ENCLOSURE N

Geotechnical Report

Initia Geotechnical Specialists

INITIA

GEOTECHNICAL SPECIALISTS

EVANS FAMILY TRUST

996 STATE HIGHWAY 2, WHIRINAKI

GEOTECHNICAL REPORT

INITIA REF P-001359 REV 1

JUNE 2022

Contents

1. Introduction 3
   - 1.1 Site Description 3
   - 1.2 Proposed Development 3
   - 1.3 Published Geology 4
2. Geotechnical Investigations 5
   - 2.1 Test Pits 5
   - 2.2 Static Cone Penetration Tests (CPTs) 6
3. Subsurface Conditions 7
   - 3.1 Stratigraphy 7
   - 3.2 Groundwater 8
4. Geotechnical Considerations 9
   - 4.1 General 9
   - 4.2 Seismic Considerations 9
     - 4.2.1 Seismic Subsoil Class and Seismicity 9
     - 4.2.2 Liquefaction Potential and Effects on the Development 10
   - 4.3 Consolidation Settlement 10
   - 4.4 Foundations 11
   - 4.5 Pavements and Services 11
5. Applicability 12

Appendix A Figures 14

Appendix B Test Pit Logs 15

Appendix C Static Cone Penetration Tests 16

Appendix D CPT Analysis 17

1. Introduction

This report outlines the findings of a geotechnical assessment carried out for the proposed subdivision development at 996 State Highway 2, Whirinaki. This report is intended to provide geotechnical recommendations for the subdivision design phase, including earthworks, and to support the Resource Consent Application to Hastings District Council (HDC).

This assessment is based on recent geotechnical investigations across the site comprising 22 No. Test Pits and 21 No. Static Cone Penetration Tests (CPTs).

1.1 Site Description

The site is located between North Shore Road in the north, Pohutukawa Drive in the east and a large stream/drainage channel in the west.

The site is legally described as SECS 44 PT 25 BLK XII PUKETAPU SD LOT 8 DP 381095 LOT 101 DP 505383 LOT 1 DP. The area is relatively flat, with a total area of approximately 10ha. The site is currently used as farmland.

The site is surrounded by residential developments to the north and east of the site. The stream is present along the western edge of the site. The stream bank comprises clayey silt with sand lenses up to 1.0m thick.

Figure 1.1: Site Location

1.2 Proposed Development

We have not been provided with any development plans for the site, but we understand that residential dwellings are proposed. Numerous options were being considered at the time of the investigations.

Due to the relatively flat nature of the site, it is anticipated that bulk earthworks will be limited to removal of topsoil/material, unless the site needs to be raised to mitigate the effects of flooding (assessed by others).

1.3 Published Geology

The published geological map for the area[1] indicates that the site is underlain by Holocene shoreline deposits comprising unconsolidated marine gravel, sand, and mud on modern beach.

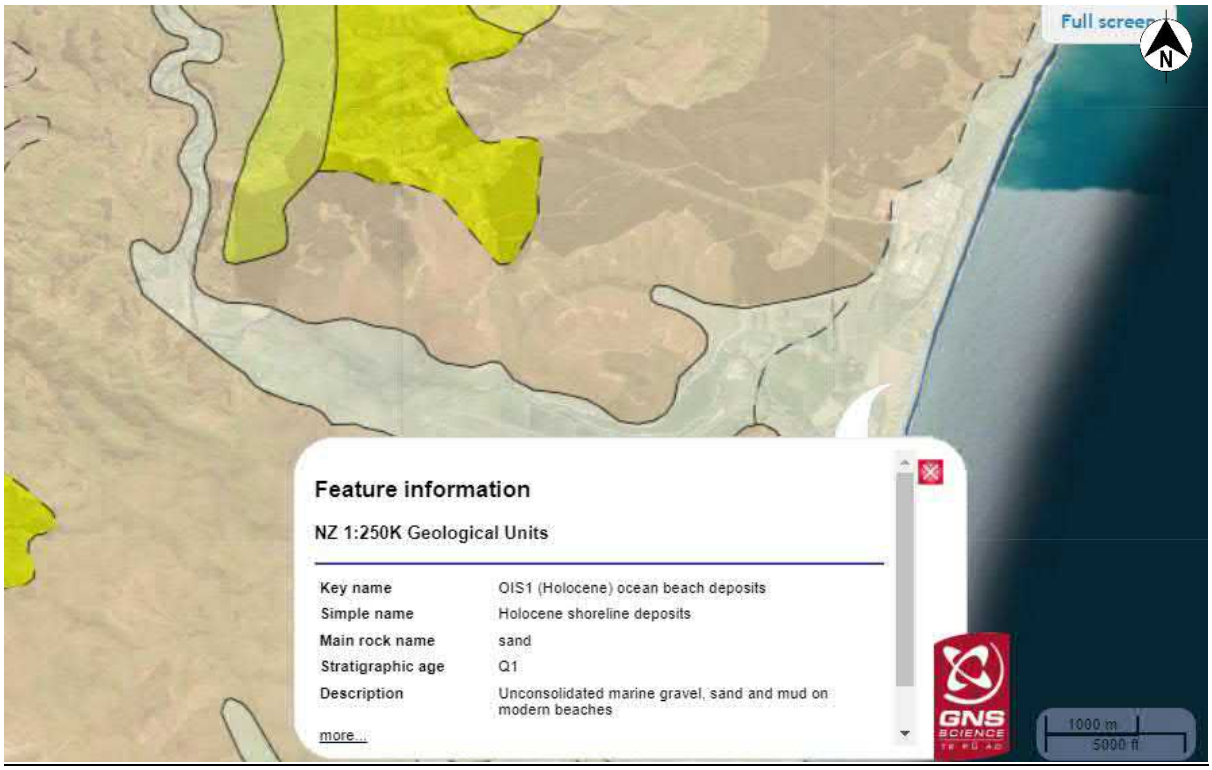


Figure 1-2: Published geology (sourced by GNS)

[1] Lee, J.M.; Townsend, D.; Bland, K.; Kamp, P.J.J. (compilers) 2011: Geology of the Hawke's Bay area: scale 1:250,000. Lower Hutt: Institute of Geological & Nuclear Sciences Limited: Institute of Geological & Nuclear Sciences 1:250,000 geological map 8. 86 p. 1 folded map.

2. Geotechnical Investigations

The geotechnical site investigations comprised, 22 No. Test Pits and 21 No. Static Cone Penetration Tests (CPTs) between March and May 2022. Details of the respective investigation techniques are outlined below. The locations of all investigations were obtained using a hand-held GPS and are presented on Figure 1359-001 (Appendix A).

2.1 Test Pits

Test Pits were undertaken using a 14-tonne digger, under the supervision of an Initia Engineering Geologist and the soils were logged in accordance with NZGS guidelines[2]. The Test Pit logs are presented in Appendix B.

Undrained shear strengths were undertaken where cohesive material was encountered.

Table 2-1: Test Pit Investigations

Investigation ID	Coordinates (NZTM)[1]		Ground Surface Elevation[2] (m RL)	Termination Depth (m BGL)
	Easting (mE)	Northing (mN)		
TP01	1934629	5633063	5.9	4.2
TP02	1934720	5633022	6.3	4.2
TP03	1934812	5632979	5.7	3.8
TP04	1934799	5632898	5.8	3.8
TP05	1934745	5632927	5.7	4.2
TP06	1934683	5632953	6.1	4.2
TP07	1934615	5633001	5.8	3.8
TP08	1934621	5632932	6.0	4.0
TP09	1934619	5632868	5.8	4.0
TP10	1934683	5632859	5.8	3.8
TP11	1934774	5632818	5.8	3.7
TP12	1934733	5632801	5.4	4.0
TP13	1934625	5632801	5.7	4.0
TP14	1934689	5632751	5.3	4.0
TP15	1934746	5632740	5.7	4.2
TP16	1934631	5632726	5.4	4.0
TP17	1934707	5632671	5.8	3.0
TP18	1934641	5632666	5.5	3.8
TP19	1934637	5632588	5.9	3.0
TP20	1934686	5632573	5.8	3.5
TP21	1934643	5632493	5.9	3.5
TP22	1934637	5632429	5.8	1.0

[2] New Zealand Geotechnical Society Inc, December 2005: Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

2.2 Static Cone Penetration Tests (CPTs)

21 No. CPTs were undertaken by Geotech Drilling Ltd using a truck mounted rig (with 20 tonne reaction force) to between 3m and 9m below ground level. Refusal was met when the CPT measured 20MPa on the cone tip resistance. CPT results are provided in Appendix C.

Table 2-2: Summary of CPT Investigations

Investigation ID	Coordinates (NZTM)[1]		Ground Surface Elevation[2] (m RL)	Termination Depth (m BGL)
	Easting (mE)	Northing (mN)		
CPT01	1934608	5633067	5.8	6.5
CPT02	1934678	5633045	6.1	9.0
CPT03	1934748	5633019	6.1	8.7
CPT04	1934828	5632984	5.8	3.1
CPT05	1934804	5632918	5.8	3.1
CPT06	1934720	5632918	5.9	8.1
CPT07	1934678	5632979	6.2	8.0
CPT08	1934607	5632998	5.7	8.9
CPT09	1934613	5632910	5.8	8.3
CPT10	1934622	5632821	5.8	7.3
CPT11	1934713	5632844	5.5	7.0
CPT12	1934769	5632829	5.7	3.3
CPT13	1934750	5632745	5.7	4.2
CPT14	1934688	5632772	5.5	7.2
CPT15	1934624	5632741	5.3	6.6
CPT16	1934638	5632657	5.5	6.9
CPT17	1934718	5632649	5.8	7.8
CPT18	1934686	5632570	5.8	8.7
CPT19	1934642	5632575	5.9	7.0
CPT20	1934646	5632486	6.0	9.0
CPT21	1934627	5632426	5.6	8.2

Note 1: Co-ordinate system – NZTM 2000. Test location coordinates are determined via hand-held GPS Survey and/or measured distance from existing structures.

Note 2: Datum – NZVD2016. Ground surface elevations are based on interpretation from LINZ LiDAR Contours and are expected to be accurate + or – 0.5m.

3. Subsurface Conditions

3.1 Stratigraphy

The geotechnical model presented in this report is based on available information obtained from geotechnical investigations at point locations completed by Initia. The nature and continuity of the subsoil conditions away from investigation locations is inferred and it must be appreciated that the actual soil conditions may vary from the assumed model. While the succession of deposits encountered by the investigations, was broadly consistent, due to their alluvial deposition, the deposits are typically thinly bedded with significant spatial variability.

Generally, the site is underlain by the following sequence of materials:

- A layer of topsoil up to 0.3m,
- Unit 1 comprising loosely packed silty sand/sandy silt to depths of typically in the order of 1m and 2m;
- Unit 2 comprising clayey silt, very stiff, high plastic, to depths of typically in the order of 2m and 6m (black gravel layer at the east portion of the site in TP 03, 04, 11, 12 and CPT 04, 05, 12, 13);
- Unit 3 comprising loose to medium dense sand/silty sand, moist to wet, up to the maximum depth of the investigations (9m).

