29 August 2022

WHENUAPAI BUSINESS PARK

69 AND 71 TRIG AND 151, 155 TO 157 BRIGHAM CREEK ROADS

GEOTECHNICAL INVESTIGATION REPORT

Neil Construction Limited

AKL2019-0040AM Rev.0

AKL2019-0040AM		
Date	**Revision**	**Comments**
7 June 2022	A	Initial draft for internal review
29 August 2022	0	Final issue

	Name	**Signature**	**Position**
Prepared by	Jasmine Walden		Project Engineering Geologist
Reviewed by	Andrew Linton		Principal Geotechnical Engineer CMEngNZ, CPEng
Authorised by	Richard Knowles		Principal Geotechnical Engineer CMEngNZ, CPEng

EXECUTIVE SUMMARY

This report represents the geotechnical investigations, recommendations and works completed to date within the sites at 69 and 71 Trig Road and 151, 155 to 157 Brigham Creek Road, Whenuapai for the formation of residential and commercial subdivision.

These combined addresses give an approximate site area of 22.5 hectares with the properties located directly to the south of Brigham Creek Road and the east of Trig Road, Whenuapai. The sites are characterised by alluvial terraces of the Puketoka Formation and further detailed descriptions are outlined in Section 2.

Earthworks within 69 Trig Road and 151 and 155 to 157 Brigham Creek Road began in 2020. Bulk earthworks within 69 Trig Road to date are nearly completed and much of the area has been topsoiled. Works within 151, 155 to 157 Brigham Creek are still ongoing.

Bulk earthworks within 71 Trig Road began at the beginning of the 2022 season and are generally complete. The site currently sits with all lots topsoiled and road gullets left exposed for trimming.

Design details for geotechnical aspects of the development are summarised as follows:

- The combined site is underlain by alluvial soils of the Puketoka Formation. The main geotechnical hazards within this strata are low bearing capacity and settlement from soft/organic soils.
- Groundwater impact assessment was completed for the combined sites including groundwater monitoring within 71 Trig Road. Following review of the groundwater levels recorded in the investigation boreholes against the proposed cuts and fills within the above-mentioned earthworks plans, the proposed works within the sites are considered to be compliant against the AUP standards E7.6.1.6 and E7.6.1.10.
- Preliminary geotechnical ultimate bearing pressure of 300kPa should be available for shallow strip and pad foundations constructed within both the natural cut ground and engineered fill areas.
- Due to the presence of softer alluvial deposits underlying the stiffer surficial crust, subsoils may be subject to consolidation settlements due to the proposed loadings from industrial buildings. Site specific investigation and analysis would be required to confirm what settlements may occur based on specific development proposals.
- Specific plasticity index laboratory testing was undertaken within 69 Trig Road and showed that the soils tested returned plasticity indices of much greater than 12 and are therefore not considered liquefiable.
- Based on the ground conditions observed during this investigation, combined with experience working in the surrounding area, the seismic site subsoil category is assessed as being Class C (shallow soil site) in accordance with NZS1170.5.
- Initially it was envisaged that settlement monitoring would be required within the south-eastern gully in 69 Trig Road during earthworks due to the soils encountered in the investigation, as well as analysis results. However during site stripping and observations (as detailed in the earthworks to date Section 4 of this report) significant quantities of the subsoils underlying the topsoil were undercut and replaced with compacted engineered fill. In conjunction with the adjusted earthworks plans that required less filling within the gully, settlement monitoring was considered unnecessary and was therefore not undertaken.
- All of the soils at this site are clayey in nature and have very low coefficients of permeability.

TABLE OF CONTENTS

Appendices

1 INTRODUCTION

1.1 Project Brief

CMW Geosciences (CMW) was engaged by Neil Construction Limited to form a combined report of the geotechnical investigation and analysis/reporting/construction completed to date of the sites located at 69 and 71 Trig and 151, 155 to 157 Brigham Creek Roads, which is currently under construction to form a combination of commercial and residential lots.

The scope of work and associated terms and conditions of our engagement were detailed in our email agreement from 11 May 2022.

This report is to support a fast-tracked Consenting process to be submitted to the Ministry for the Environment.

1.2 Scope of Work

As detailed in our email agreement on the 11 May 2022, the agreed scope of work to be conducted by CMW was to form a Geotechnical Report that outlines all the investigation/reporting and recommendations to date on the subject site including all currently completed and ongoing earthworks operations.

The data supplied within this report is a compilation of the reports outlined below:

- Geotechnical Investigation Report for Trig & Brigham Creek Road, referenced AKL2019-0040AB Rev.0, dated 29 March 2019;
- Geotechnical Investigation Report for Trig & Brigham Creek Road, referenced AKL2019-0040AD Rev.0, dated 15 January 2020;
- CMW Geosciences Natural Hazards Risk Assessment for Land Subdivision at Trig & Brigham Creek Road, referenced AKL2019-0040AE Rev.0, dated 15 January 2020;
- CMW Geosciences Land Development Geotechnical Works Specification for Trig & Brigham Creek Road, referenced AKL2019-040AF Rev.0, dated 15 January 2020;
- Section 92 Response Letter for Trig & Brigham Creek Road, referenced AKL2019-0040AG Rev.1, dated 9 July 2020;
- Falling Head Soakage Test Letter for Trig & Brigham Creek Road, referenced AKL2019-0040AH Rev.0, dated 1 June 2021;
- Geotechnical Investigation Report for 71 Trig Road, referenced AKL2020-0231AB Rev.1, dated 24 June 2021;
- Infiltration Memorandum for 71 Trig Road, referenced AKL2020-0231AC Rev.0, dated 25 June 2021;
- Groundwater Assessment Letter for 71 Trig Road, referenced AKL2020-0231AD Rev.0, dated 13 October 2021;
- Bridge Abutment Pile Parameters for Trig & Brigham Creek Road, referenced AKL2019-0040AJ Rev.0, dated 22 December 2021.

2 SITE DESCRIPTION

2.1 Site Location

The site comprises a combined total area of approximately 22.45 hectares, formed from the combination of 151, 155 to 157 Brigham Creek Road and 69 and 71 Trig Road, Whenuapai as illustrated in ***Figure 1*** below.

Figure 1: Site Location Plan (Auckland Council GIS)

2.2 Landform

The general landform, together with associated features located within and adjacent to the site is presented on the attached Site Investigation Plans in ***Appendix A***, and is summarised below based on property addresses. Descriptions are based on the site conditions prior to any works commencing.

2.2.1 69 Trig Road, 151 and 155-157 Brigham Creek Road

These properties are characterised by an alluvial terrace that grades moderately from approximately RL35m on the southern boundary to RL15m at the south-eastern and RL13m at the north-eastern corners of the site.

Two gullies with associated overland flow paths and streams are present towards the north and south-eastern sections of the site.

The site is bound to the north by Brigham Creek Road, and to the south, east and west by neighbouring rural residential properties. An existing residential dwelling is located on 149 Brigham Creek Road, which is incorporated in the northern corner of 151 Brigham Creek Road.

There are no residential dwellings present on 69 Trig Road or 155-157 Brigham Creek Road, however there is an existing culvert crossing located on 155-157 Brigham Creek Road.

The site has historically been used for agricultural purposes.

2.2.2 71 Trig Road

The property at 71 Trig Road is roughly rectangular in shape, stretching in a west to east direction.

The gradient across the site is generally consistent, falling gradually from the south at approximately RL42.0m down to RL25.5.0m in the north-eastern corner with an approximate gradient of 1(V):15(H) across most of the site.

Auckland Council GIS maps a possible creek exiting the north-eastern corner of the site with numerous contributary overland flow paths mapped across the site.

The site itself previously comprised mostly pasture and overgrown, historic horticultural patches. Tall trees run along most of the paddock fence lines as well as being scattered in the north and north-eastern areas of the property. An existing structure is located along the northern boundary.

The site is bound to the north by residential dwellings in the form of larger lifestyle blocks and to the west and south by farmland. The eastern boundary backs onto the wider Trig and Brigham Creek Road development site.

3 PROPOSED DEVELOPMENT

For the proposed development, the combined properties described above are referred to as Whenuapai Business Park.

The current development plans supplied by Cato Bolam Consultants are outlined below:

- Finished Contour Plans referenced 44315-DR-C-2000 to 2005 (Sheets 1 to 5), dated 13 July 2022.
- Cut Fill Contours (Existing Surface to Finished Surface) referenced 44315-DR-C-2100 to 2105 (Sheets 1 to 5), dated 15 July 2022.
- Sediment and Erosion Control Plan referenced 44315-DR-C-2200 to 2202 (Sheets 1 to 3), dated 20 July 2022.

The Cato Bolam plans depict the formation of 21 industrial lots/superlots of varying size, and 2 balance lots (referenced Lots 200 and 300) along the northern boundary for future residential development.

Cuts and fills are proposed across the entire site. Cuts of up to 1.5m depth are proposed through the centre of 69 Trig Road and 151 Brigham Creek Road, as well as along the southern half of 71 Trig Road with an approximate total of 11,900m^3. Fills will range up to approximately 2.0m depth and will largely be located in the south-eastern corner of 69 Trig Rd. Fills are also proposed adjacent to the existing creek alignment along the northern perimeter of 151 Brigham Creek Road and part of 157 Brigham Creek Road.

The plans also depict 2 proposed bridges and associated abutments/retaining walls. The main, larger, bridge is proposed as part of the new intersection of the subdivisions Road 1 with Brigham Creek Road and the neighbouring development. A smaller bridge to the north-west is proposed to create access to 155 Brigham Creeks future residential development from 151 Brigham Creek Road. Approximately 7 retaining walls are proposed as part of these works to support the new proposed levels.

Supplied development plans are attached to this report in ***Appendix B***.

4 INVESTIGATION SCOPE

4.1 Desktop Study

A desktop study was carried out before commencing fieldwork for all properties. This included online research through Auckland Council Geo Maps, Dial Before You Dig, aerial photographs and an underground services search, as well as a number of documents provided by Neil Construction from the Auckland Council property file.

Based on the historical use of the site as agricultural land and surrounding land levels, inferred from aerial photographs and recorded history, some reasonable depths of fill should be anticipated as a result of soft

landscaping and historic earthworks across the site. We understand that uncontrolled fill has been placed in the south-eastern part of 69 Trig Road, dating back to 2001.

A review of historic and recent aerial photographs between 1959 and 2017 indicated the following activity on 71 Trig Road:

- Between 1959 and 1996 the subject site was developed from agricultural land for horticultural purposes. The existing structure on site appears to have been constructed around the same time as the development of the land.
- From 2003 to approximately 2012 the sites horticultural development appears to have been let go and the area returned to farmland.
- From approximately 2015 onwards the site appears to have been returned to horticultural activities, however, to date the site is currently unattended.

Previous reports as described in Section 1.2 above were also reviewed and compiled.

4.2 Field Investigation

The approximate locations of the respective investigation sites referred to below are shown on the Site Investigation Plans appended to this report. Test locations were measured using a handheld GPS. Elevations were inferred from the existing Auckland Council GIS contours.

4.2.1 69 Trig Road, 151 and 155-157 Brigham Creek Road

The field investigation for these properties was carried out between 18 March 2019 and 22 March 2019, and 25 November 2019 and 27 November 2019. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS guidance[1]. The scope of fieldwork completed was as follows:

- A walkover survey of the site was undertaken to assess the general landform, site conditions and adjacent structures / infrastructure;
- An on-site services search was carried out by a specialist contractor to identify the presence of any underground obstructions or hazards prior to the field investigation program commencing;
- Seven Cone Penetrometer Tests (CPT), denoted CPT01 to CPT07, were pushed to depths of up to 16.5m to define the ground model through the underlying zone of influence of future building foundations and to provide preliminary parameters for retaining wall and foundation design. Results of the CPT's, presented as traces of tip resistance (qc), friction resistance (fs) and friction ratio are presented in ***Appendix C***;
- Two machine boreholes, denoted MH01-19 and MH02-19, were drilled using HQ3 diamond coring drilling techniques to depths of up to 20m to determine the ground model through and below the proposed earthworks profile. Engineering logs and photographs of the boreholes are provided in ***Appendix C***;
- Seven test pits, denoted TP01-19 to TP07-19, were excavated using a 20-tonne hydraulic excavator fitted with a 2m wide blade bucket to depths of between 1.2m and 3.0m below existing ground levels to determine the quality and extent of the fill within the south-eastern corner of 69 Trig Road. TP02-19 was terminated due to encountering an old drainage pipe, while TP01-19 and TP03-19 to TP07-19 were terminated at target depth, below any fill materials. Engineering logs and photographs of the test pits are presented in ***Appendix C***;
- Twenty two hand auger boreholes, denoted HA01-19 to HA022-19, were drilled using a 50mm diameter auger to target depths of up to 5.0m below existing ground levels to visually observe the

[1] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

near surface soil profile and to facilitate vane shear strength testing. Refusal was met in HA01-19 at 1.6m due to the presence of gravel fill. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths are presented in ***Appendix C***.

- Additional hand augers and machine boreholes are currently being undertaken to support design of the bridges and retaining walls within 151 and 155 - 157 Brigham Creek Road.

4.2.2 71 Trig Road

The field investigation for this property was carried out on 16 September 2020. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS guidelines[1]. The scope of the fieldwork was as follows:

- A walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure. The site walkover generally confirmed the existing contours of the area and there was no evidence of any recent change in the site conditions.
- Ten hand auger boreholes, denoted HA01-20 to HA10-20, were drilled using a 50mm diameter auger to target depths of up to 5.0m below existing ground levels to observe the near surface soil profile and to facilitate vane shear strength testing. All ten hand auger boreholes reached the target depth of 5.0m. Engineering logs of the hand augers, together with peak and remoulded vane shear strengths can be found appended to this report in ***Appendix C***.

4.3 Laboratory Testing

Laboratory testing was carried out generally in accordance with the requirements of NZS4402[2] (where applicable). Where a test was not covered by a New Zealand standard, a local or International standard was adopted and noted on the laboratory test certificate.

All testing was scheduled by CMW and carried out by Roadtest and Babbage Geotechnical Laboratory, both of which are IANZ registered Testing Authorities.

The extent of testing carried out to provide the geotechnical parameters required for this study are presented in Table 1.

Table 1: Laboratory Testing Schedule

Type of Test	Test Method	Quantity
Water Content	NZS4402 – 1986 2.1	3
Atterberg Limits	NZS4402 – 1986 2.3 / 2.4 / 2.5	1
One Dimensional Consolidation	NZS4402 – 1986 7.1	2

Certificates for the test results outlined above are presented in ***Appendix D***.

5 GROUND MODEL

5.1 Published Geology

Published geological maps[3] for the area depict the regional geology as comprising Late Pliocene to Mid Pleistocene alluvial deposits of the Puketoka Formation (Pup) as illustrated in ***Figure 2*** below.

[2] New Zealand Standard NZS4402 (1986), Methods of testing soils for civil engineering purposes.

[3] Edbrooke, S. W. (compiler) 2001: Geology of the Auckland area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 3. 1 sheet +74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.

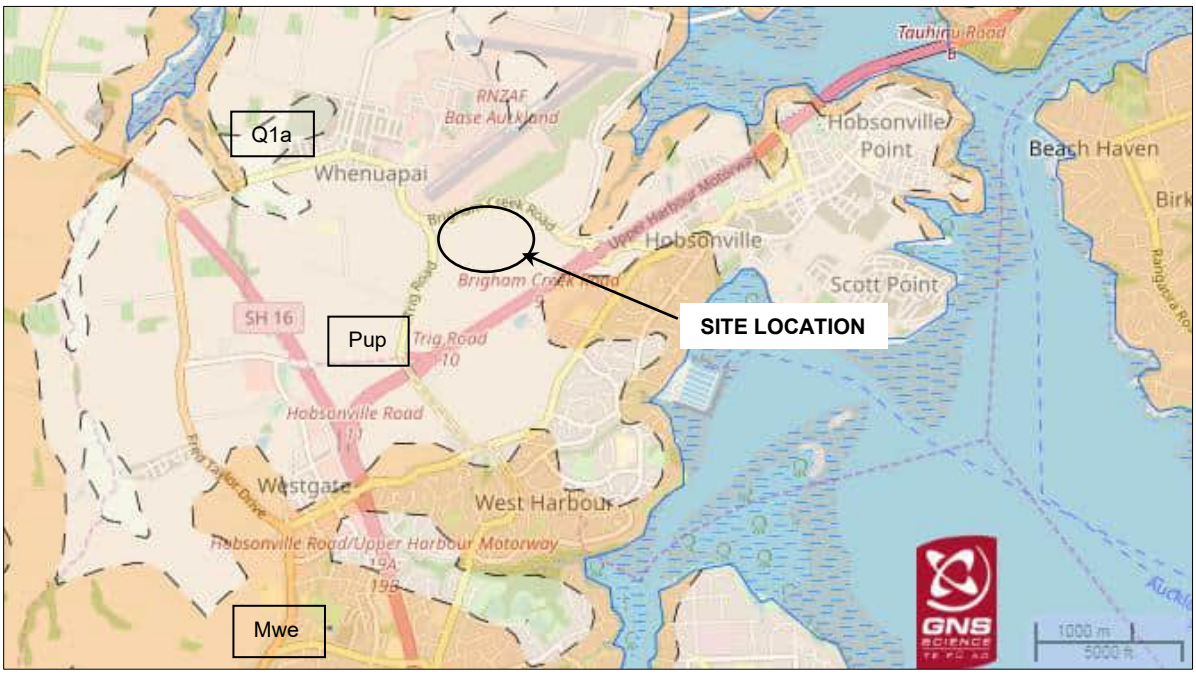


Figure 2: Regional Geology (GNS Science Geology Map)

These alluvial deposits include pumiceous mud, sand and gravel with muddy peat and lignite, rhyolitic pumice (including non-welded ignimbrite, tephra and alluvial pumice deposits) and massive micaceous sand beds. Below these upper soil layers, the deeper geological formation is reported to comprise, interbedded muddy sandstones and siltstones of the East Cast Bays Formation (Mwe) within the Waitemata Group.

The main geotechnical hazards within the Puketoka Formation strata are low bearing capacity and settlement from soft/organic soils.

We understand that uncertified fill is present across some areas of the development site.

5.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigation were considered to be generally consistent with the published geology for the area and can be generalised according to the following subsurface sequences.

5.2.1 Topsoil

Topsoil was encountered in all test pits and boreholes, excluding HA12-19, to depths of between 0.05m and 0.4m. Topsoil was generally dry to moist across the site.

5.2.2 Uncertified Fill

Historic uncontrolled/uncertified fill was encountered as expected in the southeast corner of 69 Trig Road and the northern portion of 155-157 Brigham Creek Road, with a thin veneer also encountered in the central portion of 151 Brigham Creek Road. Uncertified fill was encountered in all recent test pits and boreholes, excluding TP04-19, TP06-19, HA17-19, HA21-19, HA22-19, and MH02-19.

Fill encountered in the south eastern corner of 69 Trig Road generally comprised grey, brown, orange and black, clays, gravels, clay/gravel mixtures and clay/silt mixtures, with organic material, concrete, old drainage pipes and plastic throughout. Testing throughout this material demonstrated peak shear strengths of between 48kPa and >217kPa.

A thin layer (0.1m) of buried topsoil was encountered at the base of this fill in TP05-19 and TP07-19.

Fill encountered in the northern portion of 155-157 Brigham Creek Road generally comprised stiff to very stiff, orange, brown, yellow, grey, and black, clay/silt mixtures, with trace gravel and sand. Testing throughout this fill demonstrated peak shear strengths of between 61kPa and greater than 178kPa.

A thin lens of up to approximately 200mm depth of non-engineered fill was encountered below the topsoil in HA19-19 and HA20-19. This comprised stiff, dark brown, yellow, orange and grey silty clay.

5.2.3 Buried Topsoil

A layer of buried topsoil was also encountered underlying some of the uncertified fill in 69 Trig Road and 155-157 Brigham Creek Road. This topsoil layer was generally encountered from depths of 0.4m up to depths of 2.6m, was generally 50mm to 400mm in thickness, and firm and brown with some gravel throughout.

5.2.4 Alluvium

Alluvial deposits of the Puketoka Formation were encountered in all test pits, hand augers and machine boreholes (excluding HA01-19) and generally comprised yellow, brown, and grey mottled orange and black, clays and clay/silt and clay/sand mixtures, with some organics and organic staining.

Alluvium was encountered from depths of 0.2m to depths of 10.3m and was generally firm to hard, with peak shear strengths quite variable and ranging from 25kPa to 224kPa.

Outlier vane shear strengths of 40kPa in HA02-20, 52kPa in HA06-20 and 39kPa in HA08-20 were generally encountered where the groundwater was sitting or within organic stained material.

SPT testing demonstrated N values ranging from 6 to 20 throughout this stratum.

5.2.5 Residual Waitemata Group Soils

Residual soils of the East Coast Bays Formation (Waitemata Group) were encountered in all hand auger boreholes and both machine boreholes (excluding HA03-19, HA04-19 and HA12-19 and all boreholes within 71 Trig Road). Residual soils generally comprised grey, orange and dark grey, clays, clay/silt mixtures, sand/silt mixtures and clay/sand mixtures.

Residual soils were encountered from depths of 2.2m up to 12.7m, and were generally stiff to hard, with peak shear strengths ranging from 58kPa to greater than 224kPa.

SPT testing demonstrated N values ranging from 15 to 50+ throughout this stratum.

5.2.6 Waitemata Group (Weathering) Transition Zone

Transitional soils of the East Coast Bays Formation (Waitemata Group) were encountered in MH01-19 and MH02-19.

Transition zone soils were encountered from depths of 11.5m to depths greater than 20m and generally comprised completely to highly weathered, grey, extremely weak, siltstones and sandstones, weathered to sand/silt mixtures.

SPT testing demonstrated N values of 50+ throughout this stratum.

5.2.7 Waitemata Group Bedrock

Highly to moderately weathered, interbedded siltstones and sandstones of the East Coast Bays Formation (Waitemata Group) were encountered in MH02-19.

This Waitemata Group bedrock was encountered from depths of 13.8m to depths greater than 15.5m and was generally grey and very weak to weak.

SPT testing demonstrated N values of 50+ throughout this stratum.

5.2.8 Summary

The distribution of these units is illustrated on the appended Geological Sections A to D and presented below in ***Table 2***.

Table 2: Summary of Strata Encountered

Unit	Depth to base (m)		Thickness (m)[5]	
	Min	Max	Min	Max
Topsoil	0.05	0.40	0.05	0.40
Uncertified Fill[1] – firm to very stiff, orange, brown, yellow, grey, and black, clays and clay/silt mixtures, with trace gravel, sand, organics and unsuitables.	0.20	2.60	0.20	2.45
Buried Topsoil[2]	0.45	2.70	0.05	0.40
Alluvium – firm to hard, yellow, brown, and grey mottled orange and black, clays and clay/silt and clay/sand mixtures, with some organics and organic staining.	2.20	>5.00	0.50	10.05
Residual Waitemata Group Soils[3] **–** stiff to hard, grey, orange and dark grey, clays, clay/silt mixtures, sand/silt mixtures and clay/sand mixtures.	11.50	12.70	1.20	5.20
Waitemata Group Transition Zone[3] **–** completely to highly weathered, grey, extremely weak, siltstones and sandstones, weathered to sand/silt mixtures.	13.80	>20.00	2.30	7.30
Waitemata Group Bedrock[3,4] **–** highly to moderately weathered, grey, interbedded siltstones and sandstones, very weak to weak.	>15.50	>15.50	- [5]	- [5]

Notes: [1] Strata not encountered in TP04-19, TP06-19, HA03-19-HA11-19, HA17-19, HA21-19, HA22-19 and MH02-19, or HA01-20 to HA10-20.
[2] Strata only encountered in TP05-19, TP07-19, HA12-19, HA13-19 and HA15-19.
[3] Strata not encountered in test pits, HA03-19, HA04-19 and HA12-19, or HA01-20 to HA10-20.
[4] Strata only encountered in MH02-19.
[5] Thickness only recorded were base of strata has been confirmed.

5.3 Laboratory Test Results

Results of the civil engineering laboratory tests are provided in ***Appendix D*** and summarised in Table 3.

Table 3: Summary of Civil Engineering Laboratory Test Results

Test Location	Depth (mbgl)	LL (%)	PL (%)	PI (%)	MC (%)
MH01-19	2.5 – 3.0	95	28	67	51.8
MH01-19	5.0 – 5.5	-	-	-	33.2
MH02-19	3.45 – 3.95	-	-	-	45.1

Note: LL = liquid limit, PL = plasticity limit, PI = plasticity index, MC = Natural Moisture Content.

5.4 Groundwater

During the investigation, which was completed in late spring conditions (November 2019 and September 2020), groundwater was encountered within the boreholes at the depths provided in Table 4 below.

Table 4: Groundwater Monitoring Data

Investigation Location	18 March 2019		25 November 2019 & 26 November 2019		16 September 2020	
	Depth (mbgl)	Elevation (m RL)	Depth (mbgl)	Elevation (m RL)	Depth (mbgl)	Elevation (m RL)
HA01-19	NE	NE	-	-	-	-
HA02-19	2.9	15.1	-	-	-	-
HA03-19	NE	NE	-	-	-	-
HA04-19	NE	NE	-	-	-	-
HA05-19	NE	NE	-	-	-	-
HA06-19	3.1	23.9	-	-	-	-
HA07-19	3.0	21.5	-	-	-	-
HA08-19	3.6	18.9	-	-	-	-
HA09-19	2.8	20.7	-	-	-	-
HA10-19	NE	NE	-	-	-	-
HA11-19	NE	NE	-	-	-	-
HA12-19	-	-	2.8	20.7	-	-
HA13-19	-	-	2.9	20.1	-	-
HA14-19	-	-	2.5	18.7	-	-
HA15-19	-	-	2.2	18.0	-	-
HA16-19	-	-	2.0	18.1	-	-
HA17-19	-	-	2.0	15.5	-	-
HA18-19	-	-	2.0	16.6	-	-
HA19-19	-	-	2.0	19.4	-	-
HA20-19	-	-	2.6	20.8	-	-
HA21-19	-	-	2.8	22.2	-	-
HA22-19	-	-	2.6	26.0	-	-
TP01-19	-	-	NE	NE	-	-
TP02-19*	-	-	1.0	24.5	-	-
TP03-19	-	-	NE	NE	-	-
TP04-19	-	-	1.2	21.8	-	-
TP05-19	-	-	2.6	18.8	-	-
TP06-19	-	-	NE	NE	-	-
TP07-19	-	-	NE	NE	-	-
HA01-20	-	-	-	-	4.0	29.0
HA02-20	-	-	-	-	2.2	32.6

Table 4: Groundwater Monitoring Data						
Investigation Location	18 March 2019		25 November 2019 & 26 November 2019		16 September 2020	
	Depth (mbgl)	Elevation (m RL)	Depth (mbgl)	Elevation (m RL)	Depth (mbgl)	Elevation (m RL)
HA03-20	-	-	-	-	4.4	35.6
HA04-20	-	-	-	-	3.2	29.5
HA05-20	-	-	-	-	4.5	31.0
HA06-20	-	-	-	-	2.5	29.3
HA07-20	-	-	-	-	1.0	28.8
HA08-20	-	-	-	-	2.7	26.7
HA09-20	-	-	-	-	4.8	31.1
HA10-20	-	-	-	-	2.2	29.7
Notes: mbgl = metres below ground level. NE = Not Encountered. * = Perched Groundwater Encountered. Elevations are approximate and are inferred from Auckland Council GIS.						

Although groundwater was measured at the above elevations during investigations, it should be noted that groundwater levels will vary seasonally and with rainfall.

Given the presence of a variable and clayey soil profile, it is also possible that perched groundwater may occur during and following periods of rainfall.

6 GEOHAZARDS ASSESSMENT

6.1 Context

Section 106 of the Resource Management Act[4] (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land or structures (consequence).

The following sections of this report provide an assessment of the geohazards relevant to this site and provide the basis for the Natural Hazards Risk Assessment presented in ***Appendix E***.

6.2 Liquefaction

6.2.1 General

Soil liquefaction is a process where typically saturated, granular soils develop excess pore water pressures during cyclic (earthquake) loading that exceed the effective stress of the soil. In loose soils, some dilation can occur during this process, which can lead to individual soil grains moving into suspension. Following the onset of liquefaction, the shear strength and stiffness of the liquefied soil is effectively lost causing excessive differential settlement of the ground surface, bearing capacity failure and collapse of structures and low-angle lateral spreading of slopes in liquefiable soils.

In accordance with NZGS guidance[5] the liquefaction susceptibility of the soils at this site has been considered with respect to geological age and soil fabric.

[4] Resource Management Act (1991), as at 29 October 2019

[5] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (May 2016)

6.2.2 Geological Age

The vast majority of case history data compiled in empirical charts for liquefaction evaluation comes from Holocene deposits or man-made fills (Seed and Idriss, 1971). Youd and Perkins, 1978 also state that young Holocene age (15,000 years) sediments and man-made fills are susceptible to liquefaction. Table 1 of Idriss and Boulanger (extracted from Youd and Perkins (1978)), presents the susceptibility of soil deposits to liquefaction based on geological age, which states that Pleistocene aged alluvium (>12,000 years) has a very low to low risk of liquefaction.

Across the elevated terraces, soils below the water table comprise alluvial deposits of the Puketoka Formation. These soils are defined as being of Late Pliocene to Mid Pleistocene in geological age with a dated age at 71k to 3.6Ma old. These deposits are therefore significantly older than what case history data would suggest as being susceptible to liquefaction.

6.2.3 Soil Fabric

Soils are also classified with respect to their grain size and plasticity to assess liquefaction susceptibility. Based on more recent case histories, there is general agreement that sands, non-plastic silts, gravels and their mixtures form soils that are susceptible to liquefaction. Clays, although they may significantly soften under cyclic loading, do not exhibit liquefaction features, and therefore are not considered liquefiable. NZGS guidance[5] sets out the plasticity index (PI) criteria for liquefaction susceptibility as follows:

PI < 7: Susceptible to Liquefaction

7 ≤ PI ≥ 12: Potentially Susceptible to Liquefaction

PI ≥ 12: Not Susceptible to Liquefaction

The fines content of the sands beneath the site also has a significant impact on their liquefaction susceptibility.

Specific plasticity index laboratory test results are presented in Section 5.3 above and show that the soils tested provided plasticity indices of much greater than 12 and are therefore not considered liquefiable.

6.3 Slope Stability

6.3.1 Design Criteria

The stability of cut batters and fill embankments under a range of design conditions is expressed in terms of a factor of safety, which is defined as the ratio of forces resisting failure to the forces causing failure. The following performance standards are recommended for slope stability assessment:

Table 5: Slope Stability Factor of Safety Criteria

Condition	Required Factor of Safety
Static long-term conditions (normal groundwater)	1.5
Transient short-term conditions (elevated groundwater)	1.3
Ultimate Limit State (ULS) seismic condition	1.2

6.3.2 Shear Strength Parameters

Drained shear strength parameters for the various geological units that underlie the site were inferred from the field investigation and experience, and are summarised in Table 6 below.

Table 6: Summary of Effective Stress Parameters			
Geological Unit	**Unit Weight (kN/m^3)**	**Effective Stress Parameters**	
		Back Analysis	
		c' (kPa)	**Ø' (deg)**
Engineered Fill	18	5	30
Uncertified Fill	17	2	27
Puketoka Formation Alluvium	17	2	27
Residual Waitemata Group Soils	18	3	30
Waitemata Group Transition Zone	18	10	30
Waitemata Group Bedrock	18	10	40
Note: Where c' = effective cohesion, Ø' = effective friction angle.			

6.3.3 Slope Stability Analyses

Four cross sections (Sections A, B, C and D) were analysed at 69 Trig Road, 151 and 155-157 Brigham Creek Road, as indicated on the appended Site Investigation Plan (referenced AKL2019-0040, Drawing 01).

Slope stability analyses were undertaken using the Morgenstern-Price method of slices under both circular and translational failure mechanisms using the proprietary software SLIDE Version 8.0. Earthquake loads were calculated in accordance with NZS 1170.5 and NZTA Bridge Manual (BM) Section 6.2.2 for earthquake loads for the assessment of slope stability. An ULS design earthquake return period of 150 years as recommended within the Auckland Council Code of Practice (ACCoP) has been assumed in the assessment. The peak ground acceleration (PGA) for stability analyses was calculated as 0.115g.

Selected stability printouts are attached in ***Appendix F*** and summarised as follows:

Table 7: Slope Stability Analyses Results			
Location	**Slope Stability Factor of Safety (Proposed Profile)**		
	Prevailing	**Transient**	**Seismic**
Geological Section A-A	2.8	2.4	1.7
Geological Section B-B	2.3	1.6	1.7
Geological Section C-C	2.3	1.7	1.6
Geological Section D-D	1.8	1.4	1.4

Results show that the slope stability factor of safety criteria are achieved for the proposed landform and assessed ground model conditions described above. However, detailed design of future developments will need to take into account the potential for soil creep on any steep batters, and proposed working loads. If loads greater than 20kPa are proposed, further analyses will be required.

We note that Section A-A analyses previously assumed the existing non-engineered fill would remain in place. While acceptable factors of safety are achieved for slope stability, there would be an inherent risk of settlement occurring within this fill if it is not reworked as part of the earthworks operations. This non-engineered fill has since been removed and replaced with engineered fill (see Section 8 below) which is considered to have low risk of settlement.

6.4 Erosion

Erosion of cut and fill batters during earthworks is considered to be a high-risk natural hazard and easily addressed during construction. Erosion around batters may subsequently contribute to slope instability and

falling debris. This hazard can be controlled during the design phase by limiting batters to a maximum of 1V:3H gradients and during earthworks via benches, geotextiles and stormwater control.

6.5 Load Induced Settlement

6.5.1 71 Trig Road

Based on the materials observed in our boreholes, settlement is considered to be a low risk for light weight commercial or industrial buildings. The soft materials within the creek/gully uncovered as part of earthworks operations (see Section 8 below) have been undercut to competent ground and replaced with compacted engineered fill.

Soft subsoils may be subject to consolidation settlements due to potential loadings from industrial buildings and floor slabs. Pre-loading of soft soils, general ground improvement during earthworks and possibly piling, or reinforced fill rafts and basal reinforcements may be necessary to mitigate any significant settlement hazards across the industrial zones.

Depending on the future proposed development plans, settlement analyses may need to be undertaken as part of any future detailed investigation and design. This will allow for the development of appropriate ground remediation options if necessary.

6.5.2 69 Trig Road, 151 and 155-157 Brigham Creek Road

6.5.2.1 Design Parameters

The ground conditions around the northern stream are stiff and considered unlikely to be subject to significant settlements under the proposed fill heights and future development loads.

Proposed fill embankments and / or future building loads in the area of the southern gully in 69 Trig Road will induce settlements within the underlying subsoils, as well as across adjacent areas of the site subject to minimal excavation to form the final subgrade levels. CPT and oedometer laboratory testing were carried out to assess the soil modulus parameters for load induced settlement analyses.

Results of the laboratory oedometer testing show that the soils are over-consolidated meaning that for the proposed fill embankment / foundation pressures, these soils are not expected to settle significantly, with settlement expected to follow the unload-reload compression (Cr) line.

A summary of the parameters adopted for preliminary design is summarised as follows:

Table 8: Summary of Consolidation Design Parameters

Parameter	Test Range	Design Value
Compression Index (Cc)	0.24 - 0.47	0.24
Recompression Index (Cr)	0.06	0.06
Initial void ratio (e_0)	0.88 - 1.303	0.88
Secondary / Primary Compression Index ratio (Cα/ Cc)	0.05	0.05
Coefficient of vertical consolidation (Cv – m^2/year)	10 - 20	15

6.5.2.2 Settlement Predictions

The construction of earthfill embankments over weak alluvial soils will induce consolidation and post construction creep settlements. An assessment of static settlements was completed for the proposed range of fill embankment heights. For the range of proposed fill heights, it is assessed that the imposed loads will be less than the pre-consolidation pressure of the subgrade materials where they will behave in an over-consolidated state following the Cr compression line.

Primary consolidation settlements were assessed using a CMW in house spreadsheet in accordance with the following Terzaghi 1-dimensional consolidation theory for over-consolidated soils:

$$S_{consol} = \frac{C_r}{1 + e_0} . H . \log\left(\frac{\sigma_v' + \Delta\sigma_v}{\sigma_v'}\right)$$

Where S_{consol} = consolidation settlement, Cr and e0 are defined in Table 8 above, H = thickness of compressible layer, σv' = initial vertical stress and $\Delta\sigma$v = change in vertical stress or load applied. In construction practice, 90% of the consolidation settlement (t90) is often targeted during the construction phase.

On the basis that t90 settlements are achieved during earthworks construction, subsequent post construction settlements were also estimated, which are made up of the remaining 10% consolidation settlement, additional consolidation due to subsequent building loads and secondary creep settlements due to the original fill embankment loads. Creep settlements (S_{creep}) were estimated in accordance with the following relationship:

$$S_{creep} = \frac{C_\alpha}{1 + e_0} . H . \log\left(\frac{t}{t_l}\right)$$

Where Cα and e_0 are defined in Table 8 above, H = thickness of compressible layer, t = design life (50 years), $t_l = t_{90}$ or construction period, whichever is greatest.

Estimated static settlements are summarised as follows:

Table 9: Estimated Fill Induced Static Settlements – Southern Gully

Embankment Height (m)	Construction Settlement (t_{90}, mm)	Additional Settlement due to 20kPa floor load (mm)	Post Construction Settlement (mm)
1	25	20	30
3	55	15	35
5	80	10	40

Notes: Post construction settlements made up of secondary creep + remaining 10% fill induced consolidation, do not include floor load induced consolidation.

Fill construction using available borrow materials (compacted unit weight = 18kN/m^3) assumed, greater settlements will occur if using imported rockfill or sand.

The combination of predicted post construction ground settlements and settlements from the anticipated future floor loads are considered as generally appropriate for the proposed development, however specific ground improvement measures may be considered, as discussed in Section 7.2 below, to reduce post construction settlement magnitudes.

6.5.2.3 Time Rate of Settlement

Static settlements are expected to be predominantly elastic (immediate) and are therefore considered to be largely built out during construction, with an estimated time to t_{90} consolidation of approximately 6 months.

Time rates of settlement are notoriously difficult to estimate due to their depositional environment where there is inherent material composition lateral and depth variability and presence of intermediate sand lenses. Reference to coefficient of vertical consolidation (Cv) laboratory data shows a wide scatter of data although a value of 15m^2/year looks to provide a reasonable lower bound estimate for preliminary design purposes.

It is noted that Cv values measured in the lab represent a particularly small volume of soil and can therefore be conservative as they don't take into account thin sand lenses and other discontinuities within the soil mass. Actual settlement timeframes may therefore be less than those tabulated above.

6.5.2.4 Monitoring and Approval

Monitoring of the rate and quantum of settlement must be completed during the construction of the works as described in Section 7.2.3 below. Review of the results and approval is to be described by the Geotechnical Engineer and incorporated into the Geotechnical Completion Report.

6.6 Expansive Soils

Seasonal shrinking and swelling results in vertical surface ground movement which can cause significant cracking of floor slabs and walls. There have been instances of concrete floors and/ or foundations that have been poured on dry, desiccated subgrades in summer months on expansive soils and have undergone heaving and cracking requiring extensive repairs or re-building once the soil moisture contents have returned to higher levels. This hazard is addressed by a combination of careful foundation design and site preparation.

NZS 3604:2011[6] excludes from the definition of 'good ground', soils with a liquid limit of more than 50% and a linear shrinkage of more than 15% due to their potential to shrink and swell as a result of seasonal fluctuations in water content. For soils exceeding these limits, NZS 3604 has historically referenced AS 2870[7]. for foundation design advice. However the November 2019 update of Acceptable Solution B1/AS1[8] provides amendments to NZS 3604 that define a method for testing and classifying the soils and provides foundation designs for specific, simple house configurations across the range of expansive soil conditions.

Nevertheless, there is evidence[9] indicating that the use of the B1/AS1 method of assessment of expansiveness may be inaccurate. Accordingly, our assessments herein have been made in line with our experience, BRANZ Report SR120A[10] and AS2870.

Additional commentary based on our knowledge of this geology and experience with local soils is provided in Section 7.5 below.

6.7 Groundwater Impact Assessment

An assessment has been made of the impact of the proposed works on groundwater conditions in accordance with the requirements of Section E7 of the Auckland Unitary Plan (AuP).[11] The assessment has considered the impacts of the proposals for diversion activities and the results are contained in the table presented in ***Appendix G***.

6.7.1 69 Trig Road, 151 and 155-157 Brigham Creek Road

Following review of the groundwater levels recorded in the investigation boreholes against the proposed cuts and fills within the above-mentioned earthworks plans, the proposed works within the site are considered to be compliant against the AUP standards E7.6.1.6 and E7.6.1.10.

6.7.2 71 Trig Road

Two hand auger boreholes were drilled inside the southern boundary of the site, in the location of the proposed deepest cuts which range up to 3m depth. The borehole locations are shown on the appended Groundwater Assessment Investigation Location Plan. The hand augers were drilled to depths of 5m below the existing ground surface and then a standpipe piezometer was installed in each hole.

Groundwater monitoring has been undertaken periodically and the results are presented in Table 10 below.

[6] Standards New Zealand (2011) Timber-framed buildings, NZS 3604:2011, NZ Standard

[7] Standards Australia Limited (2011) *Residential slabs and footings*, AS 2870-2011, Australian Standard, NSW

[8] Ministry of Business, Innovation and Employment (2019) *Acceptable Solutions and Verification Methods for NZ Building Code Clause B1 Structure,* B1/AS1, Amendment 19

[9] Rogers, N., McDougall, N., Twose, G., Teal, J. & Smith, T. (2020) The Shrink Swell Test: A Critical Analysis, *NZ Geomechanics News,* Issue 99, pages 66-80.

[10] Fraser Thomas Limited (2008) - Addendum Study Report (BRANZ SR120A), Soil Expansivity in the Auckland Region – Final Report

[11] Auckland Unitary Plan Operative in Part (Updated 12 June 2020)

Table 10: Groundwater Monitoring Results				
Hand Auger	**Groundwater Depth Below Ground Surface (m)**			
	Date			
	22/09/2021	**01/10/2021**	**06/10/2021**	**13/10/2021**
HA01-21	0.60	0.64	0.85	0.77
HA02-21	0.50	0.53	0.65	0.44

Following review of the groundwater levels recorded in the investigation boreholes against the proposed cuts and fills, the proposed works within the site are considered to be non-compliant against the AUP standards E7.6.1.6 and E7.6.1.10, and a Groundwater Take and /or Diversion Consent is likely to be required. However, due to the proposed batter slopes adjacent to the site boundary, and the distance from the site boundary of the proposed maximum cuts, we do not anticipate any significant effect on groundwater levels beyond the site boundary. As such, the effects of such a diversion are expected to be negligible.

7 GEOTECHNICAL RECOMMENDATIONS

7.1 Seismic Site Subsoil Category

Based on those ground conditions observed during this investigation, combined with experience working in the surrounding area, the seismic site subsoil category is assessed as being Class C (shallow soil site) in accordance with NZS1170.5.

7.2 Ground Improvement for Static Settlement (69 Trig Road)

7.2.1 Ground Improvement Options

To minimise post construction static ground settlements, a range of options are often considered, including the following:

- Construction of a temporary surcharge or pre-load fill embankment above design finished ground level, to over-consolidate the compressible soils and minimise post construction embankment settlements;
- Use of lightweight geofoam, such as EPS-block materials for embankment construction to keep embankment pressures below pre-consolidation pressures within the compressible soil unit thereby reducing consolidation settlements;
- Undertake ground improvement beneath the embankment footprint, such as stone columns, soil mixed columns, CFA piles, Rammed Aggregate Piers (RAP's) or similar rigid inclusions to transfer loads from the embankment to more competent underlying soils at depth.

7.2.2 Ground Improvement Design

It was expected that pre-loading or surcharging was likely to be the preferred ground improvement technique for this project to reduce post construction static settlements to acceptable magnitudes, in conjunction with underfill drains where appropriate.

