

Rotorua Lakes Council

Museum, Government Gardens, Oruawhata Drive, Rotorua

Geotechnical Factual Report

16592
15 May 2017

Rotorua Lakes Council

Museum, Government Gardens, Oruawhata Drive, Rotorua

Geotechnical Factual Report

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Date: 15 May 2017
Reference: 16592
Status: Final
Revision: NA
Previous Revision Date: NA

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1. INTRODUCTION AND SCOPE OF WORK

Cheal Consultants (Cheal) has been engaged by Rotorua Lakes Council (Client) to carry out a geotechnical investigation to assess existing below ground features immediately adjoining the Rotorua Museum with emphasis to the seismic behaviour of foundation ground and, if applicable, to propose and design geotechnical seismic strengthening.

This Geotechnical Factual Report presents the results of the ground investigation undertaken on 15 March 2017 and 3 to 7 April 2017.

2. SCOPE OF INVESTIGATION

The investigation scope was prepared to describe ground below the bath house, determine the foundations below the Northern and Southern extensions and assess the liquefaction risk. To determine this information the following ground investigation was undertaken:

- 16 Scala Penetrometer Tests (Scala);
- 3 machine drilled boreholes (BH) including Standard Penetration Tests (SPT) and push tube sampling where appropriate;
- 4 Cone Penetration Tests;
- 2 trial pits (TP);
- Laboratory tests consists of:
 - Four natural water contents and Atterberg limits (LL, PL, PI)
 - Four Fines Contents passing 75µm and 63µm sieve
 - One one-dimensional consolidation test

The location of the investigation points are shown in Appendix 1.

3. SITE DESCRIPTION

The site is located on the east side of Oruawhata Drive, on the north side of Hatupatu Drive and on the south side of Queens Drive, Rotorua. The site around the museum building is generally flat with elevation varied approximately from RL +285 at the western central part to RL +282 at the east-south corner. Following historical documents, we understand the ground level along the western site of the building (RL +235m) is formed by earth fill placed between 1906 and 1908¹.

An aerial photograph of the site is shown on the following Figure 1. The site investigation plan including location of historical investigation up to 2009 is attached in Appendix 1.

¹ Terrane (2009), "Rotorua Bath House, Government Gardens, Rotorua, Proposed South Wing Extension, Geotechnical Design Report", ref. 3278.SouthExt.desrep, 27 May 2009

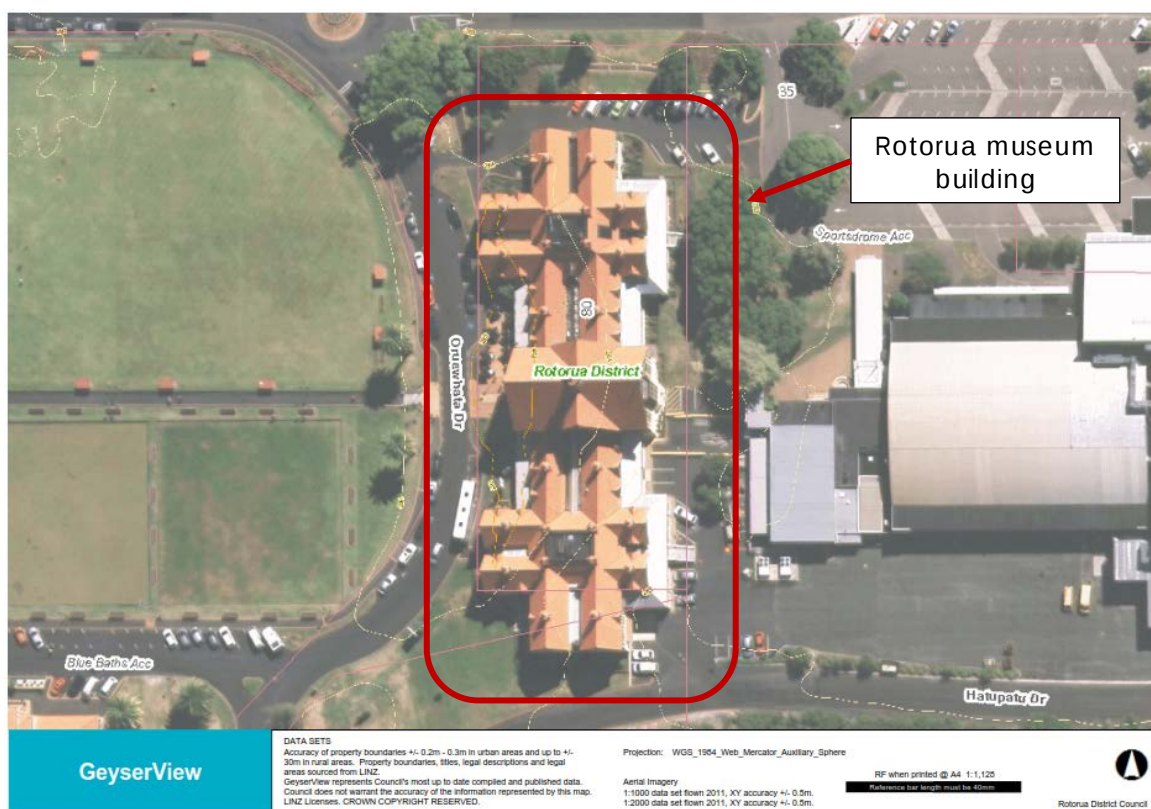


Figure 1: Aerial photograph of the site²

4. PERFORMED INVESTIGATION

4.1 Scala Penetrometer Tests

On 15 March 2017, a Cheal representative undertook 16 Scala Penetrometer Tests (Scala) in the basement of the building at the locations shown in Appendix 1. As drill rigs cannot access the basement, the purpose of the Scala tests was to assess the ground below the Bath House (central) section and compare the results with available historical data. The Scala results are summarised below and results are in Appendix 2.

4.2 Machine Boreholes

Three machine drilled boreholes (BH) were undertaken by Drillcore Limited using a rotary coring drill rig mounted on a tractor to determine the conditions of the ground adjacent to the Museum. BHs locations are shown in Appendix 1. The recovered soils were logged by a Geotechnical Engineer in accordance with NZ Geotechnical Society Guidelines. Borehole logs are included within Appendix 3 and core photographs in Appendix 4. Groundwater level was recorded following completion and is presented on the borehole logs and in Table 1 below. It should be noted that groundwater levels were recorded immediately after drilling and, consequently, are influenced by drilling mud and not considered to be accurate.

² http://geodev.rdc.govt.nz/HTML5_EXT/Index.html?viewer=GeyserView

Push tube samples were taken where soft ground was encountered. Six push tube samples were undertaken during drilling; 5 within BH3 and 1 within BH1.

Standard Penetration Tests (SPT) were undertaken in BH 1 and 3 in accordance with the NZ Standard NZS 4402.6.5.1:1988, where applicable. SPT results are included within the BH logs included in Appendix C.

Shear Vane tests were undertaken at the bottom of the drill barrel where recovered soil was suitable for testing.

The purpose of BH2 was to assess the ground directly below the Bath House in the central section of the museum. As a drill rig cannot access the building basement, BH2 was drilled approximately 2m from the bath house at an angle of 60° from horizontal to below the museum.

Table 1 – Borehole locations

Point ID	Depth (mbgl)	Coordinates		Elevation (m RL)	Groundwater level (mbgl)
		Northing	Easting		
BH01	12.45	758460.8	381862.4	283.266	2.8
BH02*	7.36	758426.5	381862.0	283.276	2.8
BH03	16.30	758359.2	381830.1	283.390	2.4

*borehole is angled 60° from the horizontal

4.3 Cone Penetration Tests

Four Cone Penetration Tests (CPTs) with temperature measurement were undertaken at the locations shown in Appendix 1 and listed in Table 2 below. Results are presented in Appendix 5. The purpose of these tests is to assess liquefaction risk and test geothermal field.

The tests were undertaken by Drillcore Limited using a Georig 220 with a pushing capacity of 200kN. Measurements of cone resistance, sleeve friction, pore water pressure and temperature were taken every 100mm. The tests were pushed until the high ground temperatures at the site started affecting results (>65°C). Termination depths are presented in Table 2 along with recorded groundwater level.

Table 2 – CPT locations

Point ID	Depth (mbgl)	Coordinates		Elevation (m RL)	Groundwater Level (mbgl)
		Northing	Easting		
CPT01	6.06	758462.7	381861.0	283.308	2.90
CPT02	7.58	758397.5	381863.3	282.622	2.80
CPT03	8.76	758401.8	381832.8	285.152	3.20
CPT04	8.00	758355.1	381840.3	283.205	2.90

4.4 Trial Pits

Two trial pits were excavated at the edge of the Northern and Southern extensions to the building at the locations shown in Appendix 1. The purpose of these pits was to confirm the foundation types of the Northern and Southern extensions.

Trial pit logs and associated sketches are attached in Appendix 6.

4.5 Laboratory Testing

As aforementioned six push tube soil samples were collected from the machine drilled boreholes for the laboratory testing. The following geotechnical laboratory tests were carried out by Geotechnics Ltd:

- Four natural water contents and Atterberg limits (LL, PL, PI)
- Four Fines Contents passing 75µm and 63µm sieve
- One one-dimensional consolidation test

It should be noted that some of the tests which did not require undisturbed sample were carried out with soil samples collected from core boxes. Summary of performed laboratory test is presented in the table 3 below.

Table 3 – Laboratory tests

Sample		Natural water content	Atterberg limits (LL, PL, PI)	Fines Content passing 75µm and 63µm sieve	One one-dimensional consolidation test
Pushed tube samples	BH03 5.6-5.65m bgl	No	No	No	Yes
	BH03 7.5-7.9m bgl	Yes	Yes	Yes	No
Core box sample	BH03 4.5-4.8m bgl	Yes*	Yes	Yes	No
	BH03 5.0-5.3m bgl	Yes*	Yes	Yes	No
	BH03 6.8-7.0m bgl	Yes*	Yes	Yes	No

* Measured values are not representative and only for indication

The laboratory test results are included in Appendix 7.

5. DISCLAIMER

This Report has been prepared solely for the use of our client with respect to the particular brief given to Cheal Consultants.

No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this Report are the result from the application of accepted industry methods of site investigation. As factual evidence over much of the site has been obtained solely from cone penetration tests, boreholes and trial pits, which by their nature only provide information about that exact location, there may be special conditions pertaining to this site which have not been identified by the investigation and which have not been taken into account in the report. Any groundwater levels measured during the investigation may change over time.

If variations in the subsoils occur from those described or assumed to exist then the matter should be referred back to Cheal Consultants immediately.

CHEAL CONSULTANTS LIMITED
15 May 2017

Appendix 1

Ground Investigation Plan

NOTES:

1. All dimensions are in metres unless noted otherwise.
2. Coordinate Datum: Bay of Plenty Circuit 2001 Moturiki Vertical datum 1953
3. Aerial photo sourced from Google Earth

LEGEND

BH01

Machine Drilled Borehole (Cheal, 2017)

CPT01

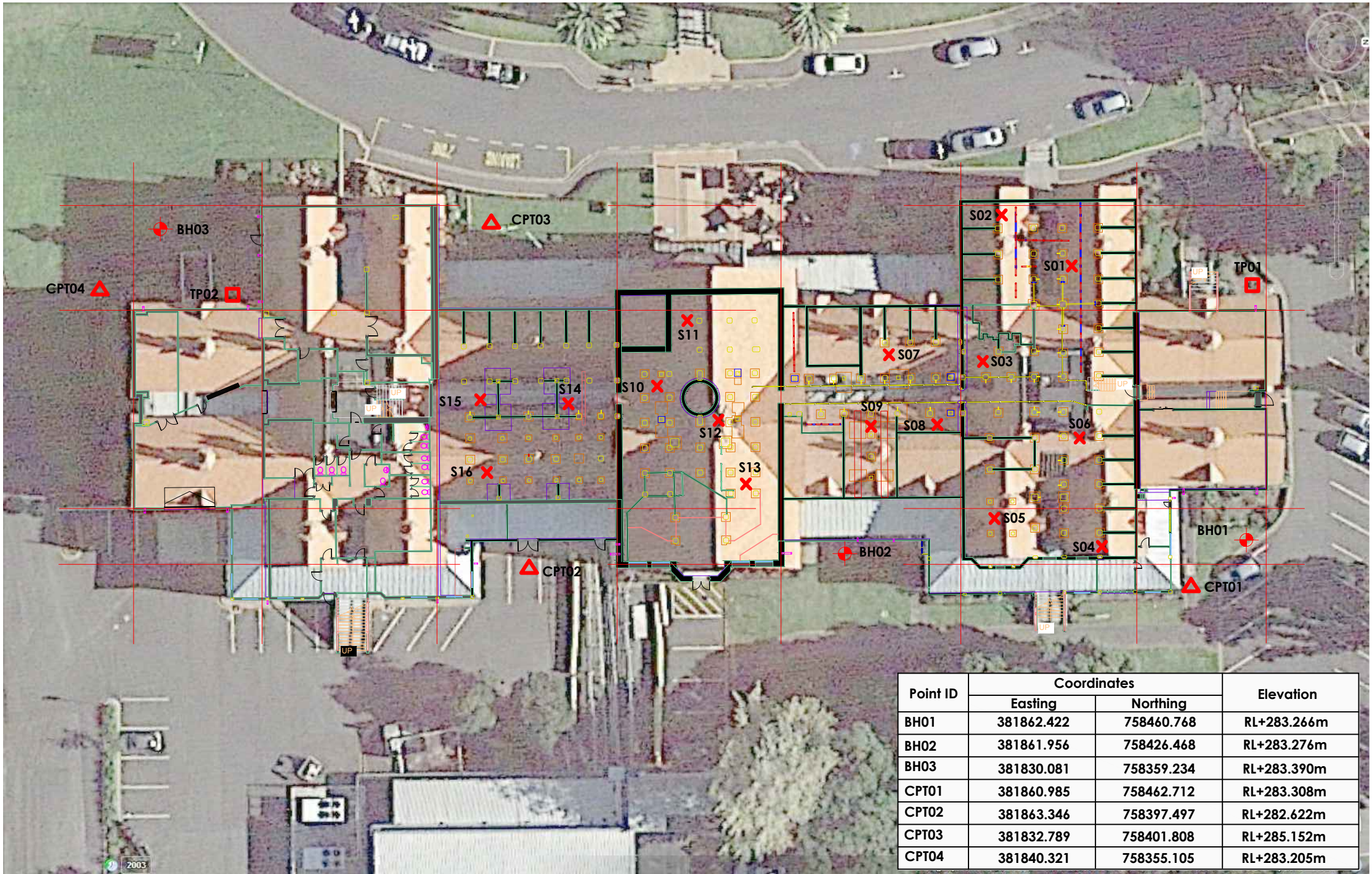
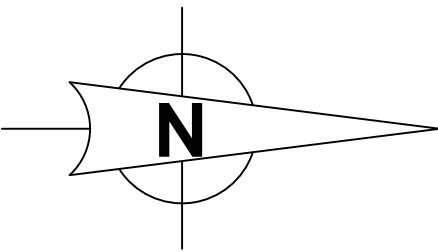
CPT (Cheal, 2017)

TP01

Trail Pit (Cheal, 2017)

S01

Scala Penetrometer Test (cheal, 2017)



Client Ref			
Rev	Date	Amendment	By Chk App
Project Title			
Rotorua Lakes Council			
Museum, Government Gardens			
Oruawhata Drive, Rotorua			
Drawing Title			
Site Investigation Plan			
Surveyed			
Designed	KD	11/05/2017	
Drawn	KD	11/05/2017	
Checked	FH	11/05/2017	
Approved			
Status			
Scale	Not to Scale		A3
Drawing Number		Rev	
16592-01		0	

Appendix 2

Scala Penetrometer Test Results

SCALA PENETROMETER TEST SHEET

CLIENT:	Rotorua Lakes Council	JOB REF:	16592
SITE ADDRESS:	Museum, Oruawhata Drive, Rotorua	DATE:	15/03/2017
JOB DESCRIPTION:	Site Investigation	TEST BY:	KD

DEPTH: Millimetres Below Ground Level (BGL)	TEST No. / Approximate surface RL								
	S01	S02	S03	S04	S05	S06	S07	S08	S09
0 - 100	3	1	4	2	2	3	2	3	3
100 - 200	3	1	2	4	3	5	4	3	3
200 - 300	6	1	1	12	17	4	3	3	2
300 - 400	5	5	5	5	19	9	2	16	4
400 - 500	3	2	4	6	23	10	2	40	6
500 - 600	18	3	2	9	17	20	3	24	8
600 - 700	6	5	3	4	14	4	4	15	2
700 - 800	5	2	5	2	5	3	5	14	5
800 - 900	6	5	6	5	7	7	4	11	4
900 - 1000	4	3	8	11	9	10	10	10	4
1000 - 1100	12	3	9	22	19	16	15	10	6
1100 - 1200	13	20	7	10	15	21	8	11	20
1200 - 1300	4	19	3	3	10	9	9	28	16
1300 - 1400	4	5	1	4	5	6	3	9	9
1400 - 1500	5	3	3	7	7	4	6	9	10
1500 - 1600	6	2	4	7	11	3	9	9	12
1600 - 1700	11	7	3	11	16	8	16	9	14
1700 - 1800	8	6	4	11	19	10	33	8	18
1800 - 1900	7	6	9	15	37	16	33	8	24
1900 - 2000	6	16	8	10	35	16	24	8	24
2000 - 2100	13	26	11	12		16	28	17	40
2100 - 2200	40	29	12	9		21	40	24	40
2200 - 2300	40	28	15	9		14			
2300 - 2400		11	15	7		10			
2400 - 2500		12	14	11		13			
2500 - 2600		15	16	14		11			
2600 - 2700		15	20	18		14			
2700 - 2800		21		14		14			
2800 - 2900		21		14		14			
2900 - 3000									
3000 - 3100									
3100 - 3200									
3200 - 3300									
3300 - 3400									
3400 - 3500									
3500 - 3600									
3600 - 3700									
3700 - 3800									
3800 - 3900									
3900 - 4000									