The units vary spatially across the site with the medium dense to very dense gravel layer dipping from east (Zone B) to west (Zone A) as shown on Figure 1359-002 in Appendix A.

A summary of the geological units underlying the site is description is presented is summarised in Table 3-1 below.

Table 3-1: Summary of site stratigraphy and in situ testing.

Geological Unit	Soil/Rock type	Depth to Top of Unit (m, bgl)	Typical layer Thickness (m) [Typical Value]	In Situ Strength Parameters Range [Typical value]	
				Su (kPa)[2]	CPT qc (MPa)[1]
Topsoil	Topsoil with rootlets.	0	0.2 - 0.3	NA	NA
Holocene Shoreline Deposits	Unit 1 loose to moderately packed silty sands.	0.2 – 0.3	1 – 2 [1]	-	1 – 2 [2]
	Unit 2a Very stiff clayey Silt, high plasticity[3] Unit2b Loosely packed gravels[4]	1 – 2 0 – 1.5	0 - 1.5	-	1 – 2 [1] 20 – refusal
	Unit 3 – loose to medium dense SAND/Silty SAND and Gravels	6.0 – 7.0	Base of unit >9 depth	-	10 – 31 [26]

[3] Zone A (refer to site plan in appendix A)
[4] Zone B (refer to site plan in appendix A)

3.2 Groundwater

Groundwater within the Test Pits ranged between 3.1 and 4.2m below ground level. Groundwater within the CPTs ranged between 1.8m and 4.2m. The high readings within the CPT were likely perched with the upper silt material. We consider the ground water levels in the Test Pits to be more representative. For the purposes of geotechnical analyses, we have adopted a groundwater level of 3m below existing ground level.

4. Geotechnical Considerations

4.1 General

Based on the encountered ground conditions, the key geotechnical considerations for the proposed subdivision, outlined in further detail in subsequent sections are as follows:

1. Site Seismicity;
2. Liquefaction potential and lateral spread;
3. Consolidation Settlement;
4. Foundation options; and
5. Earthworks considerations.

4.2 Seismic Considerations

4.2.1 Seismic Subsoil Class and Seismicity

In accordance with NZS 1170.5:2004 and the depth to inferred rock level (greater than 40m below existing ground level), it is recommended that the site subsoil **Class D (Deep Soil)** be utilised for the structural design of the proposed buildings on the site. We have assessed this on the basis that:

- Rock is expected to be a significant depth below existing ground level, i.e., the depths of soil are likely to exceed the allowable levels for Class C – Shallow Soil; and
- The strengths of material exceed those required for Class E – Very Soft Soil.

The peak ground accelerations for geotechnical analyses have been derived using the MBIE Geotechnical Earthquake Engineering Guidelines, Module 1[5], we have assumed the following in deriving the seismic design loading:

- 50 years design life for the proposed building;
- Importance level 2 - IL2;
- SLS return period – 1 in 25 years return period events; and
- ULS return period – 1 in 500 years return period events.

The geotechnical peak ground accelerations calculated for the site and the associated effective magnitudes are assumed in Table 4-1 below.

Table 4-1: Design Peak Ground Accelerations

Limit State Design Condition	Annual Probability of Exceedance	Effective Magnitude, M_{eff}	Peak Ground Acceleration, (g)
Serviceability Limit State (SLS)	1 in 25	6.4	0.12
Ultimate Limit State (ULS)	1 in 500	7.1	0.58

[5] MBIE, Earthquake Geotechnical Engineering Practice, Module 1: Overview of the Guidelines, Appendix A, dated November 2021

4.2.2 Liquefaction Potential and Effects on the Development

A CPT-based liquefaction analysis has been carried out using the software CLiq v.3.0[6] on the recent Initia CPTs. The adopted analysis method is based on the study by Boulanger and Idriss (2014). A transition layer correction to allow for the highly stratified nature of the soil.

Our analyses indicate the following:

- Under SLS levels of shaking, liquefaction is unlikely to be triggered;
- Under ULS levels of shaking, thin, localised bands of material within the subsoil profile are potentially liquefiable. The thickness of these liquefiable layers is generally between 0.2m and 0.5m and the layers are not continuous.

There are no site-specific records of site performance in the 1931 earthquake[7].

We have split the site into Zones based on soil type. The zones are shown in the site investigation plan with in Appendix A.

Zone A

Calculated LSN values under ULS levels of shaking range between 0.5 and 10.5 (on average 5) under ULS levels of shaking which suggests expected damage is likely to be little to minor[8].

Given the thickness of the potentially liquefiable layers, vertical settlement is likely to be negligible.

The nearest free face runs at the western part of the site boundary. We understand that the site layout has a buffer of 10m. Analyses indicate the depth of potentially liquefiable layers are at a significant depth below the stream bed. Accordingly, we consider this material to be confined laterally and, accordingly, lateral spreading is not considered a risk to the development.

Zone B

LSN values range between 0 and 1 under ULS levels of shaking which suggests expected damage is likely to be little to no expression of liquefaction[9].

Given the thickness of the potentially liquefiable layers, vertical settlement is likely to be negligible.

4.3 Consolidation Settlement

Preliminary analyses have been undertaken to estimate the likely consolidation settlement from the proposed building loads. The investigations encountered loose to medium dense silt sands and very still clayey silts with sand lenses. Accordingly, it is anticipated that any settlement arising from this unit would be within the tolerable limits for typical residential dwellings. Based on assumed load of 10kPa for typical single storey dwellings, estimated consolidation settlements are expected to be less than 25mm based on expected loads.

Our assumptions and analyses should be reviewed and amended once layouts are confirmed.

[6] Geologismiki (2020), CLiq - Cone Penetration Test based soil liquefaction software.
[7] El Kortbawi (2017)., Insights into the liquefaction hazards in Napier and Hastings based on assessment of data from the 1931 Hawke's Bay, New Zealand Earthquake.
[8] MBIE (2016). Earthquake Engineering Module 3
[9] MBIE (2016). Earthquake Engineering Module 3

4.4 Foundations

Based on the results of the liquefaction assessment indicating mild to moderate risk, shallow foundations are considered appropriate for the proposed structures.

We recommend that a NZS3604 foundations or rib raft type foundations should be designed with the bearing capacities given in the table 4.1 below.

Geotechnical ultimate bearing capacity (unfactored)	Design bearing pressure for ULS design (Including a strength reduction factor of 0.5)	Allowable bearing pressure for SLS design loads
300 kPa	150 kPa	100 kPa

Table 4.1: Bearing Capacities for shallow foundations

All topsoil should be removed from site and the subgrade inspected by a suitably qualified geotechnical engineer to ensure there are no soft spots prior to constructing the raft foundation.

4.5 Pavements and Services

If any hardstanding areas such as yards or driveways are to be designed as part of the development, a CBR of 3% could be used for design of any floor slabs or pavements situated in the near surface sand soils.

Drainage should be maintained during subgrade preparation to ensure that stormwater does not erode the subgrade or pond at the basecourse/subgrade interface during construction

5. Applicability

This report has been prepared for our client, Evans Family Trust, with respect to the brief provided to us. The advice and recommendations presented in this report should not be applied to any other project or used in any other context without prior written approval from Initia Limited.

The liquefaction analyses outlined in this report are based on empirical methods derived from databased of various earthquakes. Earthquakes are unique and impose variable levels of shaking on different sites. Accordingly, it is important to understand that the actual performance may vary from that calculated.

During detailed design a review of the geotechnical aspects of the civil design to ensure the considerations in this report have been adequately addressed.

During excavation and construction observations should be undertaken a suitably qualified geotechnical engineer to confirm the exposed subsoils are compatible with the conditions on which this report has been based.

Report prepared by:

Bruno Souza
Engineering Geologist

Report reviewed by:

Nathan Hickman
Senior Geotechnical Engineer

Report approved by:

Andy Pomfret
Senior Geotechnical Engineer/Director

Document control record

Report Title		996 State Highway 2, Whirinaki Geotechnical Report			
Initia Project Reference		P-001359			
Client		Evans Family Trust			
Revision	Date	Revision detail	Author	Reviewer	Approved by
1	01-06-22	First Issue	Bruno Souza	N. Hickman	A. Pomfret
Current Revision		1			

Appendix A Figures

LEGEND

INITIA INVESTIGATIONS (MAY 2022)

TP01 — TEST PIT

INITIA INVESTIGATIONS (MAR 2022)

CPT01 — CONE PENETRATION TEST

ZONE A
CLAYEY SILT WITH LENSES LAYER

ZONE B
SHALLOW GRAVEL LAYER

SITE BOUNDARY

0.5 EXISTING GROUND CONTOUR (0.5m INTERVAL)

N SHORE ROAD

NEW ZEALAND STATE HIGHWAY 2

POHUTUKAWA DRIVE

N SHORE ROAD

N

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: HAWKES BAY 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE, PROPERTY BOUNDARY AND LIDAR CONTOUR 2020 EXISTING FROM KOORDINATES.

SCALE A3 1:3,000

0 40 80 120 160m

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
A	INVESTIGATION LOCATION (03/06/2022)	AP	GG	AP

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052

Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

EVANS FAMILY TRUST

996 STATE HIGHWAY 2, WHIRANAKI

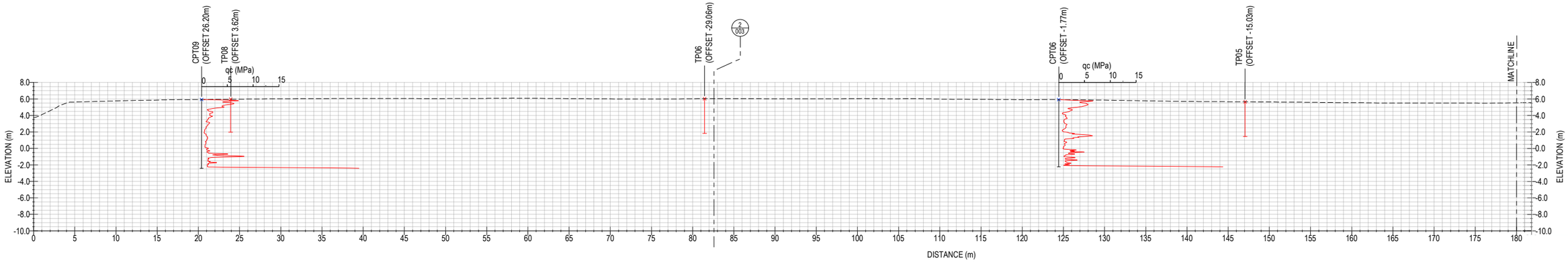
GEOTECHNICAL INVESTIGATION LOCATION PLAN

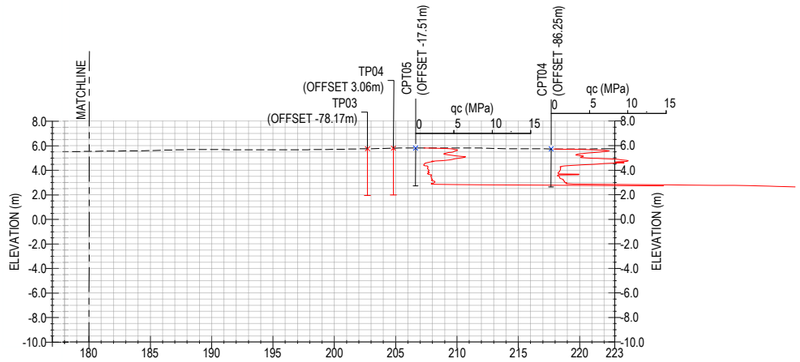
Initia Project ref: P001359

Figure Number 1359-001

Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - 1301_1400\P-001359 - WHIRINAKI SD_HBCAD\2_WORKING FILES\1359-001.DWG, 6/3/2022 8:20 AM