Preliminary pre-load designs were carried out using laboratory derived / best estimate consolidation parameters from our database and knowledge of these typical ground conditions across the region.

Resulting creep settlement magnitudes were estimated using the method described in Mesri et al (1994) based on the following:

- Weak alluvium zone – widespread floor loads = 20kPa, post construction settlement ≤ 50mm;

- 90% consolidation plus additional consolidation from future 20kPa floor loads achieved during pre-load.

Based on those requirements, a 1m surcharge above design building platform level across the southern gully fill and adjacent areas where proposed cuts are less than 1m depth were initially recommended. However, as detailed below due to slight changes in proposed earthworks volumes and review of the soil composition on site during earthworks, it was decided that this preload was not necessary.

7.2.3 Settlement Monitoring

The above settlement magnitude and time rate estimates were preliminary and only based on a limited amount of laboratory test data and have been averaged across the length of the project.

It was initially envisaged that regular settlement monitoring would be required during earthworks due to the values recorded above, however full undercutting and removal of the non-engineered fill and particularly soft alluvial soils within the gully alignment was undertaken (as detailed in the earthworks to date Section 8 below) during the earthworks operations. Along with review of the soil composition, and the slight changes in proposed earthworks volumes, it was decided on site during earthworks that settlement monitoring was no longer required.

7.3 Earthworks

7.3.1 General

All earthworks activities must be carried out in general accordance with the requirements of NZS4431 and the requirements of the Auckland Council Infrastructure Development Code under the guidance of a Chartered Professional Geotechnical Engineer.

A Geotechnical Works Specification is provided as ***Appendix H*** and standard detail drawings are provided as ***Drawings 06*** to ***07***. Between them, these documents provide the requirements for site preparation, fill placement, subsoil drainage, compaction requirements, quality assurance testing and as-built requirements.

Those requirements are summarised below.

7.3.2 Non-Engineered Fill

Uncontrolled existing fills were observed in the southeast corner of 69 Trig Road, the northern portion of 151 Brigham Creek Road and the northern portion of 155-157 Brigham Creek Road. These existing uncertified fills will need to be inspected by the Geotechnical Engineer following site stripping. It is anticipated that the fill will need to be undercut, reworked and placed to engineering standards, due to the presence of buried topsoil beneath the fill and unsuitable inclusions. Once reworked, the fill material should generally be suitable for placement as engineered fill.

7.3.3 Excavatability

Given the stiffness of the units that will be encountered within the proposed earthworks cuts, it is expected that excavation of these materials will be readily achieved with normal earthworks plant, such as scrapers and bulldozers with scoops.

7.3.4 Subgrade Preparation

Preparation of the subgrade beneath the proposed fill areas should comprise stripping of all vegetation, topsoil, any pre-existing fill materials or soft soils followed by benching of the exposed subgrade where natural slopes beneath the fill exceed gradients of nominally 1:5 (vertical to horizontal). The subgrade should then be scarified and moisture conditioned where necessary, and then proof rolled to verify the subgrade stiffness and consistency.

Where any particularly weak materials are encountered that weave excessively during the proof rolling process, they should be undercut and removed prior to placing engineered fill.

7.3.5 Stockpiles

Careful consideration must be given to the location of temporary topsoil / unsuitables stockpiles to ensure that they are not located immediately above steep or unstable slopes or immediately above proposed stormwater pond excavations.

The location of all temporary stockpiles must be approved by the Geotechnical Engineer prior to placement. Where stockpiles cannot be avoided above sloping ground, they should be placed over a wide area with the height restricted under the direction of the Geotechnical Engineer.

7.3.6 Underfill Drainage

Underfill drains will need to be installed beneath new fills within low lying tributaries and gully inverts to allow for the continued release of groundwater seepages.

We have provided approximate positions of the underfill drainage network required for the subdivision works based on existing contour data. Details are in the Geotechnical Works Specification (***Appendix H***), Underfill Drainage Plan (***Drawings 06***) and in the Typical Underfill Drain Detail (***Drawing 07***).

Underfill drain locations should be confirmed onsite by the Geotechnical Engineer, particularly once existing uncertified fill has been removed from the south eastern gully area.

7.3.7 Compaction

Earthfill must be placed, spread and compacted in controlled 250mm to 300mm thick (loose) lifts under the direction of a Geotechnical Engineer. The fill may comprise either granular or cohesive material subject to being free of any organic material and having no particles greater than 150mm diameter.

Most of the proposed cut material, including the natural and existing fill materials should be suitable for reuse as Engineer Certified Fill. Soil textures and moisture contents will however vary widely, and careful management, conditioning and compaction control will be required.

All earthfill must be placed to ensure adequate knitting of successive fill lifts by ripping any natural subgrade or fill surfaces that have become dry prior to placing the following fill lift.

7.3.8 Temporary Sediment Retention Ponds

Temporary sediment retention ponds may be required to store stormwater for significant periods (several months to years) and therefore their construction should be subject to design and observation input from the geotechnical engineer. As a minimum, the following input is recommended from the project geotechnical engineer:

- Advise on pond locations with respect to land stability and seepage potential;
- Structural design of pond fill embankments including key and compaction specification;
- Observe embankment subgrade conditions and advise on undercut requirements;
- Earthfill QA / QC testing of all embankment materials to ensure compliance with specification.

When decommissioning temporary sediment ponds, all water softened material in the bases and sides of the ponds shall be removed and undercut to the satisfaction of the Geotechnical Engineer. Backfilling of temporary ponds shall be to the compaction standard for general filling unless otherwise specified.

7.3.9 Quality Control

The stripping of existing topsoil, cutting of pre-existing fill materials and undercutting of organic soils (if encountered), where required from across the site as well as the gully areas must be subject to observation by the project Geotechnical Engineer to ensure that all unsuitable materials have been removed.

The source and / or type of material used for engineered fill will dictate the type of quality control testing undertaken.

The recommended specification for the proposed development is presented in the Geotechnical Works Specification in ***Appendix H***.

The source of the fill should be discussed with and approved by the project Geotechnical Engineer to verify its appropriateness and quality control testing requirements.

7.4 Civil Works

7.4.1 Subgrade CBR

The subdivision roading is shown as being constructed in a combination of both cut and fill areas, although given the requirement to over-excavate exposed rock deposits, the vast majority will be formed in engineered fills. Typical CBR values of between 5% and 6% should be available in fills. In areas of cut natural ground, CBR values as low as 2% or 3% are likely.

As described for the fills, subgrade improvement with lime (if desired) is expected to provide better results than the use of cement due to the clayey nature of the soils.

7.4.2 Service Trenches

All of the materials to be exposed during the excavation of service trenches should be readily removed using an excavator.

Services trenches excavated along contour in areas of steep ground may need to be backfilled with engineered filling and if in natural ground, may require a drain coil in the base of the trench connected to the stormwater system. Identification of critical service lines must be made once drawings are available.

At the completion of the development, Specific Design Zones for services will be applied in the Geotechnical Completion Report to protect future foundations from settlement from poorly compacted trench backfill and to prevent new loads crushing service pipes. This is a restriction on building foundations within the 45 degree zone of influence from pipe inverts as depicted in Auckland Council's drawing SW22 from their Code of Practice for Land Development and Subdivision.

7.4.3 Retaining Walls

Design parameters for permanent retaining walls are summarised in Table 11.

Table 11: Retaining Wall Design Parameters

Soil Unit	Ɣ (kN/m^3)	Ø′(deg)	c′ (kPa)	Su (kPa)
Engineered Fill	18	30	5	100
Uncertified Fill	17	27	2	60
Puketoka Formation Alluvium	17	27	2	60
Residual Waitemata Group Soils	18	30	3	70
Waitemata Group Transition Zone	18	30	10	100
Waitemata Group Bedrock	18	40	10	200

Notes:

1. Refer to Table 2 for definition of soil unit levels
2. Ɣ – soil unit weight; Ø′ - angle of internal soil friction; c′ – effective cohesion; Su – undrained shear strength.

Table 11: Retaining Wall Design Parameters				
Soil Unit	**Y (kN/m^3)**	**Ø'(deg)**	**c' (kPa)**	**Su (kPa)**
3. The above parameters are based on the condition of a horizontal ground surface behind the retaining structure. Applicable surcharge loads behind the wall must also be considered in the design.				

During detailed design of the walls, allowance must be made for the additional earth pressure due to the surcharges from structures (i.e. any existing or proposed retaining structures and/or buildings) behind the wall.

Retaining walls should be designed with appropriate toe drainage and be backfilled with free-draining aggregate.

Temporary stability of any site cuts must also be considered in the construction methodology. This work should not be undertaken in poor or unfavourable weather conditions and cuts/excavations should be backfilled as soon as possible.

Careful consideration of underfill drainage locations should be made during retaining wall construction. Underfill drains should be clearly marked out onsite and piles should be positioned to avoid damaging the draincoil.

If any draincoil is intercepted by excavations or building works, it must be reinstated under the direction of a Chartered Professional Engineer to ensure the integrity of the drainage system. Removal of a portion of the drainage scoria is not expected to be problematic provided the draincoil and a quantum of surrounding scoria remains intact.

At the completion of the development, **Specific Design Zones (retaining)** are expected to be applied in the Geotechnical Completion Report to protect retaining walls from future overloading at the crest or undermining at the toe that could lead to instability. These zones typically extend the same distance as the wall height and where they are present above a wall, require deepening of foundations unless the wall has been designed for future foundation loads. Where they are present below a wall, careful consideration needs to be given to location, depth and timing of any future excavations.

7.4.4 Stormwater Soakage

Three falling head tests were carried out at 69 and 71 Trig Road, and 151 Brigham Creek Road, as shown on the appended site plan in ***Appendix I***, where test results are also presented.

The falling head percolation testing methodology is in accordance with the Auckland Council Technical Report 2013/040: Stormwater Disposal Via Soakage in the Auckland Region dated October 2016.

Based on test data, we have estimated the percolation rates with the followings methods:

- Ciria 113 Appendix 4, Control of Groundwater for Temporary Works
- Auckland Council Technical Report 2013/040, Stormwater Disposal via Soakage in the Auckland Region.

The percolation rate estimates are summarised in Table 12 below.

Table 12: Percolation Rate Estimates			
Location	**Calculation Method**	**Percolation Rate**	
		m/s	**mm/hour**
HA01-21	Ciria 113	8.67×10^{-7}	3.12

	Auckland Council Technical Report	$8.46x10^{-7}$	3.04
HA02-21	Ciria 113	$1.65x10^{-7}$	0.59
	Auckland Council Technical Report	$5.25x10^{-7}$	1.89
HA03-21	Ciria 113	$3.51x10^{-6}$	12.6
	Auckland Council Technical Report	$6.91x10^{-6}$	24.9

All of the soils at this site are clayey in nature and have very low coefficients of permeability, particularly in HA01-21 and HA02-21. Accordingly, rain gardens are not expected to provide any significant ground soakage function.

7.5 Foundations

7.5.1 Residential Building Platforms

Once bulk earthworks are completed in accordance with the recommendations provided in Section 7.3 above, a preliminary geotechnical ultimate bearing pressure of 300kPa should be available for shallow strip and pad foundations constructed within both the natural cut ground and engineered fill areas.

There may be areas where localised variations in shear strength within the natural cut ground occur, particularly where the depth of cut varies across the building platforms, and where the depth of excavation exceeds 1.5m so that the stiff overburden crust is significantly reduced or removed. Further confirmation of available bearing pressures will be addressed at the time of post earthworks soil testing and preparation of the Geotechnical Completion Report (GCR) for the development.

NZS3604 recommends that sites with expansive soils are classified according to AS2870 "Residential Slabs and Footings – Construction". AS2870 describes a range of Classes having different levels of characteristic surface movement and provides acceptable foundation solutions for each Class, depending on the construction typology and materials.

While no site specific laboratory testing has been undertaken, on the basis of our visual / tactile assessment we anticipate that the AS2870 Site Class for the development site to be M (moderate) to H1 (high). Foundation design may be selected in accordance with appropriate solutions for this Class from AS2870 or may be undertaken by specific engineering design.

Mitigation of the expansive soil hazard is undertaken by a combination of appropriate foundation design selection at Building Consent stage and appropriate moisture control within subgrade soils during construction. Foundation contractors must be aware of this issue and the need to maintain appropriate moisture contents in the footings and building platform subgrade between the time of excavation and pouring concrete.

7.5.2 Industrial Building Platforms

Due to the presence of softer alluvial deposits underlying the stiffer surficial crust, subsoils may be subject to consolidation settlements due to the proposed loadings from industrial buildings. Site specific investigation and analysis would be required to confirm what settlements may occur based on any particular development proposal, and to develop appropriate ground remediation options as necessary.

7.6 Proposed Bridges and Retaining Walls

As detailed in the proposed development plans outlined in Section 3 above, 2 bridges (with associated abutments) and 7 retaining walls are proposed as part of the subdivision. Based on the investigation to date within this area we are satisfied that the proposed location of this infrastructure is satisfactory provided it is designed appropriately to accommodate the existing ground conditions.

Currently detailed investigation is underway for the proposed retaining wall alignments and bridge locations, and this will be used to support the detailed design of these structures.

8 EARTHWORKS SUMMARY TO DATE

8.1 151, 155 to 157 Brigham Creek Road and 69 Trig Road

The siteworks within Brigham Creek and Trig Road (above addresses) began in September 2020 with the removal of all trees by Treescape, followed by the installation of appropriate sediment controls.

Earthworks began in the 155-157 Brigham Creek Road site in early November 2020. The site stripping and installation of a sediment pond uncovered historic farm drains and uncontrolled fill. The location of Sediment Pond B had to be revised due to the soft soils and uncontrolled fill that was encountered in its initially proposed location.

A large sediment retention pond within Stage 2 of the Trig Road site (south of Brigham Creek, within 157 Brigham Creek Road) was constructed in February 2021 and this subsequently allowed for the site stripping and cut/fill within the Stage 2 area. During the site stripping a number of soft organic areas were encountered and these were appropriately undercut and replaced with engineered fill.

There was a surplus of topsoil on site from the site stripping and this was stockpiled along the western boundary of 69 Trig and was being screened and removed from site at the same time as the site earthworks was being undertaken.

The main gully muck out within Stage 3 of the site (69 Trig Road) began in March 2021. This involved both the muck out of the uncertified fill material (which was encountered during the site investigation and is detailed in this report) and also the installation of a subsoil drain and drainage blanket.

A vertical cut was excavated along the north-eastern boundary of the site during the site stripping in Stage 2 and this area was subsequently remediated with engineered fill placed to a batter gradient of 1(V):3(H) to ensure no instability occurred along this boundary.

The bulk earthworks within Stage 2 was completed in April 2021 and was covered in topsoil. The road gullet within the main proposed road through Stage 2 was cut out and left approximately 200mm above finished level in preparation for the future formation of this road.

The 2021 earthworks season ended in May 2021, and this saw the close out of both 69 Trig and Brigham Creek Road sites for winter. The sediment pond within the main gully of 69 Trig Road had been finished in preparation for the future earthworks season.

Earthworks for the 2022 season restarted in early November 2021 within 69 Trig Road. These works consisted of the ongoing filling within the main gully, extension of the underfill drain/drainage blanket and the site stripping of the remainder of the topsoil within Stage3. An undercut at the toe of the proposed batter within the main gully was observed in late November 2021 and this was to ensure the new batter fills were appropriately benched into the existing ground.

Following the completion of the works within the main gully of 69 Trig Road, earthworks restarted within 155-157 Brigham Creek Road in early February 2022. This involved the stripping of unsuitable material, installation of underfill drainage and bulk filling. These works were undertaken in conjunction with the bulk earthworks within 69 and 71 Trig Road. From late February 2022 works within 69 Trig Road and Brigham Creek were put on hold and all attention was focused within 71 Trig Road as outlined in Section 8.2 below.

8.2 71 Trig Road

The clearing of trees and installation of silt controls were completed in mid-January 2022 in preparation for the start of bulk earthworks.

Following the construction of the sediment pond, bulk earthworks begin in early February 2022. This involved the undercutting of unsuitable material encountered around the existing creek and overland flow path and included the installation of a subsoil drain within an existing drainage channel.

Bulk earthworks within 71 Trig Road continued through to the end of May 2022 when the site was closed up for the winter season. All lots were topsoiled with only the road gullets left open.

9 FURTHER WORK

The recommendations provided in Section 8 above are based on the supplied development plans appended to this report. If development plans change significantly from the current development proposal, the matter should be referred back to CMW or a Chartered Professional Geotechnical Engineer familiar with the contents of this report, who should be given the opportunity to review any changes against recommendations provided within this report.

USE OF THIS REPORT

Site subsurface conditions cause more construction problems than any other factor and therefore are generally the largest technical risk to a project. These notes have been prepared to help you understand the limitations of your geotechnical report.

Your geotechnical report is based on project specific criteria

Your geotechnical report has been developed on the basis of our understanding of your project specific requirements and applies only to the site area investigated. Project requirements could include the general nature of the project; its size and configuration; the location of any structures on or around the site; and the presence of underground utilities. If there are any subsequent changes to your project you should seek geotechnical advice as to how such changes affect your report's recommendations. Your geotechnical report should not be applied to a different project given the inherent differences between projects and sites.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface investigation, the conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation of factual data

Site investigations identify actual subsurface conditions at points where samples are taken. Additional geotechnical information (e.g., literature and external data source review, laboratory testing on samples, etc) are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can exactly predict what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

Your report's recommendations require confirmation during construction

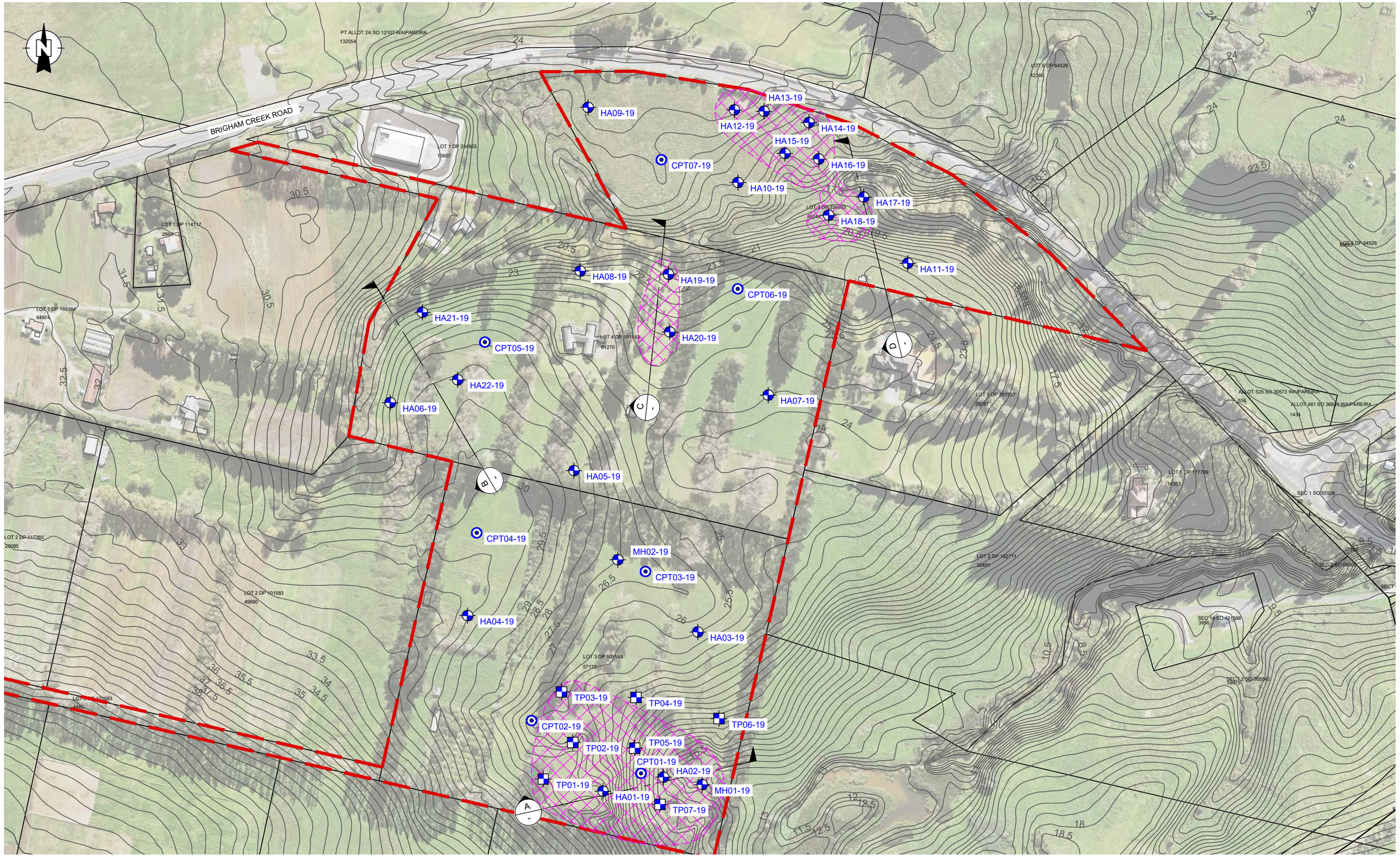
Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site. A geotechnical designer, who is fully familiar with the background information, is able to assess whether the report's recommendations are valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. Read all geotechnical documents closely and do not hesitate to ask any questions you may have. To help avoid misinterpretations, retain the assistance of geotechnical professionals familiar with the contents of the geotechnical report to work with other project design professionals who need to take account of the contents of the report. Have the report implications explained to design professionals who need to take account of them, and then have the design plans and specifications produced reviewed by a competent Geotechnical Engineer.

Appendix A: CMW Drawings

Title	Reference No.	Date	Revision
Site Investigation Plan	AKL2019-0040	06/12/2019	1
Site Investigation Plan	AKL2020-0231	21/09/2020	0
Section A	AKL2019-0040	28/11/2019	1
Section B	AKL2019-0040	28/11/2019	0
Section C	AKL2019-0040	28/11/2019	0
Section D	AKL2019-0040	28/11/2019	0
Underfill Drainage Plan	AKL2019-0040	09/12/2019	0
Typical Underfill Drain Detail	AKL2019-0040	09/12/2019	0



LEGEND:

- HA01-19 HAND AUGER (HA) LOCATION
- CPT01-19 CONE PENETROMETER TEST (CPT) LOCATION
- TP01-19 TEST PIT (TP) LOCATION
- SITE BOUNDARY
- APPROXIMATE EXTENT OF UNCERTIFIED FILL

NOTES:

1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:2500 0 25 50 75 100 125 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 01
		REVISION: 1	SCALE: 1:2500
TITLE: SITE INVESTIGATION PLAN		DATE: 06/12/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040- FIG01 SITE PLAN REV 1.DWG

LEGEND:

- HA01-20 — HAND AUGER (HA) LOCATION
- SITE BOUNDARY
- 400 PE — WASTEWATER LINE

NOTES:

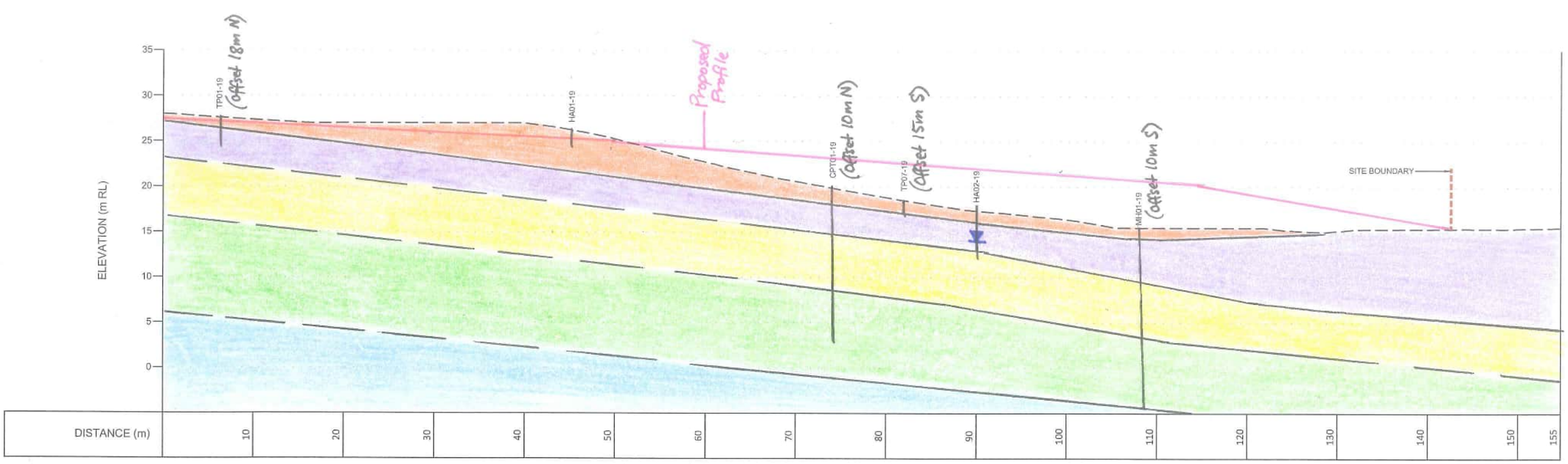
1. BASE PLAN ADAPTED FROM AUCKLAND COUNCIL GIS.
- OVERLAND FLOW PATH.

1:1500 0 15 30 45 60 75 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: WPJ	PROJECT No: AKL2020-0231
PROJECT: 71 TRIG ROAD, WHENUAPAI		CHECKED: JW	DRAWING: 01
		REVISION: 0	SCALE: 1:1500
TITLE: SITE INVESTIGATION PLAN		DATE: 21/09/2020	SHEET: A3

C:\USERS\WINNIEPJ\CMW GEOSCIENCES PTY LTD\CMW CONNECT - AKL\2020\AKL2020-0231 71 TRIG ROAD, WHENUAPAI\DRAWINGS\AKL2020-0231 SI PLAN REVA.DWG



SECTION A

LEGEND:

- EXISTING PROFILE
- SITE BOUNDARY
- Groundwater
- Uncertified Fill
- Puketoka Formation Alluvium
- Residual Waitemata Group Soils
- Waitemata Group Transition Zone
- Waitemata Group Bedrock

NOTES:

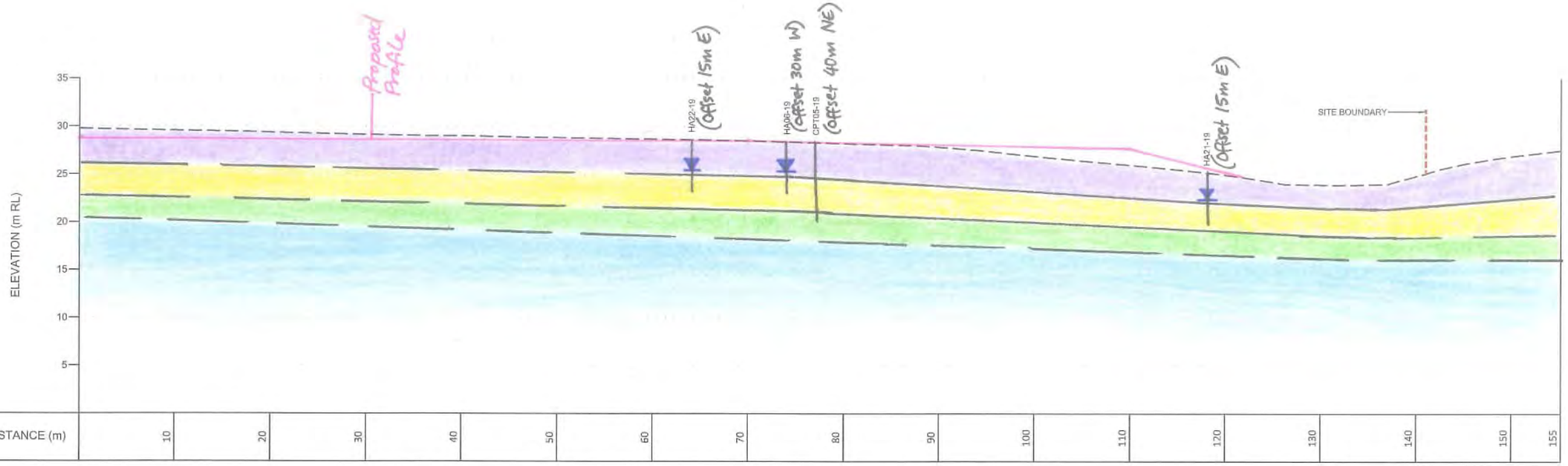
1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:500 0 5 10 15 20 25 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 02
		REVISION: 1	SCALE: 1:500
TITLE: SECTION A		DATE: 28/11/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040-FIG02 SECTION REV 1.DWG



SECTION B

LEGEND:

- EXISTING PROFILE
- SITE BOUNDARY
- Groundwater
- Puketoka Formation Alluvium
- Residual Waitemata Group Soils
- Waitemata Group Transition Zone
- Waitemata Group Bedrock

NOTES:

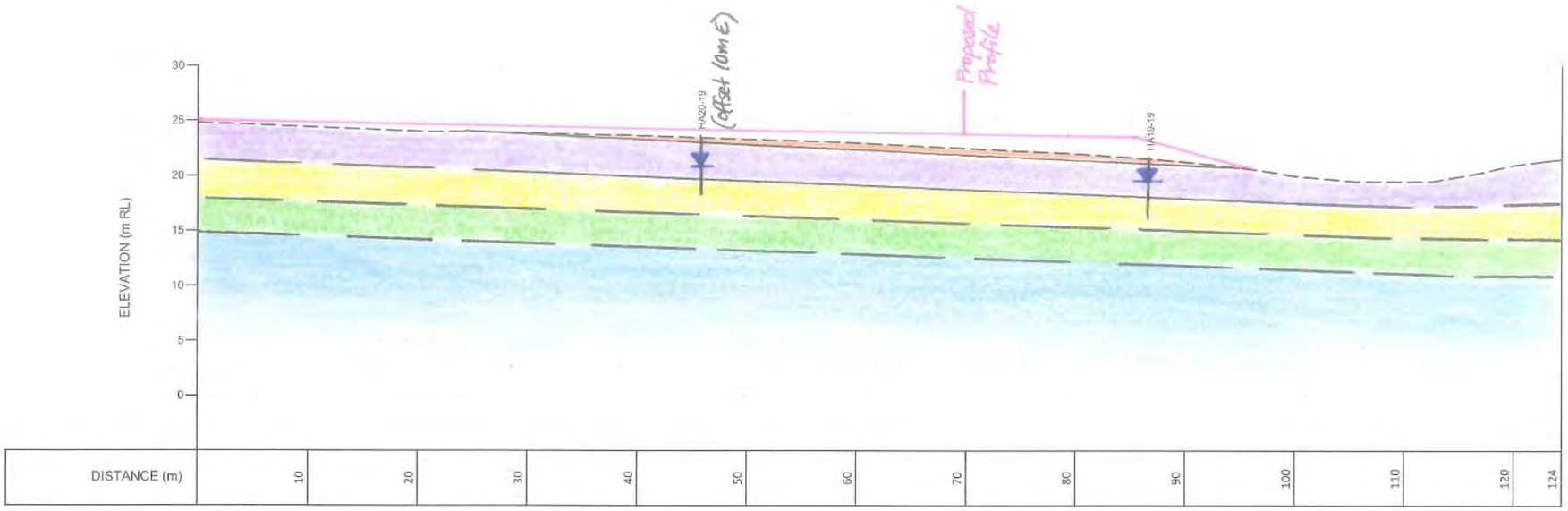
1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:500 0 5 10 15 20 25 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 03
		REVISION: 0	SCALE: 1:500
TITLE: SECTION B		DATE: 28/11/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040-FIG02 SECTION REV 1.DWG



SECTION C

LEGEND:

- EXISTING PROFILE
- SITE BOUNDARY
- Groundwater
- Uncertified Fill
- Puketoka Formation Alluvium
- Residual Waitemata Group Soils
- Waitemata Group Transition Zone
- Waitemata Group Bedrock

NOTES:

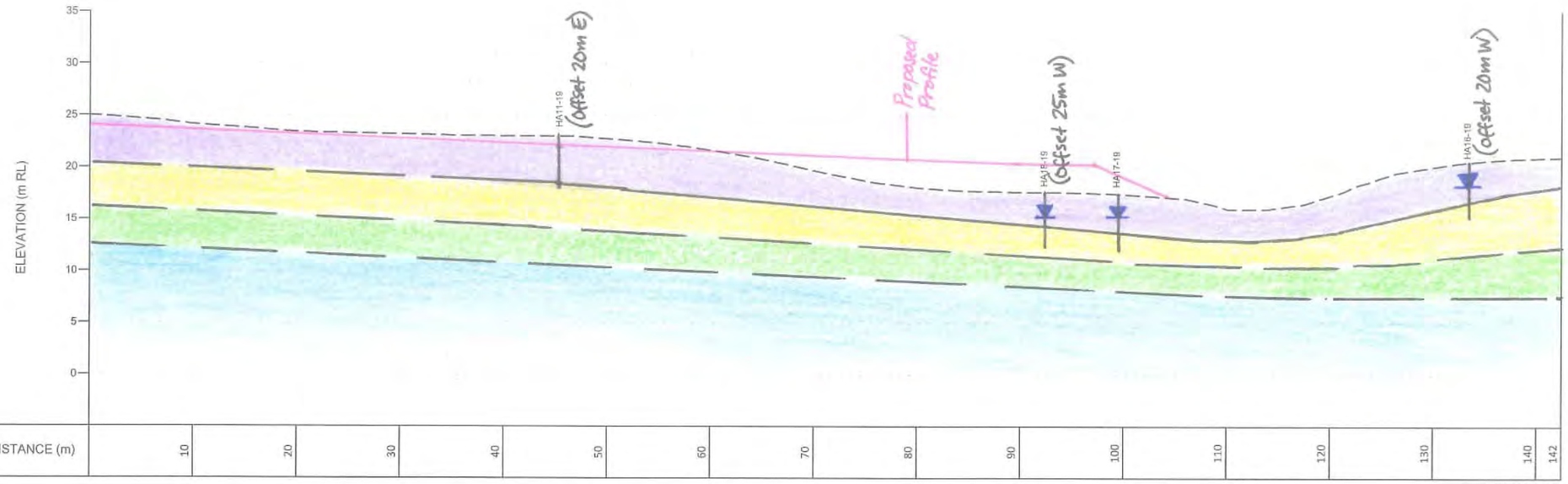
1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:500 0 5 10 15 20 25 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 04
		REVISION: 0	SCALE: 1:500
TITLE: SECTION C		DATE: 28/11/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040-FIG02 SECTION REV 1.DWG



SECTION D

LEGEND:

- EXISTING PROFILE
- SITE BOUNDARY
- Groundwater
- Puketoka Formation Alluvium
- Residual Waitemata Group Soils
- Waitemata Group Transition Zone
- Waitemata Group Bedrock

NOTES:

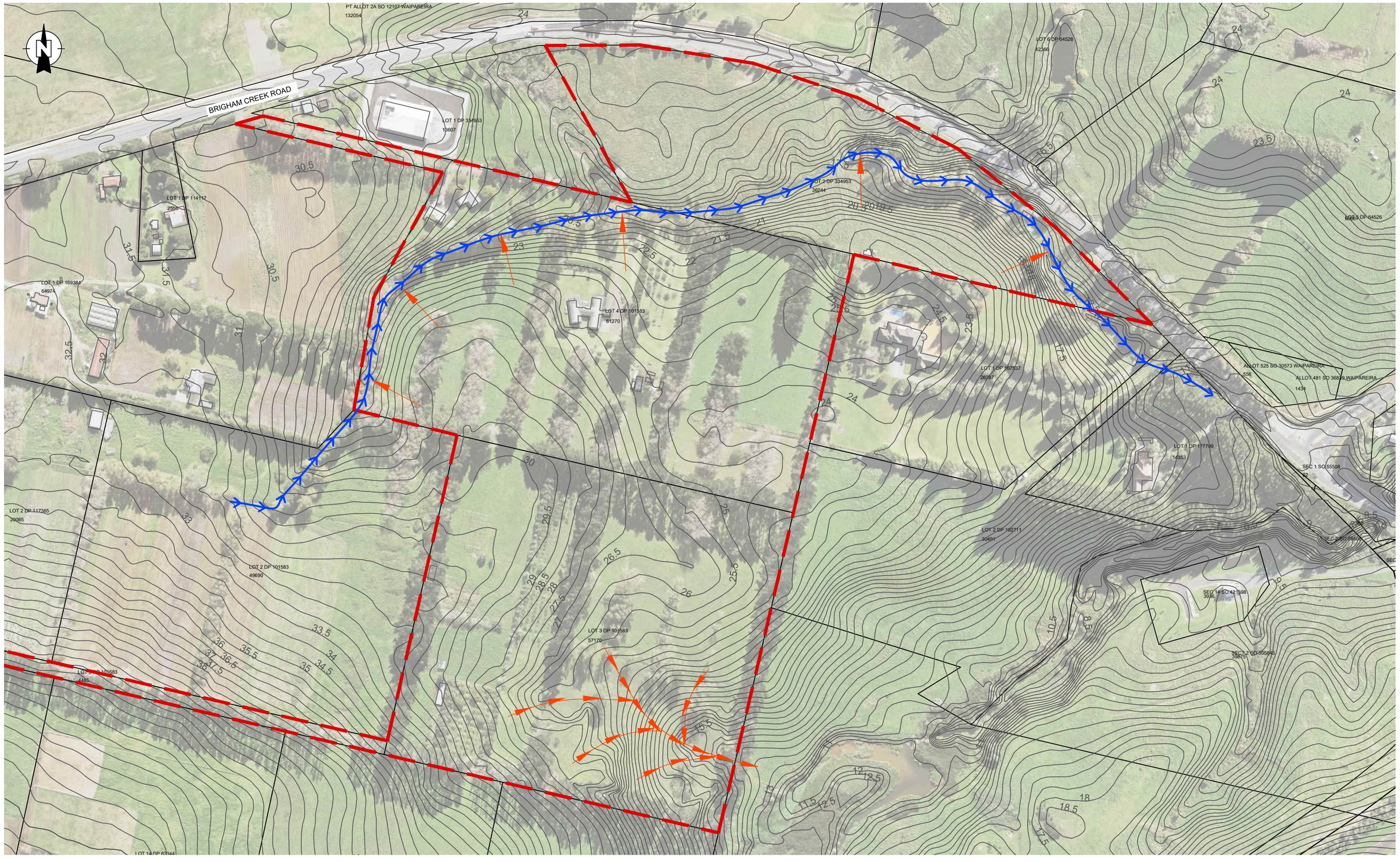
1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:500 0 5 10 15 20 25 m

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 05
		REVISION: 0	SCALE: 1:500
TITLE: SECTION D		DATE: 28/11/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040-FIG02 SECTION REV 1.DWG



LEGEND:

- HA01-19 HAND AUGER (HA) LOCATION
- CPT01-19 CONE PENETROMETER TEST (CPT) LOCATION
- TP01-19 TEST PIT (TP) LOCATION
- SITE BOUNDARY
- UNDERFILL DRAINAGE (INDICATIVE)
- EXISTING WATERWAY

NOTES:

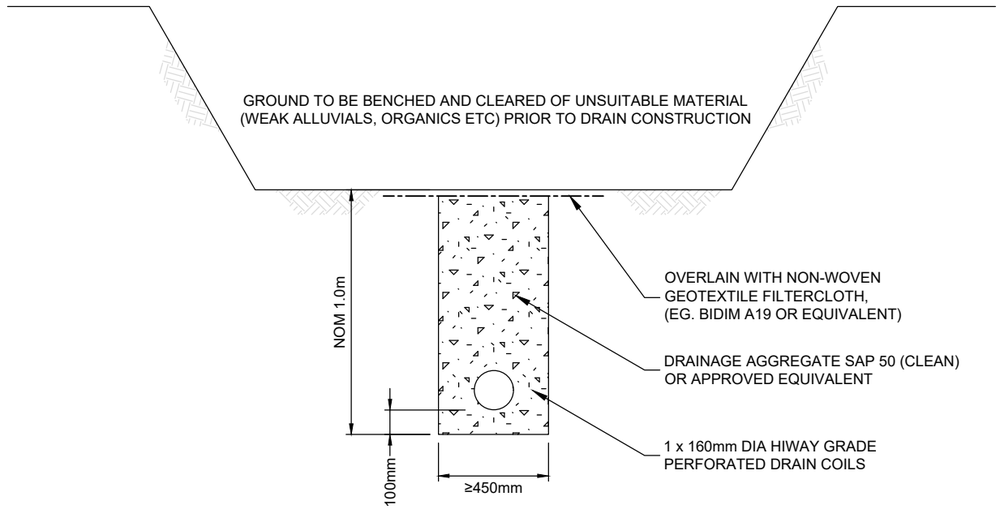
1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS MAP

1:2500 0 25 50 75 100 125 m

CMW Geosciences

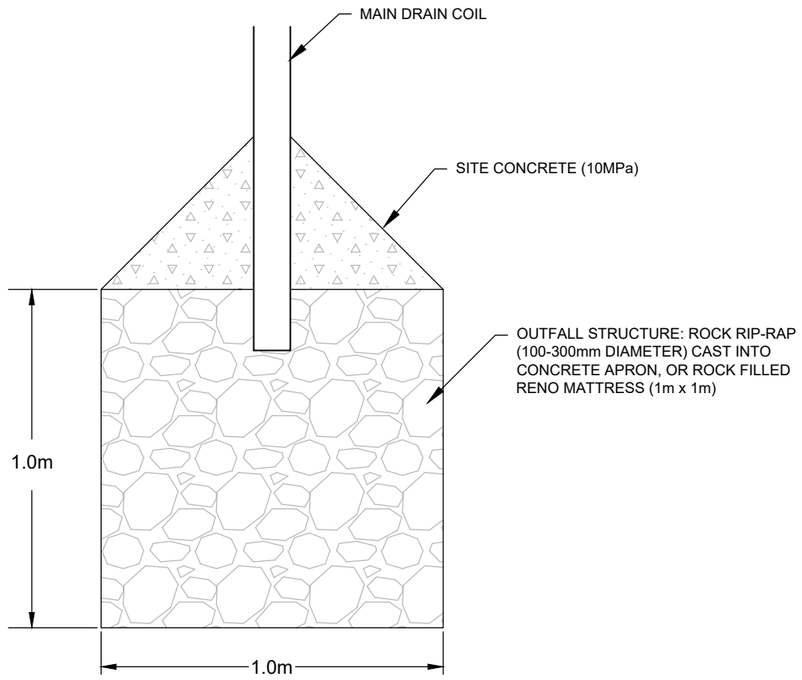
CLIENT: NEIL CONSTRUCTION LIMITED		DRAWN: FMS	PROJECT No: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD		CHECKED: TG	DRAWING: 06
		REVISION: 0	SCALE: 1:2500
TITLE: UNDERFILL DRAINAGE PLAN		DATE: 09/12/2019	SHEET: A3

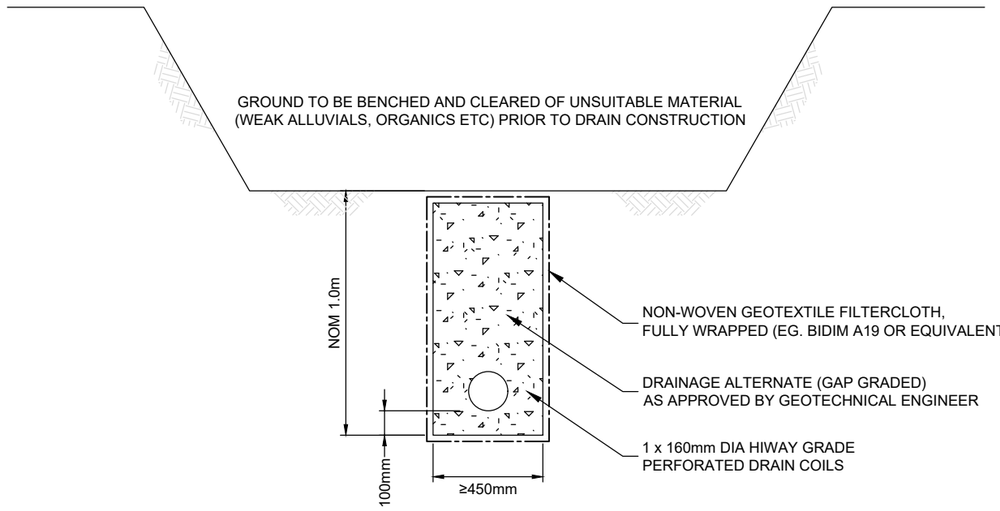
X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040- FIG01 SITE PLAN REV 1.DWG



TYPICAL UNDERFILL DRAIN DETAIL

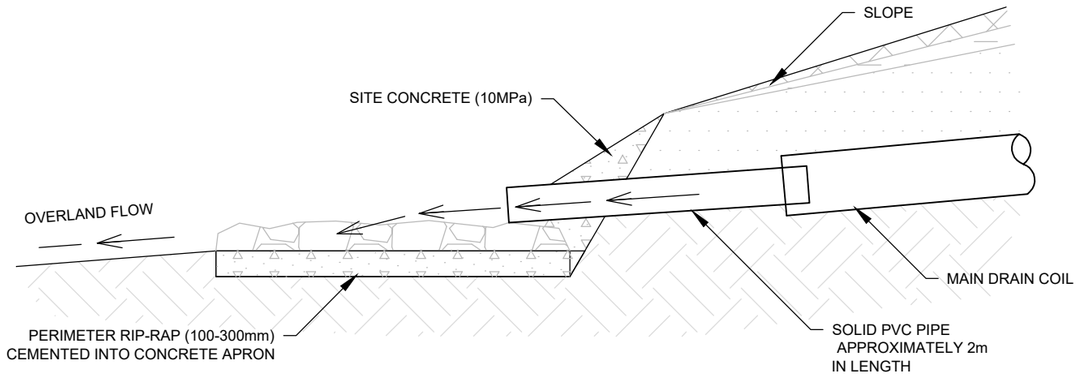
NTS





ALTERNATE UNDERFILL DRAIN DETAIL

NTS



TYPICAL OUTLET DRAIN DETAIL

NTS

REV	DATE	DESCRIPTION	BY
0	09/12/2019	FOR REPORT AKL2019-0040 AD REV 0	TG

CMW Geosciences

CLIENT: NEIL CONSTRUCTION LIMITED	DRAWN: FMS	PROJECT: AKL2019-0040
PROJECT: TRIG & BRIGHAM CREEK ROAD	CHECKED: TG	DRAWING: 07
	REVISION: 0	SCALE: NTS
TITLE: TYPICAL UNDERFILL DRAIN DETAIL	DATE: 09/12/2019	SHEET: A3

X:\01 PROJECTS\AKL\AKL2019\AKL2019-0001 TO 0050\AKL2019-0040 TRIG AND BRIGHAM CREEK ROAD\07 DRAWINGS\CAD\AKL2019-0040 DG07 UNDERFILL DRAIN DETAIL REV A.DWG

Appendix B: Supplied Development Plans

Proposed Earthworks Legend

- 35 — Existing Contours
- 0 — Proposed Contours Major
- Proposed Contours Minor
- 35 — Finished Contours (Under Existing Consent)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks Under Construction Consent LUC60350837
- Earthworks Under Construction Consent LUC60376543

N

Refer Drawing 44315-DR-C-2005

Brigham Creek Road

Road 20

1
DP 334953
153 Brigham Creek Road
Spark NZ

200

Proposed Bridge

21

Road 1

Existing Stream

300

Maximum 1 in 3 Batter

Maximum 1 in 3 Batter
Proposed Bridge

1
DP 114117
145 Brigham Creek Road

1
DP 169384
141 Brigham Creek Road

20

Earthworks Under Construction Consent LUC60350837

1
DP 167537
159 Brigham Creek Road

Kauri Road

1
DP117365
73 Trig Road

Refer Drawing 44315-DR-C-2003

Refer Drawing 44315-DR-C-2004

1
DP 177709
163 Brigham Creek Road

Trig Road

18

19

Road 4

Earthworks Under Construction Consent LUC60376543

Road 3

Road 2

Road 5

400

6

2
DP 182711

17

16

15

14

13

12

100

11

10

9

7

8

401

1
DP 50603
67 Trig Road

14
DP 62344
65 Trig Road

13
DP 62344
63 Trig Road

12
DP 62344
61 Trig Road

Refer Drawing 44315-DR-C-2001

Refer Drawing 44315-DR-C-2002

Sec 1
SO 516731
61 Brigham Creek Road

NOTES

1. The Contractor shall be responsible for locating all existing services prior to commencement of works. The Contractor shall make good at their own expense any damage to existing services.
2. Levels are in terms of Auckland Vertical Datum 1946.
3. All works are to be installed in accordance with Auckland Council Design Manual - Code of Practice for Land Development and Subdivision: (www.aucklanddesignmanual.co.nz/regulations/codes-of-practice)
   - Chapter 1 - General Requirements
   - Chapter 2 - Earthworks & Geotechnical
   - Chapter 3 - Transport (Auckland Transport)
   - Chapter 4 - Stormwater
   - Chapter 5 - Wastewater (Watercare)
   - Chapter 6 - Water (Watercare)

   Standard Drawings available from their respective websites or the Engineer.
4. If discrepancies are found between the standards, confirmation shall be sought from the Engineer and supervising council field officer.
5. Contours interval 0.5m.