Notes:

Minimum Test Depth as per NZS 3604.....1.0m (1000mm) or 2x width of footing below bottom of footing

Blow count for Good Ground as per NZS 3604.....5 blows/100mm to a depth of 1.0m or 2x width of footing (whichever is the greater)

Blow count for Good Ground as per NZS 3604.....3 blows/100mm below the above depths

Blow count for 100kPa Allowable Bearing Pressure.....4 blows/100mm

SCALA PENETROMETER TEST SHEET

CLIENT:	Rotorua Lakes Council	JOB REF:	16592
SITE ADDRESS:	Museum, Oruawhata Drive, Rotorua	DATE:	15/03/2017
JOB DESCRIPTION:	Site Investigation	TEST BY:	KD

DEPTH: Millimetres Below Ground Level (BGL)	TEST No. / Approximate surface RL							
	S10	S11	S12	S13	S14	S15	S16	
0 - 100	10	1	2	1	4	4	10	
100 - 200	9	2	4	2	1	1	5	
200 - 300	1	17	3	7	2	3	28	
300 - 400	0	8	0	14	0	2	4	
400 - 500	1	5	2	8	1	1	32	
500 - 600	3	1	3	3	3	0	20	
600 - 700	3	4	3	2	40	1	7	
700 - 800	4	6	2	2	40	4	6	
800 - 900	9	4	4	4		5	7	
900 - 1000	4	5	3	5		3	6	
1000 - 1100	2	6	4	7		4	5	
1100 - 1200	3	6	5	12		1	5	
1200 - 1300	2	5	3	5		2	8	
1300 - 1400	3	2	8	1		1	7	
1400 - 1500	3	2	40	1		3	3	
1500 - 1600	3	3	40	2		2	4	
1600 - 1700	6	4		9		3	24	
1700 - 1800	7	8		13		4	25	
1800 - 1900	10	10		22		16	16	
1900 - 2000	15	15		35		29	20	
2000 - 2100	22	24		40		33	16	
2100 - 2200	20	30				21	37	
2200 - 2300	40	8				5		
2300 - 2400		5				3		
2400 - 2500		11				5		
2500 - 2600		11				5		
2600 - 2700		7				7		
2700 - 2800		6				7		
2800 - 2900		7				9		
2900 - 3000								
3000 - 3100								
3100 - 3200								
3200 - 3300								
3300 - 3400								
3400 - 3500								
3500 - 3600								
3600 - 3700								
3700 - 3800								
3800 - 3900								
3900 - 4000								

Notes:

Minimum Test Depth as per NZS 3604.....1.0m (1000mm) or 2x width of footing below bottom of footing

Blow count for Good Ground as per NZS 3604.....5 blows/100mm to a depth of 1.0m or 2x width of footing (whichever is the greater)

Blow count for Good Ground as per NZS 3604.....3 blows/100mm below the above depths

Blow count for 100kPa Allowable Bearing Pressure.....4 blows/100mm

Appendix 3

Borehole Logs

Bore: BH01		Borehole Logging Record					cheal		
Project no.: 16592			Drilling Date: 07 April 2017			Drilled Depth: 12.45 (mBGL)			
Project Name: Rotorua Lakes Council			Coordinates: 381862.4 E : 758460.8 N			Drilling Company: Drillcore			
Location: Rotorua			Ground Elevation: 283.266 (mRL)			Drilling Method: HQ			
Depth (mBGL)	R.L. (m)	Recovery (%)	Graphic Log	Soil or Rock Field Material Description	SPT (blows/300mm)	Undrained Shear Strength	In situ/ Lab Test	Geological unit	
0.0	283	100		Topsoil, sandy SILT with some coarse pumice sand, dark brown, firm, moist, non plastic				Topsoil	
				Sinter (siliceous), dark brown, cemented, moist					
1.0		99		Fine to medium SAND with minor fine pumice gravel, brown, moist				Holocene river deposits	
				SILT, light yellow, firm to stiff, moist, non plastic					Holocene river deposits
2.0	281	100		Fine SAND, light grey, moist, uniformly graded	△			SPT (4),1,0 N=1 Push Tube	Holocene river deposits
		100		Sandy SILT, greenish grey, firm, wet, low plastic, moderate sensitive					
3.0		100		Coarse SAND with minor pumice gravel, greenish grey, medium dense, moist	△			SPT (4),3,3 N=6	Holocene river deposits
		100		Sandy fine pumice GRAVEL, grey, medium dense, wet, well graded					
4.0	279	100		Sandy fine pumice GRAVEL, grey, medium dense, wet, well graded	△			SPT (622),1 ,3 N=4	Holocene river deposits
		100		Sandy medium to coarse pumice GRAVEL, medium dense, wet, well graded					
5.0		100		Sandy medium to coarse pumice GRAVEL, medium dense, wet, well graded				SPT (5),7,7 N=14	Holocene river deposits
		100		Sandy SILT, grey, firm, moist, non plastic	△		×		
6.0	277	100		Cemented sandy SILT (altered pumice), light grey, very stiff to hard, wet				SPT (17),23 ,13 N=36	Holocene river deposits
		100		Sandy SILT (altered pumice), light grey, firm to stiff, saturated with strong sulphur odour					
7.0		100		Cemented sandy SILT (altered pumice), light grey, very stiff to hard, wet				SPT (6),8,1 3 N=21	Holocene river deposits
		100		Silty SAND with minor fine pumice gravel, dark greenish brown, dense, saturated					
8.0	275	72.3		Silty fine SAND, grey, dense, wet				SPT (6),8,1 3 N=21	Holocene river deposits
				100	Cemented fine SAND with minor pumice gravel, grey, medium dense to dense, saturated	△			
9.0		100		Fine SAND with some pumice gravel, dark grey, medium dense, saturated					Holocene river deposits
		100							
10.0									

Bore: BH01		Borehole Logging Record				cheal	
Project no.: 16592 Project Name: Rotorua Lakes Council Location: Rotorua		Drilling Date: 07 April 2017 Coordinates: 381862.4 E : 758460.8 N Ground Elevation: 283.266 (mRL)		Drilled Depth: 12.45 (mBGL) Drilling Company: Drillcore Drilling Method: HQ			

Depth (mBGL)	R.L. (m)	Recovery (%)	Graphic Log	Soil or Rock Field Material Description	SPT (blows/300mm)	Undrained Shear Strength	In situ/ Lab Test	Geological unit	
					0 10 20 30 40 50	0 50 100 150 200 250			
11.0	273	100		Cemented fine SAND with some pumice gravel, dark grey, dense, saturated			SPT (0),0,2 N=2	Holocene river deposits	
		100		Silty pumice SAND, greenish grey, loose, saturated	▲				
		100							
		12.0		271	100	Silty pumice SAND, greenish grey, loose to dense, saturated, cemented with depth			SPT (1),2,1 N=3
		100		▲					
				EOB 12.45m					

Bore: BH03

Borehole Logging Record

cheal

Project no.: 16592

Project Name: Rotorua Lakes Council

Location: Rotorua

Drilling Date: 05 April 2017

Coordinates: 381830 E : 758359.2 N

Ground Elevation: 283.39 (mRL)

Drilled Depth: 16.3 (mBGL)

Drilling Company: Drillcore

Drilling Method: HQ

Depth (mBGL)	R.L. (m)	Recovery (%)	Graphic Log	Soil or Rock Field Material Description	SPT (blows/300mm)	Undrained Shear Strength	In situ/ Lab Test	Geological unit
					0 10 20 30 40 50	0 50 100 150 200 250		
0.0	283	100		Topsoil, silty fine SAND with some pumice, brownish black			Push Tube	Topsoil
				Sandy SILT with some coarse pumice sand and some ash, dark brown to black, dense, moist, slight sulphur odour				Holocene river deposit
				Sinter (siliceous), yellowish grey, cemented, wet				Sinter
1.0				SILT with traces of coarse pumice sand, orange and grey, soft, moist, moderate plastic, sensitive, sulphur odour				Holocene river deposit
	281	100		Core loss			Push Tube	
2.0				SILT with traces of coarse pumice sand, yellowish grey to grey, very soft to soft, moist to wet, high plastic, moderate sensitivity, slight sulphur odour (altered sediments)		X		Holocene river deposit
				Core loss				
3.0				Gravelly pumice SILT, dark grey to black, soft, wet, non plastic (altered sediments)				Holocene river deposit
	279	54		SILT with some fine sand, dark grey, very soft to soft, saturated, non plastic, extra sensitive (altered sediments)			Push Tube	Holocene river deposit
4.0								
5.0				SILT with traces of fine sand, grey, firm to stiff, saturated, non plastic, insensitive (altered sediments)		X		Holocene river deposit
				Core loss				
6.0	277	100			△		SPT (1), 1.2 N=3	Holocene river deposit
				Silty fine to coarse pumice SAND, greenish grey, saturated, sulphur odour (altered sediments)				
7.0								
				Silty fine pumice SAND with traces of coarse pumice sand, greenish grey, saturated, sulphur odour (altered sediments)		X		Holocene river deposit
8.0	275	72.3		Sinter (siliceous)			SPT (3), 4.5 N=9	Sinter
				Sandy SILT with traces of coarse pumice sand, greenish grey, stiff to very stiff, saturated, low plastic, moderate sensitivity, sulphur odour, interbedded layers of sinter (altered sediments)	△			Holocene river deposit
9.0								
10.0						X		

Bore: BH03		Borehole Logging Record					cheal		
Project no.: 16592			Drilling Date: 05 April 2017			Drilled Depth: 16.3 (mBGL)			
Project Name: Rotorua Lakes Council			Coordinates: 381830 E : 758359.2 N			Drilling Company: Drillcore			
Location: Rotorua			Ground Elevation: 283.39 (mRL)			Drilling Method: HQ			
Depth (mBGL)	R.L. (m)	Recovery (%)	Graphic Log	Soil or Rock Field Material Description	SPT (blows/300mm)	Undrained Shear Strength	In situ/ Lab Test	Geological unit	
					0 10 20 30 40 50	0 50 100 150 200 250			
		N/R	X	Core loss					
	273	100		Sandy SILT with minor coarse pumice sand, greenish grey, stiff, saturated, non plastic, moderately sensitive, with thin interbedded layers of medium pumice sand (altered sediments)			Push Tube	Holocene river deposit	
11.0		100			△		SPT (62),0,2 N=2		
		100				X			
12.0		100			△		SPT (0),1,0 N=1		
	271								
13.0		89.5							
		100			△	X	SPT (0),0,2 N=2		
14.0		99		Sandy SILT with minor coarse pumice sand, greenish grey, stiff, saturated, non plastic, moderately sensitive, with interbedded layers of cemented medium pumice sand (altered sediments)				Holocene river deposit	
	269								
15.0		100		Sandy SILT with minor coarse pumice sand, greenish grey, stiff, saturated, non plastic, moderately sensitive (altered sediments)	△		SPT (0),0,1 N=1	Holocene river deposit	
16.0		100	X X X X X	Cemented silty pumioce SAND with some medium pumice gravel, grey, dense, saturated (altered sediments)				Holocene river deposit	
	267			EOB 16.3m					

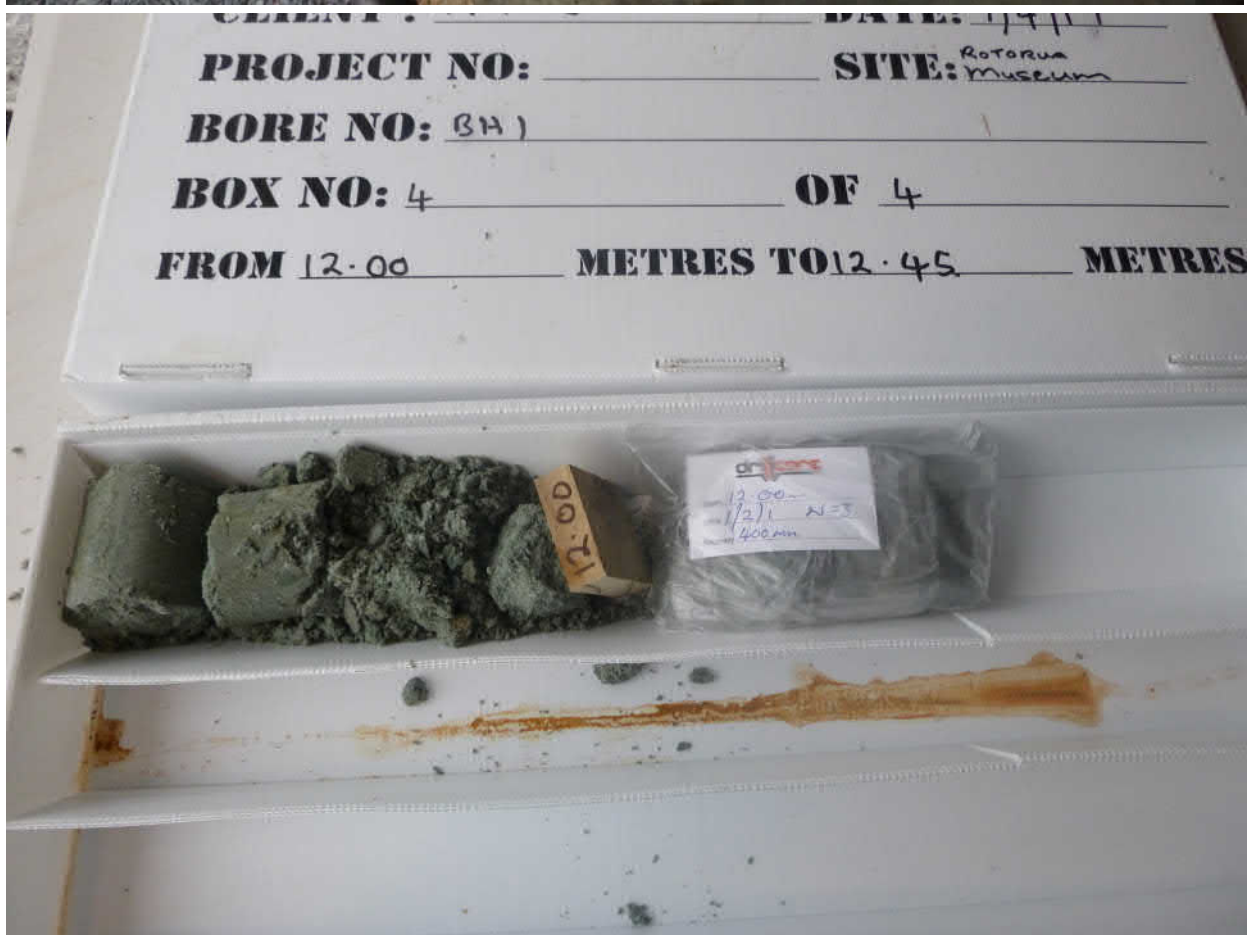
Appendix 4

Borehole Core Photographs

BH01: Box01 (0-4.35m) and Box02 (4.35-8.05m)



BH01: Box03 (8.05-11.87m) and Box04 (11.87-12.45m)



BH02: Box01 (0-2.6m) and Box02 (2.6-5.5m)



BH02: Box03 (5.5-8.5m)



BH03: Box01 (0-4.8m) and Box02 (4.8-9.5m)