1/002 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (03/06/2022)		JG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN | Original Size A3

INITIA GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052

Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

EVANS FAMILY TRUST

996 STATE HIGHWAY 2, WHIRANAKI

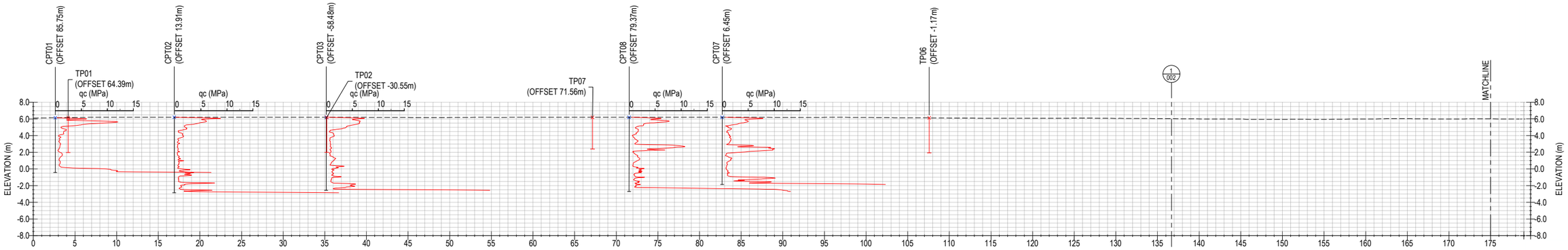
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 1

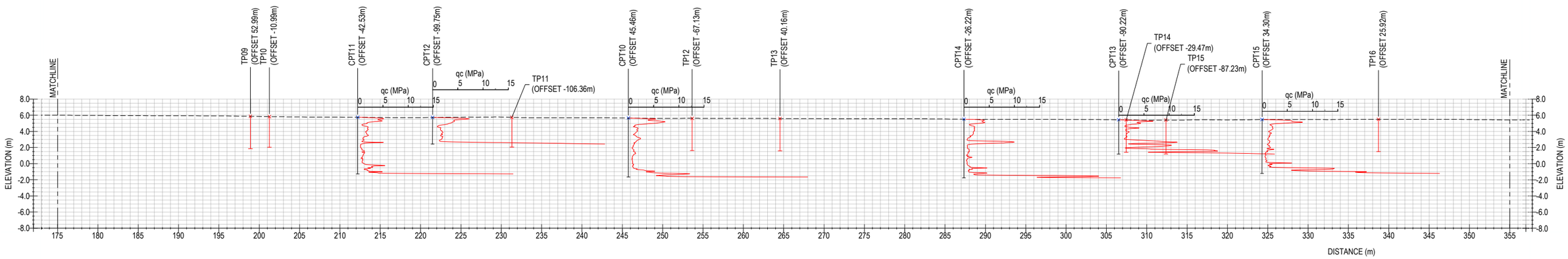
Initia Project ref: P001359

Figure Number 1359-002

Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - 1301_1400\P-001359 - WHIRINAKI SD_HBICAD\2. WORKING FILES\C3D\C3D-1359-SECTION.DWG, 6/3/2022 7:41 AM





2/003 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

Rev	Revision Description	Designed	Drawn	Checked	
					NOT FOR CONSTRUCTION
					THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
					APPROVED:
					DATE:
A	FIRST ISSUE (03/06/2022)		JG		Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

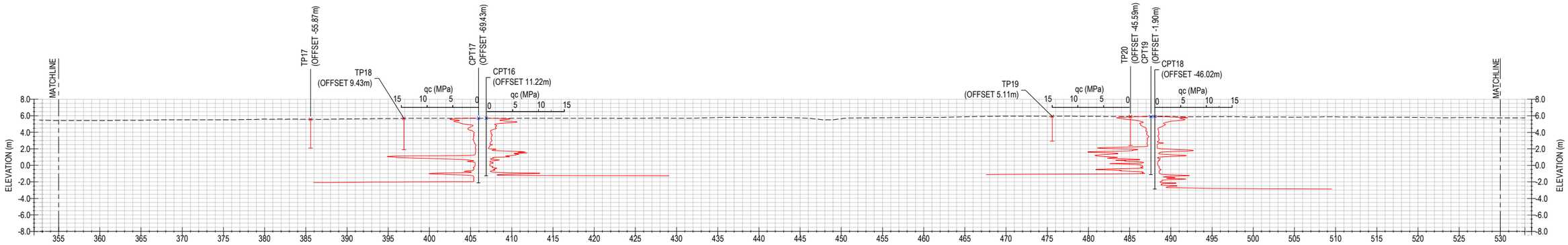
EVANS FAMILY TRUST

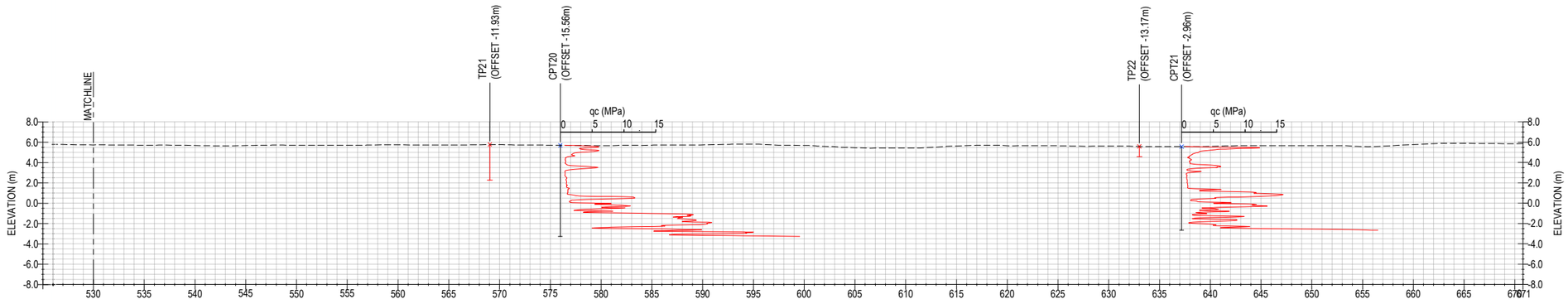
996 STATE HIGHWAY 2, WHIRANAKI

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 2
(SHEET 1 OF 2)

Initia Project ref: P001359
Figure Number 1359-003
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - 1301_1400\P-001359 - WHIRINAKI SD, HBRCAD\2. WORKING FILES\C3D\C3D-1359-SECTION.DWG, 6/3/2022 7:41 AM





2/004 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (03/06/2022)		JG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN | Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

EVANS FAMILY TRUST

996 STATE HIGHWAY 2, WHIRANAKI

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 2
(SHEET 2 OF 2)

Initia Project ref: P001359
Figure Number 1359-003
Revision A

D:\INITIA LIMITED\INITIA LIMITED - TEAM SITE - 1301_1400\P-001359 - WHIRINAKI SD, H&I\CAD\2. WORKING FILES\C3D\C3D-1359-SECTION.DWG, 6/3/2022 7:41 AM

Appendix B Test Pit Logs

TEST PIT LOG

HOLE NO.: TP01

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934629.4mE, 5633063.2mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 5.9m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil SILT, with trace rootlets and sand; brown. Firm; moist; sand, fine.		0.0 – 0.2	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	
Silty SAND; light brown. Low plasticity; moist; sand, fine to medium; Loosely packed.		0.2 – 1.6	TS			
Holocene Beach Deposits Clayey SILT, with trace sand; grey with light orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.6 – 4.2			139 42	
EOH: 4.20m		4.2				13/05/2022

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP02

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934720.5mE, 5633021.9mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 6.3m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil: SILT, with minor rootlets; dark brown. Firm; moist.		0.0	TS			
Silty SAND, with some clay; light brown with orange brown speckles. Loose; low plasticity; moist; sand, fine to medium.		0.2 – 1.6	TS			
Holocene Beach Deposits: Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.8 – 4.2			148 / 51	12/05/2022
EOH: 4.20m		4.2				

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Ver 2. Generated with CORE-GS by Geroc - Test Pit_Initia - 2/06/2022 1:11:27 PM

Checked By: NAH

TEST PIT LOG

INITIA
GEOTECHNICAL SPECIALISTS

HOLE NO.: TP03

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934811.7mE, 5632978.7mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 5.7m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil SILT, with minor rootlets and clay, with trace sand; brown. Firm; moist; sand, fine to medium.		0.0 – 0.2	TS			
Holocene Beach Deposits Sandy SILT; brown. Loose; low plasticity; moist; sand, fine to medium.		0.2 – 0.6				
GRAVEL, with some sand; black. Moist; gravel, fine to coarse, subround; sand, coarse; loosely packed.		0.6 – 1.4				
Clayey SILT, with trace sand; greyish brown with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.4 – 3.0			133 45	Groundwater Not Encountered
Silty GRAVEL, with some sand; grey. Non-plastic; moist; gravel, fine to coarse, subround; sand, fine; loosely packed.		3.0 – 3.8				
EOH: 3.80m		3.8				

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP04

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934798.6mE, 5632898.4mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 5.8m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	Values	WATER
Topsoil	SILT, with trace rootlets; greyish brown. Firm; low plasticity; moist.		0.0 – 0.4	TS				
Holocene Beach Deposits	Silty SAND, with minor clay; light brown with orange brown mottles. Low plasticity; moist; sand, fine; moderately packed.		0.4 – 0.8					
	GRAVEL; black. Moist; gravel, fine to coarse, subround; moderately packed.		0.8 – 1.4			115 42		
	Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist.		1.4 – 3.0			106 21 94 18		Groundwater Not Encountered
	Silty GRAVEL; grey. Moist; gravel, fine to coarse, subround; moderately packed.		3.0 – 3.8					
	EOH: 3.80m		3.8					

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP05

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934745.2mE, 5632927.0mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 5.7m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil: SILT, with minor sand, with trace rootlets; greyish brown. Firm; moist; sand, fine.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	
Silty SAND; brown. Low plasticity; moist; sand, fine; moderately packed.		0.2 – 1.2	TS			
Holocene Beach Deposits: Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.4 – 3.6			127, 48; 118, 45	13/05/2022
SAND; greyish blue. Moist to wet; sand, fine to medium; moderately packed.		3.8 – 4.2				
EOH: 4.20m		4.2				

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP06

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934683.3mE, 5632953.1mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 6.1m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil: SILT, with minor sand, with trace rootlets; greyish brown. Firm; moist; sand, fine.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	
Silty SAND; brown. Low plasticity; moist; sand, fine; moderately packed.		0.2 – 1.2	TS			
Holocene Beach Deposits: Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.4 – 3.6			118 48 / 118 39	13/05/2022
SAND; greyish blue. Moist to wet; sand, fine to medium; moderately packed.		3.8 – 4.2				
EOH: 4.20m		4.2				