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Overall Layout Plan

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

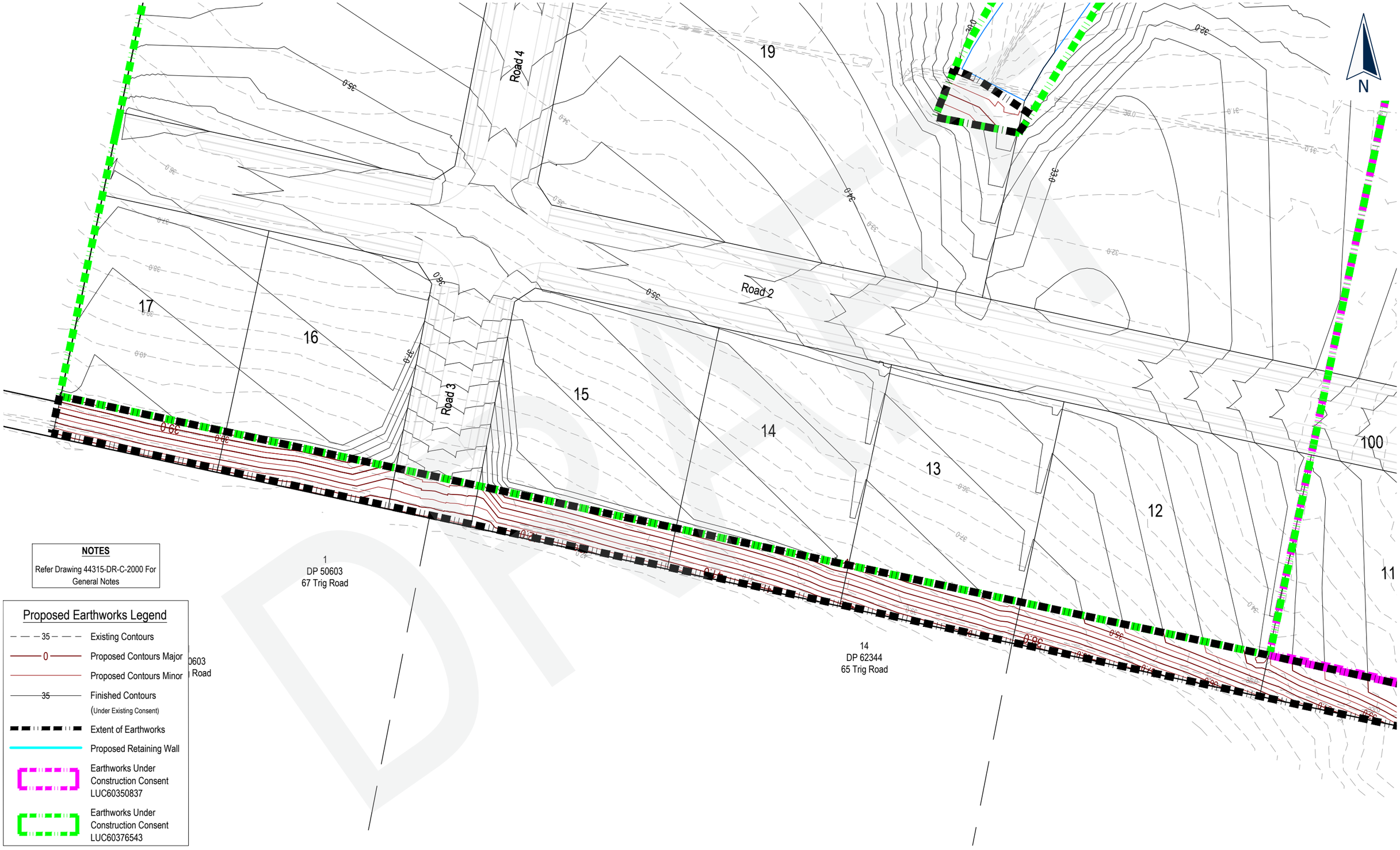
DRAFT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:3000	A3

DRAWING NO. 44315-DR-C-2000

REVISION A



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Enlarged Layout Plan
Sheet 1

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

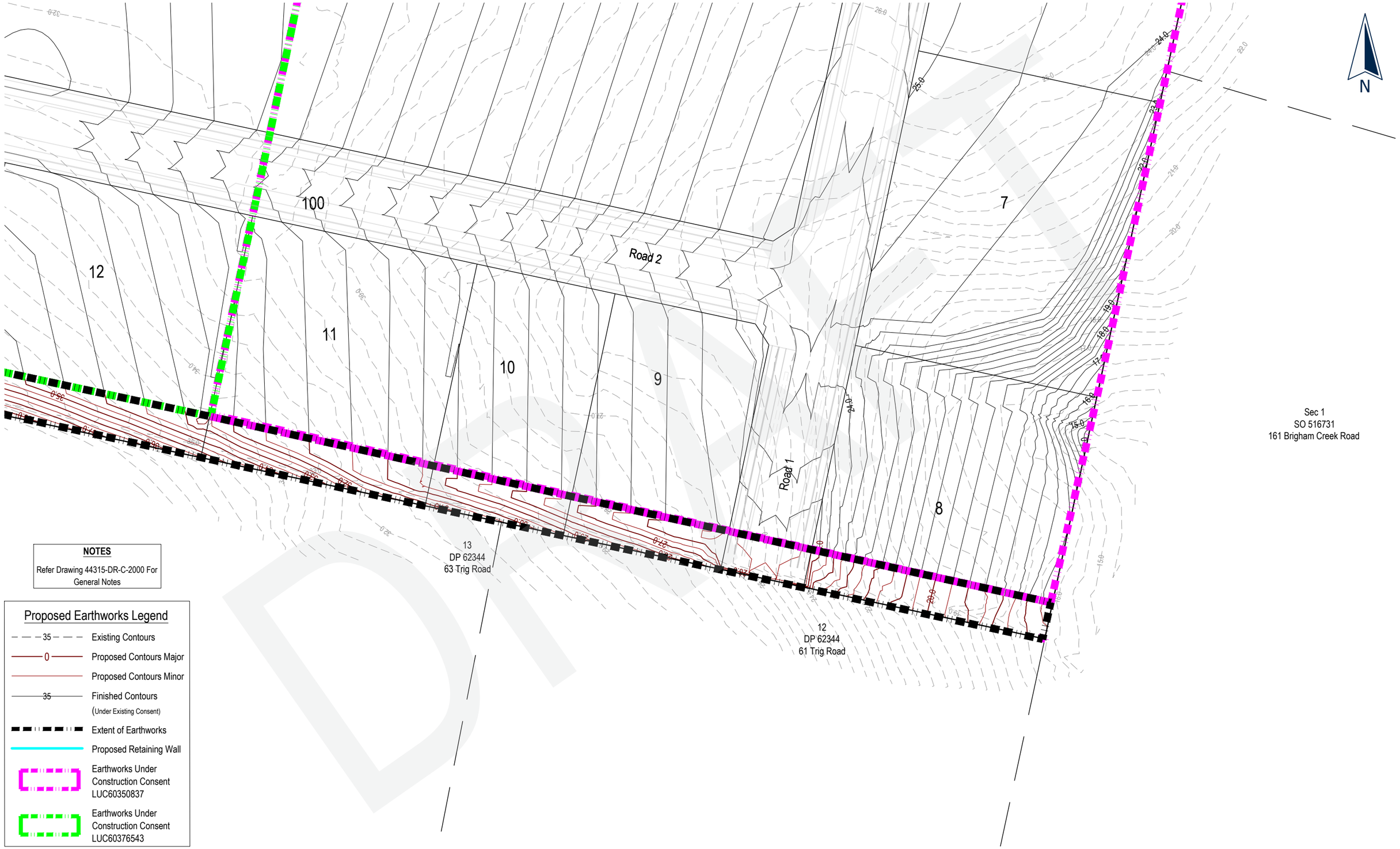
DRAFT

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:1000	A3

DRAWING NO.	REVISION
44315-DR-C-2001	A



Sec 1
SO 516731
161 Brigham Creek Road

NOTES

Refer Drawing 44315-DR-C-2000 For General Notes

Proposed Earthworks Legend

- 35 — Existing Contours
- 0 — Proposed Contours Major
- Proposed Contours Minor
- 35 — Finished Contours (Under Existing Consent)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks Under Construction Consent LUC60350837
- Earthworks Under Construction Consent LUC60376543

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Enlarged Layout Plan
Sheet 2

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

DRAFT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:1000	A3

DRAWING NO. 44315-DR-C-2002

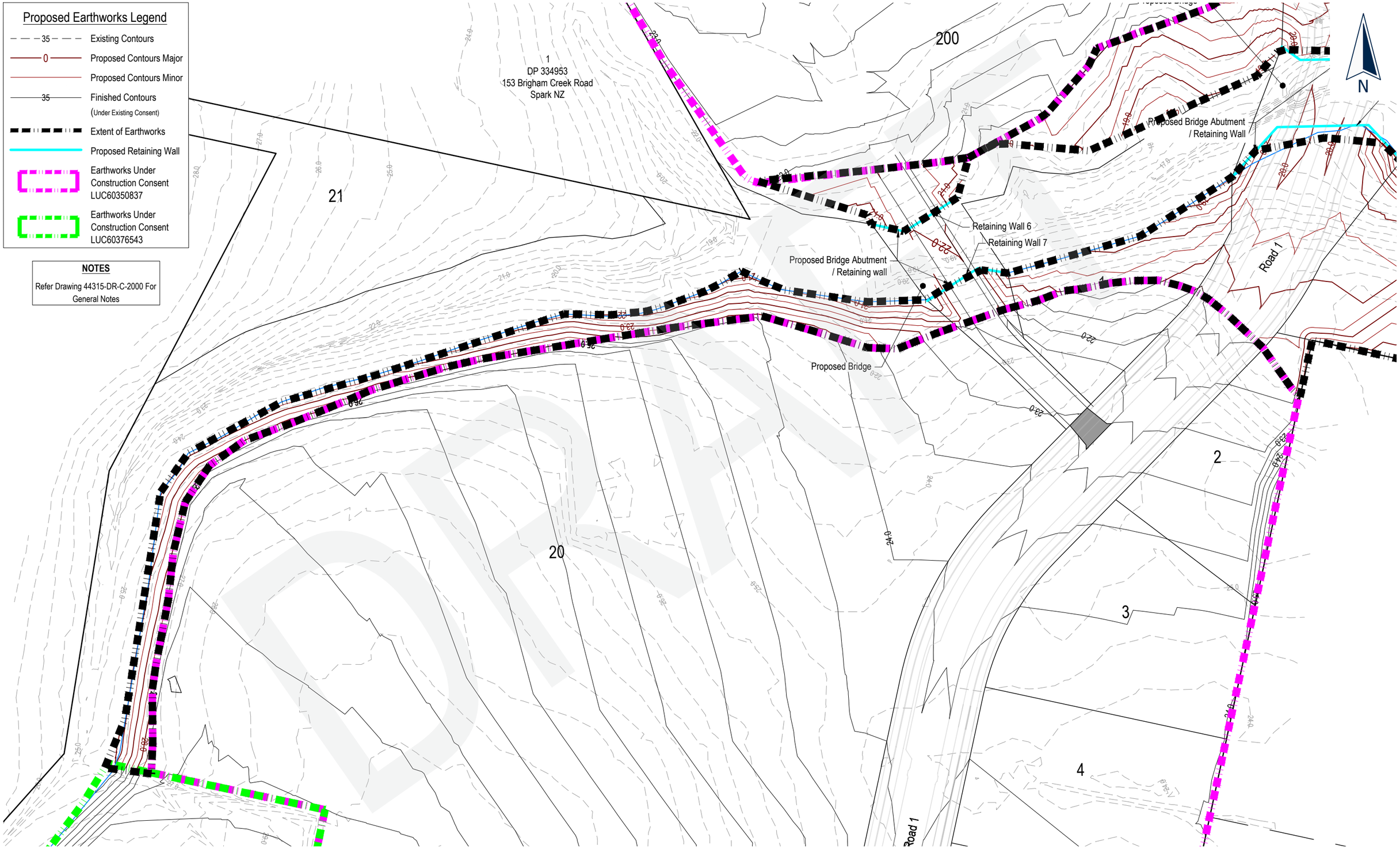
REVISION A

Proposed Earthworks Legend

- 35 — Existing Contours
- 0 — Proposed Contours Major
- Proposed Contours Minor
- 35 — Finished Contours (Under Existing Consent)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks Under Construction Consent LUC60350837
- Earthworks Under Construction Consent LUC60376543

NOTES

Refer Drawing 44315-DR-C-2000 For General Notes



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Enlarged Layout Plan
Sheet 3

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

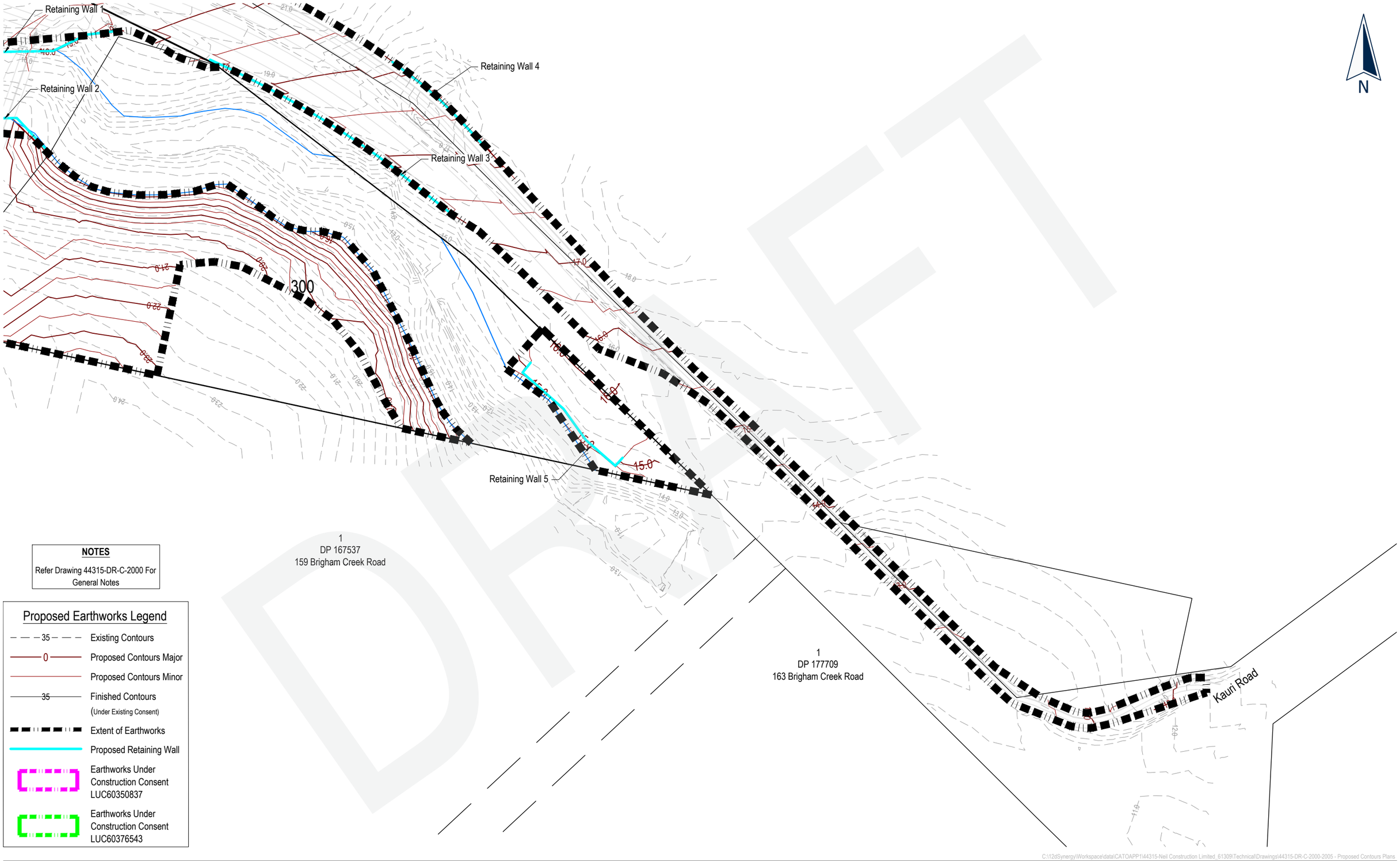
DRAFT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:1000	A3

DRAWING NO. 44315-DR-C-2003

REVISION A



NOTES

Refer Drawing 44315-DR-C-2000 For General Notes

Proposed Earthworks Legend

- Existing Contours
- Proposed Contours Major
- Proposed Contours Minor
- Finished Contours (Under Existing Consent)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks Under Construction Consent LUC60350837
- Earthworks Under Construction Consent LUC60376543

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Enlarged Layout Plan
Sheet 4

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

DRAFT

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:1000	A3

DRAWING NO. 44315-DR-C-2004

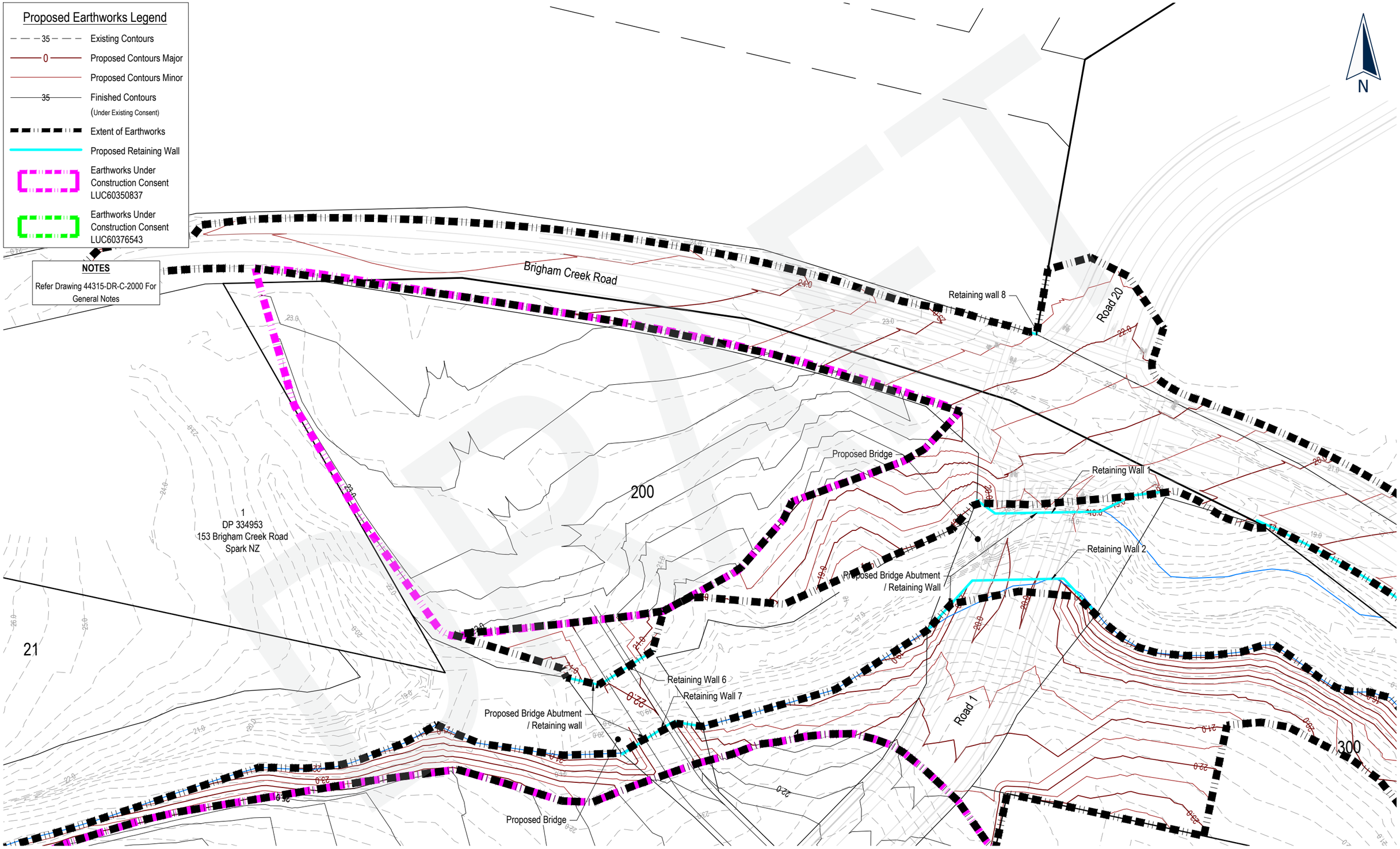
REVISION A

Proposed Earthworks Legend

- 35 — Existing Contours
- 0 — Proposed Contours Major
- Proposed Contours Minor
- 35 — Finished Contours (Under Existing Consent)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks Under Construction Consent LUC60350837
- Earthworks Under Construction Consent LUC60376543

NOTES

Refer Drawing 44315-DR-C-2000 For General Notes



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2000-2005 - Proposed Contours Plans

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Contour
Enlarged Layout Plan
Sheet 5

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

DRAFT

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	B.Nel	13/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
13/07/2022	1:1000	A3

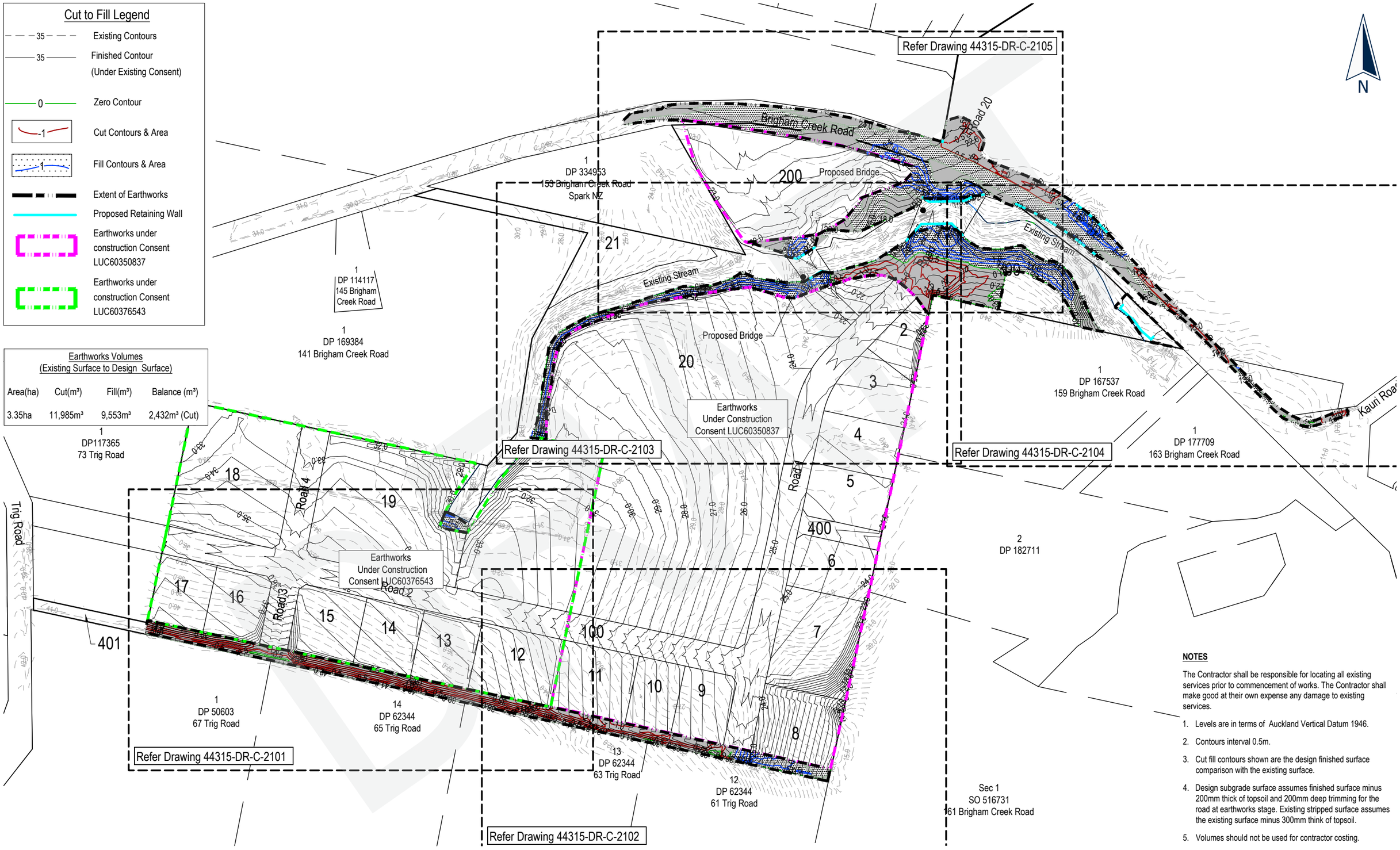
DRAWING NO.	REVISION
44315-DR-C-2005	A

Cut to Fill Legend

- Existing Contours
- Finished Contour (Under Existing Consent)
- Zero Contour
- Cut Contours & Area
- Fill Contours & Area
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks under construction Consent LUC60350837
- Earthworks under construction Consent LUC60376543

Earthworks Volumes (Existing Surface to Design Surface)

Area(ha)	Cut(m³)	Fill(m³)	Balance (m³)
3.35ha	11,985m³	9,553m³	2,432m³ (Cut)



NOTES

The Contractor shall be responsible for locating all existing services prior to commencement of works. The Contractor shall make good at their own expense any damage to existing services.

1. Levels are in terms of Auckland Vertical Datum 1946.
2. Contours interval 0.5m.
3. Cut fill contours shown are the design finished surface comparison with the existing surface.
4. Design subgrade surface assumes finished surface minus 200mm thick of topsoil and 200mm deep trimming for the road at earthworks stage. Existing stripped surface assumes the existing surface minus 300mm think of topsoil.
5. Volumes should not be used for contractor costing.

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Cut Fill Contours
(Existing Surface to Finished Surface)

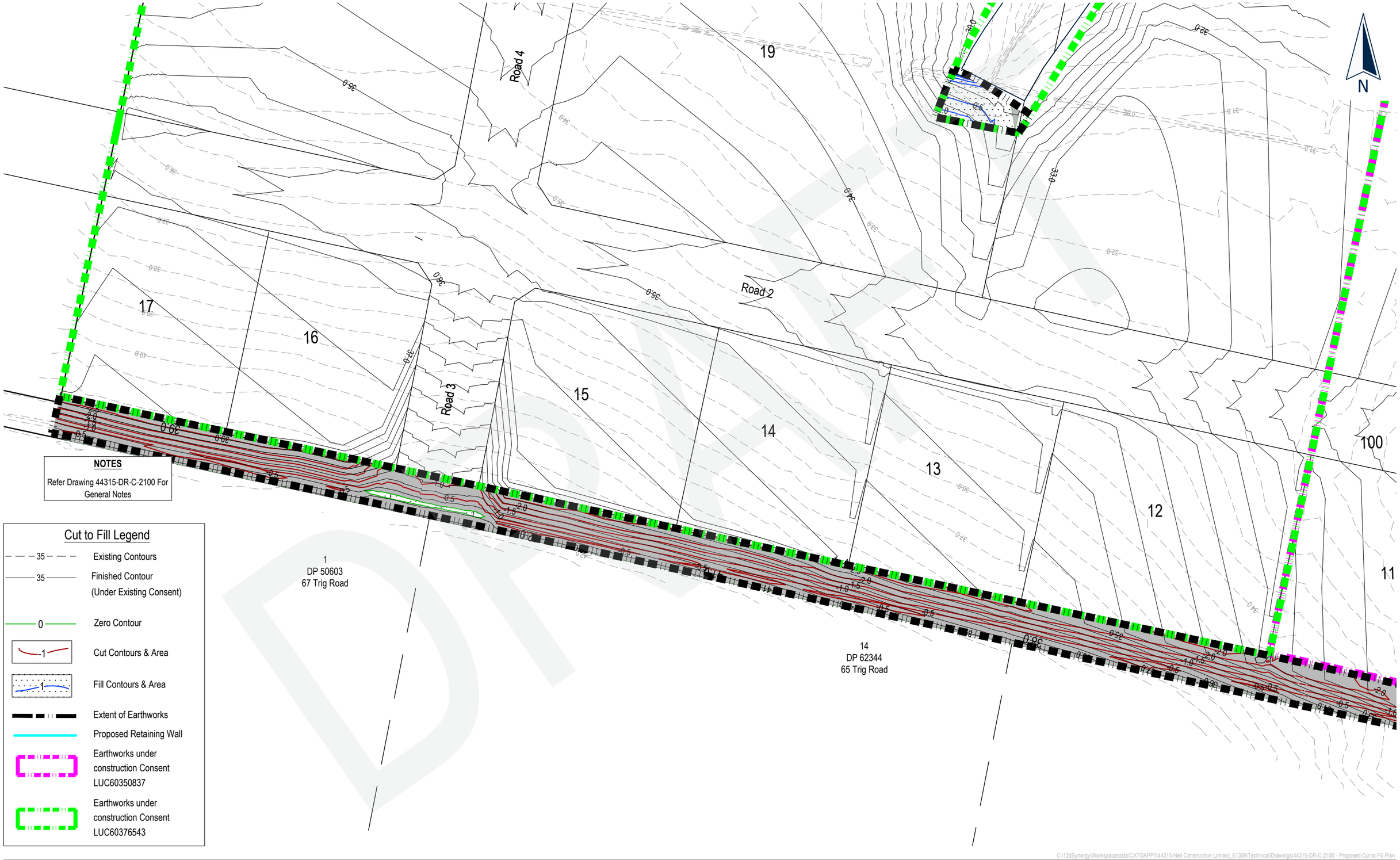
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

DRAFT
FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:3000	A3

DRAWING NO. 44315-DR-C-2100
REVISION A



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Cut to Fill
Enlarged Layout Plan
Sheet 1

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

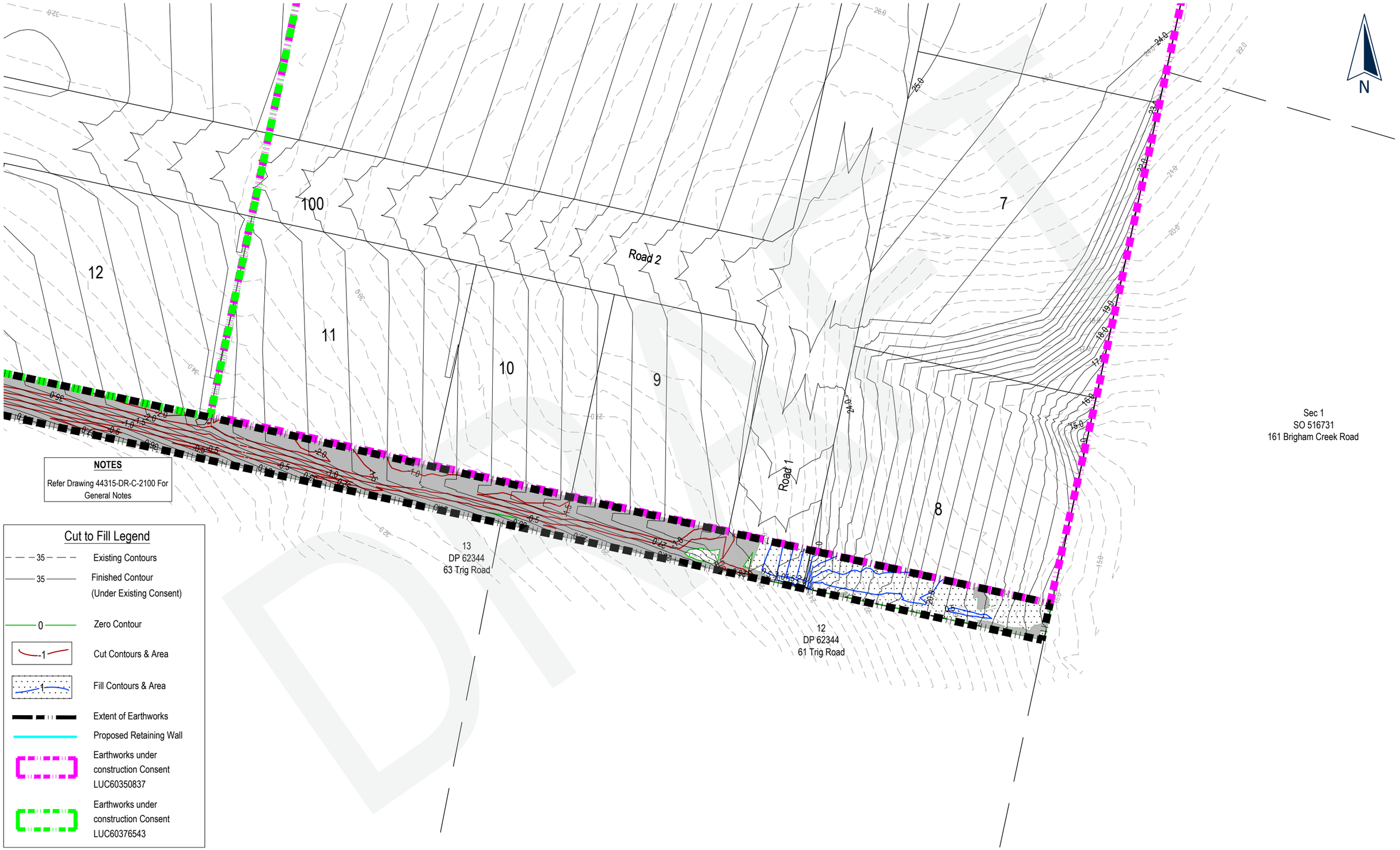
FOR RESOURCE CONSENT

DRAFT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:1000	A3

DRAWING NO.	REVISION
44315-DR-C-2101	A



Sec 1
SO 516731
161 Brigham Creek Road

NOTES

Refer Drawing 44315-DR-C-2100 For General Notes

Cut to Fill Legend

- Existing Contours
- Finished Contour (Under Existing Consent)
- Zero Contour
- Cut Contours & Area
- Fill Contours & Area
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks under construction Consent LUC60350837
- Earthworks under construction Consent LUC60376543

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Cut to Fill
Enlarged Layout Plan
Sheet 2

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:1000	A3

DRAWING NO.	REVISION
44315-DR-C-2102	A

Cut to Fill Legend

- Existing Contours (35)
- Finished Contour (Under Existing Consent) (35)
- Zero Contour (0)
- Cut Contours & Area (-1)
- Fill Contours & Area (1)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks under construction Consent LUC60350837
- Earthworks under construction Consent LUC60376543

NOTES

Refer Drawing 44315-DR-C-2100 For General Notes

1
DP 334953
153 Brigham Creek Road
Spark NZ

200

21

20

2

3

4

Proposed Bridge Abutment / Retaining Wall

Retaining Wall 6

Retaining Wall 7

Proposed Bridge Abutment / Retaining wall

Proposed Bridge

Road 1

N

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Cut to Fill
Enlarged Layout Plan
Sheet 3

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

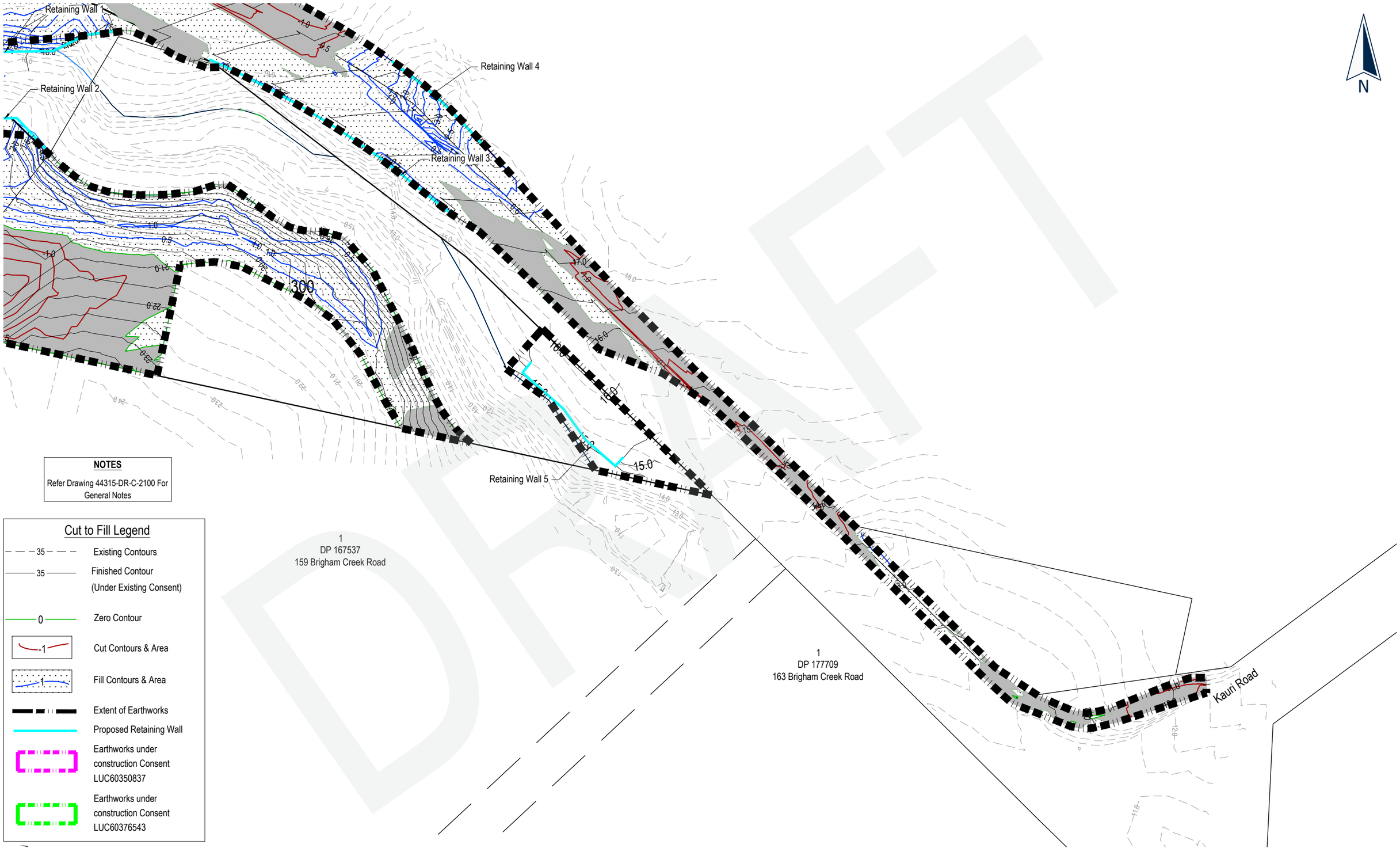
DRAFT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:1000	A3