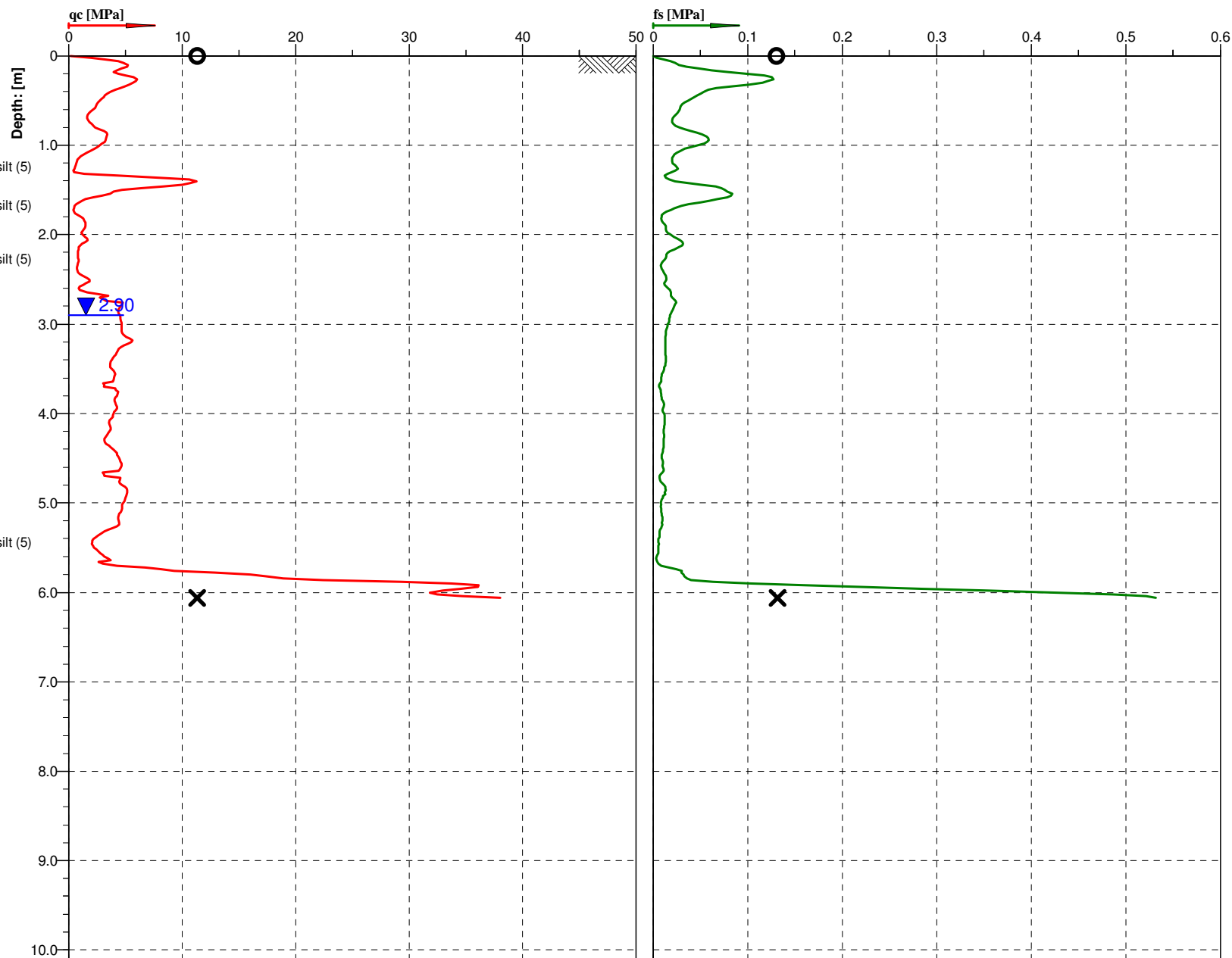
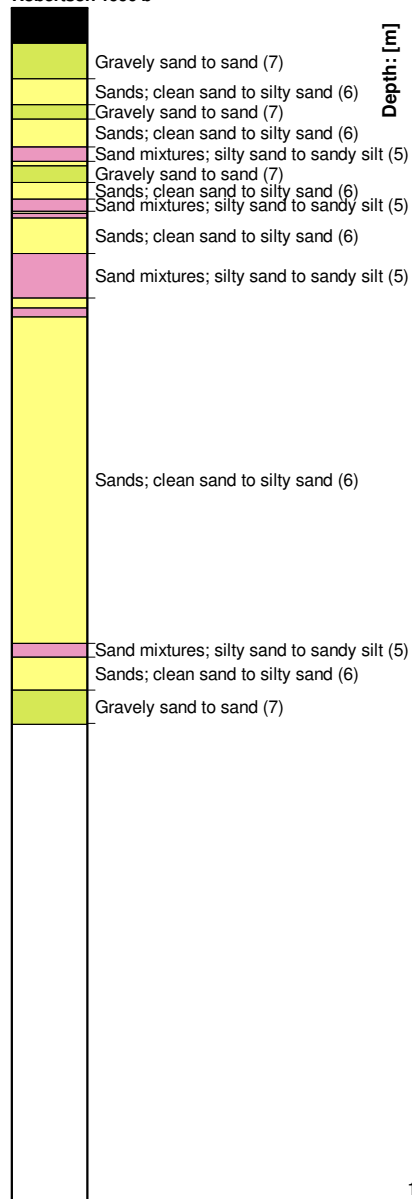
BH03: Box03 (9.5-13.75m) and Box04 (13.75-16.3m)



Appendix 5

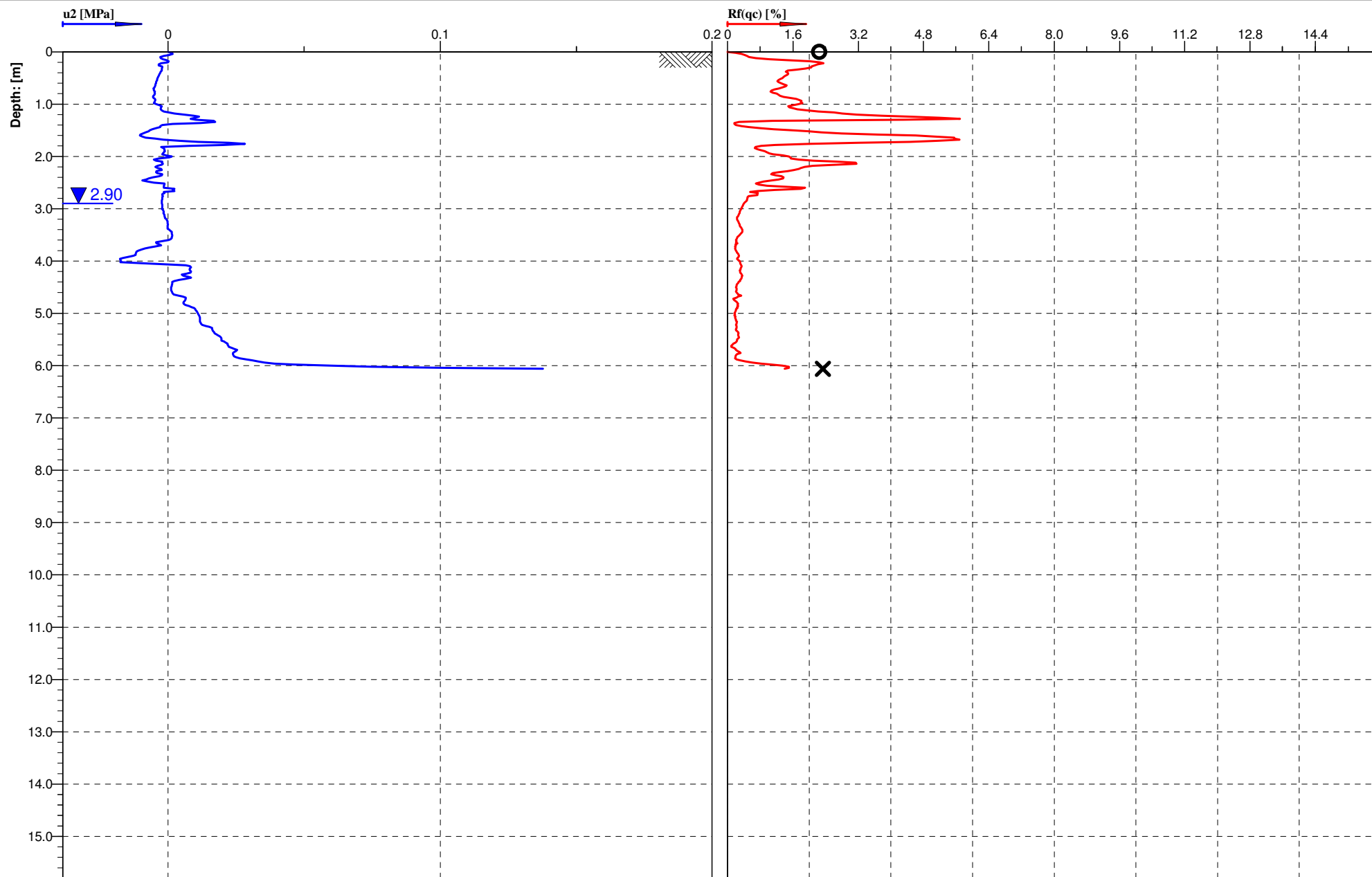
Cone Penetration Tests

Classification by
Robertson 1990 b



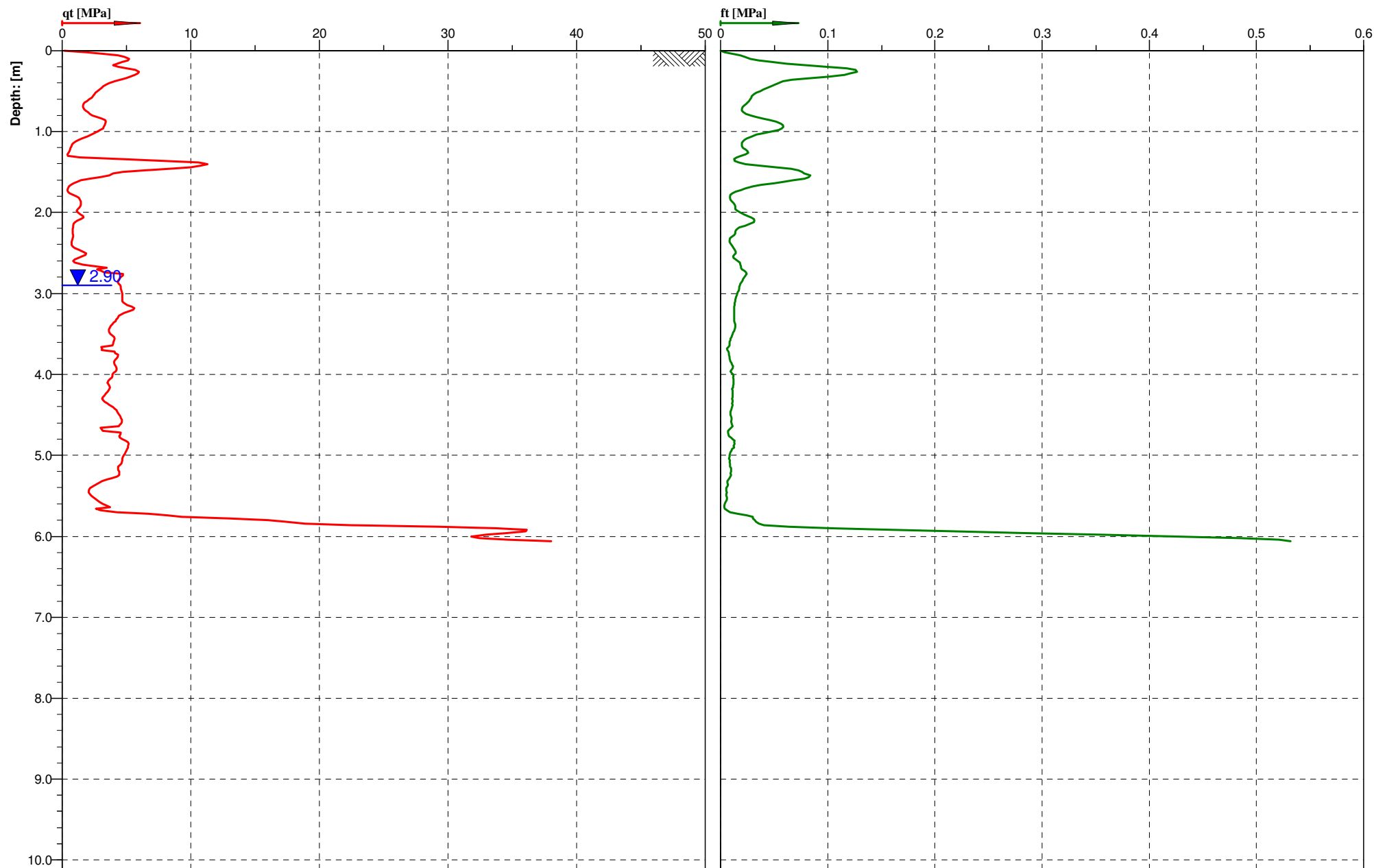
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	Rotorua Museum	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT01
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	1/4	Fig.:	
Refusal at 6.06m				File:	CPT01 (004).cpt		



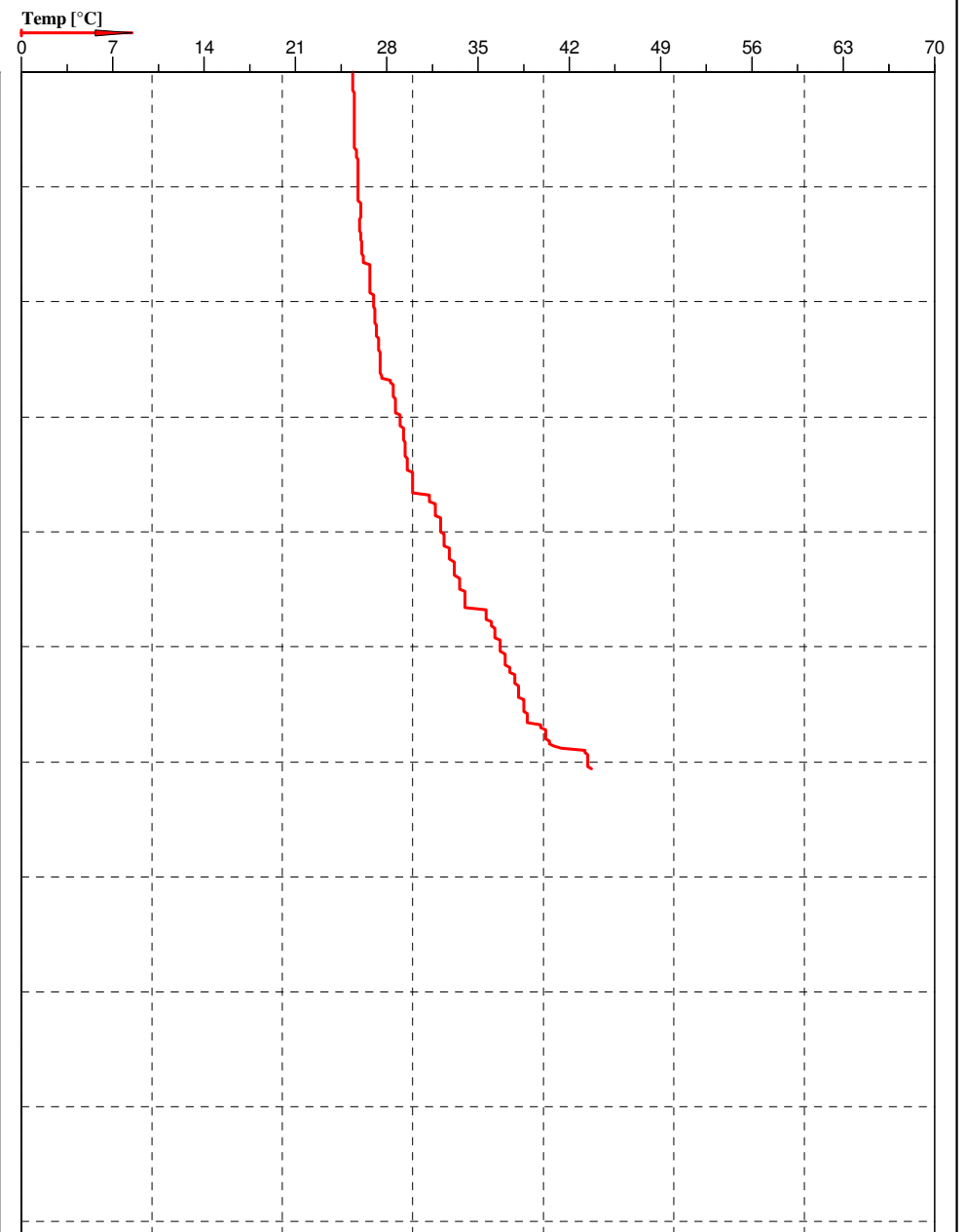
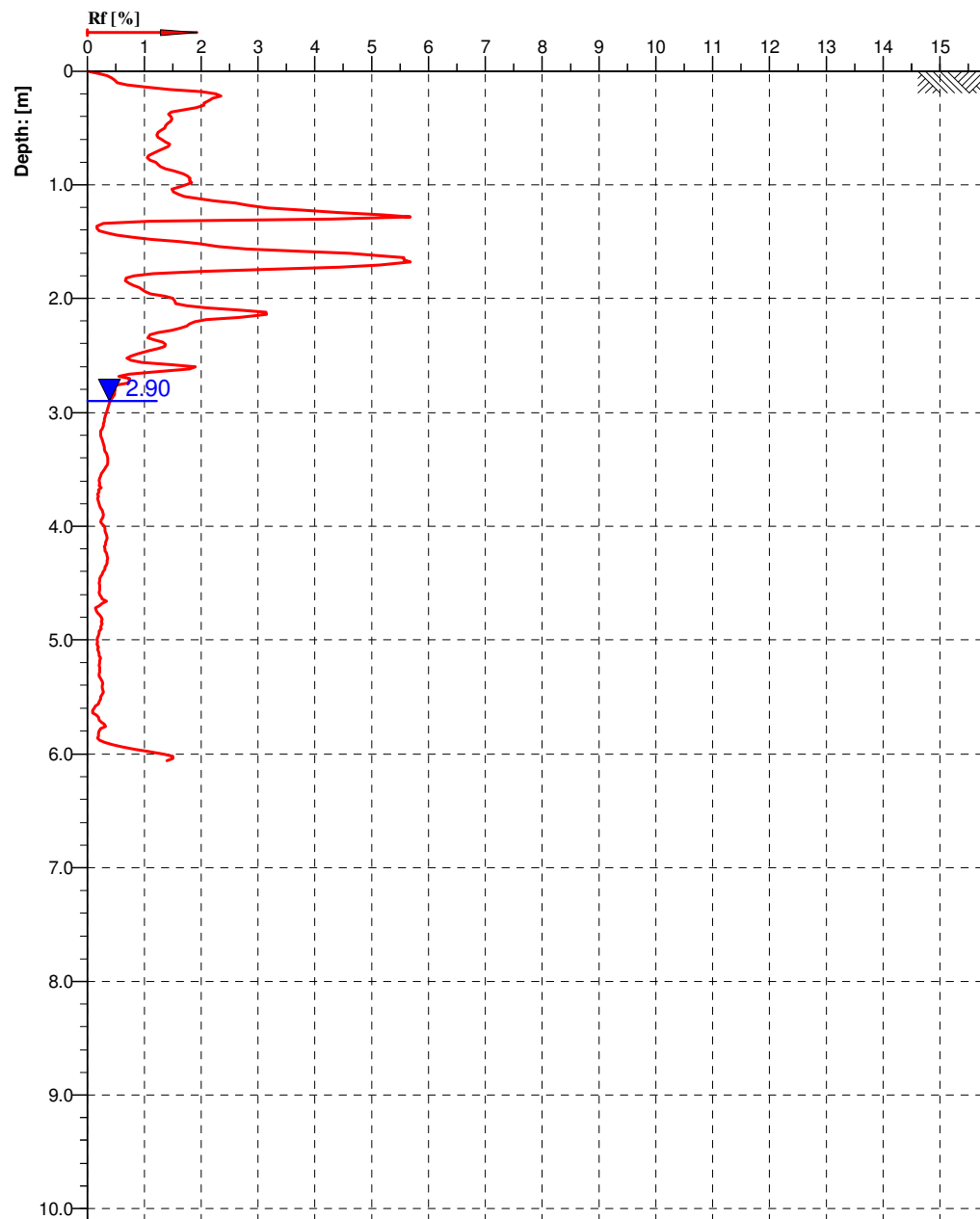
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	Rotorua Museum	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT01
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 100
Project:	ROTORUA MUSEUM			Page:	2/4	Fig.:	
Refusal at 6.06m				File:	CPT01 (004).cpt		



Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

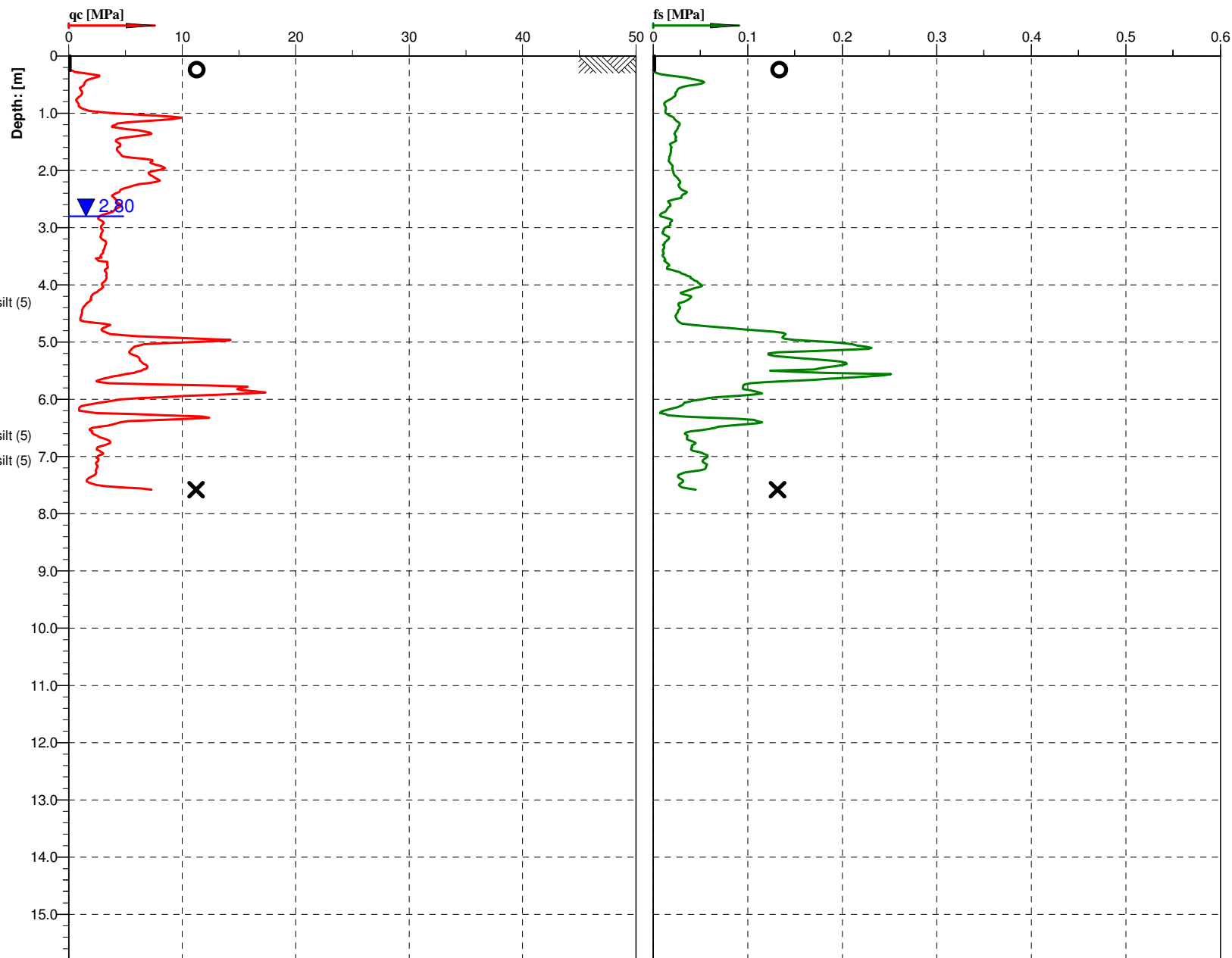
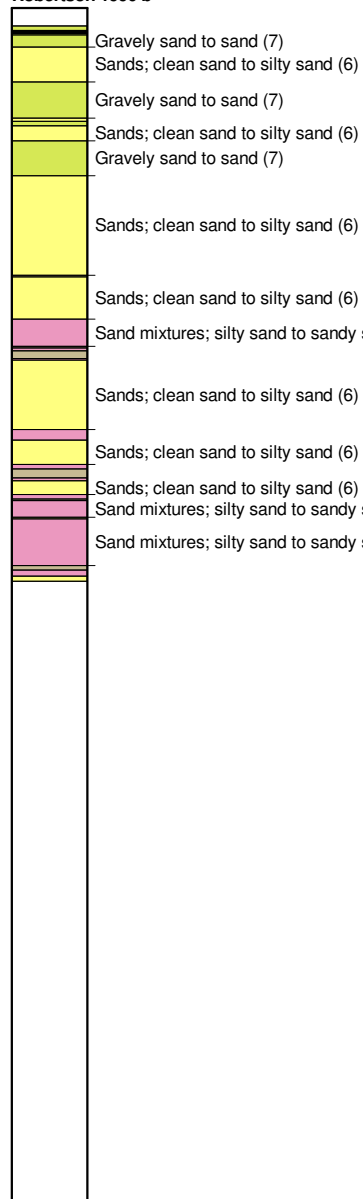
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Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	3/4	Fig.:	
Refusal at 6.06m				File:	CPT01 (004).cpt		



Cone No: 4756
Tip area [cm2]: 10
Sleeve area [cm2]: 150

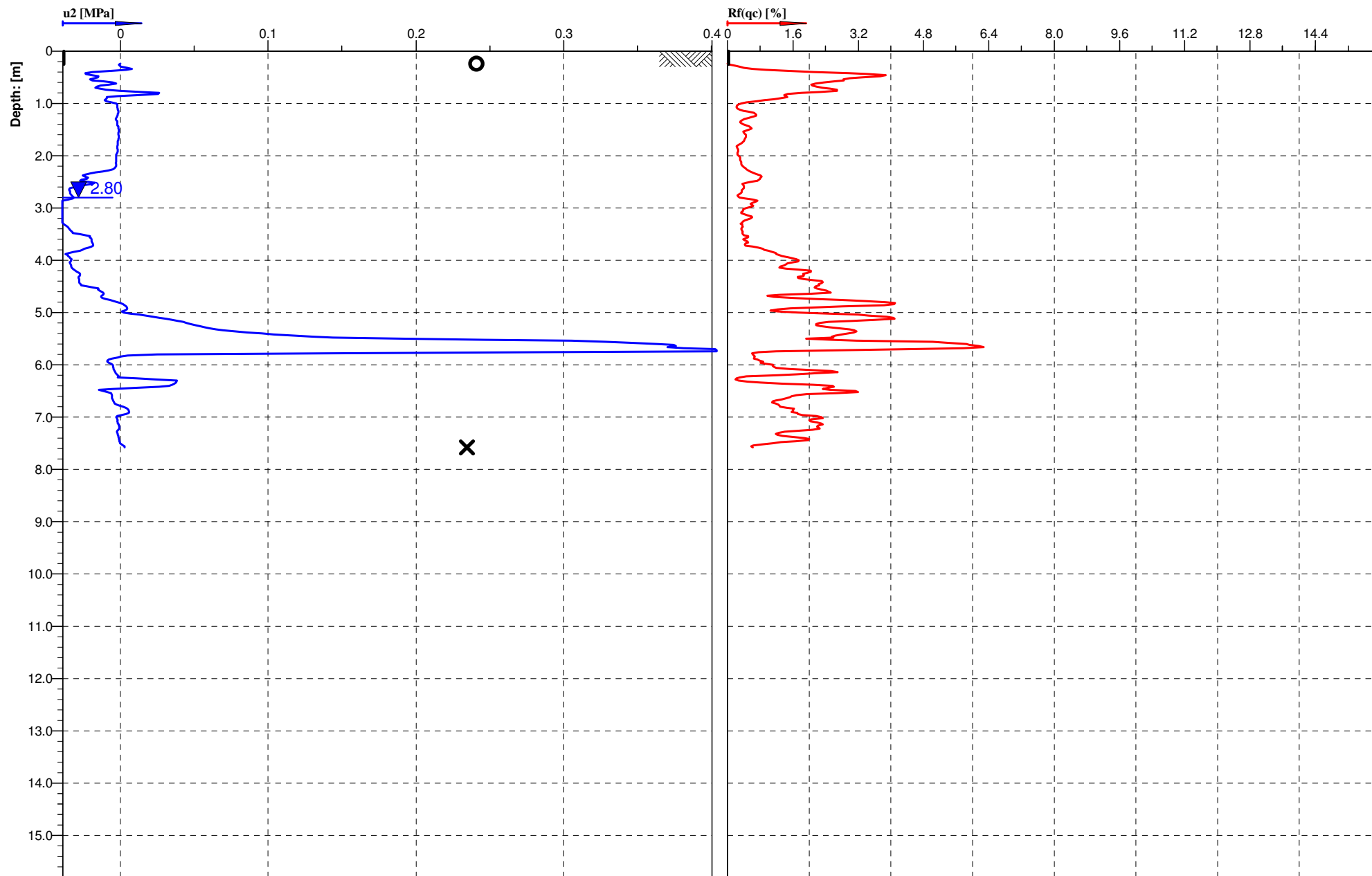
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Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	4/4	Fig.:	
Refusal at 6.06m				File:	CPT01 (004).cpt		

Classification by
Robertson 1990 b



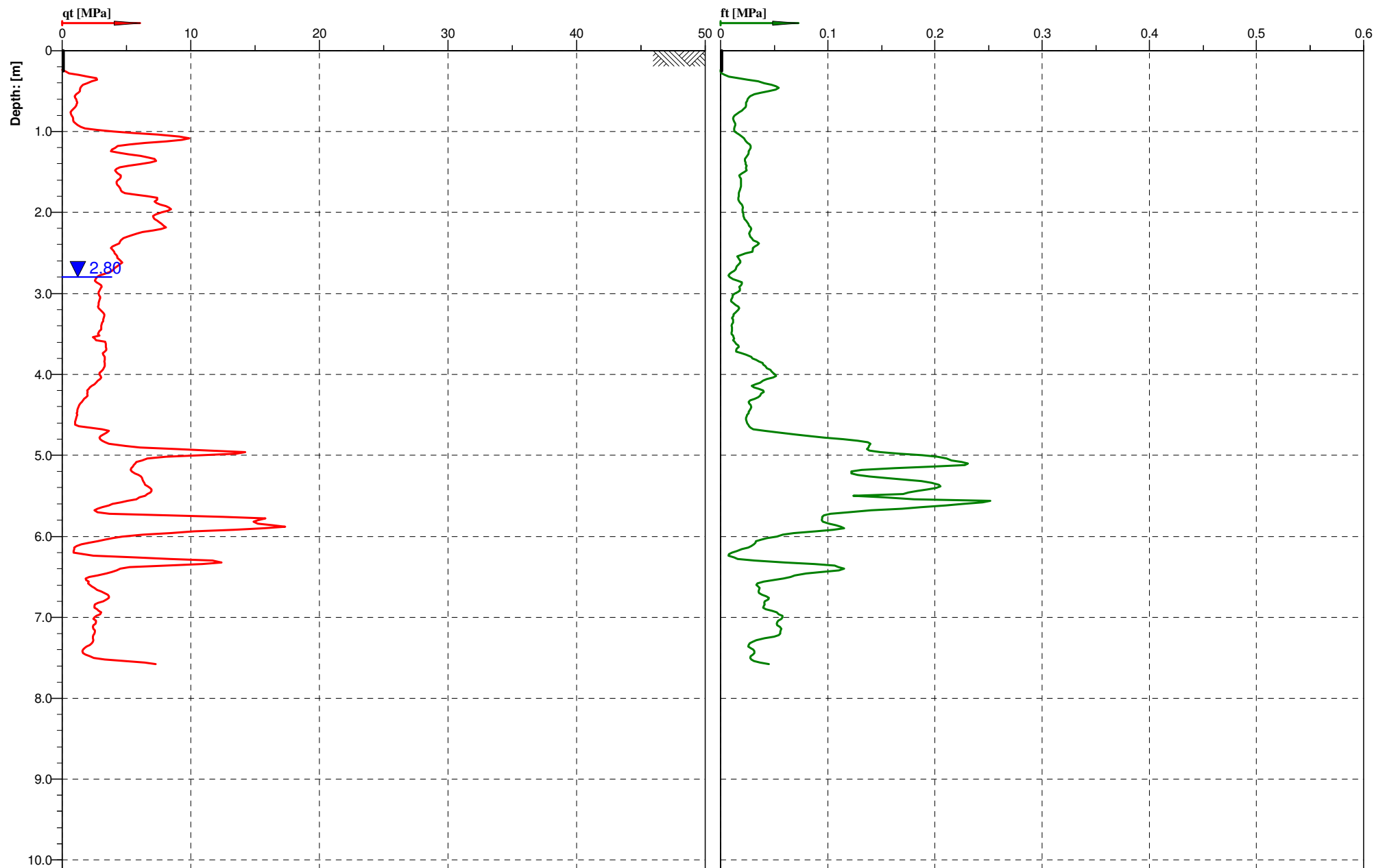
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT02
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 100
Project:	ROTORUA MUSEUM			Page:	1/4	Fig.:	
Pre drill 250mm, temperature exceeding 62 degrees				File:	CPT02 (005).cpt		