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP07

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934615.4mE, 5633001.3mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 5.8m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	Values	WATER
Topsoil SILT, with trace rootlets; greyish brown. Firm; moist.		0.0 – 0.2	TS				
Holocene Beach Deposits Silty SAND; light brown. Low plasticity; moist; sand, fine; moderately packed.		0.2 – 1.4					
Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.4 – 3.8				109 27 91 24	Groundwater Not Encountered
EOH: 3.80m		3.8					

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP08

CLIENT: Pacific Cleanfills Limited
PROJECT: 996 State Highway 2, Whiranaki
SITE LOCATION: 996 State Highway 2, Whiranaki
Project Ref.: P-001359

CO-ORDINATES: 1934620.6mE, 5632931.8mN
Co-ordinate system: NZTM
Location method: GPSH
ELEVATION: 6m
Datum: HAWKTM 2000
Level method: CONTOUR
CONTRACTOR: Galbraith Earthmover
MACHINE: Doosan DX140LCR
OPERATOR: John
START DATE: 12/05/2022
END DATE: 12/05/2022
LOGGED BY: BSS
CHECKED BY: NAH

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	WATER
Topsoil: SILT, with some sand, with trace rootlets; greyish brown. Firm; moist; sand, fine.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	
Silty SAND; light greyish brown. Low plasticity; moist; sand, fine; moderately packed.		0.2 – 1.4	TS			
Holocene Beach Deposits: Clayey SILT, with trace sand; grey with orange brown mottles. Very stiff; high plasticity; moist; sand, fine.		1.4 – 4.0			106 39	13/05/2022
EOH: 4.00m		4.0				

REMARKS

WATER
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE
- ☐ Hand Auger
- ☑ Test Pit

Checked By: NAH

TEST PIT LOG

INITIA GEOTECHNICAL SPECIALISTS	**CLIENT:** Pacific Cleanfills Limited **SITE LOCATION:** 996 State Highway 2, Whiranaki	**HOLE NO.:** TP09
	PROJECT: 996 State Highway 2, Whiranaki	**Project Ref.:** P-001359
	CO-ORDINATES: 1934619.4mE, 5632868.2mN **ELEVATION:** 5.8m **CONTRACTOR:** Galbraith Earthmover	**START DATE:** 12/05/2022
	Co-ordinate system: NZTM **Datum:** HAWKTM 2000 **MACHINE:** Doosan DX140LCR	**END DATE:** 12/05/2022
	Location method: GPSH **Level method:** CONTOUR **OPERATOR:** John	**LOGGED BY:** BSS
		CHECKED BY: NAH

Unit	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 210	Values	WATER
Topsoil	SILT, with trace rootlets and sand; greyish brown. Firm; moist; sand, fine.		0.0–0.2	TS				
Holocene Beach Deposits	Silty SAND; light brown. Low plasticity; moist; sand, fine; moderately packed.		0.2–1.1					
Holocene Beach Deposits	Clayey SILT, with trace sand; grey with orange brown speckles. Very stiff; high plasticity; moist; sand, fine.		1.1–4.0			1.5 m	109 / 27	
						2.0 m	100 / 18	
			3.0					▼ 13/05/2022
	EOH: 4.00m		4.0					

REMARKS

WATER

- ▼ Standing Water Level
- ◁ Out flow
- ▷ In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

TEST PIT LOG

HOLE NO.: TP10

CLIENT: Pacific Cleanfills Limited **SITE LOCATION:** 996 State Highway 2, Whiranaki

PROJECT: 996 State Highway 2, Whiranaki

Project Ref.: P-001359

CO-ORDINATES: 1934682.8mE, 5632858.8mN **ELEVATION:** 5.8m **CONTRACTOR:** Galbraith Earthmover **START DATE:** 12/05/2022

Co-ordinate system: NZTM **Datum:** HAWKTM 2000 **MACHINE:** Doosan DX140LCR **END DATE:** 12/05/2022

Location method: GPSH **Level method:** CONTOUR **OPERATOR:** John **LOGGED BY:** BSS

CHECKED BY: NAH

Unit	MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	DEPTH (m)	VANE SHEAR STRENGTH (kPa) Vane: 210 – Values	WATER
Topsoil	SILT, with trace rootlets and sand; greyish brown. Firm; moist; sand, fine.	0.0 – 0.2		Groundwater Not Encountered
Holocene Beach Deposits	Silty SAND; light brown. Low plasticity; moist; sand, fine; moderately packed.	0.2 – 1.3		
Holocene Beach Deposits	Clayey SILT, with trace sand; grey with orange brown speckles. Very stiff; high plasticity; moist; sand, fine.	1.3 – 3.8	151 / 48 (approx. 1.5 m); 133 / 24 (approx. 2.0 m)	
	EOH: 3.80m			

SCALA PENETROMETER (Blows / 0mm): no readings plotted.

REMARKS

WATER

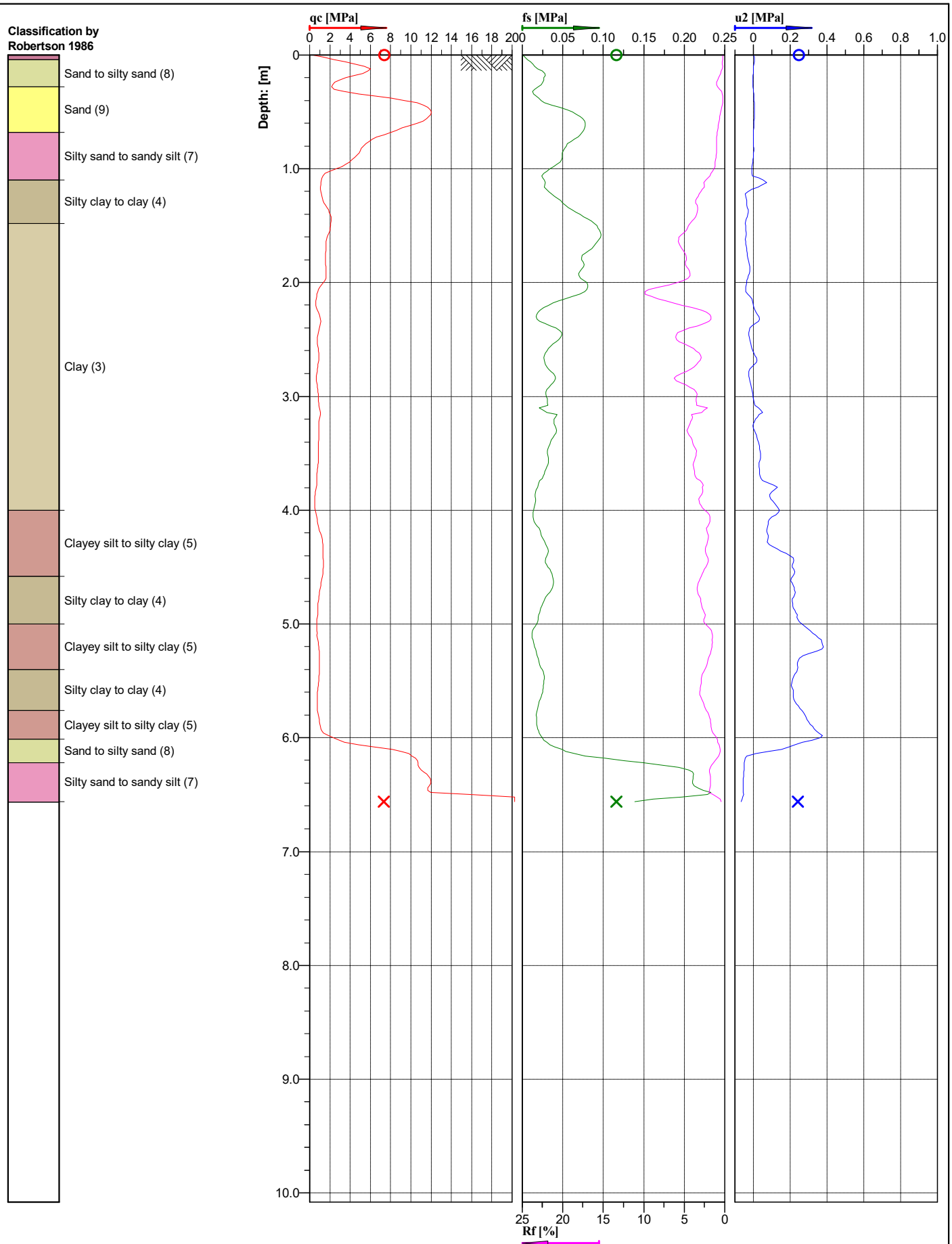
- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- ☐ Hand Auger
- ☑ Test Pit

