



Watercare Services Limited

Whenuapai Redhills Wastewater Package 1 Geotechnical Interpretive Report

March 2021

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1. Introduction

1.1 General

GHD Limited (GHD) has been commissioned by Watercare Services Limited (Watercare) to undertake a geotechnical assessment relating to a proposed gravity sewer, pump station and rising sewer main, located in Whenuapai, Auckland. The location of each element is presented as Figure 1A in Appendix A.

The purpose of this report is to provide geotechnical recommendations to support the design of the elements outlined in Section 1.2 and in accordance with GHD's scope of services defined in Section 1.3. The recommendations made in this report are based on a Geotechnical Factual Report (T&T 2021) which is currently in a draft format and will be finalised on completion of the groundwater monitoring programme.

The limitations and references associated with this report follow the main text as Sections 8 and 9 respectively.

1.2 Proposed design

1.2.1 Pipe alignments

It is proposed to construct approximately 2.5 km of wastewater pipelines to service planned residential subdivision within the greater area. The proposed alignment is presented as Figure 1A in Appendix A and will be separated into a gravity sewer main and a rising main. It is understood that the position of this pipe may change slightly as the design progresses however in general the location and length of the pipes is as follows:

- Gravity sewer main (approximately 740 m length). The gravity sewer main will be located immediately north of Brigham Creek Road between Totara Creek and Joseph McDonald Road and flow from the north east to south west and terminate at 23-27 Brigham Creek Road.
- Pump station and rising main (approximately 1.8 km length). The rising main begins at a pumping station, where the gravity sewer main terminates, located at 23-27 Brigham Creek Road. The rising main then trends in a south east direction along Spedding Road to the intersection with Maramari Road where it will connect with the Massey Connector (outside the scope of this report).

Multiple manholes along the alignment are included within the proposed design and their positions are shown on the geological long sections included in Appendix D and discussed in Section 4.

The proposed pipe construction and invert levels are as follows:

- The gravity sewer main is proposed to be constructed of a 375 mm PVC pipe. Invert levels range between approximately 2.4 – 6.3 meters below ground level (m bgl) however typically range between 2.5 m and 3.0 m bgl.
- The rising main is proposed to comprise a 560 mm outer diameter PE 100 pipe. Invert levels follow the ground level profile and range between approximately 1.4 – 2.6 meters below existing ground level (m bgl).

1.2.2 Pumping station

A proposed pump station plan has been provided and is included in Appendix A as Drawing 3-AWD32.C001. The pump station is shown to be at the interface of the gravity and rising main at 23-27 Brigham Creek Road.

The details of this pumping station were under development at the time of the preparation of this report. However, it is understood that the pumping station footprint will measure approximately 25 m wide by 15 m long and will include:

- Two ~ 8 m deep wet well
- Five ~ 5 m deep storage tanks
- Two ~ 2.4 m deep valve chamber

The existing ground level undulates slightly with an overall gentle dip to the southeast therefore earthworks will be required to provide a level platform. The area will be paved upon installation of the pump station and connect to a proposed cul-de-sac immediately east of the pumping station. It is expected some amount of cut will be required to allow this connection.

A wetland exists immediately north of the proposed pumping station and establishment of a wetland riparian strip is proposed along this boundary. The details of this are yet to be confirmed.

1.2.3 Proposed pipe construction approach

It is currently proposed to install the gravity and rising main pipeline through open trench (OT) excavation methods, however Horizontal Direction Drilling (HDD) may also be employed. The manholes will be installed in open excavations.

1.3 Scope of services

This report is intended to provide geotechnical recommendations to the civil and wastewater designers to allow the progression of design. The geotechnical recommendations are based on a Geotechnical Factual Report, T&T 2021.

The scope of this report includes:

- Desktop review of available information including:
 - Published geological maps
 - Historical aerial photography
- Interpretation of geotechnical data included within T&T 2021 for the purposes of developing an engineering geology ground model, engineering geological units and geological site characterisation
- Slope stability assessment where the alignment or pump station is proposed near a slope
- Assessment of site seismicity and liquefaction risk
- Provision of geotechnical design parameters
- Discussion of key geotechnical risks and recommendations for design and construction

2. Site setting

2.1 Site layout

2.1.1 General

The overall alignment is approximately 2.5 km long and its location is detailed in Section 1.2.1. The gravity sewer main and the rising main both have a unique design chainage, both starting at CH 00 at the location of the pump station (i.e. the gravity sewer increases in chainage to the north and the rising main increases in chainage to the south). These chainages, coupled with manhole locations and names, are presented on the geological long sections included in Appendix D (see Section 4).

Three connecting streams are present over the site, known as Slaughter House Stream, Sinton Stream and Totara Stream. These are presented on Figure 1A in Appendix A.

A more detailed review of the surrounding area is given in the following sections.

2.1.2 Gravity sewer main

The gravity main sewer is located in the approximate northern third of the alignment, commencing adjacent to a stormwater pond in a recently constructed residential development located between Dale Road and Brigham Creek Road. The gravity sewer main trends in a south west direction from the stormwater pond, through agricultural land towards Brigham Creek Road at CH 167 (RP 0.650). The following features are of note between CH 740 and CH 167 and are illustrated in Figure 1:

- Recent earthworks associated with the construction of a swale for a stormwater pond between SSMH-12 to SSMH-11
- A small stream, known as Slaughter House Stream, approximately 0.5 m wide and 0.2 m deep runs adjacent to SSMH-11 to SHMH-5 offset approximately 3.6 m at its closest point (SSMH-8).

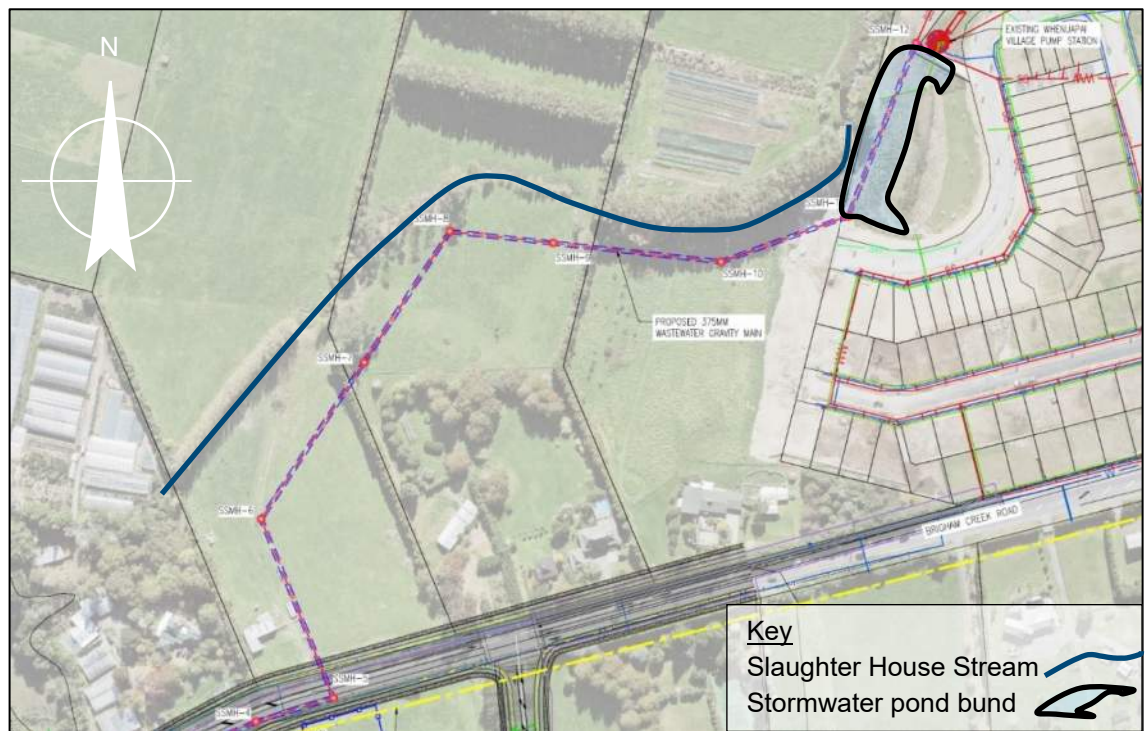


Figure 1 Features of note along between CH 167 and CH 740 along gravity sewer main alignment

The alignment turns west at CH 167 (SWMH-5) and runs along the southern edge (east bound lane) of Brigham Creek Road for approximately 85 m where it turns south at CH 82 into 23-27 Brigham Creek Road.

23-27 Brigham Creek Road is currently an open agricultural field that dips gently to the south west with no significant features other than a small wetland shown in Figure 2 below. The south-western boundary of this property is formed by Sinton Stream, which resides approximately 5.0 m below the ground level of 23-27 Brigham Creek Road. The banks of Sinton Stream are steep ($>45^\circ$) and densely vegetated.

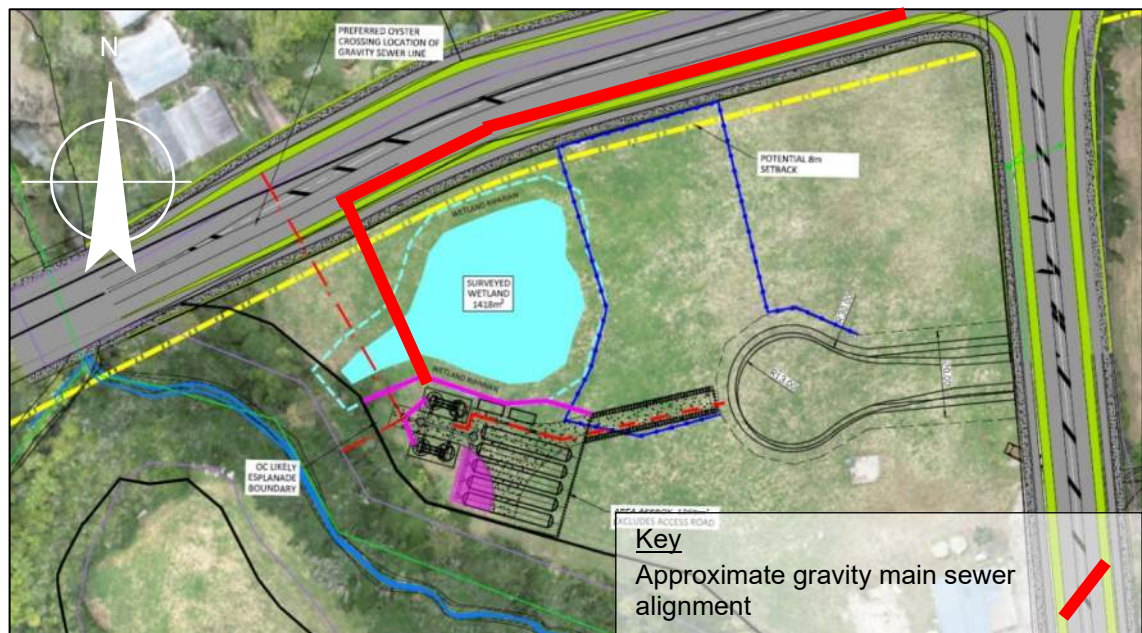


Figure 2 Location of wetland within 23-27 Brigham Creek Road

2.1.3 Rising main

The proposed rising main is located over the southern two thirds of the total alignment. The rising main begins at the proposed pump station (see Figure 2 above). The alignment then follows Spedding Road to the termination of the alignment at the intersection of Mamari Road and Spedding Road. It is proposed to connect the proposed pipe to the Massey Connector at this point. It is however noted that the investigations within T&T 2021 extend over the proposed Massey Connector location and this should be reviewed by the Massey Connector team.

It should be noted that Spedding Road does not currently extend beyond CH 120, but it will be extended to CH 912 as part of development works by others. The road extension will include the culverted crossing of Sinton Stream between CH 220 and CH 250.

2.2 Historical aerial photography

Retrolens Historical Image Resource and Google Earth were accessed to obtain information on the site's history via aerial photography between the available date ranges of 1940 and 2017. The historical aerial photographs are included in Appendix B coupled with a brief description of relevant features for each. A summary of the site history is given below.

The first available image dated 1940 shows rural grassed lands with sporadic buildings present. Slaughter House Stream and Sinton Stream are shown in their current positions. Brigham Creek Road and Spedding Road are shown in their current position.

Minimal development is noted on the historical aerial photographs until 2015 when the photograph shows recent development adjacent the northern most end of the alignment and includes the creation of the stormwater pond (see Figure 1). The only significant feature of note is earthworks occurring in the area of the wetland (see Figure 2) in the photograph dated 1996 suggesting this feature is manmade.

2.3 Published geology

2.3.1 1:250,000 Geological Map of Auckland

The 1:250,000 Geological Map of Auckland (Edbrooke 2001) shows the gravity sewer main to straddle the geological boundary of Tauranga Group Alluvium and Tauranga Group Puketoka Formation. The rising main is shown to be underlain by the Puketoka Formation only. An extract of the geological map is presented as Figure 3 with the units identified with their corresponding map descriptions in Table 1. It is noted that the 1:250,000 map presents the same geology as the 1:50,000 published geological map.

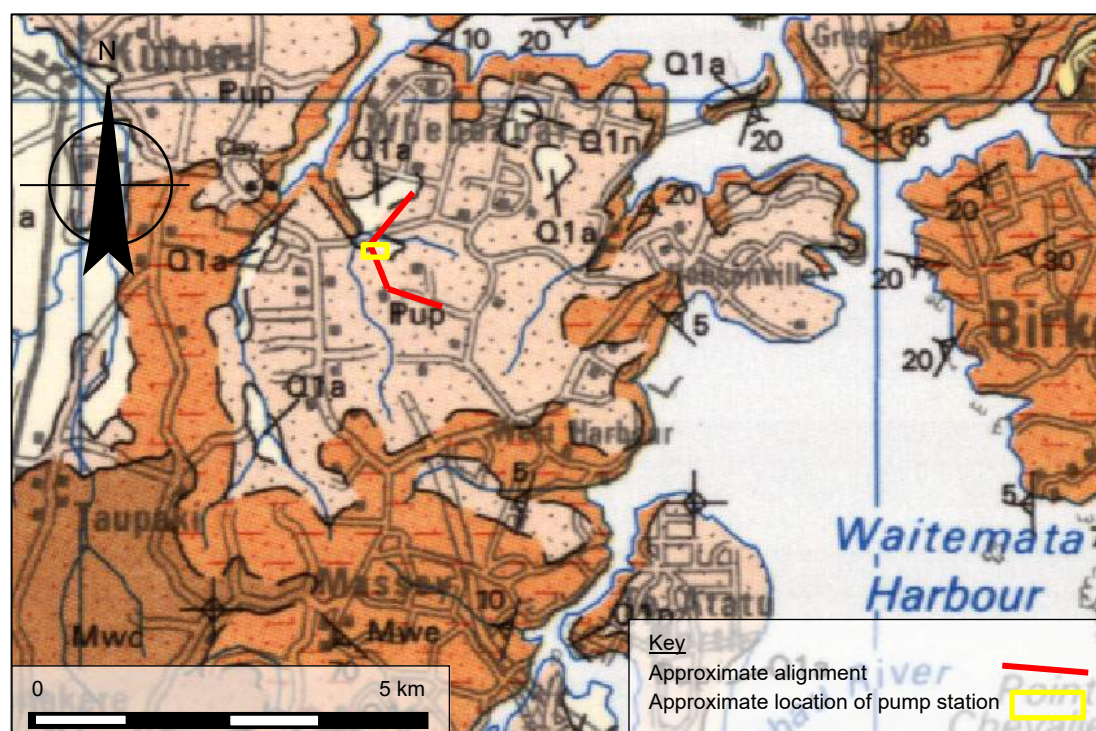


Figure 3 Extract from 1:250,000 geological map

Table 1 Extract from 1:250,000 geological map of the Auckland area key

Map Symbol	Group	Geological Unit	Description (Edbrooke, 2001)
	Tauranga Group	Alluvium / Colluvium	Alluvial / colluvial deposits, estuarine deposits, lacustrine / swamp deposits and fan deposits
	Waitemata Group	East Coast Bays Formation	Alternating sandstone and mudstone with variable volcanic content and interbedded volcanoclastic grit beds.
	Tauranga Group	Puketoka Formation	Pumiceous mud, sand and gravel with muddy peat and lignite; rhyolite pumice, including non-welded ignimbrite, tephra and alluvial pumice deposits; massive micaceous sand.

2.3.2 New Zealand Geotechnical Database

NZGD was reviewed, however no relevant logs were identified.

3. Site investigation summary

3.1 General

A ground investigation was completed by Tonkin and Taylor along the proposed alignment to inform design. The factual information is reported in T&T 2021 attached as Appendix C. T&T 2021 should be referred to for locations, results, methods and calibration certificates. It should be noted that a 100 series naming convention has been used for the gravity main and a 01 series has been used for the rising main.

3.2 Summary of investigation data

A summary of the available information presented in T&T 2021 is included below. This includes test locations requested by GHD coupled with historical records completed as part of previous packages of work.

- 33 hand auger boreholes to a maximum depth of 5.3 m
- 11 Machine Boreholes to a maximum depth of 21.1 m
- 17 Cone Penetration Tests to a maximum depth of 17.5 m
- Installation of 9 piezometers

The geotechnical testing completed as part of the works included:

- 9 Falling & Rising Slug Tests
- 14 natural moisture contents
- 18 Atterberg Limits Tests (NZS 4402:1986 Tests 2.2, 2.3 & 2.4)
- 29 Wet Sieve particle size distributions (NZS 4402:1986 Test 2.8.1)
- 5 hydrometer particle size distributions (NZS 4402:1986 Test 2.8.4)
- 6 Unconfined Compressive Strength Tests (NZS 4402:1986 Test 6.3.1)
- 7 Organic Matter Ignition Tests (NZS 4402:1986 Test 3.1.2)
- 4 One-Dimensional Consolidation Test (NZS 4402:1986 Test 7.1)
- 5 Hydrometer Test (NZS 4402:1986 Test 2.8.4)

4. Engineering geology

4.1 Engineering geological ground model

4.1.1 General

The ground model has been developed based ground investigation data gathered from T&T 2021 (see Section 0), a study of the geomorphology (see Section 4.3) and experience within the region. It is presented as geological long sections included within Appendix D and should be reviewed in conjunction with the discussions in this assessment.

The ground model has been developed to highlight the expected ground conditions along the alignment.

4.1.2 Ground model uncertainty

The ground model has required some interpretation between locations where the alignment has changed or locations were difficult to access.

4.2 Summary of ground conditions

In general, the geology along the alignment can be described as alluvial soils (Tauranga Group) that overlie weathered sedimentary soil and rock (East Coast Bays Formation) to depth. Localised deposits of the Albany Conglomerate were also encountered below 7.5 m below ground level.

The Tauranga Group can be split into

- undifferentiated recent alluvium in low lying areas adjacent streams; and
- less recent Puketoka Formation in all other areas.

However, for the purposes of this report the materials are all referred to as Tauranga Group alluvium.

The interface of the Tauranga Group and the East Coast Bays Formation (ECBF) is typically within 2.0 m to 3.0 m of ground surface near the pump station and deepens to over 15.0 m along other parts of the alignment. The interface along the alignment has been delineated, where possible, in the geological long sections presented in Appendix D (see Section 4.1).

A brief summary of each unit coupled with a summary of available testing is included below for each geological unit. These sections should be reviewed in conjunction with the ground model discussed in Section 4.1 and the borehole records included in T&T 2021. Where average values have been provided they should not be used as design value. They provide an indication only.

4.2.1 Topsoil

Topsoil (surficial, decomposed organic matter) was encountered where the test locations were advanced through grassed areas. This was typically confined to the gravity sewer main alignment as the rising main passes through the road. The material is comprised organic rich silt and varies in thickness, typically between 0.2 – 0.5 m.

4.2.2 Fill

Limited amounts of fill were encountered on site. The most significant deposit was encountered in the northern most end of the gravity sewer alignment between SSMH11 and SSMH12 and in test locations HA110A, HA110B and HA111. This fill is likely associated with the adjacent stormwater bund works (see Section 2.1.2).

The fill was typically described as being stiff to very stiff silty clay. Topsoil appears to be intermixed throughout the profile therefore it is likely that the material was placed with limited earthworks control.

A summary of the tests completed within the deposit are included as Table 2 below.

Table 2 Summary of bund fill in-situ and laboratory testing

Test	Number of tests	Range of results	Average value
Undrained shear strength (kPa) ¹	13	16 to 219	102
Organic content (%)	1	6	-
Water content (%)	1	52	-
Liquid limit (%)	1	71	-
Plastic limit (%)	1	35	-
Plasticity index	1	36	-

¹ obtained from a hand held shear vane

4.2.1 Tauranga Group Alluvium (TGA)

General

Tauranga Group deposits were encountered from ground level, below any topsoil or fill. The profile was layered and alternated between the following four sub-units:

- TGA-C: Silty clay / clayey silt
- TGA-St: Silt / sandy silt
- TGA-Sa: Sand / silty sand
- TGA-O: Organic clay

The majority of the deposit falls into either TGA-C or TGA-St type soils. Very generally, TGA-C typically sits towards the top of the deposit grading to TGA-St below approximately 5.0 m bgl. TGA-St was however locally encountered near surface, particularly in the eastern most extent of the alignment. TGA-O and TGA-Sa was sporadically encountered in thin layers, typically no thicker than 0.5 m, and did not appear to be laterally continuous.

A brief summary of each sub-unit is presented in the following sub-sections. Atterberg test results for all sub-units is plotted on a Casagrande graph presented as Figure 4 below. The majority of the data indicates high plasticity clays are present, with plasticity indices generally in excess of 25.

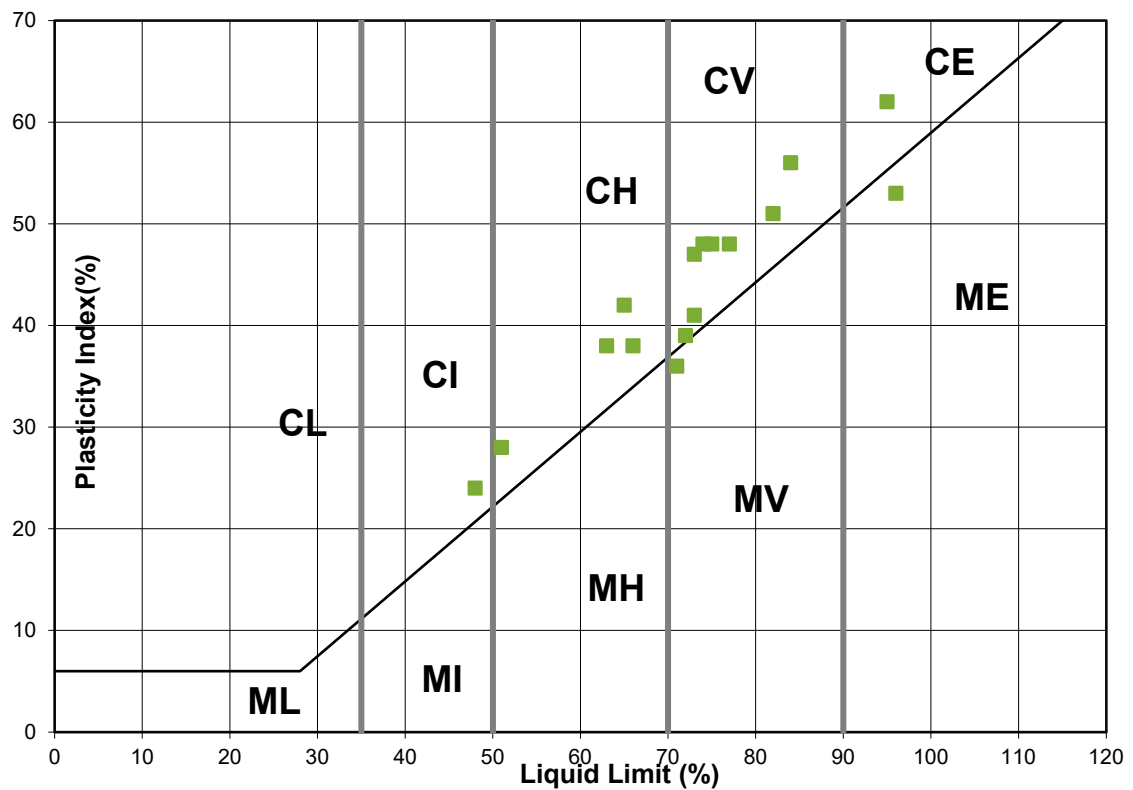


Figure 4: Casagrande (A-line) graph (PI vs LL)

TGA-C: Silty clay / clayey silt

TGA-C was generally located within 5.0 m from ground level. It was typically described as being a stiff silty clay or clayey silt with varying amounts of sand. A summary of the available testing is presented as Table 3 below.

Table 3 Summary of in-situ and laboratory testing for TGA-C

Test	Number of tests	Range of results	Average value
Undrained shear strength (kPa) ¹	79	25 to 200	93
Organic content (%)	3	3 to 20	9
Moisture content (%)	8	38 to 50.1	43
Liquid limit (%)	8	63 to 84	71
Plastic limit (%)	8	23 to 32	27
Plasticity index	8	24 to 56	44

Test	Number of tests	Range of results		Average value
Particle size distribution (%)	-	Sand	Silt	Clay
Wet sieve	5	23 to 61	39 to 76	
Hydrometer	4	7 to 22	48 to 72	21 to 44
¹ obtained from a hand held shear vane				

TGA-St: Silt / sandy silt

TGA-St was described as being a stiff either silt or sandy silt with some clay. This was the dominant unit within the Tauranga Group materials and encountered either near surface or below the TGA-C.

A summary of the available testing is presented as Table 4 below.

Table 4 Summary of in-situ and laboratory testing for TGA St

Test	Number of tests	Range of results		Average value
Undrained shear strength (kPa) ¹	88	19 to 218		101
Moisture content (%)	6	42 to 69.4		53
Liquid limit (%)	7	48 to 135		85
Plastic limit (%)	7	23 to 33		32
Plasticity index	7	28 to 95		53
Particle size distribution (%)	-	Sand	Silt	Clay
Wet sieve	7	10 to 33	67 to 90	
¹ obtained from a hand held shear vane				

TGA-Sa: Sand / silty sand

TGA-Sa was typically described as being a loose to medium dense sand or silty sand. SPTs completed within the material were limited given the thin layers in which it was encountered. Where possible, uncorrected SPT N values ranged between 4 and 15. No other in situ or laboratory testing was completed in the sand dominant layers of the TGA-Sa group.

TGA-O: Organic clay

TGA-O was typically described as being stiff organic silty clay or clayey silt. It was typically located in localised pockets no larger than 0.5 m thick and confined to the northern half of the alignment.

A summary of the available testing is presented as Table 5 below.

Table 5 Summary of in-situ and laboratory testing for TGA-O

Test	Number of tests	Range of results		Average value
Undrained shear strength (kPa) ¹	3	16 to 96		-
Organic content (%)	3	6 to 15		9
Moisture content (%)	1	52		-
Liquid limit (%)	4	66 to 148		104
Plastic limit (%)	4	28 to 60		43
Plasticity index	4	36 to 88		62
Particle size distribution (%)	-	Sand	Silt	Clay
Wet sieve	3	13 to 18	81 to 87	
¹ obtained from a hand held shear vane				

4.2.2 Albany Conglomerate

Albany conglomerate rock was identified in BH05B located at CH 200 of the rising main alignment at a depth of 7.5 m bgl and in BH116 at CH 640 along the gravity sewer at a depth of 13.5 m bgl. This unit was typically described as being a completely to highly weathered sandstone or conglomerate. It was typically recovered as a gravel and is inferred to be weakly cemented.

A summary of the available testing is presented as Table 6 below.

Table 6 Summary of in-situ and laboratory testing for the Albany Conglomerate

Test	Number of tests	Range of results	Average value
Undrained shear strength (kPa) ¹	1	119	-
UCS (kPa)	1	730	-
Water content (%)	1	22.6	-
Bulk density	1	2.05	-
Dry density	1	1.65	-
Young's Modulus	1	94	-
¹ obtained from a hand held shear vane			

4.2.3 East Coast Bays Formation residual soils

Residual East Coast Bays Formation soils were typically located near surface in the northern third of the alignment. It was typically described as being a stiff to very stiff clayey silt or a sandy silt.

A summary of the available testing is presented as Table 7 below.

Table 7 Summary of in-situ and laboratory testing for ECBF residual soil

Test	Number of tests	Range of results		Average value
Undrained shear strength (kPa) ¹	5	34 to 186		93
Particle size distribution (%)	-	Sand	Silt	Clay
Wet sieve	3	30 to 50	50 to 70	
¹ obtained from a hand held shear vane				

4.2.4 East Coast Bays Formation weathered rock

ECBF weathered rock was encountered below the residual soils and was typically described as being extremely weak becoming very weak sandstone interbedded with siltstone.

A summary of the available testing is presented as Table 8 below.

Table 8 Summary of in-situ and laboratory testing for weathered ECBF rock

Test	Number of tests	Range of results	Average value
UCS (kPa)	4	610 to 1200	910
Water content (%)	4	20.5 to 24	22
Bulk density	4	1.98 to 2.06	2.03
Dry density	4	1.65 to 1.7	1.66
Young's Modulus (MPa)	4	85 to 183	131.5

4.3 Geomorphology

GHD is in general agreement that the published geological map suitably represents the greater area. However, GHD would note the following based on our site walkover and a review of the contours:

- The mapped geology (see Section 2.3.1) shows Totara Creek to be flanked by ECBF north of Brigham Creek Road. This has occurred due the creek incising a 5 to 10 m deep channel through the overlying alluvium and into ECBF weathered rock. A walkover by GHD identified this exposure continuing south within the similar sized banks of Sinton Stream adjacent 22-27 Brigham Creek Road.
- Brigham Creek Road is level with the surrounding topography along the northern side of the road. The southern side of the road is however formed by an approximately 30° 1.5 m high batter when compared to the adjacent topography. It is therefore expected that the road is founded on a fill batter approximately 1.5 m deep along the southern edge thinning to ground level along the northern side of the road.
- The gravity sewer is shown to pass in and out of the Puketoka Formation and recent alluvium between CH 167 and CH 647 on the published geological map. The recent alluvium is associated with the Slaughter House Stream flood plain however it could

possibly include colluvium from the gentle slope above to the south. The alignment through this area is presented as Figure 5 below. The geology within this area is expected to be highly variable.

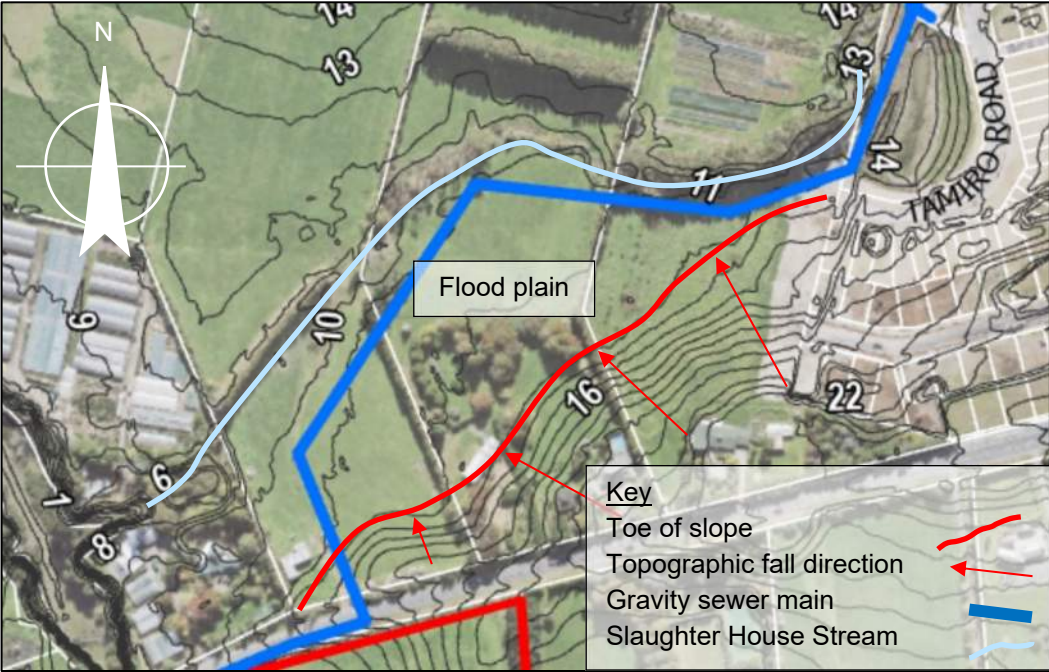


Figure 5 Gravity sewer main between CH 167 and CH 647 geomorphology

4.4 Groundwater conditions

4.4.1 Static groundwater levels

Static groundwater monitoring was underway during the time of the preparation of this report. The monitoring to date show groundwater levels to range between 0.4 m bgl to 4.8 m bgl.

4.4.2 Hydraulic conductivity

The hydraulic conductivity (permeability) of the main geological units across the site was assessed in T&T 2021. These values are summarised below in Table 9.

Significant variation in the hydraulic conductivity can exist from the encountered materials as a function of preferential flow paths created from defects (bedding planes or joints) or more/less permeable layers or lenses. These are provided for reference only.

Table 9 Hydraulic Conductivity of main stratigraphic units

Geological Unit	Saturated Hydraulic Conductivity kH (m/s)
Tauranga Group	8.2 x 10 ⁻⁸
	8.7 x 10 ⁻⁸
	1.7 x 10 ⁻⁷
	1.7 x 10 ⁻⁷
	5.8 x 10 ⁻⁷
Residual East Coast Bays Formation Silts and Sands	5.1 x 10 ⁻⁷
	9.3 x 10 ⁻⁷
	1.0 x 10 ⁻⁶
Albany Conglomerate	2.2 x 10 ⁻⁵

5. Geotechnical assessment

5.1 Geotechnical design parameters

Recommended geotechnical design parameters for the geological units summarised in Section 4.2 are presented in Table 10 below. These parameters have been developed from review of existing site investigation data, existing reports (Section 0) as well as our experience of similar materials within the Auckland region.

Table 10 Geotechnical design parameters

Geological Unit	Shear Strength Su (kPa)	Bulk Unit Weight, γ (kN/m ³)	Effective Cohesion c' (kPa)	Angle of Internal Friction ϕ' (°)	Unconfined Compressive Strength, UCS (MPa)
Non-Engineered Fill	50	18	0	28	NA
TGA-C	50	18	2	28	NA
TGA-St	50	17	1	28	NA
TGA-Sa	-	18	-	30	NA
TGA-O	50	16	0	28	NA
ECBF Residual Soil	60	18	5	30	NA
ECBF weathered rock	1000	21	25	35	1.0
NA: Not Applicable					

5.2 Site seismic classification

The Damage Control Limit State (“DCLS”) and Serviceability Limit State (“SLS”) design earthquake loadings for the assessment of liquefaction and the stability and displacement of soil structures have been calculated in accordance with the NZTA Bridge Manual (NZTA 2018a). The equation used in is reproduced below:

- $PGA = C_{0,1000} \times (R_u/1.3) \times f \times g$

The various input parameters for the equation are presented in Table 11 below.

Table 11 Input parameters for determination of peak ground acceleration

Seismic Case	Input Parameter	Parameter Value	Comment
General	Importance Level (IL)	3	NZS 1170.0
	Design Life	100 years	Client Specified
	Subsoil Class	D	NZS 1170.5 Clause 3.1.3.2 to 3.1.3.5
	DCLS Return Period	1/2500	Table 3.3 NZS1170.0
	SLS Return Period	1/25	Table 3.3 NZS1170.0
	Effective Magnitude Earthquake	5.9	NZTA 2018b Table C6.1

Seismic Case	Input Parameter	Parameter Value	Comment
Ultimate Limit State	1000 year return period PGA coefficient ($C_{0,1000}$)	0.19	NZTA 2018b Table C6.1
	Return Period Factor (R_u)	1.8	NZTA 2018a Table 3.5
	Site subsoil class factor (f)	1.00	NZTA 2018a Section 6.2.2
Serviceability Limit state	25 year return period PGA coefficient ($C_{0,1000}$)	0.2	NZTA 2018a Figure 6.1(a)
	Return Period Factor (R_s)	0.25	Table 3.5 NZS 1170.5
	Site subsoil class factor (f)	1.0	NZTA 2018a Section 6.2.2

The following PGA's have been calculated, accordingly:

- DCLS PGA = 0.26 g
- SLS PGA = 0.04 g

Where retaining walls are unanchored and are designed to support surfaces, driveways, laydown areas and the like and do not provide direct support to building footings, we recommend that the DCLS acceleration is used in conjunction with a wall displacement factor of 0.3*.

* - the use of wall displacement factors is described in detail in "Earthquake geotechnical engineering practice, Module 6 : Earthquake resistant retaining wall design. MBIE & NZGS, May 2017."

5.3 Liquefaction vulnerability assessment

The liquefaction vulnerability of the proposed Whenuapai-Redhills wastewater pipelines has been assessed using the ground investigation results and geological characterization of the site outlined in Section 4. The assessment aims to determine whether the reported subsurface conditions are prone to liquefaction during earthquake, and more generally to discuss the induced effects on the proposed pipelines.

The laboratory data available in Appendix C and summarised in Section 4.2 for each unit, includes eighteen Atterberg Limit tests completed between 1.5 m bgl and 5.8 m bgl along the alignment. The Plasticity Index (PI) values were greater than 24 in all tests, with a median PI of 48. These results indicate that the clay and silt mixtures encountered are highly plastic. Soils that exhibit PI greater than 12 are generally considered unlikely to liquefy (MBIE 2016). It should be noted that the soil descriptions included on the borehole logs does not always reflect the high plasticity materials reported in the laboratory test results.

Although there is the potential for thin, isolated liquefiable lenses to exist, for design purposes, this site can be considered non-liquefiable.

5.4 Slope Stability

5.4.1 Qualitative assessment

The only slope stability risks to be considered for this project are at the pump station which is located within a few metres of the banks of the Sinton Stream.

The underlying geological profile at the pump station comprises Tauranga Group alluvium to approximately 2.5 m depth followed by residual ECBF soils grading to weathered rock at 4.0 m bgl. The proposed elements of the pumping station are typically founded at depths greater than 4.0 m bgl therefore will be embedded into weathered rock.

Weathered rock poses a small risk of instability. However, it is possible that the crest of the Sinton Stream banks will regress with time possibly exposing the buried tanks. A cross section through the pump station and Sinton River is presented as Figure 6 and shows the stream banks and an assumed 1 V (vertical) to 3 H (horizontal) regression slope angle.

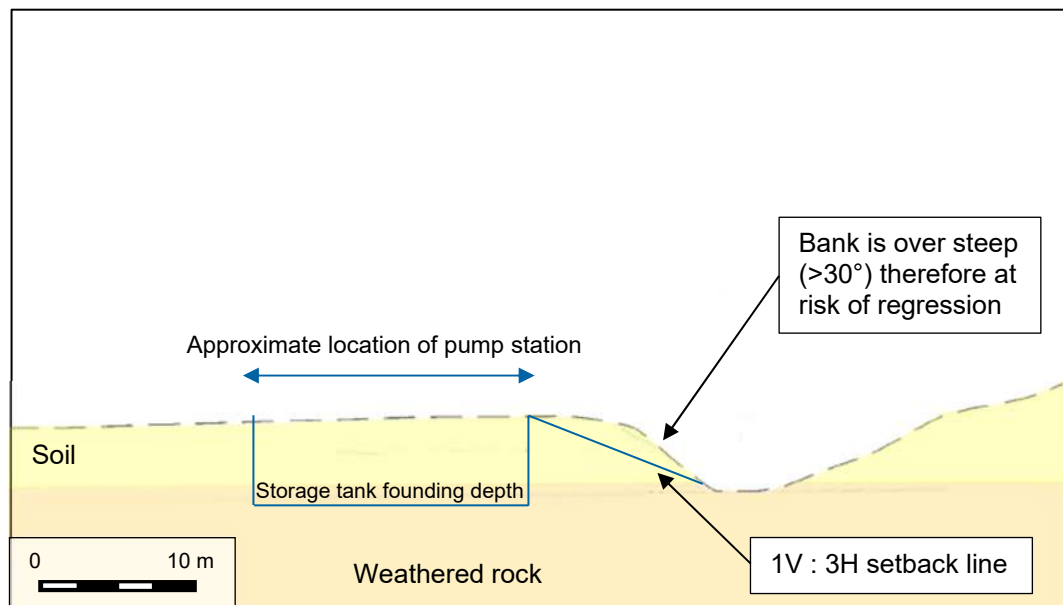


Figure 6 Cross section through pump station

It is recommended that the pump station be set back 6 m from the crest of the slope to allow for the regression of the slope.

5.5 Buoyancy

The majority of the proposed sewer alignment, manholes and detention tanks will be hollow during the majority of their operation, with occasional periods where they will be full with wastewater. In addition, the proposed invert level of these structures, coupled with the generally shallow groundwater level, means that it is more likely they will experience uplift forces (buoyancy) as opposed to settlement resulting from foundation loading. Buoyancy forces could potentially damage the infrastructure or cause heave of the overlying ground.

We recommend that all pipe sections, tanks and shafts be designed to resist buoyancy forces at a depth below the groundwater table. This will likely comprise of the use of 'flanges' or over excavation of shafts and backfill around a concrete base pad. The use of uplift piles may also be required in some sections.

6. Design considerations

6.1 Pump station recommendations

6.1.1 Local geological profile

The following geological profile can be expected based on boreholes (HA112, BH110 and BH111) and CPTs (CPT111-112):

- Topsoil up to 0.4 m thick;
- Tauranga alluvial soils below the topsoil to 2.5 m bgl;
- ECBF residual soils to 4 m bgl;
- ECBF weathered rock beyond 4 m bgl, comprising extremely weak to weak sandstone units with a gradual increase in stiffness over depth up to 7.5 mbgl where unweathered sandstone was encountered.

6.1.2 Groundwater

Groundwater levels of approximately 2.0 m bgl were observed within the boreholes. Excavations deeper than this are likely to require dewatering measures. The risk of settlements resulting from drawdown are discussed in Section 7.

6.1.3 Switch room

Details of the above ground switch room were not provided at the time of the preparation of this report however are expected to be light weight container / portacom type structures.

It is recommended that the switch rooms are founded on short piles or strip and pad foundations. The foundations should embed past the base of the wetland which is approximately 0.5 m to 1.0 m below the existing contours below the pump station. The choice of foundation will be dependent on the final location of the switch room and the proposed loadings.

An Ultimate Bearing Strength of 300 kPa is available for short bored piles with diameters up to 0.6 m, or strips no greater than 0.7 m wide embedded within natural ground. This reduces to a Design Bearing Strength of 150 kPa using a Strength Reduction Factor of $\phi = 0.5$ as per B1/VM4.

Shallow footings should be designed to Site Soil Class H1 with the corresponding depths as per AS 2870:2011 requirements.

6.1.4 Storage tanks, wet well and valve chamber

Founding conditions

The storage tanks, wet wells and valve chamber are to be founded below ground level. These will be excavated through the generalised profile in Section 6.1.1 and will be founded on the following geological units:

- The wet well is founded 8 m bgl therefore expected to be embedded in unweathered sandstone (SPT $N > 50$);
- The valve chambers is founded 2.5 m bgl therefore expected to be founded at the interface of the ECBF soils and the overlying Tauranga Group alluvium;
- The storage tanks' invert levels typically range between 5.2 and 5.5 mbgl therefore expected to be founded on weathered sandstone units (SPT $N > 50$).

Positioning

The pump station should be set back 6 m from the crest of the slope as outlined in Section 5.4.1. This will remove the risks to the station from slope instability.

Backfill

Due to the water content of the in situ material, use of site won material as backfill will not be feasible.

We therefore recommend an imported, engineered backfill is used. This should be placed and compacted in accordance with a formal site-specific Specification.

6.1.5 Pavement design

The proposed pavement subgrade will either be formed of engineered fill placed to backfill around the various elements or Tauranga Group alluvium likely comprising stiff silty clay. It is therefore recommended that an unsoaked CBR of 3% is adopted for design. To achieve the CBR value it is recommended that the formation level is proof rolled, inspected and any soft, loose or deleterious material is removed and replaced with compacted granular fill.

6.2 Sinton Stream crossing

6.2.1 General

It is understood that an earth embankment is proposed to be constructed by the developer where the rising main alignment crosses Sinton Stream between CH 220 and CH 250. The design of this embankment is outside the scope of this report however it is expected that the weight of embankment will induce settlement. These settlements should be assessed and the effect on the pipe studied.

It is also noted that a change in 'bedrock' occurs below this stream with the north underlain by Albany Conglomerate and the south underlain by the East Coast Bays Formation rock. This is unlikely to significantly effect design given the relative depth to rock is similar however this should be assessed by the designer.

6.3 Pipe design

6.3.1 Native soil modulus

The native soil modulus is a function of the pipe design, foundation soils and installation technique, which were under development at the time of the preparation of this report. These values will therefore be confirmed at a later stage of design.

6.3.2 Backfill

Trench backfill

Trench backfill should be placed in accordance with the Watercare or Auckland Transport Minimum Requirements as appropriate. Any site specific Specification should take the following into account:

- It is recommended that in areas where the alignment passes through permeable land (i.e. the gravity main sewer), an impermeable clay 'cap' should be placed to prevent surface sheet flows from flooding the trench.

- Trench backfill material should retain a similar permeability to the in-situ ground conditions, to avoid interfering with transient groundwater flows that may instigate slope instability.

Trench stops

To control the potential transient flow of groundwater within backfilled trench excavations, which could lead to over saturation of supporting soils and/or permanent groundwater drawdowns, trench-stops consisting of clay or bentonite, or the use of sheet piles. The requirement for the use of trench stops should be determined in further design stages (this includes sizing and spacing). This may require supporting hydrogeological analysis.

6.4 Earthworks

6.4.1 Permanent cuts

The design of permanent cuts are currently not proposed. If during the progression of design they are required a proposed a preliminary angle of no greater batter angle than 1V : 3H within Puketoka Formation and East Coast Bays Formation materials should be adopted. However, the design of any cuts is a function of existing structures, geology, geomorphology etc. and should therefore be discussed with GHD prior to finalisation.

7. Construction Considerations

7.1 General

We have not identified any significant geotechnical risks that would preclude the use of an open trench methodology or Horizontal Directional Drilling (HDD). However, each method has inherent risks during construction which need to be addressed and controlled by the Contractor.

It is recommended this section (and the ground model in Section 4 and the geotechnical parameters in Section 5) is reviewed by the Contractor prior to the commencement of construction.

7.2 Temporary groundwater drawdown induced settlement

Groundwater was recorded at relatively shallow depths across the site, generally ranging from 1.5 – 4.0 mbgl, with an average level of approximately 2.0 mbgl. It is anticipated that the majority of excavations required for pipe, shaft and tank installation will be below the groundwater table. Management of inflowing groundwater will therefore be required. Dewatering of these excavations will cause localised drawdown of the groundwater table, which may induce settlement of the surrounding ground surface.

Proper management of inflowing groundwater will also help to mitigate the risk of trench excavation collapse. The contractor should manage groundwater drawdown and ground settlement as part of temporary works design and during construction. We recommend that dilapidation surveys of existing structures and ongoing settlement monitoring are considered, particularly where the pipelines will be constructed adjacent to existing developments.

Consideration should also be given to higher groundwater pressures and inflow rates along uncemented sand layers and through rock defects, when excavating within the ECBF rock.

For the construction of shafts, appropriate temporary support that prevents groundwater inflow into the excavation should be considered. This may include designs such as driven steel sheet piles and ground curtains.

7.3 Rock defects

Rock defects were encountered within the ECBF rock. These defects may daylight within deep excavations, particularly those for the gravity trunk sewer adjacent to the pump station. Kinematic failure may be induced along these defects causing cave-in of the excavations.

If encountered, the defects may also act as conduits for groundwater seepage into the excavations. This could result in higher pressure and faster than anticipated groundwater inflows.

7.4 Trench, shaft and chamber excavation short term stability

Instability of trench, shaft and chamber excavations could result in injury or death of persons in the trench and damage to equipment.

Temporary support will be required where shafts and trenches are greater than 1.5 m deep and is recommended beyond 1.0 m deep for trenches on sloping ground. Design and implementation of suitable temporary support solutions is the responsibility of the contractor and should be assessed and approved by a suitably qualified geotechnical professional.

GHD notes that sand dominated layers below the groundwater table exist along the alignment and therefore will be at risk of 'running sands' (i.e. immediate collapse of the layer upon excavation).

7.1 Hydraulic fracturing and surface heave

Where it is proposed to install the pipelines via Horizontal Directional Drilling (HDD), there is risk of hydraulic fracturing ('frac-out') or surface heave due to fluid pressure from the injected slurry. This risk is highest in sections of the alignment where surface cover is shallow (e.g. < 3.0 m) and/or where soft or sandy and recently deposited alluvial soils exist.

The Contractor should review the anticipated ground conditions and associated material parameters (section 4 and 5) prior to undertaking any HDD activities (in particular afore mentioned areas where increased risk is expected).

7.2 Variable ground conditions

The expected ground conditions along the alignment are predominantly Tauranga Group alluvial soils, however residual and weathered ECBF, as well as localised deposits of recent alluvium, colluvium, and man-made fill, were encountered. Variable ground conditions may be associated with localised fluctuations in groundwater pressure. Other risks to the proposed construction of the sewer and pump station, associated with the variable ground conditions expected, include:

- Possibility of buried logs within organic/peat lenses in Puketoka Formation however it should be noted none were encountered during the investigation
- Sandy/soft and saturated lenses, within Puketoka Formation, Colluvium, and recently deposited alluvium

7.3 Soft and compressible soils

Soft or compressible soils are expected along the alignment of the pipe alignments. Where soft or compressible materials are encountered, they should be over-excavated and replaced with compacted fill.

7.4 Disaggregation of ECBF Rock

ECBF rock can disaggregate when mechanically worked, and break down to a 'sticky paste'. This disaggregation generally occurs when particles are broken down to a clay size. These clay particles then swell. Although the majority of the rock that the alignment is expected to be constructed in is Sandstone, the finer grained 'matrix' is typically comprised of silt and clay particles. The residually weathered soil that overlies the sandstone may also disaggregate more readily than the less weathered parent rock.

7.5 Inspections and Certification

At this stage, GHD are not retained to carry out site observations, any form of advice during site works, or to provide a PS4 for the works.

8. Limitations

This report has been prepared by GHD Limited for Watercare and may only be used and relied on by Watercare for the purpose agreed between GHD and Watercare as set out in Section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Watercare arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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Data queried from the New Zealand Geotechnical Database (NZGD) have been considered in the preparation of this report. Where boreholes, test pits, cone penetration tests, laboratory tests, geophysical tests and similar work have been performed and recorded by others, the data are included and used in the form provided by others to the NZGD. No warranty or representation whatsoever (including as to its accuracy, adequacy, completeness, or fitness for any purpose) is provided by GHD in connection with the data.

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An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended, abbreviated, or issued in part in any way without prior written approval by GHD. GHD does not accept liability in connection with the issuing of an unapproved or modified version of this report.

This report is based on information obtained from specific investigation locations, test points and sample points undertaken at a specific point in time. As a result such information may not represent the conditions that may be encountered across the site at any future point in time. The actual characteristics of materials may vary significantly. Ground and groundwater conditions have been inferred between locations. Ground conditions, including groundwater levels and contaminant concentrations can change over time. GHD does not accept liability in connection with varied conditions.

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. If the revealed ground or

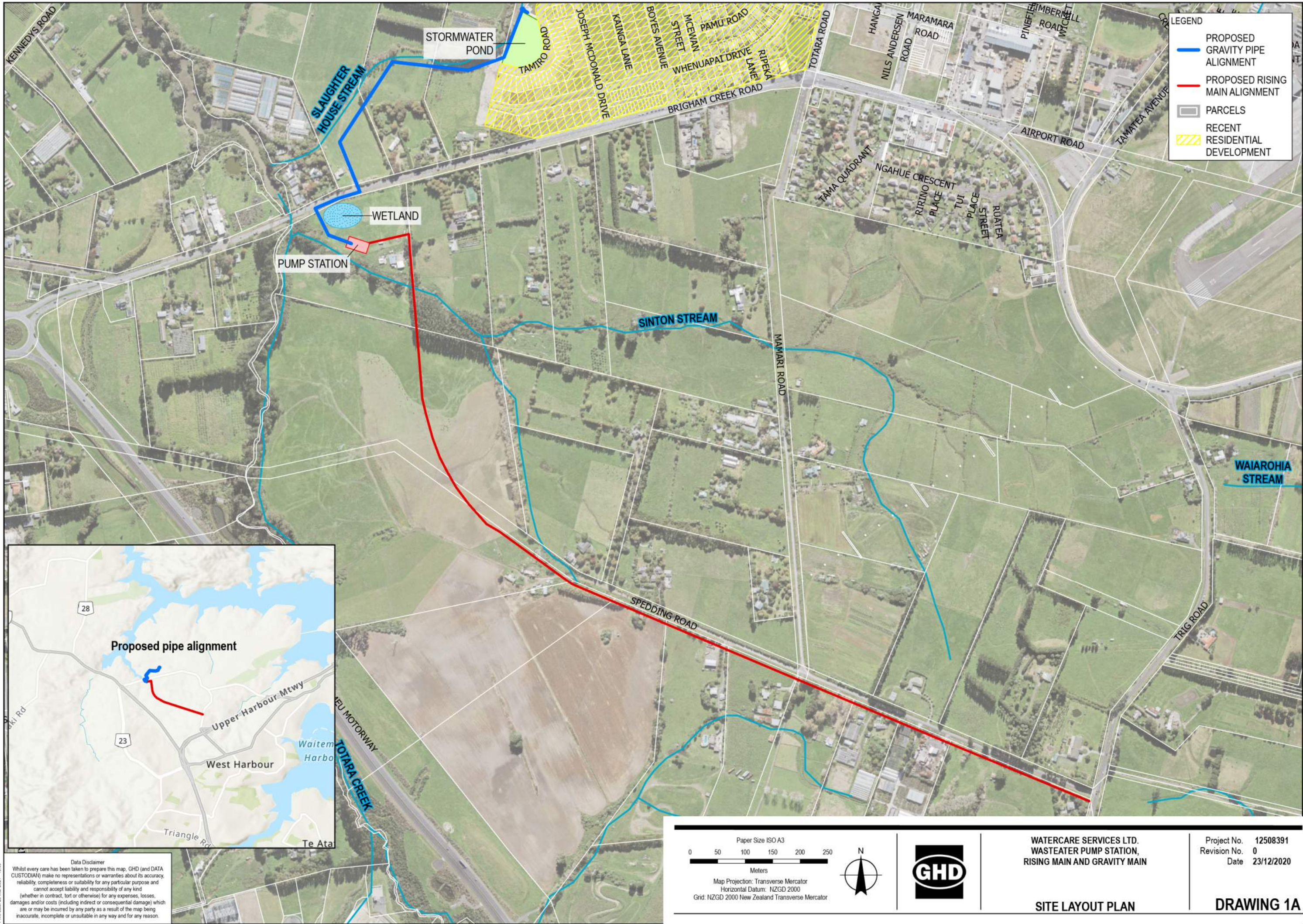
groundwater conditions vary from those assumed or described in this report the matter should be referred back to GHD.

9. References

- Auckland Council. Auckland Council GIS Viewer GIS Viewer. Retrieved March 2021, from <https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>.
- Komode, L.O. 1992: Geology of the Auckland urban area. Scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 2. 1 sheet + 63 p. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand.
- Ministry of Business, Innovation & Employment & New Zealand Geotechnical Society (2016), *Earthquake geotechnical engineering practise, Module 3: identification, assessment and mitigation of liquefaction hazard*.
- New Zealand Building Code – Department of Building and Housing (2000), *Verification Method B1/VM4 – Structure Foundations*.
- NZS1170.0:2002, *Structural Design Actions – Part 0: General principles*
- NZS1170.5:2004, *Structural Design Actions – Part 5: Earthquake Actions – New Zealand*
- New Zealand Transport Agency (NZTA), October 2018a, *NZTA Bridge Manual (SP/M/022)*, Third edition, amendment 3.
- New Zealand Transport Agency (NZTA), October 2018b, *NZTA Bridge Manual Commentary*, First Edition, Amendment 0.
- Retrolens Historical Image Resource. Retrieved November 2018, <http://retrolens.nz/map/#/>.
- Youd, L., Et Al. 2001, *Liquefaction Resistance of soils: Summary Report* from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils. Journal of Geotechnical and Geoenvironmental Engineering.
- Youd, L., & Hoose, S, 1997, *Liquefaction Susceptibility and Geologic Setting*.

Appendices

Appendix A – Drawings

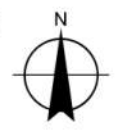


- LEGEND
- PROPOSED GRAVITY PIPE ALIGNMENT
 - PROPOSED RISING MAIN ALIGNMENT
 - PARCELS
 - RECENT RESIDENTIAL DEVELOPMENT



Data Disclaimer
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Meters
Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

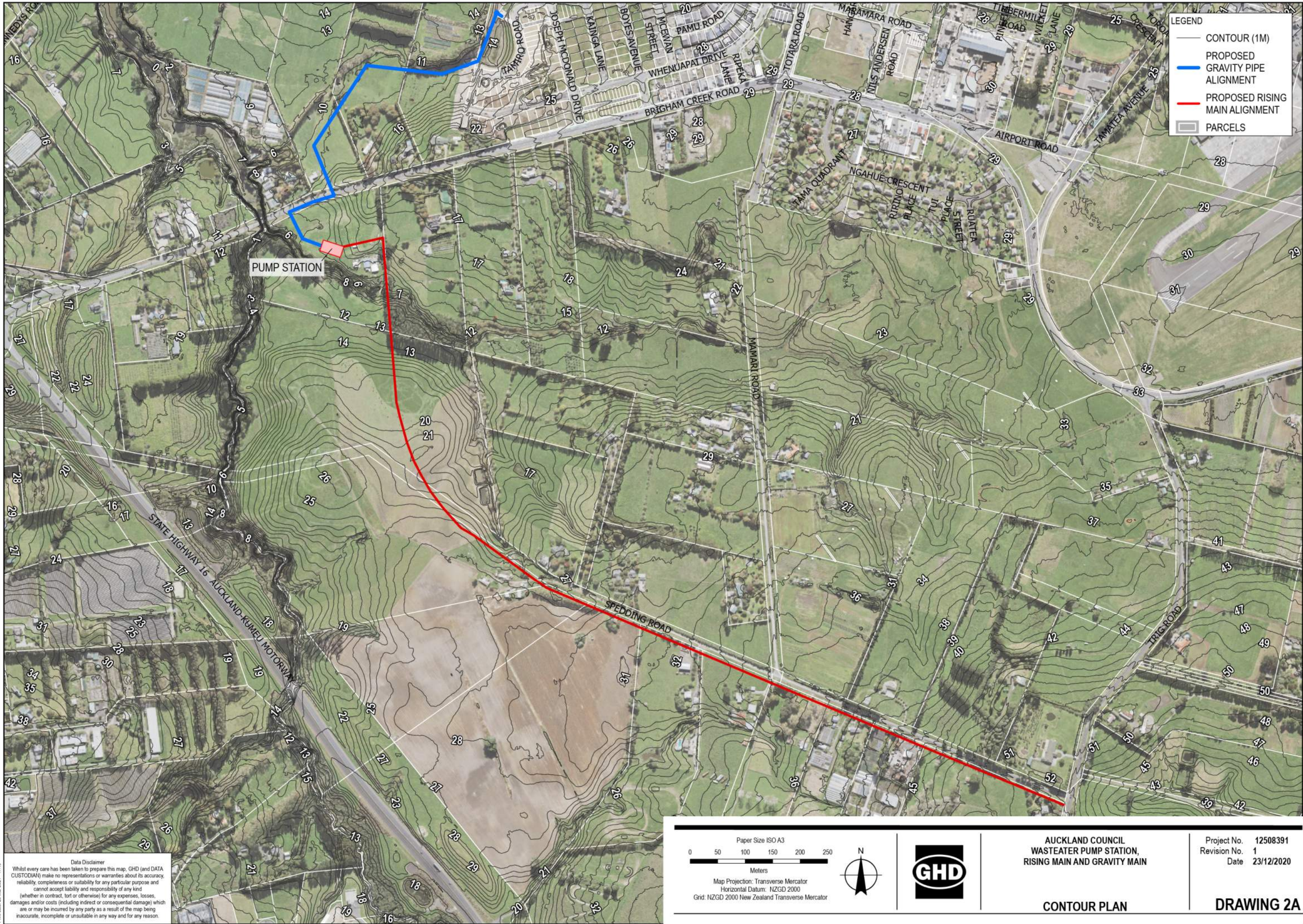


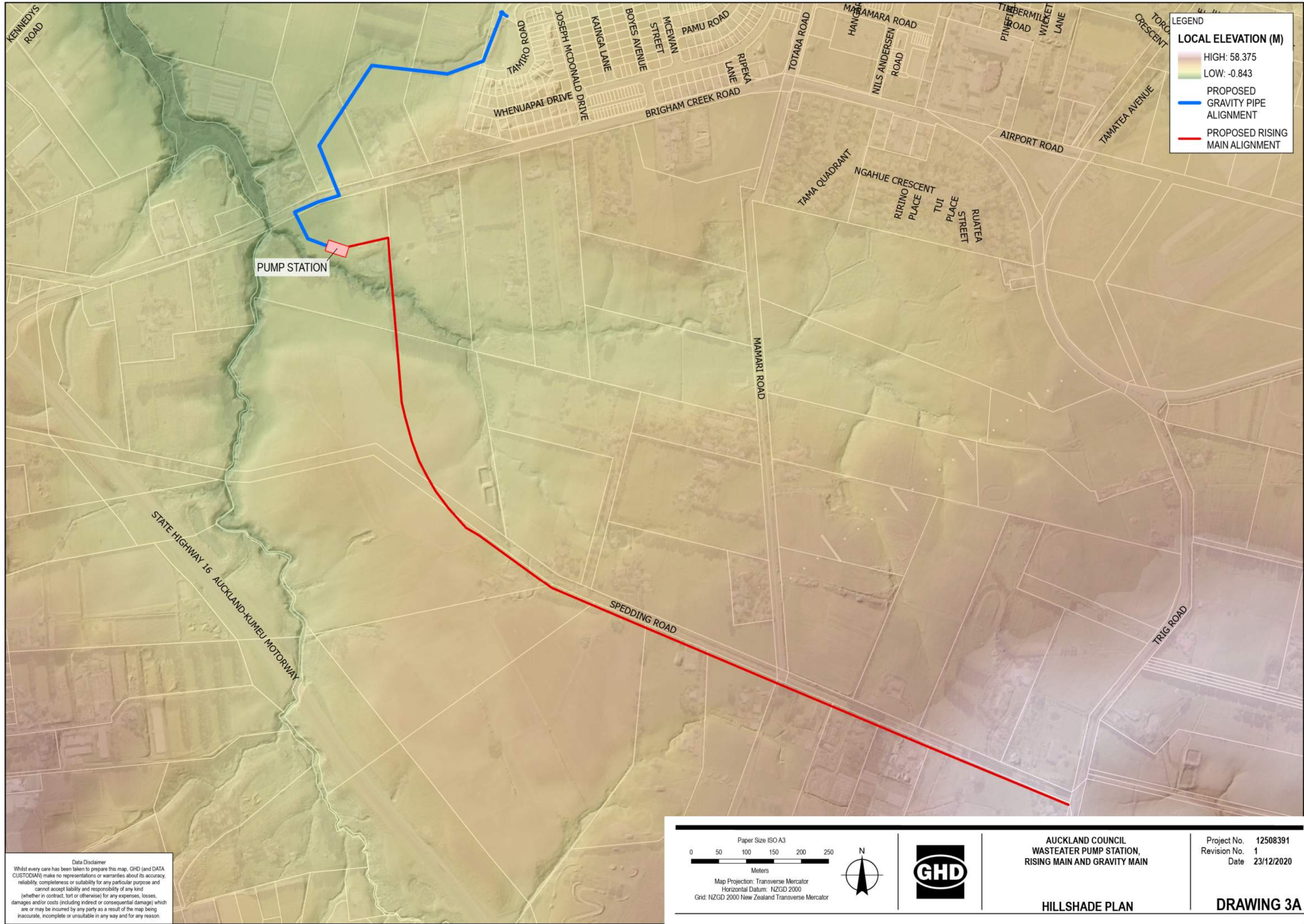
WATERCARE SERVICES LTD.
WASTEWATER PUMP STATION,
RISING MAIN AND GRAVITY MAIN

Project No. 12508391
Revision No. 0
Date 23/12/2020

SITE LAYOUT PLAN

DRAWING 1A





LEGEND

LOCAL ELEVATION (M)

HIGH: 58.375

LOW: -0.843

PROPOSED GRAVITY PIPE ALIGNMENT

PROPOSED RISING MAIN ALIGNMENT

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Horizontal Datum: NZGD 2000

Grid: NZGD 2000 New Zealand Transverse Mercator



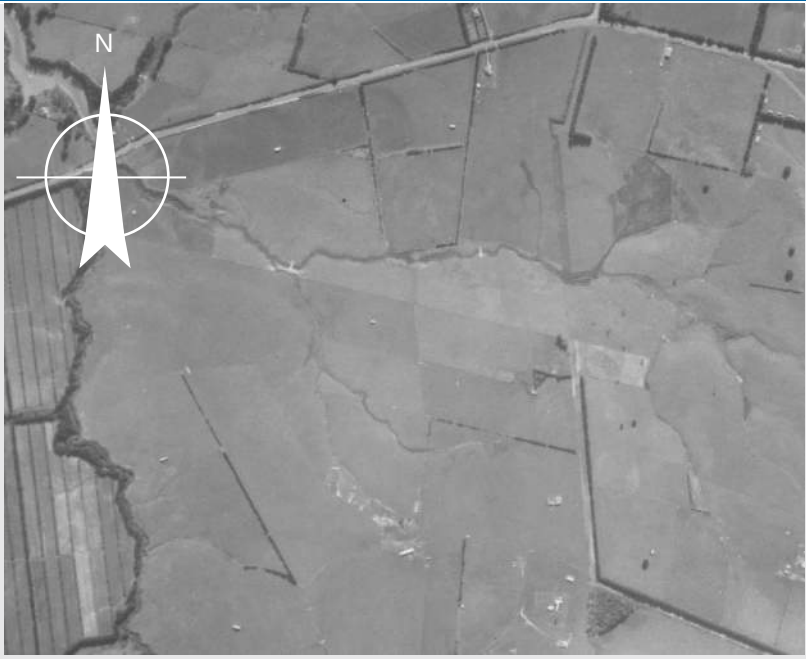
AUCKLAND COUNCIL
WASTEWATER PUMP STATION,
RISING MAIN AND GRAVITY MAIN

Project No. 12508391
Revision No. 1
Date 23/12/2020

HILLSHADE PLAN

DRAWING 3A

Appendix B – Historical aerial photography

Historical Aerial Photographs	Comments
	1940 – SN70335 - Retrolens Rural grassed plains
	1961 – Retrolens (unknown SN) Housing at NE end. Growth of vegetation (trees). Additional roads down the southern end



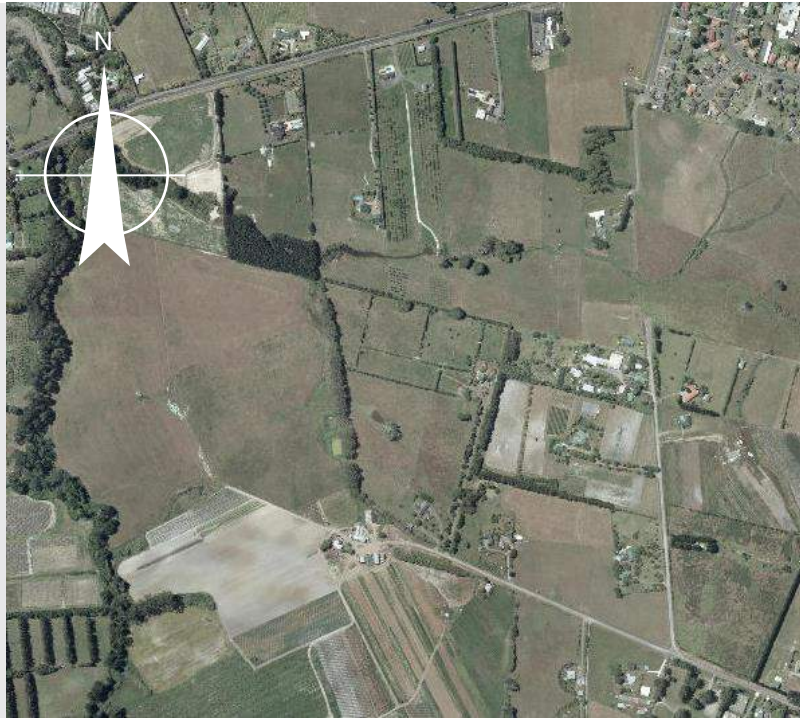
1980 – SN5783 - Retrolens

Removal of vegetation at SW end replaced with extended roads down the southern end



2000– Auckland Council GeoMaps

Clearer distinctions in property of lands through vegetation, fencing, crops, etc. More buildings/houses scattered around the area. New growth and removal of vegetation at the eastern ends



**2006 – Auckland Council
GeoMaps**

No significant changes



**2008 – Auckland Council
GeoMaps**

No significant changes



**2010-11 – Auckland
Council GeoMaps**

No significant changes



**2015-16 – Auckland
Council GeoMaps**

No significant changes



**2017 – Auckland Council
GeoMaps**

Latest available aerial shot.

No significant changes

Appendix C – Geotechnical Factual Report



Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station (Package 1)

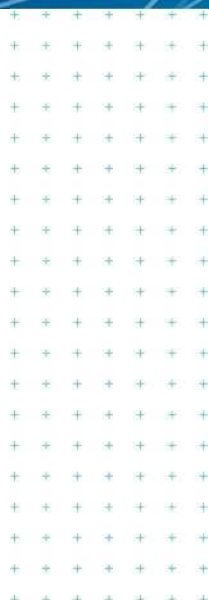
Geotechnical Ground Investigation
Factual Report

Prepared for
Watercare Services Limited

Prepared by
Tonkin & Taylor Ltd
Date

January 2021

Job Number
1014985.0000



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Document Control

Title: Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station (Package 1), Geotechnical Ground Investigation Factual Report					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
December 2020	0.1	Draft – Laboratory Test Results Pending	Chris Monk	Ben Westgate	Robert Hillier
January 2021	1.0	Geotechnical Factual Report – Groundwater monitoring Pending	Chris Monk	Ben Westgate	Robert Hillier

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1 Introduction

Tonkin & Taylor Ltd (T+T) was engaged by Watercare Services Limited (Watercare) to conduct a ground investigation at Whenuapai-Redhills (Figure 1, Appendix A). The investigations were undertaken to assess the ground conditions along the alignment of the proposed Whenuapai-Redhills Wastewater Servicing Rising Main / Gravity Main Pipeline and Interim Pump Station.

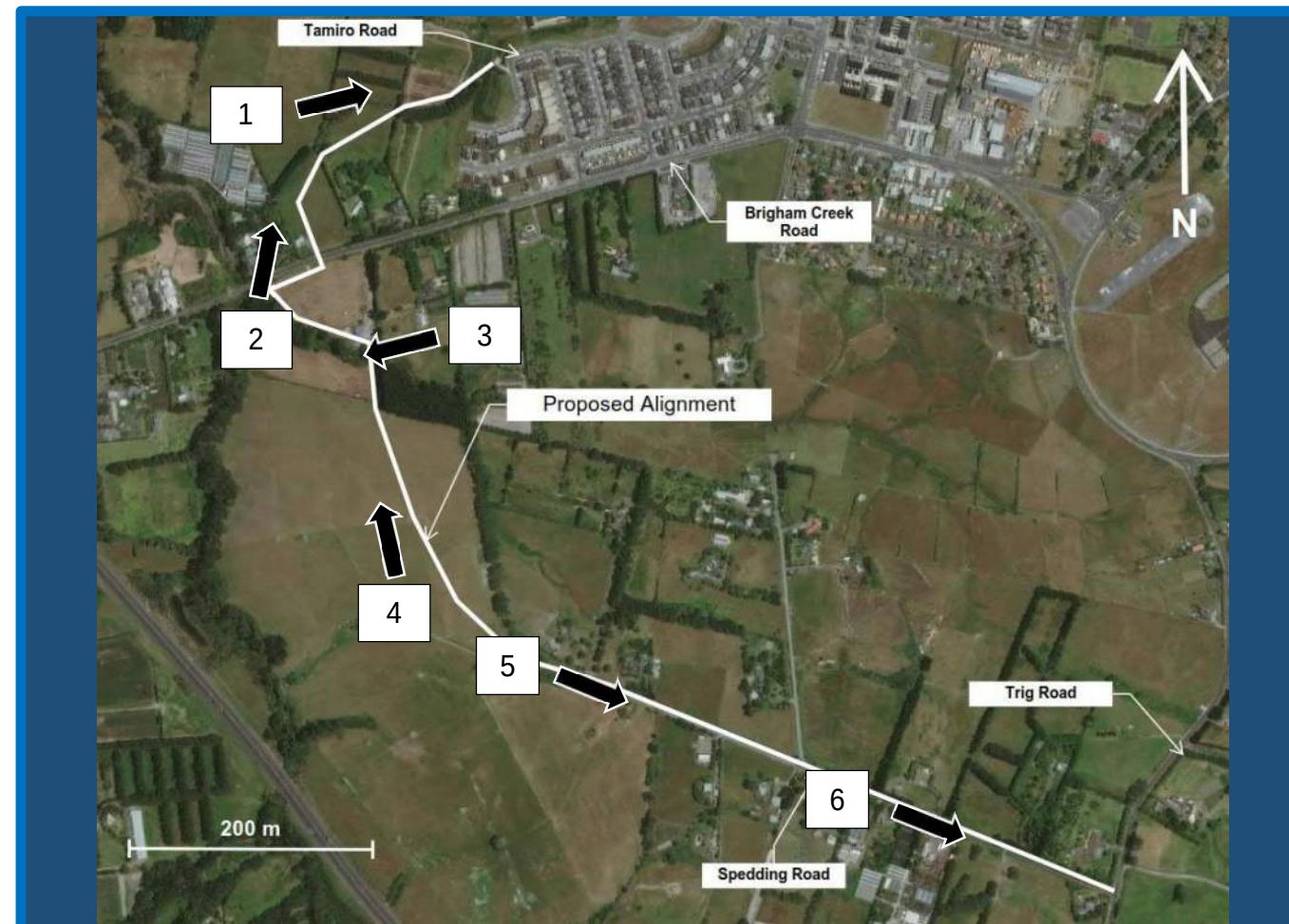
T+T provided geotechnical services in accordance with our proposal dated 28 October 2020¹ and included the scope of works summarised below:

- Eleven (11) rotary cored machine boreholes drilled to between 2.5 and 22 m depth;
- Fifteen (15) Cone Penetration Tests (CPT) with pore water pressure (u) to refusal;
- Twenty-two (22) geotechnical hand augered boreholes to depths between 2.5 and 7.5 m, with associated Scala Penetrometer tests;
- Four (4) environmental hand augers to depths between 1.0 and 2.0 m;
- Installation of nine (9) standpipe piezometers with level loggers for continuous monitoring of groundwater conditions; and
- Submission of 23 samples to the Geotechnics soils laboratory for geotechnical analysis.

This factual report details the results of the 2020 geotechnical assessment, including ground investigation locations, the type of investigation methods undertaken, and the suite of samples submitted to the laboratory, along with the testing results received.

At the time of reporting, a final round of groundwater measurement is planned to occur in March 2021. Once the last round of groundwater measurement is completed, a final version of this report, with all data, will be issued.

¹ T+T (October 2020) *TT 1014985 Watercare – Whenuapai Redhills Package 1 – LOE_Rev2_20201028*. T+T Ref: 1014985.0000



Site Description

The Package 1 ground investigation site is located in Whenuapai Auckland, between Tamiro Road at the northern end and Trig Road at the southern end.

This section of the proposed alignment is approximately 2.5 km in length.

The alignment crosses private residential properties at the northern end of the alignment between Tamiro Road and Brigham Creek Road. This section is relatively flat and crosses paddocks and farmland with occasional minor gully features.

The section of the alignment from Brigham Creek Road to Spedding Road consists of gently rolling hills and is across farmland with a gully in the centre.

The section of the alignment between Spedding Road and Trig Road extends along the road berm and is flat with a small hill at the Trig Road end.

3 Published geology

The published geological map of the area² indicates that the site is underlain by undifferentiated alluvium of the Tauranga Group for the northern section of the alignment. Pumiceous deposits of the Tauranga Group occur near the surface for the remainder of the alignment and alternating sandstone and mudstone deposits of the East Coast Bays Formation (ECBF) is the basement geology for the area. Within the ECBF, layers of Albany Conglomerate have been identified.

The location of the alignment is shown in the context of the regional geology as presented on Figure 3.1 below.

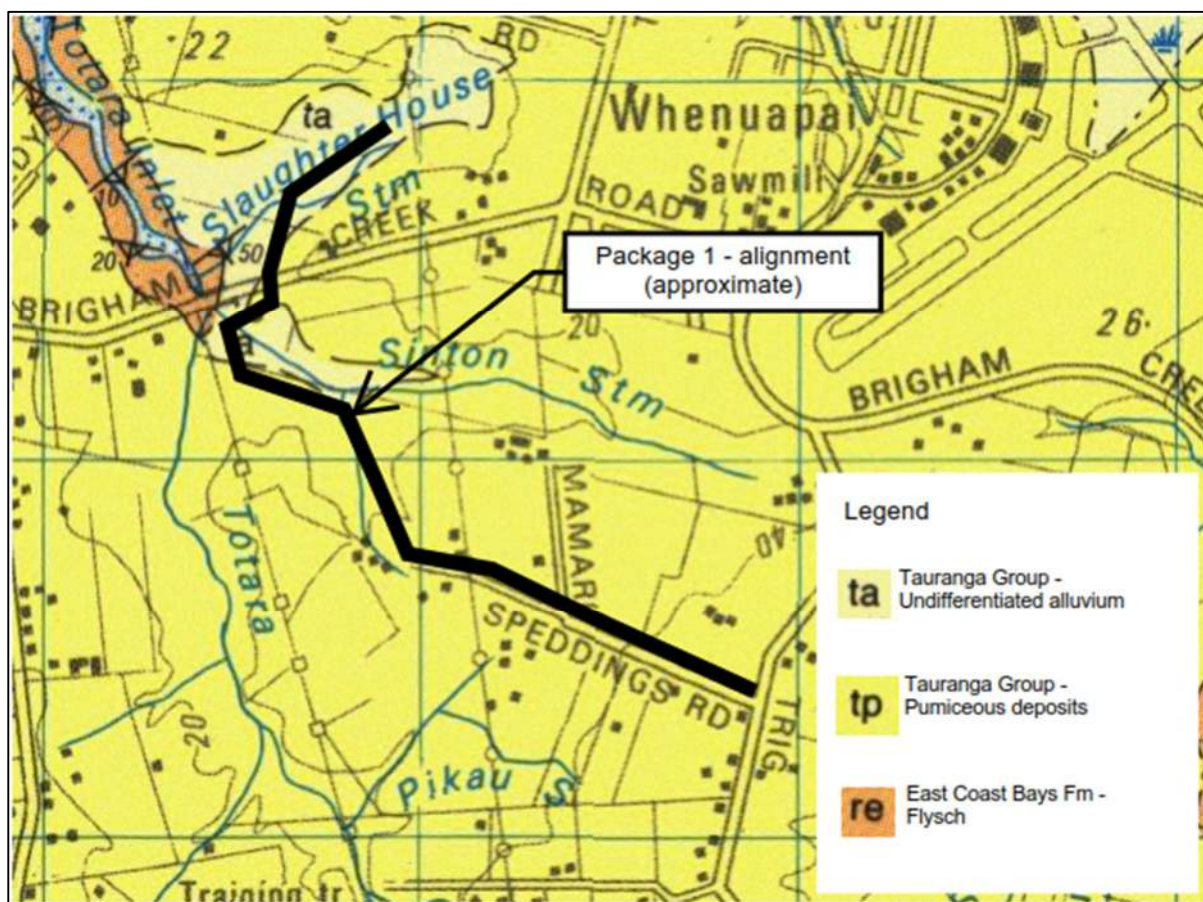


Figure 3-1: Published geology in relation to the project area

² Kermode, L.O. 1992. Geology of the Auckland Urban Area. 1:50,000. Institute of Geological & Nuclear Sciences.

4 Site investigations

The project-specific ground investigations undertaken by T+T in 2020 were prioritised in areas without existing ground investigation data. However, there is a portion of Spedding Road that has previously been investigated and for ease of reference, those previously completed investigations are included in this report.

4.1 Previously completed investigations

T+T have completed rotary cored machine boreholes and CPT's along Spedding Road as part of the North Waitakere Sewer project in 2009. Those investigations are summarised in Table 4.1 below and the investigation locations are shown on Figure 1 in Appendix A. The logs for the previously completed investigations are attached in Appendix B.

Table 4-1: Summary of previously completed investigations

Test Reference	Site	Location (NZTM)		Depth (m)
		Easting (m)	Northing (m)	
Machine Drilled Boreholes				
BH43	NORSGA Wastewater Project – (AGD5882)	1744395	5925634	5
BH44	NORSGA Wastewater Project – (AGD5882)	1744291	5925675	5
BH45	NORSGA Wastewater Project – (AGD5882)	1744196	5925716	5
BH46	NORSGA Wastewater Project – (AGD5882)	1744093	5925760	5
BH47	NORSGA Wastewater Project – (AGD5882)	1743995	5925801	5
BH48	NORSGA Wastewater Project – (AGD5882)	1743750	5925890	5
Cone Penetrometer Tests				
CPT36	NORSGA Wastewater Project – (AGD5882)	1743873	5925859	7.9
CPT43	NORSGA Wastewater Project – (AGD5882)	1744287	5925688	10.5

4.2 Project specific investigations

Ground investigations were carried out at the project site between 2 November 2020 and 8 December 2020, (Figure 1, Appendix A). The investigations comprised:

- Eleven (11) rotary cored machine boreholes;
- Fifteen (15) cone penetrometer tests (CPT's);
- Twenty-two (22) geotechnical hand augered boreholes with associated Scala Penetrometer testing;
- Four (4) environmental hand augered boreholes;
- Installation of nine (9) standpipe piezometers with level loggers for continuous monitoring of groundwater conditions.

The investigation locations were determined by the designer (GHD). The final position of each investigation location was chosen on a case-by-case basis by T+T, with consideration given to health and safety, access constraints, and the presence of nearby overhead and/or buried services.

The as-built position of each ground investigation was surveyed by Axis Consulting to a positional accuracy of 50 mm in the horizontal plane, and 5 mm in the vertical plane.

All geological materials recovered during the investigations were logged and photographed in accordance with the NZGS (2005) field description of soil and rock guidelines. The following sections describe and summarise the geotechnical investigations undertaken for this project.

4.2.1 Machine boreholes

The machine drilling of eleven (11) vertical boreholes was undertaken during the period between 2 and 23 November 2020. The works were carried out using a track-mounted machine borehole rig, supplied and operated by McMillan Drilling Limited under full time supervision from an engineering geologist or geotechnical engineer from T+T. Core was recovered during drilling using PQ sized triple tube rotary coring. Wash drilling was used in a single case for BH05B to quickly drill a hole to facilitate installation of a standpipe piezometer adjacent to BH05A.

The termination depth of each borehole was agreed with the designer (GHD) during drilling on site.

In situ Standard Penetration Testing (SPT) was carried out at regular (1.5 m) intervals for the length of each rotary cored machine borehole. Hand-held shear vane tests were undertaken on material contained within the end of the core barrel for the portion of the borehole within the soil profile. Corrected undrained shear strength values are presented on the borehole logs in kPa.

The boreholes were drilled at key locations along the Package 1 proposed alignment and the investigation locations are presented on Figure 1 in Appendix A. Summary borehole logs and core photographs are presented in Appendix C. Summary borehole details are presented in Table 4-2 below.

Table 4-2: Summary of the Machine Boreholes

BH ID	Location (NZTM)		Ground Surface Elevation (NZVD)	Depth (m bgl)
	Easting (m)	Northing (m)	RL (m)	
BH05A*	1743191.1	5926551.9	9.0	15.14
BH05B*	1743191.3	5926553.7	9.2	7.0
BH06*	1743208.2	5926435.0	12.6	15.12
BH07	1743224.8	5926205.3	21.8	6.0
BH08*	1743457.3	5926036.5	24.6	10.95
BH110*	1743051.9	5926611.7	9.6	15.11
BH111*	1743088.2	5926614.2	9.9	18.04
BH111A	1743090.2	5926614.2	9.9	2.5
BH113*	1743286.2	5926965.5	12.2	20.0
BH116*	1743342.7	5926934.4	13.6	18.23
BH117*	1743092.7	5926691.0	10.9	21.15

*denotes installation of a piezometer

Cone Penetration Tests

Fifteen (15) Cone Penetrometer Tests (CPT's) were completed by Ground Investigation Ltd between 2 and 18 November 2020. In all cases, the CPT's were advanced to 'refusal' which occurred when the

cone terminated on, or within a hard impenetrable strata (cone resistance >20 MPa) such as rock or dense sand.

The CPT locations are presented on Figure 1, Appendix A. CPT logs are appended in Appendix D. A summary of the CPT's is presented in Table 4-3 below.

Table 4-3: Summary of the CPT results

CPT ID	Location (NZTM)		Ground Surface Elevation (NZVD)	Termination depth (m)	Reason for termination
	Easting (m)	Northing (m)	RL (m)		
CPT02	1743191.6	5926559.0	9.5	10.57	High friction resistance
CPT03	1743186.3	5926510.5	10.2	11.23	Danger of buckling rods
CPT04	1743209.6	5926417.5	13.7	9.72	High friction resistance
CPT05	1743220.3	5926265.9	20.1	19.27	High friction resistance
CPT06	1743304.7	5926145.2	22.8	13.46	Inclination high or rapid increase
CPT07	1743414.9	5926065.7	20.8	16.06	Inclination high or rapid increase
CPT08	1744106.9	5925758.1	39.6	13.08	High pore water pressure
CPT111	1743068.8	5926625.3	9.3	5.02	High friction resistance
CPT112	1743076.8	5926598.1	9.6	5.73	High friction resistance
CPT117	1743357.6	5927037.2	13.7	18.0	High cone end resistance
CPT121	1743241.4	5926964.4	11.6	13.22	High total load
CPT126	1743234.1	5926918.1	11.8	17.54	Limit of reaction force
CPT128	1743077.2	5926742.2	10.8	16.05	High total load
CPT129	1743011.3	5926655.9	7.8	3.28	High friction resistance
CPT131	1743108.6	5926585.1	9.9	11.29	High friction resistance

4.2.3 Hand augered boreholes

4.2.3.1 Geotechnical hand augered boreholes

Twenty-two (22) hand augers were advanced for the purpose of geological logging and in-situ material testing. Each hand auger also included a Scala Penetrometer test at the end of the investigation to test material stiffness/density beneath the auger termination depth. The hand augers were completed by engineering geologists from T+T and Geotechnics Ltd between 25 November and 8 December 2020.

Each hand auger had a target depth of 5.0 m or refusal, whichever occurred first. A Scala Penetrometer Tests were then undertaken for a further 2 m or refusal. In-situ hand-held shear vane testing was completed at 300- or 500-mm intervals within each auger where cohesive soils were encountered, and the corrected undrained shear strength is shown on the logs in kPa.

The hand auger locations are presented on Figure 1 in Appendix A. Hand auger logs are attached to this report in Appendix E. Summary hand auger details are presented in Table 4-4 below.

Table 4-4: Hand Auger Summary

Hand auger ID	Location (NZTM)		Ground Surface Elevation (NZVD)	Hand auger depth (m bgl)	Scala Penetrometer depth (m bgl)	Reason for termination
	Easting (m)	Northing (m)	RL (m)			
HA03	1743214.3	5926343.5	19.4	5.2	6.4	Target depth
HA04	1743388.9	5926082.1	21.2	5.2	6.85	Target depth
HA05	1743549.7	5925977.7	27.2	5.2	7.2	Target depth
HA06	1743672.8	5925924.3	30.7	5.2	7.25	Target depth
HA07	1743823.0	5925859.5	32.9	5.0	5.5	Refusal
HA07A	1743968.7	5925813.7	35.6	5.0	5.8	Refusal
HA08	1744277.5	5925683.6	49.1	5.0	5.85	Refusal
HA08A	1744164.5	5925734.6	41.8	5.0	6.2	Target depth
HA107A	1743320.8	5926927.6	13.5	5.0	6.65	Target depth
HA107B	1743265.2	5926922.3	12.3	5.0	6.85	Target depth
HA108	1743173.5	5926898.6	11.5	5.0	6.7	Target depth
HA109	1743136.4	5926901.8	11.0	5.2	7.25	Target depth
HA110A	1743387.7	5926999.3	14.6	5.0	6.85	Target depth
HA110B	1743376.7	5926965.4	14.7	5.0	6.95	Target depth
HA111	1743395.9	5927039.3	14.4	3.5	6.45	Target depth
HA112	1743164.2	5926554.9	9.6	Not undertaken		Terminated (contamination)
HA113	1743032.1	5926630.2	7.9	2.6	2.6	Refusal
HA114	1743108.4	5926872.8	11.0	5.2	7.25	Target depth
HA115	1743054.0	5926794.2	9.9	5.0	6.0	Refusal
HA116	1743047.9	5926675.9	8.8	3.35	3.35	Refusal
HA117	1743138.4	5926564.4	10.0	5.0	6.3	Refusal
HA119	1743195.9	5926938.0	11.4	5.2	7.2	Target depth

4.2.3.2 Environmental hand augers

Four (4) hand augers were advanced for the purpose of environmental sampling and testing. The hand augers were completed by a contaminated land specialist from T+T between 4 and 10 November 2020. Each hand auger was completed to a target depth of 1.0 m, or 2.0 m. The hand augers were logged to NZGS 'Field Description of Soil and Rock' guidelines.

The hand auger locations are presented on Figure 1 in Appendix A. Hand auger logs are attached to this report in Appendix E. Summary hand auger details are presented in Table 4-5 below.

The results will be provided in a separate report.

Table 4-5: Environmental Hand Auger Summary

Hand auger ID	Location (NZTM)		Ground Surface Elevation (NZVD)	Hand auger depth (m)	Reason for termination
	Easting (m)	Northing (m)	RL (m)		
ENVR-HA03	1744024.4	5925787.0	36.7	1.0	Target depth
ENVR-HA04	1744104.7	5925759.8	39.5	1.0	Target depth
ENVR-HA05	1744151.8	5925739.9	41.0	1.0	Target depth
ENVR-HA101	1743340.3	5926989.6	12.8	2.0	Target depth

5 Hydrogeology

Groundwater levels have been measured on a 6-weekly cycle, and the final round of measurement is due in March 2021, at which point this report will be finalised and reissued.

5.1 Piezometer details

Groundwater piezometers were installed in nine (9) of the eleven (11) machine boreholes following the completion of drilling at each location. The screened interval depths for the 50 mm standpipe piezometers were selected based on instruction from the designer (GHD). Summary details of the piezometer installations are presented in Table 5-1 below. Installation records are present in the borehole logs attached in Appendix C.

5.2 In-situ permeability (slug) testing

5.2.1 Overview

This section presents the results of in-situ permeability (hydraulic conductivity) testing and analysis for the boreholes installed for the Whenuapai-Redhills wastewater Scheme. Slug testing was undertaken in a total of nine (9) boreholes between 17 November and 7 December 2020. Table 5-1 provides details of the boreholes used for slug testing.

Table 5-1: Boreholes used for slug testing details

Borehole	Screen length (m)	Screen depth (m bgl)	Bore diameter (mm)
BH05A	3	8.5 – 11.5	50
BH05B	2	3.5 – 5.5	50
BH06	1.5	3.5 – 5.0	50
BH08	3	3.0 – 6.0	50
BH110	3	8.0 – 11.0	50
BH111	2	3.0 – 5.0	50
BH113	2	2.0 – 4.0	50
BH116	3	2.0 – 5.0	50
BH117	2	2.0 – 4.0	50

5.2.2 Field methods

The methodology for permeability testing was undertaken in accordance with the Investigation Scope (specification) provided to T+T³. A slug with an approximate volume of 1.25 L (1 m length and 40 mm diameter), was used to complete the slug tests. Static water levels (SWL) were measured in each borehole prior to the tests (Table 5-2). The slug tests comprised:

- Falling head test, which commenced when the slug was fully submerged into the well to displace water; and
- Rising head test, which commenced immediately after the slug was removed from the well.

³ Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Ground Investigation Scope (Package 1) REVISION 2 October 2020.

In accordance with the Investigation Scope³, where the test response was less than one hour three sets of falling and rising head tests were carried out on each bore. Where the test duration was longer than one hour, the number of tests was reduced to one rising and one falling head test.

Changes in water level during the tests were recorded at 1 second intervals by Solinst brand level loggers (unvented pressure transducers), and manually every 5 minutes using a handheld dip-meter. The transducer data was corrected for the effect of atmospheric pressure changes, with barometer readings recorded at the BH111 location.

5.2.3 Field results

Groundwater levels in BH05A, BH110 and BH113 recovered within 30 minutes of the first falling head tests, therefore three sets of falling and rising head tests were conducted on these wells. For BH110 and BH113, all tests were completed in 30 minutes. The first falling and rising head test in BH05A lasted 30 minutes each, and the second two sets had a duration of only 20 minutes.

Groundwater level data collected by the level logger is recorded with respect to metres of hydraulic head above the level logger. These level logger data were converted to equivalent values with respect to metres below ground (m bgl) for the purpose of analysis. A comparison between manual dip data and corrected level logger data (at the same clock time) was compared for each borehole to check for consistency between methods. Figure 5-1 provides an example of this comparison using BH110 test data.

Figure 5-2 shows example groundwater level data recorded by the level logger (transducer) in BH05A. Table 5-2 shows the groundwater levels (m bgl) at start of each test, and the duration of each test.

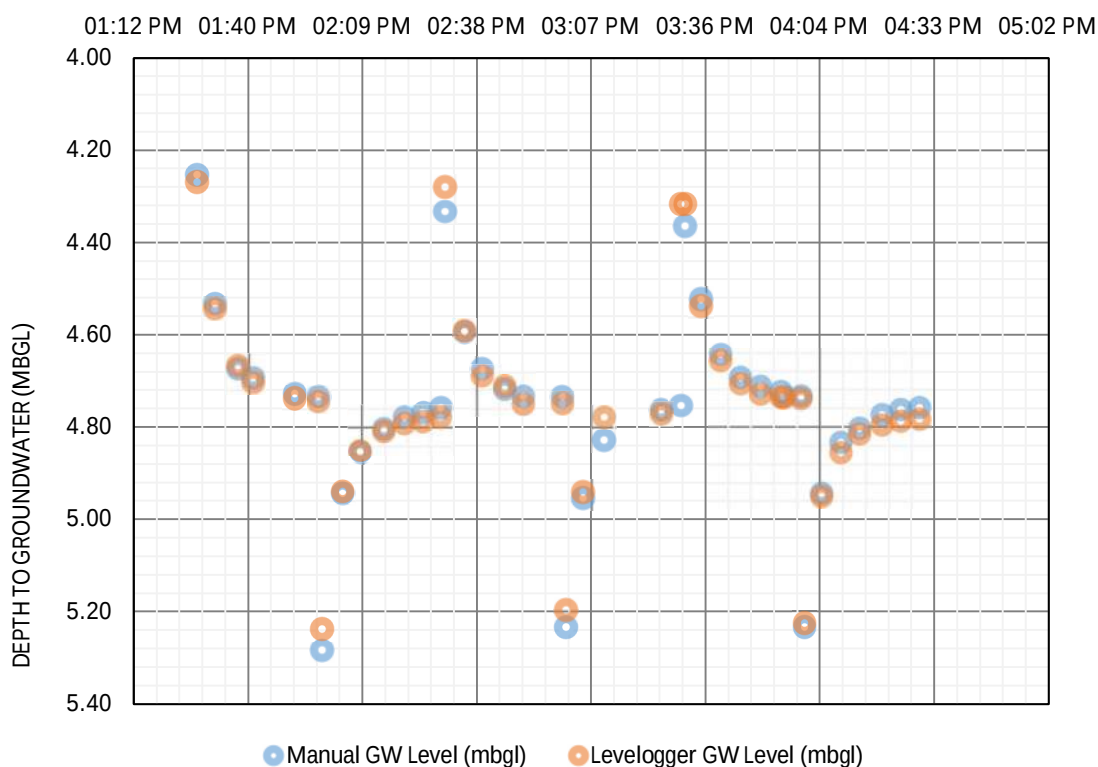


Figure 5-1: Comparison of manual dip data and level logger (transducer) data, for the falling and rising head tests in BH110.

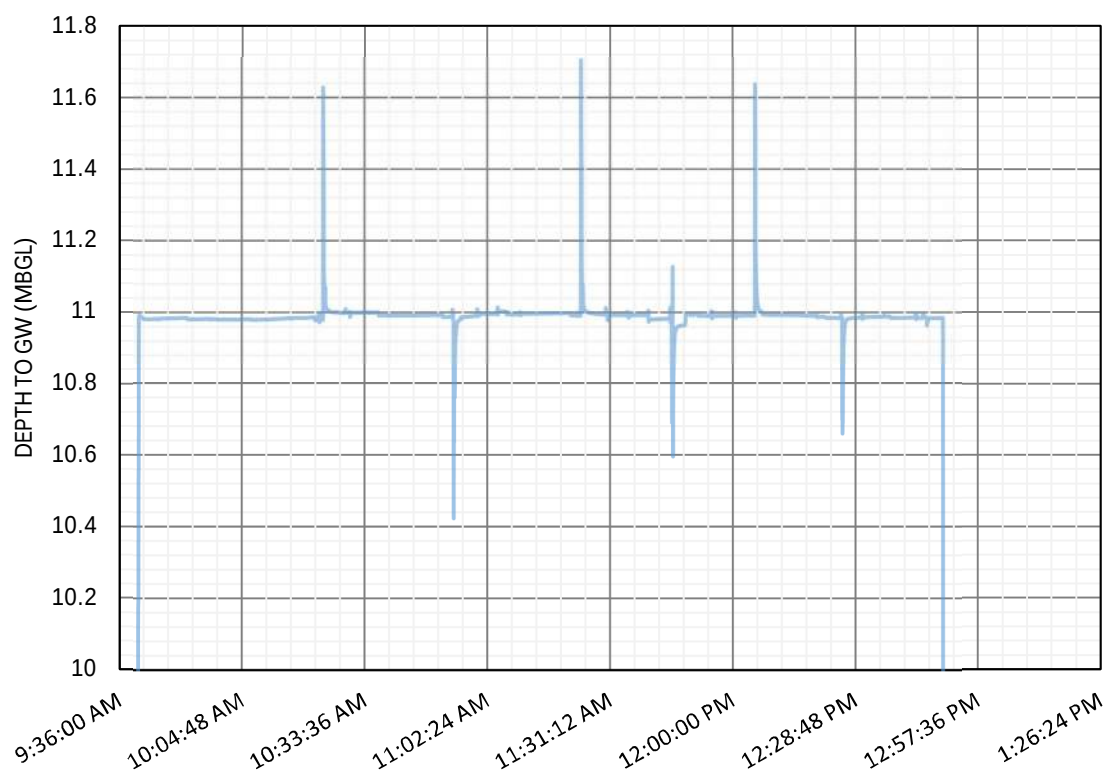


Figure 5-2: Example groundwater level data recorded by the level logger (transducer) in BH05A

Table 5-2: Groundwater level (m bgl) at start of each test, and duration of each test

Borehole	Slug test number	Groundwater level (m bgl) at start of falling head test	Groundwater level (m bgl) at start of rising head test	Duration of test (mins) ¹
BH05A	1	0.37	0.38	30 (30)
BH05A	2	0.38	0.36	15 (18)
BH05A	3	0.36	0.37	19 (21)
BH05B	1	2.25	3.00	60 (62)
BH06	1	2.44	2.47	60 (60)
BH08	1	1.21	1.16	60 (60)
BH110	1	4.75	4.75	31 (30)
BH110	2	4.75	4.78	30 (30)
BH110	3	4.78	4.77	30 (30)
BH111	1	1.94	1.87	60 (60)
BH113	1	1.89	1.86	31 (30)
BH113	2	1.86	1.92	30 (32)
BH113	3	1.92	1.86	30 (30)
BH116	1	0.76	0.65	60 (60)
BH117	1	2.25	2.28	60 (60)

¹ Value outside of brackets denotes falling head test duration, value inside brackets denotes rising head test duration

5.2.4 Analysis methods

To calculate the hydraulic conductivity of the screened lithology the rising and falling head tests were analysed using the Hvorslev, and Bouwer & Rice methods available in AquiferTest Pro⁴. This analysis was undertaken to validate the field data. The Designers are responsible for the calculation of the final permeability values.

Butler⁵ recommends matching the straight-line slug test solutions to the data within recommended normalised head ranges to provide a reliable data analysis. For the Hvorslev method this range is recommended to be from 0.15 to 0.25, and 0.20 to 0.30 for the Bouwer & Rice method.

The Hvorslev solution⁴ assumes the following:

- Unconfined or non-leaky confined aquifer of infinite extent;
- Homogeneous, isotropic aquifer of uniform thickness;
- Water table is horizontal prior to the test;
- Instantaneous injection/withdrawal of a volume of water results in an instantaneous change in water level;
- Inertia of water column and non-linear well losses are negligible;
- Fully penetrating well;
- The well is considered to be of an infinitesimal width;
- Flow is horizontal toward or away from the well;

And the Bouwer & Rice method⁴ assumes:

- Unconfined or leaky-confined aquifer (with vertical drainage from above) of infinite extent;
- Homogeneous, isotropic aquifer of uniform thickness;
- Water table is horizontal prior to the test;
- Instantaneous change in head at start of test;
- Inertia of water column and non-linear well losses are negligible
- Fully or partially penetrating well
- The well storage is not negligible
- The flow to the well is in a steady state
- There is no flow above the water table

5.2.5 Analysis results

The hydraulic conductivities results obtained from each rising and falling head is summarised in Table 5-4. The AquiferTest Pro⁴ report outputs are provided in Appendix F.

The average hydraulic conductivity values for each borehole are provided in Table 5-5. These include adopting the average value obtained from each field method (falling head and rising head) and each analysis method (Hvorslev, and Bouwer & Rice).

We note that the x-axis (time axis) of a selection of AquiferTest Pro⁴ output plots in Appendix F do not show the overall duration of the test, because these have been adjusted to illustrate the test results with respect to the recommended normalised head ranges (i.e. Hvorslev method: from 0.15

⁴ AquiferTest Pro: Version 9.0, build 9.0.0.5, Waterloo Hydrogeologic, Ontario, Canada

⁵ Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests, Lewis Publishers, New York, 252p

to 0.25, and Bouwer & Rice method: from 0.20 to 0.30). The duration of each slug test is shown in Table 5-2.