DRAWING NO. 44315-DR-C-2103

REVISION A



NOTES

Refer Drawing 44315-DR-C-2100 For General Notes

Cut to Fill Legend

- 35 — Existing Contours
- 35 — Finished Contour (Under Existing Consent)
- 0 — Zero Contour
- -1 — Cut Contours & Area
- 1 — Fill Contours & Area
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks under construction Consent LUC60350837
- Earthworks under construction Consent LUC60376543

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Cut to Fill
Enlarged Layout Plan
Sheet 4

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

FOR RESOURCE CONSENT

DRAFT

	NAME	DATE
SURVEYED		
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:1000	A3

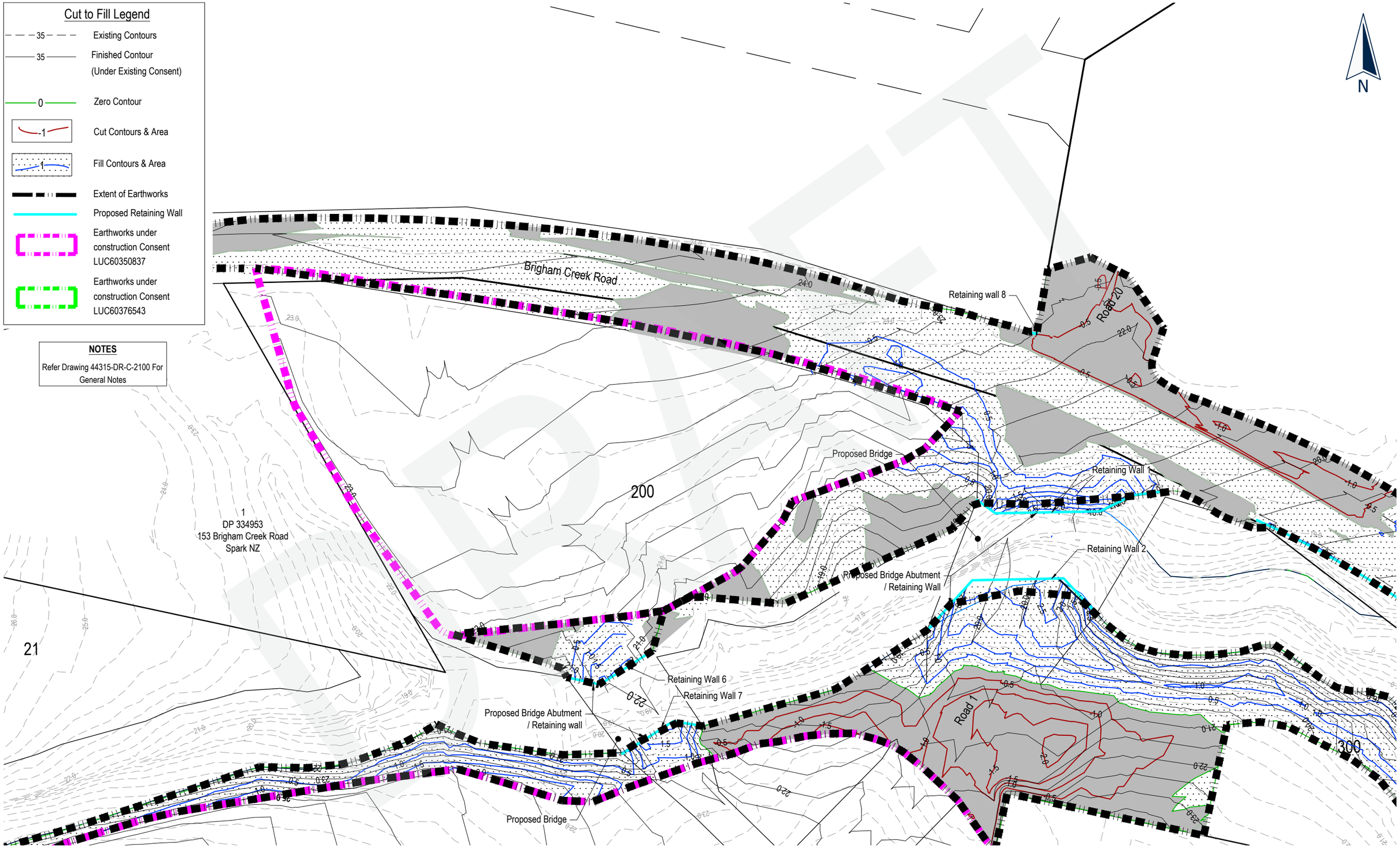
DRAWING NO.	REVISION
44315-DR-C-2104	A

Cut to Fill Legend

- Existing Contours (35)
- Finished Contour (35) (Under Existing Consent)
- Zero Contour (0)
- Cut Contours & Area (-1)
- Fill Contours & Area (1)
- Extent of Earthworks
- Proposed Retaining Wall
- Earthworks under construction Consent LUC60350837
- Earthworks under construction Consent LUC60376543

NOTES

Refer Drawing 44315-DR-C-2100 For General Notes



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2100 - Proposed Cut to Fill Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Limited
Brighams Creek Road
Whenuapai

Finished Cut to Fill
Enlarged Layout Plan
Sheet 5

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	TBC

DRAFT

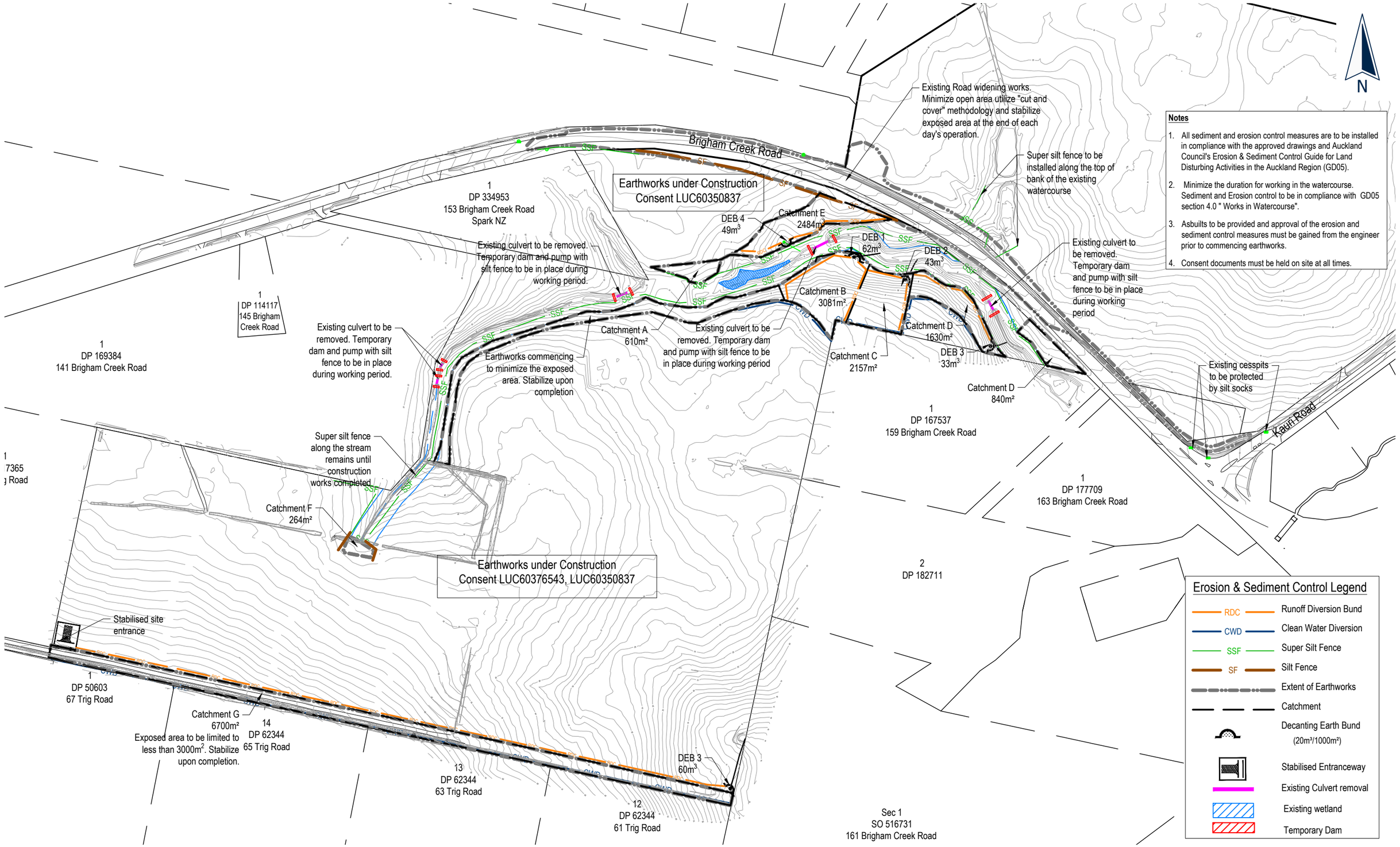
FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	-
DESIGNED	M.Chen	17/09/2021
DRAWN	S.Baby	15/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
15/07/2022	1:1000	A3

DRAWING NO. 44315-DR-C-2105

REVISION A



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2200 - Proposed Erosion & Sediment Ctrl Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Ltd
151,155-157 Brigham Creek Road
69 & 71Trig Road, Whenuapai

Sediment and Erosion Control Plan
Sheet 1of 3

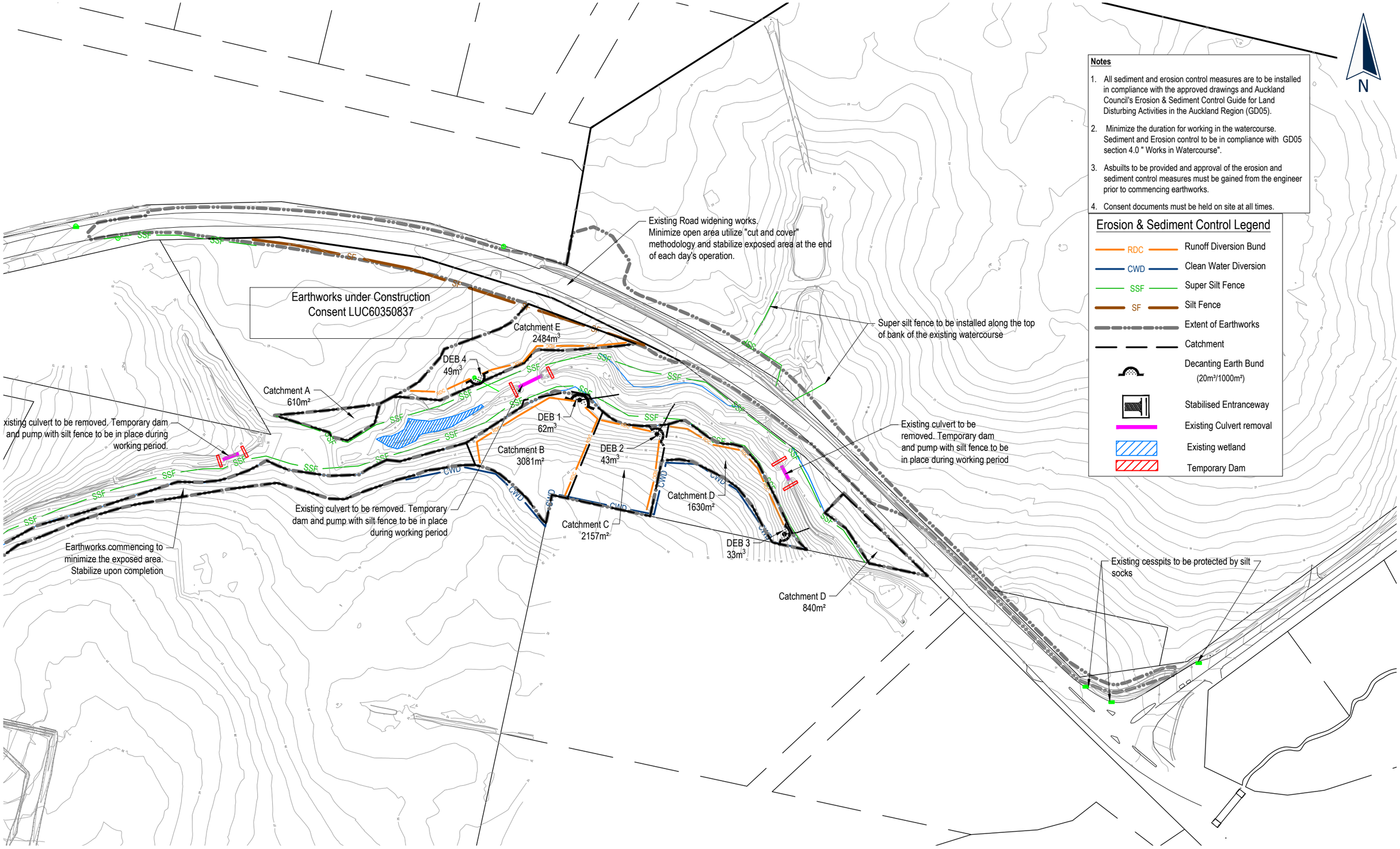
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	20/07/2022
B	Issued For Resource Consent	M.Chen	03/08/2022

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	
DESIGNED	M.Chen	20/07/2022
DRAWN	M.Chen	20/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
20/07/2022	1:3000	A3

DRAWING NO.	REVISION
44315-DR-C-2200	B



C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2200 - Proposed Erosion & Sediment Ctrl Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Ltd
151,155-157 Brigham Creek Road
69 & 71Trig Road, Whenuapai

Sediment and Erosion Control Plan
Sheet 2 of 3

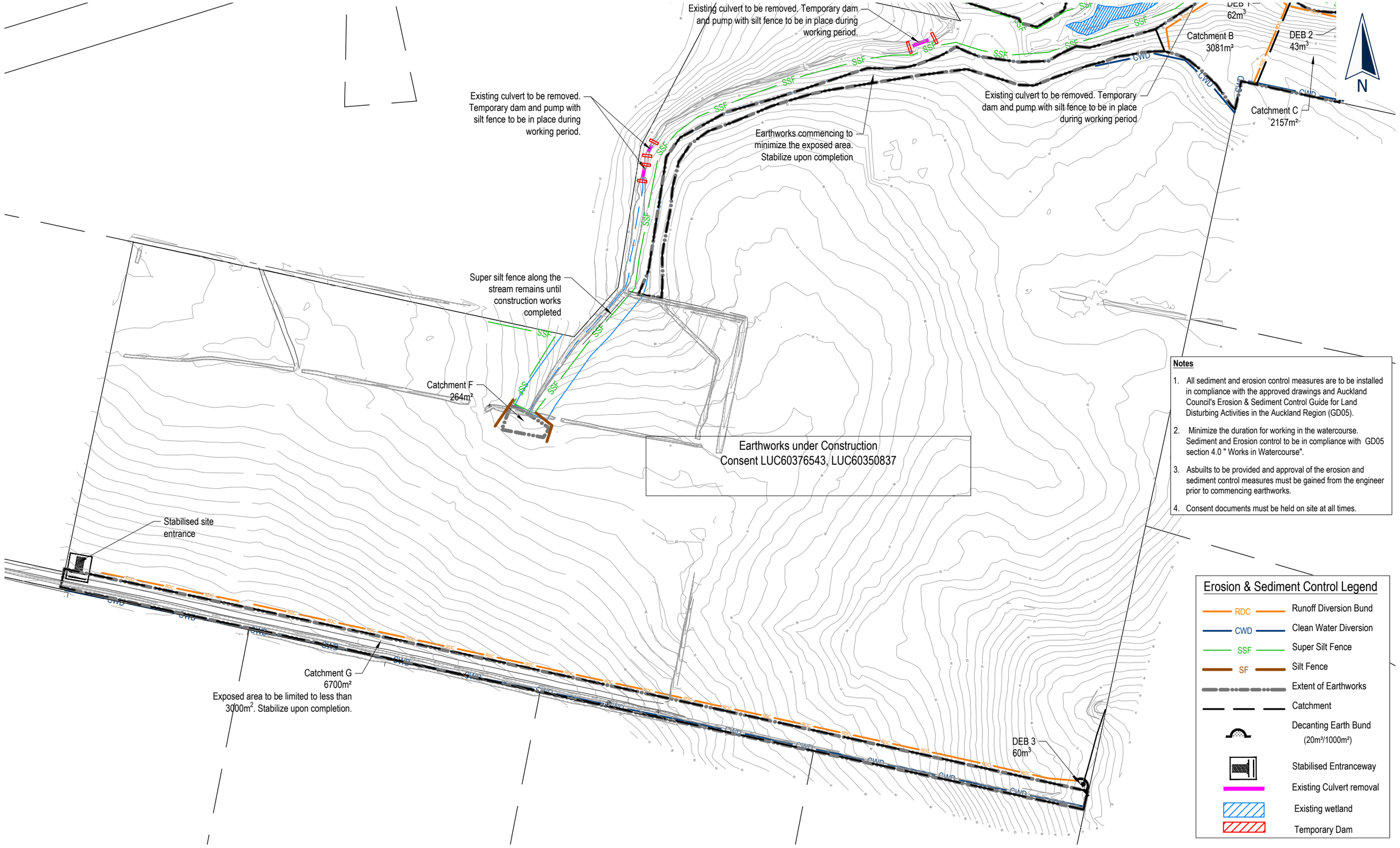
No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	M.Chen	20/07/2022
B	Issued For Resource Consent	M.Chen	03/08/2022

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	
DESIGNED	M.Chen	20/07/2022
DRAWN	M.Chen	20/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
20/07/2022	1:2000	A3

DRAWING NO. 44315-DR-C-2201
REVISION B



Notes

1. All sediment and erosion control measures are to be installed in compliance with the approved drawings and Auckland Council's Erosion & Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05).
2. Minimize the duration for working in the watercourse. Sediment and Erosion control to be in compliance with GD05 section 4.0 " Works in Watercourse".
3. Asbuilts to be provided and approval of the erosion and sediment control measures must be gained from the engineer prior to commencing earthworks.
4. Consent documents must be held on site at all times.

Erosion & Sediment Control Legend

- RDC — Runoff Diversion Bund
- CWD — Clean Water Diversion
- SSF — Super Silt Fence
- SF — Silt Fence
- Extent of Earthworks
- Catchment
- Decanting Earth Bund (20m³/1000m²)
- Stabilised Entranceway
- Existing Culvert removal
- Existing wetland
- Temporary Dam

C:\12dSynergy\Workspace\data\CATOAPP1\44315-Neil Construction Limited_61309\Technical\Drawings\44315-DR-C-2200 - Proposed Erosion & Sediment Ctrl Plan

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction Ltd
151,155-157 Brigham Creek Road
69 & 71Trig Road, Whenuapai

Sediment and Erosion Control Plan
Sheet 3 of 3

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued For Resource Consent	-	20/07/2022

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED	-	
DESIGNED	M.Chen	20/07/2022
DRAWN	M.Chen	20/07/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
20/07/2022	1:2000	A3

DRAWING NO. 44315-DR-C-2202
REVISION A

Appendix C: Investigation Data

BOREHOLE LOG - HA01-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745248.4m N.5925965.4m | Elevation: RL 26.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
		0.4	Peak = UTP	26.0	0		OL: TOPSOIL	D to M	H		HA	5 10 15	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
		0.8	Peak = UTP	25.8			CL: Gravelly CLAY: brown and orange. Low plasticity. (Fill)						
		1.2	Peak = 204+kPa		1		*... at 0.90m, with trace topsoil.*						
		1.6	Peak = UTP	24.6			GC: GRAVEL with some clay: black and grey. (Fill)	M	MD				
							Borehole terminated at 1.6 m						
					2								
					3								
					4								
					5								

Termination reason: Unable to Penetrate Further

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA02-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: RD | Position: E.1745291.5m N.5925975.4m | Elevation: RL 18.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
		18.0		OL: TOPSOIL						
0.4	Peak = 217+kPa	17.7		CL: CLAY with some silt: dark brown, grey mottled orange. Low plasticity. (Fill)	M	H				
0.8	Peak = 124kPa Residual = 53kPa		1			VSt				
1.2	Peak = 56kPa Residual = 35kPa	16.8		CH: CLAY: grey streaked blackish brown. High plasticity. (Puketoka Formation)	M to W	St				
				... from 1.20m to 1.40m, organic stained with loose sand inclusions.						
1.6	Peak = 46kPa Residual = 28kPa			*... at 1.50m, with trace fine sand.*	W					
		16.1								
2.0	Peak = 28kPa Residual = 15kPa		2	OH: CLAY: blackish grey. High plasticity. With fibrous, decomposing wood inclusions. (Puketoka Formation)						
		15.9		CH: CLAY: grey streaked blackish brown. High plasticity. (Puketoka Formation)		F				
2.4	Peak = 40kPa Residual = 28kPa				W to S			HA		
2.8	Peak = 62kPa Residual = 15kPa									
			3			St				
3.2	Peak = UTP	14.8		SM: Sandy SILT with minor clay: grey. Low plasticity. Sand is fine grained. (Waitemata Group)	S	VSt				
3.6	Peak = 124kPa Residual = 54kPa	14.3		CH: CLAY with minor fine sand: grey. High plasticity. (Waitemata Group)						
4.0	Peak = 96kPa Residual = 59kPa		4			St				
4.4	Peak = 186kPa Residual = 65kPa				W to S					
4.8	Peak = 112kPa Residual = 50kPa					VSt				
			5	Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater encountered at 2.9m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA03-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: RD | Position: E.1745316.0m N.5926078.6m | Elevation: RL 26.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
				26.0			OL: TOPSOIL						
		0.4	Peak = 77kPa Residual = 23kPa	25.7			CH: CLAY with minor silt: light grey streaked orange. High plasticity. (Puketoka Formation)		St				
		0.8	Peak = 155kPa Residual = 65kPa	25.2			CH: CLAY with minor silt trace fine sand: light grey streaked orange. High plasticity. (Puketoka Formation)						
					1								
		1.2	Peak = 170kPa Residual = 77kPa	24.9			CL: CLAY with some silt trace fine sand: grey mottled orange. Low plasticity. (Puketoka Formation)						
		1.6	Peak = 124kPa Residual = 65kPa					M	VSt				
		2.0	Peak = 103kPa Residual = 62kPa		2								
				23.8			CL: Clayey SILT with minor fine sand: whitish grey mottled orange. Low plasticity. (Puketoka Formation)						
		2.4	Peak = 93kPa Residual = 59kPa								HA		
		2.8	Peak = 77kPa Residual = 46kPa										
					3								
		3.2	Peak = 93kPa Residual = 54kPa						St				
		3.6	Peak = 77kPa Residual = 62kPa					W					
		4.0	Peak = 77kPa Residual = 44kPa		4								
		4.4	Peak = 124kPa Residual = 46kPa										
								W to S	VSt				
		4.8	Peak = 100kPa Residual = 50kPa										
					5		Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA04-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745152.1m N.5926090.1m | Elevation: RL 30.50m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Structure & Other Observations
		30.5		OL: TOPSOIL					
		30.2		CH: CLAY with minor silt: orange. High plasticity. (Puketoka Formation)					
0.4	Peak = 160kPa Residual = 35kPa								
				... at 0.60m, becoming light grey with orange streaks.					
0.8	Peak = 204+kPa								
		29.6		CH: Silty CLAY: light grey. High plasticity. (Puketoka Formation)					
1.2	Peak = 175kPa Residual = 88kPa		1						
1.6	Peak = 152kPa Residual = 102kPa					VSt			
2.0	Peak = 143kPa Residual = 114kPa		2	... at 2.00m, becoming with pinkish staining.					
2.4	Peak = 160kPa Residual = 117kPa				M			HA	
2.8	Peak = 140kPa Residual = 93kPa								
		27.6	3	CH: Silty CLAY: dark brownish grey with pink and orange streaks. High plasticity. (Puketoka Formation)					
3.2	Peak = 111kPa Residual = 73kPa	27.3		CH: Silty CLAY: light pinkish orange. High plasticity. (Puketoka Formation)					
3.6	Peak = 99kPa Residual = 82kPa			... at 3.60m, becoming light brown with orange staining.					
4.0	Peak = 85kPa Residual = 73kPa		4			St			
4.4	Peak = 82kPa Residual = 70kPa								
4.8	Peak = 73kPa Residual = 58kPa								
			5	Borehole terminated at 5.0 m					

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination reason: Target Depth Reached

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA05-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745227.8m N.5926193.3m | Elevation: RL 28.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
				28.0			OL: TOPSOIL	D to M				5 10 15	
		0.4	Peak = UTP	27.7			CL: CLAY: orange. Low plasticity. (Puketoka Formation)						
		0.8	Peak = 190kPa Residual = 120kPa		1								
		1.2	Peak = 175kPa Residual = 131kPa										
		1.6	Peak = 196kPa Residual = 160kPa	26.4			CH: Silty CLAY: light greyish orange. High plasticity. (Puketoka Formation)	M	VSt				
		2.0	Peak = 143kPa Residual = 85kPa	26.1	2		ML: Clayey SILT : greyish white. Low plasticity. No dilatant behavior. (Puketoka Formation)				HA		
		2.4	Peak = 114kPa Residual = 50kPa										
		2.8	Peak = 117kPa Residual = 44kPa		3								
		3.2	Peak = 128kPa Residual = 90kPa	24.7			CH: Silty CLAY: light whitish orange. (Puketoka Formation)		St				
		3.6	Peak = 67kPa Residual = 44kPa										
		4.0	Peak = 111kPa Residual = 73kPa	24.1	4		CL: Silty CLAY with trace fine sand: light orange. Low plasticity. Sand is completely weathered siltstone. (Waitemata Group)	W	St to VSt				
		4.4	Peak = 105kPa Residual = 67kPa										
		4.8	Peak = 99kPa Residual = 67kPa										
					5		Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA06-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745097.1m N.5926241.7m | Elevation: RL 27.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
				27.0			OL: TOPSOIL						
				26.7			CL: CLAY: light brownish grey with orange streaks. Low plasticity. (Puketoka Formation)	D to M					
		0.4	Peak = 204+kPa										
							... at 0.60m, becoming moist and high plasticity.						
		0.8	Peak = 178kPa Residual = 82kPa		1				VSt				
		1.2	Peak = 117kPa Residual = 82kPa					M					
		1.6	Peak = 102kPa Residual = 61kPa										
		2.0	Peak = 90kPa Residual = 61kPa		2								
				24.7			CH: Silty CLAY: dark brown with orange streaks. High plasticity. (Puketoka Formation)	M to W	St		HA		
		2.4	Peak = 88kPa Residual = 47kPa										
		2.8	Peak = 90kPa Residual = 47kPa										
	▼			23.9	3		CH: Silty CLAY: dark grey. High plasticity. (Waitemata Group)						
		3.2	Peak = 175kPa Residual = 96kPa										
		3.6	Peak = 178kPa Residual = 111kPa						VSt				
		4.0	Peak = 181kPa Residual = 111kPa		4			W					
		4.4	Peak = 204+kPa						H				
		4.8	Peak = 204+kPa										
					5		Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater encountered at 3.1m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA07-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: RD | Position: E.1745366.0m N.5926247.1m | Elevation: RL 24.50m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
		24.5		OL: TOPSOIL						
		24.3		CH: CLAY: orange. High plasticity. (Puketoka Formation)						
0.4	Peak = 217+kPa			... at 0.40m, becoming light grey streaked orange.						
0.8	Peak = 217+kPa		1		M	VSt to H				
1.2	Peak = 217+kPa									
		23.0		CL: Silty CLAY with minor fine sand: light grey streaked orange. Low plasticity. (Puketoka Formation)						
1.6	Peak = UTP									
2.0	Peak = >209kPa Residual = 77kPa		2							
		22.4		CH: CLAY with minor silt: orange streaked light grey. High plasticity. (Puketoka Formation)	M to W			HA		
2.4	Peak = 87kPa Residual = 47kPa									
2.8	Peak = 72kPa Residual = 46kPa									
			3							
		21.4		CH: CLAY with minor silt and minor fine sand: orange brown. High plasticity. (Puketoka Formation)		St				
3.2	Peak = 77kPa Residual = 41kPa									
		21.1		CL: CLAY with some fine to medium sand: orange and grey. Low plasticity. (Puketoka Formation)						
3.6	Peak = 66kPa Residual = 43kPa									
4.0	Peak = 118kPa Residual = 38kPa		4		W to S					
		20.4		ML: Clayey SILT with minor fine sand: grey. Low plasticity. Dilatant. (Puketoka Formation)						
		20.2		ML: Sandy SILT: grey. Low plasticity. Sand is fine to medium grained. (Waitemata Group)		VSt				
4.4	Peak = 155kPa Residual = 65kPa									
4.8	Peak = 190kPa Residual = 87kPa									
			5	Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater encountered at 3.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA08-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745232.3m N.5926335.4m | Elevation: RL 22.50m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
		22.5		OL: TOPSOIL						
		22.3		CL: Silty CLAY: light whitish grey with orange streaks. Low plasticity. (Puketoka Formation)	D to M	H				
0.4	Peak = 204+kPa									
0.8	Peak = 204+kPa		1							
1.2	Peak = 187kPa Residual = 82kPa			... at 1.20m, becoming moist and highly plastic.						
1.6	Peak = 111kPa Residual = 61kPa									
2.0	Peak = 111kPa Residual = 44kPa		2							
		20.3		CH: Silty CLAY: grey with brown orange staining. High plasticity. (Puketoka Formation)	M	VSt		HA		
2.4	Peak = 102kPa Residual = 41kPa									
2.8	Peak = 105kPa Residual = 50kPa			... at 2.80m, becoming dark grey with orange streaks.						
		19.5	3	CL: CLAY: dark grey. Low plasticity. (Waitemata Group)						
3.2	Peak = 160kPa Residual = 73kPa									
3.6	Peak = 160kPa Residual = 82kPa			... at 3.60m, becoming wet.	W	H				
4.0	Peak = 204+kPa		4							
4.4	Peak = 204+kPa									
4.8	Peak = 204+kPa									
			5	Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater encountered at 3.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA09-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: JMJ | Position: E.1745237.9m N.5926451.8m | Elevation: RL 23.50m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
		23.5		OL: TOPSOIL		
		23.3		CL: CLAY : light orange. Low plasticity. (Puketoka Formation)	D to M	H
0.4	Peak = 204+kPa					
		23.0		CH: Silty CLAY: dark brownish grey. High plasticity. (Puketoka Formation)		
0.8	Peak = 117kPa Residual = 44kPa		1			
1.2	Peak = 140kPa Residual = 82kPa			... at 1.30m, becoming with black and orange staining. Minor organic smell.	M	VSt
1.6	Peak = 140kPa Residual = 73kPa					
		21.7		CH: Silty CLAY : black with brown streaks. High plasticity. Organic smell and minor fibrous rootlets and wood inclusions. (Puketoka Formation)	M to W	
2.0	Peak = 67kPa Residual = 32kPa		2			
		21.2		CH: Silty CLAY: light brownish grey. High plasticity. (Puketoka Formation)		
2.4	Peak = 70kPa Residual = 44kPa					
2.8	Peak = 82kPa Residual = 47kPa					St
3.2	Peak = 88kPa Residual = 29kPa		3			
3.6	Peak = 93kPa Residual = 47kPa				W	
		19.7		CL: CLAY with some silt and trace fine sand: dark grey. Low plasticity. Sand is crushed completely weathered siltstone. (Waitemata Group)		
4.0	Peak = 90kPa Residual = 29kPa		4			
4.4	Peak = 160kPa Residual = 41kPa					VSt
4.8	Peak = UTP					
			5	Borehole terminated at 5.0 m		

Recovery: HA

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

Termination reason: Target Depth Reached

Remarks: Groundwater encountered at 2.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA10-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: RD | Position: E.1745346.6m N.5926396.7m | Elevation: RL 21.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
				21.0			OL: TOPSOIL					5 10 15	
		0.4	Peak = 108kPa Residual = 28kPa	20.7			ML: Clayey SILT with trace fine sand: light grey and light brown. Low plasticity. (Puketoka Formation)						
		0.8	Peak = 110kPa Residual = 32kPa		1				VSt				
		1.2	Peak = 121kPa Residual = 41kPa					M					
		1.6	Peak = 109kPa Residual = 46kPa	19.3			CL: Silty CLAY with trace fine sand: grey. Low plasticity. (Puketoka Formation)						
		2.0	Peak = 81kPa Residual = 34kPa		2				St				
							... at 2.10m, with some fine sand.						
		2.4	Peak = 155kPa Residual = 49kPa								HA		
		2.8	Peak = 189kPa Residual = 46kPa	18.1			ML: Sandy SILT with minor clay: grey. Low plasticity. Sand is fine grained. (Waitemata Group)						
		3.2	Peak = 217+kPa		3				VSt to H				
		3.6	Peak = 201kPa Residual = 46kPa										
		4.0	Peak = 217+kPa		4			W					
		4.4	Peak = UTP										
		4.8	Peak = 217+kPa										
					5		Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - HA11-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 18/03/2019
Borehole Location: Refer to site plan

CMW Geosciences

1:25 Sheet 1 of 1

Logged by: RD | Position: E.1745465.3m N.5926340.9m | Elevation: RL 22.00m | Hole Diameter: 50mm
Checked by: TG | Survey Source: Measured onsite | Datum: NZTM | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
				22.0			OL: TOPSOIL						
				21.9			ML: SILT: orange. Low plasticity. Friable. (Puketoka Formation)	D					
		0.4	Peak = UTP	21.6			CH: CLAY with minor silt: orange brown. High plasticity. (Puketoka Formation)		VSt to H				
		0.8	Peak = 217+kPa										
				21.1	1		CL: Silty CLAY with minor fine sand: light greyish orange. Low plasticity. (Puketoka Formation)	M					
		1.2	Peak = 155kPa Residual = 65kPa										
		1.6	Peak = 116kPa Residual = 46kPa						VSt				
				20.3			ML: Clayey SILT with minor fine sand: light grey streaked orange. Low plasticity. (Puketoka Formation)						
		2.0	Peak = 96kPa Residual = 34kPa		2				St				
		2.4	Peak = 118kPa Residual = 32kPa								HA		
		2.8	Peak = 143kPa Residual = 32kPa					M to W					
					3				VSt				
		3.2	Peak = 167kPa Residual = 47kPa										
		3.6	Peak = 217+kPa										
		4.0	Peak = 217+kPa		4				H				
				17.9			ML: Sandy SILT with minor clay: light grey streaked orange. Low plasticity. Sand in fine grained. (Waitemata Group)						
		4.4	Peak = 139kPa Residual = 44kPa					W					
		4.8	Peak = 153kPa Residual = 29kPa						VSt				
					5		Borehole terminated at 5.0 m						

Termination reason: Target Depth Reached

Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA12-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745342.0mE; 5926450.0mN Projection: NZTM
Elevation: 23.50m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			23.5			ML: SILT with minor clay: brown. Low plasticity. (Uncontrolled Fill)			
			23.3			ML: SILT with some clay: orange brown. Low plasticity. Trace limonite streaks throughout. (Puketoka Formation)			
	0.4	Peak = 160kPa Residual = 58kPa						VSt	
			22.8			CH: CLAY with minor silt: light brown streaked dark orange. High plasticity. (Puketoka Formation)			
	0.8	Peak = 64kPa Residual = 26kPa						St	
				1		... at 1.00m, becoming grey with trace organic staining and rootlets			
	1.2	Peak = 160kPa Residual = 32kPa					M		
			22.0			CH: Silty CLAY: grey brown. High plasticity. Trace organic staining. (Puketoka Formation)		VSt	
	1.6	Peak = 128kPa Residual = 45kPa							
			21.8			CH: Organic stained Silty CLAY: black. High plasticity. Rootlets. (Puketoka Formation)			
	2.0	Peak = 83kPa Residual = 58kPa	21.5	2		CH: CLAY with minor silt: grey with black streaks. High plasticity. (Puketoka Formation)			
	2.4	Peak = 99kPa Residual = 64kPa						St	
▼	2.8	Peak = 86kPa Residual = 32kPa	20.7			CH: Silty CLAY with minor fine to coarse sand: grey. High plasticity. Sand is sub angular to sub rounded. Trace organics. (Puketoka Formation)	W		
				3		... at 3.00m, saturated			
	3.2	Peak = 128kPa Residual = 35kPa				... at 3.20m, with some fine to coarse grained sand			
	3.6	Peak = 131kPa Residual = 32kPa	19.9			CH: Sandy CLAY with some silt: grey. Low plasticity. Trace organics. (Puketoka Formation)	S		
	4.0	Peak = 147kPa Residual = 38kPa		4				VSt	
	4.4	Peak = 157kPa Residual = 58kPa							
	4.8	Peak = 176kPa Residual = 70kPa	18.7			CH: Silty CLAY: dark grey. High plasticity. Trace organic staining. (Puketoka Formation)	M to W		
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater encountered at 2.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA13-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745363.0mE; 5926449.0mN Projection: NZTM
Elevation: 23.00m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			23.0			OL: TOPSOIL			
			23.0			CL: Silty CLAY with trace gravel: orange, grey, brown and black. Low plasticity. (Uncontrolled Fill)			
	0.4	Peak = 147kPa Residual = 64kPa	22.6			OL: Buried TOPSOIL		VSt	
			22.6			CH: Silty CLAY with trace fine to coasre sand: grey streaked orange and brown. High plasticity. (Puketoka Formation)			
	0.8	Peak = 83kPa Residual = 35kPa				... at 0.80m, 100mm seam of black organic stained CLAY			
			22.1	1		CH: CLAY with minor silt and trace rootlets: grey mottled orange. High plasticity. Trace white pumiceous inclusions. (Puketoka Formation)		St	
	1.2	Peak = 128kPa Residual = 80kPa					M		
	1.6	Peak = 115kPa Residual = 58kPa						VSt	
						... at 1.80m, with trace fine to medium grained sand			
	2.0	Peak = 99kPa Residual = 51kPa	21.0	2		CH: Silty CLAY with minor fine to coarse sand: grey. High plasticity. Trace white pumiceous mottles and trace organics. (Puketoka Formation)		St	
	2.4	Peak = 115kPa Residual = 51kPa							
▼	2.8	Peak = 134kPa Residual = 48kPa	20.2			CH: Sandy CLAY with minor silt: dark grey. High plasticity. Sand is fine to coarse grained. Trace organics. (Puketoka Formation)			
				3					
	3.2	Peak = 144kPa Residual = 48kPa				... at 3.20m, with some silt			
	3.6	Peak = 147kPa Residual = 45kPa					M to W	VSt	
	4.0	Peak = 138kPa Residual = 35kPa		4					
			18.8			CH: Silty CLAY: dark grey. High plasticity. (Waitemata Group)			
	4.4	Peak = 176kPa Residual = 74kPa					W to S		
	4.8	Peak = 224+ kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater encountered at 2.9m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA14-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745395.0mE; 5926441.0mN Projection: NZTM
Elevation: 21.20m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			21.2			OL: TOPSOIL			
			21.2			CH: Silty CLAY with trace gravel: orange, brown, grey, black. High plasticity. (Uncontrolled Fill)			
	0.4	Peak = 166kPa Residual = 70kPa						VSt	
			20.4			OL: Buried TOPSOIL		F	
			20.2	1		CH: CLAY with minor silt and trace fine to coarse sand: brown streaked orange. High plasticity. Trace rootlets. (Puketoka Formation)			
	1.2	Peak = 90kPa Residual = 45kPa				*... at 1.20m, becoming grey streaked orange*	M		
			19.9			CH: Silty CLAY with minor fine to coarse sand: grey brown streaked orange. High plasticity. Trace organic staining and trace rootlets. (Puketoka Formation)		St	
	1.6	Peak = 67kPa Residual = 19kPa							
			19.4			CH: Sandy CLAY with minor rootlets: dark grey. High plasticity. Trace organic staining. Alternating every 100-150mm with Clayey SILT, dark grey, low plasticity. (Puketoka Formation)			
	2.0	Peak = 173kPa Residual = 45kPa		2					
▼	2.4	Peak = 144kPa Residual = 80kPa							
	2.8	Peak = 115kPa Residual = 48kPa							
			18.2	3		CH: Sandy CLAY: dark grey. High plasticity. Sand is fine to coarse grained. Inter-bedded with Clayey SILT, dark grey, low plasticity. (Waitemata Group)		VSt	
	3.2	Peak = 176kPa Residual = 45kPa							
	3.6	Peak = 192kPa Residual = 58kPa					W to S		
	4.0	Peak = 224+ kPa		4					
	4.4	Peak = UTP							
	4.8	Peak = UTP							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater encountered at 2.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA15-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745378.0mE; 5926419.0mN Projection: NZTM
Elevation: 20.20m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			20.2			OL: TOPSOIL	D		
	0.4	Peak = 178+ kPa	19.8			CI: Silty CLAY: Yellowish brown, mottled grey. Low-high plasticity. Trace fine sand. (Uncontrolled Fill)		VSt	
	0.8	Peak = 135kPa Residual = 61kPa		1			M		
	1.2	Peak = 61kPa Residual = 28kPa							
			18.9			OL: Buried TOPSOIL: Contains gravel.	W to S		
	1.6	Peak = 28kPa Residual = 18kPa						F to St	
			18.5			CL: Silty CLAY with some sand: Brownish grey, mottled brown. Low plasticity, trace organic fragments and roots (<15mm) (Puketoka Formation)			
▼	2.0	Peak = 74kPa Residual = 18kPa		2			W		
			18.0			MH: Clayey SILT: Grey. Low plasticity. (Waitemata Group)			
	2.4	Peak = 178+ kPa							
			17.6			MH: Sandy SILT: Grey. Low plasticity. Fine to medium. (Waitemata Group)			
	2.8	Peak = 178+ kPa							
				3		*... from 3.00m to 5.00m, Becoming moist, loosely packed*			
	3.2	Peak = 178+ kPa							
	3.6	Peak = 178+ kPa						VSt to H	
	4.0	Peak = UTP		4			M		
	4.4	Peak = 178+ kPa							
	4.8	Peak = 178+ kPa							
	5.0	Peak = 178+ kPa		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.2m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA16-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745402.0mE; 5926415.0mN Projection: NZTM
Elevation: 20.10m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			20.1			OL: TOPSOIL:	D		
			19.9			CL: Silty CLAY: Yellow, mottled brown. Low plasticity. (Uncontrolled Fill)			
	0.4	Peak = 123kPa Residual = 42kPa							
			19.5			ML: Clayey SILT: Brown, mottled yellow and grey. Low plasticity. Friable. (Uncontrolled Fill)			
	0.8	Peak = 120kPa Residual = 60kPa					M	VSt	
				1					
	1.2	Peak = 114kPa Residual = 57kPa				*... from 1.20m to 1.60m, Becoming yellow, mottled brown, grey, some orange.*			
	1.6	Peak = 81kPa Residual = 42kPa	18.5			CH: Silty CLAY: Yellow-orange. High plasticity. (Puketoka Formation)		St	
▼	2.0	Peak = 211+ kPa	18.1	2		CH: Silty CLAY: Dark grey, streaked orange. High plasticity (Puketoka Formation)			
	2.4	Peak = 211+ kPa							
	2.8	Peak = 211+ kPa							
			17.1	3		CL: Clayey SILT with some sand: Dark grey, Low plasticity. Sand is fine to coarse grained. (Waitemata Group)			
	3.2	Peak = 211+ kPa					M to W	VSt to H	
	3.6	Peak = 211+ kPa							
	4.0	Peak = 211+ kPa		4					
	4.4	Peak = UTP							
	4.8	Peak = UTP							
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2082 DCP No:
Remarks: Groundwater encountered at 2.0m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA17-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745434.0mE; 5926388.0mN Projection: NZTM
Elevation: 17.50m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			17.5			OL: TOPSOIL	D		
			17.2						
	0.4	Peak = 178+ kPa				CI: Silty CLAY with trace sand: Orange mottled grey. Low-High plasticity. Sand is fine to medium. (Puketoka Formation)			
	0.8	Peak = 145kPa Residual = 63kPa						VSt	
				1		... at 0.90m, Becoming light grey mottled orange			
	1.2	Peak = 122kPa Residual = 36kPa					M		
	1.6	Peak = 99kPa Residual = 43kPa							
						... at 1.80m, Trace organic fragments of <20mm appearing			
▼	2.0	Peak = 56kPa Residual = 23kPa	15.5	2		CH: CLAY: Brown. High plasticity. Trace organic fragments of <10mm. (Puketoka Formation)		St	
	2.4	Peak = 43kPa Residual = 23kPa				... at 2.30m, Becoming grey, mottled brown and orange		F	
	2.8	Peak = 61kPa Residual = 15kPa				... at 2.70m, Trace medium to coarse sand appearing	W to S		
				3					
	3.2	Peak = 56kPa Residual = 23kPa						St	
	3.6	Peak = 41kPa Residual = 18kPa						F	
			13.6						
	4.0	Peak = 137kPa Residual = 36kPa		4		CI: Silty CLAY with minor sand: Grey. Low to high plasticity. Sand is medium to coarse. (Waitemata Group)			
	4.4	Peak = 152kPa Residual = 56kPa					W	VSt	
	4.8	Peak = 132kPa Residual = 48kPa							
	5.0	Peak = 152kPa Residual = 36kPa		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.0m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA18-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 25/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745409.0mE; 5926375.0mN Projection: NZTM
Elevation: 18.60m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			18.6			OL: TOPSOIL:			
			18.4			MH: Clayey SILT: Grey, mottled brown and orange. Low plasticity, friable. (Uncontrolled Fill)			
	0.4	Peak = 172kPa Residual = 60kPa							
	0.8	Peak = 135kPa Residual = 84kPa							
			17.6	1		MH: Clayey SILT: Grey, mottled brown and orange. High plasticity. (Uncontrolled Fill)	M	VSt	
	1.2	Peak = 135kPa Residual = 63kPa							
	1.6	Peak = 105kPa Residual = 42kPa	17.0			CH: Silty CLAY: Yellow, mottled orange and grey. High plasticity. (Puketoka Formation)			
			16.8			MH: Clayey SILT with minor sand: Grey, small orange and brown mottles. High plasticity. (Puketoka Formation)			
▼	2.0	Peak = 54kPa Residual = 27kPa		2					
			16.4			CH: Silty CLAY: Grey and dark brown. High plasticity. Poor recovery after 2.4m, shear strengths are not an accurate representation. (Puketoka Formation)			
	2.4	Peak = 69kPa Residual = 27kPa							
	2.8	Peak = 57kPa Residual = 30kPa							
				3				St	
	3.2	Peak = 66kPa Residual = 48kPa					S		
	3.6	Peak = 60kPa Residual = 45kPa							
	4.0	Peak = 105kPa Residual = 81kPa		4					
	4.4	Peak = 211+ kPa	14.2			ML: Clayey SILT with some sand: Grey. Low plasticity. (Waitemata Group)		VSt to H	
	4.8	Peak = 211+ kPa					W		
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2082 DCP No:
Remarks: Groundwater encountered at 2.0m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA19-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745295.0mE; 5926333.0mN Projection: NZTM
Elevation: 21.40m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			21.4			OL: TOPSOIL:			
	0.4	Peak = 124kPa Residual = 28kPa	21.0			CL: Silty CLAY: Yellow mottled grey and orange. Low plasticity (Uncontrolled Fill)			
			20.8			ML: Clayey SILT with minor sand: Dark brown. Low plasticity. Friable. Fine to medium sand. (Puketoka Formation)			
	0.8	Peak = 140kPa Residual = 48kPa	20.6			CL: Silty CLAY with minor sand: Grey mottled orange and brown. Low plasticity (Puketoka Formation)		VSt	
				1			M		
	1.2	Peak = 142kPa Residual = 79kPa							
			20.0			ML: Clayey SILT: Light grey and brown. Low plasticity. (Puketoka Formation)			
	1.6	Peak = 58kPa Residual = 25kPa						St	
▼	2.0	Peak = 36kPa Residual = 18kPa		2		*... from 2.00m to 2.20m, Becoming saturated, high plasticity*		F	
			19.2			ML: Clayey SILT: Grey mottled orange. Low plasticity. (Puketoka Formation)			
	2.4	Peak = UTP				*... from 2.60m to 2.80m, Becoming brown*			
	2.8	Peak = UTP				*... from 2.80m to 3.60m, Becoming grey mottled orange*	S		
				3					
	3.2	Peak = 178+ kPa							
	3.6	Peak = UTP	17.8			ML: Clayey SILT with some sand: Dark grey. Low plasticity. (Waitemata Group)		VSt	
	4.0	Peak = UTP		4			W		
	4.4	Peak = UTP							
			16.9			ML: Clayey SILT with some sand: Dark grey. Low to high plasticity. (Waitemata Group)	S		
			16.7			ML: Clayey SILT with some sand: Dark grey. Low plasticity. (Waitemata Group)			
	4.8	Peak = UTP					W		
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.0m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA20-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745296.0mE; 5926292.0mN Projection: NZTM
Elevation: 23.40m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			23.4			OL: TOPSOIL:			
			23.2			CL: Silty CLAY: Dark brown, mottled orange. Low plasticity. (Uncontrolled Fill)			
	0.4	Peak = 178+ kPa	23.0			CL: Silty CLAY: Grey, mottled orange. Low plasticity. (Puketoka Formation)			
	0.8	Peak = 119kPa Residual = 58kPa		1		*... from 1.00m to 1.60m, Orange mottles ending*			
	1.2	Peak = 160kPa Residual = 109kPa					M	VSt	
	1.6	Peak = 142kPa Residual = 79kPa	21.8			ML: Clayey SILT: Light grey, mottled orange. Low plasticity (Puketoka Formation)			
			21.6			MH: Clayey SILT: Yellow, mottled orange and grey. Low to high plasticity. (Puketoka Formation)			
	2.0	Peak = 114kPa Residual = 76kPa		2					
	2.4	Peak = 99kPa Residual = 43kPa							
▼			20.8			ML: Clayey SILT with trace sand: Orange. Low to high plasticity. (Puketoka Formation)	S	St	
	2.8	Peak = 178+ kPa	20.6			CL: Silty CLAY: Grey. Low plasticity. (Waitemata Group)			
	3.2	Peak = 168kPa Residual = 76kPa		3			W		
	3.6	Peak = UTP							
			19.6			ML: Clayey SILT with some sand: Grey. Low plasticity. (Waitemata Group)		VSt	
	4.0	Peak = UTP		4					
	4.4	Peak = UTP					M		
	4.8	Peak = UTP							
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.6m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA21-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745120.0mE; 5926306.0mN Projection: NZTM
Elevation: 25.00m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			25.0			OL: TOPSOIL:			
			24.8			CL: Silty CLAY with trace sand: Grey, streaked orange/yellow. Small brown mottles. Low plasticity. Sand is fine to medium. (Puketoka Formation)			
	0.4	Peak = 168kPa Residual = 56kPa							
	0.8	Peak = 114kPa Residual = 50kPa							
			24.0	1		ML: Clayey SILT with some sand: Light grey, almost white, mottled orange. Low plasticity. Friable. Sand is fine to medium. (Puketoka Formation)			
	1.2	Peak = 132kPa Residual = 72kPa					M		
	1.6	Peak = 117kPa Residual = 69kPa							
	2.0	Peak = 112kPa Residual = 63kPa		2					
	2.4	Peak = 147kPa Residual = 63kPa	22.6			CL: Silty CLAY: Grey mottled orange. Low to high plasticity. (Puketoka Formation)		VSt	
			22.4			MH: Clayey SILT: Light grey. High plasticity. (Puketoka Formation)			
▼	2.8	Peak = 150kPa Residual = 51kPa							
			22.0	3		ML: Clayey SILT with some sand: Dark grey. Low plasticity. (Waitemata Group)			
	3.2	Peak = 178+ kPa							
	3.6	Peak = UTP					W to S		
	4.0	Peak = UTP		4					
	4.4	Peak = UTP							
	4.8	Peak = UTP							
	5.0	Peak = UTP		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.8m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA22-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: LSW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745145.0mE; 5926258.0mN Projection: NZTM
Elevation: 28.60m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			28.6			OL: TOPSOIL:			
	0.4	Peak = 160kPa Residual = 69kPa	28.2			CL: Silty CLAY: Orange, mottled brown, grey, dark grey. Low plasticity (Puketoka Formation)			
	0.8	Peak = 102kPa Residual = 63kPa		1				VSt	
	1.2	Peak = 155kPa Residual = 69kPa					M		
	1.6	Peak = 124kPa Residual = 53kPa							
			26.8			CL: Silty CLAY: Orange, mottled grey. Low to high plasticity. (Puketoka Formation)			
	2.0	Peak = 56kPa Residual = 25kPa		2				St	
▼	2.4	Peak = 99kPa Residual = 63kPa							
	2.8	Peak = 59kPa Residual = 41kPa							
			25.6	3		ML: Clayey SILT: Grey, mottled orange. Low to high plasticity. (Puketoka Formation)			
	3.2	Peak = 61kPa Residual = 51kPa							
	3.6	Peak = 99kPa Residual = 61kPa							
			24.8			ML: Clayey SILT with some sand: Grey. Low plasticity. (Waitemata Group)			
	4.0	Peak = 129kPa Residual = 58kPa		4			W to S		
	4.4	Peak = 150kPa Residual = 84kPa						VSt	
						... from 4.60m to 5.00m, ecoming interbedded with Silty CLAY			
	4.8	Peak = 124kPa Residual = 58kPa							
	5.0	Peak = 117kPa Residual = 74kPa		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.6m