Checked By: NAH

Appendix C Static Cone Penetration Tests

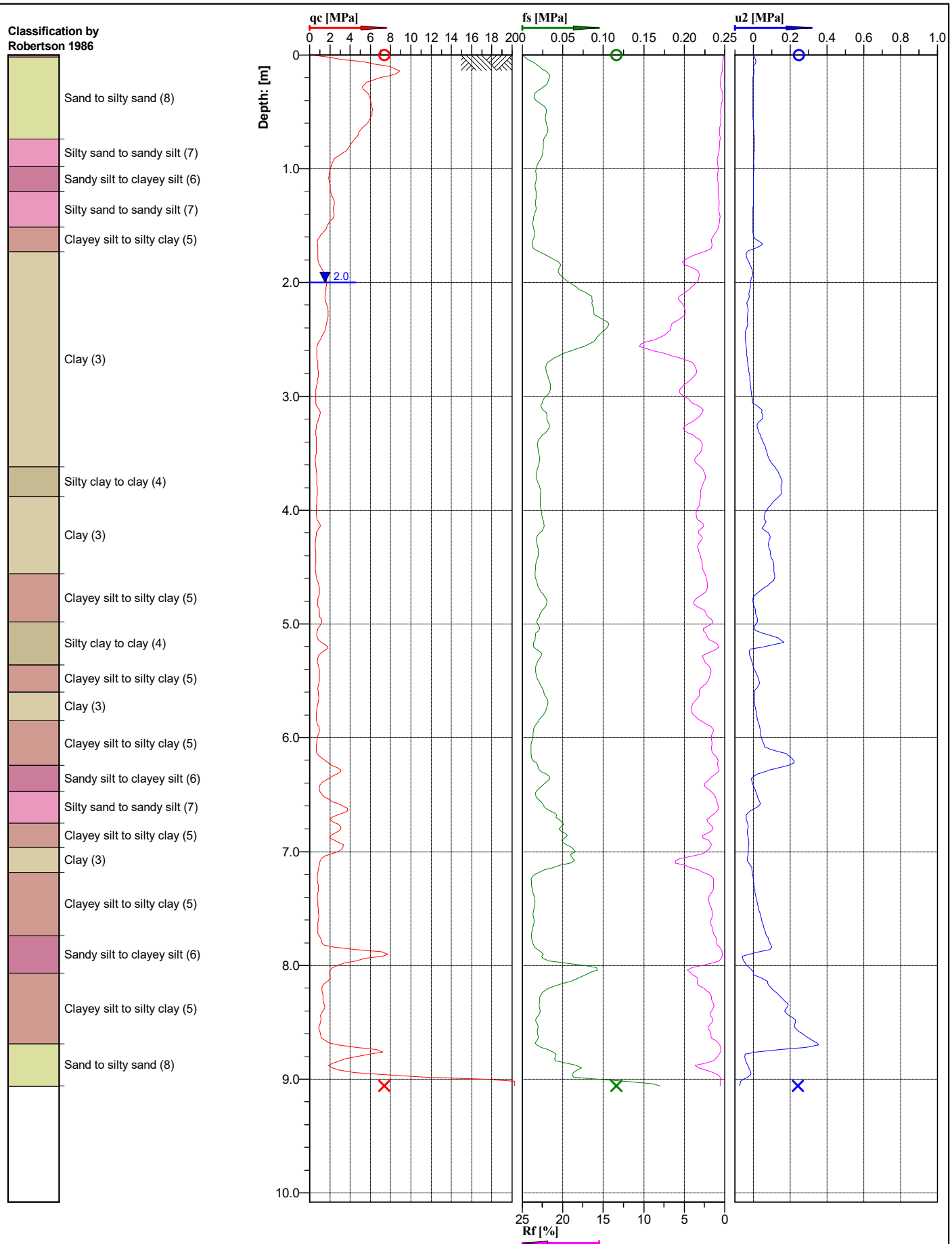


GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

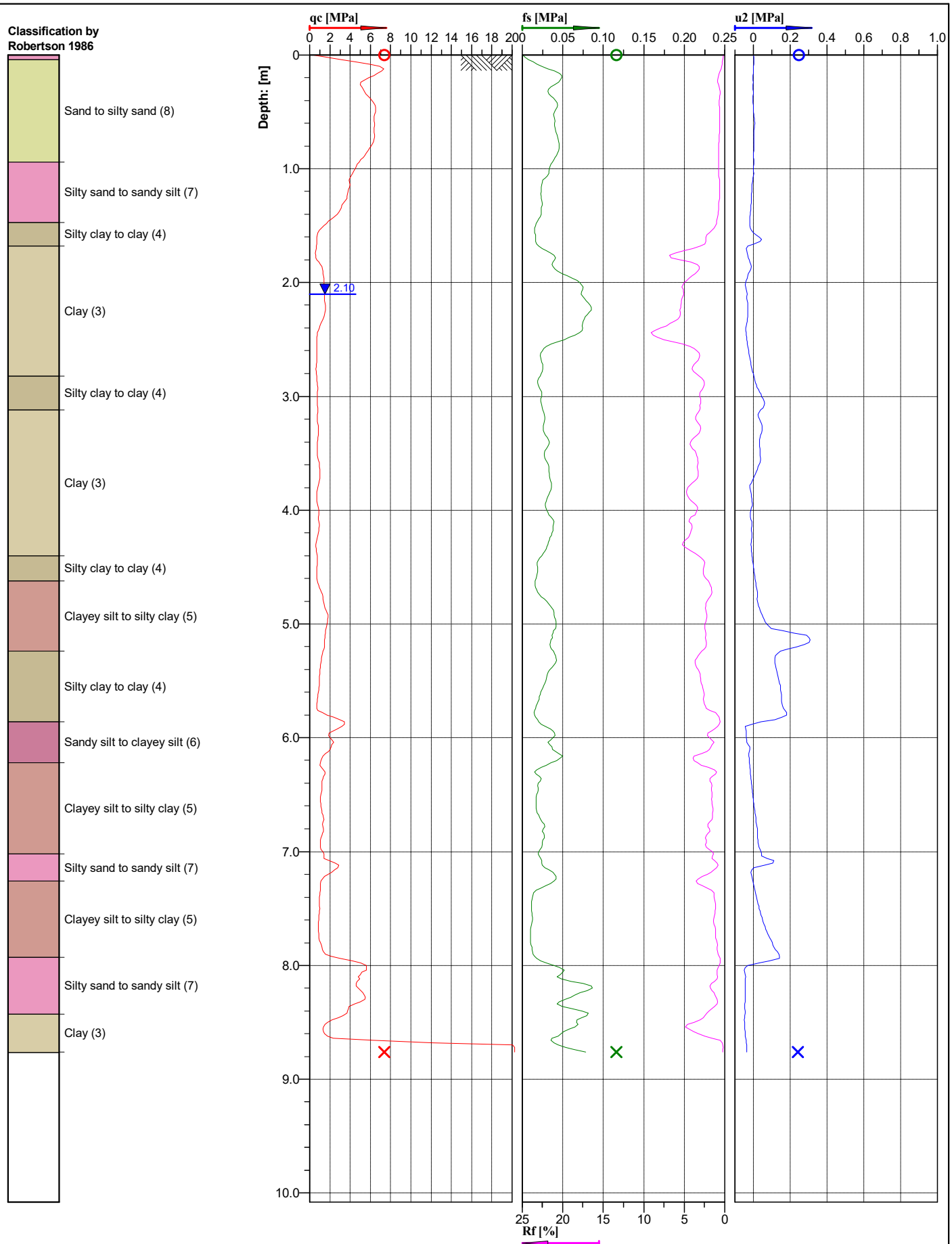
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT01
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH2 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38706, E 176.88492		File: CPT01.cpt	



GEOTECH DRILLING

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

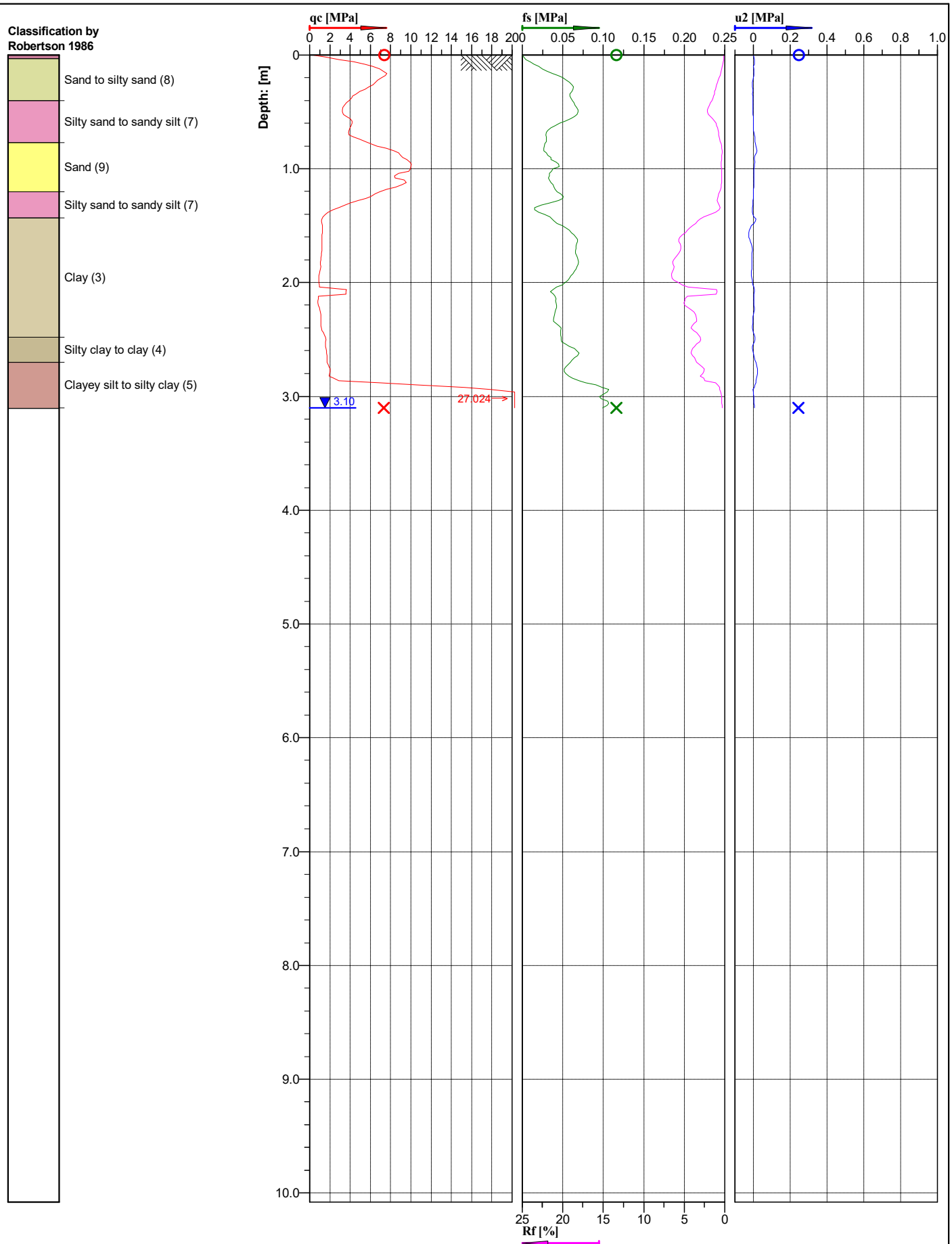
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT02
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38722, E 176.88571		File: CPT02.cpt	



GEOTECH DRILLING

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT03
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38743, E 176.88654		File: CPT03.cpt	