The slug test method is used to estimate permeability values for the geologic medium immediately outside the screened section of each borehole and the results are typically valid within an order of magnitude. A summary of the measured hydraulic conductivity for the lithology at each screened interval is provided in Table 5-3 below:

Table 5-3: Hydraulic Conductivity at each Piezometer Screen

Investigation ID	Screened depth (m bgl)	Hydraulic Conductivity (m/s)	Expected range for lithology
BH05A	8.5 – 11.5	2.2×10^{-5}	Yes
BH05B	3.5 – 5.5	8.2×10^{-8}	Yes
BH06	3.5 – 5.0	9.3×10^{-7}	Yes
BH08	3.0 – 6.0	1.7×10^{-7}	Yes
BH110	8.0 – 11.0	1.0×10^{-6}	Yes
BH111	3.0 – 5.0	5.1×10^{-7}	Yes
BH113	2.0 – 4.0	5.8×10^{-7}	Yes
BH116	2.0 – 5.0	8.7×10^{-8}	Yes
BH117	2.0 – 4.0	1.7×10^{-7}	Yes

As shown in Table 5-4, the hydraulic conductivity results are similar (within the same order of magnitude) when:

- Both the falling and rising head test results are compared.
- Both the Hvorslev, and Bouwer and Rice methods are compared.
- The falling head and rising head tests were repeated, due to the short duration of the test due to the rapid recovery of groundwater levels in the borehole.

Table 5-4: Hydraulic conductivities estimated using the Hvorslev and Bouwer & Rice methods in AquiferTest Pro⁴

Borehole	Geologic Formation	Screened lithology (m)	Hydraulic conductivities (m/s)		
			Test	Bouwer & Rice Method	Hvorslev Method
BH05A	Albany conglomerate	Weathered sandstone and conglomerate	Falling head 1	9.6E-06	6.4E-06
			Rising head 1	2.1E-05	2.6E-05
			Falling head 2	2.2E-05	2.3E-05
			Rising head 2	2.3E-05	2.0E-05
			Falling head 3	1.8E-05	1.6E-05
			Rising head 3	3.6E-05	4.2E-05
BH05B ¹	Tauranga group	Silt, sand (See note ¹)	Falling head	1.1E-07	1.3E-07
			Rising head	3.4E-08	5.3E-08
BH06	East coast bay Formation	Silt, sand	Falling head	8.4E-07	1.1E-06
			Rising head	7.7E-07	1.0E-06
BH08	Tauranga group	Silt	Falling head	2.0E-07	2.6E-07
			Rising head	9.5E-08	1.3E-07
BH110	East coast bay Formation	Unweathered siltstone and sandstone	Falling head 1	1.1E-06	1.3E-06
			Rising head 1	8.5E-07	8.6E-07
			Falling head 2	1.2E-06	1.4E-06
			Rising head 2	9.2E-07	1.1E-06
			Falling head 3	8.9E-07	9.9E-07
			Rising head 3	7.4E-07	7.6E-07
BH111	East coast bay Formation	Sand, moderately weathered siltstone sandstone	Falling head	4.0E-07	5.7E-07
			Rising head	4.9E-07	5.9E-07

Borehole	Geologic Formation	Screened lithology (m)	Hydraulic conductivities (m/s)		
			Test	Bouwer & Rice Method	Hvorslev Method
BH113	Tauranga group	Silt, and Sand	Falling head 1	7.1E-07	8.1E-07
			Rising head 1	5.2E-07	6.1E-07
			Falling head 2	5.7E-07	7.8E-07
			Rising head 2	5.1E-07	6.2E-07
			Falling head 3	5.7E-07	7.0E-07
			Rising head 3	3.2E-07	2.6E-07
BH116	Tauranga group	Silt, sand, clay	Falling head	1.0E-07	1.4E-07
			Rising head	4.4E-08	6.0E-08
BH117	Tauranga group	Silt	Falling head	2.2E-07	2.7E-07
			Rising head	9.0E-08	1.2E-07

- 1 Geological description based on BH05A log. BH05B log does not exist because it was completed using wash drilling method (no core available). BH05A and BH5B are positioned approximately 2 metres apart.

Table 5-5: Average hydraulic conductivity results

Borehole	Average hydraulic conductivity (m/s)	Average hydraulic conductivity (m/day)
BH05A	2.2E-05	1.9
BH05B	8.2E-08	7.1E-03
BH06	9.3E-07	8.1E-02
BH08	1.7E-07	1.5E-02
BH110	1.0E-06	8.7E-02
BH111	5.1E-07	4.4E-02
BH113	5.8E-07	5.0E-02
BH116	8.7E-08	7.5E-03
BH117	1.7E-07	1.5E-02

5.3 Groundwater level monitoring

Groundwater level monitoring commenced in nine (9) of the eleven (11) machine boreholes following the completion of drilling at each location. The screened interval depths for the 50 mm standpipe piezometers are presented in Table 5-1. Installation records are present in the borehole logs attached in Appendix C.

Continuous groundwater level monitoring was undertaken at 15-minute intervals and was completed using Solinst brand level loggers (unvented pressure transducers). These data were corrected for the effect of atmospheric pressure changes, with barometer readings recorded at the BH111 location. Manual groundwater level readings were collected using a handheld dip-meter during installation and retrieval of the level loggers.

Figure 5-13 shows the results of groundwater level monitoring during the monitoring period, presented as levels recorded m bgl. Figure 5-13 also shows the groundwater levels (m bgl) recorded relative to hourly rainfall data recorded at a nearby weather station⁶.

Figure 5-4 shows the results of groundwater level monitoring during the monitoring period, presented as levels with respect to m RL.

We note that the final round of measurement is due in March 2021, at which point this report will be updated and reissued.

⁶ Sourced from CliFlo, agent number 41351 MOTAT, located approx. 15 km southeast of the site <https://cliflo.niwa.co.nz/>

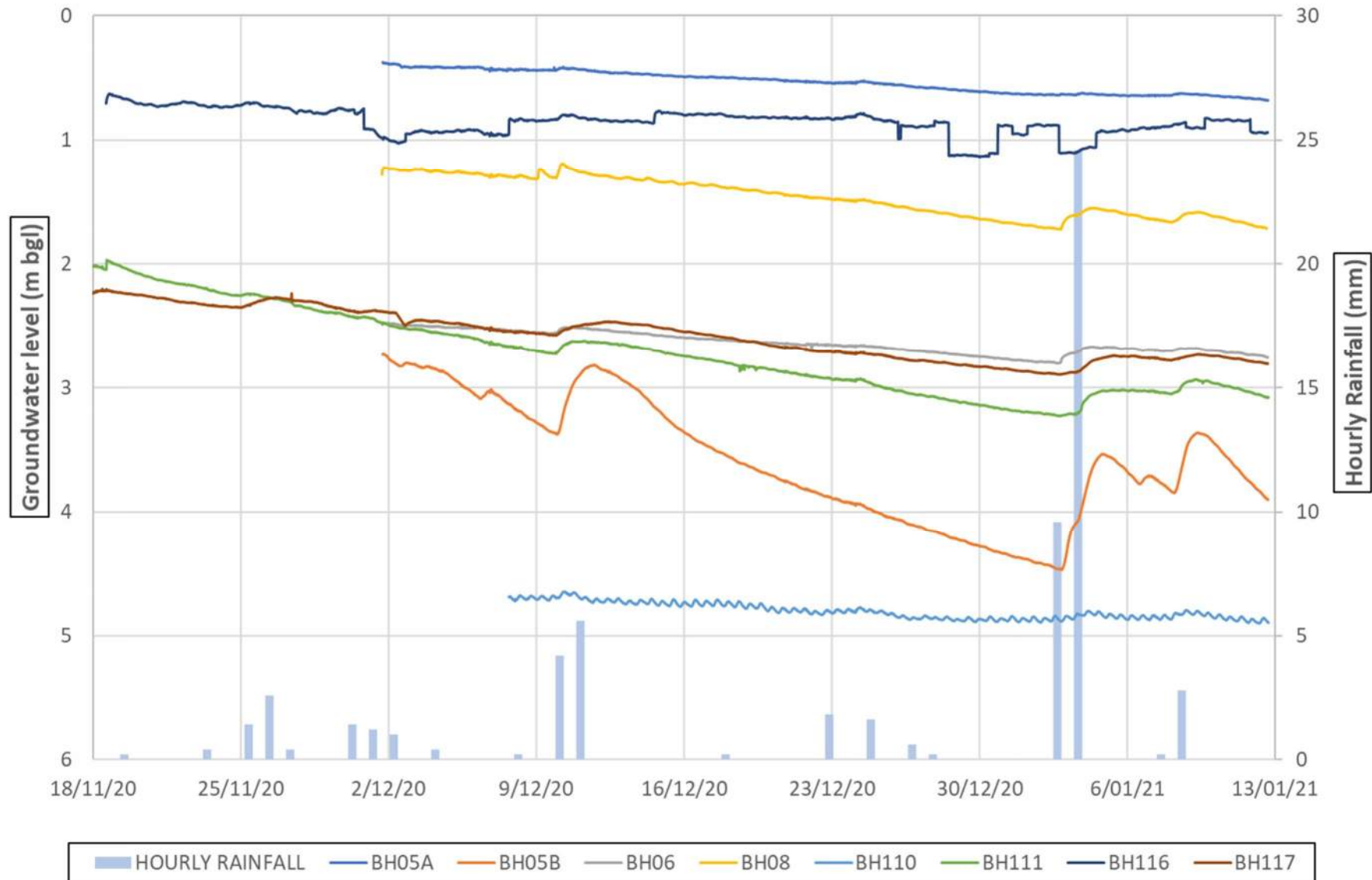


Figure 5-3: Continuous groundwater level monitoring results (m bgl), and rainfall (mm) recorded at the MOTAT gauging site located approx. 15 km southeast of the site.

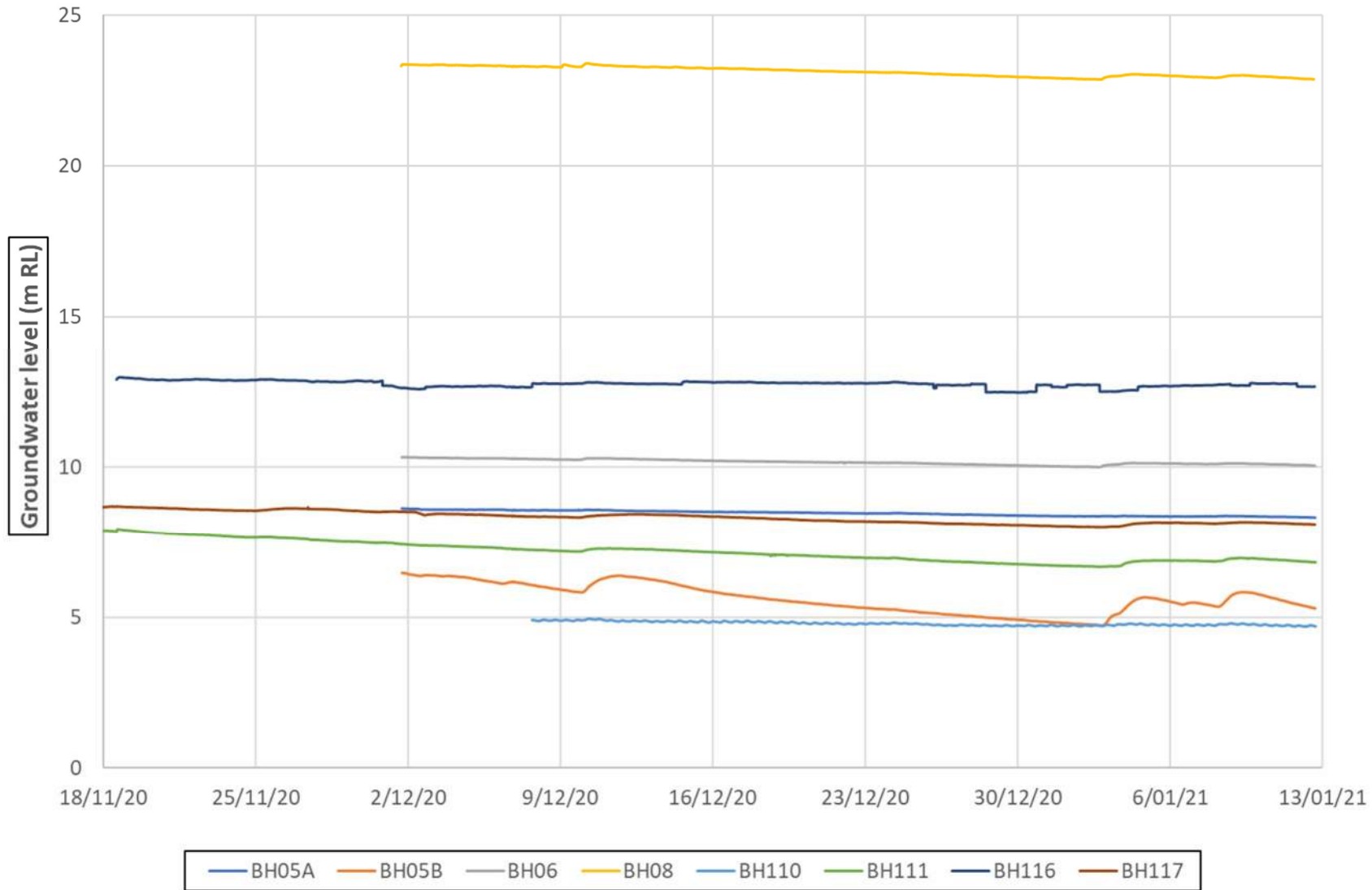


Figure 5-4: Continuous groundwater level monitoring results (m RL)

6 Laboratory Testing

6.1 Geotechnical testing

Samples collected during the borehole and hand auger investigations have been selected for a series of geotechnical laboratory tests. The samples and test schedules have been selected in consultation with the designer (GHD).

Soil samples (disturbed) recovered from the investigations have been collected from SPT samples from nine boreholes and from six hand augered boreholes. Rock core has been selected from five boreholes for unconfined compressive strength (UCS) testing.

All laboratory testing was undertaken by Geotechnics in their IANZ accredited laboratory located in Onehunga.

A summary of the geotechnical laboratory testing schedule is included in Table 6-1, and the results of all geotechnical laboratory tests are presented in Appendix G.

Table 6-1 Geotechnical laboratory testing summary

Investigation ID	Sample Depth (m)	Test Type						
		NMC NZS4402 Test 2.1	Atterberg Limits NZS4402 Test 2.2, 2.3, 2.4	PSD Sieve NZS4402 Test 2.8.1	PSD Hydro NZS4402 Test 2.8.4	UCS NZS4402 Test 6.3.1	1D Consol NZS4402 Test 7.1	Organic Matter NZS4402 Test 3.1.2
BH05A	3.5	X	X	X				
BH05A	6							X
BH05A	14.2					X		
BH06	1.5	X	X					
BH06	3			X				
BH06	5			X				
BH06	13.8					X		
BH07	2.5	X	X	X				
BH07	5.5	X	X	X				
BH08	1.5	X	X	X				
BH08	3	X	X	X				
BH08	6						X	
BH110	1.5	X	X		X			
BH110	3.5			X				
BH110	9.4					X		
BH111	1.5	X	X		X			
BH111	3			X				
BH111	7.3					X		
BH113	3			X				
BH113	4.5		X		X			
BH113	5.7		X	X				X
BH113	6.0						X	X

Investigation ID	Sample Depth (m)	Test Type						
		NMC NZS4402 Test 2.1	Atterberg Limits NZS4402 Test 2.2, 2.3, 2.4	PSD Sieve NZS4402 Test 2.8.1	PSD Hydro NZS4402 Test 2.8.4	UCS NZS4402 Test 6.3.1	1D Consol NZS4402 Test 7.1	Organic Matter NZS4402 Test 3.1.2
BH113	16.2					X		
BH116	1.5		X	X				
BH116	4.5						X	X
BH116	5		X	X				
BH116	17.5					X*		
BH117	1.5			X				
BH117	3		X	X				X
BH117	4.5						X	X
HA108	2.4	X	X	X				
HA109	2.5	X		X				
HA110A	3.4	X	X	X				X
HA114	3.5	X	X		X			
HA115	2.6	X	X	X				
HA119	1.5	X	X		X			

Note: * the UCS sample for BH116 at 17.5 m failed before the UCS test could be completed

7 Applicability Section

This report has been prepared for the exclusive use of our client Watercare Services Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:

.....
Chris Monk
Engineering Geologist

.....
Robert Hillier
Project Director

CBM
\\ttgroup.local\files\akl\projects\1014985\issueddocuments\1014985_whenuapai-redhills_gfr_20210127 final.docx

Appendix A: Site Location Plan



Appendix B: Previous Investigation Logs

PROJECT: NorthWaitakSewer-SI										LOCATION: Hobsonville-Westharbour-Whenuapai										JOB No: 26182.001																	
CO-ORDINATES 808378.1 mN 387015.8 mE										DRILL TYPE: Terrier										HOLE STARTED: 5/6/09																	
R.L. 52.00 m										DRILL METHOD: Percussion										HOLE FINISHED: 5/6/09																	
DATUM										DRILL FLUID:										DRILLED BY: JRSS																	
																				LOGGED BY: RBE																	
																				CHECKED: CJL																	
GEOLOGICAL										ENGINEERING DESCRIPTION																											
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.										FLUID LOSS WATER		CORE RECOVERY (%) METHOD		CASING		TESTS		SAMPLES R.L. (m)		DEPTH (m)		GRAPHIC LOG		CLASSIFICATION SYMBOL		MOISTURE / WEATHERING CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		COMPRESSION STRENGTH (MPa)		DEFECT SPACING (mm)		SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	
TOPSOIL																																SILT non plastic, organic stained, dark brown					
RESIDUAL SOILS										Hole dry on completion		100		100		• 143/66kPa in situ		51		1		ML		W		Vst								SILT slightly to non plastic, brown			
																																		-hard, rusty, cemented (pan) 0.55-0.6m			
																																		-weakly to non plastic, yellow brown			
																																		clayey SILT slightly plastic, yellow-brown			
100		100		• 183/138kPa in situ		50		2														-moderately plastic, light grey-white mottled yellow-brown															
																						-light grey-white with reddish brown mottles															
100		100		• 185/136kPa in situ		49		3														SILT some clay, slightly plastic, yellow-brown															
																						clayey SILT moderately plastic, yellow-brown, light grey from 2.6m															
																						-occasional reddish to yellowish brown mottles															
100		100		• 113/72kPa in situ		48		4														SILT some clay, slightly plastic, light grey with reddish brown mottles															
						47		5														END OF BOREHOLE 5m (target depth)															
						46		6																													
						45		7																													
						44		8																													
						43		9																													
						42		10																													



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH44

Hole Location: refer site plan

SHEET 1 OF 1

PROJECT: NorthWaitakSewer-SI				LOCATION: Hobsonville-Westharbour-Whenuapai				JOB No: 26182.001										
CO-ORDINATES 808417.6 mN 386910.9 mE				DRILL TYPE: Terrier				HOLE STARTED: 5/6/09										
R.L. 49.80 m				DRILL METHOD: Percussion				HOLE FINISHED: 5/6/09										
DATUM				DRILL FLUID:				LOGGED BY: RBE CHECKED: CJL										
GEOLOGICAL				ENGINEERING DESCRIPTION														
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL			100								ML	M	Vst					SILT non plastic, friable, brown
PUKETOKA FORMATION			100			● 88/41 kPa in situ		49	1		ML	W						SILT slightly to non plastic, greyish light brown
			100			● 141/75 kPa in situ		48	2		ML							clayey SILT moderately plastic, light brown with yellow-brown mottles -moderately plastic, greyish light brown with occasional yellow-brown mottles
			60			● 113/70 kPa in situ		47	3		ML							SILT some clay, slightly plastic, greyish light brown
			50			● 88/63 kPa in situ		46	4		ML		St					core lost
			50			● 94/78 kPa in situ		45	5		ML		St					SILT slightly to non plastic, light whitish grey
PUKETOKA FORMATION								44	6									core lost
								43	7									core lost
								42	8									core lost
								41	9									core lost
								40	10									core lost
																		hand augered to 5.8m 18/6/09: SILT some clay, trace fine sand, weakly to non plastic, light whitish grey
																		END OF BOREHOLE 5.8m (target depth)



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH45

Hole Location: refer site plan

SHEET 1 OF 1

PROJECT: NorthWaitakSewer-SI										LOCATION: Hobsonville-Westharbour-Whenuapai										JOB No: 26182.001																																																																																																																																																																																																																																																																																																		
CO-ORDINATES 808457.2 mN 386814.4 mE										DRILL TYPE: Terrier										HOLE STARTED: 5/6/09																																																																																																																																																																																																																																																																																																		
R.L. 43.60 m										DRILL METHOD: Percussion										HOLE FINISHED: 5/6/09																																																																																																																																																																																																																																																																																																		
DATUM										DRILL FLUID:										LOGGED BY: RBE										CHECKED: CJL																																																																																																																																																																																																																																																																																								
GEOLOGICAL										ENGINEERING DESCRIPTION																																																																																																																																																																																																																																																																																																												
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.										FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.																																																																																																																																																																																																																																																																																											
TOPSOIL																													SILT organic stained, dark brown																																																																																																																																																																																																																																																																																									
PUKETOKA FORMATION												100					43														SILT some fine sand, non plastic, weakly dilatant, light brown																																																																																																																																																																																																																																																																																							
																																							clayey SILT slightly to moderately plastic, light brown -light brown with grey mottles																																																																																																																																																																																																																																																																															
												100																														silty fine SAND non plastic, light brown																																																																																																																																																																																																																																																																												
																																												fine sandy SILT slightly to non plastic, light brown with vertical black rootlets																																																																																																																																																																																																																																																																										
												100																																		core lost 4-5m; fine sandy SILT weakly to moderately plastic, brown , adhering to barrel																																																																																																																																																																																																																																																																								



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH46

Hole Location: refer site plan

SHEET 1 OF 1

PROJECT: NorthWaitakSewer-SI				LOCATION: Hobsonville-Westharbour-Whenuapai				JOB No: 26182.001													
CO-ORDINATES 808498.7 mN 386710.8 mE				DRILL TYPE: Terrier				HOLE STARTED: 5/6/09													
R.L. 39.50 m				DRILL METHOD: Percussion				HOLE FINISHED: 5/6/09													
DATUM				DRILL FLUID:				LOGGED BY: RBE													
								CHECKED: CJL													
GEOLOGICAL				ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.				FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (kPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL												39		ML	W	VSt					SILT non plastic, organic stained, dark brown
PUKETOKA FORMATION	water level on completion	100						● 117/22kPa in situ			39		ML								SILT some fine sand, non plastic, light brown
		100					● 107/60kPa in situ			38		ML	Sat							clayey SILT light greyish white moderately plastic, with vertical bands of dark brown silt (fissure filling) -moderately plastic, light greyish white	
		100					● 88/47kPa in situ			37				St						-light greyish white mottled dark brown -moderately plastic, dark brown -light brown mottled dark brown -light brown	
		100					● 107/33kPa in situ			36		ML		VSt						clayey SILT sandy, slightly plastic, light brown	
		80					● 111/55kPa in situ			35		ML								fine sandy SILT non plastic, light brown with vertical black rootlets	
											34		SM							silty fine SAND light grey with occasional rootlets	
END OF BOREHOLE 5m (target depth)																					
											33										
											32										
											31										
											30										
											29										
											28										
											27										
											26										
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											12										
											11										
											10										



TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH47

Hole Location: refer site plan

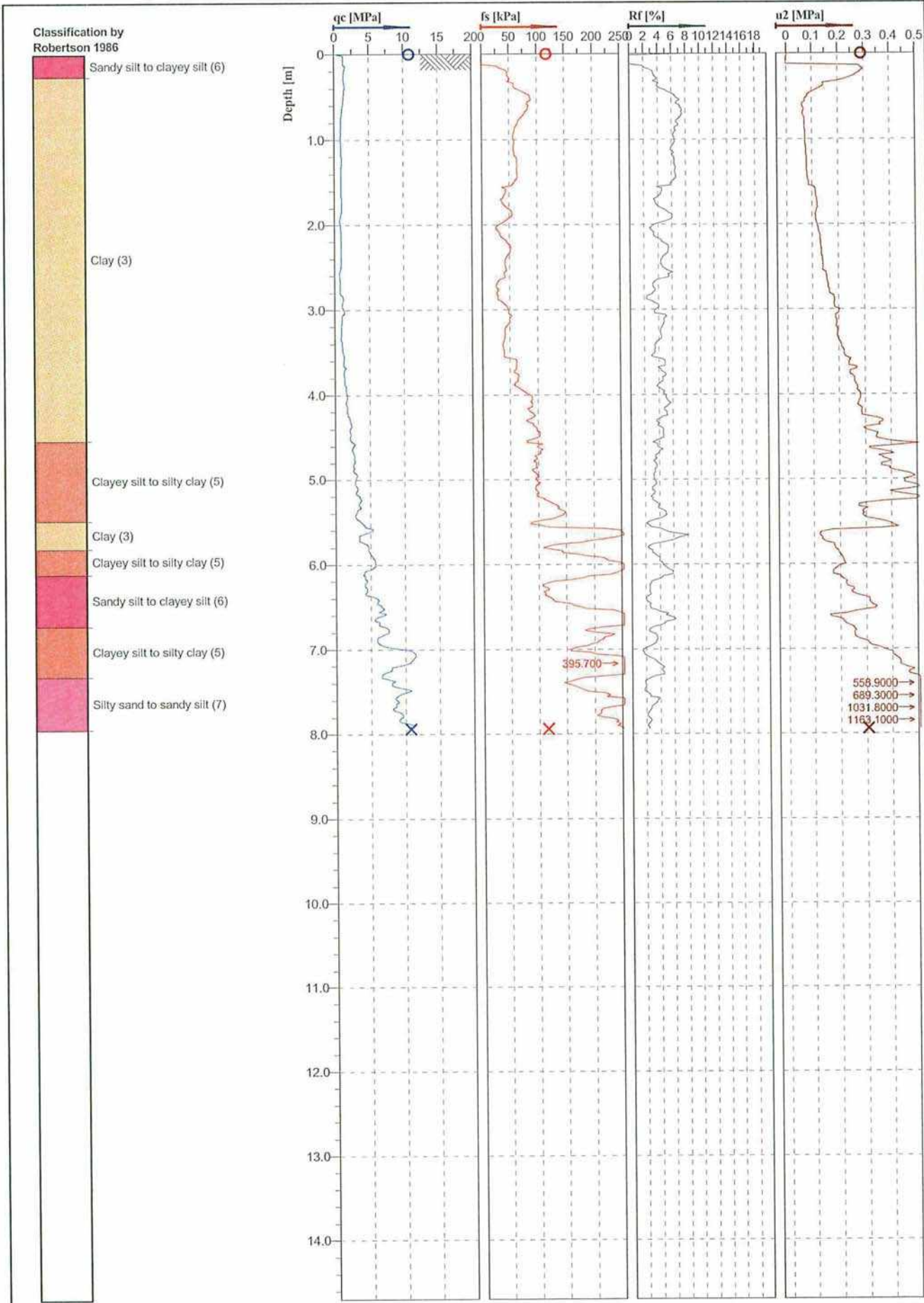
SHEET 1 OF 1

PROJECT: NorthWaitakSewer-SI				LOCATION: Hobsonville-Westharbour-Whenuapai				JOB No: 26182.001													
CO-ORDINATES 808537.9 mN 386612. mE				DRILL TYPE: Terrier				HOLE STARTED: 5/6/09													
R.L. 36.10 m				DRILL METHOD: Percussion				HOLE FINISHED: 5/6/09													
DATUM				DRILL FLUID:				LOGGED BY: RBE CHECKED: CJL													
GEOLOGICAL				ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.				FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (kPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL											36		ML	W/Sat	St						SILT organic stained, dark brown
PUKETOKA FORMATION	water level on completion	80						● 83/31kPa in situ		35	1	ML	Sat								fine sandy SILT non plastic, greyish brown
		90						● 86/31kPa in situ		34	2	ML									SILT non plastic, brown clayey SILT moderately plastic, brownish light grey
		75						● 91/36kPa in situ		33	3	ML									SILT some clay, slightly plastic, light grey
		50						● 122/41kPa in situ		32	4	ML									fine sandy SILT non plastic, brownish light grey, occasional black rootlets
		50						● 188/78kPa in situ		31	5										-becoming grey no core (displaced)
																					fine sandy SILT weakly to non plastic, grey
																					no core (displaced)
																					END OF BOREHOLE 5m (target depth)
											31										
											30	6									
											29	7									
											28	8									
											27	9									
											26	10									

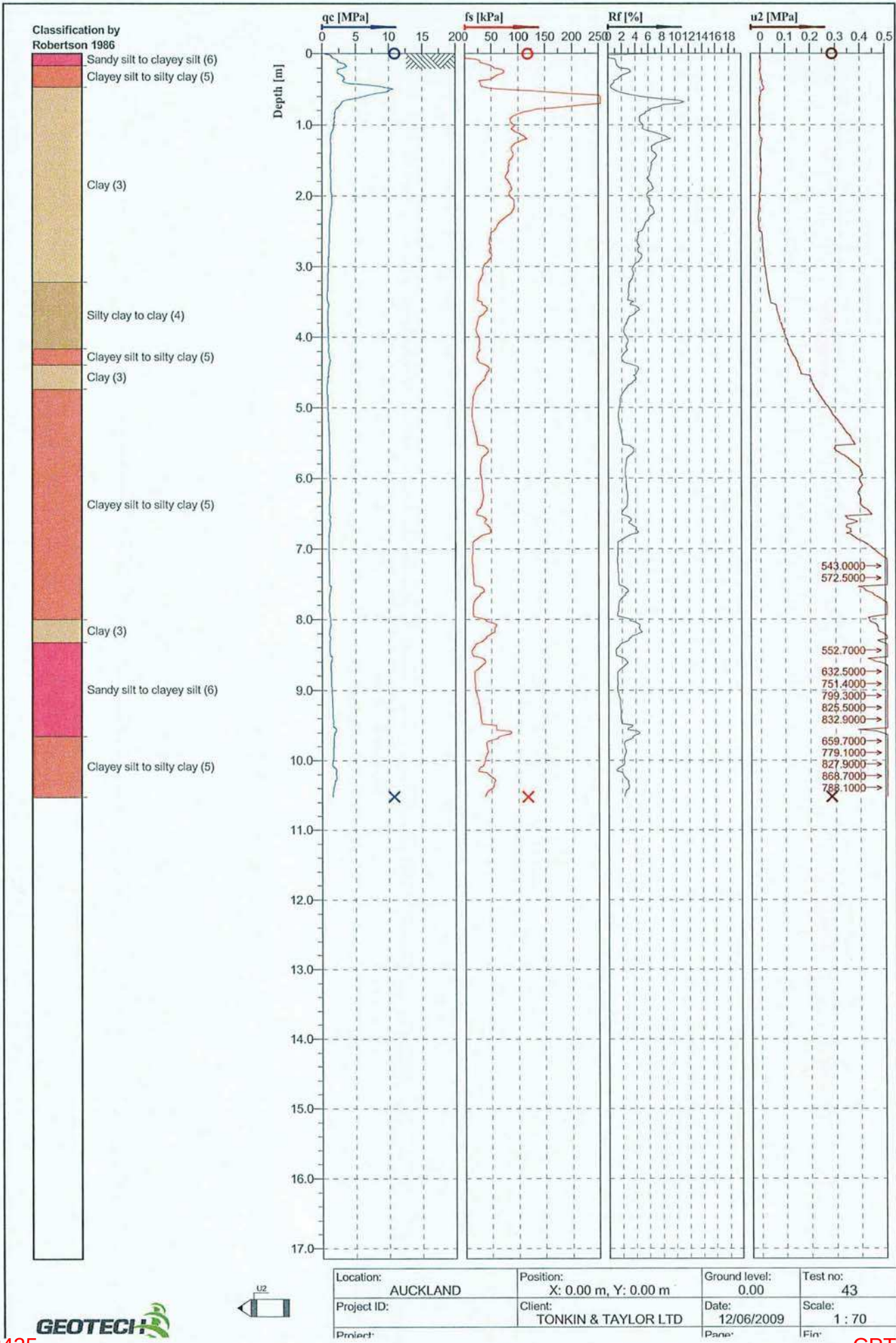
BOREHOLE LOG

SHEET 1 OF 1

[illegible]



Location:	AUCKLAND	Position:	X: 0.00 m, Y: 0.00 m	Ground level:	0.00	Test no:	36
Project ID:		Client:	TONKIN & TAYLOR LTD	Date:	12/06/2009	Scale:	1 : 60
Project:		Panel:		File:			



Appendix C: Machine Borehole Logs

BOREHOLE LOG

BOREHOLE No.:
BH05A

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT		DESCRIPTION OF CORE		Rock Weathering	Rock Strength	SAMPLING METHOD		Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
		SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation				Core Recovery (%)						Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Top		Sandy gravelly SILT, trace organics; brown & grey. Firm, moist, low plasticity; sand, fine to coarse, Quartz, gravel, fine to coarse, subangular, unweathered, Basalt & Concrete; organics, rootlets.				PQTT	46	1 @ 0.10m 1 x Glass Jar 1x plastic Jar			TS									
		Silty CLAY, minor sand, trace organics; light brown mottled orange and dark brown, speckled black, homogeneous. Stiff, moist, high plasticity; sand, fine; organics, rootlets.						7 @ 0.35m 1 x plastic Jar (Corrosivit y)		0.5					0.35m: PID - 1.3ppm					
		0.35 - 0.75m: CORE LOSS																		
		Silty CLAY, minor sand, trace organics; light brown mottled orange & dark brown, speckled black, homogeneous. Stiff, moist, high plasticity; sand, fine; organics, rootlets.						0/- kPa							0.75m: Shear Vane failed					
		Sandy SILT, some clay; light brown mottled orange & dark brown speckled white and black, homogeneous. Stiff, moist, high plasticity; sand, fine.				SPT	86	2 @ 1.00m 1 x Glass Jar 1x plastic Jar		1.0										
		Silty CLAY, minor sand, trace organics; light brown mottled orange & dark brown speckled black & white, homogeneous. Stiff, moist; sand, fine; organics, rootlets.						93/44 kPa		1.5										
		Sandy SILT, trace organics; brown spotted black, homogeneous. Stiff, moist, low plasticity; sand, fine; organics, rootlets.				PQTT	124	0/1 1/0 1/1 N=3												
		SILT, some sand, minor clay, trace organics; light brown mottled orange, homogeneous. Stiff, moist, low plasticity; sand, fine; organics, rootlets.						3 @ 2.00m 1 x Glass Jar 1x plastic Jar 1 x Split 1 x Duplicate		2.0					2.00m: PID - 0.4ppm					
		SILT, minor clay, trace organics; light green - grey, speckled black. Firm to stiff, moist, low plasticity; organics, fibrous.																		
		2.00 - 2.17m: Grey-brown mottled brown, speckled black				SPT	100			2.5										
		SILT, trace clay; grey-brown mottled brown, speckled black. Firm to stiff, moist, low plasticity.						8 @ 2.90m 1 x plastic Jar (Corrosivit y)		3.0										
		3.0 - 3.5 m: Push Tube				PQTT	0	4 @ 3.00m 1 x Glass Jar 1x plastic Jar 9 @ 3.00m												
		SILT, trace clay; grey-brown mottled brown, speckled black. Firm, moist, low plasticity.				PT	173	28/9 kPa 0/0 0/1 1/1 N=3		3.5										
		SILT, trace organics; brown speckled black. Firm, moist, low plasticity; organics, fibrous.																		
		SILT, minor sand, trace organics and clay; light green, speckled black. Firm, moist, medium plasticity; sand, fine; organics, fibrous.				PQTT	100	5 @ 4.00m 1 x Glass Jar 1x plastic Jar		4.0										
		4.03m: Light brown mottled brown, speckled black																		
		Sandy SILT, trace organics; light brown mottled brown, speckled black. Stiff, moist, low plasticity; sand, fine; organics, fibrous.						19/4 kPa Core disturbed by drilling		4.5										
		Silty SAND; green speckled black, homogeneous. Medium dense, moist, poorly graded; sand, fine.				SPT	100	2/3 3/3 3/4 N=13												
		SAND, minor silt; light brown speckled black. Medium dense, moist, poorly graded; sand, fine.																		

Box 1, 0.0-3.0m

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Box 1, 0.0-3.0m

BOREHOLE LOG

BOREHOLE No.:

BH05A

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	4.95 - 5.35 m: CORE LOSS					6 @ 5.00m 1 x Glass Jar 1x plastic Jar												
	Organic clayey SILT, trace rootlets; dark brown speckled black. Stiff, moist, high plasticity. Organics; amorphous			PQTT	61			5.5										
	6.25 - 6.45 m: CORE LOSS			SPT	55	0/- kPa 1/0 0/1 N=2		6.0					6.00m: Shear Vane failed					
	PEAT (AMORPHOUS), minor sand; dark brown, homogeneous. Firm to stiff, moist; sand, fine.							6.5										
	Organic SILT; dark brown speckled black. Stiff, moist, low plasticity. Organics; amorphous			PQTT	100			7.0										
Albany Conglomerate	PEAT (AMORPHOUS), minor sand; dark brown. Firm to stiff, moist; sand, fine.							7.5										
	7.50m: Very stiff			SPT	106	116/29 kPa 0/1 2/2 3/4 N=11		8.0										
	8.2 - 9.0 m: CORE LOSS			PQTT	23			8.5										
	9.0 - 9.45 m: Solid Cone SPT			SPT	0	UTP 3/3 5/5 5/6 N=21 Solid		9.0					9.00 - 10.50m: Re-drilled due to core loss					
	Completely weathered, brown-grey, massive, SANDSTONE. Extremely Weak, (Recovered as SAND, minor gravel; brown-grey. Medium dense, moist, poorly graded; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered, Sandstone & Siltstone).							9.5										

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH05A

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)							
Albany Conglomerate	10.05 - 10.5 m: CORE LOSS				PQTT	57														
	Highly weathered, brown and dark grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Gravelly SAND; brown & dark grey. Medium dense, moist; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered).				SPT	93	UTP 4/4 5/5 7/7 N=24		10.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as GRAVEL; grey. Moist; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone).				PQTT	76			11.0											
	Moderately weathered, grey, SANDSTONE. Extremely Weak, Weakly cemented. SAND; grey. Very dense, moist, poorly graded; sand, fine.				PQTT	76			11.5				0							
	11.75 - 12.0 m: CORE LOSS													11.80m: J, 60° dip, VN, CN 11.84m: J, 65° dip, CN						
	12.0 - 12.25 m: Solid cone SPT				SPT	100	UTP 5/21 27/23 N>=50		12.0											
	Highly weathered, brown & grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Sandy GRAVEL; brown & grey. Medium dense, moist, poorly graded; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & siltstone; sand, fine to coarse).				PQTT	56			12.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (recovered as GRAVEL; grey. Gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone)				PQTT	56			13.0				0							
	Moderately weathered, grey, SANDSTONE. Extremely Weak, very weakly cemented. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).								13.5											
	13.5 - 13.64 m: Solid Cone SPT				SPT	0	15/35 for 65mm N>=50 Solid		13.5											
	Unweathered, grey, SANDSTONE. Extremely Weak, Widely spaced fractures. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).				PQTT	129			14.0				63							
	13.96 - 13.98m: Slightly weathered, grey, SILTSTONE. Extremely Weak. SILT; grey. Hard, moist, low plasticity.								14.5											

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926551.90 mN (NZTM2000) 1743191.10 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.: 9.00m		DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-6.75m

CORE PHOTOS

BOREHOLE No.: **BH05A**

SHEET: 2 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926551.90 mN (NZTM2000) 1743191.10 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.:	9.00m	DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



6.75-10.50m



10.50-13.20m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926551.90 mN 1743191.10 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.:	9.00m	DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



13.20-15.14m

BOREHOLE LOG

BOREHOLE No.:
BH05B

SHEET: 1 OF 2

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 18/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926553.70 mN
(NZTM2000) 1743191.30 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100	UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100															
	Wash drilled to 7.0 m BGL. See BH05A for geology details																	

COMMENTS: 50 mm standpipe piezometer with screened interval from 3.5 - 5.5 m.

Hole Depth
7m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	Organic SILT; brown. Hard, moist, non-plastic.																	
	0.30 - 0.40m: Very stiff; [Recovered from next run].			PQTT	40	● UTP												
Tauranga Group	SILT, trace sand; light brown mottled orangish brown. Stiff, moist, low plasticity; sand, fine.							0.5					0.50m: PID - 0.1 ppm					
	0.6 - 0.75 m: CORE LOSS																	
	SILT, trace sand; light grey mottled orangish brown. Stiff, moist, low plasticity; sand, fine.			PQTT	140			1.0					1.00m: PID - 0.0 ppm					
	Clayey SILT, trace sand; light grey mottled orangish brown. Firm, moist, high plasticity; sand, fine.																	
	SILT, some clay, trace organics; light grey. Firm, moist, medium plasticity; organics, rootlets.			SPT	100	● 36/5 kPa 0/0 0/1 1/1 N=3		1.5										
	Sandy SILT, trace organics; light grey mottled orangish brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.																	
East Coast Bays Formation	SILT, some clay and sand; grey. Stiff, moist, medium plasticity; sand, fine.			PQTT	100			2.0										
	SAND; grey. Loose, moist; sand, fine.																	
				SPT	100	● 34/8 kPa 1/0 1/1 1/1 N=4		3.0										
	3.45 - 3.55 m: CORE LOSS																	
	SILT; grey. Stiff, moist, low plasticity.							3.5										
	Clayey SILT; grey. Stiff, moist, high plasticity.																	
	Sandy SILT; grey. Stiff, moist; sand, fine.			PQTT	90			4.0										
	Silty SAND; grey. Loose, moist; sand, fine.																	
				SPT	100	● 0/- kPa crumble soils 1/1 1/2 1/2 N=6		4.5										

COMMENTS: Piezometer installed with screened interval from 3.5 - 5.0 m

Hole Depth
15.12m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
East Coast Bays Formation	[Cont.] Silty SAND; grey. Loose, moist; sand, fine.																	
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as SILT, trace sand; grey. Very Stiff, moist; sand, fine.).			PQTT	100			5.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Sandy SILT; grey. Very Stiff, moist, non-plastic; sand, fine).																	
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Loose, moist; sand, fine).			SPT	100	0/- kPa crumble soils 1/2 1/3 2/3 N=9		6.0										
	6.45 - 6.6 m: CORE LOSE							6.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Sandy SILT; grey. Hard, moist, non-plastic; sand, fine).			PQTT	85			7.0										
	6.90 - 6.95m: Silty SAND; grey. Loosely packed, moist; sand, fine. 6.95 - 7.17m: Very stiff.																	
	7.17 - 7.25m: Very stiff; carbonaceous.																	
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).			SPT	100	0/- kPa crumble soils 2/2 2/3 3/3 N=11		7.5										
	7.40 - 7.50m: Sandy SILT; light grey. Very stiff, moist, non-plastic; sand, fine. 7.50 - 7.95m: Sand, coarse.																	
	7.95 - 8.1 m: CORE LOSS							8.0										
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).			PQTT	85			8.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Clayey SILT, minor sand; grey. Hard, moist, high plasticity; sand, fine).																	
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).																	
	9.00 - 9.20m: Sand, coarse.			SPT	100	0/- kPa crumble soils 2/3 4/5 6/7 N=22		9.0										
	Moderately weathered, grey, SILTSTONE. Extremely Weak. (Recovered as SILT, trace sand; grey. Hard, moist; sand, fine).							9.5										
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine).																	
	9.54 - 9.57m: Highly weathered, grey, SILTSTONE. Extremely Weak, (SILT; grey. Hard, moist, low plasticity).																	

COMMENTS: Piezometer installed with screened interval from 3.5 - 5.0 m

Hole Depth
15.12m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	[Cont.] Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine).				PQTT	100	● UTP 9/15 20/26 4 for 10mm N>=50						81						Box 4, 8.6-11.5m
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Dense, moist; sand, medium). - INTERBEDDED WITH - Moderately weathered, grey, SILTSTONE. Extremely Weak.				SPT	100			10.5				0						
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Dense, moist; sand, medium).								11.0										
	10.81 - 11.1 m: CORE LOSS																		
	Unweathered, medium grained, SANDSTONE. Very Weak, very weakly cemented. 11.21 - 11.25m: Moderately weathered, SILTSTONE. Extremely Weak.				PQTT	75						75							
	11.50 - 11.57m: Unweathered, grey, SILTSTONE. Very Weak.																		
	Unweathered, grey, medium grained, SANDSTONE. Very Weak. 11.78 - 11.84m: Unweathered, grey, SILTSTONE. Very Weak, Carbonaceous. 11.84 - 12.00m: Unweathered, grey, medium grained, SANDSTONE. Very Weak.																		
	12 - 12.12 m: SOLID SPT				SPT	0	■ 25/25 for 45mm N>=50 Solid		12.0				0						
	12.12 - 12.6 m: CORE LOSS																		
	Unweathered, grey, medium grained, SANDSTONE. Very Weak. 13.18 - 13.26m: Unweathered, grey, SILTSTONE. Very Weak.				PQTT	65							28						
13.5 13.65 m: SOLID SPT				SPT	0	■ 16/34 for 55mm N>=50 Solid		13.5				0							
13.63 - 13.8 m: CORE LOSS																			
Unweathered, grey, medium grained, SANDSTONE. Very Weak. 13.80 - 13.84m: Unweathered, grey, SILTSTONE. Very Weak.																			
14.40 - 14.90m: medium to coarse grained SANDSTONE				PQTT	87							73							
14.90 - 15.00m: Unweathered, grey, medium to coarse grained, SANDSTONE. Extremely Weak, Weakly cemented.																			

COMMENTS: Piezometer installed with screened interval from 3.5 - 5.0 m

Hole Depth
15.12m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH06**

SHEET: 1 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000) 1743208.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	12.60m	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-2.70m



2.70-5.55m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000) 1743208.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	12.60m	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



5.55-8.60m



8.60-11.48m

CORE PHOTOS

BOREHOLE No.: **BH06**

SHEET: 3 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000) 1743208.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	12.60m	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



11.48-14.26m



14.26-15.12m

BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 1 OF 2

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 20/11/2020

FINISH DATE: 20/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926205.30 mN
(NZTM2000) 1743224.80 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 21.80m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	Organic SILT; brown. Stiff, moist, low plasticity; organics, amorphous and rootlets. 0.35 - 0.50m: Light brown mottled orangish brown.			PQTT	100			0.5										
Tauranga Group	Clayey SILT; light grey mottled orangish brownm. Very stiff, moist, high plasticity.			PQTT	100	● 168/67 kPa	21	1.0					0.50m: PID - 0.1 ppm 1.00m: PID - 0.0 ppm					
	1.95 - 2.40m: Stiff.			SPT	66	1/1 1/1 1/2 N=5	20	1.5										
	2.40 - 3.00m: Firm to stiff.			PQTT	100		19	2.0										
	3.0 - 3.5 m: PUSH TUBE			PT	100	● 58/11 kPa Push tube @ 3.00m	18	3.0										
East Coast Bays Formation	Clayey SILT; organish brown. Firm, moist, medium plasticity.			SPT	100	1/0 1/0 1/1 N=3	18	3.5										
	Sandy SILT; grey. Firm, moist, non-plastic; sand, fine.			PQTT	100		17	4.0										
	Clayey SILT; grey. Firm, moist, high plasticity.			PQTT	100	● 40/9 kPa	17	4.5										
	Sandy SILT; grey. Firm, moist, low plasticity; sand, fine.			SPT	100	1/0 1/1 1/1 N=4	17	4.5										

COMMENTS:

Hole Depth
6m

Scale 1:25

Box 1, 0.0-2.6m

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH07

SHEET: 2 OF 2

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 20/11/2020

FINISH DATE: 20/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926205.30 mN
(NZTM2000) 1743224.80 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 21.80m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	[Cont.] Sandy SILT; grey. Firm, moist, low plasticity; sand, fine.																	
	SILT, some clay, minor sand; grey. Stiff, moist, low plasticity; sand, fine.			PQTT	100			5.5										
	6m: END OF INVESTIGATION					● 93/17 kPa		6.0										Box 2, 2.6-5.0m

COMMENTS:

Hole Depth
6m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH07**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926205.30 mN (NZTM2000) 1743224.80 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 20/11/2020
R.L.: 21.80m	DRILL METHOD: RC	HOLE FINISHED: 20/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling
		LOGGED BY: YCWA
		CHECKED: CBM



0.00-2.55m



2.55-6.00m

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 1 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Fill	Sandy SILT, trace organics; brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.				PQTT	100	3 @ 0.10m 1 x Glass Jar 1 x Plastic Jar		0.5										
	Silty sandy CLAY, trace organics; brown, orange & light grey mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, rootlets.				PQTT	100	1 @ 0.25m 1 x Plastic Jar Corrosivity												
	Sandy SILT; brown mottled orange. Stiff, moist, low plasticity; sand, fine.				PQTT	100	4 @ 0.50m 1 x Glass Jar 1 x Plastic Jar												
Tauranga Group	Clayey sandy SILT; brown & orange mottled orange. Stiff, moist, medium plasticity; sand, fine.				PQTT	100	5 @ 1.00m 1 x Glass Jar 1 x Plastic Jar		1.0										
	Silty CLAY, trace organics; light grey-grey mottled orange & brown. Stiff, moist, high plasticity; organics, rootlets.				PQTT	100	81/41 kPa 1/1 1/1 1/2 N=5		1.5										
	1.95 - 2.05 m: CORE LOSS				PQTT	90	6 @ 2.00m 1 x Glass Jar 1 x Plastic Jar		2.0										
	Clayey sandy SILT, trace organics; grey mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, fibrous.				PQTT	90	2 @ 2.30m 1 x Plastic Jar Corrosivity		2.5										
	Clayey SILT, minor sand, trace organics; light grey-brown mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, fibrous.				PQTT	90	7 @ 3.00m 1 x Glass Jar 1 x Plastic Jar		3.0										
	SILT, minor sand, trace organics; light brown mottled orange, speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.				PQTT	66	8 @ 4.00m 1 x Glass Jar 1 x Plastic Jar		4.0										
	SILT, minor clay and sand, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.				PQTT	66	52/12 kPa 0/1 1/0 1/0 N=4		4.5										
	Sandy SILT, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.				PQTT	66													
	Sandy SILT, trace organics; grey speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.				PQTT	66													
					PQTT	66													

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 2 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										2000 600 400 200 100 50 20			25 50 75				
Tauranga Group	SILT, minor clay, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; organics, fibrous.			PQTT	100	9 @ 5.00m 1 x Glass Jar 1 x Plastic Jar		5.5										
	6.0 - 6.5 m: Push tube			PT	0	47/19 kPa 1/0 1/1 1/2 N=5		6.0										
	SILT, minor clay, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; organics, fibrous. 6.80 - 6.92m: Grades to: Sandy SILT			SPT	100			6.5										
	SILT, minor sand, trace organics; brown speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous. 7.00m: Grades to: some sand			PQTT	100			7.0										
	Sandy SILT, trace organics; light brown & brown speckled black. Very loose, moist, poorly graded; sand, fine; organics, fibrous.							7.5										
	SILT, some sand, trace organics; brown mottled light brown speckled black. Firm, moist, low plasticity; sand, fine; organics, fibrous.			SPT	100	0/0 0/1 1/1 N=3		8.0										
	Sandy SILT, trace organics; light brown speckled black. Firm, moist, low plasticity; sand, fine; organics, fibrous.							8.5										
	Sandy SILT, trace organics; dark brown speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous. Sandy SILT, minor organics and clay; brown spotted black. Stiff, moist, low plasticity; sand, fine; organics, fibrous. 9.35m: Grades to: No Sand			SPT	117	59/19 kPa 1/1 2/2 2/2 N=8		9.0										
								9.5										

7.40 - 7.65m: Core disturbed due to core drop-out and re-drilling

7.65m: Core run extended to 7.65m due to core drop out of barrel

8.10 - 9.00m: Core disturbed due to core drop-out and re-drilling

Box 2 3.4-4.3m
Box 3 5.2-8.4m

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 3 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	[CONT] Sandy SILT, minor clay and organics; brown spotted black. Stiff, moist, low plasticity; sand, fine; organics, fibrous				PQTT	100	133/31 1/2 2/2 3/3 N=10	14	10.5		2000 800 600 400 200 100 50 20								
	Silty SAND, trace organics; light brown-grey spotted black. Loose to medium dense, moist, poorly graded; sand, fine; organics, fibrous. 10.88 - 10.93m: Decomposed wood 10.93m: Brown spotted black				SPT	100													
	10.95m: END OF INVESTIGATION																		

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH08**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926036.50 mN (NZTM2000) 1743457.30 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 23/11/2020
R.L.: 24.60m		DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-2.40m



2.40-5.20m

CORE PHOTOS

BOREHOLE No.: **BH08**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926036.50 mN (NZTM2000) 1743457.30 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 23/11/2020
R.L.: 24.60m	DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling
		LOGGED BY: ROM CHECKED: CBM



5.20-8.35m



8.35-10.95m

BOREHOLE LOG

BOREHOLE No.:

BH110

SHEET: 1 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SILT, trace rootlets; brown. Stiff, moist, non-plastic.					1 @ 0.10m												
	SILT, trace sand; light brown mottled orangish brown. Stiff to very stiff, moist, low plasticity; sand, fine. 0.50 - 0.80m: Trace rootlets.			PQTT	100	2 @ 0.50m		0.5					0.50m: PID - 0.6 ppm					
	Silty CLAY; light brown mottled orangish brown. Very stiff, moist, high plasticity. 0.80 - 0.90m: Trace rootlets.					8 @ 0.80m 3 @ 0.90m		1.0					1.00m: PID - 0.3 ppm					
Tauranga Group	1.50 - 2.45m: Light brown.					4 @ 1.25m 153/59 kPa / 1 2/1 3/2 N=8		1.5										
				SPT	84	5 @ 1.95m		2.0										
				PQTT	100	9 @ 2.30m		2.5										
East Coast Bays Formation	Silty SAND; light brown mottled orangish brown. Loosely packed, saturated; sand, fine.					96/16 kPa		2.5										
	Sandy SILT; grey. Tightly packed, moist; sand, fine.			PQTT	100	6 @ 2.90m		3.0										
	3.1 - 3.5 m: PUSH TUBE			PT	100	0/- kPa crumble Push Tube @ 3.10m		3.5										
	Sandy SILT; grey. Hard, moist, non-plastic; sand, fine.			SPT	100	5/10 15/17 18 for 65mm N>=50		4.0										
	3.87 - 4.0 m: CORE LOSS							4.0										
	Moderately weathered, grey, SANDSTONE. Extremely weak. (Recovered as SAND, grey. Very dense, moist; sand fine)			PQTT	79	7 @ 4.00m		4.5										
	Moderately weathered, grey, SILTSTONE. Extremely weak. (Recovered as Sandy SILT, grey. hard, moist, low plasticity; sand fine)			SPT	0	UTP 6/25 20/30 for 45mm N>=50 Solid		5.0										
	4.77 - 4.87 m: CORE LOSS							5.5										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH110

SHEET: 2 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength		Sampling Method		Core Recovery (%)		Testing		RL (m)		Depth (m)		Graphic Log		Defect Log		Fracture Spacing (mm)		RQD (%)		Description & Additional Observations		Fluid Loss (%)		Water Level		Casing		Installation		Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																																			
East Coast Bays Formation	Moderately weathered, grey, fine, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine)																																			
	Moderately weathered, grey, SILTSTONE. Very Weak.																																			
	Moderately weathered, grey, fine SANDSTONE. Extremely weak. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	Slightly weathered, grey, SANDSTONE. Extremely weak, very weakly cemented. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	6.93m: Carbonaceous																																			
	Unweathered, grey, SANDSTONE. Very Weak.																																			
	7.5 - 7.63 m: Solid SPT																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	8.00 - 8.15m: Unweathered SILTSTONE. Very Weak.																																			
	8.15 - 8.3 m: CORE LOSS																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.0 - 9.18 m: SOLID SPT																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.30 - 9.40m: Unweathered SILTSTONE. Very Weak.																																			
	9.90 - 9.97m: Unweathered SILTSTONE. Very Weak.																																			

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth

15.11m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH110

SHEET: 3 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No		
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations								
East Coast Bays Formation	Unweathered, grey, medium to coarse, SANDSTONE. Very Weak, Weakly cemented.				PQTT	100								54								
	Unweathered, grey, SILTSTONE. Very Weak.						20/30 for 35mm N>=50 Solid	10.5						0								
	Unweathered, grey, fine, SANDSTONE. Very Weak.				PQTT	100								48								
	11.22 - 11.23m: Unweathered SILTSTONE. Very Weak.																					
	11.35 - 11.53m: SANDSTONE grades fine to medium grained																					
	11.85 - 11.95m: Unweathered SILTSTONE. Very Weak				PQTT	100									21							
	12.0 - 12.09 m: SOILD SPT				SPT	0	32/18 for 15mm N>=50 Solid	12.0							0							
	Unweathered, grey, fine, SANDSTONE. Very Weak.																					
	Unweathered, grey, SILTSTONE. Very Weak. 12.21 - 12.29m: Carbonaceous																					
	12.29 - 12.35m: Carbonaceous 12.63 - 12.64m: SANDSTONE interbed 12.69 - 12.70m: SANDSTONE interbed																					
	Unweathered, grey, fine, SANDSTONE. Very Weak, Weakly cemented.				PQTT	100									55							
	13.37 - 13.46m: Unweathered SILTSTONE. Very Weak.																					
	Unweathered, grey mottled light grey, fine to medium grained, SANDSTONE. Weak, Moderately cemented.						32/18 for 20mm N>=50 Solid	13.5							0							
	Unweathered, grey, fine, SANDSTONE. Very Weak.																					
	14.21 - 14.22m: Unweathered SILTSTONE. Very Weak.				PQTT	75									32							
	14.4 - 14.75 m: CORE LOSS																					
	Unweathered, grey, SANDSTONE. Very weak																					
	Unweathered, grey, SILTSTONE. Very Weak.																					

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 4 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

DIRECTION:

ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										2000 600 200 100 50 20							
	15.0 - 15.11 m: SOLID SPT			SPT	0	23/27 for						0						
	15.11m: END OF INVESTIGATION					35mm N>=50 Solid												
								15.5										
								16.0										
								16.5										
								17.0										
								17.5										
								18.0										
								18.5										
								19.0										
								19.5										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH110**

SHEET: 1 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926611.70 mN (NZTM2000) 1743051.90 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.:	9.60m	DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-2.50m



2.50-5.10m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: YCWA
			CHECKED: CBM



5.10-7.10m



7.10-9.61m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: YCWA
			CHECKED: CBM



9.61-11.90m



11.90-14.10m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016			DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



14.10-15.11m

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Top	Clayey SILT, some organics; brown. Very stiff, moist, high plasticity; organics, rootlets.					BH111 Sample 1 @ 0.05m												
	Clayey SILT, trace sand; light brown. Stiff, moist, high plasticity; sand, fine.																	
	0.3 - 1.4 m: CORE LOSS																	
Tauranga Group	Clayey SILT, trace sand; light brown mottled brown. Stiff, moist, high plasticity; sand, fine.					73/31 kPa 1/1 0/1 1/2 N=4												
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; sand, fine; organics, rootlets.					BH111 Sample 2 @ 2.00m BH111 Sample 3 @ 2.20m												
	Sandy SILT; grey mottled orangish brown. Firm, moist, non-plastic; sand, fine.																	
East Coast Bays Formation	Silty SAND; grey. Medium dense, moist; sand, fine.					BH111 Sample 4 @ 2.80m 2/3 5/6 7/7 N=25												
	3.45 - 3.7 m: CORE LOSS																	
	Moderately weathered, grey, fine grained, SANDSTONE. Extremely Weak, (Recovered as Silty SAND; grey. Medium dense, moist; sand, fine)					BH111 Sample 5 @ 3.70m BH111 Sample 6 @ 3.90m												
	3.90 - 4.05m: Recovered as GRAVEL																	
	Moderately weathered, grey fine grained SANDSTONE; Extremely weak. (Recovered as fine grained SAND; grey. Dense, moist.)																	
	Moderately weathered, grey SILTONE; Extremely weak. (Sandy SILT; grey. Hard, moist, low plasticity; sand, fine.)					0/- kPa Crumble. 6/5 5/9 15/21 N>=50 Solid												
	4.70 - 4.72m: SILT; light brown. Moist, low plasticity.																	
	4.85m: 2 mm thick SILT; light brown.																	
	4.90 - 4.95m: SAND; grey. Dense, moist; sand, fine.																	

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Description & Additional Observations								
East Coast Bays Formation	4.95 - 5.05 m: CORE LOSS				PQTT	81	8/15 15/25 10 for 15mm N>=50 Solid	5.5			2000 1000 500 200 100 50 20	65	5.23m: BF, 10° dip, VN, CN 5.27 - 5.28m: BF, 0° dip, MN, light brown veneer					Box 2, 3, 5-6, 0m	
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak. 5.05 - 5.15m: SAND; grey, Dense, moist; sand, fine. 5.28 - 5.32m: Slightly weathered, grey, SILTSTONE. Very Weak. 5.40m: Carbonaceous																		
	Unweathered, light grey, fine grained SANDSTONE. Weak.		PQTT	12				6.0				0							Box 2, 3, 5-6, 0m
	5.56 - 6.0 m: CORE LOSS																		
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak, Carbonaceous [logged after solid SPT testing].		SPT	100				6.5				0							Box 2, 3, 5-6, 0m
	Slightly weathered, grey, fine, SANDSTONE. Very Weak, (Recovered as GRAVEL).																		
	6.42 - 6.6 m: CORE LOSS		PQTT	84				7.0				53							Box 2, 3, 5-6, 0m
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 6.68 - 6.72m: SILTSTONE 6.90 - 6.92m: SILTSTONE																		
	7.20 - 7.26m: SILTSTONE		PQTT	80				7.5				45							Box 2, 3, 5-6, 0m
	Unweathered, grey, SILTSTONE. Very Weak. - INTERBEDDED WITH - Unweathered, grey, fine, SANDSTONE. Very Weak.																		
Unweathered, grey, fine grained SANDSTONE. Very Weak.		SPT	95				8.0				31							Box 2, 3, 5-6, 0m	
8.32 - 8.33m: SILTSTONE 8.37 - 8.38m: SILTSTONE 8.44 - 8.53m: SILTSTONE 8.53 - 8.90m: Weakly cemented SANDSTONE																			
8.9 - 9.0 m: CORE LOSS		SPT	95				8.5				31							Box 2, 3, 5-6, 0m	
Unweathered, grey, SANDSTONE. Very Weak, carbonaceous. [logged after solid SPT test].																			
9.24 - 9.45 m: CORE LOSS		PQTT	80				9.0				45							Box 2, 3, 5-6, 0m	
Unweathered, grey, fine grained SANDSTONE. Very Weak.																			
9.78 - 9.80m: SILTSTONE 9.86 - 9.97m: SILTSTONE		PQTT	80				9.5				31							Box 2, 3, 5-6, 0m	

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		ROCK DEFECTS										Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations			
East Coast Bays Formation	[CONT] unweathered, grey, fine grained SANDSTONE. Very Weak. 10.02 - 10.06m: Fine to coarse grained SANDSTONE 10.24 - 10.48m: Fine to coarse grained SANDSTONE				PQTT	83							31	10.02m: BF, 0° dip, VN, CN 10.06 - 10.11m: BF, 0° dip, N, CG (grey silt) 10.15m: DD 10.21m: BF, 0° dip, N, CN 10.24m: BF, 0° dip, N, CN 10.38m: DD 10.44m: DD			
	10.5 - 10.63 m: Solid SPT				SPT	0	20/27 for 50mm N>=50 Solid		10.5				0				
	10.63 - 11.15 m: CORE LOSS								11.0								
	Unweathered, grey, fine grained SANDSTONE. Very Weak. Unweathered, grey, coarse grained SANDSTONE. Very Weak. Unweathered, grey, fine grained SANDSTONE. Very Weak. 11.61 - 11.65m: SILTSTONE 11.77 - 11.82m: Coarse grained SANDSTONE				PQTT	62			11.5				9	11.22m: BF, 0° dip, N, CN 11.28m: BF, 0° dip, N, CN 11.36m: BF, 0° dip, N, CN 11.45m: DD 11.50m: DD 11.59m: DD 11.73m: DD 11.77m: BF, 0° dip, N, CN 11.82m: DD 11.88m: DD			
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	80	5/14 30/20 for 25mm N>=50 Solid		12.0				0				
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 12.74 - 12.77m: SILTSTONE 13.14 - 13.20m: SILTSTONE				PQTT	100			12.5				61	12.46m: DD 12.63 - 12.73m: BZ, 70° dip, VN, CN 12.87m: DD 13.14m: DD 13.27m: DD 13.32m: BF, 0° dip, N, CN 13.42m: DD			
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	100	20/30 for 30mm N>=50 Solid		13.5				0				
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 14.26 - 14.41m: Weakly cemented				PQTT	73			14.0				46	13.76m: DD 13.85m: DD 14.02m: DD 14.10m: DD 14.15m: DD			
	14.41 - 14.78 m: CORE LOSS								14.5								
	Unweathered, grey, fine grained SANDSTONE. Very Weak.								14.5					14.88m: DD			

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 4 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method		Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation			Core Recovery (%)	Core Recovery (%)					Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
East Coast Bays Formation	[CONT] Unweathered, grey, fine grained SANDSTONE. Very Weak.				SPT	100	20/30 for 45mm N>=50 Solid		15.5				0	15.27m: DD 15.35m: DD 15.40m: DD						
	15.65 - 15.75 m: CORE LOSS				PQTT	84						38								
	Unweathered, grey, coarse grained SANDSTONE. Very Weak.				PQTT	100						52	15.89m: DD 15.96m: DD 16.13m: DD 16.22m: DD 16.28m: DD 16.40m: DD							
	16.62 - 16.77 m: CORE LOSS				SPT	100	16/34 for 40mm N>=50 Solid		16.5			0								
	Unweathered, grey, coarse grained SANDSTONE. Weak.				PQTT	76			17.0			66	16.93m: DD 17.10m: DD 17.16m: DD							
	Unweathered, grey, SILTSTONE. Very Weak.																			
	17.25 - 17.4 m: CORE LOSS																			
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 17.46 - 17.48m: SILTSTONE 17.51 - 17.55m: SILTSTONE 17.67 - 17.86m: SILTSTONE				PQTT	80			17.5			44	17.60m: BF, 0° dip, N, CN							
	Unweathered, grey, medium grained SANDSTONE. Very Weak.													18.00m: SPT calibration undertaken between 10.5 - 18.0m						
	18.0 - 18.04 m: Solid SPT								18.0				0							
	18.04m: END OF INVESTIGATION						for 35mm N>=50 Solid Bouncing		18.5											
									19.0											
									19.5											
									-10											

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH111**

SHEET: 1 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-3.45m



3.45-6.00m

CORE PHOTOS

BOREHOLE No.: **BH111**

SHEET: 2 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926614.20 mN (NZTM2000) 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



6.00-8.30m



8.30-11.45m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



11.45-13.60m



13.60-16.50m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



16.50-18.00m

BOREHOLE LOG

BOREHOLE No.:
BH111A

SHEET: 1 OF 1

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 12/11/2020

FINISH DATE: 12/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743090.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	SILT, minor rootlets; brown. Stiff to very stiff, low plasticity.																	
	Clayey SILT; light brown mottled orangish brown. Stiff, moist, high plasticity. 0.60 - 0.80m: Trace rootlets. Firm.												0.50m: PID - 0.3 ppm					
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; organics, fleck; sand, fine.												1.00m: PID - 0.5 ppm					
	1.75 - 2.0 m: CORE LOSS																	
	2.0 - 2.5 m: PUSH TUBE																	
	2.5m: END OF BOREHOLE																	

COMMENTS: Drilled 1.5 m from BH111 to recover core in the upper 2.5 m.

Hole Depth
2.5m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743090.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 12/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 12/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



0.00-2.50m

BOREHOLE LOG

BOREHOLE No.:

BH113

SHEET: 2 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 04/11/2020

FINISH DATE: 05/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	[CONT] SILT, some clay, trace organics; grey-green. Stiff, moist, moderate plasticity; organics, rootlets			PQTT	100		7	5.5										
	5.50m: Grades: Light brown																	
	Organic SILT, minor clay, trace organics; brown speckled black. Firm, moist, low plasticity; organics, rootlets																	
	6.0 - 6.5 m: Push Tube			PT	0	96/10 kPa 1 @ 6.00m	6	6.0										
	SILT, trace clay, trace organics; grey speckled black. Firm to stiff, moist, low plasticity; organics, carbonaceous.			SPT	100	0/0 0/0 0/1 N=1	6.5											
				PQTT	100		5	7.0										
				SPT	111	0/- kPa 0/0 1/0 0/1 N=2	7.5											
	Clayey SILT, trace organics; grey-green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.																	
				PQTT	100		4	8.0										
	9.00 - 9.05m: Brown mottled grey-green, speckled black.			SPT	148	79/30 kPa 0/1 2/0 1/1 N=4	3	9.0										
	9.50m: Grey-brown speckled black.							9.5										

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Rev.: A



Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:

BH113

SHEET: 3 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 04/11/2020

FINISH DATE: 05/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
Tauranga Group	[CONT] Clayey SILT, trace organics; grey-green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			PQTT	100			2											
	Clayey SILT, minor sand, trace organics; light green speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets.			SPT	122	78/38 kPa 1/1 1/2 1/3 N=7		10.5											
	SILT, trace organics; grey, brown & light green. Firm, moist, low plasticity; organics, rootlets.							11.0											
	Clayey SILT, trace organics; grey-brown & light green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			PQTT	100			11.5											
	SILT, trace organics; brown, grey-brown & light green. Firm - stiff, moist, low plasticity; organics, rootlets.							12.0											
	Clayey SILT, trace organics; grey-brown & light green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			SPT	128	44/10 kPa 0/1 3/3 3/3 N=12		12.0											
	Sandy SILT, trace organics; grey & grey-green. Stiff, moist, low plasticity; Sand, fine; organics, wood fragments.							12.5											
	13.05m: Grey			PQTT	100			13.0											
	Silty fine to coarse SAND, trace gravel, trace organics; grey & grey-green. Medium dense, moist, well graded; Gravel, fine to coarse grained, sub-angular Siltstone & Sandstone; organics, wood fragments.			SPT	124	UTP 5/5 6/12 10/12 N=40		13.5											
	East Coast Bays Formation	Moderately weathered, grey and grey-green, fine, SANDSTONE. Extremely Weak, bedded, thin. - INTERBEDDED WITH - Moderately weathered, grey and grey-green, SILTSTONE. Extremely Weak, thin, (recovered as Gravelly SAND).			PQTT	100			-2										
Moderately weathered, grey SILTSTONE; Extremely weak (Recovered as, Clayey SILT, some sand; grey. Hard, moist, low plasticity).								14.5											
Slightly weathered, grey, SANDSTONE; EW																			

Box 4, 9.8-12.5m

Box 5, 12.5-14.9m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH113

SHEET: 4 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 04/11/2020

FINISH DATE: 05/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
East Coast Bays Formation	15.0 - 5.37 m: Core Loss				SPT	0	2/5 10/17 24 for 75mm N>=50 Solid	-3					0							
	Slightly weathered, grey SILTSTONE; Very weak				PQTT	100		15.5					36	15.66m: BF, 12° dip, VN, CN						
	15.65m: Very weak							16.0						15.85 - 15.87m: BZ 15.90m: BF, 18° dip, VN, CN 15.98m: BF, 15° dip, VN, CN						
	16.5 - 16.91m: Solid cone SPT				SPT	0	2/4 6/8 23/13 for 35mm N>=50 Solid	16.5					0	16.10 - 16.19m: BZ 16.25 - 16.32m: BZ 16.35m: BF, 12° dip, VN, CN						
	Unweathered, grey, SILTSTONE. Weak, laminated. - INTERBEDDED WITH - Unweathered, grey, SANDSTONE. Weak.				PQTT	100		17.0					28	17.15m: BF, 15° dip, VN, CN 17.26m: BF, 0° dip, VN, CN 17.30m: BF, 15° dip, VN, CN 17.45m: BF, 13° dip 17.49m: BF, 12° dip, VN, Brown veneer 17.51 - 18.00m: BZ 17.55m: J, 55° dip, N 17.60m: J, 55° dip, VN 17.88m: J, 55° dip, VN						
	18.0 - 18.28 m: Solid cone SPT				SPT	0	12/25 30/20 for 50mm N>=50 Solid	-6					0							
								18.5												
								19.0												
								19.5												

Box 6, 14.9-17.4m

Box 7, 17.4-18.3m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH113**

SHEET: 1 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-4.00m



4.00-7.30m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



7.30-9.75m



9.75-12.45m

CORE PHOTOS

BOREHOLE No.: **BH113**

SHEET: 3 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



12.45-14.90m



14.90-17.40m

CORE PHOTOS

BOREHOLE No.: **BH113**

SHEET: 4 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



17.40-18.28m

BOREHOLE LOG

BOREHOLE No.:

BH116

SHEET: 1 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 02/11/2020

FINISH DATE: 03/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Fill	SILT, some sand, minor clay, trace gravel, trace organics; Dark brown. Stiff, moist, moderate plasticity; Sand, fine grained; Gravel, fine grained, angular; organics, rootlets [FILL]						1 @ 0.10m							0.10m: PID - 0.1ppm		18/11/2020			
	Silty CLAY; some sand, trace gravel; trace organics; Brown mottled orange and dark brown. Very stiff, moist, high plasticity. Sand, fine to coarse grained; Gravel; fine grained, angular Basalt; organics, rootlets [FILL].						2 @ 0.50m	0.5						0.50m: PID - 0.0ppm					
	Silty CLAY, some sand, trace organics; grey-brown mottled orange, speckled white. Very stiff, moist, high plasticity; Sand, fine grained; Gravel, fine grained, angular; organics, rootlets. 0.85 - 1.5 m: CORE LOSS				PQTT	56	3 @ 1.00m	1.0						1.00m: PID - 0.0ppm					
Tauranga Group	Sandy SILT, trace organics; grey mottled orange & brown. Stiff, moist, low plasticity; Sand, fine grained; organics, rootlets.						0/- kPa Geo not present - service clearance	1.5	12					2.00m: PID - 0.2ppm		03/11/2020			
					SPT	77	1/0 1/1 1/1 N=4 4 @ 2.00m	2.0											
	Grades to: Silty fine grained SAND, trace organics; grey mottled orange & brown. Loose, moist, poorly graded; Sand, fine; organics, rootlets							2.5	11										
	2.80m: Grades: grey						7 @ 3.00m	3.0											
	3.05 - 3.45 m: CORE LOSS						0/- kPa Geo not present - service clearance												
					SPT	11	0/1 0/1 0/1 N=2 5 @ 3.45m	3.5											
	3.45 - 3.95 m: PUSH TUBE																		
					PT	0													
	Silty CLAY, minor sand; green-grey. Very stiff, moist, high plasticity; Sand, fine.						8 @ 4.00m	4.0											
	Organic Silty CLAY, trace organics; dark brown speckled black, Firm, moist, high plasticity; organics, carbonaceous						6 @ 4.50m	4.5											
	4.5 - 5.0 m: PUSH TUBE						0/- kPa Geo not present - service clearance		9										

Box 1, 0.0-2.9m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH116

SHEET: 2 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 02/11/2020

FINISH DATE: 03/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering RQD (%) Fracture Spacing (mm) Defect Log	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
Tauranga Group	[CONT] Organic Silty CLAY, trace organics; dark brown speckled black, Firm, moist, high plasticity; organics, carbonaceous			SPT	140	9 @ 5.00m 0/0 0/0 1/1 N=2		5.5					5.00 - 5.45m: Core extended					
	Silty CLAY, trace organics; grey speckled black. Stiff, moist, high plasticity; organics, rootlets			PQTT	100			6.0										
	6.00m: Grades: green speckled black			SPT	106	0/- kPa 1/1 1/1 0/1 N=3		6.5										
	6.90m: Grades: brown speckled black			PQTT	100			7.0										
	Grades to: Clayey SILT; grey-green. Firm to stiff, moist, moderate plasticity.			SPT	100	69/31 kPa 0/0 1/0 1/1 N=3		7.5										
	Grades to: SILT; grey. Soft to firm, moist, low plasticity, slightly sensitive.							8.0										
	Grades to: Clayey SILT; grey-green. Stiff, moist, moderate plasticity, slightly sensitive.			PQTT	60			8.5										
	Grades to: SILT, minor clay; brown. Firm to stiff, moist, low plasticity, slightly sensitive.							9.0					9.00m: Shear vane indicates material is sensitive. Minimal sensitivity recognized during tactile remoulding					
	Silty CLAY, grey-green. Stiff, moist, high plasticity.			SPT	133	53/9 kPa 1/1 1/1 1/2 N=5		9.5										
	SILT; grey-brown & grey-green. Soft to firm, moist, low plasticity, slightly sensitive.																	
	SILT, minor clay; grey-green & brown-grey. Firm to stiff, moist, low plasticity, slightly sensitive.																	

Box 2, 2.5-5.8m

Box 3, 6.8-9.5m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH116

SHEET: 3 OF 4

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 02/11/2020
FINISH DATE: 03/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

R.L. GROUND: 13.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

DIRECTION:
ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength		Sampling Method		Core Recovery (%)		Testing		RL (m)		Depth (m)		Graphic Log		Defect Log		Fracture Spacing (mm)		RQD (%)		Description & Additional Observations		Fluid Loss (%)		Water Level		Casing		Installation		Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																																			
Tauranga Group	Silty CLAY, grey-green. Stiff, moist, high plasticity.						PQTT		100																											
	Sandy CLAY, some silt, trace organics. Grey-green speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, carbonaceous						SPT		142		98/32 kPa 1/1 2/1 2/3 N=8																									
	12.6 - 13.5 m: CORE LOSS						PQTT		100																											
Albany Conglomerate	Completely weathered, grey speckled black, SANDSTONE. Extremely Weak, (Recovered as Fine SAND, some silt, trace carbonaceous material; grey speckled black. Medium dense, moist, poorly graded)						SPT		115		119/57 kPa 2/2 3/4 3/4 N=14																									
	14.70m: Sand, fine to medium grained 14.85m: SILTSTONE coarse gravel-sized clasts x2						PQTT		100																											
	Completely weathered, grey-green, SANDSTONE. Extremely Weak, (Recovered as Gravelly SAND).																																			

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH116

SHEET: 4 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 02/11/2020

FINISH DATE: 03/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
Albany Conglomerate	[CONT] Completely weathered, grey-green, SANDSTONE. Extremely weak (Recovered as Gravelly SAND)			SPT	100	4/3 6/12 13/20 for 40mm N>=50													
	Slightly weathered, grey fine to medium grained SANDSTONE; Very weak			PQTT	100		15.5				12	15.42 - 15.53m: J, 35° dip, VN, CN 15.50m: BF, 6° dip, VN, CN 15.57m: BF, 6° dip, VN, CN 15.63m: BF, 15° dip, VN, CN 15.63 - 15.75m: J, VN, CN 15.74 - 15.84m: BZ, CN							
	15.92 - 15.94m: Slightly weathered, grey SILTSTONE; Extremely weak 16.00 - 16.50m: Recovered as: Gravelly SAND due to core drop-out and re-drilling.			PQTT	100		16.0												
	16.5 - 16.88 m: Solid cone SPT			SPT	0	8/14 18/16 16 for 75mm N>=50 Solid	16.5				0	16.00 - 16.50m: Core disturbed due to drilling process (fell out of barrel)							
	Slightly weathered, grey, SANDSTONE. Very Weak, moderately thick, (60%). - INTERBEDDED WITH - Slightly weathered, grey, SILTSTONE. Very Weak, thin, (40%).			PQTT	84		17.0				36	16.88m: BF, 6° dip, VN, CN 16.94m: BF, 6° dip, VN, CN 16.95m: BF, 4° dip, VN, CN 16.97m: BF, 12° dip, VN, CN 17.11m: BF, 25° dip, VN, CN 17.11 - 17.28m: J, 45° dip, VN, CN 17.15m: BF, 4° dip, VN, CN 17.28m: BF, 10° dip, VN, CN 17.49m: BF, 10° dip, VN, CN							
	17.83 - 18.0 m: CORE LOSS						17.5												
	18.0 - 18.23 m: Solid cone SPT			SPT	0	11/22 45/5 for 5mm N>=50 Solid	18.0				0	17.80m: DD							
	18.23m: END OF INVESTIGATION						18.5												
							19.0												
							19.5												

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH116**

SHEET: 1 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926934.40 mN 1743342.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.:	13.60m	DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-2.90m



2.90-6.75m

CORE PHOTOS

BOREHOLE No.: **BH116**

SHEET: 2 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926934.40 mN (NZTM2000) 1743342.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.:	13.60m	DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



6.75-9.45m



9.45-11.85m

CORE PHOTOS

BOREHOLE No.: **BH116**

SHEET: 3 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926934.40 mN (NZTM2000) 1743342.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.:	13.60m	DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



11.85-15.42m



15.42-18.23m

BOREHOLE LOG

BOREHOLE No.:

BH117

SHEET: 1 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	Sandy SILT, trace organics; dark brown. Firm, saturated, low plasticity; Sand, fine; organics, rootlets [TOPSOIL].					2 @ 0.10m												
Tauranga Group	Sandy SILT, some clay, trace organics; Brown mottled orange. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets 0.55m: Brown mottled orange speckled white			PQTT	52	3 @ 0.50m		0.5										
	0.78 - 1.5m: Core Loss							1.0										
	Silty fine grained SAND, minor organics; brown-grey. Medium dense, moist, poorly graded; organics, wood.			SPT	84	1/3 4/5 5/5 N=19		1.5										
	Clayey SILT, minor sand, trace organics; grey-brown speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets			PQTT	64	4 @ 2.00m		2.0										
	2.63 - 3.0m: Core Loss							2.5										
	Organic SILT, some clay, trace organics; dark grey - brown. Stiff, moist, low plasticity; organics, wood.			SPT	100	5 @ 3.00m 1/1 1/1 N=4		3.0										
	Grades to: Organic Clayey SILT, trace organics; dark grey-brown. Stiff, moist, low plasticity; organics, wood.			PQTT	83	6 @ 4.00m		4.0										
	4.5 - 5.0m: PUSH TUBE			PT	0	1 @ 4.50m		4.5										

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 2 OF 5

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 06/11/2020
FINISH DATE: 09/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	Organic Clayey SILT; dark grey-brown. Stiff, moist, low plasticity; organics, wood. 5.20m: grey-brown, mottled brown speckled black			SPT	100	7 @ 5.00m 0/0 1/1 2/1 N=5		5.5										
				PQTT	100			5										
				SPT	133	0/0 1/1 1/1 N=4		6.0										
	Sandy organic SILT; dark brown speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous							6.5										
	6.85m: Sand inclusions (5%); dark brown, speckled black spotted grey							7.0										
	7.10m: Grades: grey-brown			PQTT	100			7.5										
	Sandy SILT, trace organics; light grey-green, speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous			SPT	100	0/0 2/1 2/2 N=7		8.0										
	8.10m: Grades: grey-brown, mottled brown, speckled black							8.5										
	8.90 - 9.00m: Fine to medium grained SAND; grey. Medium dense, moist, poorly graded.			PQTT	100			9.0										
	Sandy SILT, trace organics; grey speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous 9.28 - 9.29m: Wood (10mm) 9.34 - 9.35m: Wood (10mm)			SPT	100	1/2 2/3 4/3 N=12		9.5										
	Fine to coarse SAND, minor silt, trace organics; grey. Medium dense, moist, poorly graded; organics, wood.																	
	Sandy SILT, some clay, trace organics; grey speckled black. Stiff, moist, low plasticity; sand, fine; organics, fibrous.																	

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH117

SHEET: 3 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	Fine SAND, some silt, trace organics; grey & brown. Loose, moist, poorly graded; organics, wood				PQTT	100													
	Fine SAND, some silt, some organics; grey. Loose, moist, poorly graded; organics, wood 9.75 - 9.80m: Wood							10.5											
	Clayey SILT, trace organics; light green. Stiff, moist, moderate plasticity; organics, fibrous. 10.34 - 10.39m: Wood				SPT	113	1/2 1/2 2/2 N=7												
	Sandy SILT, some clay, trace organics; light grey-green. Stiff, moist, low plasticity; organics, fibrous. 10.40m: brown							11.0											
	Silty SAND, trace organics; brown mottled grey. Medium dense, moist, poorly graded; sand, fine; organics, fibrous. 11.03 - 11.07m: Wood				PQTT	80		11.5											
	Silty SAND, some clay, trace organics; brown. Medium dense, moist, poorly graded; sand, fine; organics, wood.				SPT	108	1/2 3/4 4/4 N=15	12.0											
	SAND, some silt, trace organics; grey. Medium dense, moist, poorly graded; sand, fine; organics, wood.							12.5											
	Grades to: Sandy SILT, minor clay, trace organics; grey. Very stiff, moist, low plasticity; Sand, fine; organics, wood				PQTT	90		13.0											
	13.50m: Grey & brown, speckled black				SPT	124	1/1 2/2 3/3 N=10	13.5											
	13.90m: Grey							14.0											
	Sandy SILT, some clay, trace organics. Grey & brown speckled black. Very stiff, moist, low plasticity; Sand, fine; organics, carbonaceous.				PQTT	100		14.5											

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Box 4, 9.8-12.6m

Box 5, 12.6-15.0m

BOREHOLE LOG

BOREHOLE No.:

BH117

SHEET: 4 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	Sandy SILT, some clay, trace carbonaceous. Grey & brown speckled black. Very stiff, moist, low plasticity; Sand, fine				SPT	144	2/2 3/3 3/5 N=14						0						
	Fine to medium grained SAND, some silt, trace carbonaceous; light green & brown. Medium dense, moist, poorly graded				PQTT	85		15.5					0						
	16.35 - 16.5m: Core Loss																		
	Sandy SILT, some clay, trace carbonaceous light green. Stiff, moist, low plasticity; Sand, fine				SPT	128	2/3 2/4 3/4 N=13						0						
	Fine SAND, some silt, trace carbonaceous; light green - grey. Loosely packed, moist, poorly graded																		
	17.30m: minor silt.																		
	17.60m: some silt																		
	18.10 - 18.14m: Wood (40mm)																		
	Slight weathered, brown, fine grained SANDSTONE; Very weak				SPT	100	6/6 4/4 4/6 N=18							0					
	Highly weathered, grey-green speckled white, coarse, SANDSTONE. Extremely Weak, (Recovered as fine to coarse SAND, minor gravel; grey-green speckled white, red, brown & green. Medium dense, moist, poorly graded).																		
18.75 - 19.5m: Core Loss																			
Highly weathered, grey-green speckled white, red, brown & green, coarse, SANDSTONE. Extremely Weak, (Recovered as Fine to coarse SAND, minor gravel; grey-green speckled white, red, brown & green. Very dense, moist, poorly graded).				SPT	77	4/4 5/7 21/18 for 50mm N>=50		19.5					0						

Box 6, 15.0-17.8m

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH117

SHEET: 5 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering UNW MW SW VSW CSW VCSW	Rock Strength CS VCS UCS VUCS CIS VICIS	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%) 25 50 75	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm) 2000 800 600 400 200 100 50 20	RQD (%) 100 75 50 25 0	Description & Additional Observations					
East Coast Bays Formation	Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)																		
	20.38 - 21.0 m: Core Loss				PQTT	42			20.5				0						
	Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)				SPT	100													

CORE PHOTOS

BOREHOLE No.: **BH117**

SHEET: 1 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.75m



3.75-7.05m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



7.05-9.75m



9.75-12.60m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



12.60-15.00m



15.00-17.80m

CORE PHOTOS

BOREHOLE No.: **BH117**

SHEET: 4 OF 4

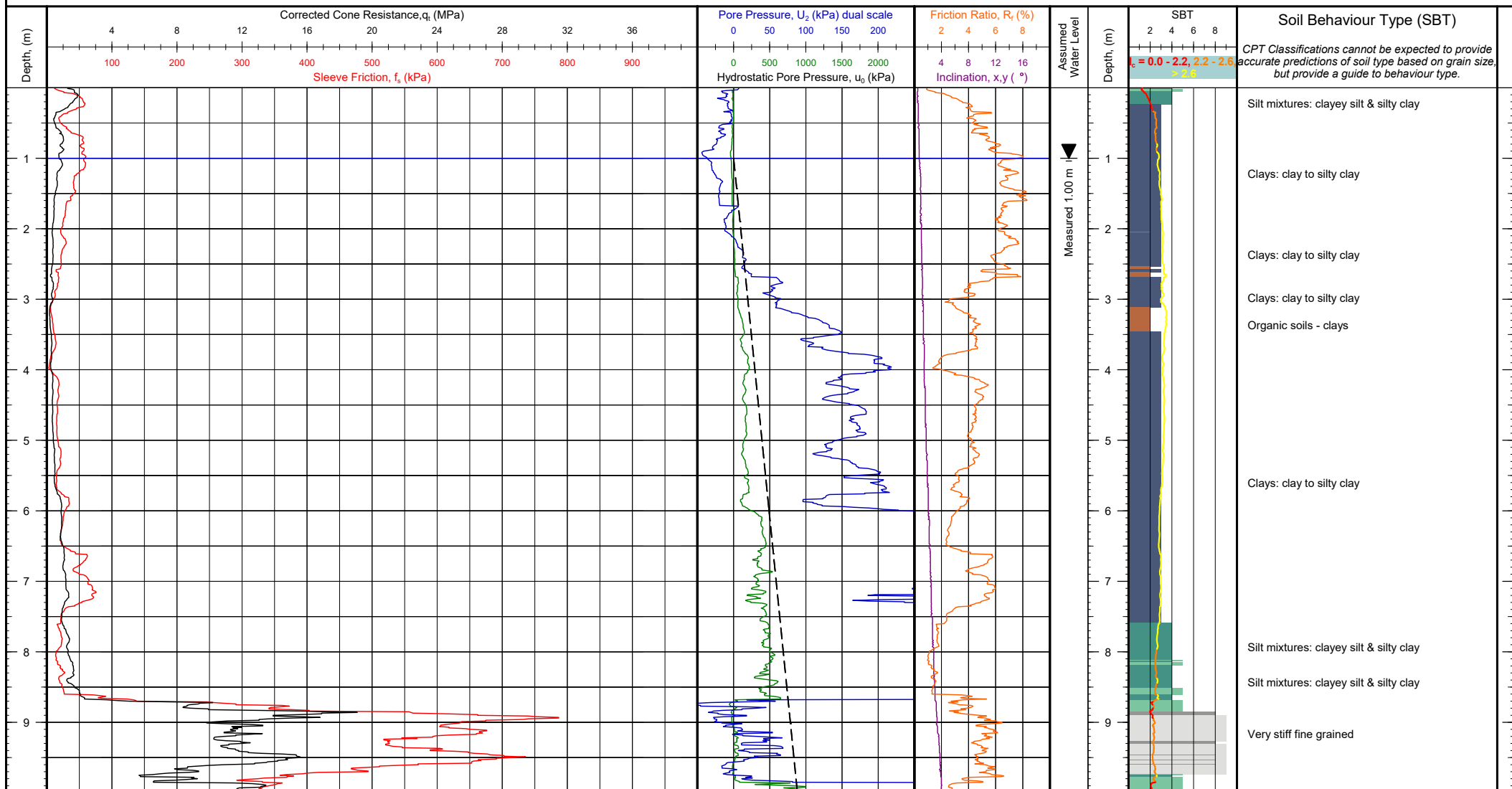
PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926691.00 mN 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



17.80-21.15m

Appendix D: CPT Logs

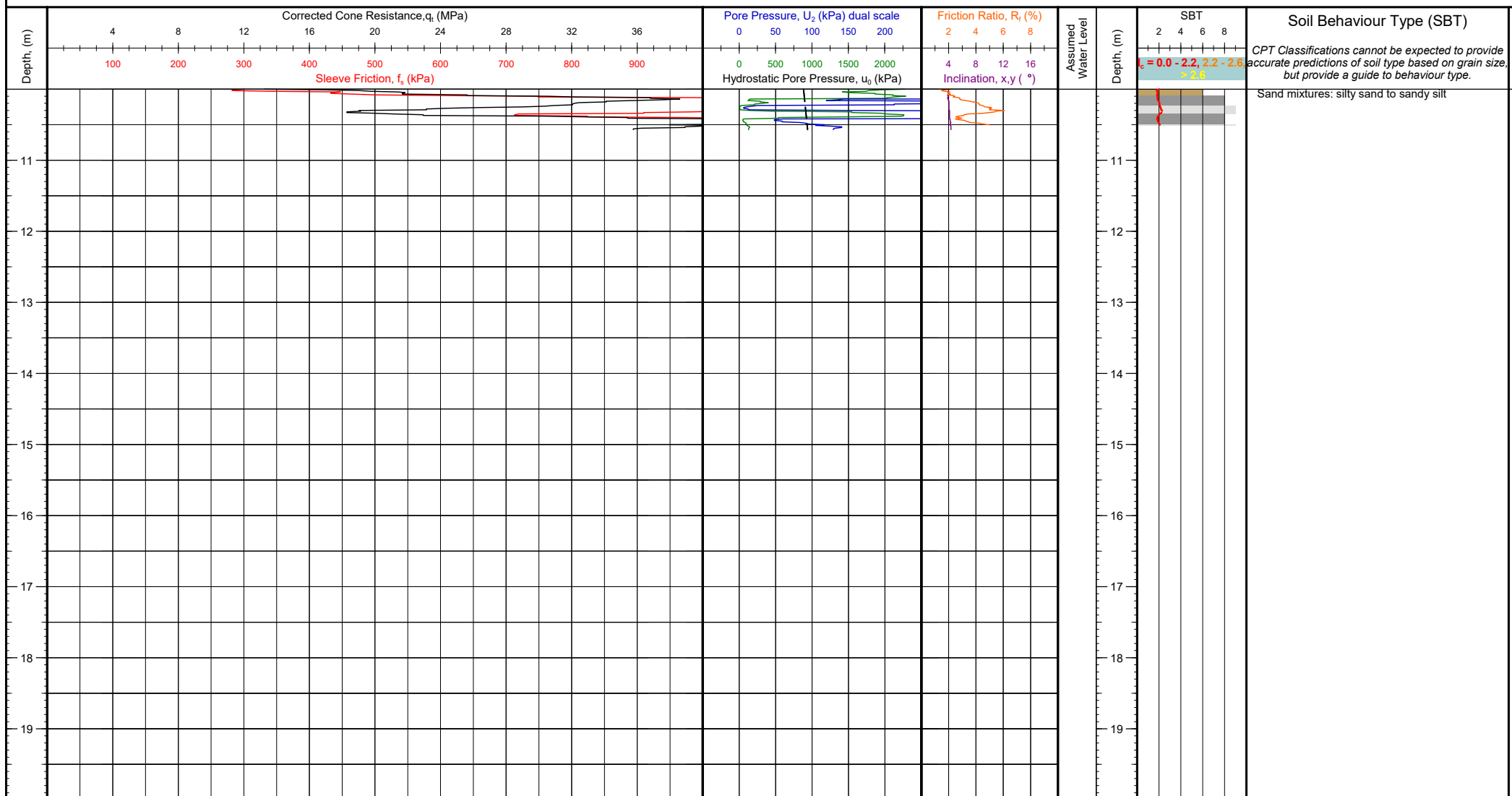
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926555.13, 1743194.03 WGS84 (deg): -36.796009, 174.605017 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 10.57 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-02 G.I. Job Ref: 200824

Comments:

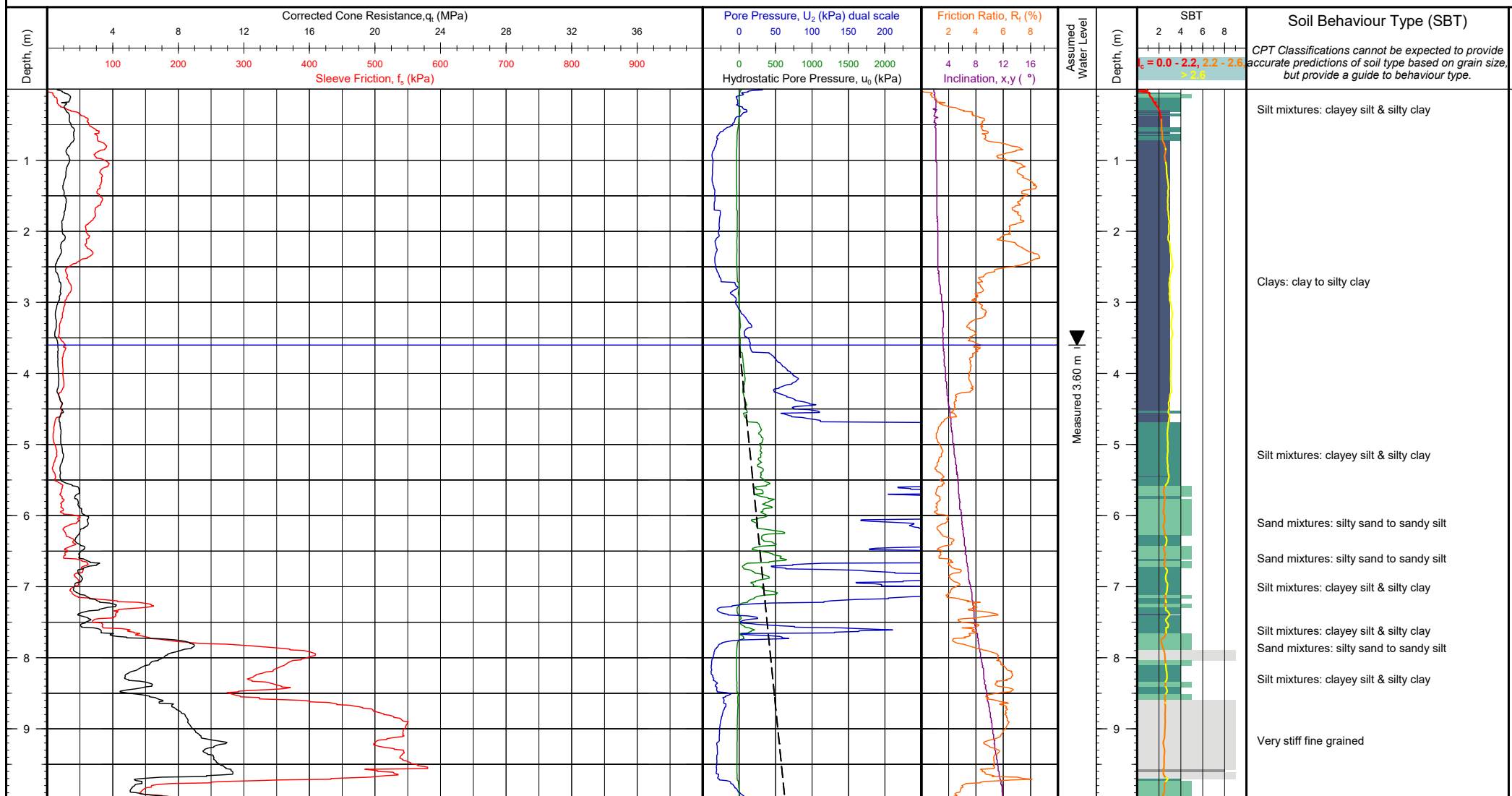
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926555.13, 1743194.03 WGS84 (deg): -36.796009, 174.605017 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 10.57 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-02 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u₂

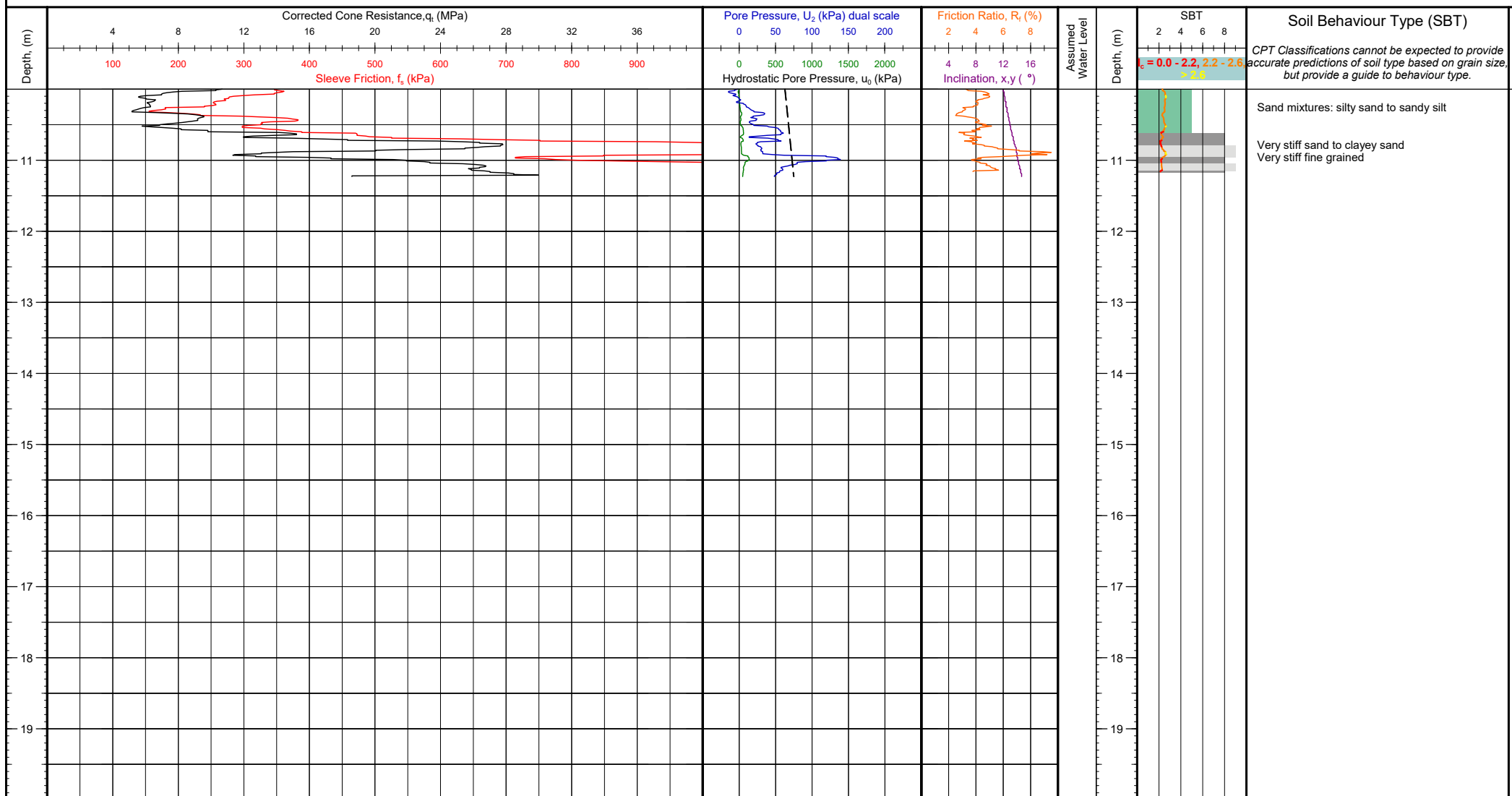
NZTM 2000 N, E (m): 5926510.40, 1743188.37
WGS84 (deg): -36.796413, 174.604962
Location Method: Handheld GPS
Surveyor:
Termination Reason: Danger of buckling rods

