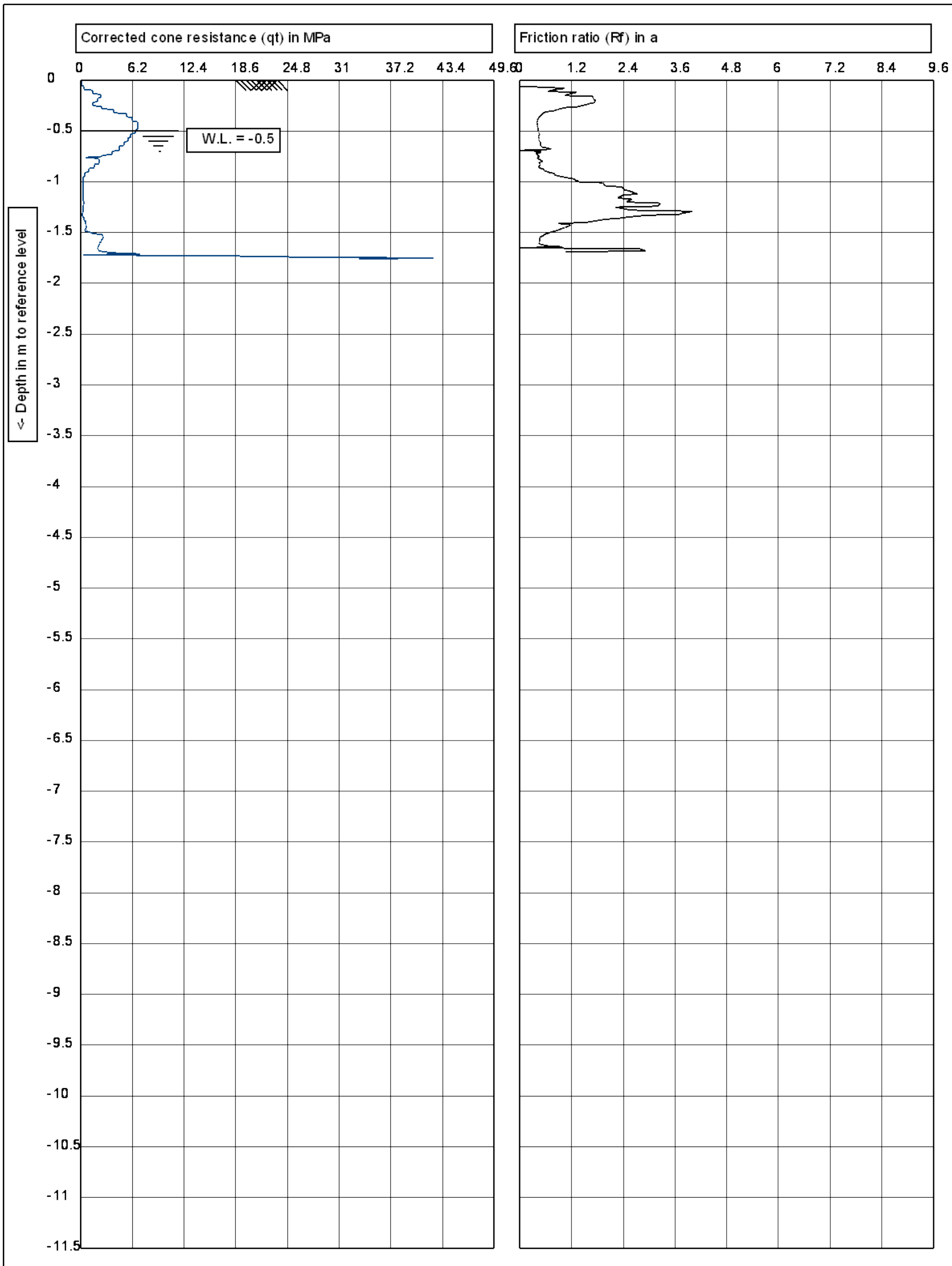
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	15/10/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Westbrooks		Project no.:	Westbrooks
Position:			CPT no.:	1 2/3



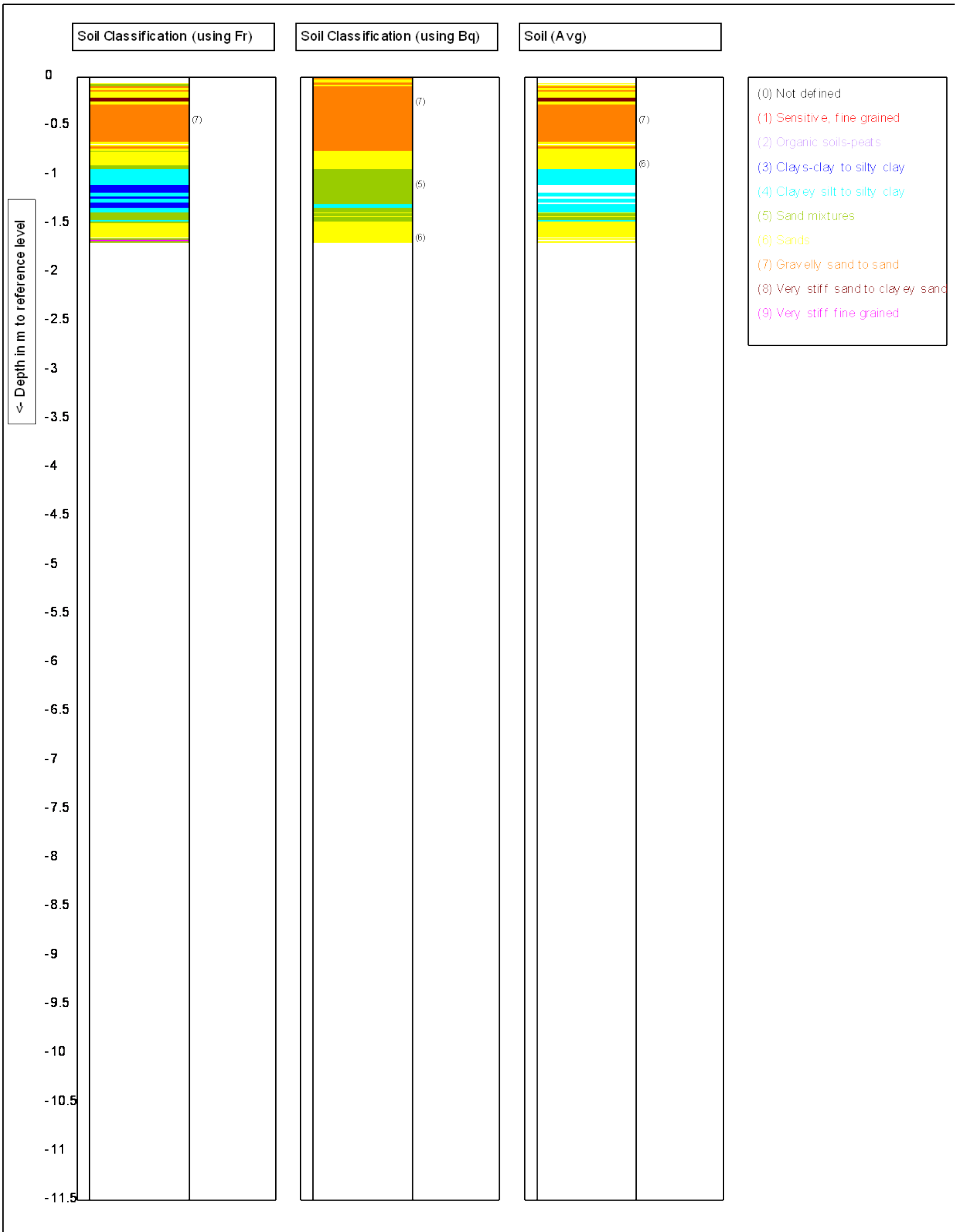
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Westbrooks			Project no.:	Westbrooks
Position:			CPT no.:	1 — 3/3



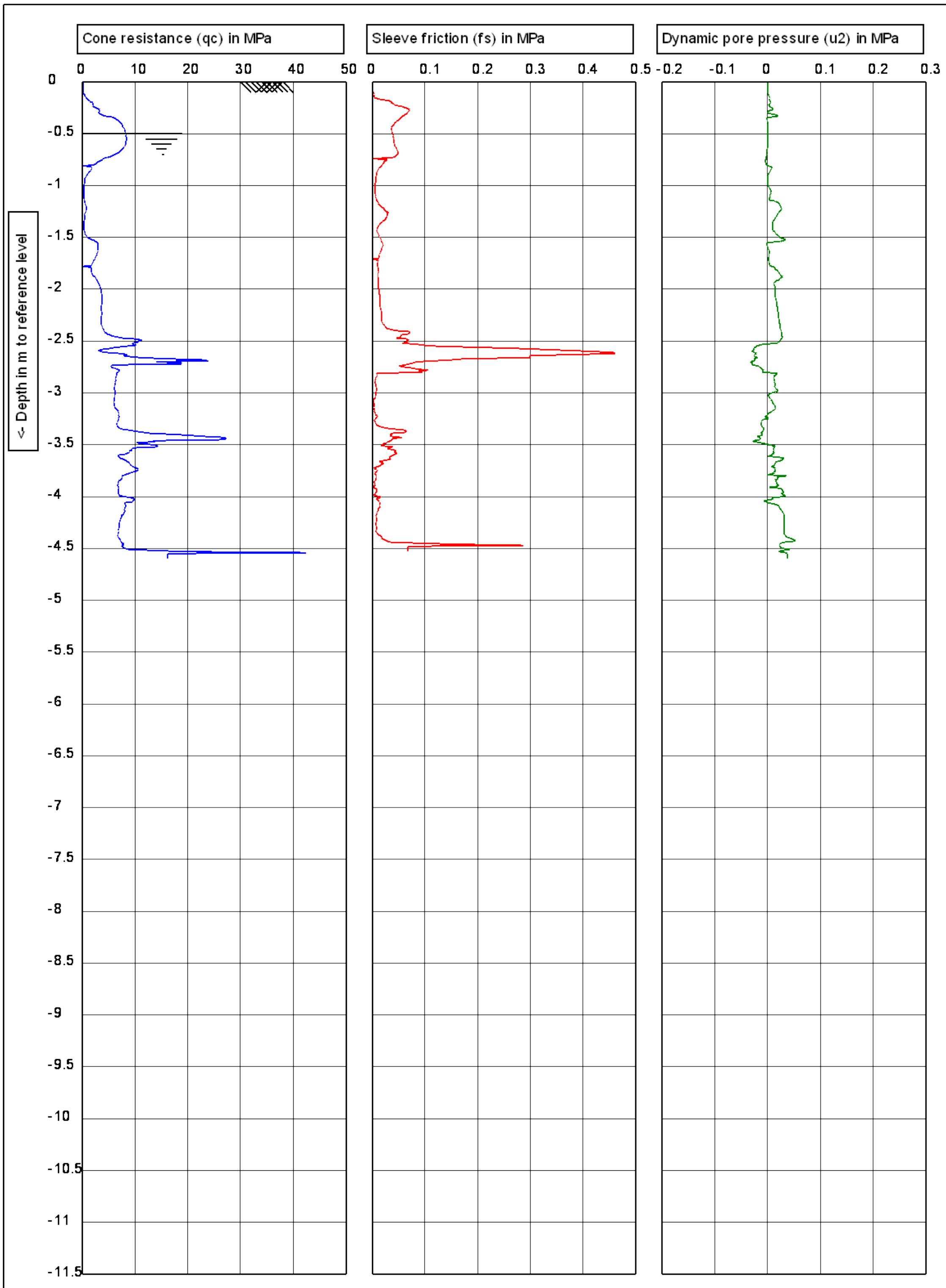
u2, 150 cm², 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: a0.5	Date:	15/10/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Westbrooks		Project no.:	Westbrooks
Position:		CPT no.:	2 1/3



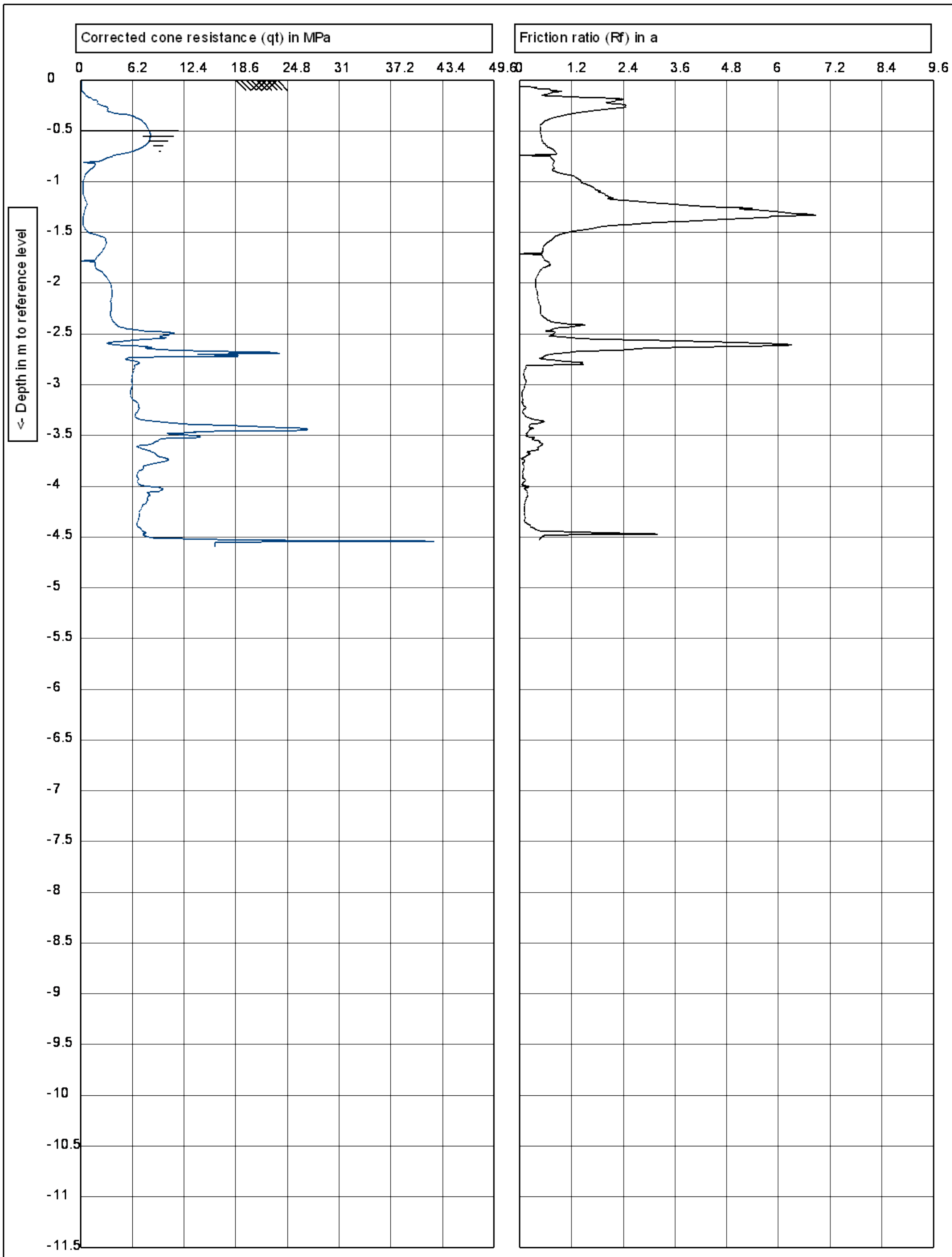
150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP / W.L.: a0.5	Date:	15/10/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Westbrooks		Project no.:	Westbrooks
Position:		CPT no.:	2 — 2/3



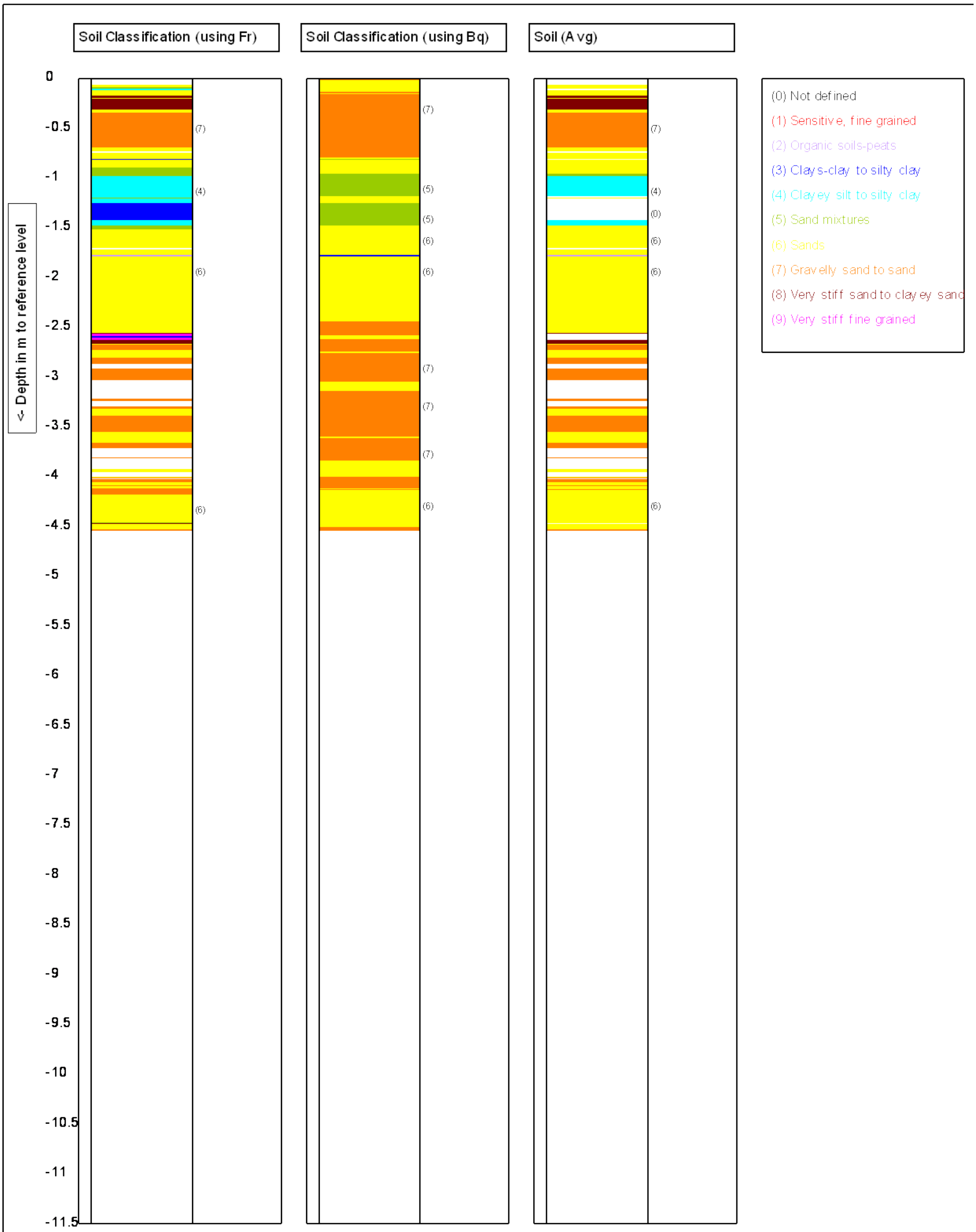
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	15/10/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Westbrooks		Project no.:	Westbrooks
Position:			CPT no.:	2 3/3



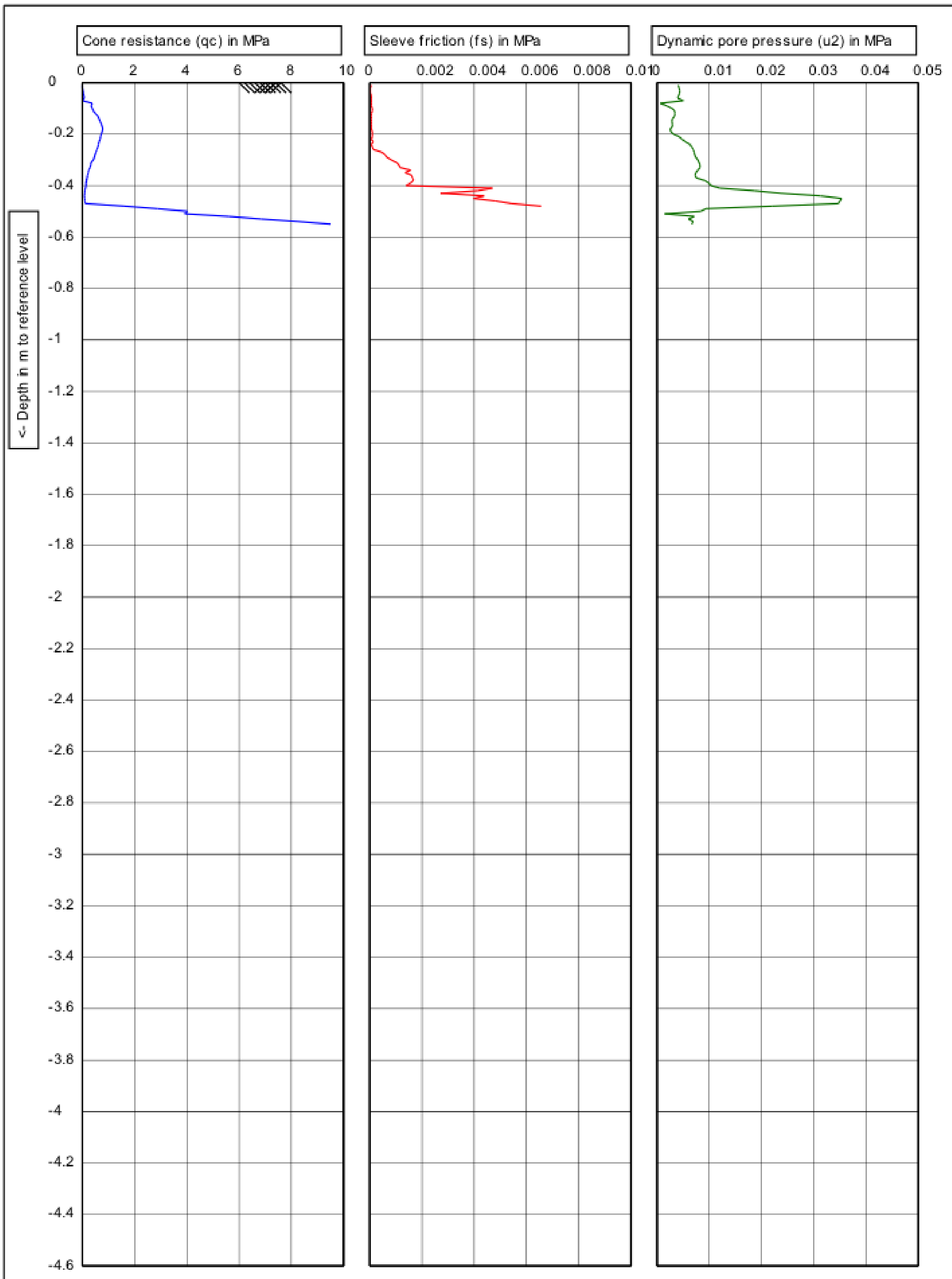
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: a0.5	Date:	15/10/2014
Project:	Project E.1.8	Cone no.:	C10CFIIP.G67
Location:	Westbrooks	Project no.:	Westbrooks
Position:		CPT no.:	3 1/3



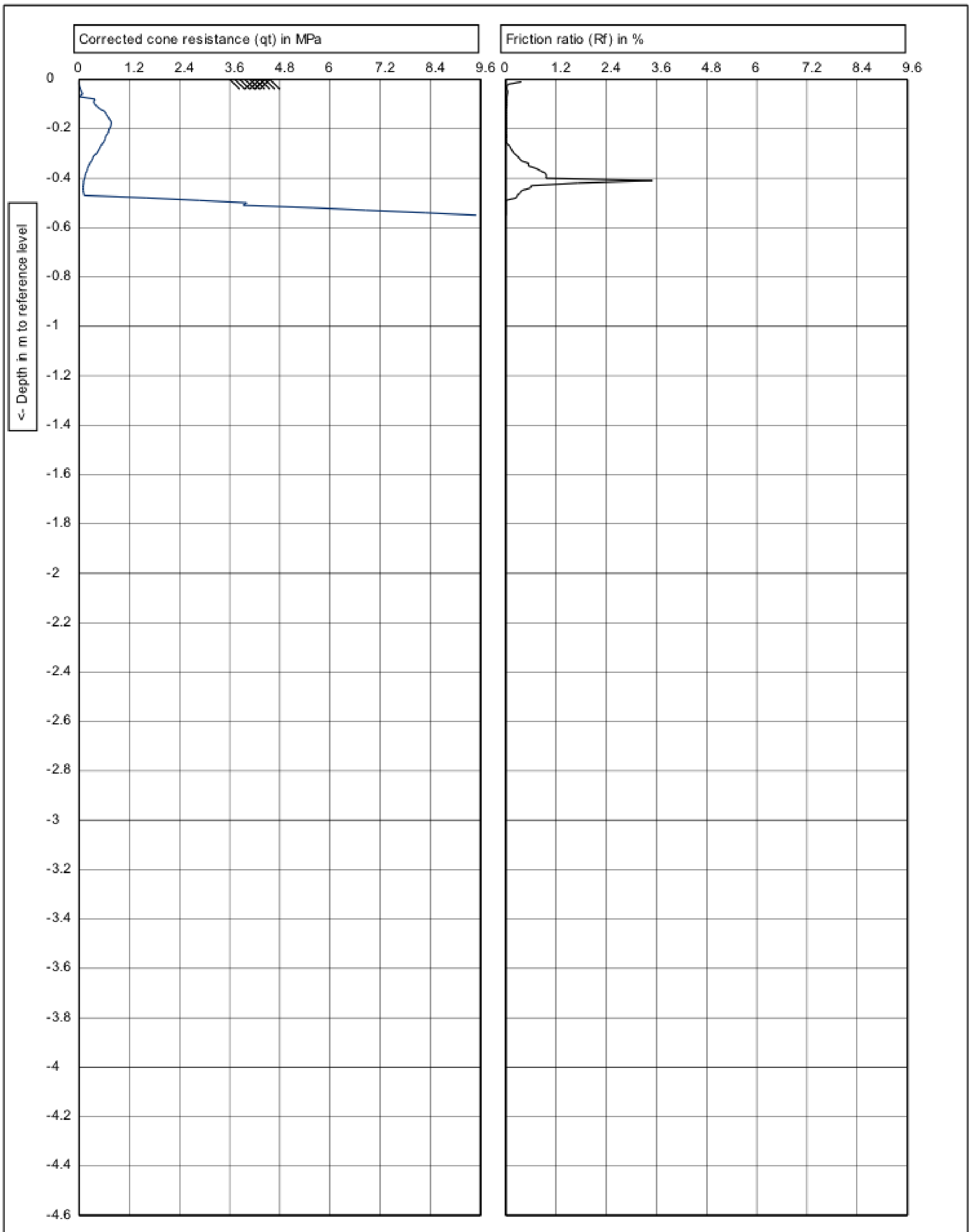
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	15/10/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Westbrooks			Project no.:	Westbrooks
Position:			CPT no.:	3 · 2/3



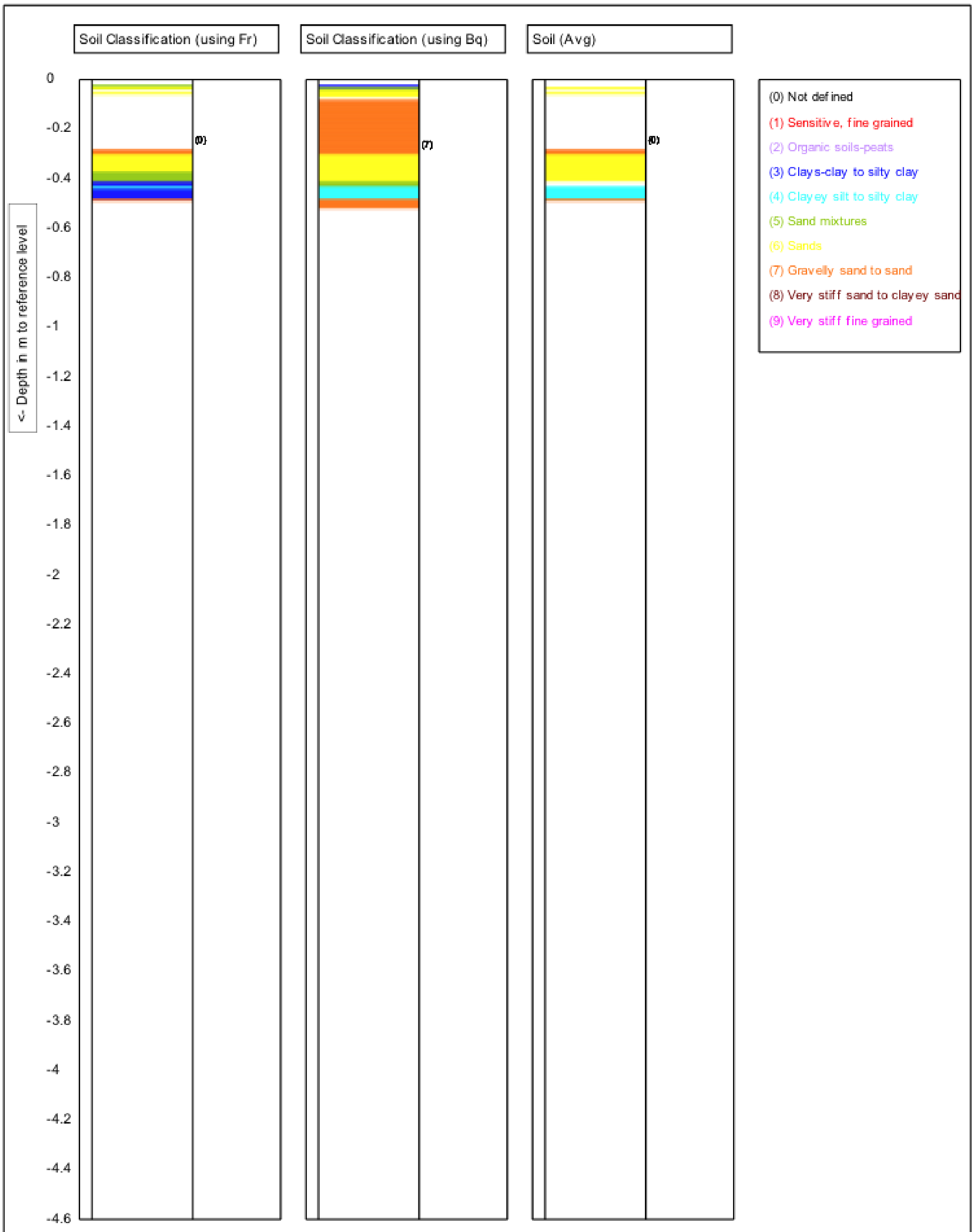
Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP W.L.: a0.5	Date:	15/10/2014
Project: Project E.1.8	Cone no.:	C10CFIIP.G67
Location: Westbrooks	Project no.:	Westbrooks
Position:	CPT no.:	3 3/3



Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP / W.L.: 0.3	Date:	11/02/2014
Project: **LMR0214**	Cone no.:	C10CFIIP.G67
Location: **Westbrooks**	Project no.:	LMR0214_WB
Position:	CPT no.:	1 — 1/3

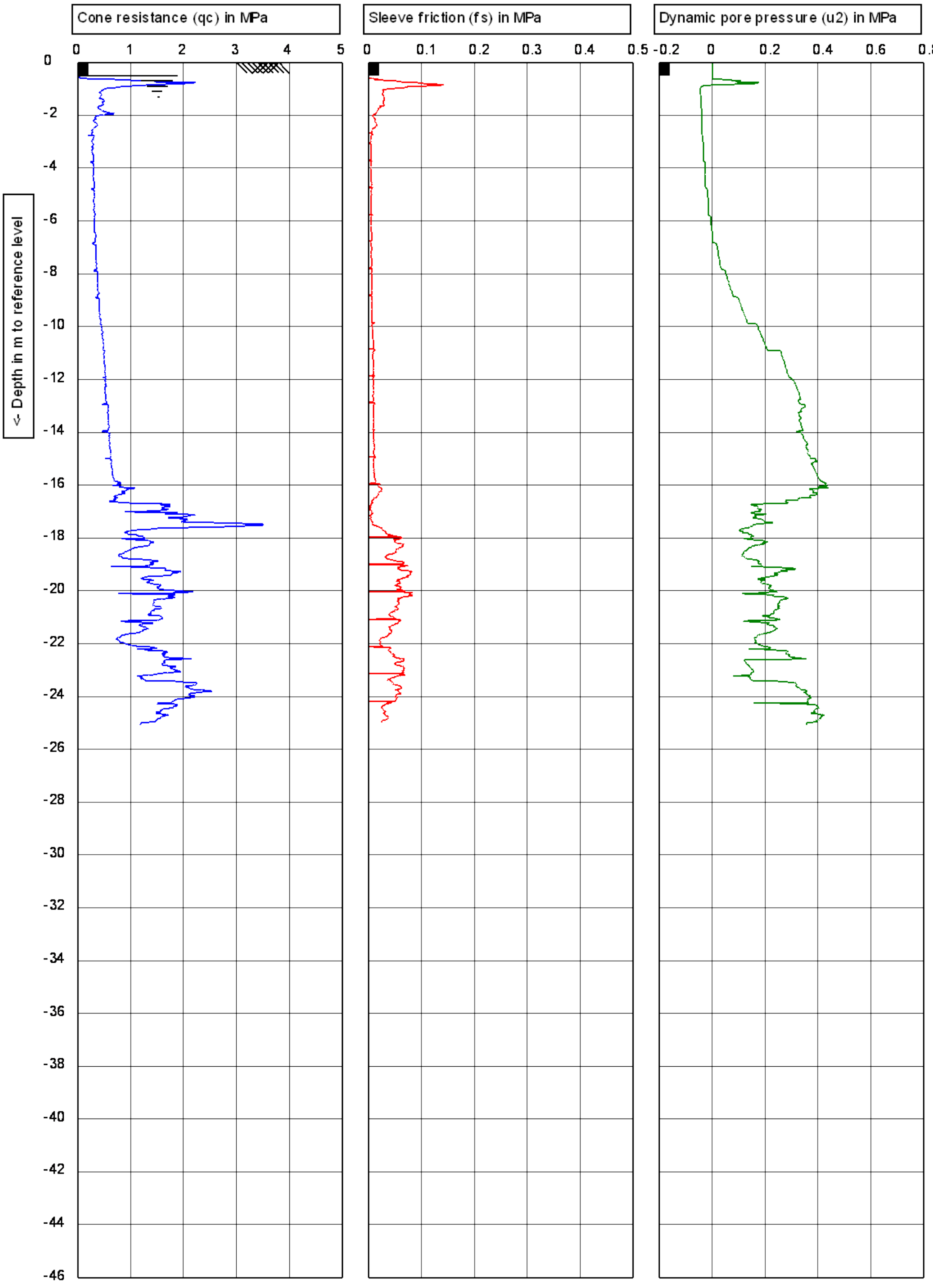


u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: **0.3**	Date:	**11/02/2014**
Project: **LMR0214**		Cone no.:	**C10CFIIP.G67**
Location: **Westbrooks**		Project no.:	**LMR0214_WB**
Position:		CPT no.:	**1** 2/3

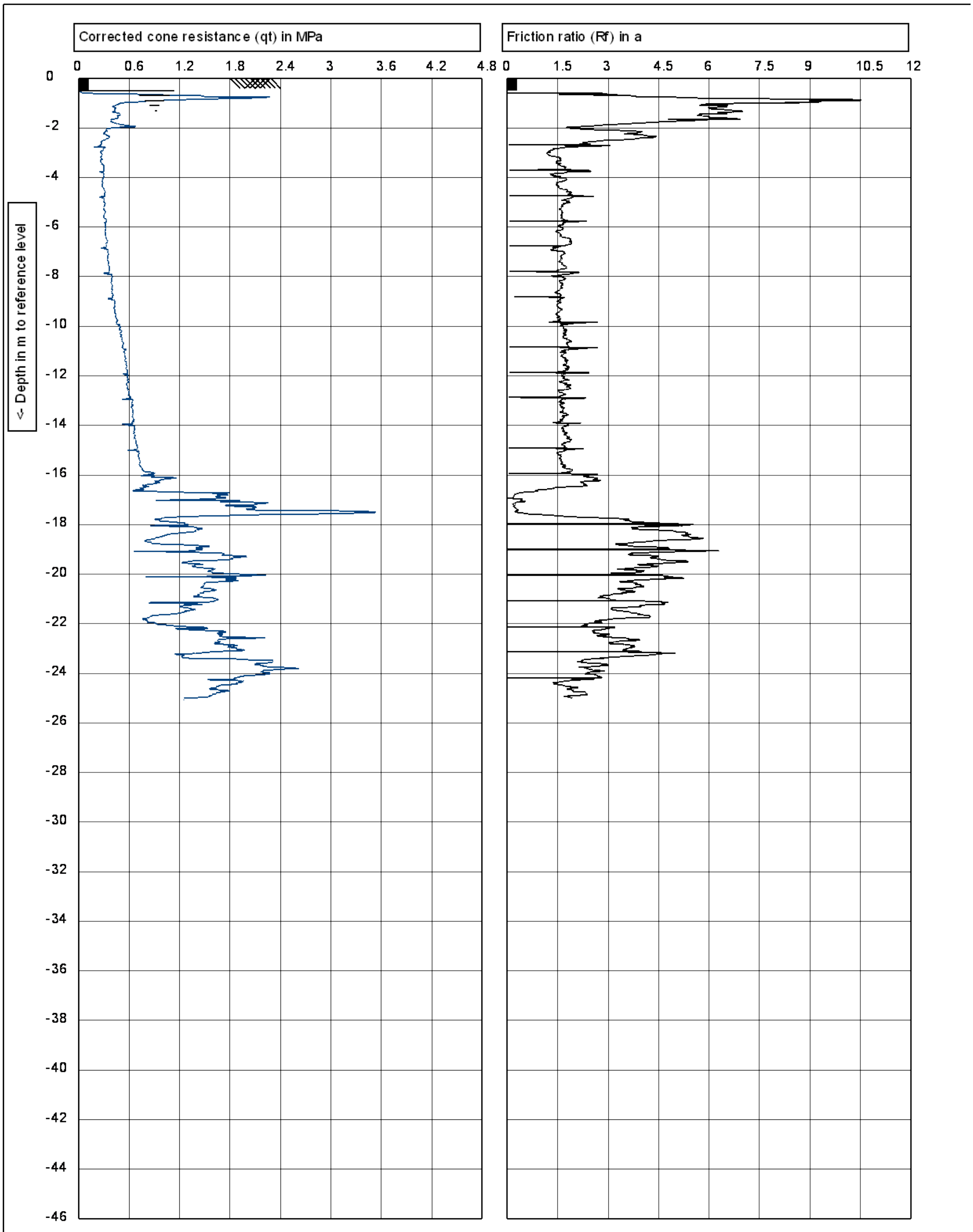


u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	**0 m Predrilled**
	G.L. 0 NAP W.L.: **0.3**	Date:	**11/02/2014**
	Project: **LMR0214**	Cone no.:	**C10CFIIP.G67**
	Location: **Westbrooks**	Project no.:	**LMR0214_WB**
	Position:	CPT no.:	**1** **3/3**

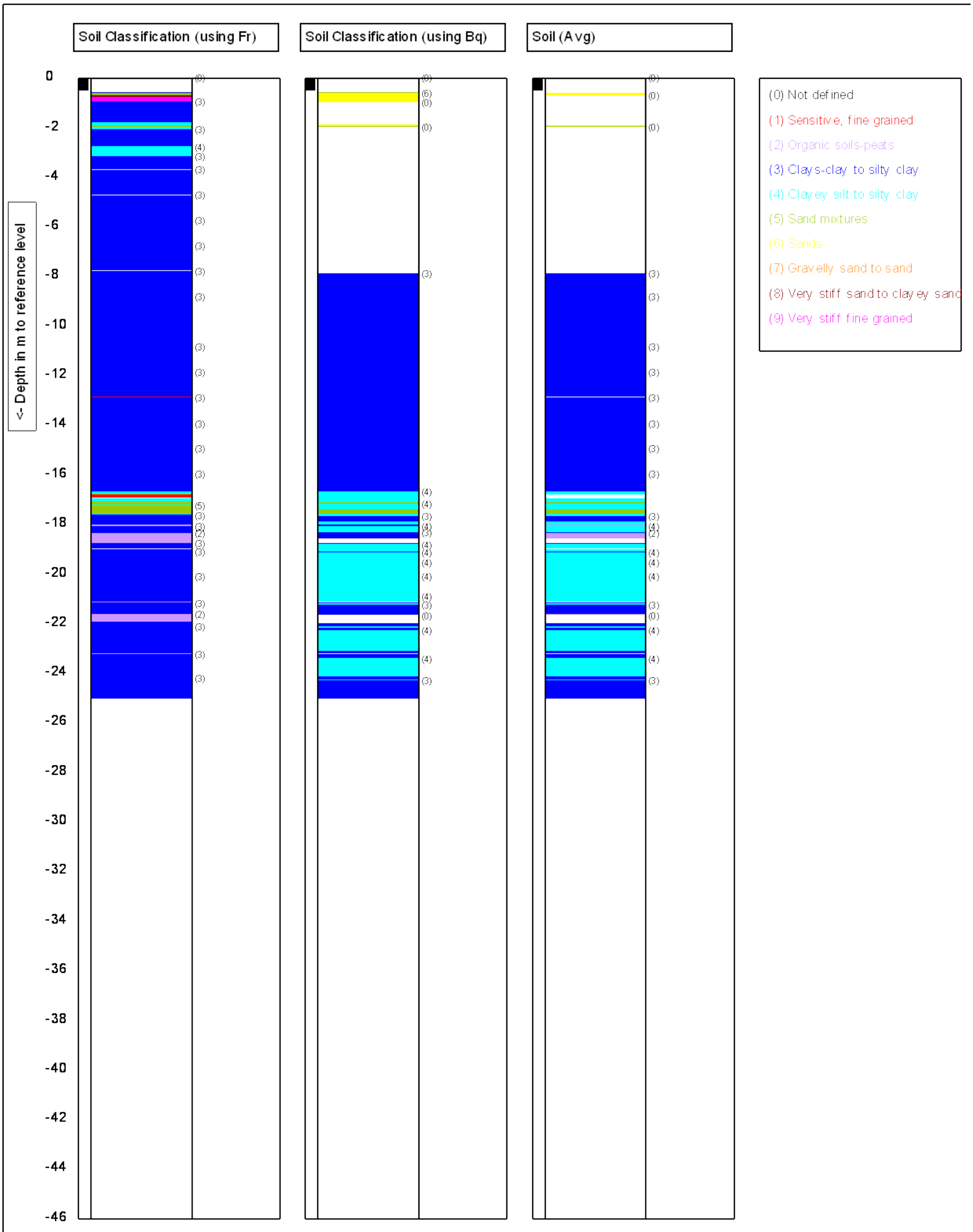
Appendix 7 Bells Landing Reserve, Monteith — Cone Penetration Test Results



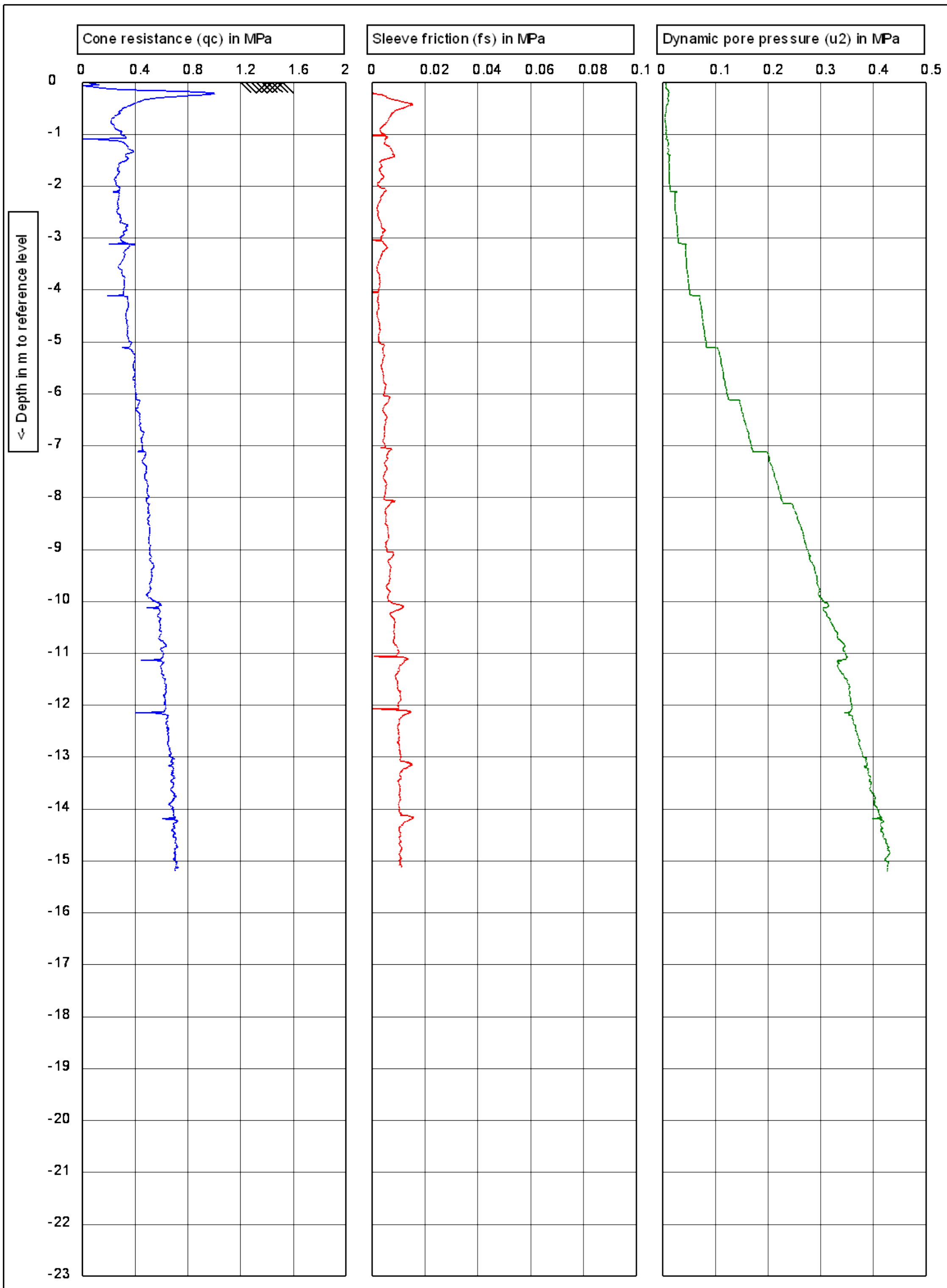
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: -0.5	Date:	23/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G65
Location: Bells Landing Reservea Monteith			Project no.:	Bells Landing ReserveaMo
Position:			CPT no.:	1 — 1/3



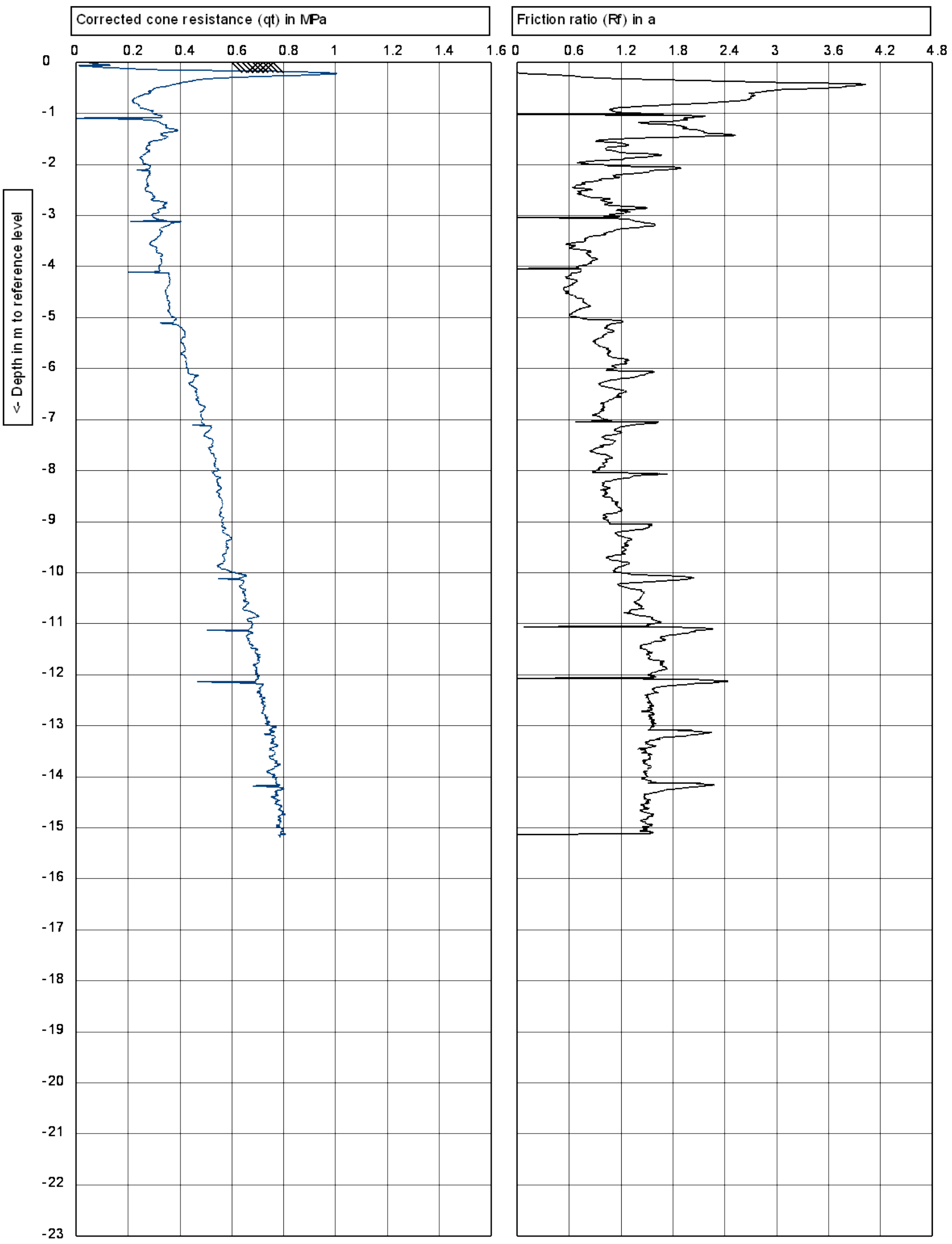
150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: -0.5	Date:	23/07/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G65
Location:	Bells Landing ReserveaMonteith		Project no.:	Bells Landing ReserveaMo
Position:			CPT no.:	1	2/3