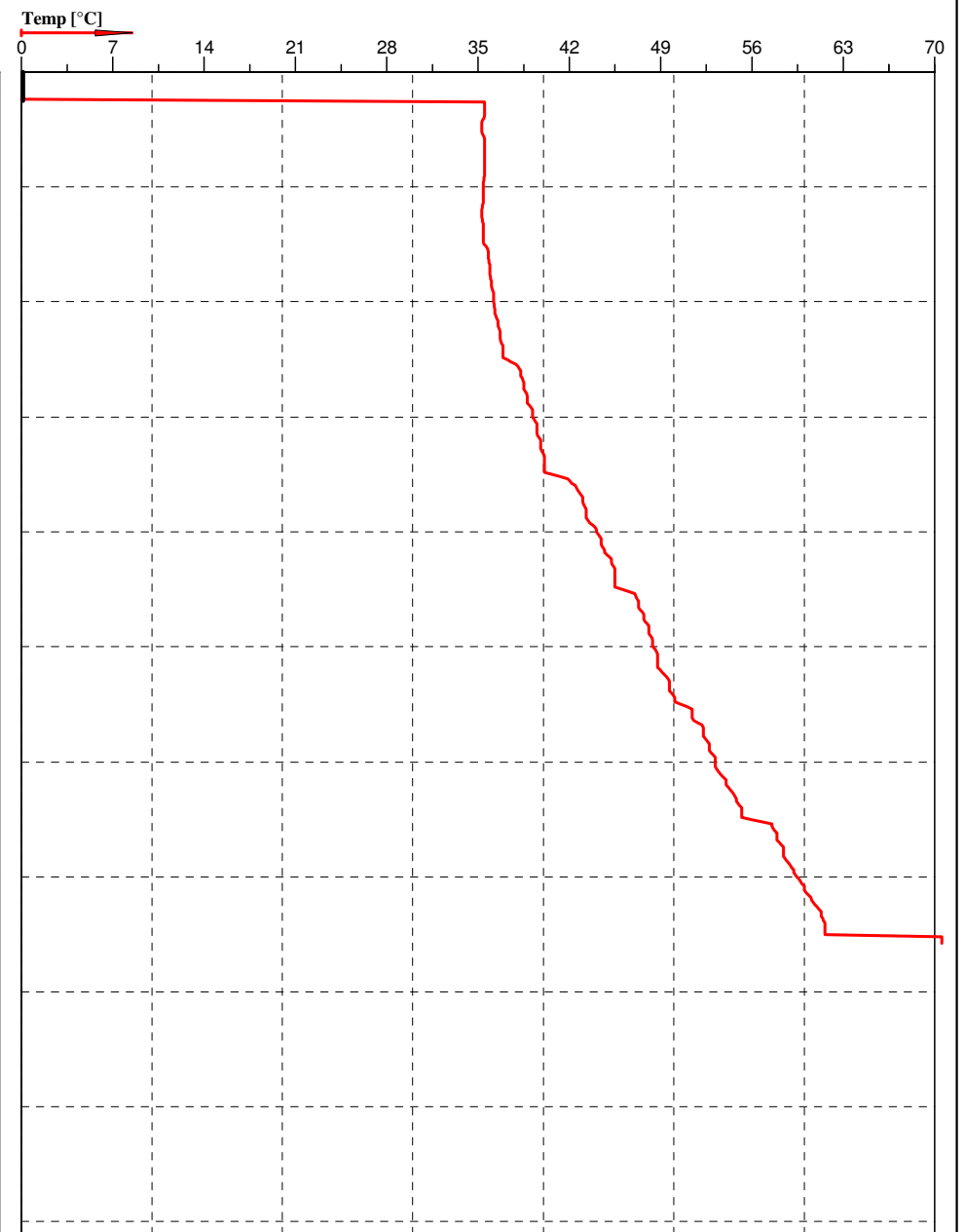
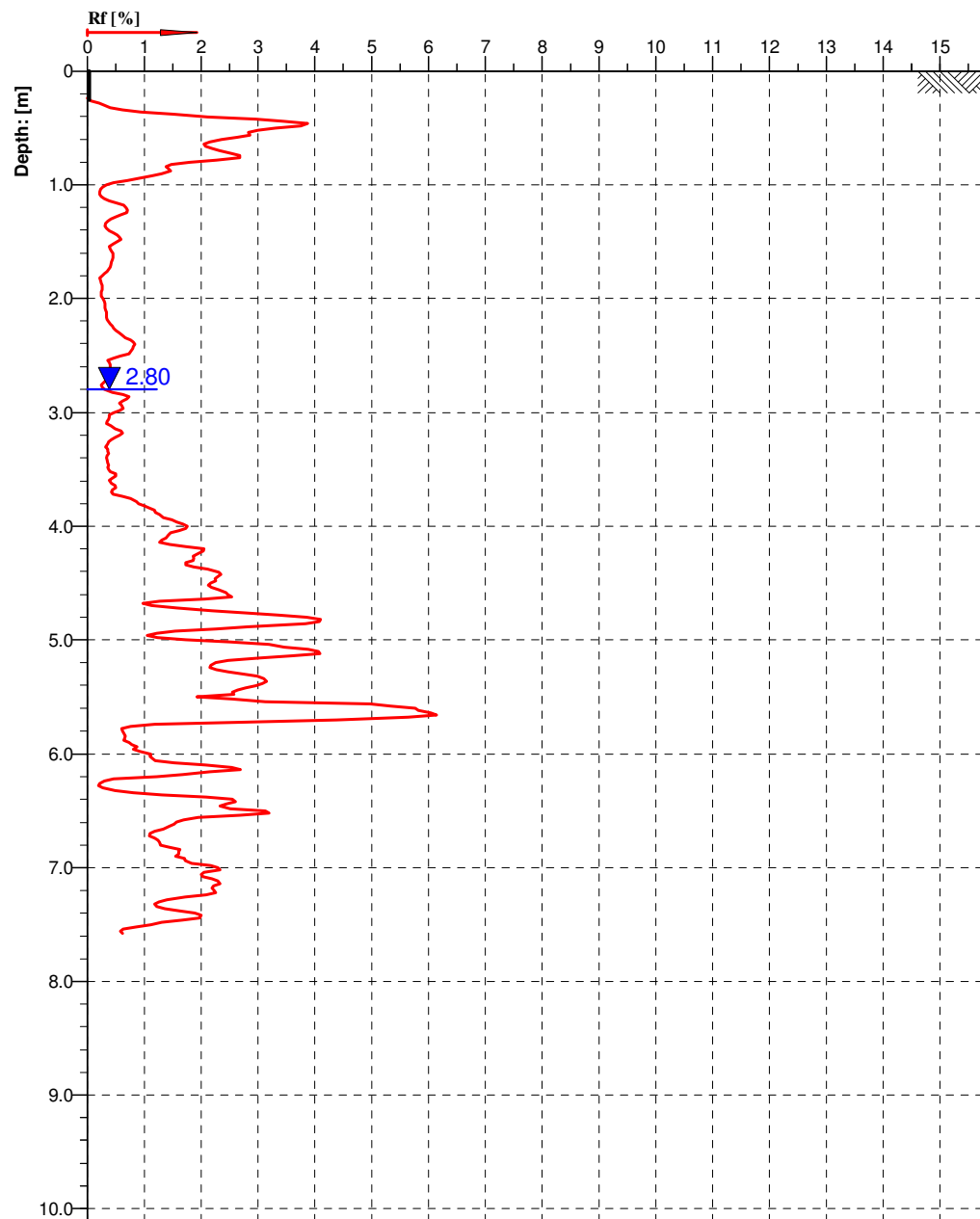
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT02
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 100
Project:	ROTORUA MUSEUM			Page:	2/4	Fig.:	
Pre drill 250mm, temperature exceeding 62 degrees				File:	CPT02 (005).cpt		



Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

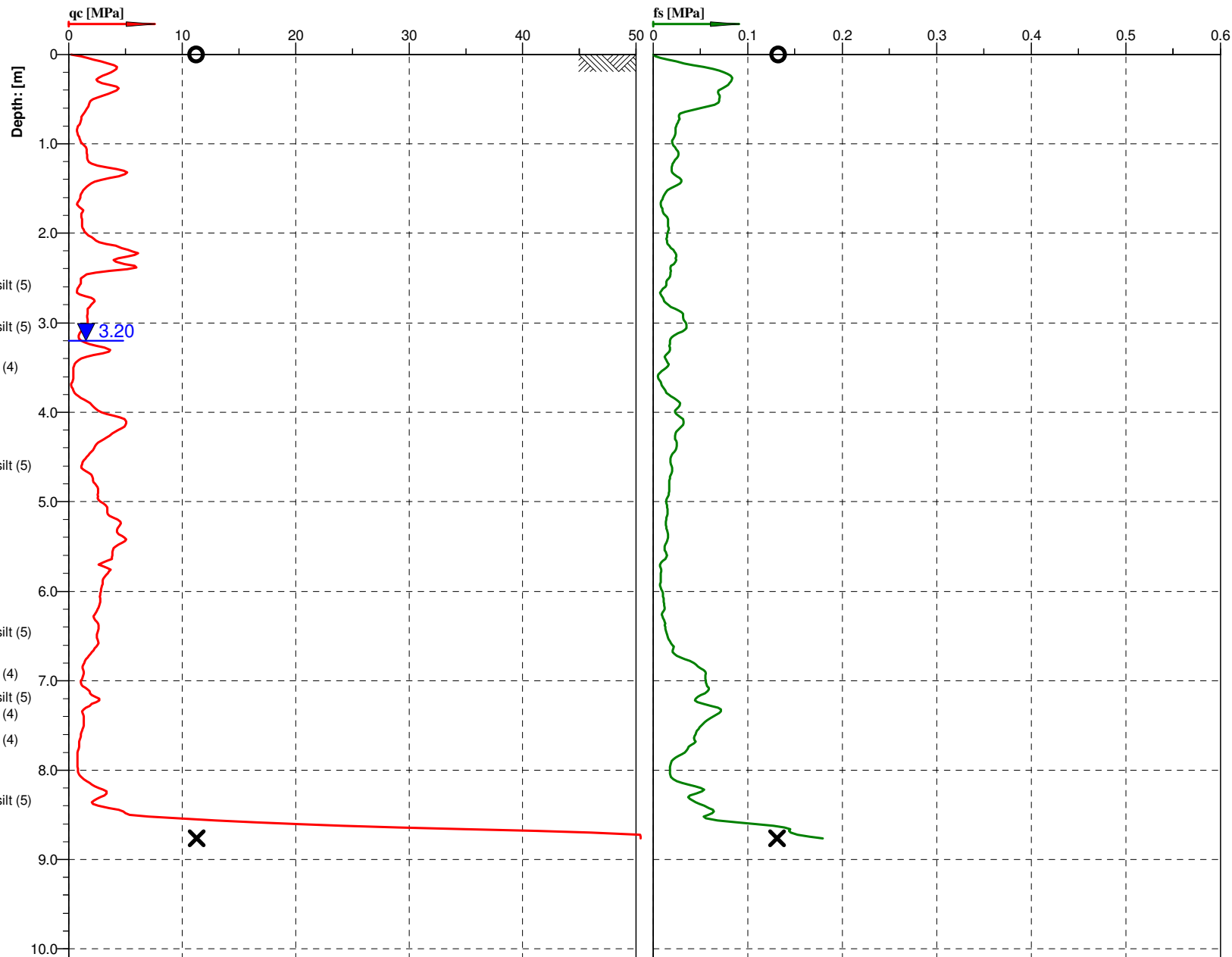
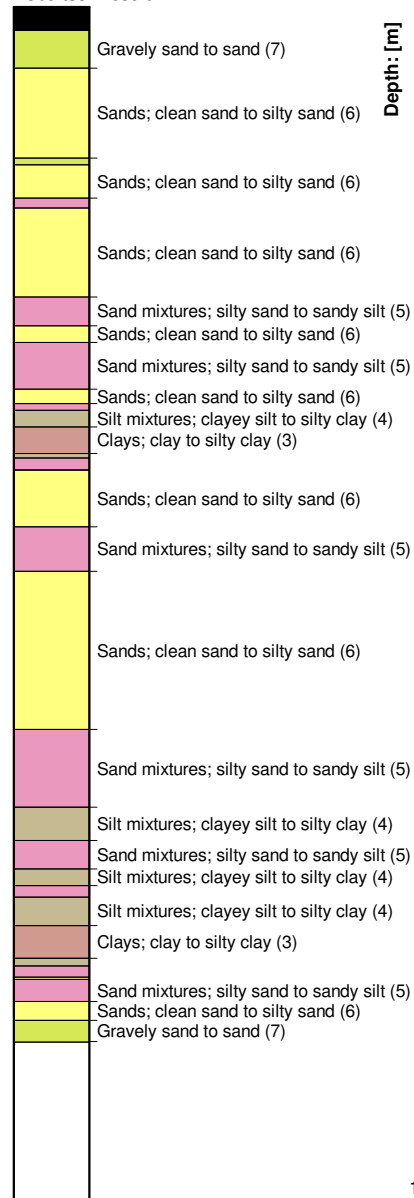
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Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	1/1	Fig.:	
Pre drill 250mm, temperature exceeding 62 degrees				File:	CPT02 (005).cpt		



Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

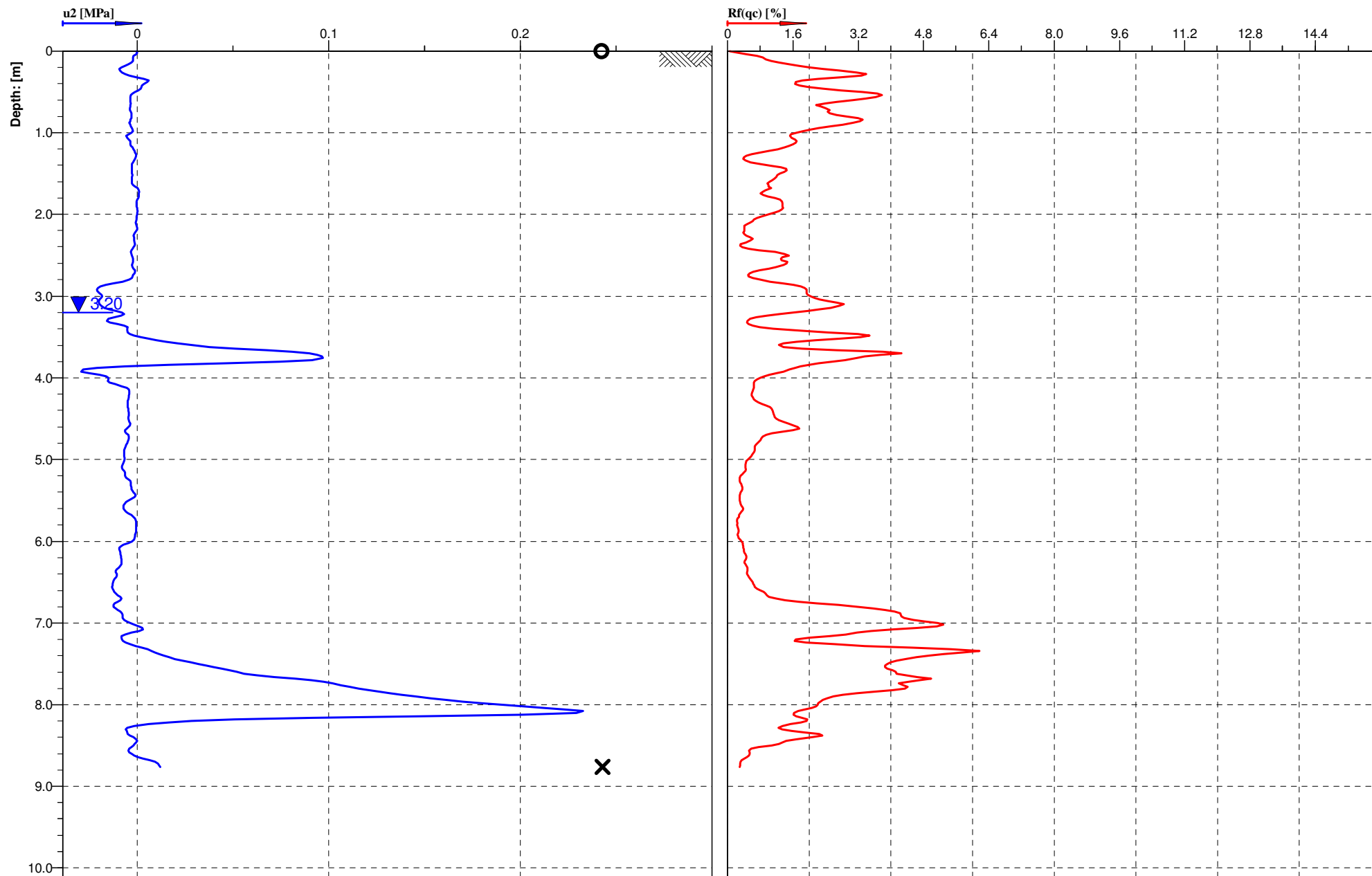
Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT02
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	4/4	Fig.:	
Pre drill 250mm, temperature exceeding 62 degrees				File:	CPT02 (005).cpt		

Classification by
Robertson 1990 b



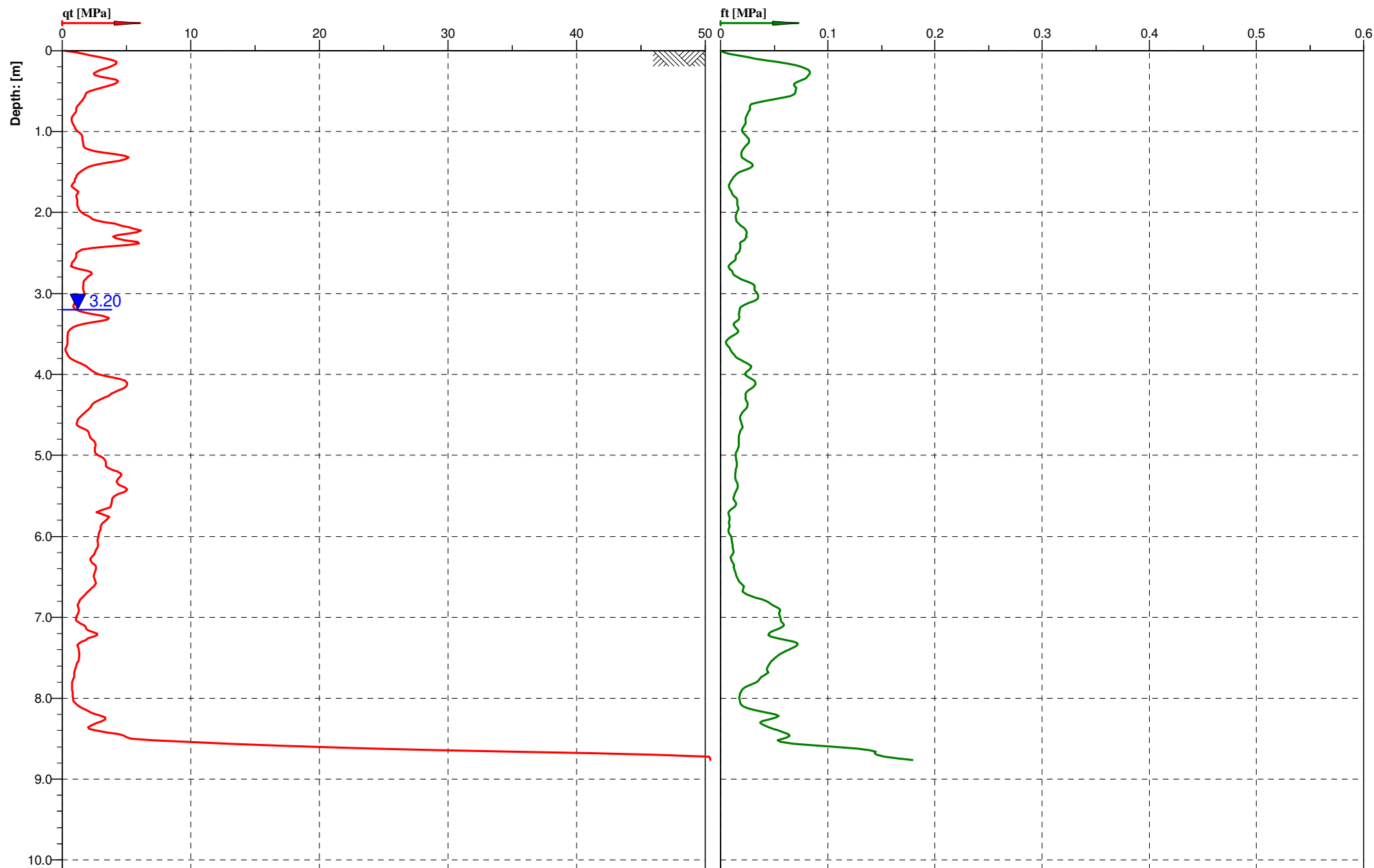
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	1/4	Fig.:	
Refusal at 8.76m				File:	CPT03 (003).cpt		