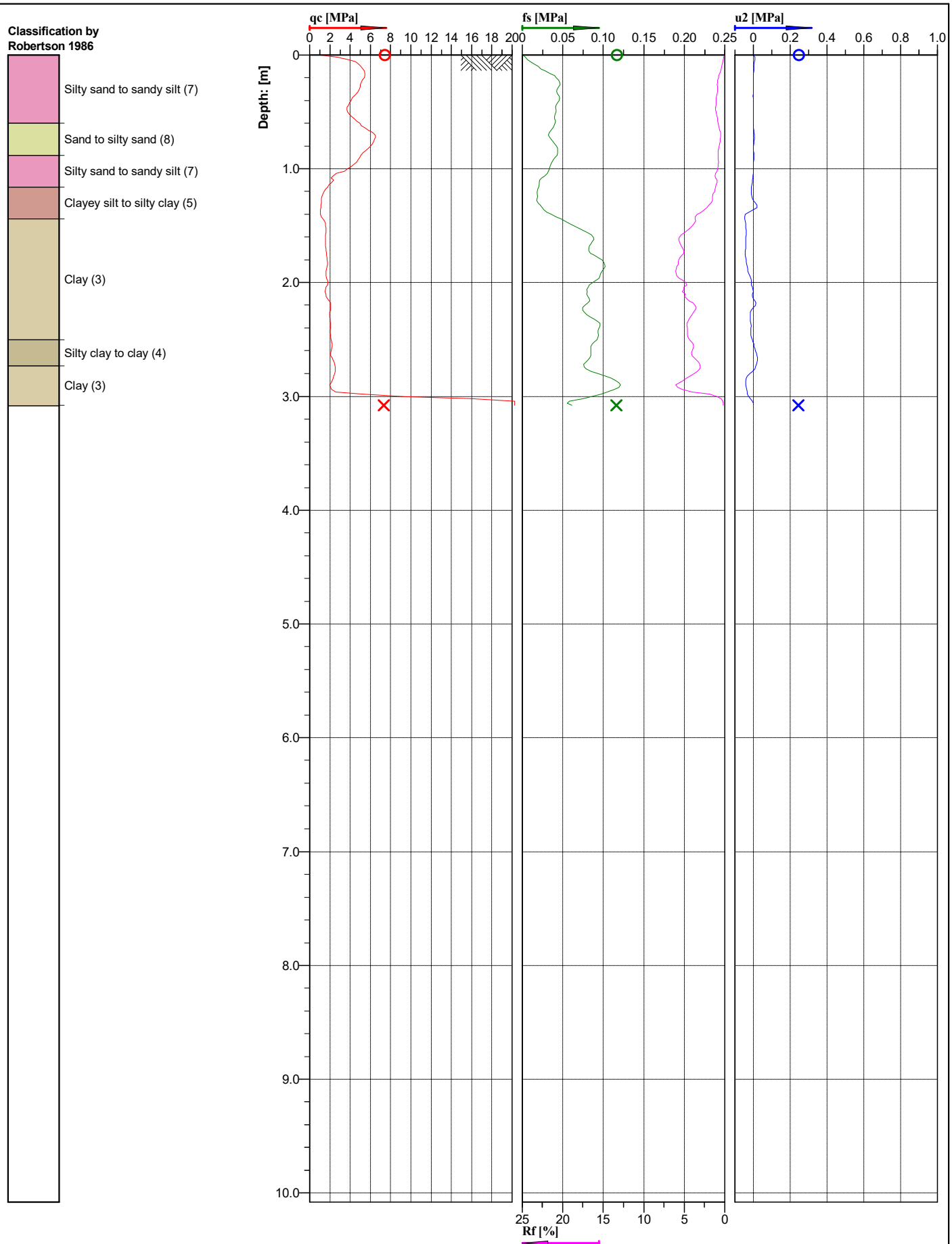


Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT04
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38768, E 176.88745		File: CPT04.cpt	

GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

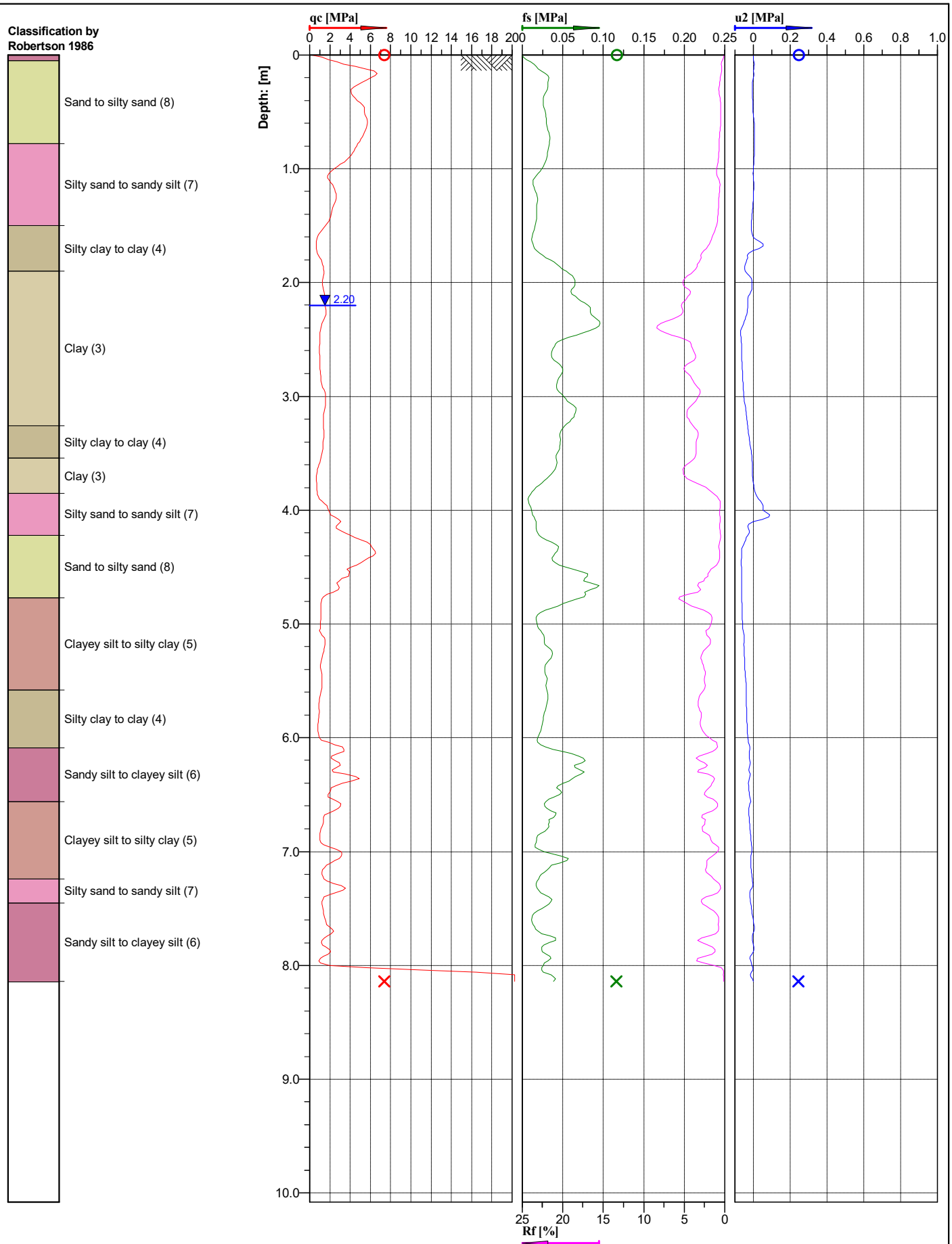


Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT05
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38827, E 176.88722		File: CPT05.cpt	

GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

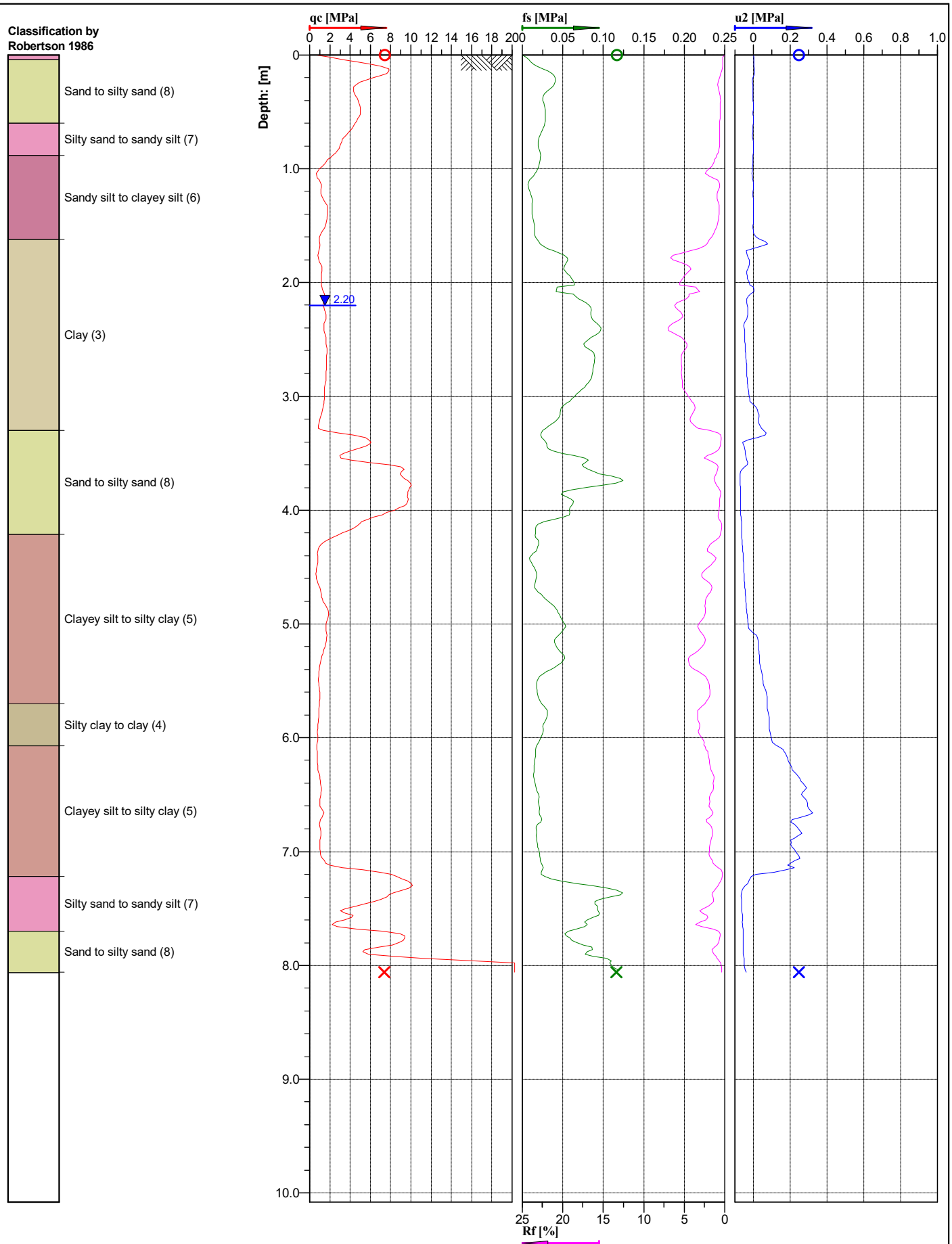


GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT06
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38795, E 176.88643		File: CPT06.cpt	