Elevation (m): Unknown
Date of Test: 3/11/2020
Depth (m): 11.23
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-03
G.I. Job Ref: 200824

Comments:

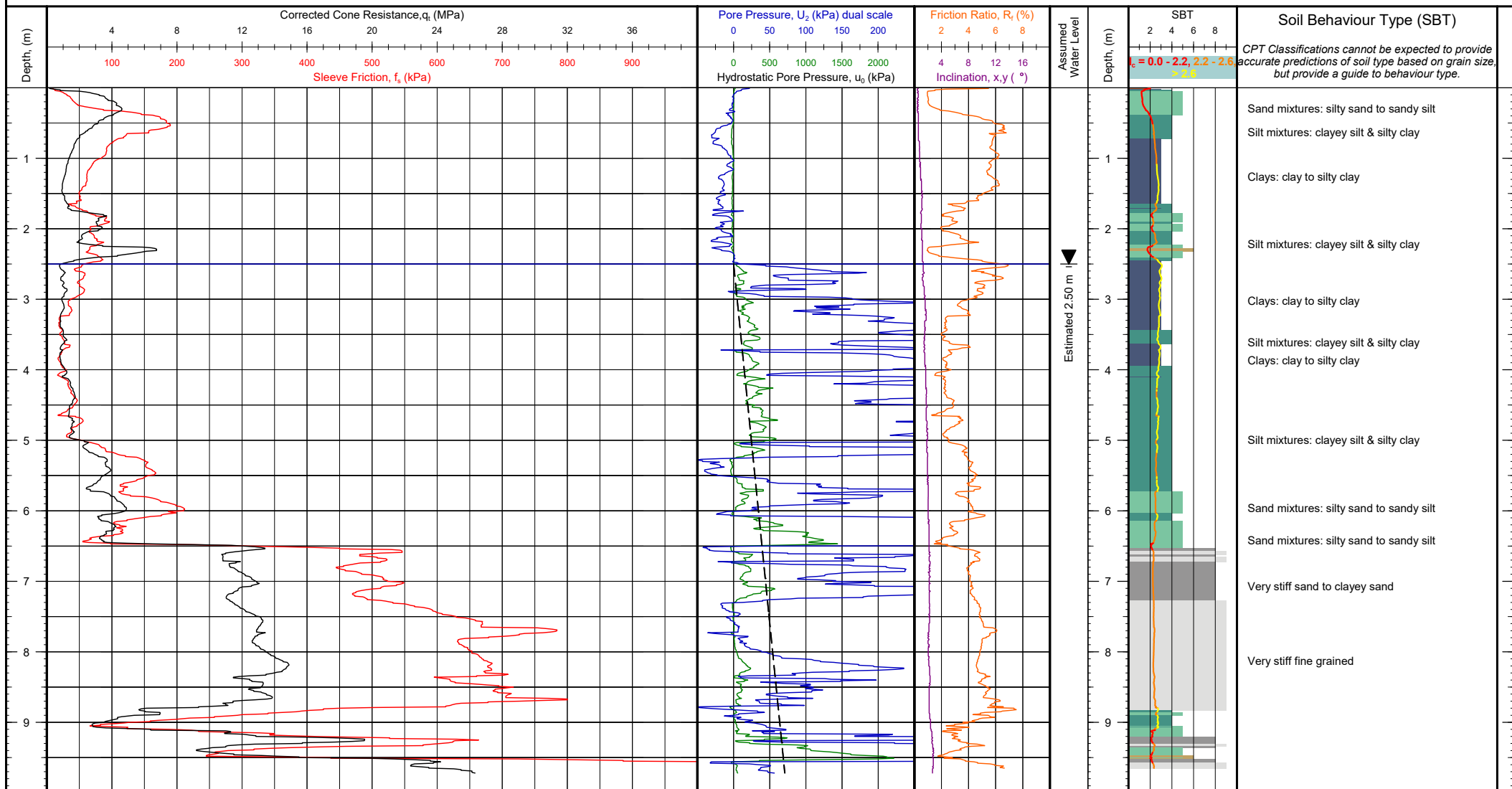
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926510.40, 1743188.37 WGS84 (deg): -36.796413, 174.604962 Location Method: Handheld GPS Surveyor: Termination Reason: Danger of buckling rods	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 11.23 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-03 G.I. Job Ref: 200824

Comments:

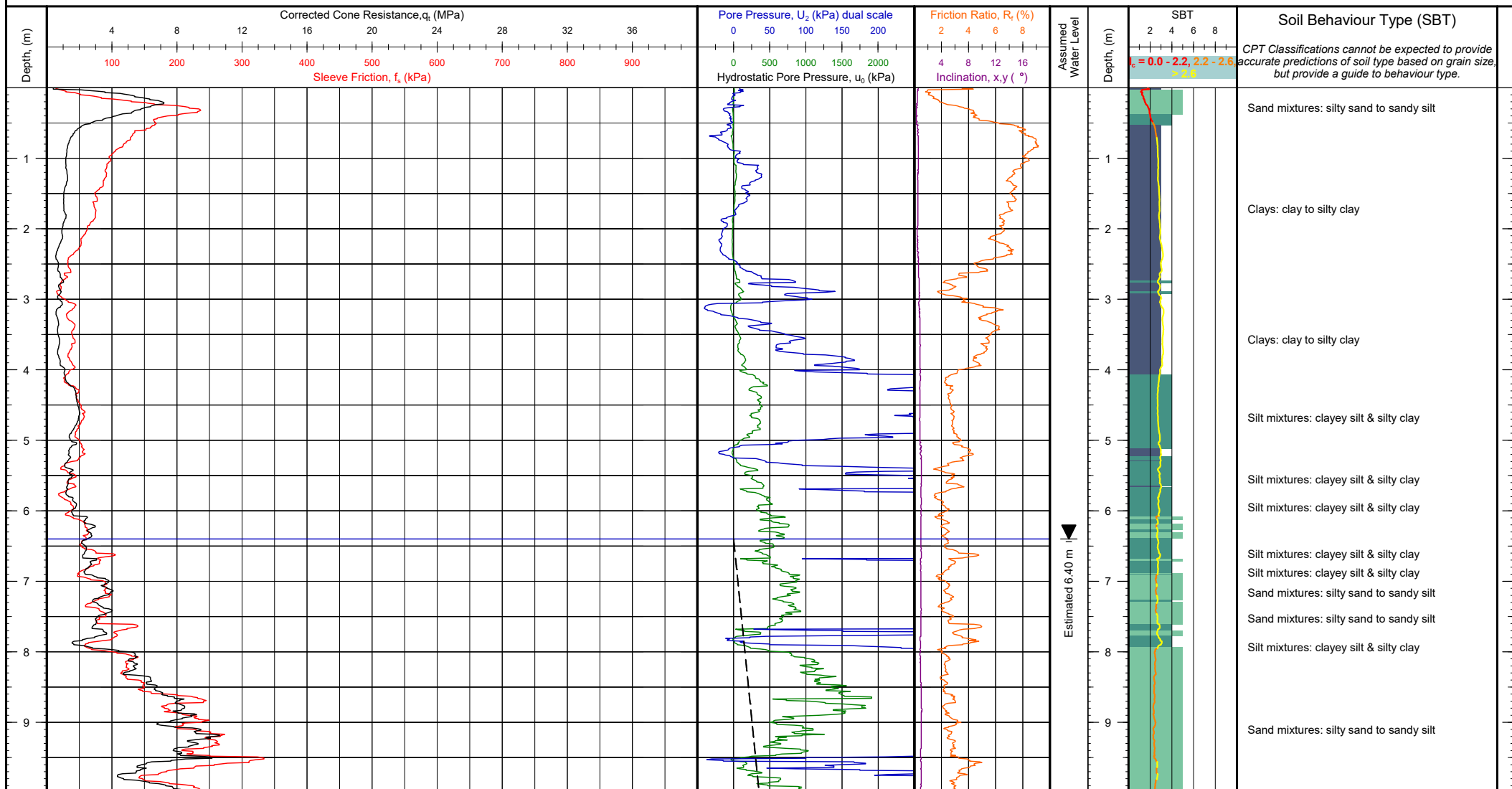
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926415.00, 1743205.87 WGS84 (deg): -36.797270, 174.605176 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 9.72 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-04 G.I. Job Ref: 200824

Comments:

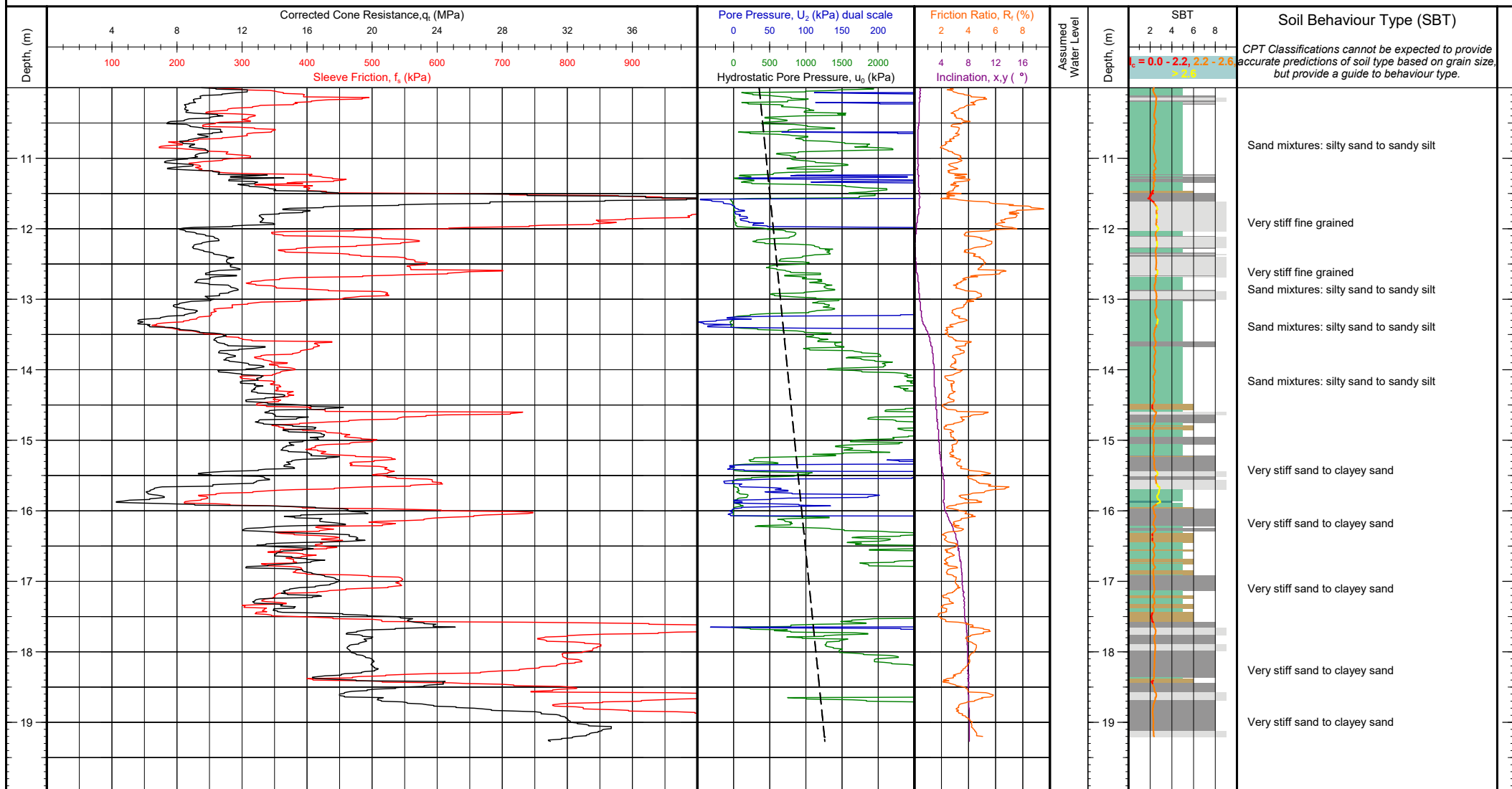
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926270.32, 1743217.01 WGS84 (deg): -36.798572, 174.605328 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 19.27 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-05 G.I. Job Ref: 200824

Comments:

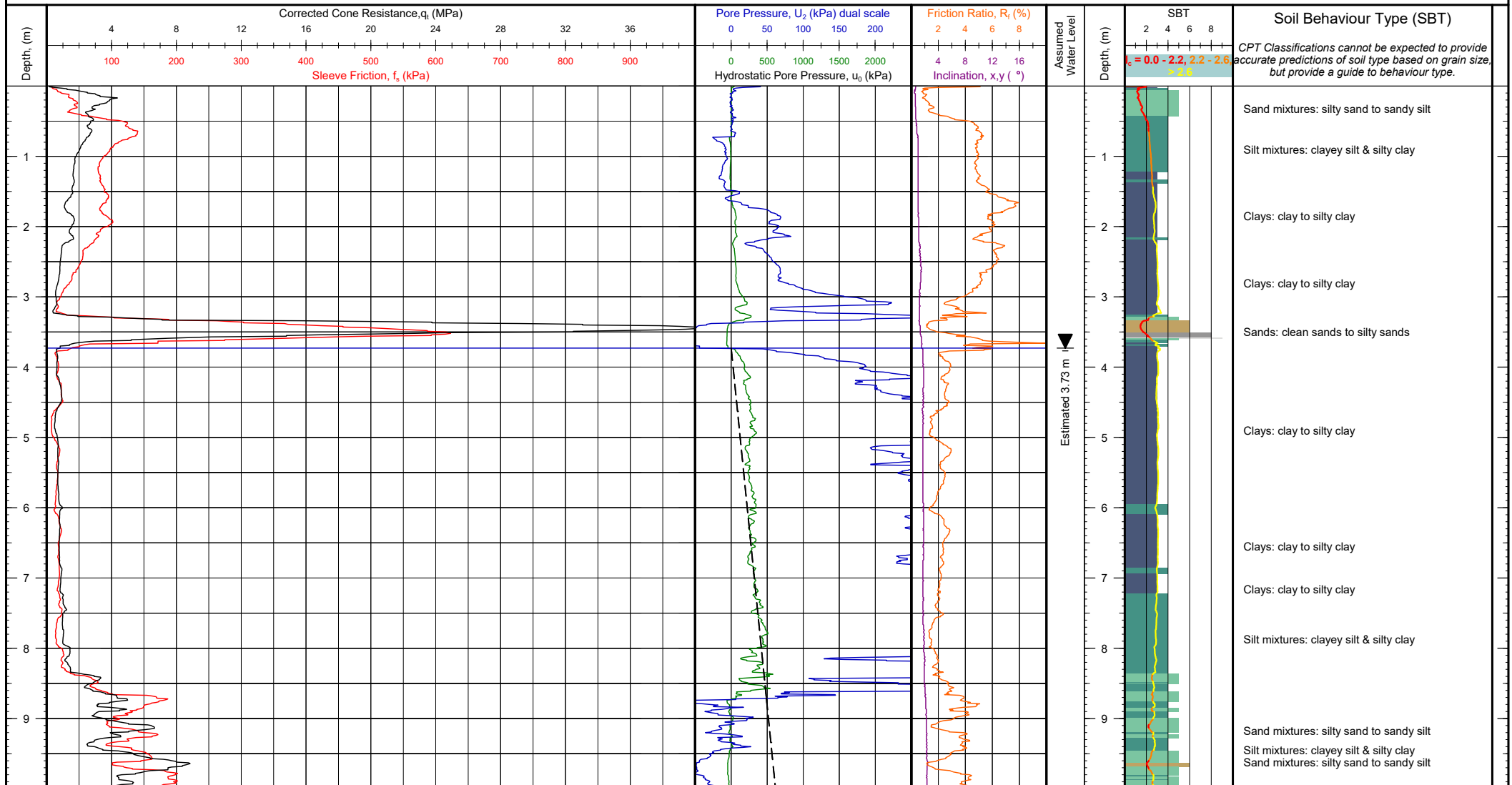
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926270.32, 1743217.01 WGS84 (deg): -36.798572, 174.605328 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 19.27 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-05 G.I. Job Ref: 200824

Comments:

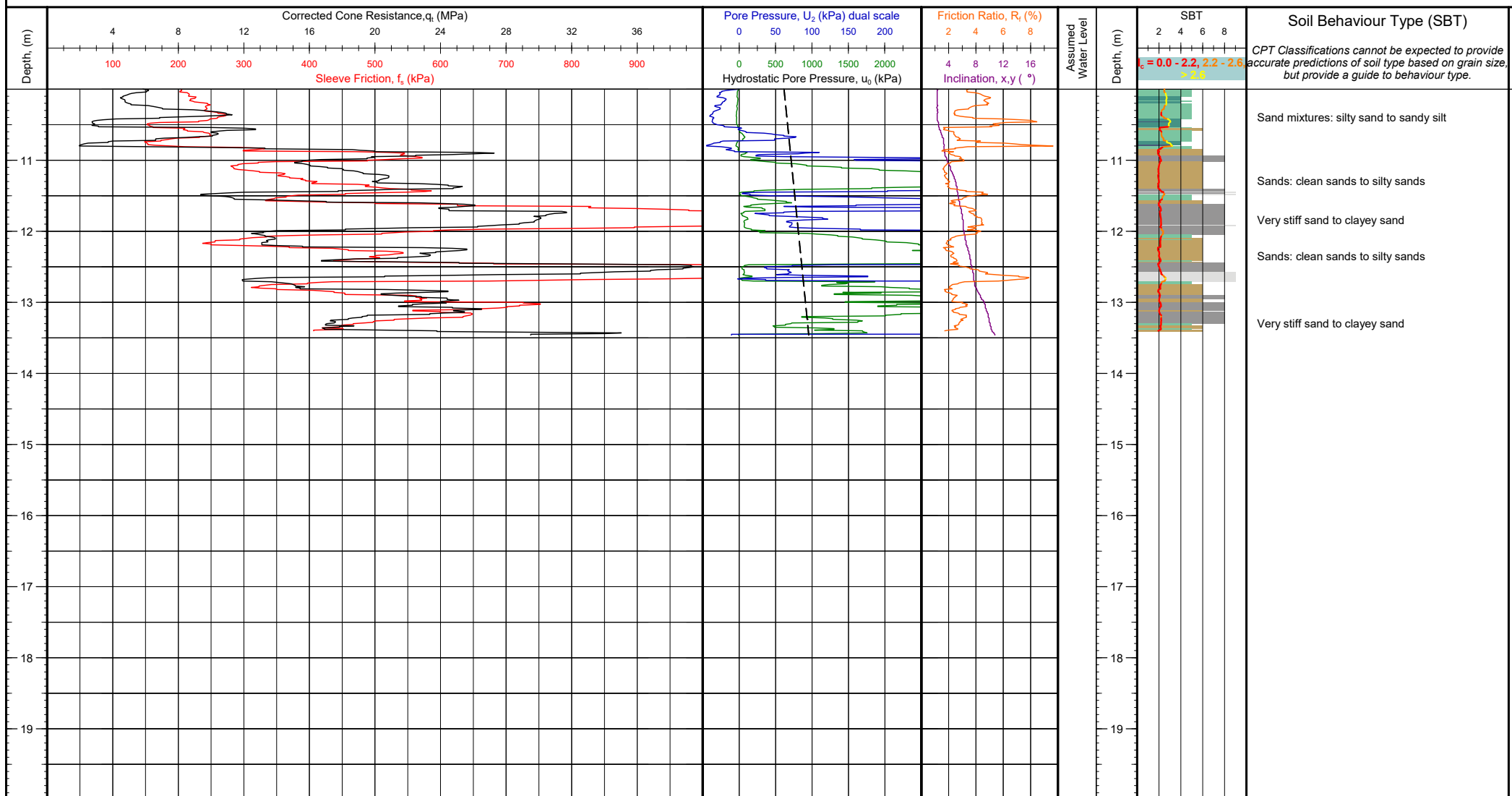
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926158.21, 1743337.57 WGS84 (deg): -36.799564, 174.606700 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 13.46 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-06 G.I. Job Ref: 200824

Comments:

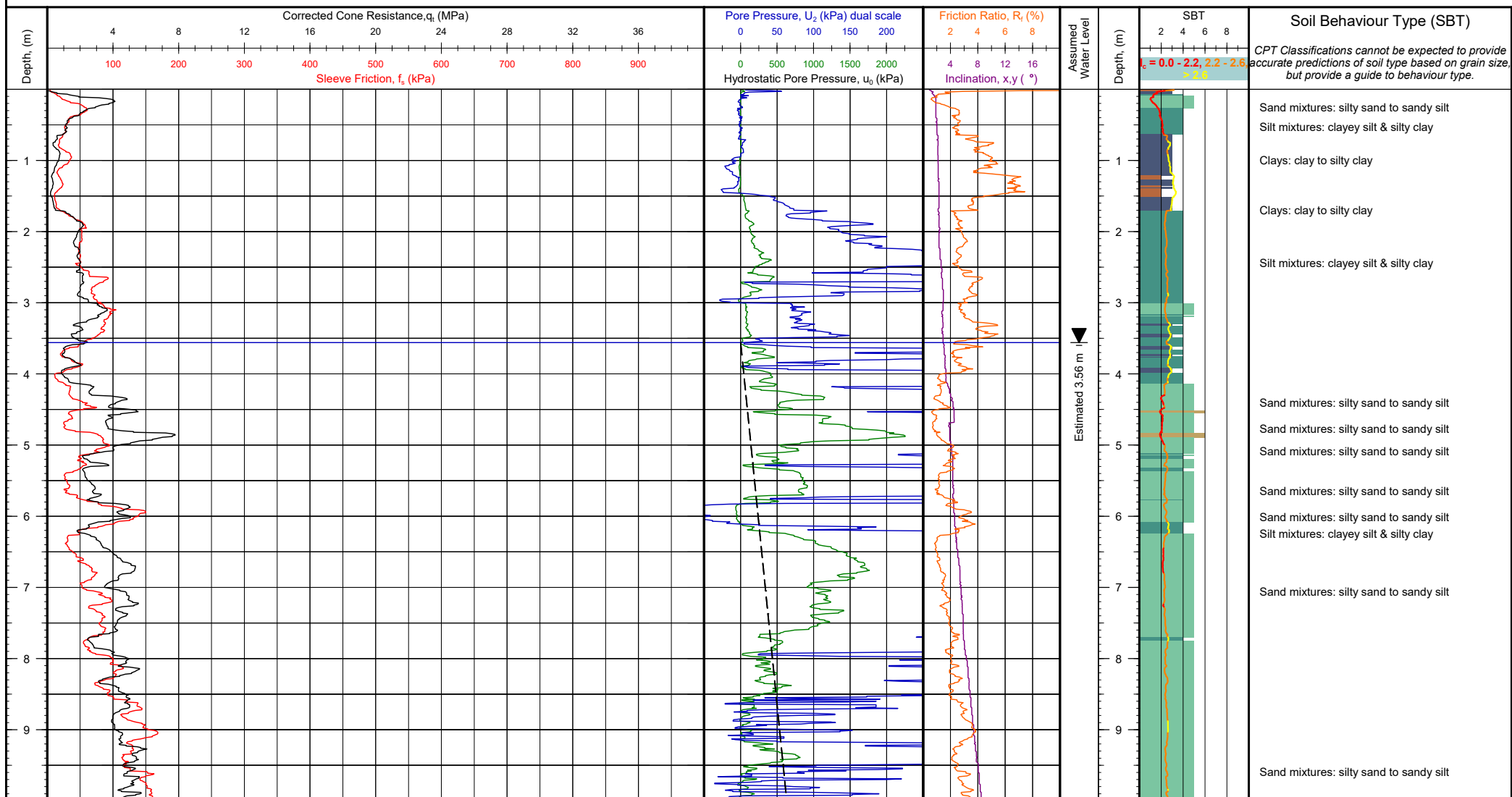
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor	Operator: Ben Thom	NZTM 2000 N, E (m): 5926158.21, 1743337.57	Elevation (m): Unknown	Client Reference:
Project: Whenuapai-Redhills Wastewater Servicing	Cone Ref: MKJ333	WGS84 (deg): -36.799564, 174.606700	Date of Test: 4/11/2020	
Location: Trig Road to Tamiro Road, Auckland	Cone Type: 10cm ² Compression	Location Method: Handheld GPS	Depth (m): 13.46	Test Number: CPT-06
Engineer: Benjamin Westgate	Area Ratio: 0.80	Surveyor:	Pre Drill (m): N/A	
Contractor: Ground Investigation Ltd	Filter Type: u_2	Termination Reason: Inclination high or rapid increase		G.I. Job Ref: 200824

Comments:

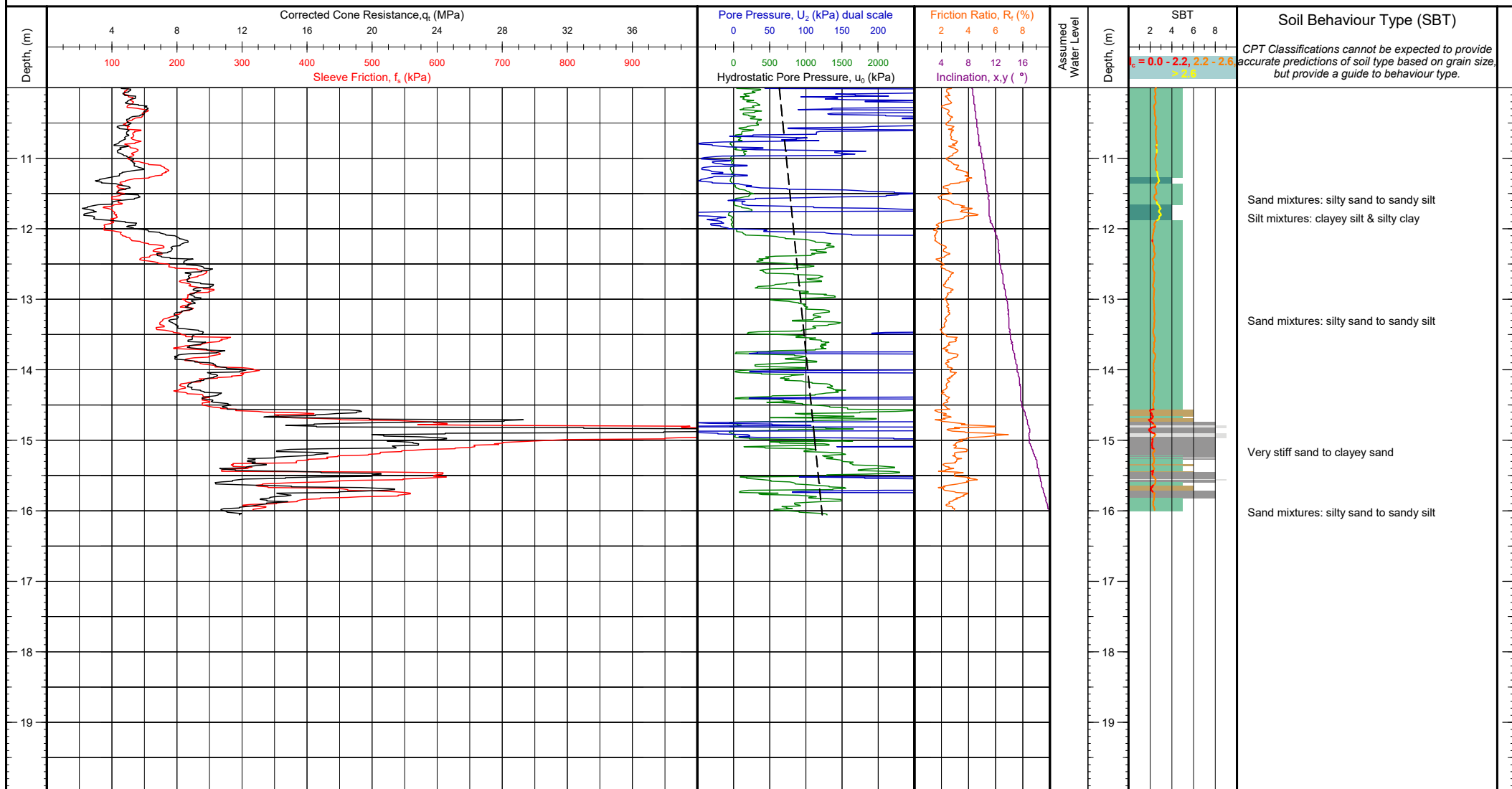
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926057.82, 1743414.41 WGS84 (deg): -36.800457, 174.607580 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 16.06 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-07 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG

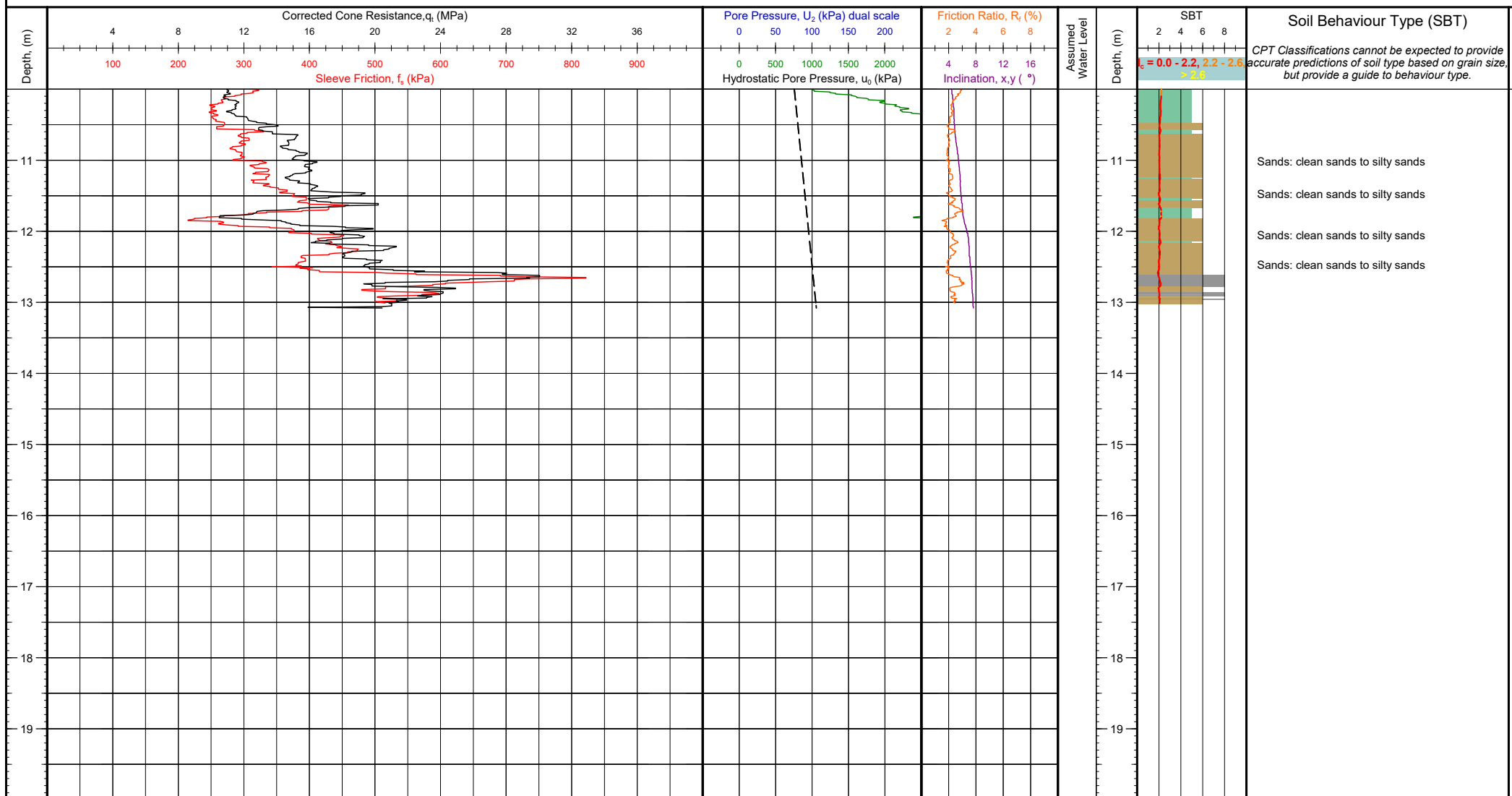


Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926057.82, 1743414.41 WGS84 (deg): -36.800457, 174.607580 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 16.06 Pre Drill (m): N/A	Client Reference: Test Number: CPT-07 G.I. Job Ref: 200824
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Comments:

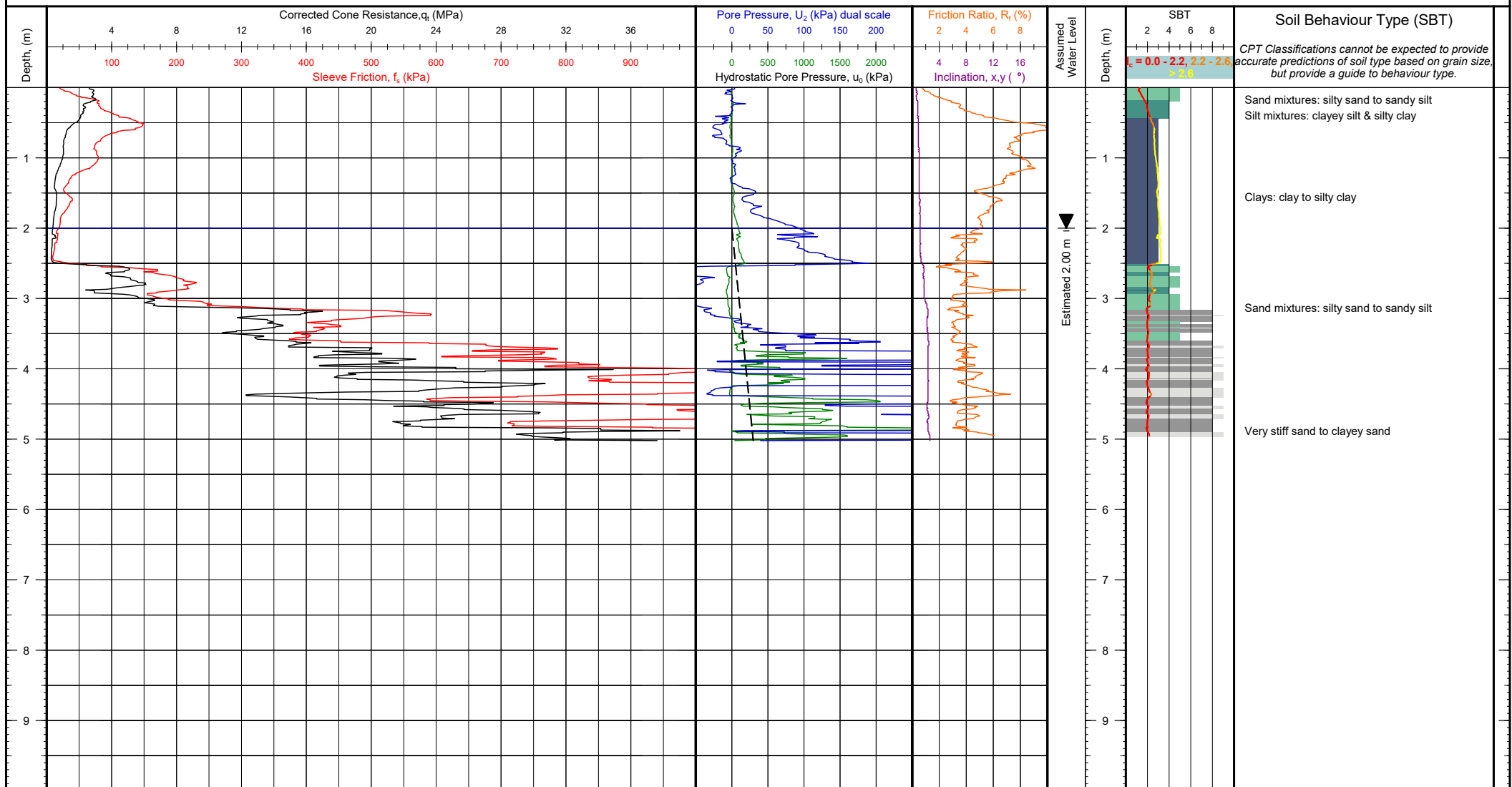
[illegible]

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor	Operator: Ben Thom	NZTM 2000 N, E (m): 5925758.53, 1744112.15	Elevation (m): Unknown	Client Reference:
Project: Whenuapai-Redhills Wastewater Servicing	Cone Ref: MKJ539	WGS84 (deg): -36.803048, 174.615455	Date of Test: 18/11/2020	
Location: Trig Road to Tamiro Road, Auckland	Cone Type: 10cm ² Compression	Location Method: Handheld GPS	Depth (m): 13.08	Test Number: CPT-08
Engineer: Benjamin Westgate	Area Ratio: 0.80	Surveyor:	Pre Drill (m): N/A	
Contractor: Ground Investigation Ltd	Filter Type: u_2	Termination Reason: High pore water pressure		G.I. Job Ref: 200824
Comments:				

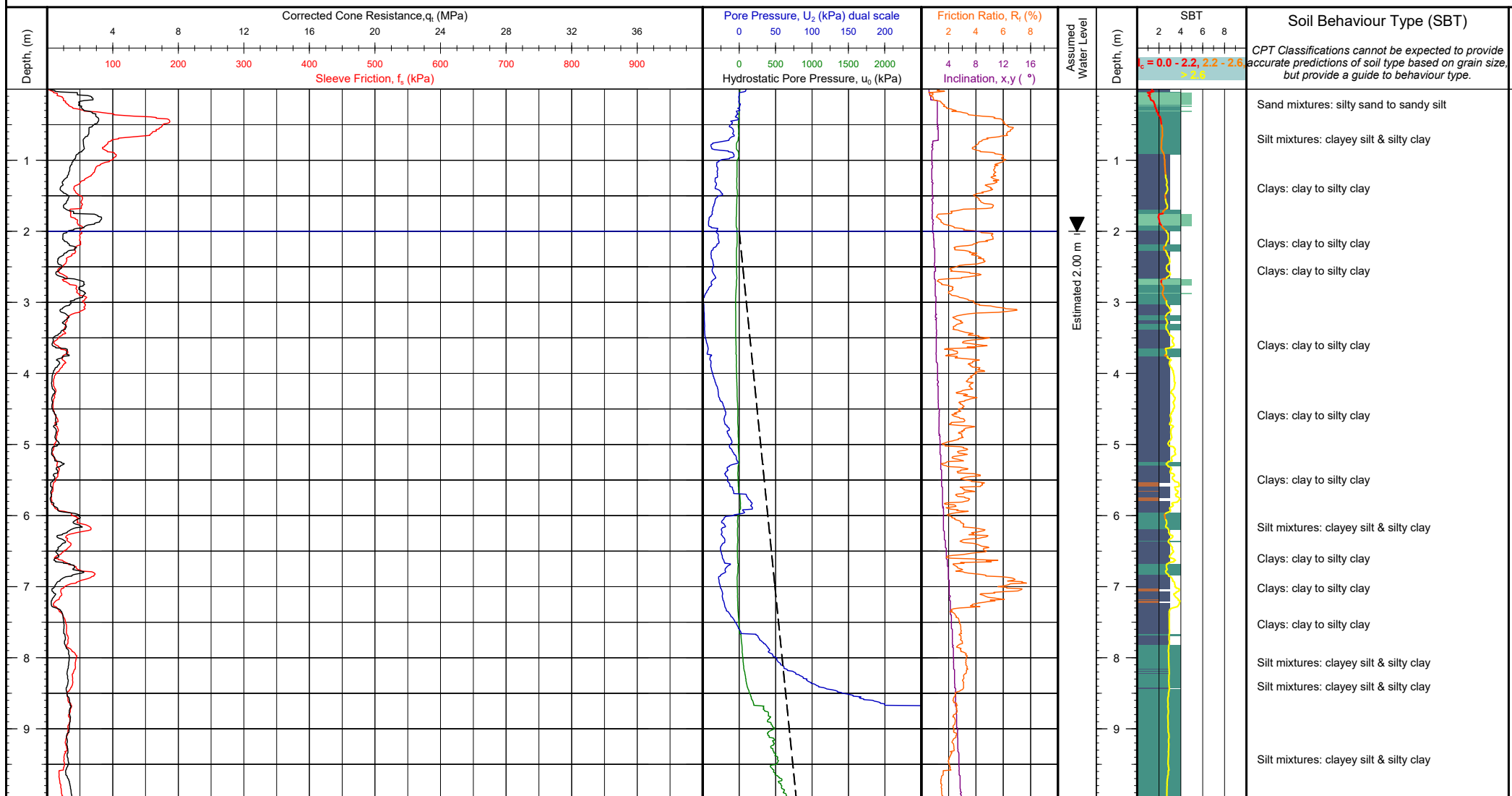
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd Comments:	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u ₂	NZTM 2000 N, E (m): 5926630.28, 1743073.91 WGS84 (deg): -36.795350, 174.603657 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 5.02 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-111
				G.I. Job Ref: 200824

Comments:				
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CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

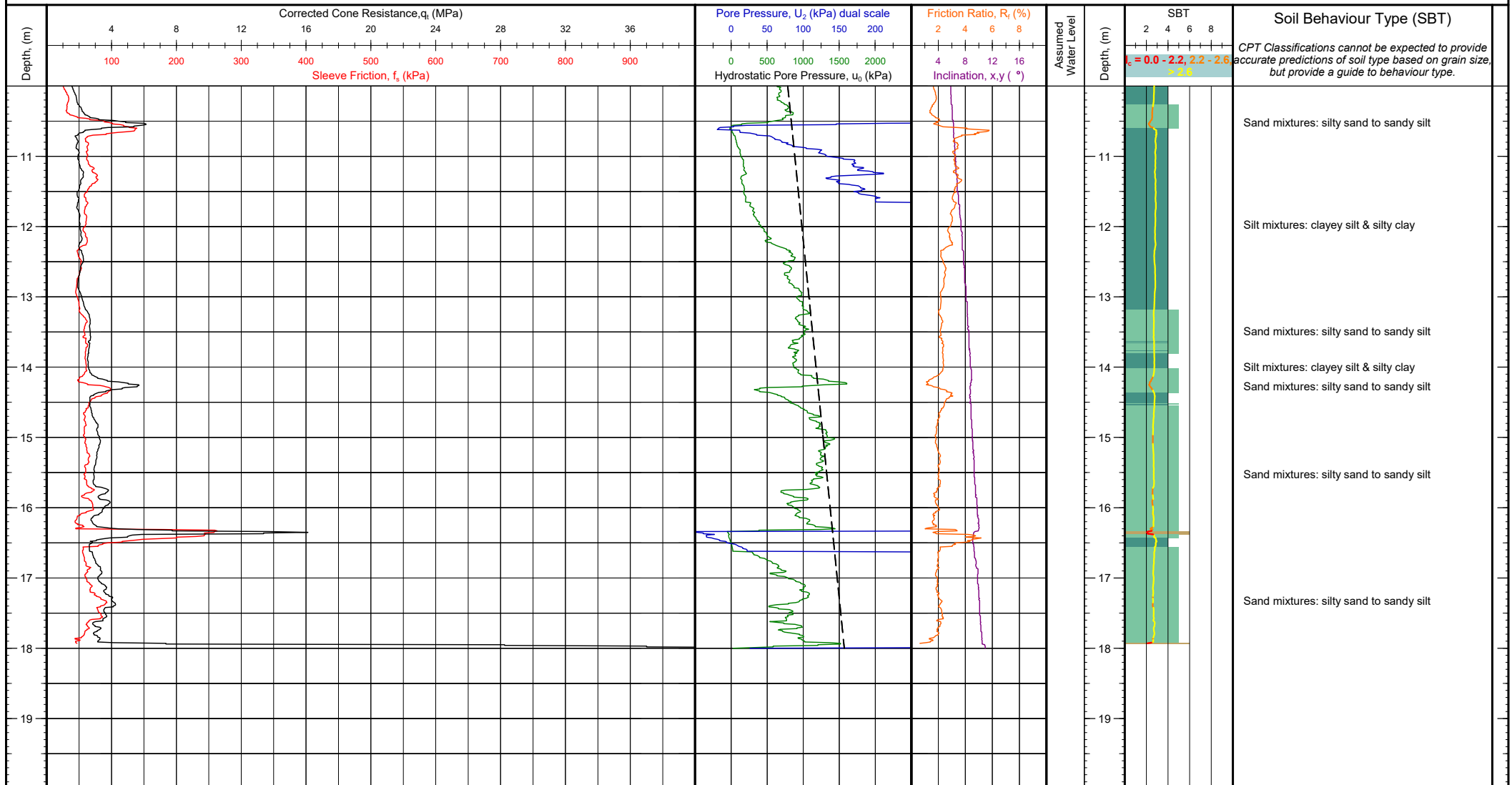
NZTM 2000 N, E (m): 5927036.96, 1743360.27
WGS84 (deg): -36.791642, 174.606789
Location Method: Handheld GPS
Surveyor:
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 18.00
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-117
G.I. Job Ref: 200824

Comments:

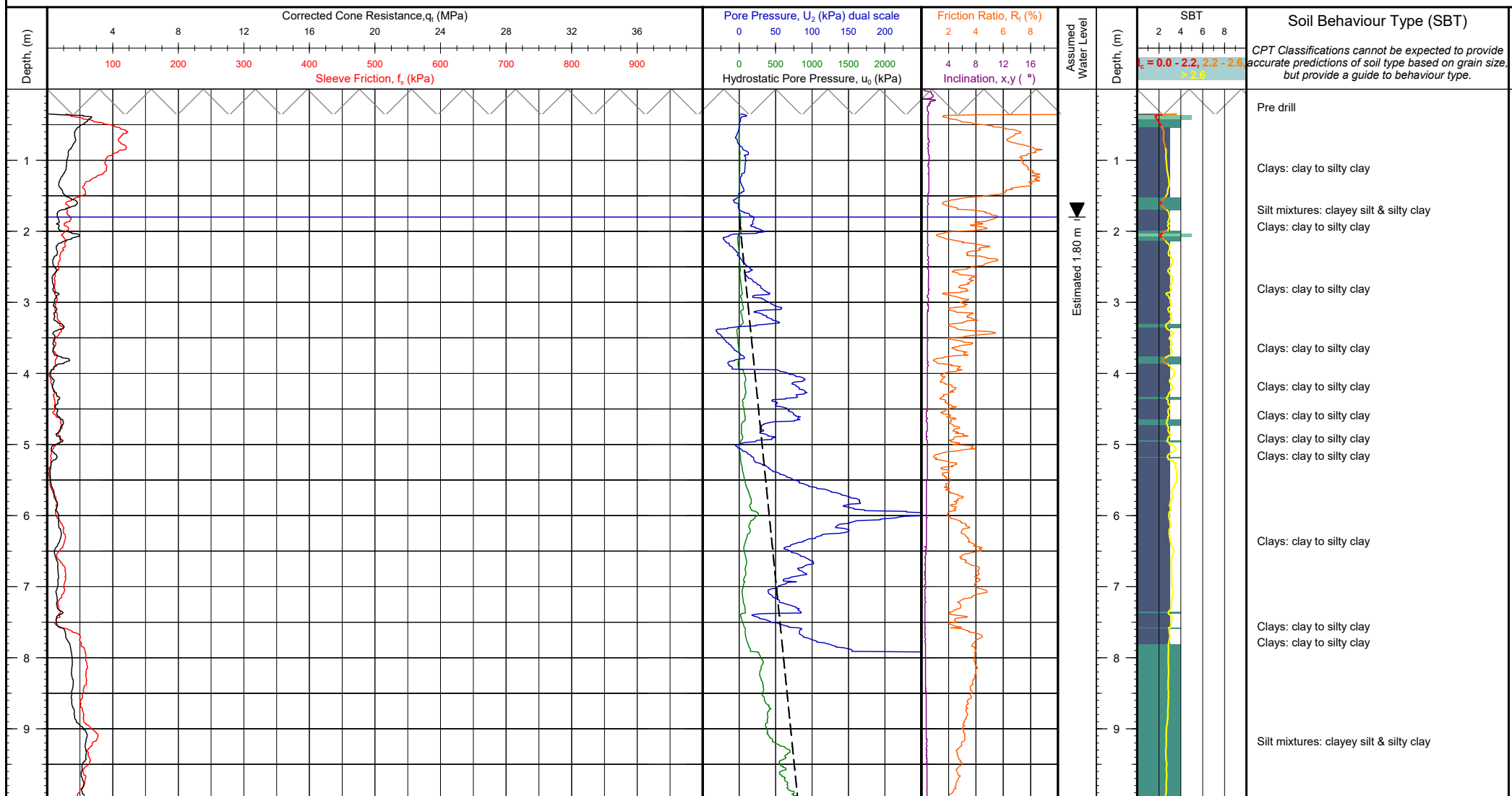
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5927036.96, 1743360.27 WGS84 (deg): -36.791642, 174.606789 Location Method: Handheld GPS Surveyor: Termination Reason: High cone end resistance	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 18.00 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-117 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

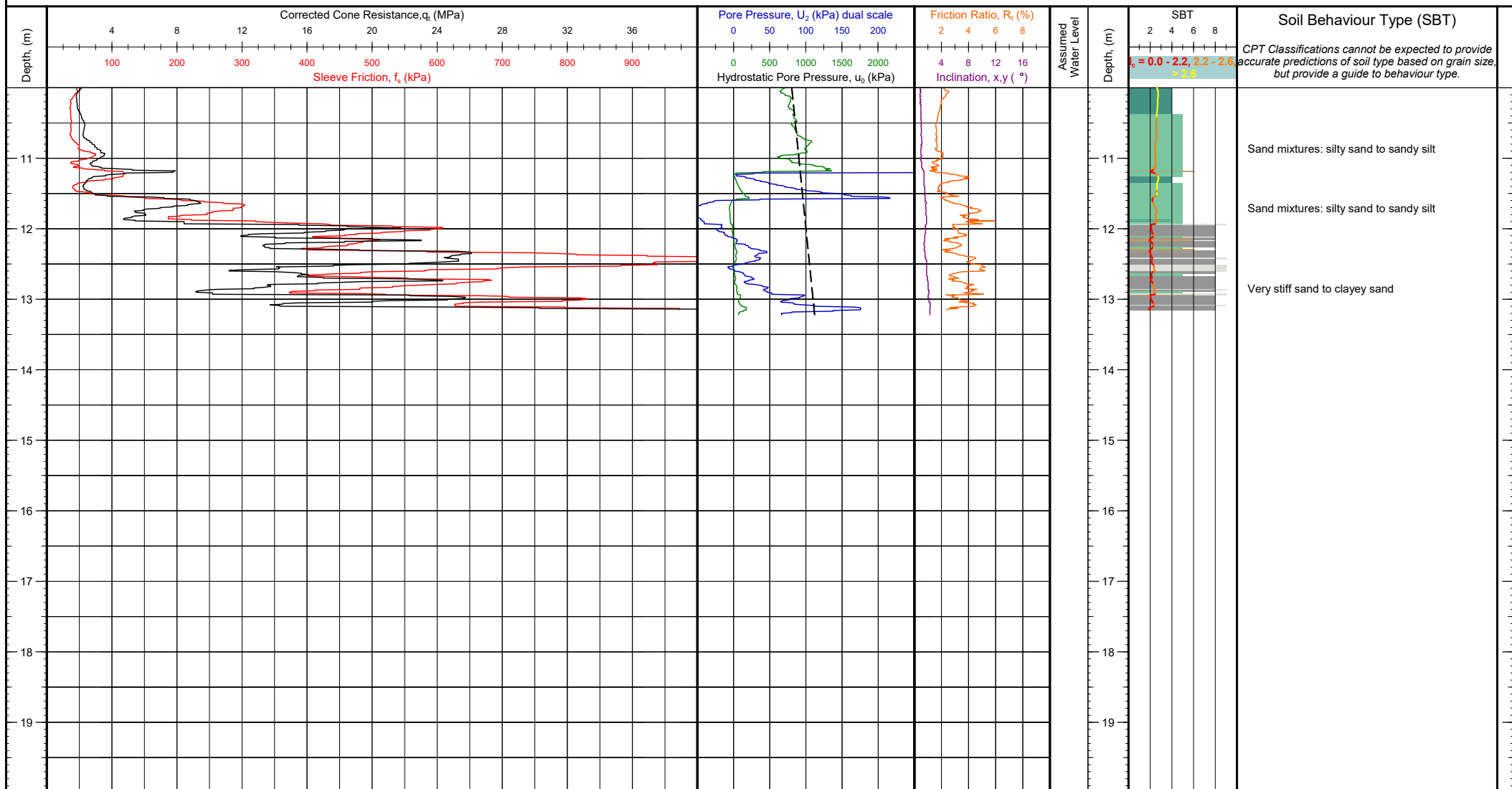
NZTM 2000 N, E (m): 5926965.38, 1743234.65
WGS84 (deg): -36.792306, 174.605395
Location Method: Handheld GPS
Surveyor:
Termination Reason: High total load

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 13.22
Pre Drill (m): 0.34 m

Client Reference:
Test Number: CPT-121
G.I. Job Ref: 200824

Comments:

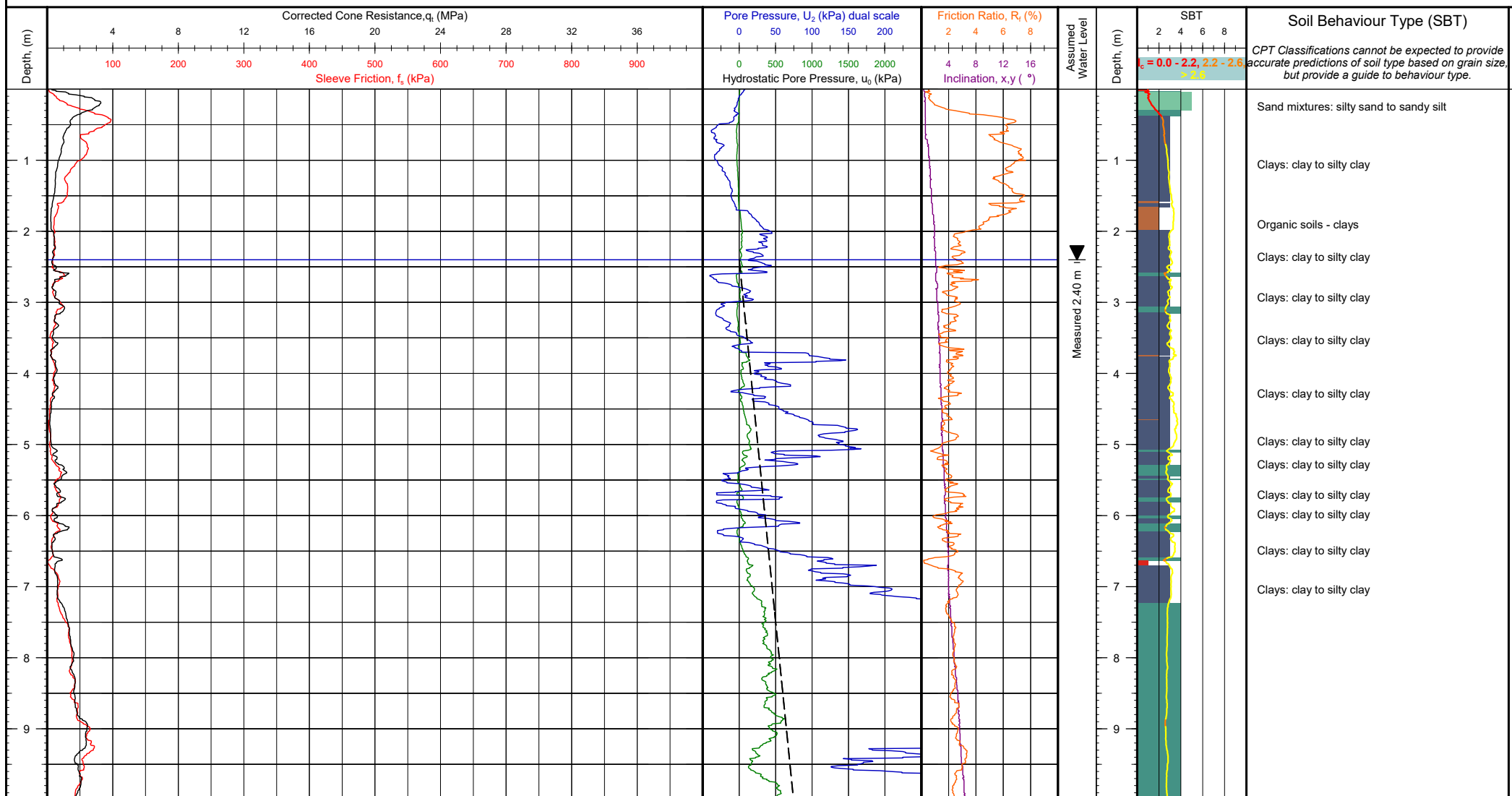
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926965.38, 1743234.65 WGS84 (deg): -36.792306, 174.605395 Location Method: Handheld GPS Surveyor: Termination Reason: High total load	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 13.22 Pre Drill (m): 0.34 m	Client Reference:
				Test Number: CPT-121 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

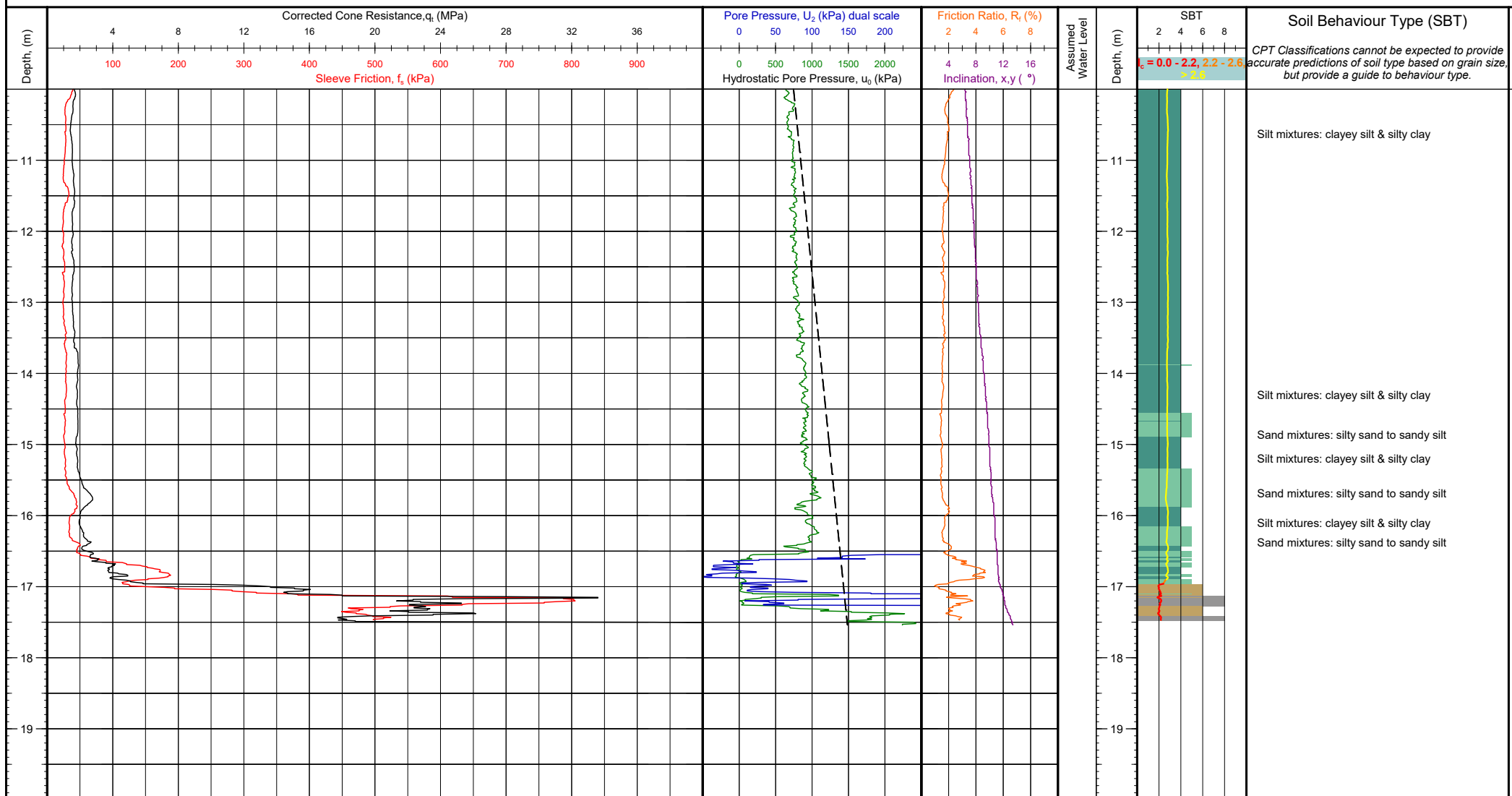
NZTM 2000 N, E (m): 5926924.83, 1743237.45
WGS84 (deg): -36.792671, 174.605434
Location Method: Handheld GPS
Surveyor:
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 17.54
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-126
G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

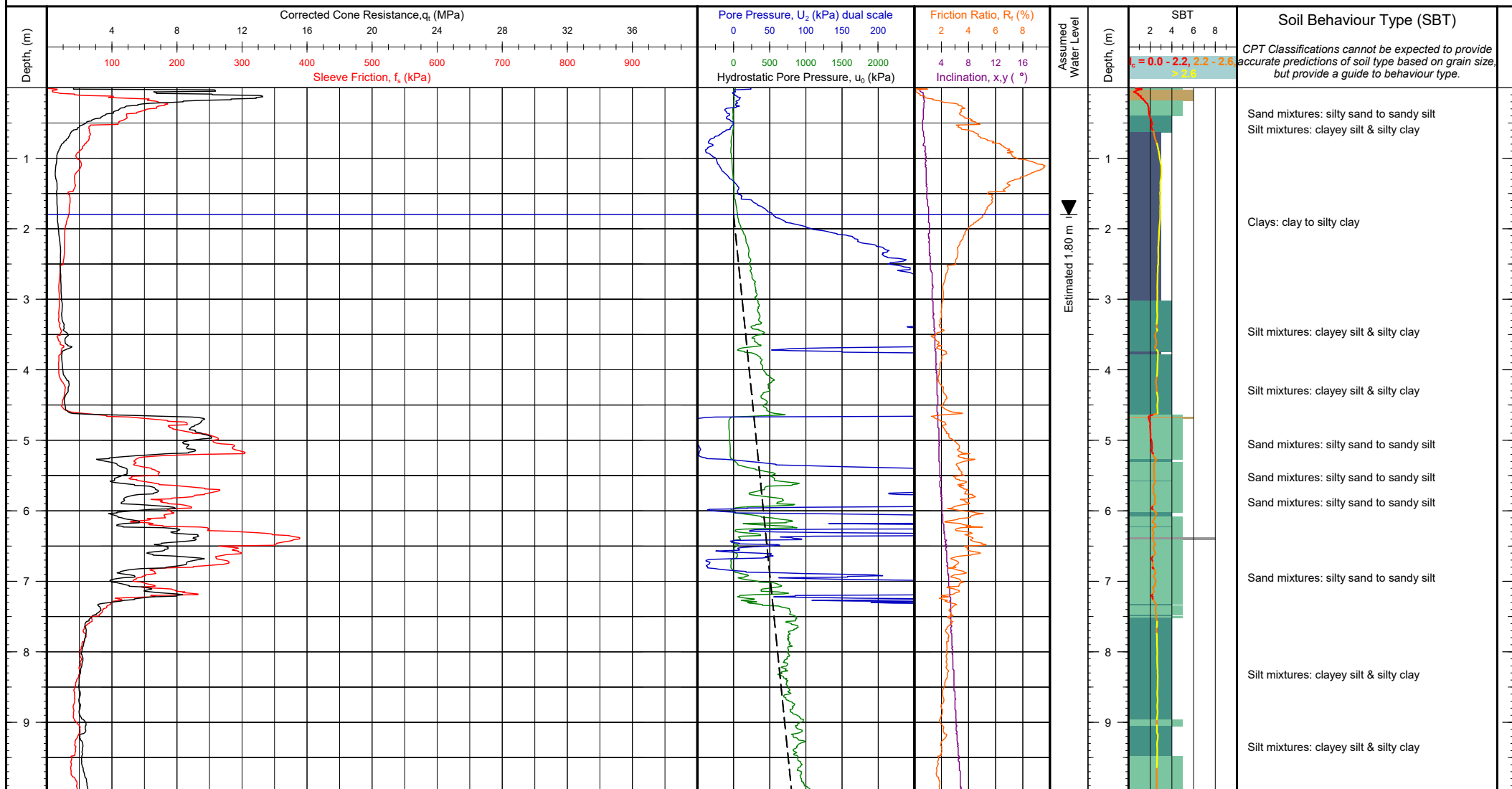
NZTM 2000 N, E (m): 5926924.83, 1743237.45
WGS84 (deg): -36.792671, 174.605434
Location Method: Handheld GPS
Surveyor:
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 17.54
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-126
G.I. Job Ref: 200824

Comments:

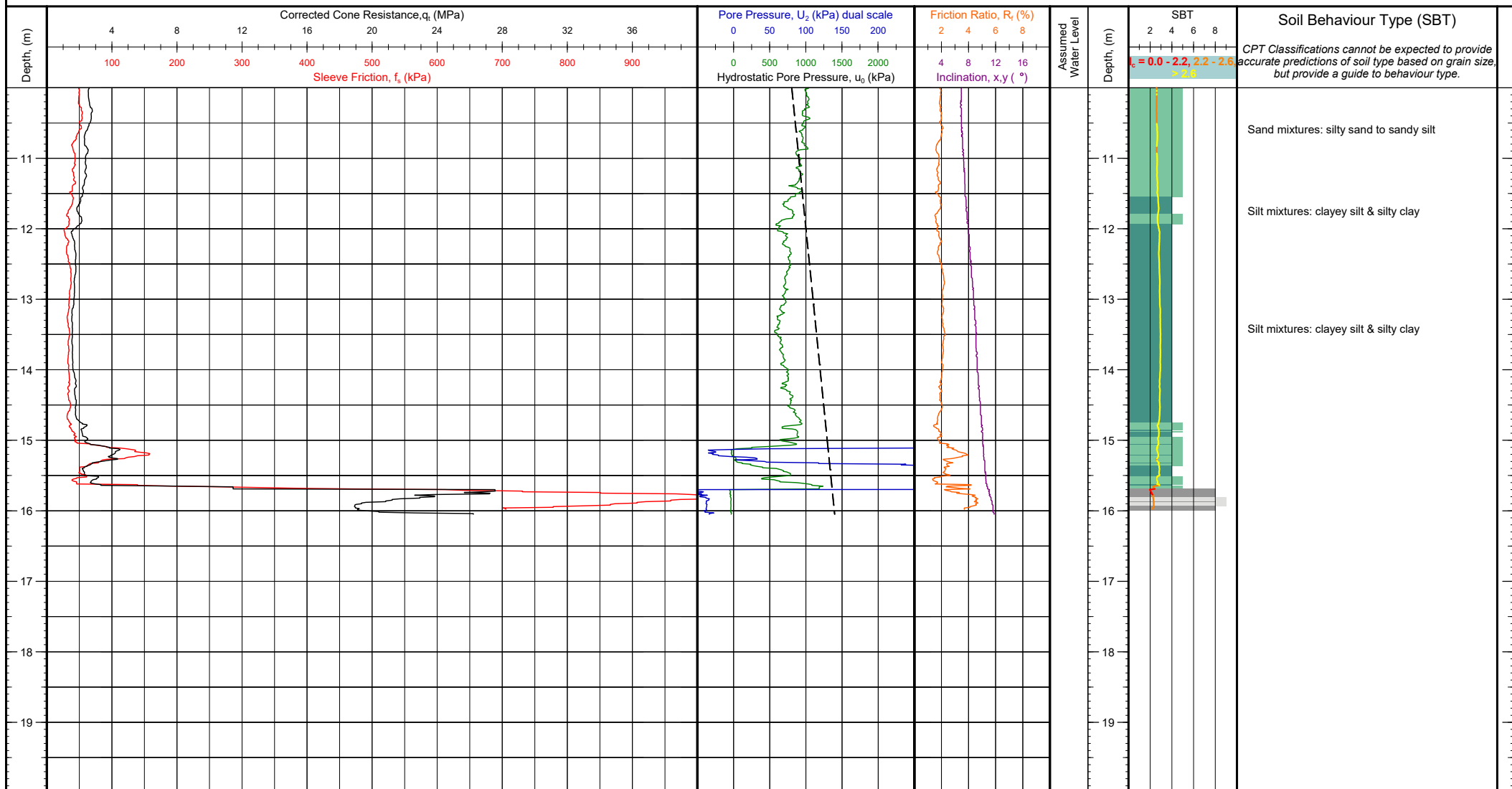
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926740.32, 1743076.38 WGS84 (deg): -36.794358, 174.603664 Location Method: Handheld GPS Surveyor: Termination Reason: High total load	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 16.05 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-128 G.I. Job Ref: 200824

Comments:

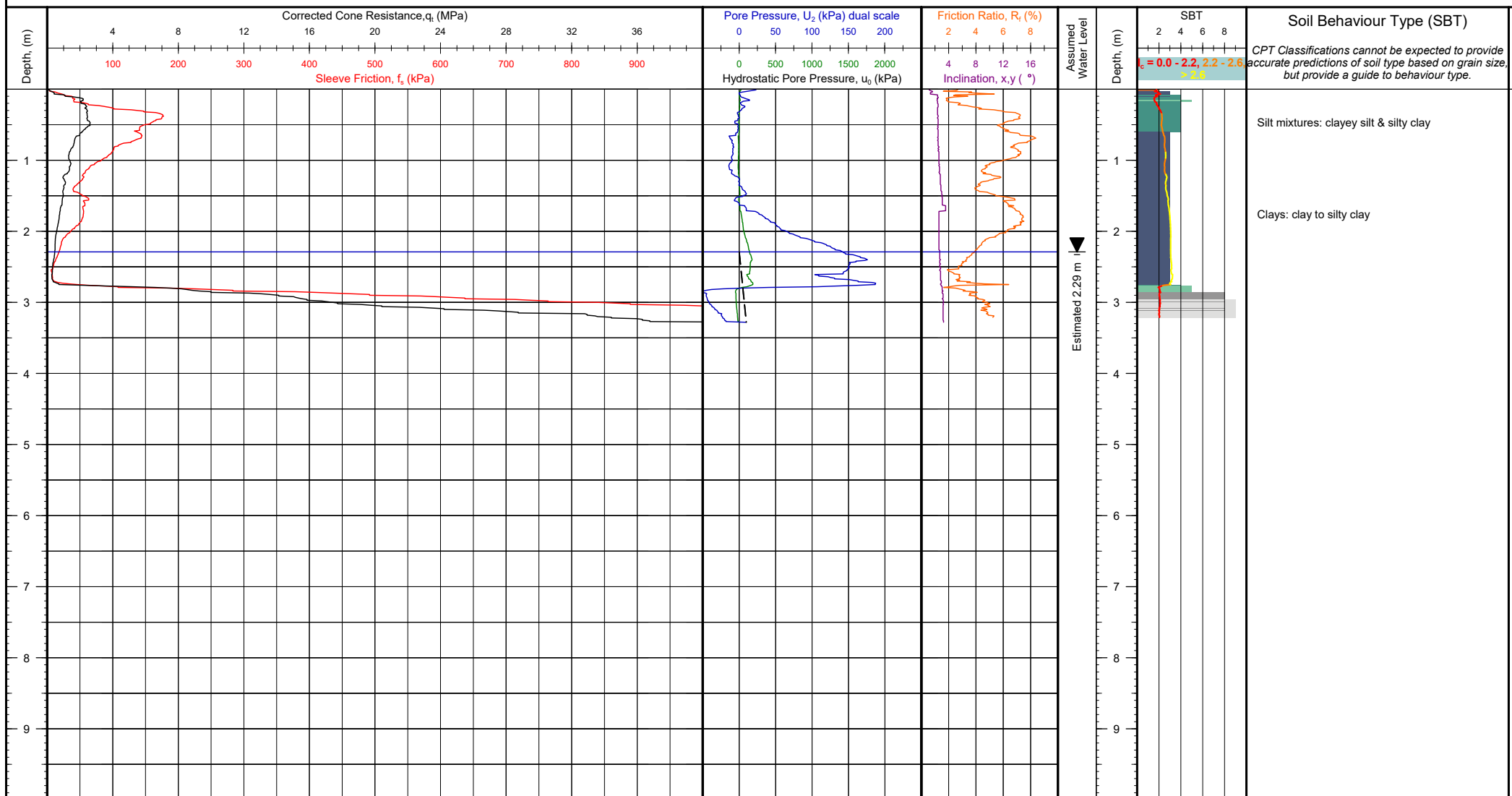
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926740.32, 1743076.38 WGS84 (deg): -36.794358, 174.603664 Location Method: Handheld GPS Surveyor: Termination Reason: High total load	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 16.05 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-128 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

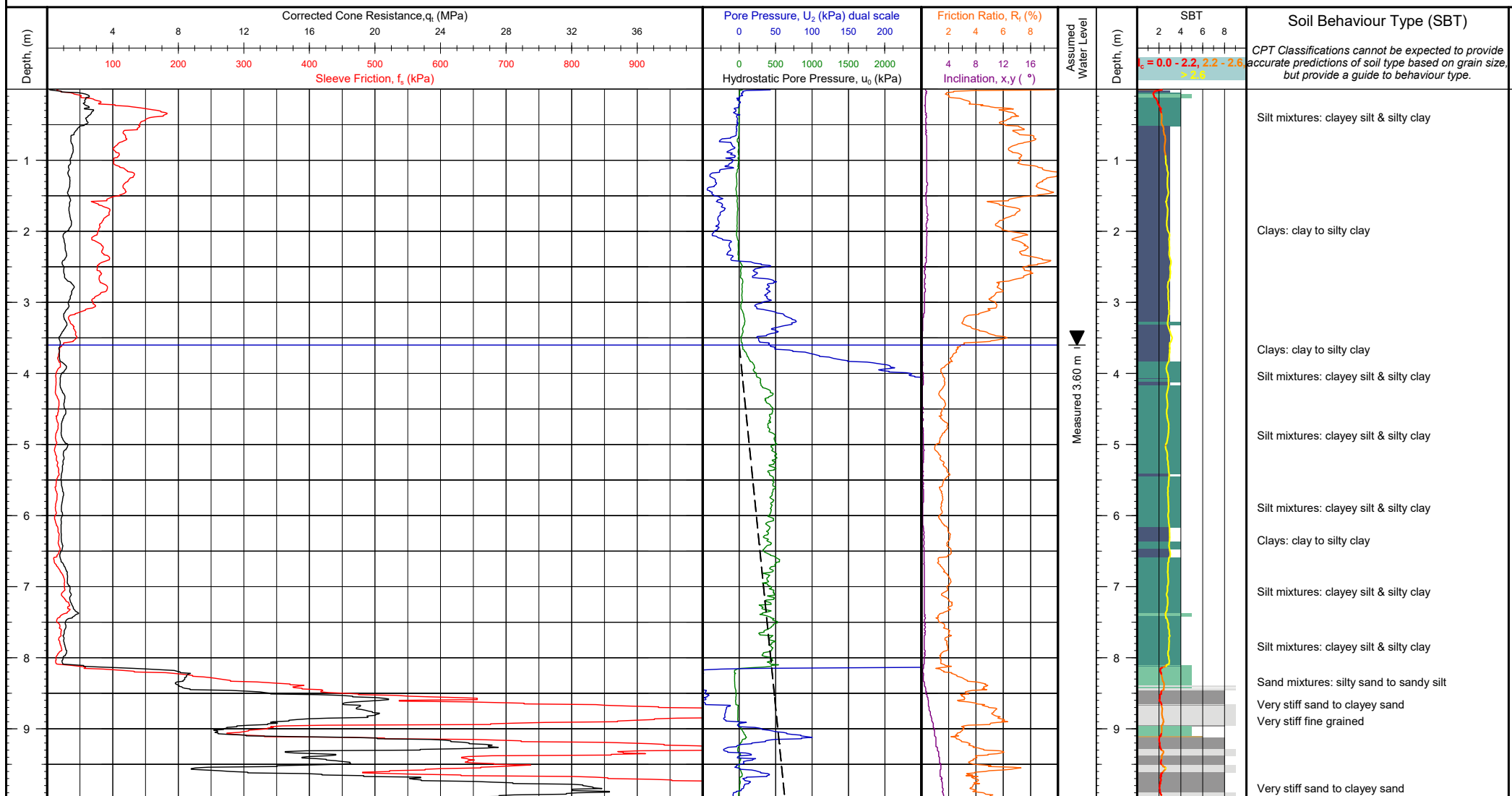
NZTM 2000 N, E (m): 5926650.80, 1743015.08
WGS84 (deg): -36.795174, 174.602994
Location Method: Handheld GPS
Surveyor:
Termination Reason: High friction resistance

Elevation (m): Unknown
Date of Test: 3/11/2020
Depth (m): 3.28
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-129
G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u₂

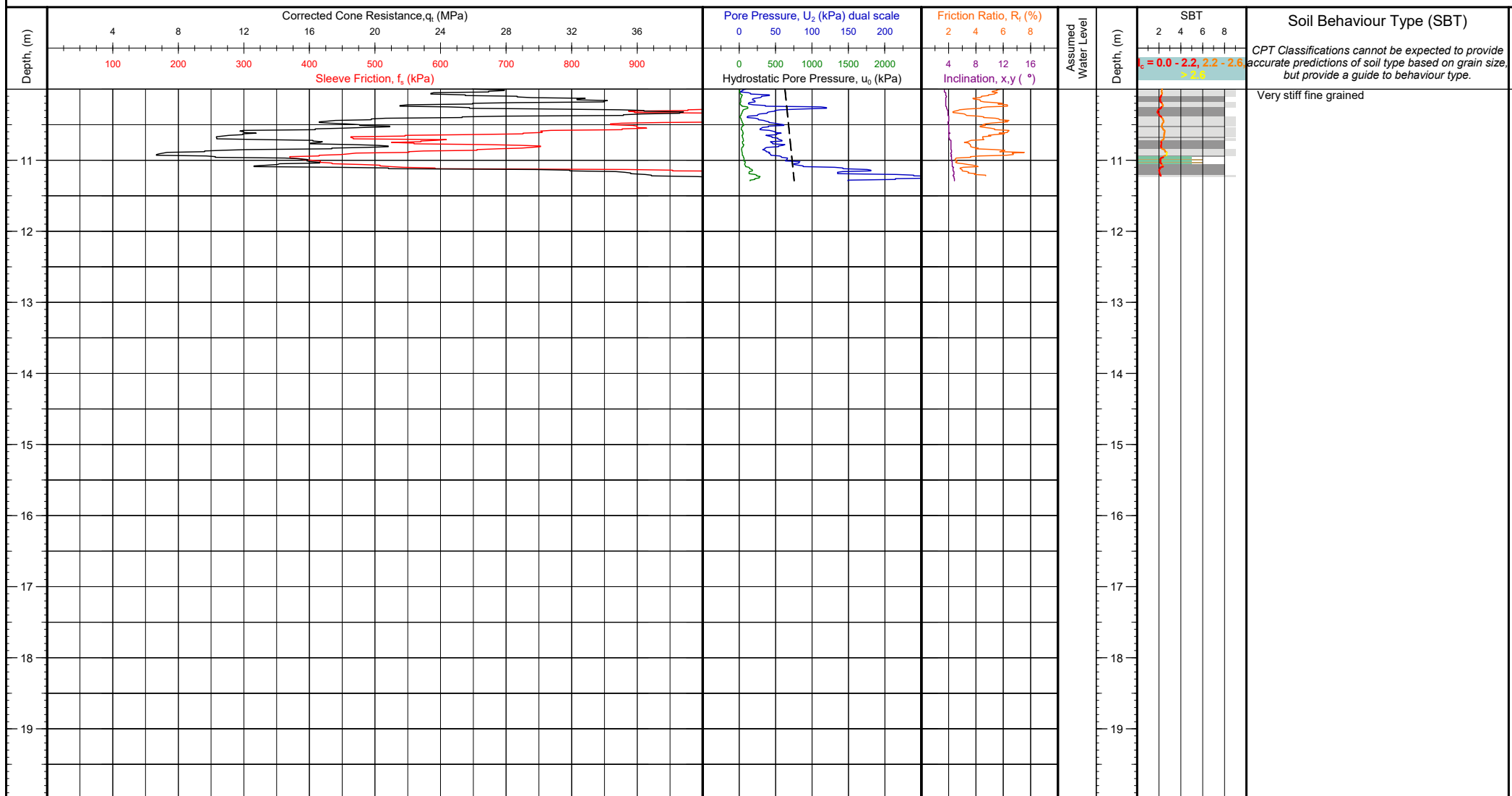
NZTM 2000 N, E (m): 5926584.78, 1743106.98
WGS84 (deg): -36.795755, 174.604036
Location Method: Handheld GPS
Surveyor:
Termination Reason: High friction resistance

Elevation (m): Unknown
Date of Test: 3/11/2020
Depth (m): 11.29
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-131
G.I. Job Ref: 200824

Comments:

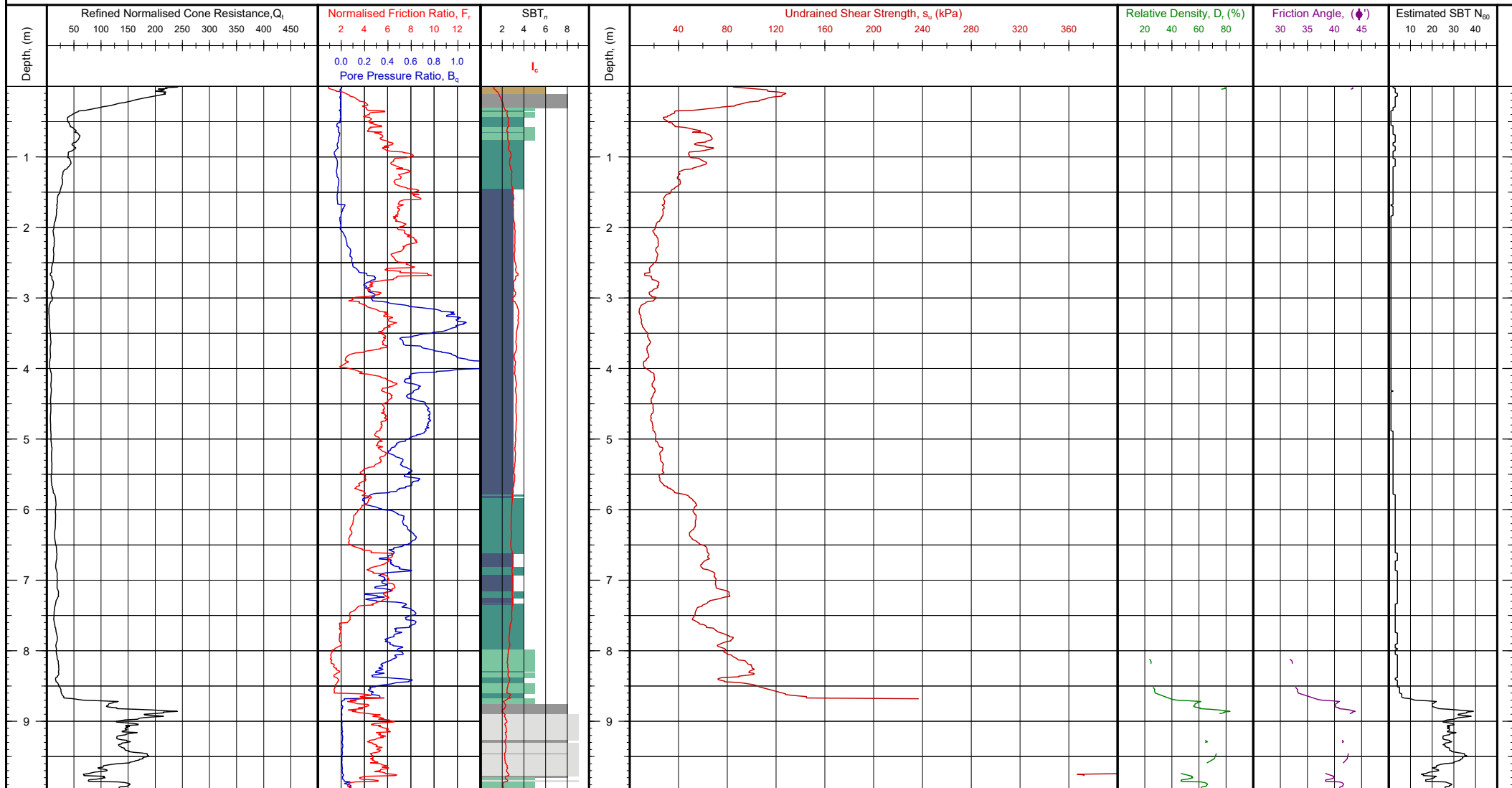
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926584.78, 1743106.98 WGS84 (deg): -36.795755, 174.604036 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 11.29 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-131 G.I. Job Ref: 200824

Comments:

CPT PARAMETER LOG



Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-02

G.I. Job Ref: 200824

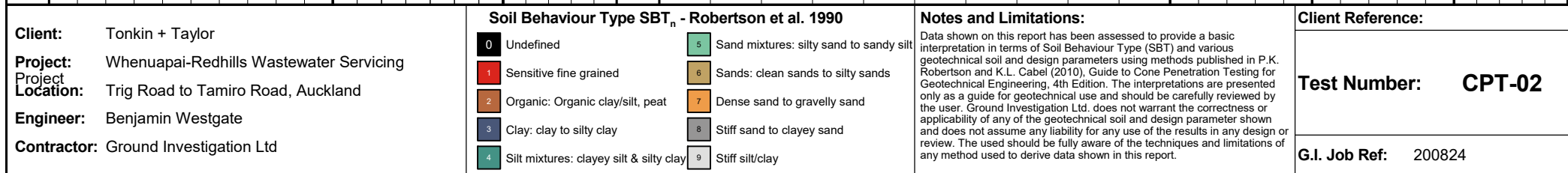
Client: Tonkin + Taylor

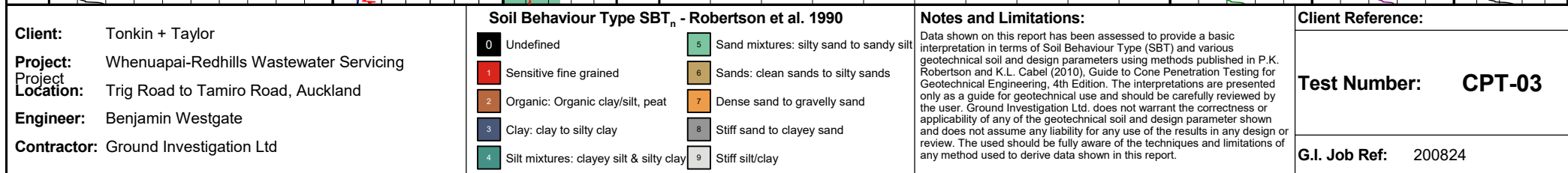
Project: Whenuapai-Redhills Wastewater Servicing

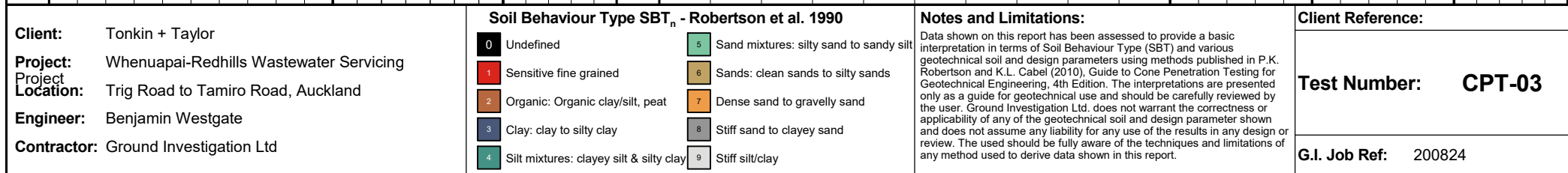
Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

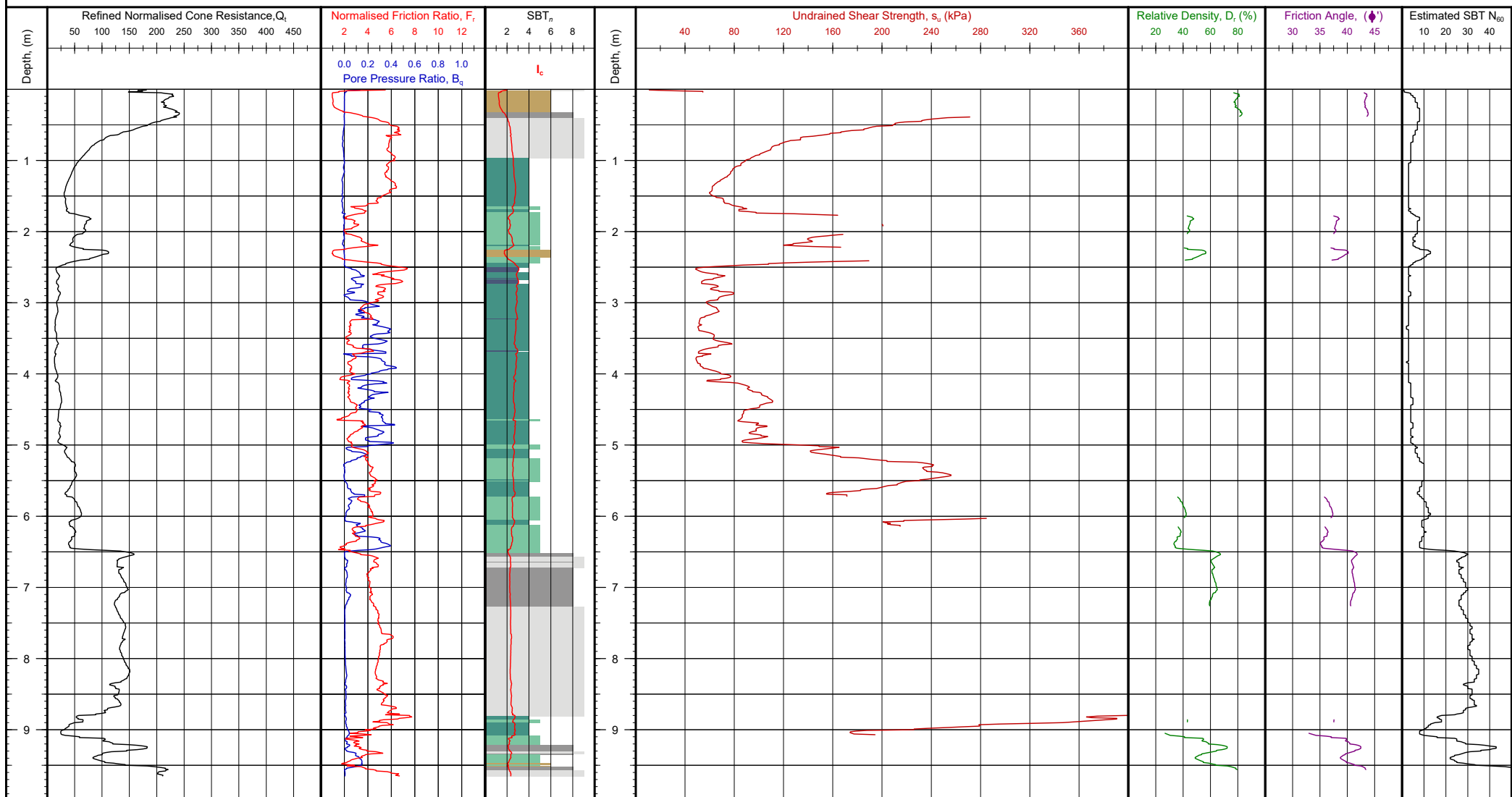
Contractor: Ground Investigation Ltd







CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

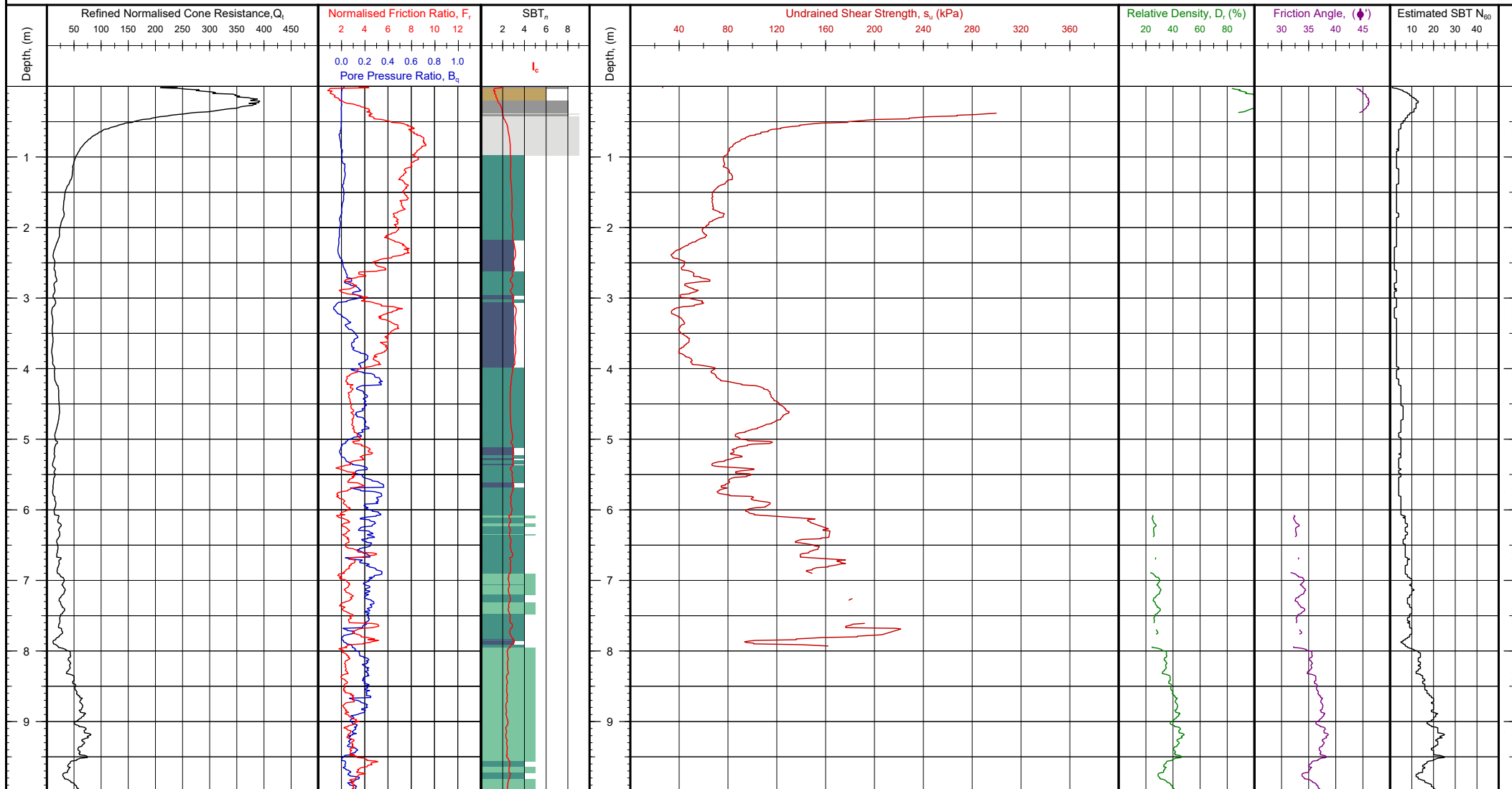
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-04

G.I. Job Ref: 200824

CPT PARAMETER LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

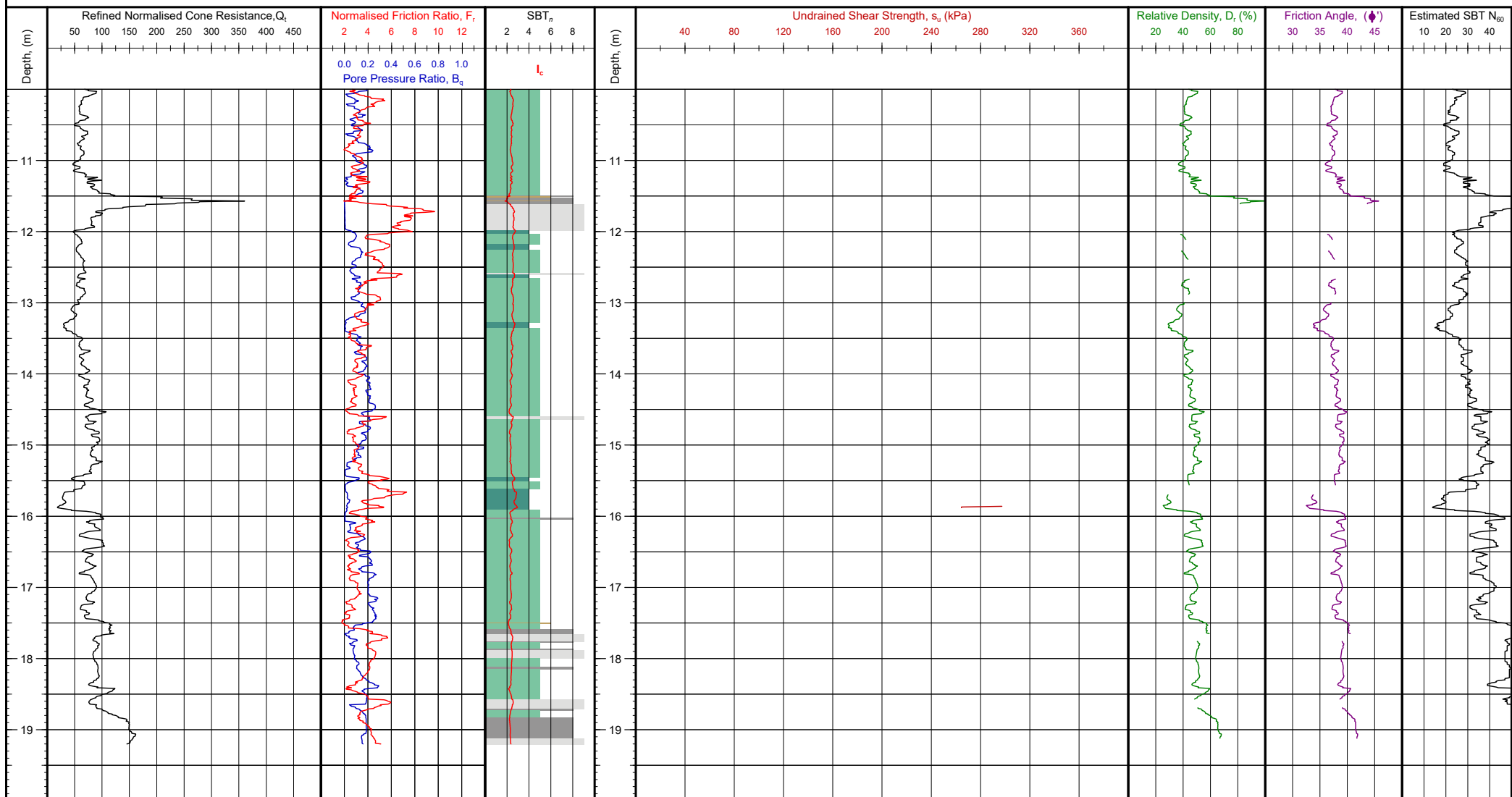
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-05

G.I. Job Ref: 200824

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

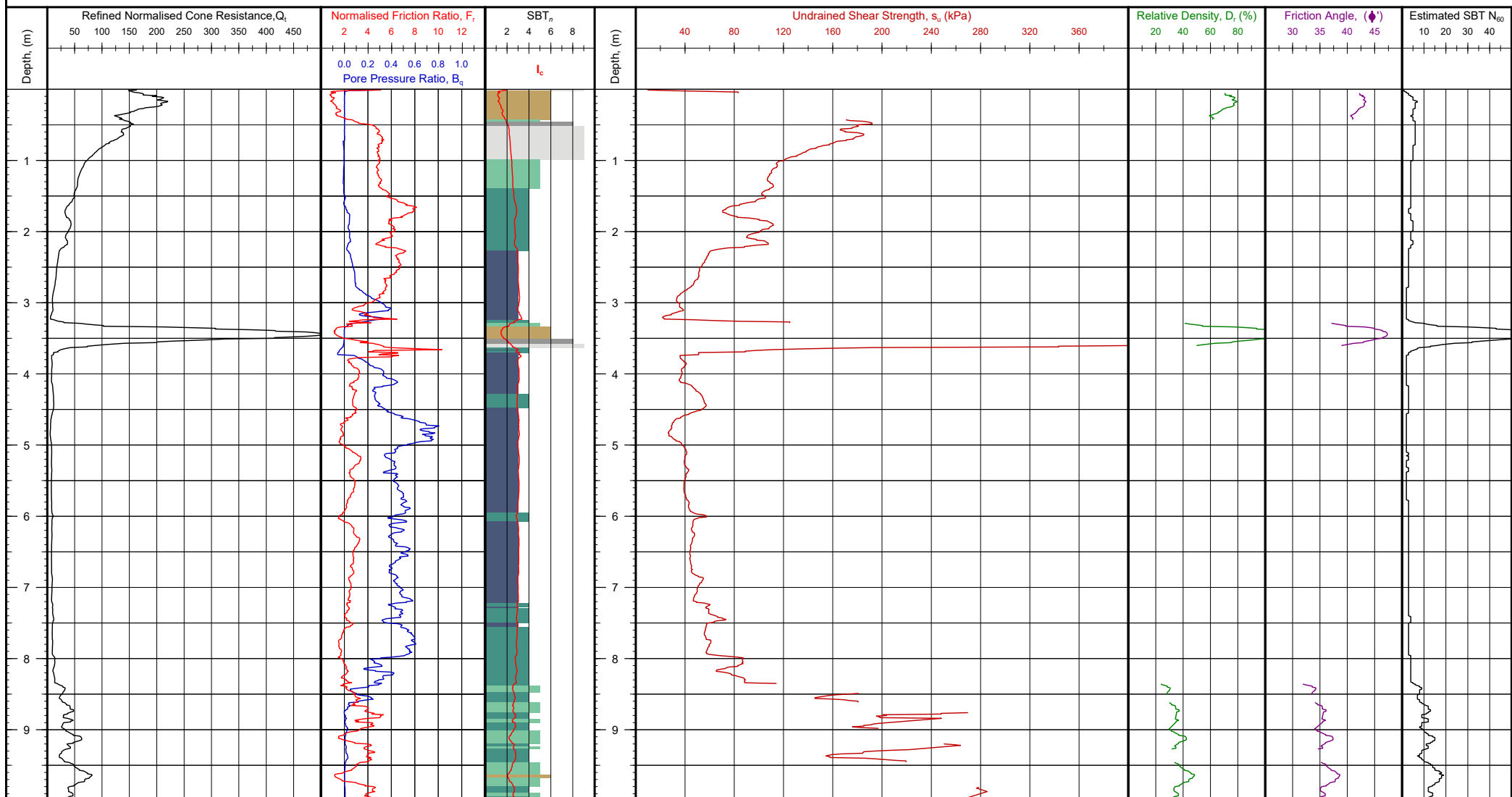
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-05