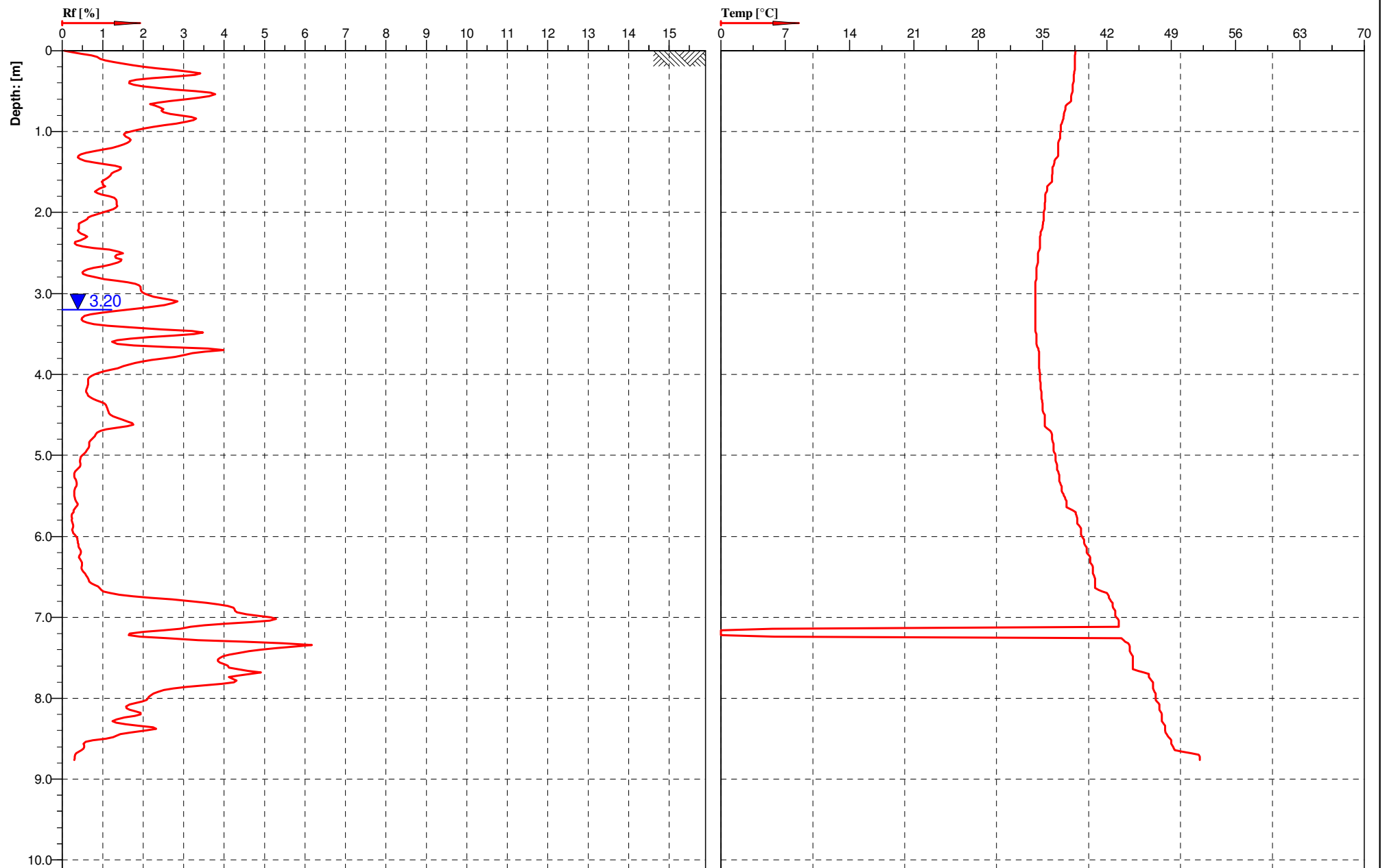
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	2/4	Fig.:	
Refusal at 8.76m				File:	CPT03 (003).cpt		



Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

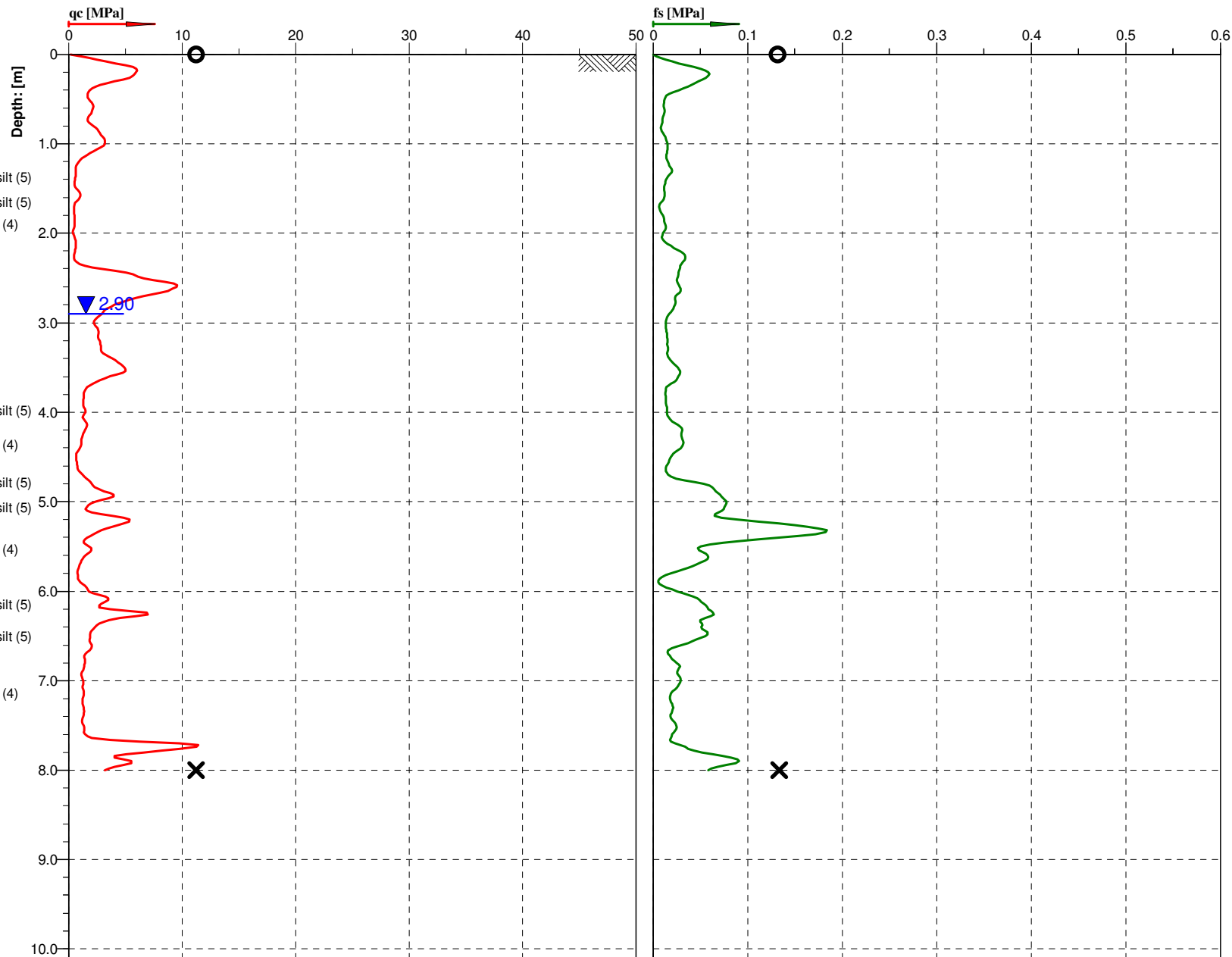
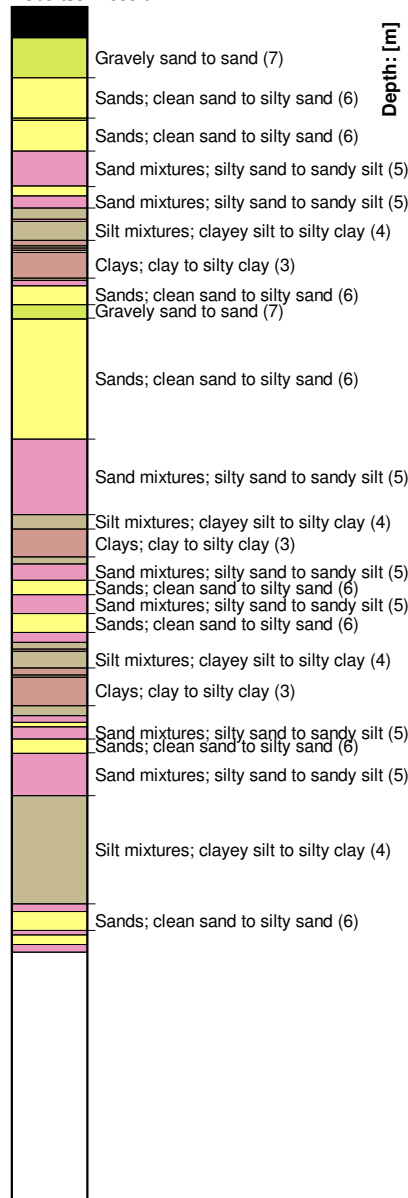
Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	3/4	Fig.:	
Refusal at 8.76m				File:	CPT03 (003).cpt		



Cone No: 4756
Tip area [cm2]: 10
Sleeve area [cm2]: 150

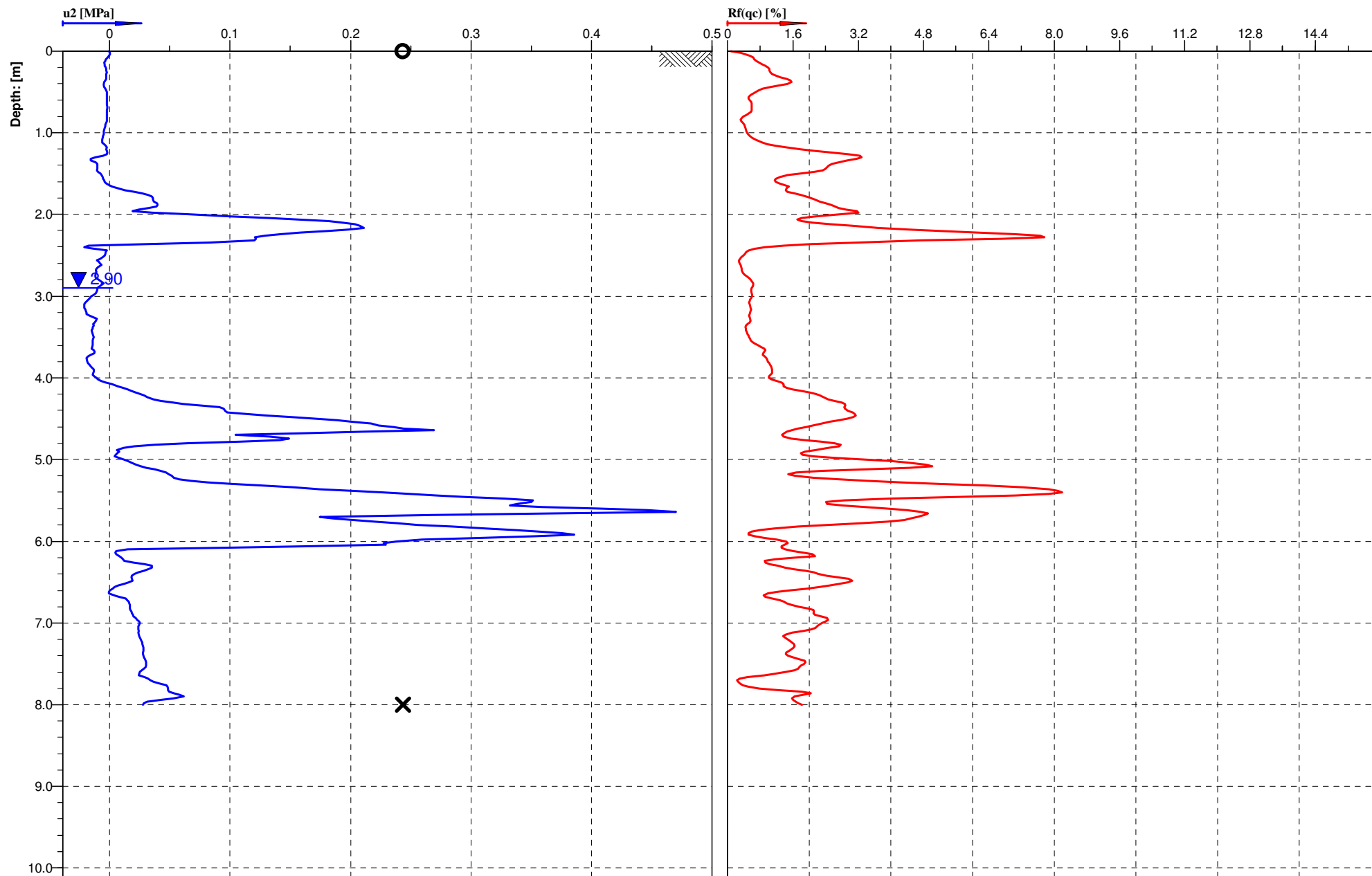
Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT03
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	4/4	Fig.:	
Refusal at 8.76m				File:	CPT03 (003).cpt		

Classification by
Robertson 1990 b



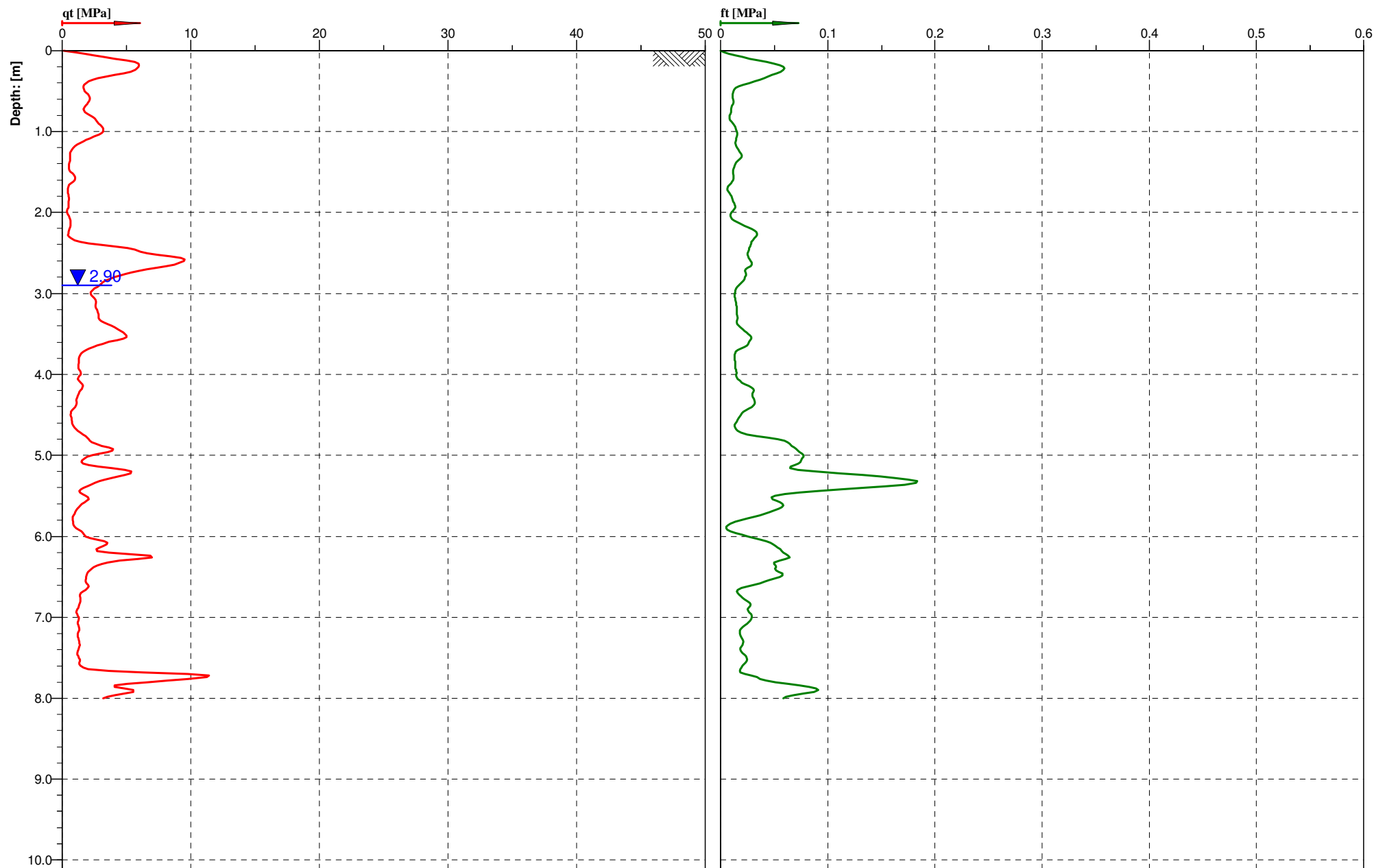
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT04
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	1/4	Fig.:	
Temperature exceeding 62 degrees				File:	CPT04.cpt		