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MH01-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:50 Sheet 1 of 2
Position: 1745319.0mE; 5925970.0mN Projection: NZTM Angle from horizontal: 90°
Elevation: 15.80m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support
		15.8		TOPSOIL: brown.	D to…			
		15.7		CH: Silty CLAY: with trace fine to medium sand; brown mottled light grey. High plasticity. (Uncontrolled Fill)				
0.5	Peak = 74kPa Residual = 36kPa				M	St	60	OB / PQ3
1.0	Peak = 110kPa Residual = 53kPa		1				100	
		14.6		CH: Silty CLAY: with trace fine to medium sand; light brownish grey mottled orange. High plasticity. (Puketoka Formation)		VSt	100	
1.5	Peak = 63kPa Residual = 20kPa SPT = (4,4,10) N* = 14						89	SPT
1.5			2				86	OB / PQ3
				… at 2.20m, trace organic fragments <20 mm	M to W			
3.0	Peak = 74kPa Residual = 30kPa SPT = (4,7,10) N* = 17		3				100	SPT
				… at 3.70m, becoming bluish grey			95	OB / PQ3
			4	… at 4.00m, becoming brownish grey, minor fine to medium sand		St		
4.5	SPT = (3,3,3) N* = 6			… at 4.50m, becoming grey mottled orange.			100	SPT
5.0-5.5	Push Tube 1 U63		5				91	U63
							100	OB / PQ3
6.0	SPT = (3,3,3) N* = 6		6				100	SPT
							86	OB / PQ3
			7	… at 7.10m, becoming brownish grey mottled dark grey, minor medium to coarse sand.	W			
7.5	SPT = (5,7,10) N* = 17	8.3		ML: Sandy SILT: with minor clay; bluish grey. Low plasticity. Medium to coarse sand. (Waitemata Group)			100	SPT
			8			VSt	100	OB / PQ3
9.0	SPT = (7,13,17) N* = 30		9				100	SPT
							100	OB / PQ3
			10					

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MH01-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:50 Sheet 2 of 2
Position: 1745319.0mE; 5925970.0mN Projection: NZTM Angle from horizontal: 90°
Elevation: 15.80m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering	Recovery	RQD	Estimated Strength	Defect Spacing (mm)	Drilling Method/ Support	Structure & Other Observations
				5.5			Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)			RS CW HW MW SW UW			EW VW W MS S VS ES	<20 20-60 60-200 200-600 600-2000 >2000		Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
							ML: Sandy SILT: bluish grey. Low plasticity. Medium to coarse sand. (Waitemata Group)									
		10.5	SPT = (12,22,30) N* = 52		11						100				SPT	
									H		100				OB / PQ3	
		12.0	SPT = (17,28,32/70mm) N* = 50+		12						100				SPT	
				3.1			Grey, SANDSTONE. Weathered to a silty SAND, grey, medium to coarse. (Waitemata Group)				93				OB / PQ3	
		13.5	SPT = (29,50/55mm) Nc = 50+	2.3	13		Grey, SANDSTONE. Weathered to a sandy SILT grey mottled dark grey, low plasticity. (Waitemata Group)				0				SPT	
					14						100				TT / HQ3	
		15.5	SPT = (50/90mm) Nc = 50+	0.3	15		Grey, SANDSTONE. Weathered to a silty SAND, grey, medium to coarse. (Waitemata Group)				0				S P T	
					16						93				TT / HQ3	
		17.0	SPT = (50/115mm) Nc = 50+		17						0				S P T	
					18						61				TT / HQ3	
		18.5	SPT = (50/90mm) Nc = 50+								0				S P T	
					19						100				TT / HQ3	
					20		Borehole terminated at 20.00 m									

Termination Reason: Target Depth Reached
Shear Vane No: 1620 DCP No:
Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE CORE PHOTOGRAPHS: MH01-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/19

Logged by: TK	Position: 1745319.0 E, 5925970.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 15.8m	Angle from Horizontal: 90°	Contractor: Prodrill

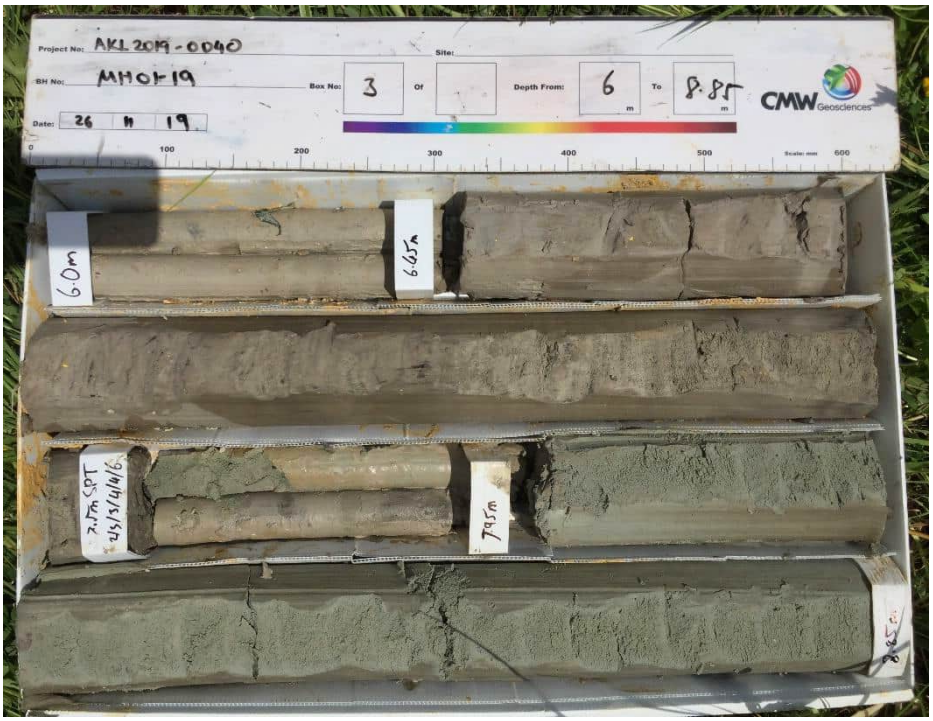
MH01-19: 0m to 3.0m

MH01-19: 3.0m to 6.0m

BOREHOLE CORE PHOTOGRAPHS: MH01-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/19

Logged by: TK	Position: 1745319.0 E, 5925970.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 15.8m	Angle from Horizontal: 90°	Contractor: Prodrill



MH01-19: 6.0m to 8.85m

MH01-19: 8.85m to 11.65m

BOREHOLE CORE PHOTOGRAPHS: MH01-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/19

Logged by: TK	Position: 1745319.0 E, 5925970.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 15.8m	Angle from Horizontal: 90°	Contractor: Prodrill

MH01-19: 11.65m to 15.0m

MH01-19: 15.0m to 18.9m

BOREHOLE CORE PHOTOGRAPHS: MH01-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/19

Logged by: TK	Position: 1745319.0 E, 5925970.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 15.8m	Angle from Horizontal: 90°	Contractor: Prodrill

MH01-19: 18.9m to 20.0m

BOREHOLE LOG - MH02-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 27/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:50 Sheet 1 of 2
Position: 1745259.0mE; 5926130.0mN Projection: NZTM Angle from horizontal: 90°
Elevation: 27.00m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support
		27.0		TOPSOIL: brown.	D to…			
		26.8		CH: Silty CLAY: with trace fine to medium sand; orange mottled grey. High plasticity. (Puketoka Formation)	M		80	
0.5	Peak = 178+ kPa			*... at 0.50m, becoming grey mottled orange.*			100	OB / PQ3
1.0	Peak = 152kPa Residual = 58kPa		1				100	
1.5	Peak = 120kPa Residual = 86kPa SPT = (2,6,14) N* = 20						100	SPT
			2			VSt	100	OB / PQ3
3.0	Peak = 142kPa Residual = 33kPa SPT = (4,4,4) N* = 8		3		M to W		100	SPT
3.4-4.0	Push Tube 2 U63						91	U63
		23.0	4	CL: Silty CLAY: with minor fine to medium sand; grey. Low plasticity. (Puketoka Formation)			100	OB / PQ3
4.5	Peak = 38kPa Residual = 13kPa SPT = (4,4,7) N* = 11	22.5		ML: Clayey SILT: with minor fine to medium sand; grey. Low plasticity. (Puketoka Formation)			100	SPT
			5	*... at 5.50m, becoming grey mottled dark grey, some medium to coarse sand.*			67	OB / PQ3
6.0	Peak = 28kPa Residual = 10kPa SPT = (3,3,3) N* = 6		6				100	SPT
		20.0	7	Sandy SILT: with minor clay; grey. Low plasticity, medium to coarse. (Puketoka Formation)	W	F	86	OB / PQ3
7.5	Peak = 36kPa Residual = 10kPa SPT = (1,3,3) N* = 6						100	SPT
			8				71	OB / PQ3
9.0	Peak = 25kPa Residual = 3kPa SPT = (2,4,4) N* = 8		9				100	SPT
				... from 9.80m to 9.85m, with trace organic fragments.			100	OB / PQ3
			10					

Termination Reason: Refusal met
Shear Vane No: 1620 DCP No:
Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MH02-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 27/11/2019
Borehole Location: Refer to site plan Logged by: TK Checked by: TG Scale: 1:50 Sheet 2 of 2
Position: 1745259.0mE; 5926130.0mN Projection: NZTM Angle from horizontal: 90°
Elevation: 27.00m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Depth	Type & Results	RL (m)	Depth (m)	Material Description	Consistency/ Relative Density	Recovery	RQD	Drilling Method/ Support	Structure & Other Observations
		16.7		ML: Sandy SILT: dark grey interbedded with clay layers. Low plasticity. (Waitemata Group)	St to VSt	100		SPT	
10.5	Peak = 58kPa Residual = 15kPa SPT = (4,6,9) N* = 15		11						
		15.5		Grey mottled dark grey, SANDSTONE. Weathered to Silty SAND fine to medium sand. (Waitemata Group)		100		OB / PQ3	
12.0	SPT = (14,30,20/75mm) N* = 50+ Peak = UTP		12			100		SPT	
		14.5		Grey SILTSTONE. Weathered to a Sandy SILT, grey, medium to coarse. (Waitemata Group)		100		OB / PQ3	
		14.2	13	Grey mottled dark grey, SANDSTONE. Weathered to Silty SAND fine to medium sand. (Waitemata Group)		0		SPT	
13.2	SPT = (32,50/95mm) Nc = 50+	13.2		Grey, SANDSTONE. (Waitemata Group) *... from 14.00m to 14.30m, Core loss due to core bound.*		32		TT / HQ3	13.8-14.0m:DI,
			14			53	7	TT / HQ3	14.7-14.9m:5,DI,5°,UN,R,CL,CN, 15.0m:1,B,ST,R,GA,IF,(Z), 15.0m:1,B,5°,PL,S,CL, 15.2-15.4m:4,B,5°,UN,R,CL,CN, 15.4m:1,CN,5°,PL,S,CL,
		11.9	15	Grey, SILTSTONE. (Waitemata Group)					
		11.7		Grey, SANDSTONE. (Waitemata Group)					
15.5	SPT = (50/115mm) Nc = 50+			Borehole terminated at 15.50 m		0		SPT	15.4m:1,DI,
			16						
			17						
			18						
			19						
			20						

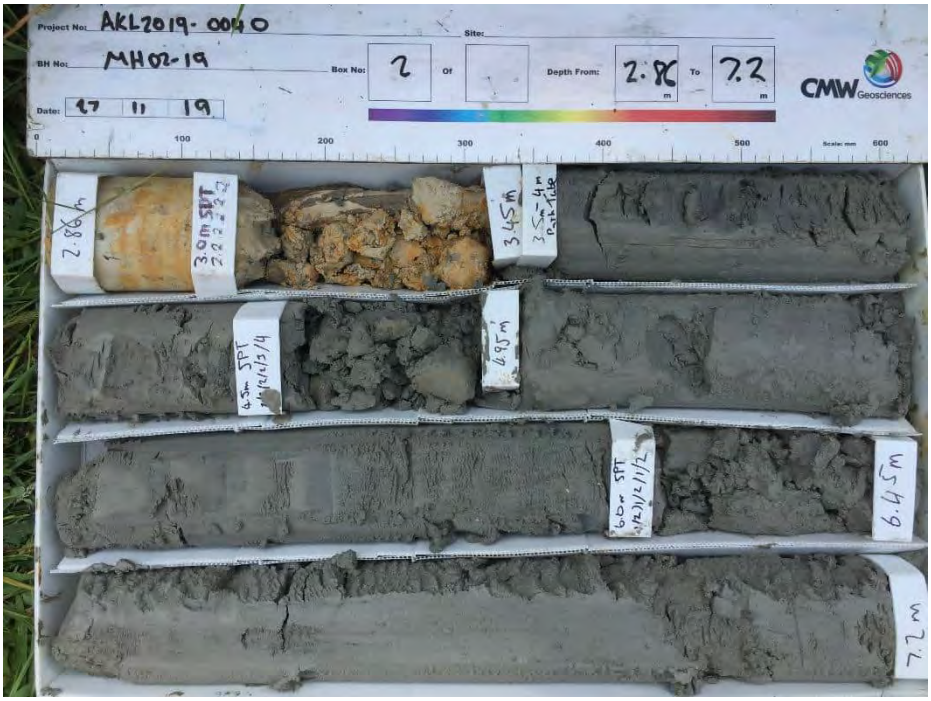
Termination Reason: Refusal met
Shear Vane No: 1620 DCP No:
Remarks:

BOREHOLE CORE PHOTOGRAPHS: MH02-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 27/11/19

Logged by: TK	Position: 1745259.0 E, 5926130.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 27.0m	Angle from Horizontal: 90°	Contractor: Prodrill

MH02-19: 0m to 2.86m



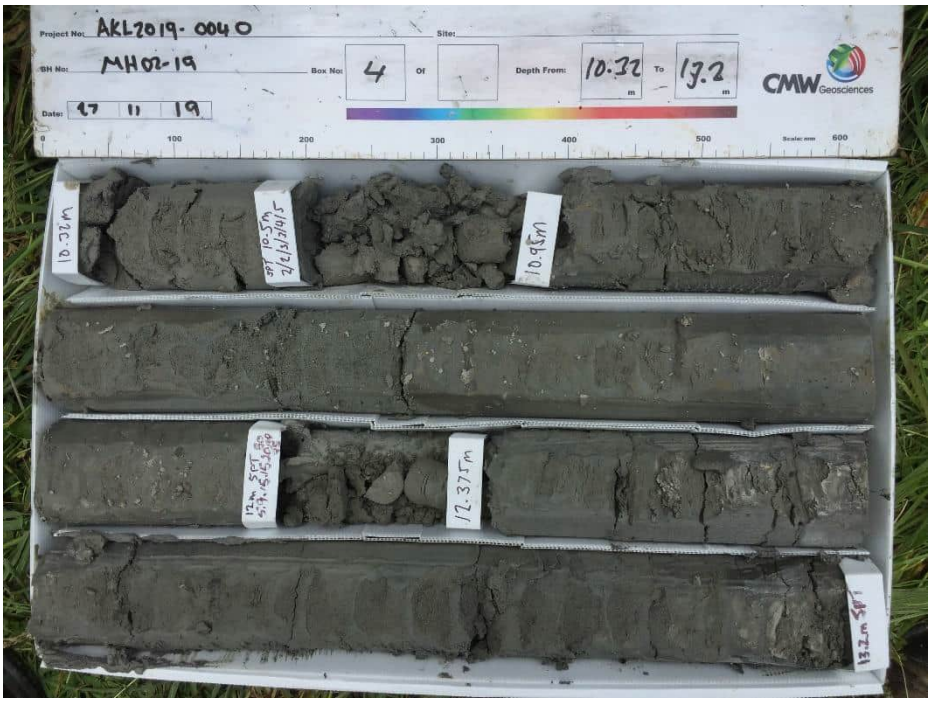
MH02-19: 2.86m to 7.2m

BOREHOLE CORE PHOTOGRAPHS: MH02-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 27/11/19

Logged by: TK	Position: 1745259.0 E, 5926130.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 27.0m	Angle from Horizontal: 90°	Contractor: Prodrill

MH02-19: 7.2m to 10.32m



MH02-19: 10.32m to 13.2m

BOREHOLE CORE PHOTOGRAPHS: MH02-19

Client: Neil Group Ltd
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 27/11/19

Logged by: TK	Position: 1745259.0 E, 5926130.0 N	Hole Diameter: 100mm	Plant: Tractor Rig
Checked by: TG	Elevation: RL 27.0m	Angle from Horizontal: 90°	Contractor: Prodrill

MH02-19: 13.2m to 15.5m

TEST PIT LOG - TP01-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745206.0mE; 5925974.0mN Projection: NZTM
Elevation:Elevation: 27.00m Datum: AUCKHT 1946

Pit Dimensions: 3.0m by 2.0m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			27.0			OL: TOPSOIL			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			26.8			ML: Clayey SILT: brown, orange, grey and black. Low plasticity. Trace gravel, concrete and old drain pipe. (Uncontrolled Fill)				
	0.5	Peak = UTP								
	1.0	Peak = >200kPa Residual = 48kPa	26.0	1		CH: CLAY with some silt: light grey streaked orange. High plasticity. (Puketoka Formation)				
	1.5	Peak = 224+ kPa					M	VSt to H		
	2.0	Peak = 192kPa Residual = 112kPa		2						
	2.5	Peak = 163kPa Residual = 74kPa								
			24.4			MH: Clayey SILT: light grey mottled orange. High plasticity. (Puketoka Formation)				
	3.0	Peak = 144kPa Residual = 51kPa		3		Test pit terminated at 3.00 m				
				4						
				5						

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

TEST PIT PHOTOGRAPHS: TP01-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

Logged by: JW	Position: E: 1745206 N: 5925974	Dimensions: 3.0m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 27.0m	Termination Depth: 3.0m	Contractor: Abernethy Contractors

TP01-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP02-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745227.0mE; 5926000.0mN Projection: NZTM
Elevation:Elevation: 25.50m Datum: AUCKHT 1946

Pit Dimensions: 3.0m by 2.5m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			25.5			OL: TOPSOIL			5 10 15 20	
			25.3			CH: Silty CLAY with minor topsoil: brown streaked orange and grey. Rootlets. Trace organics. Very loosely compacted. (Uncontrolled Fill)				
	0.5	Peak = 48kPa Residual = 13kPa					M	F		
▼	1.0	Peak = 77kPa Residual = 29kPa		1		... at 1.00m, perched groundwater and trace organics				
	1.5	Peak = 51kPa Residual = 19kPa	24.0			CH: Organic stained Silty CLAY with some organics: dark grey streaked black. Highly plasticity. (Puketoka Formation)	M to W	St		
	2.0	Peak = 83kPa Residual = 29kPa		2		Test pit terminated at 2.00 m				2.0m: yellow nova coil at the base of test pit
				3						
				4						
				5						

Termination Reason: Terminated early due to nova coil encountered.
Shear Vane No: 2081 DCP No:
Remarks: Perched groundwater at 1.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

TEST PIT PHOTOGRAPHS: TP02-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

Logged by: JW	Position: E: 1745227 N: 5926000	Dimensions: 3.0m x 2.5m	Plant: 20T Excavator
Checked by: TG	Elevation: 25.50m	Termination Depth: 2.0m	Contractor: Abernethy Contractors

TP02-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP03-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745219.0mE; 5926036.0mN Projection: NZTM
Elevation:Elevation: 25.40m Datum: AUCKHT 1946

Pit Dimensions: 3.0m by 2.0m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			25.4			OL: TOPSOIL			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			25.2			CH: Silty CLAY with trace organics: orange, brown, grey and black. High plasticity. Trace pipe, trace concrete. Loosely compacted. (Uncontrolled Fill)				
						... at 0.30m, large block of concrete, 0.4m x 0.4m				
	0.5	Peak = 72kPa Residual = 29kPa						St		
	1.0	Peak = 80kPa Residual = 32kPa		1			M			
			24.2			CH: CLAY with minor silt: grey streaked orange. High plasticity. Trace rootlets and trace organics. (Puketoka Formation)				
	1.5	Peak = 128kPa Residual = 61kPa						VSt		
						... at 1.90m, moist to wet	M...			
	2.0	Peak = 131kPa Residual = 64kPa		2		Test pit terminated at 2.00 m				
				3						
				4						
				5						

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: No groundwater encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

TEST PIT PHOTOGRAPHS: TP03-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

Logged by: JW	Position: E: 1745219 N: 5926036	Dimensions: 3.0m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 25.40m	Termination Depth: 2.0m	Contractor: Abernethy Contractors

TP03-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP04-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745272.0mE; 5926032.0mN Projection: NZTM
Elevation:Elevation: 23.00m Datum: AUCKHT 1946

Pit Dimensions: 3.0m by 2.0m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			23.0			OL: TOPSOIL			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			22.8			ML: Clayey SILT with organics: dark brown. Low plasticity. (Puketoka Formation)				
			22.7			CH: Silty CLAY: grey mottled orange. High plasticity. Organic staining. (Puketoka Formation)				
	0.5	Peak = 147kPa Residual = 35kPa					M to W	VSt		
	1.0	Peak = 160kPa Residual = 83kPa		1						
▼	1.2	Peak = 176kPa Residual = 80kPa				Test pit terminated at 1.20 m				
				2						
				3						
				4						
				5						

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater seepage observed at 1.2m.

TEST PIT PHOTOGRAPHS: TP04-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

Logged by: JW	Position: E: 1745272 N: 5926032	Dimensions: 3.0m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 23.0m	Termination Depth: 1.2m	Contractor: Abernethy Contractors

TP04-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP05-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745271.0mE; 5925996.0mN Projection: NZTM
Elevation:Elevation: 21.40m Datum: AUCKHT 1946

Pit Dimensions: 3.5m by 2.0m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			21.4			OL: TOPSOIL			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			21.2			CH: Silty CLAY: orange, brown, grey and black. High plasticity. Trace pipe, concrete, gravel, cobbles, cloth and plastic. (Uncontrolled Fill)				
	0.5	Peak = 147kPa Residual = 35kPa					M			
	1.0	Peak = >200kPa Residual = 51kPa		1		... at 1.00m, well compacted				
						... at 1.20m, trace concrete		VSt		
	1.5	Peak = 157kPa Residual = 45kPa				... at 1.50m, moist to wet with trace organics				
			19.6			CH: CLAY with some silt: grey, black, orange and brown. High plasticity. (Uncontrolled Fill)				
	2.0	Peak = 125kPa Residual = 51kPa		2			M to W			
▼	2.5	Peak = 64kPa Residual = 42kPa								
			18.8			OL: Buried TOPSOIL				
			18.7			CH: Silty CLAY with organics: grey mottled orange. High plasticity. Organic staining throughout. (Puketoka Formation)		St to VSt		
	3.0	Peak = 131kPa Residual = 48kPa		3		Test pit terminated at 3.00 m				
				4						
				5						

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater seepage observed at 2.6m in the topsoil.

TEST PIT PHOTOGRAPHS: TP05-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

CMW Geosciences

Logged by: JW	Position: E: 1745271 N: 5925996	Dimensions: 3.5m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 21.40m	Termination Depth: 3.0m	Contractor: Abernethy Contractors

TP05-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP06-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1
Position: 1745331.0mE; 5926017.0mN Projection: NZTM Pit Dimensions: 3.0m by 2.0m
Elevation:Elevation: 20.00m Datum: AUCKHT 1946 Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			20.0			OL: TOPSOIL			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			19.8			ML: Clayey SILT: brown. Low plasticity. With large roots. (Puketoka Formation)				
			19.6			CH: Silty CLAY: grey mottled orange. High plasticity. (Puketoka Formation)				
	0.5	Peak = >200kPa Residual = 51kPa					M	VSt to St		
	1.0	Peak = 147kPa Residual = 48kPa	19.0	1		CH: CLAY with minor silt: grey mottled orange. High plasticity. (Puketoka Formation)				
	1.5	Peak = 83kPa Residual = 32kPa				Test pit terminated at 1.50 m				
				2						
				3						
				4						
				5						

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

TEST PIT PHOTOGRAPHS: TP06-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

Logged by: JW	Position: E: 1745331 N: 5926017	Dimensions: 3.0m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 20.0m	Termination Depth: 1.5m	Contractor: Abernethy Contractors

TP06-19 – TEST PIT EXCAVATION

TEST PIT LOG - TP07-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Site Location: Whenuapai
Project No.: AKL2019-0040
Date: 26/11/2019
Test Pit Location: Refer to site plan Logged by: JW Checked by: TG Scale: 1:25 Sheet 1 of 1

Position: 1745289.0mE; 5925956.0mN Projection: NZTM
Elevation:Elevation: 18.50m Datum: AUCKHT 1946

Pit Dimensions: 3.0m by 2.5m
Survey Source: Hand Held GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			18.5			OL: TOPSOIL				
			18.4			CH: Silty CLAY: orange, brown, grey and black. High plasticity. Trace rootlets, trace gravel, trace concrete and loosely compacted. (Uncontrolled Fill)				
	0.5	Peak = 141kPa Residual = 19kPa					M	VSt		
	1.0	Peak = 192kPa Residual = 96kPa		1						
			17.4			OL: Buried TOPSOIL				
			17.3			CH: CLAY with some silt: grey streaked orange. High plasticity. Trace rootlets, trace limonite staining. Trace organic staining. (Puketoka Formation)				
	1.5	Peak = 147kPa Residual = 64kPa				Test pit terminated at 1.50 m				
				2						
				3						
				4						
				5						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

Termination Reason: Target depth reached
Shear Vane No: 2081 DCP No:
Remarks: Groundwater no encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

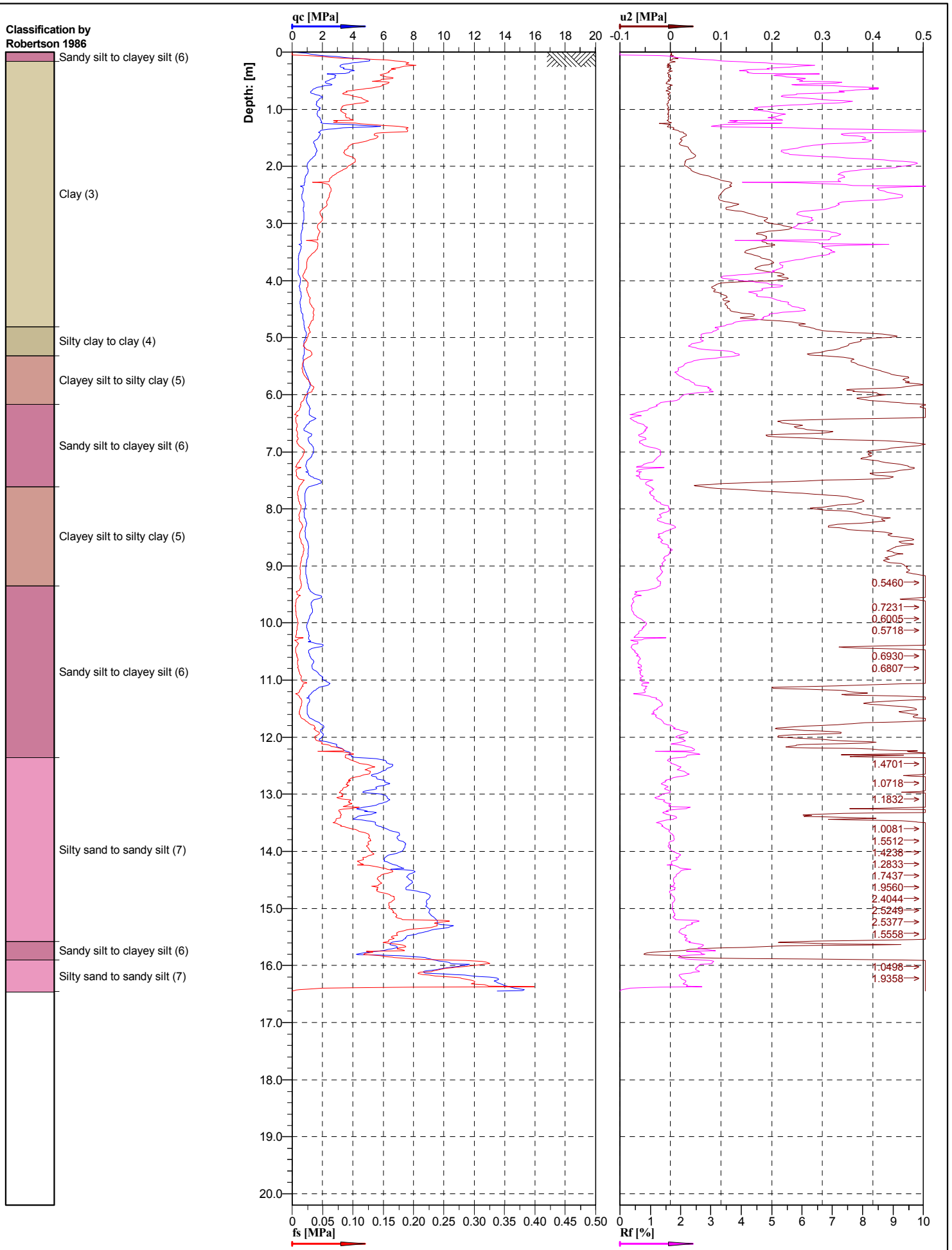
TEST PIT PHOTOGRAPHS: TP07-19

Client: Neil Group Limited
Project: Trig & Brigham Creek Road
Location: Whenuapai
Project No: AKL2019-0040
Date: 26/11/2019

CMW Geosciences

Logged by: JW	Position: E: 1745289 N: 5925956	Dimensions: 3.0m x 2.0m	Plant: 20T Excavator
Checked by: TG	Elevation: 18.50m	Termination Depth: 1.5m	Contractor: Abernethy Contractors

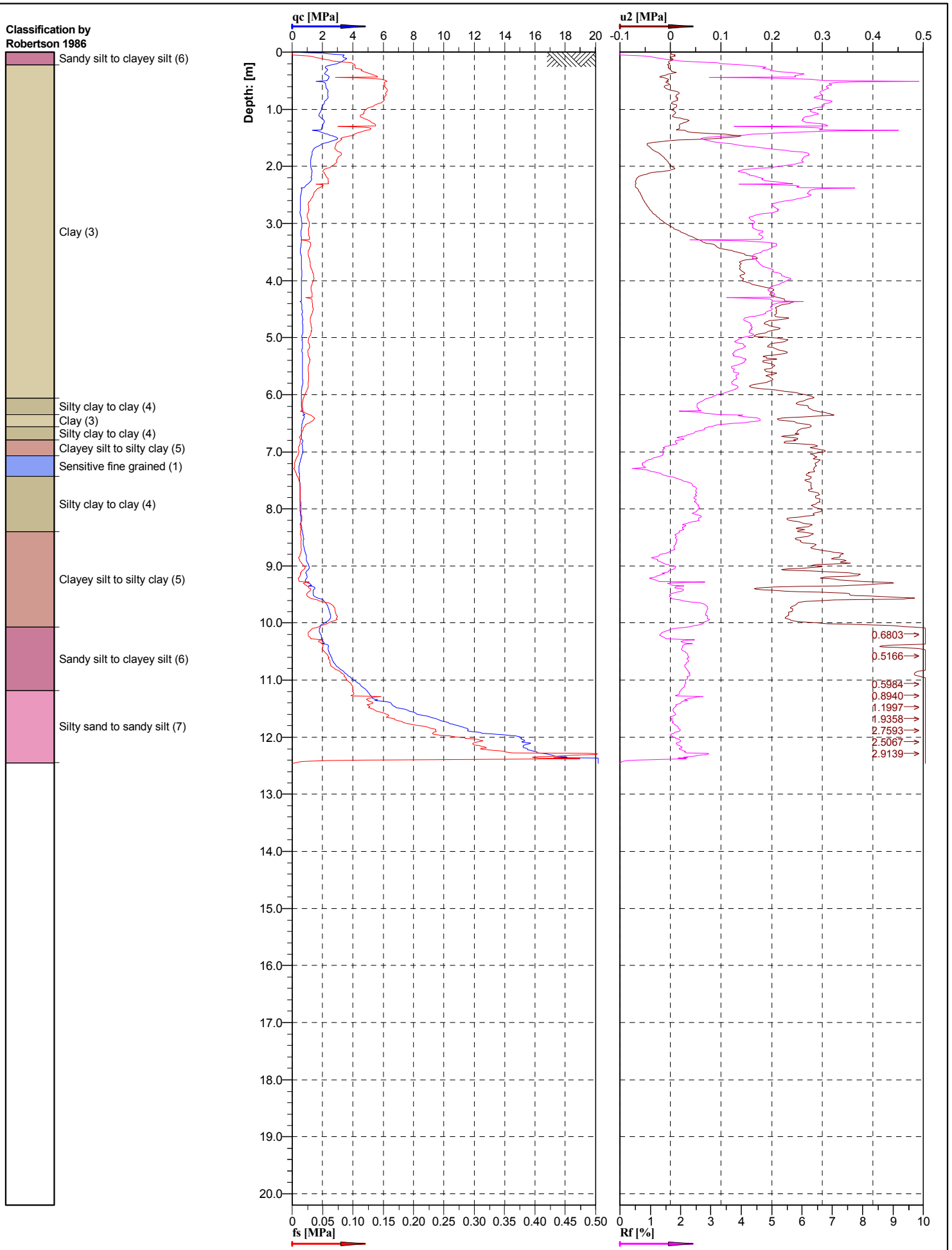
TP07-19 – TEST PIT EXCAVATION



Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT01
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT01.GEF	