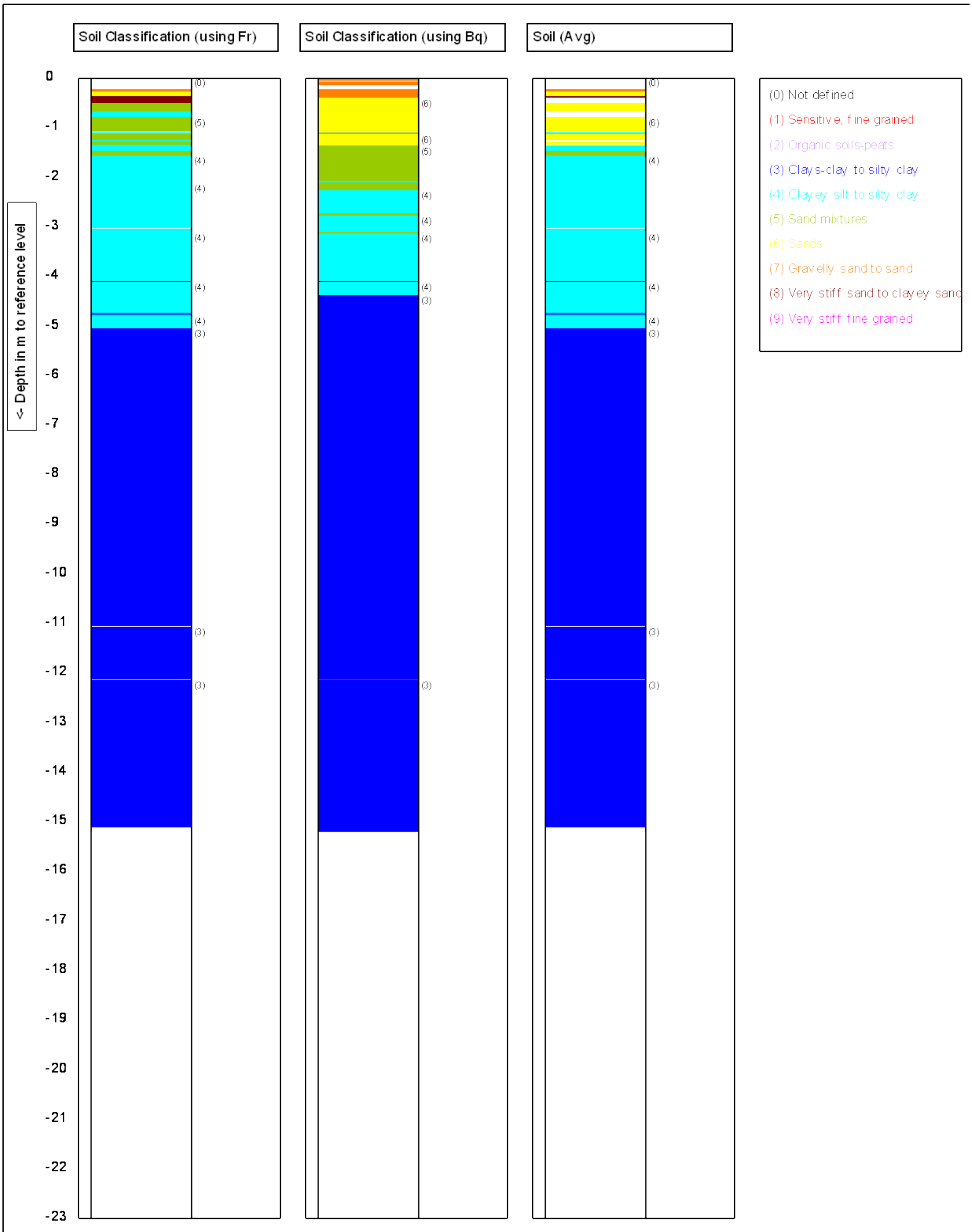
Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: -0.5	Date:	23/07/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G65
Location: Bells Landing ReserveaMonteith		Project no.:	Bells Landing ReserveaMo
Position:		CPT no.:	1 — 3/3



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a7	Date:	4/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: BELLS RESERVE MONTEITH			Project no.:	LMR0214_BR
Position:			CPT no.:	1 1/3



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a7	Date:	4/02/2014
Project:	LMR0214		Cone no.:	C10CFIIPaG67
Location:	BELLS RESERVE MONTEITH		Project no.:	LMR0214_BR
Position:			CPT no.:	1 2/3



Test according NEN 5140 class 1

G.L. 0 NAP W.L.: 0a7

Predrill : 0 m Predrilled

Date: 4/02/2014

Project: LMR0214

Location: BELLS RESERVE MONTEITH

Position:

Cone no.: C10CFIIPaG67

Project no.: LMR0214_BR

CPT no.: 1 3/3

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 1 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 16.6 m	REDUCED LEVEL	: - m
LOCATION	: Bells Landing Reserve, Monteith	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 23 July 2014 DATE FINISHED : 23 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 60 N1 N2 N3 N	Pocket Penetrometer (KPa)	DEPTH (M)
23RD JULY 2014	NIL					SC/CL	Fill: Clayey SAND or Sandy CLAY, top soil with organic matters, vegetation and roots.	D/M					
			23/07/14	0.5									0.5
							U50 sample						
				1.0									1.0
						CH	Silty Clay,	>PL					
						CH	Silty Clay,	>PL					
				1.5									1.5
							U50 sample						
				2.0									2.0
				3			NO SAMPLE RECOVERED						2.5
				3.0									3.0
				4									3.5
				4.0									4.0
				5									4.5
				5.0									5.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

Reported by:

Signature :

Date :

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 2 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 16.6 m	REDUCED LEVEL	: - m
LOCATION	: Bells Landing Reserve, Monteith	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 23 July 2014 DATE FINISHED : 23 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
23RD JULY 2014	NIL			5.5		CH	Silty Clay,	>PL					5.5
				6.0									6.0
				6.5									6.5
				7.0									7.0
				7.5									7.5
							NO SAMPLE RECOVERED						
				8.0									8.0
				8.5									8.5
				9.0									9.0
				9.5									9.5
				10.0									10.0

BORING RESISTANCE:
L : LOW RESISTANCE
M : MEDIUM RESISTANCE
H : HIGH RESISTANCE
R : REFUSAL

SAMPLE CODE:
UN-DISTURBED SAMPLE
DISTURBED SAMPLE
STANDARD PENETRATION TEST (SPT)
PREDRILL

GROUND WATER CONDITION:
WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
D : DRY
M : MOIST
W : WET
<<PL : MUCH LESS THAN PLASTIC LIMIT
<PL : LESS THAN PLASTIC LIMIT
~PL : APPROX. PLASTIC LIMIT
>PL : GREATER THAN PLASTIC LIMIT
>>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
VS : VERY SOFT (0 - 25 kPa)
S : SOFT (25 - 50 kPa)
F : FIRM (50 - 100 kPa)
St : STIFF (100 - 200 kPa)
VSt : VERY STIFF (200 - 400 kPa)
H : HARD (> 400 kPa)
Fb : FRIABLE (unable to test)
VL : VERY LOOSE
L : LOOSE
MD : MEDIUM DENSE
D : DENSE
VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

Reported by:

Signature : ____________________
Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 3 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 16.6 m	REDUCED LEVEL	: - m
LOCATION	: Bells Landing Reserve, Monteith	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 23 July 2014 DATE FINISHED : 23 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
23RD JULY 2014	NIL			10.5 – 13.4	Predrill		NO SAMPLE RECOVERED						10.5, 11.0, 11.5, 12.0, 12.5, 13.0
				13.4 – 14.0	Un-disturbed sample	CH	Silty Clay,	>PL					13.5, 14.0
				14.0 – 14.3	Predrill		NO SAMPLE RECOVERED						
				14.3 – 14.8	Un-disturbed sample	CH	Silty Clay,	>PL					14.5
				15.0									15.0

BORING RESISTANCE:

L : LOW RESISTANCE
M : MEDIUM RESISTANCE
H : HIGH RESISTANCE
R : REFUSAL

SAMPLE CODE:

UN-DISTURBED SAMPLE
DISTURBED SAMPLE
STANDARD PENETRATION TEST (SPT)
PREDRILL

GROUND WATER CONDITION:

WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:

D : DRY
M : MOIST
W : WET
<<PL : MUCH LESS THAN PLASTIC LIMIT
<PL : LESS THAN PLASTIC LIMIT
~PL : APPROX. PLASTIC LIMIT
>PL : GREATER THAN PLASTIC LIMIT
>>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:

VS : VERY SOFT (0 - 25 kPa)
S : SOFT (25 - 50 kPa)
F : FIRM (50 - 100 kPa)
St : STIFF (100 - 200 kPa)
VSt : VERY STIFF (200 - 400 kPa)
H : HARD (> 400 kPa)
Fb : FRIABLE (unable to test)
VL : VERY LOOSE
L : LOOSE
MD : MEDIUM DENSE
D : DENSE
VD : VERY DENSE

THE UNIVERSITY of ADELAIDE

Reported by:

Signature :
Date :

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 4 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 16.6 m	REDUCED LEVEL	: - m
LOCATION	: Bells Landing Reserve, Monteith	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 23 July 2014 DATE FINISHED : 23 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
23RD JULY 2014	NIL					CH	Silty Clay,	>PL					
				15.5		CH	Silty Clay,	>PL					15.5
				16.0		CH	Silty Clay,	>PL					16.0
				16.5		CH	Silty Clay,	>PL					16.5
							Borehole terminated at 16.6 m.						
				17.0									17.0
				17.5									17.5
				18.0									18.0
				18.5									18.5
				19.0									19.0
				19.5									19.5
				20.0									20.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

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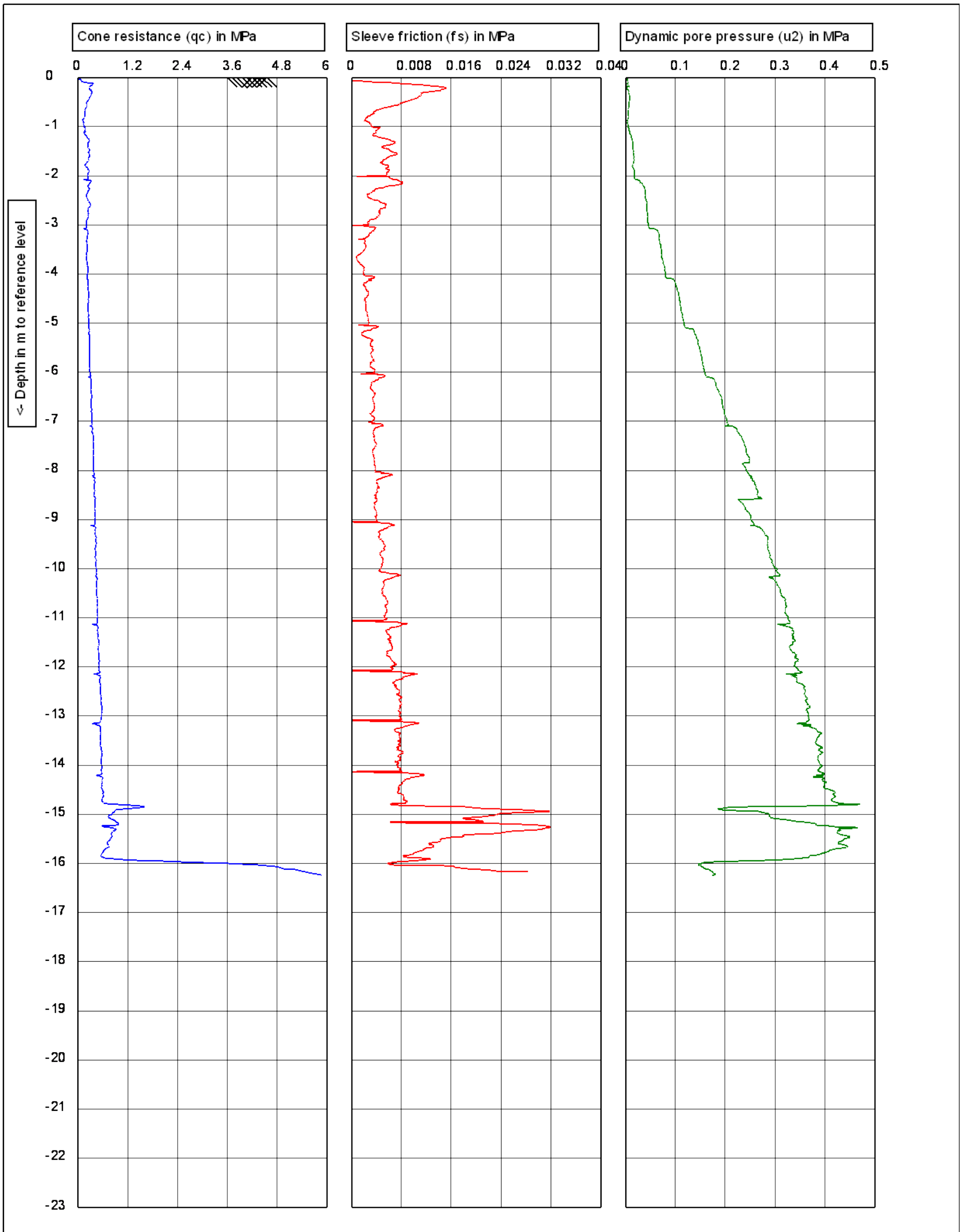
Reported by:

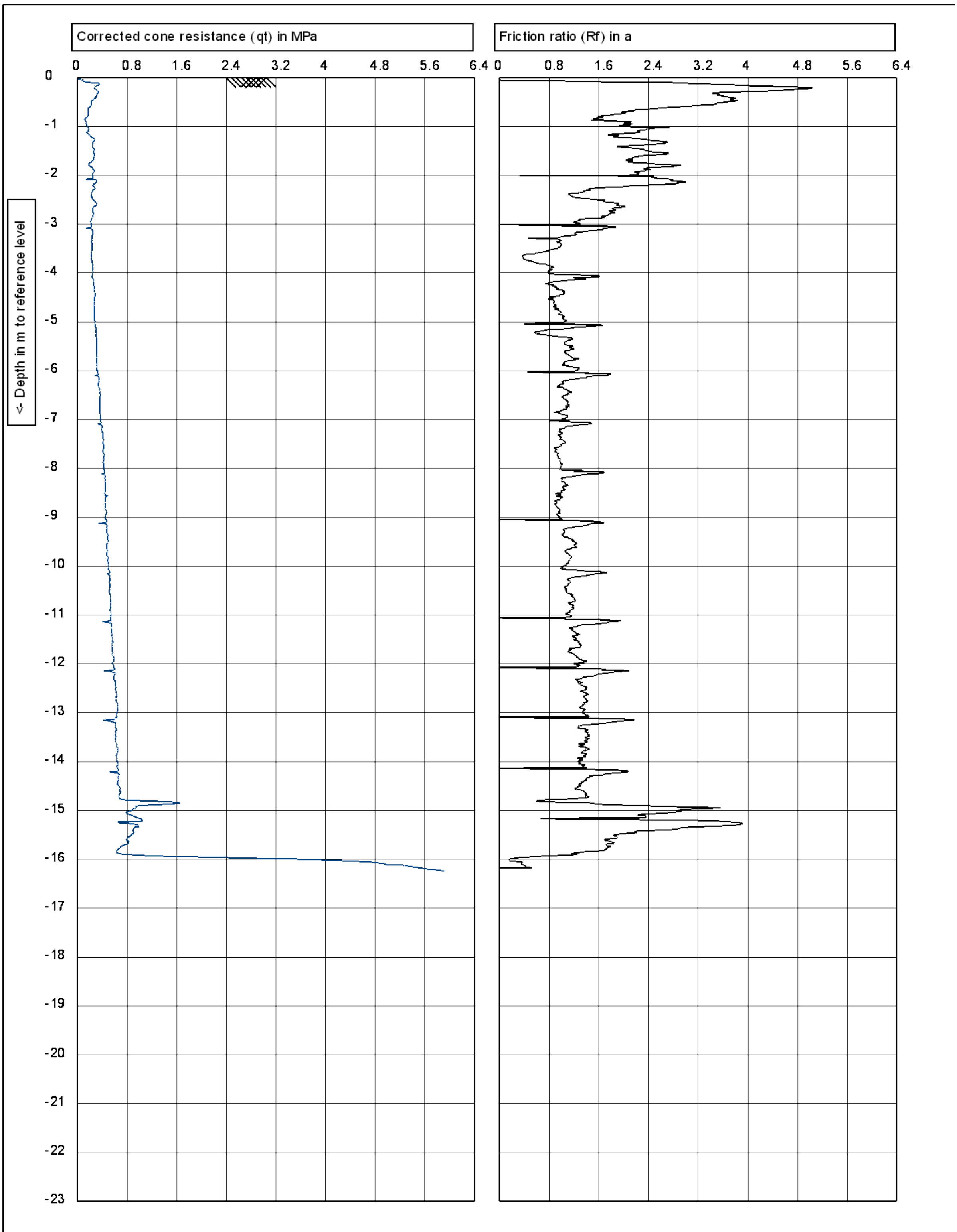
Signature : ____________________

Date : ____________________

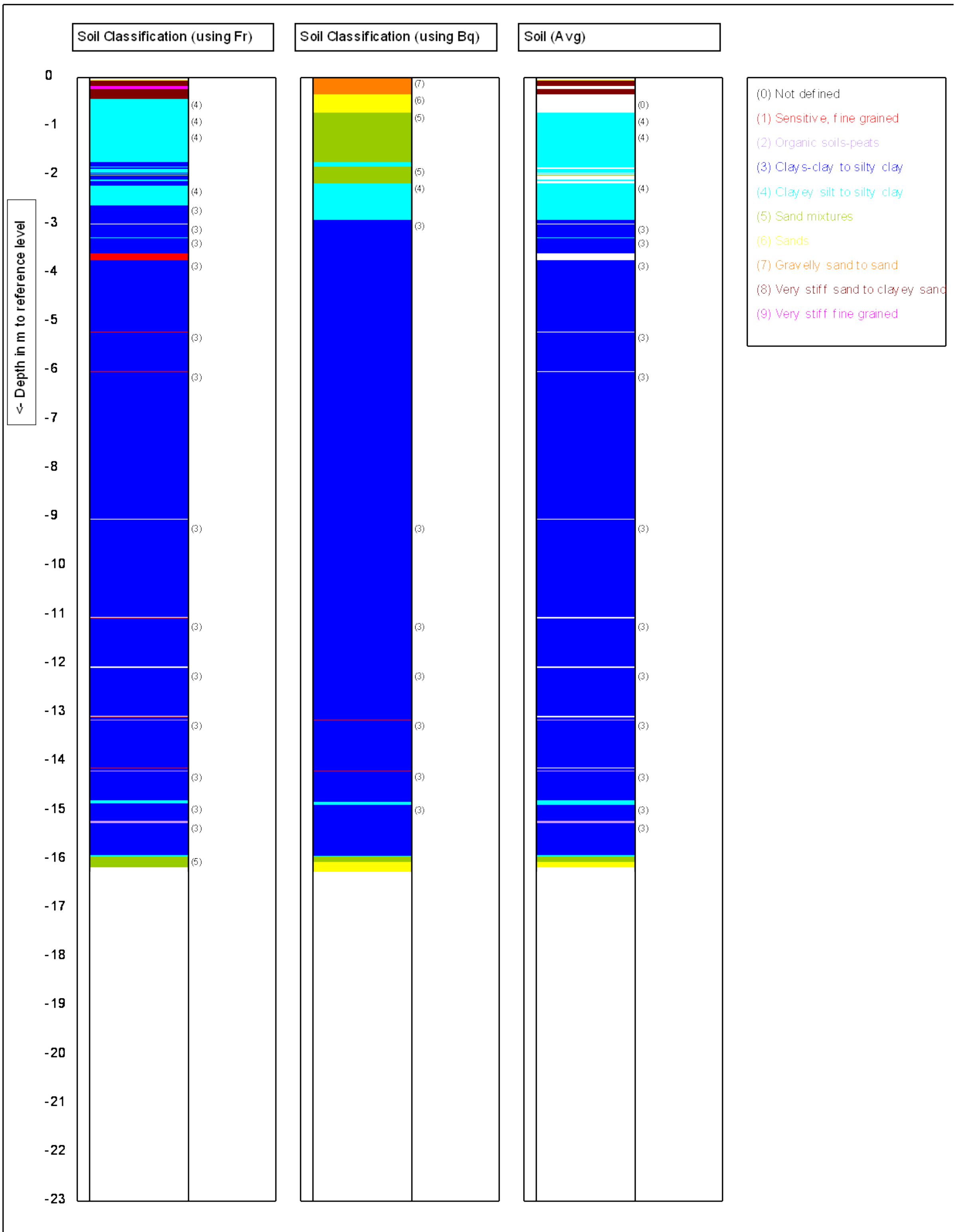
Appendix 8 Murray Bridge West — Cone Penetration Test Results



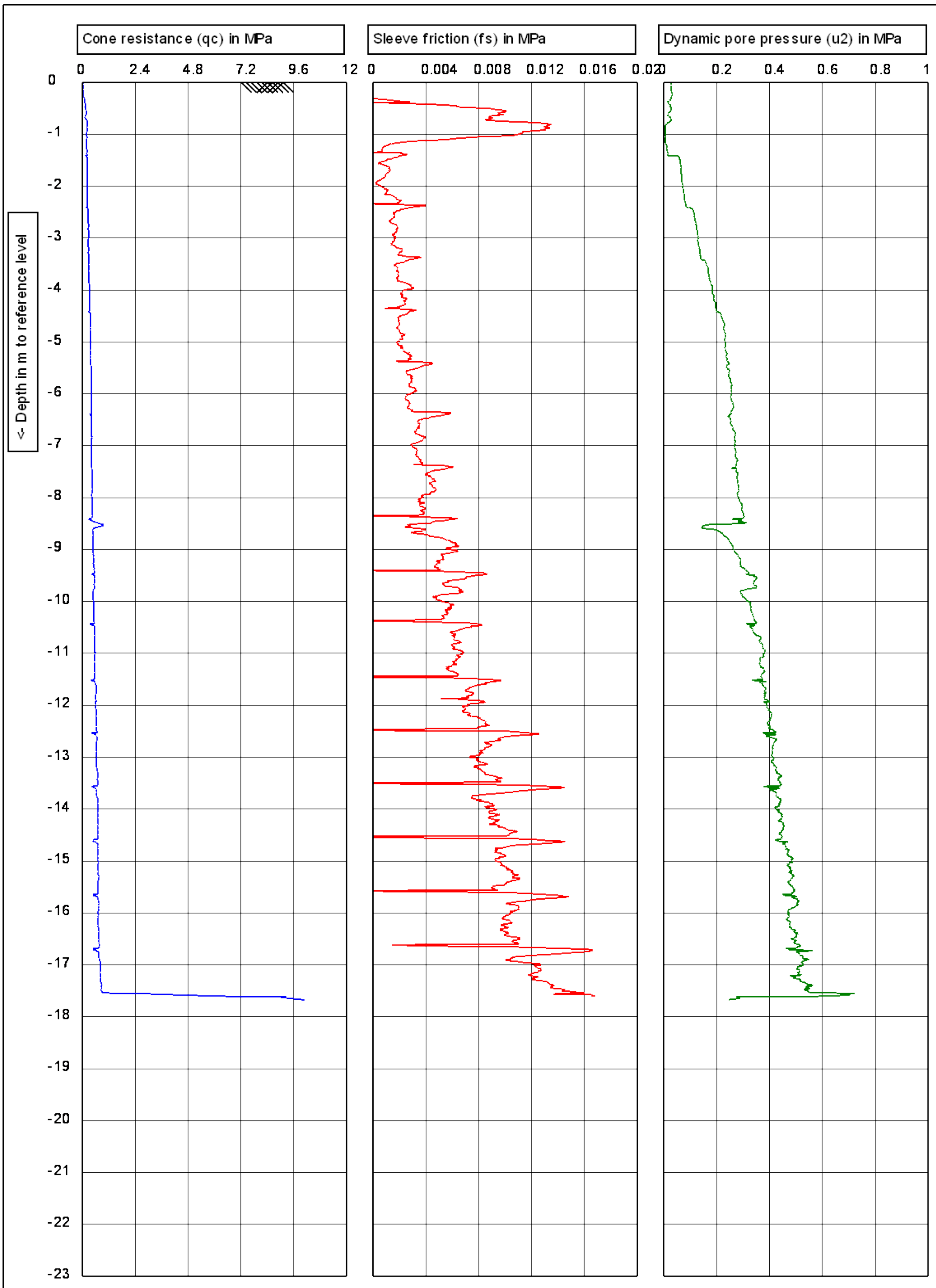
u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: 0a4	Date:	11/02/2014
Project:	LMR0214	Cone no.:	C10CFIIPaG67
Location:	LONG ISLAND MARINA	Project no.:	LMR0214_LIM
Position:		CPT no.:	1 1/3



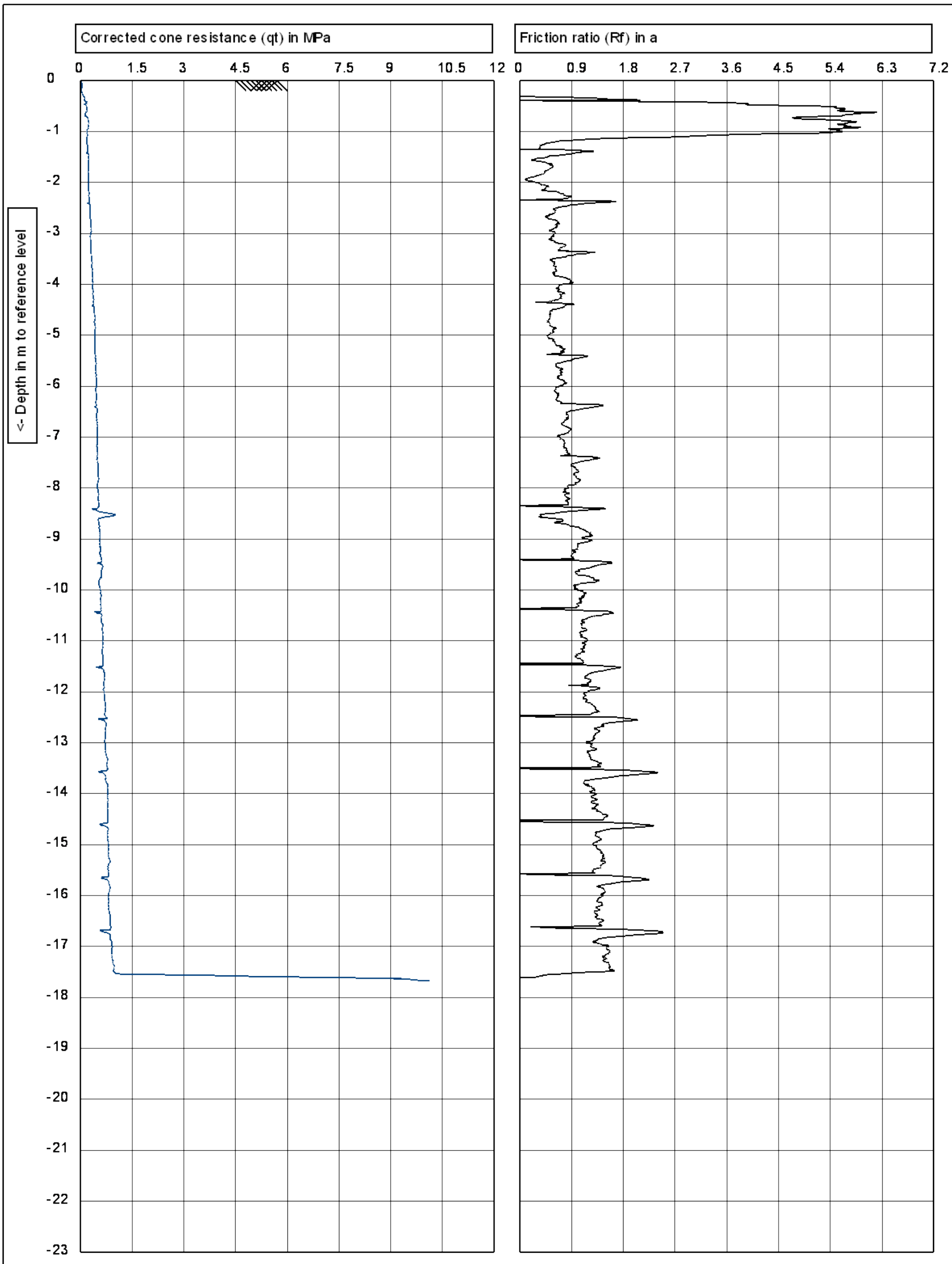
ru2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: LONG ISLAND MARINA			Project no.:	LMR0214_LIM
Position:			CPT no.:	1 2/3



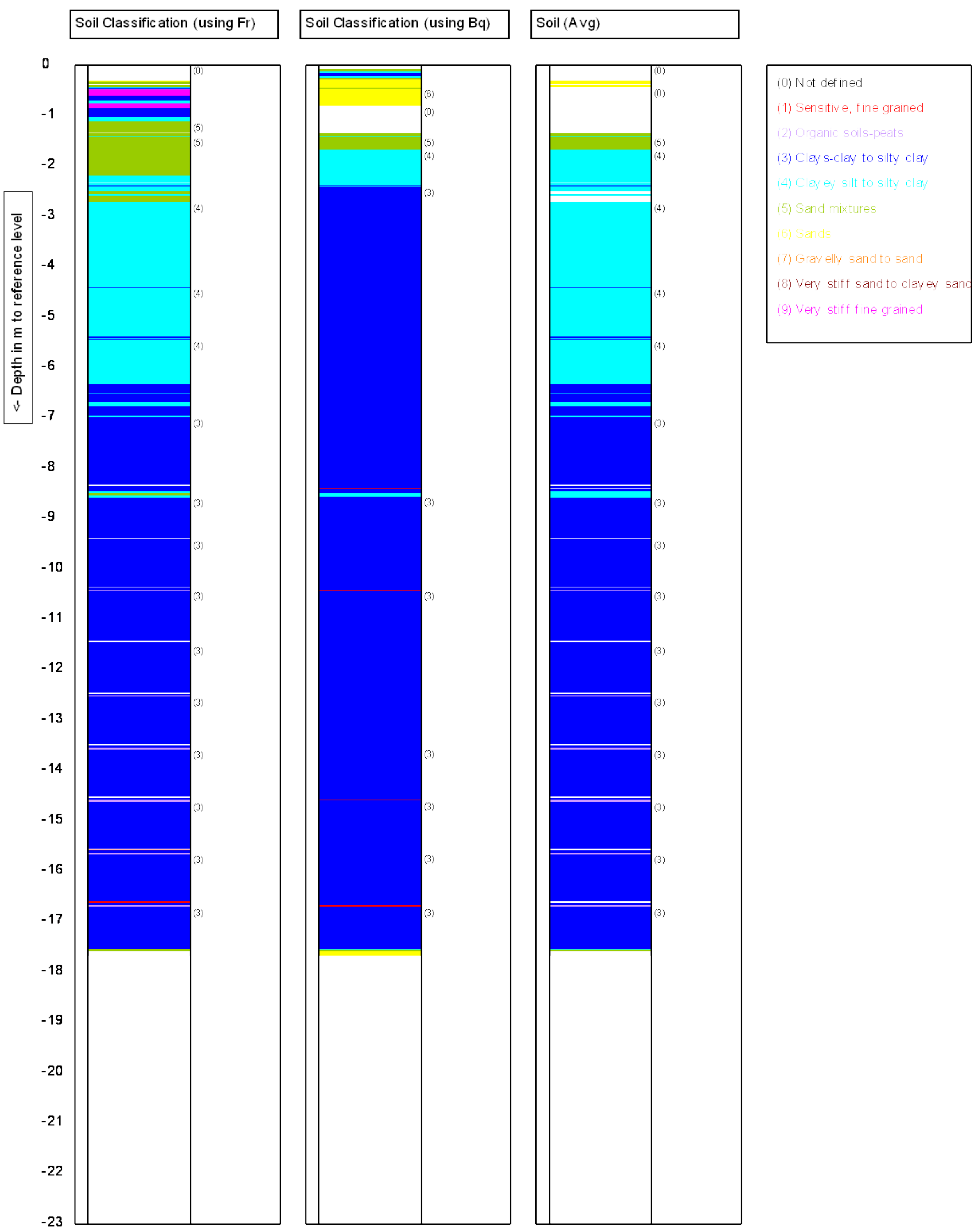
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: LONG ISLAND MARINA			Project no.:	LMR0214_LIM
Position:			CPT no.:	1 3/3



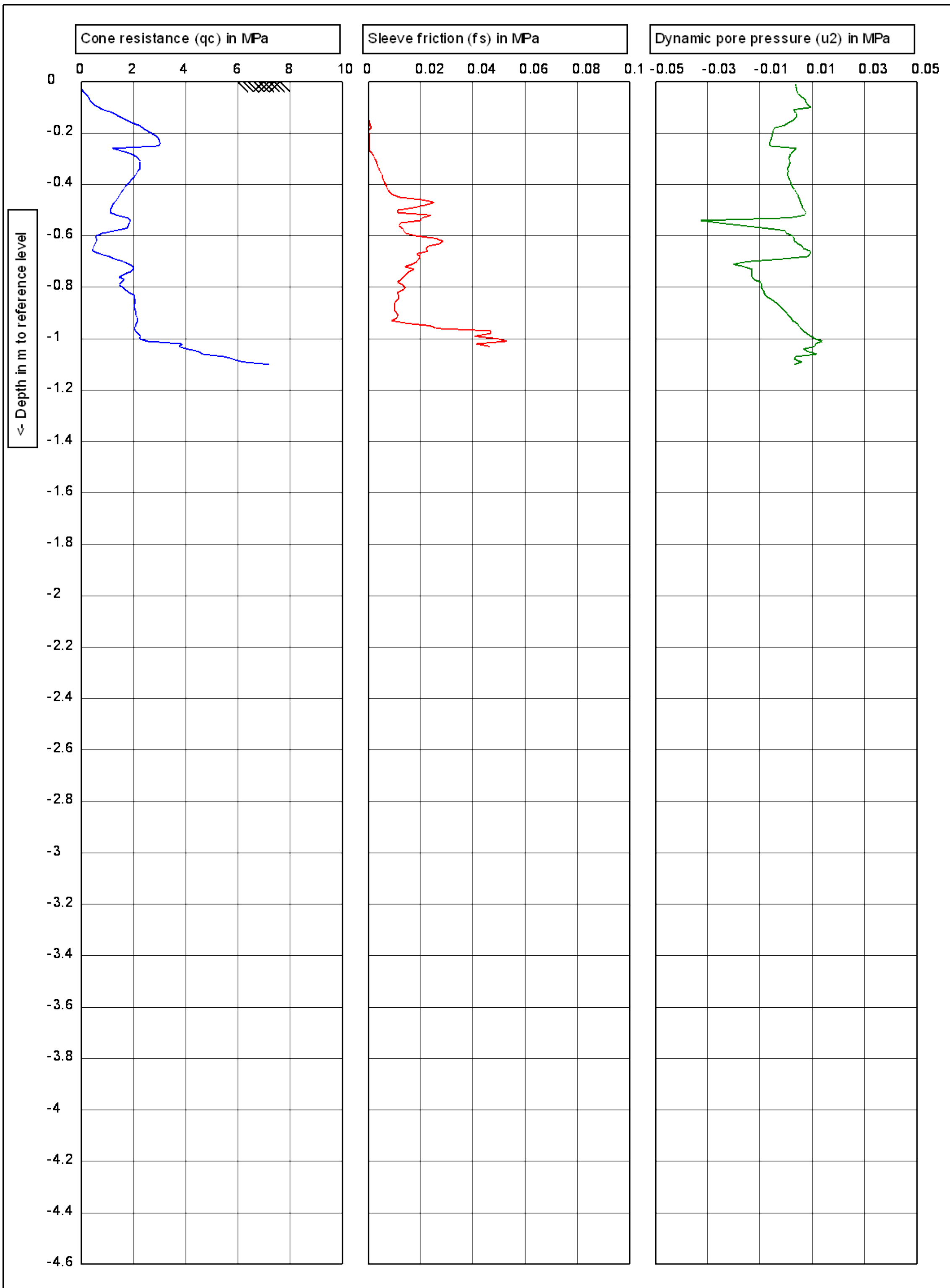
u2, 150 cm², 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a9	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: LONG ISLAND MARINA			Project no.:	LMR0214_LIM
Position:			CPT no.:	2 — 1/3



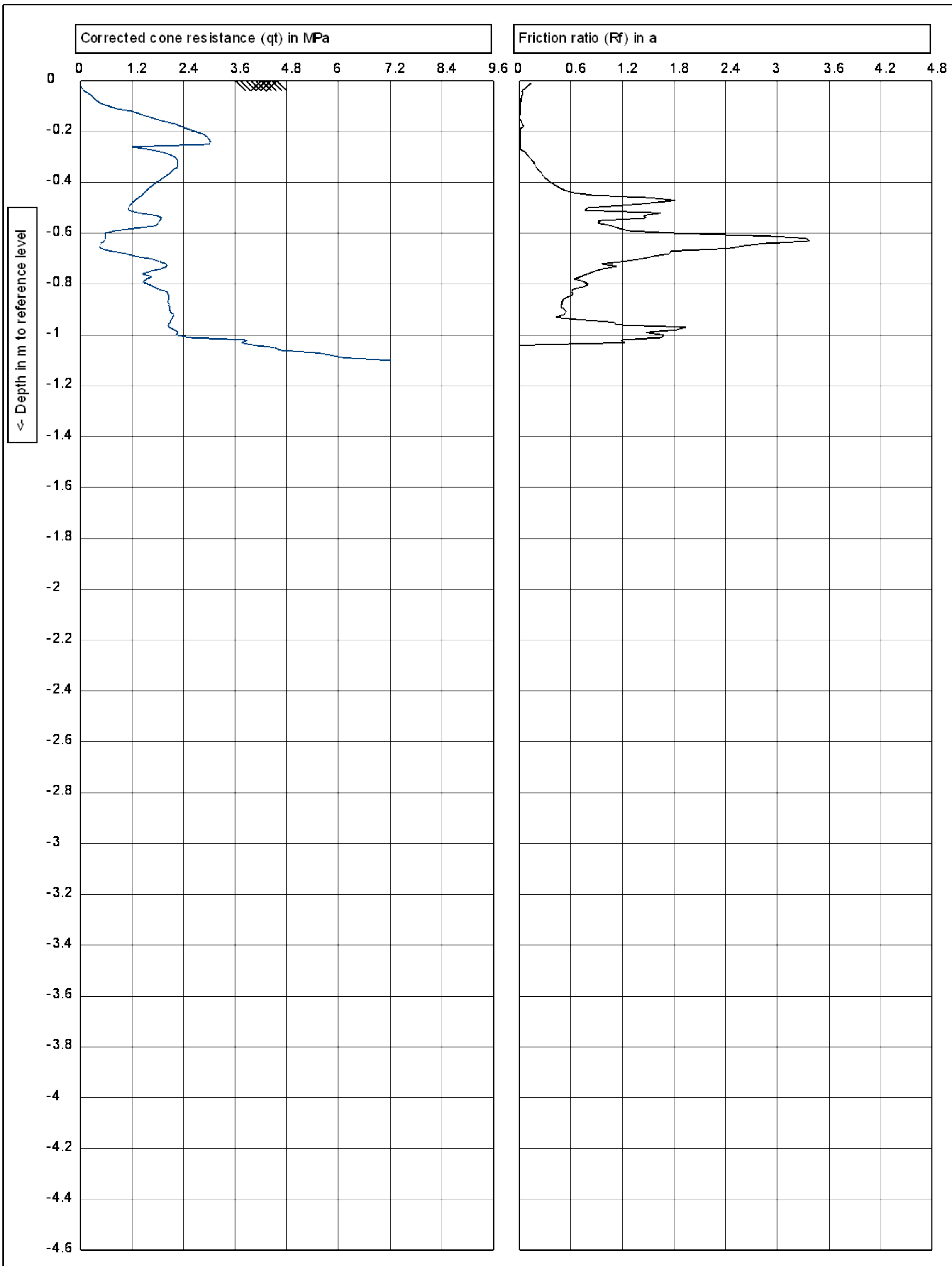
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a9	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: LONG ISLAND MARINA			Project no.:	LMR0214_LIM
Position:			CPT no.:	2 — 2/3



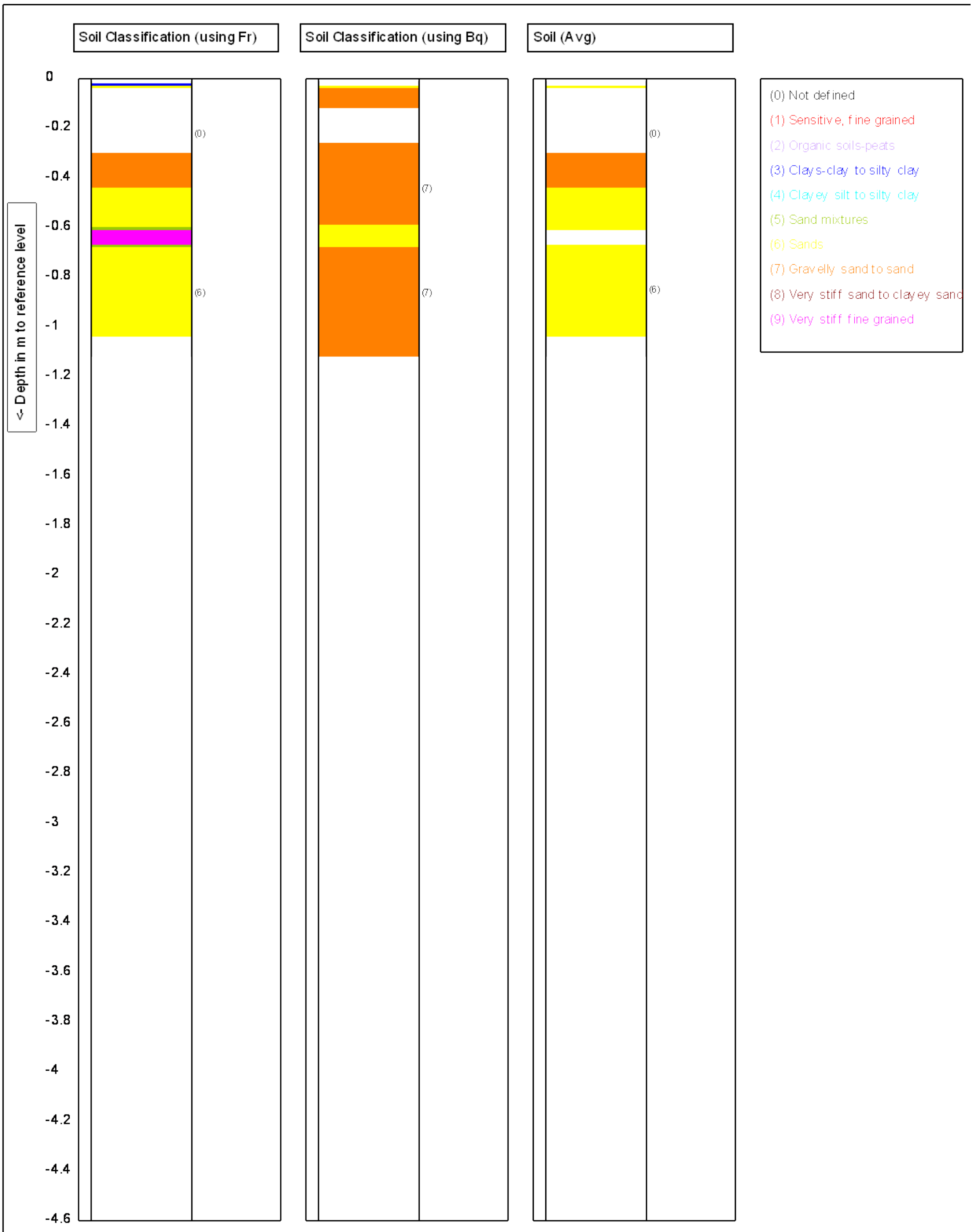
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a9	Date:	11/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: LONG ISLAND MARINA			Project no.:	LMR0214_LIM
Position:			CPT no.:	2 3/3



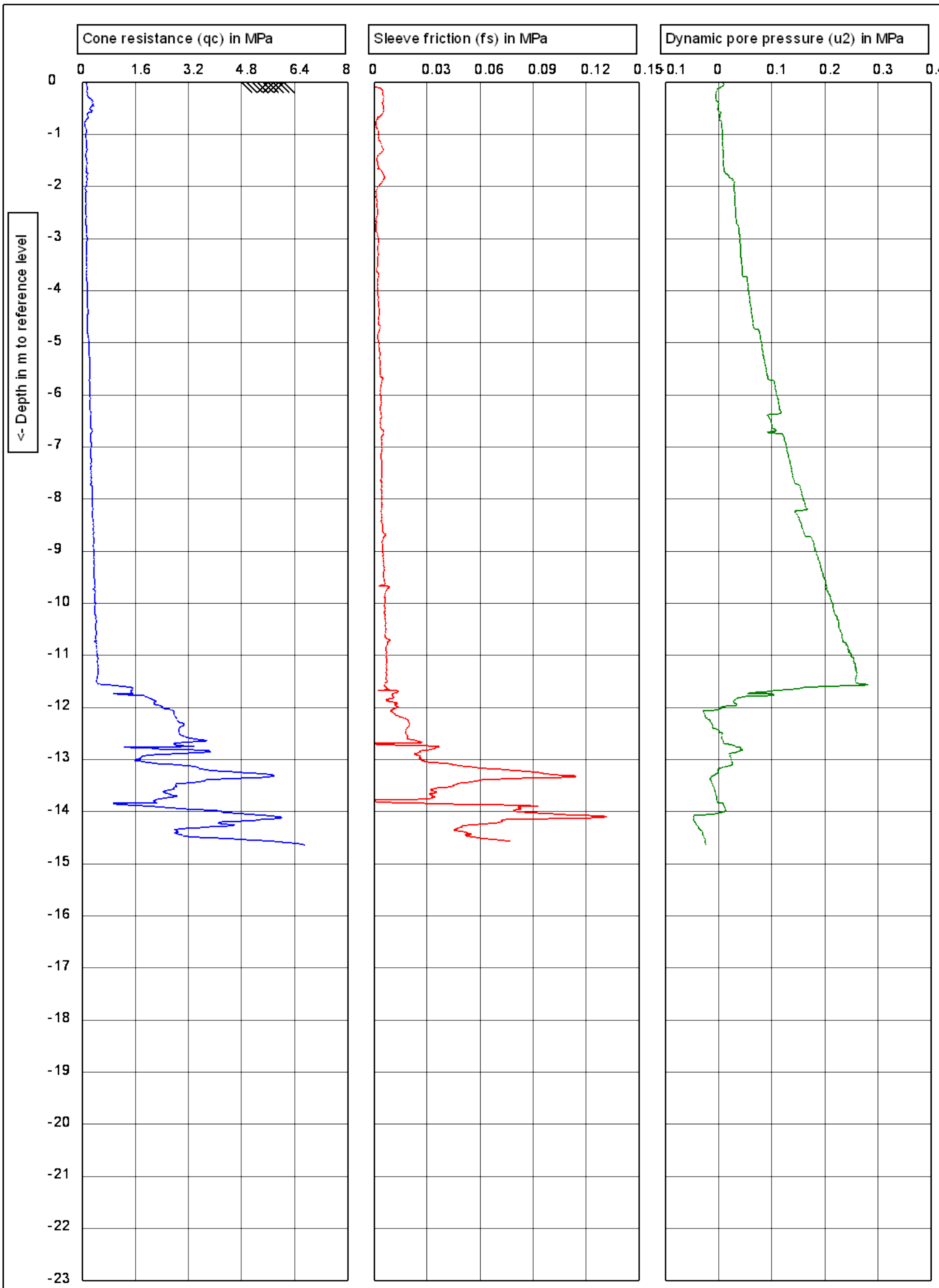
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	5/02/2014
Project:	LMR0214		Cone no.:	C10CFIIPaG67
Location:	STURT RESERVE MURRAY BRIDGE		Project no.:	LMR0214_SR
Position:			CPT no.:	1 — 1/3



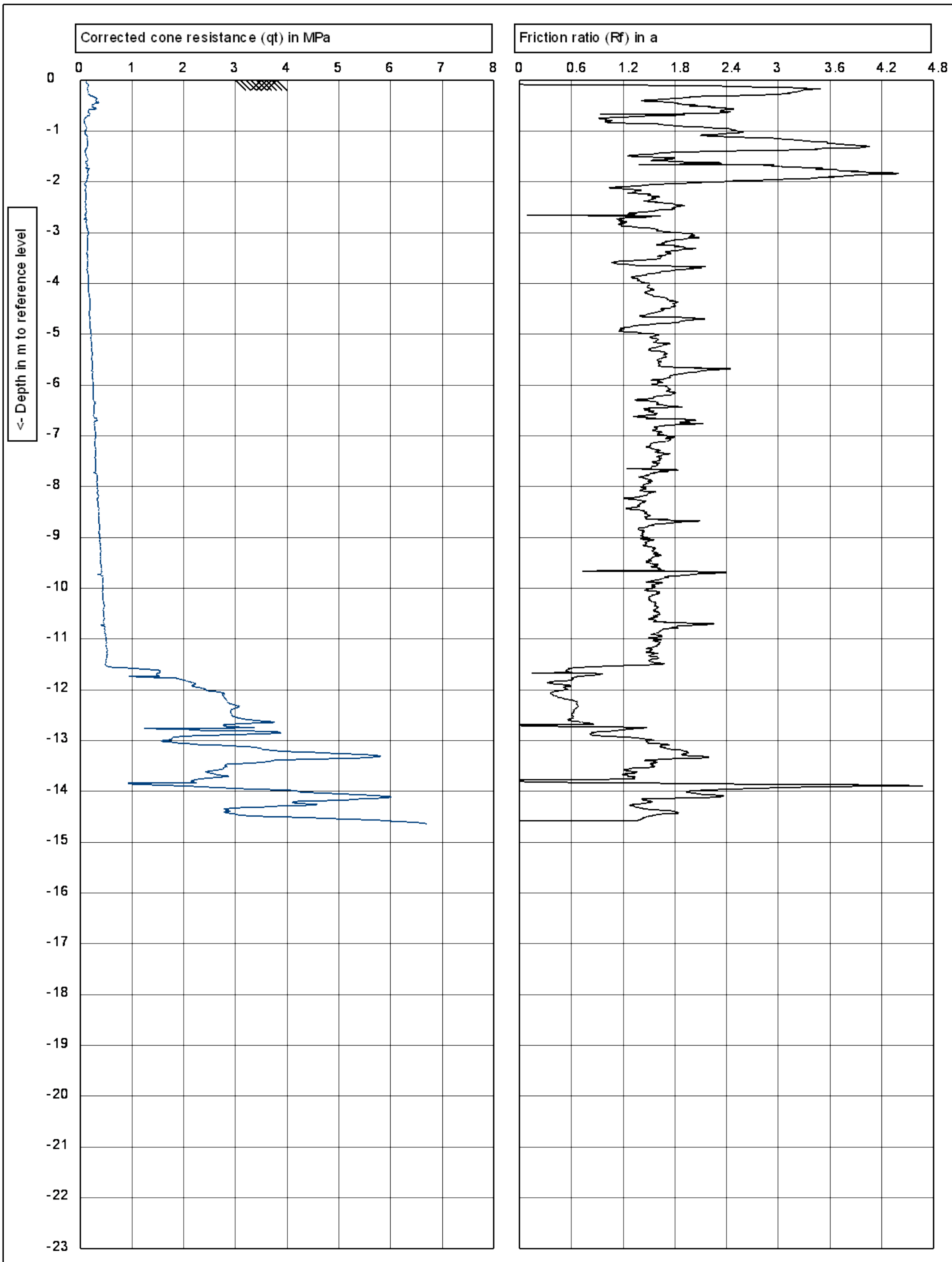
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	5/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: STURT RESERVE MURRAY BRIDGE			Project no.:	LMR0214_SR
Position:			CPT no.:	1 2/3