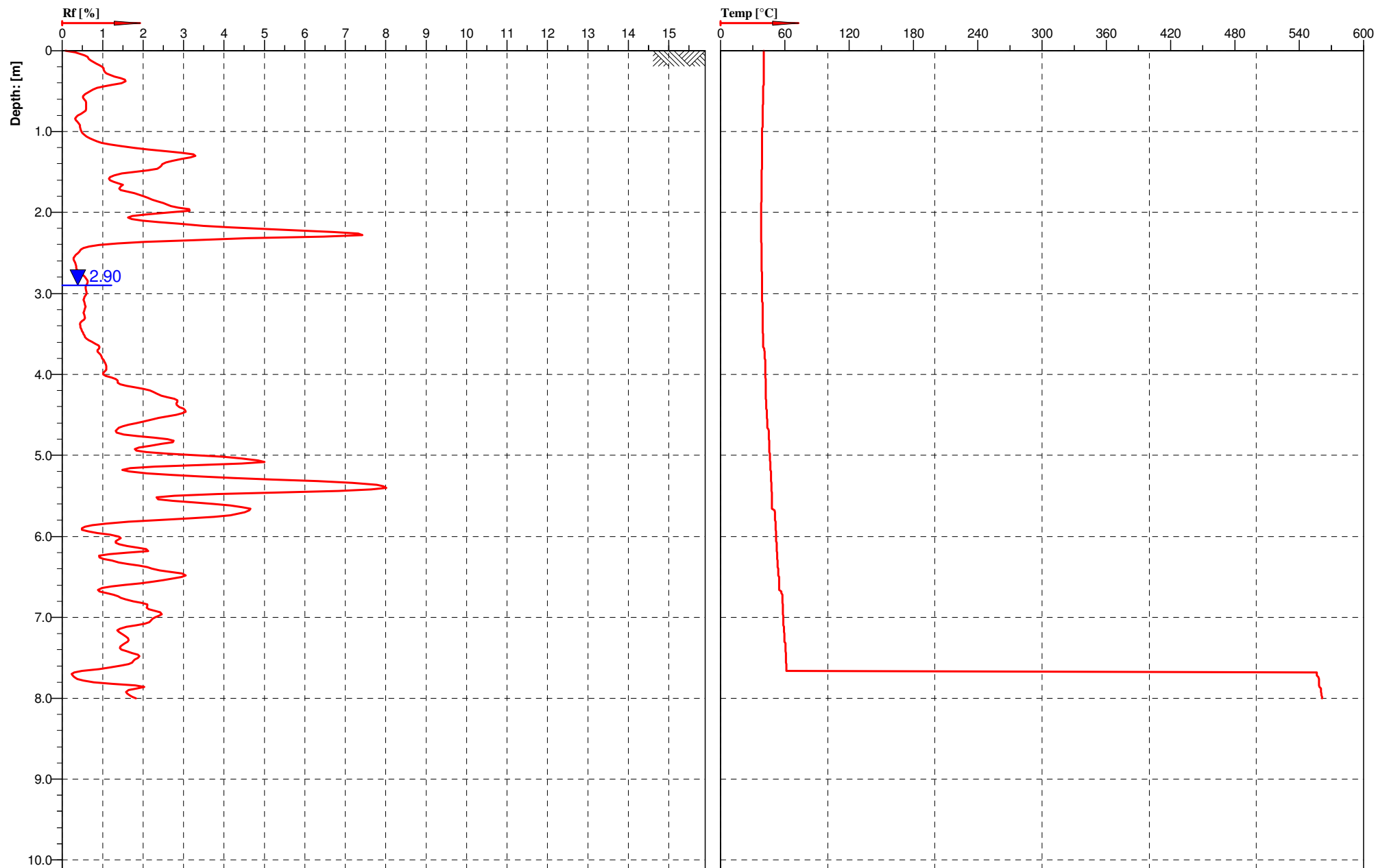
Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT04
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	2/4	Fig.:	
Temperature exceeding 62 degrees				File:	CPT04.cpt		



Cone No: 4756
Tip area [cm²]: 10
Sleeve area [cm²]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT04
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	1/1	Fig.:	
Temperature exceeding 62 degrees				File:	CPT04.cpt		



Cone No: 4756
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location:	ROTORUA MUSEUM	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test No.:	CPT04
Project ID:		Client:	Rotorua Lakes Council	Date:	3/04/2017	Scale:	1 : 64
Project:	ROTORUA MUSEUM			Page:	4/4	Fig.:	
Temperature exceeding 62 degrees				File:	CPT04.cpt		

Appendix 6

Trial Pit Logs

Trial pit no: TP01

Trial pit logging record

cheal

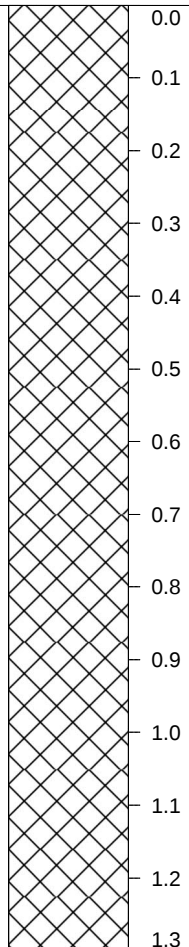
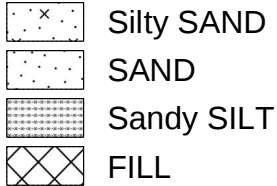
Project no.: 16592

Project: Rotorua Lake Council, Rotorua Museum

Date: 07 April 2017

Profiled by: CT

Legend



FILL - Gravelly medium to coarse SAND with some ash and pumice, dark brown, grey and black, dry

DEPTH OF WATER TABLE: No water table encountered

MACHINE: Hand excavation

CONTRACTOR: Drillcore

PROFILED BY: CT

REMARKS: Black geomembrane located on the side of building foundation

Trial pit no: TP02

Trial pit logging record

cheal

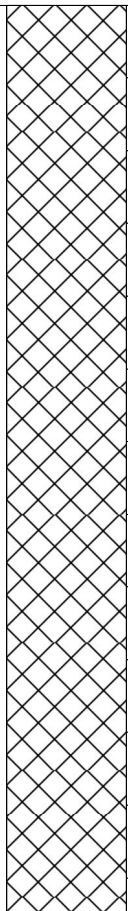
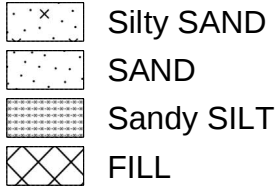
Project no.: 16592

Project: Rotorua Lake Council, Rotorua Museum

Date: 03 April 2017

Profiled by: FH

Legend



0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2

FILL - SAND with some silt, dark brown to dark grey, moist

DEPTH OF WATER TABLE: No water table encountered

MACHINE: Hand excavation

CONTRACTOR: Drillcore

PROFILED BY: FH

REMARKS: Black geotextile and geomembrane located on the side of building foundation and bottom of excavation

Appendix 7

Laboratory Tests Results



Our Ref: 1002982.0.1000.0/Rep1
Customer Ref: 16592
9 May 2017

Rotorua Lakes Council c/- Cheal Consultants
Level 1, 318 Grey Street
Hamilton East 3216

Attention: Dr Frank Havel

Dear Frank

Rotorua Museum Geotech Investigation Laboratory Test Report

Samples from the above mentioned site have been tested as received and according to your instructions. Test results are included in this report.

One-dimensional consolidation testing for BH03 (5.60 – 5.65m) was performed at our Auckland Laboratory. Test results are included as a separate report at the end of this report.

Samples not destroyed during testing will be retained for one month from the date of this report before being discarded.

Descriptions are enclosed for your information, but are not covered under the IANZ endorsement of this report.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of this page.

GEOTECHNICS LTD

Report prepared by:

.....
Brendon Kingham
Laboratory Technician

Authorised for Geotechnics by:

Paul Burton
I have reviewed this
document
2017.05.10 11:07:29 +12'00'

.....
Paul Burton
Project Director

Report checked by:

.....
David Boston
Laboratory Manager
Approved Signatory



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

This document consists of 12 pages.

10-May-17

T:\geotechnicsgroup\projects\1002982\1 tauranga laboratory testing\workingmaterial\20170509.rotorua museum.rep1.docx

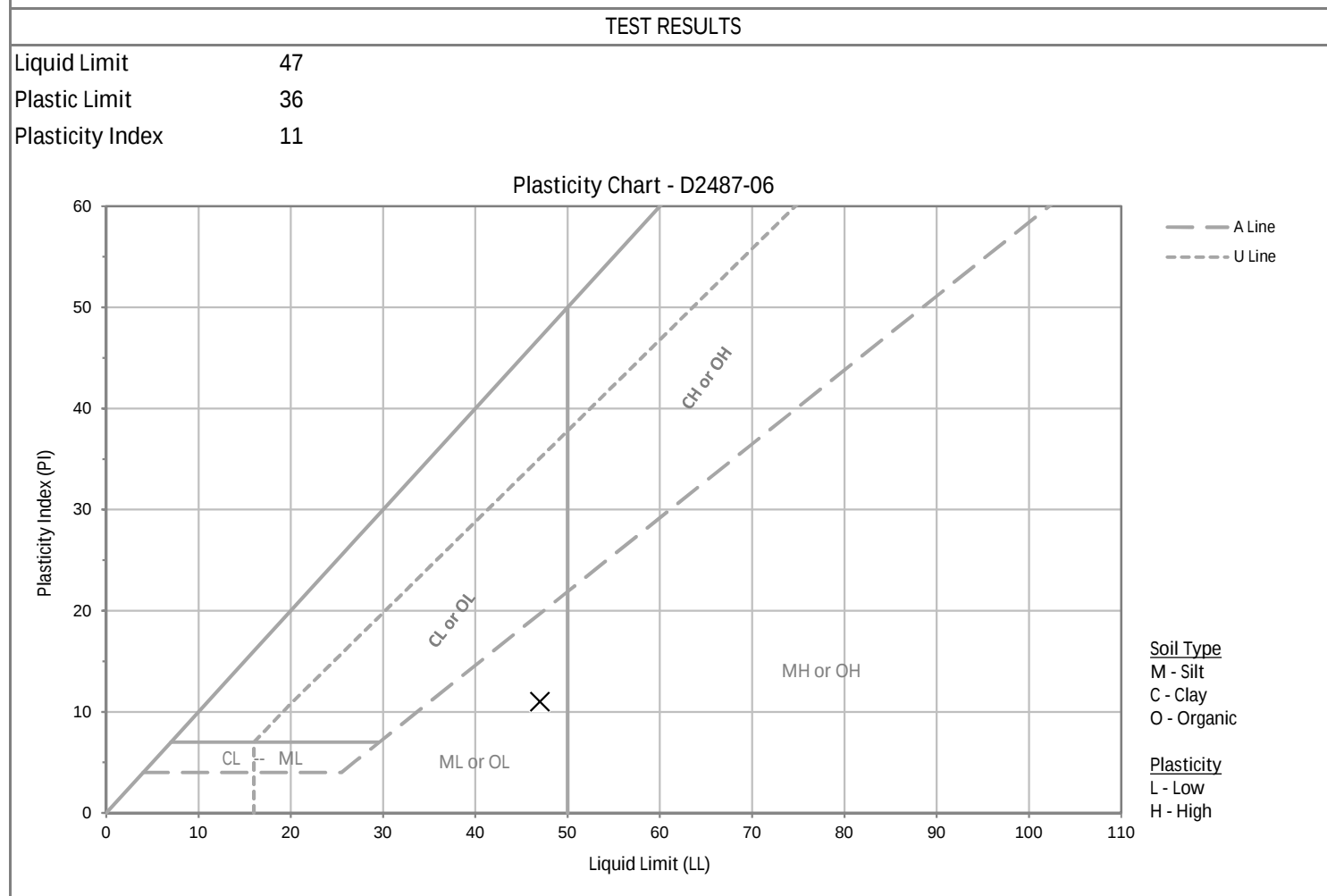


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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - ASTM Test D4318-10 (Method A)

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704280	Date Received	Unknown
	Reference	N/A	Depth	4.50m - 4.80m
	Description	SILT, minor sand, trace gravel; grey. Wet.		
SPECIMEN	Reference	1	Depth	N/A
	Description	N/A		



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS			
- The material used for testing was natural, whole soil. - The liquid limit was done with a manual device. The plastic limit was mechanically rolled. A plastic grooving tool was used. - The maximum grain size was approximately 4.75mm.			
This test result is IANZ accredited.			
Approved By	DFB	Date	8/05/2017

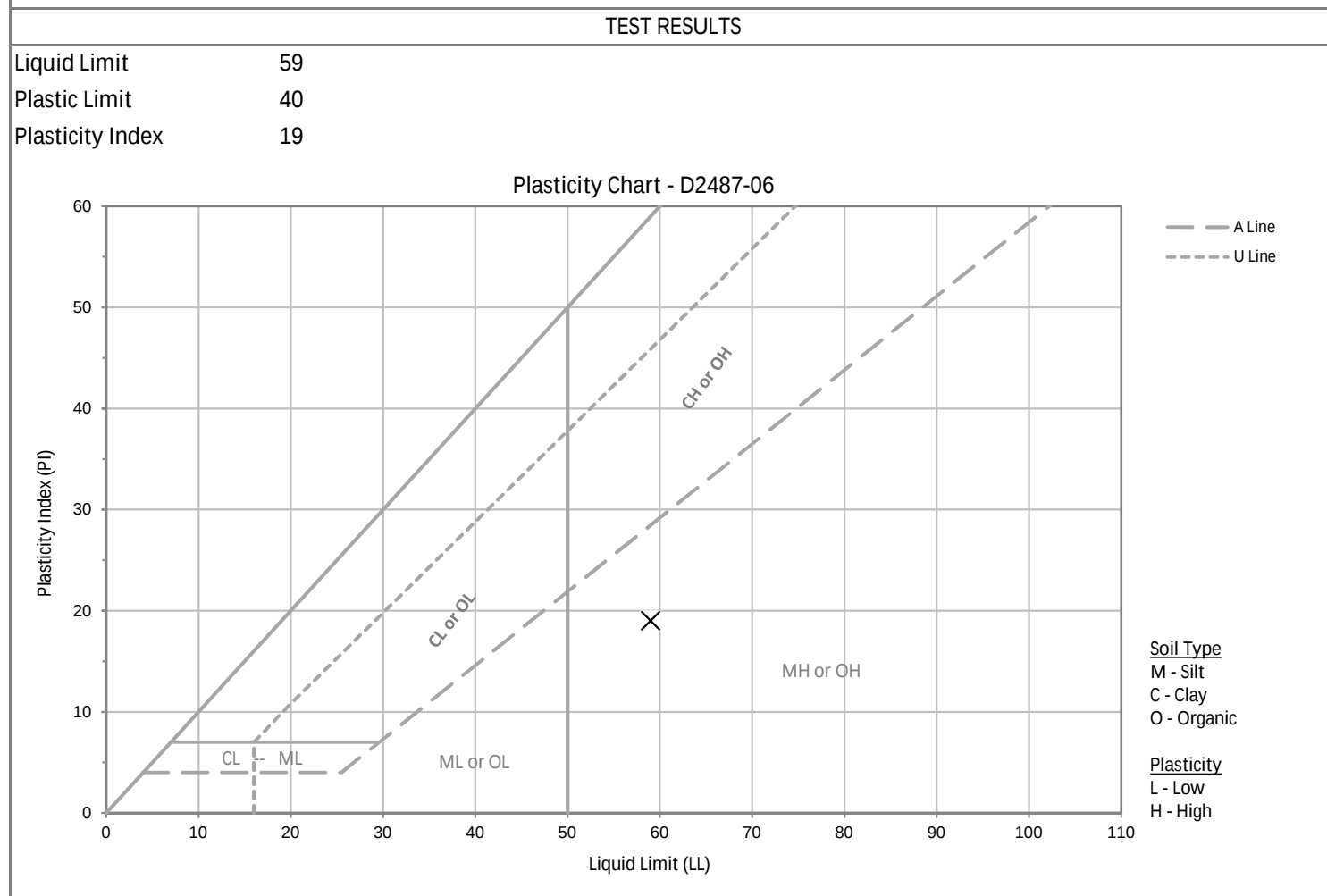


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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - ASTM Test D4318-10 (Method A)

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704281	Date Received	Unknown
	Reference	N/A	Depth	5.00m - 5.30m
	Description	SILT, trace sand; light grey with grey mottling. Wet.		
SPECIMEN	Reference	1	Depth	N/A
	Description	N/A		