PRO-DRILL

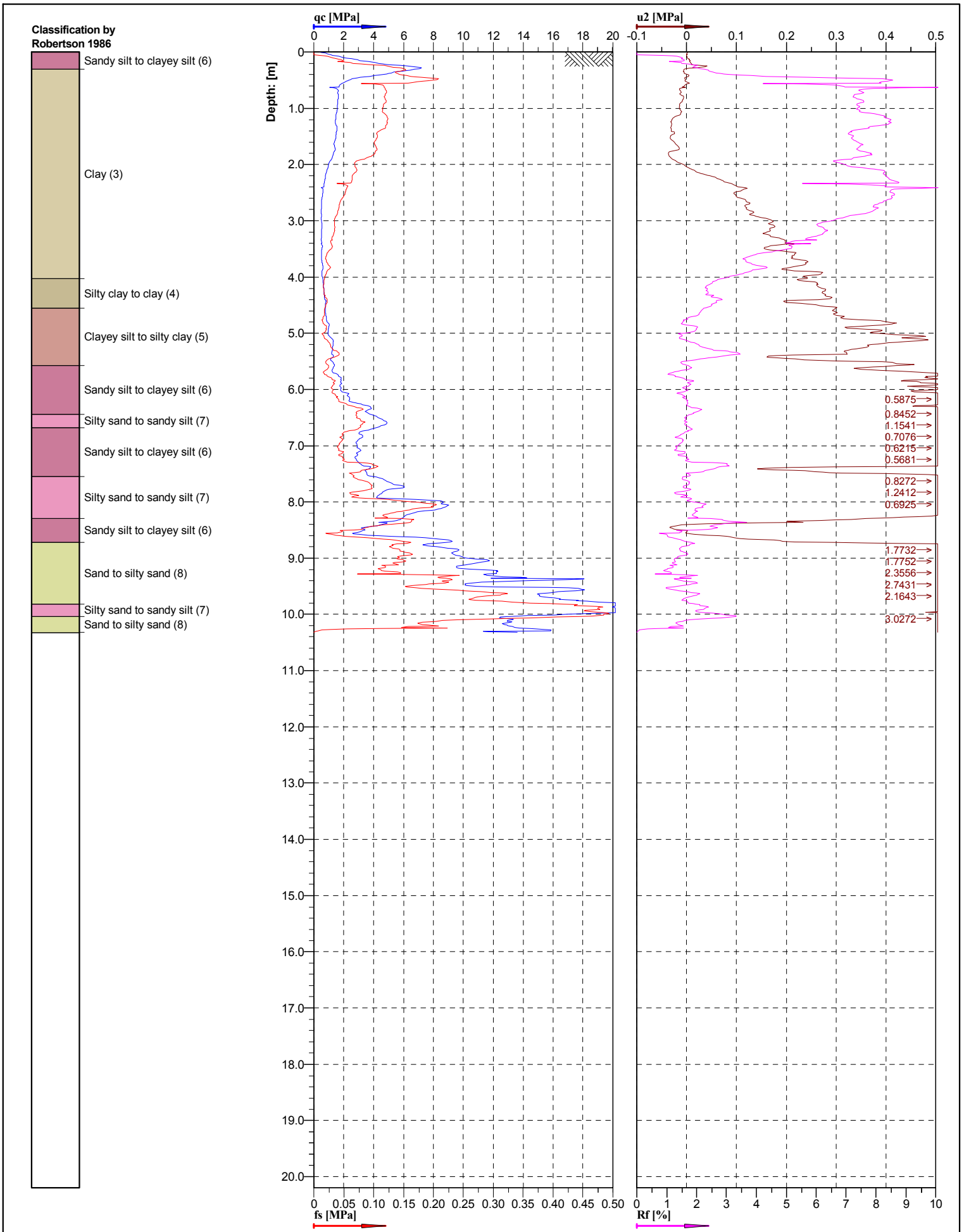
Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT02
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT02.GEF	

PRO-DRILL

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

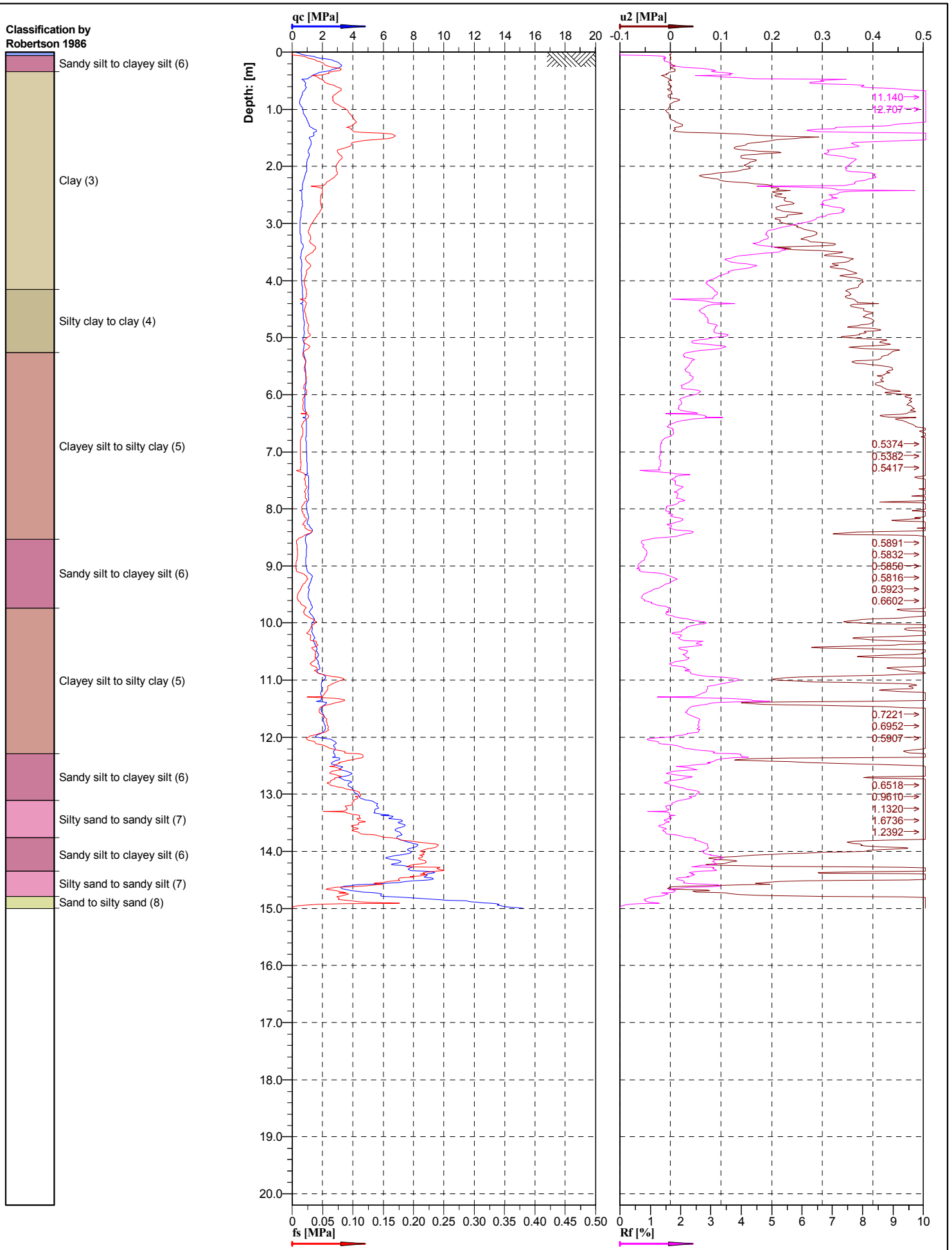


Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT03
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT03.GEF	

PRO-DRILL

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

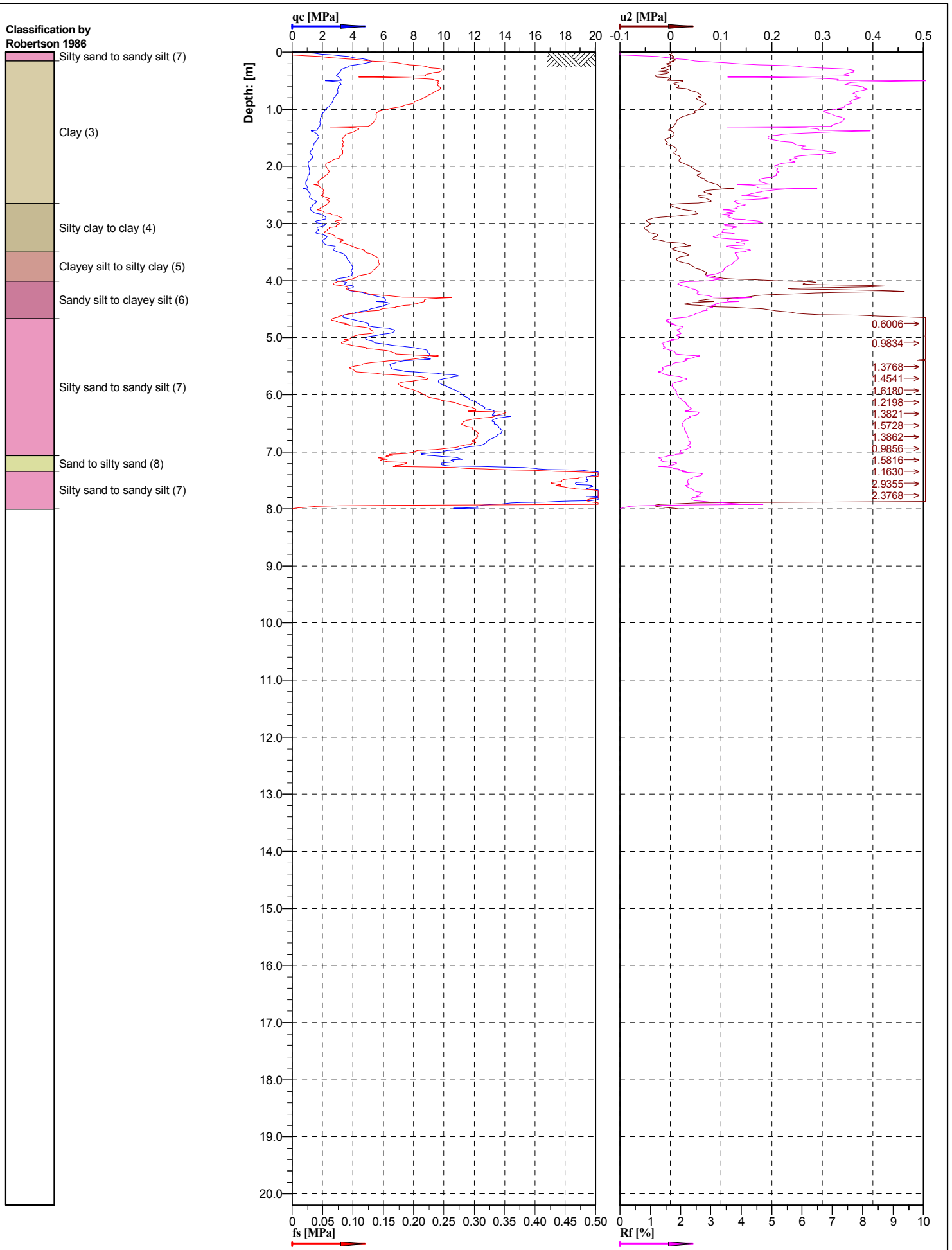


Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT04
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT04.GEF	

PRO-DRILL

u2

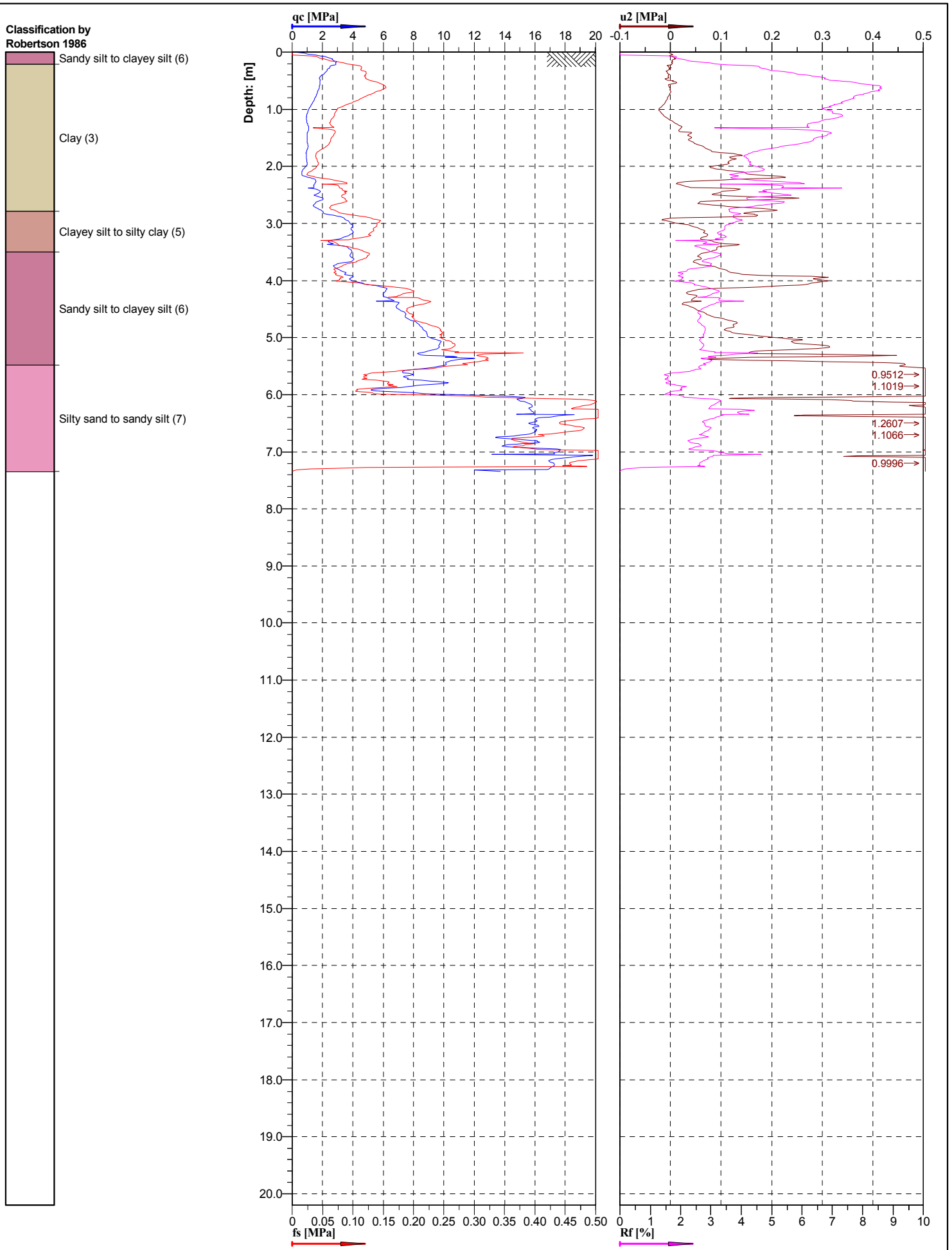
Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT05
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT05.GEF	

PRO-DRILL

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

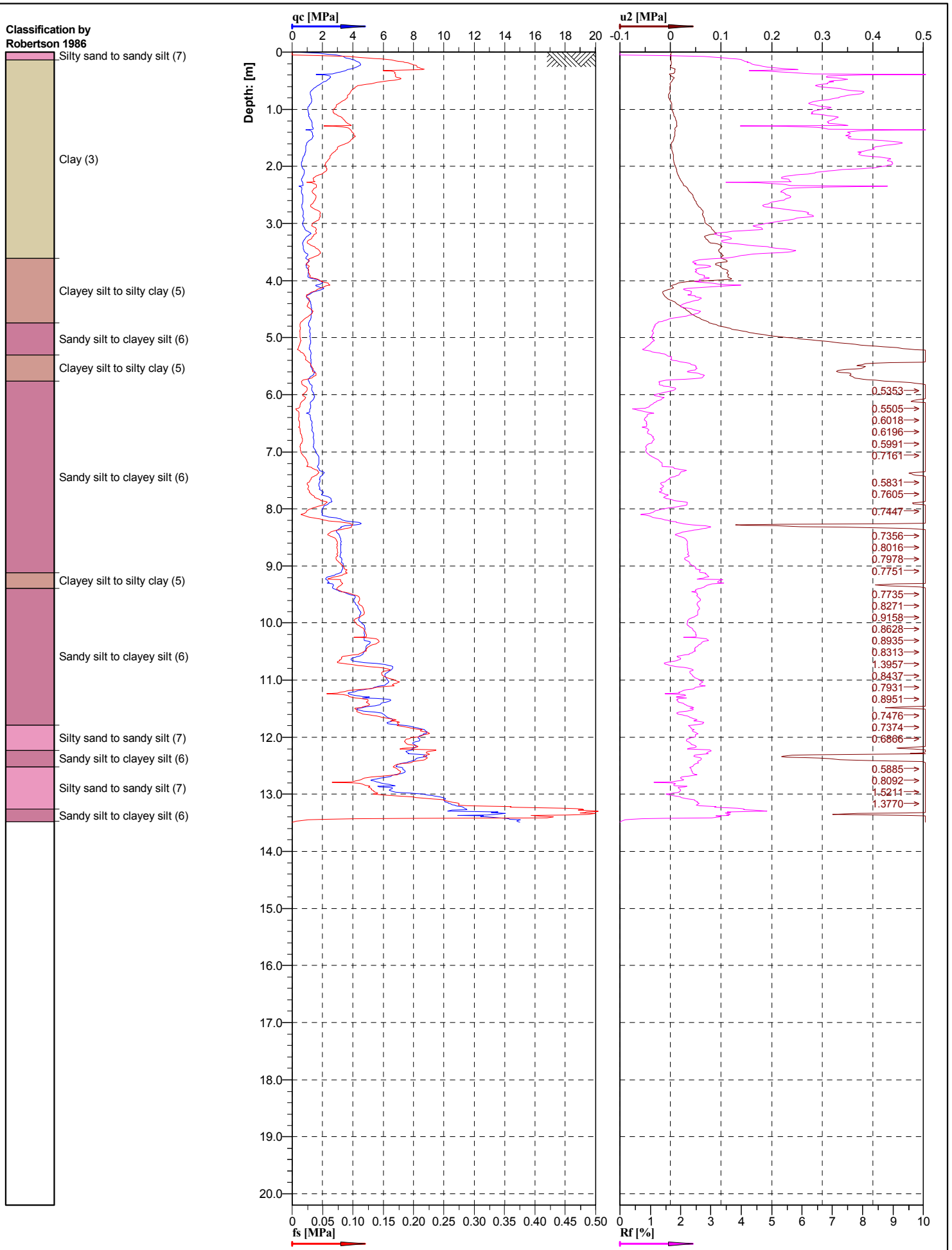


Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT06
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT06.GEF	

PRO-DRILL

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



PRO-DRILL

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: 151 Brigham Creec Road	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT07
Project ID: CMW Brigham creek	Client: CMW	Date: 22/03/2019	Scale: 1 : 85
Project: CMW Brigham creek		Page: 1/1	Fig.:
		File: CMW Brigham creek_CPT07.GEF	

HAND AUGER BOREHOLE LOG - HA01-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: FS Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744840.0mE; 5926203.0mN Projection: NZTM
Elevation: 33.00m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			33.0			OL: TOPSOIL: dark brown.	M to W		
			32.7			ML: Clayey SILT: brown mottled dark brown and orange. Very stiff, low plasticity, moderately sensitive. (Puketoka Formation)			
	0.4	Peak = 155kPa Residual = 40kPa							
						... at 0.60m, becoming greyish brown mottled orange.			
	0.8	Peak = 134kPa Residual = 37kPa							
				1		... at 1.00m, becoming light grey mottled orange.			
	1.2	Peak = 142kPa Residual = 40kPa					M		
	1.6	Peak = 174kPa Residual = 67kPa							
	2.0	Peak = 136kPa Residual = 67kPa		2				VSt	
			30.7			CH: CLAY with minor silt: light grey. Stiff to very stiff, high plasticity, insensitive to moderately sensitive. (Puketoka Formation)			
	2.4	Peak = 110kPa Residual = 64kPa							
	2.8	Peak = 107kPa Residual = 64kPa							
				3		... at 3.00m, becoming light grey mottled orange.	M to W		
	3.2	Peak = 110kPa Residual = 70kPa				... at 3.20m, becoming dark grey with minor black mottling.			
	3.6	Peak = 123kPa Residual = 60kPa							
16-09-2020						... at 3.80m, silt becoming absent.	W		
	4.0	Peak = 104kPa Residual = 67kPa		4					
						... at 4.20m, becoming grey.			
	4.4	Peak = 78kPa Residual = 60kPa					S	St	
						... at 4.60m, becoming dark grey.			
	4.8	Peak = 88kPa Residual = 67kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 4.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA02-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: FS Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744811.0mE; 5926143.0mN Projection: NZTM
Elevation: 34.75m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			34.8			OL: TOPSOIL: dark brown.	M to W		
			34.4			ML: Clayey SILT: brown and grey. Stiff to very stiff, low plasticity, moderately sensitive. (Puketoka Formation)			
	0.4	Peak = 83kPa Residual = 21kPa							
	0.8	Peak = 123kPa Residual = 59kPa				... at 0.80m, becoming grey mottled orange.			
				1					
	1.2	Peak = 112kPa Residual = 48kPa				... at 1.20m, becoming light grey.	W	St to VSt	
	1.6	Peak = 128kPa Residual = 53kPa							
16-09-2020	2.0	Peak = 140kPa Residual = 59kPa		2		... at 2.00m, becoming light grey mottled orange.			
	2.4	Peak = 155kPa Residual = 64kPa	32.4			CL: CLAY with trace silt: dark grey. Very stiff to hard, low plasticity. (Puketoka Formation)			
	2.8	Peak = >187							
				3		... from 3.00m to 3.10m, contains trace fine grained sand.			
	3.2	Peak = UTP						VSt to H	
	3.6	Peak = >187					S		
	4.0	Peak = 120kPa Residual = 60kPa	30.8	4		ML: SILT with trace clay: dark grey. Firm, low plasticity, insensitive. (Puketoka Formation)		VSt	
	4.4	Peak = 40kPa Residual = 33kPa						F	
	4.8	Peak = 160kPa Residual = 107kPa						VSt	
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 2.2m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA03-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: FS Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744834.0mE; 5926061.0mN Projection: NZTM
Elevation: 40.00m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			40.0			OL: TOPSOIL: dark brown.			
	0.4	Peak = 91kPa Residual = 13kPa	39.6			ML: Clayey SILT: greyish brown mottled orange. Stiff to very stiff, low plasticity, insensitive to sensitive. (Puketoka Formation)			
	0.8	Peak = 185kPa Residual = 63kPa				... *at 0.80m, becoming light brownish grey mottled orange.*			
				1					
	1.2	Peak = UTP				... *at 1.20m, becoming light grey mottled orange.*			
	1.6	Peak = 160kPa Residual = 88kPa					M		
	2.0	Peak = 150kPa Residual = 96kPa		2					
	2.4	Peak = 174kPa Residual = 110kPa						St to VSt	
						... *at 2.60m, becoming light grey mottled orange and red.*			
	2.8	Peak = 147kPa Residual = 90kPa							
				3					
						... *at 3.10m, becoming orange mottled grey.*			
	3.2	Peak = 120kPa Residual = 64kPa							
	3.6	Peak = 131kPa Residual = 70kPa					W		
	4.0	Peak = 118kPa Residual = 67kPa		4					
16-09-2020						... *at 4.20m, becoming light brownish grey.*	W to S		
	4.4	Peak = 96kPa Residual = 64kPa	35.5			CL: CLAY with minor silt: dark grey. Very stiff, low plasticity, insensitive. (Puketoka Formation)	S	VSt	
	4.8	Peak = 160kPa Residual = 90kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 4.4m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA04-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: FS Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744922.0mE; 5926198.0mN Projection: NZTM
Elevation: 32.75m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			32.8			OL: TOPSOIL: dark brown.	M		
			32.4			ML: Clayey SILT: orangeish brown. Stiff to very stiff, low plasticity, insensitive to moderately sensitive. (Puketoka Formation)			
	0.4	Peak = 94kPa Residual = 27kPa							
	0.8	Peak = 134kPa Residual = 59kPa				... at 0.80m, becoming grey mottled orange.			
				1					
	1.2	Peak = 136kPa Residual = 53kPa							
	1.6	Peak = 127kPa Residual = 67kPa				... at 1.50m, becoming light grey.	M to W		
	2.0	Peak = 147kPa Residual = 78kPa		2		... at 1.90m, becoming grey and dark grey.			
						... at 2.20m, becoming light grey mottled orange.		St to VSt	
	2.4	Peak = 131kPa Residual = 67kPa							
						... at 2.50m, becoming with minor clay and trace fine grained sand, whitish grey mottled orange.			
	2.8	Peak = 126kPa Residual = 62kPa							
16-09-2020				3					
	3.2	Peak = 107kPa Residual = 59kPa							
						... at 3.50m, becoming with some fine grained sand, clay becoming absent.			
	3.6	Peak = 88kPa Residual = 43kPa							
	4.0	Peak = 91kPa Residual = 43kPa		4			S		
			28.6			ML: Sandy SILT: light brownish grey mottled orange. Very stiff, low plasticity, insensitive to moderately sensitive. Sand is fine grained, poorly graded. (Puketoka Formation)			
	4.4	Peak = 110kPa Residual = 56kPa						VSt	
	4.8	Peak = 115kPa Residual = 53kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: DCP No:
Remarks: Groundwater encountered at 3.2m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA05-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: FS Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744921.0mE; 5926099.0mN Projection: NZTM
Elevation: 35.50m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			35.5			OL: TOPSOIL: dark brown.			
			35.2			ML: Clayey SILT: dark brownish grey mottled orange. Very stiff to hard, low plasticity, insensitive to sensitive. (Puketoka Formation)			
	0.4	Peak = 107kPa Residual = 27kPa							
	0.8	Peak = 120kPa Residual = 37kPa		1					
	1.2	Peak = 144kPa Residual = 56kPa				... at 1.20m, becoming grey mottled orange.			
	1.6	Peak = >187				... at 1.50m, becoming light grey mottled orange.	M to W	VSt to H	
	2.0	Peak = >187		2					
	2.4	Peak = >187				... at 2.60m, becoming light grey mottled orange and red.			
	2.8	Peak = 174kPa Residual = 107kPa		3					
	3.2	Peak = 120kPa Residual = 59kPa	32.3			CH: CLAY with trace silt: light grey mottled orange and red. Stiff, low plasticity, insensitive. (Puketoka Formation)			
	3.6	Peak = 70kPa Residual = 51kPa				... at 3.50m, becoming dark brownish grey mottled black.			
	4.0	Peak = 88kPa Residual = 64kPa		4		... at 3.80m, becoming grey with minor black mottling.	W	St	
16-09-2020	4.4	Peak = 67kPa Residual = 53kPa				... from 4.50m to 4.70m, contains 200mm lens of dark brown to black clay.			
	4.8	Peak = 78kPa Residual = 64kPa					S		
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 1620 DCP No:
Remarks: Groundwater encountered at 4.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA06-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: CK Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744965.0mE; 5926161.8mN Projection: NZTM
Elevation: 31.80m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			31.8			TOPSOIL: (Puketoka Formation)			
			31.5			CH: CLAY with minor silt: light grey streaked trace orange and light brown. High plasticity, moderately sensitive. (Puketoka Formation)			
	0.4	Peak = 165kPa Residual = 47kPa							
	0.8	Peak = 141kPa Residual = 44kPa				*... from 0.70m to 1.20m, ... becoming CLAY*			
				1					
	1.2	Peak = 132kPa Residual = 66kPa				*... from 1.20m to 2.60m, ... becoming whitish grey streaked orange and light brown*	M		
	1.6	Peak = 135kPa Residual = 52kPa							
	2.0	Peak = 177kPa Residual = 83kPa		2				VSt	
▼	2.4	Peak = 171kPa Residual = 85kPa							
			29.2			CH: Silty CLAY: light greyish white mottled orange and black. High plasticity, moderately sensitive. (Puketoka Formation)			
	2.8	Peak = 116kPa Residual = 41kPa							
				3					
	3.2	Peak = 135kPa Residual = 50kPa							
	3.6	Peak = 138kPa Residual = 55kPa					W		
			27.9			CH: CLAY: black. High plasticity (Puketoka Formation)			
	4.0	Peak = 52kPa Residual = 39kPa		4					
			27.6			CH: Silty CLAY with minor sand: light brownish grey mottled black. High plasticity, sand is fine grained. (Puketoka Formation)		St	
	4.4	Peak = 91kPa Residual = 41kPa							
	4.8	Peak = 138kPa Residual = 58kPa						VSt	
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 2904 DCP No:
Remarks: Groundwater encountered at 2.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA07-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: CK Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1745024.3mE; 5926151.6mN Projection: NZTM
Elevation: 29.75m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			29.8			TOPSOIL:			
			29.6			MH: Clayey SILT: dark brown streaked orange. Low plasticity. (Puketoka Formation)			
	0.4	Peak = 152kPa Residual = 63kPa						VSt	
			29.2			CH: CLAY: light greyish brown mottled black. High plasticity, insensitive to sensitive. (Puketoka Formation)	M		
	0.8	Peak = 97kPa Residual = 22kPa							
▼				1					
						... from 1.10m to 3.10m, ... becoming streaked orange and dark brown			
	1.2	Peak = 74kPa Residual = 17kPa							
	1.6	Peak = 77kPa Residual = 14kPa						St	
	2.0	Peak = 69kPa Residual = 28kPa		2					
	2.4	Peak = 102kPa Residual = 52kPa						VSt	
	2.8	Peak = 72kPa Residual = 33kPa							
				3			W		
						... from 3.10m to 3.70m, ... becoming light brown mottled black			
	3.2	Peak = 97kPa Residual = 44kPa							
	3.6	Peak = 97kPa Residual = 41kPa							
						... from 3.70m to 4.10m, ... becoming dark greyish brown mottled trace dark orange		St	
	4.0	Peak = 85kPa Residual = 25kPa		4					
						... from 4.10m to 5.00m, ... becoming grey with trace of hard clay inclusions which are coarse gravel sized			
	4.4	Peak = 94kPa Residual = 28kPa							
	4.8	Peak = 97kPa Residual = 33kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 2904 DCP No:
Remarks: Groundwater encountered at 1.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA08-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: CK Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1745065.3mE; 5926163.3mN Projection: NZTM
Elevation: 29.40m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			29.4			TOPSOIL:			
			29.1			CH: CLAY: light grey streaked orange and brown. High plasticity, insensitive to moderately sensitive. (Puketoka Formation)			
	0.4	Peak = 168kPa Residual = 66kPa							
	0.8	Peak = 165kPa Residual = 69kPa		1					
	1.2	Peak = 149kPa Residual = 72kPa				*... from 1.20m to 1.80m, ... becoming whitish grey streaked trace dark orange*	M	VSt	
	1.6	Peak = 171kPa Residual = 99kPa				*... from 1.80m to 2.50m, ... becoming whitish grey*			
	2.0	Peak = 141kPa Residual = 85kPa		2					
	2.4	Peak = 69kPa Residual = 41kPa				*... from 2.50m to 2.70m, ... becoming black*		St	
▼	2.8	Peak = 39kPa Residual = 17kPa				*... from 2.70m to 3.10m, ... becoming light greyish brown streaked black*		F	
	3.2	Peak = 69kPa Residual = 39kPa		3		*... from 3.10m to 4.20m, ... becoming streaked orange*		St	
	3.6	Peak = 83kPa Residual = 41kPa					W		
	4.0	Peak = 113kPa Residual = 55kPa		4				VSt	
	4.4	Peak = 83kPa Residual = 41kPa				*... from 4.20m to 5.00m, ... becoming light greyish brown with minor 1-5cm black wood fragment*		St	
	4.8	Peak = 88kPa Residual = 41kPa		5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 2904 DCP No:
Remarks: Groundwater encountered 2.7m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA09-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: CK Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1744999.2mE; 5926034.5mN Projection: NZTM
Elevation: 35.90m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			35.9			TOPSOIL:			
			35.7			CH: CLAY with minor silt: Orange brown mottled grey and dark brown. High plasticity. (Puketoka Formation)			
	0.4	Peak = UTP							
	0.8	Peak = 163kPa Residual = 74kPa		1					
	1.2	Peak = UTP							
						... from 1.30m to 2.30m, ... becoming whitish grey streaked orange			
	1.6	Peak = >193							
	2.0	Peak = UTP		2			D		
						... from 2.30m to 2.70m, ... becoming streaked pinkish red		VSt	
	2.4	Peak = UTP							
						... from 2.70m to 2.90m, ... becoming dark brown streaked black with trace fine grained sand			
	2.8	Peak = UTP							
						... from 2.90m to 3.30m, ... becoming light grey streaked dark brown			
	3.2	Peak = 149kPa Residual = 110kPa		3					
						... from 3.30m to 5.00m, ... becoming whitish grey streaked orange and yellow			
	3.6	Peak = 152kPa Residual = 124kPa							
	4.0	Peak = 108kPa Residual = 80kPa		4			M		
	4.4	Peak = 77kPa Residual = 55kPa					W	St	
▼	4.8	Peak = 83kPa Residual = 52kPa							
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 2904 DCP No:
Remarks: Groundwater encountered at 4.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA10-20

Client: Neil Construction Limited
Project: 71 Trig Road
Site Location: Whenuapai
Project No.: AKL2020-0231
Date: 16/09/2020
Borehole Location: See site plan Logged by: CK Checked by: JW Scale: 1:25 Sheet 1 of 1

Position: 1745082.9mE; 5926085.7mN Projection: NZTM
Elevation: 31.90m Datum: AUCKHT1946 Survey Source: AC Geomaps

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			31.9			TOPSOIL:			
			31.7			CH: Silty CLAY: light greyish brown streaked orange. High plasticity. (Puketoka Formation)			
	0.4	Peak = UTP							
			31.2			CH: CLAY: whitish grey streaked orange. High plasticity. (Puketoka Formation)	D		
	0.8	Peak = 168kPa Residual = 72kPa		1					
	1.2	Peak = 179kPa Residual = 88kPa						VSt	
			30.6			ML: Clayey SILT with minor sand: whitish grey streaked orange. Low plasticity, sand is fine grained. (Puketoka Formation)			
	1.6	Peak = UTP							
			30.2			CH: Silty CLAY: whitish grey streaked orange. High plasticity. (Puketoka Formation)	M		
▼	2.0	Peak = UTP		2					
						... from 2.20m to 2.40m, ... becoming light greyish white streaked trace orange			
	2.4	Peak = 72kPa Residual = 50kPa				*... from 2.40m to 4.00m, ... becoming CLAY*			
	2.8	Peak = 69kPa Residual = 41kPa							
				3					
	3.2	Peak = 66kPa Residual = 41kPa						St	
	3.6	Peak = 77kPa Residual = 44kPa					W		
	4.0	Peak = 80kPa Residual = 50kPa		4		*... from 4.00m to 4.40m, ... becoming light greyish white*			
	4.4	Peak = 102kPa Residual = 58kPa				*... from 4.40m to 5.00m, ... becoming with some fine grained sand*		VSt	
	4.8	Peak = 61kPa Residual = 44kPa						St	
				5		Borehole terminated at 5.0 m			

Termination Reason: Target depth reached
Shear Vane No: 2904 DCP No:
Remarks: Groundwater encountered at 2.2m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

Appendix D: Laboratory Test Results

ROADTEST LTD

Revision: 1

DETERMINATION OF THE WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX & LINEAR SHRINKAGE TEST METHOD NZS 4402 : 1986 TEST 2.1, 2.2, 2.3, 2.4 & 2.6

Project Name : **Trig & Brigham Creek**

Project No : 19 0382 00

Client : CMW Geosciences

Page : 1 of 1

Address : PO Box 300206
Albany, Auckland 0754

Date of Order : 28.11.19

Sample Method : Hand Auger

Attention : Tessa

Sample Date : 26.11.19

Sampled By : CMW Geosciences Ltd

Test Details :

Test performed on : Whole Sample

History : Natural

Sample No.	Location	Depth (m)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Linear Shrinkage (LS)	Natural Water Content (%)
366J	MH01-19	2.5 to 3.0	95	28	67	-	51.8

Comments :

Tested By:	CK	Date :	29.11.19 to 06.12.19
Calculated By :	CK	Date :	09.12.19
Checked By :	ZH	Date :	09.12.19

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **TESSA GALBRAITH**

Job Number: 63186#L
BGL Registration Number: 2752
Checked by: JF

12th December 2019

ONE DIMENSIONAL CONSOLIDATION TESTING

Dear Tessa,

***Re: TRIG & BRIGHAM CREEK ROAD** (your reference AKL2019-0040)*
Report Number: 63186#L/Consol MH01-19 5.00 – 5.50m

Borehole No: MH01-19 Sample No: TUBE Depth: 5.00 – 5.50m

The following report presents the results of one dimensional consolidation testing at BGL of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 3rd of December 2019. Our instructions were to carry out a one dimensional consolidation test using cycle times that would give both the $\sqrt{T_{90}}$ and T_{50} values, and using a standard pressure sequence.

The push-tube sample was tested in accordance with the following standards:

Water Content:	NZS4402:1986:Test 2.1
One Dimensional Consolidation:	NZS4402:1986:Test 7.1

Please note that consolidation cycles were of a variable time duration, and hence is a departure from the test standard which states that the cycle time period for the consolidation loads after the initial cycle should be of approximately the same length. The time for each consolidation cycle was determined by observing consolidation data until the secondary consolidation could be assessed. Subsequent load cycles were taken to at least the time of the previous cycle.

The sample was extruded from the tube in small increments & trimmed into the consolidation ring, until the sample protruded from both sides of the ring. A wire was then used to cut the sample from the soil remaining in the tube, and a scalpel and straight edge was used to trim the sample flat in the ring.

These test results only relate to the sample tested. The values of m_v shown on the table have been calculated for each pressure increment, using void ratio difference for that increment. Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report. This test was carried out in a laboratory in which the temperature is kept at 20°C ± 3°C.

As per the reporting requirements of NZS4402: 1986: Test 2.1: water content is reported to two significant figures for values below 10%, and to three significant figures for values of 10% or greater. As per the reporting requirements of NZS4402: 1986: Test 7.1: one dimensional consolidation, the coefficients of consolidation (c_v's), and coefficients of volume compressibility (m_v's) are reported to two significant figures.

Note that the Coefficient of Secondary Compression (C_{sec}) and the Coefficient of Permeability (k) values reported on page 4 have been calculated based on the methods described in "Manual of Soil Laboratory Testing Volume 2: Permeability, Shear Strength & Compressibility Tests" by K.H. Head & R.J. Epps, 3rd Edition, 2011. The Coefficient of Permeability values were calculated using the c_v(log) values determined in the test. The reporting of these figures is not part of NZS4402:1986:Test 7.1, therefore these figures are not part of the IANZ endorsement for this report.

Sample Description (***not part of BGL IANZ Accreditation***)

MH01-19 / TUBE / 5.00 – 5.50m: CLAY, minor fine sand, stiff, moderately to highly plastic, light grey with white speckles, slightly moist, occasional black organics.

Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing, therefore the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Signatory (Laboratory Manager)
Babbage Geotechnical Laboratory

IANZ
ACCREDITED LABORATORY
ACCREDITATION Nº: 126

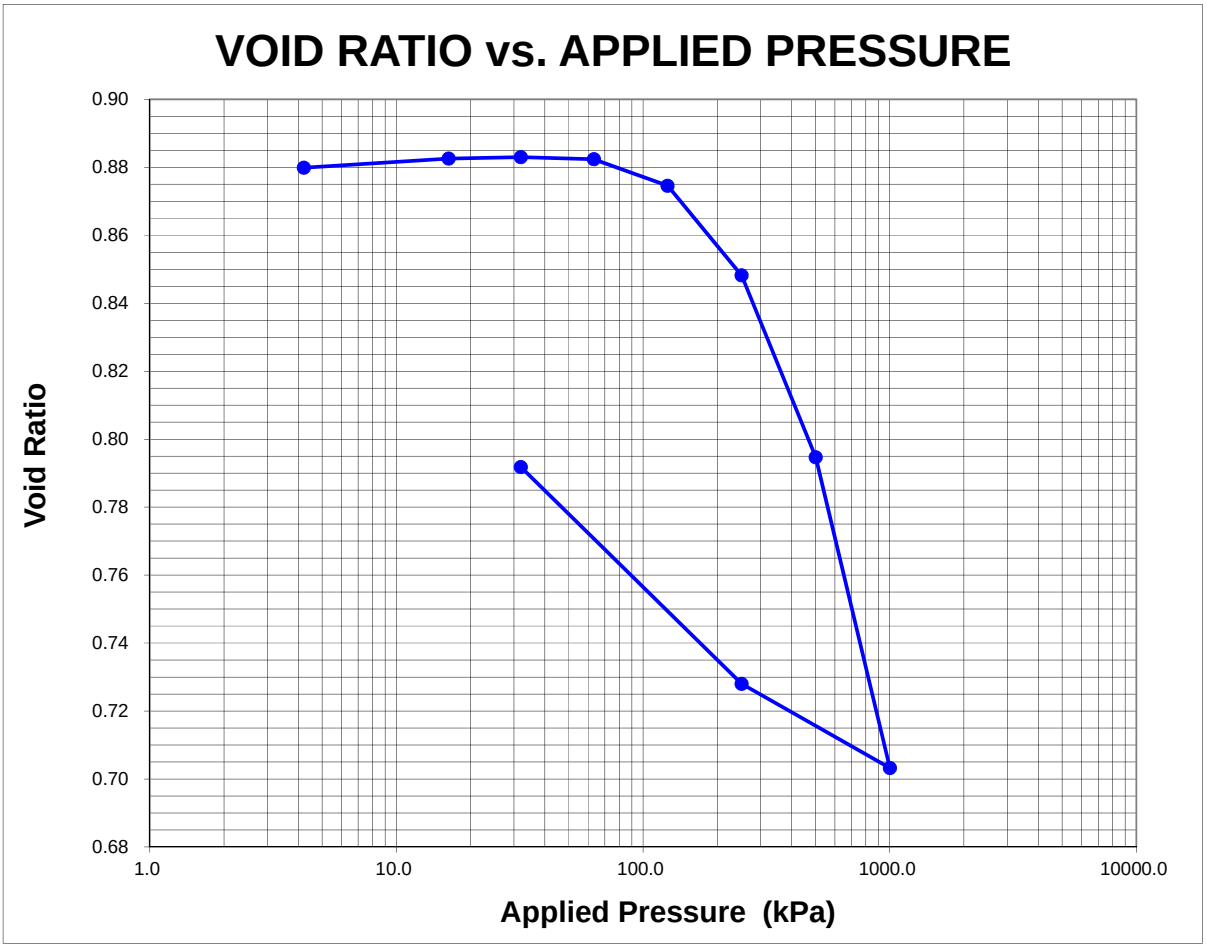
Babbage Geotechnical Laboratory	Job No:	Reg. No:	Sheet	of	Version No:	8
	63186#L	2752	3	4	Issue Date:	October 2017
	PROJECT:				Auth. By:	WEC

TRIG & BRIGHAM CREEK ROAD

ONE DIMENSIONAL CONSOLIDATION

Test Method: NZS4402:1986:Test 2.1 - Water Content	Tested By:	TH	December 2019
Test Method: NZS4402:1986:Test 7.1 - Consolidation	Compiled By:	TH	11-Dec-19
	Checked By:	JF	12-Dec-19

Borehole No: MH01-19 **Sample No:** TUBE **Depth:** 5.00 - 5.50m



SPECIMEN HISTORY

undisturbed ~~/ disturbed / remoulded / compacted / other:~~
Specimen from 60mm diameter push-tube
~~Compacted with NZ Standard Compaction effort / other compaction:~~

SPECIMEN PREPARATION

Extruded from 60mm diameter tube straight into consol ring in small increments & trimmed into consol ring. Both sides of ring then trimmed flat with a scalpel & straight edge.