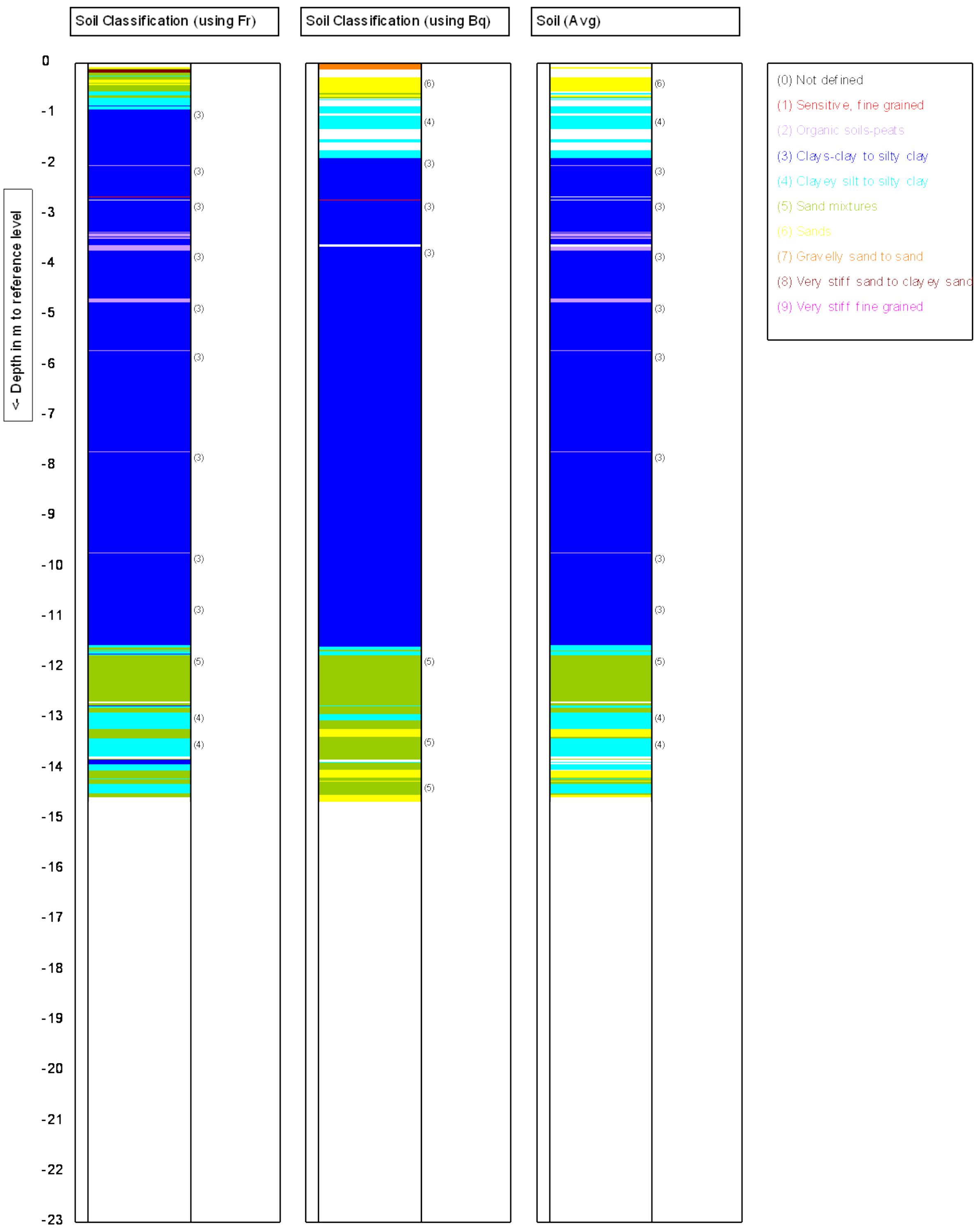
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	5/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: STURT RESERVE MURRAY BRIDGE			Project no.:	LMR0214_SR
Position:			CPT no.:	1 3/3



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	22/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Long Island			Project no.:	LMR0314
Position:			CPT no.:	1	1/3

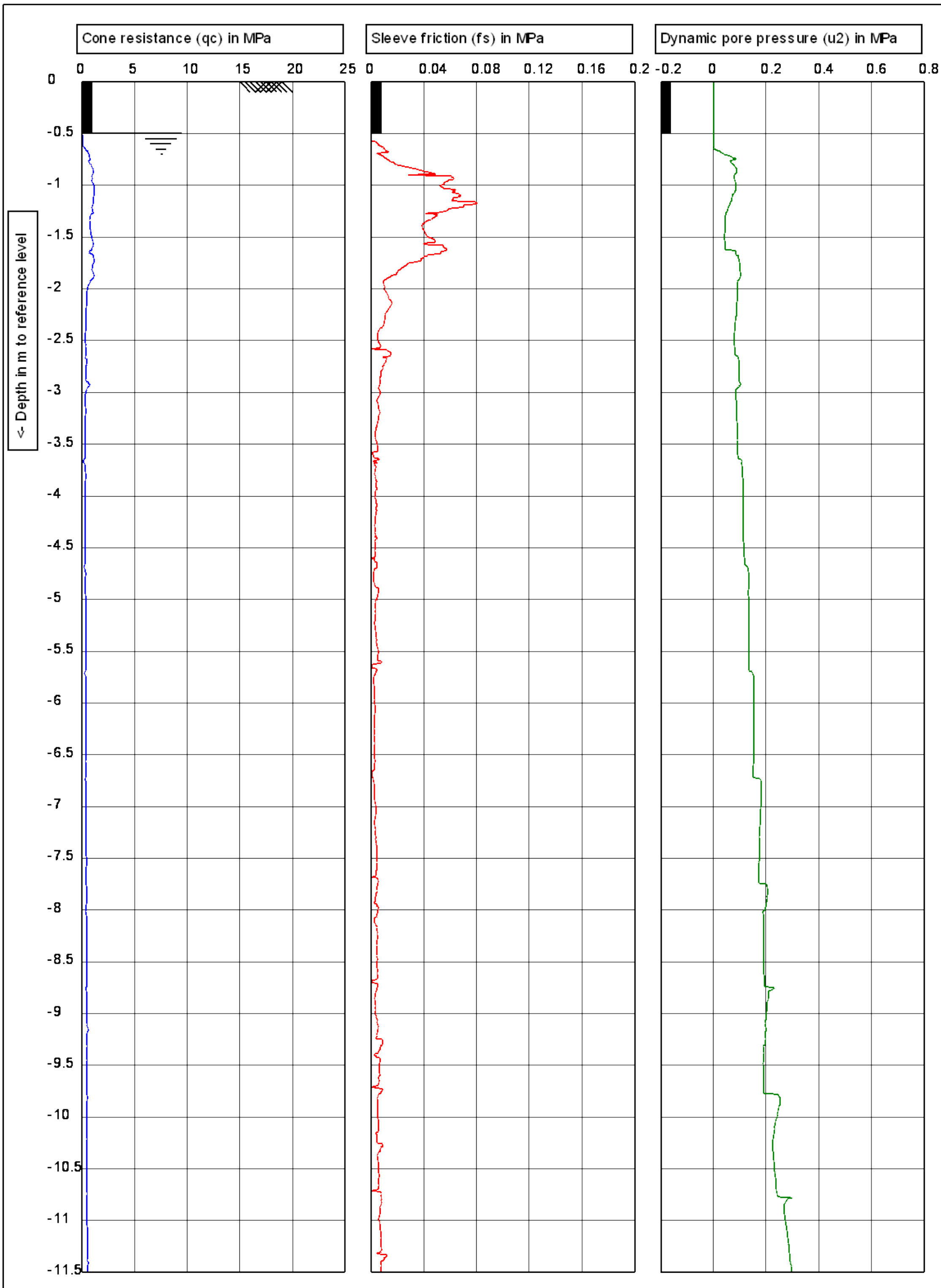


u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0á6	Date:	22/03/2014
Project: LMR0314			Cone no.:	C10CFIIPáG67
Location: Long Island			Project no.:	LMR0314
Position:			CPT no.:	1 2/3

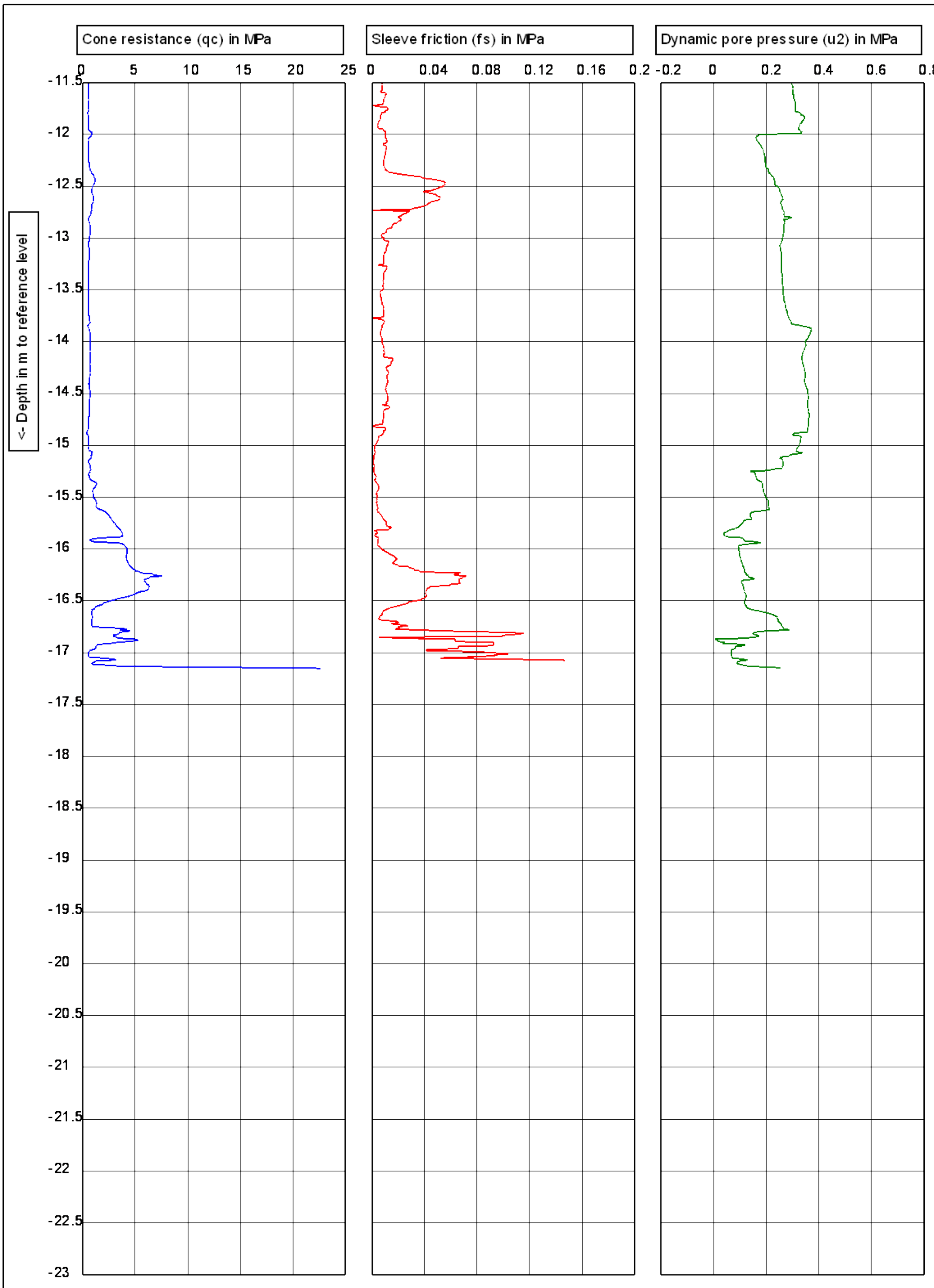


150 cm² / 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	22/03/2014
Project:	LMR0314		Cone no.:	C10CFIIPaG67
Location:	Long Island		Project no.:	LMR0314
Position:			CPT no.:	1 3/3

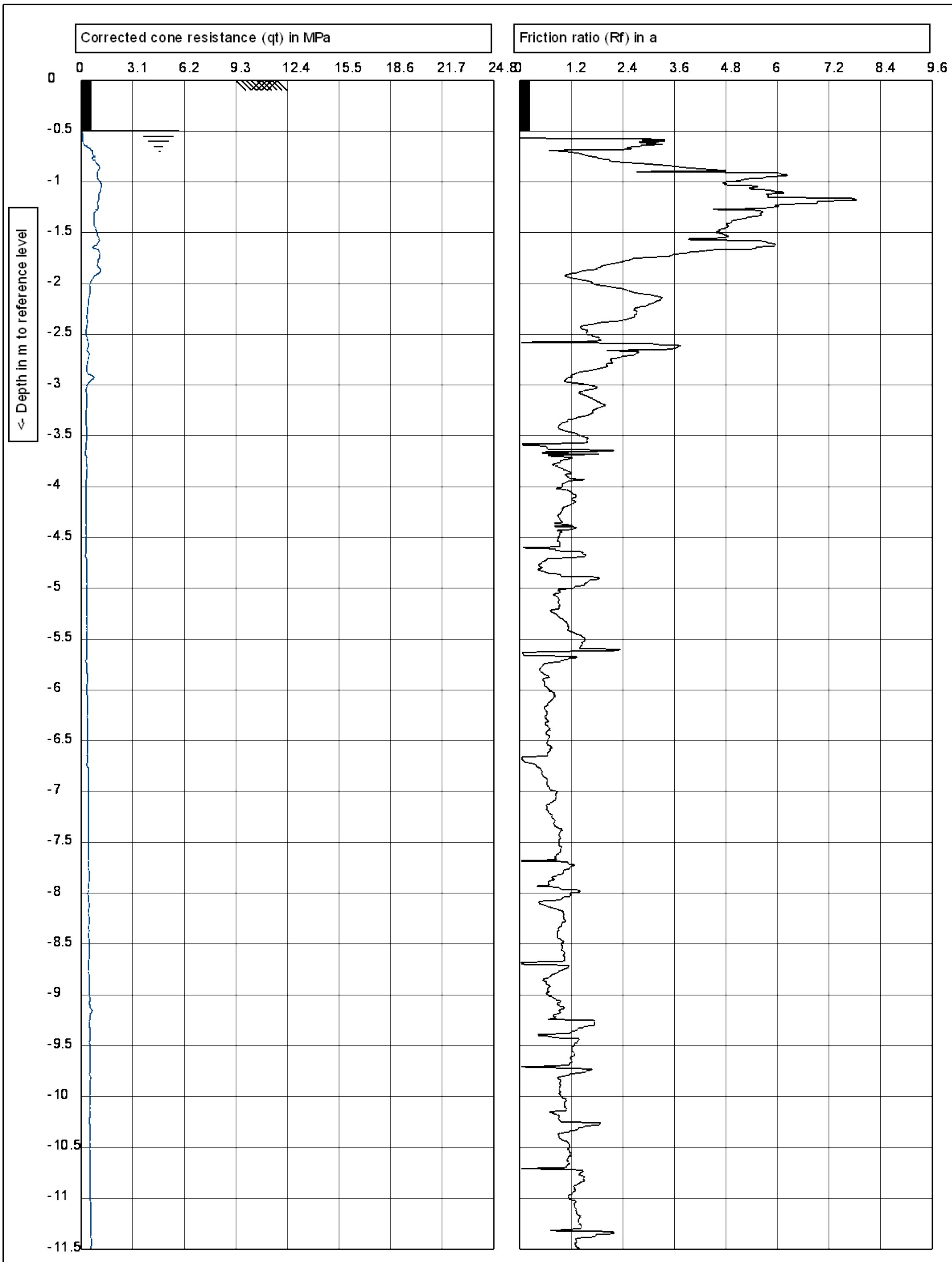
Appendix 9 Thiele Reserve — Cone Penetration Test Results



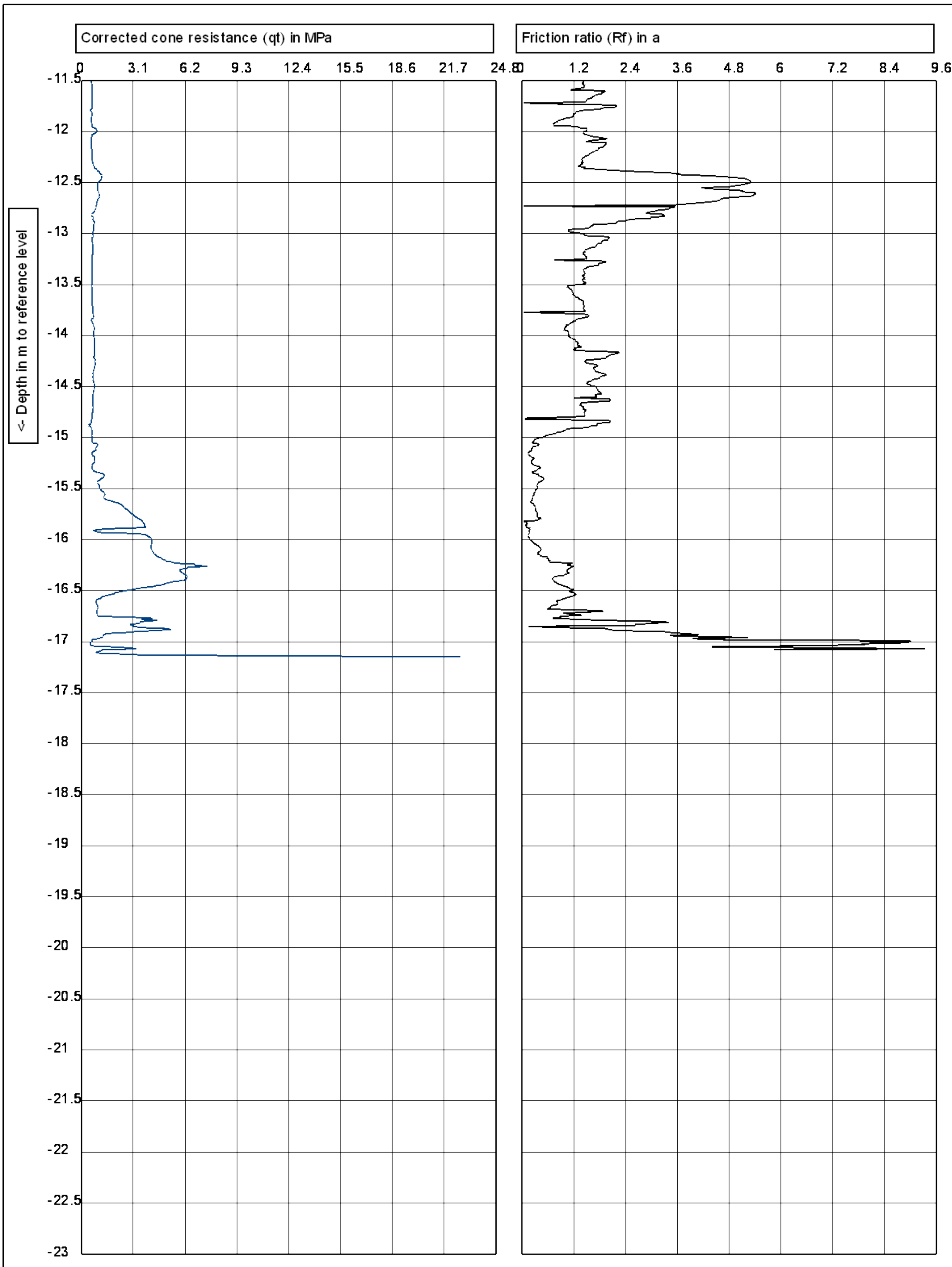
	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	21/07/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Thiele Reserve		Project no.:	Thiele Reserve
Position:			CPT no.:	1 — 1/6



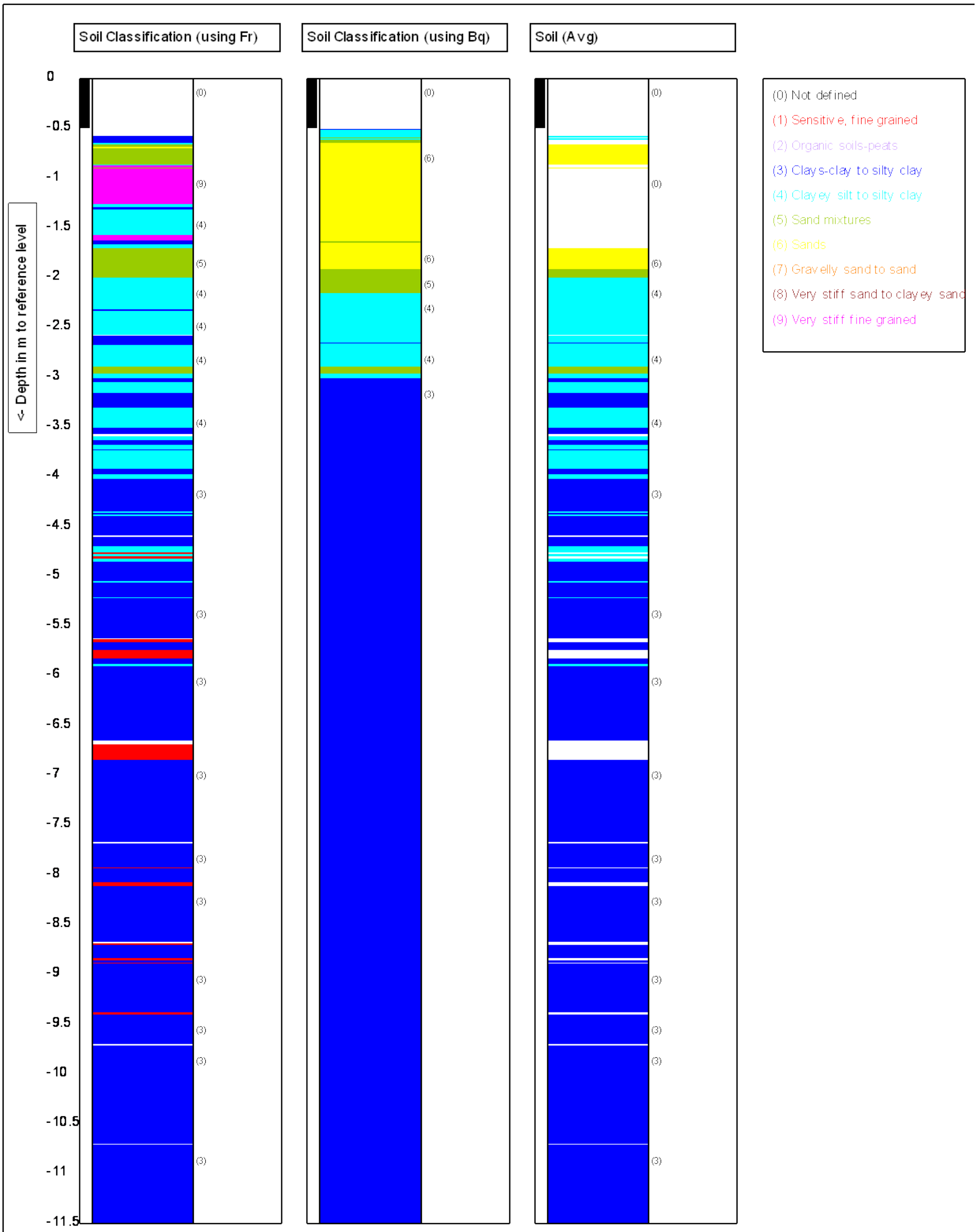
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	21/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Thiele Reserve			Project no.:	Thiele Reserve
Position:			CPT no.:	1 2/6



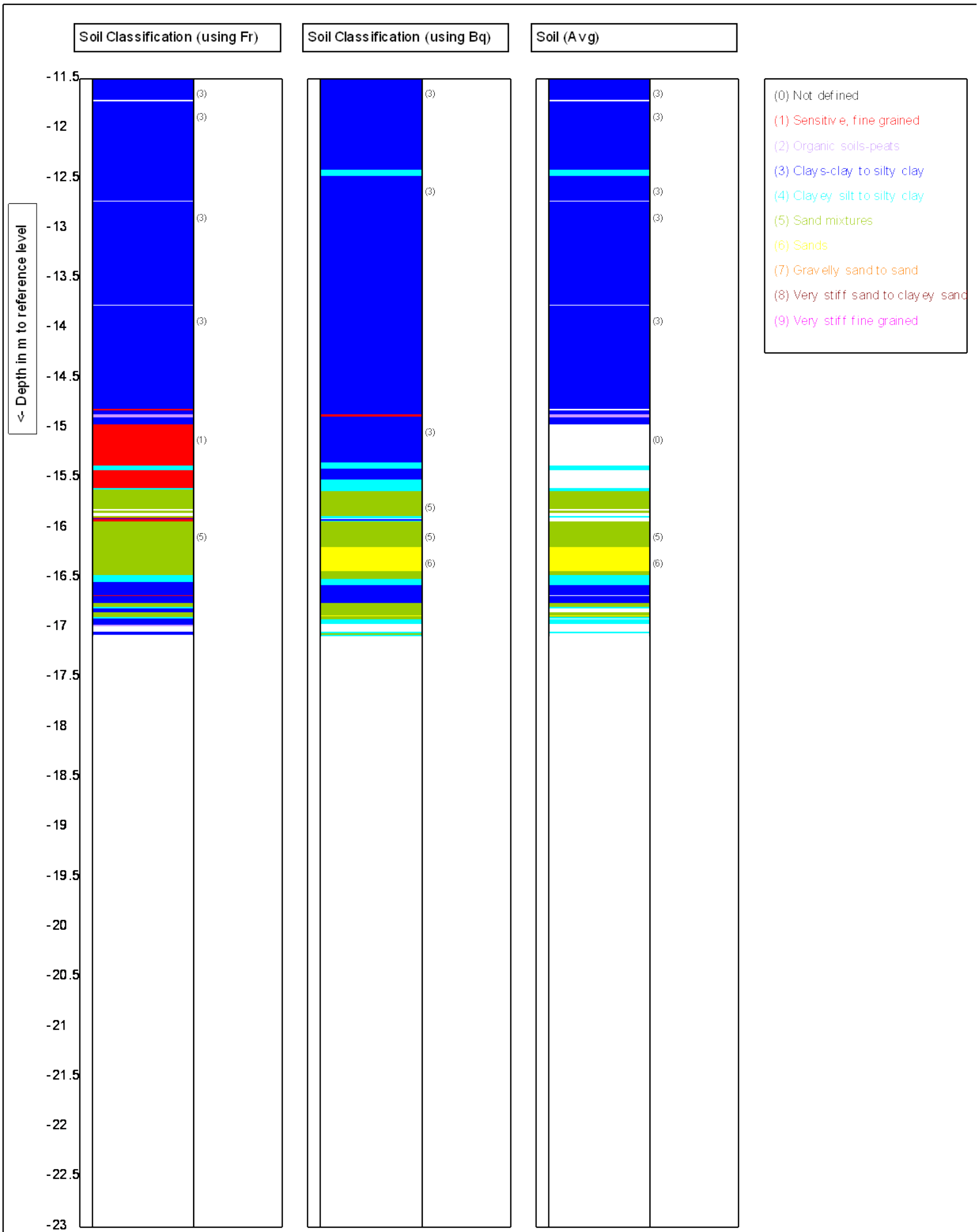
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	21/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Thiele Reserve			Project no.:	Thiele Reserve
Position:			CPT no.:	1 3/6



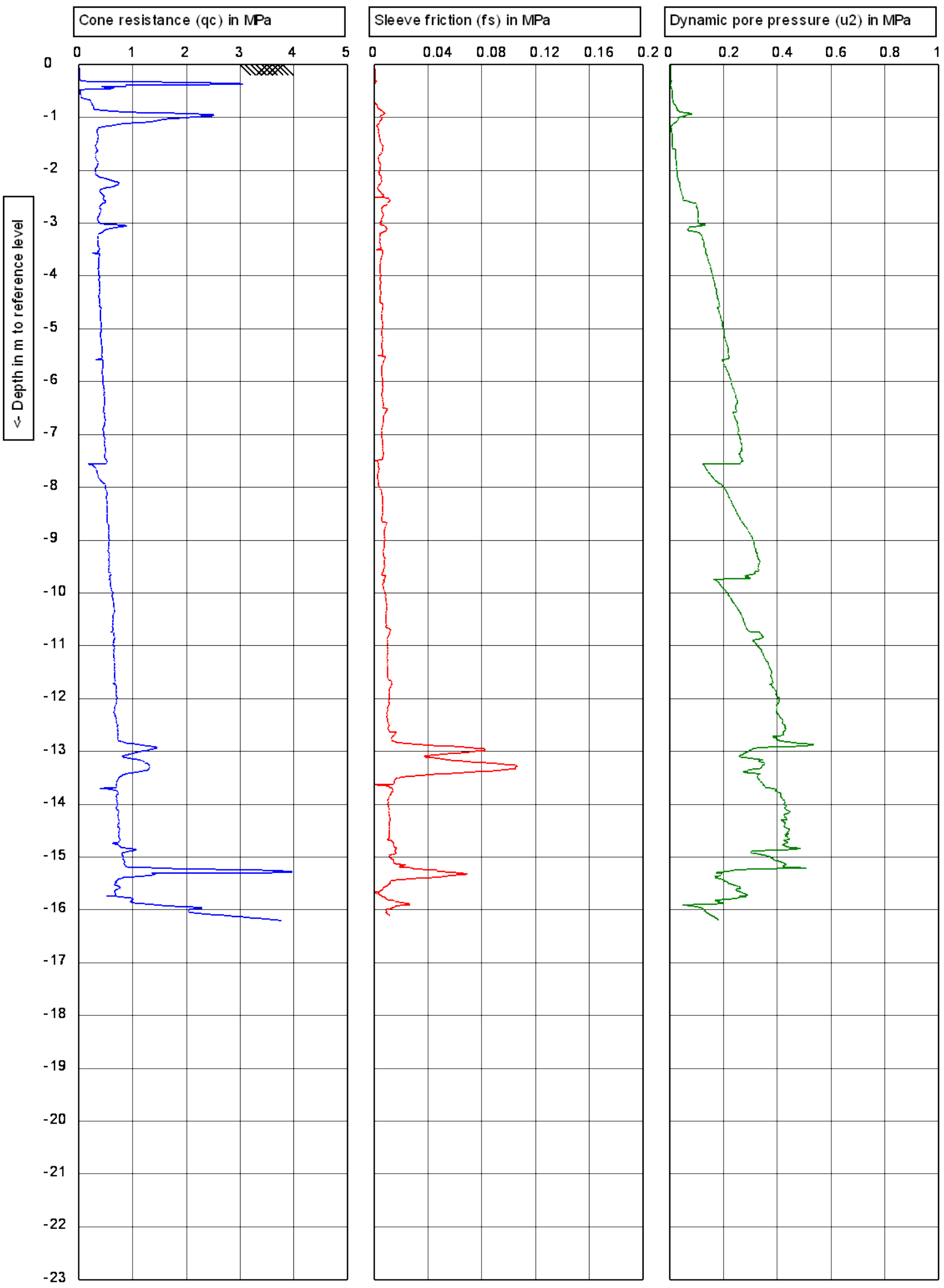
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date:	21/07/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Thiele Reserve			Project no.:	Thiele Reserve
Position:			CPT no.:	1 4/6



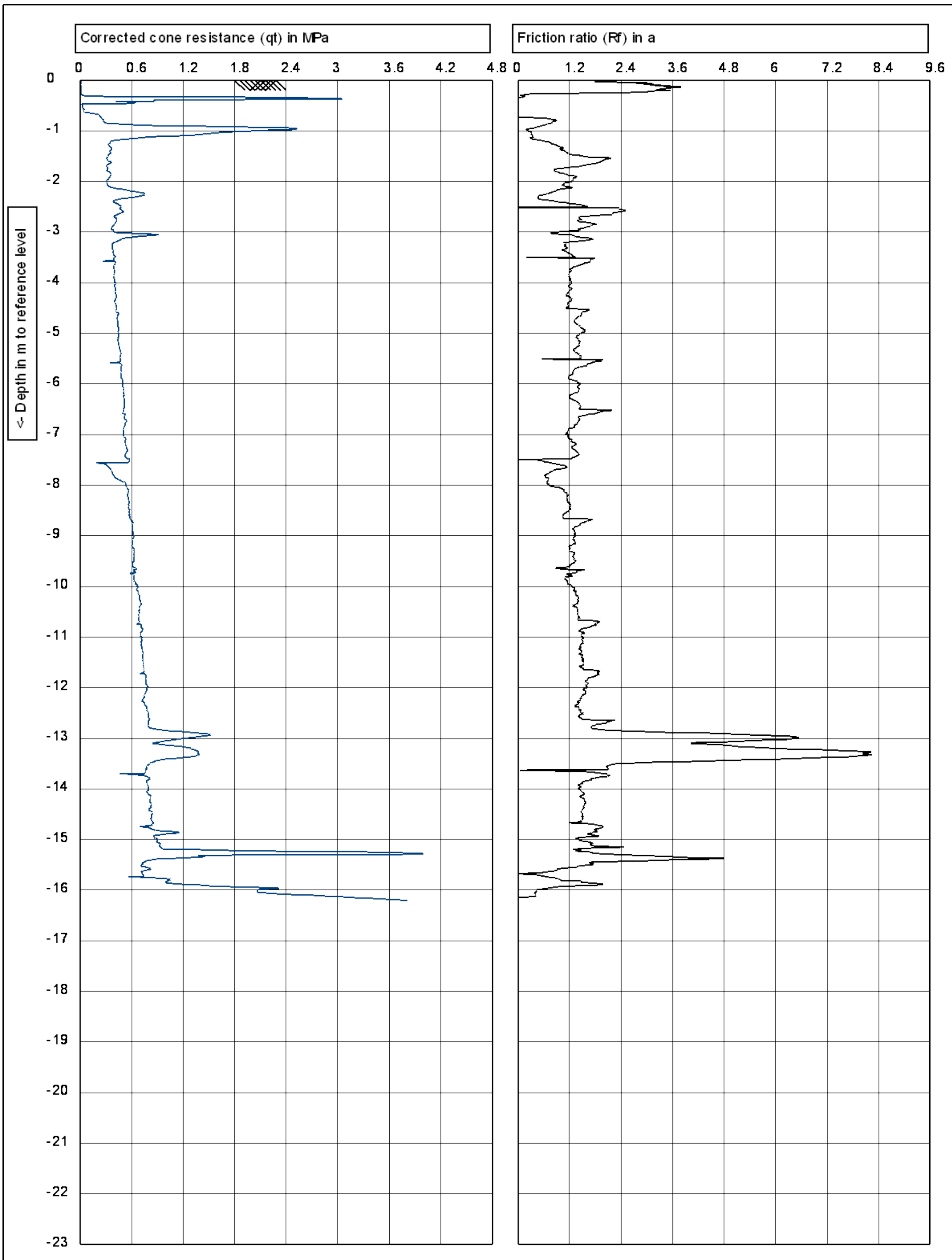
	Test according NEN 5140 class 1	Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.5	Date: 21/07/2014
Project:	Project E.1.8	Cone no.:	C10CFIIP.G67
Location:	Thiele Reserve	Project no.:	Thiele Reserve
Position:		CPT no.:	1 — 5/6



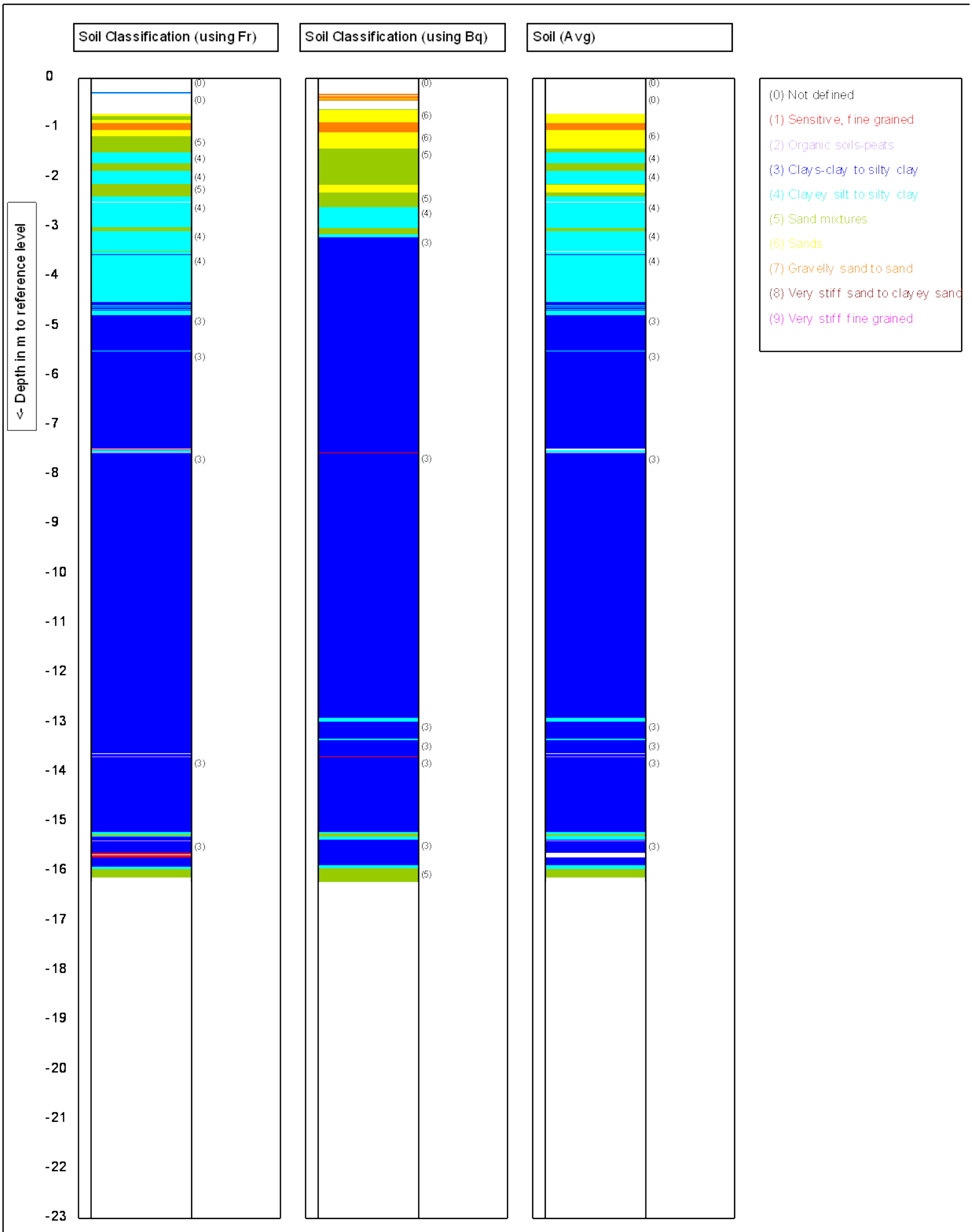
u2, 150 cm², 10 cm²	Test according NEN 5140 class 1	Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: a0.5	Date:	21/07/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Thiele Reserve		Project no.:	Thiele Reserve
Position:		CPT no.:	1 · 6/6



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1al	Date:	5/02/2014
Project:	LMR0214		Cone no.:	C10CFIIPaG67
Location:	THIELE RESERVE MURRAY BRIDGE		Project no.:	LMR0214_TR
Position:			CPT no.:	1 1/3



r u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a1	Date:	5/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: THIELE RESERVE MURRAY BRIDGE			Project no.:	LMR0214_TR
Position:			CPT no.:	1 2/3



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a1	Date:	5/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: THIELE RESERVE MURRAY BRIDGE			Project no.:	LMR0214_TR
Position:			CPT no.: 1	3/3

ENGINEERING BOREHOLE LOG	**BH 1**	**SHEET : 1 OF 4**

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 17.25 m	REDUCED LEVEL	: - m		
LOCATION	: Thiele Reserve, Murray Bridge East	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions		
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo		
DATE STARTED	: 21 July 2014 DATE FINISHED : 21 JULY 2014	RIG MODEL	:	CHECKED BY			

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (KPa)	DEPTH (M)
21ST JULY 2014	NIL		21/07/14	0.5	PREDRILL	SC/CL	Fill: Clayey SAND, top soil with organic matters, vegetation and roots.	D/M					0.5
				1.0	UN-DISTURBED SAMPLE	SP	SANDS,	W					1.0
				1.5	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					1.5
				2.0	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					2.0
				2.5	UN-DISTURBED SAMPLE								2.5
				3.0	DISTURBED SAMPLE	CH	Silty Clay,	>PL					3.0
				3.5									3.5
				4.0	PREDRILL								4.0
				5									4.5
				5.0									5.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

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Reported by:

Signature : ____________________

Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 2 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 17.25 m	REDUCED LEVEL	: - m
LOCATION	: Thiele Reserve, Murray Bridge East	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 21 July 2014 DATE FINISHED : 21 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
21ST JULY 2014	NIL			5.5									5.5
				6.0	PREDRILL	SP	SANDS,	W					6.0
				6.5									6.5
				7.0	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					7.0
				7.5	DISTURBED SAMPLE								7.5
				8.0	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					8.0
				8.5	UN-DISTURBED SAMPLE								8.5
				9.0	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					9.0
				9.5	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					9.5
				10.0	UN-DISTURBED SAMPLE	CH	Silty Clay,	>PL					10.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

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Reported by:

Signature : ____________________

Date : ____________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 3 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 17.25 m	REDUCED LEVEL	: - m
LOCATION	: Thiele Reserve, Murray Bridge East	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 21 July 2014 DATE FINISHED : 21 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
21ST JULY 2014	NIL			10.5		CH	Silty CLAY,	>PL					10.5
				11.0		CH	Silty CLAY,	>PL					11.0
				11.5		CH	Silty CLAY,	>PL					11.5
				12.0		CH	Silty CLAY,	>PL					12.0
							NO SAMPLE RECOVERED						
				12.5		CH	Silty CLAY,	>PL					12.5
				13.0									13.0
				13.5									13.5
				14.0									14.0
				14.5									14.5
				15.0									15.0

BORING RESISTANCE:
- L : LOW RESISTANCE
- M : MEDIUM RESISTANCE
- H : HIGH RESISTANCE
- R : REFUSAL

SAMPLE CODE:
- UN-DISTURBED SAMPLE
- DISTURBED SAMPLE
- STANDARD PENETRATION TEST (SPT)
- PREDRILL

GROUND WATER CONDITION:
- WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
- D : DRY
- M : MOIST
- W : WET
- <<PL : MUCH LESS THAN PLASTIC LIMIT
- <PL : LESS THAN PLASTIC LIMIT
- ~PL : APPROX. PLASTIC LIMIT
- >PL : GREATER THAN PLASTIC LIMIT
- >>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
- VS : VERY SOFT (0 - 25 kPa)
- S : SOFT (25 - 50 kPa)
- F : FIRM (50 - 100 kPa)
- St : STIFF (100 - 200 kPa)
- VSt : VERY STIFF (200 - 400 kPa)
- H : HARD (> 400 kPa)
- Fb : FRIABLE (unable to test)
- VL : VERY LOOSE
- L : LOOSE
- MD : MEDIUM DENSE
- D : DENSE
- VD : VERY DENSE

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Reported by:

Signature : ______________________

Date : ______________________

ENGINEERING BOREHOLE LOG

BH 1

SHEET : 4 OF 4

PROJECT	: Goyder Institute Project E.1.8	TOTAL DEPTH	: 17.25 m	REDUCED LEVEL	: - m
LOCATION	: Thiele Reserve, Murray Bridge East	BORE DIAMETER	: 150 mm	DRILLING CONTRACTOR	: Drilling Solutions
COORDINATE	X : - Y : -	INCLINATION	: Vertical	LOGGED BY	: Yien Lik Kuo
DATE STARTED	: 21 July 2014 DATE FINISHED : 21 JULY 2014	RIG MODEL	:	CHECKED BY	

PROGRESS	SUPPORT	BORING RESISTANCE (L M H R)	GROUND WATER DATA AND COMMENTS	DEPTH (M)	SAMPLE CODE	USCS SYMBOL	DESCRIPTION OF STRATA Colour, particle size, secondary and minor components, structure and other features	Moisture Condition	Consistency or Relative Density	PERCENTAGE SAMPLE RECOVERY (%) 25 50 75 100	STANDARD PENETRATION TEST (N - VALUES) 10 30 50 N1 N2 N3 N	Pocket Penetrometer (kPa)	DEPTH (M)
21ST JULY 2014	NIL					CH	Silty CLAY,	>PL					
				15.5		CH	Silty CLAY,	>PL					15.5
				16.0		CH	Silty CLAY,	>PL					16.0
				16.5		CH	Silty CLAY,	>PL					16.5
				17.0		CH	Silty CLAY,	>PL					17.0
							Borehole terminated at 17.25 m.						
				17.5									17.5
				18.0									18.0
				18.5									18.5
				19.0									19.0
				19.5									19.5
				20.0									20.0

BORING RESISTANCE:
L : LOW RESISTANCE
M : MEDIUM RESISTANCE
H : HIGH RESISTANCE
R : REFUSAL

SAMPLE CODE:
UN-DISTURBED SAMPLE
DISTURBED SAMPLE
STANDARD PENETRATION TEST (SPT)
PREDRILL

GROUND WATER CONDITION:
WATER LEVEL ON DATE SHOWN

MOISTURE CONDITION:
D : DRY
M : MOIST
W : WET
<<PL : MUCH LESS THAN PLASTIC LIMIT
<PL : LESS THAN PLASTIC LIMIT
~PL : APPROX. PLASTIC LIMIT
>PL : GREATER THAN PLASTIC LIMIT
>>PL : MUCH GREATER THAN PLASTIC LIMIT

CONSISTENCY AND RELATIVE DENSITY INDEX:
VS : VERY SOFT (0 - 25 kPa)
S : SOFT (25 - 50 kPa)
F : FIRM (50 - 100 kPa)
St : STIFF (100 - 200 kPa)
VSt : VERY STIFF (200 - 400 kPa)
H : HARD (> 400 kPa)
Fb : FRIABLE (unable to test)
VL : VERY LOOSE
L : LOOSE
MD : MEDIUM DENSE
D : DENSE
VD : VERY DENSE