G.I. Job Ref: 200824

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

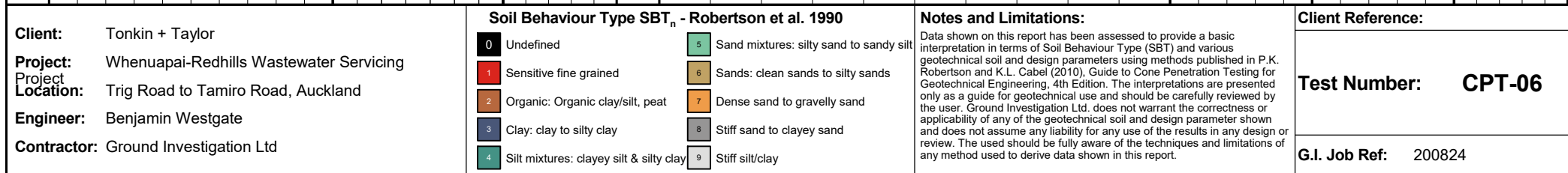
Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-06

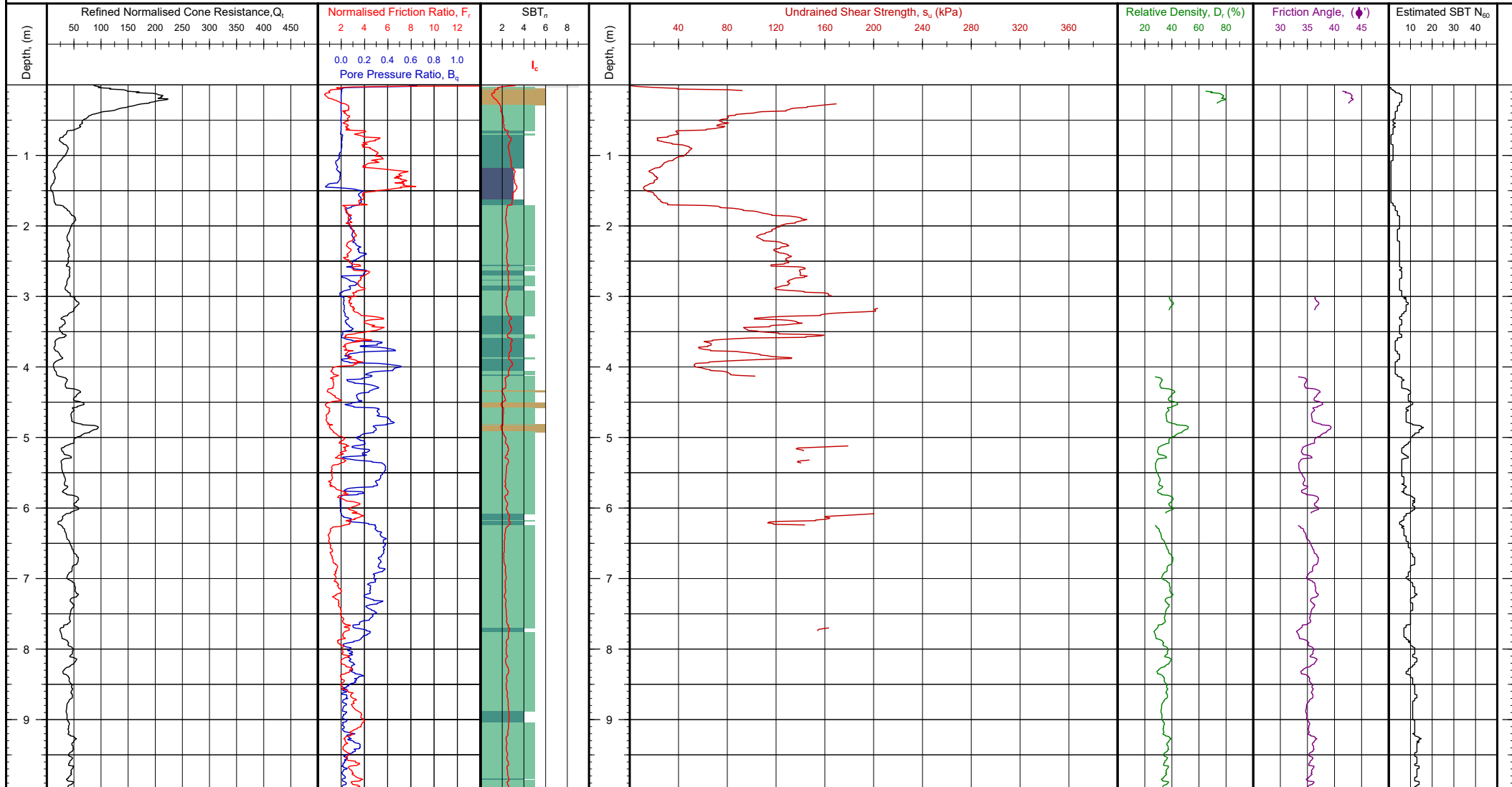
G.I. Job Ref: 200824





Tonkin+Taylor

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

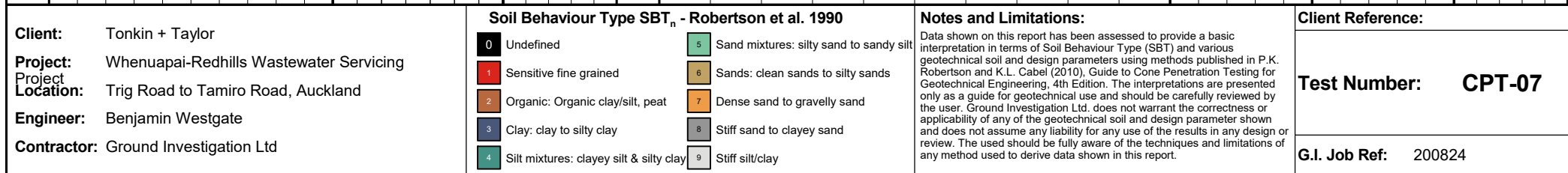
Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

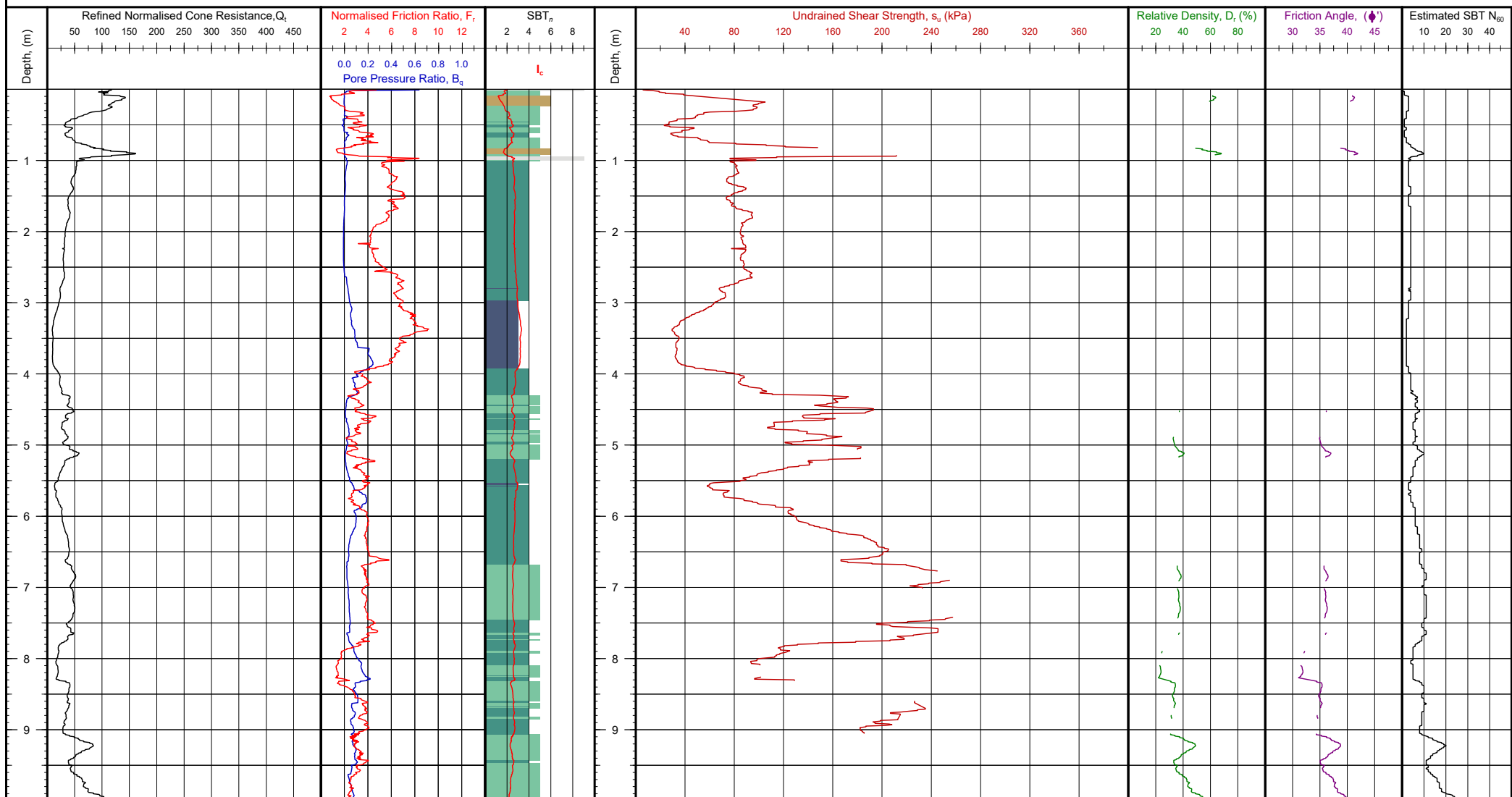
Client Reference:

Test Number: CPT-07

G.I. Job Ref: 200824



CPT PARAMETER LOG



Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

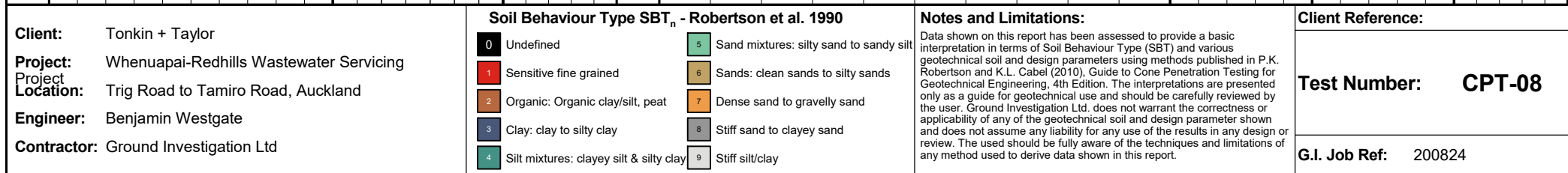
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-08

G.I. Job Ref: 200824

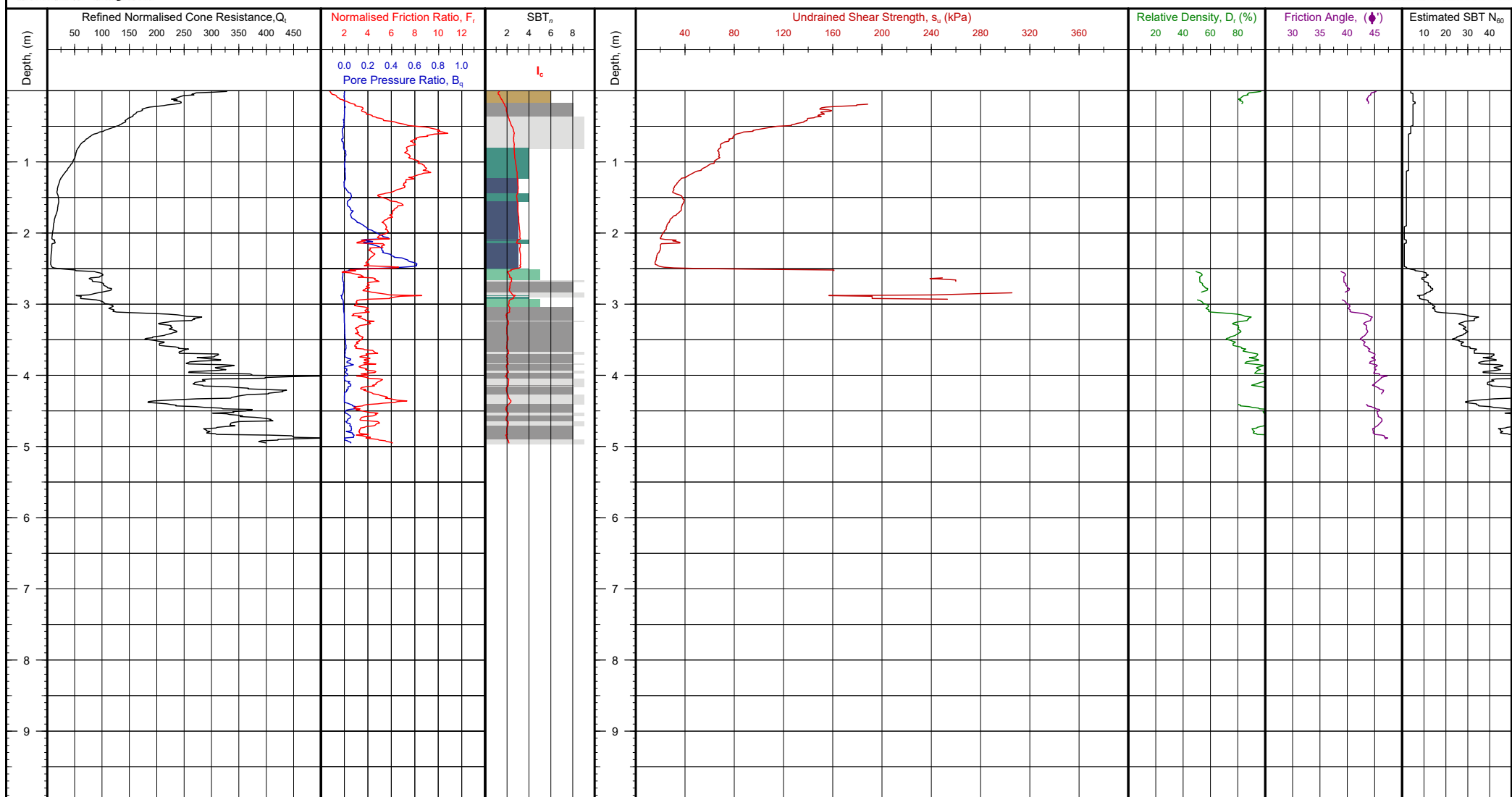
Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd





Tonkin+Taylor

CPT PARAMETER LOG



Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: **CPT-111**

G.I. Job Ref: 200824

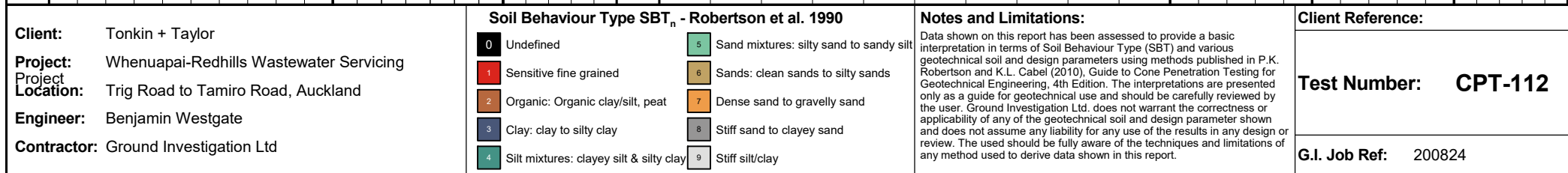
Client: Tonkin + Taylor

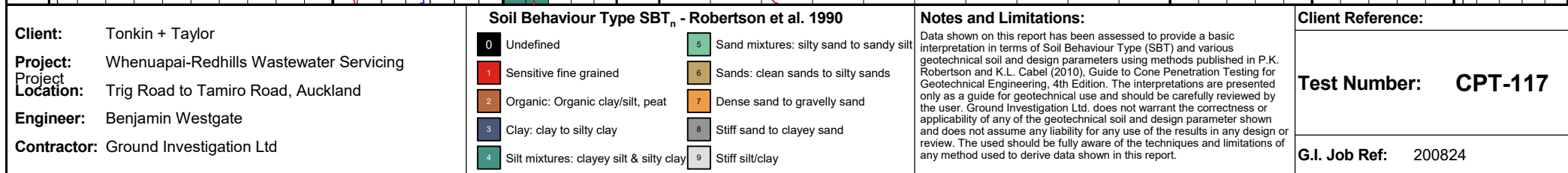
Project: Whenuapai-Redhills Wastewater Servicing

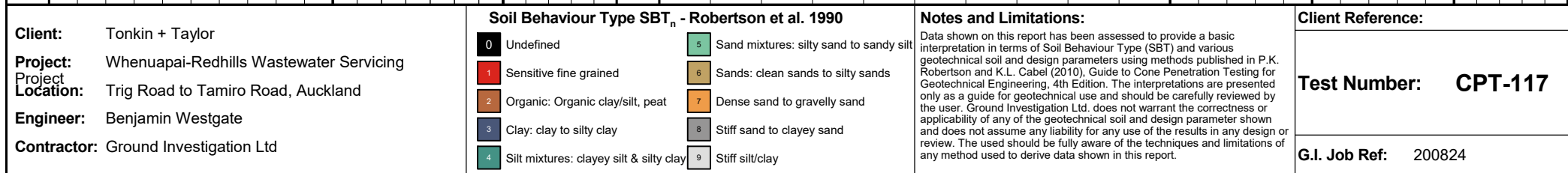
Location: Trig Road to Tamiro Road, Auckland

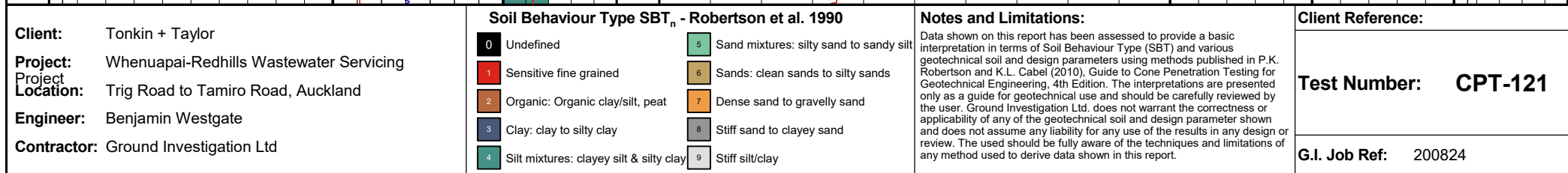
Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

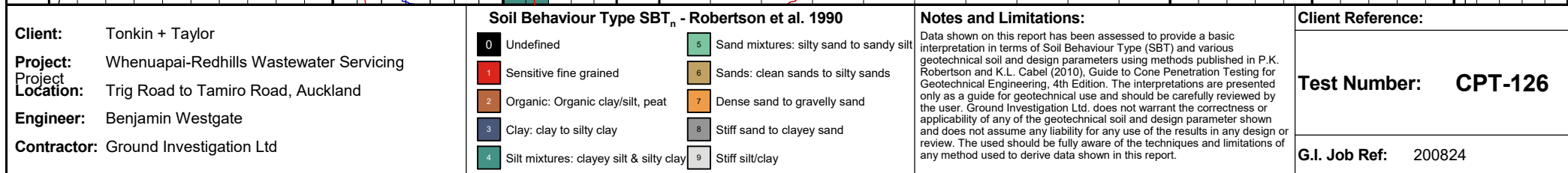


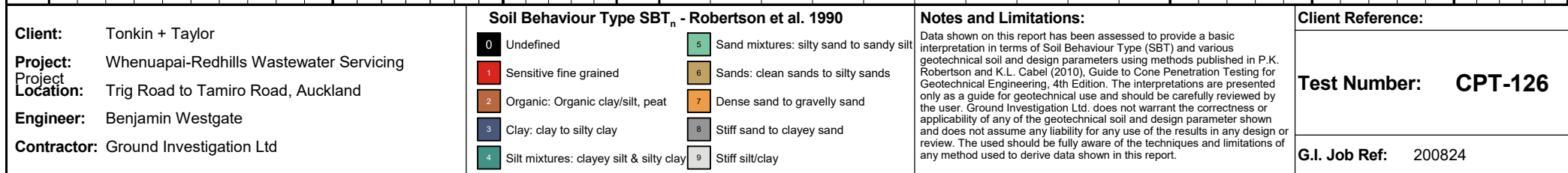








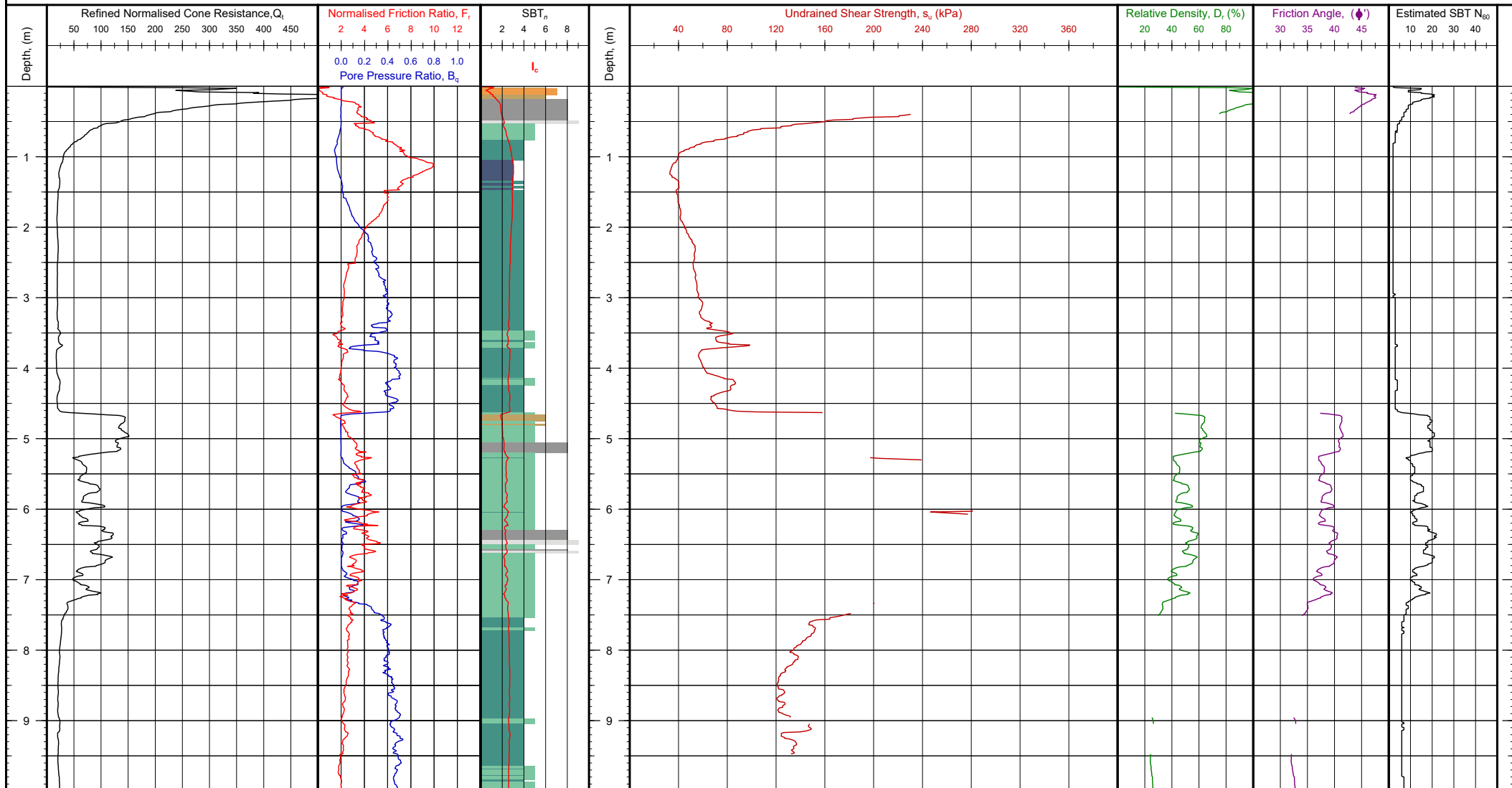






Tonkin+Taylor

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-128

G.I. Job Ref: 200824

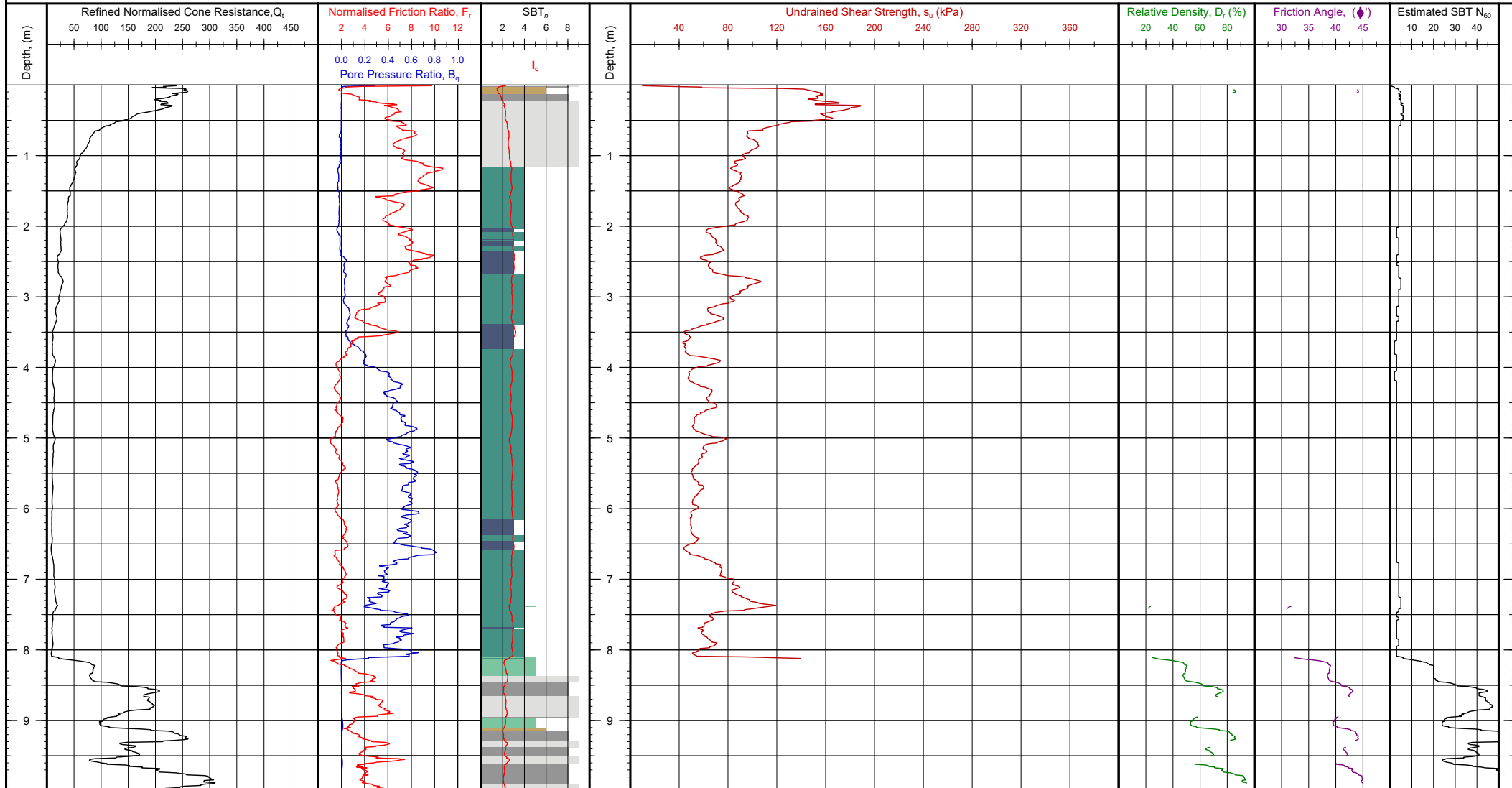






Tonkin+Taylor

CPT PARAMETER LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

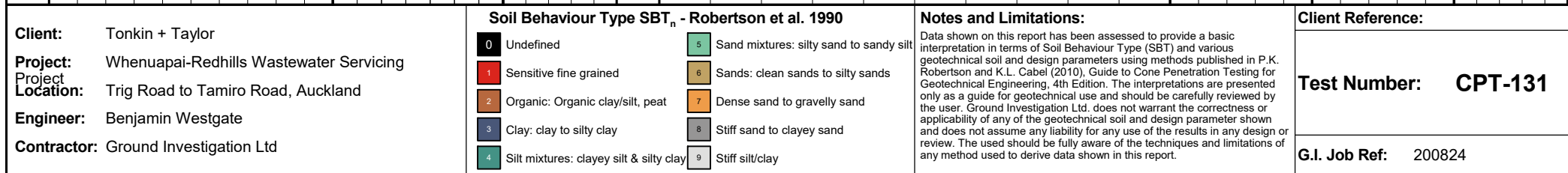
Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-131

G.I. Job Ref: 200824



CPT ZEROS AND DRIFT

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)
MKJ325	CPT-02	1	24.048	23.931	-117.3	0.2954	0.2954	0.0	2.7970	2.7994	2.4
MKJ309	CPT-03	1	9.804	9.762	-41.7	0.1323	0.1322	-0.1	1.4208	1.4215	0.7
MKJ325	CPT-04	1	24.091	24.027	-64.0	0.2951	0.2955	0.4	2.8024	2.8040	1.6
MKJ309	CPT-05	1	9.835	9.736	-99.0	0.1337	0.1324	-1.3	1.4195	1.4218	2.3
MKJ333	CPT-06	1	9.470	9.470	0.0	0.1200	0.1207	0.7	0.9416	0.9423	0.7
MKJ333	CPT-07	1	9.470	9.470	0.0	0.1215	0.1205	-1.0	0.9407	0.9426	1.9
MKJ539	CPT-08	1	20.626	20.611	-15.5	0.2498	0.2498	0.0	2.8176	2.8176	0.0
MKJ309	CPT-111	1	9.820	9.814	-5.3	0.1330	0.1331	0.1	1.4205	1.4213	0.8
MKJ325	CPT-112	1	23.995	23.974	-21.3	0.2940	0.2948	0.8	2.7981	2.7988	0.7
MKJ325	CPT-117	1	24.144	24.006	-138.6	0.2954	0.2952	-0.2	2.8047	2.8083	3.6
MKJ309	CPT-121	1	9.830	9.741	-88.6	0.1343	0.1315	-2.8	1.4169	1.4194	2.5
MKJ325	CPT-126	1	24.123	23.984	-138.6	0.2956	0.2954	-0.2	2.8048	2.8069	2.1
MKJ325	CPT-128	1	24.064	24.022	-42.6	0.2947	0.2951	0.4	2.8065	2.8067	0.2
MKJ309	CPT-129	1	9.783	9.773	-10.5	0.1315	0.1318	0.3	1.4210	1.4219	0.9

Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing Project

Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate

Note: Zero difference colour-coded based on application classes following ISO 22476-1:2012. Blue indicates Class 1, green Class 2, orange Class 3 and red Class 4. Grey represents if a test is below Class 4.

CPT ZEROS AND DRIFT

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)
MKJ309	CPT-131	1	9.866	9.767	-99.1	0.1340	0.1322	-1.8	1.4200	1.4219	1.9

Appendix E: Hand Auger Logs

CORE PHOTOS

BOREHOLE No.: **ENVR-HA03**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925787.00 mN 1744024.40 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	36.70m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925759.80 mN 1744104.70 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	39.50m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925739.90 mN 1744151.80 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	41.00m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

HAND AUGER LOG

HOLE Id: **ENVR-HA101**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926989.60 mN (NZTM2000) 1743340.30 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 04/11/2020
R.L.: 12.80m	DRILL METHOD: HA	HOLE FINISHED: 04/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: RVDK CHECKED: CBM

GEOLOGICAL													ENGINEERING DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)									TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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Tauranga Group	04/11/2020												ENVR-HA 101-0.0- 0.1m @ 0.00m								Clayey SILT; greyish brown. Stiff, dry, non-plastic.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
																0.5						Clayey SILT; brown, minor black streaking. Stiff, dry, low plasticity. 0.5m: PID= 0.0ppm																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
																1.0						Clayey SILT; brownish grey with orange mottle. Stiff, moist, medium plasticity. 1.0m: PID= 0.0ppm																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
																1.5						SILT, trace sand; light greyish brown with orange mottle. Stiff, moist, non-plastic.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
													ENVR-HA 101-1.6- 1.8m @ 1.60m		11																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

COMMENTS:
Hole Depth 2m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926989.60 mN 1743340.30 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 04/11/2020
R.L.:	12.80m	DRILL METHOD: HA	HOLE FINISHED: 04/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-2.00m

HAND AUGER LOG

HOLE Id: **HA03**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																			
CO-ORDINATES: (NZTM2000)		5926343.50 mN 1743214.30 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020																			
R.L.:		19.40m		DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020																			
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS																			
								LOGGED BY: RBE		CHECKED: CBM																	
GEOLOGICAL								ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT: GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/100mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations	
Topsoil								0 2 4 6 8 10 12 14 16 18		asb/gl/split @ 0.00m		▲		19		0.5		TS		M						SILT; brown. Moist, non-plastic.	
										● 186/56 kPa asb/gl @ 0.40m PID, 0.0ppm ● 121/48 kPa		▲		19		0.5				VSt				SILT; friable. Very stiff, moist, non-plastic.			
Tauranga Group										● 180/77 kPa asb/gl @ 0.90m PID, 0.0ppm ● 114/48 kPa		▲		18		1.0										Silty CLAY; light greyish white mottled orange brown. Very stiff, moist, high plasticity.	
										● 104/54 kPa att/psd @ 1.45m		▲		18		1.5								0.5m: mottled yellowish brown			
										● 114/60 kPa asb/gl @ 1.90m		▲		18		2.0								2.1m: light greyish white, low plasticity			
										● 162/77 kPa		▲		18		2.5											
										● 122/66 kPa		▲		17		3.0											
										● 119/72 kPa asb/gl @ 2.80m		▲		17		3.5											
										● 175/74 kPa		▲		16		4.0								Sandy SILT; light whitish grey. Moist to wet, non-plastic.			
										● 122/85 kPa att/psd @ 3.45m		▲		16		4.5								SILT; light greyish white mottled yellowish brown. Very stiff, moist, non-plastic.			
										● 186/85 kPa		▲		16		5.0								Clayey SILT; light whitish grey mottled yellowish brown and brown. Very stiff to stiff, moist, low plasticity.			
										● 122/82 kPa asb/gl @ 3.80m		▲		15		5.5								3.7m: Light brown with black mottles. Medium plasticity.			
● 123/77 kPa		▲		15		6.0																					
● 147/101 kPa		▲		15		6.5																					
● 96/32 kPa		▲		15		7.0								4.7m: Dark brown, organic stained.													
asb/gl @																St								Peaty clayey SILT; black. Stiff, moist, low			

COMMENTS: Farmland end Spedding Rd

Hole Depth
6.45m
Scale 1:25

HAND AUGER LOG

CORE PHOTOS

BOREHOLE No.: **HA03**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926343.50 mN 1743214.30 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	19.40m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: HA04

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926082.10 mN (NZTM2000) 1743388.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020							
R.L.: 21.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil					0 2 4 6 8 10 12 14 16 18	asb/gl/dupB @ 0.00m		21			M	St		SILT; dark brown. Stiff, moist, non-plastic; inclusion of agricultural plastic sheet.	
						• >186 kPa asb/gl @ 0.40m						VSt		Sandy SILT; light whitish brown. Very stiff, moist, non-plastic.	
						PID, 0.0ppm @ 0.50m			0.5			St-VSt		Silty CLAY; light greyish white mottled yellowish brown. Very stiff to stiff, moist, high plasticity.	
						• 179/50 kPa									
						• 159/61 kPa asb/gl @ 0.90m			1.0					1.0m: light grey mottled yellowish brown	
						PID, 0.1ppm @ 1.00m									
						• 122/54 kPa		20							
						• 109/44 kPa			1.5					1.8m: some sand, light brownish white	
						att/psd @ 1.45m									
						• 90/35 kPa			2.0						
						asb/gl @ 1.90m									
						• 127/46 kPa		19				VSt		Clayey SILT; light brown. Very stiff, moist, low plasticity.	
						att/psd @ 2.45m			2.5		M-W			Silty SAND; white. Moist to wet; sand, fine to medium; well packed.	
						asb/gl @ 2.80m								2.5m: Scala (blows per 100mm): 13,22,22,20,18	
									3.0					3.0m: light brown	
Tauranga Group					6										
					7										
					11										
					11										
					11										
					10										
					10										
					9										
					9										
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						• 97/45 kPa			3.5		M	St		SILT; light brown. Stiff, moist, non-plastic; Scala (blows per 100mm): 5,6,8. Clayey SILT; grey. Stiff, moist, low plasticity.	
						asb/gl @ 3.80m									
						• 90/32 kPa			4.0		W			Silty SAND; greyish brown. Wet; sand, fine to medium.	
						• 101/28 kPa		17			M	VSt		SILT; brown and grey. Very stiff, moist, non-plastic.	
						• 159/32 kPa			4.5					4.4m: abundant organics and inclusions of decomposed wood	
						• 117/33 kPa									
						asb/gl @								Clayey SILT; light grey. Very stiff, moist, low plasticity.	
COMMENTS: Farmland end Spedding Rd															
Hole Depth 6.85m															

HAND AUGER LOG

HOLE Id: **HA04**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000					
CO-ORDINATES: 5926082.10 mN (NZTM2000) 1743388.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020					
R.L.: 21.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020					
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS					
								LOGGED BY: RBE					
								CHECKED: CBM					
GEOLOGICAL						ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
Tauranga Group					4.80m ● 117/42 kPa		16						[CONT] Clayey SILT; light grey. Very stiff, moist, low plasticity. 5.15m: brown with some organics
				1 2 2 2 2 3 3 3 4 4 5 6 6 6 6 6 6 7 7 8 8 8 8 10 11 12 12				5.5 6.0 6.5					End of handauger 5.2m. Scala (blows per 100mm): 3,4,5,6,7,8,11,12,11,12, 14,15,16,16,21,24
							14	7.0 7.5 8.0 8.5 9.0 9.5					6.85m: Refusal

COMMENTS: Farmland end Spedding Rd

Hole Depth
6.85m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **HA04**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926082.10 mN 1743388.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	21.20m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: HA05

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925977.70 mN (NZTM2000) 1743549.70 mE				DRILL TYPE: 75 and 50mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.: 27.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
Fill	01/12/2020 W/L on completion				asb/gl/split @ 0.00m		27		TS	M			SILT; dark brown. Moist, non-plastic; inclusions of gravel, black plastic twine.		
					● 130/32 kPa asb/gl @ 0.40m PID, 0.1ppm @ 0.50m ● 88/29 kPa		0.5		St-Vst		Silty CLAY; light grey. Stiff to very stiff, moist, high plasticity.				
Tauranga Group	01/12/2020				● 82/32 kPa asb/gl @ 0.90m PID, 0.1ppm @ 1.00m ● 108/35 kPa		26	1.0							
					● 80/33 kPa att/psd @ 1.45m		1.5					1.8m: light greyish brown. Low plasticity			
					● 96/41 kPa asb/gl @ 1.90m		2.0	W	St		Sandy SILT; light greyish brown. Stiff, wet, non-plastic.				
							25		M	F-St		Clayey SILT, trace sand; light brown. Stiff to firm, moist, low plasticity.			
					● 56/19 kPa att/psd2 @ 2.45m		2.5								
					● 37/20 kPa asb/gl @ 2.70m										
					● 41/21 kPa		3.0		F		Silty CLAY; light grey. Firm, moist, high plasticity.				
					● 40/24 kPa		24								
					● 35/16 kPa asb/gl @ 3.70m		3.5								
					● 35/13 kPa		4.0					4.0m: brown			

HAND AUGER LOG

HOLE Id: **HA05**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES: 5925977.70 mN (NZTM2000) 1743549.70 mE				DRILL TYPE: 75 and 50mm Hand auger				HOLE STARTED: 01/12/2020						
R.L.: 27.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020						
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS						
								LOGGED BY: RBE						
								CHECKED: CBM						
GEOLOGICAL								ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
Tauranga Group					0 2 4 6 8 10 12 14 16 18	4.70m ● 77/31 kPa		22			M	St		Clayey SILT, some organics; light brown. Stiff, moist, medium plasticity; amorphous.
					1									End of handauger 5.2m Scala only (blows per 100mm) 1,3,3,3,3,4,4,5 5,5,6,6,6,8,6,6,7 6,8
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CORE PHOTOS

BOREHOLE No.: HA05

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925977.70 mN 1743549.70 mE	DRILL TYPE: 75 and 50mm Hand auger	HOLE STARTED: 01/12/2020
R.L.:	27.20m	DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA06**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925924.30 mN (NZTM2000) 1743672.80 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.: 30.70m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.								Description and Additional Observations							
WATER CORE RECOVERY (%) METHOD 0 2 4 6 8 10 12 14 16 18 SCALA PENETROMETER (Blows/100mm)								TESTS SAMPLES RL (m) DEPTH (m) GRAPHIC LOG MOISTURE CONDITION WEATHERING STRENGTH/DENSITY CLASSIFICATION SHEAR STRENGTH (kPa)							
Tauranga Group								SILT; dark brown. Moist, non-plastic; friable.							
								SILT; light yellowish brown. Very stiff, moist, non-plastic.							
								Clayey SILT; yellowish brown. Stiff to very stiff, moist; low to medium plasticity.							
								Silty CLAY; light brownish grey. Very stiff, moist, high plasticity.							
								Clayey SILT; light brown. Stiff to very stiff, moist, medium plasticity.							
								Sandy SILT; grey. Stiff, moist, low plasticity; sand, fine.							
COMMENTS: Spedding Road															
Hole Depth 7.25m															

HAND AUGER LOG

HOLE Id: HA06

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925924.30 mN (NZTM2000) 1743672.80 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.: 30.70m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,								Description and Additional Observations							
WATER CORE RECOVERY (%) METHOD								SCALA PENETROMETER (Blows/100mm) TESTS SAMPLES RL (m) DEPTH (m) GRAPHIC LOG MOISTURE CONDITION WEATHERING STRENGTH/DENSITY CLASSIFICATION SHEAR STRENGTH (kPa)							
Rev 1, 1.0x4.5m Tauranga Group								4.70m ● 96/32 kPa 3 4 4 5 6 9 9 10 13 11 11 13 14 15 16 16 16 16 17 0							

CORE PHOTOS

BOREHOLE No.: **HA06**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925924.30 mN 1743672.80 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 01/12/2020
R.L.:	30.70m	DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA07**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																			
CO-ORDINATES:		5925859.50 mN (NZTM2000) 1743823.00 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 01/12/2020																			
R.L.:		32.90m		DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020																			
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd																			
								LOGGED BY: ROM				CHECKED: CBM															
GEOLOGICAL								ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/50mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations	
Topsoil								0 2 4 6 8 10 12 14 16 18		asb/gl @ 0.10m								TS		M		F				Sandy SILT; dark brown. Firm, moist, low plasticity; sand, fine.	
Tauranga Group		01/12/2020		100		HA				● 85/22 kPa PID, 0.1ppm @ 0.50m						0.5										Sandy SILT, trace organics; brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets. 0.5m: Light brown, mottled orange. PID test, 0.1ppm.	
										asb/gl @ 0.50m																	
										att/psd @ 0.80m						32										Clayey SILT, minor sand, trace organics; light brown. Stiff, moist, medium plasticity; sand, fine; organics, rootlets. 1.0m: PID test, 0.2ppm	
										● 82/47 kPa PID, 0.2ppm @ 1.00m						1.0											
										asb/gl & att/psd @ 1.00m						1.5										SILT, some clay, minor sand; light brown, mottled orange. Stiff, moist, medium plasticity; sand, fine.	
										● 69/37 kPa						1.5											
										corrosivity @ 1.80m						31										SILT, some clay and sand; light brown, mottled orange and brown. Stiff, moist, medium plasticity; sand, fine.	
										● 63/33 kPa asb/gl @ 2.00m						2.0											
										corrosivity @ 2.40m						2.5										Sandy SILT, trace organics and clay; light brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets. 2.5m: Grey and orange.	
										● 90/47 kPa						2.5											
										● 87/31 kPa asb/gl @ 3.00m						3.0										Sandy SILT, trace organics; light brown, mottled orange. Stiff to very stiff, moist, low plasticity; sand, fine; organics, rootlets. 3.4m: Light brown, mottled orange. 3.5m: Grey.	
										● 131/31 kPa						3.5											
										● >218 kPa asb/gl @ 4.00m						29										Silty SAND, trace organics; light brown mottled orange. Dense to very dense, moist, poorly graded; sand, fine to medium; organics, rootlets.	
										● UTP						4.5											
										● UTP						28											

Box 1, 0.0-3.0m

Box 2, 3.0-5.0m

COMMENTS:

Hole Depth
5.9m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925859.50 mN (NZTM2000) 1743823.00 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 01/12/2020
R.L.: 32.90m		DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA07a**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																			
CO-ORDINATES: (NZTM2000)		5925813.70 mN 1743968.70 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 25/11/2020																			
R.L.:		35.60m		DRILL METHOD: HA+DCP				HOLE FINISHED: 25/11/2020																			
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd																			
								LOGGED BY: ROM				CHECKED: CBM															
GEOLOGICAL								ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/50mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations	
								0 2 4 6 8 10 12 14 16 18																			
Topsoil										asb @ 0.10m								TS		M						Sandy SILT, trace organics; dark brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.	
										● >218 kPa asb @ 0.50m PID, 0.0ppm @ 0.51m				35		0.5		TS		VSt-H				SILT, some sand, minor clay, trace organics; orange, mottled brown-red and brown. Very stiff, moist, low plasticity. Organics, rootlets.			
										● 174/62 kPa asb @ 1.00m PID, 0.8ppm @ 1.01m corrosivity @ 1.20m				1.0										Grades to: clayey SILT, minor sand, trace organics; grey and brown mottled orange. Very stiff to hard, moist, medium plasticity. Sand, fine; organics, rootlets.			
										● 187/75 kPa				1.5													
										● 159/87 kPa asb @ 2.00m				2.0												Sandy SILT, some clay, trace organics; grey mottled orange and brown. Very stiff, moist, low to medium plasticity. Organics, rootlets.	
										geo @ 2.20m																2.1m: trace clay; grey, mottled orange.	
										geo @ 2.40m																	
Tauranga Group										● 188/73 kPa				2.5				TS		VSt						Silty CLAY; grey, mottled orange and pink. Very stiff, moist, high plasticity.	
										● 199/84 kPa asb @ 3.00m				3.0												Sandy SILT, some clay, trace organics; grey mottled orange and brown. Very stiff, moist, low to medium plasticity. 2.8 - 2.9m: orange, mottled grey.	
										● >218 kPa				3.5												Sandy SILT; grey, speckled white. Very stiff to hard, moist, low plasticity; sand, fine to coarse.	
										● UTP asb @ 4.00m				4.0												Grades to: Silty, fine to coarse SAND; grey, speckled white. Very dense, moist, well graded.	
										● UTP				4.5												Sandy SILT; grey, speckled white. Very stiff to hard, moist, low plasticity; sand, fine to coarse.	
										● UTP																4.6m: minor fine, rounded gravel.	
COMMENTS:																											
Box 1: 0.0-3.0m																											
Box 2: 3.0-5.0m																											
Hole Depth 5.85m																											

HAND AUGER LOG

HOLE Id: **HA07a**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925813.70 mN (NZTM2000) 1743968.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 25/11/2020
R.L.: 35.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 25/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL										ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.										Description and Additional Observations									
WATER										MOISTURE / WEATHERING									
CORE RECOVERY (%)										STRENGTH/DENSITY CLASSIFICATION									
METHOD										SHEAR STRENGTH (kPa)									
SCALA PENETROMETER (Blows/50mm)										SAMPLES									
0 2 4 6 8 10 12 14 16 18										RL (m)									
										DEPTH (m)									
										GRAPHIC LOG									

COMMENTS:
Hole Depth 5.85m
Scale 1:25

CORE PHOTOS

BOREHOLE No.: HA07a

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925813.70 mN (NZTM2000) 1743968.70 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 25/11/2020
R.L.: 35.60m		DRILL METHOD: HA+DCP	HOLE FINISHED: 25/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA08**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925683.60 mN (NZTM2000) 1744277.50 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.: 49.10m	DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL					ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil					Env @ 0.10m		49		TS	M	F		Sandy SILT, trace organics; brown. Firm, moist, low plasticity; sand, fine. Organics, rootlets	
					48/16 kPa Env @ 0.50m PID, 1.8ppm @ 0.50m		0.5		TS				Sandy SILT, minor organics; grey-brown, mottled orange. Firm, moist, low plasticity; sand, fine; organics, rootlets.	
Tauranga Group	24/11/2020		94 HA+DCP		57/11 kPa Env @ 1.00m PID, 2.5ppm @ 1.00m		1.0	48					1.2-1.5m: CORE LOSS	
					82/6 kPa		1.5				St		SILT, some sand, mior clay, trace organics; grey-brown, speckled black. Stiff, moist, high plasticity; sand, fine; organics, rootlets.	
					>200 kPa Env @ 2.00m		2.0	47			VSt-H		Grades to: Silty CLAY, minor sand, trace organics; brown, mottled orange, speckled brown. Very stiff to hard, moist, high plasticity; sand, fine; organics, rootlets.	
					>200 kPa		2.5						2.4m: dark brown.	
					>200 kPa Env @ 3.00m		3.0	46			VSt		Sandy SILT, minor clay, trace organics; brown, spotted brown. Very stiff to hard, moist, low plasticity; sand, fine ; organics, rootlets.	
					135/73 kPa		3.5				VSt-H		Sandy, silty CLAY, trace organics; brown, spotted dark brown. Very stiff, moist, medium plasticity; sand, fine; organics, rootlets.	
					149/72 kPa Env @ 4.00m		4.0	45			VSt		Grades to: Sandy SILT; brown, mottled orange, spotted black and dark brown. Very stiff, moist, low plasticity; sand, fine; organics, rootlets.	
					129/56 kPa		4.5						4.2m: light grey-brown, spotted black.	
					>200 kPa						H		4.9m: hard.	

COMMENTS:

Hole Depth
5.85m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: HA08

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925683.60 mN 1744277.50 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.:	49.10m	DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA08a

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000															
CO-ORDINATES: 5925734.60 mN (NZTM2000) 1744164.50 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 24/11/2020															
R.L.: 41.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 24/11/2020															
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd															
								LOGGED BY: ROM															
								CHECKED: CBM															
GEOLOGICAL												ENGINEERING DESCRIPTION											
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.																							

HAND AUGER LOG

HOLE Id: **HA08a**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925734.60 mN (NZTM2000) 1744164.50 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 24/11/2020							
R.L.: 41.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 24/11/2020							
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
					024681012141618 5 4 4 4 7 5 5 7</										

COMMENTS:

Hole Depth
6.2m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: HA08a

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925734.60 mN 1744164.50 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.:	41.80m	DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

CORE PHOTOS

BOREHOLE No.: HA107a

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926927.60 mN 1743320.80 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.:	13.50m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA107b**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																					
CO-ORDINATES: (NZTM2000)		5926922.30 mN 1743265.20 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 04/12/2020																					
R.L.:		12.30m		DRILL METHOD: HA+DCP				HOLE FINISHED: 04/12/2020																					
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd																					
								LOGGED BY: ROM																					
								CHECKED: CBM																					
GEOLOGICAL								ENGINEERING DESCRIPTION																					
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/50mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations			
								0 2 4 6 8 10 12 14 16 18																					
Topsoil										Env @ 0.10m				12				TS		D-M		F				Sandy SILT, trace organics; brown. Firm, dry to moist, low plasticity; sand, fine; organics, rootlets.			
Fill										● 124/31 kPa Env @ 0.50m PID 0.5ppm @ 0.51m				0.5						D		VSt				Sandy SILT, trace organics; light brown and orange brown. Very stiff, dry to moist, low plasticity; sand, fine; organics, rootlets.			
										● 152/34 kPa Env @ 1.00m PID 0.1ppm @ 1.01m corrosivity @ 1.20m				1.0						M		St				Sandy SILT, trace organics and clay; grey-brown mottled orange speckled white and black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.			
Tauranga Group										● 93/53 kPa				1.5															
										● 35/16 kPa Env @ 2.00m				2.0								F				SILT, some sand, trace organics; dark brown speckled black. Firm, moist, low plasticity; sand, fine; organics, rootlets.			
										● 82/22 kPa				2.5								VSt				Sandy SILT, trace organics; grey mottled orange speckled white. Very stiff, low plasticity; sand, fine; organics, rootlets.			
										corrosivity @ 2.70m																Silty SAND; grey mottled orange speckled white. Very stiff, moist, poorly graded; sand, fine.			
										● 51/19 kPa				3.0						M-W		F				Sandy SILT, trace organics; grey mottled orange. Firm, moist to wet, low plasticity; sand, fine; organics, rootlets.			
										● 75/20 kPa				3.5						M						SILT, some sand, minor clay, trace organics; grey mottled brown. Firm, moist, low plasticity; organics, rootlets.			
										● 45/28 kPa				4.0				M-W		L-MD				Silty SAND, trace organics; grey mottled brown. Loose to medium dense, moist to wet, poorly graded; sand, fine; organics, rootlets.					
										● 59/34 kPa				4.5												4.3 - 4.45m: SILT, some sand, minor clay, trace rootlets; grey. Stiff, moist, high plasticity; sand, fine.			
										● 62/32 kPa																			

COMMENTS:

Hole Depth
6.85m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: HA107b

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926922.30 mN 1743265.20 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 04/12/2020
R.L.:	12.30m	DRILL METHOD: HA+DCP	HOLE FINISHED: 04/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA108**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926898.60 mN (NZTM2000) 1743173.50 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.50m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
														0	2
Topsoil					Env @ 0.10m				TS	M	F		Sandy SILT, trace organics; brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.		
Tauranga Group	03/12/2020	100	HA+DCP		● 131/25 kPa Env @ 0.50m		11	0.5		VSt			Sandy SILT, trace organics; brown, mottled orange. Very stiff, moist, low plasticity; sand, fine; organics, rootlets.		
					● 73/28 kPa Env @ 1.00m			1.0		St		Sandy SILT, minor clay, trace organics; brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets.			
					● 54/21 kPa		10	1.5			SILT, minor sand and clay, trace organics; light brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets.				
					● 26/9 kPa Env @ 2.00m			2.0			Sandy SILT, trace organics; greyish brown, mottled orange, spotted blue. Firm to stiff, wet, low plasticity; sand, fine; organics, rootlets.				
					Att/psd @ 2.40m										
					● 37/28 kPa		9	2.5							
					● 32/17 kPa			3.0							
					● 51/17 kPa		8	3.5							
					● 22/9 kPa			4.0							
					● 31/16 kPa		7	4.5							
	● 40/18 kPa											3.95m: grades to soft			
												4.45m: grades to firm			

COMMENTS:

Hole Depth 6.7m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926898.60 mN (NZTM2000) 1743173.50 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.: 11.50m		DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA109**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																			
CO-ORDINATES: 5926901.80 mN (NZTM2000) 1743136.40 mE		DRILL TYPE: 75 and 50mm handauger				HOLE STARTED: 03/12/2020																					
R.L.: 11.00m		DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020																					
DATUM: NZVD2016						DRILLED BY: GEOTECHNICS		LOGGED BY: RBE		CHECKED: CBM																	
GEOLOGICAL								ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/100mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations	
								0 2 4 6 8 10 12 14 16 18																			
Topsoil										asb/gl/split @ 0.00m								TS		D-M						SILT; light brown. Dry to moist, non-plastic.	
										● 122/21 kPa						0.5				M		VSt				SILT; yellowish brown. Very stiff, moist, non-plastic.	
										asb/gl @ 0.40m																SILT, some clay; light brown mottled yellowish brown. Very stiff, moist; low to no plasticity.	
										● 76/15 kPa												St				SILT; light brown. Stiff, moist, non-plastic.	
										● 76/8 kPa																	
										asb/gl @ 0.90m						1.0								F		Silty CLAY; light brown mottled yellowish brown. Firm, moist, high plasticity.	
										● 29/16 kPa																	
										● 48/19 kPa						1.5										Clayey SILT; light brown. Firm, moist, low plasticity.	
										att/psd @ 1.40m																	
										● 32/8 kPa																Silty CLAY; light brown mottled yellowish brown. Firm, moist, medium plasticity.	
										asb/gl @ 1.70m						2.0											
										● 40/21 kPa																Clayey SILT; light grey. Firm, wet, low plasticity.	
																				W						Silty CLAY; light brownish grey. Soft, moist, high plasticity.	
										● 24/13 kPa						2.5				M		S				Sandy SILT; grey. Soft, saturated, non-plastic.	
										att/psd @ 2.45m										S							
										● 24/13 kPa																	
										asb/gl @ 2.70m										W		F				Clayey SILT; grey. Firm, wet, medium plasticity.	
										● 27/16 kPa						3.0											
										● 62/24 kPa												F-St				Clayey sandy SILT; grey. Firm to stiff, wet, low plasticity.	
																3.5								F		Silty CLAY; light grey. Firm, wet, medium plasticity.	
										● 32/20 kPa																Clayey SILT; light grey. Firm, wet, medium plasticity.	
										asb/gl @ 3.70m																	
										● 32/16 kPa						4.0											
										● 37/15 kPa																	
										● 36/20 kPa						4.5										Clayey sandy SILT; light grey. Firm, wet, low plasticity.	
										● 32/17 kPa																	
										asb/gl @												F-St				Clayey SILT; light grey. Firm to stiff, moist, medium plasticity; sandy layers at 4.8m and 5m.	

COMMENTS: 26 Brigham Ck Rd

Hole Depth
7.25m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **HA109**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926901.80 mN 1743136.40 mE	DRILL TYPE: 75 and 50mm handauger	HOLE STARTED: 03/12/2020
R.L.:	11.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA110a**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926999.30 mN (NZTM2000) 1743387.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.: 14.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL										ENGINEERING DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)														TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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COMMENTS:

Hole Depth
6.85m

Scale 1:25

Rev.: A

CORE PHOTOS

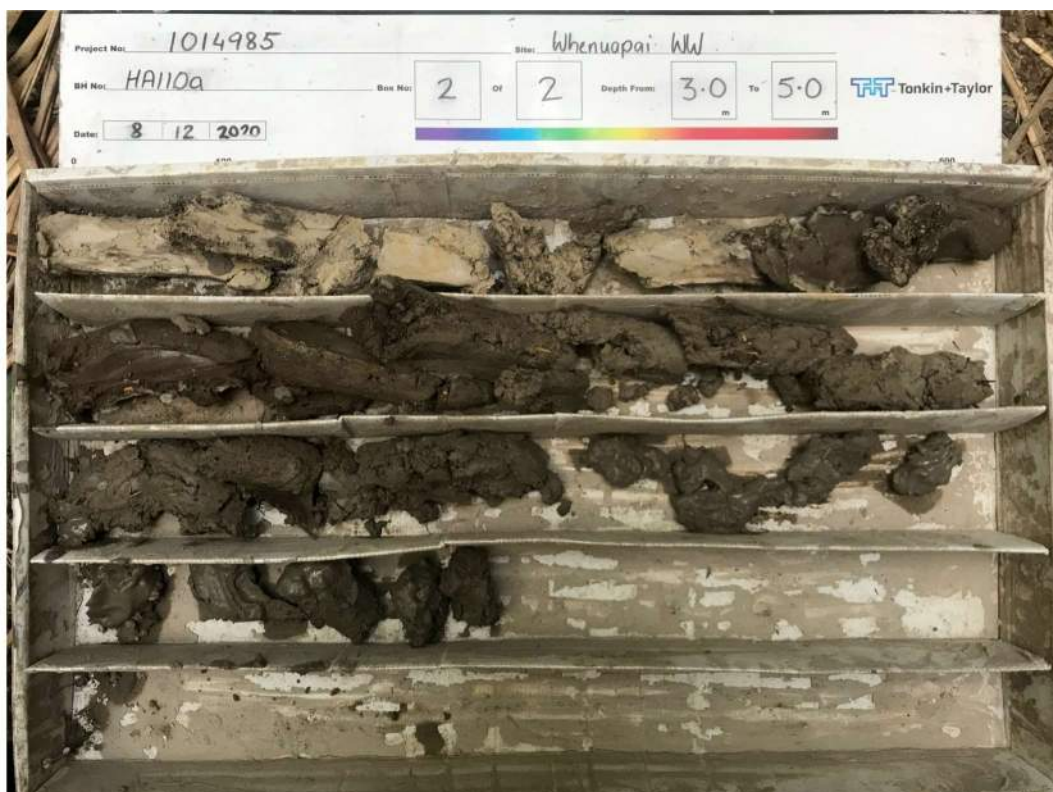
BOREHOLE No.: HA110a

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926999.30 mN 1743387.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.:	14.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

CORE PHOTOS

BOREHOLE No.: HA110b

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.40 mN 1743376.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.:	14.70m	DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA111

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000											
CO-ORDINATES: (NZTM2000)		5927039.30 mN 1743395.90 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 07/12/2020											
R.L.:		14.40m		DRILL METHOD: HA+DCP				HOLE FINISHED: 07/12/2020											
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd											
								LOGGED BY: ROM		CHECKED: CBM									
GEOLOGICAL								ENGINEERING DESCRIPTION											
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)		TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations				
Fill		07/12/2020	88	HA+DCP	0		Env/asb @ 0.10m					D	F		Sandy SILT, trace organics; dark brown. Firm, dry, low plasticity; sand, fine; organics, rootlets.				
					2		● 65/34 kPa Env/asb @ 0.50m		14	0.5						SILT, some sand, minor clay, trace gravel, and organics; light brown, mottled orange, dark grey and grey. Sand, fine; gravel, fine to medium, sub-angular, sandstone; organics, rootlets.			
					4		● 31/16 kPa Env/asb @ 1.00m			1.0									
					6		Corrosivity @ 1.20m		13	1.5			M			Sandy SILT, some gravel; dark brown. Firm, moist, low plasticity; sand, fine; gravel, fine, angular, sandstone.			
					8		● 16/9 kPa			2.0				W			1.6m: wet.		
					10		● 31/20 kPa Env/asb @ 2.00m			2.5									
					12		Corrosivity @ 2.40m		12	2.5					St			SILT, some sand, minor clay and gravel, trace organics; dark brown and black. Stiff, moist, low plasticity; sand, fine; gravel, fine, sub-angular, sandstone; organics, rootlets.	
					14		Env/asb @ 3.00m			3.0					L			Gravelly, fine SAND, some silt; dark brown. Loosely packed, wet, poorly graded; gravel, fine to medium, sub-angular, sandstone.	
					16													3.1 - 3.5m: NO RECOVERY	
					18														3.5 m: END OF HAND AUGER.
Tauranga Group					20										Scala only to 6.5 m (blows per 50 mm):				
					22											1,0,1,1,0,2,2,2,2,1,2,1,1,2,2,3,4,3,4,3,3,3,3,3,4,			
					24												3,4,3,4,3,4,3,4,5,4,4,5,6,5,5,6,6,7,7,6,7,6,9,8,7,8,		
					26												9,7,8,8,7,9,9,9		
					28														
					30														
					32														
					34														
					36														
					38														

COMMENTS:

Hole Depth
6.45m

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: HA111

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5927039.30 mN (NZTM2000) 1743395.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 07/12/2020							
R.L.: 14.40m				DRILL METHOD: HA+DCP				HOLE FINISHED: 07/12/2020							
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Tauranga Group					0 2 4 6 8 10 12 14 16 18 <!-- Simulated data for the first section --> <!-- This area contains the simulated data for the first section --> <!-- This area contains the simulated data for the first section -->							[CONT] 3.5 m: END OF HAND AUGER. Scala only to 6.5 m (blows per 50 mm): 1,0,1,1,0,2,2,2,2,1,2,1,1,2,2,3,4,3,4,3,3,3,3,3,4, 3,4,3,4,3,4,3,4,5,4,4,5,6,5,5,6,6,7,7,6,7,6,9,8,7,8, 9,7,8,8,7,9,9,9			
															6.45m: END OF INVESTIGATION

COMMENTS:

Hole Depth
6.45m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: HA111

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5927039.30 mN 1743395.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 07/12/2020
R.L.:	14.40m	DRILL METHOD: HA+DCP	HOLE FINISHED: 07/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-3.10m

HAND AUGER LOG

HOLE Id: **HA112**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
CO-ORDINATES: 5926554.90 mN (NZTM2000) 1743164.20 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 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Fill												M												St												Sandy SILT, trace organics; brown and grey mottled orange, spotted black and white. Stiff, moist, low plasticity; sand, fine; organics, rootlets & carbonaceous material.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Box 1 0.0-2.0m												Env/lsb @ 0.10m												72/16 kPa Env/lsb @ 0.50m PID 0.9ppm @ 0.51m												116/22 kPa Env/lsb @ 1.00m PID 1.8ppm @ 1.01m												UTP												Env @ 1.80m												VSt												Sandy SILT, trace organics; dark grey brown, spotted black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															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CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926554.90 mN (NZTM2000) 1743164.20 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 9.60m		DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016			DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-2.00m

Rev.: A

CORE PHOTOS

BOREHOLE No.: HA113

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926630.20 mN 1743032.10 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	7.90m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-2.60m

HAND AUGER LOG

HOLE Id: HA114

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926872.80 mN (NZTM2000) 1743108.40 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
Fill	03/12/2020 inflow 2.6m, w/l after 4hrs				Dup D, Asb/gl @ 0.00m					D			Gravelly SILT; brown. Dry, non-plastic; (farm track).		
Topsoil					M					VSt			SILT; greyish brown. Very stiff, moist, non-plastic.		
													SILT; light brown. Very stiff, moist, non-plastic.		
Tauranga Group					● 184/32 kPa asb/gl @ 0.40m			0.5					SILT; light brown. Very stiff, moist, non-plastic.		
					● 186/29 kPa										
					● 109/33 kPa asb/gl @ 0.90m								St-VSt	Clayey SILT; light grey mottled yellowish brown. Stiff to very stiff, moist, low plasticity.	
					● 104/42 kPa								1.0m: medium plasticity 1.2m: low plasticity		
					● 56/27 kPa att/psd @ 1.45m								F	Silty CLAY; light greyish brown. Firm, moist, high plasticity.	
					● 40/24 kPa asb/gl @ 1.90m								W	SILT; light brown. Firm, wet, non-plastic.	
					● 41/27 kPa								M	Clayey SILT; light brown mottled orange brown. Firm, moist, medium plasticity.	
					● 42/21 kPa								F-St	Sandy SILT; light brown. Stiff to firm, moist, non-plastic.	
					● 61/16 kPa asb/gl @ 2.70m								3.0m: grey		
					● 56/15 kPa								M-W	Silty CLAY; light greyish brown. Firm, moist to wet, high plasticity; difficult to recover.	
● 37/16 kPa att/psd @ 3.45m															
● 40/9 kPa asb/gl @ 3.70m														F	
● 27/11 kPa															
● 27/11 kPa															
● 49/24 kPa															
● 37/20 kPa asb/gl @															

COMMENTS: 26 Brigham Ck Rd

Hole Depth
7.25m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: HA114

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926872.80 mN 1743108.40 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.:	11.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: HA115

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926794.20 mN (NZTM2000) 1743054.00 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 9.90m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Fill					0 2 4 6 8 10 12 14 16 18	env @ 0.10m					M	L		Silty SAND, trace organics; brown. Moist, poorly graded; sand, fine, loosely packed; organics, rootlets.	
						● 168/40 kPa env @ 0.50m			0.5			VSt		Silty CLAY, minor sand; orange-brown mottled orange. Very stiff, moist; sand, fine.	
Tauranga Group						● 171/51 kPa env @ 1.00m split/dup @ 1.01m			1.0			St-VSt		Sandy SILT, trace organics; brown. Stiff, moist, low plasticity; sand, fine; organics, rootlets.. 0.4m: Brown & light brown	
						● 82/19 kPa			1.5					Sandy SILT, minor clay, trace organics; brown and light brown mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets.	
						● 81/25 kPa env @ 2.00m			2.0			St		SILT, minor clay and sand, trace organics; light grey-brown mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets. 1.9m: Brown mottled orange	
						● 56/22 kPa geo @ 2.60m			2.5					2.6 - 2.65m: organics, decomposed wood	
						● 56/25 kPa			3.0						
						● 34/16 kPa			3.5			W	F	Sandy SILT, trace organics; grey speckled black. Firm, wet, low plasticity; sand, fine; organics, rootlets. 3.55m: Organics, wood	
						● 40/19 kPa			4.0			W-S		SILT, minor sand, trace organics; brown speckled black. Firm, wet, low plasticity; sand, fine; organics, rootlets.	
						● 37/28 kPa			4.5					Sandy SILT, trace organics; grey speckled black. Firm, saturated to wet, low plasticity; sand, fine; organics, rootlets.	
						● 88/54 kPa						W	St	SILT, some sand, trace organics; brown speckled black. Firm, wet, low plasticity; sand, fine; organics, rootlets.	
COMMENTS:															
Hole Depth 6m															

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: HA115

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000								
CO-ORDINATES: 5926794.20 mN (NZTM2000) 1743054.00 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 03/12/2020								
R.L.: 9.90m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020								
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd								
								LOGGED BY: ROM CHECKED: CBM								
GEOLOGICAL								ENGINEERING DESCRIPTION								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
					024681012141618 <!-- Hand-drawn data from image --> <!-- 0-1m --> 2 2 3 4 4 4 6 15 17 17 8 9 9 9 10 10 12 20 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>5.0m: END OF HAND AUGER. Scala only to 6.0m(blow per 50mm): 2,2,3,2,4,4,4,6,5,7,7,8,9,7,9,9,10,10,12,20</td>											5.0m: END OF HAND AUGER. Scala only to 6.0m(blow per 50mm): 2,2,3,2,4,4,4,6,5,7,7,8,9,7,9,9,10,10,12,20
															6m: Refusal	

COMMENTS:

Hole Depth
6m

Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: HA115

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926794.20 mN 1743054.00 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.:	9.90m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA116**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000															
CO-ORDINATES: 5926675.90 mN (NZTM2000) 1743047.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020															
R.L.: 8.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020															
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS															
								LOGGED BY: RBE															
								CHECKED: CBM															
GEOLOGICAL												ENGINEERING DESCRIPTION											
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION, WATER CORE RECOVERY (%) METHOD 02/12/2020 level on completion SCALA PENETROMETER (Blows/50mm) TESTS SAMPLES RL (m) DEPTH (m) GRAPHIC LOG WEATHERING MOISTURE CONDITION STRENGTH/DENSITY CLASSIFICATION SHEAR STRENGTH (kPa)												Description and Additional Observations											
Topsoil												SILT; dark brown. Moist, non-plastic.											
Tauranga Group												Clayey SILT; greyish brown. Stiff to firm, moist, medium plasticity.											
East Coast Bays Formation												1.0m: wet to saturated											
												Sandy SILT; brown and orange brown; grey from 2.3m. Stiff to very stiff, wet, non-plastic.											
												Clayey SILT; grey. Very stiff, moist, low plasticity.											
												Silty SAND; grey. Saturated; well packed.											
												2.95m: Scala (blows per 50mm) 7,7,7,8,11,16,18,23 then bouncing Over augered, solid refusal at 3.35m											
												3.35m: Refusal											
</																							

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926675.90 mN 1743047.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	8.80m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-3.35m

HAND AUGER LOG

HOLE Id: HA117

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000															
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 02/12/2020															
R.L.: 10.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020															
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd															
								LOGGED BY: ROM															
								CHECKED: CBM															
GEOLOGICAL												ENGINEERING DESCRIPTION											
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.												Description and Additional Observations											
WATER												MOISTURE CONDITION											
CORE RECOVERY (%)												STRENGTH/DENSITY CLASSIFICATION											
METHOD												SHEAR STRENGTH (kPa)											
0 2 4 6 8 10 12 14 16 18												10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 2230 2235 2240 2245 2250 2255 2260 2265 2270 2275 2280 2285 2290 2295 2300 2305 2310 2315 2320 2325 2330 2335 2340 2345 2350 2355 2360 2365 2370 2375 2380 2385 2390 2395 2400 2405 2410 2415 2420 2425 2430 2435 2440 2445 2450 2455 2460 2465 2470 2475 2480 2485 2490 2495 2500 2505 2510 2515 2520 2525 2530 2535 2540 2545 2550 2555 2560 2565 2570 2575 2580 2585 2590 2595 2600 2605 2610 2615 2620 2625 2630 2635 2640 2645 2650 2655 2660 2665 2670 2675 2680 2685 2690 2695 2700 2705 2710 2715 2720 2725 2730 2735 2740 2745 2750 2755 2760 2765 2770 2775 2780 2785 2790 2795 2800 2805 2810 2815 2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870 2875 2880 2885 2890 2895 2900 2905 2910 2915 2920 2925 2930 2935 2940 2945 2950 2955 2960 2965 2970 2975 2980 2985 2990 2995 3000 3005 3010 3015 3020 3025 3030 3035 3040 3045 3050 3055 3060 3065 3070 3075 3080 3085 3090 3095 3100 3105 3110 3115 3120 3125 3130 3135 3140 3145 3150 3155 3160 3165 3170 3175 3180 3185 3190 3195 3200 3205 3210 3215 3220 3225 3230 3235 3240 3245 3250 3255 3260 3265 3270 3275 3280 3285 3290 3295 3300 3305 3310 3315 3320 3325 3330 3335 3340 3345 3350 3355 3360 3365 3370 3375 3380 3385 3390 3395 3400 3405 3410 3415 3420 3425 3430 3435 3440 3445 3450 3455 3460 3465 3470 3475 3480 3485 3490 3495 3500 3505 3510 3515 3520 3525 3530 3535 3540 3545 3550 3555 3560 3565 3570 3575 3580 3585 3590 3595 3600 3605 3610 3615 3620 3625 3630 3635 3640 3645 3650 3655 3660 3665 3670 3675 3680 3685 3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740 3745 3750 3755 3760 3765 3770 3775 3780 3785 3790 3795 3800 3805 3810 3815 3820 3825 3830 3835 3840 3845 3850 3855 3860 3865 3870 3875 3880 3885 3890 3895 3900 3905 3910 3915 3920 3925 3930 3935 3940 3945 3950 3955 3960 3965 3970 3975 3980 3985 3990 3995 4000 4005 4010 4015 4020 4025 4030 4035 4040 4045 4050 4055 4060 4065 4070 4075 4080 4085 4090 4095 4100 4105 4110 4115 4120 4125 4130 4135 4140 4145 4150 4155 4160 4165 4170 4175 4180 4185 4190 4195 4200 4205 4210 4215 4220 4225 4230 4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235 5240 5245 5250 5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 6230 6235 6240 6245 6250 6255 6260 6265 6270 6275 6280 6285 6290 6295 6300 6305 6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360 6365 6370 6375 6380 6385 6390 6395 6400 6405 6410 6415 6420 6425 6430 6435 6440 6445 6450 6455 6460 6465 6470 6475 6480 6485 6490 6495 6500 6505 6510 6515 6520 6525 6530 6535 6540 6545 6550 6555 6560 6565 6570 6575 6580 6585 6590 6595 6600 6605 6610 6615 6620 6625 6630 6635 6640 6645 6650 6655 6660 6665 6670 6675 6680 6685 6690 6695 6700 6705 6710 6715 6720 6725 6730 6735 6740 6745 6750 6755 6760 6765 6770 6775 6780 6785 6790 6795 6800 6805 6810 6815 6820 6825 6830 6835 6840 6845 6850 6855 6860 6865 6870 6875 6880 6885 6890 6895 6900 6905 6910 6915 6920 6925 6930 6935 6940 6945 6950 6955 6960 6965 6970 6975 6980 6985 6990 6995 7000 7005 7010 7015 7020 7025 7030 7035 7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090 7095 7100 7105 7110 7115 7120 7125 7130 7135 7140 7145 7150 7155 7160 7165 7170 7175 7180 7185 7190 7195 7200 7205 7210 7215 7220 7225 7230 7235 7240 7245 7250 7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9795 9800 9805 9810 9815 9820 9825 9830 9835 9840 9845 9850 9855 9860 9865 9870 9875 9880 9885 9890 9895 9900 9905 9910 9915 9920 9925 9930 9935 9940 9945 9950 9955 9960 9965 9970 9975 9980 9985 9990 9995 10000 10005 10010 10015 10020 10025 10030 10035 10040 10045 10050 10055 10060 10065 10070 10075 10080 10085 10090 10095 10100 10105 10110 10115 10120 10125 10130 10135 10140 10145 10150 10155 10160 10165 10170 10175 10180 10185 10190 10195 10200 10205 10210 10215 10220 10225 10230 10235 10240 10245 10250 10255 10260 10265 10270 10275 10280 10285 10290 10295 10300 10305 10310 10315 10320 10325 10330 10335 10340 10345 10350 10355 10360 10365 10370 10375 10380 10385 10390 10395 10400 10405 10410 10415 10420 10425 10430 10435 10440 10445 10450 10455 10460 10465 10470 10475 10480 10485 10490 10495 10500 10505 10510 10515 10520 10525 10530 10535 10540 10545 10550 10555 10560 10565 10570 10575 10580 10585 10590 10595 10600 10605 10610 10615 10620 10625 10630 10635 10640 10645 10650 10655 10660 10665 10670 10675 10680 10685 10690 10695 10700 10705 10710 10715 10720 10725 10730 10735 10740 10745 10750 10755 10760 10765 10770 10775 10780 10785 10790 10795 10800 10805 10810 10815 10820 10825 10830 10835 10840 10845 10850 10855 10860 10865 10870 10875 10880 10885 10890 10895 10900 10905 10910 10915 10920 10925 10930 10935 10940 10945 10950 10955 10960 10965 10970 10975 10980 10985 10990 10995 11000 11005 11010 11015 11020 11025 11030 11035 11040 11045 11050 11055 11060 11065 11070 11075 11080 11085 11090 11095 11100 11105 11110 11115 11120 11125 11130 11135 11140 11145 11150 11155 11160 11165 11170 11175 11180 11185 11190 11195 11200 11205 11210 11215 11220 11225 11230 11235 11240 11245 11250 11255 11260 11265 11270 11275 11280 11285 11290 11295 11300 11305 11310 11315 11320 11325 11330 11335 11340 11345 11350 11355 11360 11365 11370 11375 11380 11385 11390 11395 11400 11405 11410 11415 11420 11425 11430 11435 11440 11445 11450 11455 11460 11465 11470 11475 11480 11485 11490 11495 11500 11505 11510 11515 11520 11525 11530 11535 11540 11545 11550 11555 11560 11565 11570 11575 11580 11585 11590 11595 11600 11605 11610 11615 11620 11625 11630 11635 11640 11645 11650 11655 11660 11665 11670 11675 11680 1168											

HAND AUGER LOG

HOLE Id: HA117

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000								
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 02/12/2020								
R.L.: 10.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020								
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd								
								LOGGED BY: ROM CHECKED: CBM								
GEOLOGICAL								ENGINEERING DESCRIPTION								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
															0	2
				3 4 4 7 7 6 7 7 9 7 7 8 7 7 6 8 8 8 10 11 10 11 11												5.0 m: END OF HAND AUGER. Scala only to 6.3 m (blows per 50 mm): 3,4,4,4,7,7,6,7,7,9,7,7,8,7,7,6,8,8,8,10,11,10, 11,11
														6.3m: END OF INVESTIGATION		
6.5 7.0 7.5 8.0 8.5 9.0 9.5																
3 2 1																
6.5 7.0 7.5 8.0 8.5 9.0 9.5																

COMMENTS:

Hole Depth
6.3m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926564.40 mN 1743138.40 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	10.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA119**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																			
CO-ORDINATES: (NZTM2000)		5926938.00 mN 1743195.90 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020																			
R.L.:		11.40m		DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020																			
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS																			
								LOGGED BY: RBE		CHECKED: CBM																	
GEOLOGICAL								ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,		WATER		CORE RECOVERY (%)		METHOD		SCALA PENETROMETER (Blows/50mm)		TESTS		SAMPLES		RL (m)		DEPTH (m)		GRAPHIC LOG		WEATHERING MOISTURE CONDITION		STRENGTH/DENSITY CLASSIFICATION		SHEAR STRENGTH (kPa)		Description and Additional Observations	
								0 2 4 6 8 10 12 14 16 18																			
Topsoil										Dup E/asb/gl @ 0.00m										D						SILT; light brown. Dry, non-plastic.	
Tauranga Group		03/12/2020 inflow 1.6m, W/L after 45mins								● 125/4 kPa asb/gl @ 0.40m				11		0.5				M		VSt				Clayey SILT; light brown. Very stiff, moist, low plasticity.	
										● 81/32 kPa												St				Silty CLAY; light brown mottled yellowish brown. Stiff, moist, medium plasticity.	
										● 74/21 kPa asb/gl @ 0.90m						1.0										1.1m: sandy layer	
										● 56/19 kPa																Clayey SILT; light brown mottled yellowish brown. Stiff, moist, low plasticity.	
										● 58/19 kPa att/psd @ 1.45m				10		1.5				S		F-St				Sandy SILT; brown mottled yellowish brown. Firm to stiff, saturated, non-plastic.	
										● 60/11 kPa asb/gl @ 1.90m						2.0											
										● 42/19 kPa										W		S-F				Clayey SILT; grey. Soft to firm, wet, medium plasticity.	
										● 66/16 kPa att/psd @ 2.45m				9		2.5											
										● 23/8 kPa asb/gl @ 2.70m																	
										● 29/11 kPa						3.0											
										● 48/20 kPa				8		3.5						F				Clayey sandy SILT; grey. Firm, wet, low plasticity.	
										● 50/20 kPa asb/gl @ 3.70m																	
										● 56/19 kPa						4.0				M		St				Clayey SILT; grey. Stiff, moist, medium plasticity.	
										● 61/32 kPa										W						Clayey sandy SILT; light grey. Stiff, moist, low plasticity.	
										● 25/11 kPa				7		4.5				M		F-St				Sandy SILT; grey. Stiff, wet, non-plastic.	
										● 32/19 kPa asb/gl @														Clayey SILT; grey. Firm to stiff, moist, medium plasticity.			

COMMENTS: 26 Brigham Ck Rd. No core photograph, the soil is very similar to HA109

Hole Depth
7.25m

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: HA119

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926938.00 mN (NZTM2000) 1743195.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.40m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,															

Appendix F: Hydrogeology Analysis

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 1

Test Well: BH05A

Test Conducted by: BRAL

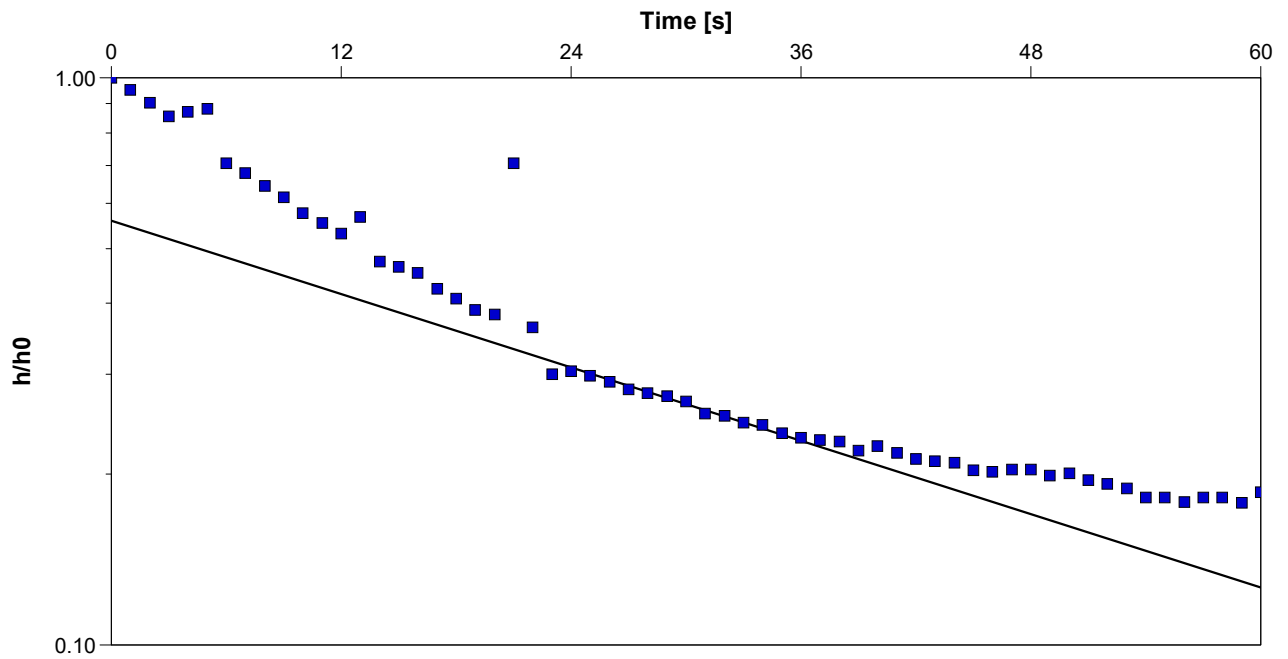
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

9.62×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 1

Test Well: BH05A

Test Conducted by: BRAL

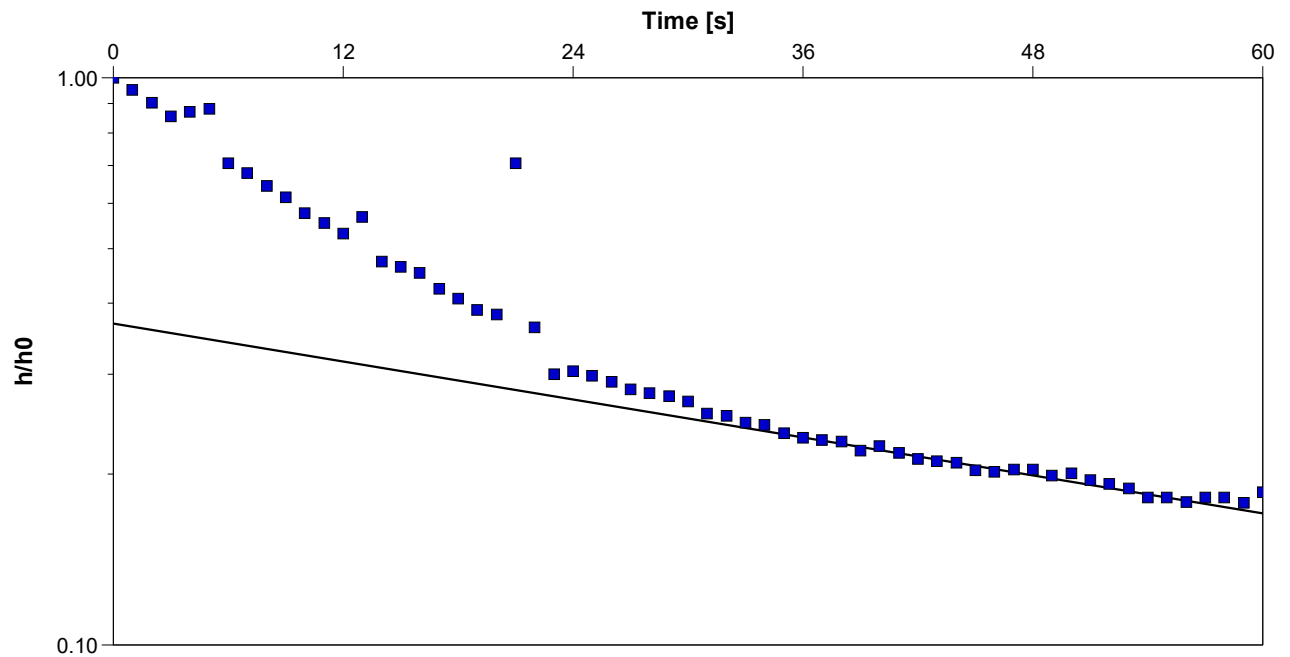
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

6.44×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 1

Test Well: BH05A

Test Conducted by: BRAL

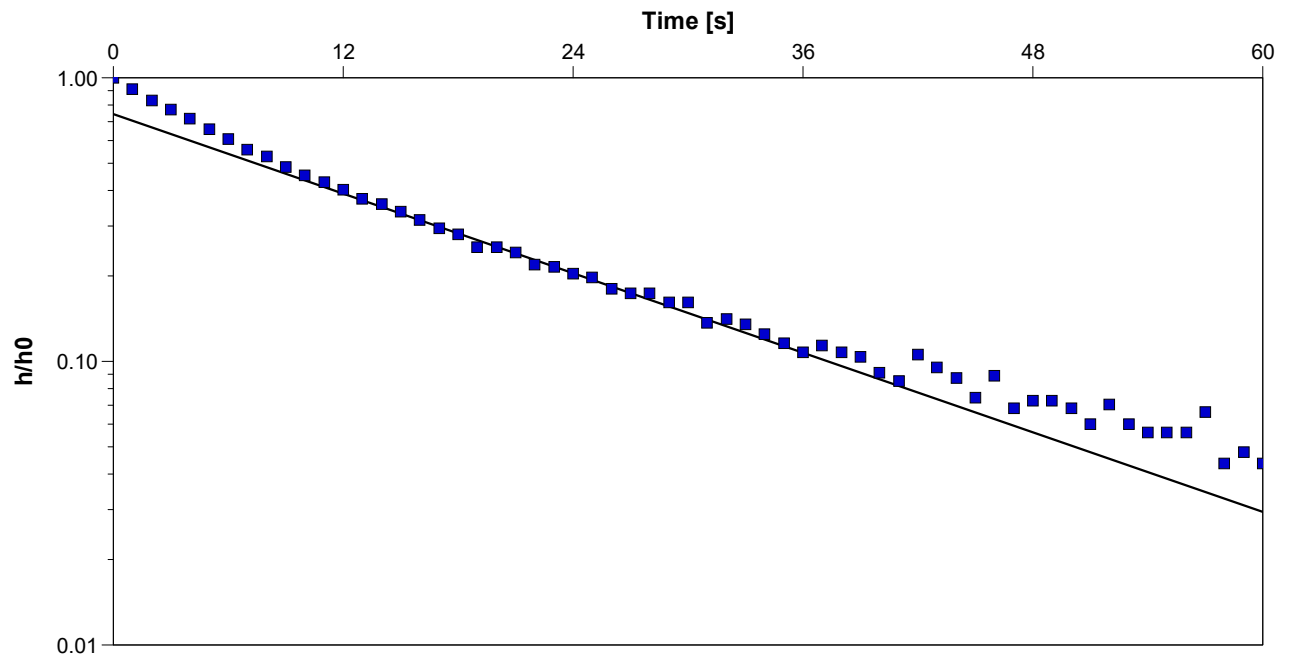
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

2.09×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 1

Test Well: BH05A

Test Conducted by: BRAL

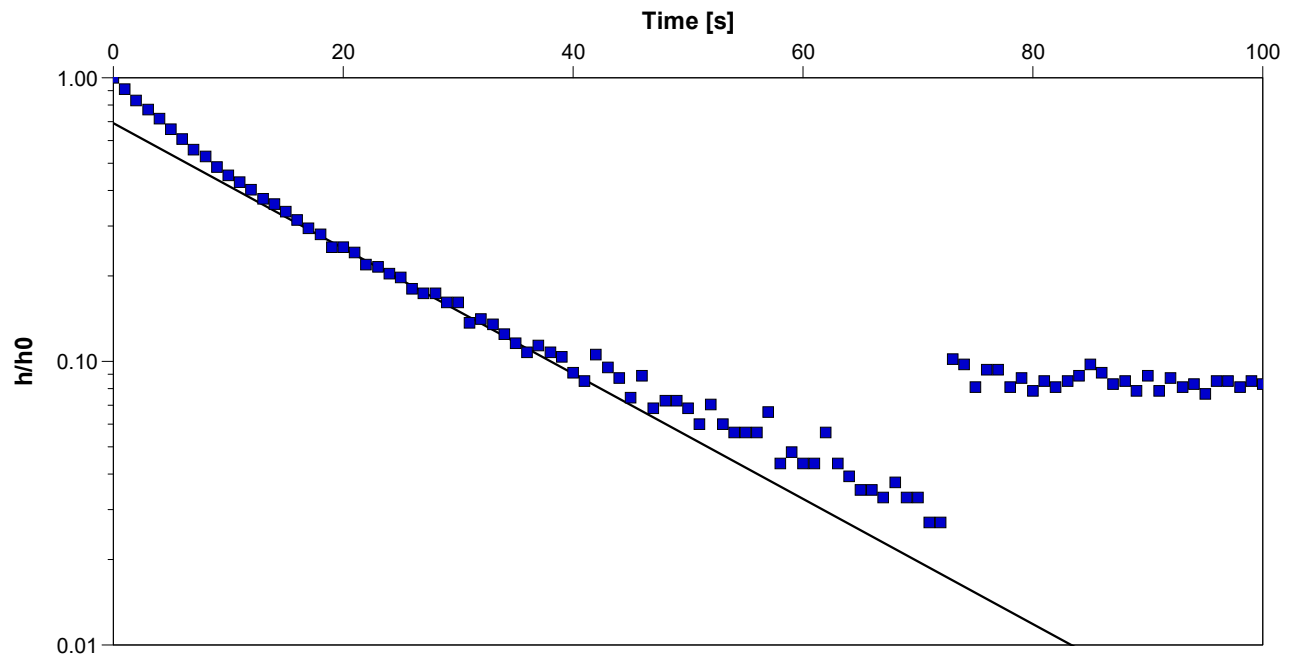
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH05A	2.55×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 2

Test Well: BH05A

Test Conducted by: BRAL

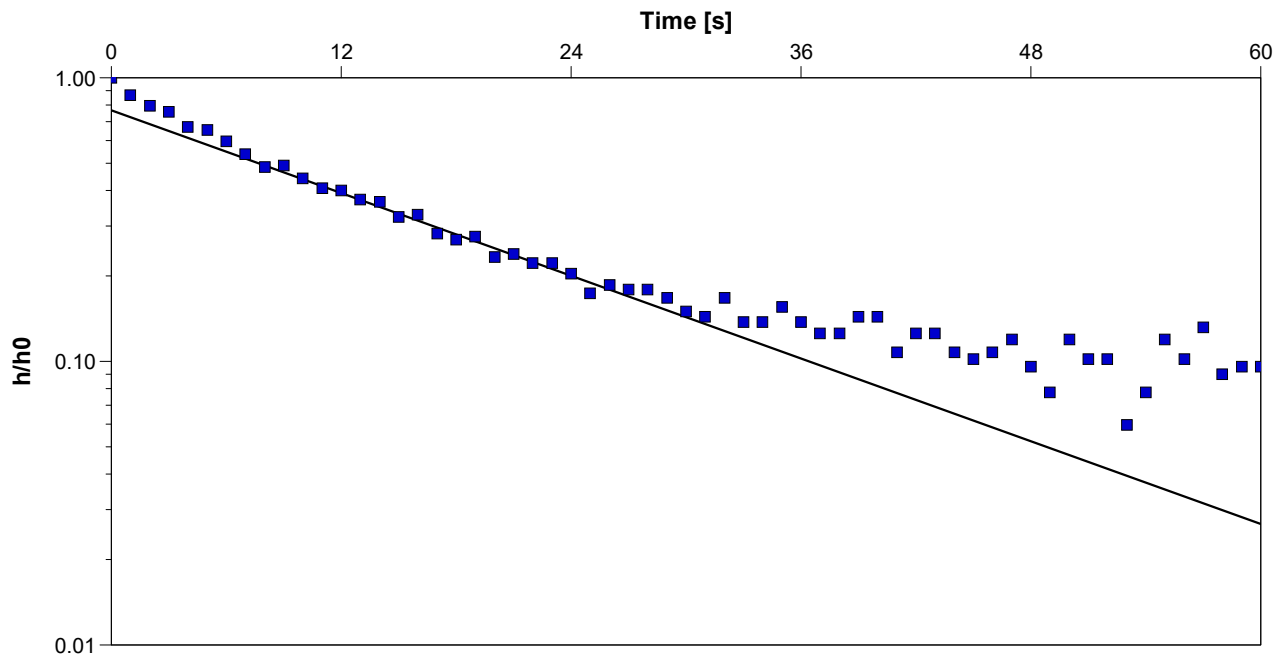
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

2.17×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 2

Test Well: BH05A

Test Conducted by: BRAL

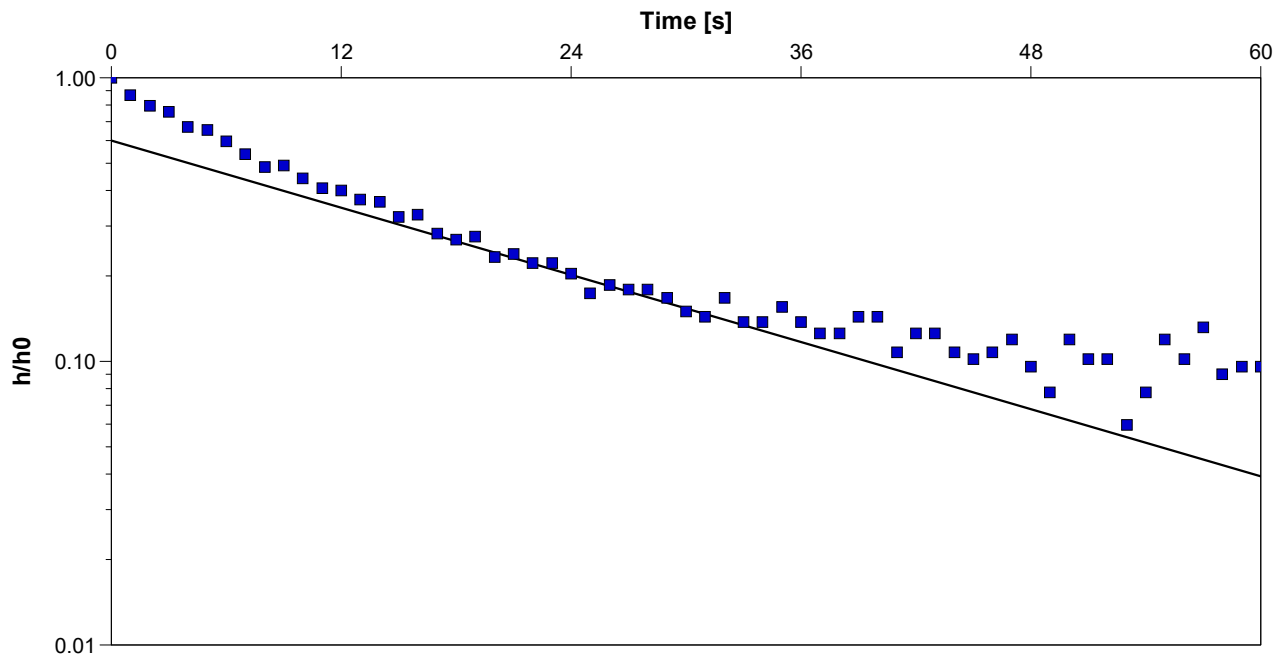
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

2.28×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 2

Test Well: BH05A

Test Conducted by: BRAL

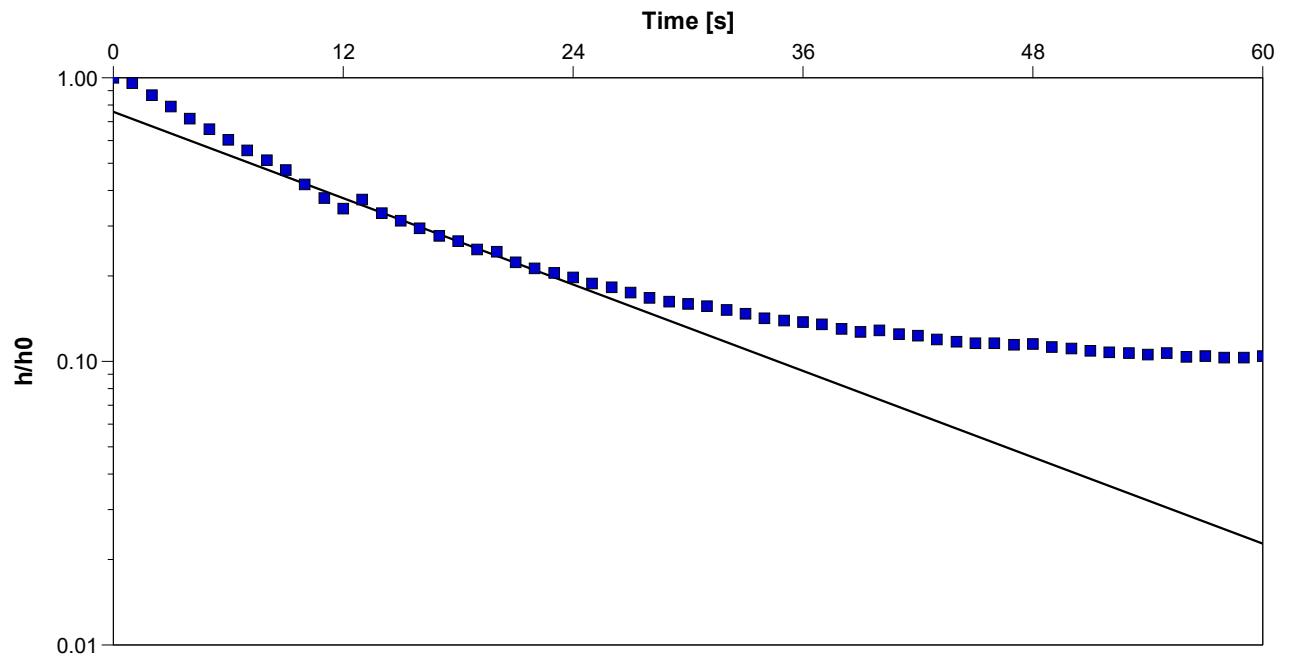
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