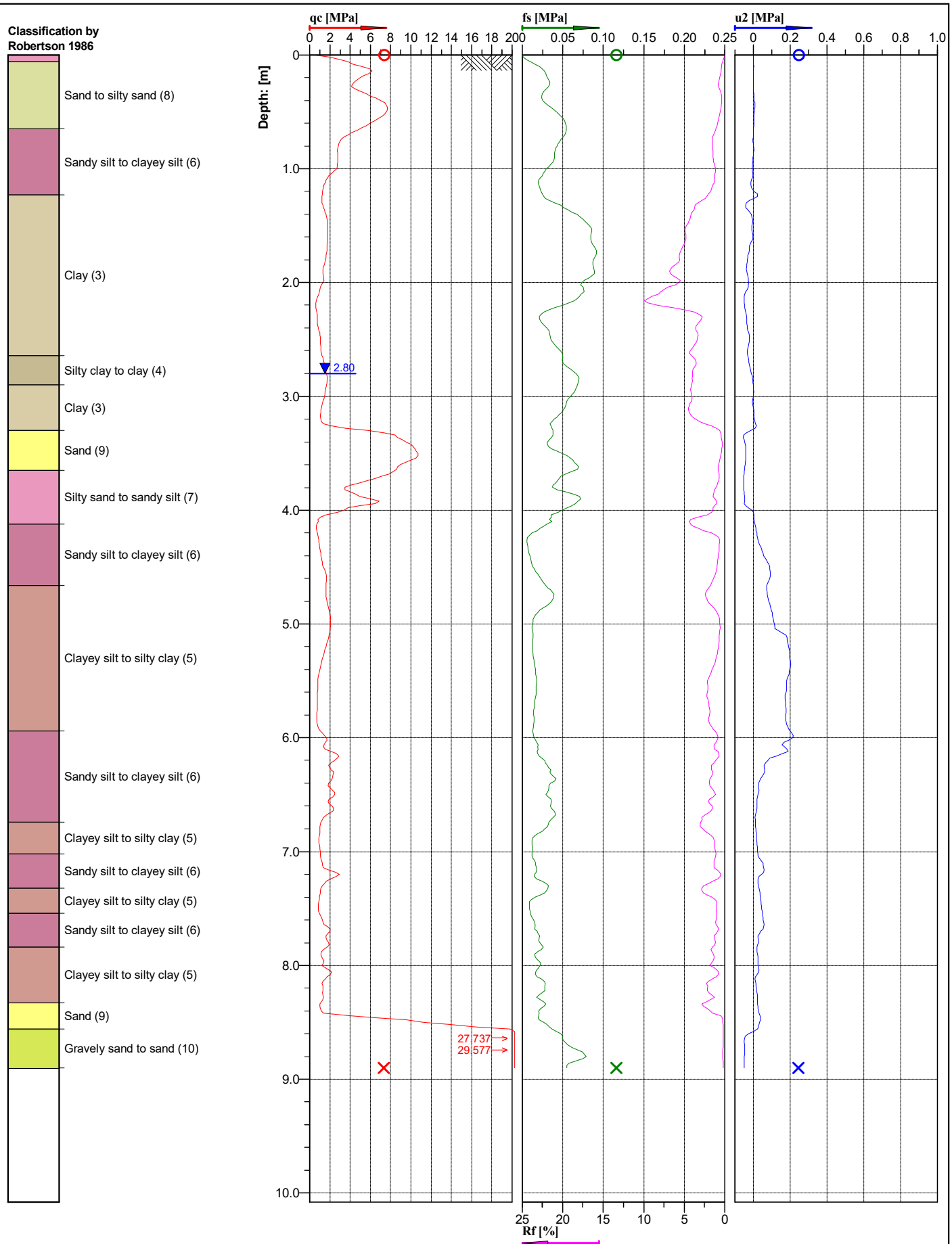


GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

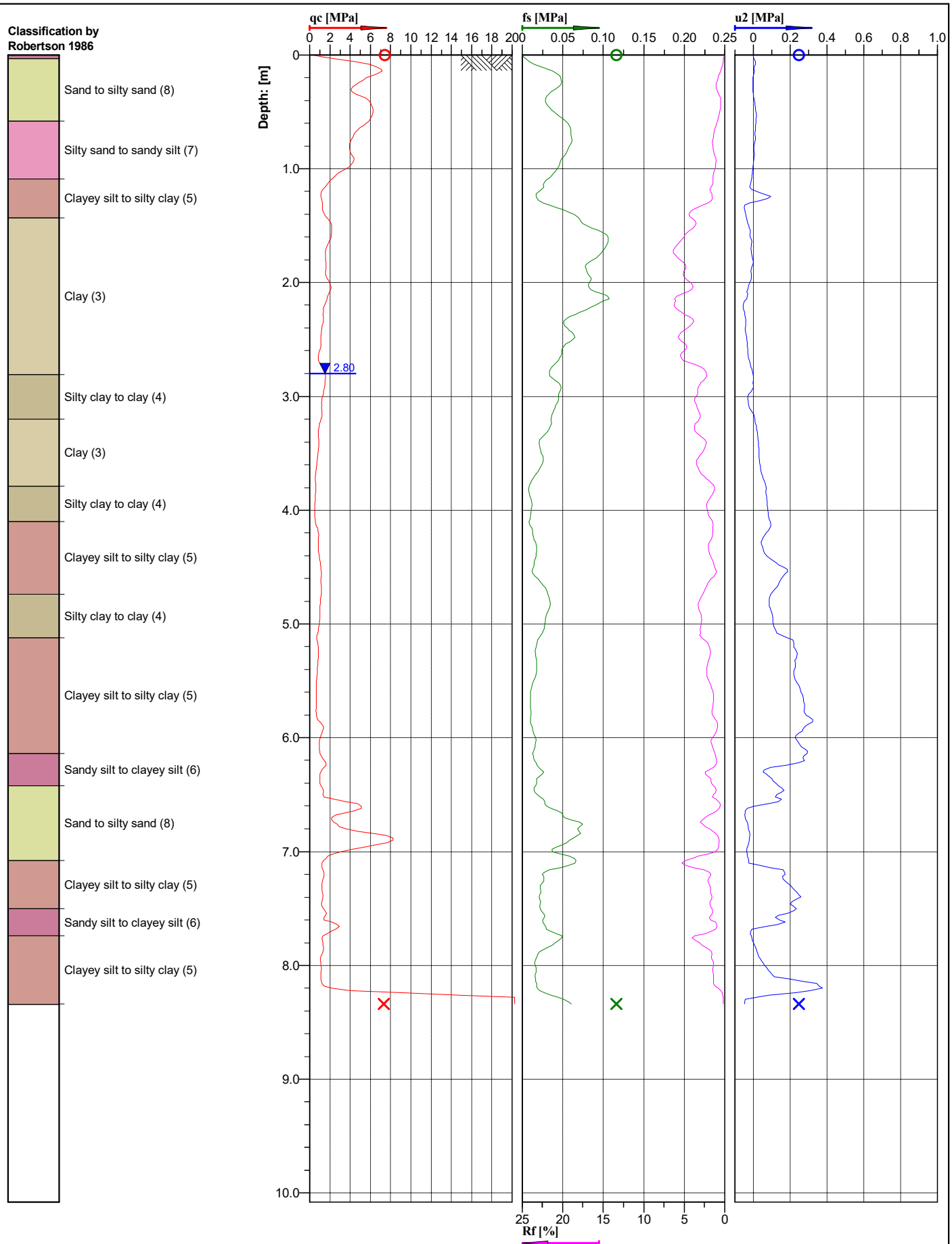
Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT07
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38780, E 176.88574		File: CPT07.cpt	



GEOTECH DRILLING

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT08
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38765, E 176.88495		File: CPT08.cpt	

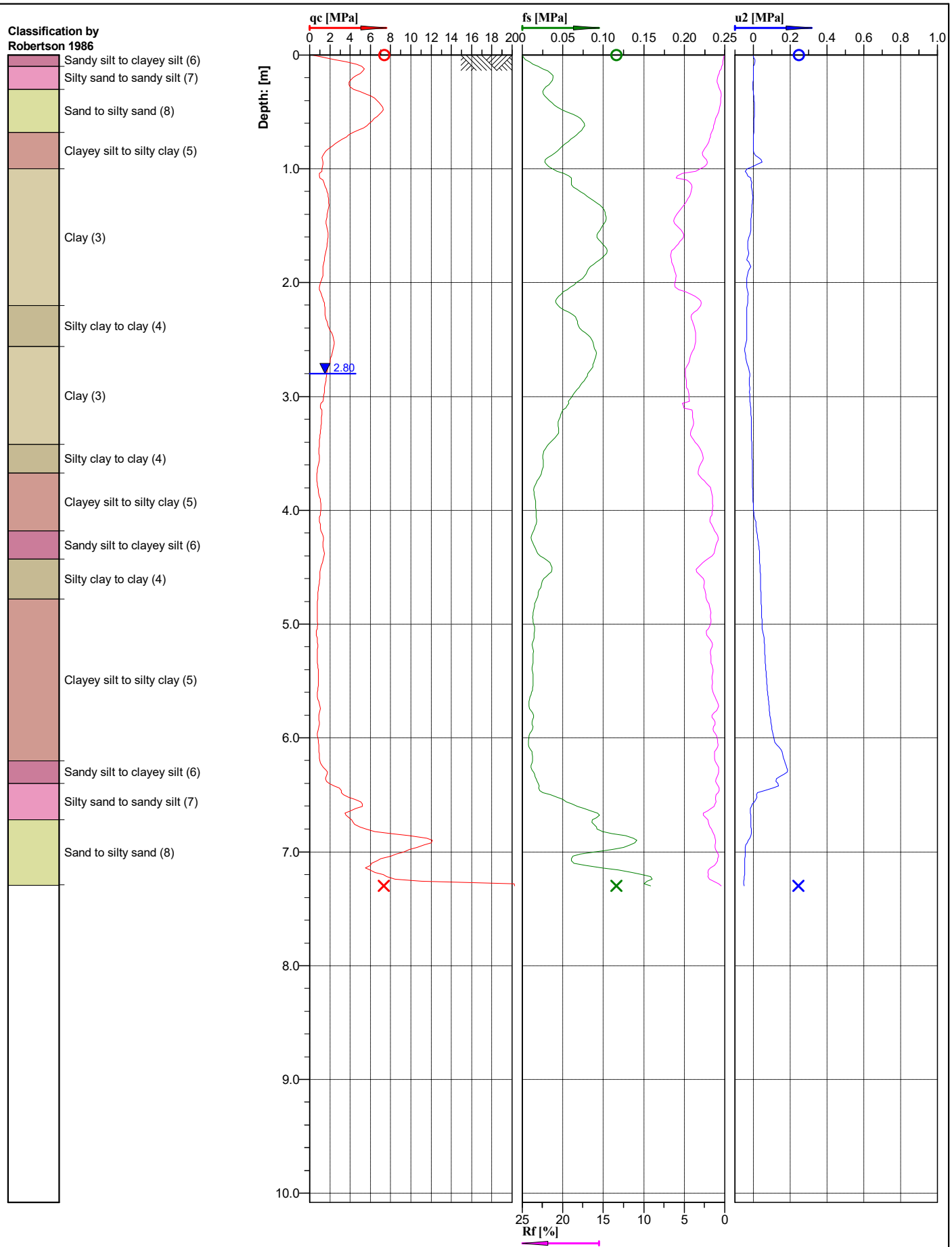


GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT09
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38844, E 176.88501		File: CPT09.cpt	



GEOTECH DRILLING

u2

Cone No: 5550
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: NAPIER	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT10
Project ID:	Client: INITIA	Date: 16/03/2022	Scale: 1 : 45
Project: 1359-996 SH02 - WHIRANAKI		Page: 1/1	Fig.:
S 39.38922, E 176.88516		File: CPT10.cpt	