TEST DETAILS

Consol machine number:	1		Surface area of top of sample:	1960	mm^2
Consol ring number:	1A		Solid density of soil particles (assumed / ~~measured):~~	2.65	t/m^3
Sample diameter:	49.95	mm			

Job No:	Reg. No:	Sheet	of	Version No:	8
63186#L	2752	4	4	Issue Date:	October 2017
PROJECT:				Auth. By:	WEC

Babbage Geotechnical Laboratory

TRIG & BRIGHAM CREEK ROAD

ONE DIMENSIONAL CONSOLIDATION

Test Method: NZS4402:1986:Test 2.1 - Water Content	Tested By:	TH	December 2019
Test Method: NZS4402:1986:Test 7.1 - Consolidation	Compiled By:	TH	11-Dec-19
	Checked By:	JF	12-Dec-19

Borehole No: MH01-19 **Sample No:** TUBE **Depth:** 5.00 - 5.50m

Applied Pressure	Incremental Deflection	Specimen Thickness	Compression Ratio	Height of Voids	Void Ratio	Coefficient of Volume Compressibility m_v	Coefficient of Consolidation - c_v (log time)	Coefficient of Consolidation - c_v (sqrt time)
kPa	mm	mm		mm	e	m^2/MN	m^2/year	m^2/year
4.2	0.000	21.150	1.000	9.899	0.880			
16.3	-0.030	21.180	1.001	9.929	0.883	sample swelled		
32.0	-0.005	21.185	1.002	9.934	0.883	sample swelled		
63.2	0.007	21.178	1.001	9.927	0.882	0.011	13	21
125.8	0.088	21.090	0.997	9.840	0.875	0.066	6.9	12
250.9	0.297	20.794	0.983	9.543	0.848	0.11	6.1	7.9
501.1	0.602	20.191	0.955	8.941	0.795	0.12	4.3	5.9
1001.6	1.029	19.163	0.906	7.912	0.703	0.10	3.2	3.7
250.9	-0.278	19.441	0.919	8.190	0.728	BACKLOAD 1		
32.0	-0.718	20.159	0.953	8.908	0.792	BACKLOAD 2		

Coefficient of Secondary Compression - C_{sec}	
Applied Pressure	C_{sec}
sample swelled	
sample swelled	
63.2	**0.001**
125.8	**0.001**
250.9	**0.002**
501.1	**0.005**
1001.6	**0.008**

Coefficient of Permeability - k	
Applied Pressure	k (m/s)
63.2	**4.3E-11**
125.8	**1.4E-10**
250.9	**2.1E-10**
501.1	**1.6E-10**
1001.6	**1.0E-10**

	INITIAL	FINAL
Mass of dry specimen (g)	58.42	58.42
Thickness of specimen (mm)	21.150	19.163 (after consolidation) 20.159 (after rebound)
Water Content (%)	33.2	31.2
Dry Density (t/m^3)	1.41	1.56
Height of soil particles (mm)	11.251	11.251
Void Ratio	0.880	0.703 (after consolidation) 0.792 (after rebound)
Degree of saturation (%)	100.0	-

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

CMW Geosciences Ltd.
PO Box 300 206
Albany
Auckland 0752

Attention: **TESSA GALBRAITH**

Job Number: 63186#L
BGL Registration Number: 2752
Checked by: JF

12th December 2019

ONE DIMENSIONAL CONSOLIDATION TESTING

Dear Tessa,

***Re: TRIG & BRIGHAM CREEK ROAD** (your reference AKL2019-0040)*
Report Number: 63186#L/Consol MH02-19 3.45 – 3.95m

Borehole No: MH02-19 Sample No: TUBE Depth: 3.45 – 3.95m

The following report presents the results of one dimensional consolidation testing at BGL of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 3rd of December 2019. Our instructions were to carry out a one dimensional consolidation test using cycle times that would give both the $\sqrt{T_{90}}$ and T_{50} values, and using a standard pressure sequence.

The push-tube sample was tested in accordance with the following standards:

Water Content:	NZS4402:1986:Test 2.1
One Dimensional Consolidation:	NZS4402:1986:Test 7.1

Please note that consolidation cycles were of a variable time duration, and hence is a departure from the test standard which states that the cycle time period for the consolidation loads after the initial cycle should be of approximately the same length. The time for each consolidation cycle was determined by observing consolidation data until the secondary consolidation could be assessed. Subsequent load cycles were taken to at least the time of the previous cycle.

The sample was extruded from the tube in small increments & trimmed into the consolidation ring, until the sample protruded from both sides of the ring. A wire was then used to cut the sample from the soil remaining in the tube, and a scalpel and straight edge was used to trim the sample flat in the ring.

These test results only relate to the sample tested. The values of m_v shown on the table have been calculated for each pressure increment, using void ratio difference for that increment. Note that a solid density value of 2.65t/m^3 was assumed for this test, and is not part of the IANZ endorsement for this report. This test was carried out in a laboratory in which the temperature is kept at 20°C ± 3°C.

As per the reporting requirements of NZS4402: 1986: Test 2.1: water content is reported to two significant figures for values below 10%, and to three significant figures for values of 10% or greater. As per the reporting requirements of NZS4402: 1986: Test 7.1: one dimensional consolidation, the coefficients of consolidation (c_v's), and coefficients of volume compressibility (m_v's) are reported to two significant figures.

Note that the Coefficient of Secondary Compression (C_{sec}) and the Coefficient of Permeability (k) values reported on page 4 have been calculated based on the methods described in "Manual of Soil Laboratory Testing Volume 2: Permeability, Shear Strength & Compressibility Tests" by K.H. Head & R.J. Epps, 3rd Edition, 2011. The Coefficient of Permeability values were calculated using the c_v(log) values determined in the test. The reporting of these figures is not part of NZS4402:1986:Test 7.1, therefore these figures are not part of the IANZ endorsement for this report.

Sample Description (***not part of BGL IANZ Accreditation***)

MH02-19 / TUBE / 3.45 – 3.95m: SILT, firm, slightly to moderately plastic, grey, moist.

Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing, therefore the test results relate only to the sample as-received, and relate only to the sample under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the person authorising this report below at your convenience.

Yours faithfully,

Wayne Campton
Signatory (Laboratory Manager)
Babbage Geotechnical Laboratory

IANZ ACCREDITED LABORATORY
ACCREDITATION Nº: 126

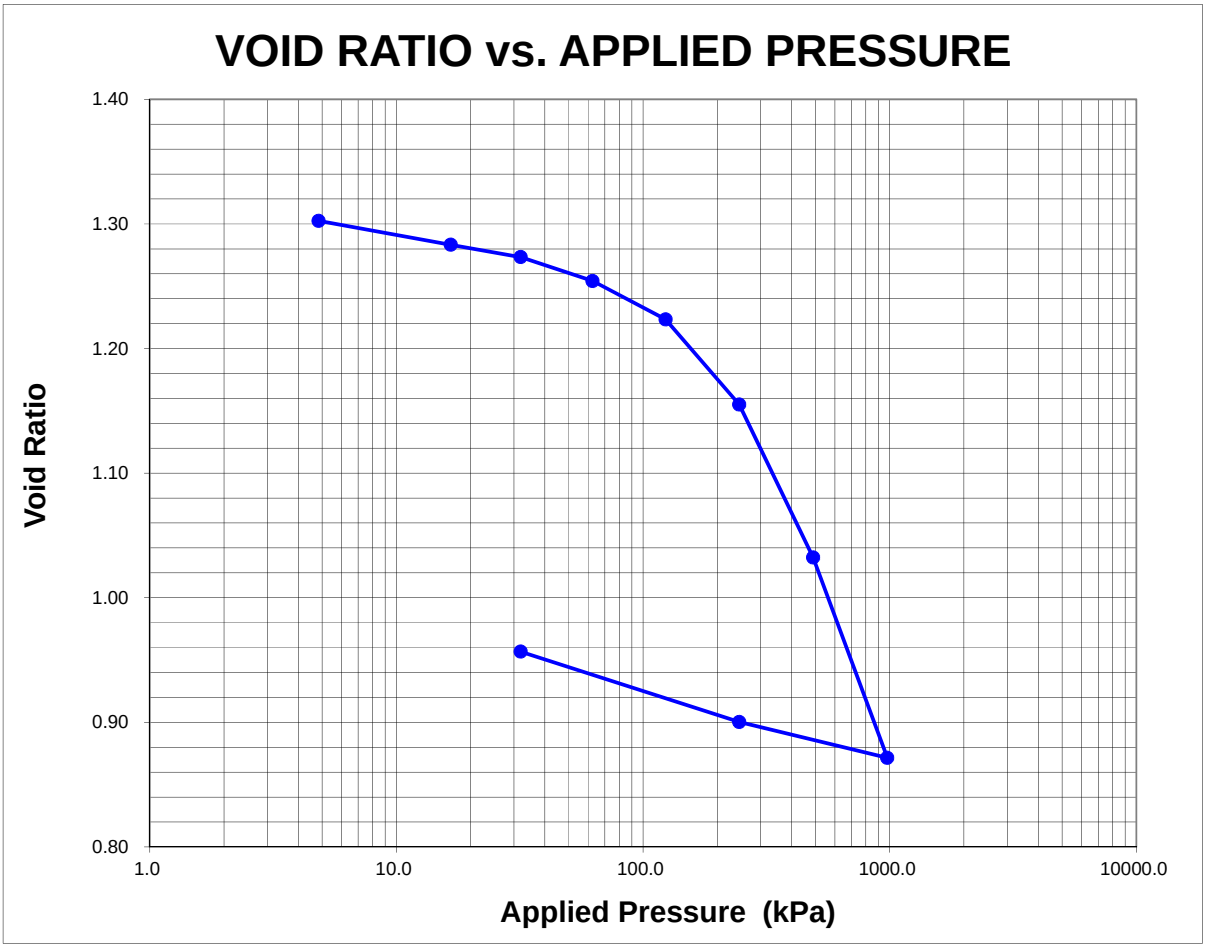
Babbage Geotechnical Laboratory	Job No:	Reg. No:	Sheet	of	Version No:	8
	63186#L	2752	3	4	Issue Date:	October 2017
	PROJECT:				Auth. By:	WEC

TRIG & BRIGHAM CREEK ROAD

ONE DIMENSIONAL CONSOLIDATION

Test Method: NZS4402:1986:Test 2.1 - Water Content	Tested By:	TH	Dec 2019
Test Method: NZS4402:1986:Test 7.1 - Consolidation	Compiled By:	TH	9-Dec-19
	Checked By:	JF	12-Dec-19

Borehole No: MH02-19 **Sample No:** TUBE **Depth:** 3.45 - 3.95m



SPECIMEN HISTORY

undisturbed ~~/ disturbed / remoulded / compacted / other:~~
Specimen from 60mm diameter push-tube
~~Compacted with NZ Standard Compaction effort / other compaction:~~

SPECIMEN PREPARATION

Extruded from 60mm diameter tube in small increments & trimmed into consol ring. Both sides of ring then trimmed flat with a scalpel & straight edge.

TEST DETAILS

Consol machine number:	2		Surface area of top of sample:	2009	mm^2
Consol ring number:	2B		Solid density of soil particles (assumed / ~~measured~~):	2.65	t/m^3
Sample diameter:	50.58	mm			

Babbage Geotechnical Laboratory	Job No:	Reg. No:	Sheet	of	Version No:	8
	63186#L	2752	4	4	Issue Date:	October 2017
	PROJECT:				Auth. By:	WEC

TRIG & BRIGHAM CREEK ROAD

ONE DIMENSIONAL CONSOLIDATION

Test Method: NZS4402:1986:Test 2.1 - Water Content	Tested By:	TH	Dec 2019
Test Method: NZS4402:1986:Test 7.1 - Consolidation	Compiled By:	TH	9-Dec-19
	Checked By:	JF	12-Dec-19

Borehole No: MH02-19 **Sample No:** TUBE **Depth:** 3.45 - 3.95m

Applied Pressure	Incremental Deflection	Specimen Thickness	Compression Ratio	Height of Voids	Void Ratio	Coefficient of Volume Compressibilit m_v	Coefficient of Consolidation - c_v (log time)	Coefficient of Consolidation - c_v (sqrt time)
kPa	mm	mm		mm	e	m^2/MN	m^2/year	m^2/year
4.8	0.000	19.890	1.000	11.252	1.303			
16.6	0.166	19.724	0.992	11.086	1.283	seating cycle		
31.9	0.086	19.638	0.987	11.000	1.273	0.28	24	22
62.4	0.165	19.473	0.979	10.835	1.254	0.28	25	30
123.4	0.267	19.206	0.966	10.568	1.223	0.22	29	29
245.4	0.590	18.616	0.936	9.978	1.155	0.25	26	28
489.5	1.061	17.555	0.883	8.917	1.032	0.23	24	27
977.5	1.388	16.167	0.813	7.529	0.872	0.16	16	24
245.4	-0.249	16.416	0.825	7.777	0.900	BACKLOAD 1		
31.9	-0.487	16.903	0.850	8.265	0.957	BACKLOAD 2		

Coefficient of Secondary Compression - C_{sec}	
Applied Pressure	C_{sec}
The logarithm of time graphs did not allow determination of the Coefficient of Secondary Compression (Csec) values for these cycles.	
123.4	0.001
245.4	0.002
489.5	0.004
977.5	0.003

Coefficient of Permeability - k	
Applied Pressure	k (m/s)
31.9	2.1E-09
62.4	2.2E-09
123.4	2.0E-09
245.4	2.0E-09
489.5	1.7E-09
977.5	8.1E-10

	INITIAL	FINAL
Mass of dry specimen (g)	46.00	46.00
Thickness of specimen (mm)	19.890	16.167 (after consolidation) 16.903 (after rebound)
Water Content (%)	45.1	37.6
Dry Density (t/m^3)	1.15	1.42
Height of soil particles (mm)	8.638	8.638
Void Ratio	1.303	0.872 (after consolidation) 0.957 (after rebound)
Degree of saturation (%)	91.7	-

Appendix E: Natural Hazards Risk Assessment

NATURAL HAZARDS RISK ASSESSMENT FOR LAND SUBDIVISION AT TRIG & BRIGHAM CREEK ROAD

A. CONTEXT

Section 106 of the Resource Management Act (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land, other land or structures (consequence).

Section 2 of the RMA defines natural hazards as any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

This appendix to CMW report reference AKL2019-0040AM Rev.0 sets out the criteria for and presents the results of an assessment of the geotechnical-related natural hazards associated with this proposed subdivision development. The remaining hazards, i.e. tsunami, wind, drought, fire and flooding hazards are not covered by this assessment.

B. BASIS OF ASSESSMENT

B1. Risk Classification

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk table is used to help assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1.

Table B1: Natural Hazard Risk Classification

		Consequence				
		Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	Almost Certain 5	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
	Likely 4	Low 4	Medium 8	High 12	Very high 16	Extreme 20
	Moderate 3	Low 3	Medium 6	Medium 9	High 12	Very high 15
	Unlikely 2	Very low 2	Low 4	Medium 6	Medium 8	High 10
	Rare 1	Very low 1	Very low 2	Low 3	Low 4	Medium 5

B2. Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification.

Table B2: Qualitative Natural Hazard Likelihood Definitions		
1	Rare	The natural hazard is not expected to occur during the design life of the project
2	Unlikely	The natural hazard is unlikely, but may occur during the design life
3	Moderate	The natural hazard will probably occur at some time during the life of the project
4	Likely	The natural hazard is expected to occur during the design life of the project
5	Almost Certain	The natural hazard will almost definitely occur during the design life of the project

B3. Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification.

Table B3: Qualitative Natural Hazard Consequence Definitions		
1	Insignificant	Very minor to no damage, not requiring any repair, no people at risk, no economic effect to landowners.
2	Minor	Minor damage to land only, any repairs can be considered normal property maintenance no people at risk, very minor economic effect.
3	Moderate	Some damage to land requiring repair to reinstate within few months, minor cosmetic damage to buildings being within relevant code tolerances, does not require immediate repair, no people at risk, minor economic effect.
4	Major	Significant damage to land requiring immediate repair, damage to buildings beyond serviceable limits requiring repair, no collapse of structures, perceptible effect to people, no risk to life, considerable economic effect.
5	Catastrophic	Major damage to land and buildings, possible structure collapse requiring replacement, risk to life, major economic effect or possible site abandonment.

B4. Risk Acceptance

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

Therefore, to give this qualitative natural hazard risk assessment some relevance to more commonly adopted numerical or quantitative geotechnical assessment techniques, a residual risk rating of very low to medium (risk value = 1 to 9 inclusive) is considered an acceptable result for the proposed subdivision development.

A risk rating of high to extreme (risk value ≥ 10) is considered an unacceptable result for the proposed subdivision development.

C. RISK ASSESSMENT

The natural hazards relevant to this proposed subdivision development and adjacent, potentially affected land have been assessed with respect to the criteria outlined above.

Assessment is based on proposed post development ground conditions with and without any geotechnical controls. The latent risk was first assessed with the site in its proposed developed state to consider the risks to the development and surrounding land, including assessment of land modifications from the pre-existing natural state, without any implemented geotechnical controls. The specific geotechnical mitigation measures and engineering design solutions outlined in the table below and CMW report, where relevant, were then considered to determine the natural hazard residual risk remaining after the proposed controls have been implemented.

Results of this assessment are presented in Table C1 below.

Table C1: Natural Hazard Risk Assessment Results

RMA S2 Hazard	Description	Proposed Site Latent Risk of Damage to Land / Structures			Comments and Geotechnical Control	Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Earthquake	Fault Rupture	1	4	Low 4	Low proximity to active faults	1	4	Low 4
	Liquefaction Induced Flooding and/ or Subsidence	2	4	Medium 8	Depth of cover / mainly clay soils based on existing information	2	4	Medium 8
	Lateral Spread	2	4	Medium 8	Depth of cover / mainly clay soils based on existing information	2	4	Medium 8

Volcanic Activity	Ash & Pyroclastic Falls	1	5	Medium 5	Low proximity to active volcanoes	1	5	Medium 5
	Lava flows & Lahars	1	5	Medium 5	Low proximity to active volcanoes	1	5	Medium 5
Geothermal Activity	Formation of geysers, hot springs, fumaroles, mud pools	1	5	Medium 5	Low proximity to active geothermal areas	1	5	Medium 5
Erosion	Cut Batters	4	3	High 12	Max 1:3 gradient / surface water control / benches	2	3	Medium 6
	Fill Batters	4	3	High 12	Max 1:3 gradient / surface water control / benches	2	3	Medium 6
Landslip	Global Slope Instability	4	4	Very High 16	Slope gradient / drainage / retaining walls	2	4	Medium 8
	Soil Creep	3	4	High 12	Foundation design / footing depth / slope regrading	2	4	Medium 8
	Bearing Capacity Failure	2	4	Medium 8	Undercut and replace / fill embankment gradient	2	4	Medium 8
	Cut & Fill Batter Instability	2	4	Medium 8	Surface water controls, regrading	1	4	Low 4
Subsidence	Expansive soils	5	4	Extreme 20	Foundation design for highly expansive soils	5	1	Medium 5
	Sinkholes	1	4	Low 4	Unlikely in existing geology	1	4	Low 4
	Soft Soils	2	4	Medium 8	Undercut and remove / pre-load / ground improvement / pile	1	4	Low 4
Sedimentation	Rockfall, debris inundation	2	4	Medium 8	Regrade slope / earthworks	1	4	Low 4

Notes:

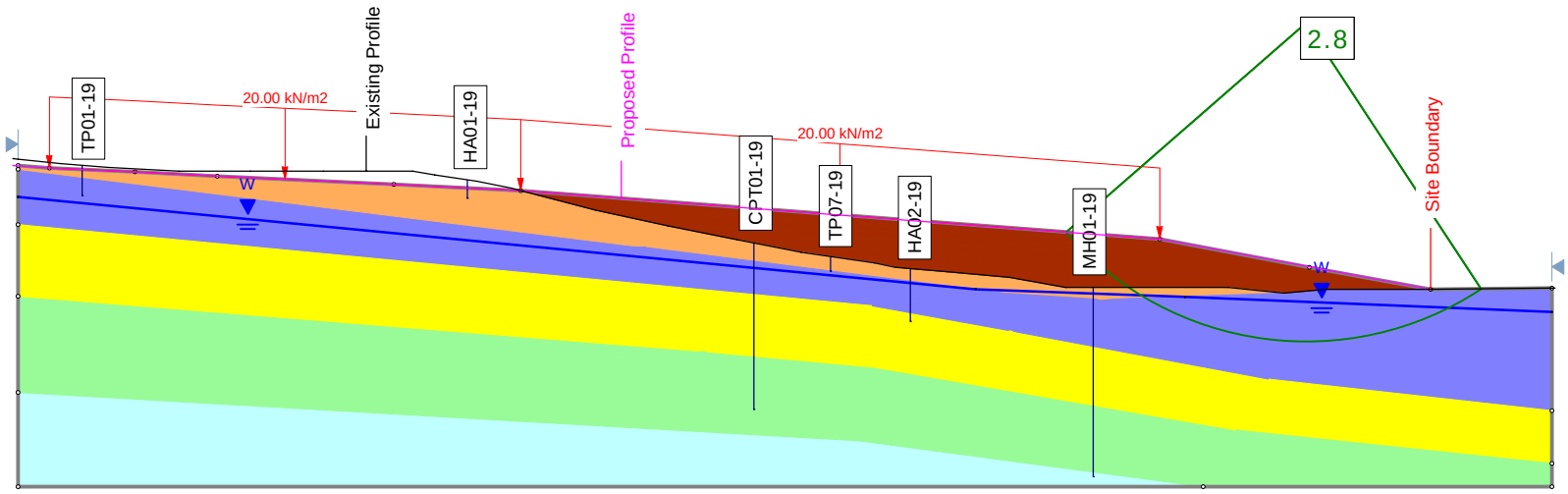
- Assessments include the impact of the proposed subdivision works on adjacent properties.
- The following reference(s) contain information on the hazards contained in this assessment and the non-geotechnical hazards that have not been included:
    - **Auckland**
      https://aucklandcouncil.maps.arcgis.com/apps/MapSeries/index.html?appid=81aa3de13b114be9b529018ee3c649c8

Appendix F: Stability Analyses Results

Project Trig & Brigham Creek Road
Job No. AKL2019-0040
Date 6/12/2019 * seismic peak ground acceleration at 0.115g
By TG

Section	Case	Failure Mode	Min. FS	Acceptance	Comments
A	Existing Contour - Normal ground water table	Circular	2.6	y	
	Existing Contour - Highly saturated (GW @ 0.5m)	Circular	1.5	y	
	Existing Contour - Seismic, Normal GWT	Circular	1.7	y	
	Proposed Contour - Normal ground water table	Circular	2.8	y	
	Proposed Contour - Highly saturated	Circular	2.4	y	
	Proposed Contour - Highly saturated (Drainage Failure)	Circular	2.1	y	
	Proposed Contour - Seismic, Normal GWT	Circular	1.7	y	
B	Existing Contour - Normal ground water table	Circular	5.0	y	
	Existing Contour - Highly saturated (GW @ 0.5m)	Circular	3.0	y	
	Existing Contour - Seismic, Normal GWT	Circular	2.4	y	
	Proposed Contour - Normal ground water table	Circular	2.3	y	
	Proposed Contour - Highly saturated	Circular	1.6	y	
	Proposed Contour - Highly saturated (Drainage Failure)	Circular	1.4	y	
	Proposed Contour - Seismic, Normal GWT	Circular	1.7	y	
C	Existing Contour - Normal ground water table	Circular	4.8	y	
	Existing Contour - Highly saturated (GW @ 0.5m)	Circular	3.1	y	
	Existing Contour - Seismic, Normal GWT	Circular	2.3	y	
	Proposed Contour - Normal ground water table	Circular	2.3	y	
	Proposed Contour - Highly saturated	Circular	1.7	y	
	Proposed Contour - Highly saturated (Drainage Failure)	Circular	1.5	y	
	Proposed Contour - Seismic, Normal GWT	Circular	1.6	y	
D	Existing Contour - Normal ground water table	Circular	3.1	y	
	Existing Contour - Highly saturated (GW @ 0.5m)	Circular	1.9	y	
	Existing Contour - Seismic, Normal GWT	Circular	2.0	y	
	Proposed Contour - Normal ground water table	Circular	1.8	y	
	Proposed Contour - Highly saturated	Circular	1.4	y	
	Proposed Contour - Highly saturated (Drainage Failure)	Circular	1.3	y	
	Proposed Contour - Seismic, Normal GWT	Circular	1.4	y	

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

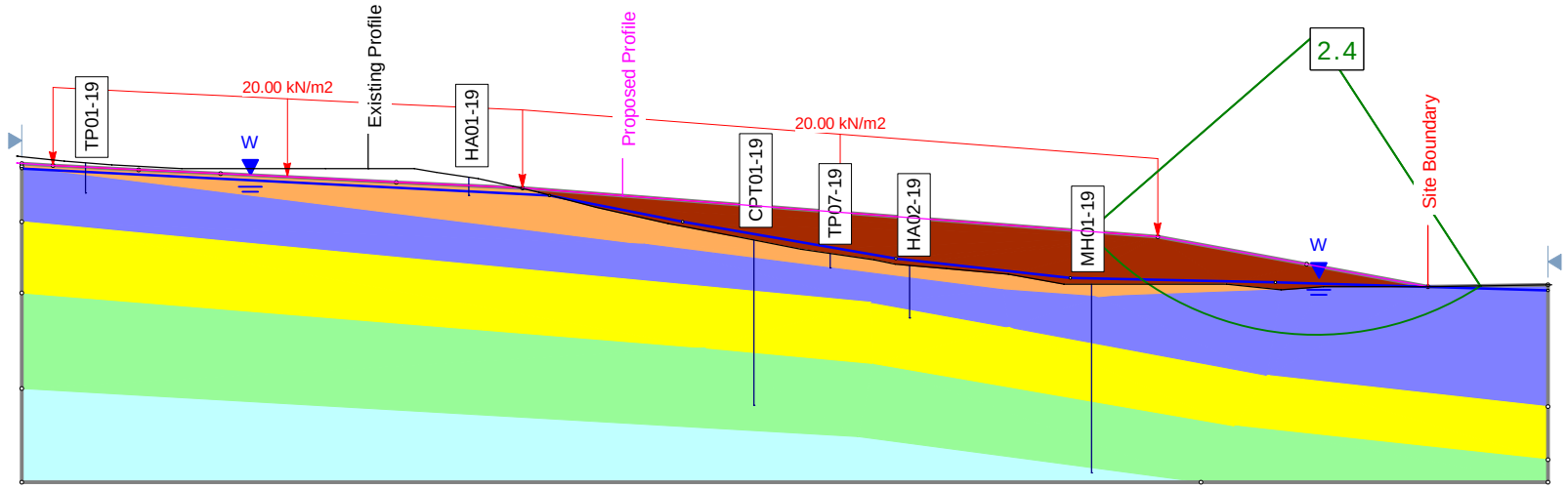


Project	Trig & Brigham Creek Road		
Analysis Description	Section A - Proposed Profile, Circular, Normal Groundwater		
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:750	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_AA'_PR_CA_NGW_061219

CMW Geosciences

SLIDE INTERPRET 8.029

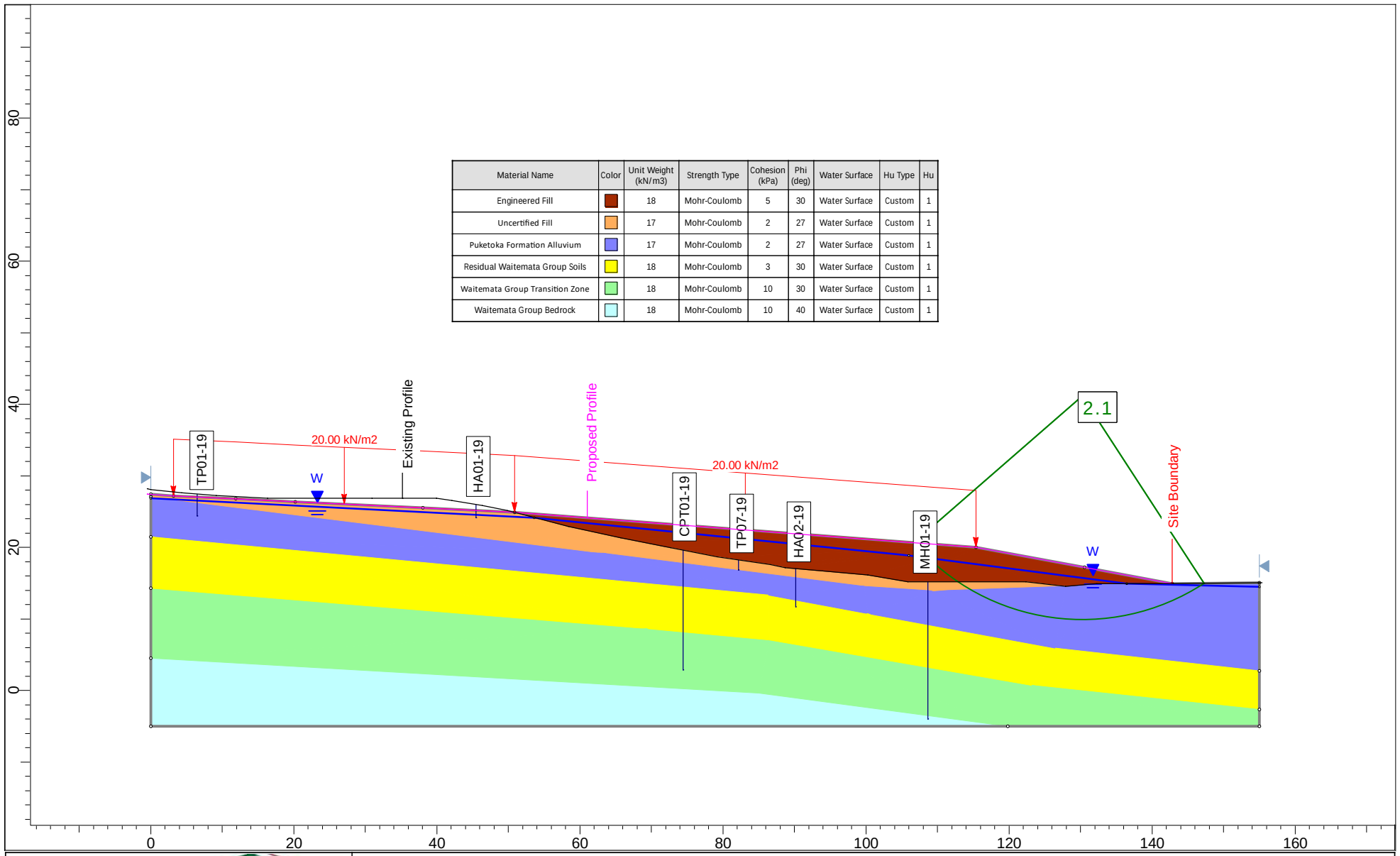
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1



SLIDE INTERPRET 8.029

Project	Trig & Brigham Creek Road		
Analysis Description	Section A - Proposed Profile, Circular, High Groundwater		
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:750	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_AA'_PR_CA_HGW_061219

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

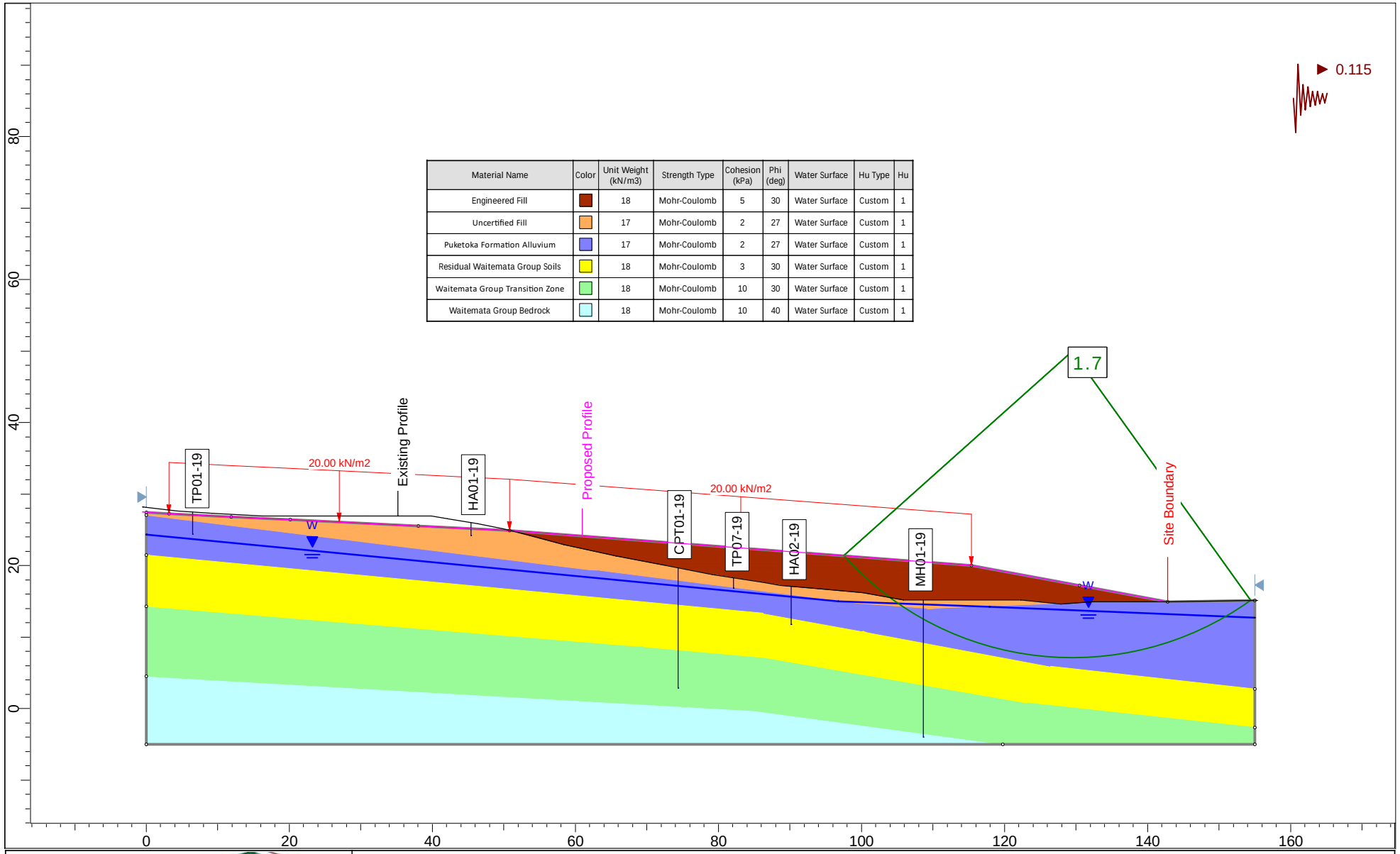


CMW Geosciences

SLIDE INTERPRET 8.029

Project	Trig & Brigham Creek Road		
Analysis Description	Section A - Proposed Profile, Circular, High Groundwater (Drainage Failure)		
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:750	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_AA'_PR_CA_HGW_061219 (Drainage Failure)

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

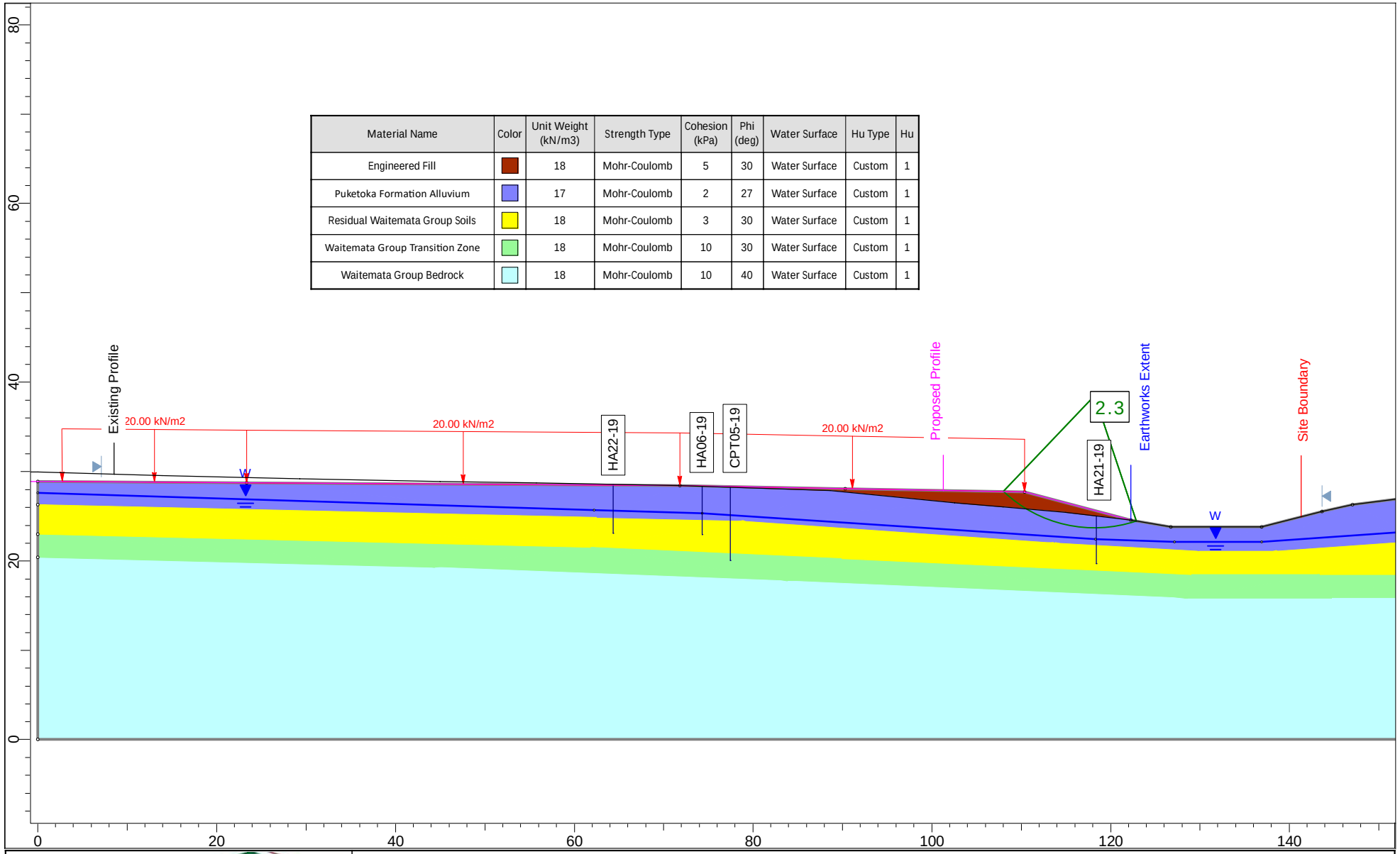


Project	Trig & Brigham Creek Road			
Analysis Description	Section A - Proposed Profile, Circular, Seismic			
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:750	*Company*	Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name*	AKL2019-0040_AA'_PR_CA_SEIS_061219

CMW Geosciences

SLIDE INTERPRET 8.029

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

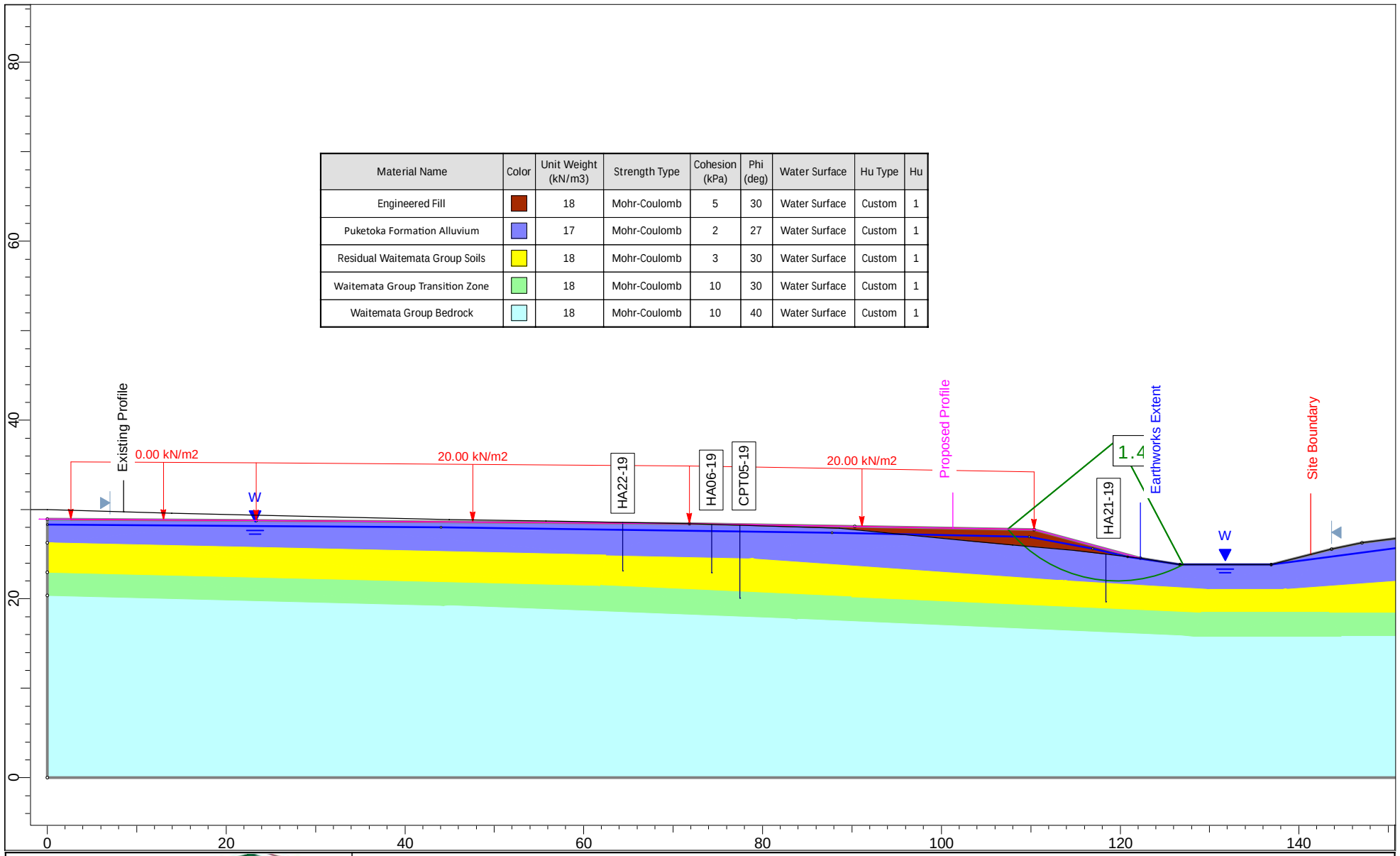


Project	Trig & Brigham Creek Road			
Analysis Description	Section B - Proposed Profile, Circular, Normal Groundwater			
Drawn By: YG	Date: 6/12/2019	Scale 1:600	Company	Neil Construciton Ltd
Figure No -	Job No AKL2019-0040		File Name	AKL2019-0040_BB'_PR_CA_NGW_061219

CMW Geosciences

SLIDE INTERPRET 8.029

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

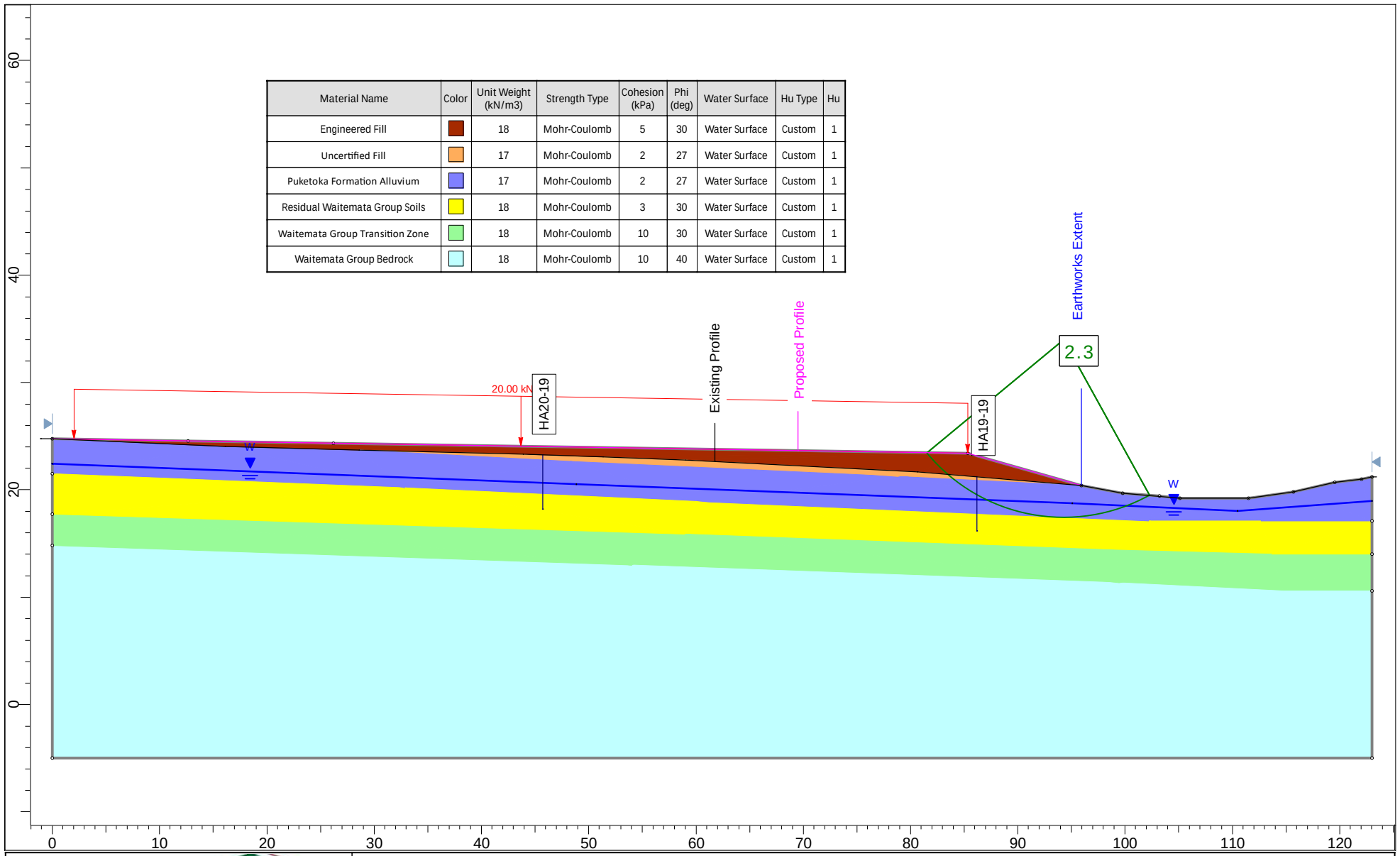


CMW Geosciences

SLIDE INTERPRET 8.029

Project	Trig & Brigham Creek Road		
Analysis Description	Section B - Proposed Profile, Circular, High Groundwater (Drainage Failure)		
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:600	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_BB'_PR_CA_HGW_061219 (Drainage Failure)