2.27×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 2

Test Well: BH05A

Test Conducted by: BRAL

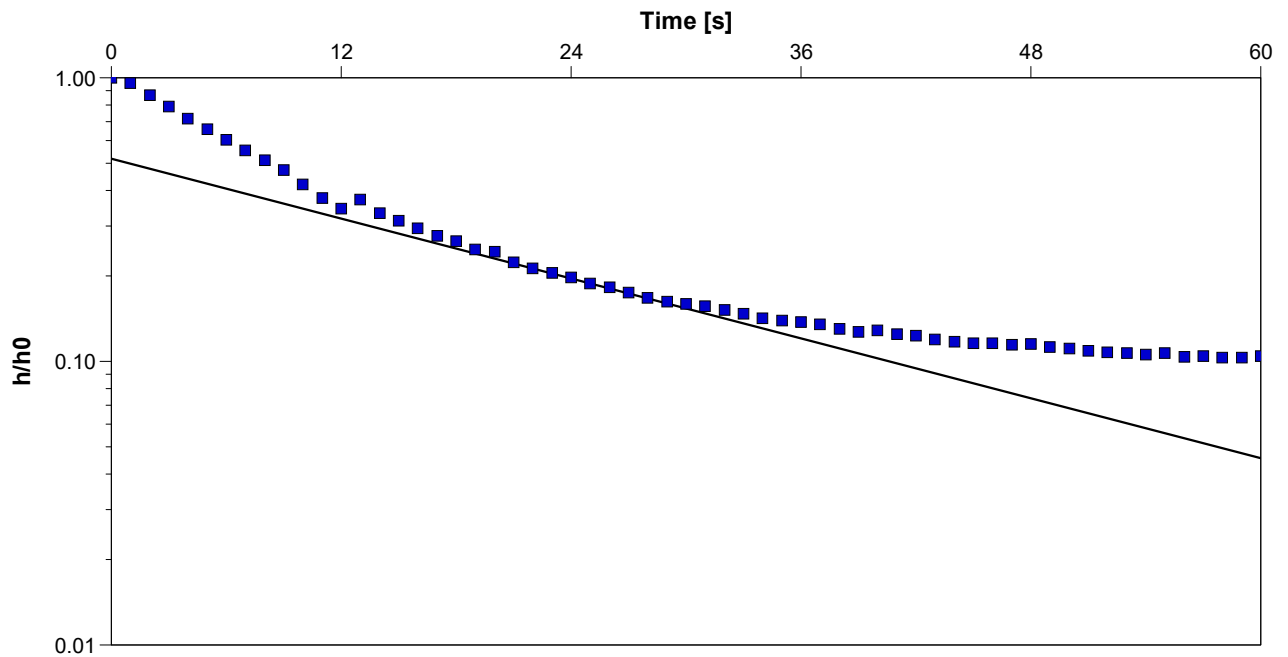
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

2.03×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 3

Test Well: BH05A

Test Conducted by: BRAL

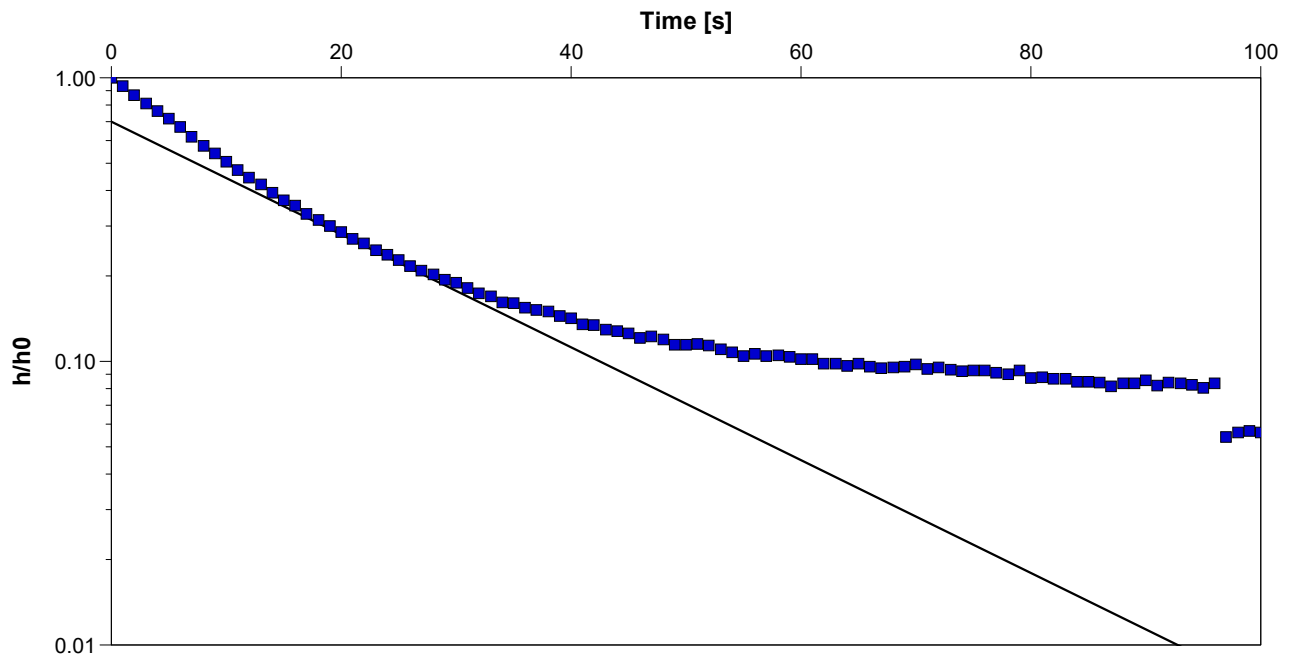
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

1.78×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Falling 3

Test Well: BH05A

Test Conducted by: BRAL

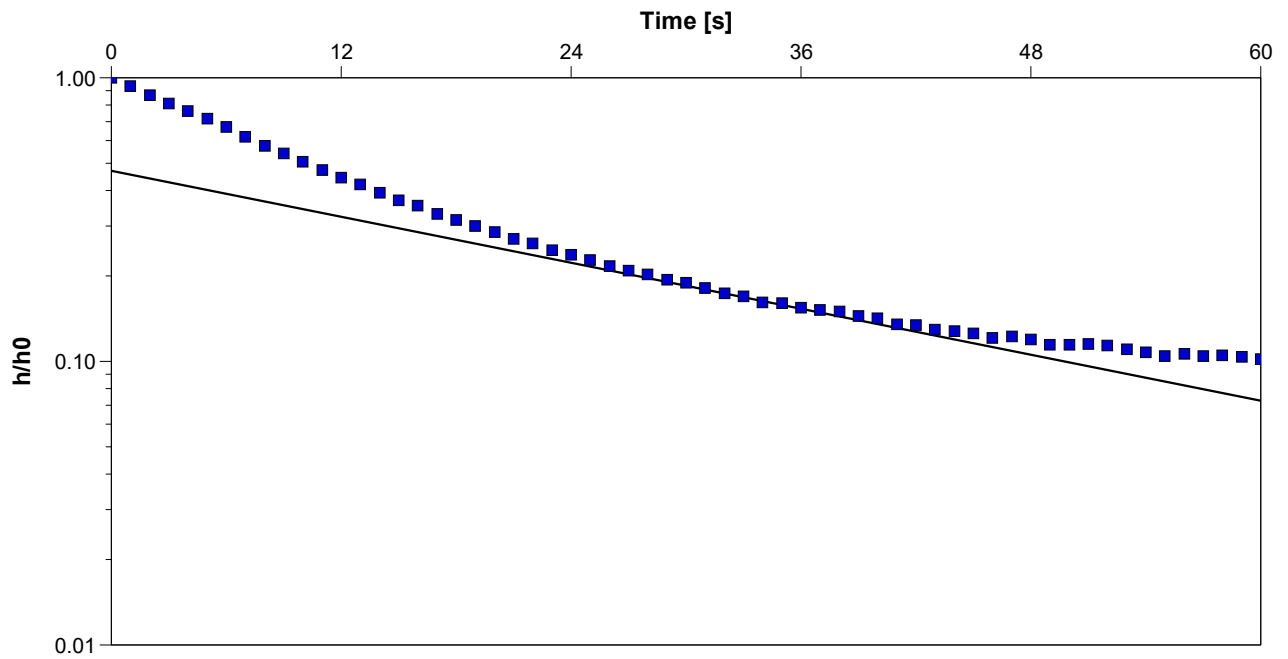
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH05A

1.56×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 3

Test Well: BH05A

Test Conducted by: BRAL

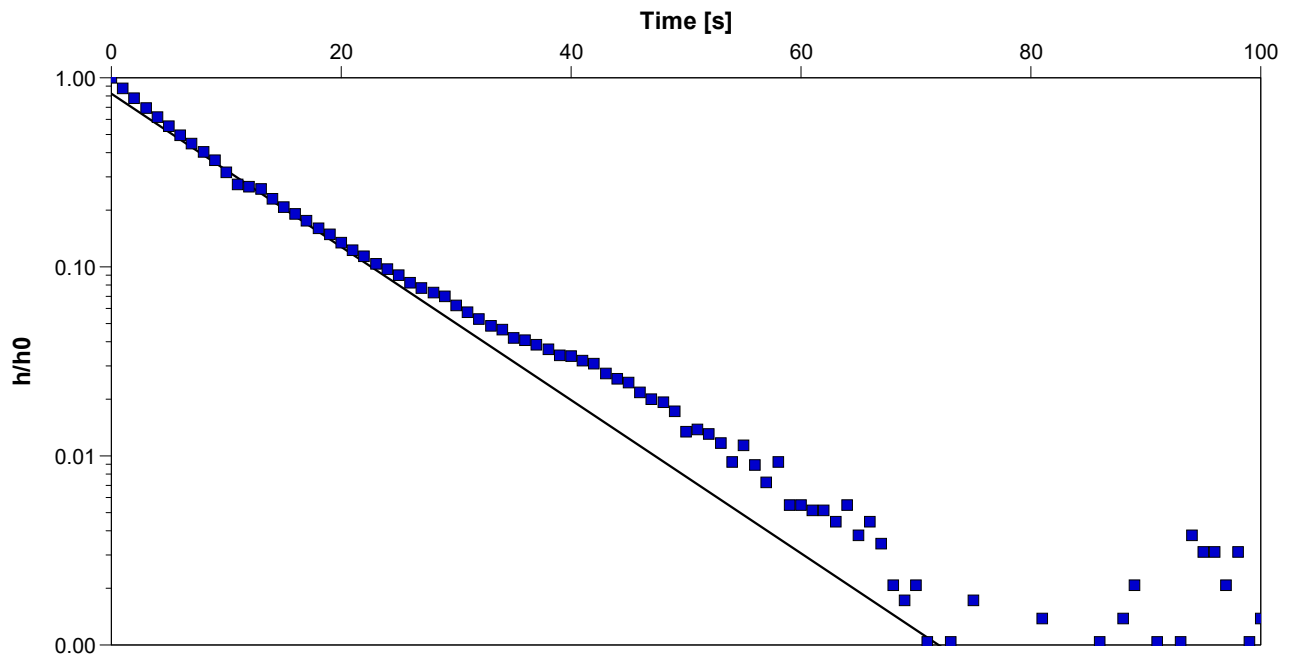
Test Date: 1/12/2020

Analysis Performed by: KELE

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH05A	3.62×10^{-5}	

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05A Rising 3

Test Well: BH05A

Test Conducted by: BRAL

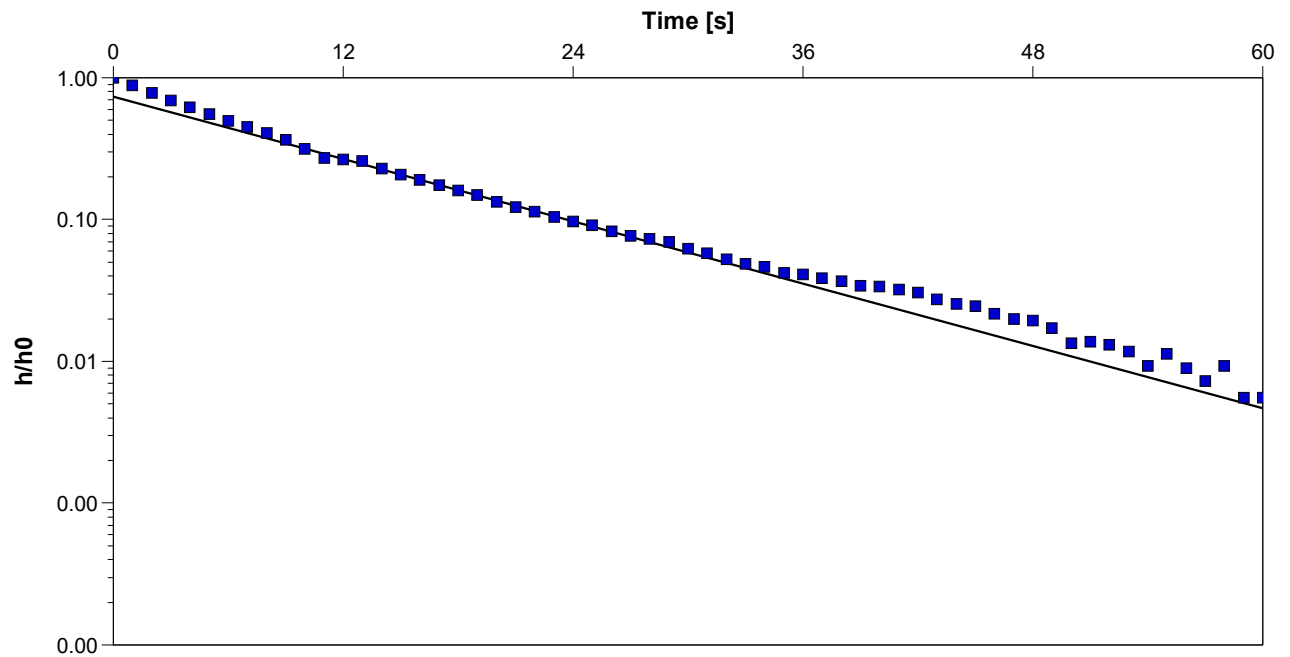
Test Date: 1/12/2020

Analysis Performed by: KELE

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 11.14 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH05A	4.23×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05B Falling

Test Well: BH05B

Test Conducted by: BRAL

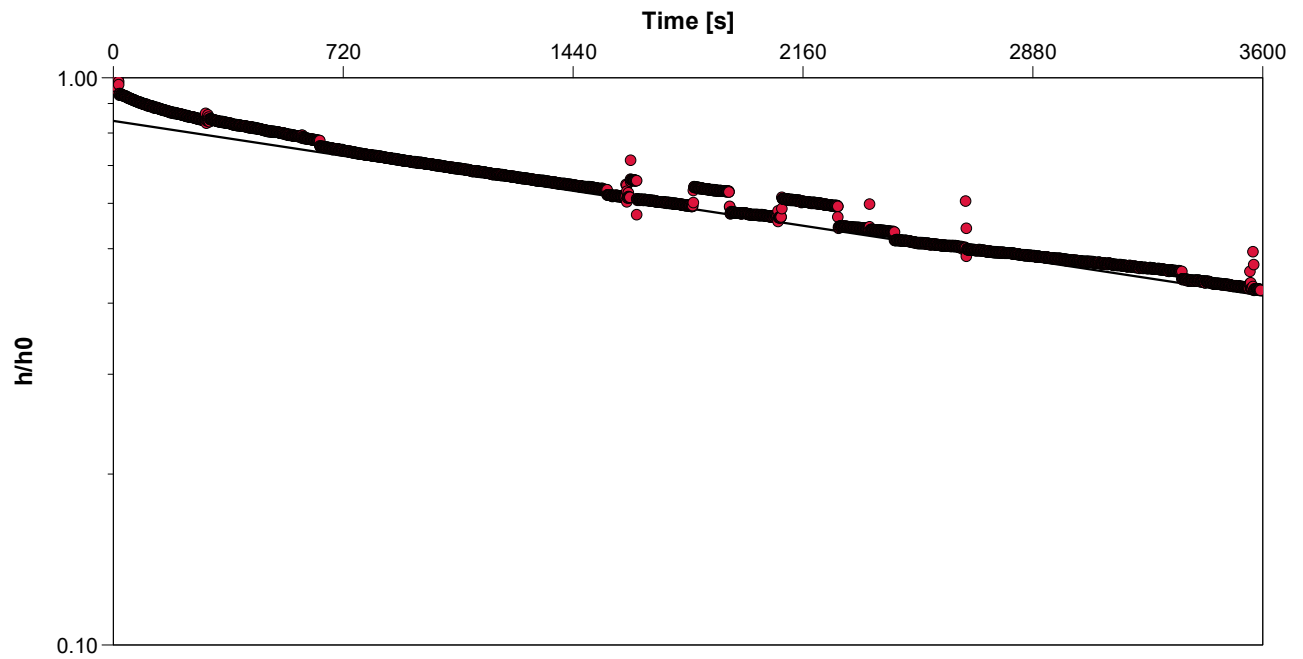
Test Date: 1/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 2.66 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
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BH05B	1.09×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05B Falling

Test Well: BH05B

Test Conducted by: BRAL

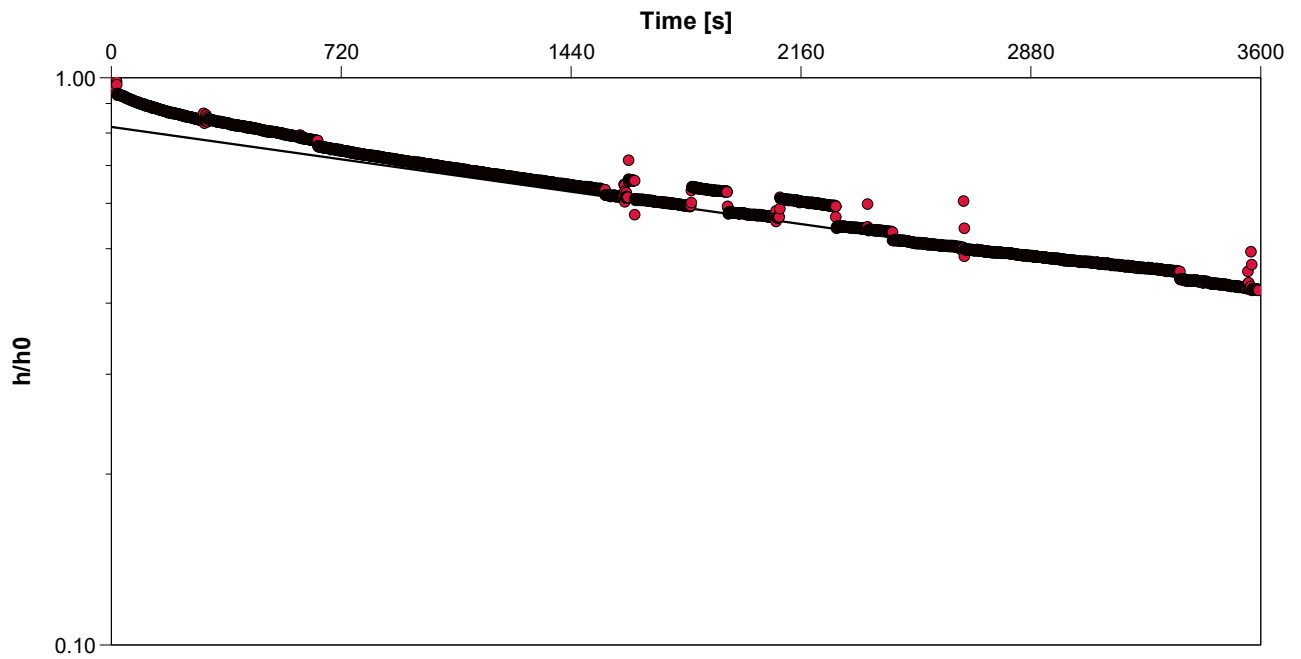
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 2.66 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH05B	1.31×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05B Rising

Test Well: BH05B

Test Conducted by: BRAL

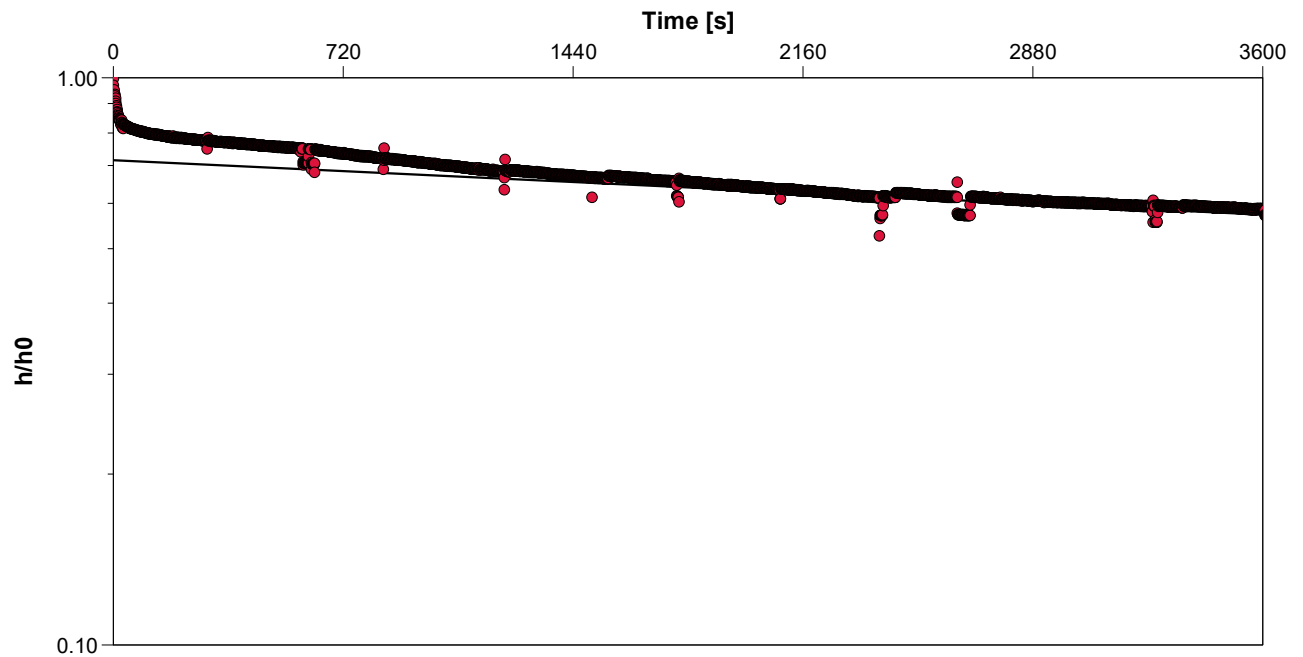
Test Date: 1/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 2.66 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH05B

3.40×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Road

Slug Test: BH05B Rising

Test Well: BH05B

Test Conducted by: BRAL

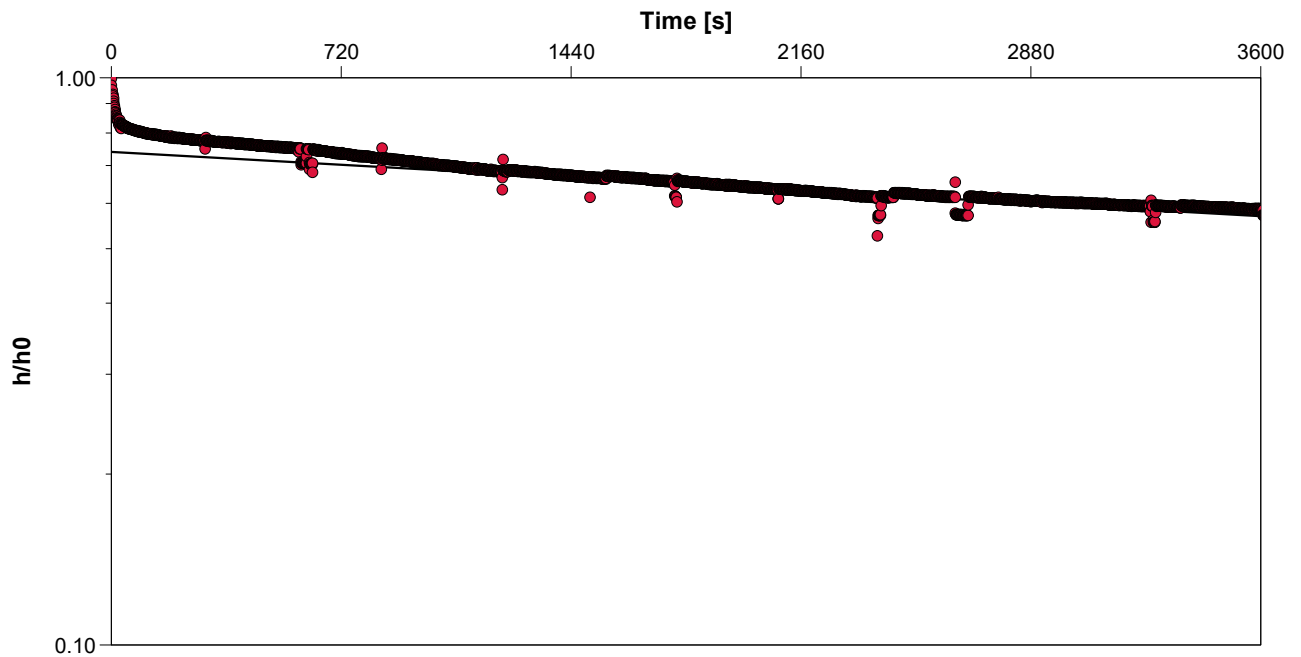
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 2.66 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH05B

5.26×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH06 Falling

Test Well: BH06

Test Conducted by: BRAL

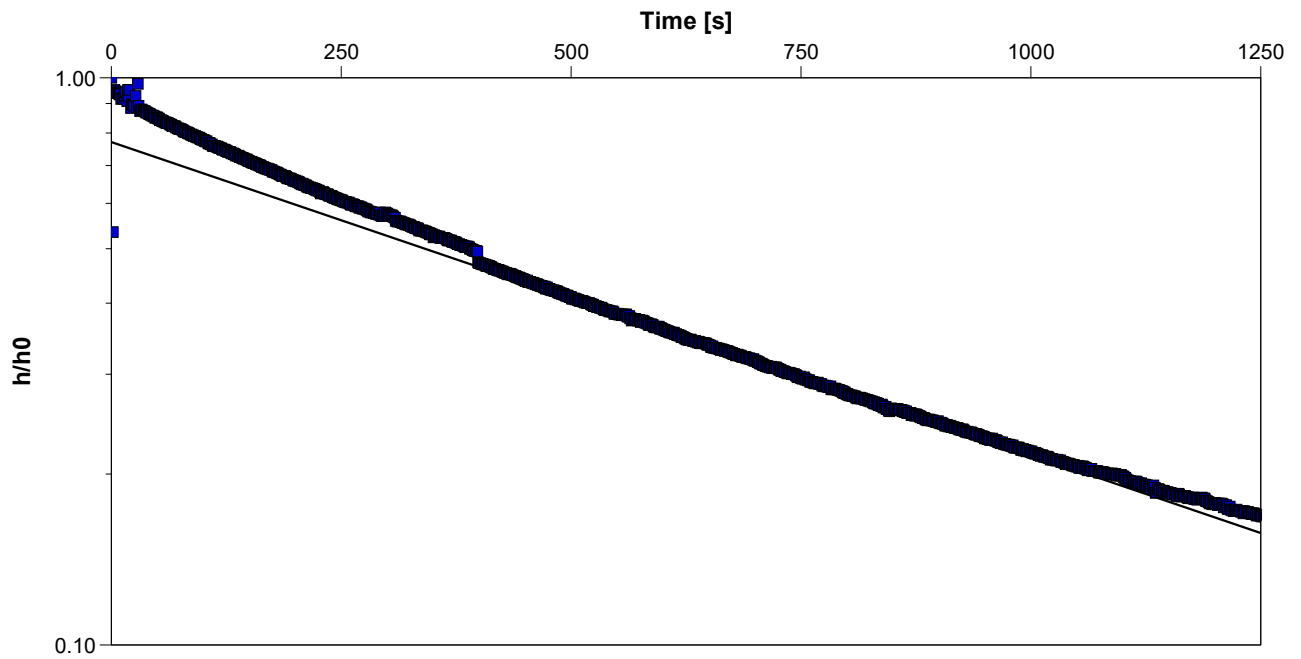
Test Date: 1/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 2.41 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH06

8.36×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH06 Falling

Test Well: BH06

Test Conducted by: BRAL

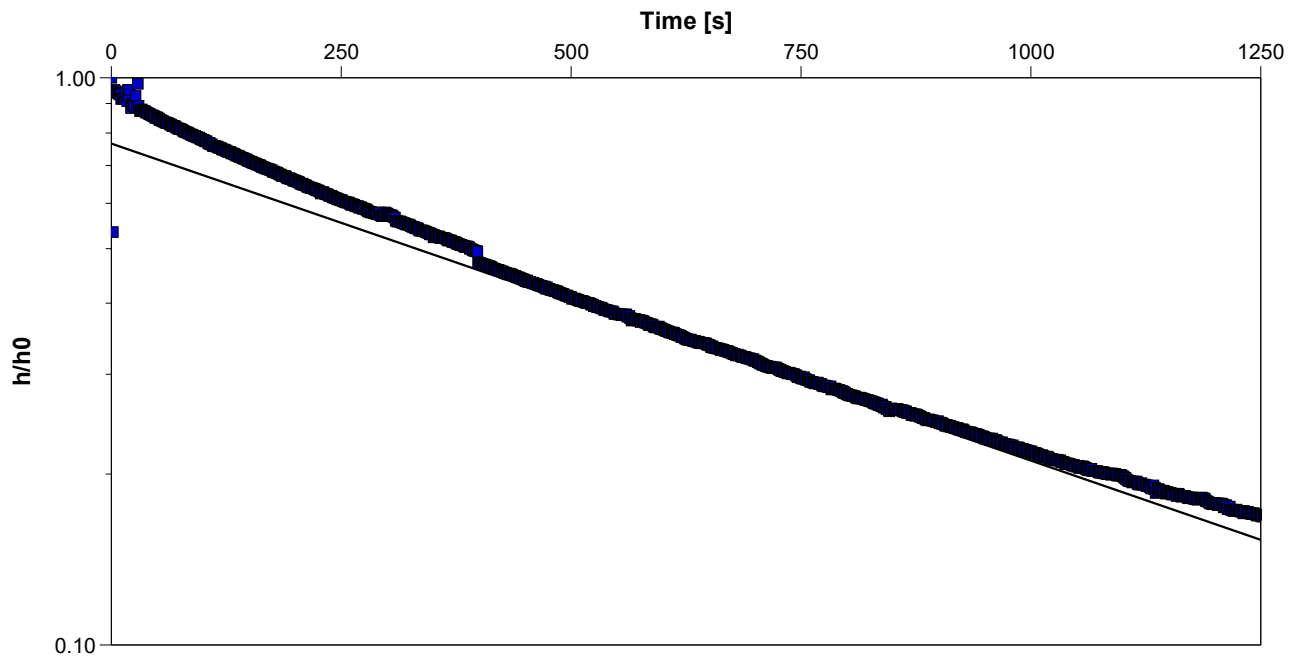
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 2.41 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH06	1.10×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH06 Rising

Test Well: BH06

Test Conducted by: BRAL

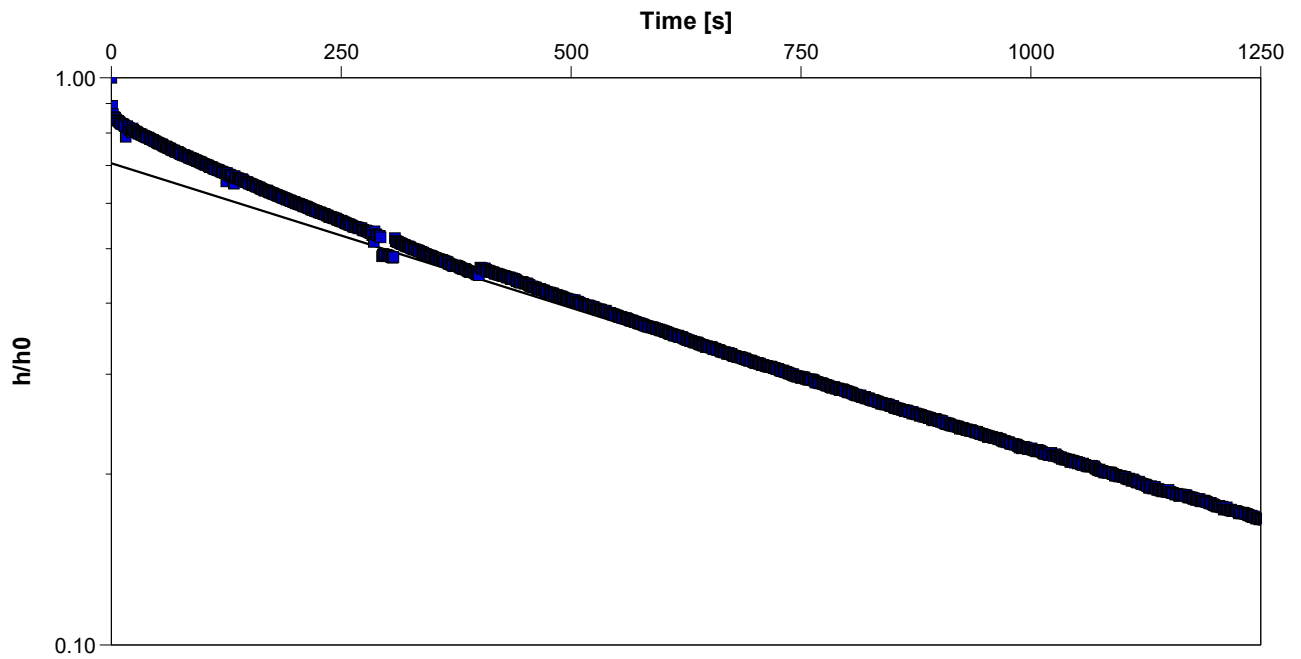
Test Date: 1/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 2.41 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH06

7.73×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH06 Rising

Test Well: BH06

Test Conducted by: BRAL

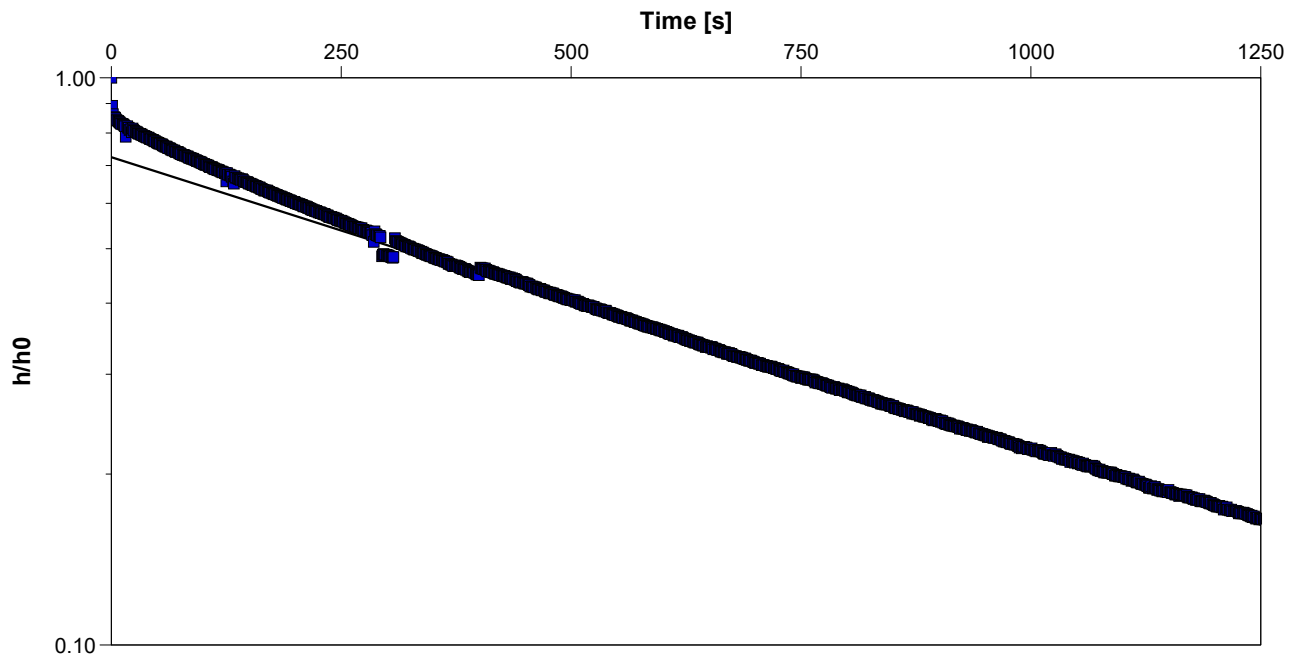
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 2.41 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH06

1.02×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH08 Falling

Test Well: BH08

Test Conducted by: BRAL

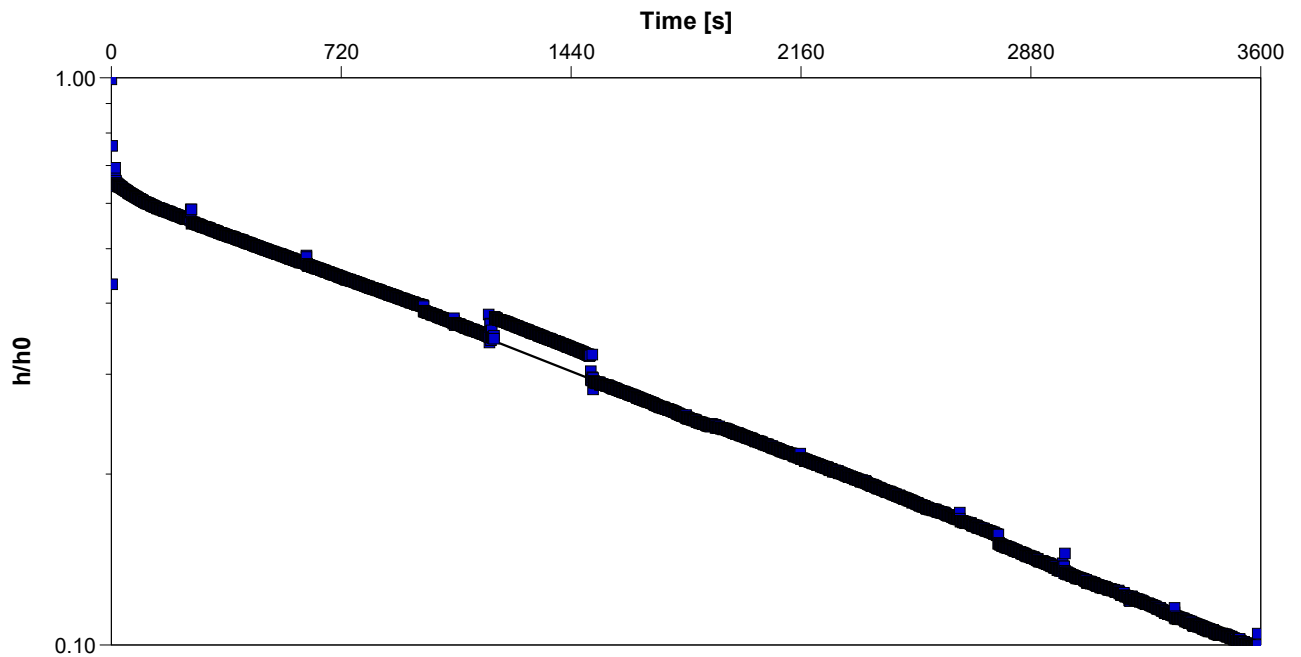
Test Date: 1/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 3/12/2020

Aquifer Thickness: 4.92 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH08

1.97×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH08 Falling

Test Well: BH08

Test Conducted by: BRAL

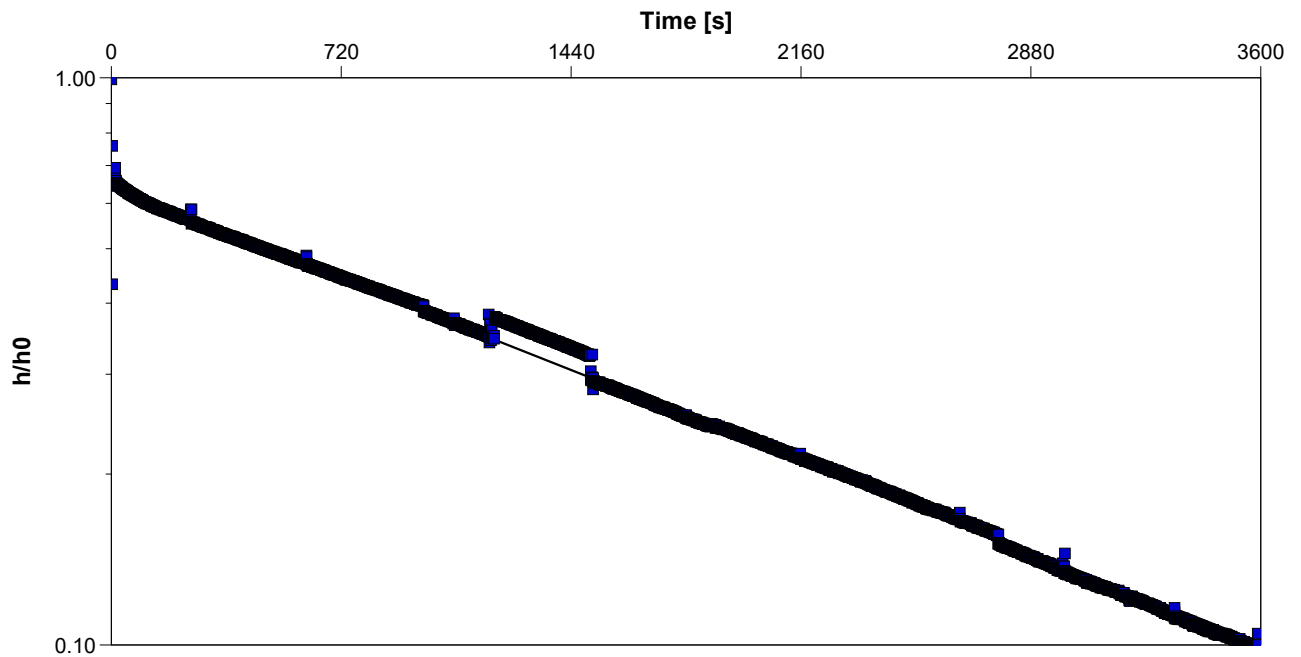
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 4.92 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH08	2.57×10^{-7}
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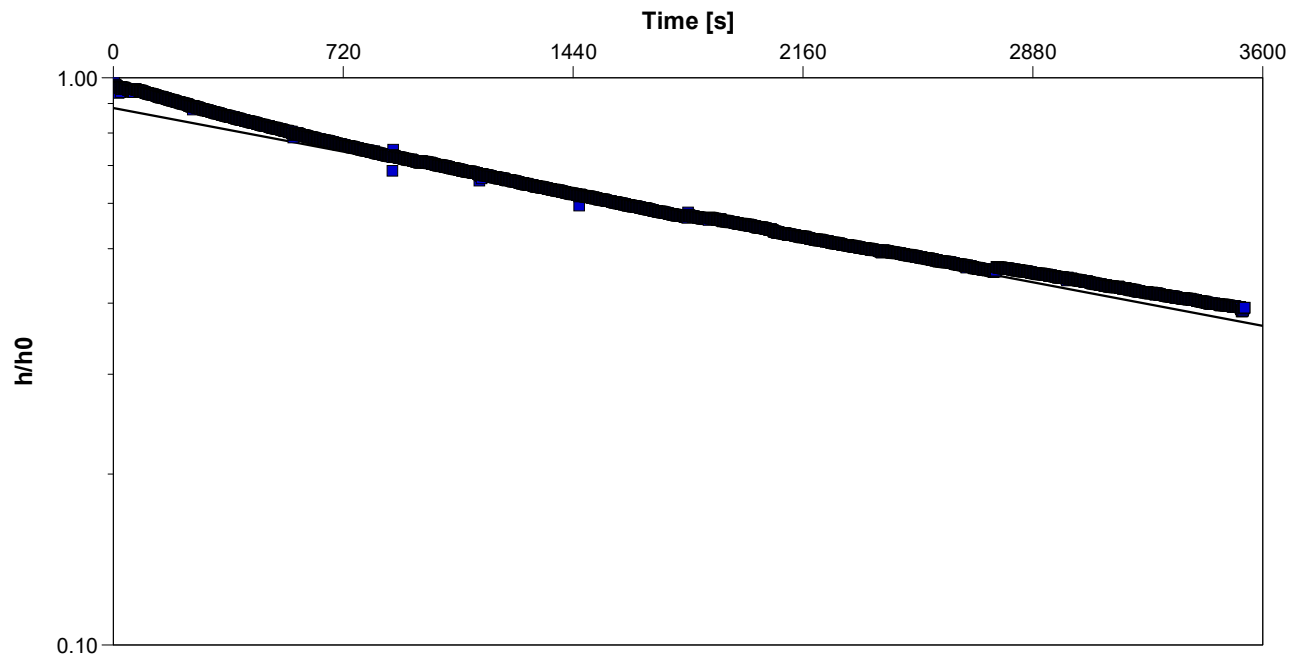
Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road	Slug Test: BH08 Rising	Test Well: BH08
Test Conducted by: BRAL		Test Date: 1/12/2020
Analysis Performed by: BRAL	Bouwer and Rice	Analysis Date: 3/12/2020
Aquifer Thickness: 4.92 m		



Calculation using Bouwer & Rice		
Observation Well	Hydraulic Conductivity [m/s]	
BH08	9.53×10^{-5}	

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 16 Spedding Road

Slug Test: BH08 Rising

Test Well: BH08

Test Conducted by: BRAL

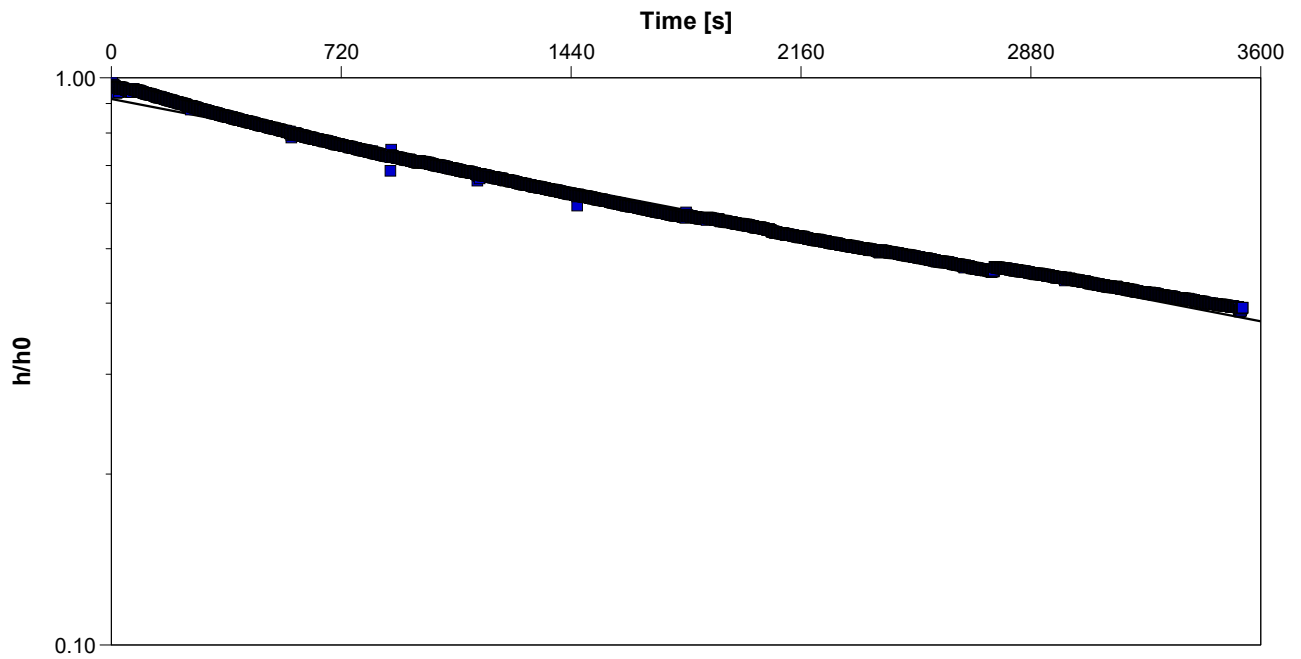
Test Date: 1/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 3/12/2020

Aquifer Thickness: 4.92 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH08	1.25×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 1

Test Well: BH110

Test Conducted by: BRAL

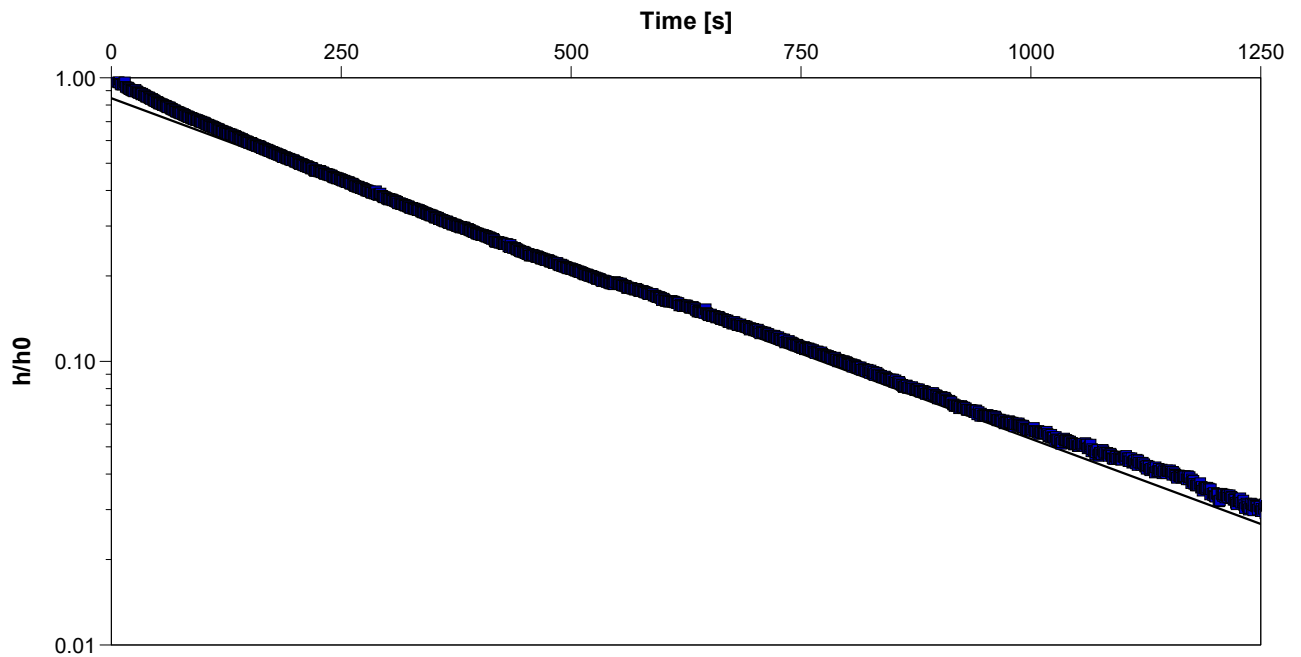
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH110

1.07×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 1

Test Well: BH110

Test Conducted by: BRAL

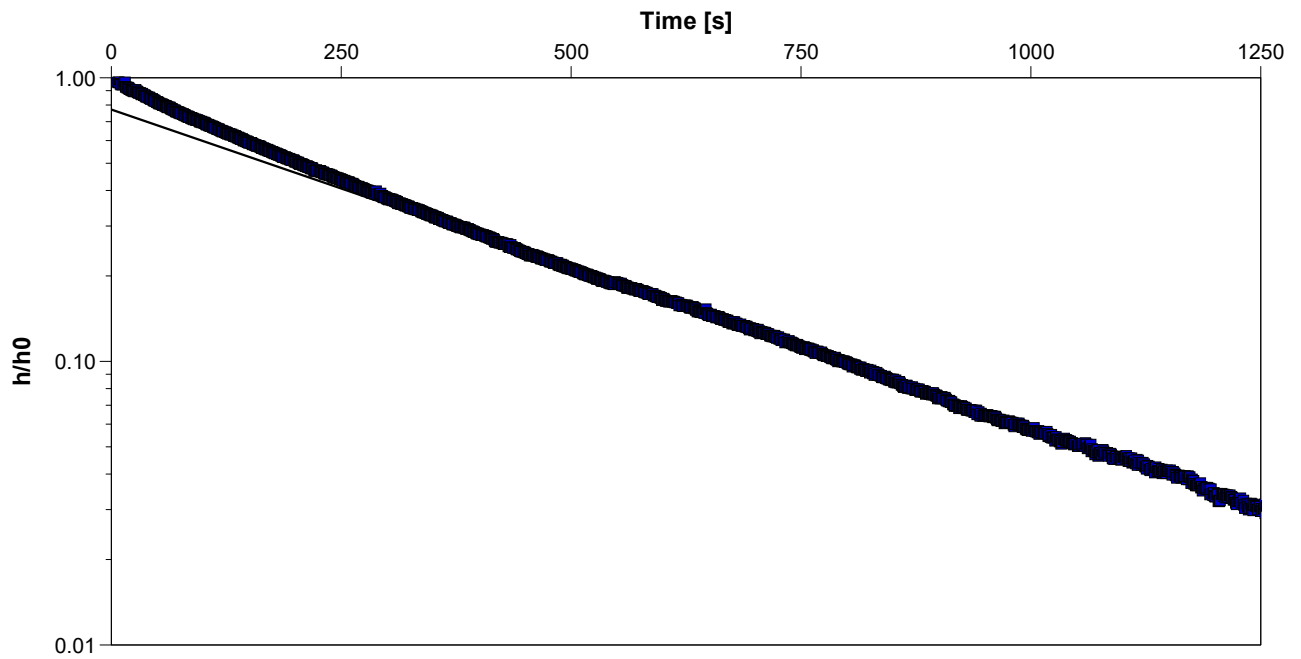
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH110	1.29×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 1

Test Well: BH110

Test Conducted by: BRAL

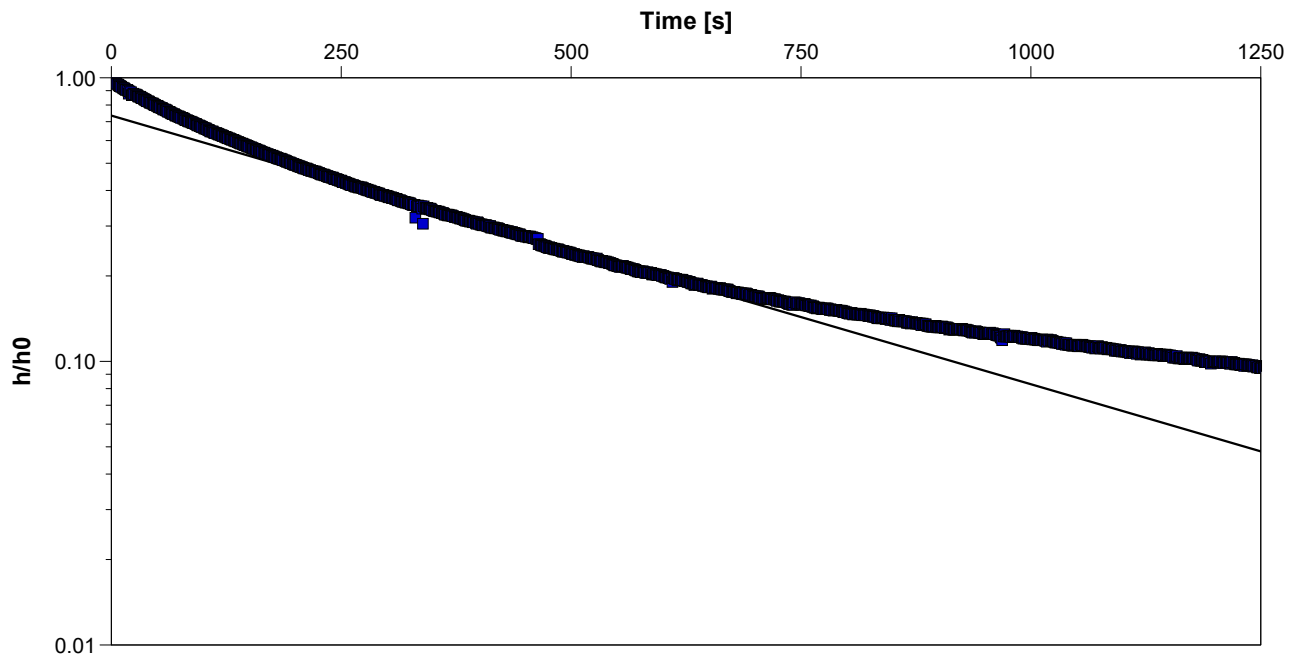
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH110	8.46×10^{-7}	



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 1

Test Well: BH110

Test Conducted by: BRAL

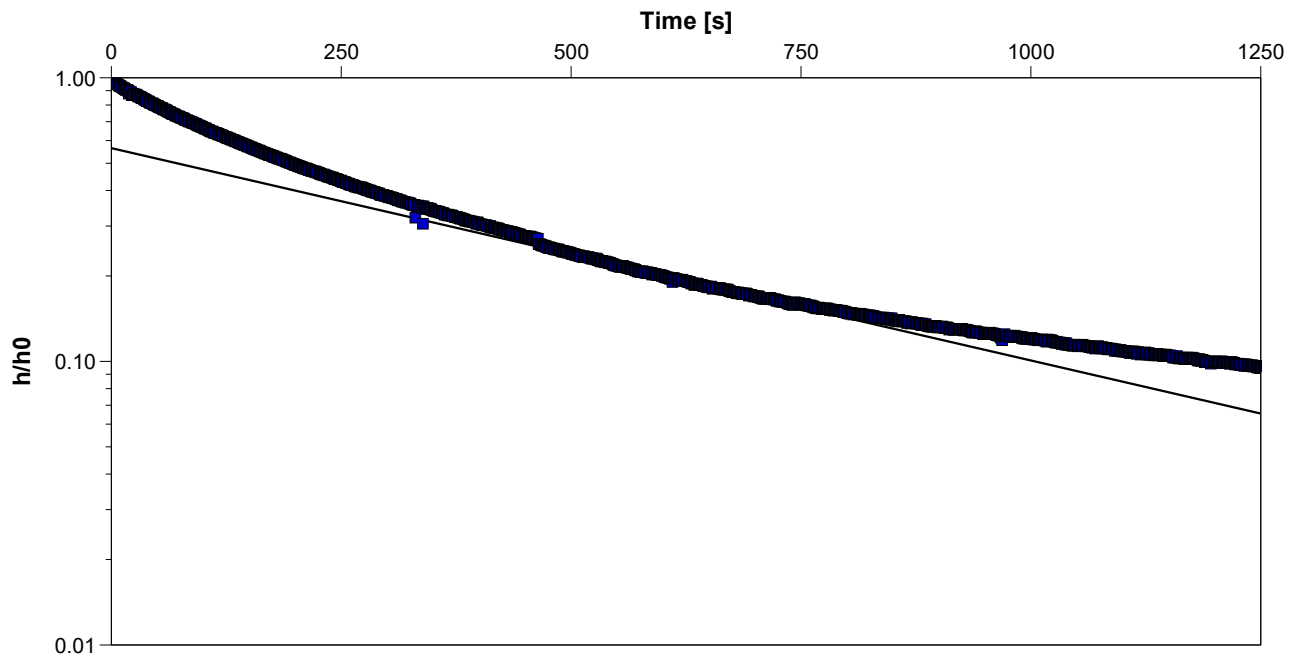
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH110	8.64×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 2

Test Well: BH110

Test Conducted by: BRAL

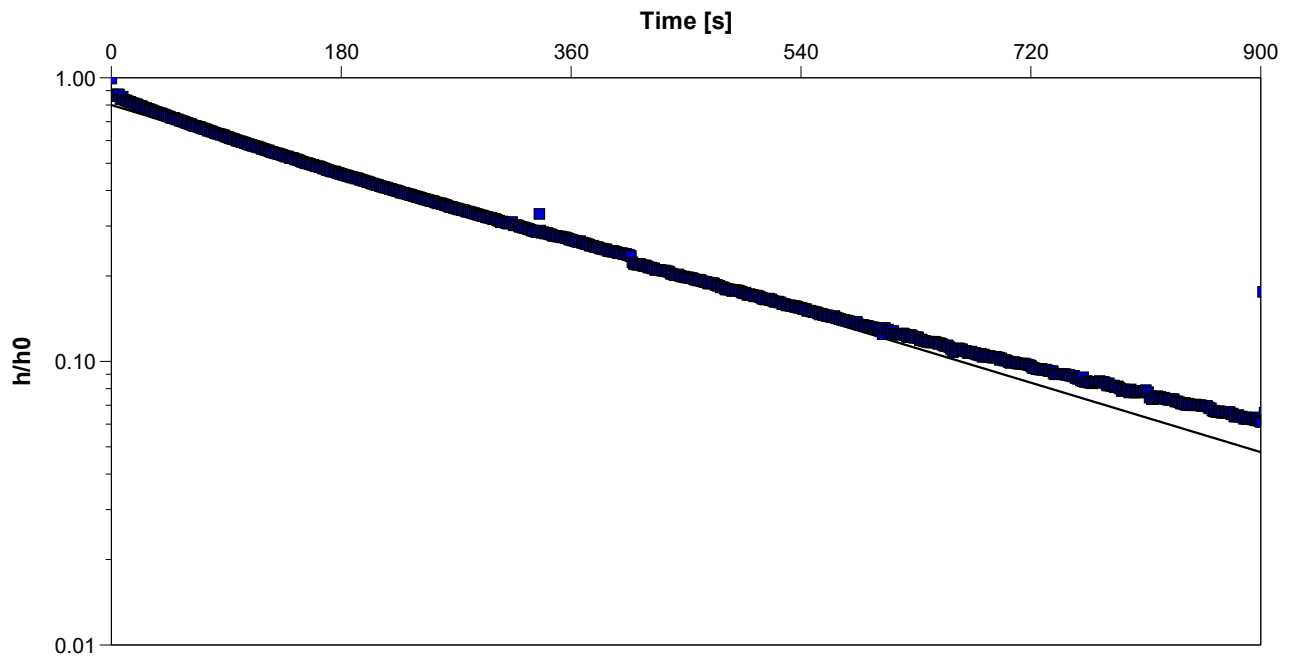
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
BH110	1.21×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 2

Test Well: BH110

Test Conducted by: BRAL

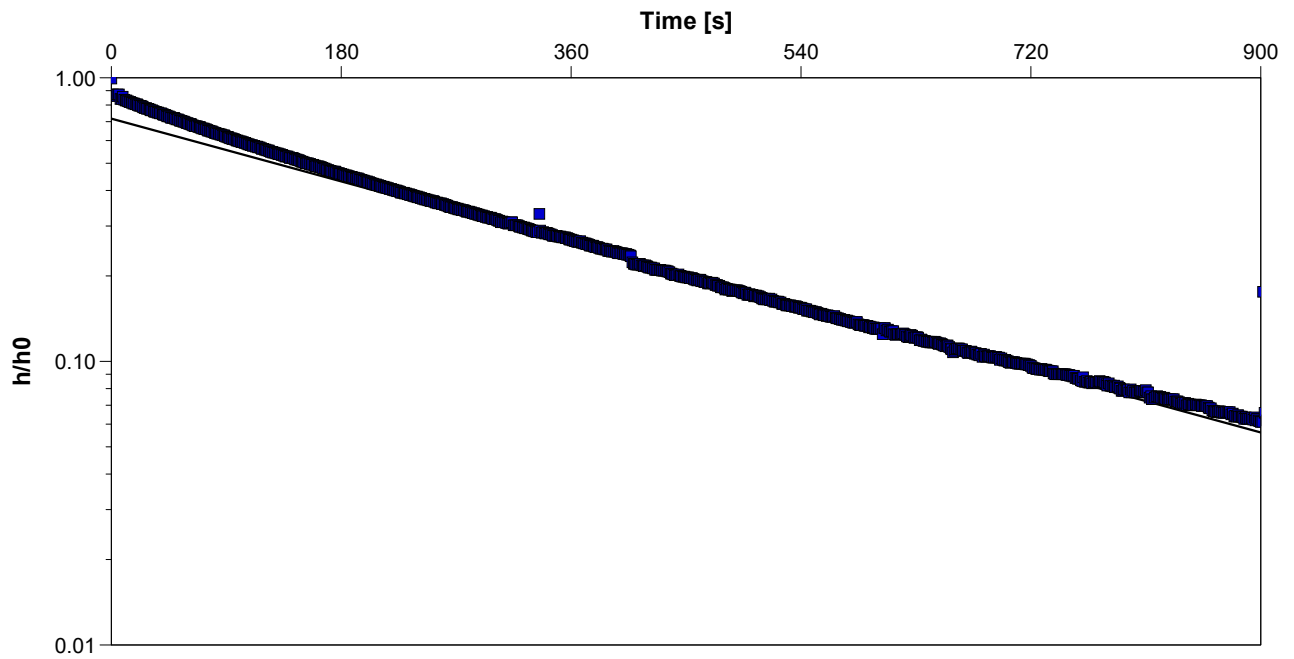
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH110	1.42×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 2

Test Well: BH110

Test Conducted by: BRAL

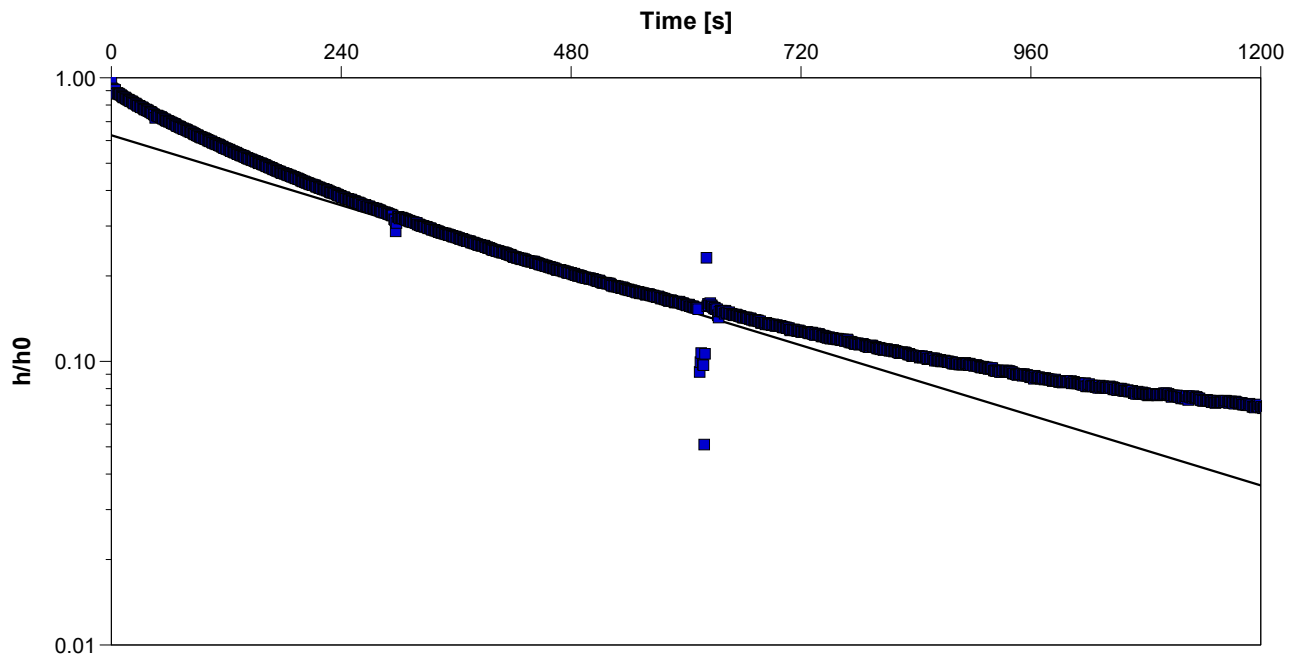
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
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BH110	9.20×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 2

Test Well: BH110

Test Conducted by: BRAL

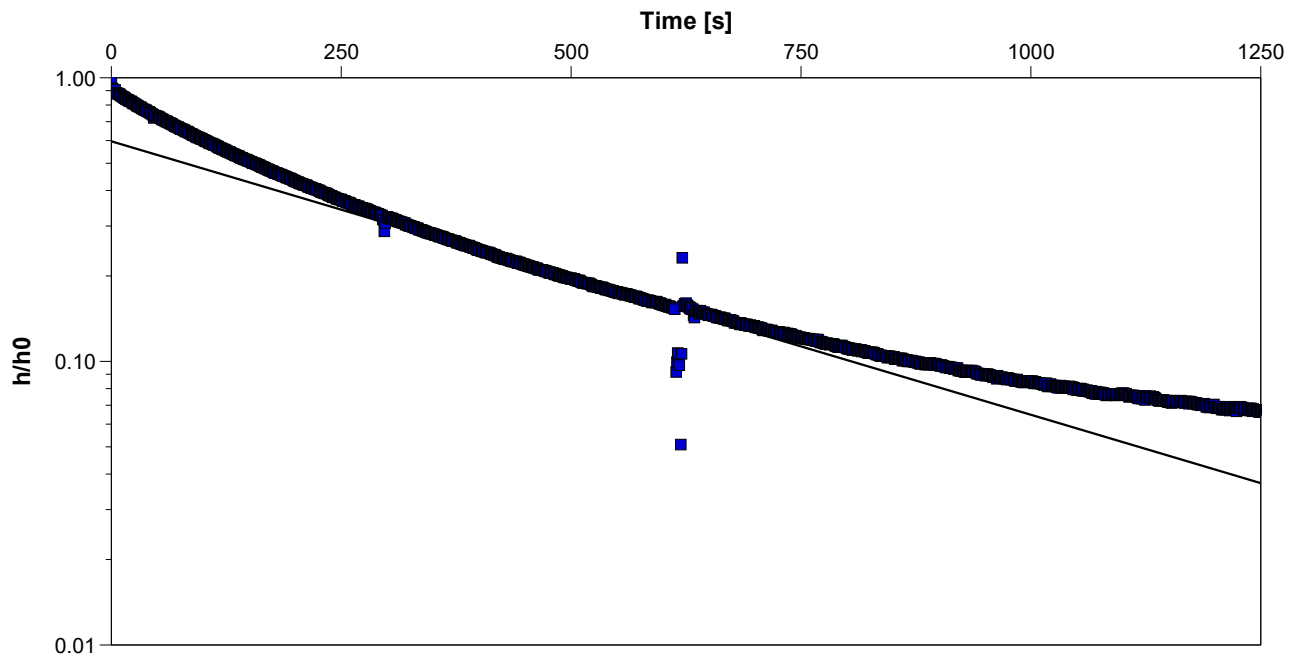
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH110	1.11×10^{-5}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 3

Test Well: BH110

Test Conducted by: BRAL

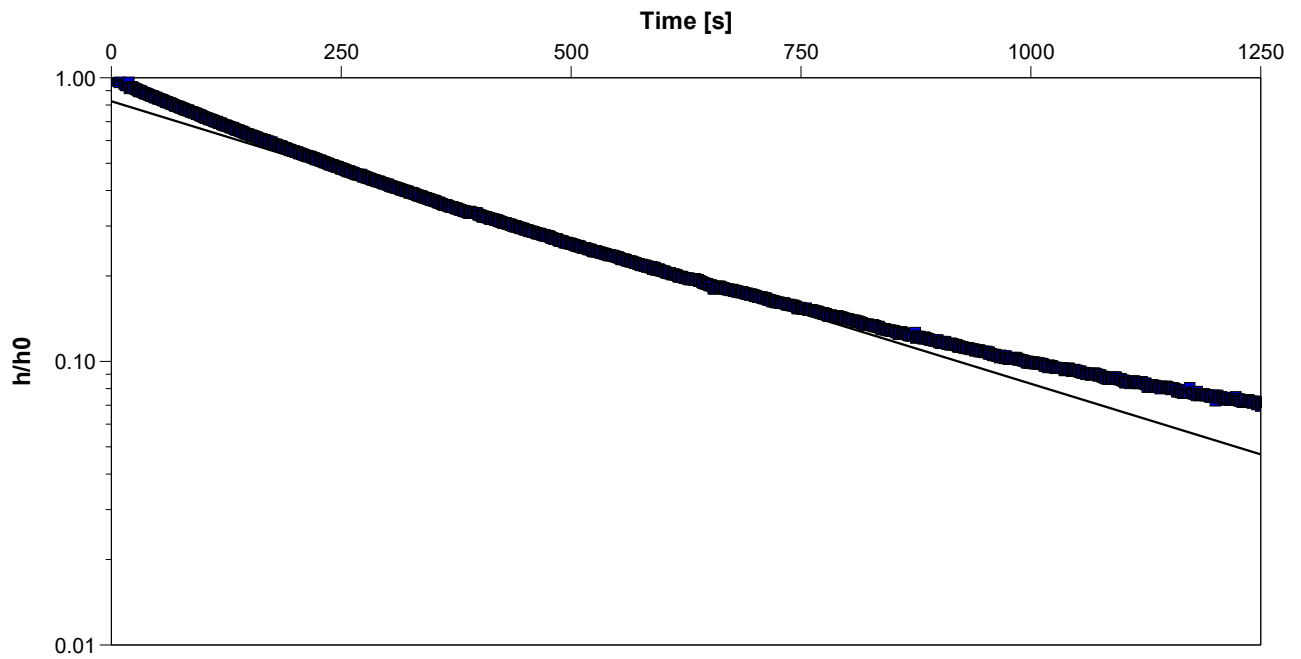
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH110	8.89×10^{-7}	



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Falling 3

Test Well: BH110

Test Conducted by: BRAL

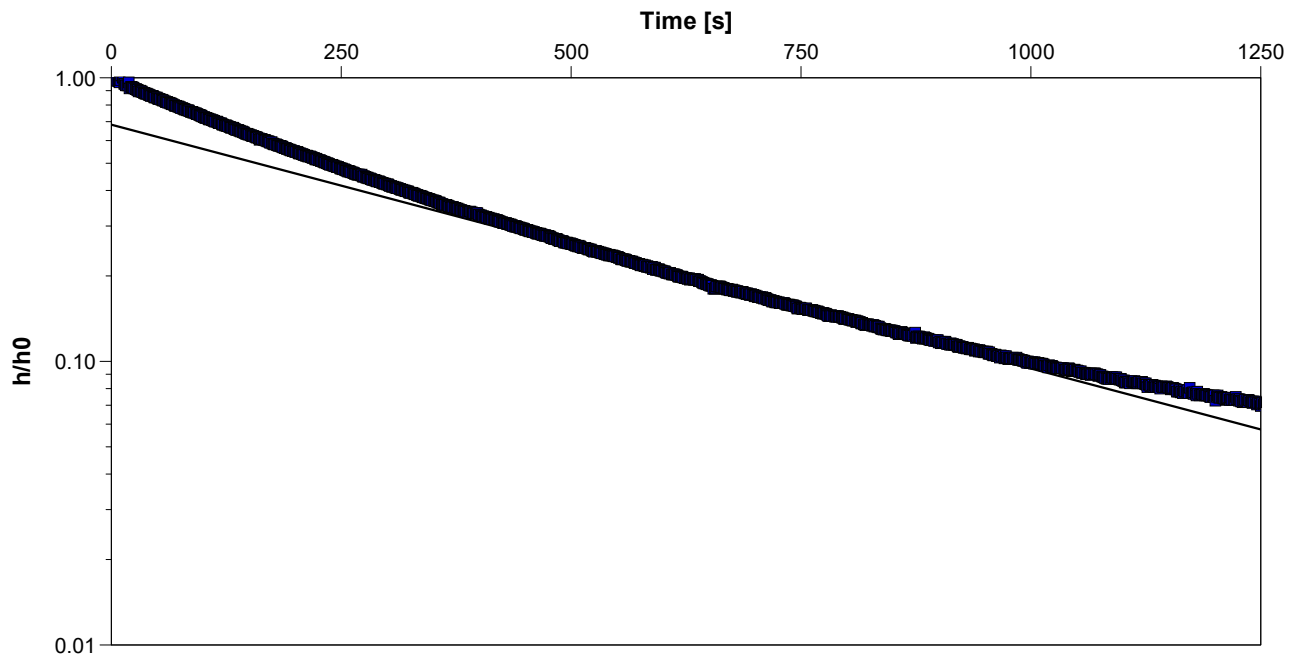
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH110	9.94×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 3

Test Well: BH110

Test Conducted by: BRAL

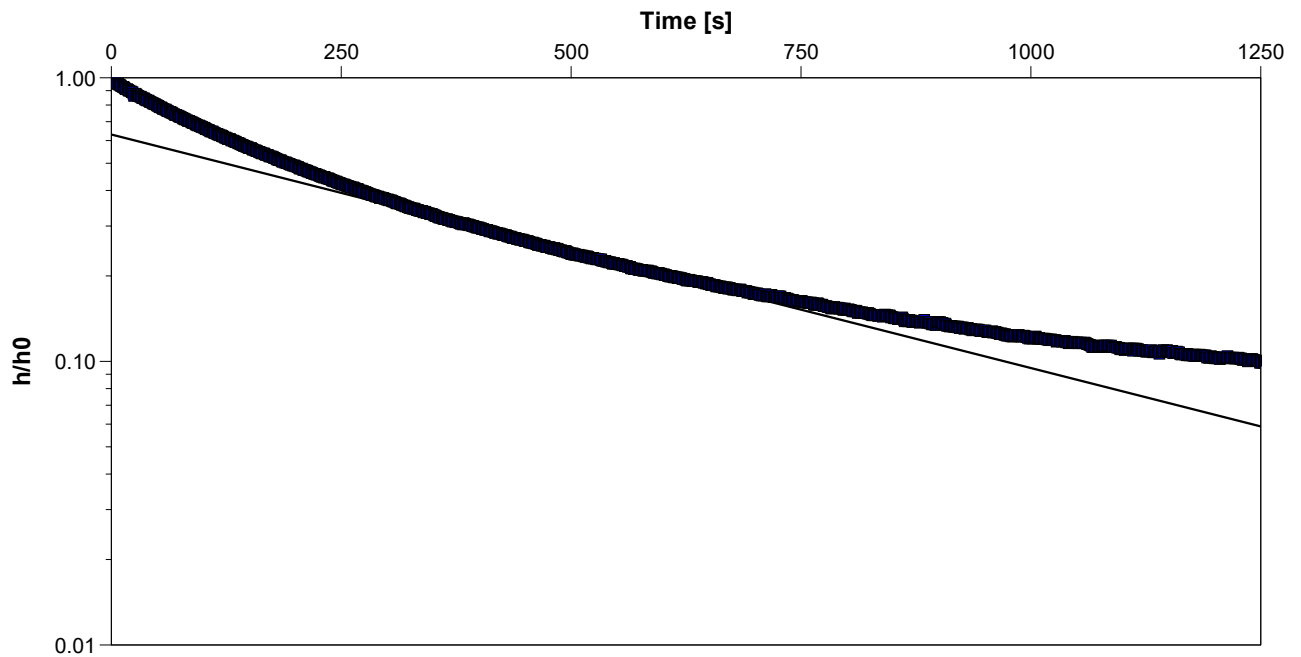
Test Date: 7/12/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH110	7.35×10^{-7}	



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH110 Rising 3

Test Well: BH110

Test Conducted by: BRAL

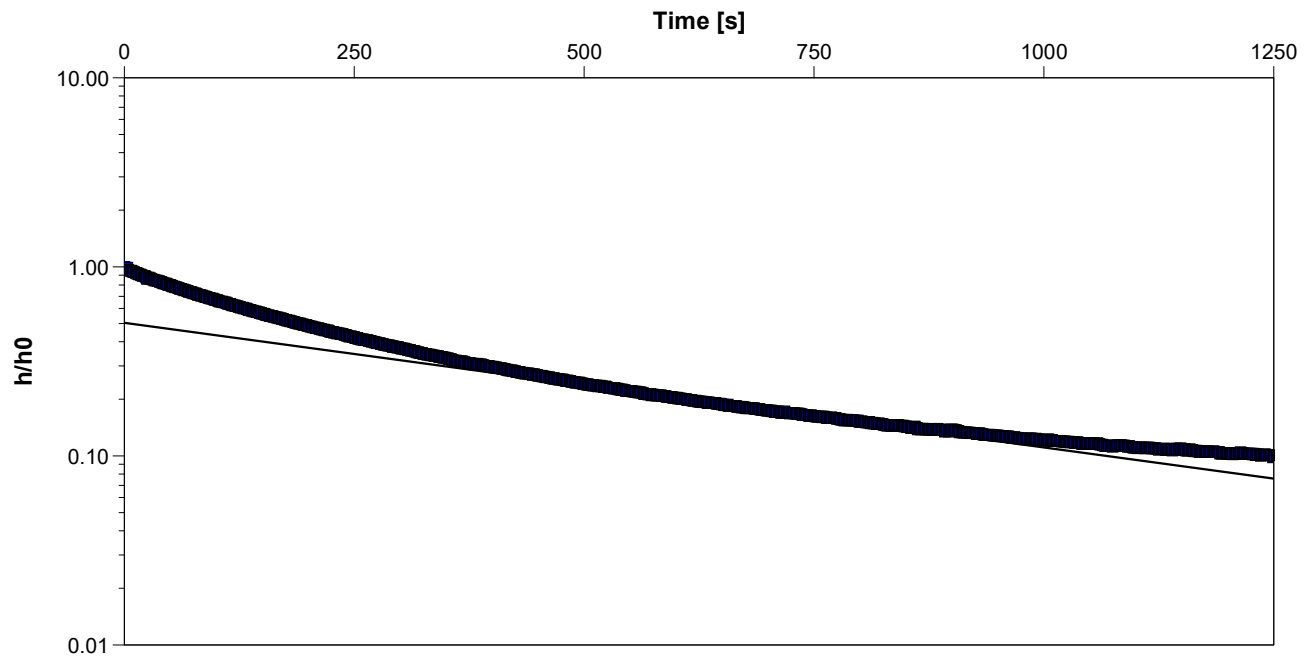
Test Date: 7/12/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 8/12/2020

Aquifer Thickness: 6.26 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110	7.63×10^{-7}	

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH111 Falling

Test Well: BH111

Test Conducted by: BRAL

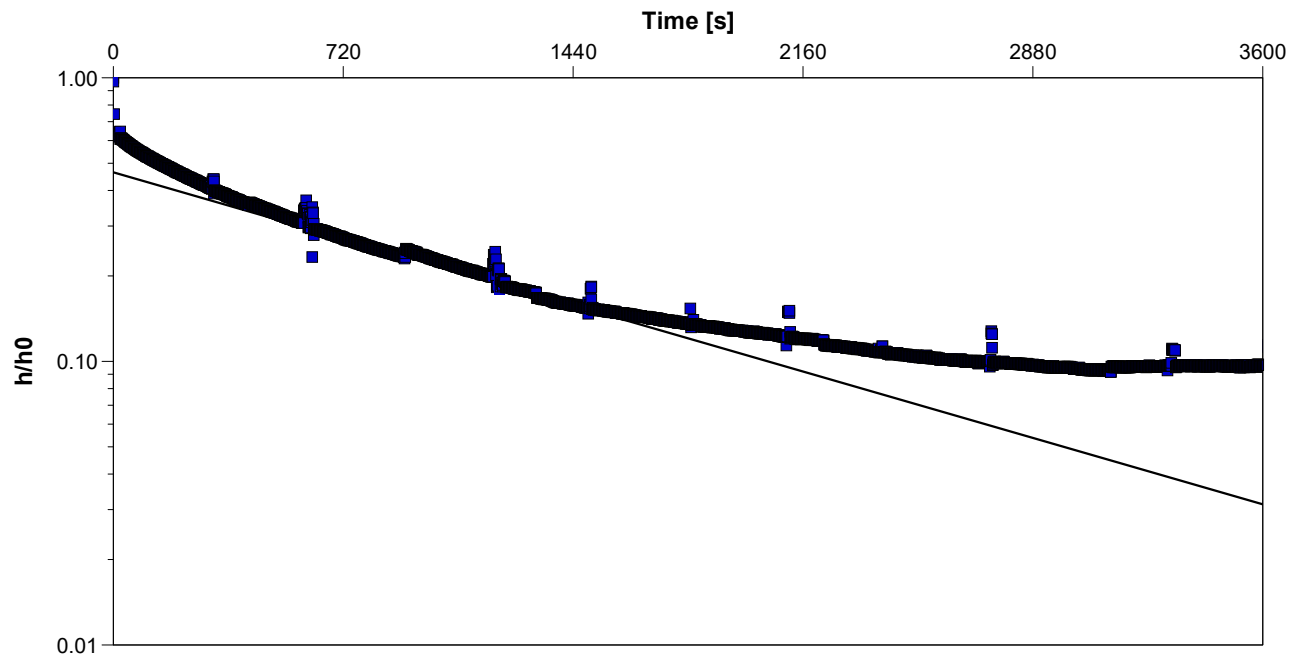
Test Date: 17/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 3.12 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
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BH111	3.96×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH111 Falling

Test Well: BH111

Test Conducted by: BRAL

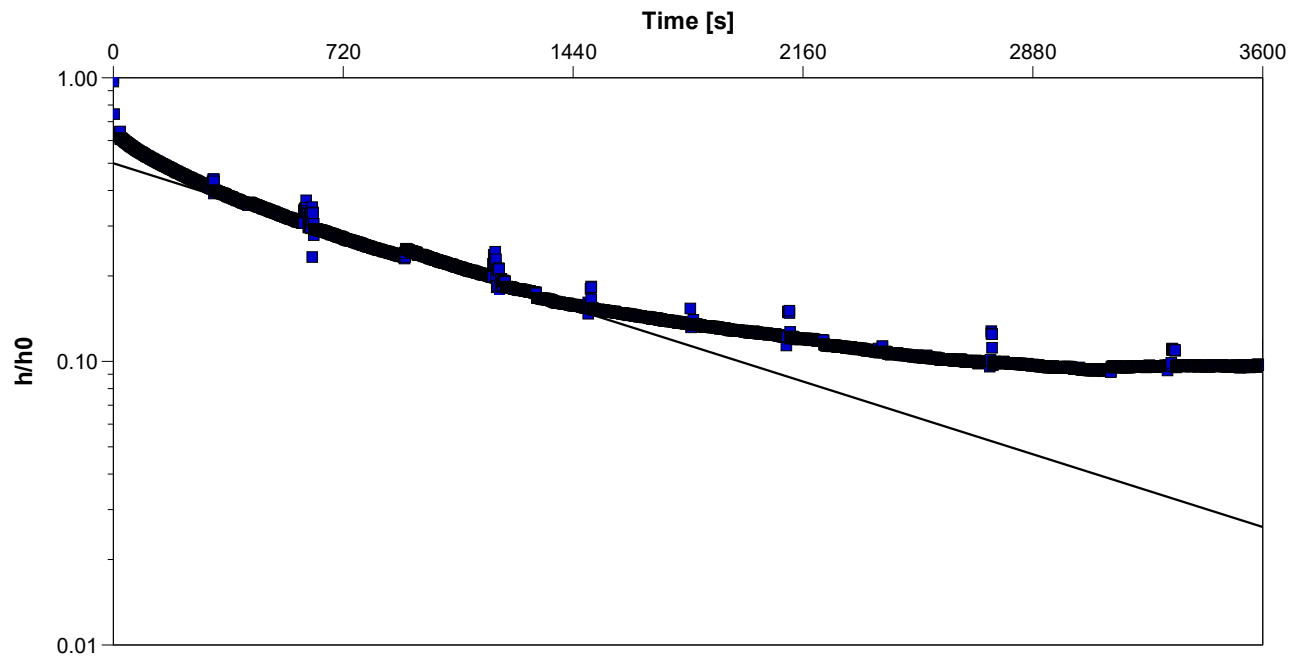
Test Date: 17/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 3.12 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH111	5.66×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH111 Rising

Test Well: BH111

Test Conducted by: BRAL

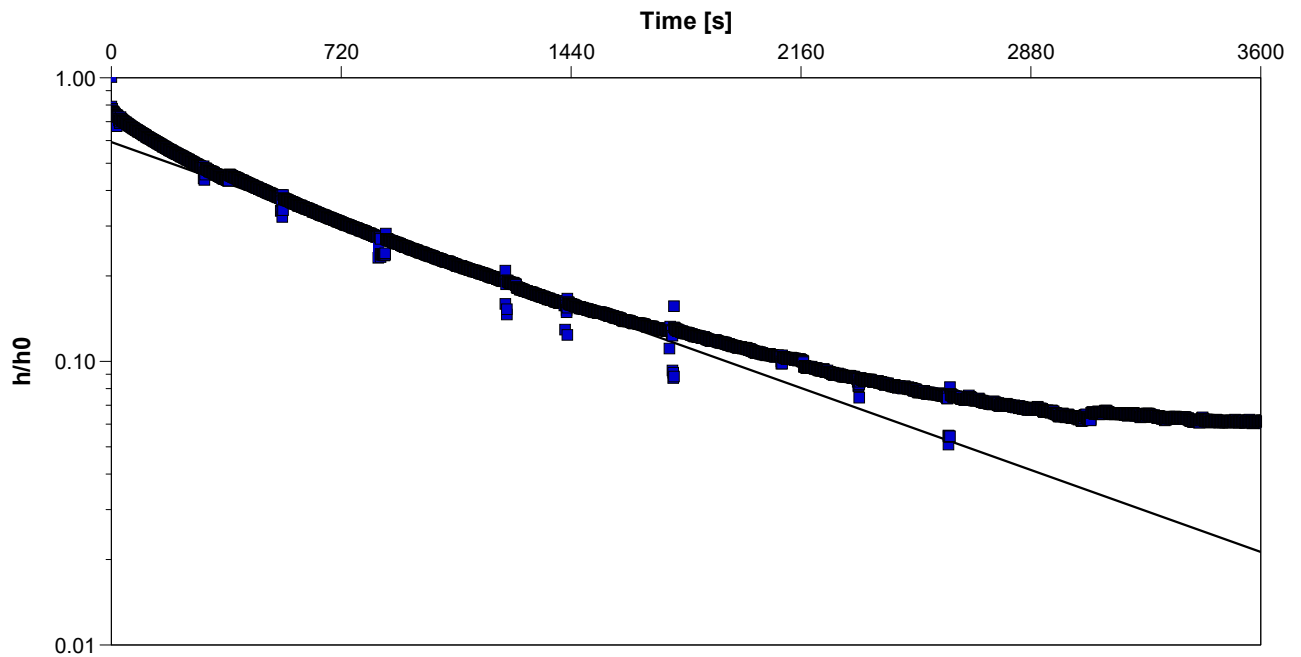
Test Date: 17/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 3.12 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
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BH111	4.90×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH111 Rising

Test Well: BH111

Test Conducted by: BRAL

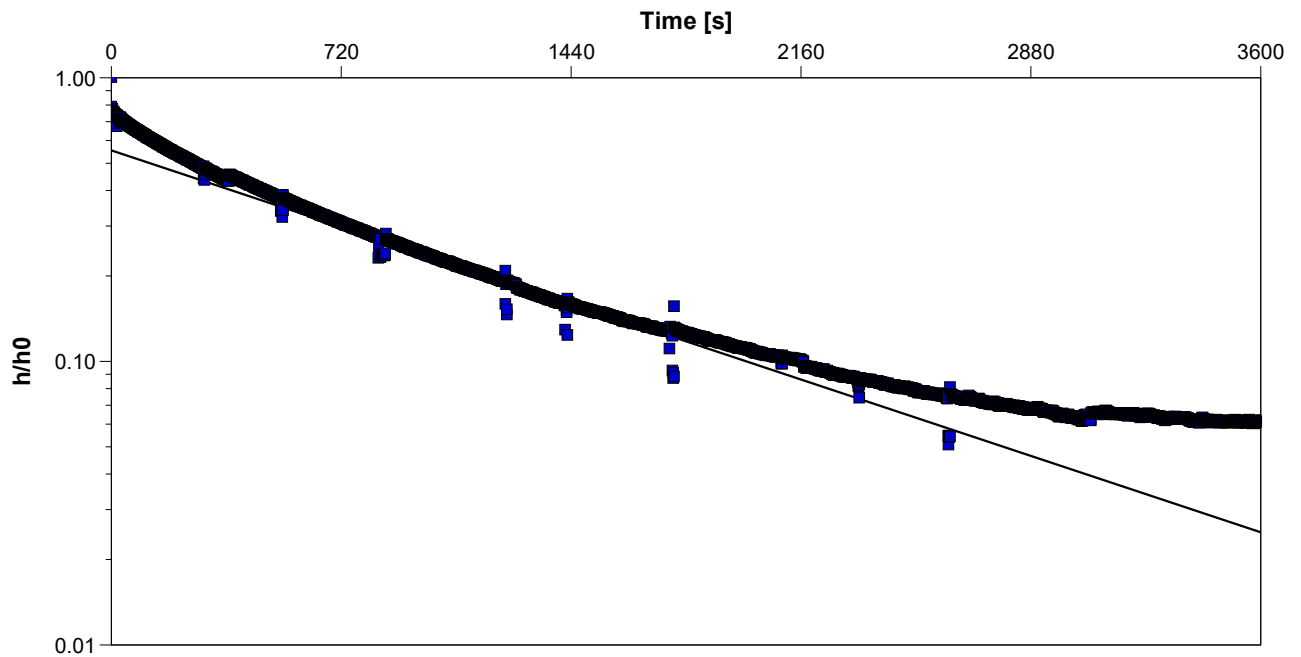
Test Date: 17/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 3.12 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
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BH111	5.93×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 1

Test Well: BH113

Test Conducted by: BRAL/AMHO

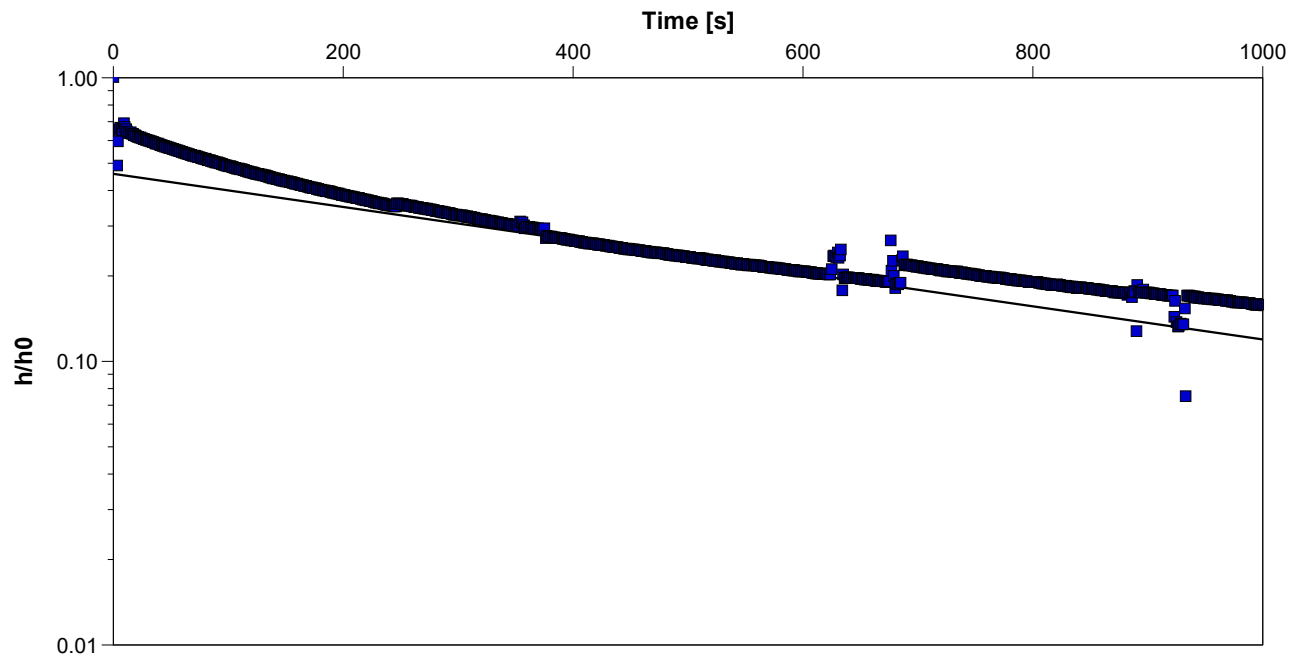
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH113

7.13×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 1

Test Well: BH113

Test Conducted by: BRAL/AMHO

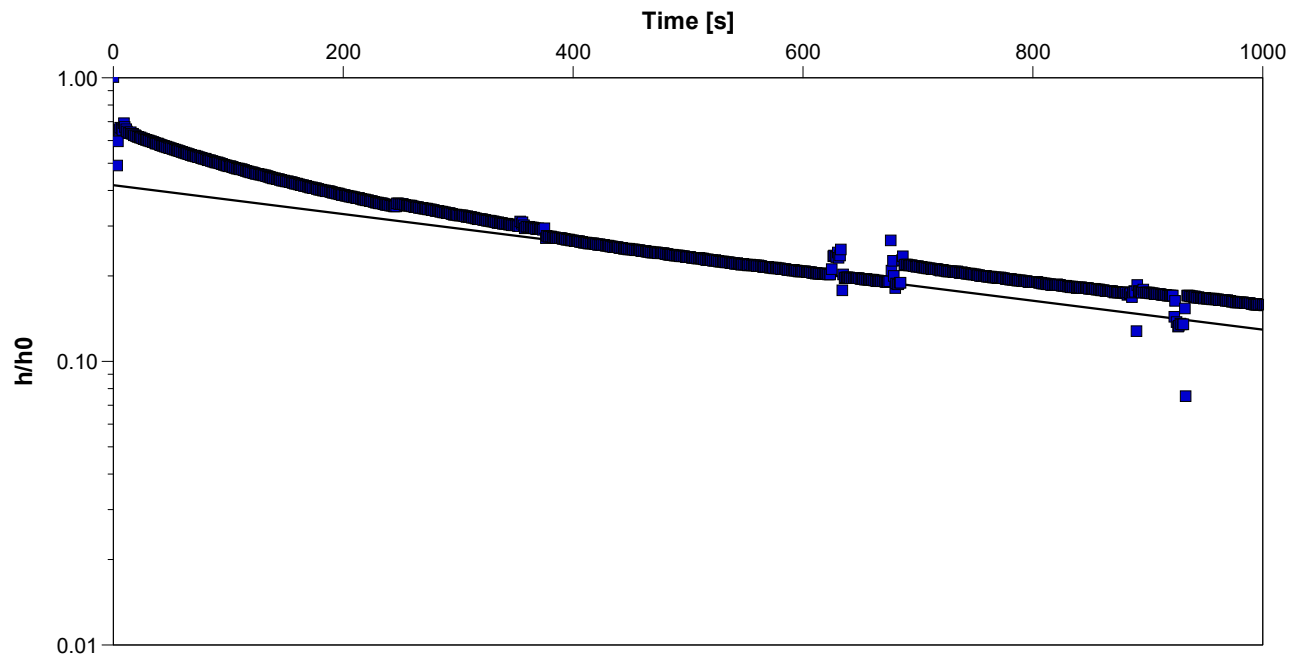
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	8.06×10^{-7}
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Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 1

Test Well: BH113

Test Conducted by: BRAL/AMHO

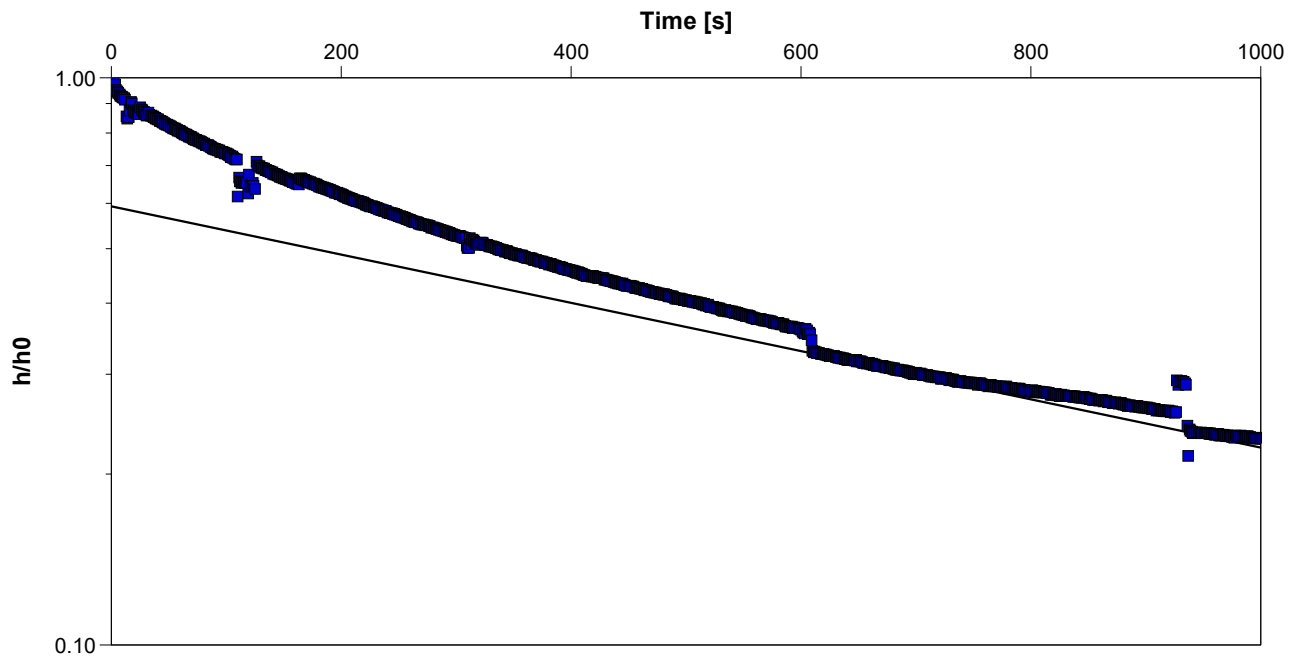
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH113

5.19×10^{-7}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 1

Test Well: BH113

Test Conducted by: BRAL/AMHO

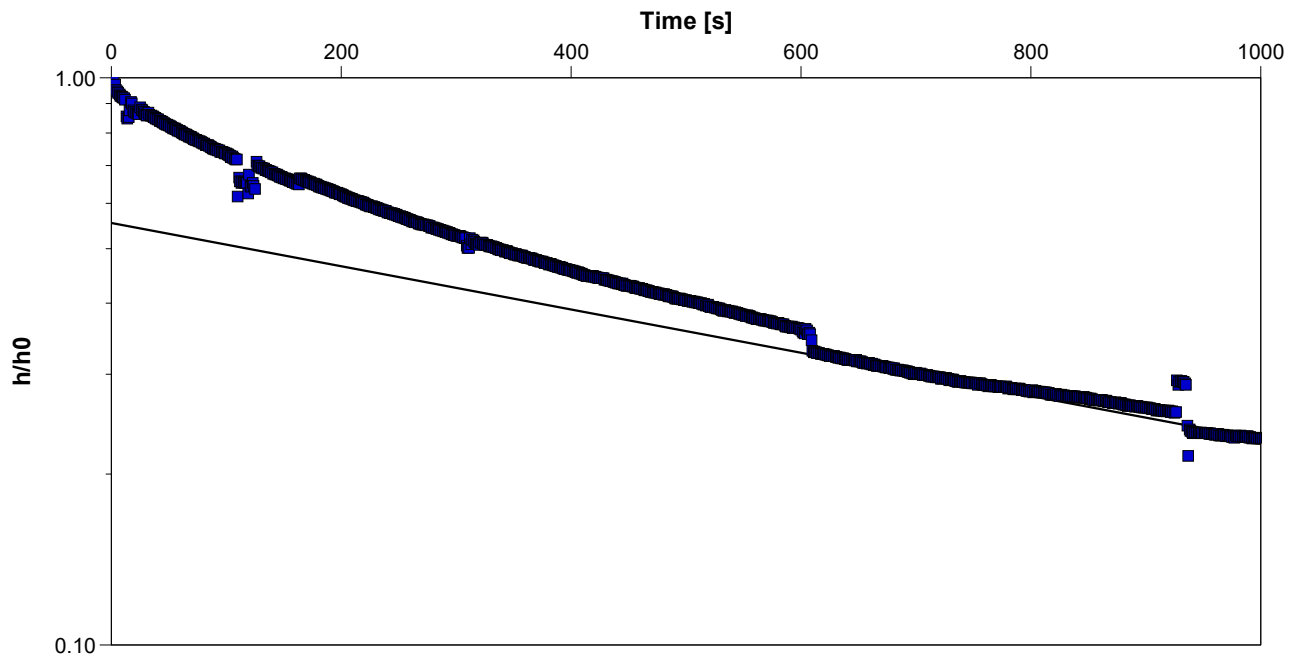
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH113