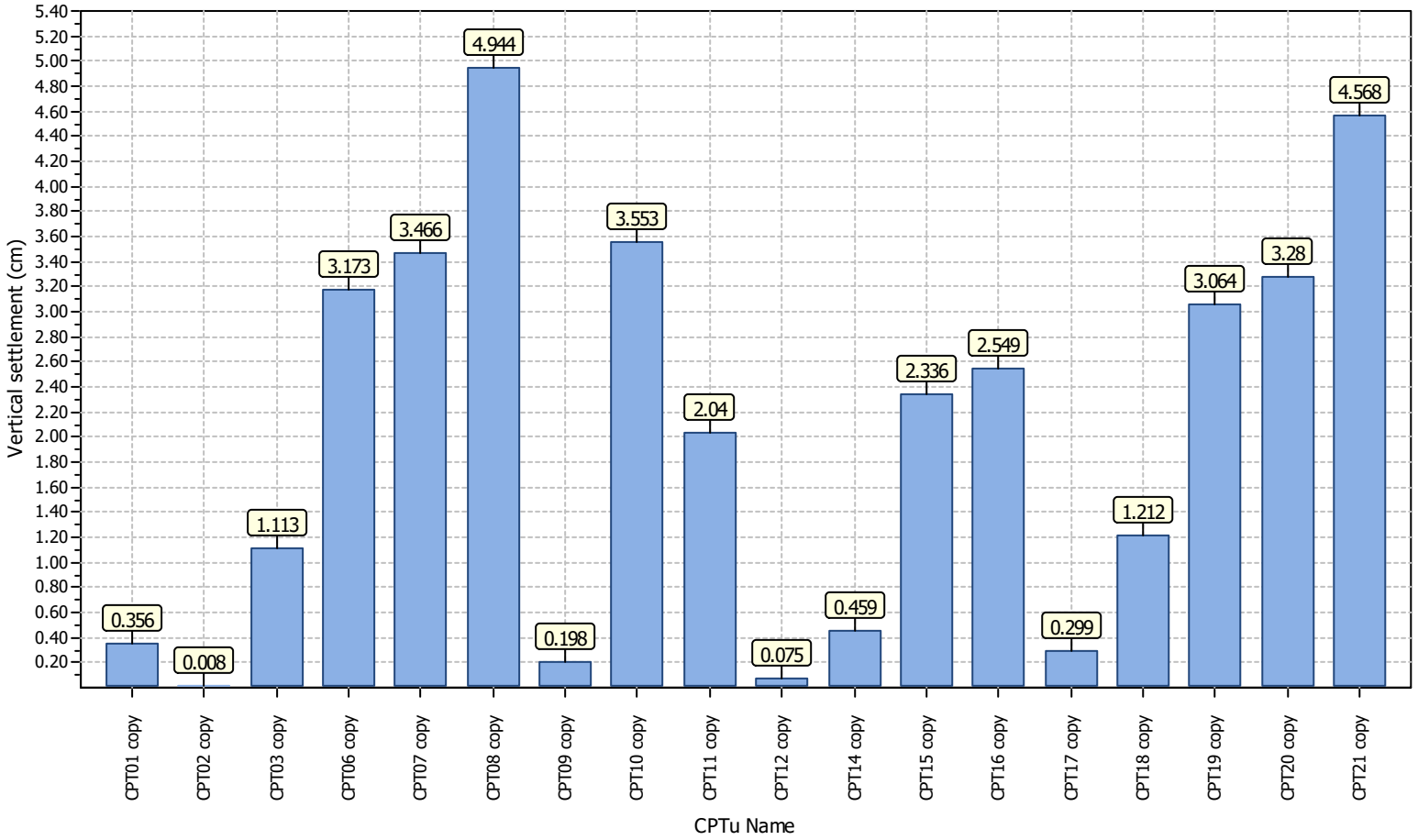
Appendix D CPT Analysis

Initia
Geotechnical Specialists
Unit 6, Level 1, 114 St Georges Bay Road, Auckland
www.initia.co.nz

Project title :

Location :

Overall vertical settlements report

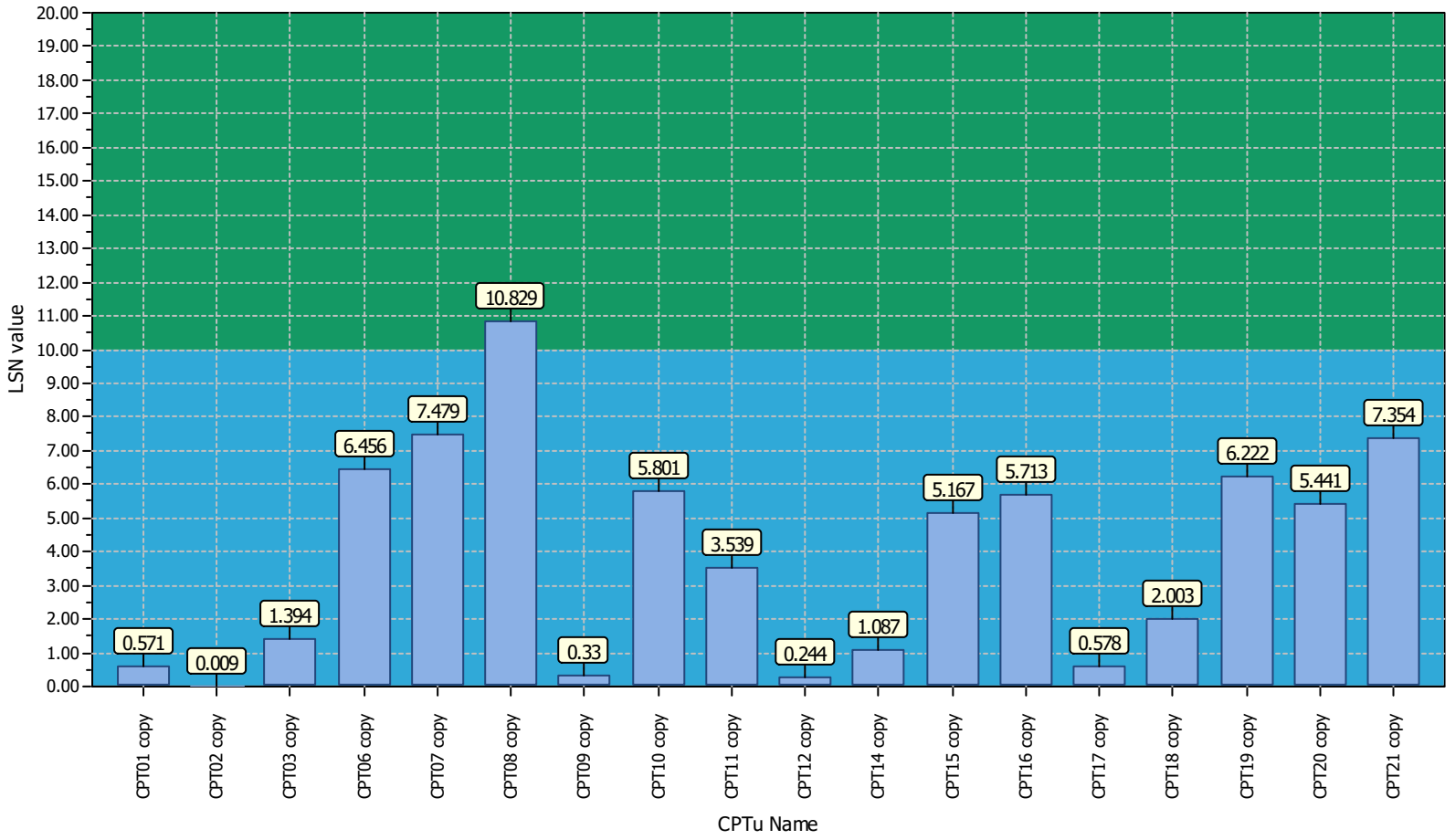


Initia
Geotechnical Specialists
Unit 6, Level 1, 114 St Georges Bay Road, Auckland
www.initia.co.nz

Project title :

Location :

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 18

94% little liquefaction

6% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

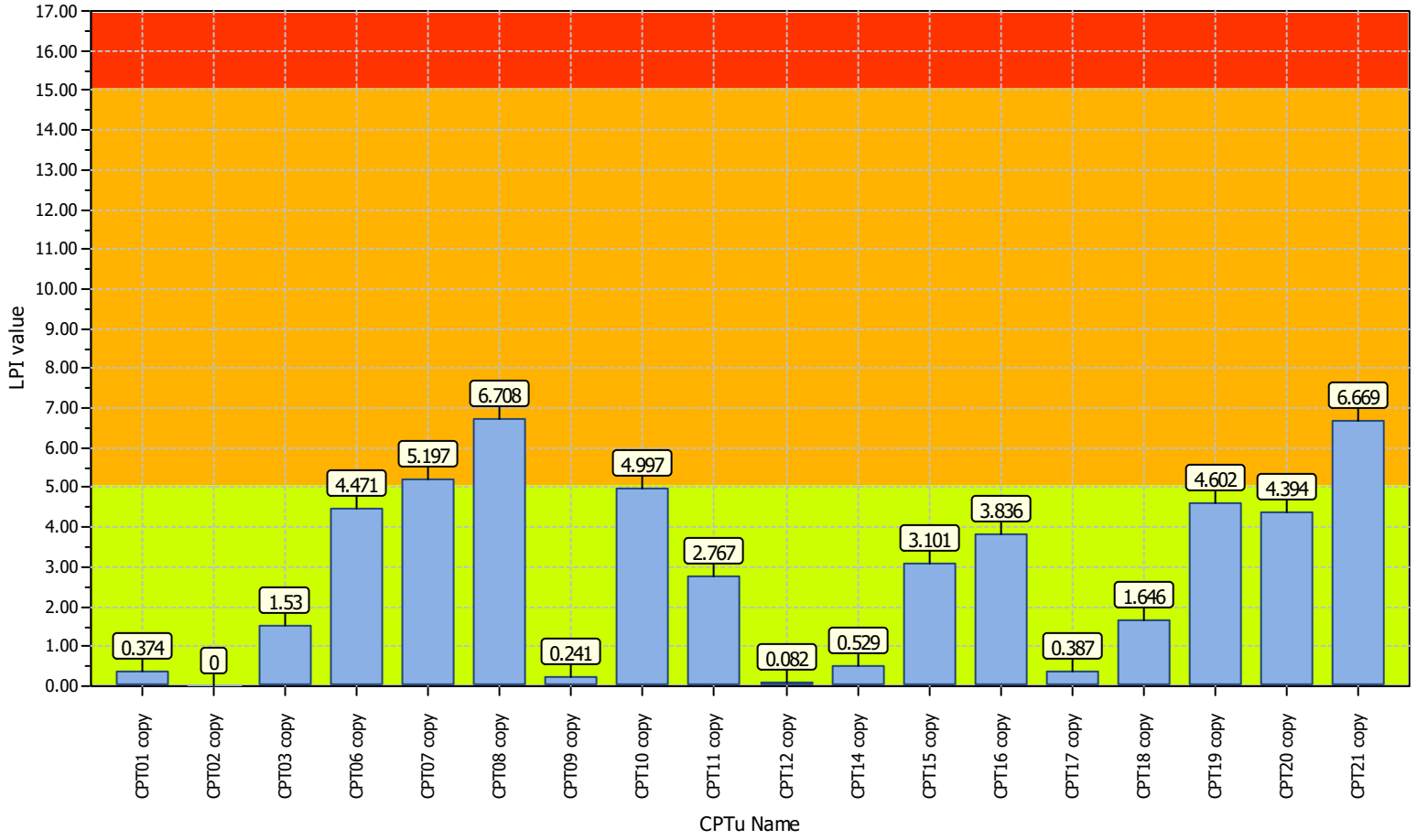
0% severe liquefaction

Initia
Geotechnical Specialists
Unit 6, Level 1, 114 St Georges Bay Road, Auckland
www.initia.co.nz

Project title :

Location :

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

Total CPT number: 18
83% low risk
17% high risk
0% very high risk