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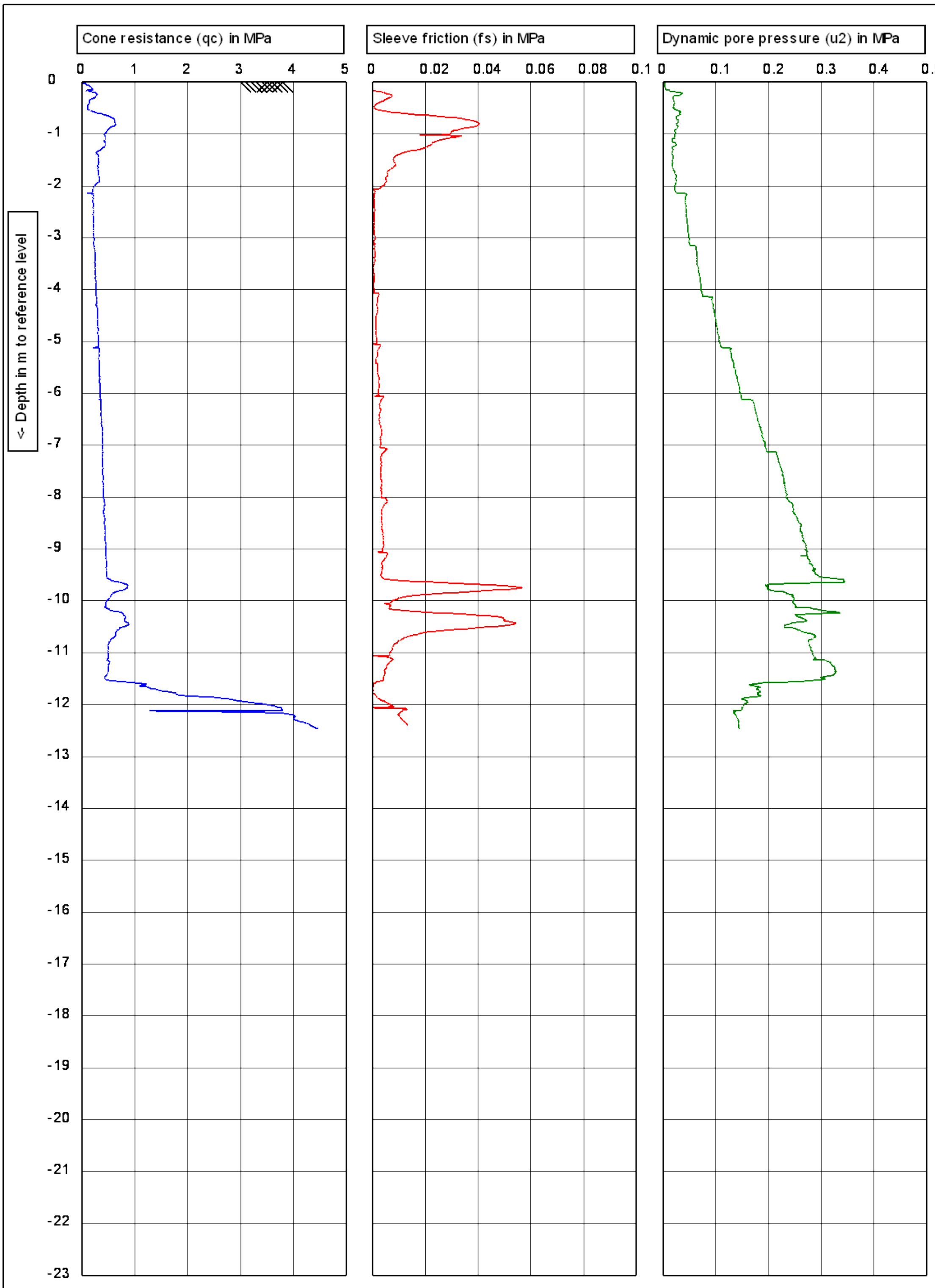
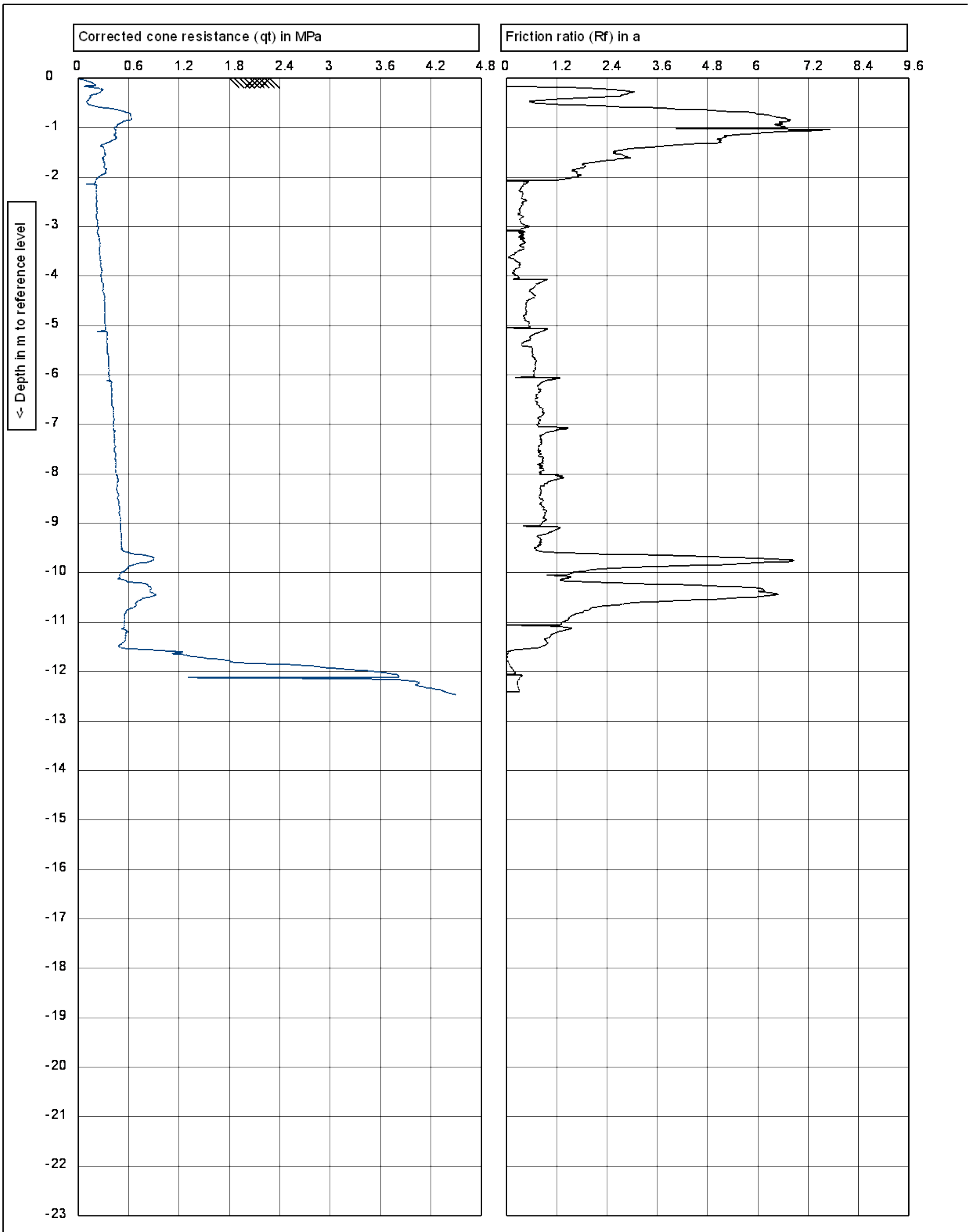
Reported by:

Signature : ____________________
Date : ____________________

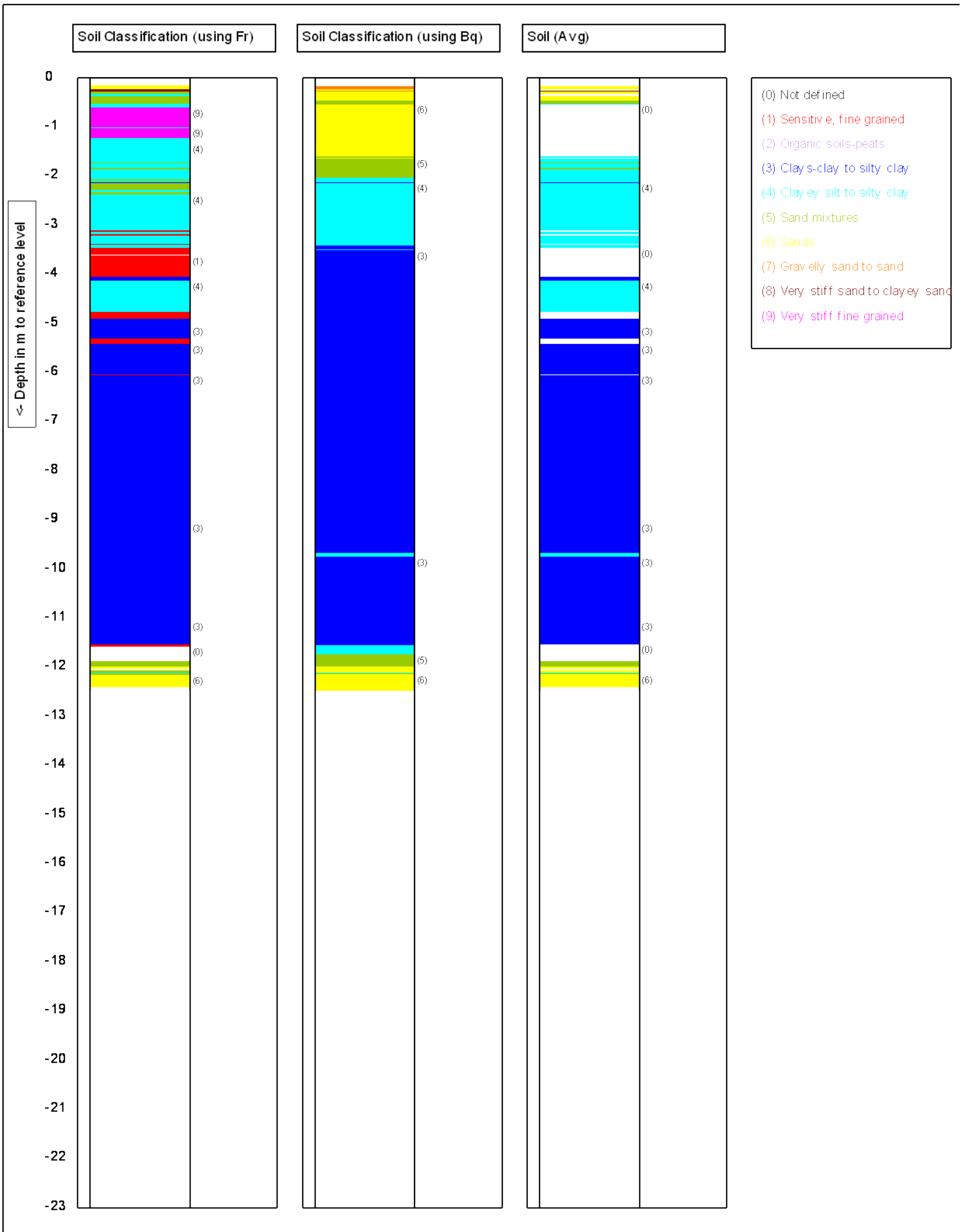
Appendix 10 Avoca Dell — Cone Penetration Test Results



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a7	Date:	5/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: AVOCA DELL			Project no.:	LMR0214_AD
Position:			CPT no.:	1 — 1/3

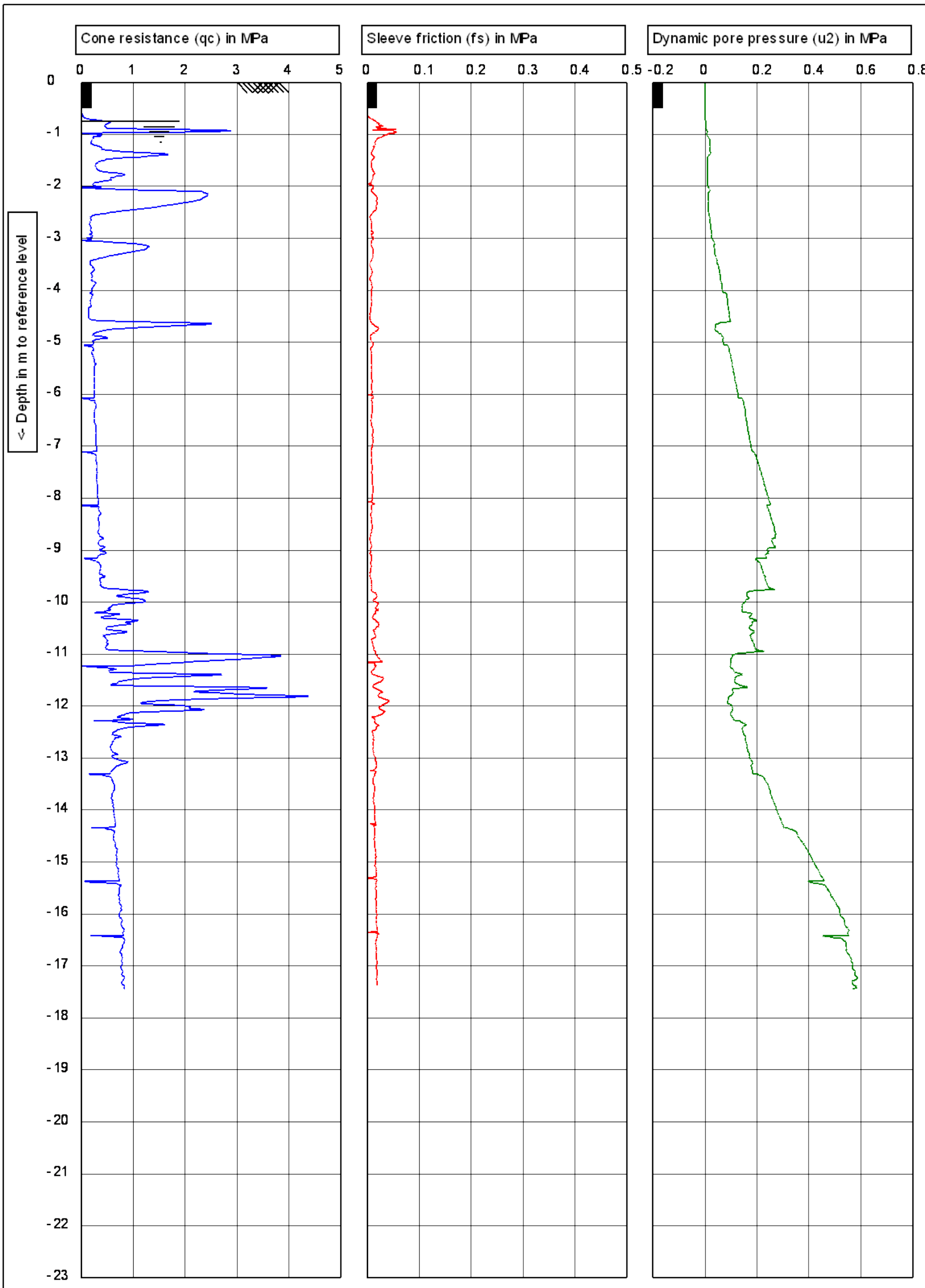


150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 1a7	Date:	5/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: AVOCA DELL		Project no.:	LMR0214_AD
Position:		CPT no.:	1 — 2/3

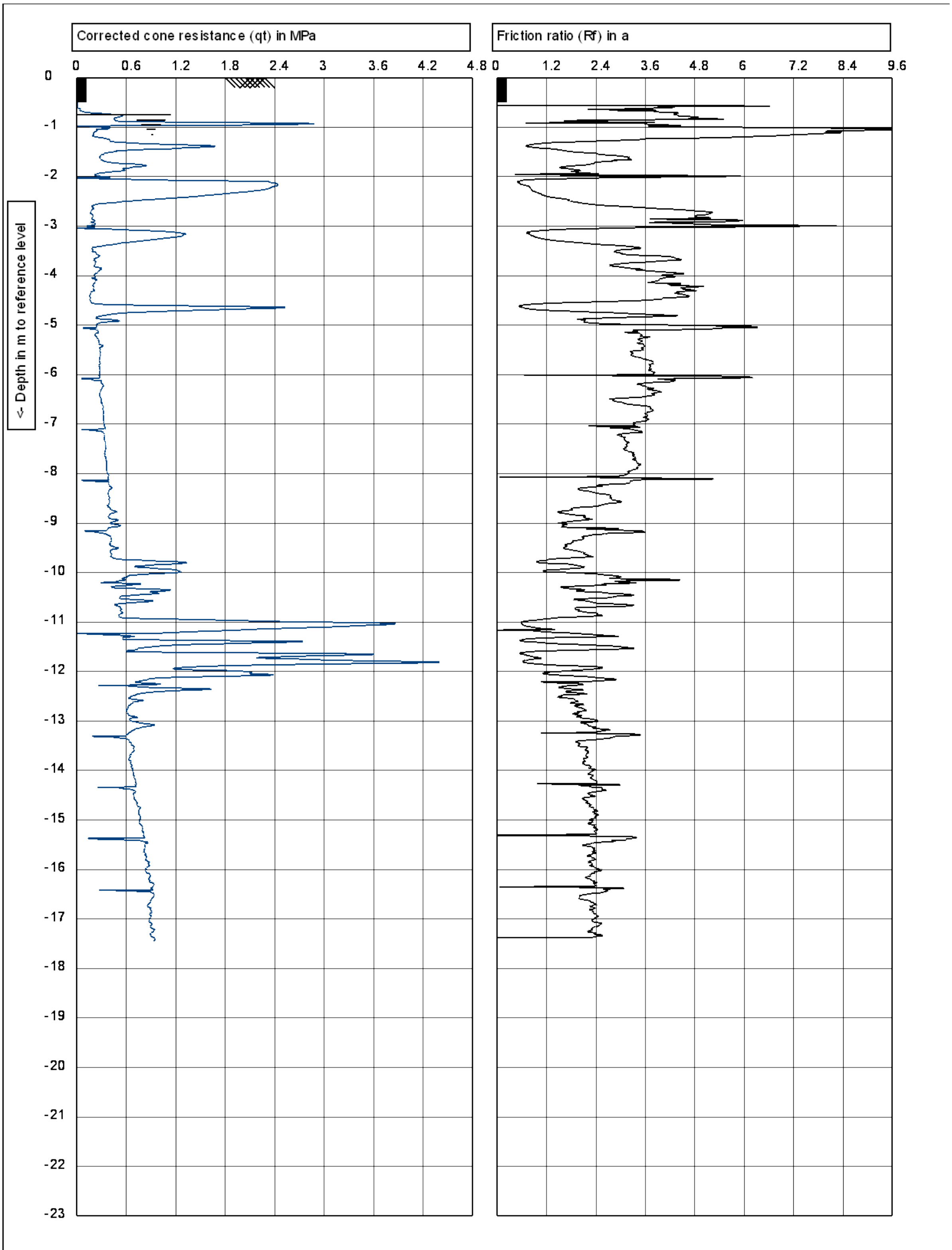


	Test according NEN 5140 class 1		Predrill : 0 m Predrilled
	G.L. 0 NAP	W.L.: 1a7	Date: 5/02/2014
Project: LMR0214			Cone no.: C10CFIIPaG67
Location: AVOCA DELL			Project no.: LMR0214_AD
Position:			CPT no.: 1 3/3

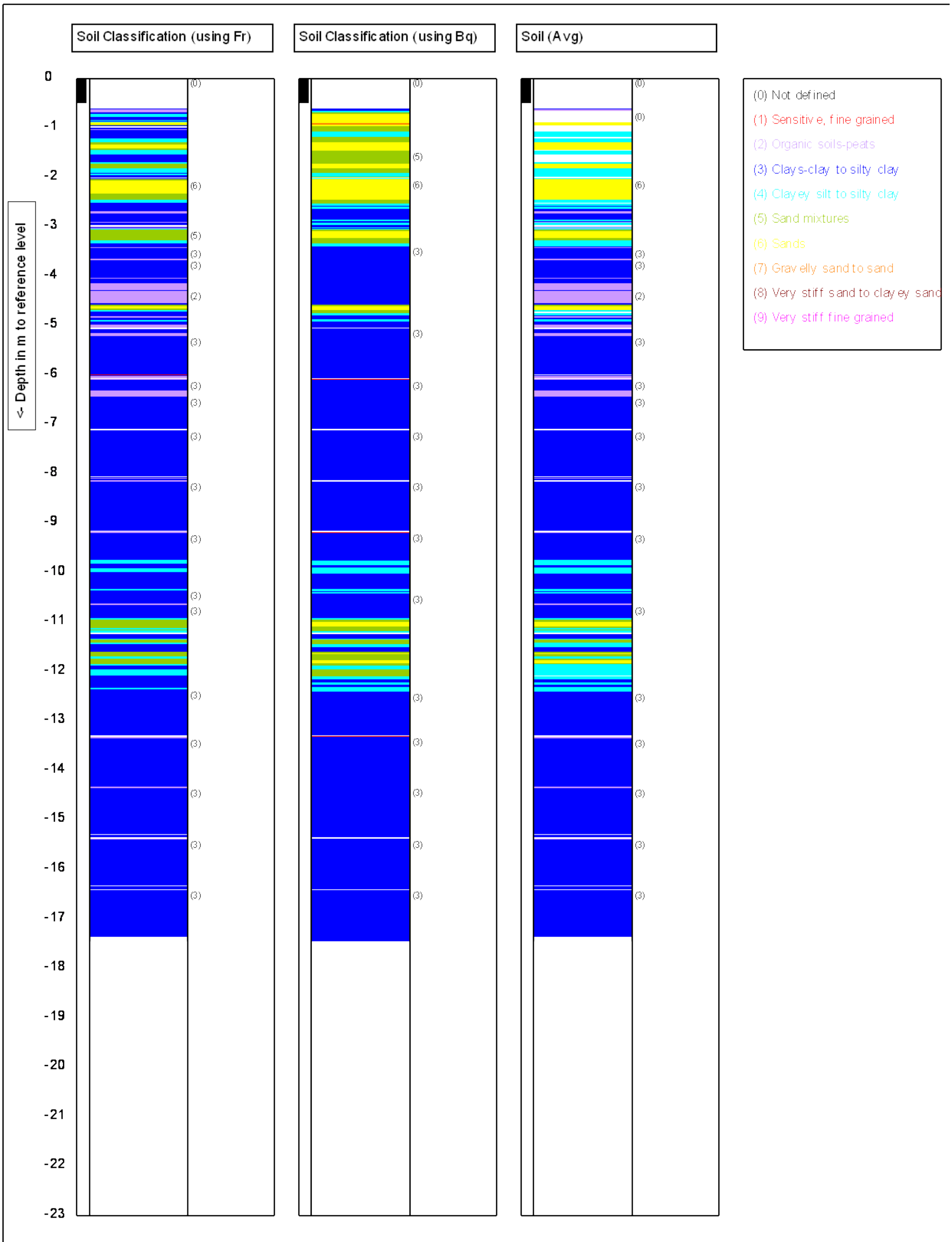
Appendix 11 Mypolonga — Cone Penetration Test Results



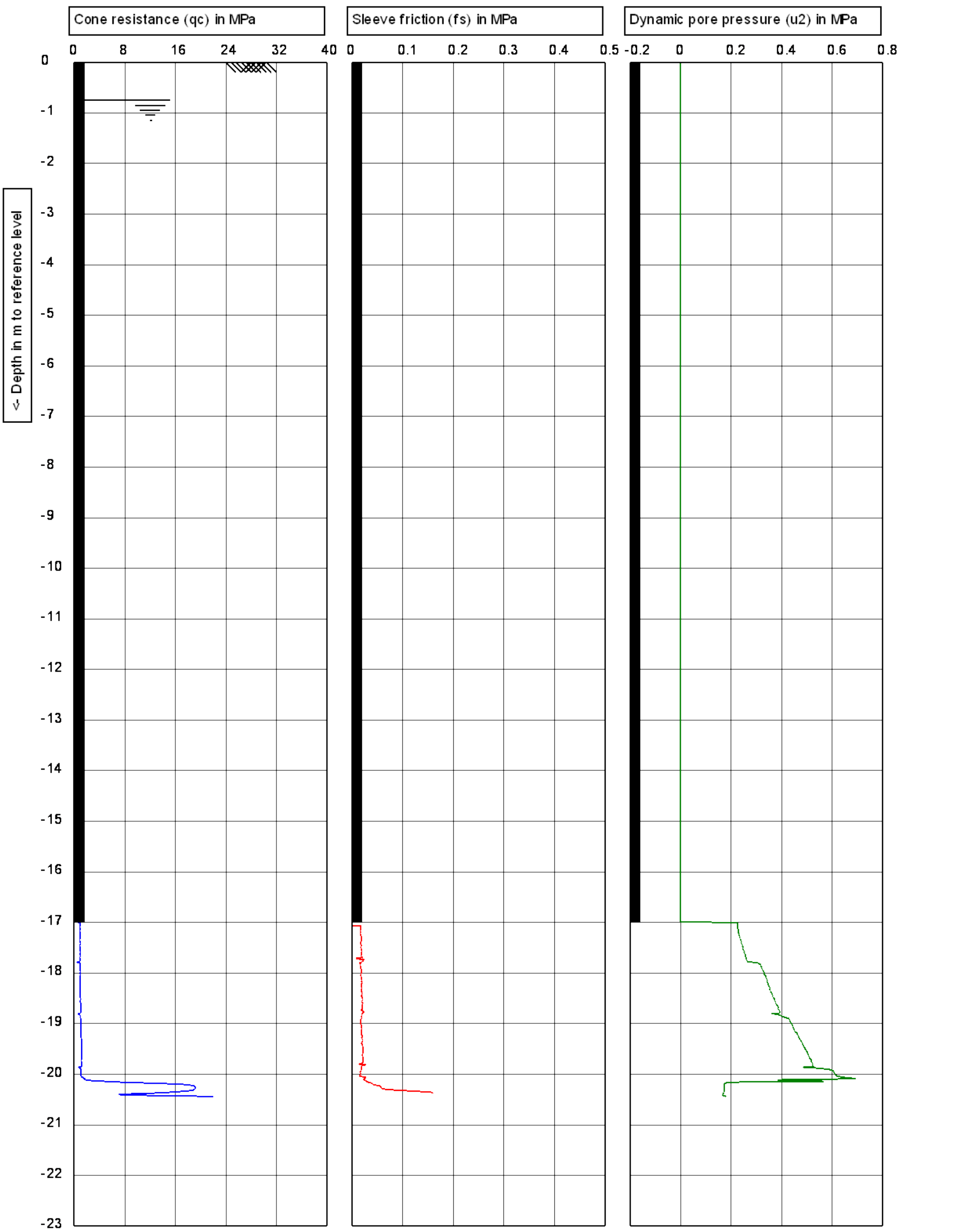
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	22/07/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G65
Location:	Mypolonga		Project no.:	Mypolonga
Position:			CPT no.:	1a 1/3



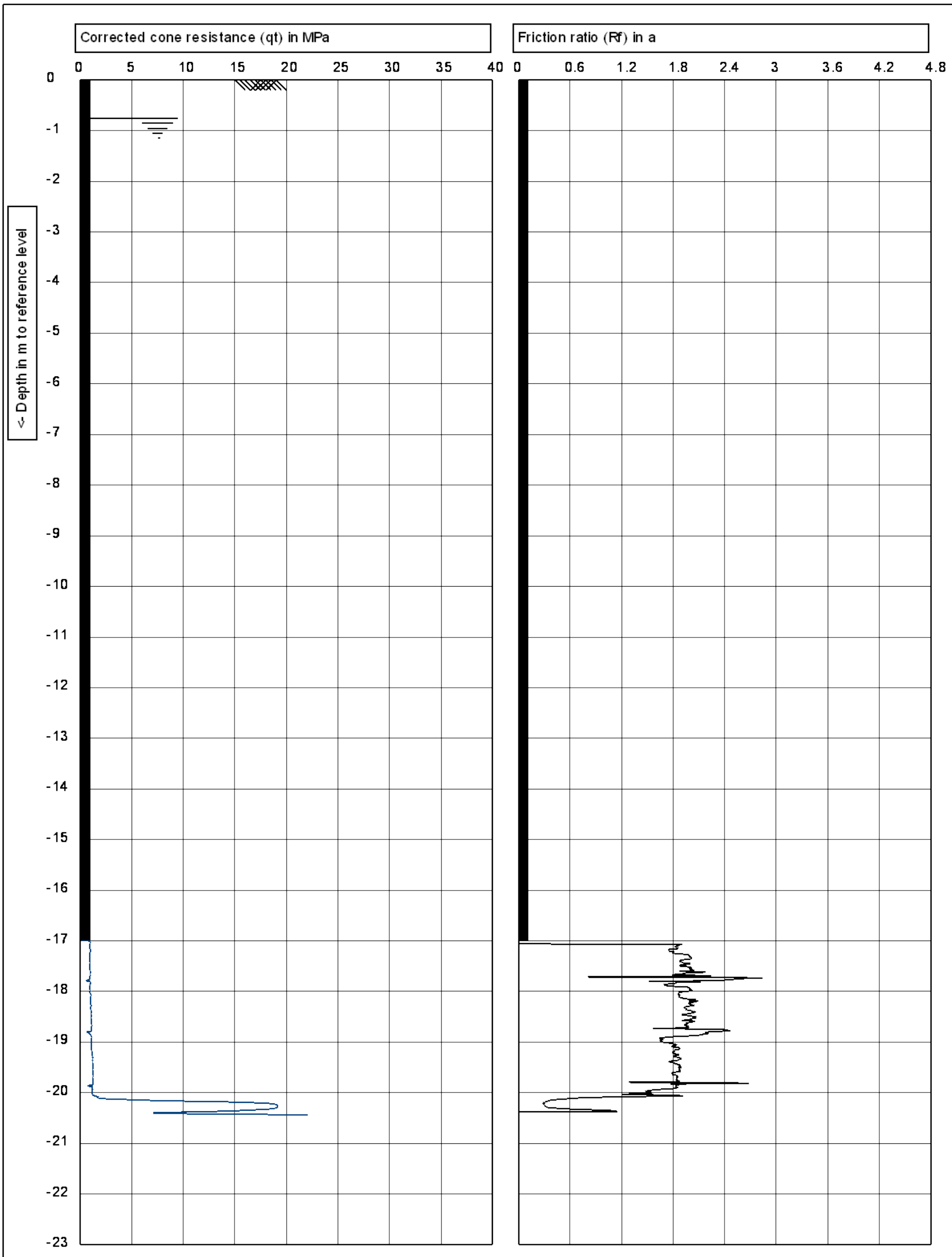
Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: a0.75	Date:	22/07/2014
Project:	Project E.1.8	Cone no.:	C10CFIIP.G65
Location:	Mypolonga	Project no.:	Mypolonga
Position:		CPT no.:	1a 2/3



Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: a0.75	Date:	22/07/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G65
Location: Mypolonga		Project no.:	Mypolonga
Position:		CPT no.:	1a 3/3



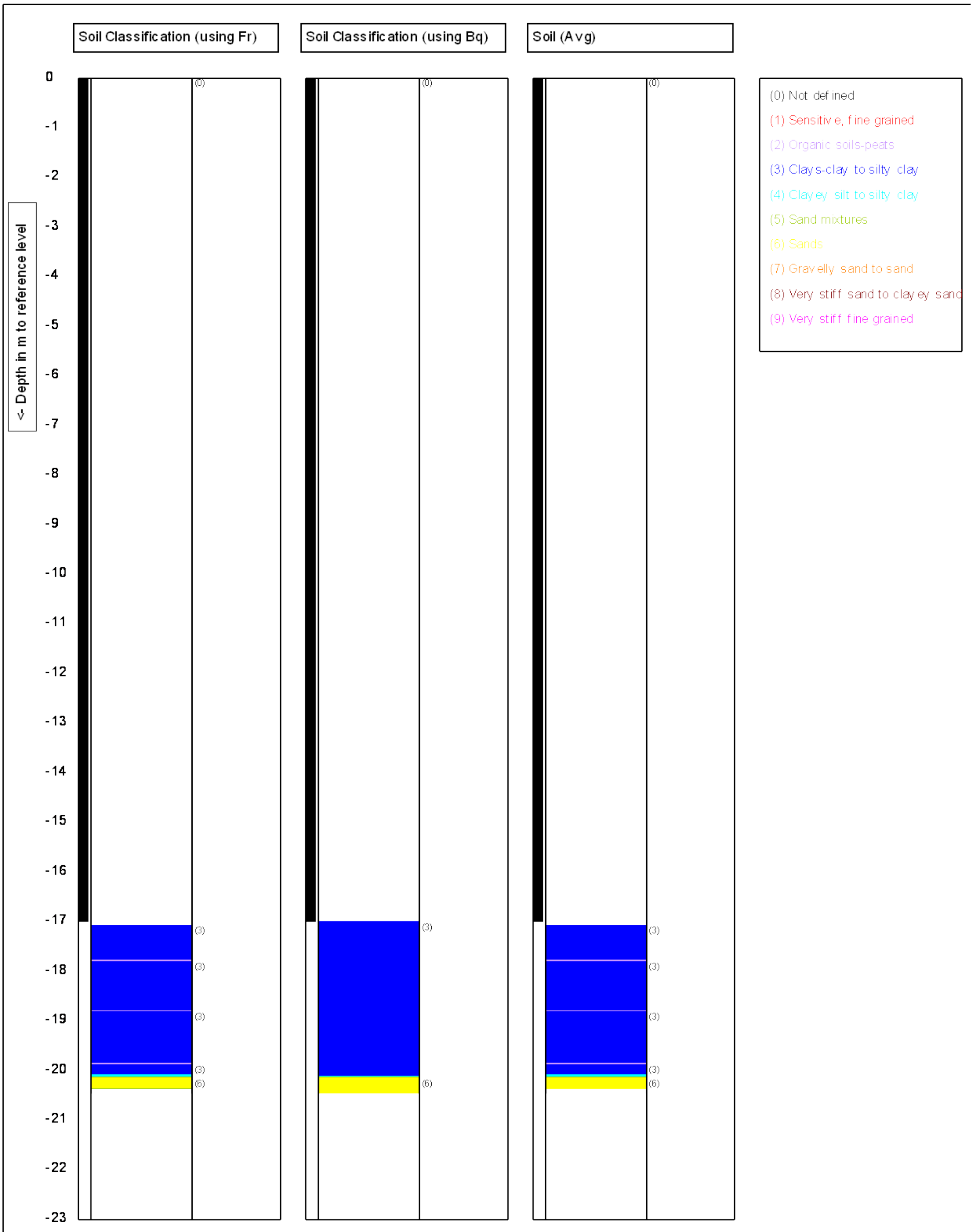
u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	17 m Predrilled
	G.L. 0 NAP / W.L.: a0.75	Date:	22/07/2014
Project:	Project E.1.8	Cone no.:	C10CFIIP.G65
Location:	Mypolonga	Project no.:	Mypolonga
Position:		CPT no.:	1b 1/3



r u2 / 150 cm² / 10 cm²	Test according NEN 5140 class 1		Predrill :	17 m Predrilled
	G.L. 0 NAP	W.L.: a0.75	Date:	22/07/2014

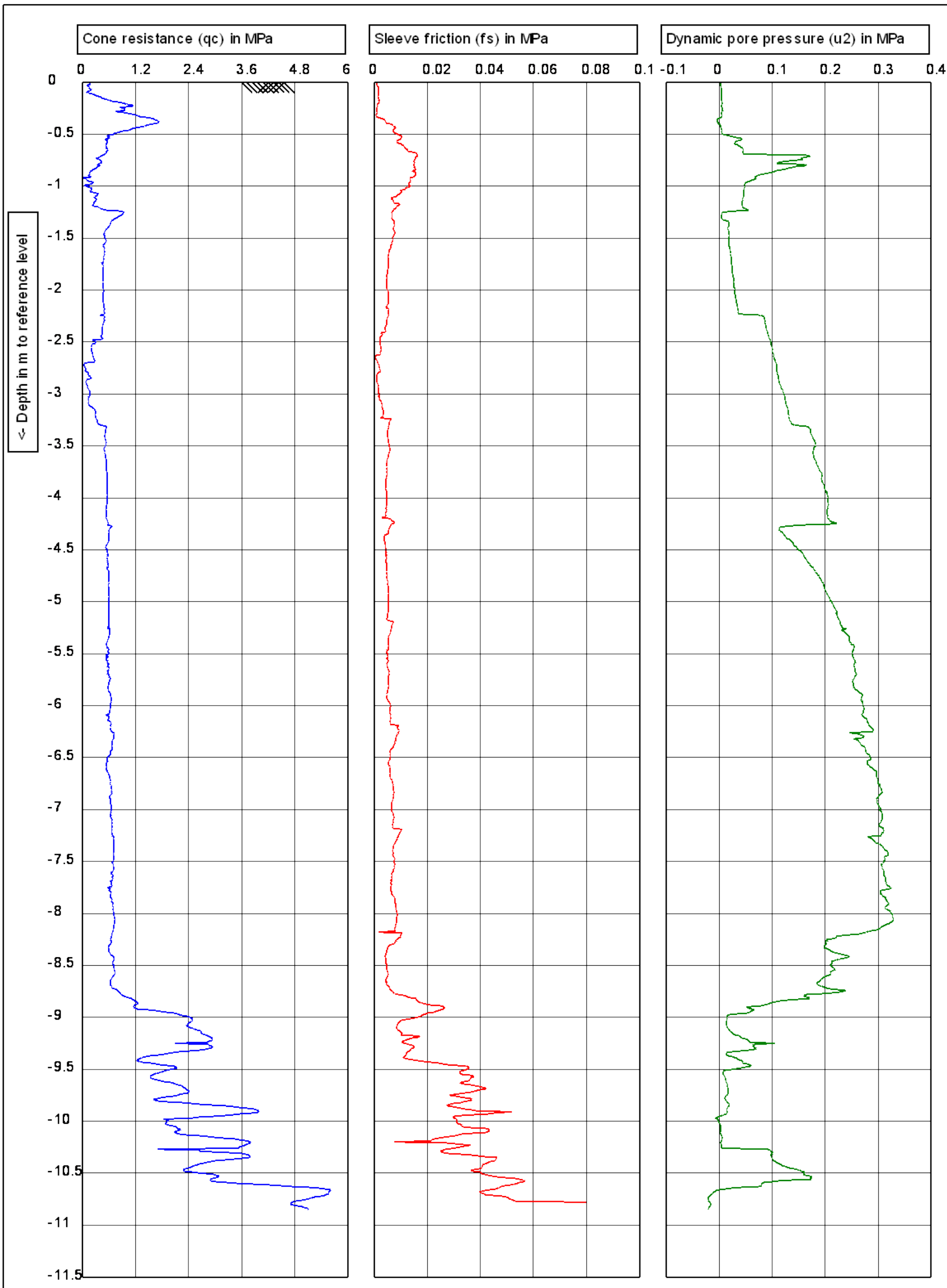
Project: Project E.1.8
Location: Mypolonga
Position:

Cone no.:	C10CFIIP.G65	
Project no.:	Mypolonga	
CPT no.:	1b	2/3

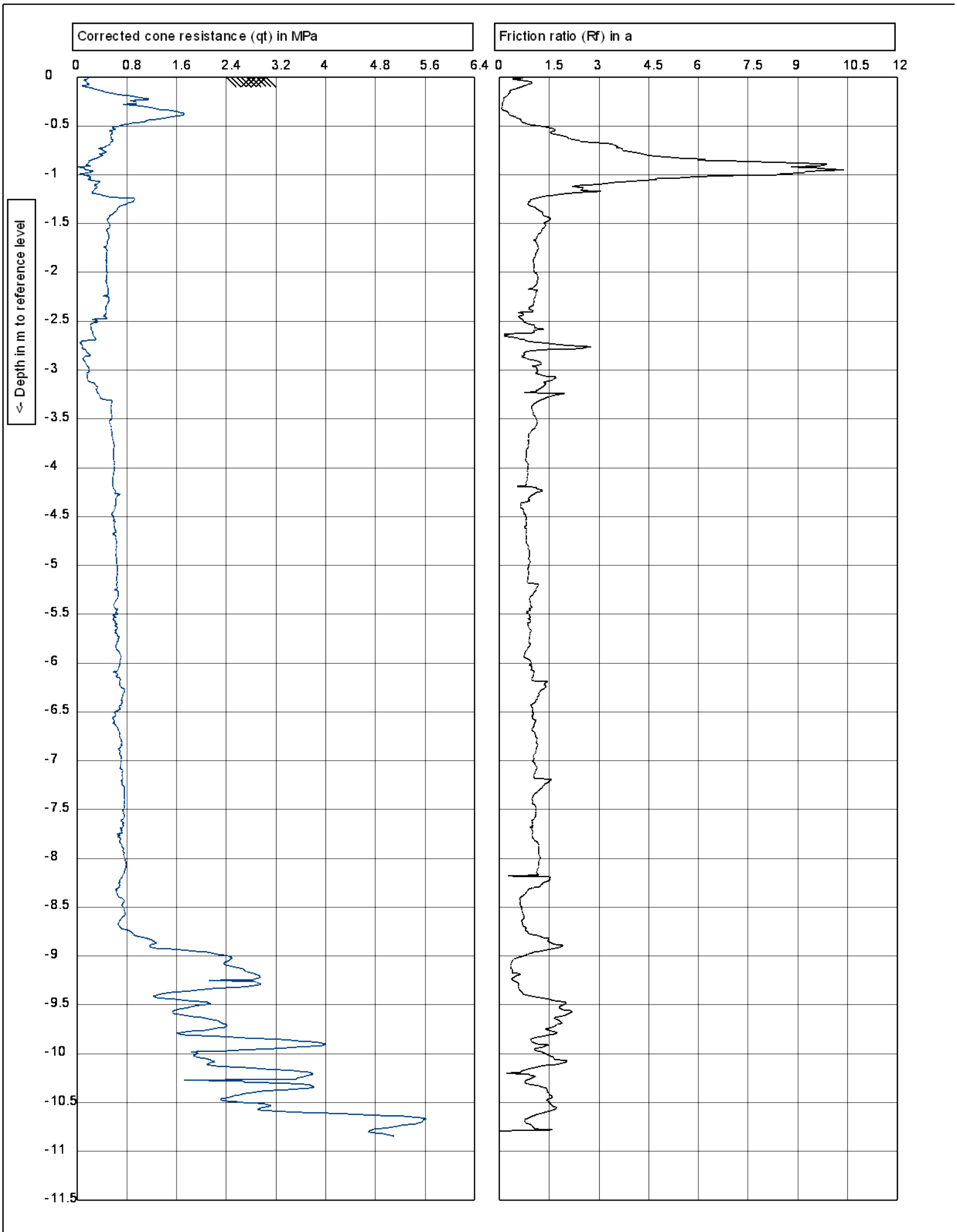


Test according NEN 5140 class 1		Predrill :	17 m Predrilled
G.L. 0 NAP	W.L.: a0.75	Date:	22/07/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G65
Location: Mypolonga		Project no.:	Mypolonga
Position:		CPT no.:	1b 3/3

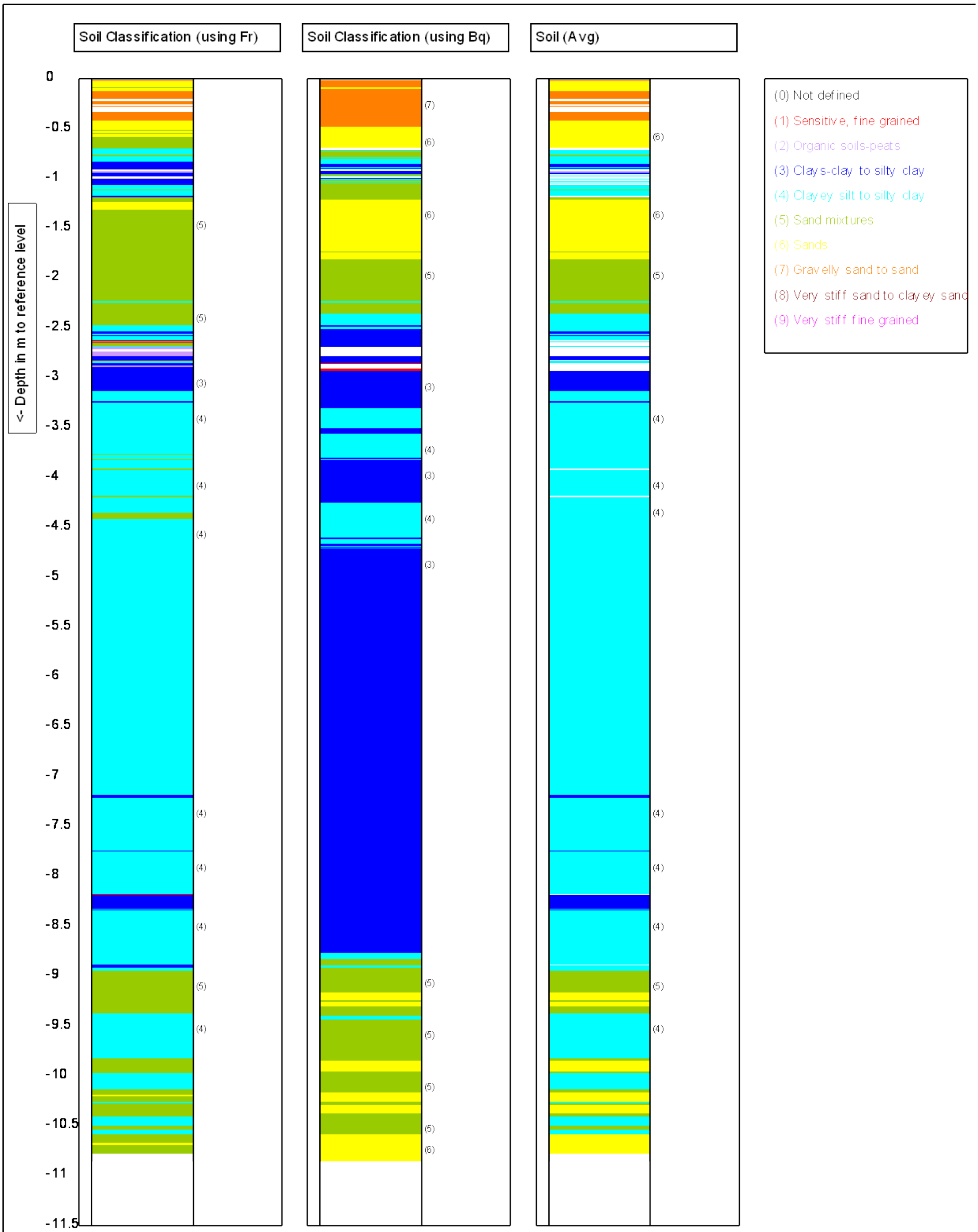
Appendix 12 Woodlane Reserve — Cone Penetration Test Results



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a65	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: WOODLANE RESERVE			Project no.:	LMR0214_WR
Position:			CPT no.:	1 — 1/3

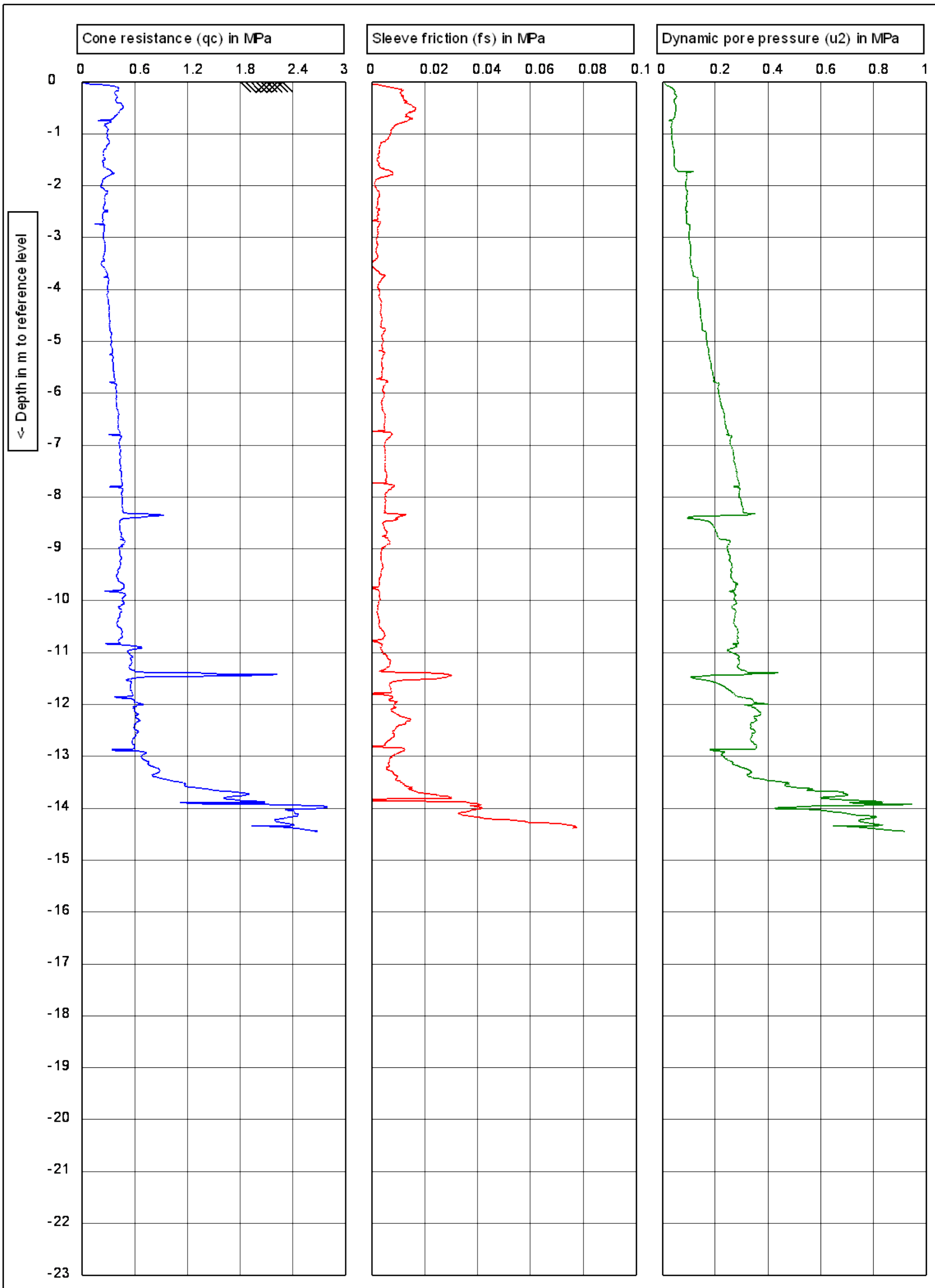


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a65	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: WOODLANE RESERVE			Project no.:	LMR0214_WR
Position:			CPT no.:	1 2/3

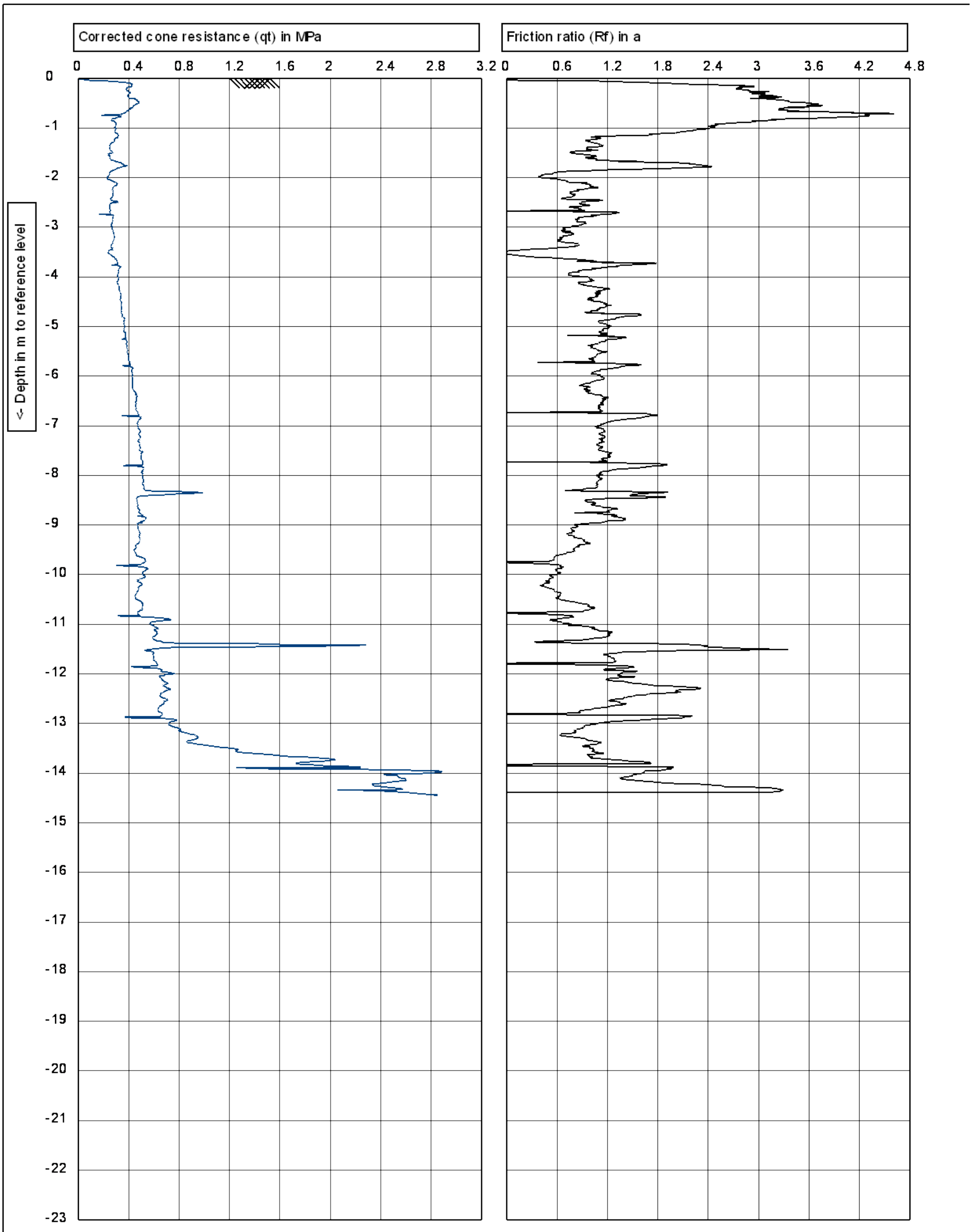


150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP / W.L.: 0a65	Date:	6/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: WOODLANE RESERVE		Project no.:	LMR0214_WR
Position:		CPT no.:	1 / 3/3