6.05×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 2

Test Well: BH113

Test Conducted by: BRAL/AMHO

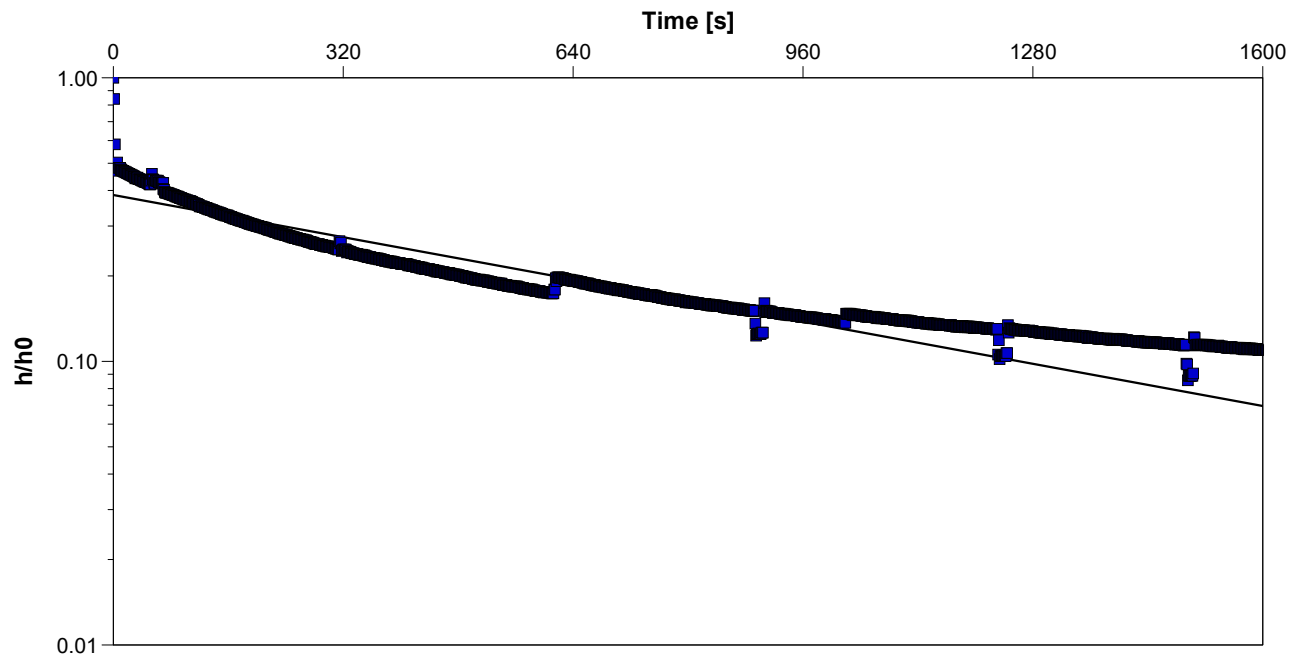
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH113

5.67×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 2

Test Well: BH113

Test Conducted by: BRAL/AMHO

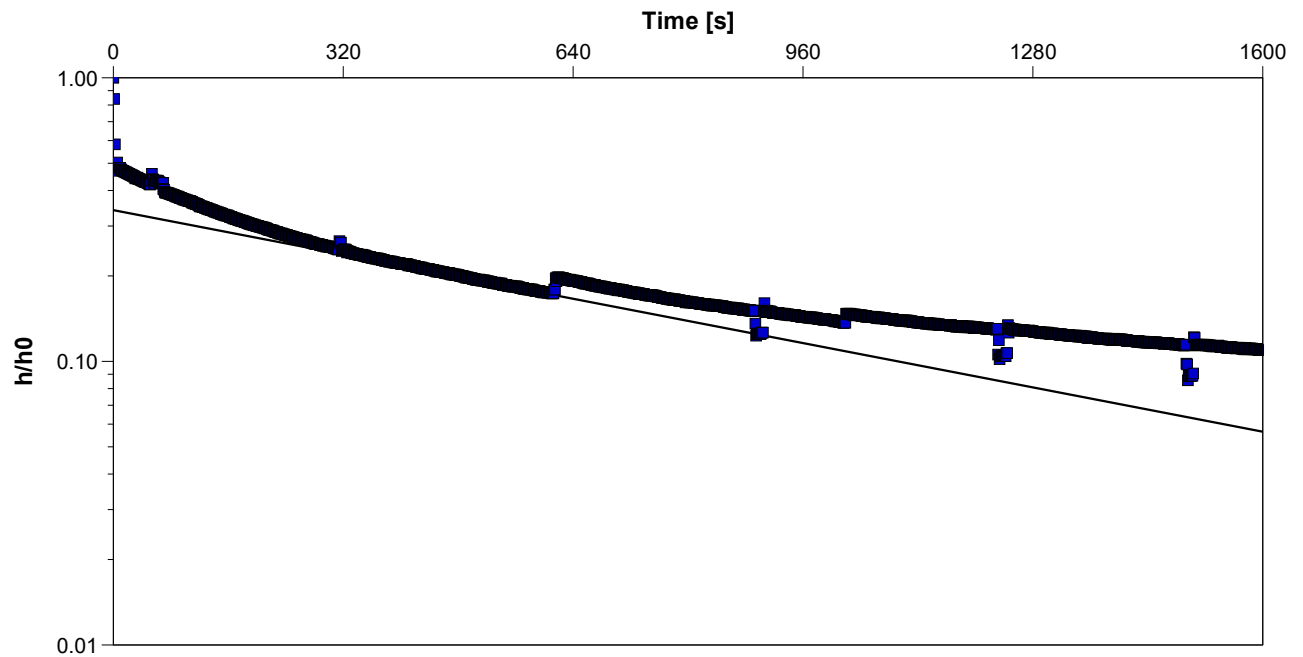
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH113

7.75×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 2

Test Well: BH113

Test Conducted by: BRAL/AMHO

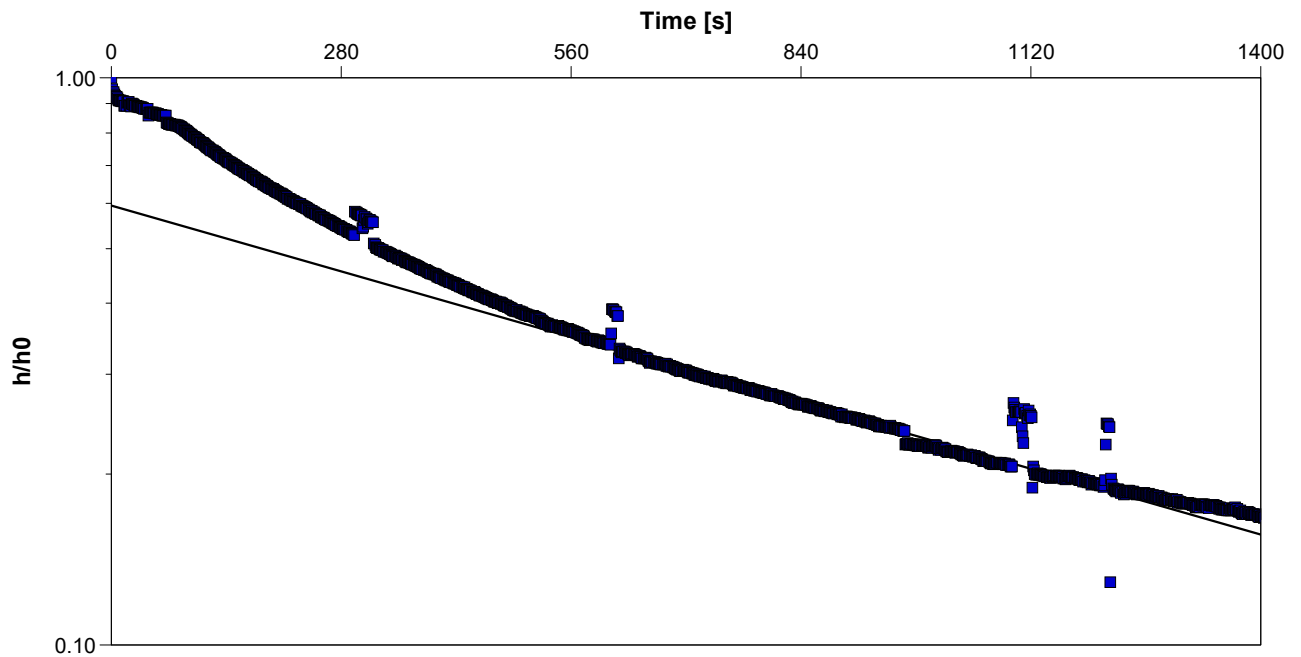
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH113	5.06×10^{-7}	

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 2

Test Well: BH113

Test Conducted by: BRAL/AMHO

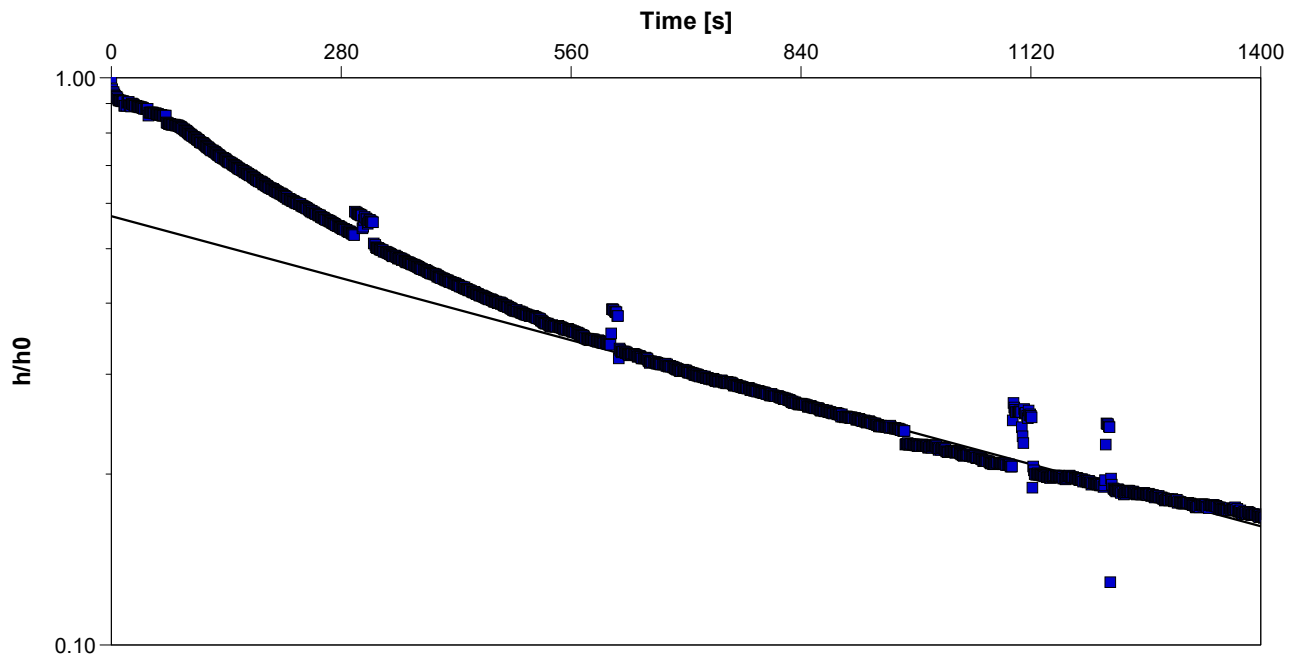
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	6.20×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 3

Test Well: BH113

Test Conducted by: BRAL/AMHO

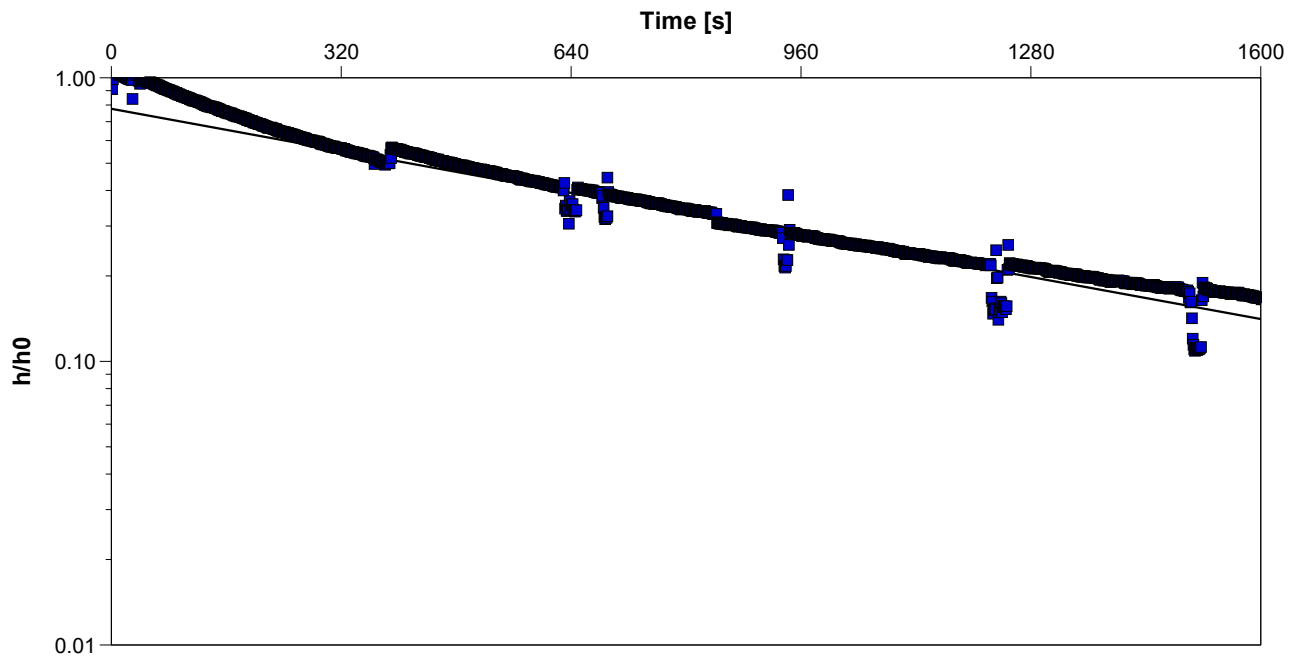
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	5.65×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Falling 3

Test Well: BH113

Test Conducted by: BRAL/AMHO

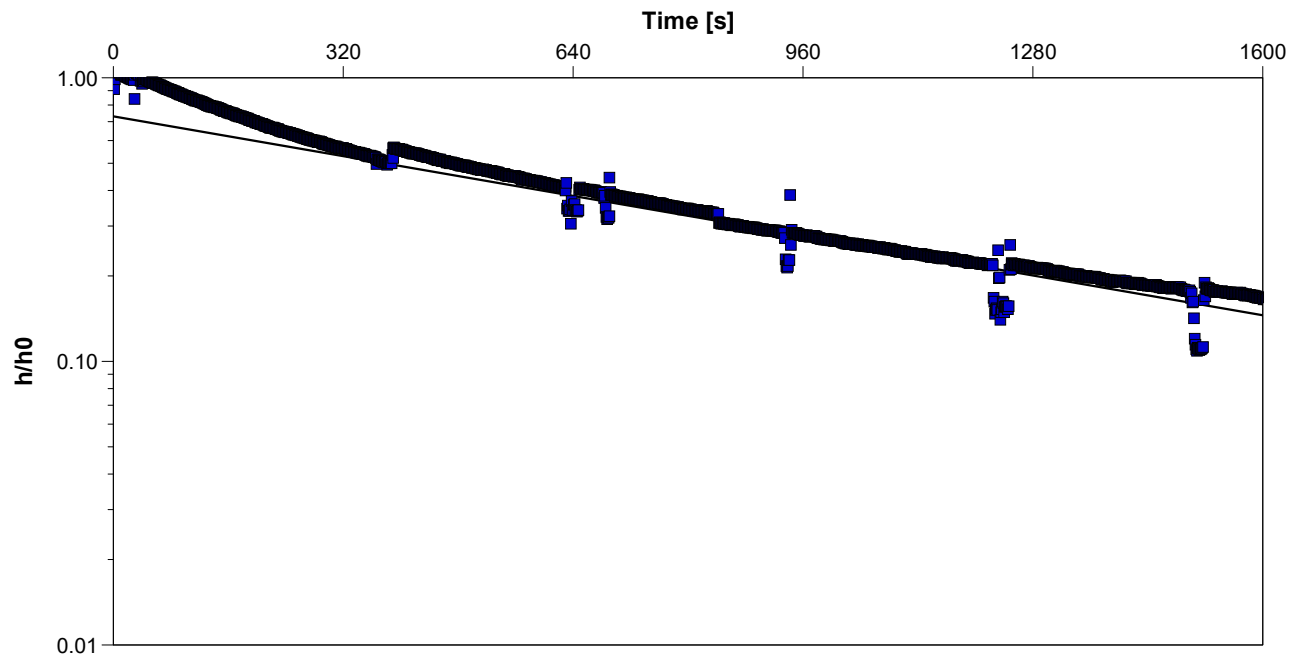
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	6.95×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 3

Test Well: BH113

Test Conducted by: BRAL/AMHO

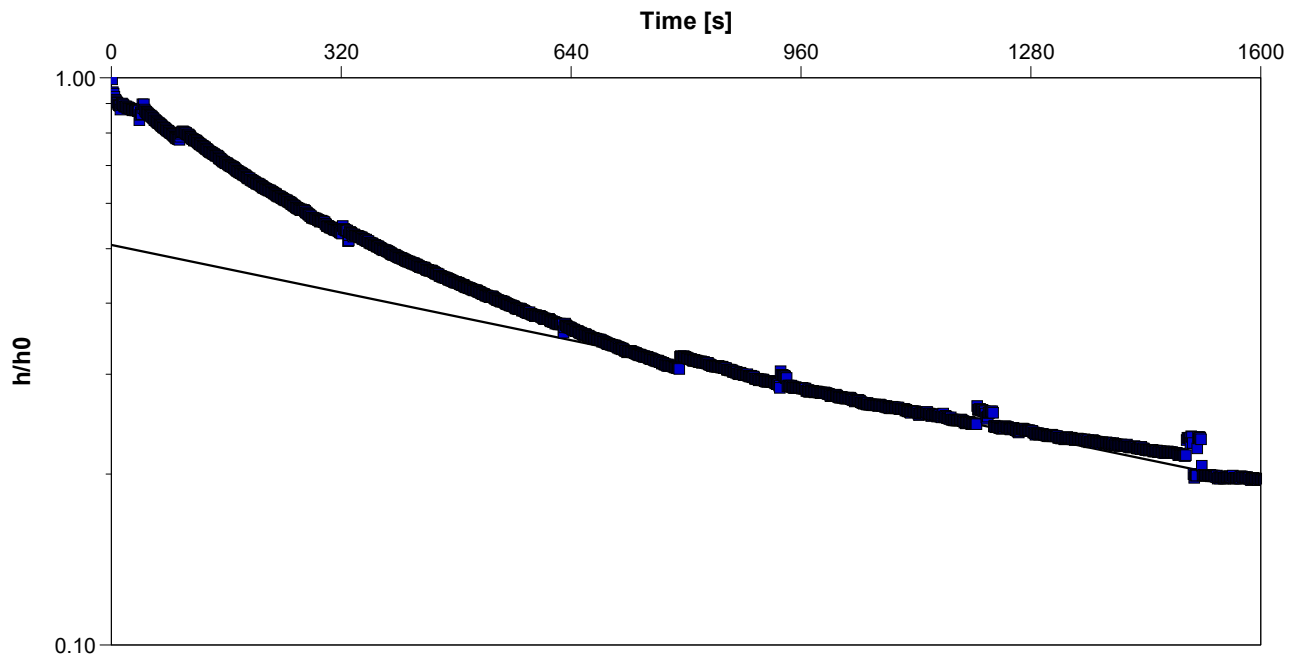
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	3.20×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH113 Rising 3

Test Well: BH113

Test Conducted by: BRAL/AMHO

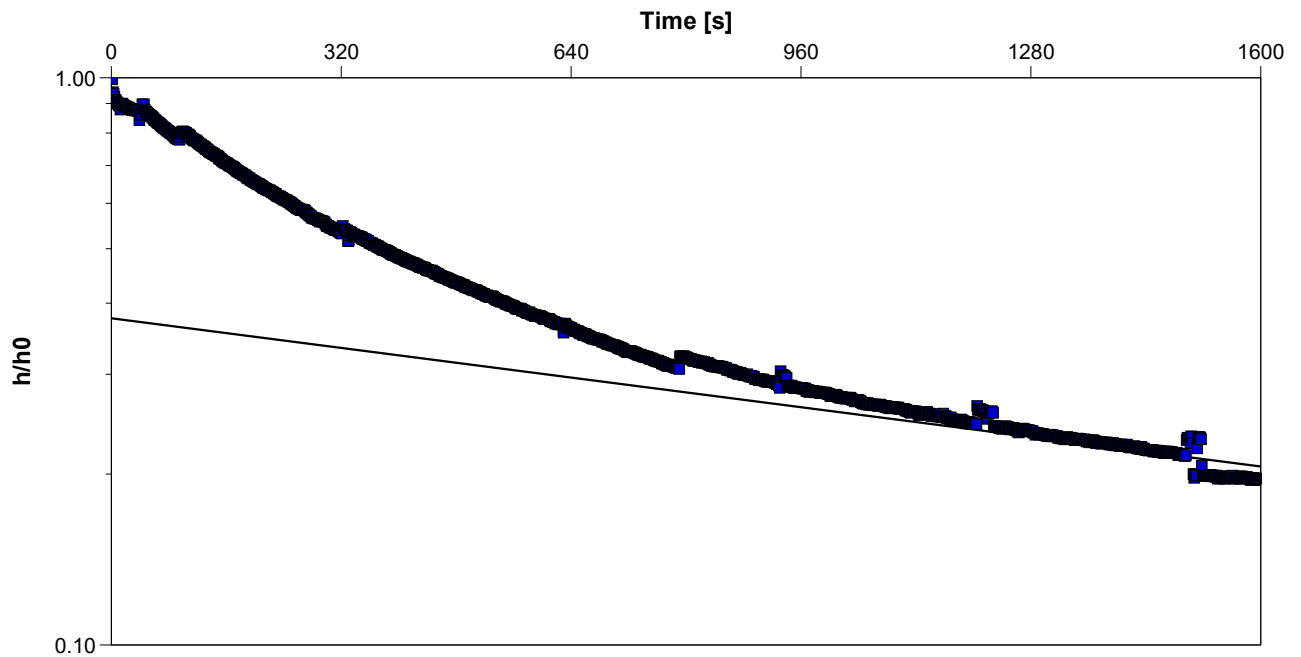
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 2.07 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH113	2.60×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH116 Falling

Test Well: BH116

Test Conducted by: BRAL

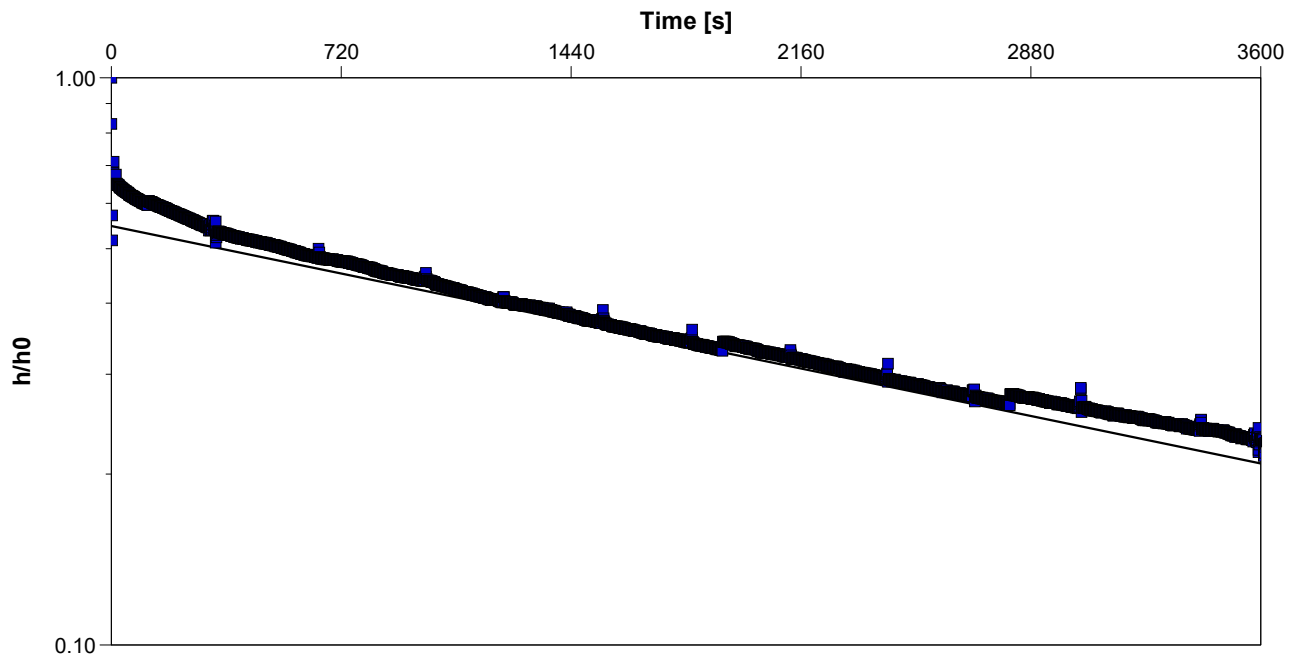
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 4.31 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH116

1.04×10^{-7}

Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH116 Falling

Test Well: BH116

Test Conducted by: BRAL

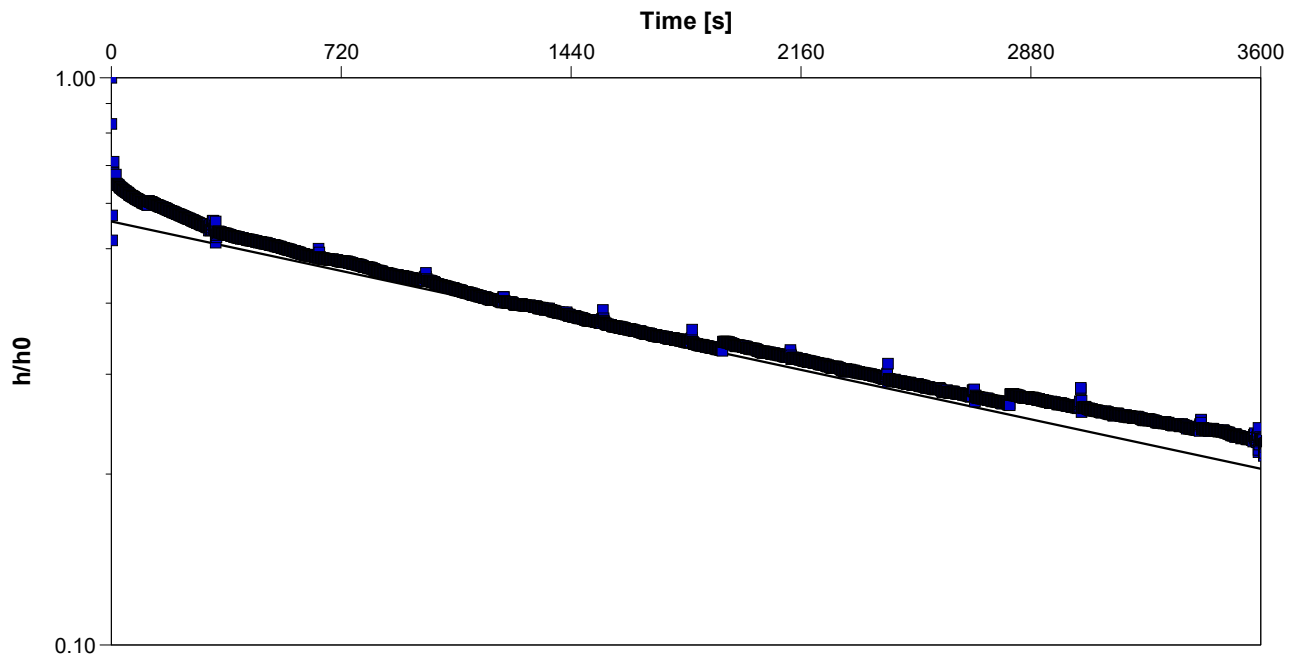
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 4.31 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH116

1.40×10^{-7}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH116 Rising

Test Well: BH116

Test Conducted by: BRAL

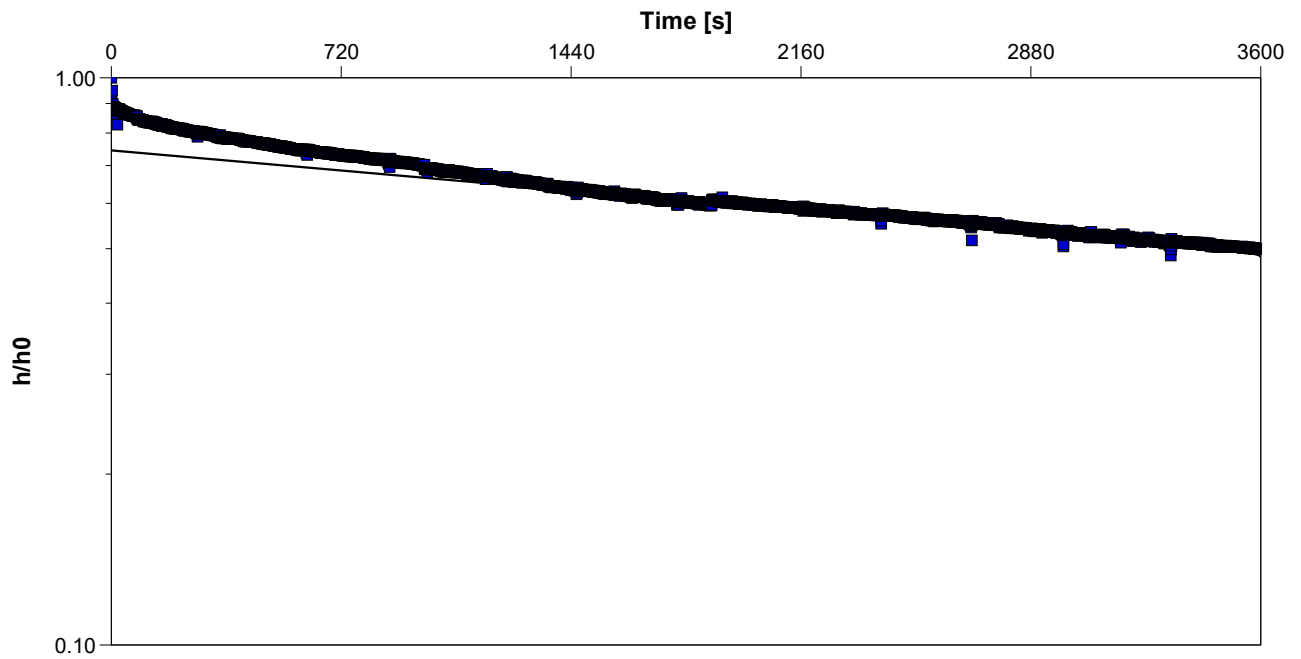
Test Date: 18/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 4.31 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH116

4.40×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhills Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 28 Brigham Creek Road

Slug Test: BH116 Rising

Test Well: BH116

Test Conducted by: BRAL

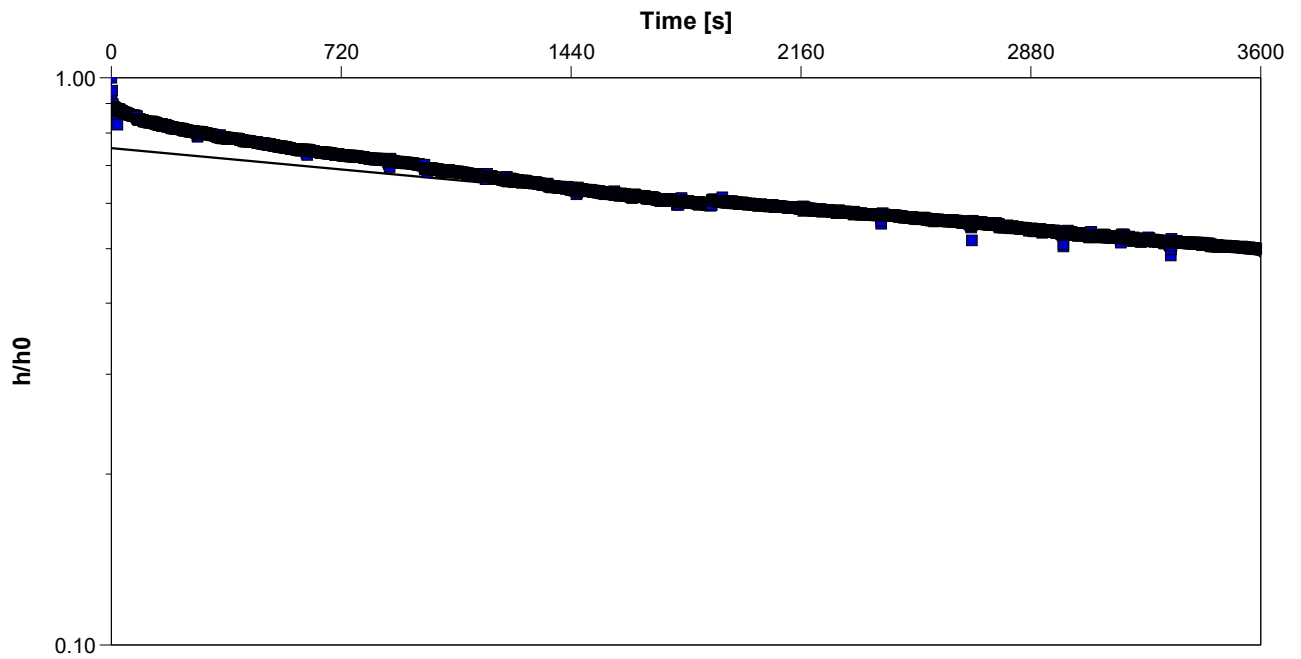
Test Date: 18/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 4.31 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH116

6.03×10^{-5}

Slug Test Analysis Report

Project: Whenuapai and Redhilss Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH117 Falling

Test Well: BH117

Test Conducted by: BRAL/AMHO

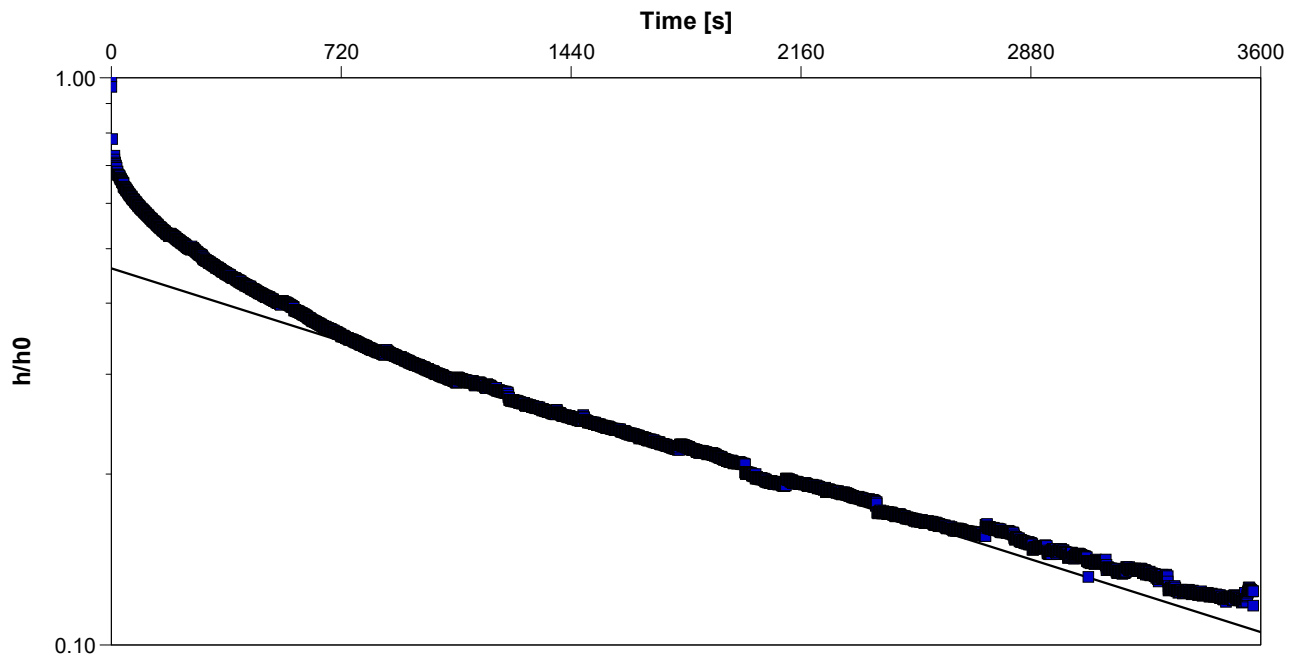
Test Date: 17/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 9.82 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH117	2.17×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhilss Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH117 Falling

Test Well: BH117

Test Conducted by: BRAL/AMHO

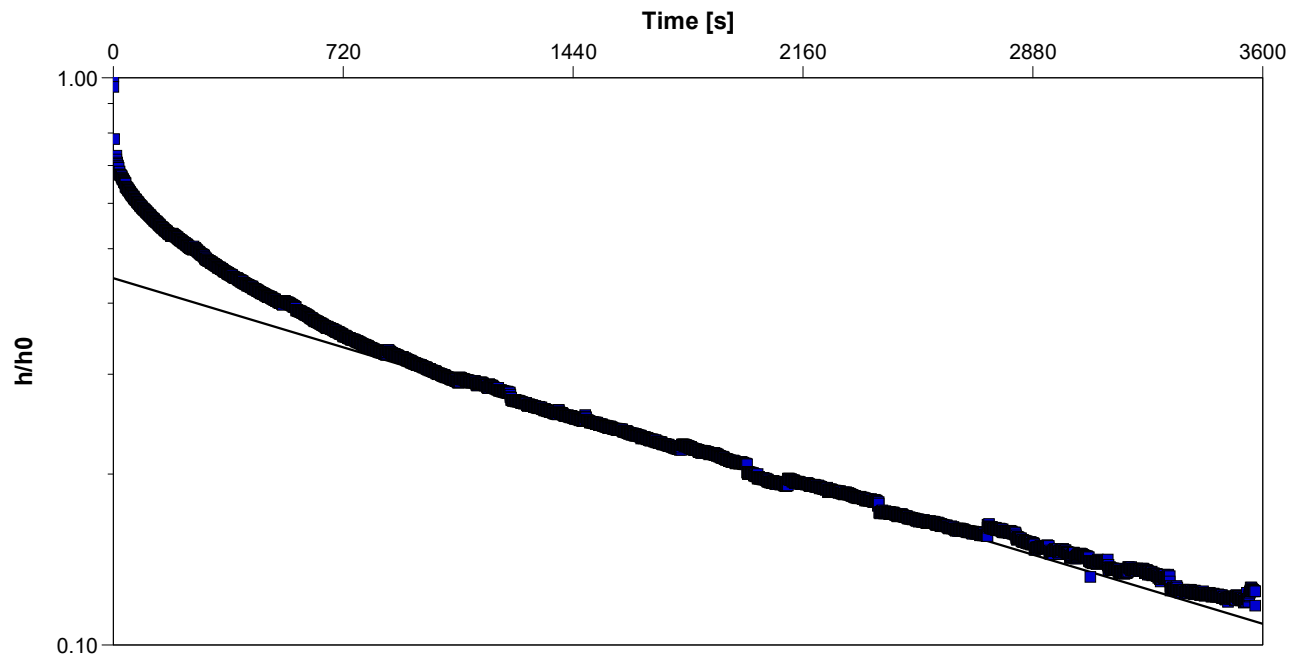
Test Date: 17/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 9.82 m



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	------------------------------

BH117	2.68×10^{-7}
-------	-----------------------

Slug Test Analysis Report

Project: Whenuapai and Redhilss Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH117 Rising

Test Well: BH117

Test Conducted by: BRAL/AMHO

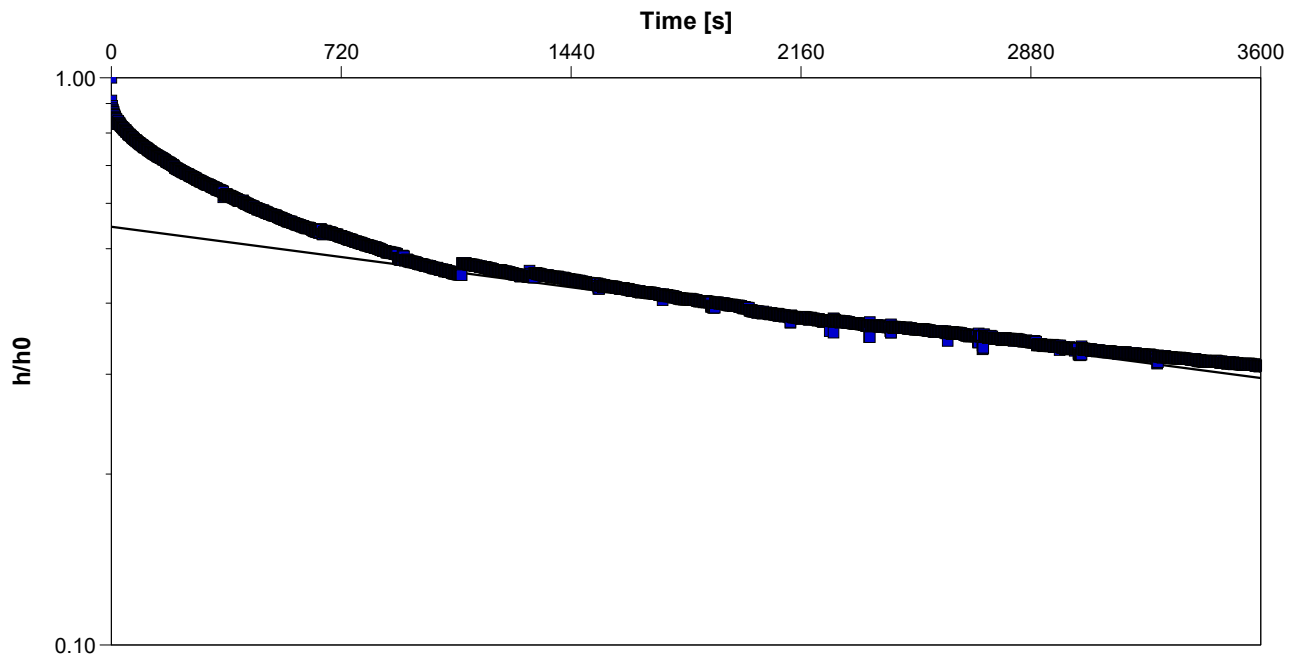
Test Date: 17/11/2020

Analysis Performed by: BRAL

Bouwer and Rice

Analysis Date: 26/11/2020

Aquifer Thickness: 9.82 m



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
BH117	9.01×10^{-5}



Slug Test Analysis Report

Project: Whenuapai and Redhilss Wastewater Scheme

Number: 1014985

Client: Watercare Services Limited

Location: 23-27 Brigham Creek Road

Slug Test: BH117 Rising

Test Well: BH117

Test Conducted by: BRAL/AMHO

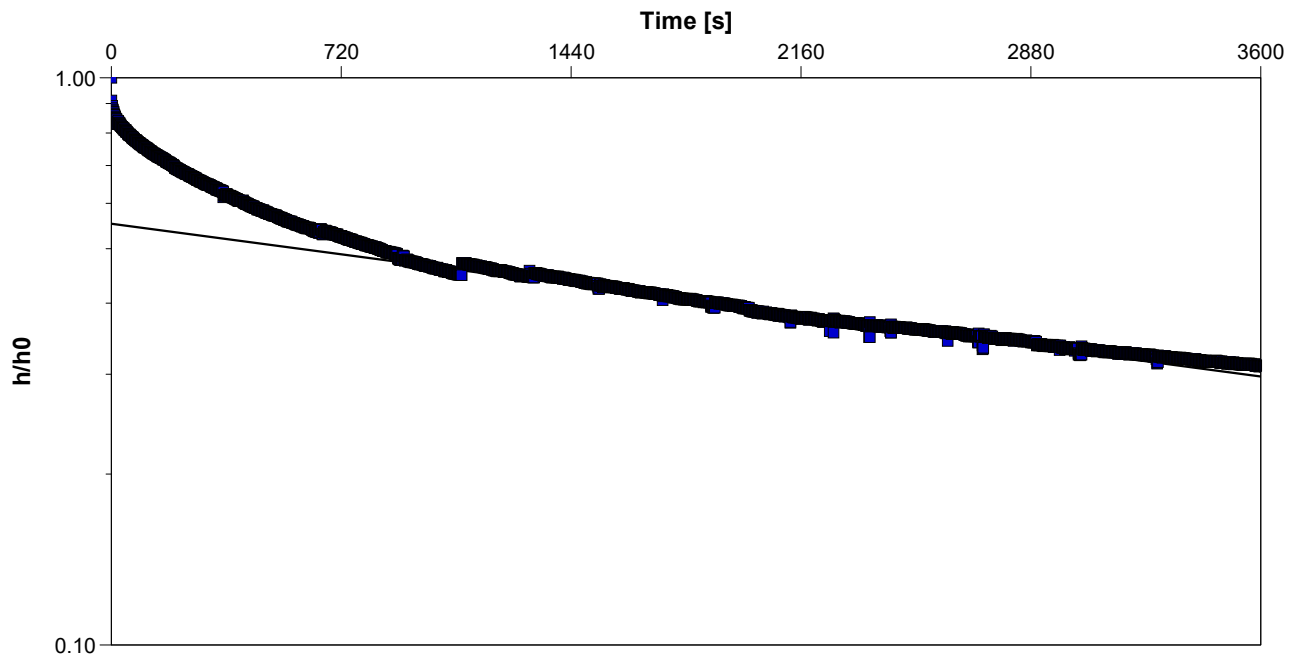
Test Date: 17/11/2020

Analysis Performed by: BRAL

Hvorslev

Analysis Date: 26/11/2020

Aquifer Thickness: 9.82 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH117

1.19×10^{-7}

Appendix G: Geotechnical Laboratory Test Results



Our Ref: 1100655.0000/Rep 1

Customer Ref: 1014985.0000

26 January 2021

Tonkin + Taylor
PO Box 5271
Victoria Street West
Auckland 1142

Attention: Chris Monk

Dear Chris

Watercare Whenuapai-Redhills

Laboratory Test Report

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

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

This report has been prepared for the benefit of Tonkin + Taylor, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

This report may be reproduced only in full.

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

Authorised for Geotechnics by:

.....

 Sim Tirunahari
 Soils Laboratory Manager
 Approved Signatory

.....


.....
 Steven Anderson
 Project Director



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

Report checked by:

.....

 James Kimiangatau
 Laboratory Technician

26-Jan-21

t:\geotechnicsgroup\projects\1100655\issueddocuments\20210126.watercare whenuapai_redhills.st.final rep1.docx



Auckland
1 Hill Street
Onehunga
Auckland 1061
New Zealand

p + 64 9 356 3510

Report No: ASM:W20AK-0256

Issue No: 3

This report replaces all previous issues of report no 'ASM:W20AK-0256'.

Material Test Report

Customer: Tonkin & Taylor Limited
Address: Level 2, 105 Carlton Gore Rd
Newmarket Auckland 1023
Project: Watercare Whenuapai-Redhills
Project No.: 1100655.0000
Customer Reference No.: 1014985.0000
Report Authorised By : Sim Tirunahari

Approved By:
Sim Tirunahari
(Soils Laboratory Manager)
Date of Issue: 26/01/2021

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

Material Details

Product:

Sampled From:

Location: Watercare Whenuapai-Redhills

Specification:

Sample Details

Sampled By:

'Sampling Endorsed:'

Sample ID:

S20AK000827	S20AK000828	S20AK000829	S20AK000830	S20AK000831	S20AK000832
BH05A_2.2m	BH05A_3.5m	BH06_1.5m	BH07_2.5m	BH07_5.5m	BH08_1.5m

Client Sample ID:

Field Sample ID:

Date Sampled:

Date Tested:

1/12/2020	1/12/2020	1/12/2020	1/12/2020	1/12/2020	1/12/2020
James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau

Tested By:

Other Test Results

Description	Method	Results
Moisture Content (%)	NZS 4402:1986 Test 2.1	69.4 73.0 44.6 46.9 43.0 36.8

Comments

N/A

If samples have been taken, and were not destroyed during testing, they will be retained for one month from the date of this report before being discarded.



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Onehunga
Auckland 1061
New Zealand

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Report No: ASM:W20AK-0256

Issue No: 3

This report replaces all previous issues of report no 'ASM:W20AK-0256'.

Material Test Report

Customer: Tonkin & Taylor Limited
Address: Level 2, 105 Carlton Gore Rd
Newmarket Auckland 1023
Project: Watercare Whenuapai-Redhills
Project No.: 1100655.0000
Customer Reference No.: 1014985.0000
Report Authorised By : Sim Tirunahari

Approved By:
Sim Tirunahari
(Soils Laboratory Manager)
Date of Issue: 26/01/2021

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

Material Details

Product:

Sampled From:

Location: Watercare Whenuapai-Redhills

Specification:

Sample Details

Sampled By:

'Sampling Endorsed:'

Sample ID:

S20AK000833 S20AK000834 S20AK000835

Client Sample ID:

BH08_3.0m BH110_1.5m BH111_1.5m

Field Sample ID:

Date Sampled:

Date Tested:

1/12/2020 1/12/2020 1/12/2020

Tested By:

James Kimiangatau James Kimiangatau James Kimiangatau

Other Test Results

Description	Method	Results
Moisture Content (%)	NZS 4402:1986 Test 2.1	42.1 36.4 45.7

Comments

N/A

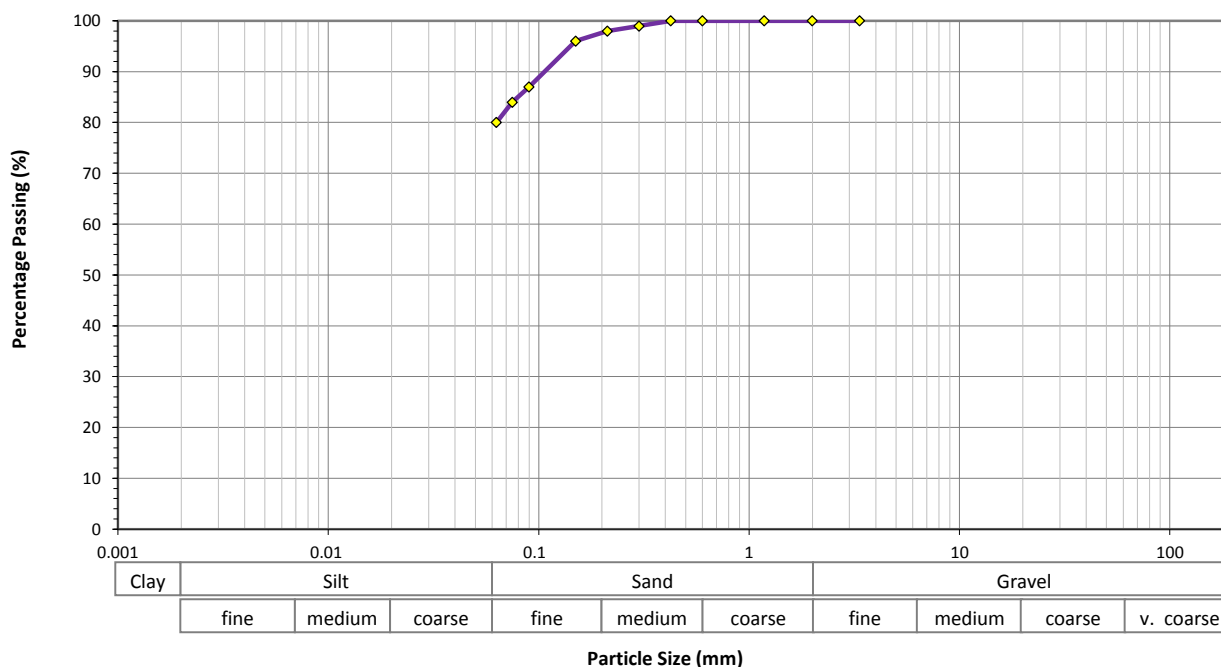
If samples have been taken, and were not destroyed during testing, they will be retained for one month from the date of this report before being discarded.

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000827		
	Reference	BH05A	Top Depth	1.5m
	Sampled By	Bottom Depth		
	Description	sandy clayey SILT, firm to stiff, light grey mixed with light yellowish orange brown, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	99
100	-	19.0	-	3.35	100	0.212	98
75.0	-	16.0	-	2.00	100	0.150	96
63.0	-	13.2	-	1.18	100	0.090	87
53.0	-	9.50	-	0.600	100	0.075	84
37.5	-	6.70	-	0.425	100	0.063	80

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



1 Hill Street
Onehunga
Auckland 1061
New Zealand
p + 64 9 356 3510

Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000828		
	Reference	BH05A	Top Depth	2.2m
	Sampled By	Bottom Depth		
	Description	clayey SILT with trace of sand, stiff, light brownish grey, mottled orange, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	135
Plastic Limit	40
Plasticity Index	95

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021



1 Hill Street, Onehunga, Auckland 1061

p 64 9 356 3510

GEOTECHNICS www.geotechnics.co.nz

Your Job No.: 1014985.0000

Site: Watercare Whenuapai-Redhills

Our Job No.: 1100655.0000

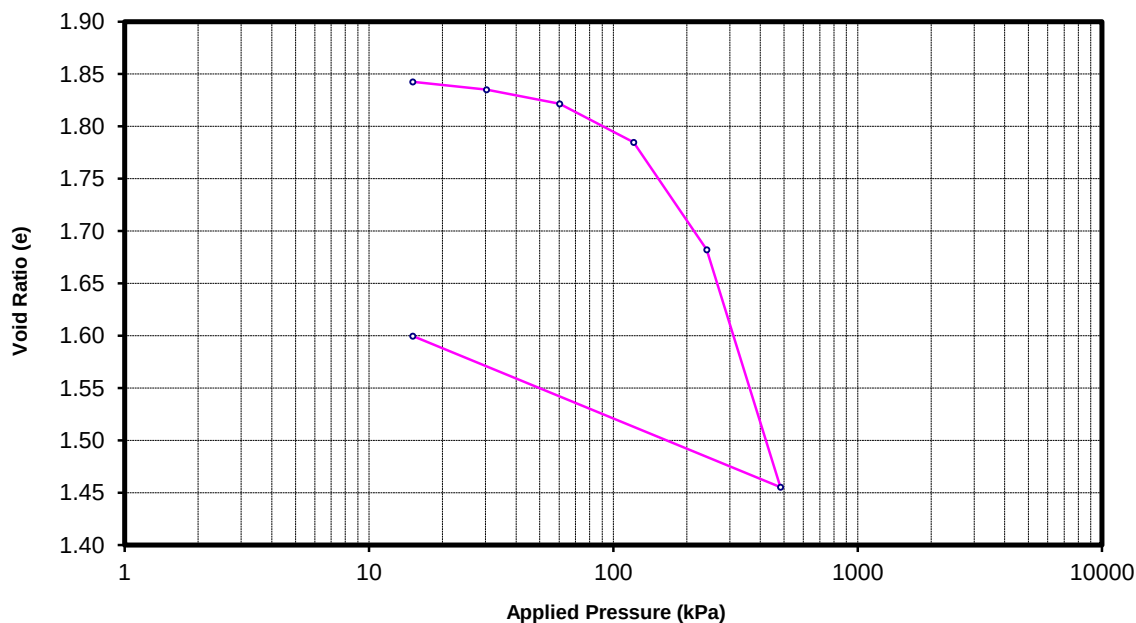
BH No.: BH 05A

Sample ID.: ---

Depth: 3.30-3.35 (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 C_v (m^2/yr)	Coefficient of Volume Compressibility M_v (m^2/MN)
As received 0	1.846			
Preload 15.1	1.843	0 to 15.1	NA	0.085
30.2	1.835	15.1 to 30.2	4.8	0.18
60.3	1.822	30.2 to 60.3	3.6	0.16
121	1.785	60.3 to 121	2.2	0.22
241	1.682	121 to 241	1.2	0.31
483	1.455	241 to 483	0.81	0.35
Unload 15.1	1.600	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor to some clay and trace of sand, firm, light greenish grey, mottled black.

Initial Dry Density (t/m^3): 0.93

Initial Water Content: 67.5%

Solid Density (t/m^3): 2.65 (Assumed)

Initial Saturation: 97%

Temperature During Testing: Max = 21 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m^3 . The calculations of void ratio are affected by the solid density value.

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

Entered by: ST

Date: 26.01.21 Checked by: JK

Date: 26.01.21

Our Ref.No.1100655.0000/Rep1



1 Hill Street
Onehunga
Auckland 1061
New Zealand
p + 64 9 356 3510

Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Page 7 of 64

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000829		
	Reference	BH05A	Top Depth	3.5m
	Sampled By	Bottom Depth		
	Description	clayey SILT with some sand, firm to stiff, light greyish brown, mottled orange-black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	96
Plastic Limit	43
Plasticity Index	53

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

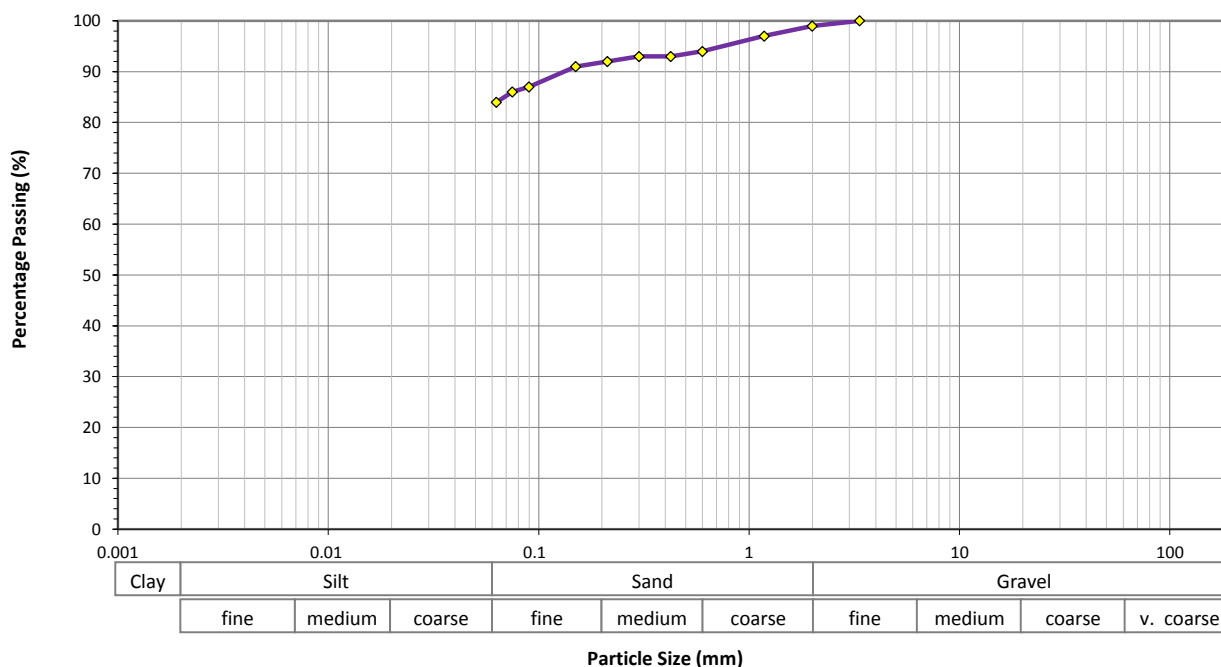
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000829	
	Reference	BH05A	Top Depth 3.5m
	Sampled By		Bottom Depth
	Description	clayey SILT with some sand, firm to stiff, light greyish brown, mottled orange-black, extremely high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	93
100	-	19.0	-	3.35	100	0.212	92
75.0	-	16.0	-	2.00	99	0.150	91
63.0	-	13.2	-	1.18	97	0.090	87
53.0	-	9.50	-	0.600	94	0.075	86
37.5	-	6.70	-	0.425	93	0.063	84

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

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Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000830		
	Reference	BH05A	Top Depth	6.0m
	Sampled By		Bottom Depth	
	BH/TP No.			
	Description	Organic SILT with minor to some clay and trace of sand, firm, dark brown mixed with black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 20%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • This test result is IANZ accredited. • Date tested 02/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021

Our Ref.No.1100655.0000/Rep1



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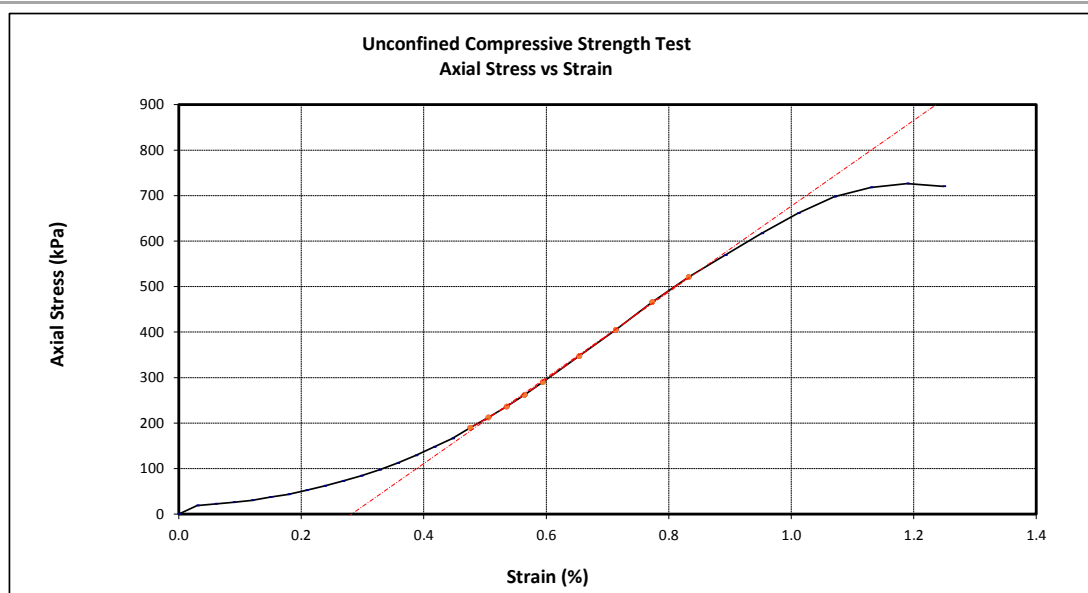
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Unconfined Compressive Strength of Cohesive Soil - NZS 4402:1986 - Test 6.3.1

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000831	BH No
	Reference	BH05A	Top Depth 14.2m
	Sampled By		Bottom Depth
	Description	Light greenish grey, extremely weak, fine to medium grained SANDSTONE.	
	Sample History	The sample used for testing was natural, undisturbed.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

Test Result



Sample Parameters

Sample Height	(mm)	168.20
Sample Diameter	(mm)	82.51
Test Height	(mm)	168.20
Test H/D Ratio		2.04

Bulk Density	(t/m ³)	2.05
Dry Density	(t/m ³)	1.65
Water Content	(%)	22.6

Failure Value

Axial Strain (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.2	730	0.065	94

Mode of Failure Shear

Test Remarks

• Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only. • Unconfined compressive strength (kPa) is rounded to 2 significant figures. • This test result is IANZ accredited. • Date tested 03/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000832		
	Reference	BH06	Top Depth	1.5m
	Sampled By	Bottom Depth		
	Description	clayey SILT with trace of sand, few rootlets, stiff, light brown mixed with light grey, mottled orange, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 82
Plastic Limit 31
Plasticity Index 51

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

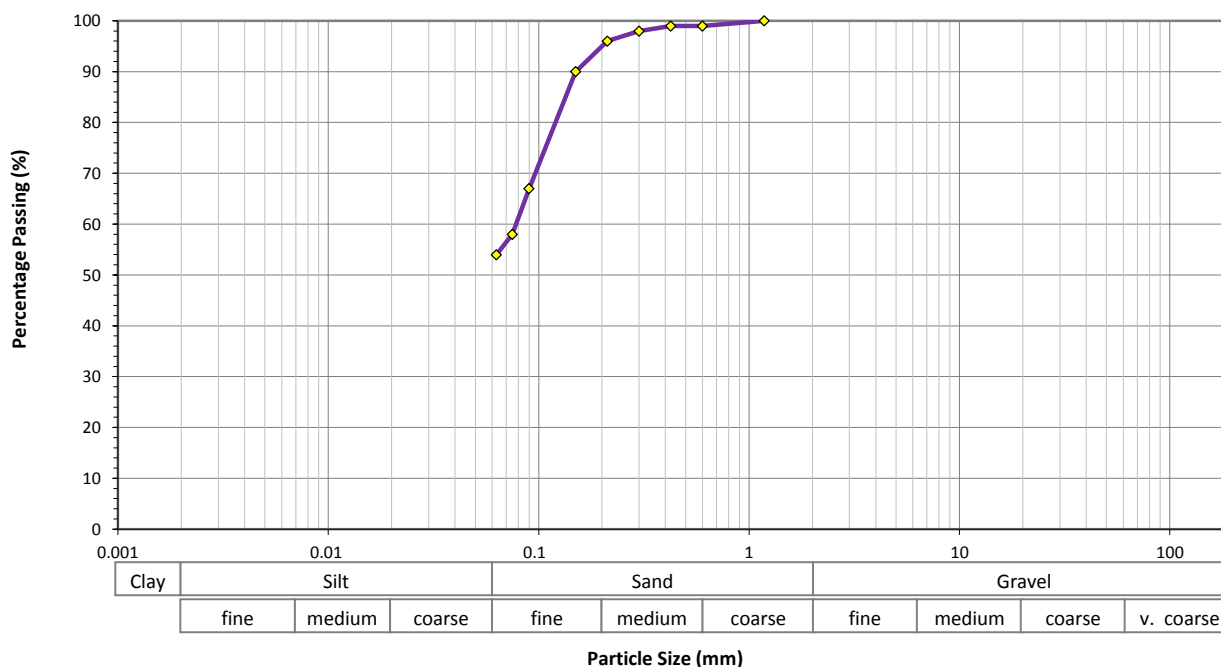
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000833		
	Reference	BH06	Top Depth	3.0m
	Sampled By	Bottom Depth		
	Description	silty SAND with minor clay, loosely packed, light greenish grey.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	98
100	-	19.0	-	3.35	-	0.212	96
75.0	-	16.0	-	2.00	-	0.150	90
63.0	-	13.2	-	1.18	100	0.090	67
53.0	-	9.50	-	0.600	99	0.075	58
37.5	-	6.70	-	0.425	99	0.063	54

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

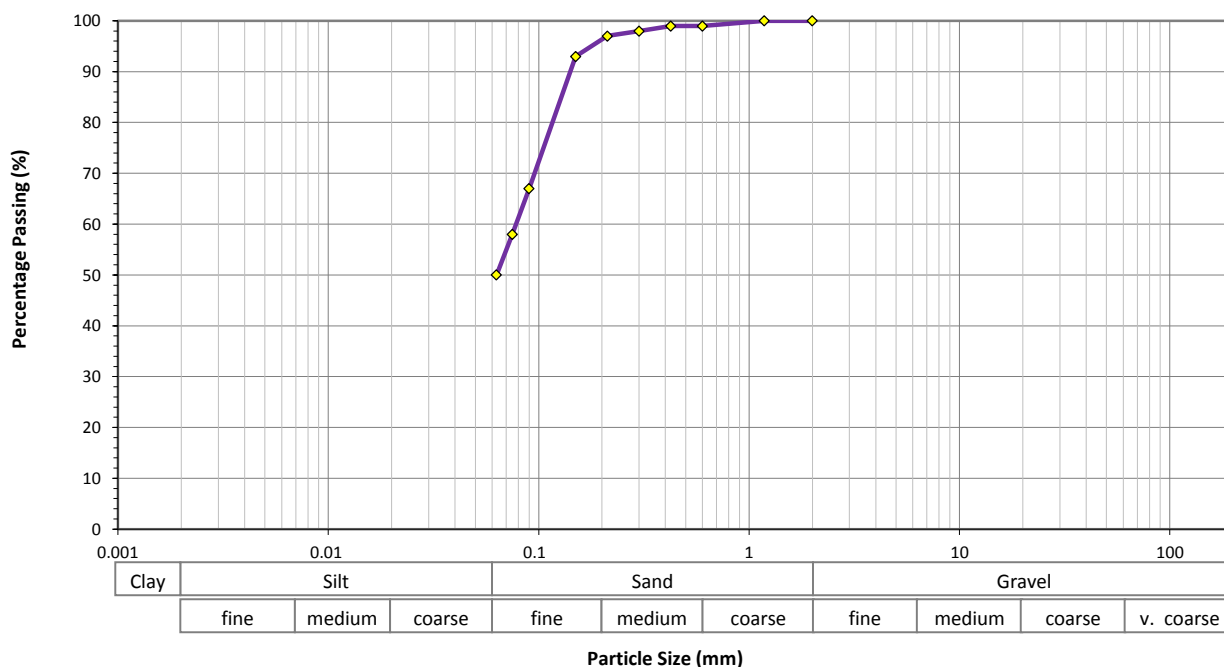
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000834	
	Reference	BH06	Top Depth 5.0m
	Sampled By		Bottom Depth
	Description	silty SAND with minor clay, tightly packed, light greenish grey, mottled orange.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	98
100	-	19.0	-	3.35	-	0.212	97
75.0	-	16.0	-	2.00	100	0.150	93
63.0	-	13.2	-	1.18	100	0.090	67
53.0	-	9.50	-	0.600	99	0.075	58
37.5	-	6.70	-	0.425	99	0.063	50

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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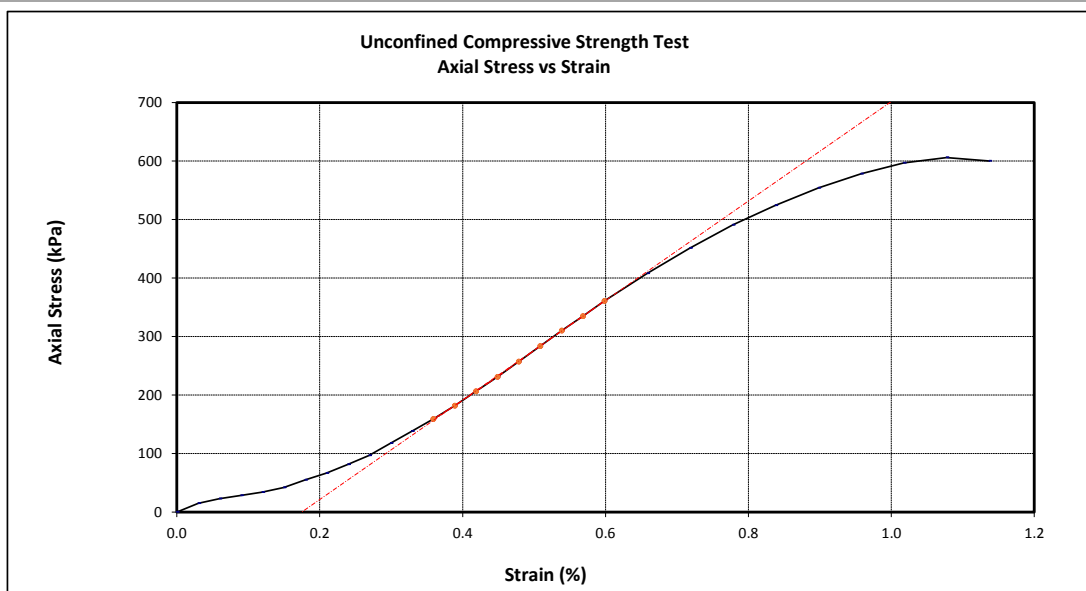
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Unconfined Compressive Strength of Cohesive Soil - NZS 4402:1986 - Test 6.3.1

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000835	BH No
	Reference	BH06	Top Depth 13.8m
	Sampled By		Bottom Depth
	Description	Light greenish grey, extremely weak, fine to medium grained SANDSTONE.	
	Sample History	The sample used for testing was natural, undisturbed.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

Test Result



Sample Parameters

Sample Height	(mm)	167.09
Sample Diameter	(mm)	81.81
Test Height	(mm)	167.09
Test H/D Ratio		2.04

Bulk Density	(t/m ³)	2.05
Dry Density	(t/m ³)	1.70
Water Content	(%)	20.5

Failure Value

Axial Strain (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.1	610	0.062	85

Mode of Failure Shear

Test Remarks

• Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only. • Unconfined compressive strength (kPa) is rounded to 2 significant figures. • This test result is IANZ accredited. • Date tested 03/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0256
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000847		
	Reference	BH07	Top Depth	2.5m
	Sampled By		Bottom Depth	
	Description	sandy clayey SILT, stiff, light brown mixed with light grey, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 73
Plastic Limit 32
Plasticity Index 41

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

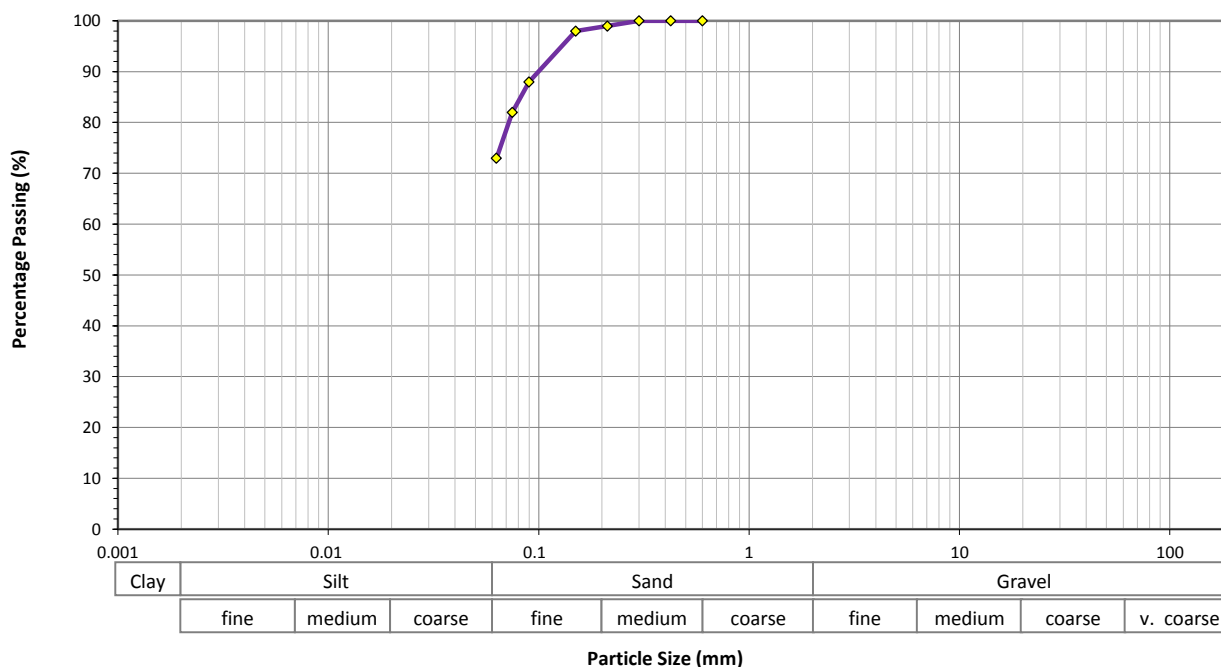
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000847	
	Reference	BH07	Top Depth 2.5m
	Sampled By		Bottom Depth
	Description	sandy clayey SILT, stiff, light brown mixed with light grey, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	98
63.0	-	13.2	-	1.18	-	0.090	88
53.0	-	9.50	-	0.600	100	0.075	82
37.5	-	6.70	-	0.425	100	0.063	73

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000034	
	Reference	BH07	Top Depth 5.5m
	Sampled By		Bottom Depth
	Description	sandy SILT with some clay, firm to stiff, light greenish grey, mottled orange, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS

Liquid Limit	75
Plastic Limit	27
Plasticity Index	48

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

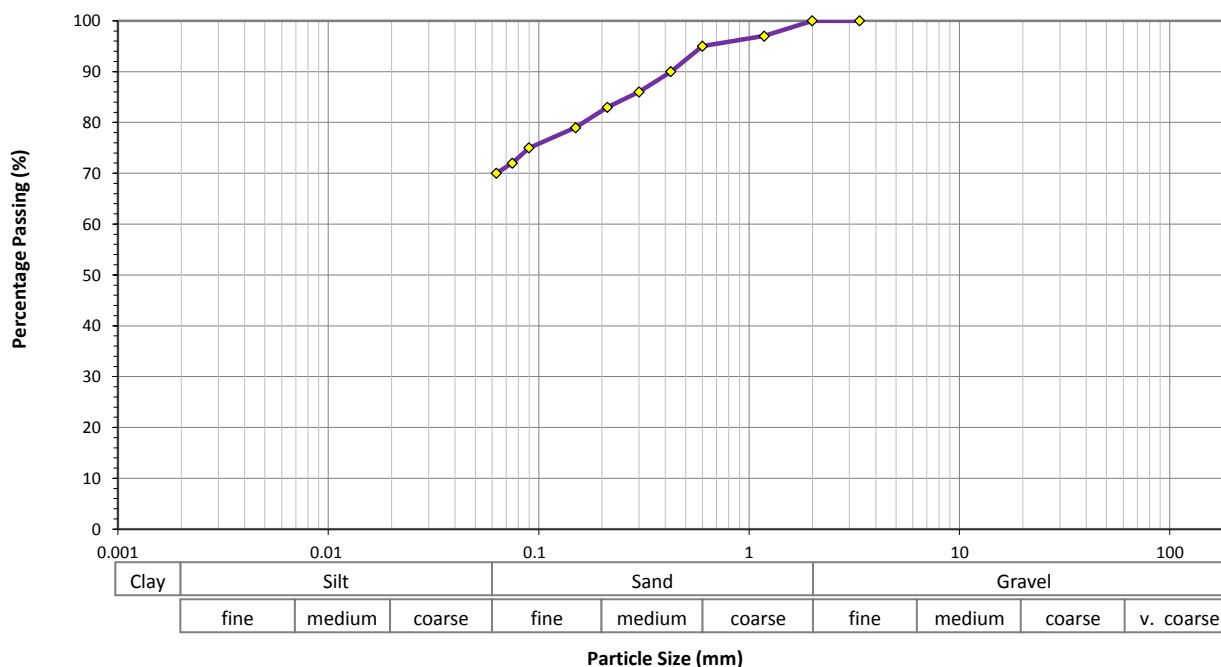
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000034		
	Reference	BH07	Top Depth	5.5m
	Sampled By			
	Description	sandy SILT with some clay, firm to stiff, light greenish grey, mottled orange, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	86
100	-	19.0	-	3.35	100	0.212	83
75.0	-	16.0	-	2.00	100	0.150	79
63.0	-	13.2	-	1.18	97	0.090	75
53.0	-	9.50	-	0.600	95	0.075	72
37.5	-	6.70	-	0.425	90	0.063	70

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000035		
	Reference	BH08	Top Depth	1.5m
	Sampled By		Bottom Depth	
	Description	sandy clayey SILT, firm to stiff, few rootlets, light greenish grey, mottled black, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	74
Plastic Limit	26
Plasticity Index	48

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

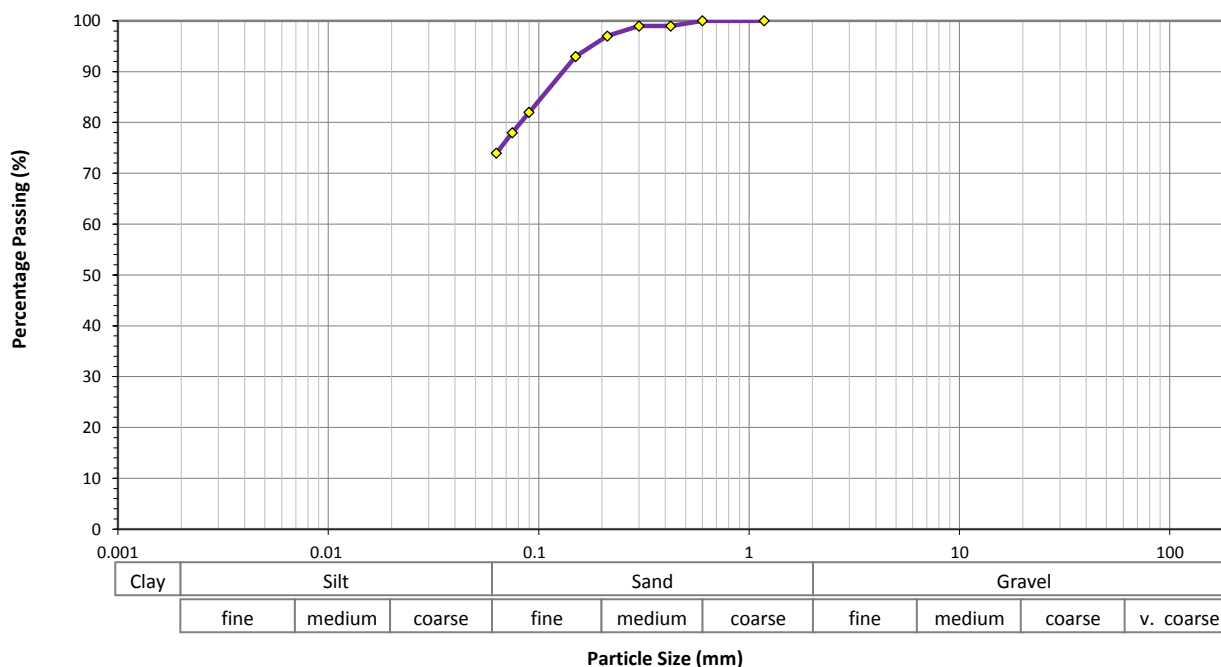
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000035		
	Reference	BH08	Top Depth	1.5m
	Sampled By	Bottom Depth		
	Description	sandy clayey SILT, firm to stiff, few rootlets, light greenish grey, mottled black, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	99
100	-	19.0	-	3.35	-	0.212	97
75.0	-	16.0	-	2.00	-	0.150	93
63.0	-	13.2	-	1.18	100	0.090	82
53.0	-	9.50	-	0.600	100	0.075	78
37.5	-	6.70	-	0.425	99	0.063	74

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000036		
	Reference	BH08	Top Depth	3.0m
	Sampled By		Bottom Depth	
	Description	clayey SILT with some sand, few rootlets, firm to stiff, light greenish grey, mottled black, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 73
Plastic Limit 26
Plasticity Index 47

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

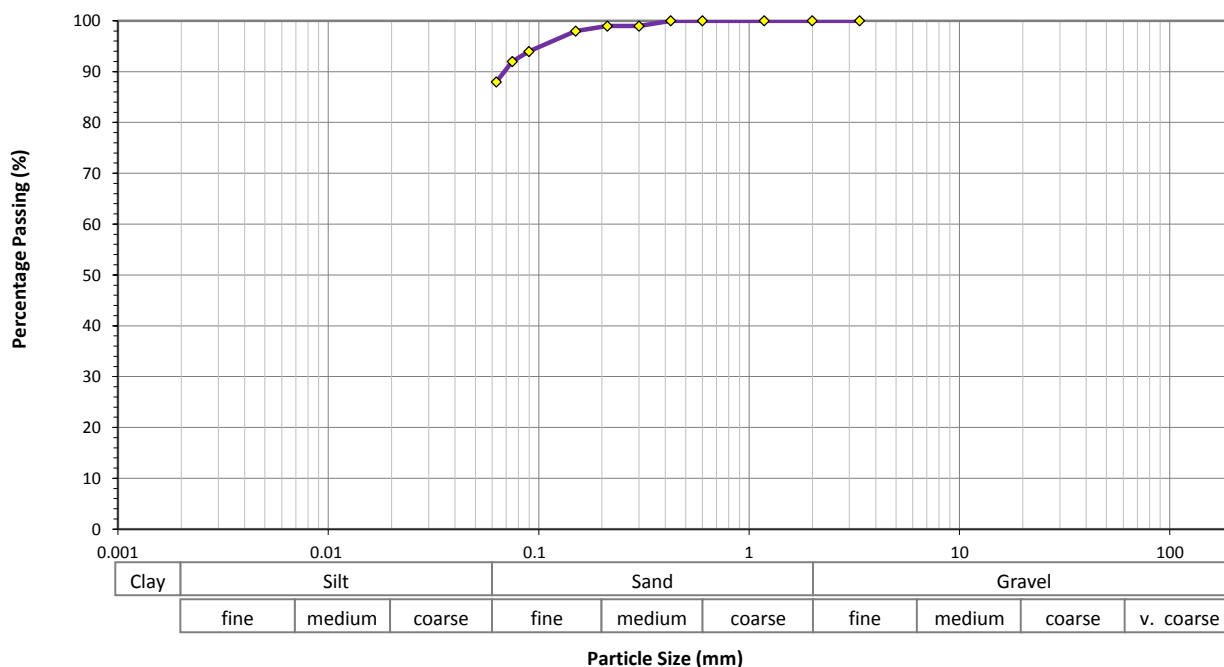
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000036	
	Reference	BH08	Top Depth 3.0m
	Sampled By		Bottom Depth
	Description	clayey SILT with some sand, few rootlets, firm to stiff, light greenish grey, mottled black, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	99
100	-	19.0	-	3.35	100	0.212	99
75.0	-	16.0	-	2.00	100	0.150	98
63.0	-	13.2	-	1.18	100	0.090	94
53.0	-	9.50	-	0.600	100	0.075	92
37.5	-	6.70	-	0.425	100	0.063	88

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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GEOTECHNICS www.geotechnics.co.nz

Your Job No.: 1014985.0000

Site: Watercare Whenuapai-Redhills

Our Job No.: 1100655.0000

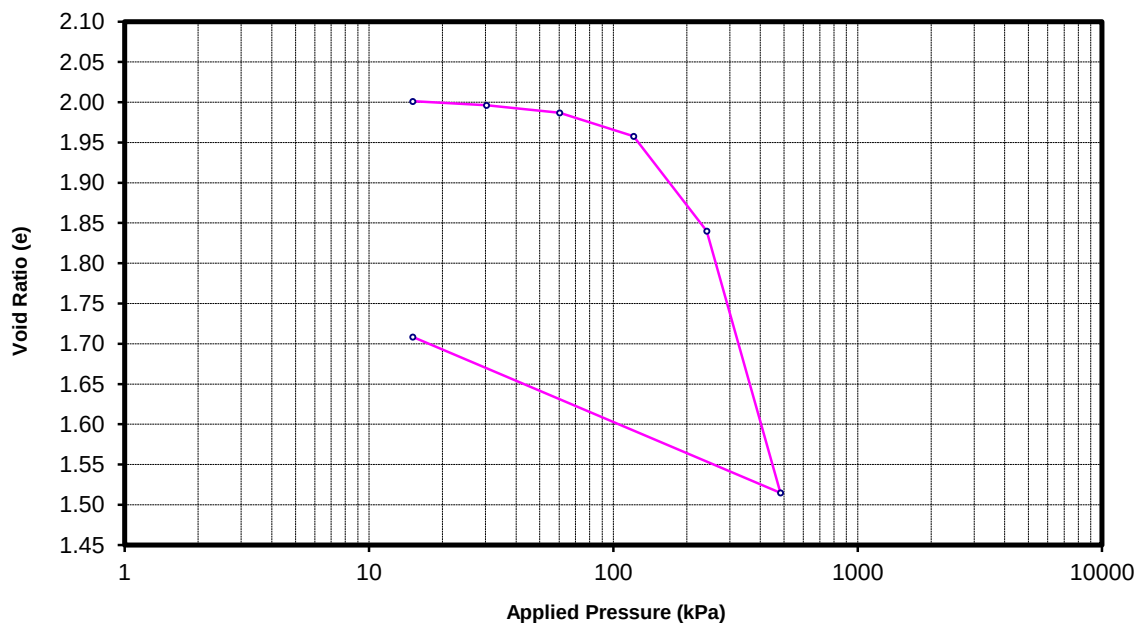
BH No.: BH 08

Sample ID.: ---

Depth: 6.30-6.35 (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 C_v (m^2/yr)	Coefficient of Volume Compressibility M_v (m^2/MN)
As received 0	2.007			
Preload 15.1	2.001	0 to 15.1	NA	0.12
30.2	1.996	15.1 to 30.2	7.9	0.11
60.3	1.987	30.2 to 60.3	6.6	0.10
121	1.958	60.3 to 121	5.2	0.16
241	1.840	121 to 241	1.4	0.33
483	1.515	241 to 483	0.62	0.47
Unload 15.1	1.708	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor to some clay and trace of sand, trace of organics, firm, grey mixed with dark brown, mottled black.

Initial Dry Density (t/m^3): 0.88

Initial Water Content: 73.6%

Solid Density (t/m^3): 2.65 (Assumed)

Initial Saturation: 97%

Temperature During Testing: Max = 21 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m^3 . The calculations of void ratio are affected by the solid density value.

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

Entered by: ST

Date: 26.01.21

Checked by: JK

Date: 26.01.21

Our Ref.No.1100655.0000/Rep1



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000037		
	Reference	BH110	Top Depth	1.5m
	Sampled By	Bottom Depth		
	Description	clayey SILT with minor sand, few rootlets, light grey mixed with light brown, mottled orange, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

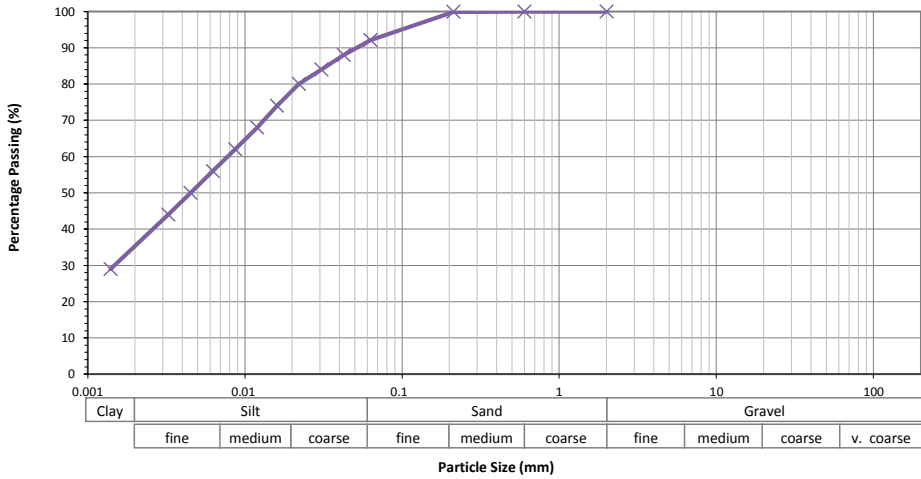
TEST RESULTS

Liquid Limit 77
Plastic Limit 29
Plasticity Index 48

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021

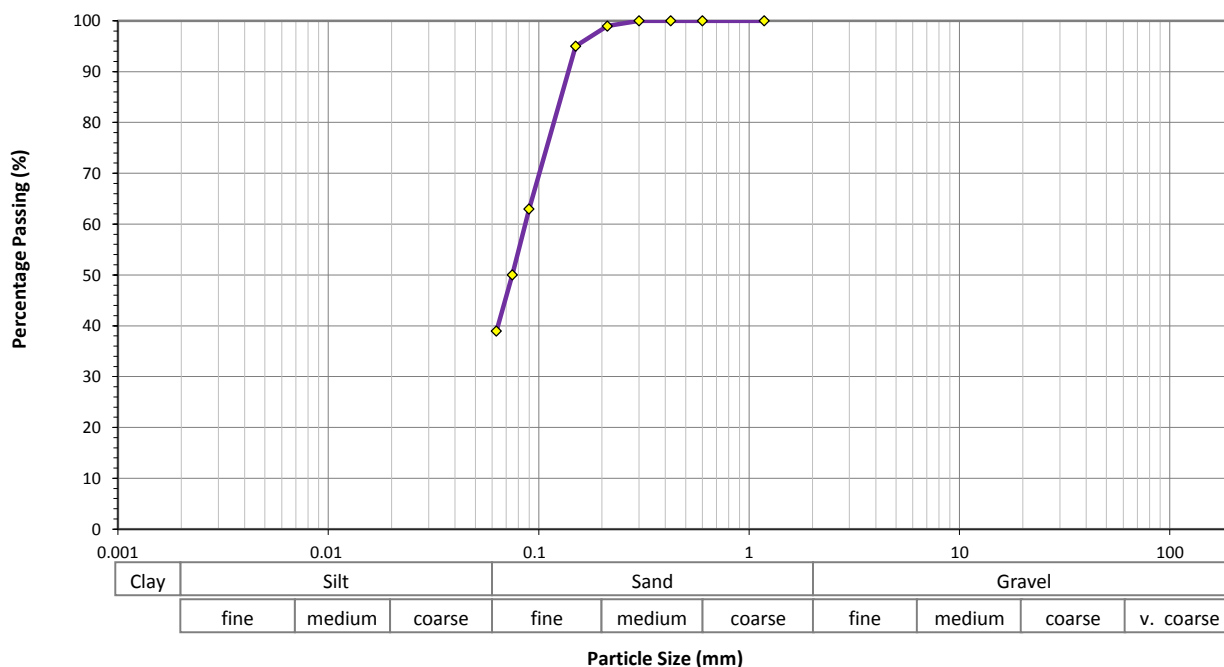
 GEOTECHNICS	1 Hill Street Onehunga Auckland 1061 New Zealand p + 64 9 356 3510	Geotechnics Project Number 1100655.0000 QESTLab Workorder ID W21AK-0012 Customer Project ID 1014985.0000																																													
Determination of the Particle-Size Distribution NZS 4402:1986 Test 2.8.4 Hydrometer Method																																															
Test Details																																															
LOCATION	Description	Watercare Whenuapai-Redhills																																													
	Data	N/A																																													
SAMPLE	Geotechnics ID	S21AK000037	Sampled By N/A																																												
	Reference	BH110	Top Depth 1.5m																																												
			Bottom Depth N/A																																												
	Description	clayey SILT with minor sand, few rootlets, light grey mixed with light brown, mottled orange, very high plasticity.																																													
		Sample History	Natural																																												
Test Results																																															
																																															
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Date tested 02/12/2020 • The material used for testing was Natural. Suspension pH 8 Solid Density (Assumed) = 2.65 t/m³ • This test result is IANZ accredited. Approved Signatory Sim Tirunahari Date 26/01/2021																																															

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000038	
	Reference	BH110	Top Depth 3.5m
	Sampled By	Bottom Depth	
	Description	silty SAND with minor clay, stiff, light greenish grey, mottled orange.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	95
63.0	-	13.2	-	1.18	100	0.090	63
53.0	-	9.50	-	0.600	100	0.075	50
37.5	-	6.70	-	0.425	100	0.063	39

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2021

Approved Signatory Sim Tirunahari

Date 26/01/2021



1 Hill Street
Onehunga
Auckland 1061
New Zealand
p + 64 9 356 3510

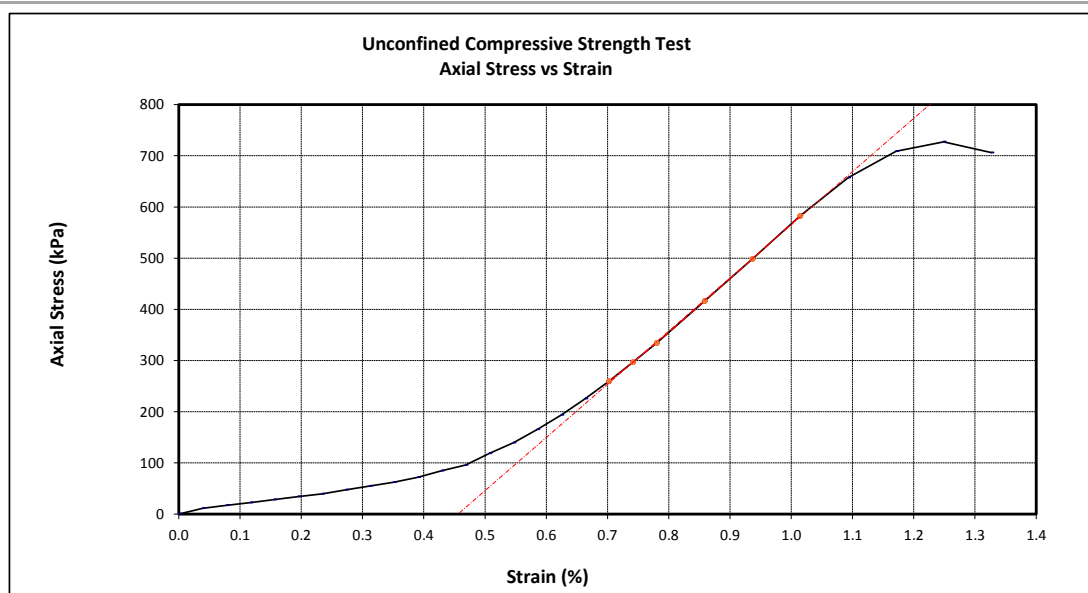
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Unconfined Compressive Strength of Cohesive Soil - NZS 4402:1986 - Test 6.3.1

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000039	BH No
	Reference	BH110	Top Depth 9.4m
	Sampled By		Bottom Depth
	Description	Light greenish grey, extremely weak, fine to medium SANDSTONE.	
	Sample History	The sample used for testing was natural, undisturbed.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

Test Result



Sample Parameters

Sample Height	(mm)	128.11
Sample Diameter	(mm)	82.02
Test Height	(mm)	128.11
Test H/D Ratio		1.56

Bulk Density	(t/m ³)	1.98
Dry Density	(t/m ³)	1.65
Water Content	(%)	20.9

Failure Value

Axial Strain (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.2	730	0.059	104

Mode of Failure Shear

Test Remarks

• Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only. • Unconfined compressive strength (kPa) is rounded to 2 significant figures. • The sample height to diameter ratio is less than the required 2. The strength may be lower, due to the height to diameter ratio. • This test result is IANZ accredited. • Date tested 03/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021



1 Hill Street
Onehunga
Auckland 1061
New Zealand
p + 64 9 356 3510

Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000040	
	Reference	BH111	Top Depth 1.5m
	Sampled By	Bottom Depth	
	Description	clayey SILT with minor sand, stiff, light grey with light brown, mottled yellow-orange, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

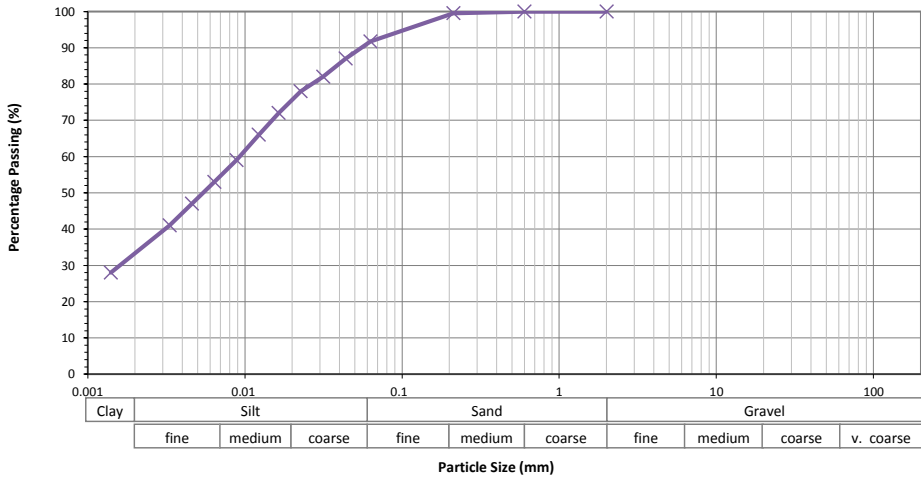
TEST RESULTS

Liquid Limit 84
Plastic Limit 28
Plasticity Index 56

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 07/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021

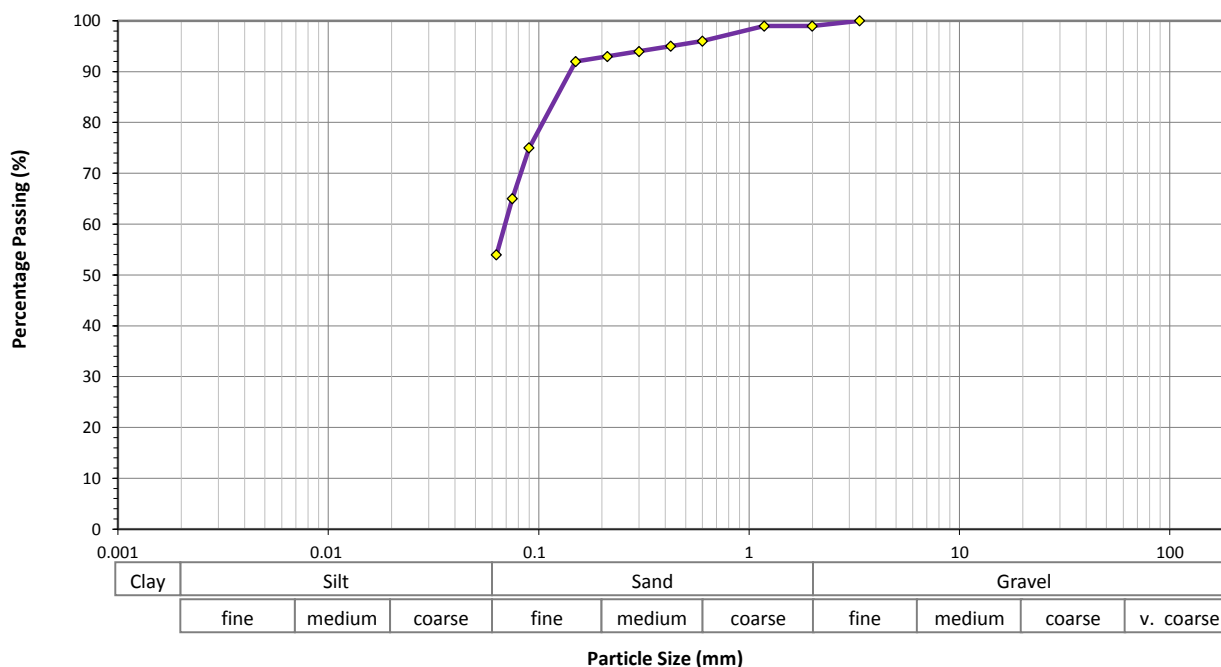
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Date tested 02/12/2020 • The material used for testing was Natural. Suspension pH 8 Solid Density (Assumed) = 2.65 t/m³ • This test result is IANZ accredited. Approved Signatory Sim Tirunahari Date 26/01/2021																																																

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000041		
	Reference	BH111	Top Depth	3.0m
	Sampled By	Bottom Depth		
	Description	silty SAND with some clay, stiff, light greenish grey, mottled orange.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	94
100	-	19.0	-	3.35	100	0.212	93
75.0	-	16.0	-	2.00	99	0.150	92
63.0	-	13.2	-	1.18	99	0.090	75
53.0	-	9.50	-	0.600	96	0.075	65
37.5	-	6.70	-	0.425	95	0.063	54

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 01/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Onehunga
Auckland 1061
New Zealand
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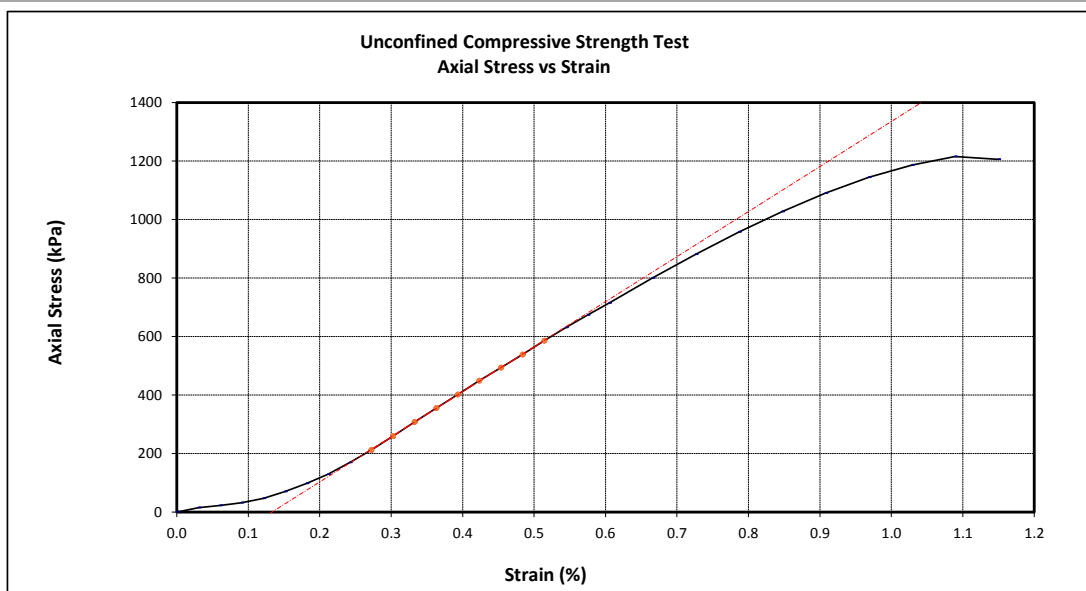
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0012
Customer Project ID 1014985.0000

Unconfined Compressive Strength of Cohesive Soil - NZS 4402:1986 - Test 6.3.1

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000042	BH No
	Reference	BH111	Top Depth 7.3m
	Sampled By		Bottom Depth
	Description	Light greenish grey, very weak, fine to medium SANDSTONE.	
	Sample History	The sample used for testing was natural, undisturbed.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

Test Result



Sample Parameters

Sample Height	(mm)	165.26
Sample Diameter	(mm)	82.13
Test Height	(mm)	165.26
Test H/D Ratio		2.01

Bulk Density	(t/m ³)	2.02
Dry Density	(t/m ³)	1.65
Water Content	(%)	22.2

Failure Value

Axial Strain (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.1	1200	0.062	154

Mode of Failure Shear

Test Remarks

• Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only. • Unconfined compressive strength (kPa) is rounded to 2 significant figures. • This test result is IANZ accredited. • Date tested 03/12/2020

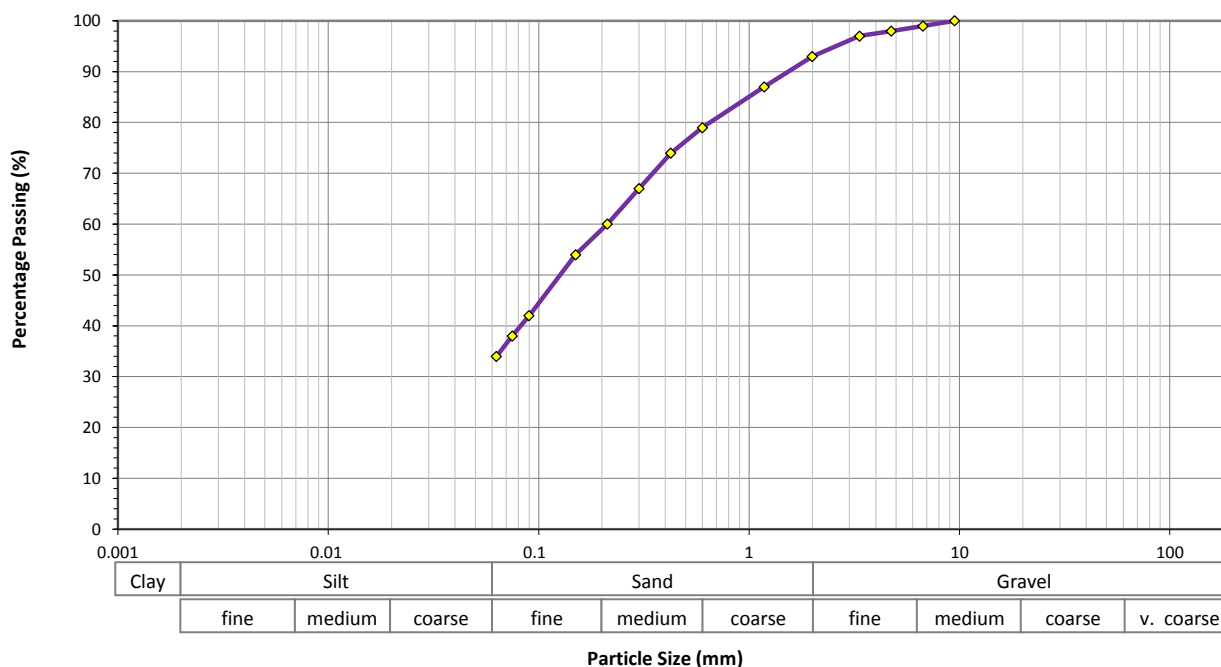
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000774		
	Reference	BH113	Top Depth	3.00m
	Sampled By		Bottom Depth	3.45m
	Description	silty SAND with minor clay and minor gravel, soft, light yellowish brown mixed with light bluish grey, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	98	0.300	67
100	-	19.0	-	3.35	97	0.212	60
75.0	-	16.0	-	2.00	93	0.150	54
63.0	-	13.2	-	1.18	87	0.090	42
53.0	-	9.50	100	0.600	79	0.075	38
37.5	-	6.70	99	0.425	74	0.063	34

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 23/11/2020

Approved Signatory Sim Tirunahari

Date 22/01/2021



1 Hill Street
Onehunga
Auckland 1061
New Zealand
p + 64 9 356 3510

Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000775		
	Reference	BH113	Top Depth	4.50m
	Sampled By		Bottom Depth	4.95m
	Description	clayey SILT with some sand, very stiff, light yellowish brown mixed with light bluish grey, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

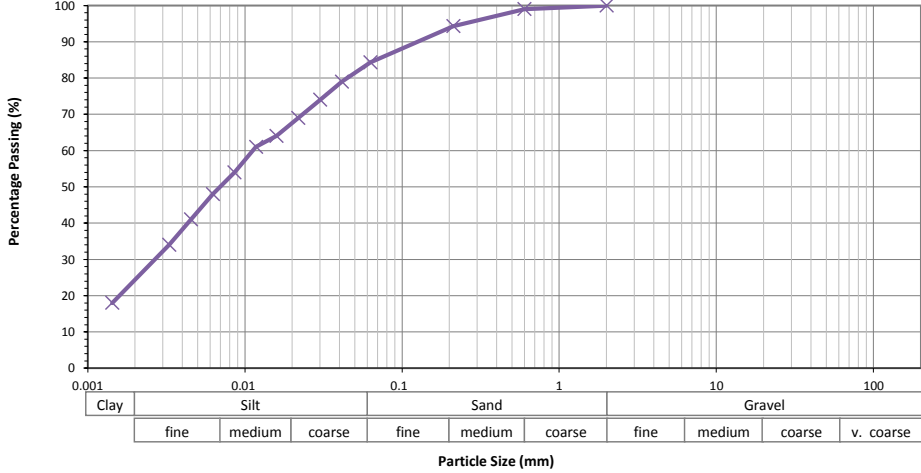
TEST RESULTS

Liquid Limit 95
Plastic Limit 33
Plasticity Index 62

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021

 GEOTECHNICS	1 Hill Street Onehunga Auckland 1061 New Zealand p + 64 9 356 3510	<table style="width: 100%;"> <tr> <td style="width: 50%;">Geotechnics Project Number</td> <td>1100655.0000</td> </tr> <tr> <td>QESTLab Workorder ID</td> <td>W20AK-0248</td> </tr> <tr> <td>Customer Project ID</td> <td>1014985.0000</td> </tr> </table>	Geotechnics Project Number	1100655.0000	QESTLab Workorder ID	W20AK-0248	Customer Project ID	1014985.0000																													
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SAMPLE	<table style="width: 100%;"> <tr> <td style="width: 50%;">Geotechnics ID</td> <td>S20AK000775</td> <td style="width: 50%;">Sampled By</td> <td>N/A</td> </tr> <tr> <td>Reference</td> <td>BH113</td> <td>Top Depth</td> <td>4.50m</td> </tr> <tr> <td></td> <td></td> <td>Bottom Depth</td> <td>4.95m</td> </tr> <tr> <td>Description</td> <td colspan="3"> clayey SILT with some sand, very stiff, light yellowish brown mixed with light bluish grey, mottled black, extremely high plasticity. </td> </tr> <tr> <td>Sample History</td> <td colspan="3">Natural</td> </tr> </table>		Geotechnics ID	S20AK000775	Sampled By	N/A	Reference	BH113	Top Depth	4.50m			Bottom Depth	4.95m	Description	clayey SILT with some sand, very stiff, light yellowish brown mixed with light bluish grey, mottled black, extremely high plasticity.			Sample History	Natural																	
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Clay		Silt		Sand			Gravel																														
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Test Remarks																																					
• The material used for testing was Natural. Suspension pH 8 Solid Density (Assumed) = 2.65 t/m³ • Date tested 23.11.20 • This test result is IANZ accredited. Approved Signatory Sim Tirunahari Date 22/01/2021																																					



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000777		
	Reference	BH113	Top Depth	6.03m
	Sampled By		Bottom Depth	6.15m
	BH/TP No.			
	Description	SILT with minor to some clay and trace of sand, some organics, firm, dark greyish brown, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 15%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • The ignition method is sufficiently accurate for day-to-day engineering purposes, but it should not be relied on for organic contents less than about 15%. • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021

Our Ref.No.1100655.0000/Rep1



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Your Job No.: 1014985.0000

Site: Watercare Whenuapai-Redhills

Our Job No.: 1100655.0000

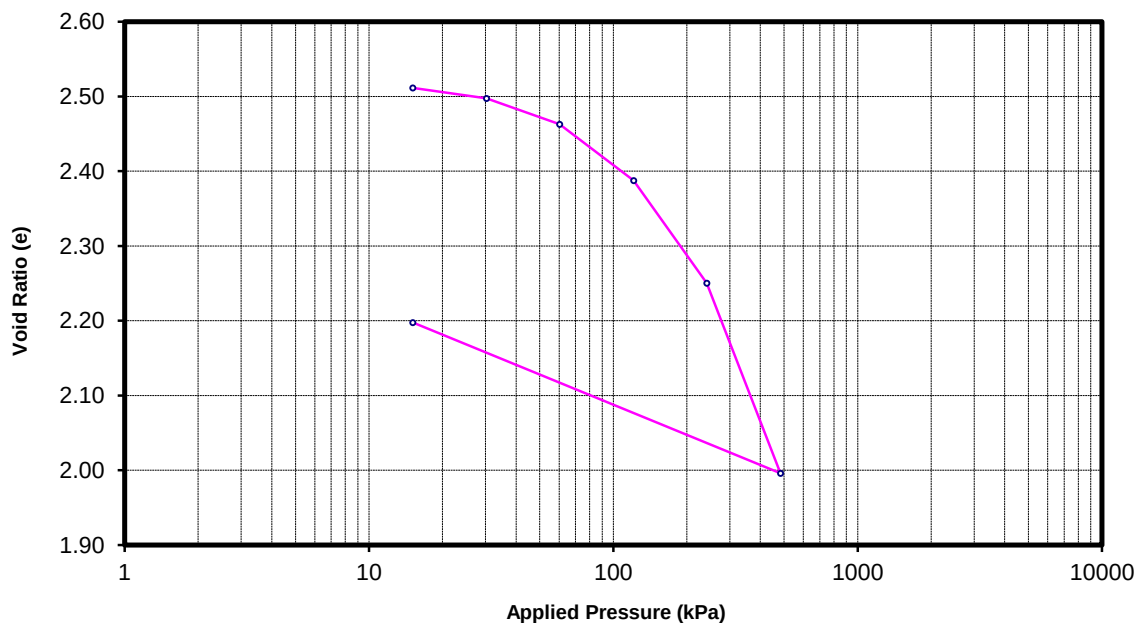
BH No.: 113

Sample ID.: ---

Depth: 6.15-6.20 (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 C_v (m ² /yr)	Coefficient of Volume Compressibility M_v (m ² /MN)
As received 0	2.516			
Preload 15.1	2.511	0 to 15.1	NA	0.090
30.2	2.498	15.1 to 30.2	1.7	0.26
60.3	2.463	30.2 to 60.3	1.3	0.33
121	2.388	60.3 to 121	0.84	0.36
241	2.250	121 to 241	0.70	0.34
483	1.996	241 to 483	0.46	0.32
Unload 15.1	2.198	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor to some clay and trace of sand, some organics, firm, dark greyish brown, mottled black.