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS	
- The material used for testing was natural, whole soil. - The liquid limit was done with a manual device. The plastic limit was mechanically rolled. A plastic grooving tool was used. - The maximum grain size was approximately <2mm.	
This test result is IANZ accredited.	
Approved By	DFB
Date	8/05/2017

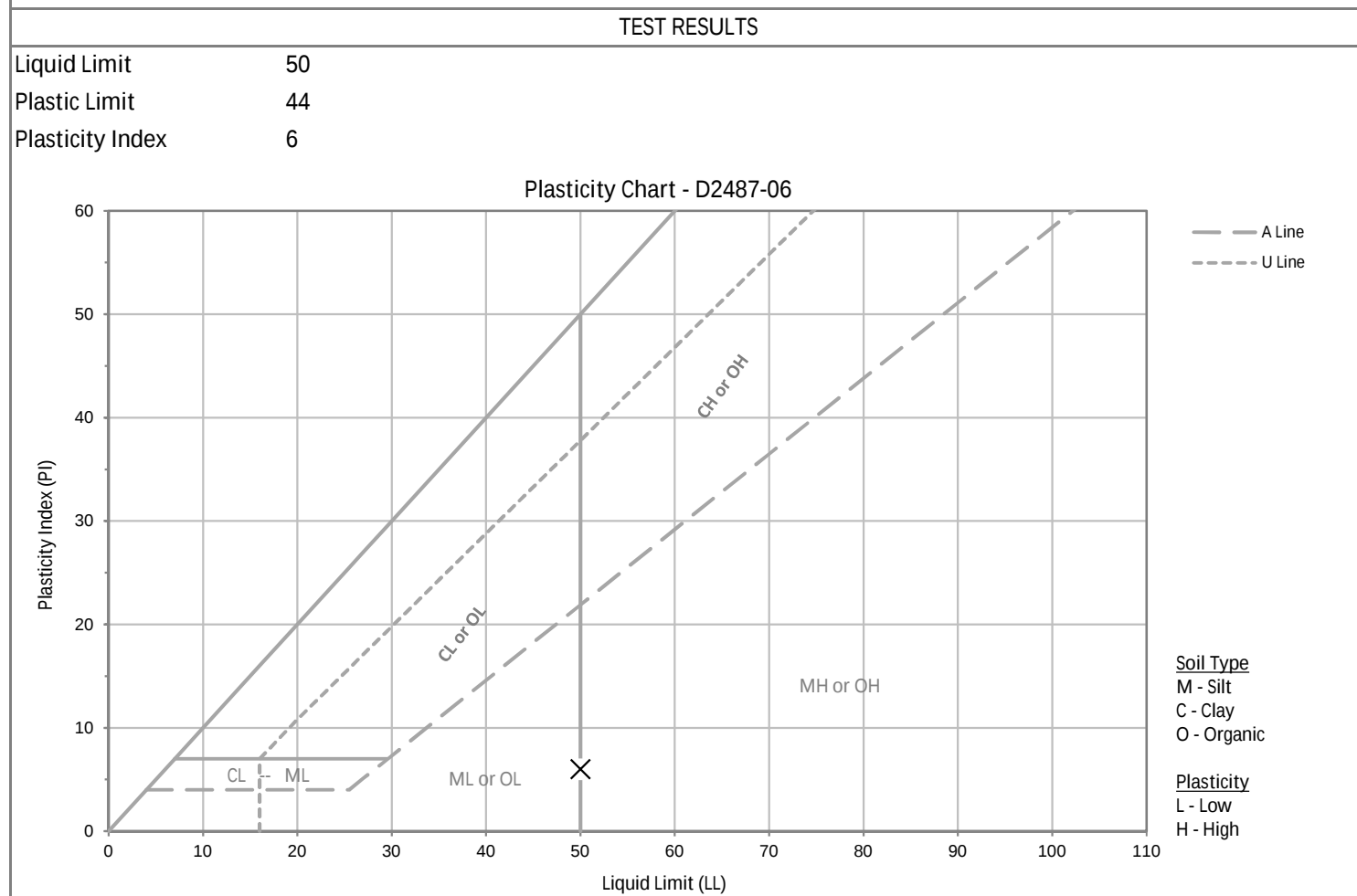


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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - ASTM Test D4318-10 (Method A)

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704282	Date Received	Unknown
	Reference	N/A	Depth	6.80m - 7.00m
	Description	Silty, SAND, with minor gravel; dark blueish grey. Wet.		
SPECIMEN	Reference	1	Depth	N/A
	Description	N/A		



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS	
- The material used for testing was natural, whole soil. - The liquid limit was done with a manual device. The plastic limit was mechanically rolled. A plastic grooving tool was used. - The maximum grain size was approximately 4.75mm.	
This test result is IANZ accredited.	
Approved By	DFB
Date	9/05/2017

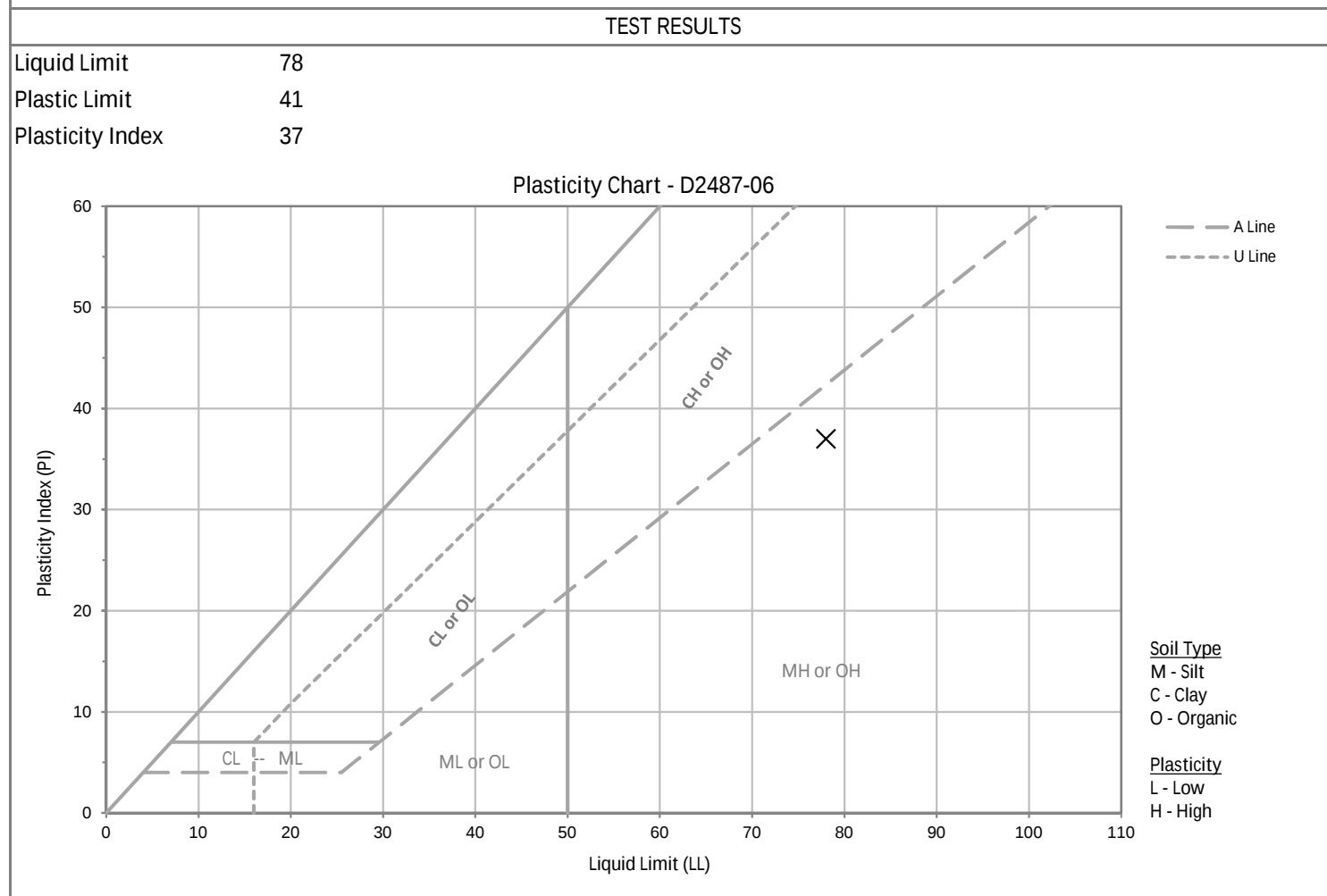


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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - ASTM Test D4318-10 (Method A)

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704283	Date Received	Unknown
	Reference	Push Tube	Depth	7.50m - 7.90m
	Description	Silty SAND, minor gravel; greenish blue with brownish orange mottling. Wet.		
SPECIMEN	Reference	1	Depth	N/A
	Description	N/A		



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS			
- The material used for testing was natural, fraction passing 425um sieve. - The liquid limit was done with a manual device. The plastic limit was mechanically rolled. A plastic grooving tool was used. - The soil was washed over a 425um sieve. The maximum grain size was approximately 9.5mm.			
This test result is IANZ accredited.			
Approved By	DFB	Date	8/05/2017



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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF THE WATER CONTENT & FINES CONTENT - GEO190-13

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704280	Date Received	Unknown
	Reference	N/A	Depth	4.50m - 4.80m
	Description	SILT, minor sand, trace gravel; grey. Wet.		
SPECIMEN	Reference	2	Depth	N/A
	Description	N/A		
TEST RESULT				
Natural Water Content		92.5%		
Fines Content Passing 75µm Sieve		82.8%		
Fines Content Passing 63µm Sieve		81.6%		
TEST REMARKS				
The material used for testing was natural, whole soil.				
This test result is IANZ accredited.				
Approved By	DFB	Date	8/05/2017	



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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF THE WATER CONTENT & FINES CONTENT - GEO190-13

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704281	Date Received	Unknown
	Reference	N/A	Depth	5.00m - 5.30m
	Description	SILT, trace sand; light grey with grey mottling. Wet.		
SPECIMEN	Reference	2	Depth	N/A
	Description	N/A		
TEST RESULT				
Natural Water Content		71.9%		
Fines Content Passing 75µm Sieve		96.4%		
Fines Content Passing 63µm Sieve		95.9%		
TEST REMARKS				
The material used for testing was natural, whole soil.				
This test result is IANZ accredited.				
Approved By	DFB	Date	8/05/2017	



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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF THE WATER CONTENT & FINES CONTENT - GEO190-13

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704282	Date Received	Unknown
	Reference	N/A	Depth	6.80m - 7.00m
	Description	Silty, SAND, with minor gravel; dark blueish grey. Wet.		
SPECIMEN	Reference	2	Depth	N/A
	Description	N/A		
TEST RESULT				
Natural Water Content		74.4%		
Fines Content Passing 75µm Sieve		26.8%		
Fines Content Passing 63µm Sieve		23.5%		
TEST REMARKS				
The material used for testing was natural, whole soil.				
This test result is IANZ accredited.				
Approved By	DFB	Date	8/05/2017	



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Geotechnics Project ID 1002982.0.1.0
Customer Project ID 16592
Customer Project Name Rotorua museum, Geotech invest

DETERMINATION OF THE WATER CONTENT & FINES CONTENT - GEO190-13

TEST DETAILS				
LOCATION	ID	BH03		
	Description	Rotorua Museum		
	Data	N/A		
SAMPLE	Geotechnics ID	GEOT201704283	Date Received	Unknown
	Reference	Push Tube	Depth	7.50m - 7.90m
	Description	Silty SAND, minor gravel; greenish blue with brownish orange mottling. Wet.		
SPECIMEN	Reference	2	Depth	N/A
	Description	N/A		
TEST RESULT				
Natural Water Content		66.7%		
Fines Content Passing 75µm Sieve		30.4%		
Fines Content Passing 63µm Sieve		28.5%		
TEST REMARKS				
The material used for testing was natural, whole soil.				
This test result is IANZ accredited.				
Approved By	DFB	Date	8/05/2017	



Our Ref: 1002982.0.2000.0
Customer Ref: 16592
8 May 2017

Rotorua Lake Council c/- Cheal Consultants
Level 1, 318 Grey Street,
Hamilton East 3216

Attention: Mr Frank Havel

Dear Frank

Rotorua Museum Laboratory Test Report

Introduction

Geotechnics was engaged to carry out laboratory testing on samples from the above mentioned location.

Sampling Procedure

Samples have been tested as received from the customer.

Sample Location Plan

Not applicable.

Samples

One push tube sample was delivered to our laboratory.

Date of Sample Receipt

19 April 2017.

Customer's Instructions

We were instructed to perform a one-dimensional consolidation on push tube sample.

Test Method(s)

NZS 4402:1986 Test 7.1 – One-dimensional consolidation.

Test Results

Test results are attached.

Test Remarks

See page 3.

General Remarks

Sample was destroyed during testing.

Descriptions are enclosed for your information, are not covered under the IANZ endorsement of this report.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:



Sim Tirunahari
I am the author of this
document
2017.05.08 16:43:06 +12'00'

.....
Sim Tirunahari
Soils Laboratory Manager

Authorised for Geotechnics by:



Steven Anderson
I am approving this
document
2017.05.08 17:01:38 +12'00'

.....
Steven Anderson
Project Director
Approved Signatory

Report checked by:



Steven Anderson
I have reviewed this
document
2017.05.08 17:01:53 +12'00'

.....
Steven Anderson
Regional Manager
Approved Signatory



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

This report consists of 3 pages.

8-May-17

t:\geotechnicsgroup\projects\1002982\2 auckland laboratory testing\issueddocuments\20170508.st.rotorua museum.docx

Site: Rotorua Museum

Our Job No.: 1002982.0.2000.0

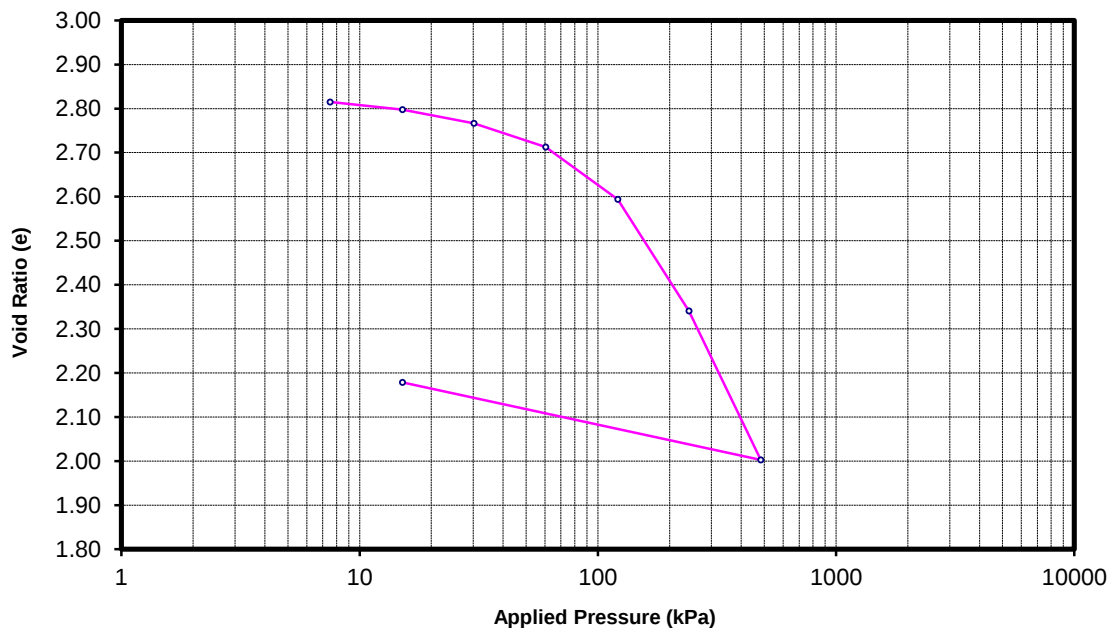
BH No.: 3

Sample ID.: ---

Depth: 5.60-5.65 (m)

Test Method Used: NZS 4402:1986 Test 7.1 One-Dimensional Consolidation

ONE-DIMENSIONAL CONSOLIDATION TEST



Pressure (kPa)	Void Ratio (e)	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m ² /yr)	Coefficient of Volume Compressibility Mv (m ² /MN)	
As received	0	2.834			
Preload	7.5	2.815	0 to 7.5	NA	0.64
	15.1	2.798	7.5 to 15.1	50	0.60
	30.2	2.766	15.1 to 30.2	42	0.54
	60.3	2.713	30.2 to 60.3	32	0.47
	121	2.594	60.3 to 121	28	0.53
	241	2.341	121 to 241	22	0.59
	483	2.003	241 to 483	18	0.42
Unload	15.1	2.179	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC. SQR of time fitting method used.

Description: SILT with minor clay and trace of sand (pumiceous?), soft, light bluish grey, mottled white-dark grey-black.

Initial Dry Density (t/m³): 0.64 Initial Water Content: 113%

Solid Density (t/m³): 2.45 (Assumed) Initial Saturation: 97%

Temperature During Testing: Max = 21 °C Min = 20 °C

Remarks: The calculations of void ratio are affected by the solid density value. We have assumed a value of 2.45 t/m³.

The test results are IANZ accredited but the sample description is not IANZ accredited.

Entered by: ST

Date: 2/5/2017

Checked by: JK

Date: 2/5/2017