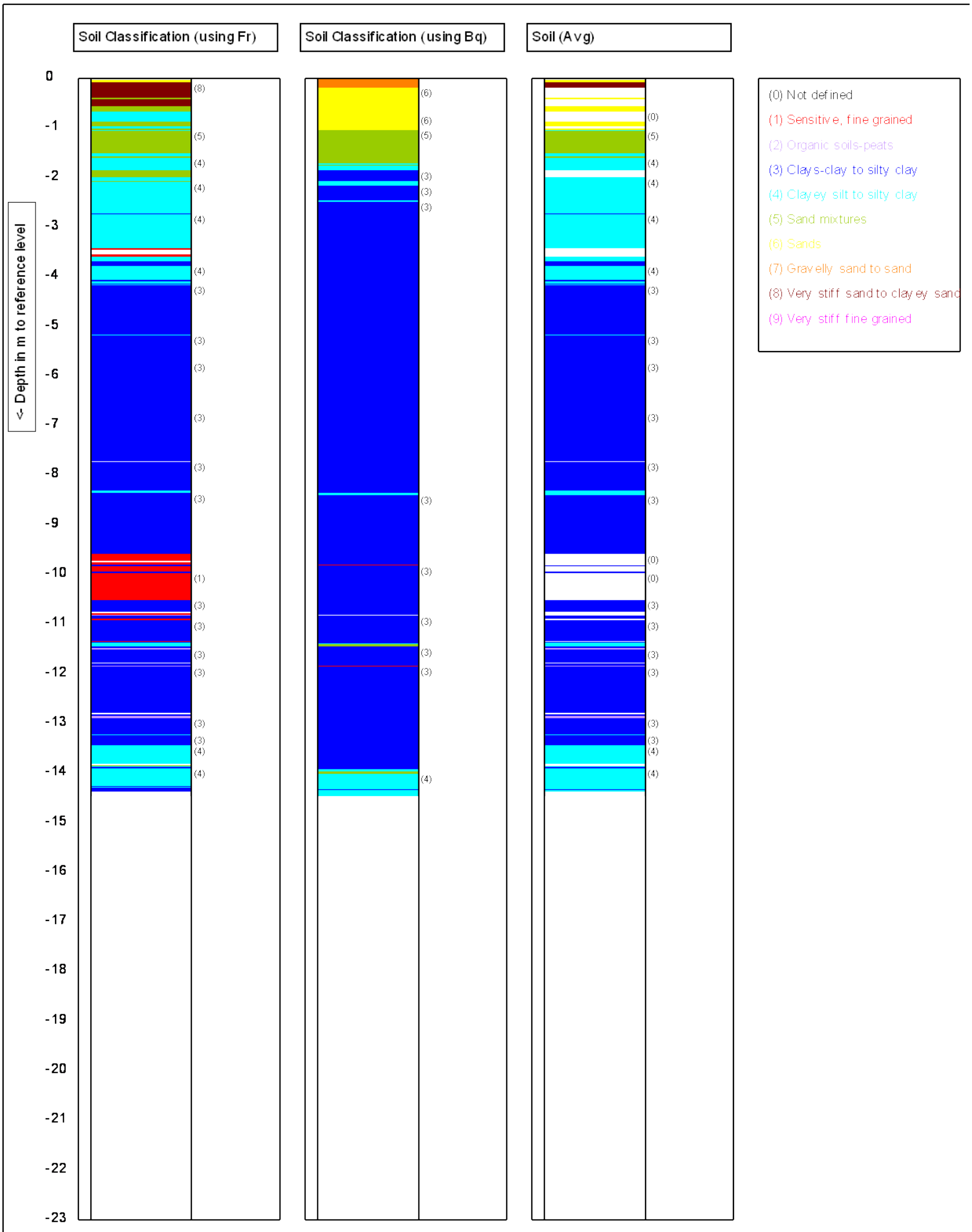
Appendix 13 Wall Flat — Cone Penetration Test Results



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIP.G67
Location: WALL FLAT			Project no.:	LMR0214_WF
Position:			CPT no.:	1 1/3

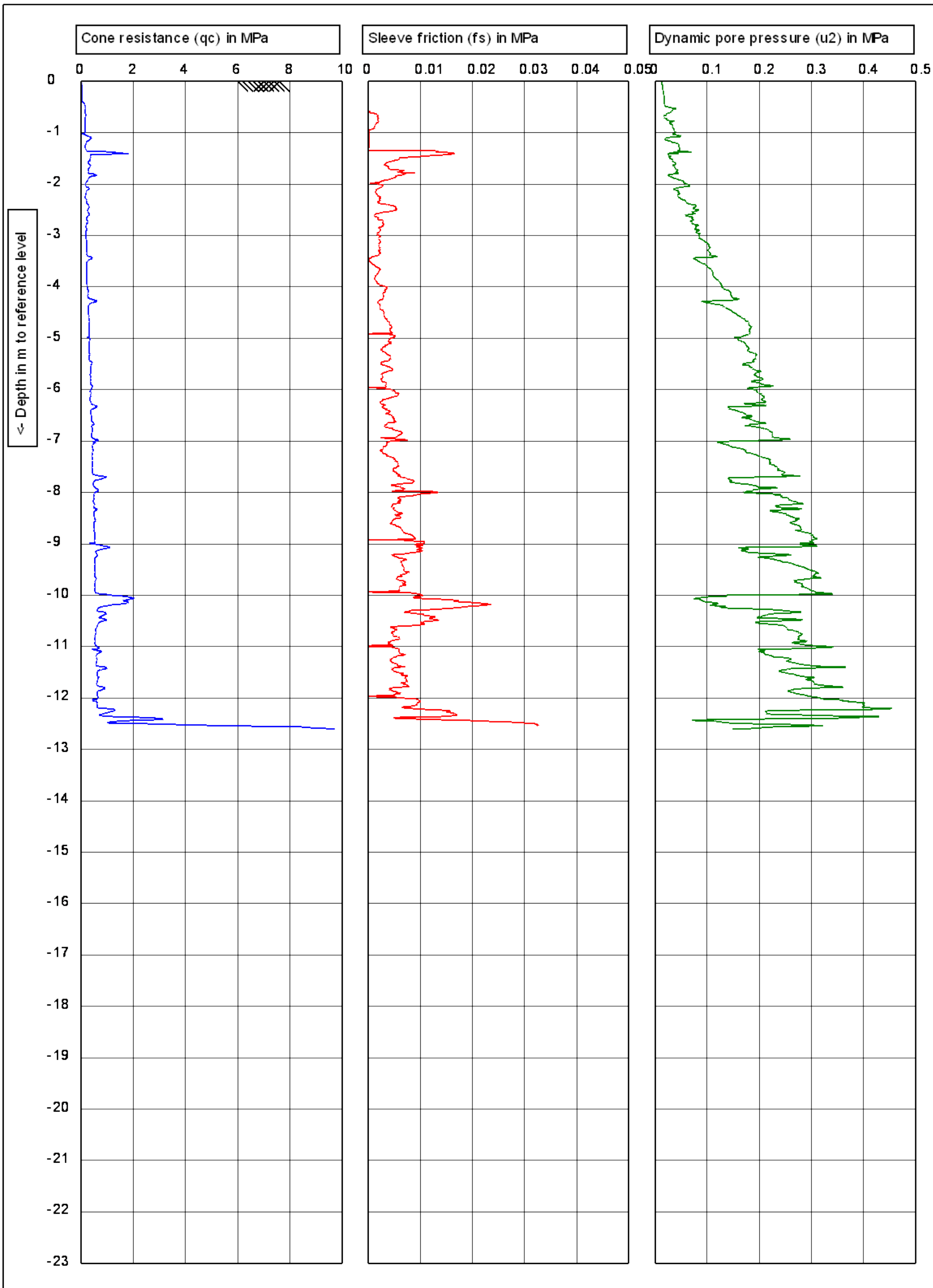


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIP.G67
Location: WALL FLAT			Project no.:	LMR0214_WF
Position:			CPT no.:	1 2/3

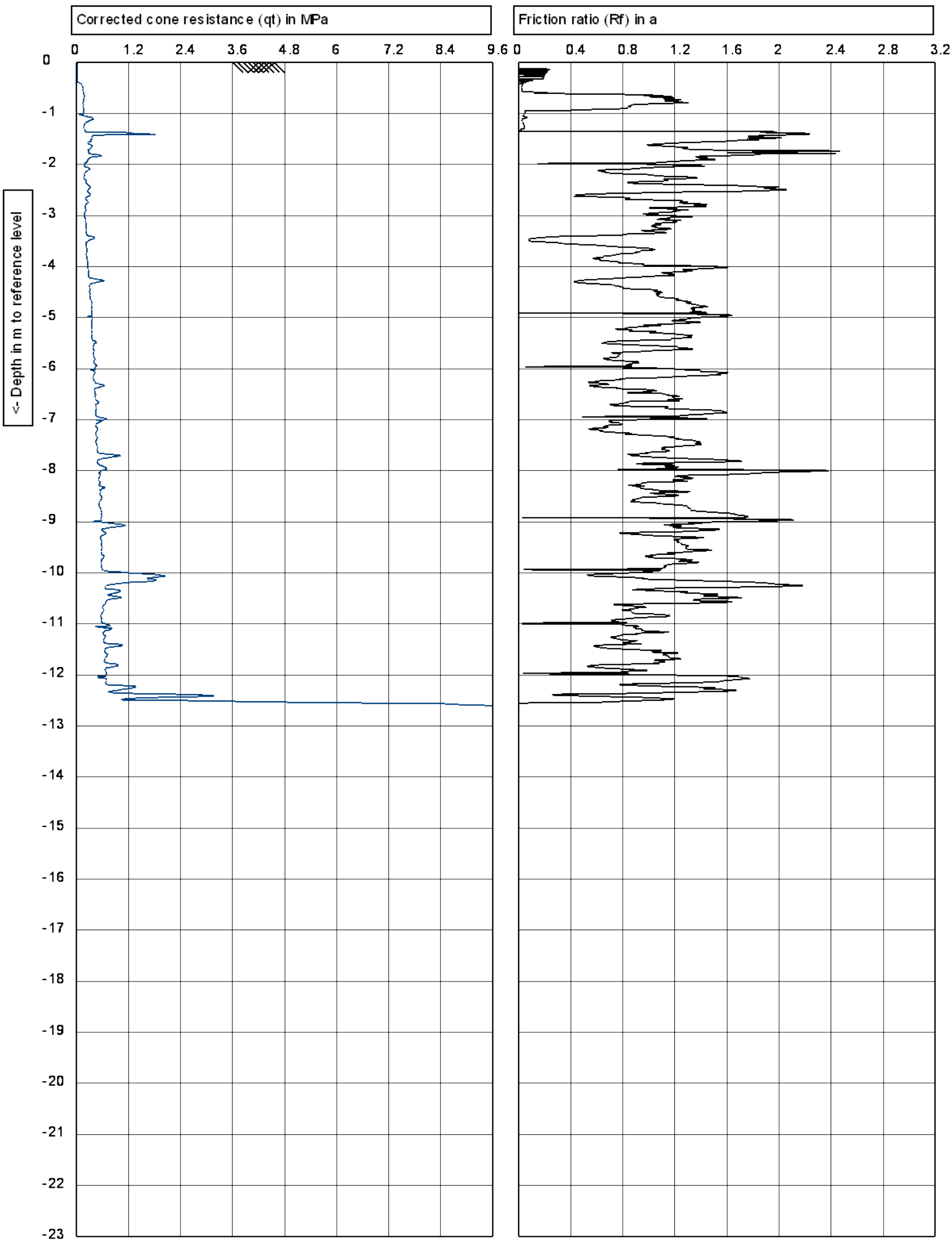


150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: 1	Date:	6/02/2014
Project: LMR0214		Cone no.:	C10CFIIP.G67
Location: WALL FLAT		Project no.:	LMR0214_WF
Position:		CPT no.:	1 3/3

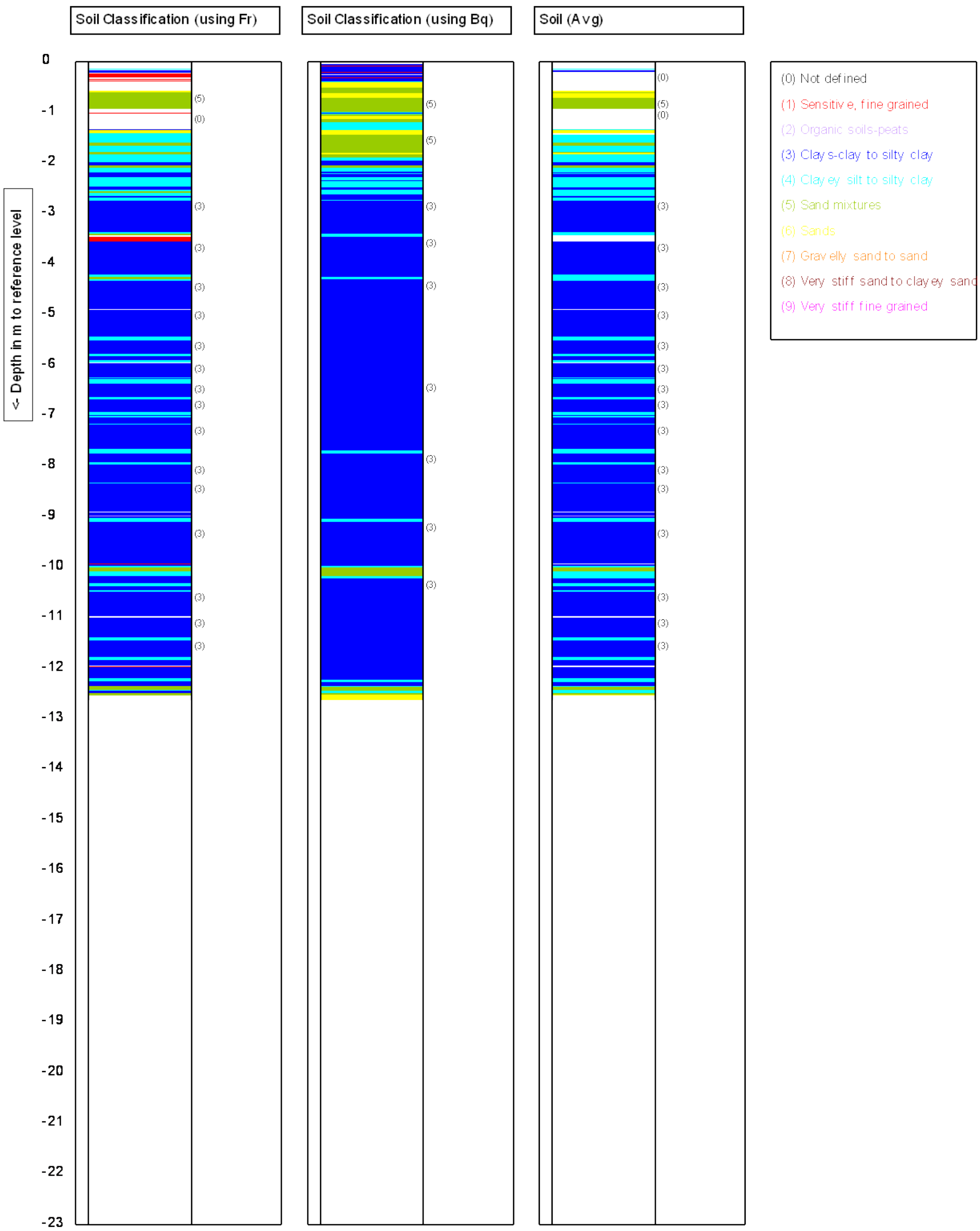
Appendix 14 Caloote — Cone Penetration Test Results



u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a05	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: NEETA IRRIGATION FLAT			Project no.:	LMR0214_NI
Position:			CPT no.:	1 — 1/3

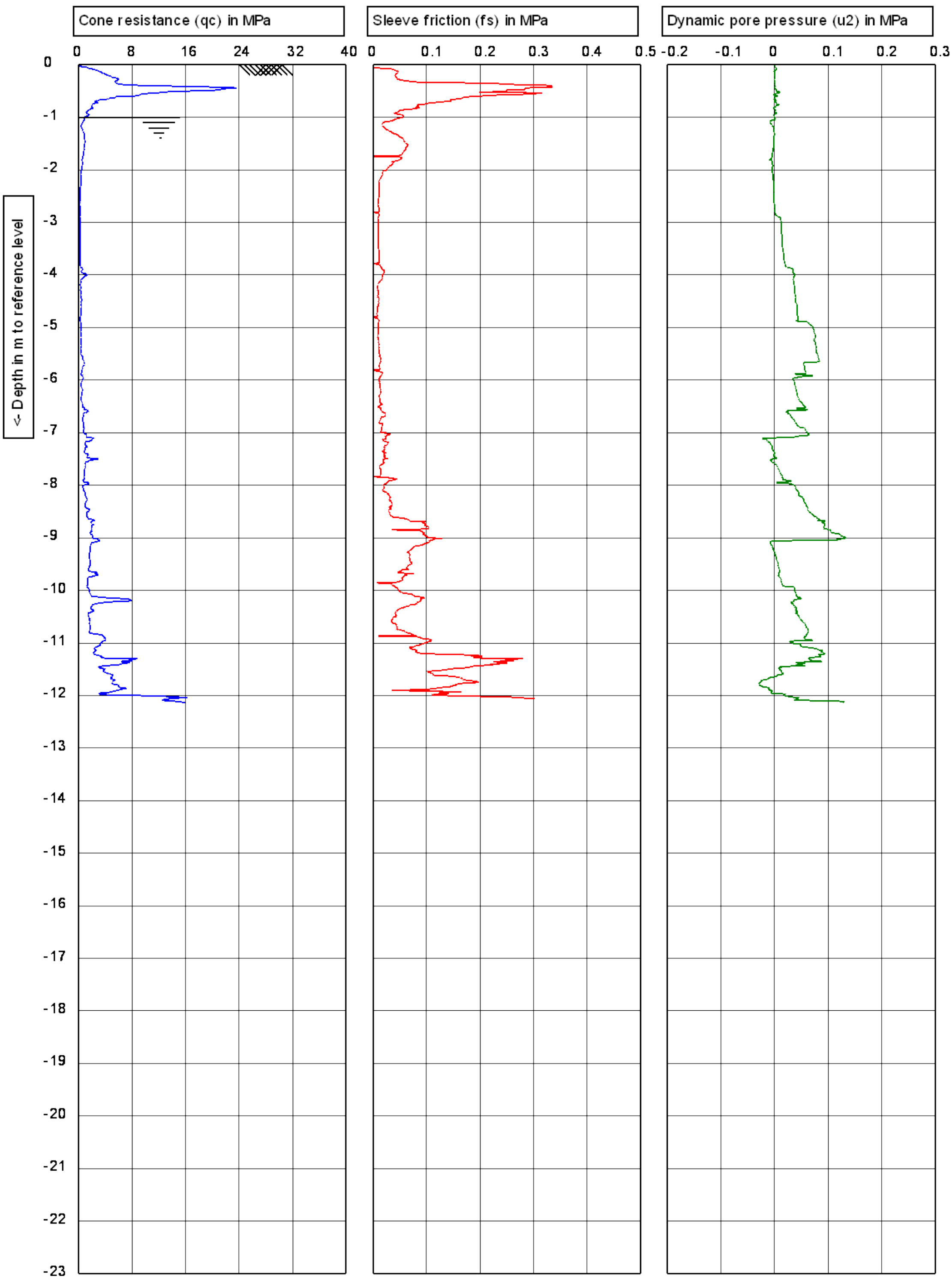


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 1a05	Date:	6/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: NEETA IRRIGATION FLAT			Project no.:	LMR0214_NI
Position:			CPT no.:	1 — 2/3

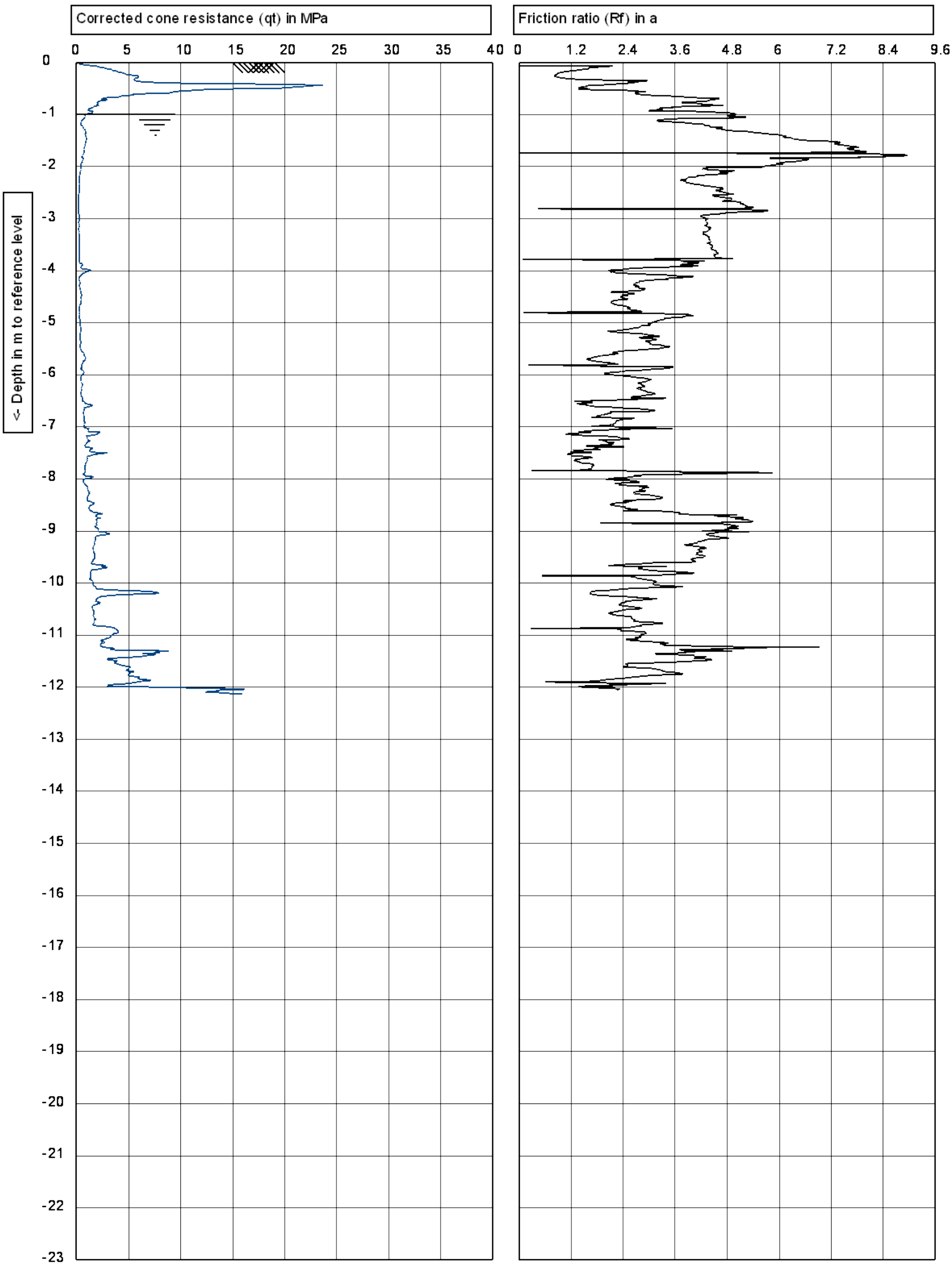


150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: 1a05	Date:	6/02/2014
	Project: LMR0214	Cone no.:	C10CFIIPaG67
	Location: NEETA IRRIGATION FLAT	Project no.:	LMR0214_NI
	Position:	CPT no.:	1 3/3

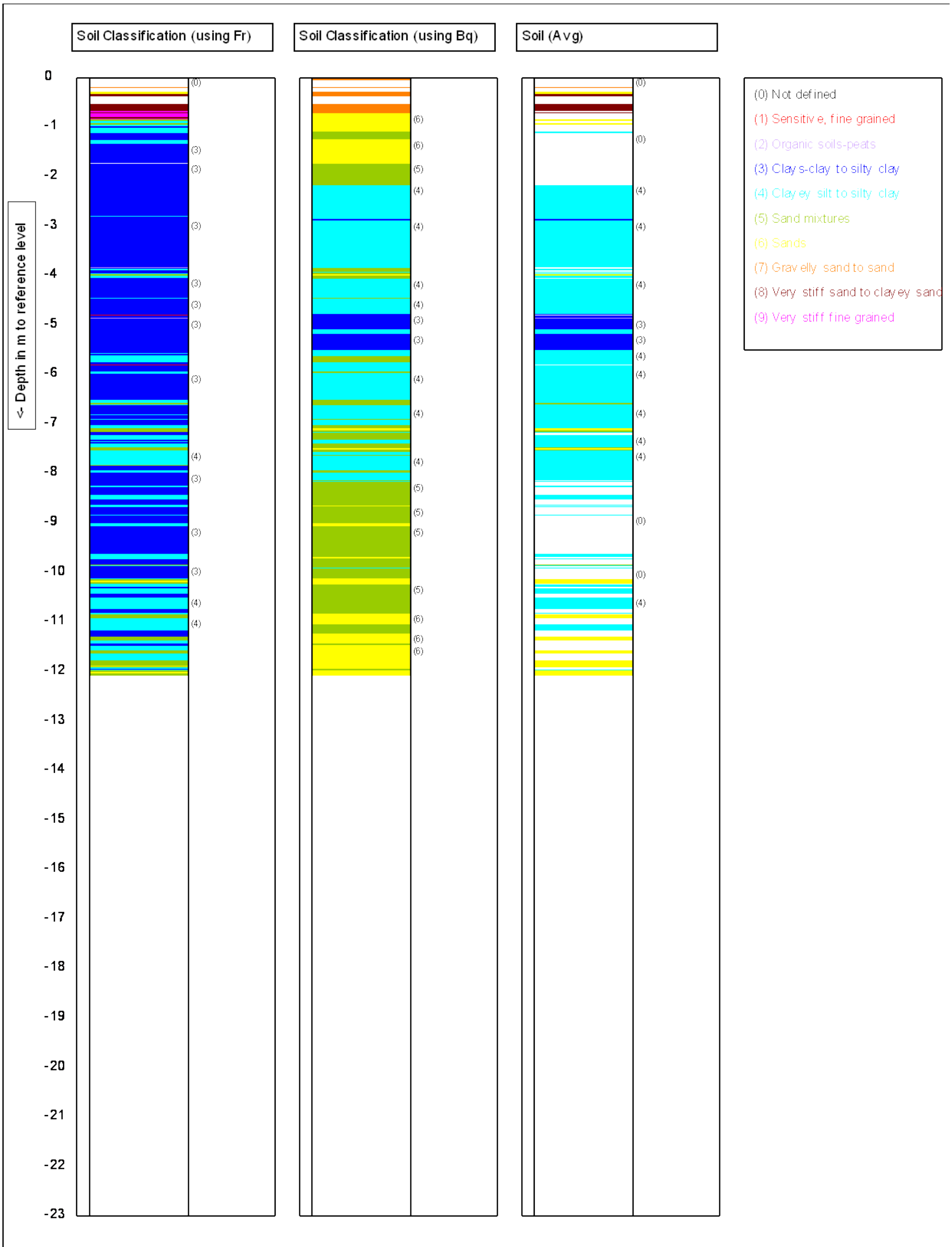
Appendix 15 Mannum — Cone Penetration Test Results



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a1	Date:	2/09/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Mannum			Project no.:	Mannum
Position:			CPT no.:	1 1/3

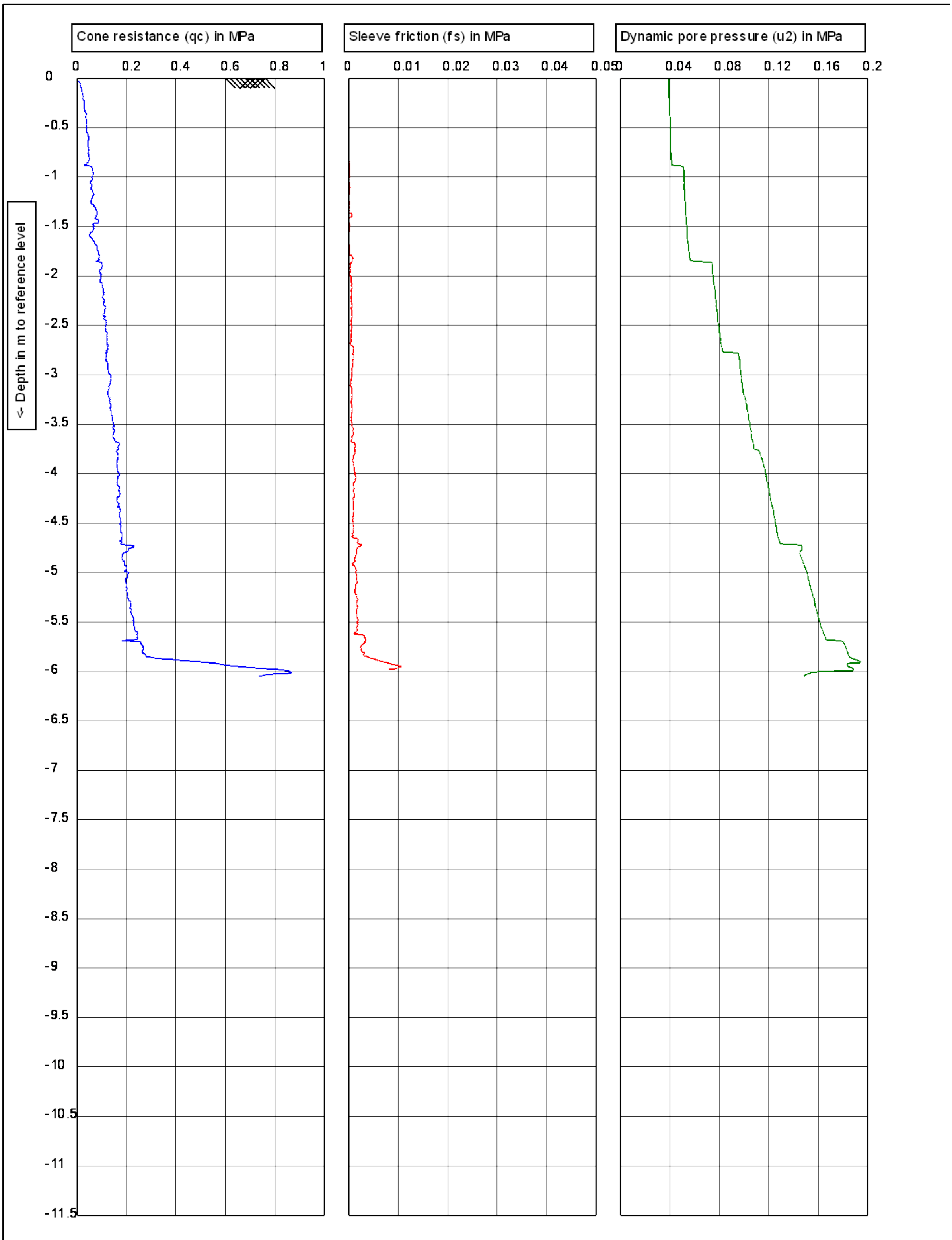


u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a1	Date:	2/09/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Mannum		Project no.:	Mannum
Position:			CPT no.:	1 2/3

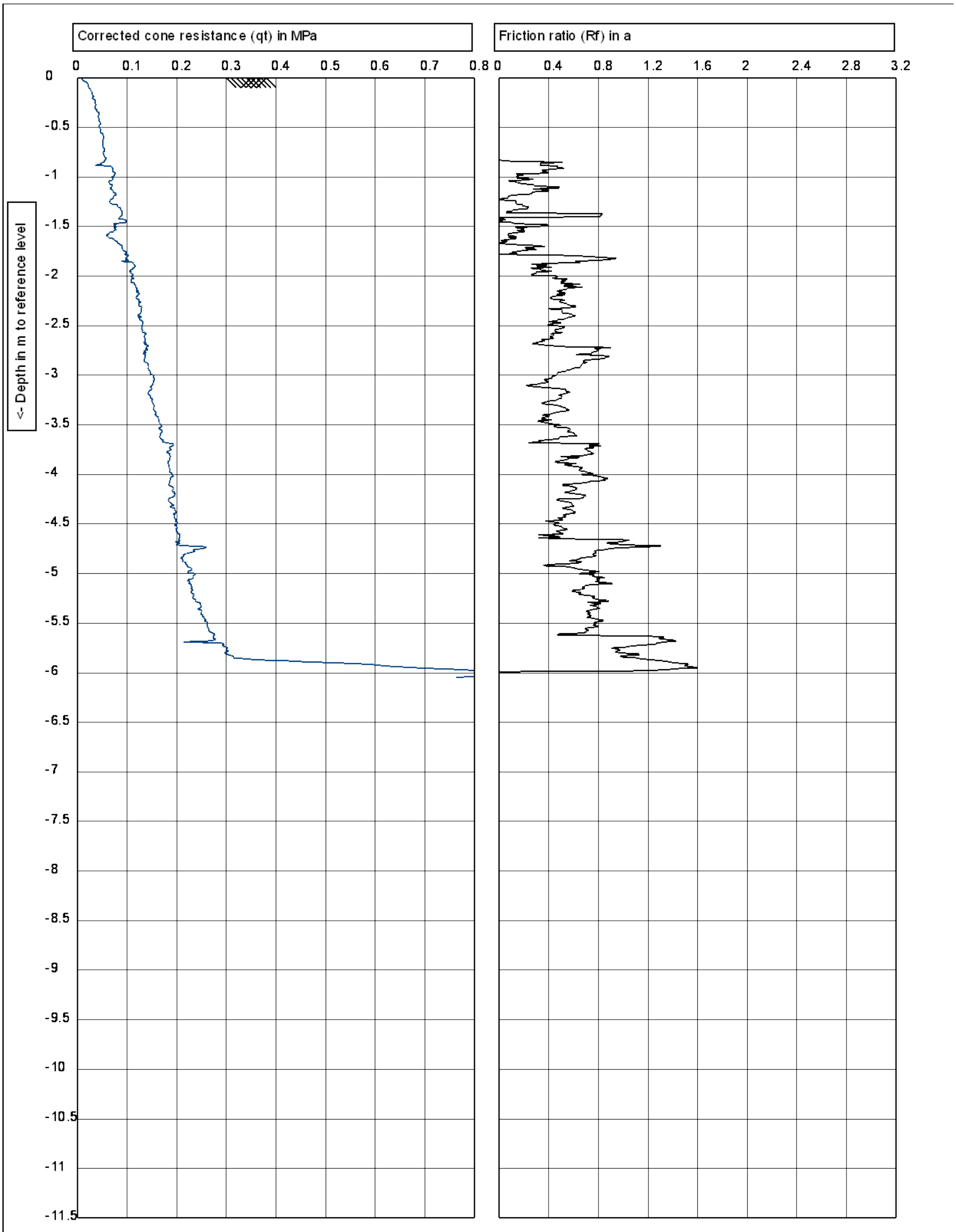


u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: a1	Date:	2/09/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Mannum		Project no.:	Mannum
Position:			CPT no.:	1	3/3

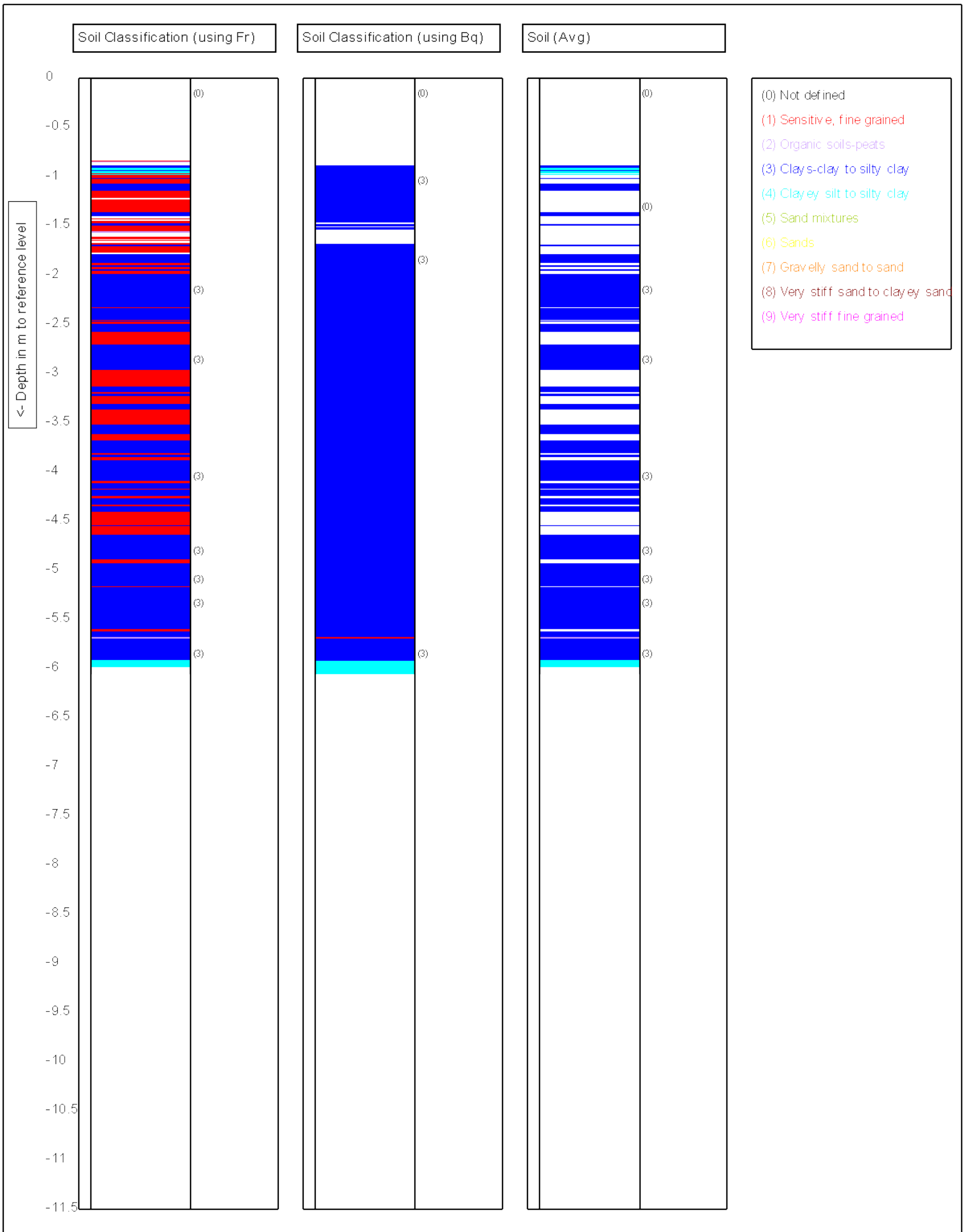
Appendix 16 East Front Road – Cone Penetration Test Results



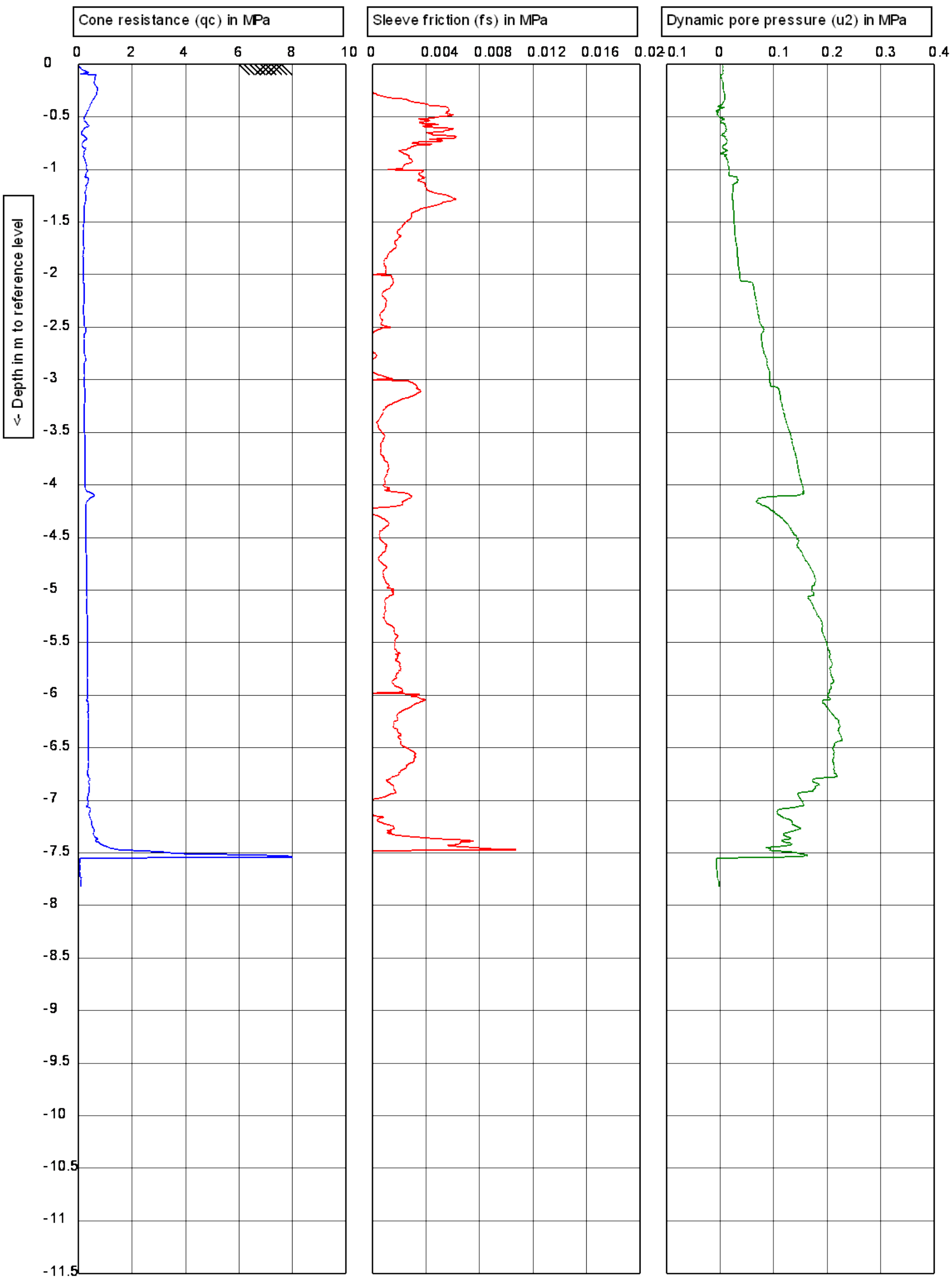
Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP W.L.: 3.83	Date:	10/05/2013
Project: LMR0513 East Front Rd	Cone no.:	C10CFIIP.G67
Location: EFR	Project no.:	LMR0513aEFR
Position:	CPT no.:	1 — 1/3



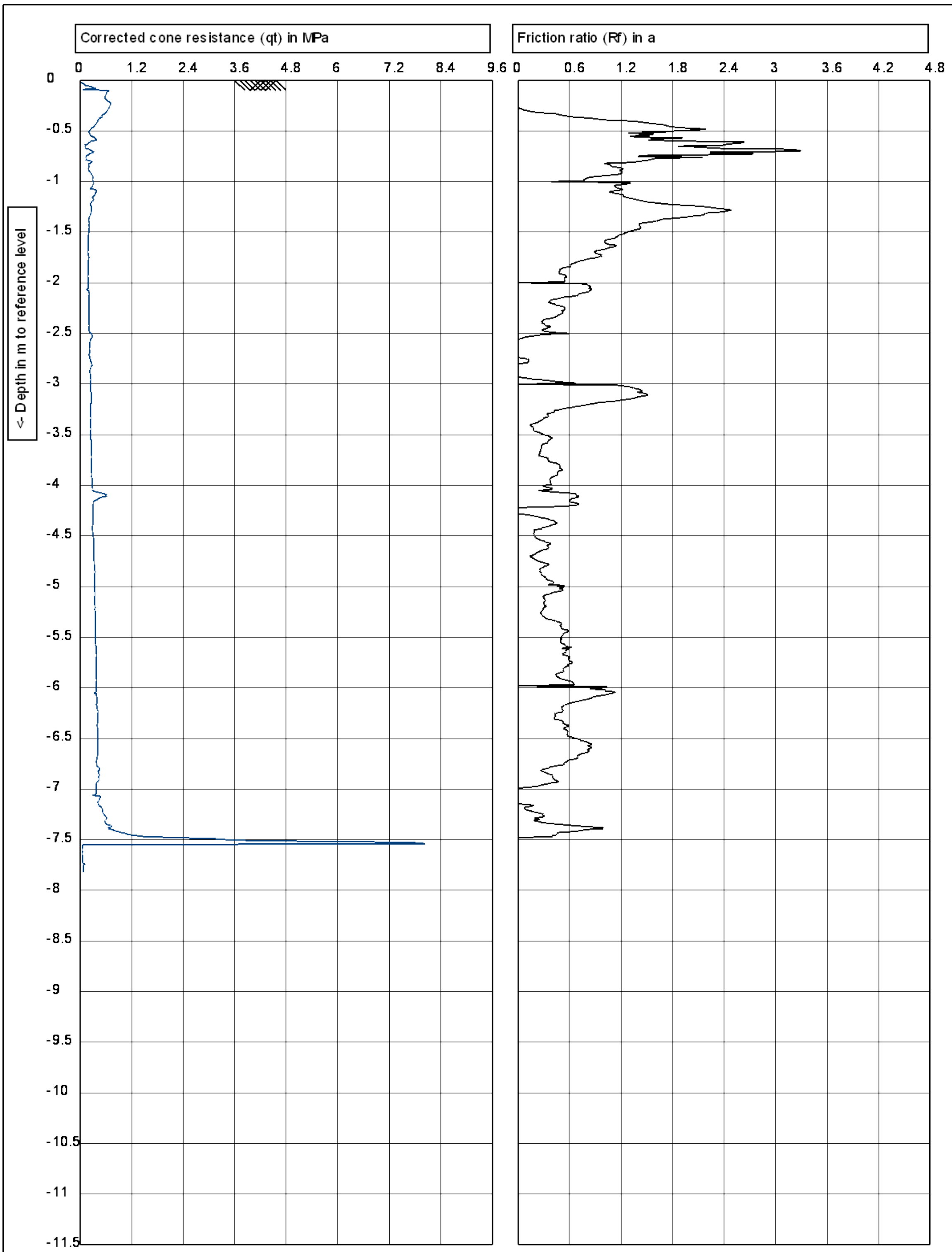
ru2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 3.83	Date:	10/05/2013
Project: LMR0513 East Front Rd			Cone no.:	C10CFIIP.G67
Location: EFR			Project no.:	LMR0513aEFR
Position:			CPT no.:	1 2/3



	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L.: 0 NAP / W.L.: 3.83	Date:	10/05/2013
Project: LMR0513 East Front Rd		Cone no.:	C10CFIIP.G67
Location: EFR		Project no.:	LMR0513aEFR
Position:		CPT no.:	1 — 3/3



u2 / 150 cm² / 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date:	7/02/2014
Project:	LMR0214		Cone no.:	C10CFIIPaG67
Location:	EAST FRONT ROAD		Project no.:	LMR0214_EFR
Position:			CPT no.:	1 — 1/3



Test according NEN 5140 class 1

G.L. 0 NAP W.L.: 0a6

Project: LMR0214

Location: EAST FRONT ROAD

Position:

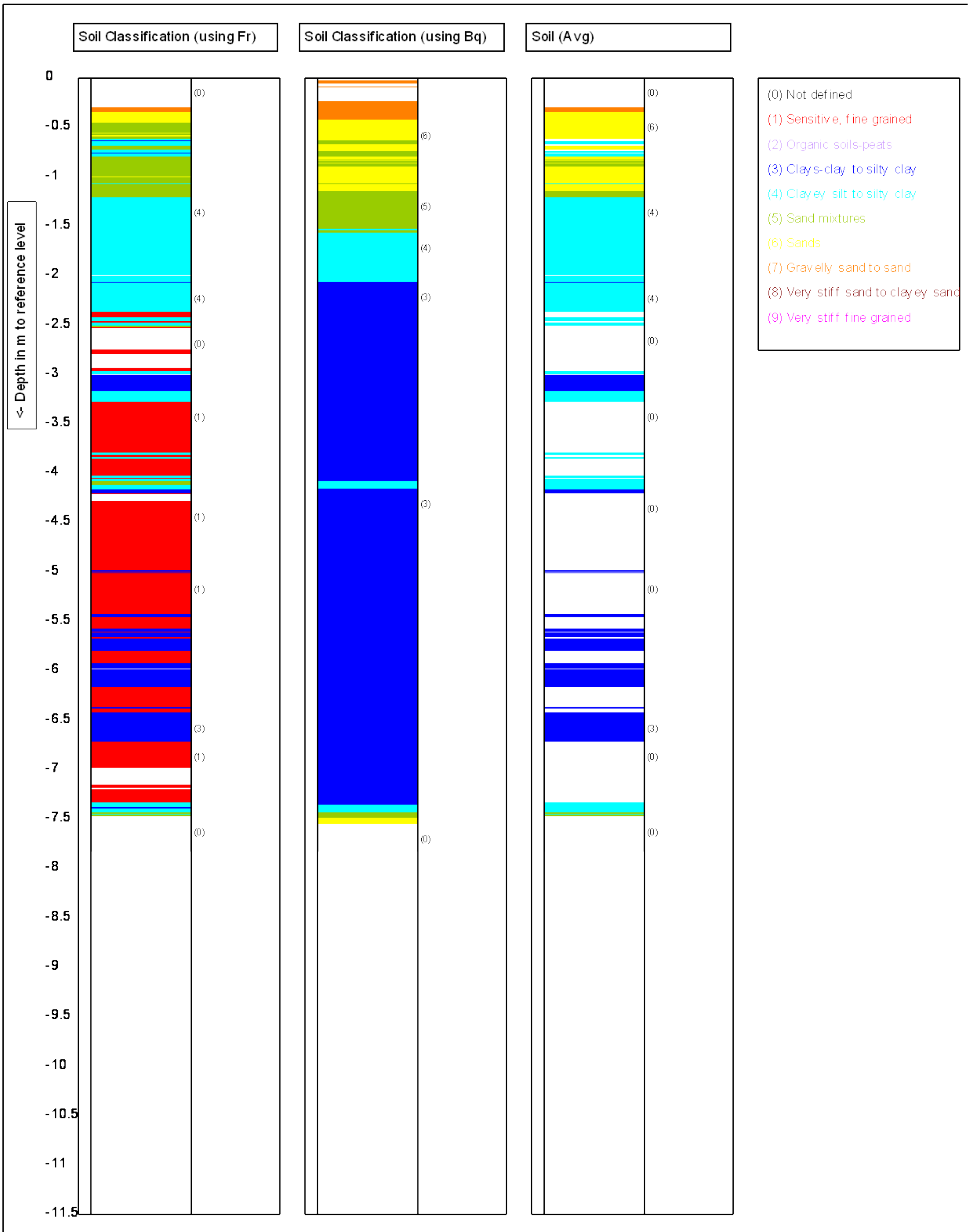
Predrill : 0 m Predrilled

Date: 7/02/2014

Cone no.: C10CFIIPaG67

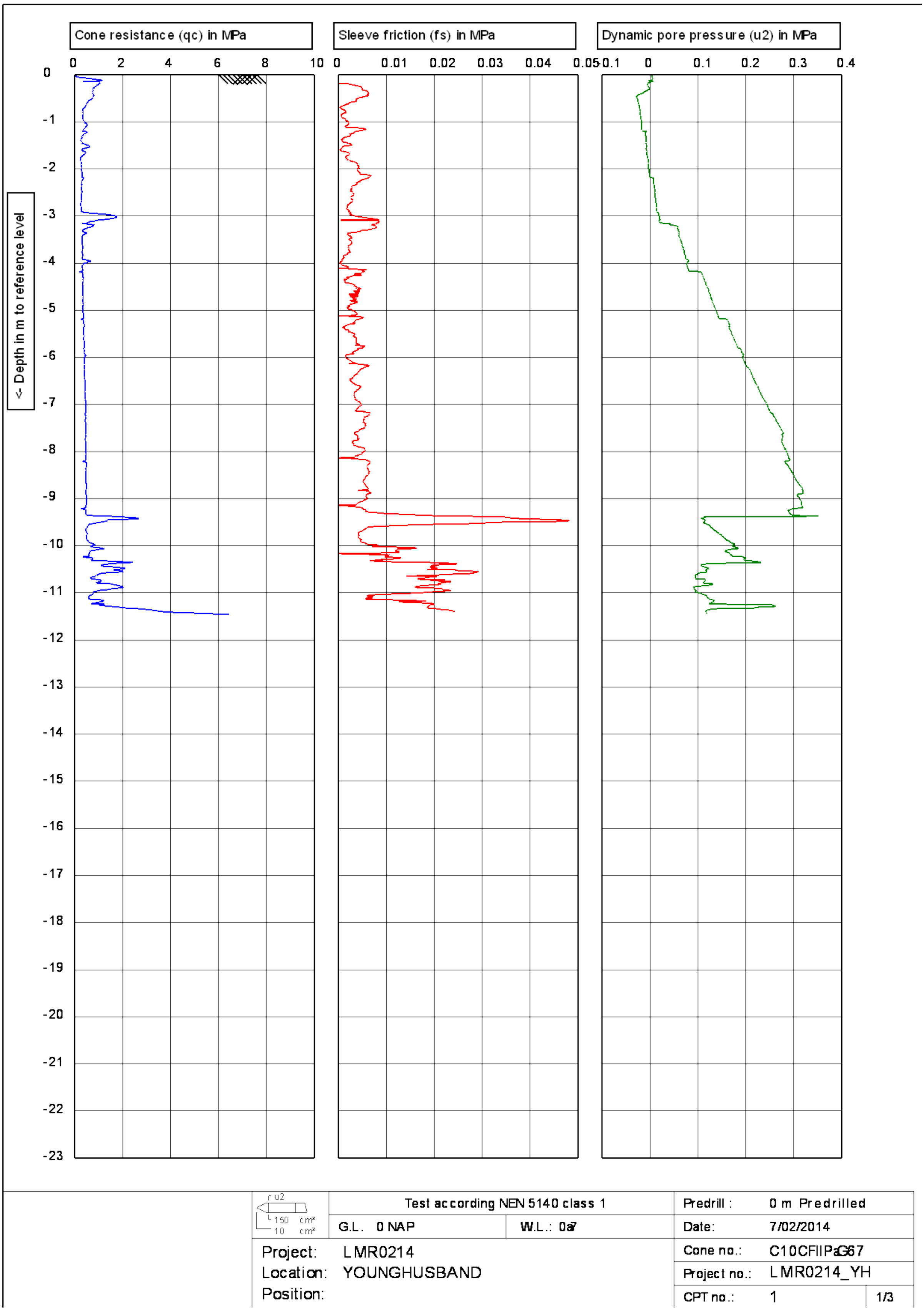
Project no.: LMR0214_EFR

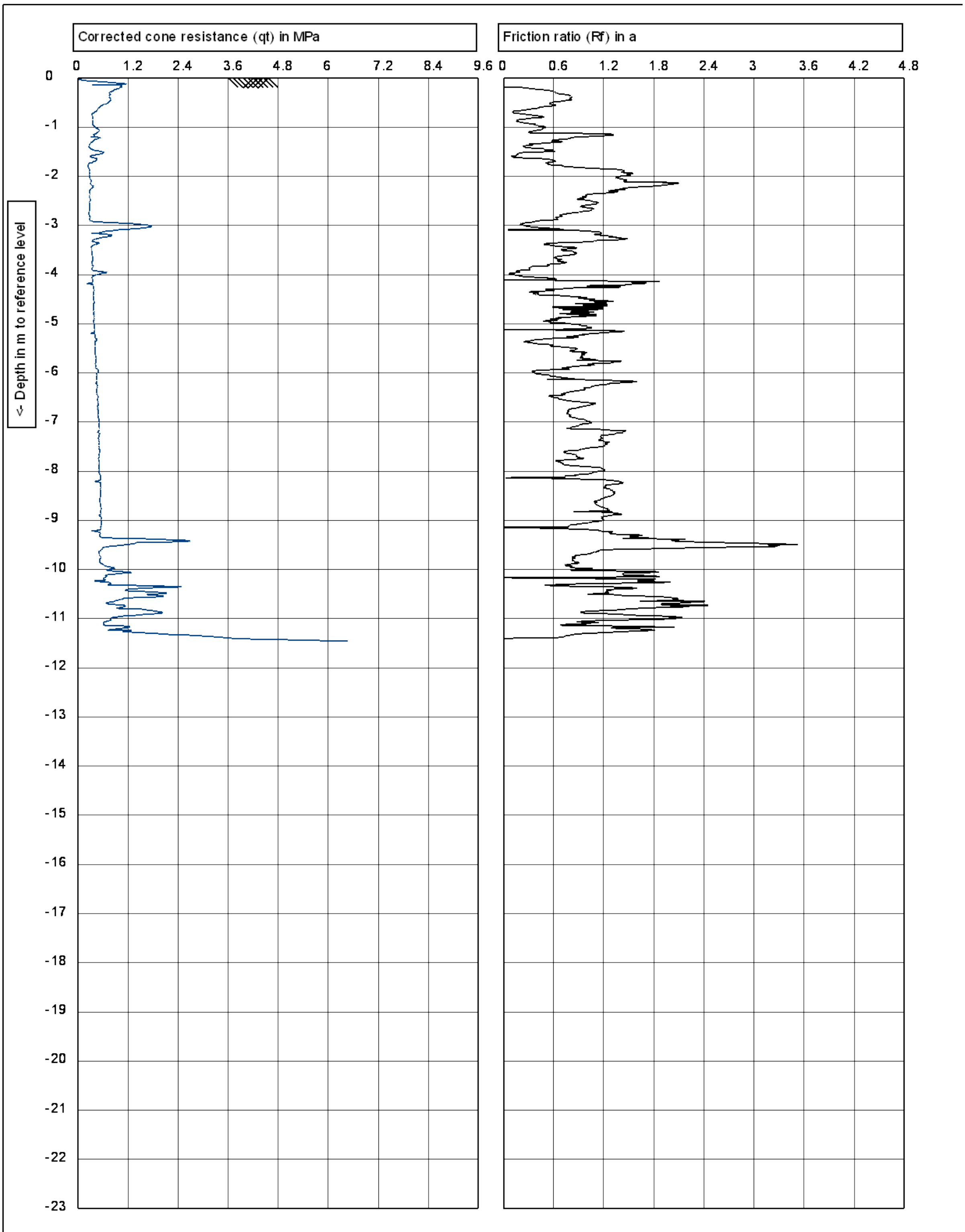
CPT no.: 1 2/3



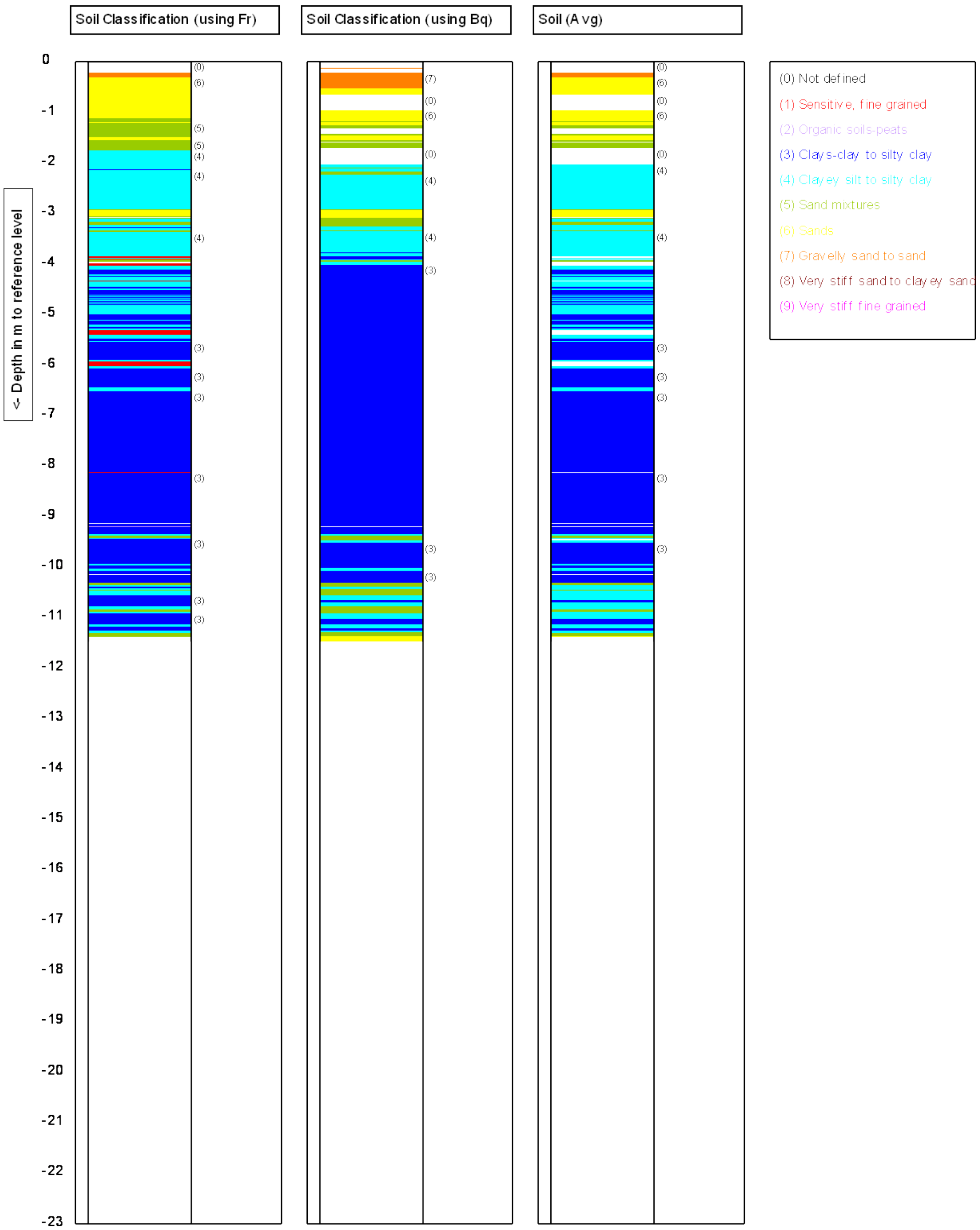
Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a6	Date:	7/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: EAST FRONT ROAD		Project no.:	LMR0214_EFR
Position:		CPT no.:	1 — 3/3

Appendix 17 Younghusband — Cone Penetration Test Results

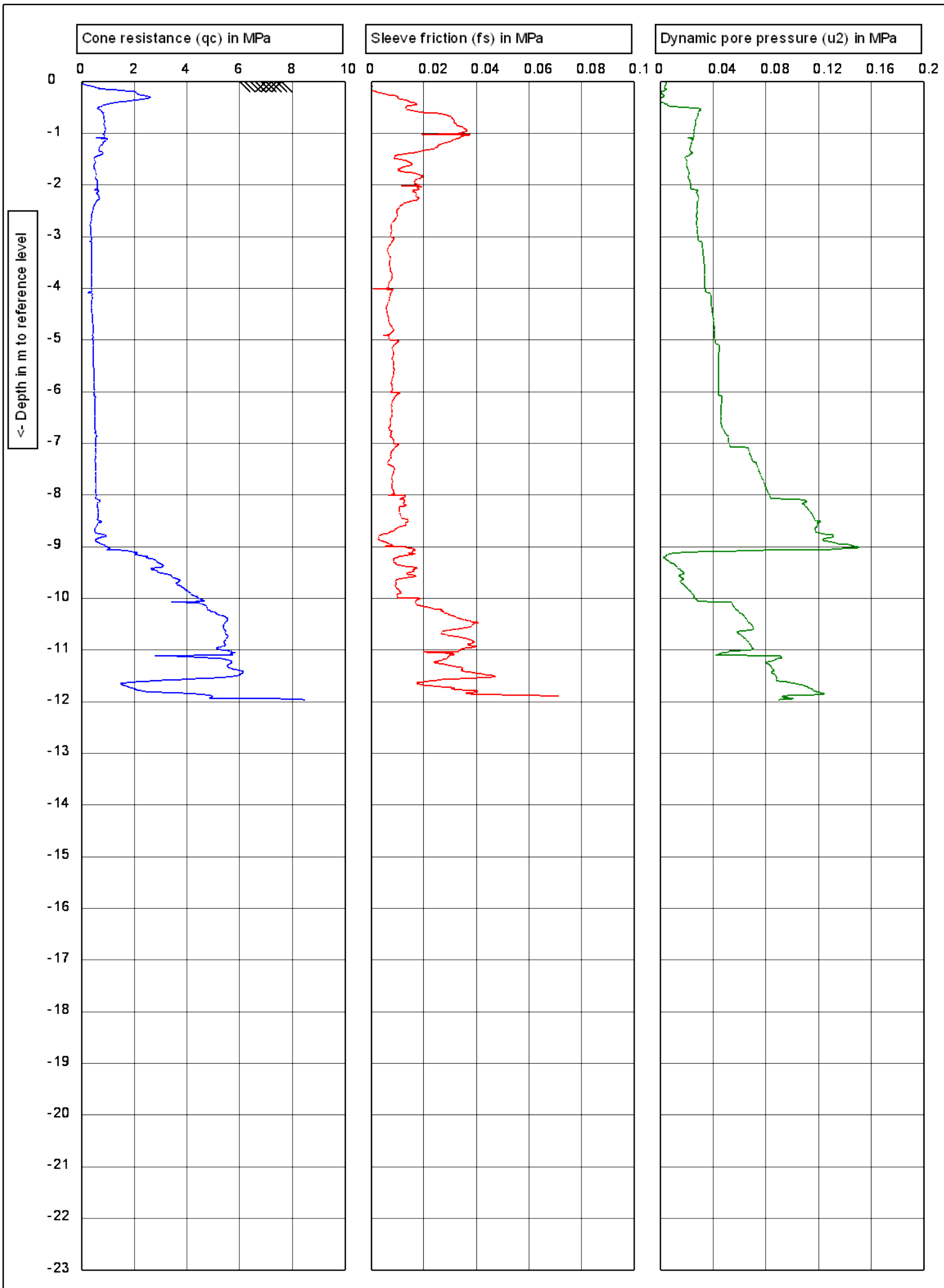




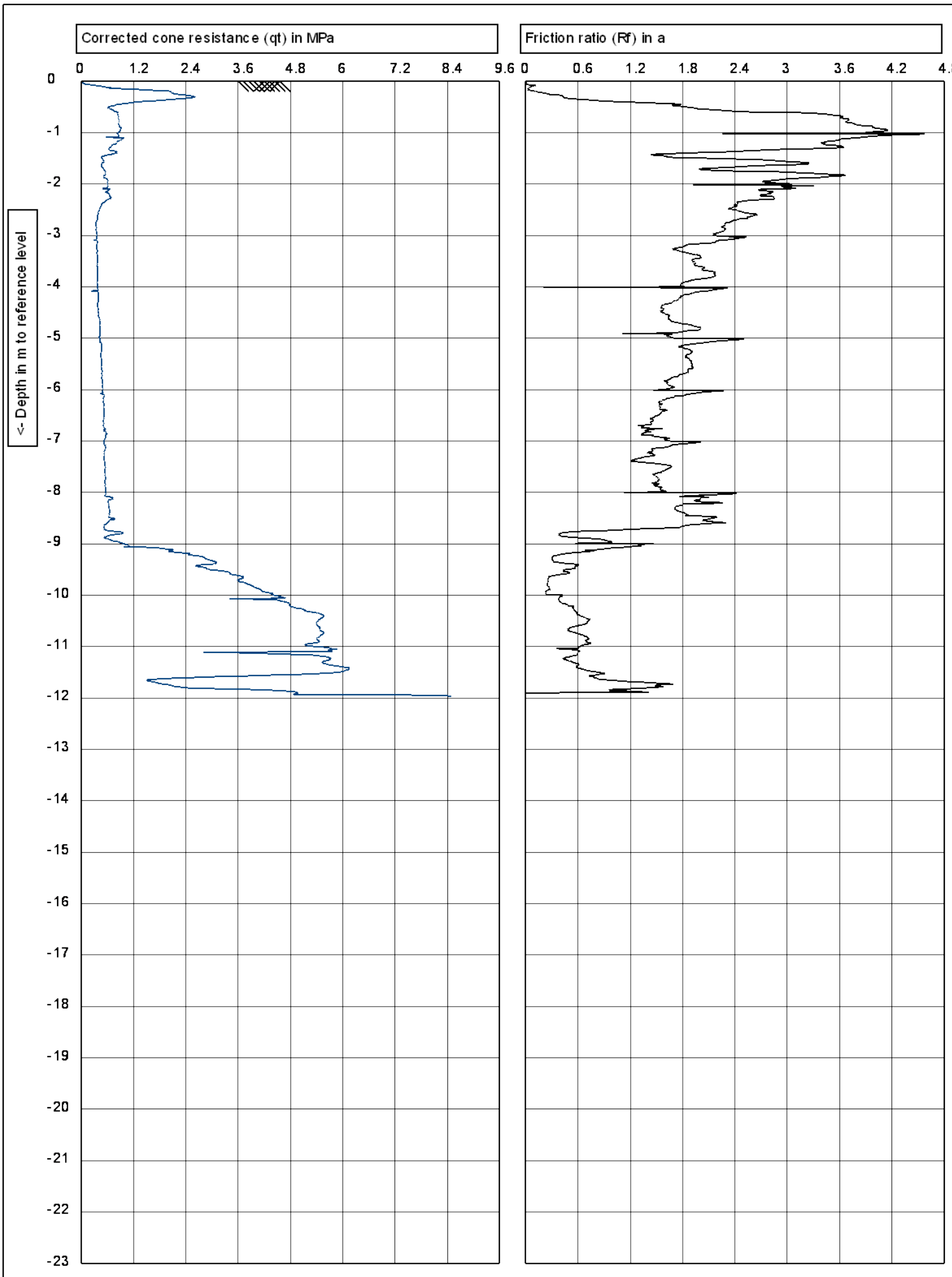
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a7	Date:	7/02/2014
Project: LMR0214			Cone no.:	C10CFIIPaG67
Location: YOUNGHUSBAND			Project no.:	LMR0214_YH
Position:			CPT no.:	1 2/3



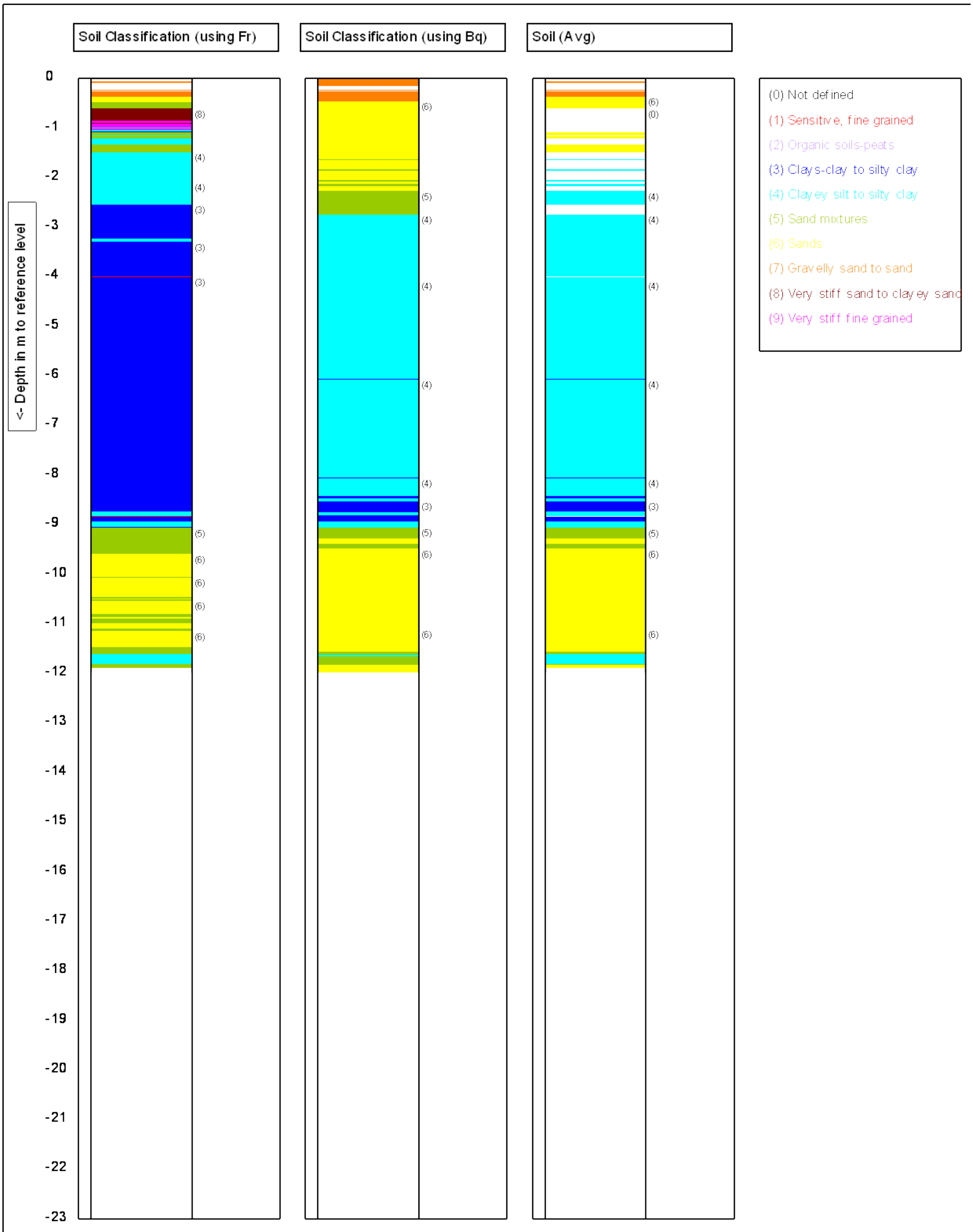
Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a7	Date:	7/02/2014
Project: LMR0214		Cone no.:	C10CFIIPaG67
Location: YOUNGHUSBAND		Project no.:	LMR0214_YH
Position:		CPT no.:	1 — 3/3



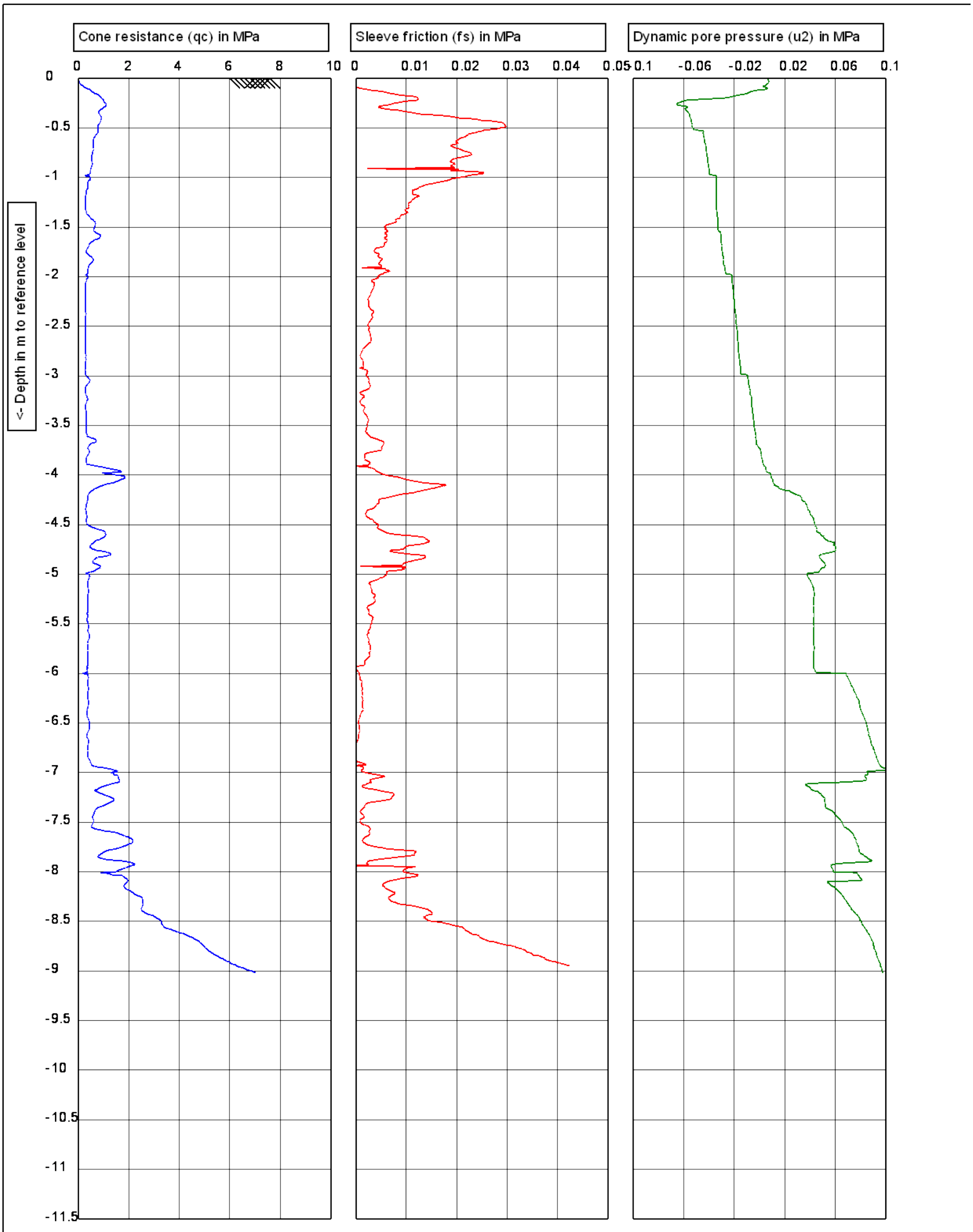
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	26/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Younghusband			Project no.:	LMR0314
Position:			CPT no.:	YH2 1/3



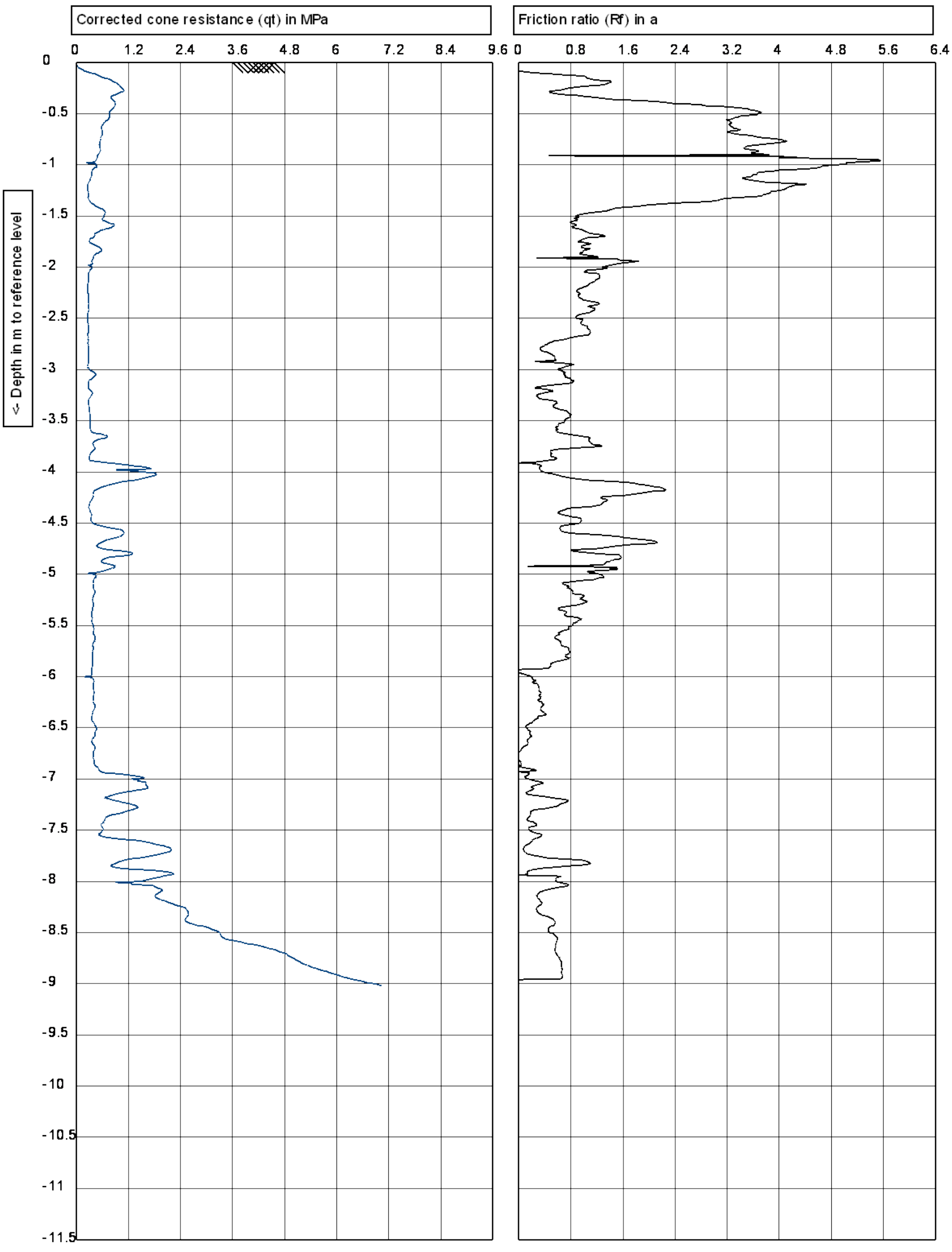
150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	26/03/2014
Project:	LMR0314		Cone no.:	C10CFIIPaG67
Location:	Younghusband		Project no.:	LMR0314
Position:			CPT no.:	YH2 2/3



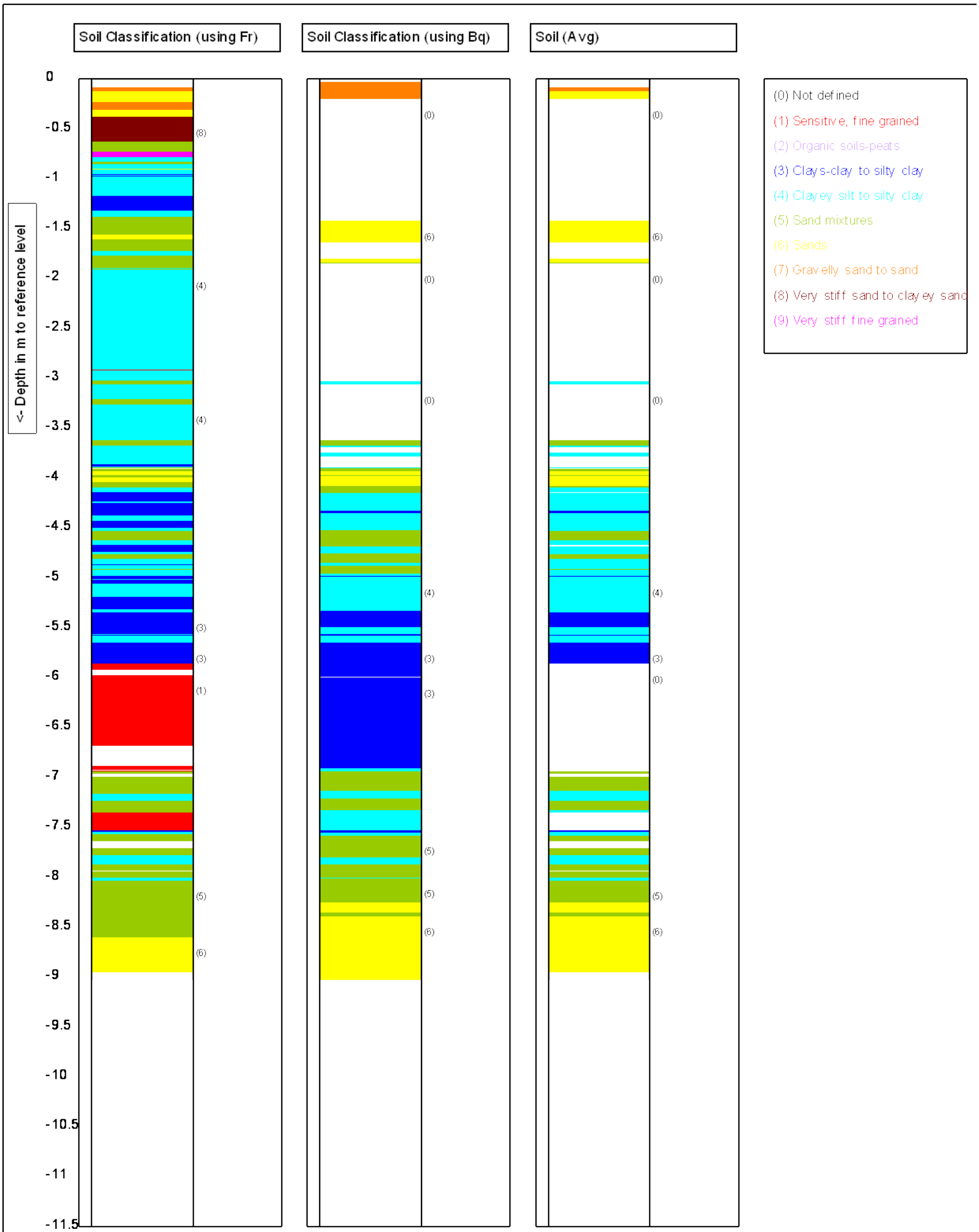
	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
150 cm² 10 cm²	G.L. 0 NAP W.L.: 0a4	Date:	26/03/2014
Project: LMR0314		Cone no.:	C10CFIIPaG67
Location: Younghusband		Project no.:	LMR0314
Position:		CPT no.:	YH2 3/3



Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a45	Date:	26/03/2014
Project:	LMR0314	Cone no.:	C10CFIIPaG67
Location:	Younghusband	Project no.:	LMR0314
Position:		CPT no.:	YH3 1/3

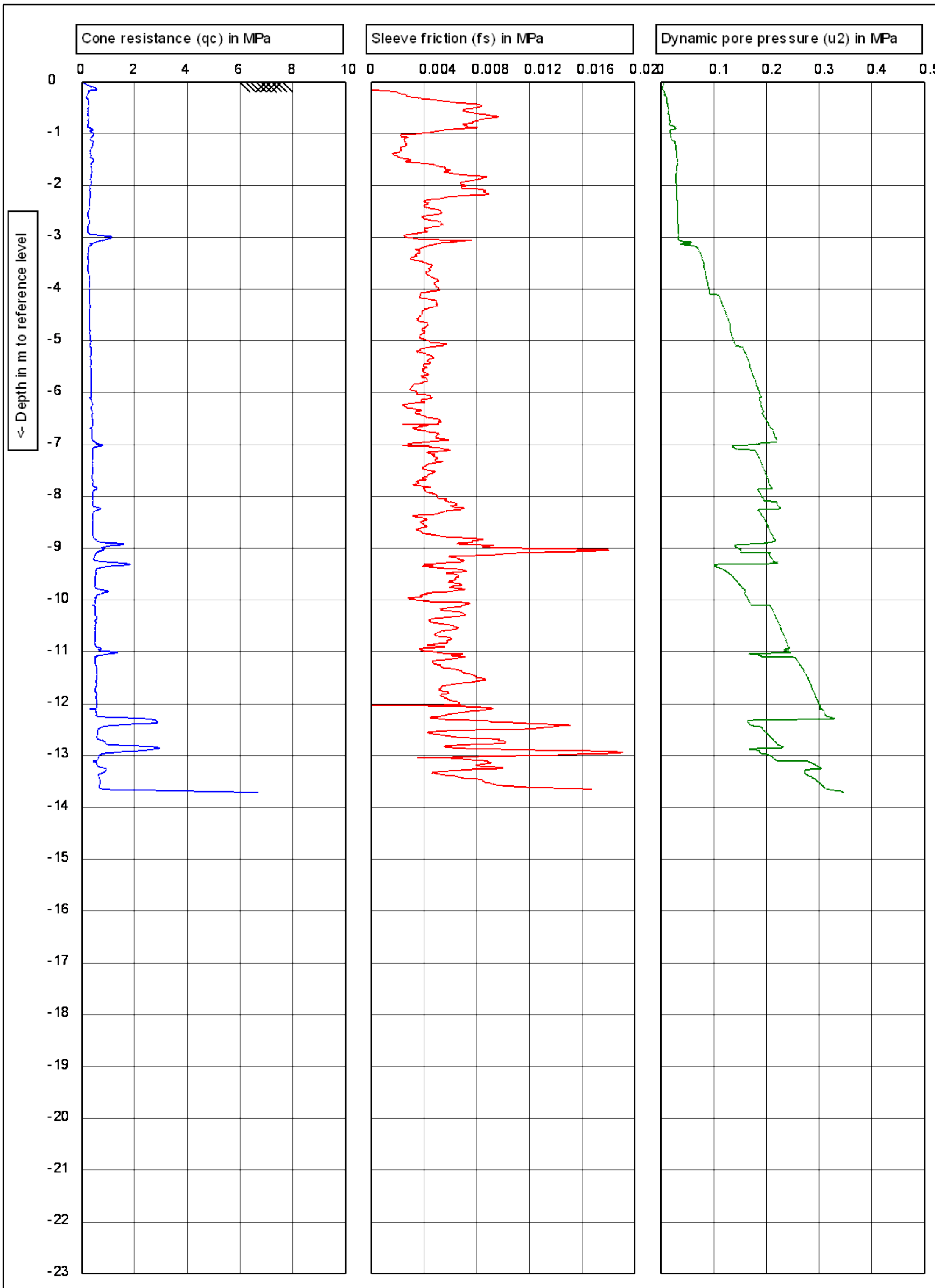


Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a45	Date:	26/03/2014
Project: LMR0314		Cone no.:	C10CFIIPaG67
Location: Younghusband		Project no.:	LMR0314
Position:		CPT no.:	YH3 2/3

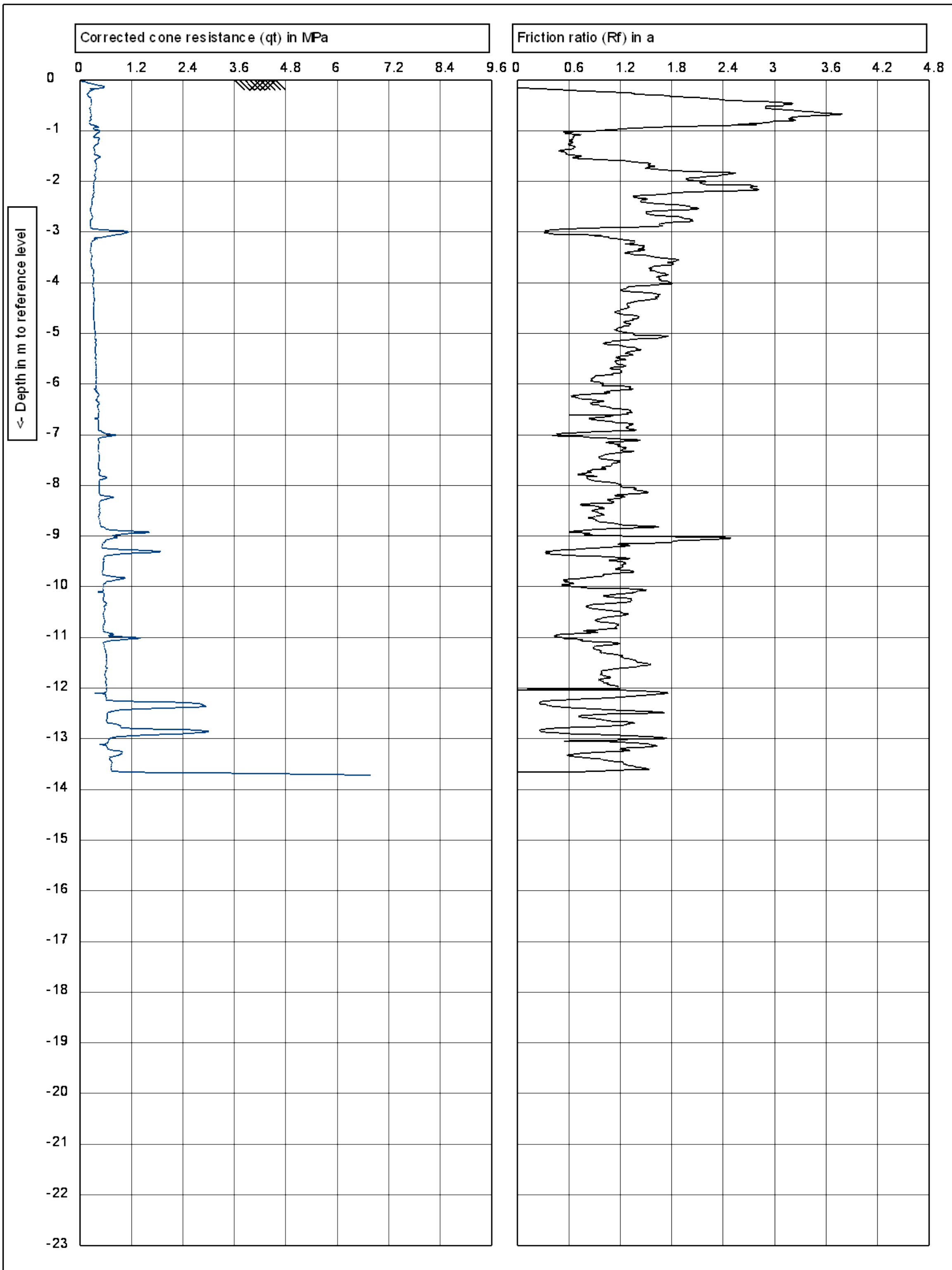


Test according NEN 5140 class 1		Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a45	Date:	26/03/2014
Project: LMR0314		Cone no.:	C10CFIIPaG67
Location: Younghusband		Project no.:	LMR0314
Position:		CPT no.:	YH3 3/3

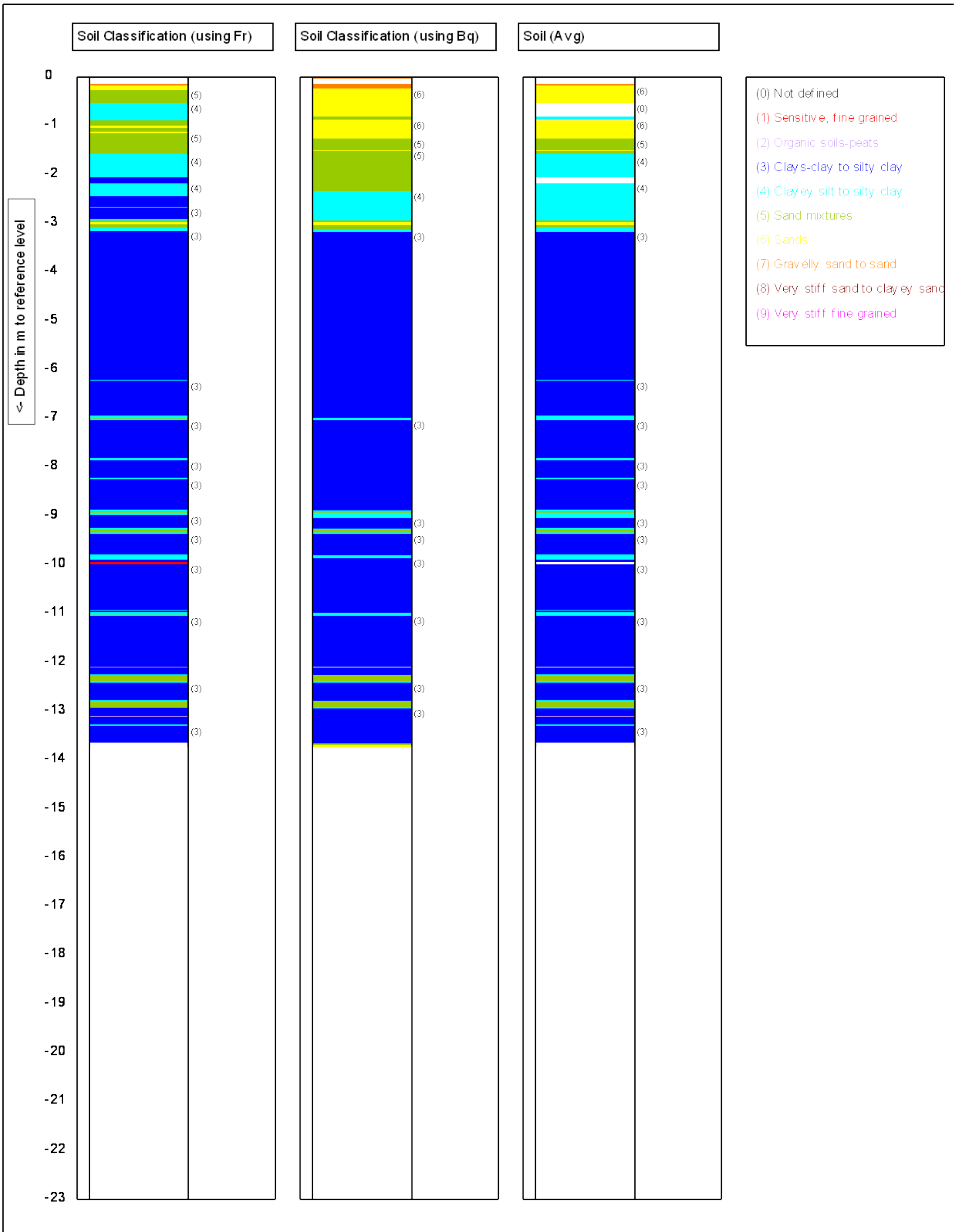
Appendix 18 Bowhill — Cone Penetration Test Results



r u2 / 150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill : 0 m Predrilled
G.L. 0 NAP	W.L.: 0a4	Date: 25/03/2014
Project: LMR0314		Cone no.: C10CFIIPaG67
Location: BowHill		Project no.: LMR0314
Position:		CPT no.: BH1 — 1/3