Initial Dry Density (t/m³): 0.74

Initial Water Content: 93.3%

Solid Density (t/m³): 2.60 (Assumed)

Initial Saturation: 96%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.60 t/m³. The calculations of void ratio are affected by the solid density value.

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

Entered by: ST

Date: 22.01.21

Checked by: JK

Date: 22.01.21

Our Ref.No.1100655.0000/Rep1



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000776		
	Reference	BH113	Top Depth	5.70m
	Sampled By		Bottom Depth	5.80m
	Description	SILT with some clay, some sand, some organics, very stiff, dark grey mixed dark brown and light yellow, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 148
Plastic Limit 60
Plasticity Index 88

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 24/11/2020

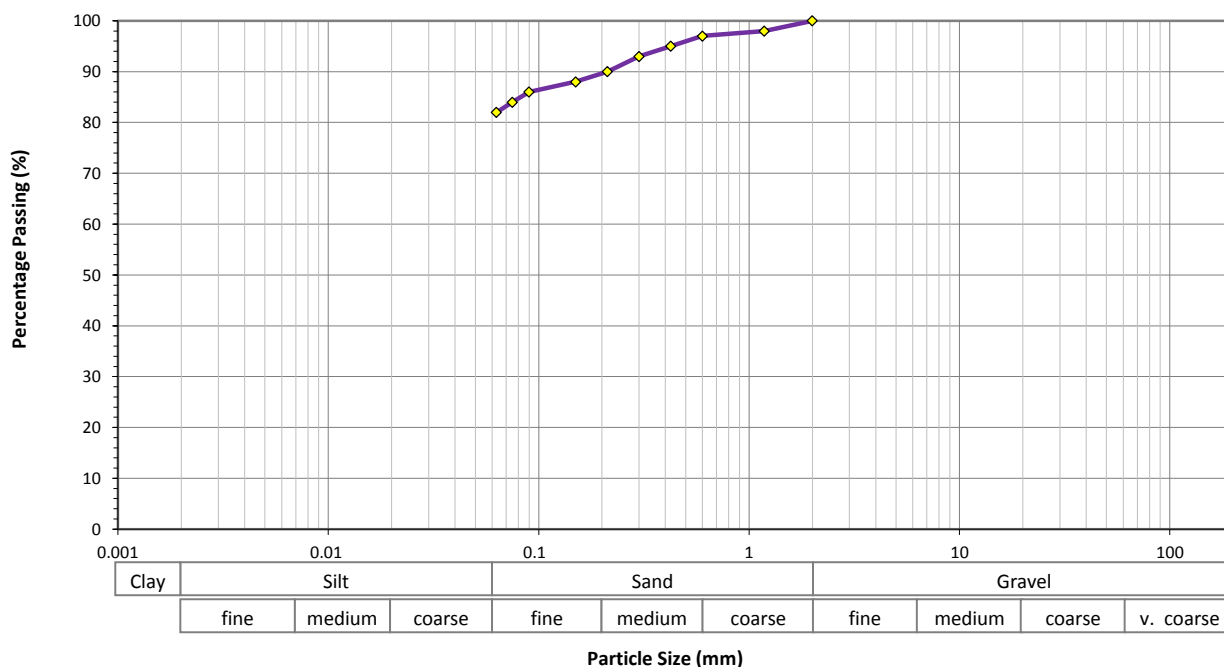
Approved Signatory Sim Tirunahari
Date 22/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000776		
	Reference	BH113	Top Depth	5.70m
	Sampled By		Bottom Depth	5.80m
	Description	SILT with some clay, some sand, some organics, very stiff, dark grey mixed dark brown and light yellow, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	93
100	-	19.0	-	3.35	-	0.212	90
75.0	-	16.0	-	2.00	100	0.150	88
63.0	-	13.2	-	1.18	98	0.090	86
53.0	-	9.50	-	0.600	97	0.075	84
37.5	-	6.70	-	0.425	95	0.063	82

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 23/11/2020

Approved Signatory Sim Tirunahari

Date 22/01/2021



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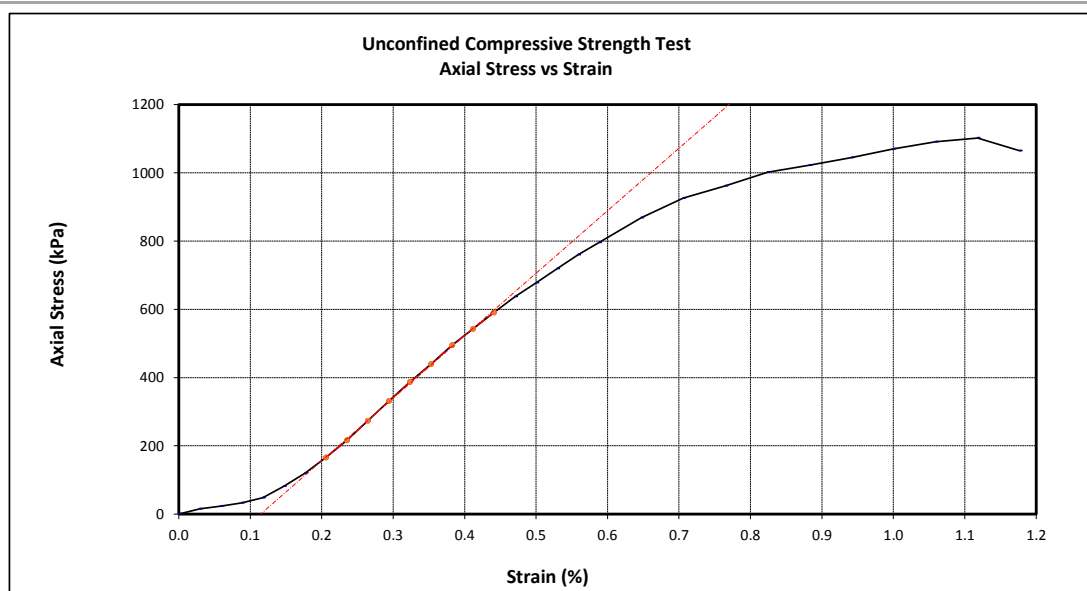
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Unconfined Compressive Strength of Cohesive Soil - NZS 4402:1986 - Test 6.3.1

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S20AK000778	BH No
	Reference	BH113	Top Depth 16.3m
	Sampled By		Bottom Depth 16.5m
	Description	Light greenish grey, very weak, SILTSTONE with a SANDSTONE laminae.	
	Sample History	The sample used for testing was natural, undisturbed.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

Test Result



Sample Parameters

Sample Height	(mm)	169.94
Sample Diameter	(mm)	81.13
Test Height	(mm)	169.94
Test H/D Ratio		2.09

Bulk Density	(t/m ³)	2.06
Dry Density	(t/m ³)	1.65
Water Content	(%)	24.0

Failure Value

Axial Strain (%)	Unconfined Compressive Strength q_u (kPa)	Rate of Compression (mm/min)	Modulus of Elasticity (MPa)
1.1	1100	0.063	183

Mode of Failure Shear

Test Remarks

• Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only. • Unconfined compressive strength (kPa) is rounded to 2 significant figures. • This test result is IANZ accredited. • Date tested 27/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000779		
	Reference	BH116	Top Depth	1.50m
	Sampled By		Bottom Depth	1.95m
	Description	sandy SILT with minor to some clay, few rootlets, stiff, light grey mixed with light yellowish brown, mottled black, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 51
Plastic Limit 23
Plasticity Index 28

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 24/11/2020

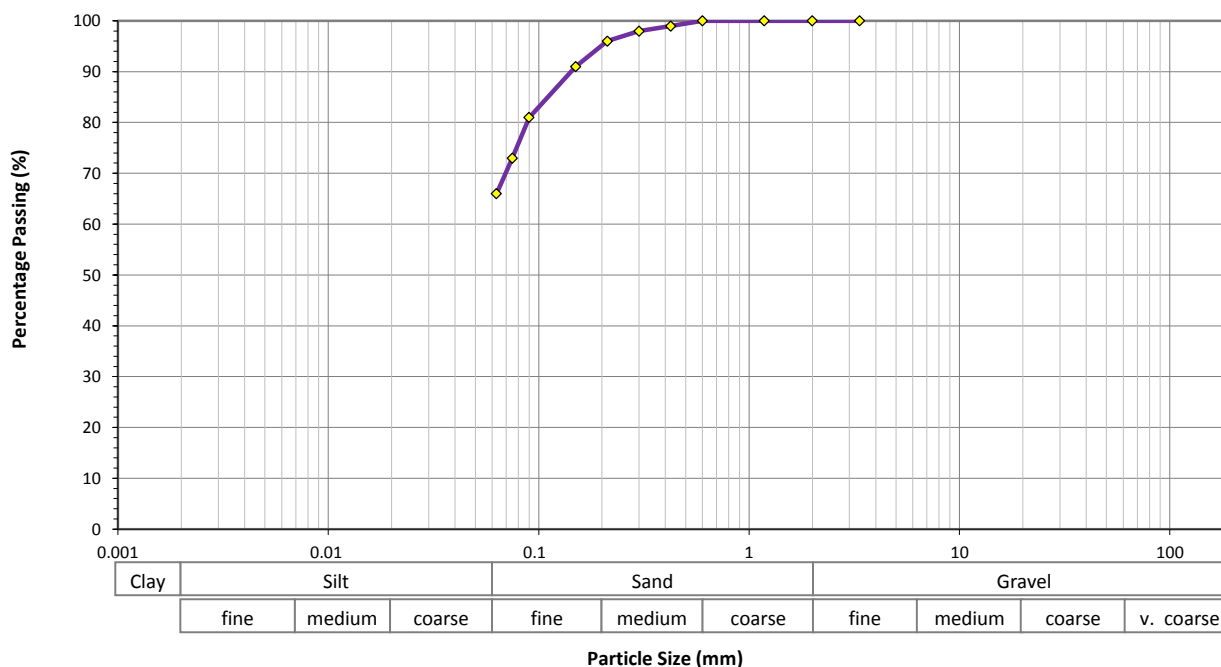
Approved Signatory Sim Tirunahari
Date 22/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000779		
	Reference	BH116	Top Depth	1.50m
	Sampled By		Bottom Depth	1.95m
	Description	sandy SILT with minor to some clay, few rootlets, stiff, light grey mixed with light yellowish brown, mottled black, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	98
100	-	19.0	-	3.35	100	0.212	96
75.0	-	16.0	-	2.00	100	0.150	91
63.0	-	13.2	-	1.18	100	0.090	81
53.0	-	9.50	-	0.600	100	0.075	73
37.5	-	6.70	-	0.425	99	0.063	66

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 23/11/2020

Approved Signatory Sim Tirunahari

Date 22/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000780		
	Reference	BH116	Top Depth	4.60m
	Sampled By		Bottom Depth	4.75m
	BH/TP No.			
	Description	SILT with some clay and trace of sand, trace of organics, firm, dark grey mixed with dark brown, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 4%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • The ignition method is sufficiently accurate for day-to-day engineering purposes, but it should not be relied on for organic contents less than about 15%. • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021

Our Ref.No.1100655.0000/Rep1



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Your Job No.: 1014985.0000

Site: Watercare Whenuapai-Redhills

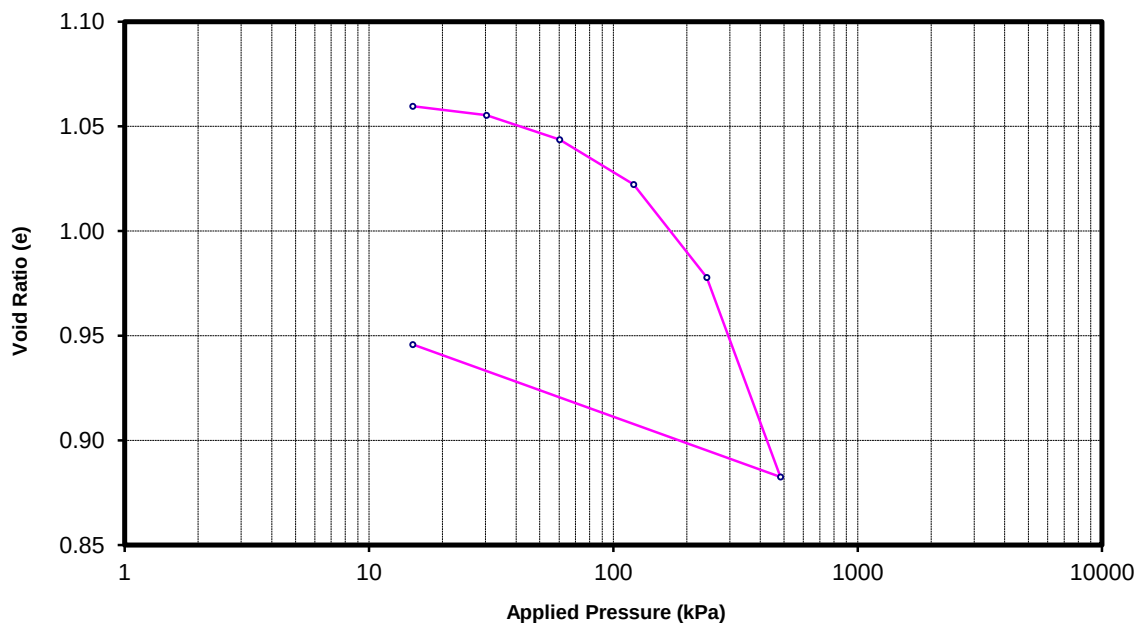
Our Job No.: 1100655.0000

BH No.: 116 Sample ID.: ---

Depth: 4.75-4.80 (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 C_v (m^2/yr)	Coefficient of Volume Compressibility M_v (m^2/MN)
As received 0	1.063			
Preload 15.1	1.060	0 to 15.1	NA	0.098
30.2	1.055	15.1 to 30.2	6.7	0.14
60.3	1.044	30.2 to 60.3	4.1	0.19
121	1.022	60.3 to 121	2.7	0.17
241	0.978	121 to 241	1.8	0.18
483	0.883	241 to 483	1.1	0.20
Unload 15.1	0.946	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with some clay and trace of sand, trace of organics, firm, dark grey mixed with dark brown, mottled black.

Initial Dry Density (t/m^3): 1.28

Initial Water Content: 38.1%

Solid Density (t/m^3): 2.65 (Assumed)

Initial Saturation: 95%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.65 t/m^3 . The calculations of void ratio are affected by the solid density value.

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

Entered by: ST

Date: 22.01.21

Checked by: JK

Date: 22.01.21

Our Ref.No.1100655.0000/Rep1



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000781		
	Reference	BH116	Top Depth	5.00m
	Sampled By		Bottom Depth	5.45m
	Description	sandy SILT with minor to some clay, firm, dark grey mixed with dark brown, mottled black, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 66
Plastic Limit 28
Plasticity Index 38

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 24/11/2020

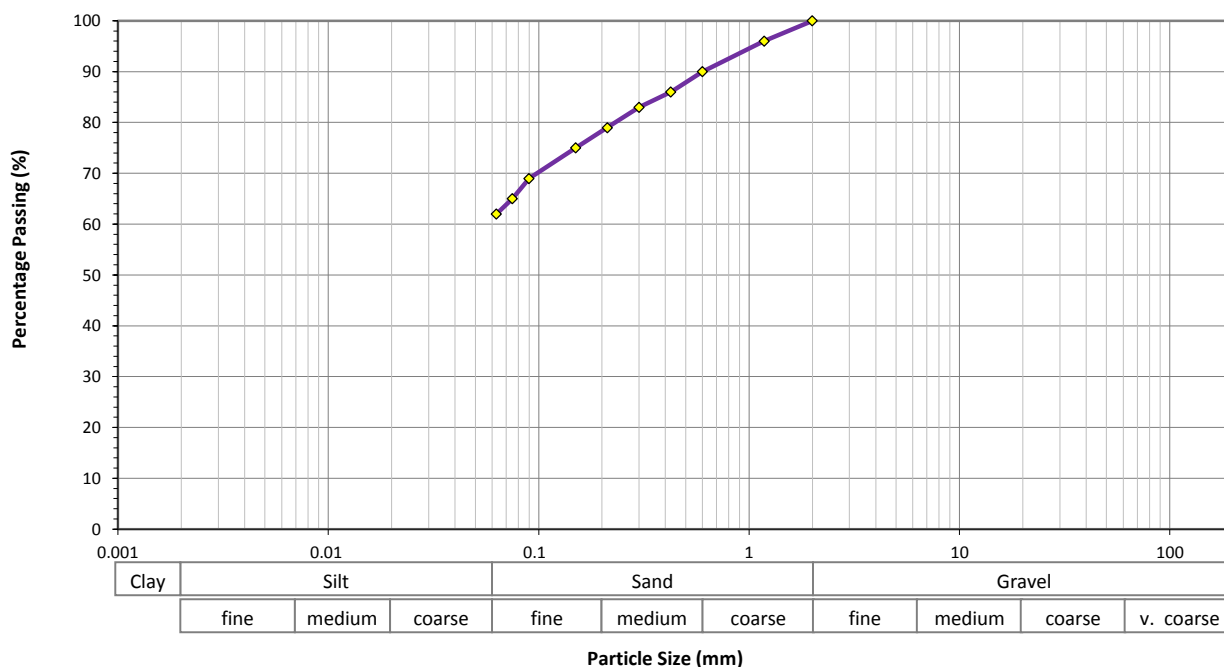
Approved Signatory Sim Tirunahari
Date 22/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000781		
	Reference	BH116	Top Depth	5.00m
	Sampled By		Bottom Depth	5.45m
	Description	sandy SILT with minor to some clay, firm, dark grey mixed with dark brown, mottled black, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	83
100	-	19.0	-	3.35	-	0.212	79
75.0	-	16.0	-	2.00	100	0.150	75
63.0	-	13.2	-	1.18	96	0.090	69
53.0	-	9.50	-	0.600	90	0.075	65
37.5	-	6.70	-	0.425	86	0.063	62

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 23/11/2020

Approved Signatory Sim Tirunahari

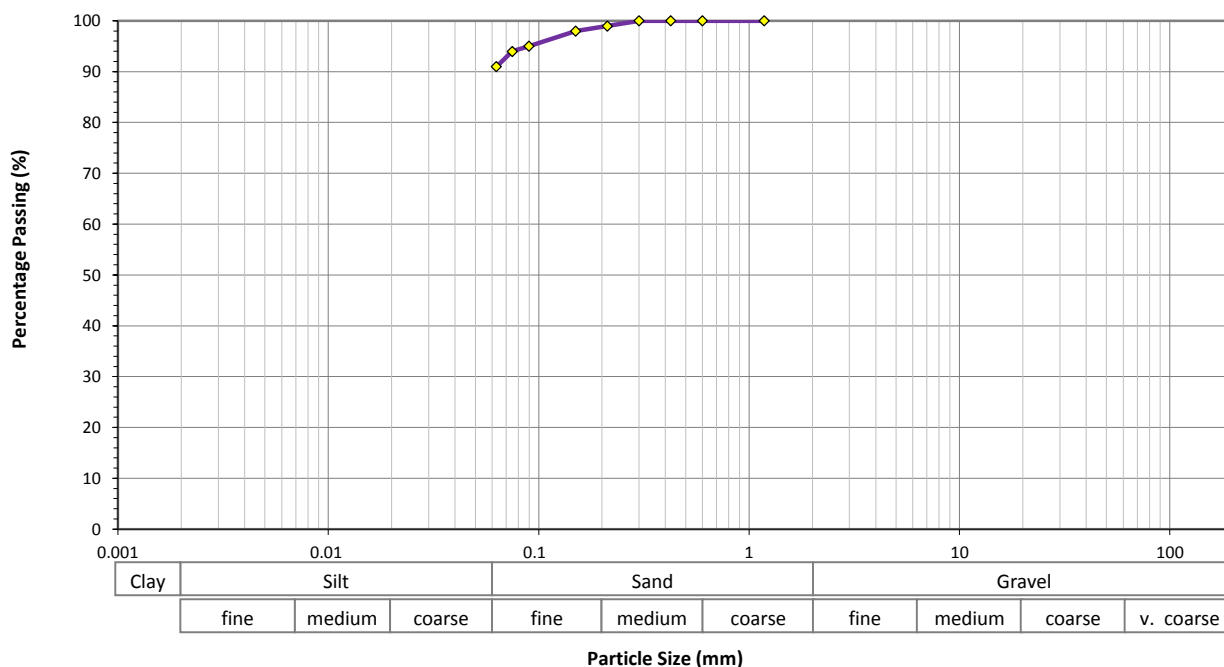
Date 22/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000783		
	Reference	BH117	Top Depth	1.50m
	Sampled By		Bottom Depth	1.95m
	Description	clayey SILT with minor sand, firm, light grey mixed with light brown.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	98
63.0	-	13.2	-	1.18	100	0.090	95
53.0	-	9.50	-	0.600	100	0.075	94
37.5	-	6.70	-	0.425	100	0.063	91

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 23/11/2020

Approved Signatory Sim Tirunahari

Date 22/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000784		
	Reference	BH117	Top Depth	3.00m
	Sampled By		Bottom Depth	3.45m
	Description	clayey SILT with some sand, minor organics, very stiff, dark grey mixed with dark brown and light yellow, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 132
Plastic Limit 47
Plasticity Index 85

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000784		
	Reference	BH117	Top Depth	3.00m
	Sampled By		Bottom Depth	3.45m
	BH/TP No.			
	Description	clayey SILT with some sand, minor organics, very stiff, dark grey mixed with dark brown and light yellow, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 6%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • The ignition method is sufficiently accurate for day-to-day engineering purposes, but it should not be relied on for organic contents less than about 15%. • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021

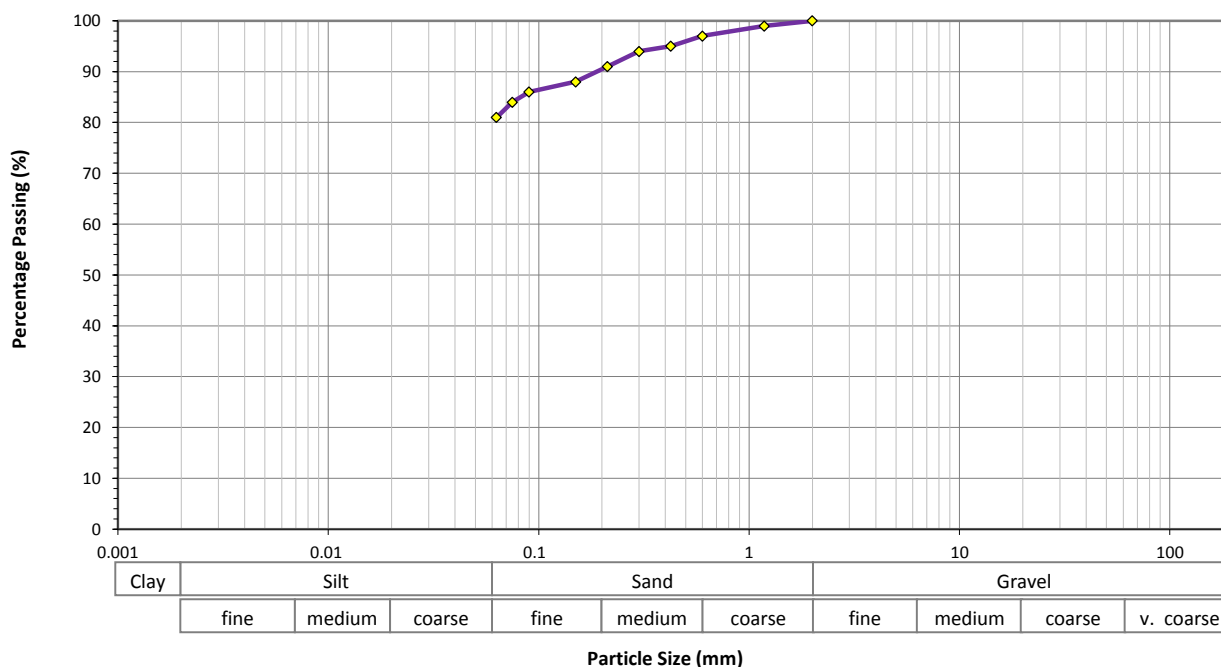
Our Ref.No.1100655.0000/Rep1

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000784		
	Reference	BH117	Top Depth	3.00m
	Sampled By		Bottom Depth	3.45m
	Description	clayey SILT with some sand, minor organics, very stiff, dark grey mixed with dark brown and light yellow, mottled black, extremely high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	94
100	-	19.0	-	3.35	-	0.212	91
75.0	-	16.0	-	2.00	100	0.150	88
63.0	-	13.2	-	1.18	99	0.090	86
53.0	-	9.50	-	0.600	97	0.075	84
37.5	-	6.70	-	0.425	95	0.063	81

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari

Date 22/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W20AK-0248
Customer Project ID 1014985.0000

Page 50 of 64

Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S20AK000785		
	Reference	BH117	Top Depth	4.65m
	Sampled By		Bottom Depth	4.80m
	BH/TP No.			
	Description	SILT with minor to some clay and trace of sand, trace of organics, firm, light greenish grey mixed with dark brown, mottled black.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 3%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • The ignition method is sufficiently accurate for day-to-day engineering purposes, but it should not be relied on for organic contents less than about 15%. • This test result is IANZ accredited. • Date tested 24/11/2020

Approved Signatory Sim Tirunahari
Date 22/01/2021



1 Hill Street, Onehunga, Auckland 1061

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GEOTECHNICS www.geotechnics.co.nz

Your Job No.: 1014985.0000

Site: Watercare Whenuapai-Redhills

Our Job No.: 1100655.0000

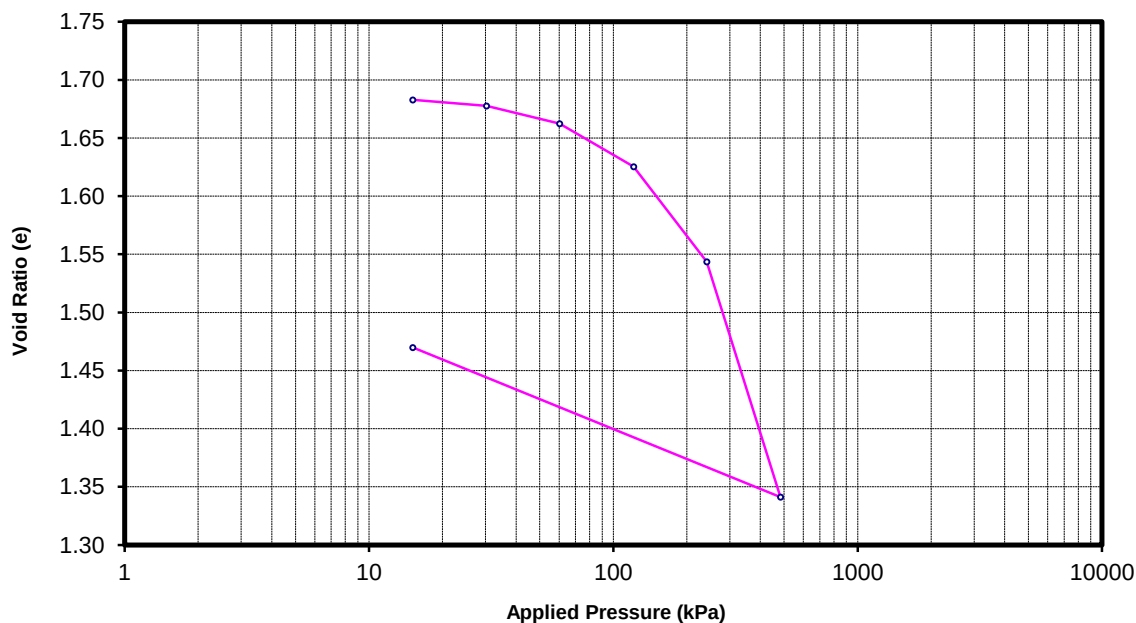
BH No.: 117

Sample ID.: ---

Depth: 4.80-4.85 (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 C_v (m ² /yr)	Coefficient of Volume Compressibility M_v (m ² /MN)
As received 0	1.687			
Preload 15.1	1.683	0 to 15.1	NA	0.098
30.2	1.678	15.1 to 30.2	4.1	0.13
60.3	1.663	30.2 to 60.3	2.9	0.19
121	1.625	60.3 to 121	2.6	0.23
241	1.544	121 to 241	0.96	0.26
483	1.341	241 to 483	0.57	0.33
Unload 15.1	1.470	483 to 15.1	NA	NA

Sample History: Undisturbed core trimmed at NWC.

Description: SILT with minor to some clay and trace of sand, trace of organics, firm, light greenish grey mixed with dark brown, mottled black.

Initial Dry Density (t/m³): 0.97

Initial Water Content: 63.1%

Solid Density (t/m³): 2.60 (Assumed)

Initial Saturation: 97%

Temperature During Testing: Max = 20 °C Min = 19 °C

Remarks: SQR of time fitting method was used. We have assumed a value of 2.60 t/m³. The calculations of void ratio are affected by the solid density value.

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

Entered by: ST

Date: 22.01.21

Checked by: JK

Date: 22.01.21

Our Ref.No.1100655.0000/Rep1



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Report No: ASM:W21AK-0004

Issue No: 3

This report replaces all previous issues of report no 'ASM:W21AK-0004'.

Material Test Report

Customer: Tonkin & Taylor Limited
Address: Level 2, 105 Carlton Gore Rd
Newmarket Auckland 1023
Project: Watercare Whenuapai-Redhills
Project No.: 1100655.0000
Customer Reference No.: 1014985.0000
Report Authorised By : Sim Tirunahari

Approved By:
Sim Tirunahari
(Soils Laboratory Manager)
Date of Issue: 26/01/2021

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

Material Details

Product:

Sampled From:

Location: Watercare Whenuapai-Redhills

Specification:

Sample Details

Sampled By:

'Sampling Endorsed:'

Sample ID:

S21AK000012	S21AK000013	S21AK000014	S21AK000015	S21AK000016	S21AK000017
HA108_2.4m	HA109_2.45m	HA110A_3.40m	HA114_3.45m	HA115_2.8m	HA119_1.5m

Client Sample ID:

Field Sample ID:

Date Sampled:

Date Tested:

18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020	18/12/2020
James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau	James Kimiangatau

Tested By:

Other Test Results

Description	Method	Results					
Moisture Content (%)	NZS 4402:1986 Test 2.1	42.3	43.6	52.0	50.1	44.9	38.0

Comments

N/A

If samples have been taken, and were not destroyed during testing, they will be retained for one month from the date of this report before being discarded.



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000012		
	Reference	HA108_2.4m		
	Description	sandy SILT with some clay, soft, light grey, mottled black, medium plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 48
Plastic Limit 24
Plasticity Index 24

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 18/01/2021

Approved Signatory Sim Tirunahari
Date 26/01/2021



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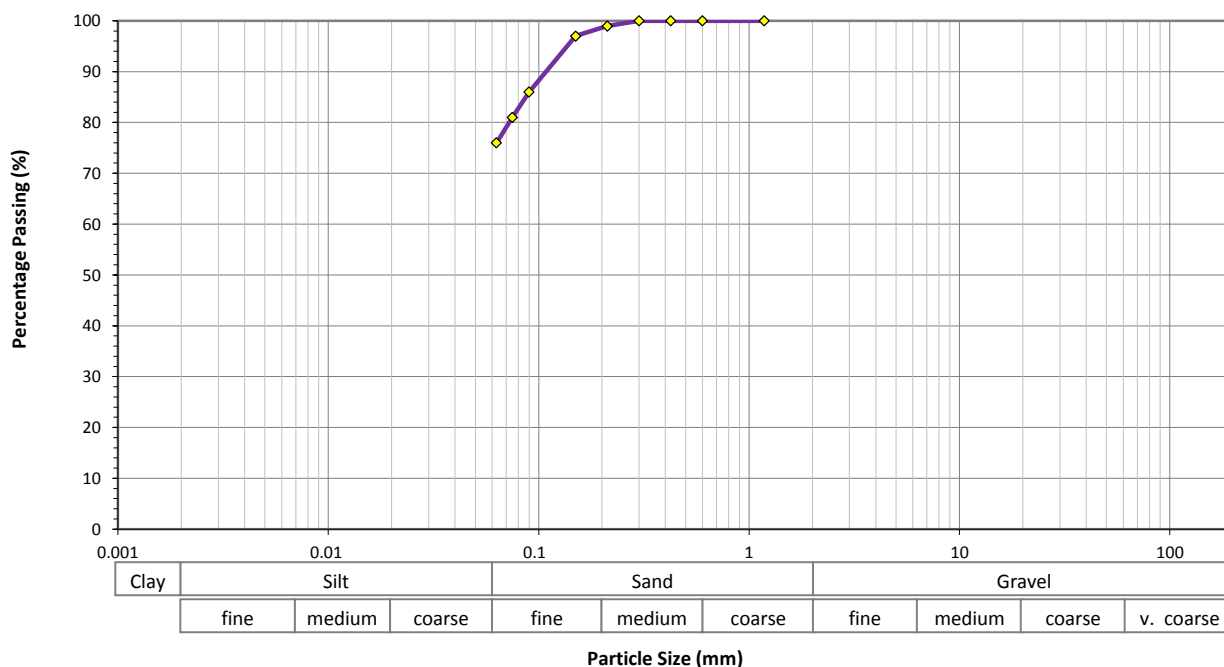
Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000012	
	Reference	HA108_2.4m	
	Description	sandy SILT with some clay, soft, light grey, mottled black, medium plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	97
63.0	-	13.2	-	1.18	100	0.090	86
53.0	-	9.50	-	0.600	100	0.075	81
37.5	-	6.70	-	0.425	100	0.063	76

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 18/12/2020

Approved Signatory Sim Tirunahari

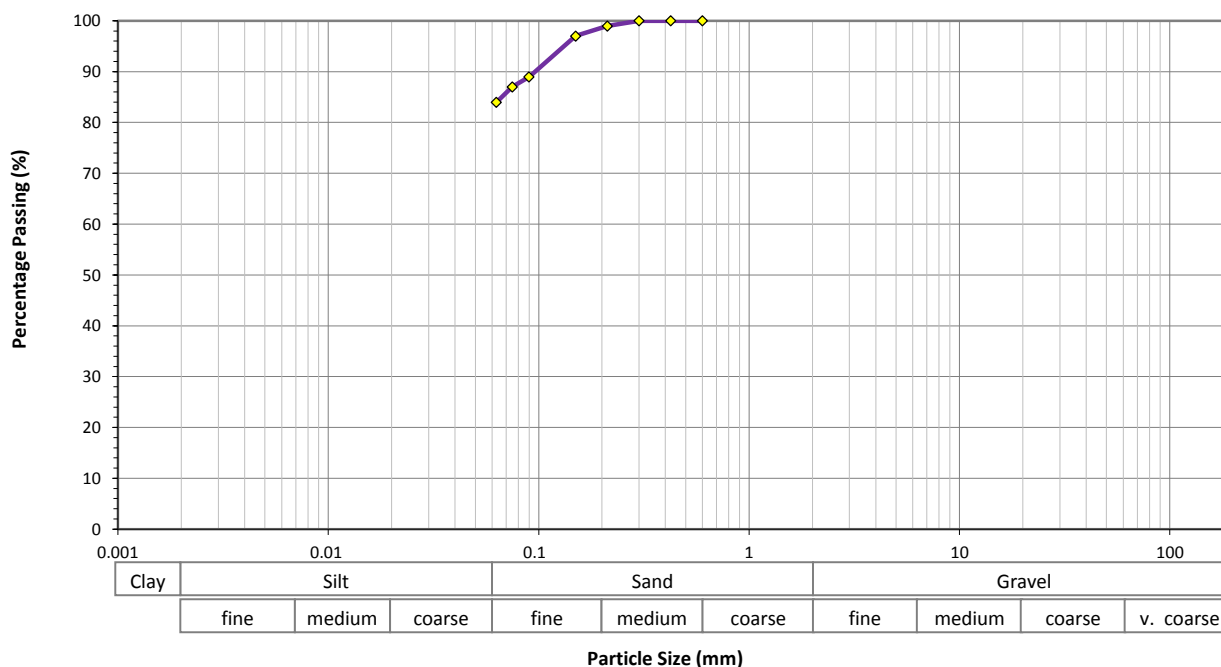
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000013	
	Reference	HA109_2.45m	
	Description	SILT with some clay and some sand, soft, light grey, mottled black.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	97
63.0	-	13.2	-	1.18	-	0.090	89
53.0	-	9.50	-	0.600	100	0.075	87
37.5	-	6.70	-	0.425	100	0.063	84

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 18/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000014		
	Reference	HA110A_3.40m		
	Description	SILT with some clay and some sand, minor organics, soft to firm, medium to dark brown mixed with grey, mottled black, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit	71
Plastic Limit	35
Plasticity Index	36

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 18/01/2021

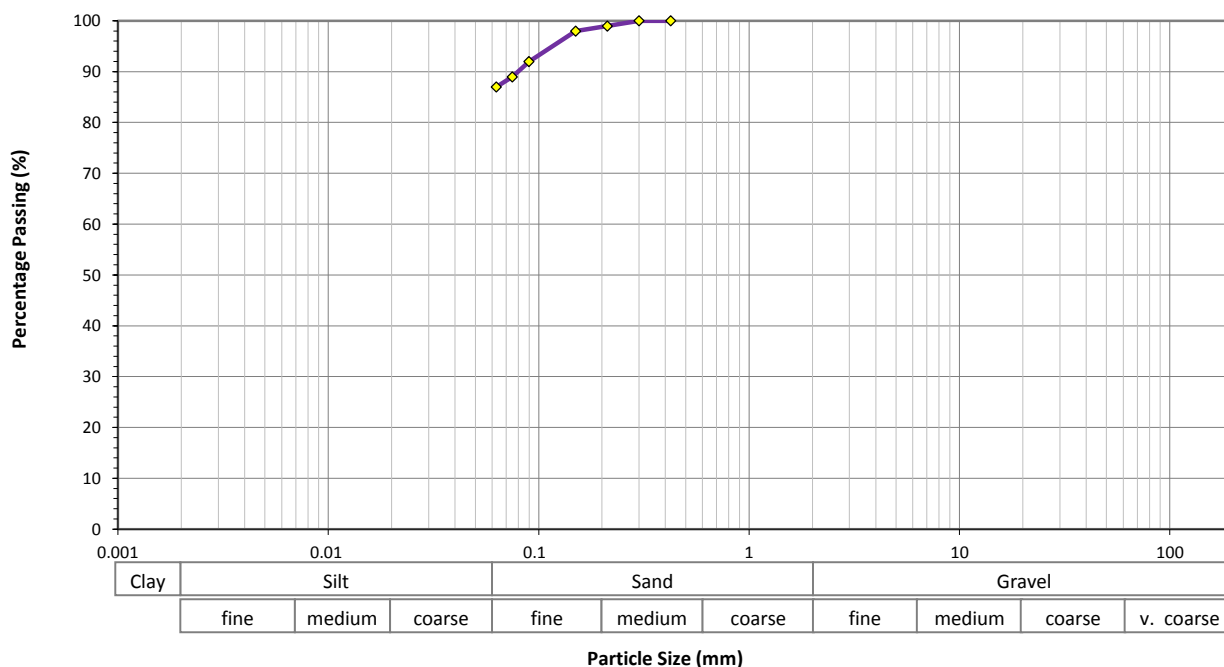
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000014	
	Reference	HA110A_3.40m	
	Description	SILT with some clay and some sand, minor organics, soft to firm, medium to dark brown mixed with grey, mottled black, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	99
75.0	-	16.0	-	2.00	-	0.150	98
63.0	-	13.2	-	1.18	-	0.090	92
53.0	-	9.50	-	0.600	-	0.075	89
37.5	-	6.70	-	0.425	100	0.063	87

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 18/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Organic Content By Ignition - NZS 4402:1986 Test 3.1.2

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000014		
	Reference	HA110A_3.40m		
	Description	SILT with some clay and some sand, minor organics, soft to firm, medium to dark brown mixed with grey, mottled black, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Organic Matter Content 6%

TEST REMARKS

• The result was obtained in accordance with the Standard Test Method. • The ignition method is sufficiently accurate for day-to-day engineering purposes, but it should not be relied on for organic contents less than about 15%. • This test result is IANZ accredited. • Date tested 21/12/2020

Approved Signatory Sim Tirunahari
Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000015		
	Reference	HA114_3.45m		
	Description	sandy clayey SILT, soft to firm, grey, mottled orange, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

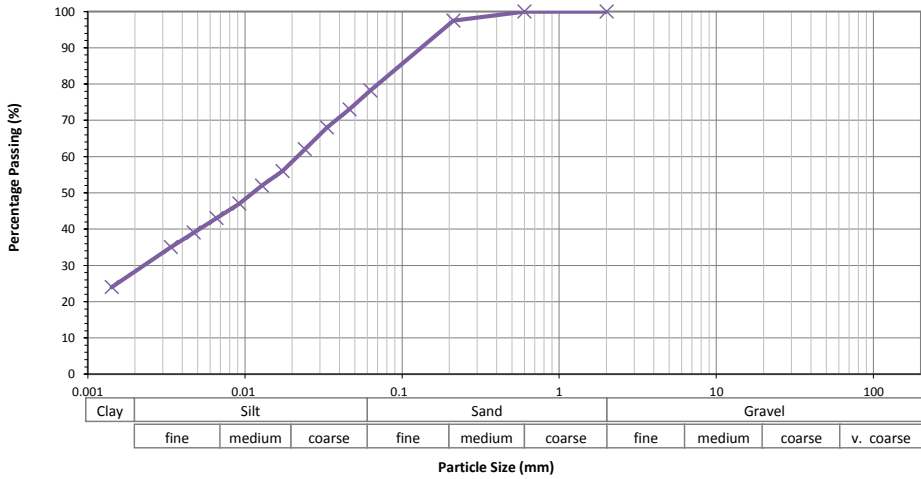
TEST RESULTS

Liquid Limit 63
Plastic Limit 25
Plasticity Index 38

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 18/01/2021

Approved Signatory Sim Tirunahari
Date 26/01/2021

 GEOTECHNICS	1 Hill Street Onehunga Auckland 1061 New Zealand p + 64 9 356 3510	Geotechnics Project Number 1100655.0000 QESTLab Workorder ID W21AK-0004 Customer Project ID 1014985.0000																																													
Determination of the Particle-Size Distribution NZS 4402:1986 Test 2.8.4 Hydrometer Method																																															
Test Details																																															
LOCATION	Description	Watercare Whenuapai-Redhills																																													
	Data	N/A																																													
SAMPLE	Geotechnics ID	S21AK000015																																													
	Reference	HA114_3.45m																																													
	Description	sandy clayey SILT, soft to firm, grey, mottled orange, high plasticity.	Sample History Natural																																												
Test Results																																															
																																															
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td colspan="2">Clay</td> <td colspan="2">Silt</td> <td colspan="3">Sand</td> <td colspan="4">Gravel</td> </tr> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td>fine</td><td>medium</td><td>coarse</td><td>fine</td><td>medium</td><td>coarse</td><td>fine</td><td>medium</td><td>coarse</td><td>v. coarse</td> </tr> </table>				Clay		Silt		Sand			Gravel																		fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	v. coarse									
Clay		Silt		Sand			Gravel																																								
		fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	v. coarse																																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">Sieve (mm)</th> <th style="width: 15%;">Total % Passing</th> <th style="width: 15%;">Equivalent Particle Diameter D (mm)</th> <th style="width: 15%;">% of Particles Finer than D</th> </tr> <tr><td>2.00</td><td>100</td><td>0.0463</td><td>73</td></tr> <tr><td>0.600</td><td>100</td><td>0.0333</td><td>68</td></tr> <tr><td>0.212</td><td>98</td><td>0.0240</td><td>62</td></tr> <tr><td>0.063</td><td>78</td><td>0.0174</td><td>56</td></tr> <tr><td></td><td></td><td>0.0128</td><td>52</td></tr> <tr><td></td><td></td><td>0.0092</td><td>47</td></tr> <tr><td></td><td></td><td>0.0066</td><td>43</td></tr> <tr><td></td><td></td><td>0.0047</td><td>39</td></tr> <tr><td></td><td></td><td>0.0034</td><td>35</td></tr> <tr><td></td><td></td><td>0.0014</td><td>24</td></tr> </table>				Sieve (mm)	Total % Passing	Equivalent Particle Diameter D (mm)	% of Particles Finer than D	2.00	100	0.0463	73	0.600	100	0.0333	68	0.212	98	0.0240	62	0.063	78	0.0174	56			0.0128	52			0.0092	47			0.0066	43			0.0047	39			0.0034	35			0.0014	24
Sieve (mm)	Total % Passing	Equivalent Particle Diameter D (mm)	% of Particles Finer than D																																												
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		0.0092	47																																												
		0.0066	43																																												
		0.0047	39																																												
		0.0034	35																																												
		0.0014	24																																												
Test Remarks																																															
Date tested 14/01/2021 • The material used for testing was Natural. Suspension pH 8 Solid Density (Assumed) = 2.65 t/m³ • This test result is IANZ accredited. Approved Signatory Sim Tirunahari Date 26/01/2021																																															



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Page 61 of 64

Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000016		
	Reference	HA115_2.6m		
	Description	SILT with some clay and minor sand, firm to stiff, light brown mixed with grey, very high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

TEST RESULTS

Liquid Limit 72
Plastic Limit 33
Plasticity Index 39

TEST REMARKS

• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 18/01/2021

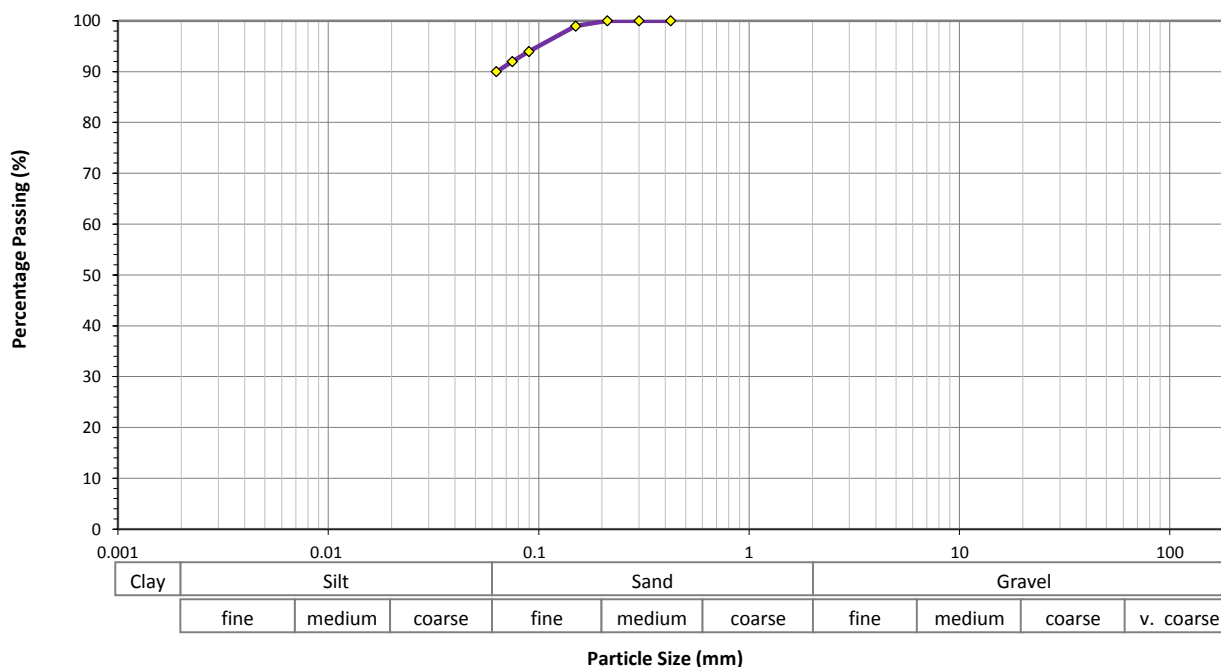
Approved Signatory Sim Tirunahari
Date 26/01/2021

Determination of the Particle Size Distribution - NZS 4402:1986 Test 2.8.1 (Wet Sieve)

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills	
	Data	N/A	
SAMPLE	Geotechnics ID	S21AK000016	
	Reference	HA115_2.6m	
	Description	SILT with some clay and minor sand, firm to stiff, light brown mixed with grey, very high plasticity.	
SPECIMEN	Reference	N/A	Depth N/A
	Description	N/A	

TEST RESULTS



Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)	Sieve Size (mm)	Percentage Passing (%)
150	-	26.5	-	4.75	-	0.300	100
100	-	19.0	-	3.35	-	0.212	100
75.0	-	16.0	-	2.00	-	0.150	99
63.0	-	13.2	-	1.18	-	0.090	94
53.0	-	9.50	-	0.600	-	0.075	92
37.5	-	6.70	-	0.425	100	0.063	90

TEST REMARKS

• The material used for testing was natural, whole soil. • The percentage passing the <0.063mm was obtained by difference. • This test result is IANZ accredited. • Date tested 18/12/2020

Approved Signatory Sim Tirunahari

Date 26/01/2021



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Geotechnics Project Number 1100655.0000
QESTLab Work Order ID W21AK-0004
Customer Project ID 1014985.0000

Determination of Liquid & Plastic Limit, Plasticity Index - NZS 4402: 1986 Tests 2.2 (single point), 2.3 & 2.4

TEST DETAILS

LOCATION	Description	Watercare Whenuapai-Redhills		
	Data	N/A		
SAMPLE	Geotechnics ID	S21AK000017		
	Reference	HA119_1.5m		
	Description	clayey SILT with minor sand, firm, light greyish brown, high plasticity.		
SPECIMEN	Reference	N/A	Depth	N/A
	Description	N/A		

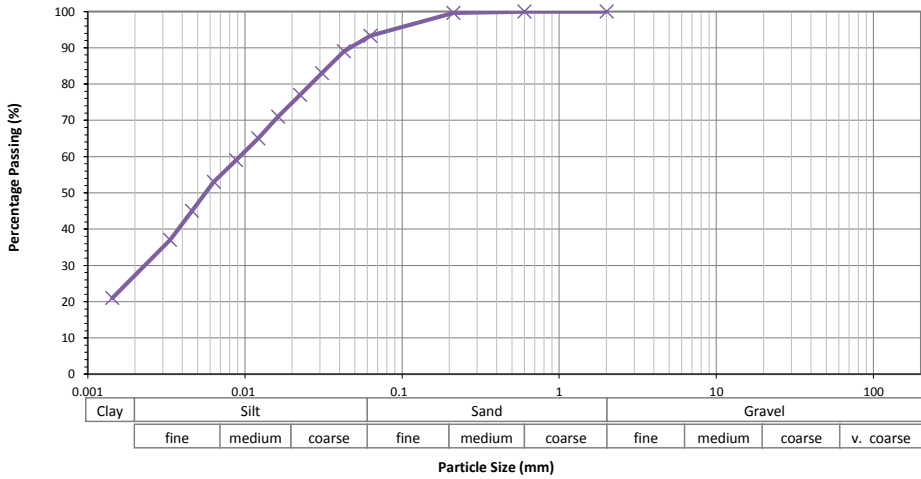
TEST RESULTS

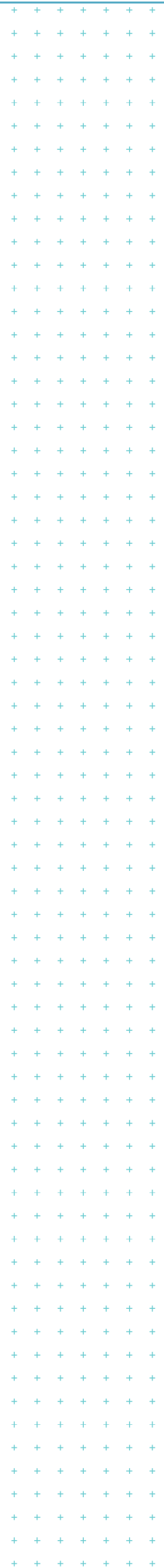
Liquid Limit 65
Plastic Limit 23
Plasticity Index 42

TEST REMARKS

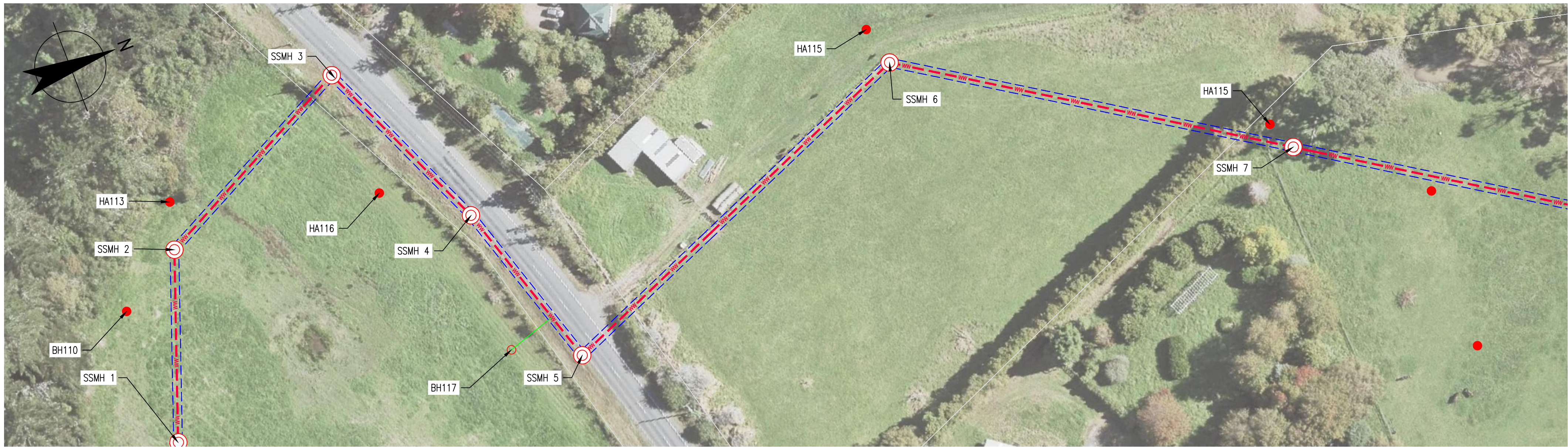
• The material used for testing was natural, fraction passing a 425um sieve. • The sample description follows the "NZGS Guidelines for field description of soil and rock". • This test result is IANZ accredited. • Date tested 18/01/2021

Approved Signatory Sim Tirunahari
Date 26/01/2021

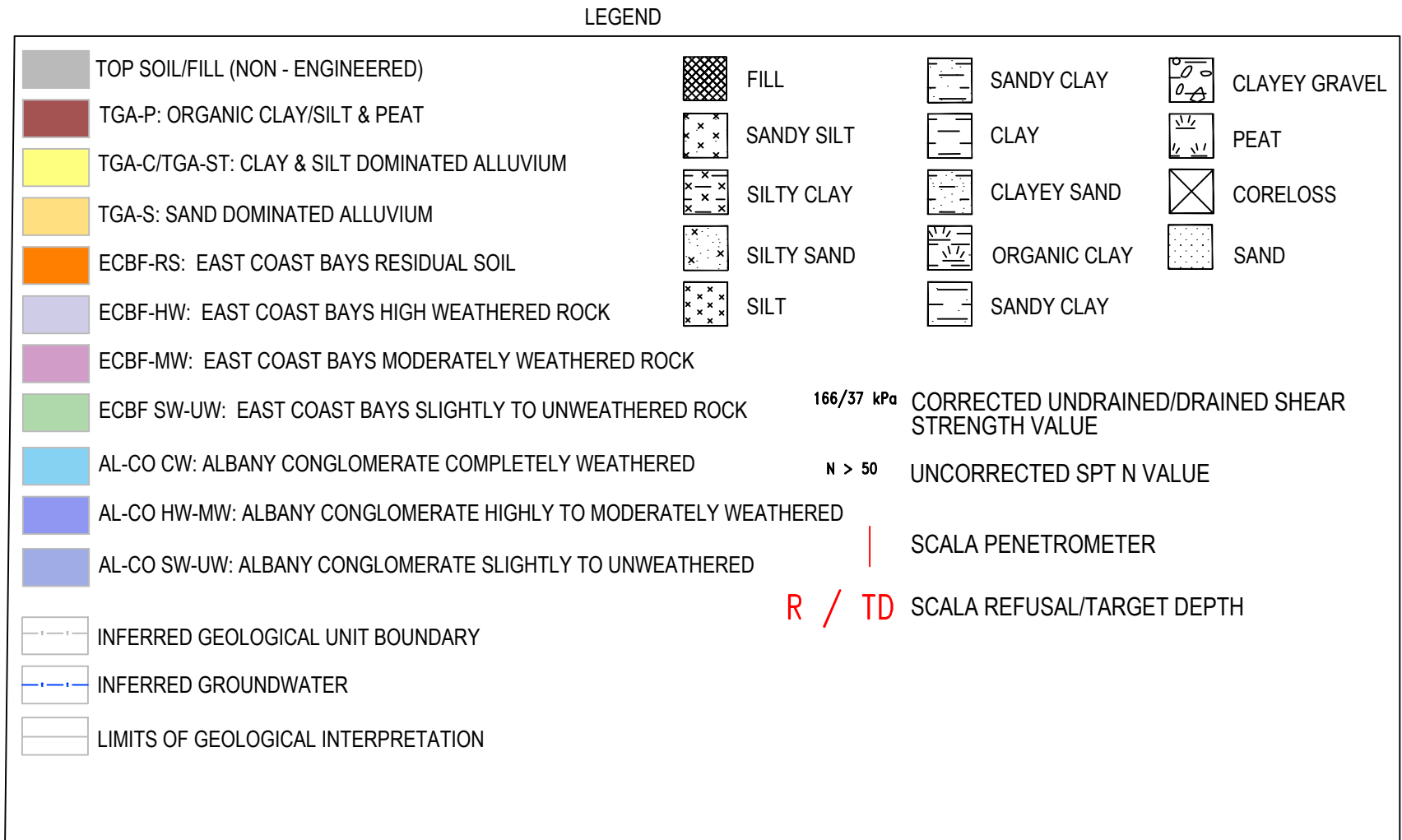
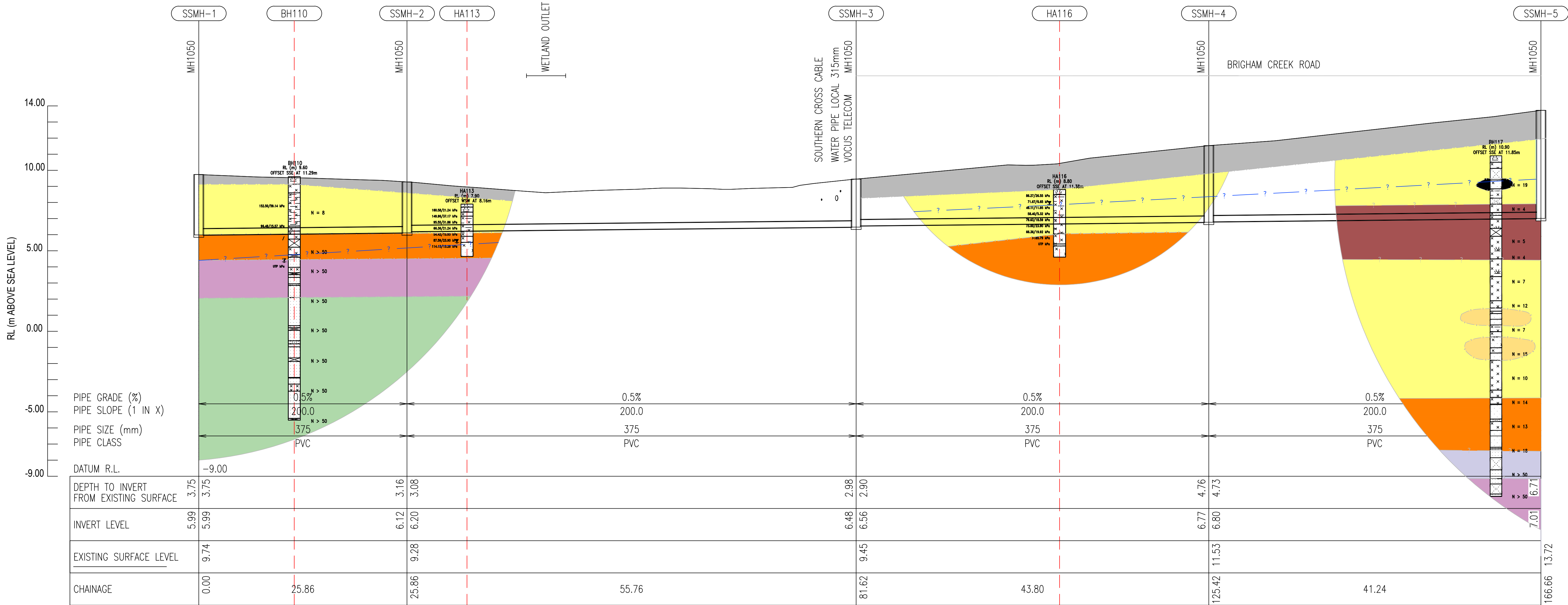
 GEOTECHNICS	1 Hill Street Onehunga Auckland 1061 New Zealand p + 64 9 356 3510	Geotechnics Project Number 1100655.0000 QESTLab Workorder ID W21AK-0004 Customer Project ID 1014985.0000																																													
Determination of the Particle-Size Distribution NZS 4402:1986 Test 2.8.4 Hydrometer Method																																															
Test Details																																															
LOCATION	Description	Watercare Whenuapai-Redhills																																													
	Data	N/A																																													
SAMPLE	Geotechnics ID	S21AK000017																																													
	Reference	HA119_1.5m																																													
	Description	clayey SILT with minor sand, firm, light greyish brown, high plasticity.	Sample History Natural																																												
Test Results																																															
																																															
<table border="1" style="width: 100%; border-collapse: collapse; font-size: small;"> <tr> <td style="width: 10%;">Clay</td> <td style="width: 20%;">Silt</td> <td style="width: 20%;">Sand</td> <td style="width: 50%;">Gravel</td> </tr> <tr> <td></td> <td>fine medium coarse</td> <td>fine medium coarse</td> <td>fine medium coarse v. coarse</td> </tr> </table>				Clay	Silt	Sand	Gravel		fine medium coarse	fine medium coarse	fine medium coarse v. coarse																																				
Clay	Silt	Sand	Gravel																																												
	fine medium coarse	fine medium coarse	fine medium coarse v. coarse																																												
<table border="1" style="width: 100%; border-collapse: collapse; font-size: small;"> <tr> <th style="width: 15%;">Sieve (mm)</th> <th style="width: 15%;">Total % Passing</th> <th style="width: 15%;">Equivalent Particle Diameter D (mm)</th> <th style="width: 15%;">% of Particles Finer than D</th> </tr> <tr><td>2.00</td><td>100</td><td>0.0426</td><td>89</td></tr> <tr><td>0.600</td><td>100</td><td>0.0309</td><td>83</td></tr> <tr><td>0.212</td><td>100</td><td>0.0224</td><td>77</td></tr> <tr><td>0.063</td><td>93</td><td>0.0162</td><td>71</td></tr> <tr><td></td><td></td><td>0.0121</td><td>65</td></tr> <tr><td></td><td></td><td>0.0088</td><td>59</td></tr> <tr><td></td><td></td><td>0.0063</td><td>53</td></tr> <tr><td></td><td></td><td>0.0046</td><td>45</td></tr> <tr><td></td><td></td><td>0.0033</td><td>37</td></tr> <tr><td></td><td></td><td>0.0014</td><td>21</td></tr> </table>				Sieve (mm)	Total % Passing	Equivalent Particle Diameter D (mm)	% of Particles Finer than D	2.00	100	0.0426	89	0.600	100	0.0309	83	0.212	100	0.0224	77	0.063	93	0.0162	71			0.0121	65			0.0088	59			0.0063	53			0.0046	45			0.0033	37			0.0014	21
Sieve (mm)	Total % Passing	Equivalent Particle Diameter D (mm)	% of Particles Finer than D																																												
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		0.0121	65																																												
		0.0088	59																																												
		0.0063	53																																												
		0.0046	45																																												
		0.0033	37																																												
		0.0014	21																																												
Test Remarks																																															
Date tested 14.1.21 • The material used for testing was Natural. Suspension pH 8 Solid Density (Assumed) = 2.65 t/m³ • This test result is IANZ accredited. Approved Signatory Sim Tirunahari Date 26/01/2021																																															



Appendix D – Geological long sections

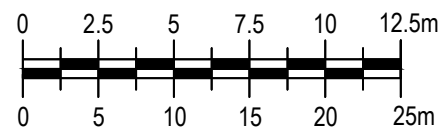


PLAN
SCALE 1:250



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Drafting Check			
Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



File Name: \\ghdnet\ghd\NZ\Auckland\Projects\5112508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C101_C106 - PB EDIT.dwg



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Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E akimall@ghd.com W www.ghd.com



Project No.
12508391

Client WATERCARE

Project WHENUAPAI REDHILLS

Status

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 1 OF 6

Status
Code

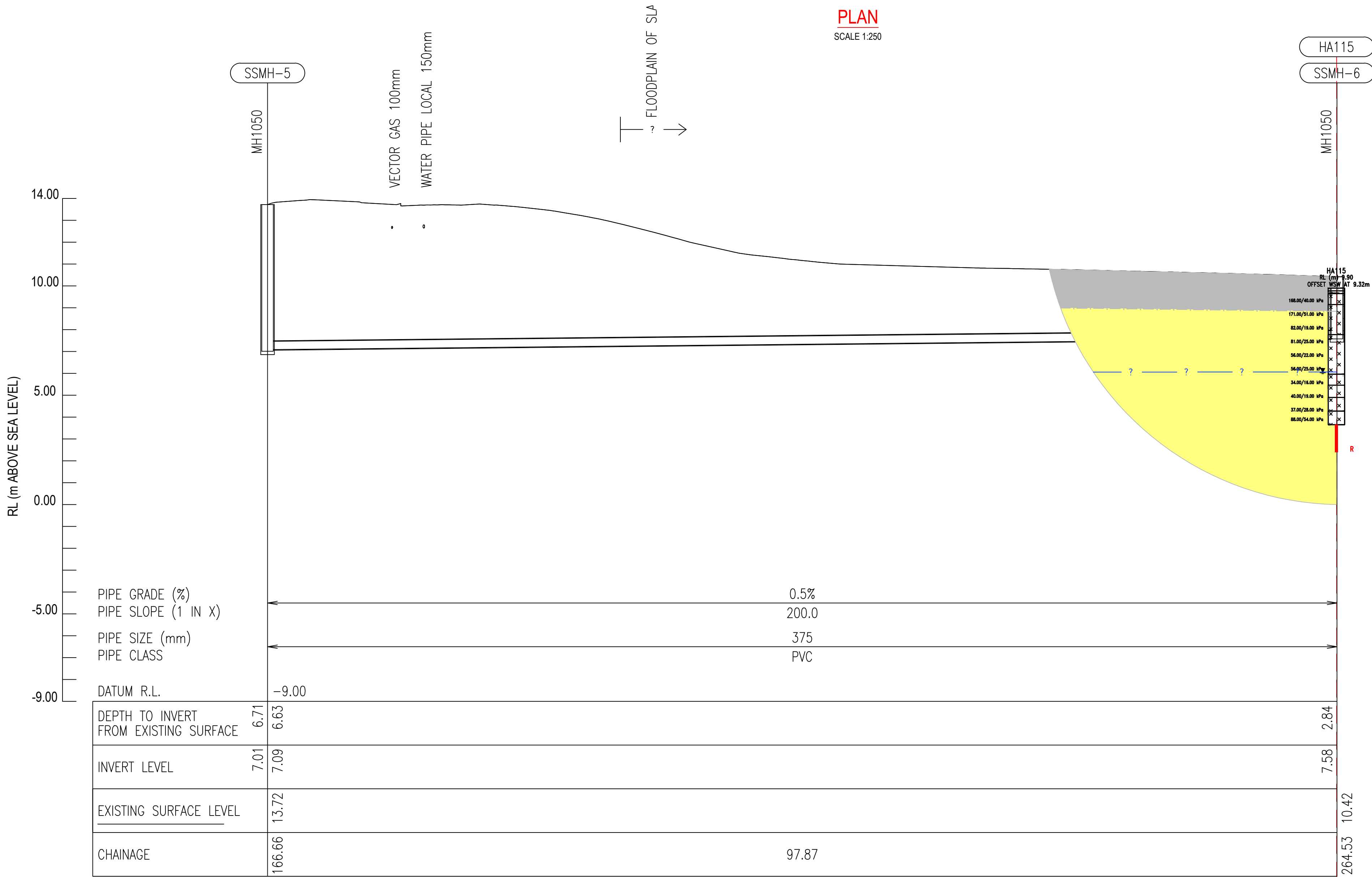
Drawing No.
12508391-C101

Size
A1

Rev
A



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	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED				SCALA PENETROMETER		
				R / TD	SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						



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Designer	Design Check			

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AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m
0 5 10 15 20 25m



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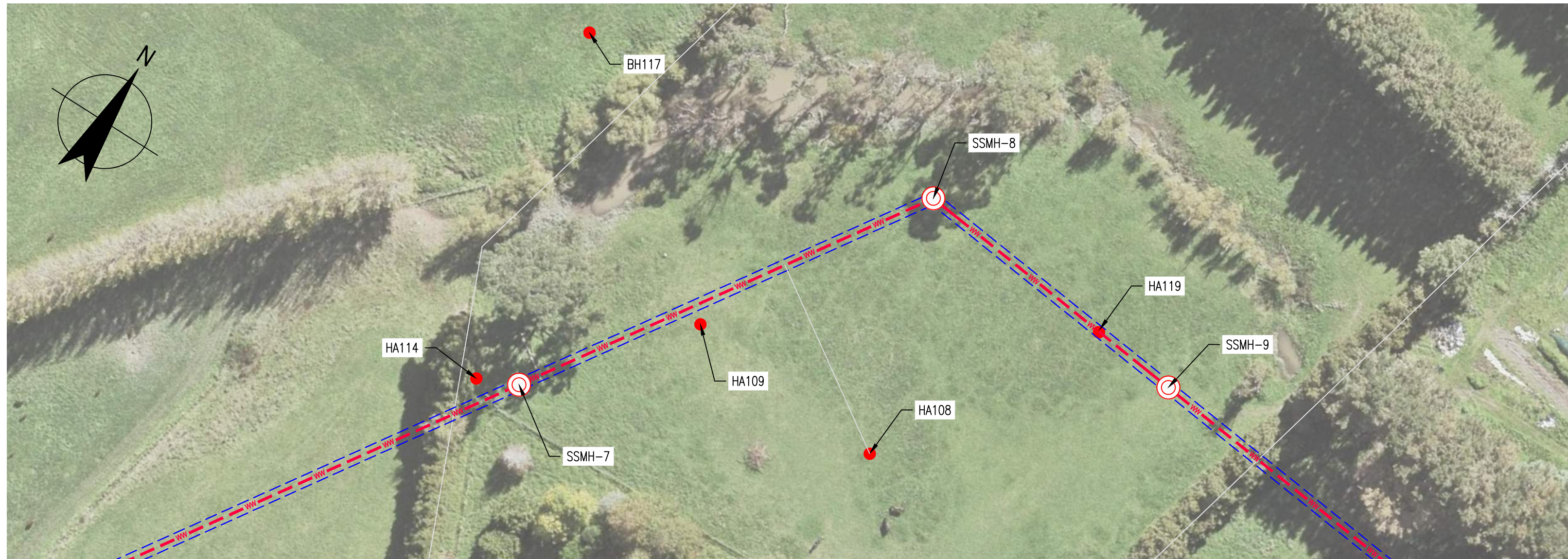
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Project No.
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Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	Status Code

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 2 OF 6	Size A1
Drawing No.	12508391-C102	Rev A



PLAN
NOT TO SCALE

LEGEND

TOP SOIL/FILL (NON - ENGINEERED)

TGA-P: ORGANIC CLAY/SILT & PEAT

TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM

TGA-S: SAND DOMINATED ALLUVIUM

ECBF-RS: EAST COAST BAYS RESIDUAL SOIL

ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK

ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK

ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK

AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED

AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED

AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED

FILL

SANDY SILT

SILTY CLAY

SILTY SAND

SILT

SANDY CLAY

CLAY

CLAYEY SAND

ORGANIC CLAY

SANDY CLAY

CLAYEY GRAVEL

PEAT

CORELOSS

SAND

166/37 kPa

N > 50

SCALA PENETROMETER

R / TD

CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE

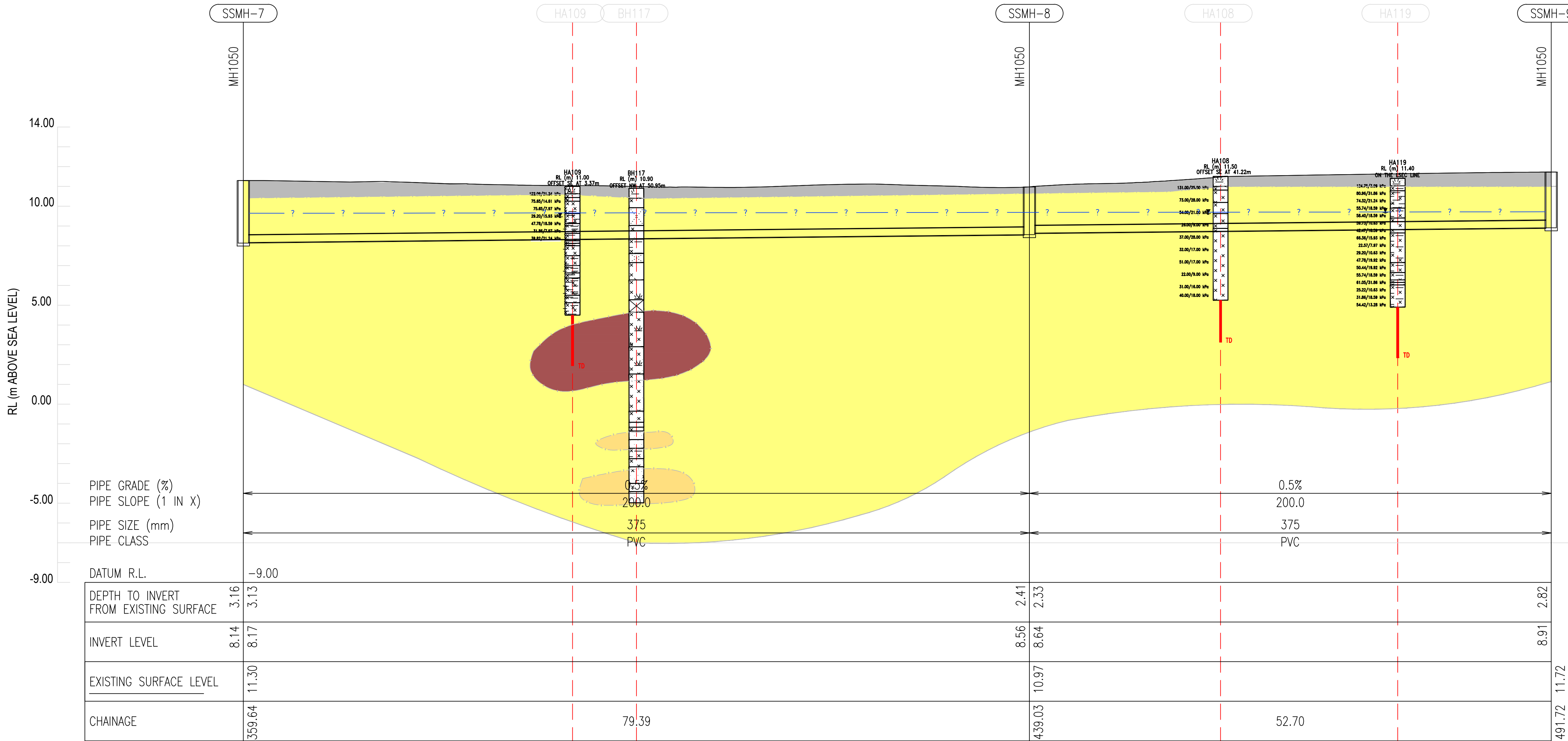
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SCALA REFUSAL/TARGET DEPTH

INFERRED GEOLOGICAL UNIT BOUNDARY

INFERRED GROUNDWATER

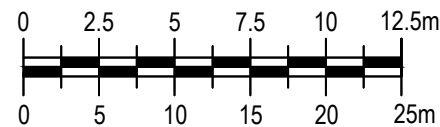
LIMITS OF GEOLOGICAL INTERPRETATION



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Designer	Design Check			

Plot Date: 23 March 2021 - 3:01 PM
Plotted by: Paige Boyed

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HORIZONTAL 1:500
AT ORIGINAL SIZE



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Client
WATER CARE

Project
WHENUAPAI REDHILLS

Status

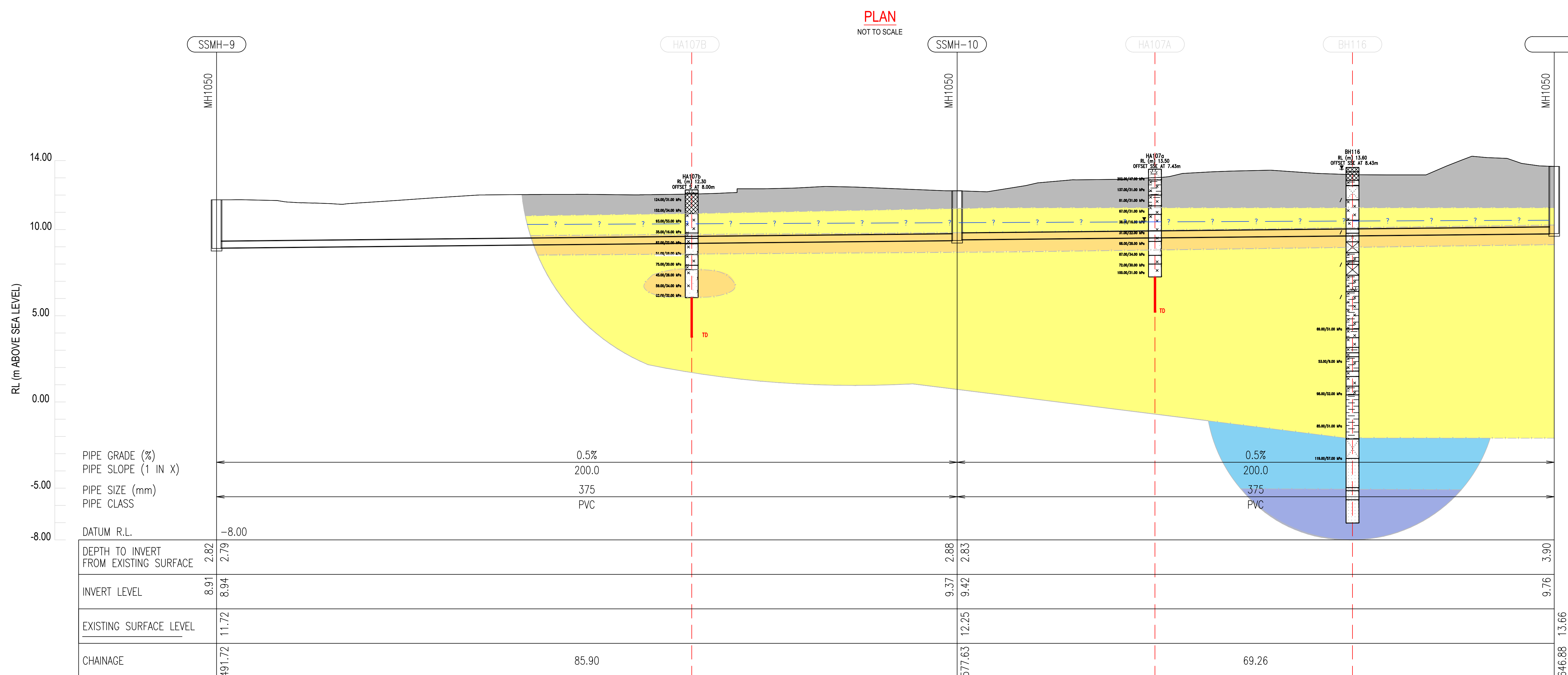
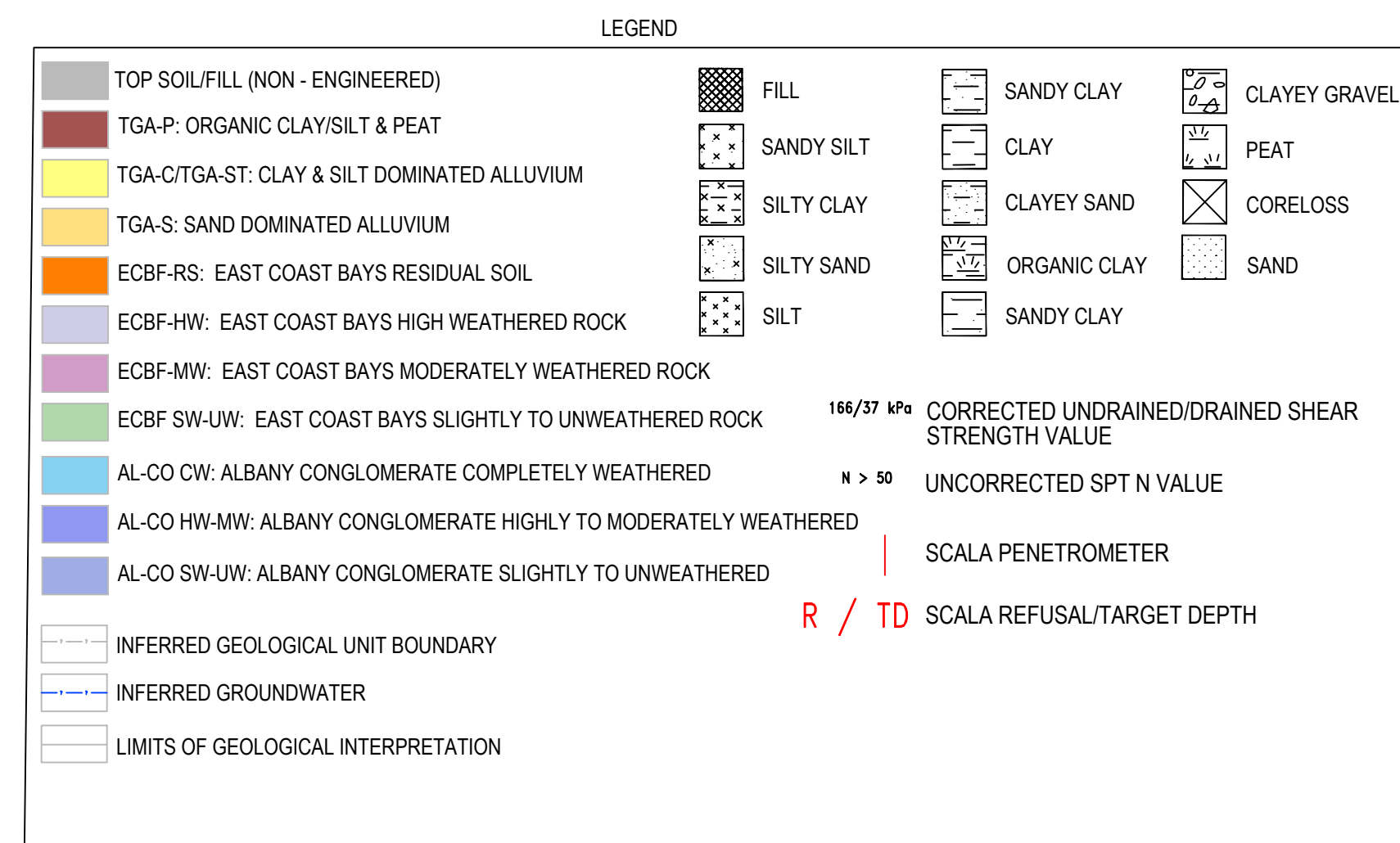
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GEOTECHNICAL LONG SECTION
SHEET 4 OF 6

Status
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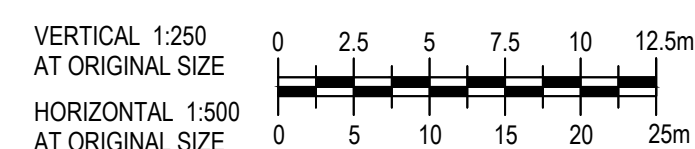
Drawing No.
12508391-C104

Size
A1

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A



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12508391

Project WHENUAPAI REDHILLS

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Status

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 5 OF 6

Drawing No.
12508391-C105

Size
A1

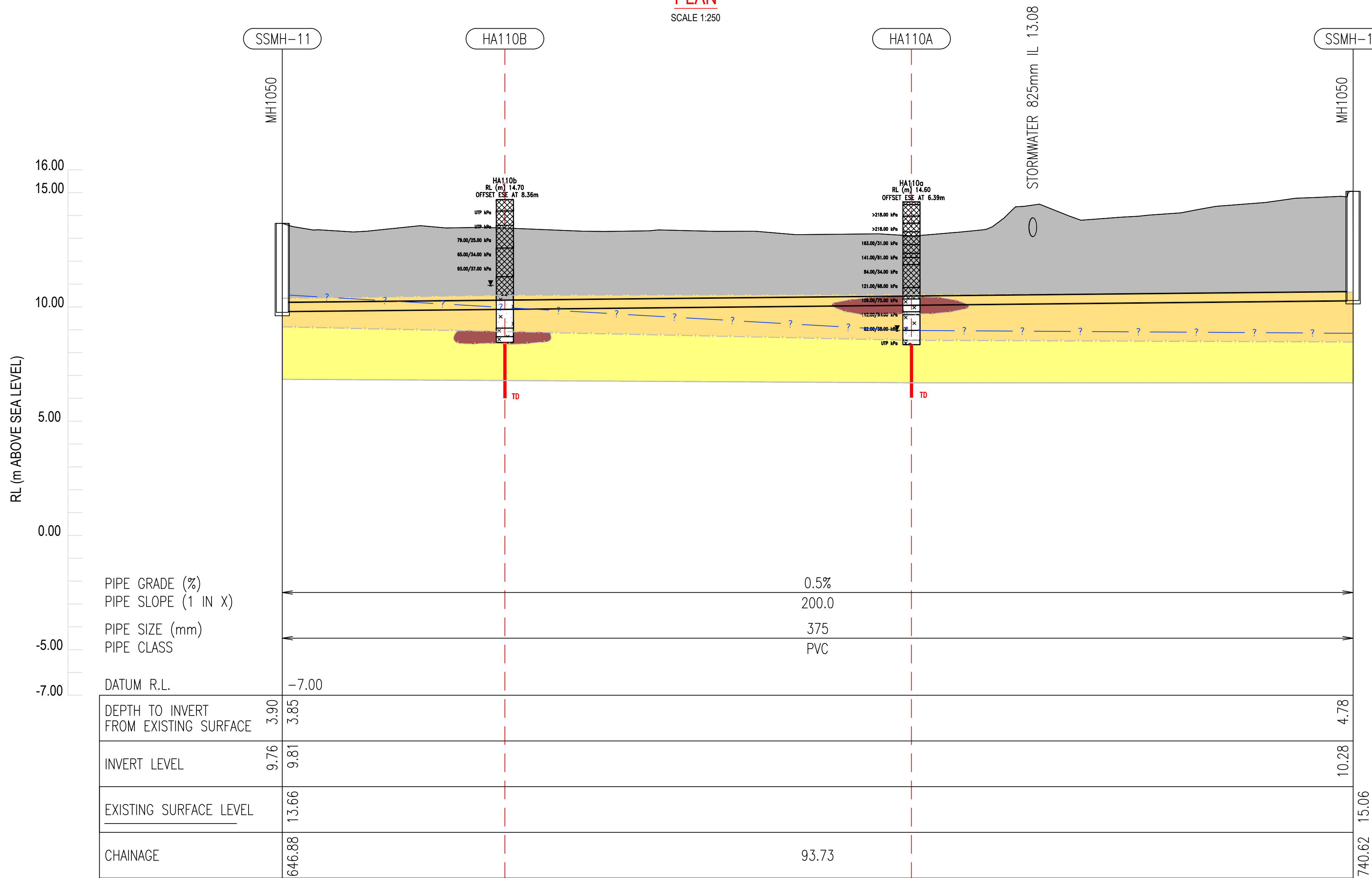
Rev



LEGEND							
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	TGA-P: ORGANIC CLAYS/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
					SCALA PENETROMETER		
				R / TD	SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

PLAN

SCALE 1:250



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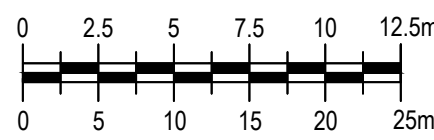
Author

Designer

Drafting Check

Design Check

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



Plot Date: 23 March 2021 - 3:02 PM Plotted by: Paige Boyed File Name: \\ghdnet\ghd\NZ\Auckland\Projects\5112508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C101_C106 - PB EDIT.dwg

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Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
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Client WATERCARE

Project WHENUAPAI REDHILLS

Status

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 6 OF 6

Status

Code

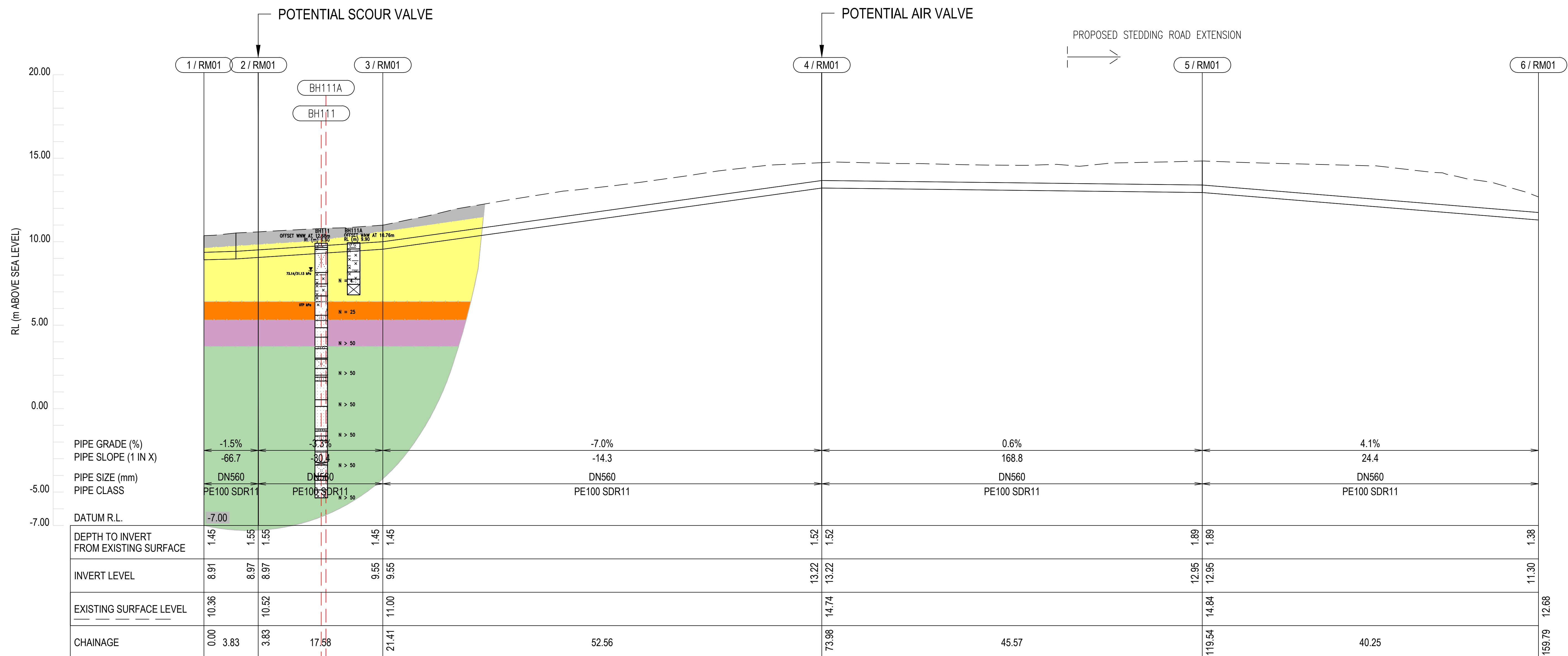
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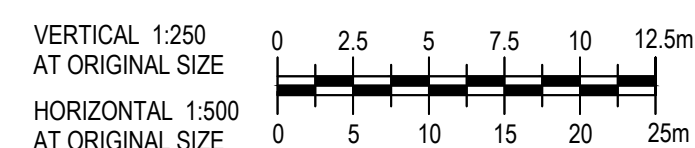
Rev
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LEGEND			
	TOP SOIL/FILL (NON - ENGINEERED)		FILL
	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK		
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK		
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK		
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED		
	INFERRED GEOLOGICAL UNIT BOUNDARY		
	INFERRED GROUNDWATER		
	LIMITS OF GEOLOGICAL INTERPRETATION		
			SANDY CLAY
			CLAY
			CLAYEY SAND
			ORGANIC CLAY
			SANDY CLAY
			CLAYEY GRAVEL
			PEAT
			CORELOSS
			SAND
			165/37 kPa CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
			N > 50 UNCORRECTED SPT N VALUE
			SCALA PENETROMETER
			R / TD SCALA REFUSAL/TARGET DEPTH



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Project **WHENUAPAI REDHILLS**

	Status
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Status
Code

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 1 OF 14

Drawing No.
12508391-C201

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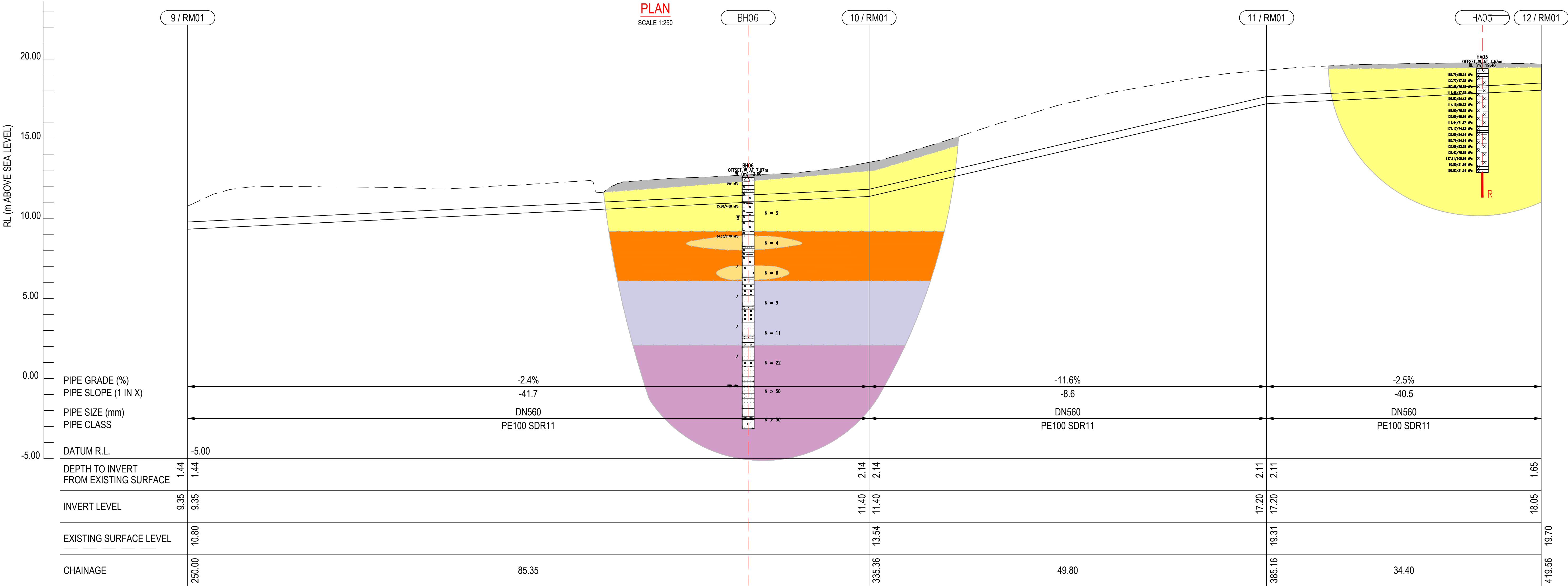
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Plot Date: 23 March 2021 - 1:28 PM

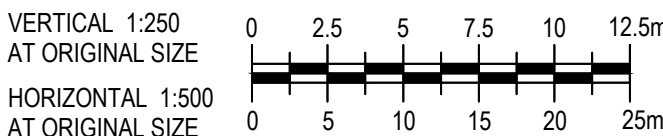
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LEGEND					
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TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY	 PEAT
TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND	 CORELOSS
TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY	 SAND
ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY	
ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK					
ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK					
ECBF-SW-LW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK					
AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED					
AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED					
AL-CO SW-LW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED					
			100/57 kPa		
			CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
			N > 50		
			UNCORRECTED SPT N VALUE		
			SCALA PENETROMETER		
			R / TD		
			SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY				
	INFERRED GROUNDWATER				
	LIMITS OF GEOLOGICAL INTERPRETATION				



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Project No.
12508391

Client WATER CARE

Project WHENUAPAI REDHILLS

Status

Status Code

Drawing Title

GEOTECHNICAL LONG SECTION
SHEET 3 OF 14

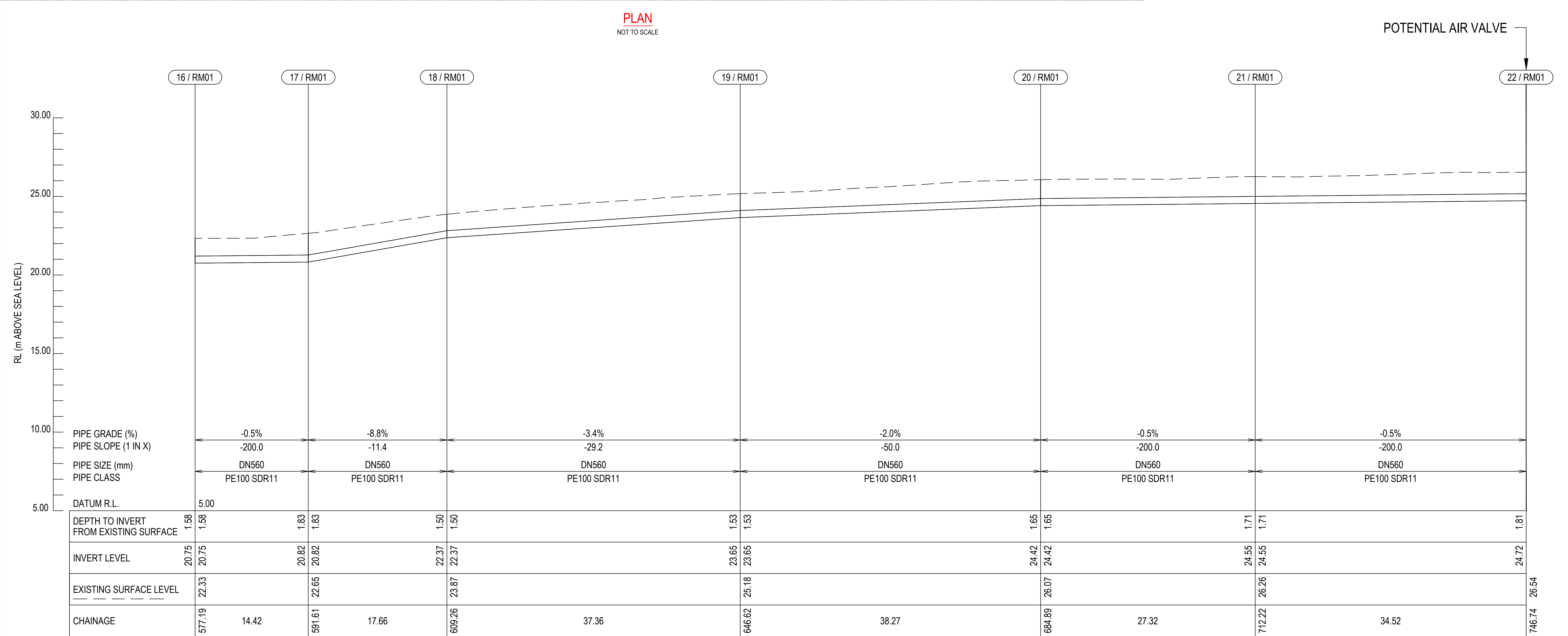
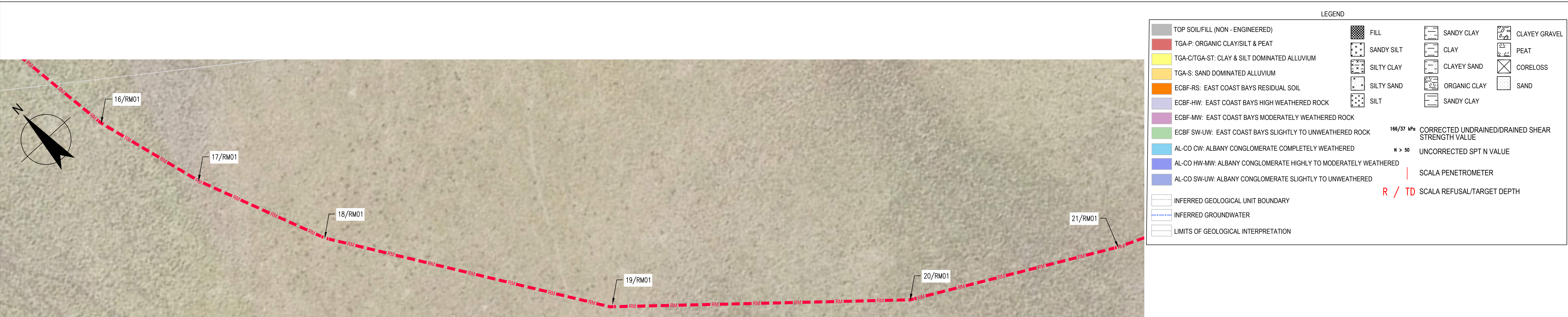
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Size

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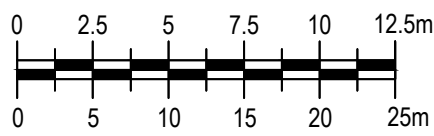
Rev

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Designer	Designing			

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AT ORIGINAL SIZE



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Client
WATER CARE

Project
WHENUAPAI REDHILLS

Status

Status

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 5 OF 14

Drawing No.
12508391-C205

Size

A1

Rev

A

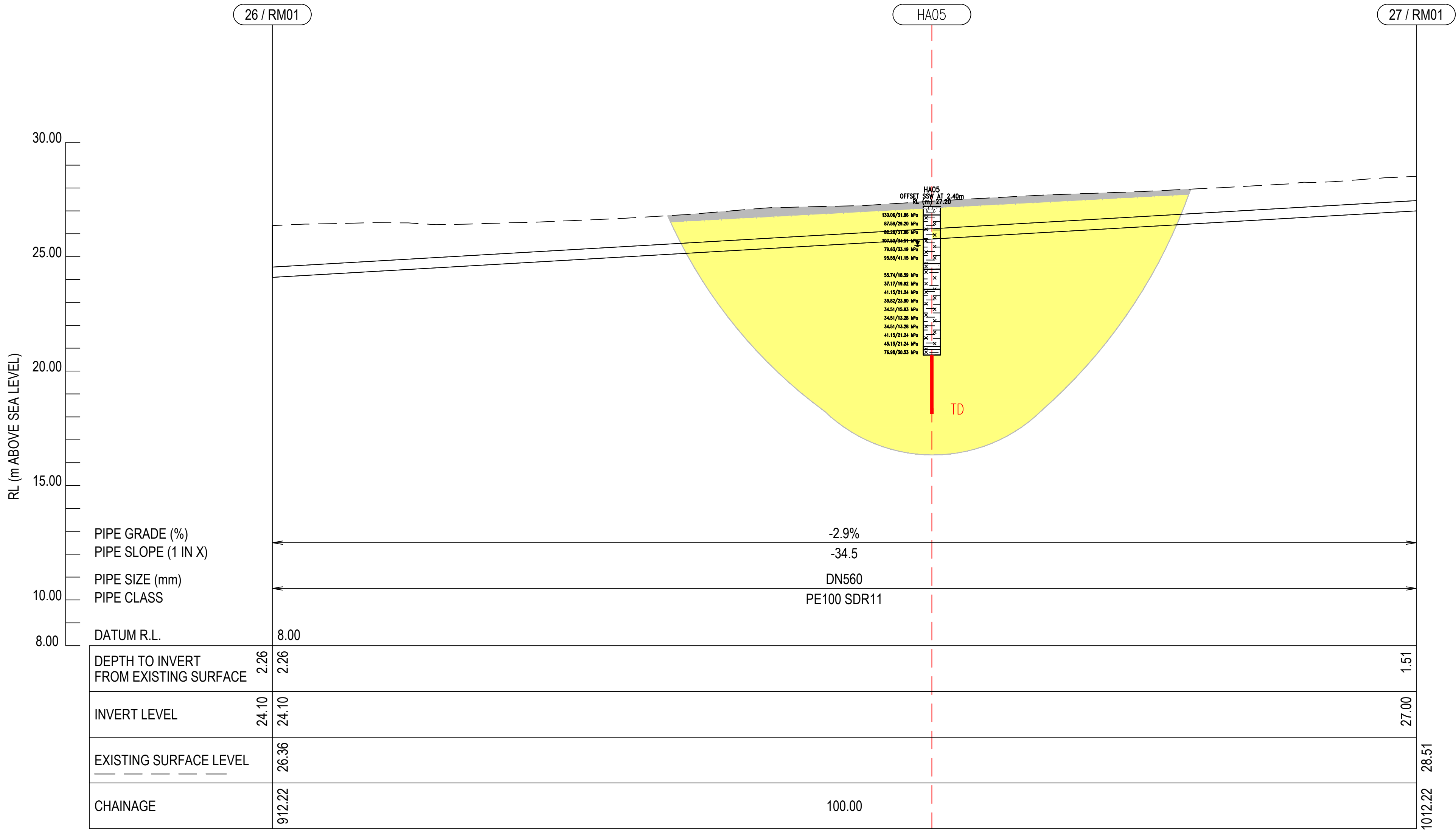


PLAN

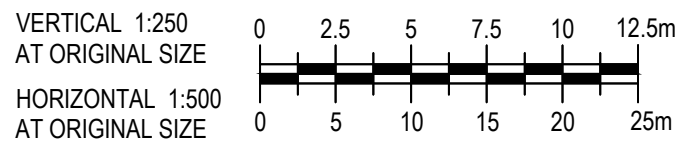
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LEGEND			
TOP SOIL/FILL (NON - ENGINEERED)	FILL	SANDY CLAY	CLAYEY GRAVEL
TGA-P: ORGANIC CLAY/SILT & PEAT	SANDY SILT	CLAY	PEAT
TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM	SILTY CLAY	CLAYEY SAND	CORELOSS
TGA-S: SAND DOMINATED ALLUVIUM	SILTY SAND	ORGANIC CLAY	SAND
ECBF-RS: EAST COAST BAYS RESIDUAL SOIL	SILT	SANDY CLAY	
ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK			
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ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			
AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			
AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			
AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED			
INFERRED GEOLOGICAL UNIT BOUNDARY			
INFERRED GROUNDWATER			
LIMITS OF GEOLOGICAL INTERPRETATION			

166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
N > 50	UNCORRECTED SPT N VALUE
R / TD	SCALA PENETROMETER
R / TD	SCALA REFUSAL/TARGET DEPTH



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Designer	Drafting Check	Design Check	



Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E akmail@ghd.com W www.ghd.com



Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 7 OF 14
Drawing No.	12508391-C207

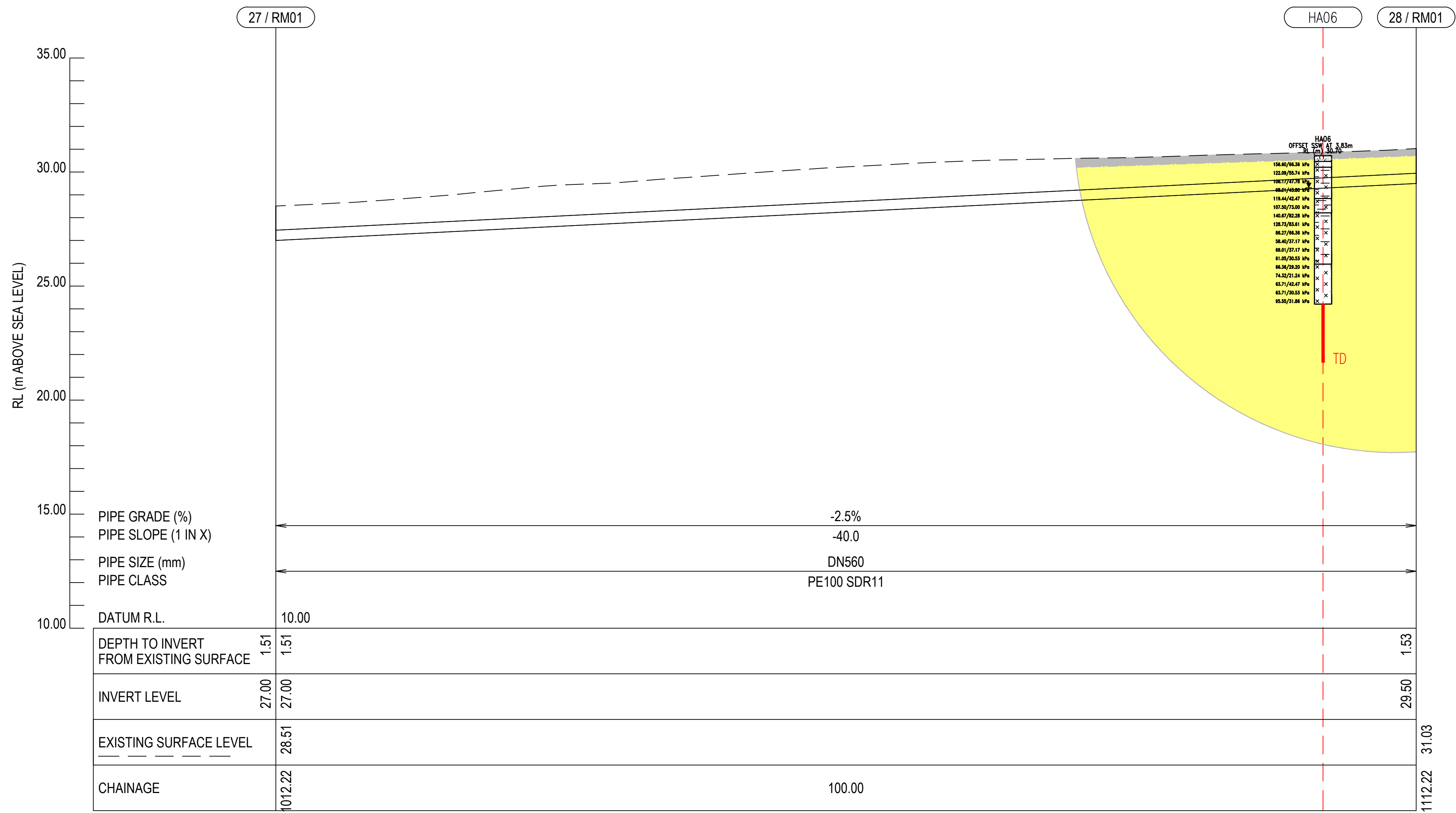
Size	A1
Rev	A



PLAN
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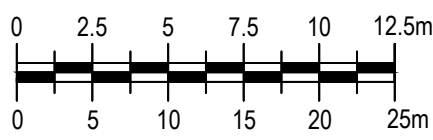
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	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED						
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED						
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

	166/57 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
	N > 50	UNCORRECTED SPT N VALUE
		SCALA PENETROMETER
	R / TD	SCALA REFUSAL/TARGET DEPTH



Rev	Description	Checked	Approved	Date
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Author	Drafting Check			
Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E akimail@ghd.com W www.ghd.com



Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 8 OF 14
Drawing No.	12508391-C208

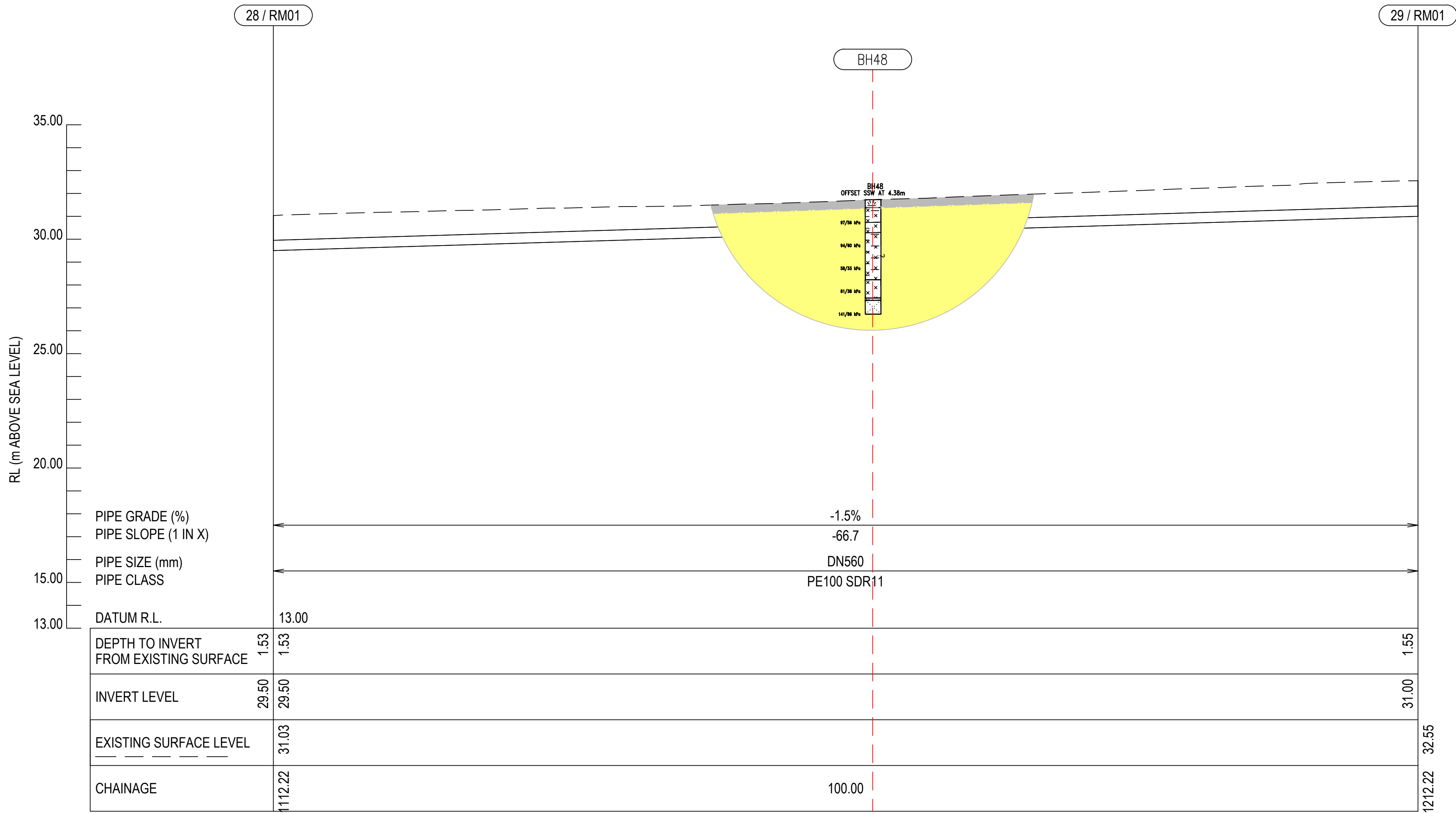
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Rev	A



PLAN
SCALE 1:250

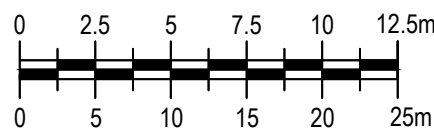
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	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK		SANDY CLAY
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK		CLAY
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK		CLAYEY SAND
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED		ORGANIC CLAY
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED		SAND
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED		CLAYEY GRAVEL
	INFERRED GEOLOGICAL UNIT BOUNDARY		PEAT
	INFERRED GROUNDWATER		CORELOSS
	LIMITS OF GEOLOGICAL INTERPRETATION		

166/27 kPa CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
N > 50 UNCORRECTED SPT N VALUE
SCALA PENETROMETER
R / TD SCALA REFUSAL/TARGET DEPTH



Rev	Description	Checked	Approved	Date
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Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E aklmail@ghd.com W www.ghd.com

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Project No.
12508391

Client
WATER CARE
Project
WHENUAPAI REDHILLS

Status

Drawing
Title
GEOTECHNICAL LONG SECTION
SHEET 9 OF 14

Drawing No.
12508391-C209

Size
A1

Rev
A

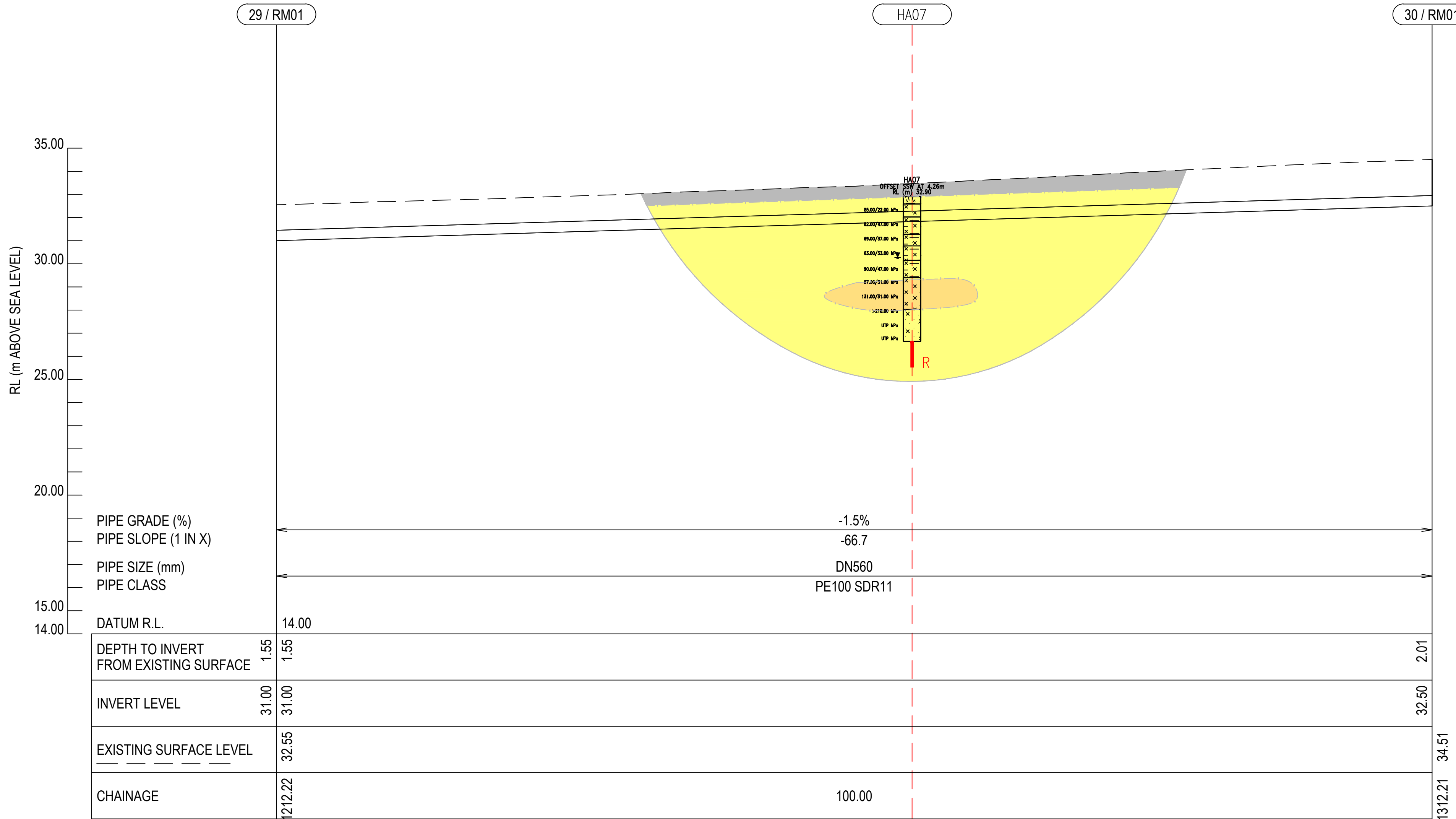


PLAN

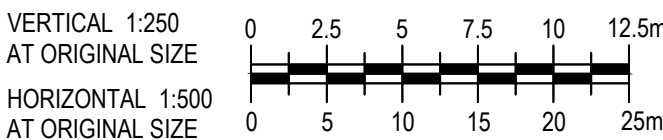
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	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED						
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED						
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

	166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
	N > 50	UNCORRECTED SPT N VALUE
		SCALA PENETROMETER
R / TD		SCALA REFUSAL/TARGET DEPTH



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Drafting Check			
Designer	Design Check			



GHD
Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E akimail@ghd.com W www.ghd.com



Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title
**GEOTECHNICAL LONG SECTION
SHEET 10 OF 14**

Drawing No.
12508391-C210

Size
A1
Rev
A



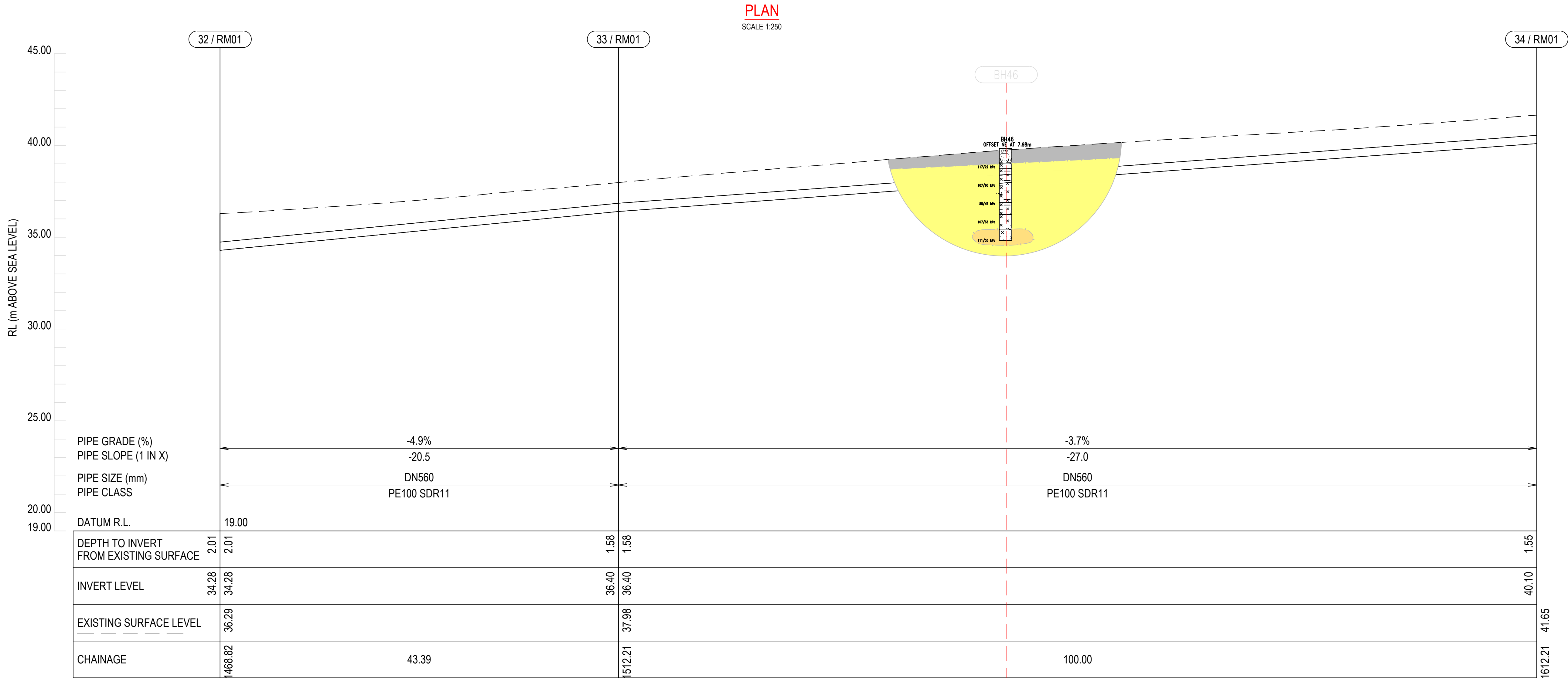
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TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM	SILTY CLAY	CLAYEY SAND	CORELOSS
TGA-S: SAND DOMINATED ALLUVIUM	SILTY SAND	ORGANIC CLAY	SAND
ECBF-RS: EAST COAST BAYS RESIDUAL SOIL	SILT	SANDY CLAY	
ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK			
ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK			
ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			
AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			
AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			
AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED			
INFERRED GEOLOGICAL UNIT BOUNDARY			
INFERRED GROUNDWATER			
LIMITS OF GEOLOGICAL INTERPRETATION			

166/37 kPa CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE

N > 50 UNCORRECTED SPT N VALUE

SCALA PENETROMETER

R / TD SCALA REFUSAL/TARGET DEPTH



Author	Drafting Check
Designer	Design Check

Plot Date: 23 March 2021 - 3:15 PM

Plotted by: Paige Boyed

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE

GHD

Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 10111 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E akimail@ghd.com W www.ghd.com



Project No.

Client WATER CARE

Project WHENUAPAI REDHILLS

Status

Status Code

Drawing Title

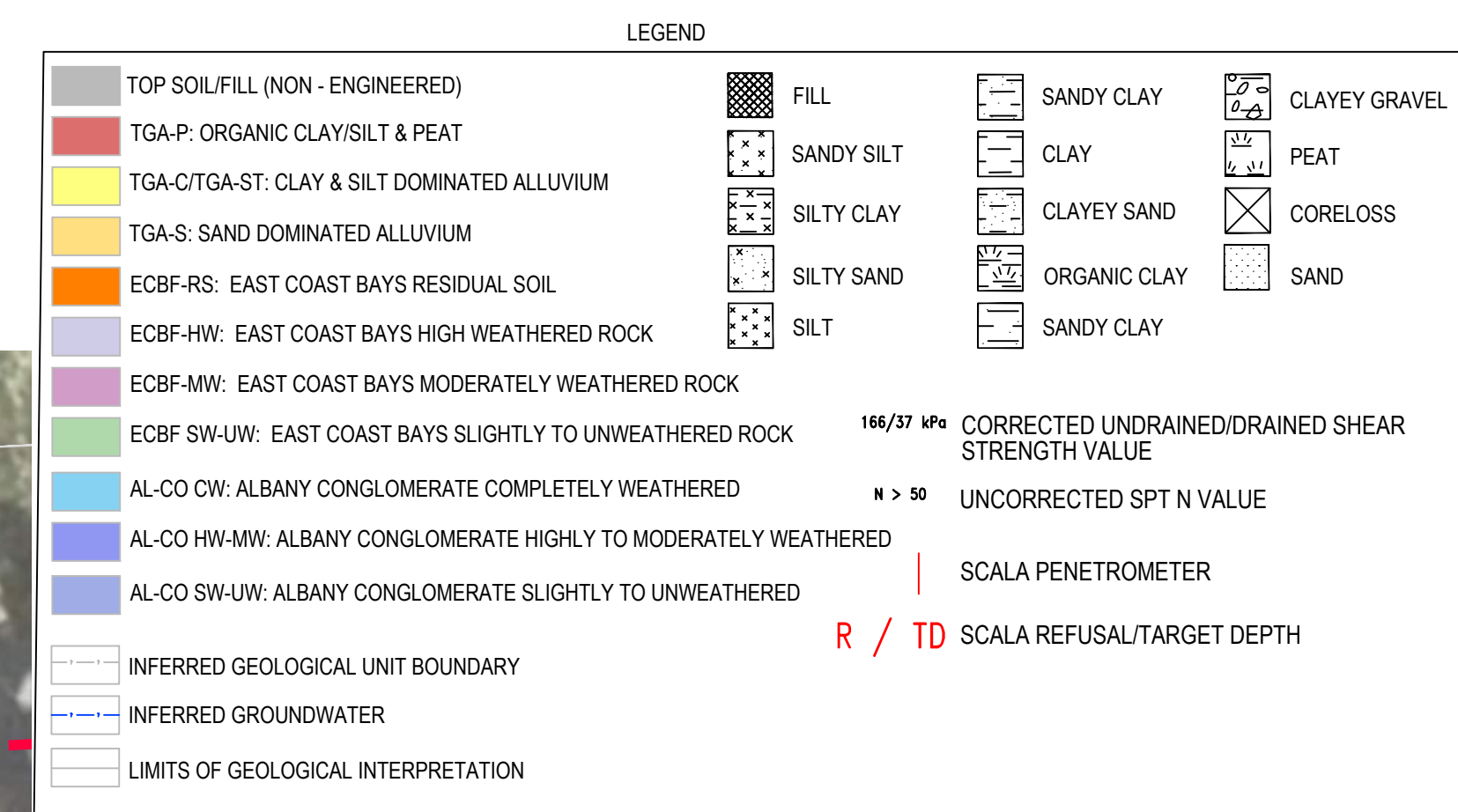
GEOTECHNICAL LONG SECTION
SHEET 12 OF 14

Drawing No.
12508391-C212

Size
A1

Rev
A

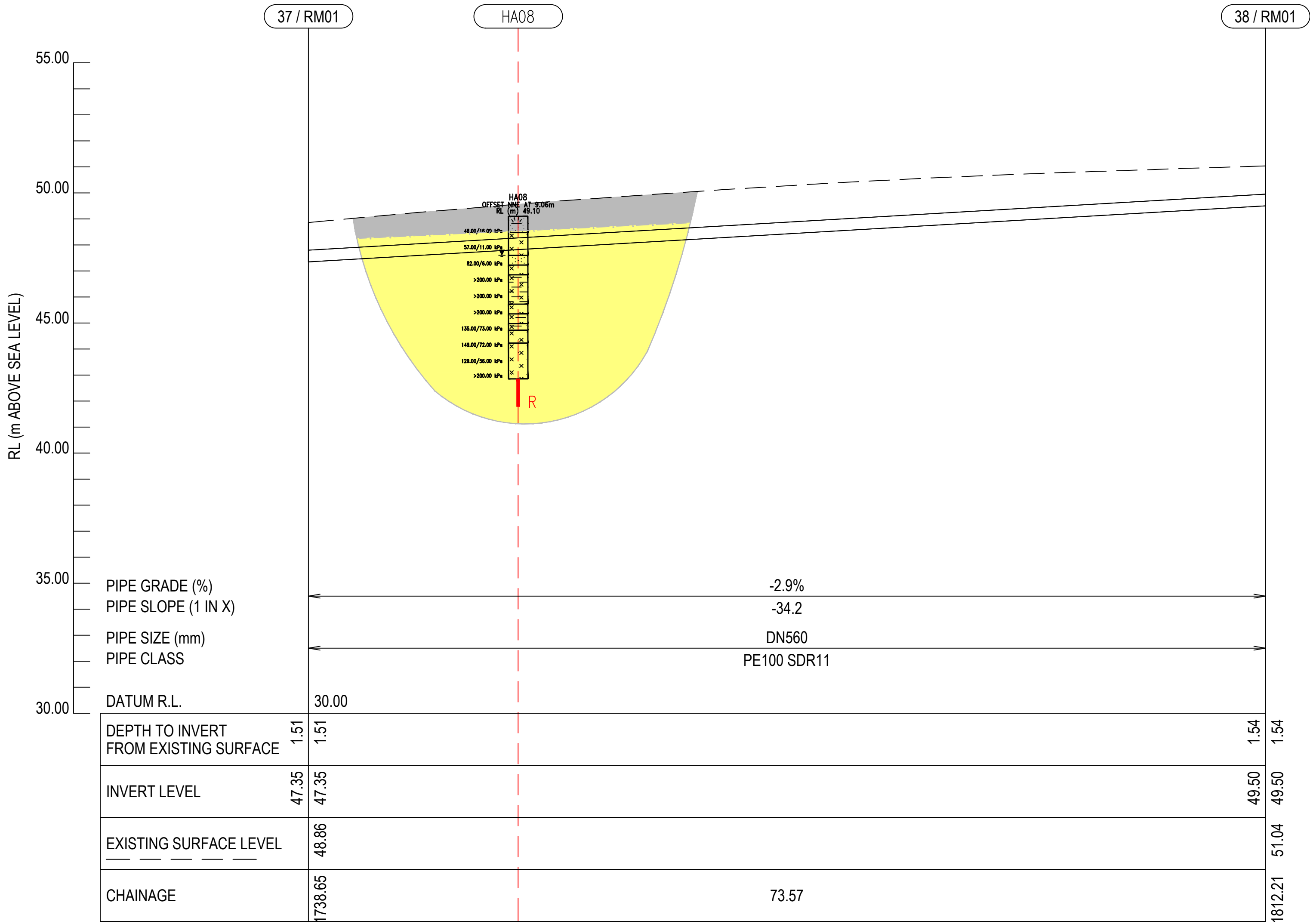
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PLAN

SCALE 1:250



LEGEND							
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	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED						
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED						
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

166/37 kPa

N > 50

SCALA PENETROMETER

R / TD

CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE

UNCORRECTED SPT N VALUE

A FOR INTERNAL GHD REVIEW				15.03.2021
Rev	Description	Checked	Approved	Date
Author	Drafting Check			
Designer	Design Check			

Plot Date: 23 March 2021 - 1:48 PM Plotted by: Paige Boyed

File Name: N:\NZ\Auckland\Projects\51\12508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C214 pb EDIT.dwg

GHD
Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 10111 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E aklmail@ghd.com W www.ghd.com

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Project No.
12508391

Client	WATER CARE	
Project	WHENUAPAI REDHILLS	
Status		Status Code

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 14 OF 14	
Drawing No.	12508391-C214	

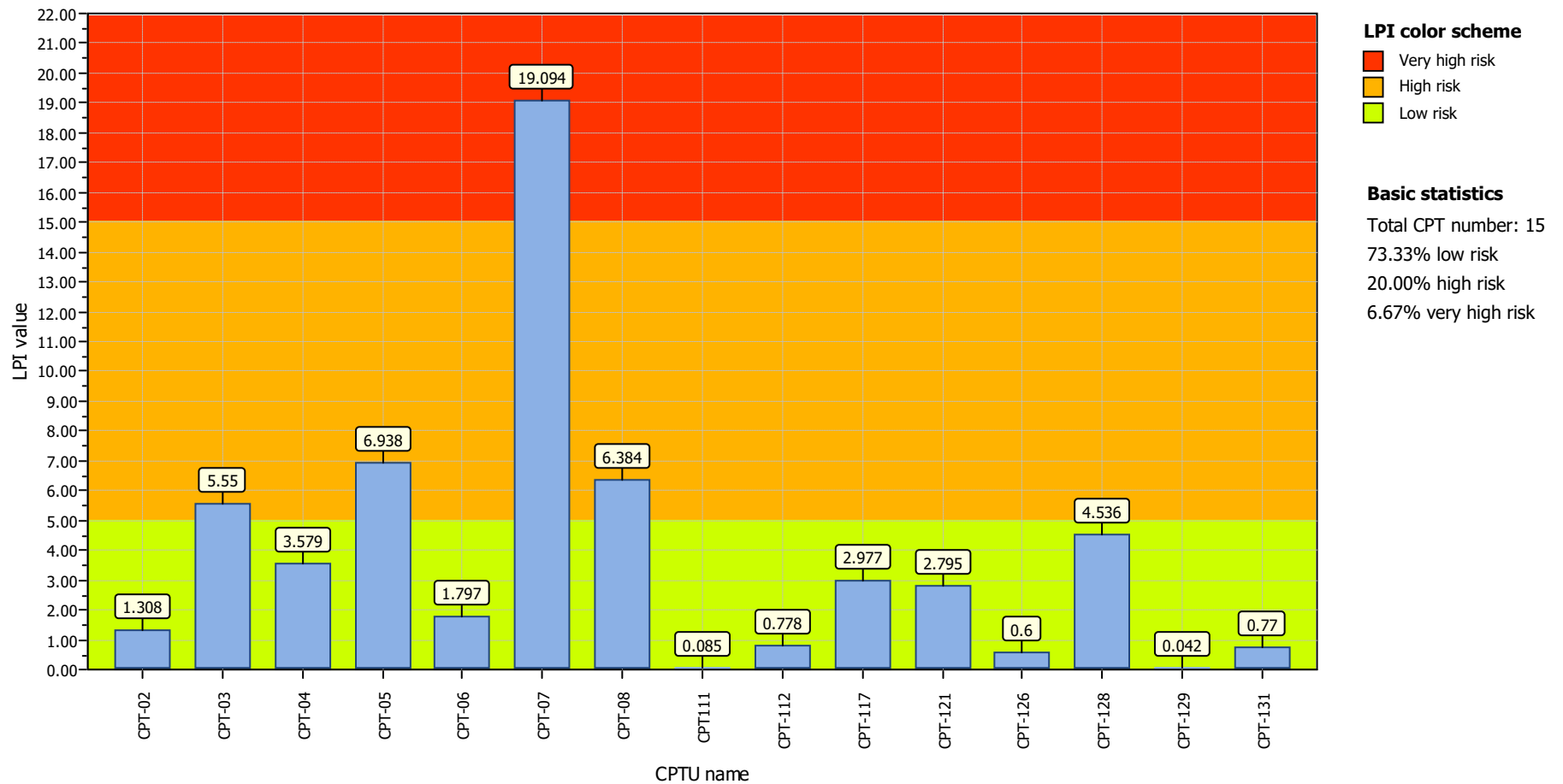
Size	A1
Rev	A

Appendix E – Liquefaction Analysis Results

Project title :

Location :

Overall Liquefaction Potential Index report

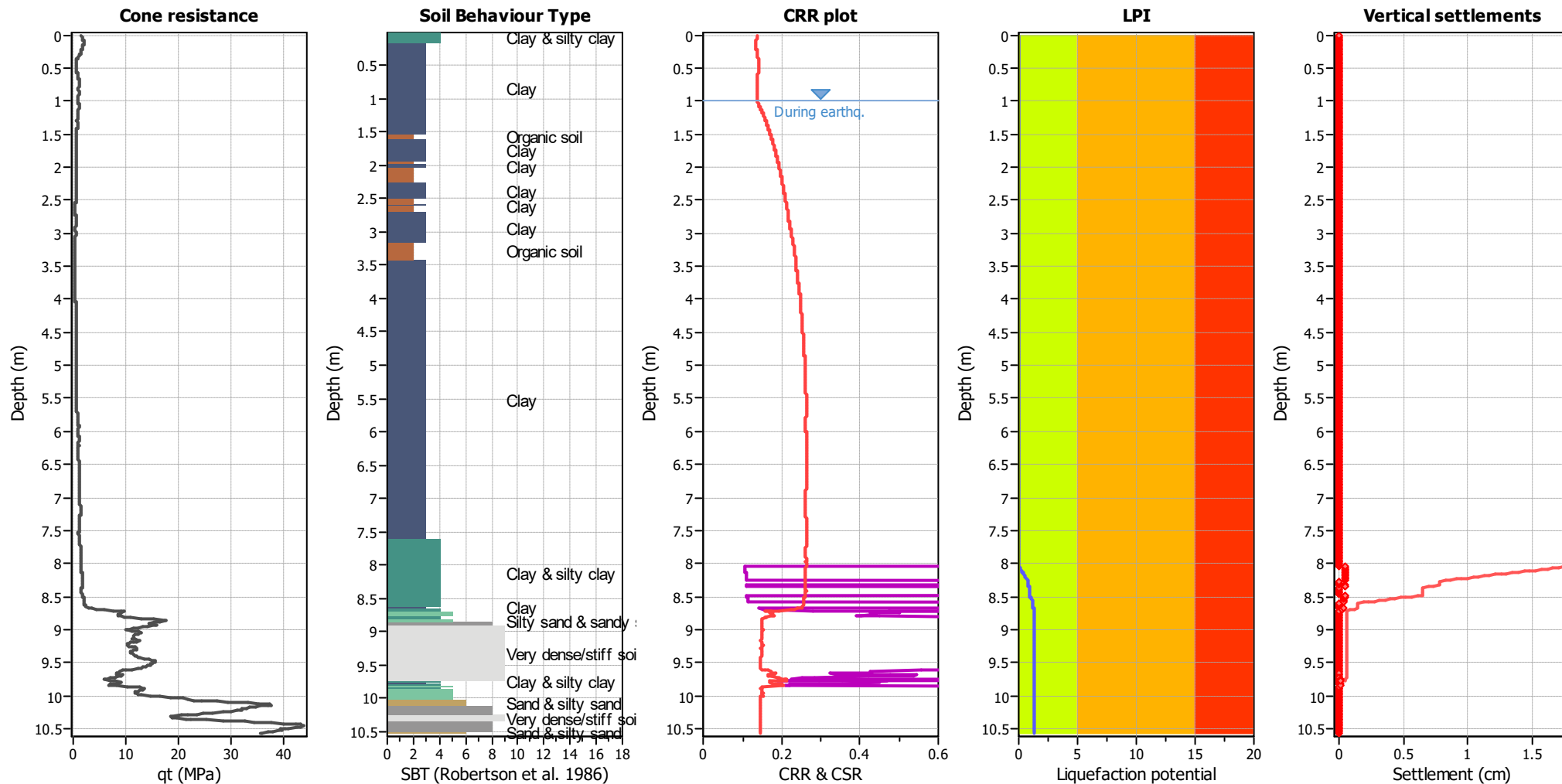


Project:

Location:

CPT: CPT-02

Total depth: 10.57 m



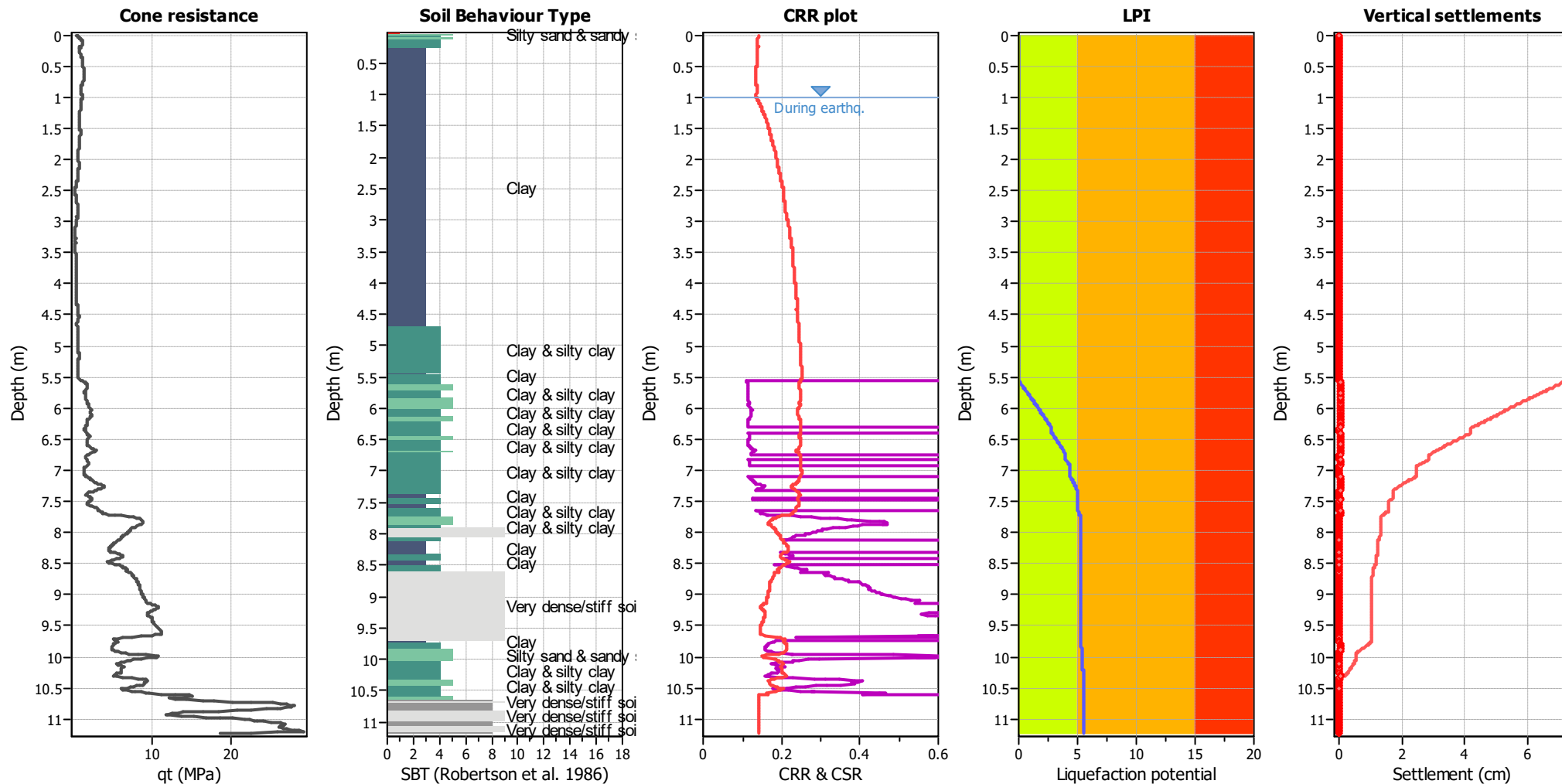
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-03

Total depth: 11.23 m



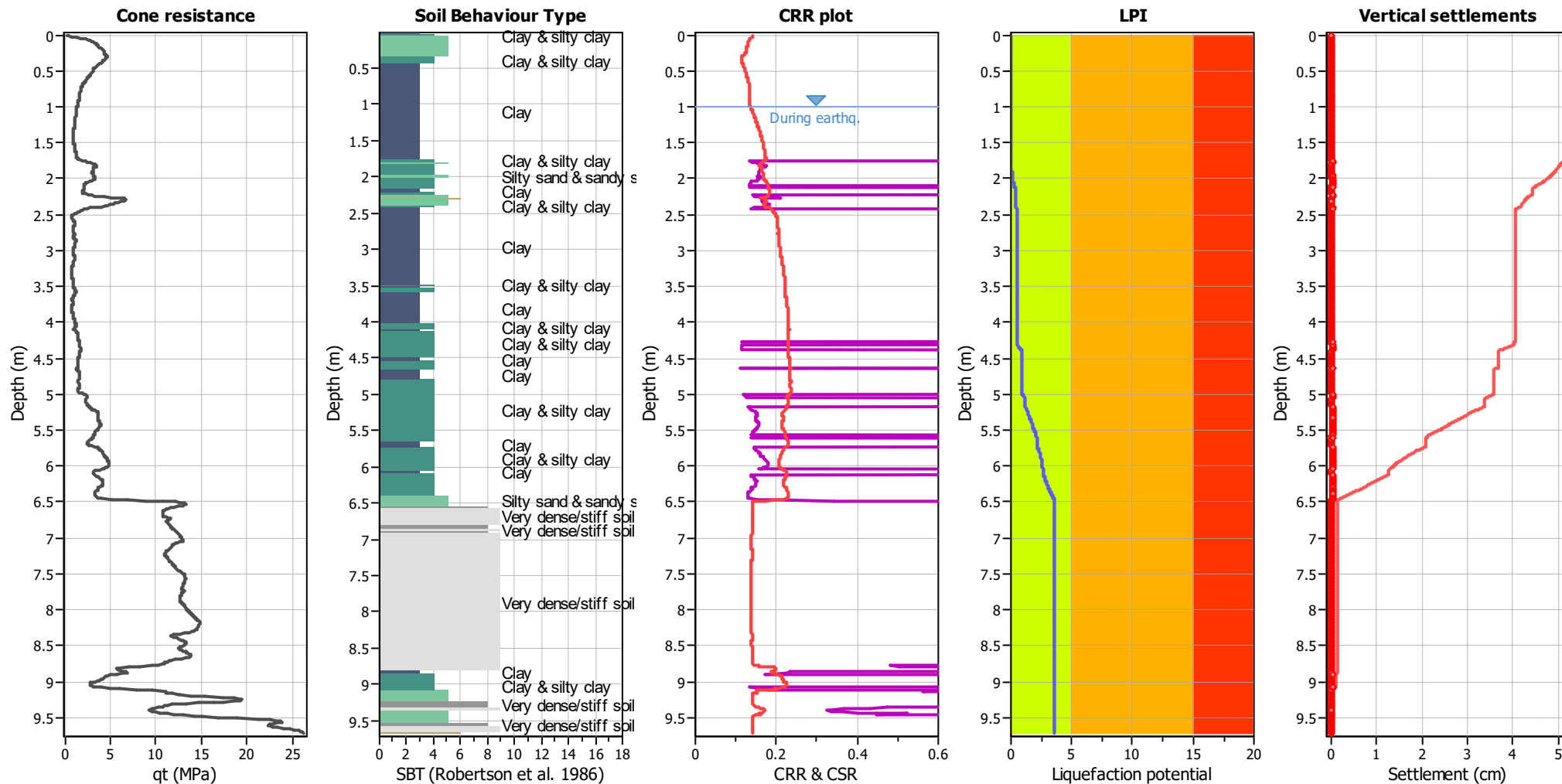
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						Method based

Project:

Location:

CPT: CPT-04

Total depth: 9.72 m



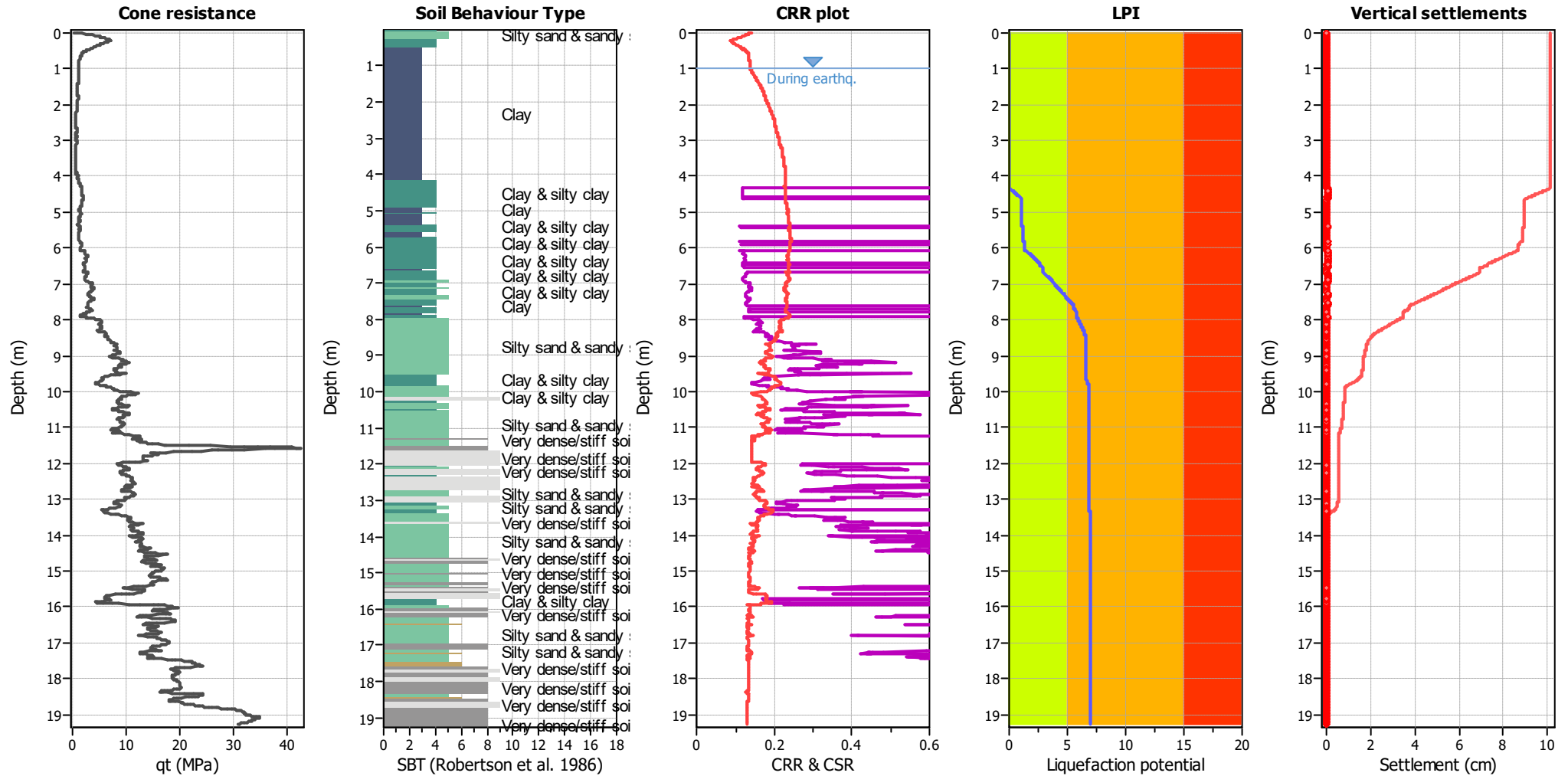
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-05

Total depth: 19.27 m



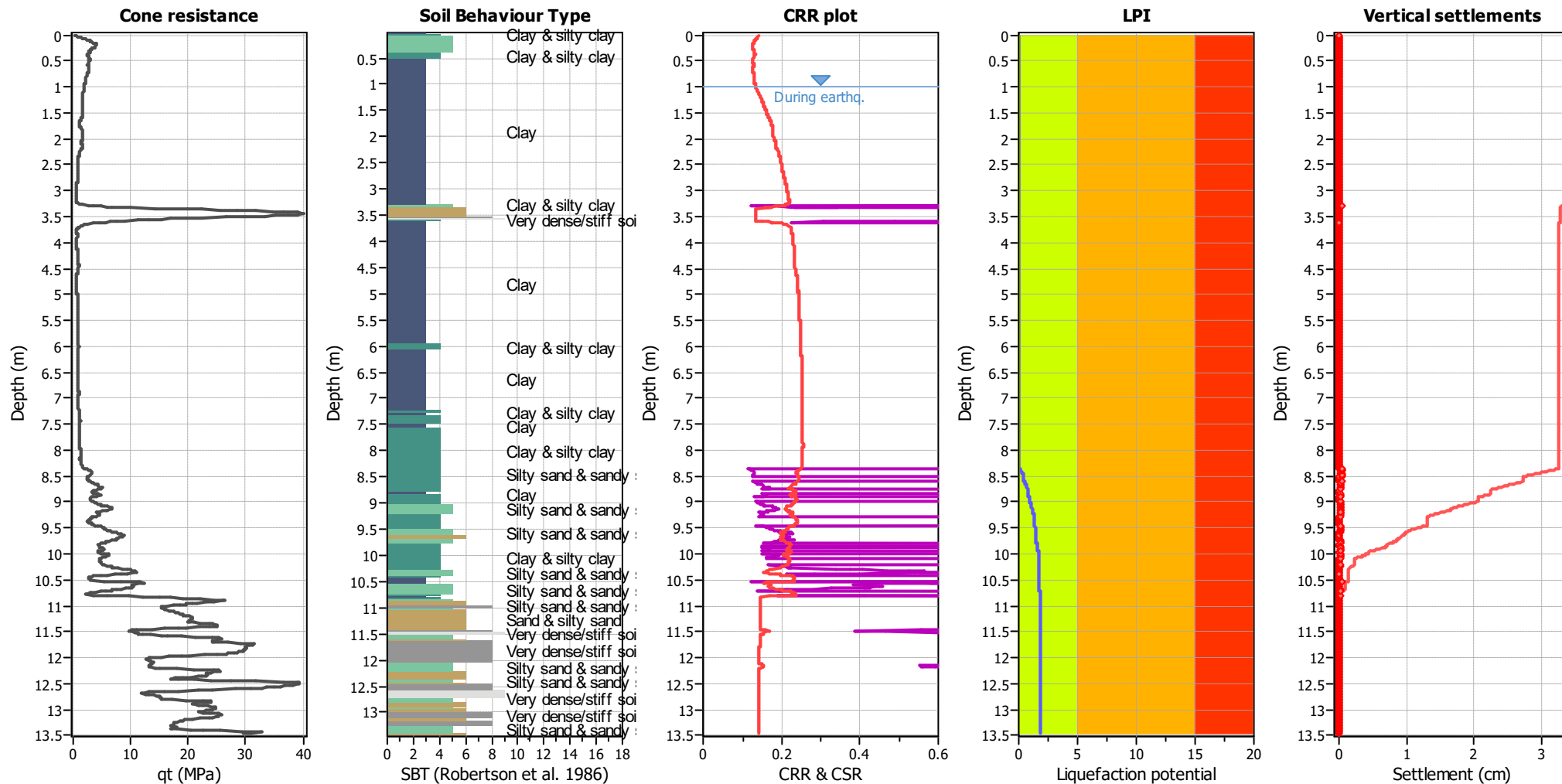
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-06

Total depth: 13.46 m



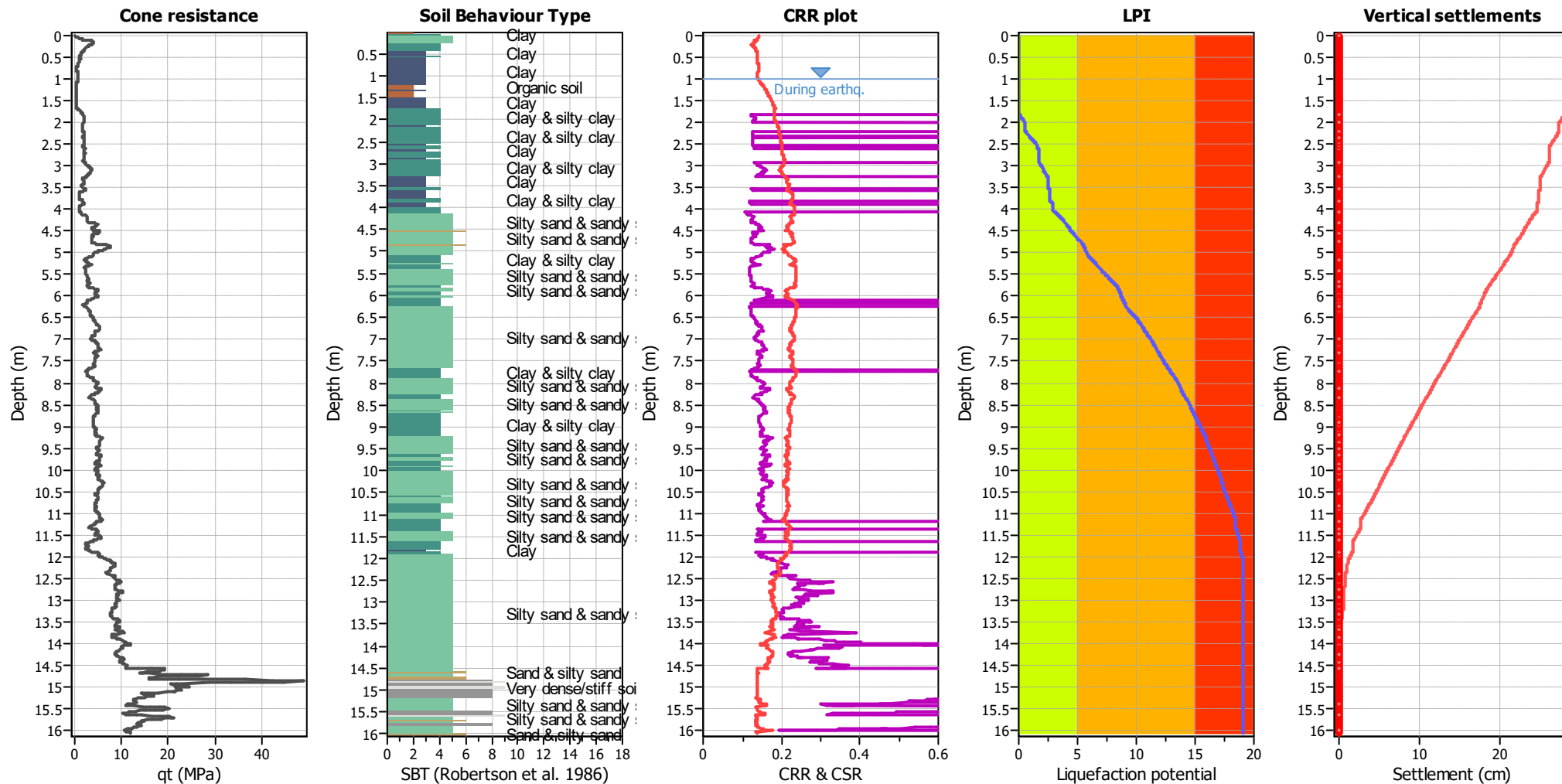
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						Method based

Project:

Location:

CPT: CPT-07

Total depth: 16.06 m



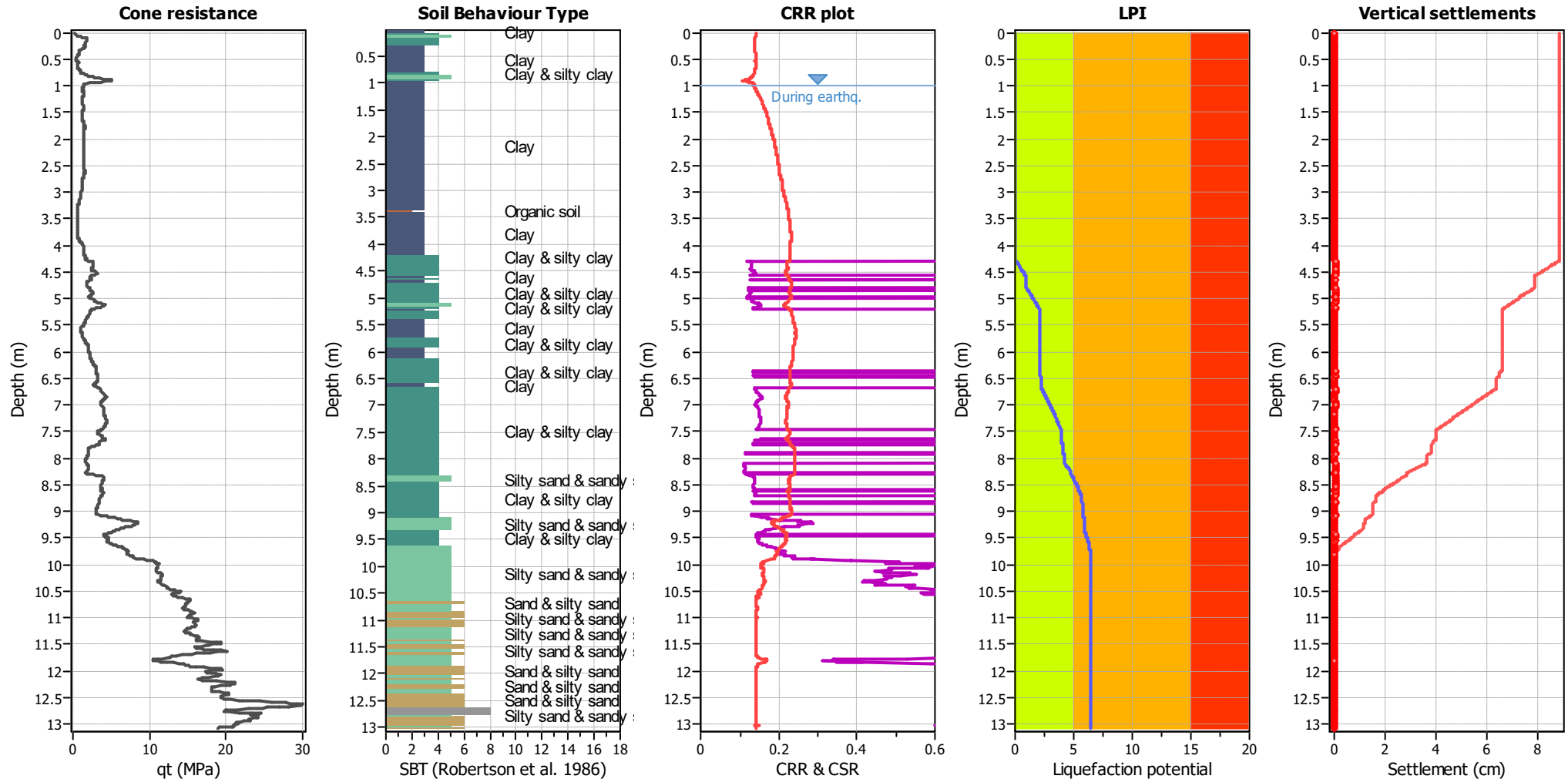
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						Method based

Project:

Location:

CPT: CPT-08

Total depth: 13.08 m



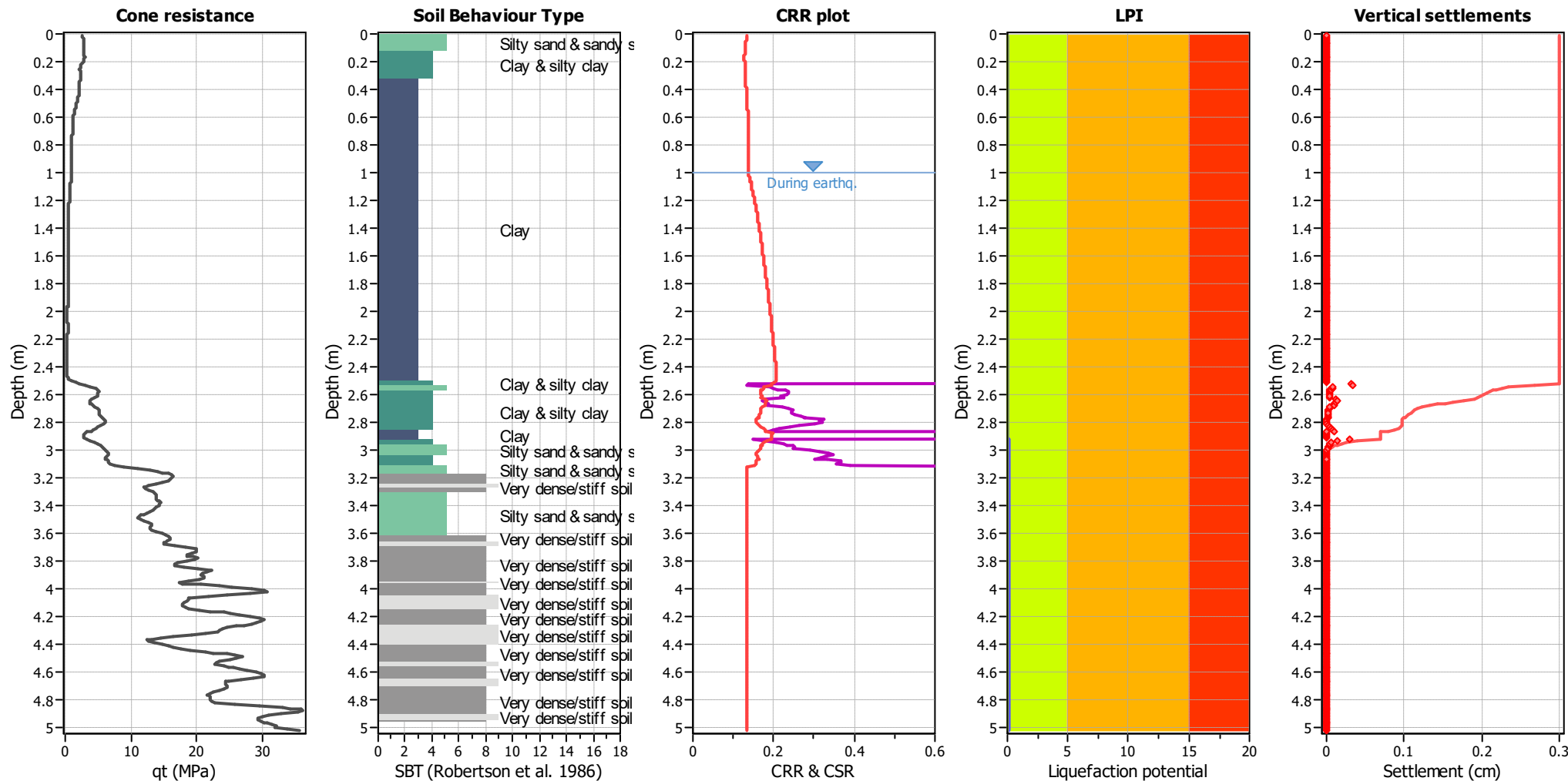
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT111

Total depth: 5.02 m



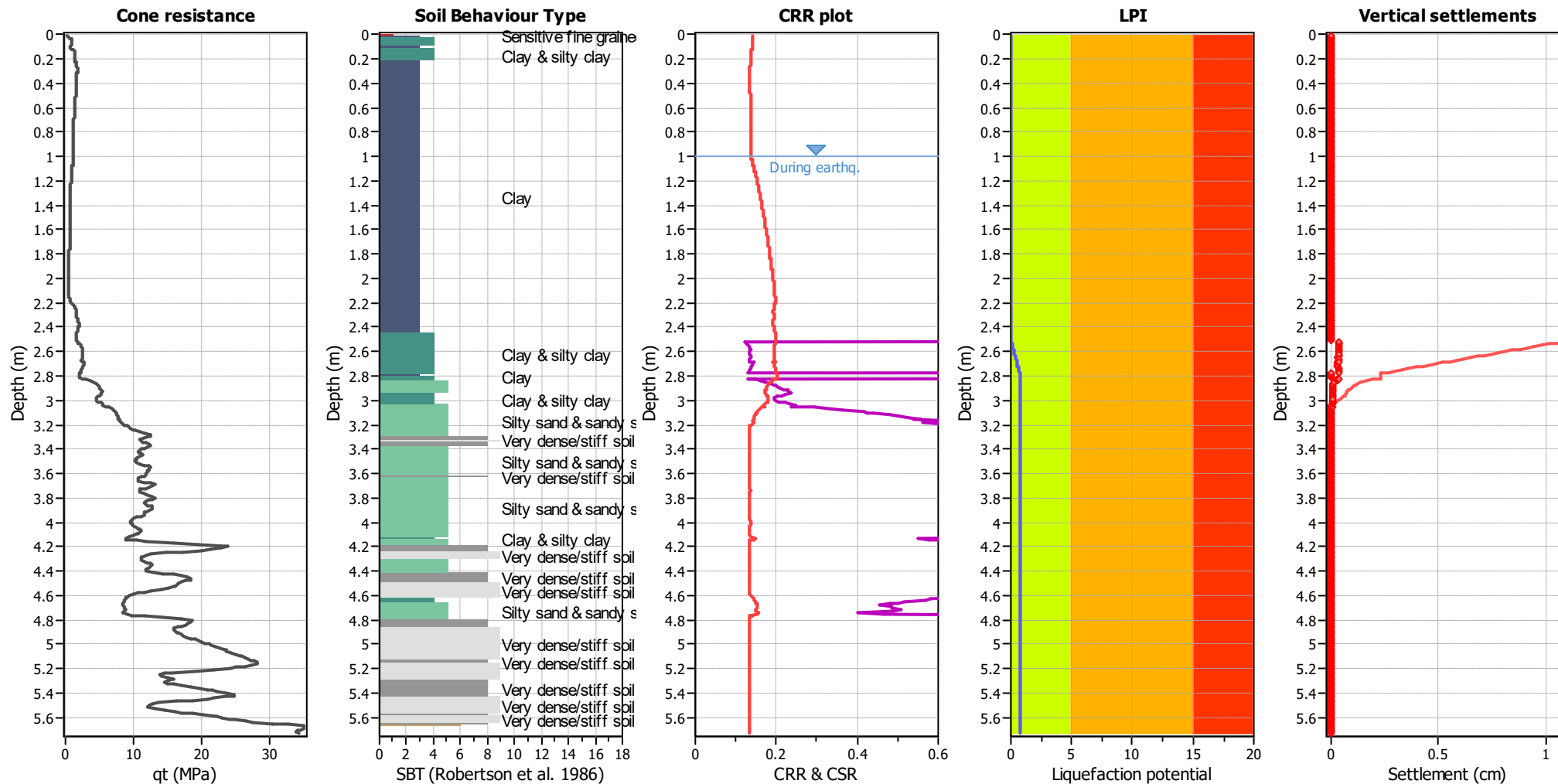
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-112

Total depth: 5.73 m



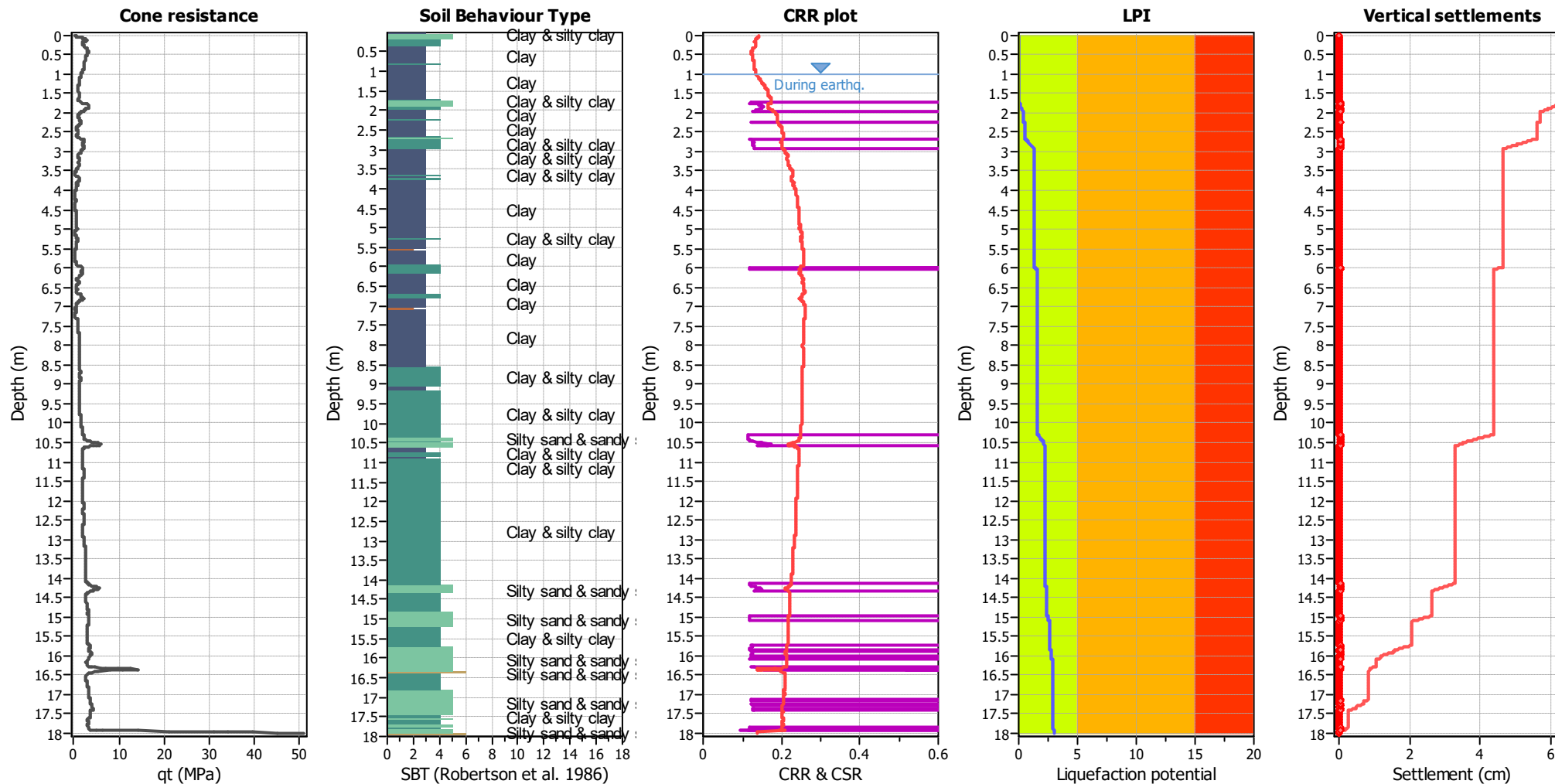
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-117

Total depth: 18.00 m



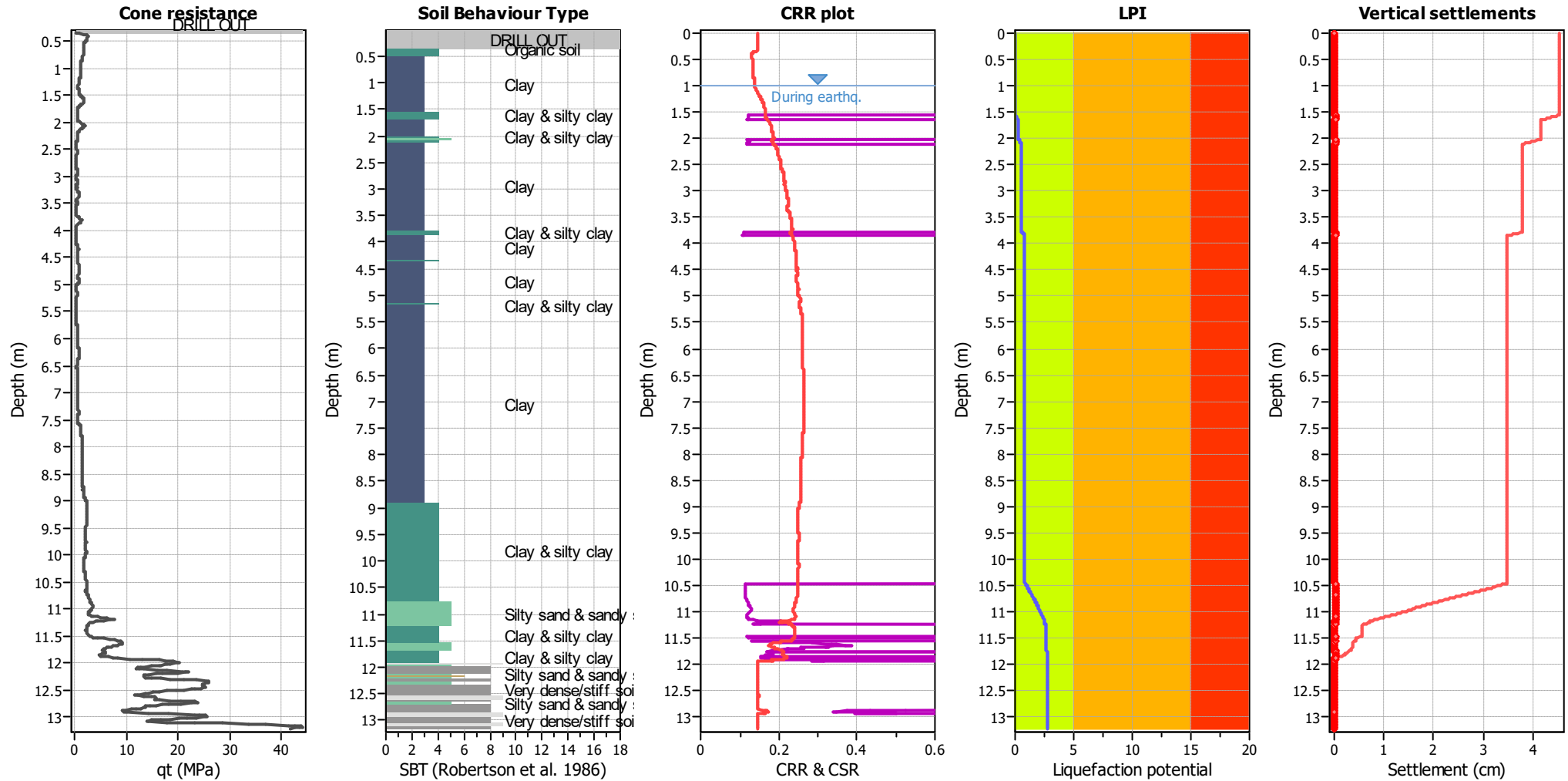
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:
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Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-121

Total depth: 13.22 m



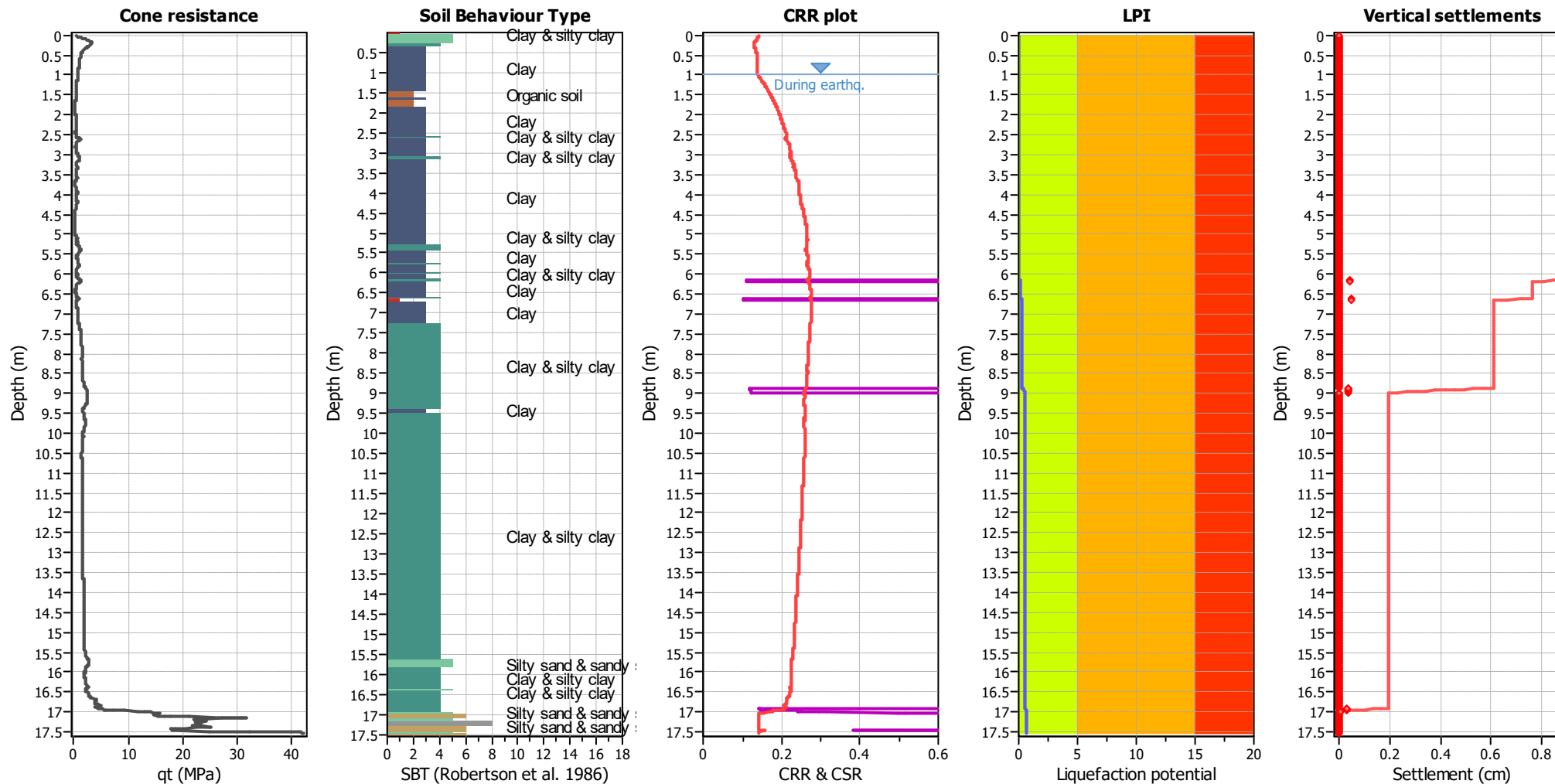
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:
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Project:

Location:

CPT: CPT-126

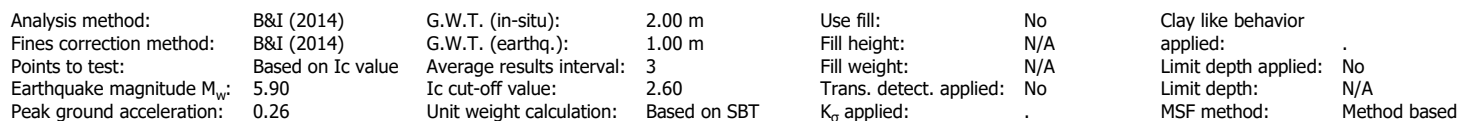
Total depth: 17.54 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:
Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Location:

Total depth: 16.05 m

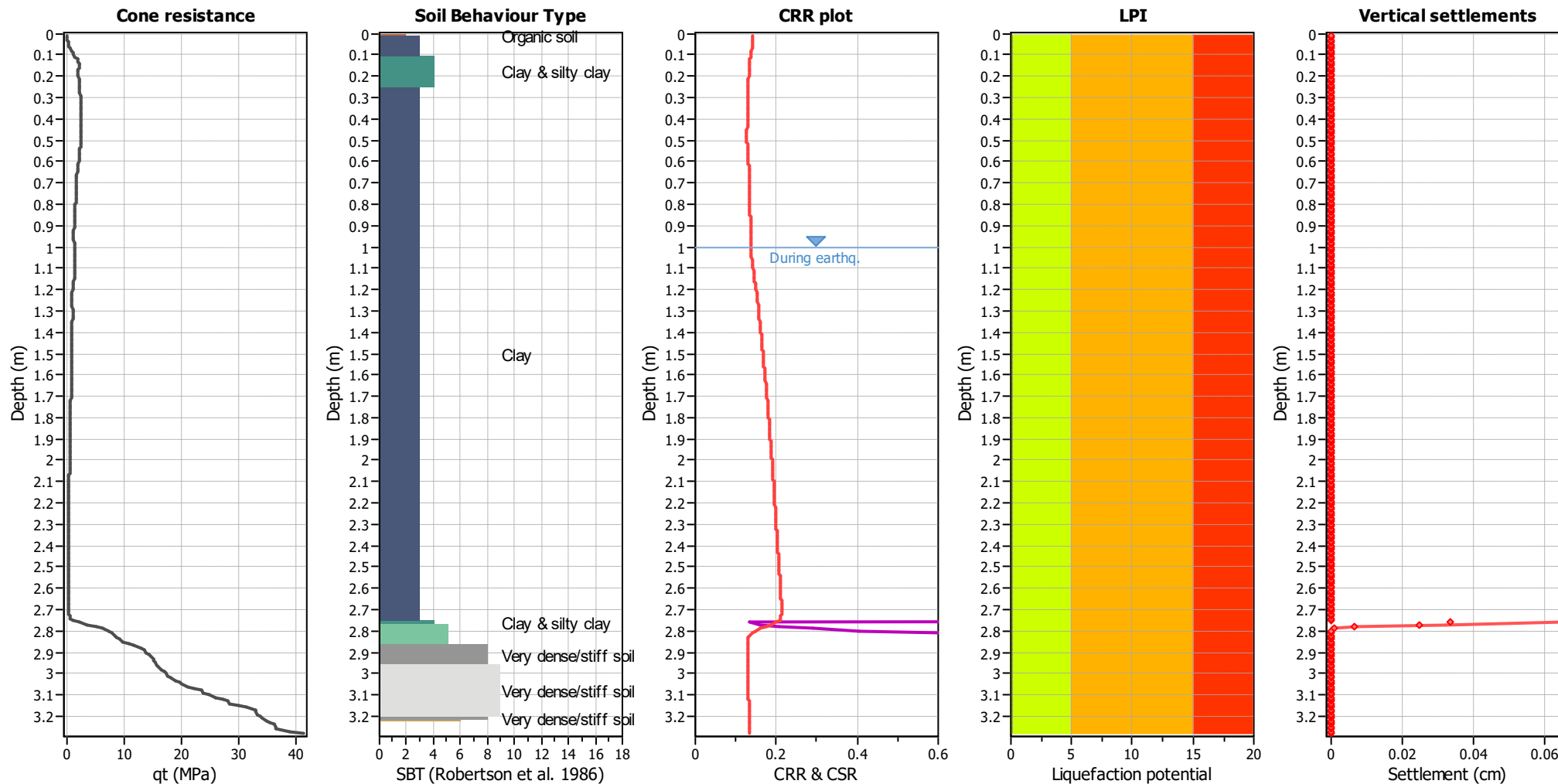


Project:

Location:

CPT: CPT-129

Total depth: 3.28 m



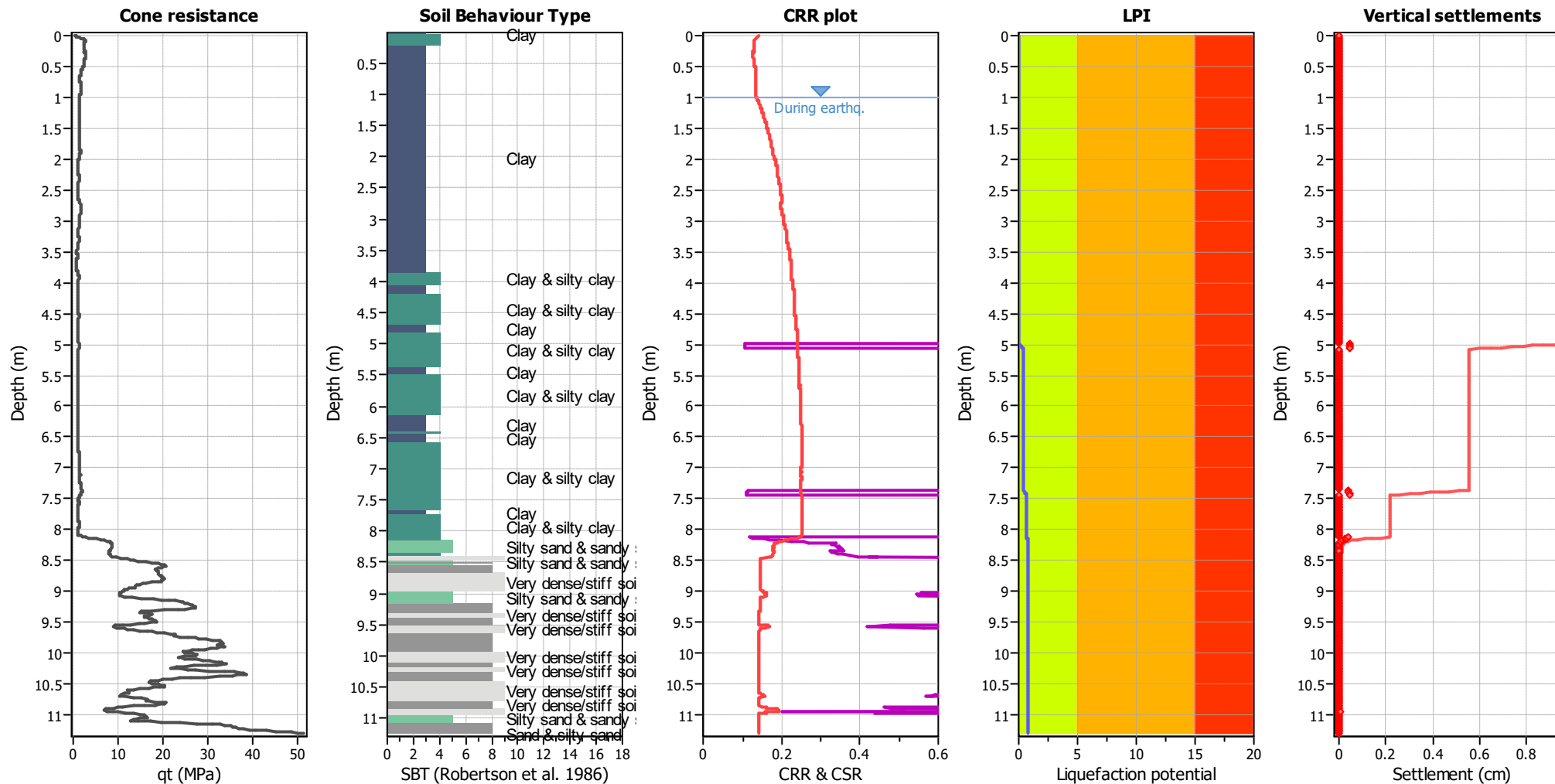
Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:
Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

Project:

Location:

CPT: CPT-131

Total depth: 11.29 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:
Peak ground acceleration:	0.26	Unit weight calculation:	Based on SBT	K_0 applied:	.	MSF method:
						Method based

GHD

Level 3, GHD Centre
27 Napier Street

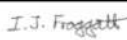
T: 64 9 370 8000 F: 64 9 370 8001 E: aklmail@ghd.com

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	D Guinibert	I. Froggatt				Digitally signed by Dragan Jovanovic Date: 2021.03.26 16:04:21 +13'00'

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