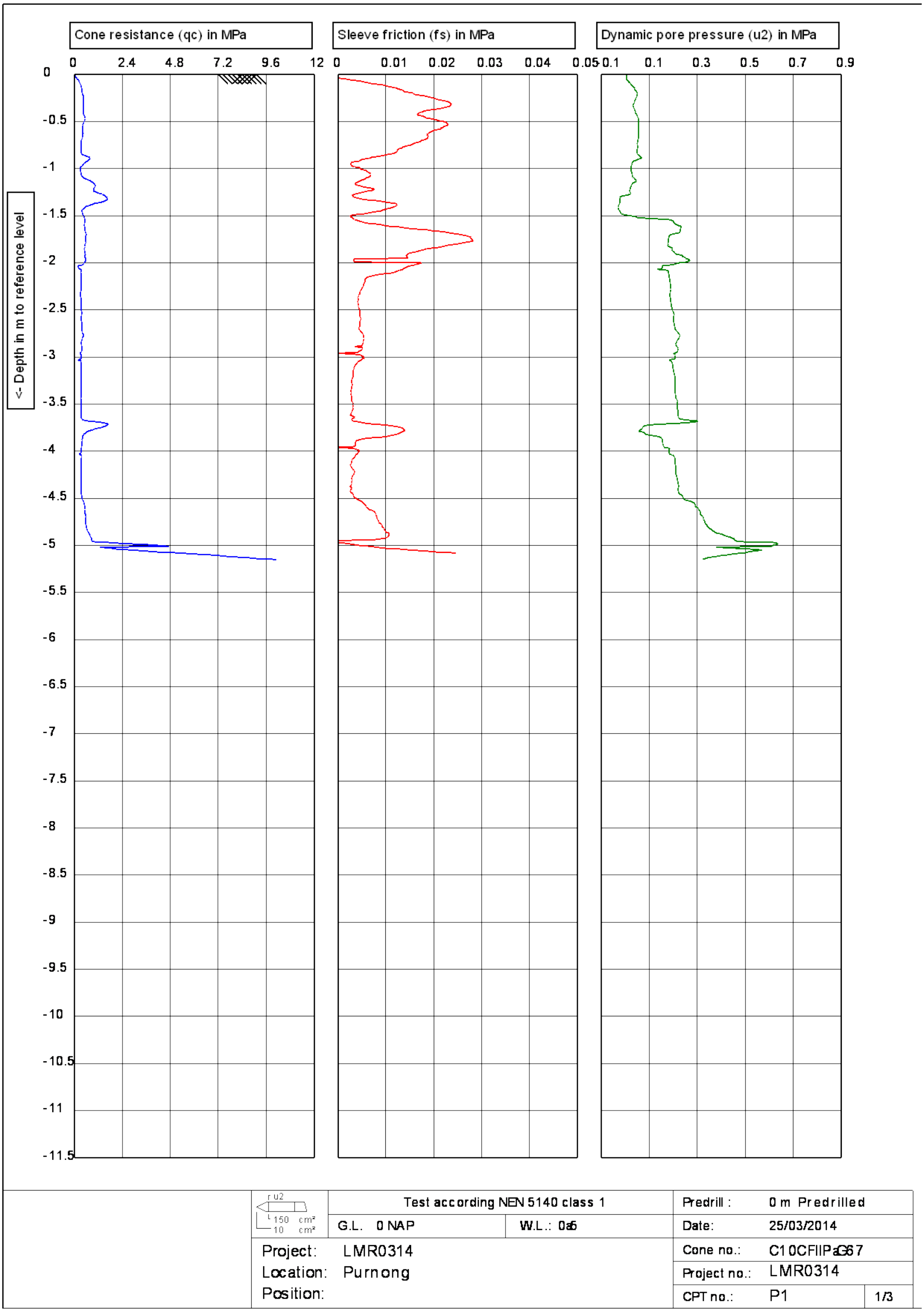


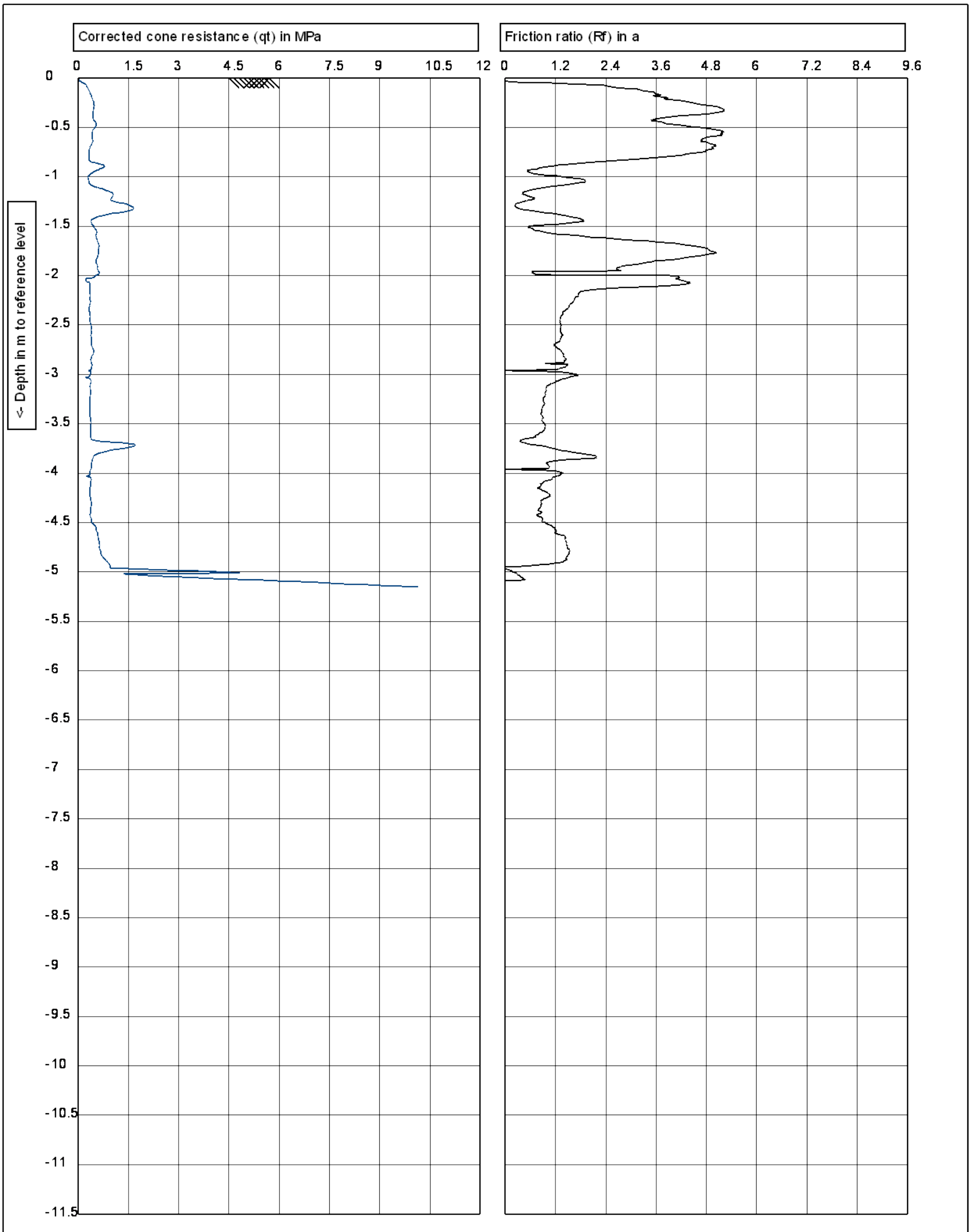
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	25/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Bow Hill			Project no.:	LMR0314
Position:			CPT no.:	BH1 2/3



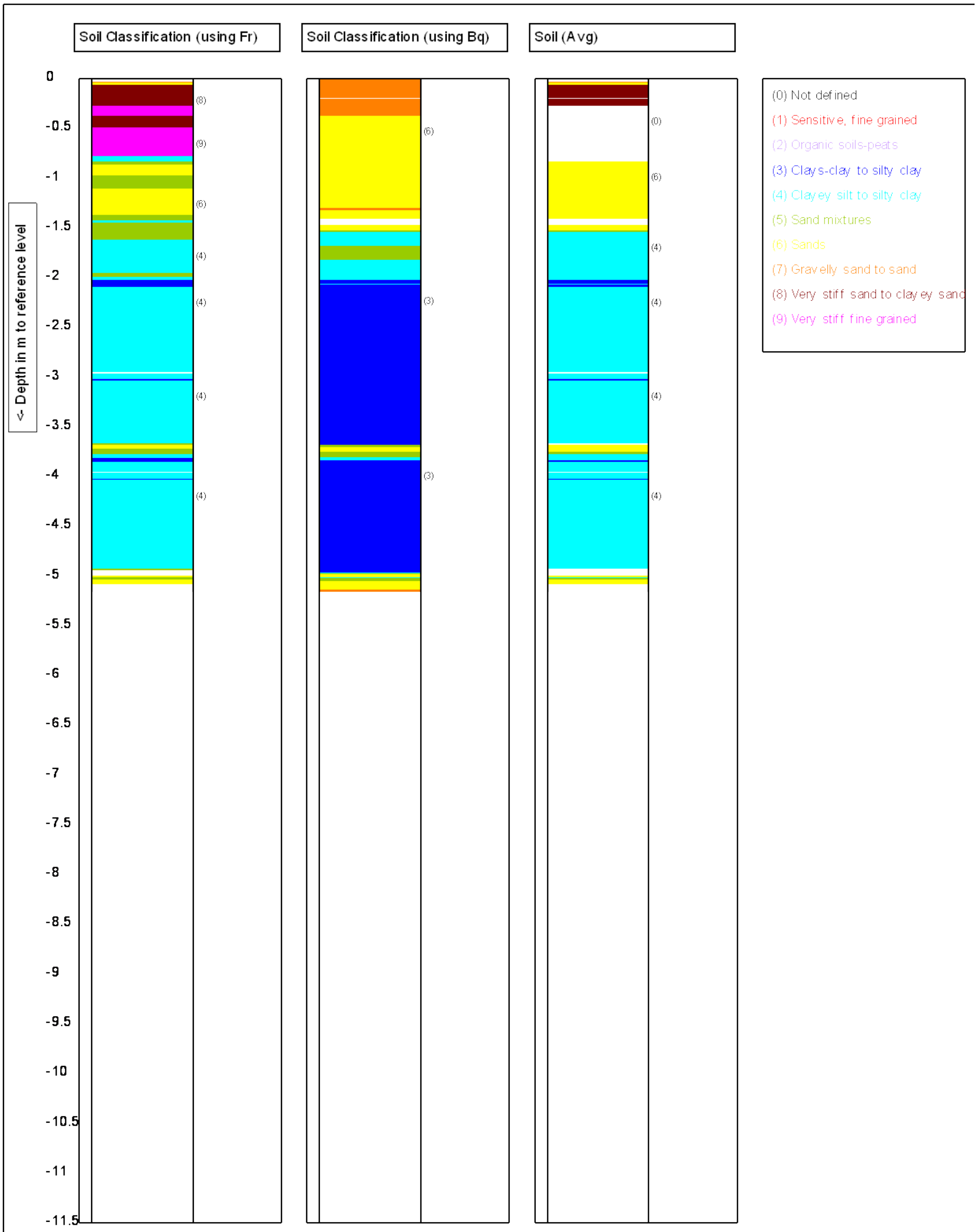
150 cm² / 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a4	Date:	25/03/2014
Project:	LMR0314		Cone no.:	C10CFIIPaG67
Location:	Bow Hill		Project no.:	LMR0314
Position:			CPT no.:	BH1 3/3

Appendix 19 Purnong — Cone Penetration Test Results



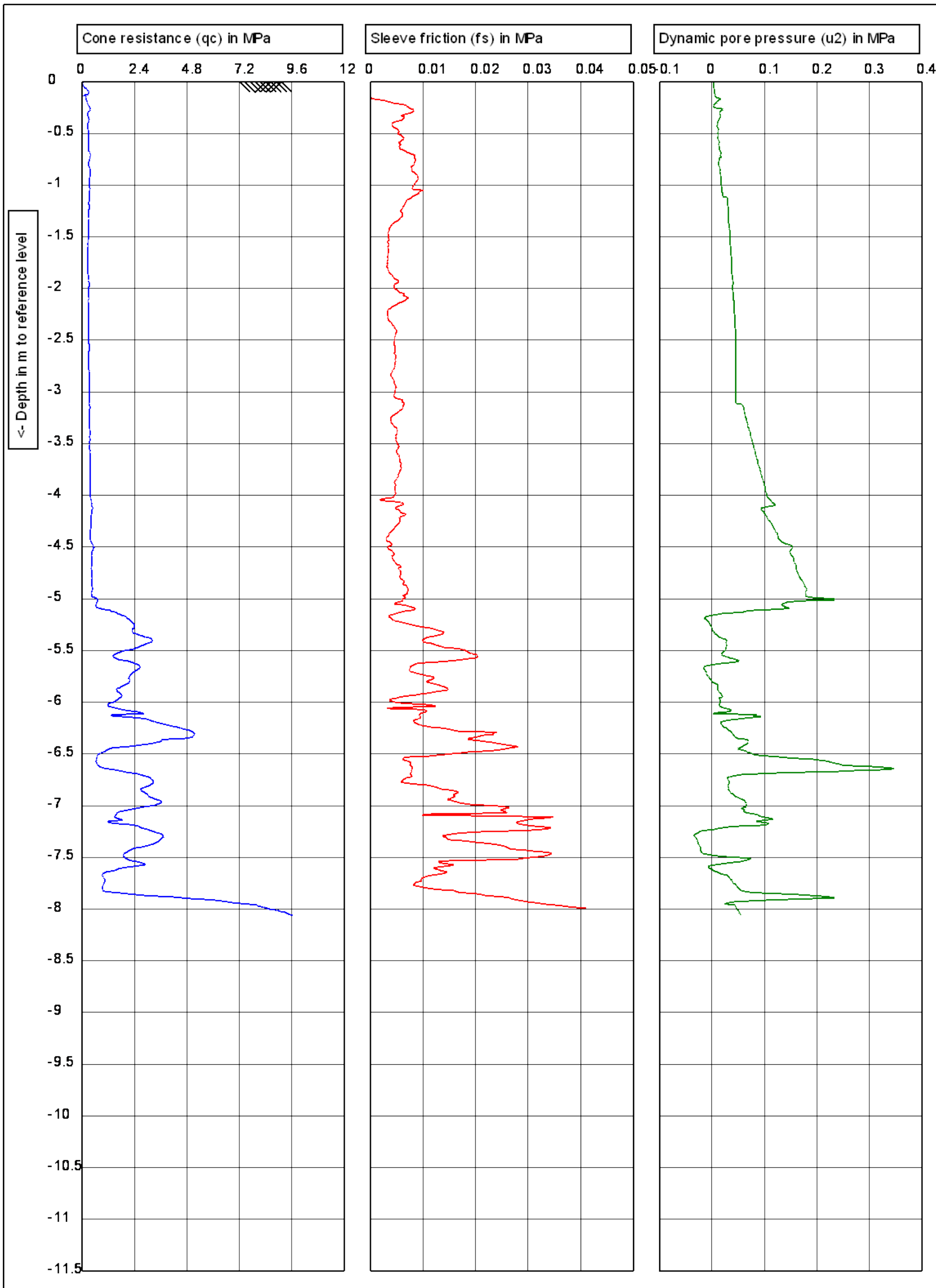


ru2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP	W.L.: 0a5	Date:	25/03/2014
Project: LMR0314		Cone no.:	C10CFIIPaG367
Location: Purnong		Project no.:	LMR0314
Position:		CPT no.:	P1 — 2/3

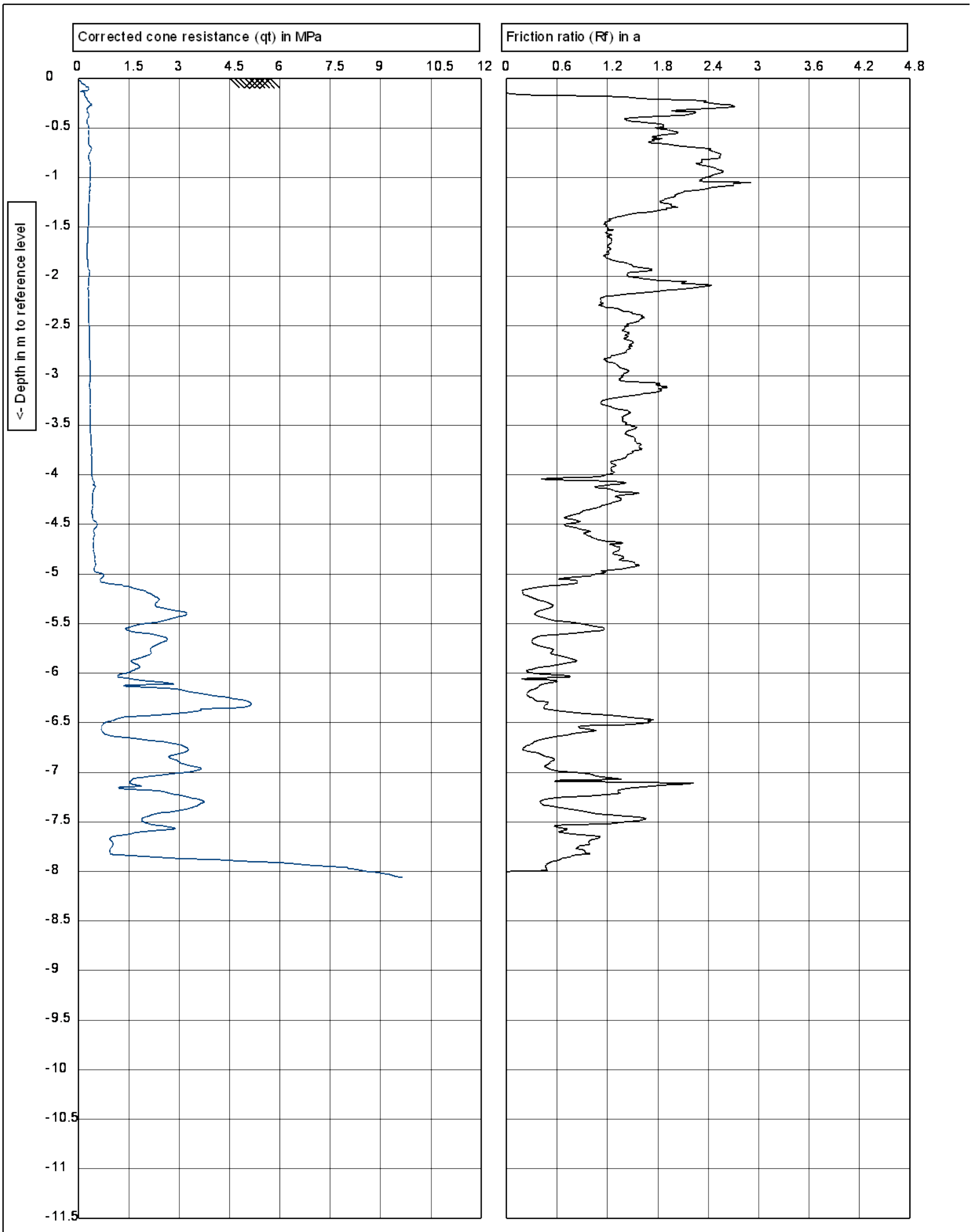


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : 0 m Predrilled
	G.L. 0 NAP	W.L.: 0a6	Date: 25/03/2014
Project: LMR0314			Cone no.: C10CFIIPaG67
Location: Purnong			Project no.: LMR0314
Position:			CPT no.: P1 — 3/3

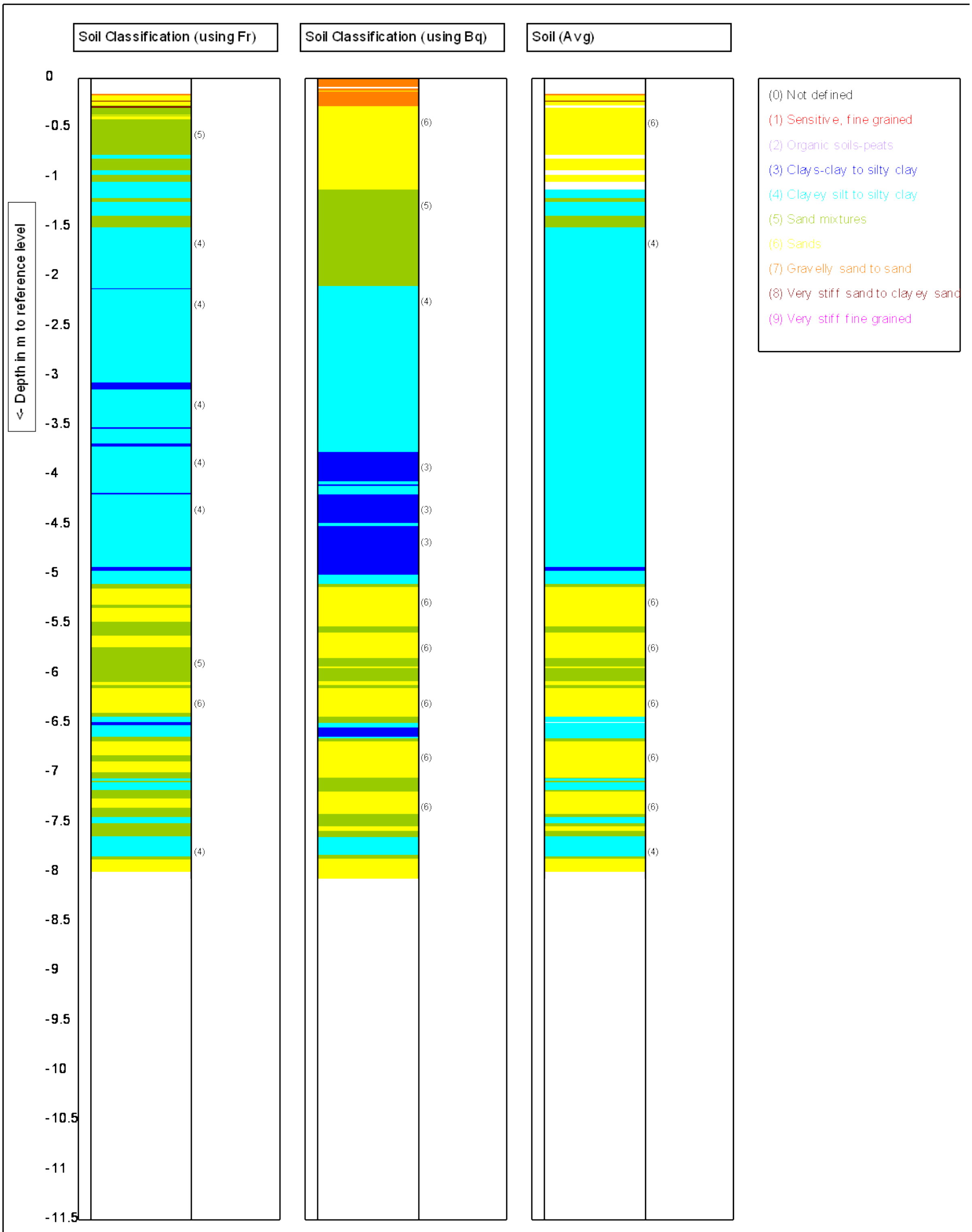
Appendix 20 Scrubby Flat — Cone Penetration Test Results



	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP / W.L.: 0.45	Date:	24/03/2014
Project: LMR0314		Cone no.:	C10CFIIP.G67
Location: Scrubby Flat		Project no.:	LMR0314
Position:		CPT no.:	SF1 1/3

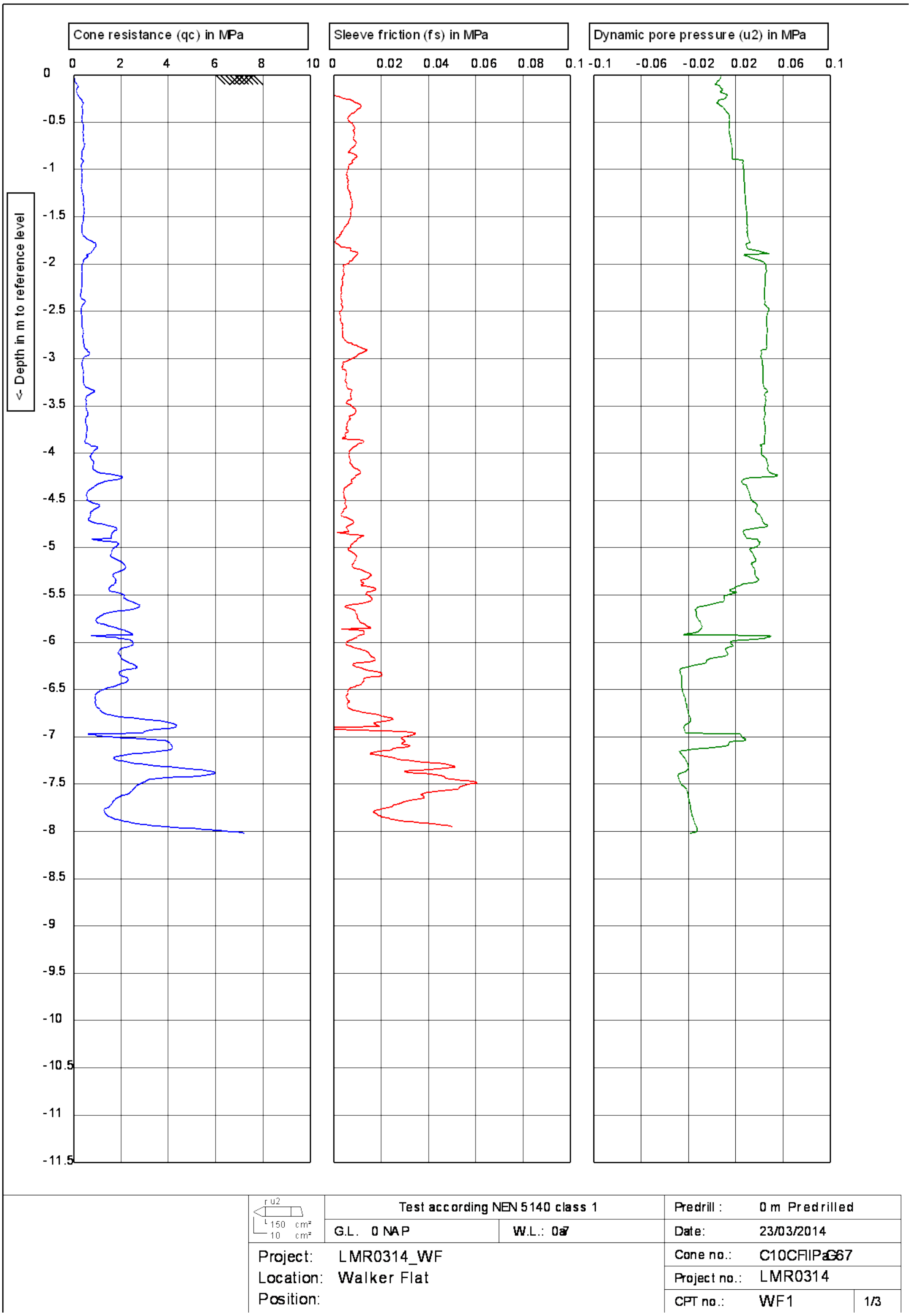


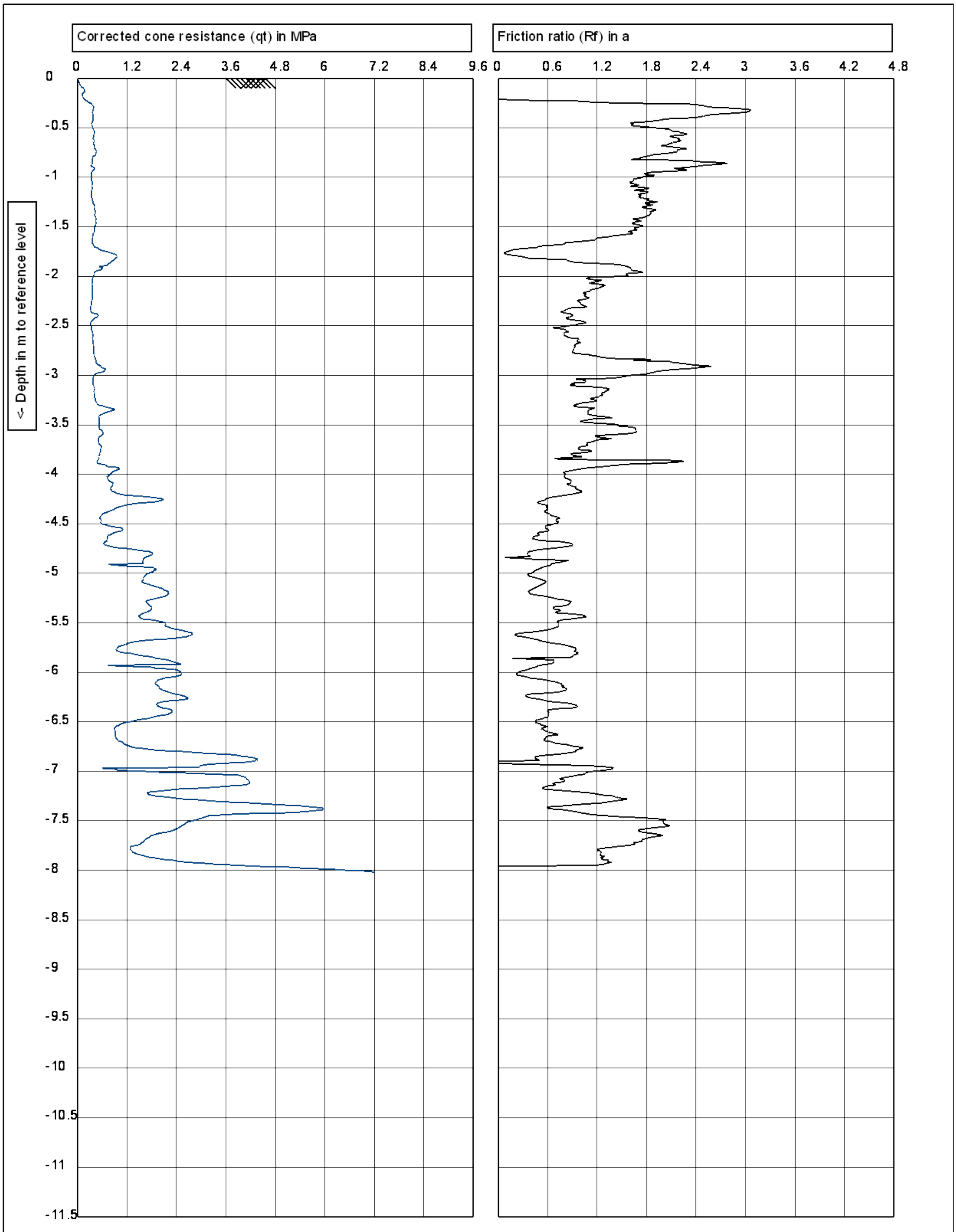
Test according NEN 5140 class 1	Predrill :	0 m Predrilled
G.L. 0 NAP W.L.: 0a45	Date:	24/03/2014
Project: LMR0314	Cone no.:	C10CFIIPaG67
Location: Scrubby Flat	Project no.:	LMR0314
Position:	CPT no.:	SF1 2/3



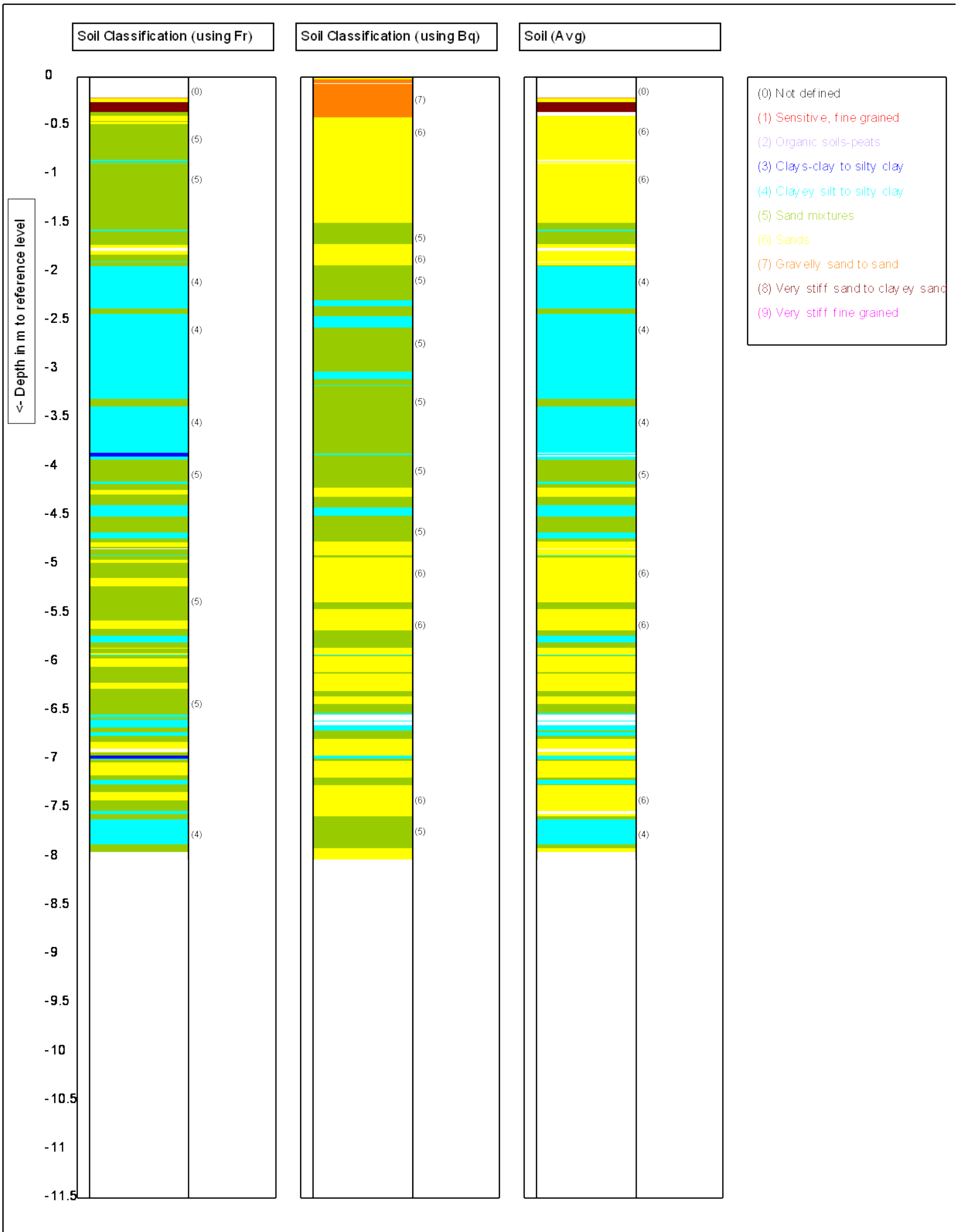
150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0 m Predrilled
	G.L. 0 NAP W.L.: 0a45	Date:	24/03/2014
Project: LMR0314		Cone no.:	C10CFIIPaG67
Location: Scrubby Flat		Project no.:	LMR0314
Position:		CPT no.:	SF1 3/3

Appendix 21 Walker Flat – Cone Penetration Test Results



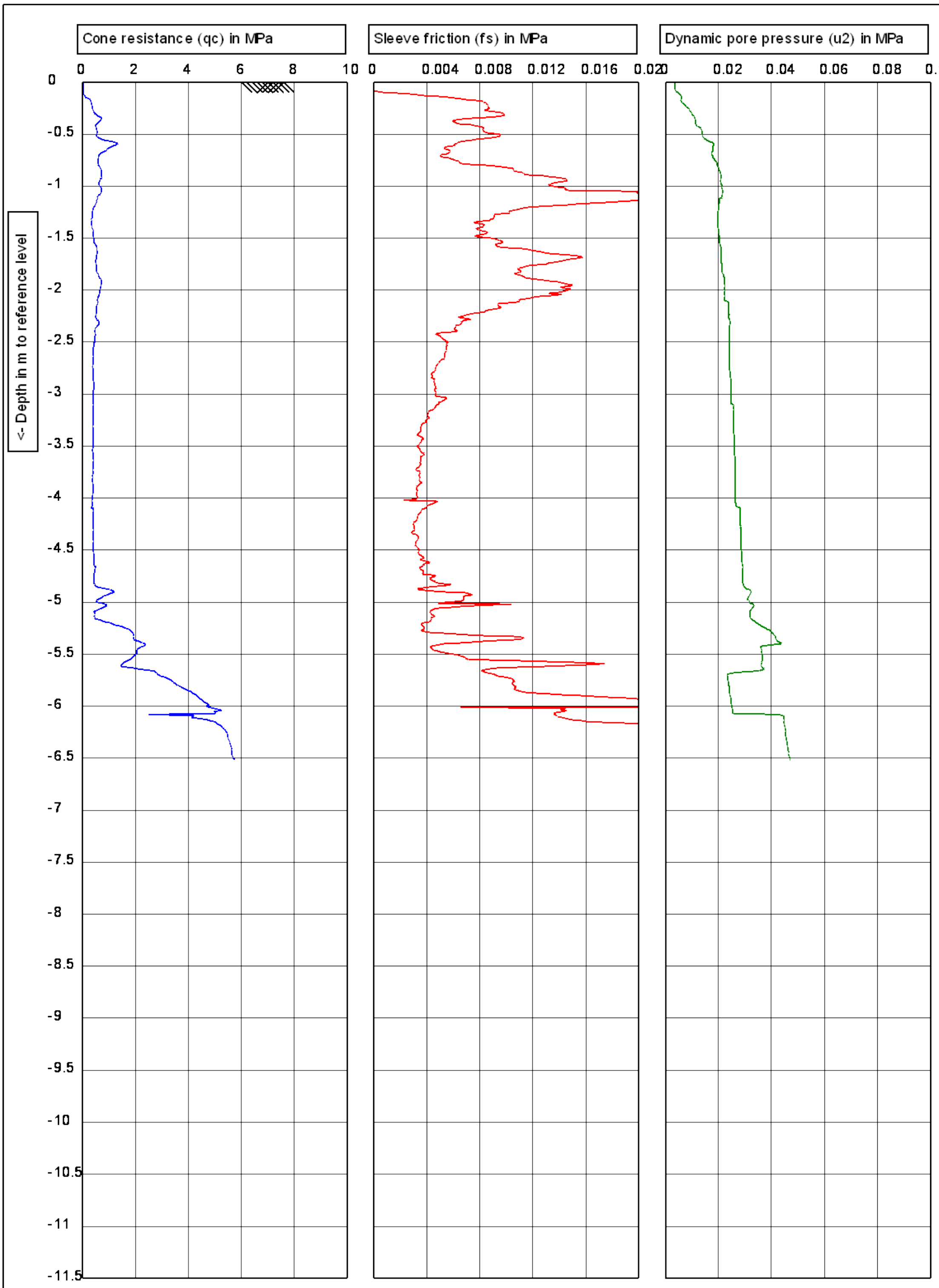


150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a7	Date:	23/03/2014
Project: LMR0314_WF			Cone no.:	C10CFIIPaG67
Location: Walker Flat			Project no.:	LMR0314
Position:			CPT no.:	WF1 2/3

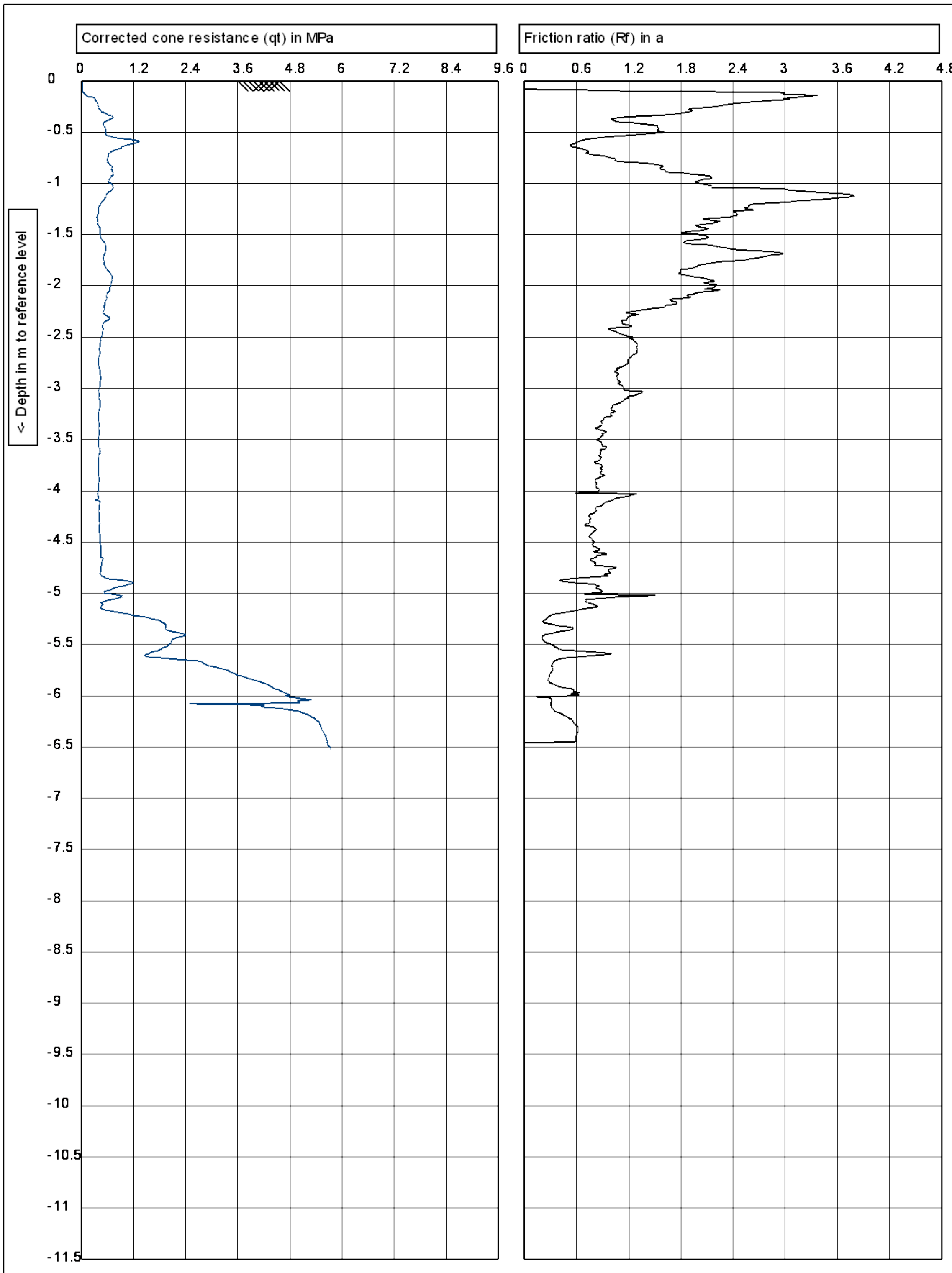


	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a7	Date:	23/03/2014
Project: LMR0314_WF			Cone no.:	C10CFIIPaG67
Location: Walker Flat			Project no.:	LMR0314
Position:			CPT no.:	WF1 3/3

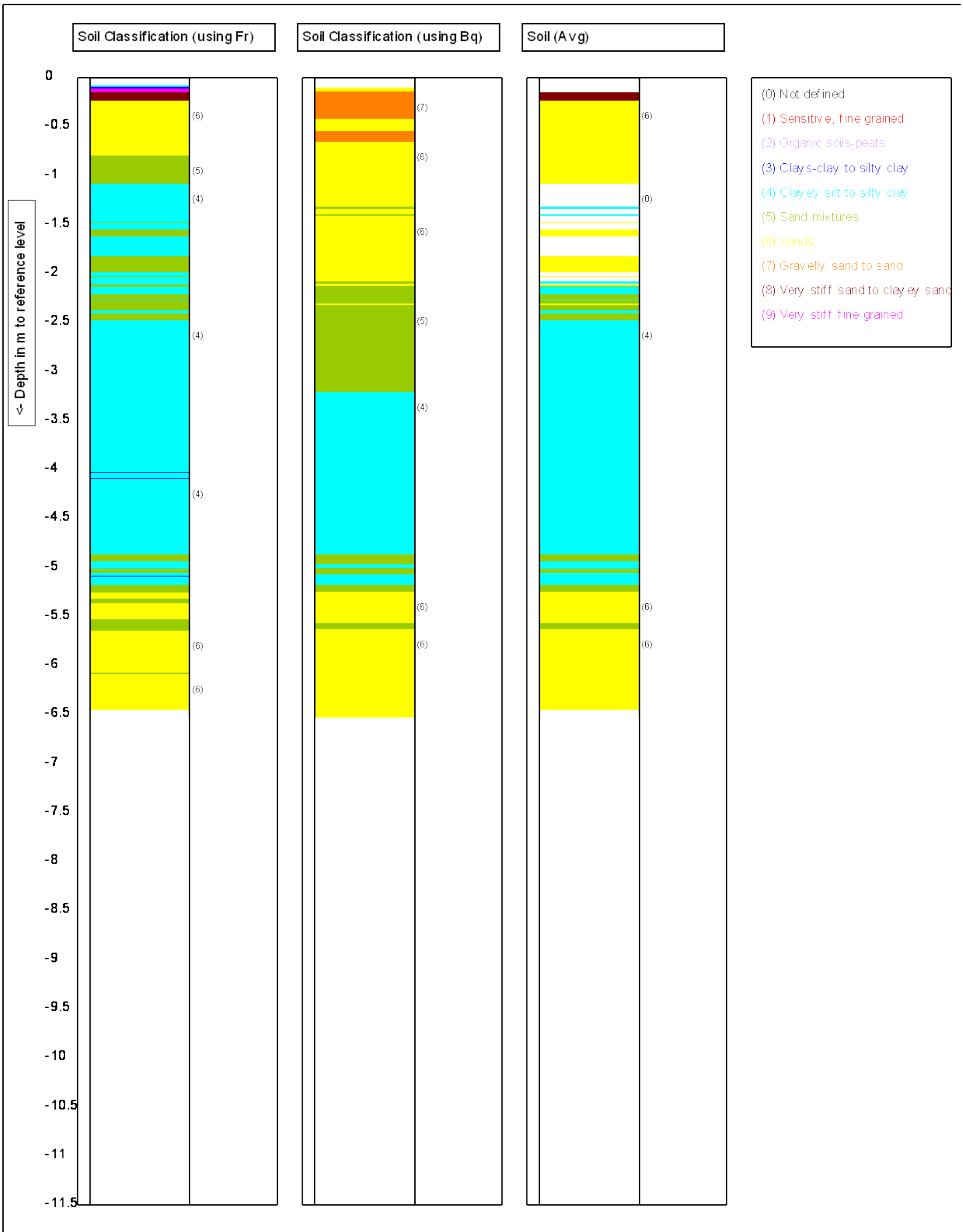
Appendix 22 Wongulla Lagoon – Cone Penetration Test Results



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a5	Date:	24/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Wongulla			Project no.:	LMR0314
Position:			CPT no.:	WON1 1/3

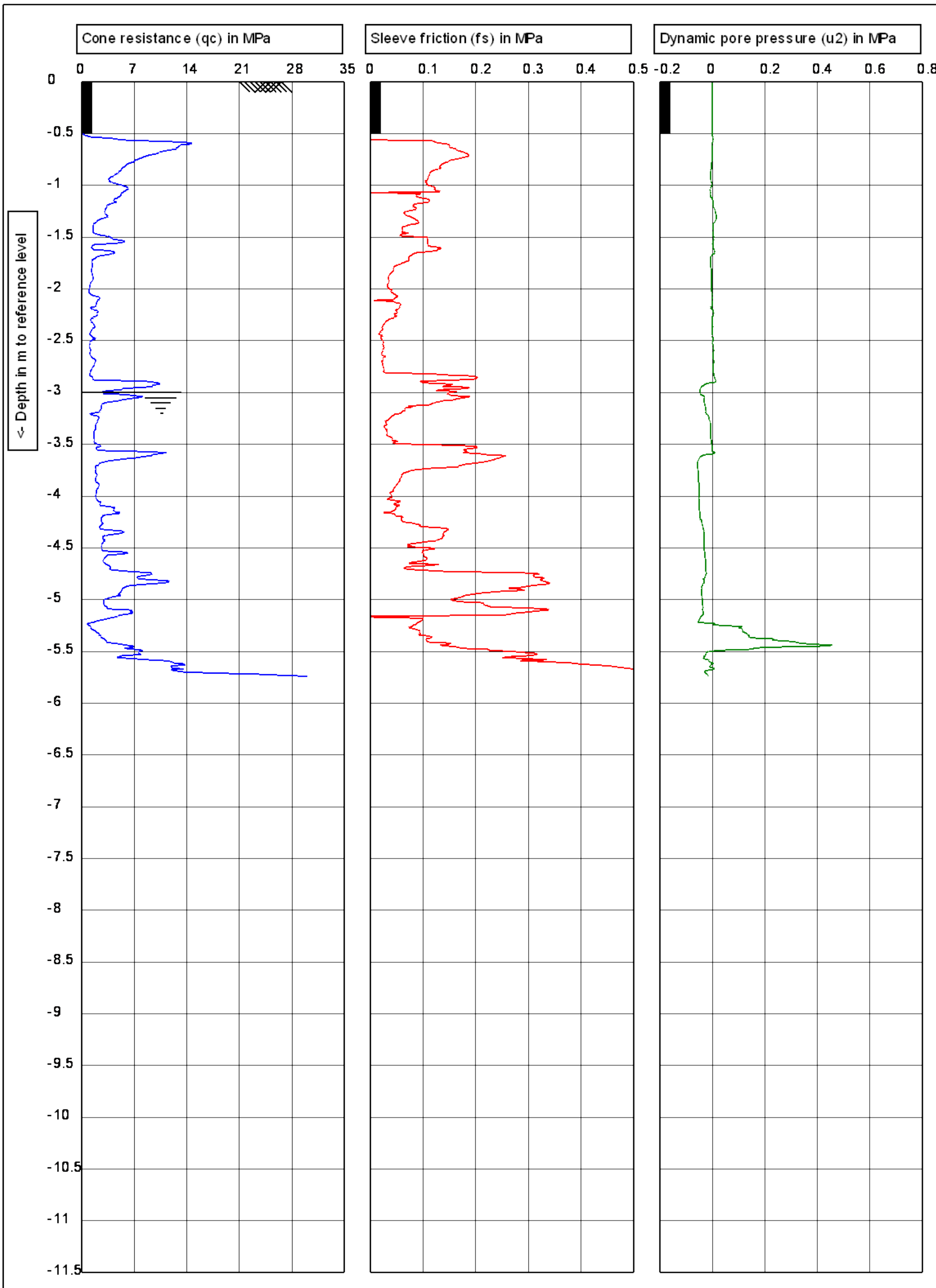


r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
	G.L. 0 NAP	W.L.: 0a5	Date:	24/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Wongulla			Project no.:	LMR0314
Position:			CPT no.:	WON1 2/3

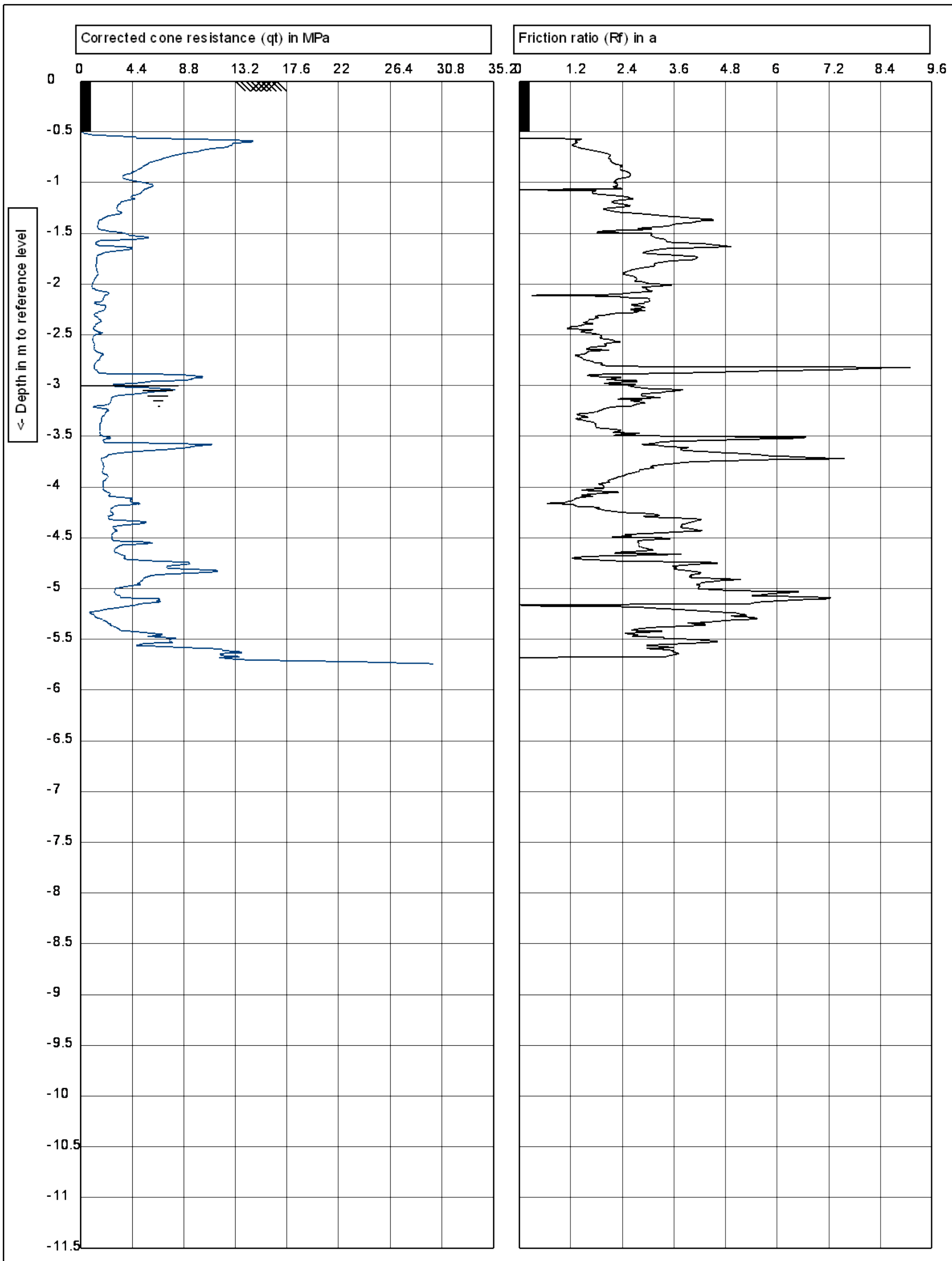


	Test according NEN 5140 class 1		Predrill :	0 m Predrilled
150 cm² / 10 cm²	G.L. 0 NAP	W.L.: 0a5	Date:	24/03/2014
Project: LMR0314			Cone no.:	C10CFIIPaG67
Location: Wongulla			Project no.:	LMR0314
Position:			CPT no.:	WON1 3/3

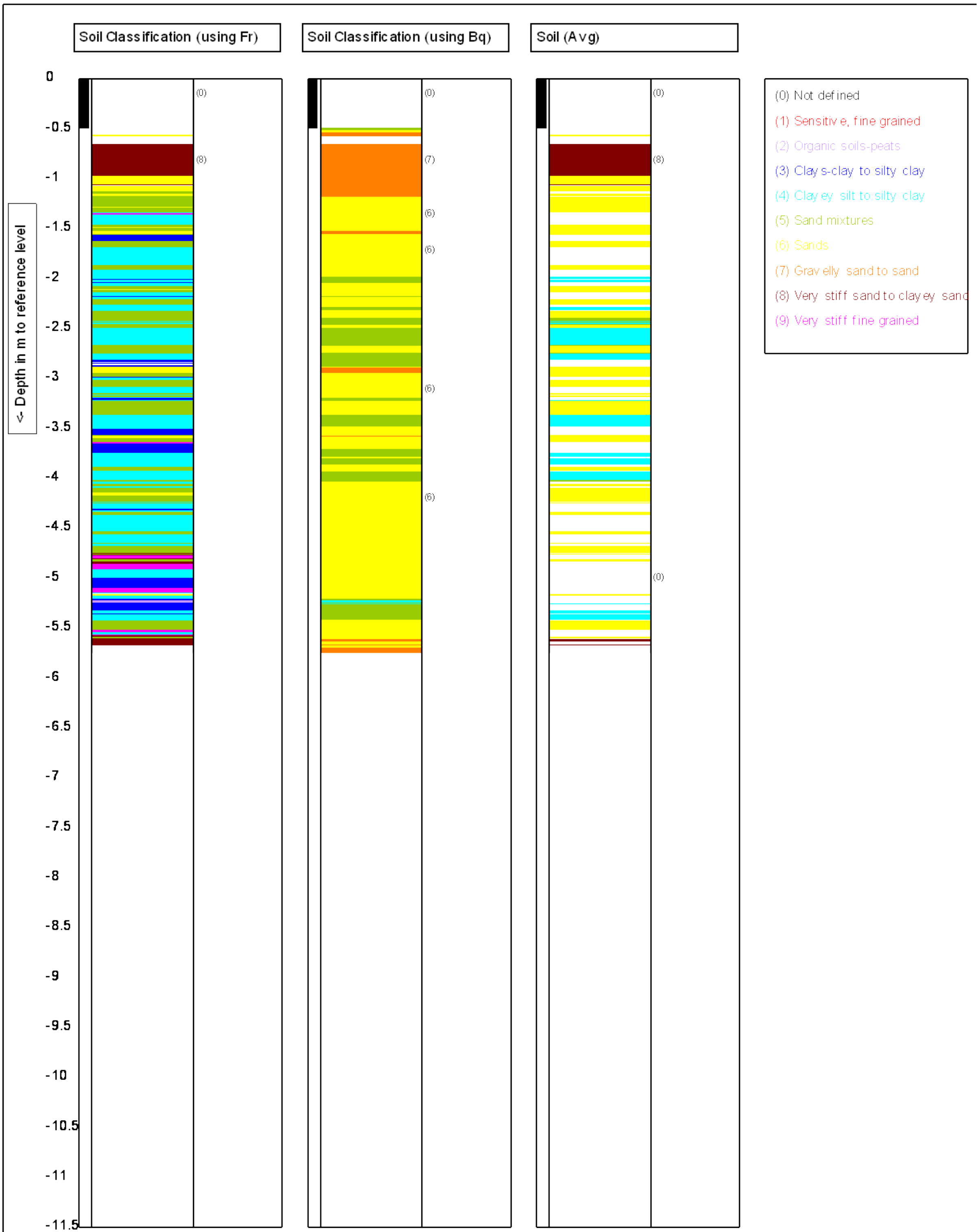
Appendix 23 Herrmanns Landing, Nildottie – Cone Penetration Test Results



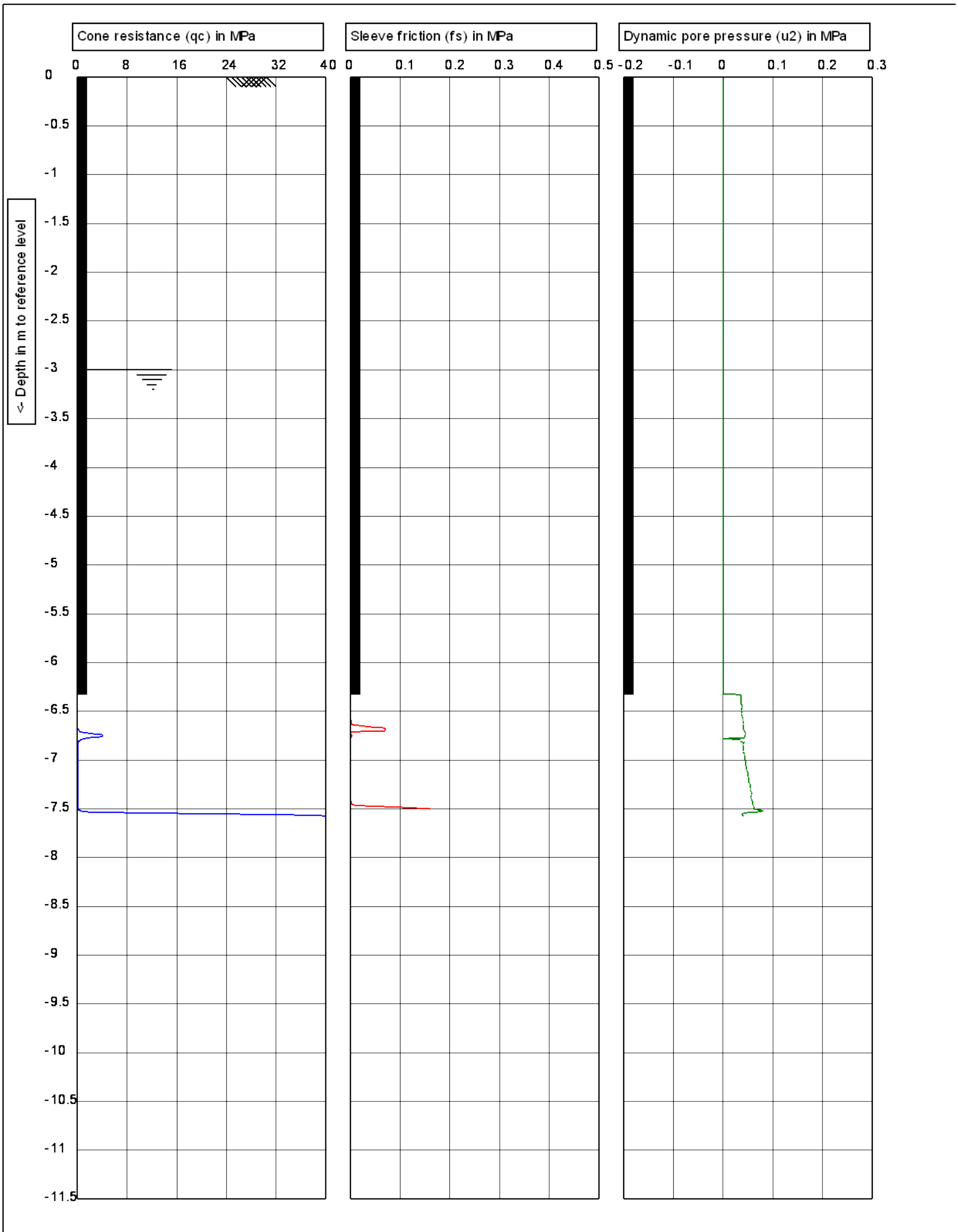
u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	0.5 m Predrilled
	G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project:	Project E.1.8		Cone no.:	C10CFIIP.G67
Location:	Nildottie		Project no.:	Nildottie
Position:			CPT no.:	1 — 1/3



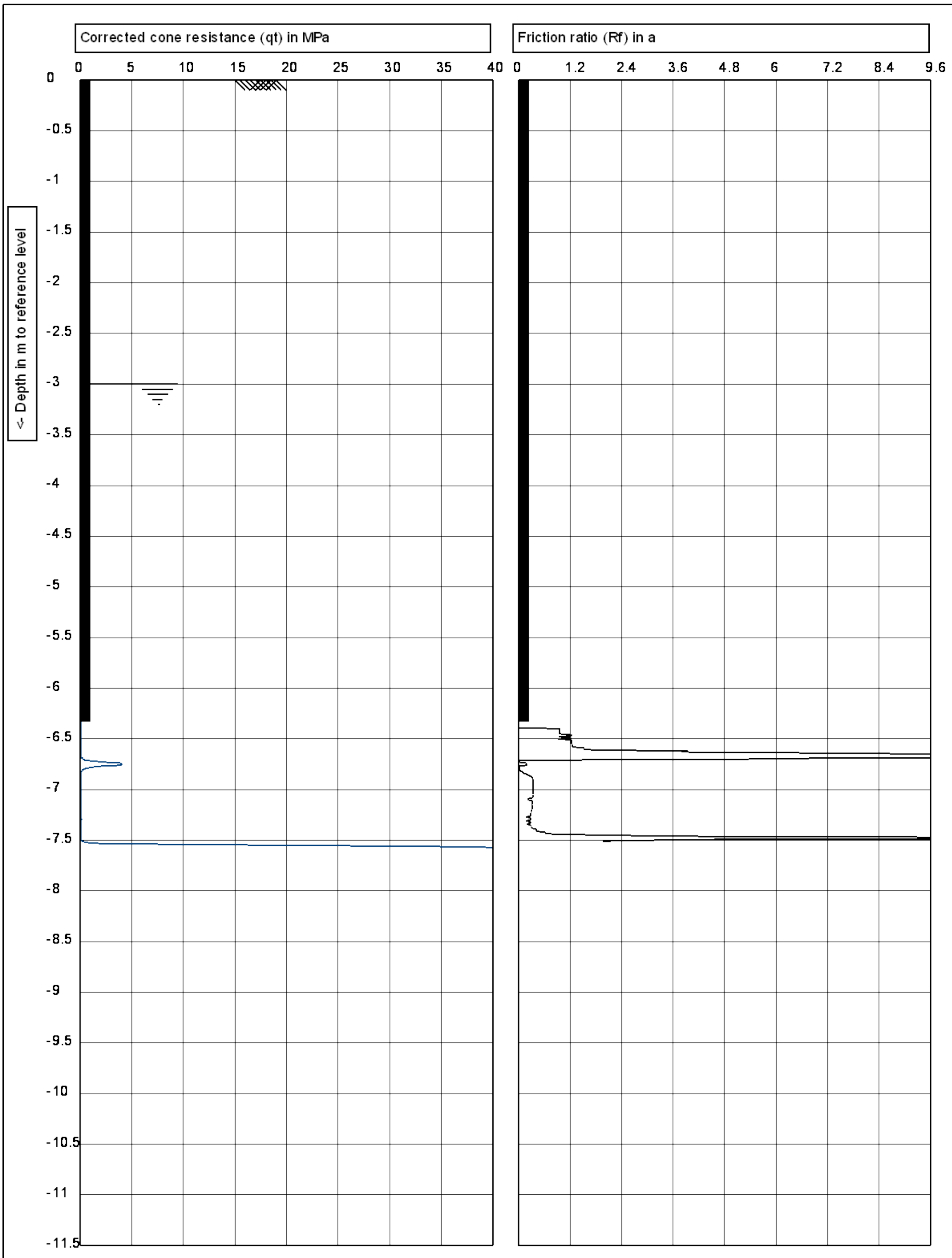
r u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Nildottie		Project no.:	Nildottie
Position:		CPT no.:	1 2/3



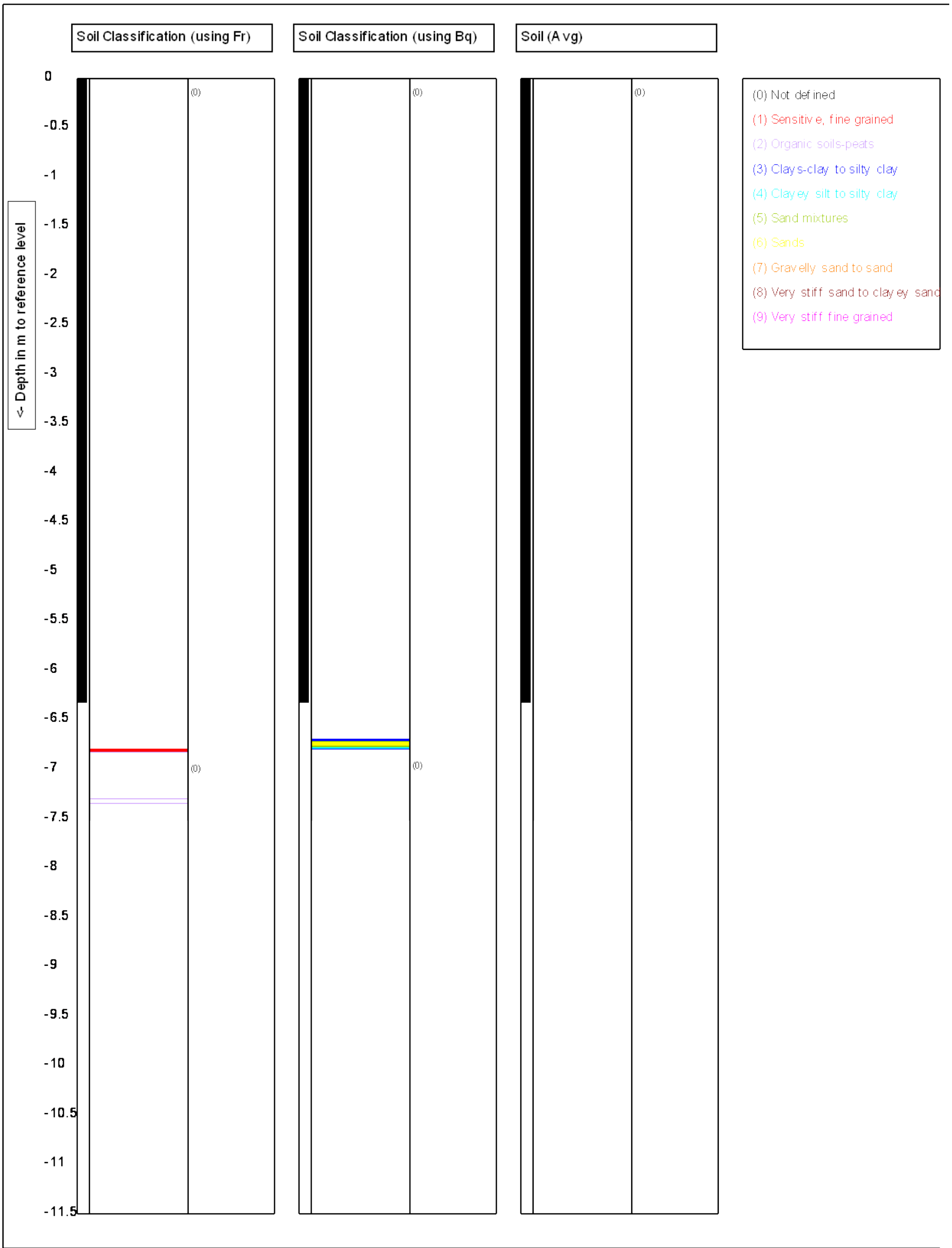
150 cm² / 10 cm²	Test according NEN 5140 class 1	Predrill :	0.5 m Predrilled
G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Nildottie		Project no.:	Nildottie
Position:		CPT no.:	1 — 3/3



Test according NEN 5140 class 1		Predrill :	6.33 m Predrilled
G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Nildottie		Project no.:	Nildottie
Position:		CPT no.:	1b 1/3



r u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	6.33 m Predrilled
	G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project: Project E.1.8			Cone no.:	C10CFIIP.G67
Location: Nildottie			Project no.:	Nildottie
Position:			CPT no.:	1b 2/3



u2 150 cm² 10 cm²	Test according NEN 5140 class 1	Predrill :	6.33 m Predrilled
G.L. 0 NAP	W.L.: a3	Date:	2/09/2014
Project: Project E.1.8		Cone no.:	C10CFIIP.G67
Location: Nildottie		Project no.:	Nildottie
Position:		CPT no.:	1b 3/3

Appendix 24 Between Swan Reach and Blanchetown East – WaterConnect Data

Driller Logs Between Swan Reach and Blanchetown East

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6828-494	0	27.43	LMST		Morgan limestone, horizontally bedded fossiliferous limestone
6828-495	0	0.3	SOIL		topsoil, grey brown sandy
6828-495	0.3	2.74	SILT	LMST	brown sandy silt, stick of limestone
6828-495	2.74	19.81	LMST		Morgan limestone, pale yellow brown to grey sandy limestone, numerous bryozoal fossil fragments
6828-495	19.81	22.86	LMST		Mannum Formation grey fine to medium grained limestone
6828-497	0	0.61	SAND		fill - sand silty, grey
6828-497	0.61	19.51	LMST		Mannum limestone (?) sand silty, fragments of limestone , yellow to yellow brown
6828-498	0	1.52	SAND		FILL - sand silty with fragments of cemented limestone to 2 cm, grey
6828-498	1.52	19.51	LMST		Mannum Formation - sand silty, weakly to moderately cemented limestone, yellow to yellow brown
6829-1519	0	0.2	CLYU	SAND	SANDY CLAY brown-red sandy clay
6829-1519	0.2	4	CLYU	CLYU	CLAY grey, stiff, moderately hard clay
6829-1519	4	8	CLYU		CLAY grey, moderately soft, plastic, micaceous clay
6829-1544	0	0.5	CLYU	SILT	Dark brown, low plasticity, dry/moist
6829-1544	0.5	1	CLYU		Dark brown-bladk, low to medium platicity, moist
6829-1544	1	2	CLYU		Dark brown-black, high plasticity, moist
6829-1544	2	3	CLYU		Dark brown-black, high plasticity, some organic matter, and Hydrogen Sulphide odour, moist
6829-1544	3	4.5	CLYU		Dark brown-black, high plasticity, some organic matter, and Hydrogen Sulphide odour, moist. EOH at 4.5 metres
6829-1545	0	0.5	CLYU		Dark brown, low plasticity, dry cracked clay at surface, moist below 0.2 metres
6829-1545	0.5	1	CLYU		Dark brown-black, medium plasticity, moist
6829-1545	1	3	CLYU		Dark brown-black, high plasticity, moist
6829-1545	3	4.5	CLYU		Dark brown-black, high plasticity, wet. EOH at 4.5 metres

Driller Logs Between Swan Reach and Blanchetown East (continue)

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6829-1546	0	0.5	CLYU		Dark brown-black-grey, low plasticity, dry/moist
6829-1546	0.5	1	CLYU		Dark brown-black-grey, low plasticity, moist
6829-1546	1	3	CLYU		Dark brown-black-grey, low plasticity, organic matter, moist
6829-1546	3	4	CLYU		Dark brown-grey, low plasticity, soft texture, moist
6829-1547	0	0.5	CLYU		Dark brown-grey, low plasticity, dry/moist
6829-1547	0.5	1	CLYU		Dark brown-grey, low plasticity, moist
6829-1547	1	2	CLYU		Dark brown-black with orange-brown mottling, high plasticity, moist
6829-1547	2	3	CLYU		Dark grey-blue, high plasticity, moist
6829-1547	3	4	CLYU		Dark grey, low plasticity, soft texture, moist
6829-1547	4	5.5	CLYU		Dark grey,low plasticity, very stiff, wet. EOH at 5.5 metres
6828-930	0	3	CLYU	SILT	SILTY CLAY grey, moderate plasticity, damp and firm to moist, firm and soft
6828-930	3	4.5	CLYU	SILT	SILTY CLAY black-grey, moderate plasticity, wet, soft to firm
6828-930	4.5	6	SAND	CLYU	CLAYEY SAND grey, high plasticity, wet, soft to firm
6828-930	6	7	SAND	CLYU	CLAYEY SAND cream, light brown, fine to medium grained sands. EOH at 7 metres
6828-951	0	3	CLYS		first 10 cm brown clayey soil, after dark grey to black clay, very plastic, firm to soft
6828-951	3	6	SILT	SAND	grey sandy silt, very fine sand, very wet
6828-952	0	2	CLYS		first 10 cm clayey soil, after brown to black clay, hard, very plastic, dry
6828-952	2	6	CLYS		green-grey hard clay, very plastic, wet from 3. meter
6828-953	0	2	SOIL	SAND	black sandy soil with clay
6828-953	2	6	CLYU	SAND	dark grey to blacksandy clay to sandy silt, pieces of limestone rock, sand is fine quartz angular around 30%, wet after 3. meter
6828-955	0	5	CLYU		first 20 cm brown clayey soil, with rots, dry, after black clay , very stiff and hard , very plastic, limestone chips in from 1-3m (up to 5mm), dry
6828-955	5	6	CLYS	SILT	dark grey silty clay, very sticky, wet
6828-956	0	2	CLYS		black clay, with roots, dry
6828-956	2	4	CLYS		green-grey clay, hard, very plastic, dry

Driller Logs Between Swan Reach and Blanchetown East (continue)

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6828-956	4	6	CLYS	SILT	grey silty clay, very plastic, very sticky, fill fine sand under fingers
6828-957	0	3	CLYS		hard black clay, dry, can`t squash by hand, coming out as balls
6828-957	3	6	CLYS	SILT	dark grey silty clay, wet, very sticky
6828-958	0	3	CLYS		first 10 cm brown soil, after dark grey clay, dryat 2.5-3 m clayey sand
6828-958	3	4	CLYS		grey clay, little wet, very plastic, 5% yellow limestone chips up to 5mm
6828-958	4	6	SAND	CLYS	grey clayey sand to silty sand, very fine sand, wet
6828-959	0	6	CLYS		dark grey clay, stiff, very plastic, hard, wet from 2. meter, coming out in "belts"
6828-960	0	4	CLYS		grey to black clay, hard, sticky, very plastic
6828-960	4	6	CLYS	SILT	grey silty clay, as above but with silt, and litlle fine sand (can fill under fingers), much softer then above, very sticky, very wet

Appendix 25 Blanchetown – WaterConnect Data

Driller Logs near Blanchetown

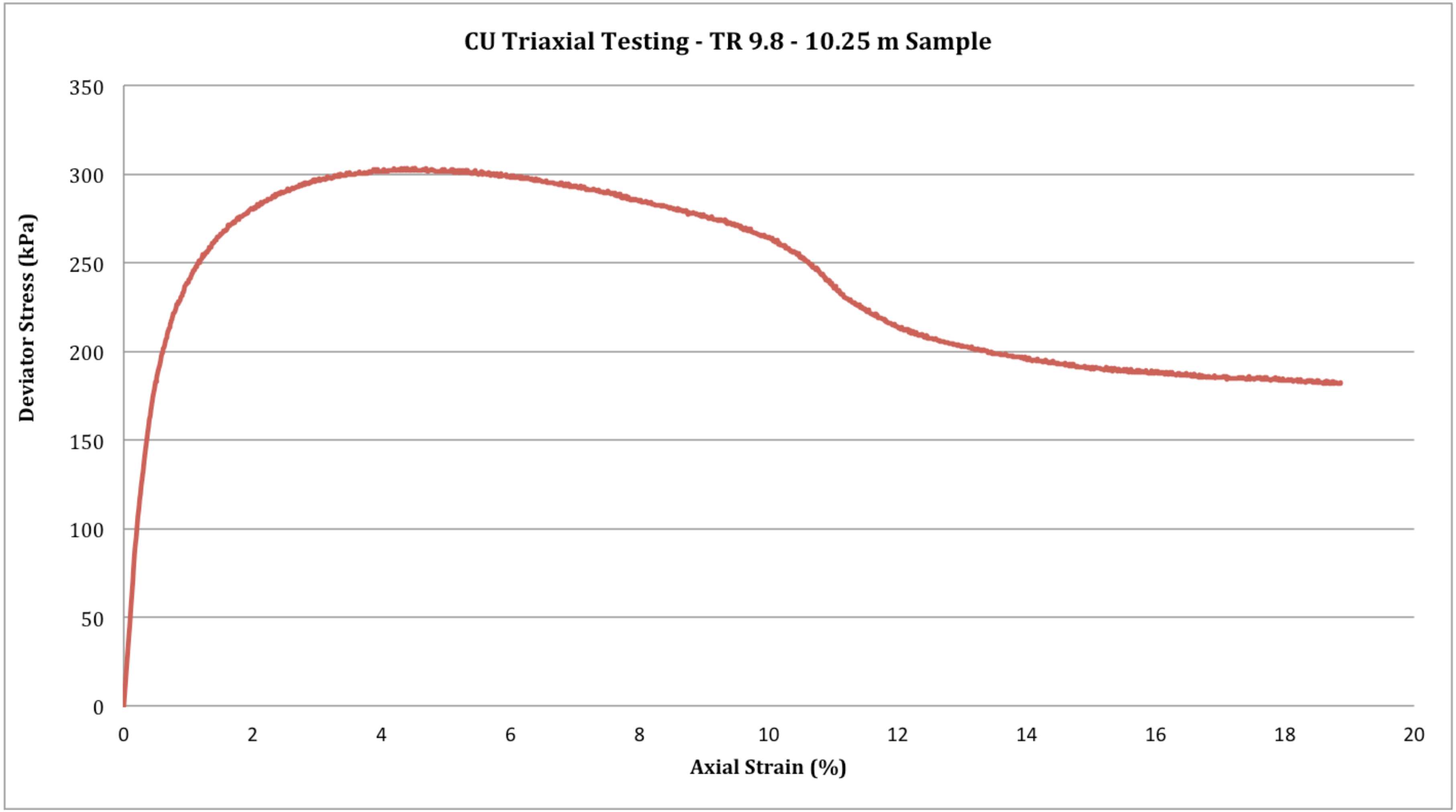
Unit_No	Obs_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6829-1519		0	0.2	CLYU	SAND	SANDY CLAY brown-red sandy clay
6829-1519		0.2	4	CLYU	CLYU	CLAY grey, stiff, moderately hard clay
6829-1519		4	8	CLYU		CLAY grey, moderately soft, plastic, micaceous clay
6829-1520		0	0.5	SAND		SAND brown fine to medium grained quartz sand
6829-1520		0.5	1	CLYU	SAND	SANDY CLAY brown-grey, moderately plastic, sandy clay
6829-1520		1	2	CLYU		CLAY grey, moderately plastic, firm, micaceous clay
6829-1520		2	3	CLYU		CLAY grey, moderately plastic, firm, micaceous clay
6829-1520		3	4.5	CLYU		CLAY grey, moderately plastic, firm micaceous clay
6829-1521		0	0.5	CLYU	SAND	SANDY CLAY brown, micaceous, hard clay
6829-1521		0.5	1.5	CLYU	SAND	SANDY CLAY brown micaceous, hard clay
6829-1521		1.5	3	SAND		SAND brown-yellow, fine to medium grained micaceous quartz sand
6829-1521		3	3.25	SAND		As above but darker and with lignum fragments throughout
6829-1521		3.25	4	SAND		SAND yellow-cream fine to medium quartz sand
6829-1521		4	6	SAND		SAND yellow-cream fine to medium quartz sand
6829-1521		6	8	SAND		SAND yellow-cream fine to medium quartz sand
6829-1522		0	0.2	CLYU	SAND	SANDY CLAY sandy brown clay
6829-1522		0.2	2	CLYU		CLAY brown-grey micaceous, moderately soft, plastic clay
6829-1522		2	3	CLYU		CLAY brown-grey micaceous, moderately soft, plastic clay
6829-1522		3	4	CLYU		CLAY soft plastic, black clay
6829-1522		4	5	CLYU		CLAY grey-black micaceous clay
6829-1522		5	6	CLYU		CLAY grey-black micaceous clay, H2S odour
6829-1568		0	1	CLYU	SILT	SILTY CLAY brown-orange, moderate to high plasticity, moist, firm
6829-1568		1	6	CLYU	SILT	SILTY SAND CLAY grey, fine to medium grained sands, moderate plasticity, wet, firm
6829-1568		6	7	CLYU	SAND	SANDY CLAY grey, fine grained sands, moderate plasticity, wet, firm. EOH at 7 metres

Appendix 26 Blanchetown East – WaterConnect Data

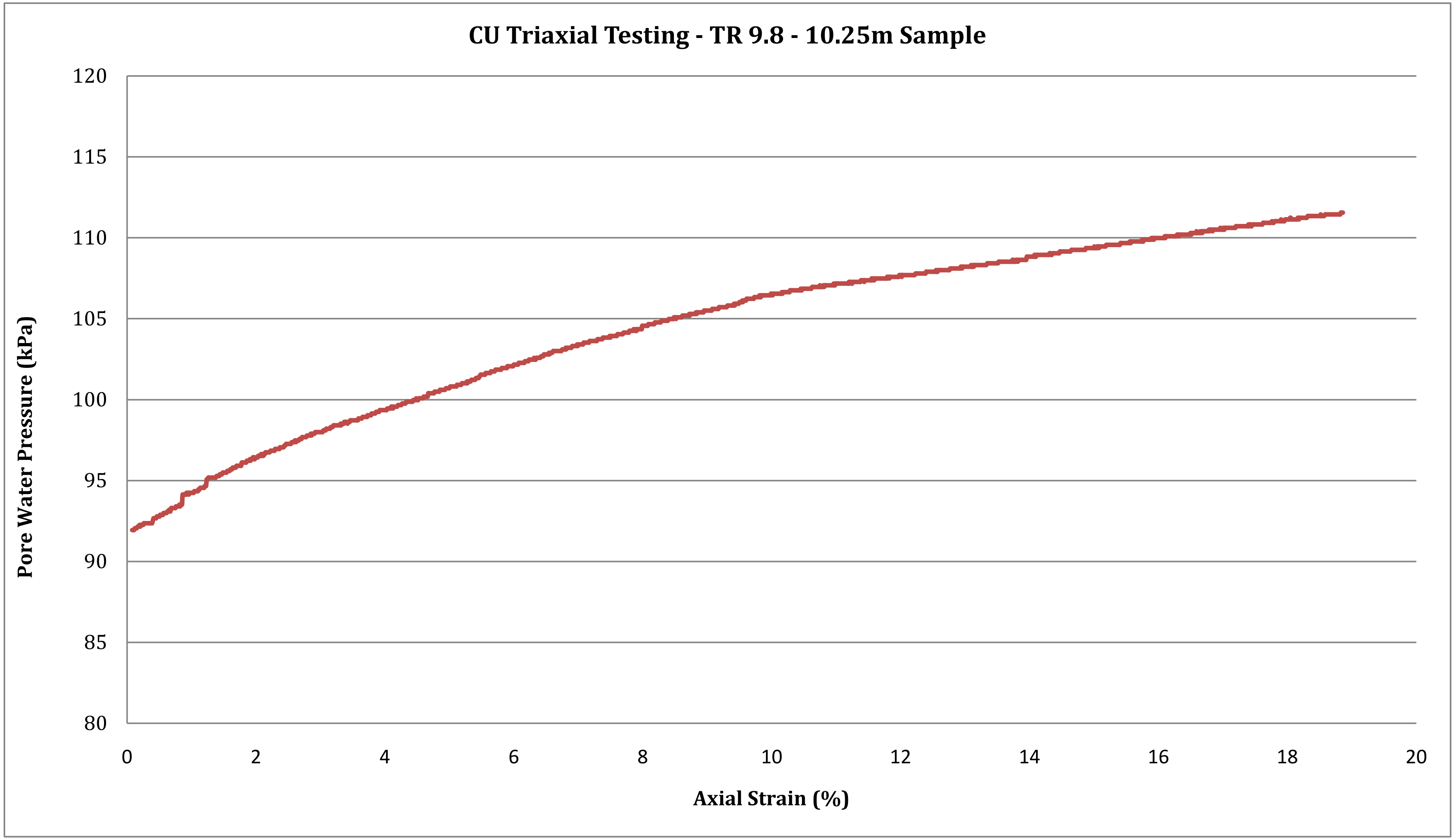
Driller Logs near Blanchetown East

Unit_No	depth_from	depth_to	major_lith_code	minor_lith_code	Description
6829-1513	0	1	CLYU		CLAY grey clay
6829-1513	1	2	CLYU		CLAY grey clay, slightly damp
6829-1513	2	4	CLYU		CLAY grey moderately soft clay
6829-1513	4	6	CLYU	SILT	SILTY CLAY grey silty clay, moderately soft
6829-1513	6	8	CLYU	SAND	SANDY CLAY grey, sandy clay
6829-1517	0	2	CLYU		CLAY grey clay
6829-1517	2	3	CLYU	SAND	SANDY CLAY grey, plastic, monderately soft sandy clay
6829-1517	3	4	SAND	CLYU	CLAYEY SAND grey clayey sand

Appendix 27 Triaxial Testing Results for TR 9.8 - 10.25 m sample

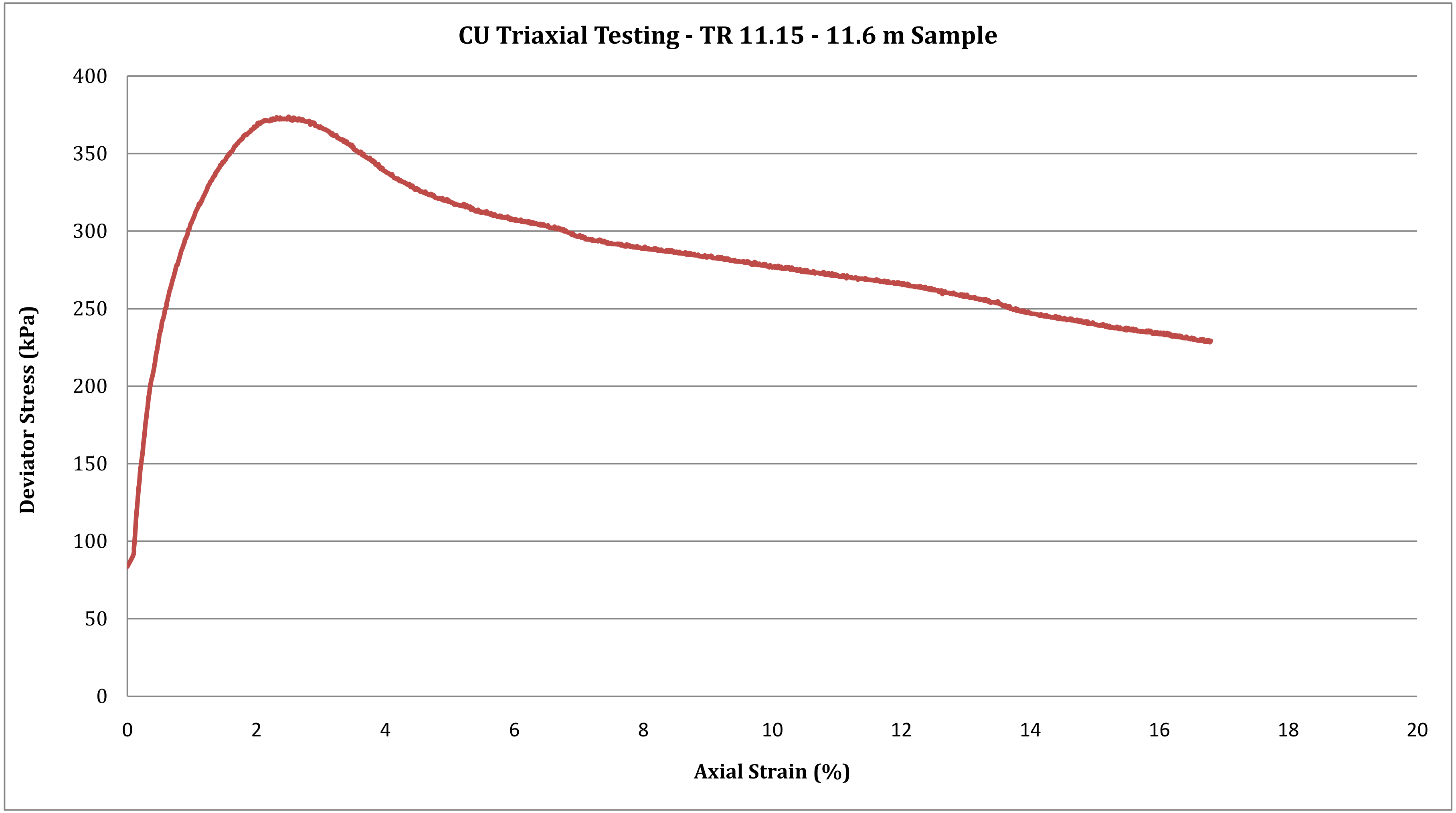


Deviator Stress versus Axial Strain

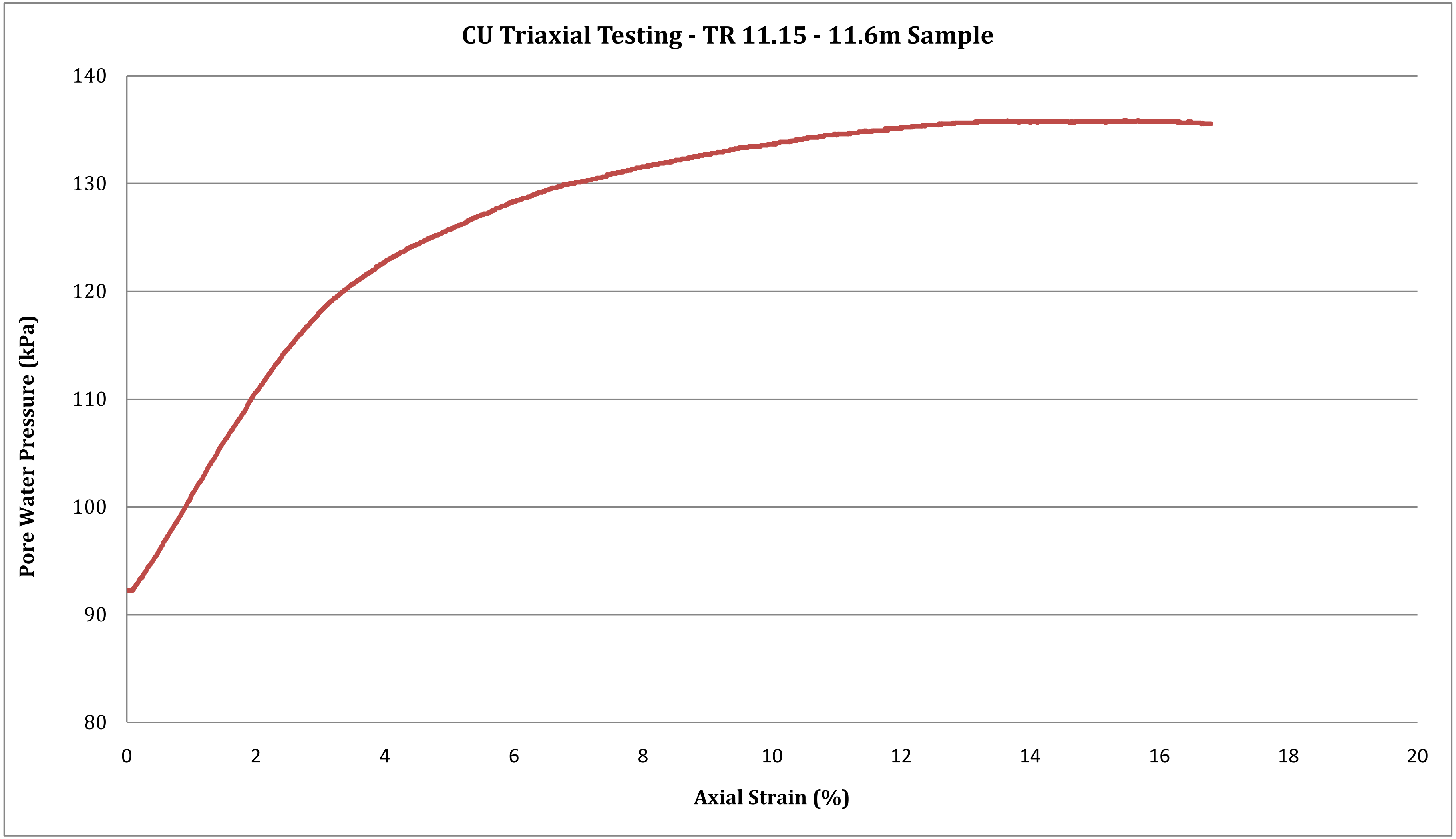


Pore Water Pressure versus Axial Strain

Appendix 28 Triaxial Testing Results for TR 11.15 - 11.6 m sample

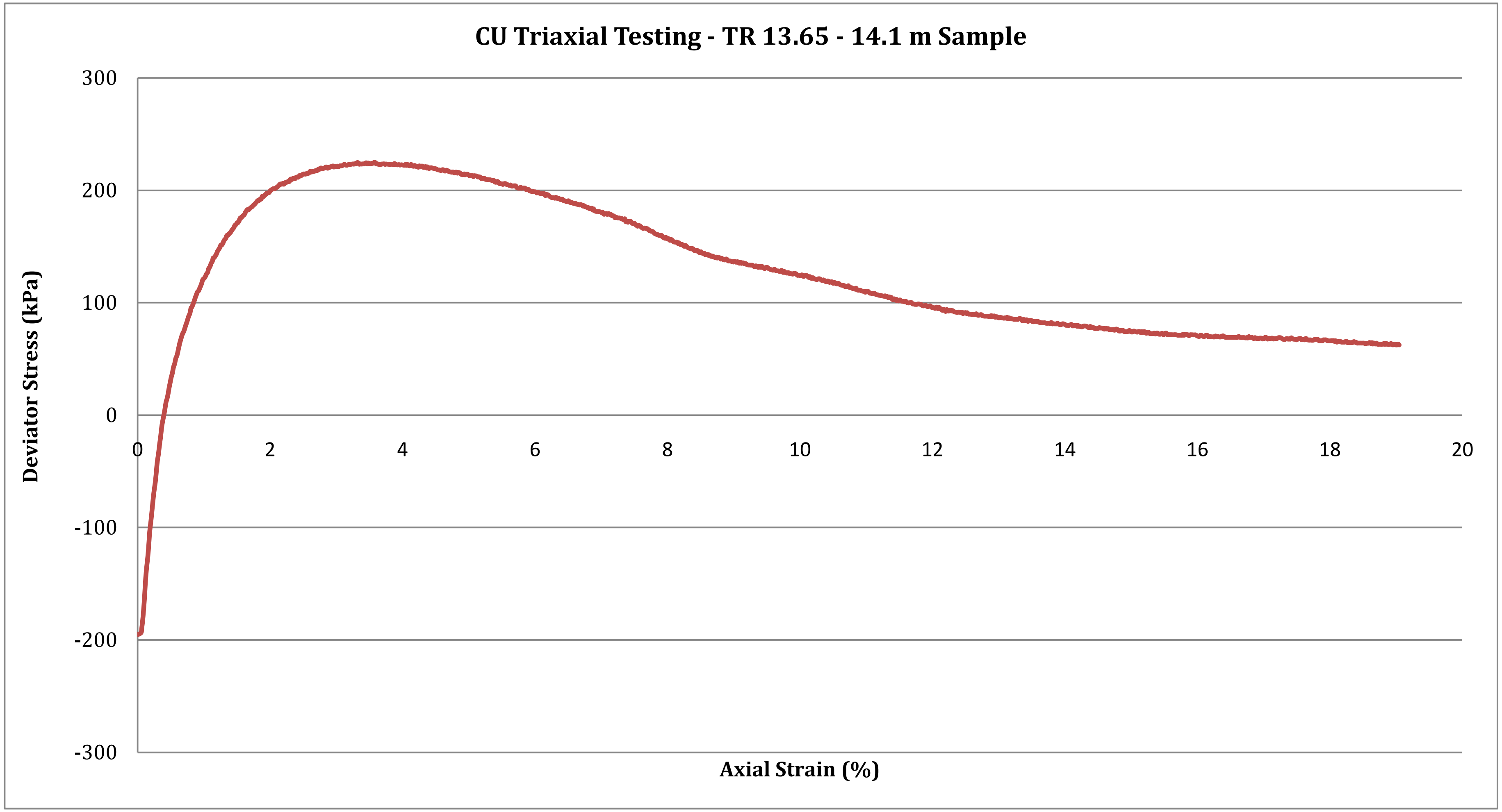


Deviator Stress versus Axial Strain

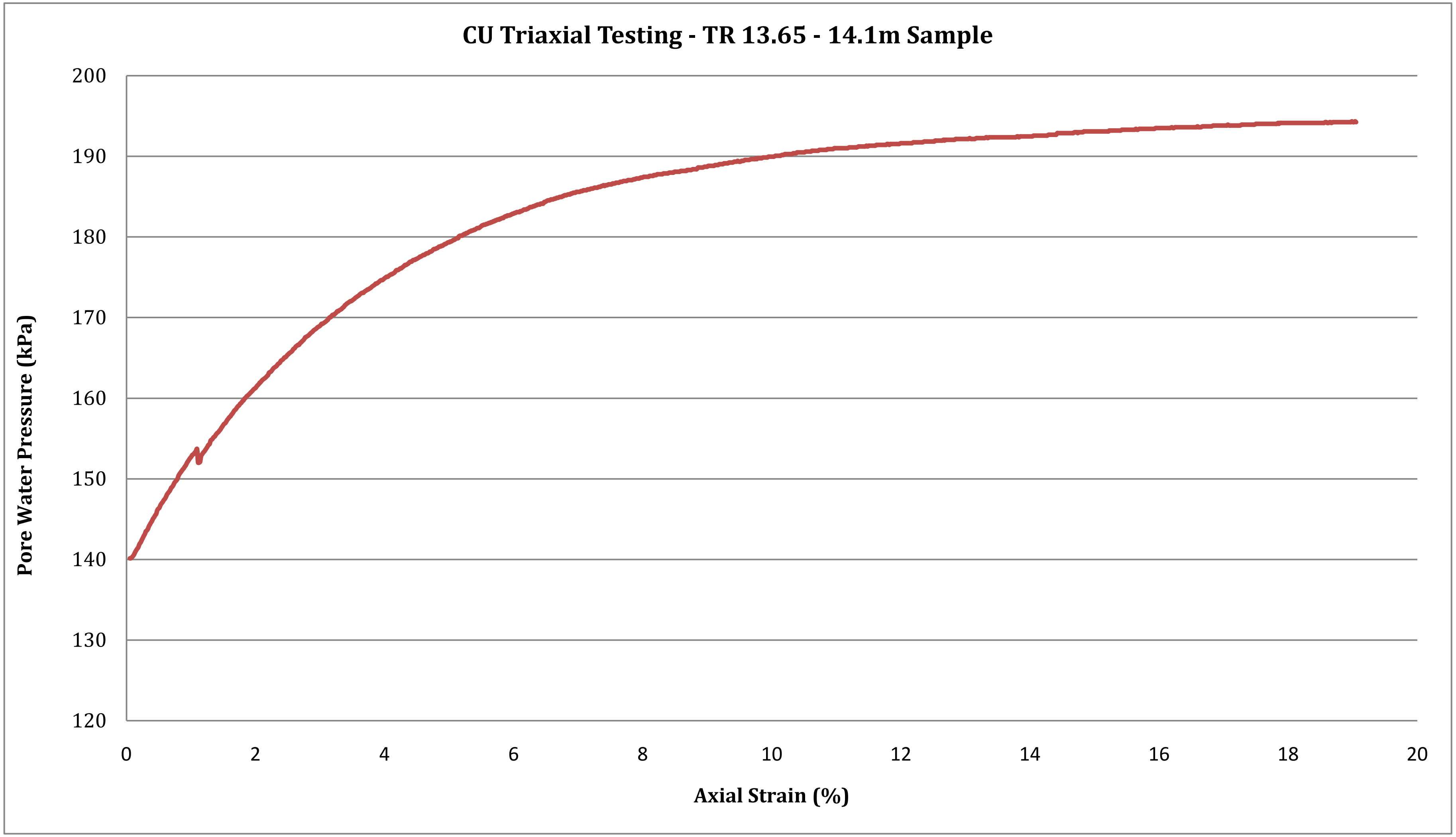


Pore Water Pressure versus Axial Strain

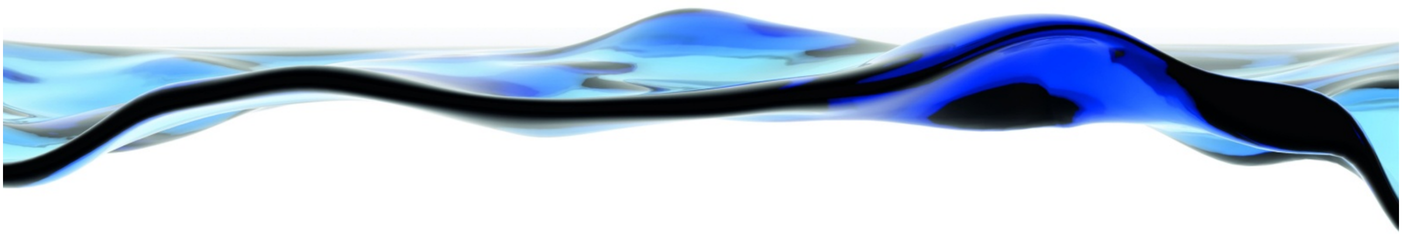
Appendix 29 Triaxial Testing Results for TR 13.65 - 14.1 m sample



Deviator Stress versus Axial Strain



Pore Water Pressure versus Axial Strain



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