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

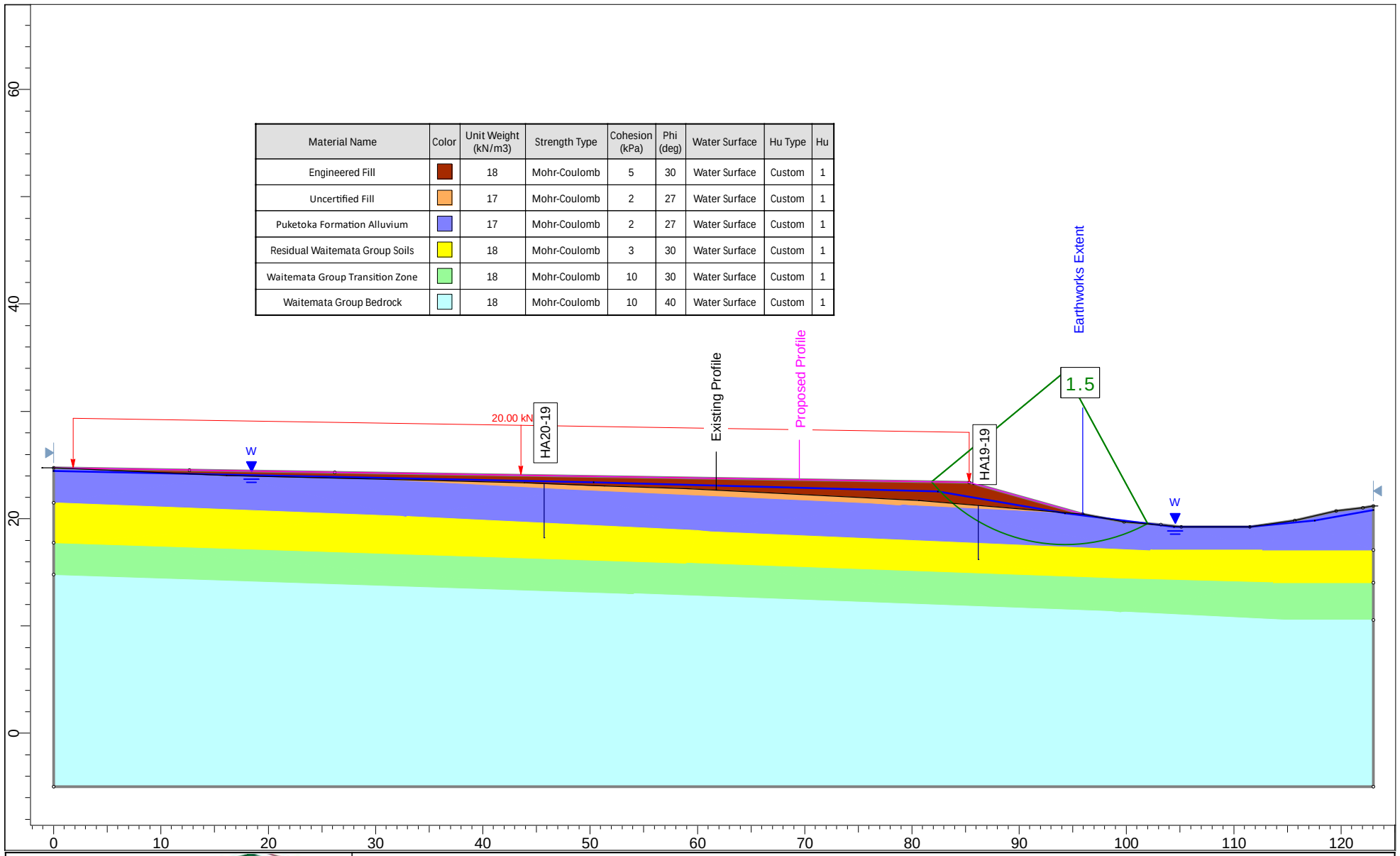


CMW Geosciences

SLIDE INTERPRET 8.029

Project	Trig & Brigham Creek Road		
Analysis Description	Section C - Proposed Profile, Circular, Normal Groundwater		
Drawn By TG	*Date:* 6/12/2019	*Scale* 1:500	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_CC'_PR_CA_NGW_061219

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Uncertified Fill		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

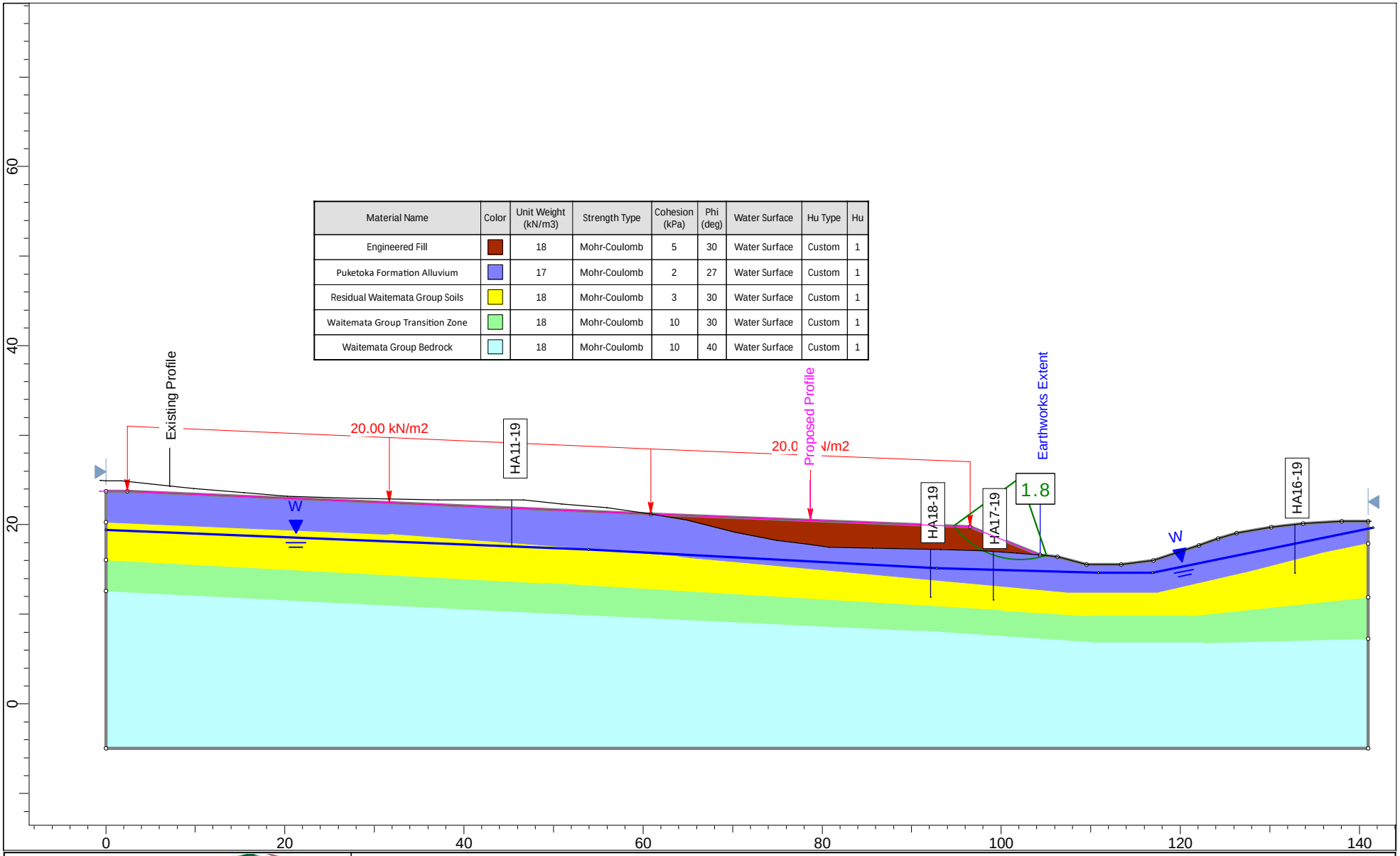


Project	Trig & Brigham Creek Road			
Analysis Description	Section C - Proposed Profile, Circular, High Groundwater (Drainage Failure)			
Drawn By YG	*Date:* 6/12/2019	*Scale* 1:500	*Company* Neil Construciton Ltd	
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_CC'_PR_CA_HGW_061219 (Drainage Failiure)	

CMW Geosciences

SLIDE INTERPRET 8.029

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1

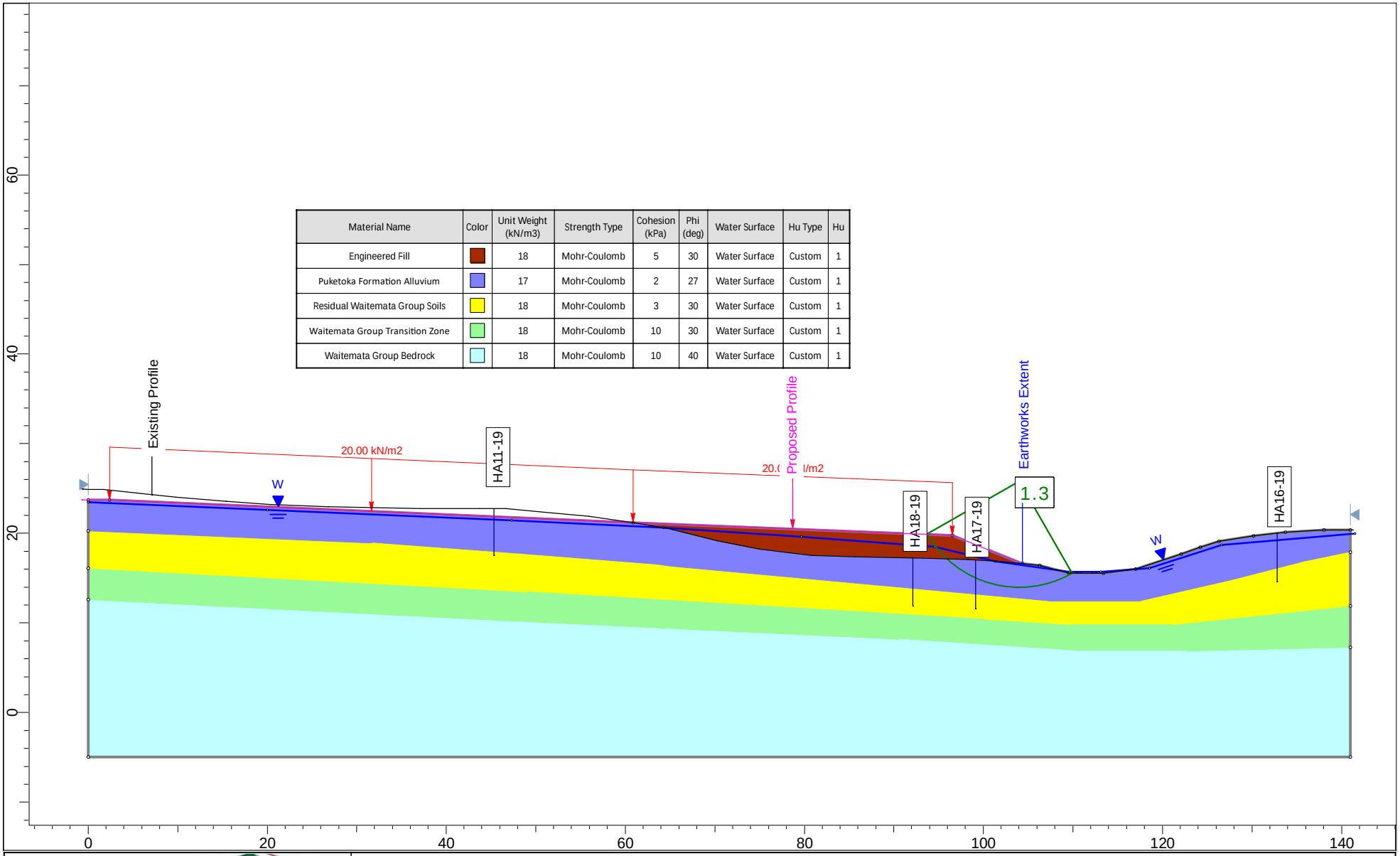


Project	Trig & Brigham Creek Road			
Analysis Description	Section D - Proposed Profile, Circular, Normal Groundwater			
Drawn By YG	*Date:* 6/12/2019	*Scale* 1:600	*Company*	Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name*	AKL2019-0040_DD'_PR_CA_NGW_061219

CMW Geosciences

SLIDE INTERPRET 8.029

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Engineered Fill		18	Mohr-Coulomb	5	30	Water Surface	Custom	1
Puketoka Formation Alluvium		17	Mohr-Coulomb	2	27	Water Surface	Custom	1
Residual Waitemata Group Soils		18	Mohr-Coulomb	3	30	Water Surface	Custom	1
Waitemata Group Transition Zone		18	Mohr-Coulomb	10	30	Water Surface	Custom	1
Waitemata Group Bedrock		18	Mohr-Coulomb	10	40	Water Surface	Custom	1



Project	Trig & Brigham Creek Road		
Analysis Description	Section D - Proposed Profile, Circular, High Groundwater (Drainage Failure)		
Drawn By YG	*Date:* 6/12/2019	*Scale* 1:600	*Company* Neil Construciton Ltd
Figure No -	*Job No* AKL2019-0040		*File Name* AKL2019-0040_DD'_PR_CA_HGW_061219 (Drainage Failure)

CMW Geosciences

SLIDE INTERPRET 8.029

Appendix G: Groundwater Impacts Assessment

Project no:

AKL2020-0231 - Rev 1

Project name:

71 Trig Road, Whenuapai

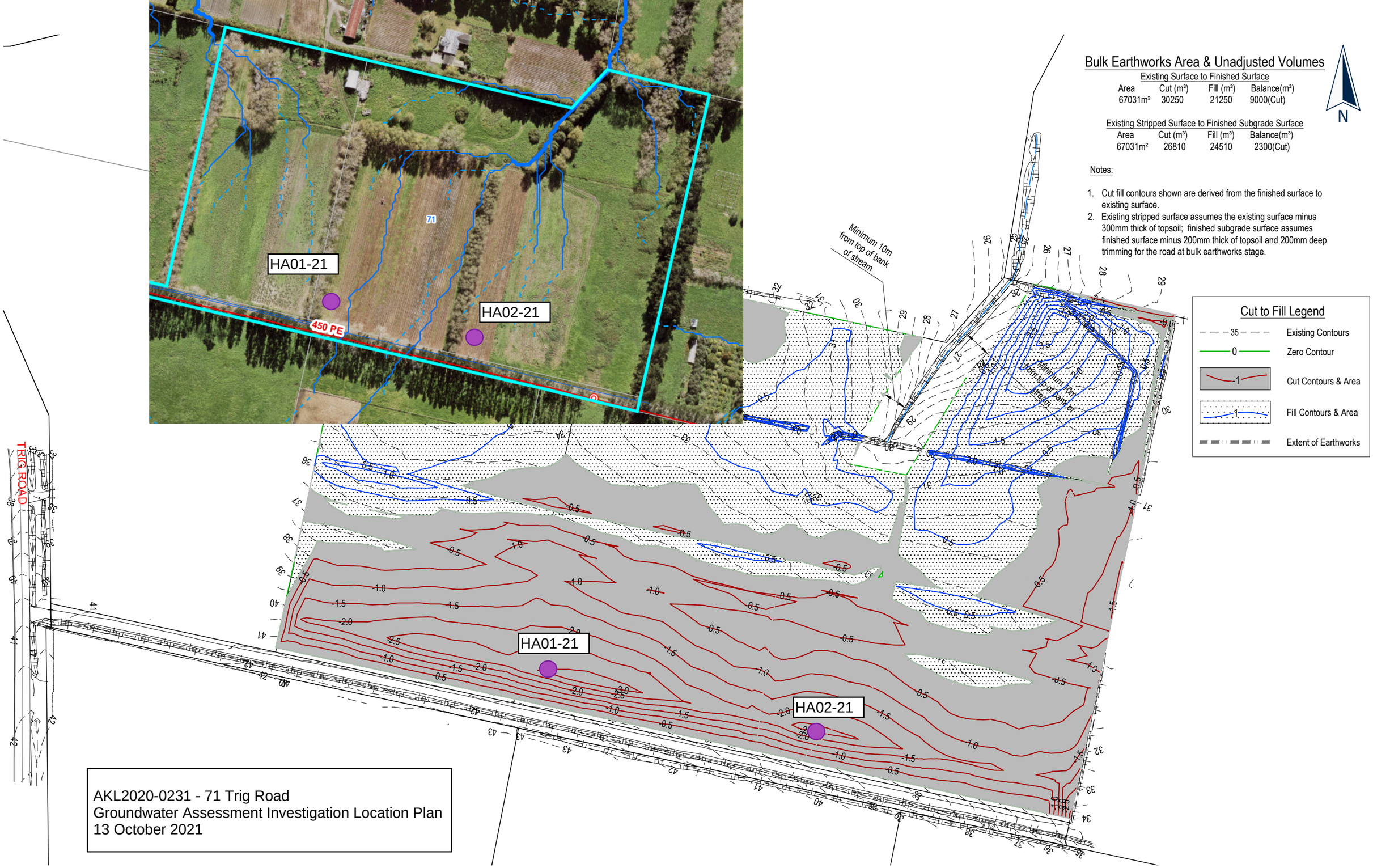
Assessment of geotechnical aspects of proposed development with respect to the Auckland Unitary Plan Operative in Part (Updated 12 June 2020)

Chapter E: Auckland-wide rules, Natural resources»E7 Taking, using, damming and diversion of water and drilling»E7.6. Standards Permitted activities»E7.6.1. Permited activities »E7.6.1.6. Dewatering or groundwater level control associated with a groundwater diversion permitted under Standard E7.6.1.10

Condition		Geotechnical Interpretation of Compliance
	Non- Compliant	
1. The water take must not be geothermal water	**Compliant**	1. Groundwater is not geothermal.
2. The water take must not be for a period of more than 10 days where it occurs in peat soils, or 30 days in other types of soil or rock	**Non - Compliant**	2. There are no peat soils identified on this site. Groundwater diversion likely to be required for more than 30 days due to the proposed development levels.
3. The water take must only occur during construction	**Non - Compliant**	3. Groundwater diversion likely to extend beyond construction period.

Chapter E: Auckland-wide rules, Natural resources»E7 Taking, using, damming and diversion of water and drilling»E7.6. Standards Permitted activities»E7.6.1. Permited activities »E7.6.1.10. Diversion of groundwater caused by any excavation, (including trench) or tunnel

Condition		Geotechnical Interpretation of Compliance
1.All of the following activities are exempt from the Standards E7.6.1.10(2) – (6)	**Non - Compliant**	
a. pipes cables or tunnels including associated structures which are drilled or thrust and are less than 1.2m in external diameter	**Compliant**	a. No pipes greather than 1.2m are proposed.
b. pipes including associated structures up to 1.5m in external diameter where a closed faced or earth pressure balanced machine is used	**Compliant**	b. Not proposed for this site.
c. piles up to 1.5m in external diameter are exempt from these standards	**Compliant**	c. Not proposed for this site.
d. diversions for no longer than 10 days; or	**Non - Compliant**	d. Groundwater likely to be encountered therefore diversions may be required.
e. diversions for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days	**Compliant**	e. Service trench excavations are not part of this application.
2.Any excavation that extends below natural groundwater level, must not exceed:	**Compliant**	
a. 1ha in total area; and		a. Although excavations are likely to extend below the natural groundwater level, the affected area will be less than 1ha.
b. 6m depth below the natural ground level		b. Not applicable for this site as cut levels are only proposed to be a maximum of 3.0m below natural ground level.
3.The natural groundwater level must not be reduced by more than 2m on the boundary of any adjoining site.	**Compliant**	3. No groundwater drawdown anticipated at any site boundary as the proposed cuts grade awy from the boundary, with the maximum cut depth located approximately 10m away from the boundary.
4.any structure, excluding sheet piling that remains in place for no more than 30 days, that physically impedes the flow of groundwater through the site must not:	**Compliant**	
a. impede the flow of groundwater over a length of more than 20m; and		a. No potentially groundwater impeding structures of this nature are proposed for this site.
b.extend more than 2m below the natural groundwater level.		b. No potentially groundwater impeding structures of this nature are porposed for this site.
5.The distance to any existing building or structure (excluding timber fences and small structures on the boundary) on an adjoining site from the edge of any:	**Compliant**	
a.trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation		a. Trenches/excavations are not proposed to extend below the natural groundwater level.
b.tunnel or pipe with an external diameter of 0.2 - 1.5m that extends below natural groundwater level must be 2m or greater; or		b. Tunnels/pipes are not proposed to extend below the natural groundwater level.
c.a tunnel or pipe with an external diameter of up to 0.2m that extends below natural groundwater level has no separation requirement.		c. Noted.
6.The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:	**Compliant**	
a.50m from the Wetland Management Areas Overlay		a. Greater than 50m from any Wetland Management Overlay
b.10m from a scheduled Historic Heritage Overlay; or		b. Greater than 10m from any Historic Heritage Overlay
c.10m from a lawful groundwater take.		c. Greater than 10m from any lawful groundwater take.



Bulk Earthworks Area & Unadjusted Volumes

Existing Surface to Finished Surface

Area	Cut (m³)	Fill (m³)	Balance(m³)
67031m²	30250	21250	9000(Cut)

Existing Stripped Surface to Finished Subgrade Surface

Area	Cut (m³)	Fill (m³)	Balance(m³)
67031m²	26810	24510	2300(Cut)

Notes:

1. Cut fill contours shown are derived from the finished surface to existing surface.
2. Existing stripped surface assumes the existing surface minus 300mm thick of topsoil; finished subgrade surface assumes finished surface minus 200mm thick of topsoil and 200mm deep trimming for the road at bulk earthworks stage.

N

Cut to Fill Legend

- 35 — Existing Contours
- 0 — Zero Contour
- -1 — Cut Contours & Area
- 1 — Fill Contours & Area
- Extent of Earthworks

AKL2020-0231 - 71 Trig Road
Groundwater Assessment Investigation Location Plan
13 October 2021

Cato Bolam
creating great places
PLANNERS | SURVEYORS | ENGINEERS
ARCHITECTS | ENVIRONMENTAL

Neil Construction
Brigham Creek and Trig Road
Whenuapai

71 Trig Road Bulk Earthworks
Cut fill Contours

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A	Issued for Information	MSC	20/01/2021
B	Issued for Resource Consent	MSC	29/01/2021
C	Issued for Resource Consent	MSC	14/04/2021
D	Issued for Resource Consent	MSC	14/04/2021

FOR RESOURCE CONSENT

	NAME	DATE
SURVEYED		
DESIGNED	MSC	20/01/2021
DRAWN	MSC	20/01/2021

DATE	ORIGINAL SCALE	ORIGINAL SIZE
20/01/2021	1:1500	A3

DRAWING NO. 44979-DR-C-2100

REVISION D

Appendix H: Geotechnical Works Specification

23 May 2022 Document Ref: AKL2019-0040AF Rev.1

Land Development Geotechnical Works Specification

For: Trig & Brigham Creek Road

1 INTRODUCTION AND SCOPE

This specification covers the geotechnical remediation works and associated earthworks outlined in the CMW Investigation Report (GIR), referenced AKL2019-0040AM Rev.0. It supplements the information provided on the design drawings and GIR. It provides detail on the required specification for:

- Site clearance and preparation including topsoil stripping and stockpiling;
- Subsoil drainage installation;
- Cut to fill earthworks operations;
- Fill materials and testing requirements;
- Earthworks finishing and respread of topsoil; and,
- As-built records.

Excluded from the scope are geotextile reinforced slopes with a face steeper than 30 degrees or retaining structures covered by a building consent. Such works will be carried out in accordance with an independent structure specific specification.

Unless varied onsite by the Geotechnical Engineer, the following specification requirements must be met in order for CMW Geosciences (CMW) to provide a Geotechnical Completion Report for the works.

2 RELEVANT DOCUMENTS

2.1 Standards, Guidelines and Consents

The works shall comply with the relevant sections of the following standards, guidelines and consents:

1. Health and Safety at Work Act 2015 and Regulations 2016;
2. All Project Resource Consent Conditions and Engineering Works Approvals;
3. The applicable Council Infrastructure Design Standard;
4. The Auckland Council, Erosion and Sediment Control Guidelines – Guidance document 2016/005;
5. NZS 4431:1989 Code of Practice for Earth Fill for Residential Development;
6. NZS 4402: 1986 Methods of Testing Soils for Civil Engineering Purposes; and,

7. NZS 4404: 2010 Code of Practice for Urban Land Subdivision.

2.2 Geotechnical Investigation and Design Report

Details of the geotechnical investigation, soil and rock conditions encountered, and the design of the geotechnical remedial works are contained in the CMW report AKL2019-0040AM Rev.0. The contractor should be aware of the contents and recommendations contained in that report.

The works shall comply with the recommendations contained in that report.

2.3 Construction Drawings

The works shall comply with the Neil Construction Limited plans referenced Brigham Creek Whenuapai, drawings 447-01-BE-200, 447-01-BE-201, 447-01-GE-200 and 447-01-GE-300.

2.4 Conflicting Information

Where there is any conflict or discrepancy in the requirements of this specification and the documents listed above the matter shall be referred to the Geotechnical Engineer (CMW) for clarification.

3 GEOTECHNICAL OBSERVATION REQUIREMENTS

The following items form hold points in the construction works that require observation, testing and approval by the Geotechnical Engineer (CMW):

1. Foundations for filling once topsoil and unsuitable materials, or existing uncertified fills, have been stripped prior to fill placement;
2. Shear key excavations and undercuts to confirm depth and extents prior to backfilling;
3. Subsoil drain excavations prior to placement of aggregate;
4. Any imported soil fill materials prior to placement on site;
5. Drainage aggregate quality prior to placement;
6. Geotextile layers once in place and prior to backfilling;
7. Filling placed at regular intervals to comply with the fill test frequency requirements below;
8. Compaction of backfilling in critical service trenches;
9. Flushing of the subsoil drainage system at the completion of earthworks;
10. Any unforeseen ground conditions that may impact on the construction works or future land use; and,
11. Installation of any settlement monitoring plates or points, application of pre-load and approval prior to its removal.

It is the contractor's responsibility to ensure that the Geotechnical Engineer is given reasonable notice and opportunity to observe the above works and that the works do not proceed until approval has been gained from the Geotechnical Engineer.

24 hours is considered reasonable notice.

4 CONSTRUCTION SPECIFICATION

4.1 Site Preparation

The Contractor shall remove all vegetation from the site of the earthworks except for trees indicated for preservation either by marking on the site or noted on the drawings, and clear the remainder of the site.

Clearing shall mean the felling of all trees, except those indicated, removal of all growth other than grass and weeds, extraction of tree stumps, demolition of fences and other minor items remaining in the way of site stripping, and the complete disposal of all items. Stumping shall mean the removal of all roots greater than 25mm in diameter.

Cleared areas shall be stripped to remove all turf and organic topsoil to depths designated by the Engineer ahead of or during the stripping operations. Stripping shall also cover picking up any old topsoil stockpiles and any buried topsoil detected during the course of the works. The depth shall be sufficient to remove all materials considered unsuitable as fill or unsuitable to remain beneath fill but will not necessarily extend to the full limit of organic penetration.

4.2 Erosion and Sediment Control

The works shall be carried out in accordance with the project Erosion and Sediment Control Management Plan and associated drawings.

The contractor shall ensure good control of surface water runoff at all times by shaping of the surface in cut and fill areas to prevent ponding during rainfall events.

The location of temporary Sediment Retention Ponds (SRP) on sloping ground shall be decided upon with input from the Geotechnical Engineer. Where comment of SRP stability is sought by Council then all fill materials used to form batters, must be placed as engineered fill and tested accordingly unless advised otherwise by the Geotechnical Engineer.

When decommissioning temporary sediment ponds, all water softened material in the bases and sides of the ponds shall be removed and undercut to the satisfaction of the Geotechnical Engineer. Backfilling of temporary ponds shall be to the compaction standard for general filling unless otherwise specified.

4.3 Stockpiles

Topsoil stockpiles can add significant driving force for slope instability when placed at or near the crest of a slope. The location of all temporary stockpiles must be approved by the Geotechnical Engineer prior to placement. Where stockpiles cannot be avoided above sloping ground they should be placed over a wide area with the height restricted under the direction of the Geotechnical Engineer.

4.4 Fill Foundations and Benching of Slopes

The foundation on which filling is to be placed must be observed by the Geotechnical Engineer following clearing and prior to the placement of any filling to confirm the strength of the underlying soils is sufficient.

Where it is found, after clearing and stripping operations as specified, that the foundation on which filling is to be placed is unstable, or in cuttings if it is found after the excavation has been cut down to the levels shown in the drawings that unstable ground is encountered, then the Engineer may direct that the soft, yielding or unstable materials causing such instability shall be removed to such depth as directed.

Benching of slopes prior to the placement and compaction of filling should be carried out in accordance with the normal requirements of NZS 4431 and related documents as mentioned above, especially on the steeper areas of the site, to ensure that the filling placed is keyed into the underlying natural ground. This would involve the cutting of benches approximately the width of a bulldozer, with a slight reverse gradient back into the slope. The optimum depth of each bench is best confirmed by careful Engineering inspections during construction.

4.5 Temporary Batters and Excavation Stability

The temporary stability of the works is the responsibility of the main contractor.

Slope instability during construction is a significant risk where earthworks may cause changes to slope geometry or groundwater conditions.

The causes of instability during earthworks may include:

- Removal of toe support due to excavation;
- Over steepening of slope angles in temporary batters;
- Geological defects in the soil or rock mass, particularly where these are exposed in excavation faces;
- Elevated groundwater levels following rainfall, perched groundwater or rapid recharge due to the reduced distance to an impermeable layer (i.e. undisturbed rock) due to cut operations; and,
- Additional loading upslope of excavations. ie. construction equipment or stockpiles.

To help mitigate these risks the contractor should consider:

- Staging excavations which reduce support to slopes or create temporarily over steepened slopes, to ensure large areas are not left unsupported. The allowable length of excavation to have open at any one time will vary and is dependent on a number of factors such as, local ground conditions, groundwater, length of time the excavation will be open, weather, depth of excavation, geological defects present and the earthworks equipment and methodology used;
- Ceasing works in excavations during rainfall and assessing stability of excavations following rainfall events prior to resuming work;
- Benching or battering back of excavation faces;
- Ensuring good control of surface water runoff above excavations and batters;
- Covering steep batters with impermeable covers where they may be left without support for any significant period of time;
- Avoiding loading the crests of slopes and excavations (including loading with working plant);
- Putting in place comprehensive risk identification and management procedures and work methodologies for temporary excavation stability;
- Carrying out regular inspections of the areas upslope of excavations and the excavation slope to look for signs of instability such as ground displacement and the development or propagation of cracks; and,
- Seeking advice from the Geotechnical Engineer where there is doubt as to the stability of a slope or excavation.

4.6 Fill Materials and Conditioning

4.6.1 Soil Fill, Rock Fill or Soil and Rock Mixed Fill

Site won materials used as engineered filling shall be free of topsoil, organic matter, rubbish and other unsuitable materials. The maximum particle size for soil and rock blended fill shall be 200mm and mixing and/ or crushing shall be carried out in a manner that ensures that significant voids are not present in the filling between rock fragments.

For rock fill without soil blending, crushing is to occur to comply with the requirements for blended fills and needs to ensure that uniform compaction can occur without significant voids between particles in the absence of the soil fill.

4.6.2 Blending of Unsuitables

The blending of ‘unsuitables’ into structural fills may be undertaken only at the discretion of the Geotechnical Engineer following a request by the contractor and with sufficient time for appropriate consideration. Approval for any such blending must be sought from and provided by the Geotechnical Engineer in writing prior to the commencement of any blending.

In consideration of any such requests, the Geotechnical Engineer will need to be able to assess, et. al., the composition of the materials requested to be blended, the location on the site for the proposed fills, the fill depths and the elevation of the blended materials within the fills and any environmental constraints.

As a minimum, it is expected that any blended fills will be directed to comply with the following conditions:

- All significant, solid inorganics (such as roots and stumps) to be removed prior to blending; and,
- All inclusions of suitable man-made materials (e.g. concrete) and any excavated rock must comply with the normal compaction requirements specified herein in terms of size and ability for appropriate compaction to be achieved in close vicinity to the inclusions.
- All blended materials must be appropriately mixed/ blended normal fill materials to the specified ratio. Un-mixed interlayering of normal engineered filling with unsuitables will not be accepted.
- As a preliminary indication, it is expected that the ratio of unsuitables to suitable fill will not exceed 1 in 10 by volume.

It is expected that the Geotechnical Engineer will also need to apply limits to the location/ depth of blended fills within any specified fill area.

4.6.3 Hardfill

Hardfill used as structural filling shall be a graded, unweathered, durable, crushed rock product approved by the Geotechnical Engineer, with a grading suitable for compaction.

4.6.4 Material Conditioning

The cut materials on site may require some drying prior to compaction to achieve the required specification. This may be done by harrowing (such as with discs) and air drying when conditions permit or by the addition of hydrated lime.

The addition of lime and/or cement to engineered filling in concentrations greater than 3% requires the approval of the Geotechnical Engineer.

All additives such as lime or cement proposed for use in backfill materials for Reinforced Earth Slopes or other materials in contact with geosynthetics must be approved and monitored by the Geotechnical Engineer.

4.7 Fill Placement, Compaction and Testing Requirements

4.7.1 Soil Fill

Soil placed in fills shall be conditioned and compacted until the following conditions are satisfied. Alternative methods based on specified compaction techniques may be selected by the Geotechnical Engineer if the method below is considered inappropriate due to the granular nature of the materials.

It should be noted that the surface of the fill area prior to placement of subsequent fill lifts should be in a state so as not to create a break in the consistency of the fill material between lifts. For example if surfaces are left to dry out, or rolled to seal them from rainfall infiltration then the surface must be broken up and scarified with rippers or by other means to ensure a good bond between fill lifts.

The maximum lift of filling placed before compaction is dependent on the size and nature of the compaction equipment. Typically, 300mm loose depth is considered the maximum for a Cat 815/820 type compactor. In any event the contractor must ensure that the fill is placed and compacted to achieve even and adequate compaction throughout each layer/lift.

The test criteria and frequency for cohesive materials (Clays & Silts) are set out in Table 1 and 2 below. If non cohesive soils (i.e. Sands) are to be placed as engineered fill the matter should be referred to the Geotechnical Engineer to define the testing requirements.

Table 1 – Cohesive Materials (soil fill and soil/ rock blended fill) Compaction Test Criteria for Engineered Filling:

	Air Voids [1]		Vane Shear Strength [2]		Moisture Content [3]	Dry Density [3]
	Average	Maximum Single Value	Average	Minimum Single Value	Maximum	Minimum
General Fill	10%	12%	140 kPa	110 kPa	40%	1.25 t/m^3
High Strength Fill	8%	10%	150 kPa	120 kPa	40%	1.3 t/m^3
Landscape Fill	TBC by Geotechnical Engineer of case by case basis					

[1] Air Voids Percentage (as defined in NZS 4402:1986)

[2] Undrained Shear Strength (Measured by hand shear vane – calibrated using NZGS 2001 method)

[3] Moisture content and minimum dry density non-compliance may be accepted on site by the Geotechnical Engineer on a case by case basis depending on the nature of the material and the other criteria results.

Table 2 – Cohesive Materials (soil fill and soil/ rock blended fill) Compaction Testing Frequencies for Engineered Filling:

	Field Density & Air Voids %	Vane Shear Strength	Solid Density	Compaction Curve
General Fill	1 test per 1500m^3 of fill placed with not less than 1 test per 500mm lift of filling for each area.	1 set of tests (4 readings within 1 metre of each other) per 500m^3 of filling placed with not less than 1 test per 500mm lift of filling for each fill area.	1 test per material type per 50,000m^3 or at least 1 test every 8 weeks.	1 test per material type per 30,000m^3 or at least 1 test every 5 weeks.
High Strength Fill	1 test per 1000m^3 of fill placed with not less than 1 test per 500mm lift of filling and for each 50m length of shear key excavation.	1 set of tests (4 readings within 1 metre of each other) per 500m^3 of filling placed with not less than 1 test per 500mm lift of filling per 25m of shear key excavation.	1 test per material type per 50,000m^3 or at least 1 test every 8 weeks.	1 test per material type per 30,000m^3 or at least 1 test every 5 weeks.
Landscape Filling	TBC by Geotechnical Engineer of case by case basis			

The test criteria and/or frequency may be relaxed at the discretion of the Geotechnical Engineer (CMW) for the project or in a discrete fill area subject to the consistency of the results achieved being acceptable over a specified period of time.

4.7.2 Compaction Testing Reporting Requirements

1 All test location coordinates to be recorded by hand held GPS with reference to the NZTM projection. Test location coordinates, with date and test number reference are to be provided to the Geotechnical Engineer in electronic (excel) format on a weekly basis. Alternatively, the Geotechnical Engineer may approve the use of site plans to mark the location of tests in lieu of GPS location.

2. The volume of filling placed for each progress claim month (typically ending 20th of the month) including all filling placed (undercut and cut to fill) to be provided to the Geotechnical Engineer monthly by the contractor or Engineer to the Contract to allow assessment of test frequency adequacy.

3. Interim fill test summaries are to be provided to the Geotechnical Engineer for review on a regular basis.

4.7.3 Hardfill

A plateau compaction test shall be carried out on site under the supervision of the Geotechnical Engineer, for each type of hardfill placed to determine the achievable maximum dry density (MDD) with no more than 20% total voids unless a laboratory derived MDD can be provided. The Geotechnical Engineer shall be given the opportunity to approve the size and type of compaction equipment to be used prior to any plateau testing.

Hardfill shall be placed and compacted to 95% of the MDD determined from the plateau test or laboratory MDD. If these conditions are not able to be met then appropriate adjustment of the moisture content or compaction equipment will be required.

In all cases, the dry density of the compacted fill at any one test site shall be not more than 5% below the minimum and the average of the dry densities of any ten consecutive test sites shall not be less than the specified minimum.

The Geotechnical Engineer, may at their discretion, alter the compaction specification to a method compaction specification based on the plateau test result for materials with a maximum particle size greater than 65mm.

The test frequency shall be 1 test per 500m^3 of hardfill placed with not less than 1 test per 500mm lift of filling for each fill area.

The test frequency may be relaxed at the discretion of the Geotechnical Engineer (CMW) for the project or in a discrete fill area subject to the consistency of the results achieved being acceptable over a specified period of time.

4.8 Subsurface Drainage

4.8.1 General

Drainage for shear keys, fill drainage keys, buttress fills, underfill gully drains and counterfort drains shall be constructed in accordance with the design drawings and standard details.

4.8.2 Materials

4.8.2.1 Pipes

Drainage pipes used in subsoil drainage shall be 160mm diameter highway grade drain coil. Drain coil walls shall be perforated or solid as detailed in the design drawings or directed by the Geotechnical Engineer on site. Drain coils shall not have a geofabric filter sock unless requested by the Geotechnical Engineer on site.

4.8.2.2 Aggregate

Auckland Council now generally require that subsoil drainage has a 100 year design life and is essentially maintenance free, unless there is an entity such as body corporate or residents association that maintenance responsibility can be transferred to. Maintenance by individual owners is not practical as the subsoil drainage systems usually cross over, and generally benefit, multiple lots.

This requires a high quality drainage aggregate with the following properties:

- Self-filters against the soils present on site preventing loss of permeability over time; or, able to be practically wrapped in a suitable geofabric filter;
- High permeability, which translates to a low fines content; and
- Stable and not subject to crushing, weathering, internal erosion or piping, or significant loss of volume (settlement) over time.

Ideally the drainage aggregate should be a well graded self-filtering material such as a clean (free of significant cohesive fines) scoria SAP50 product or Transit F/2 specification filter media.

Alternatively, for shear key drainage, blanket drains, underfill drainage and all applications where full encapsulation with a geofabric filter cloth can be relatively simply and safely achieved, an open graded product, preferably 27/7 Scoria may be used. Care will need to be taken to ensure that the cloth fully encapsulates the aggregate. Observation of the cloth wrap should form an inspection hold point prior to backfilling over the drain. Drain coils in this instance do not require a filter sock.

For counterfort trench drains and applications where a full filter cloth wrap is not practical to construct, and the performance of the drain is not critical to maintaining slope stability then a SAP20 or SAP50 may be used without a filter cloth wrap. Drains which fall into this category must be defined and confirmed as such by the Geotechnical Engineer. Additionally, where such materials are used, regular visual inspections and approval of the aggregate quality and laboratory grading curves is required. This is to comprise visual inspection of each site stockpile prior to material being placed in the trench. One wet sieve grading curve from each site stockpile per week is required while material is being imported to site to monitor the fines content. Drain coils in this instance do not require a filter sock.

For counterfort trench drains and applications where a full filter cloth wrap is not practical to construct, and the performance of the drain is critical to maintaining slope stability then a TNZ/F2 or (approved) modified F2 aggregate must be used. In conjunction with this an approved high specification drainage pipe with filter cloth surround such as the Megaflo products may be specified.

Light compaction (i.e. tamping with back of excavator bucket) only is to be applied to drainage aggregates.

4.8.2.3 Filter Cloth

Any filter cloth surround specified on the drawings shall meet the requirements of Transit Specification TNZ/F7, Filtration Class 2 and Strength Class B unless otherwise specified on the drawings.

4.8.2.4 Trench Backfill in Service Trenches

It is important on all sloping land that service trenches running parallel to contours are avoided where possible as they can permit the ingress of surface water and/or lateral movement of trench sides that could lead to progressive land slippage, help develop tension cracks and possibly lead to slope and building instability.

Backfilling of all trenches should be to the general fill standard above unless specifically varied in writing by the Geotechnical Engineer and where possible the pipe bedding in all trenches on steep ground should contain a 50mm diameter perforated drain coil that is connected into each manhole on the line. This is to help prevent instability arising from the ingress of surface water and/or lateral movement of trench sides that could lead to progressive land slippage and is especially important where the lines are in close proximity to buildings.

The subdivision drain laying contractor must be made aware of these requirements and of the need to contact us when trench backfilling is to take place.

4.8.3 Depth and Extent

The location, extent and depth of the drainage shown on the design drawings may be varied on site by the Geotechnical Engineer in response to the ground conditions encountered.

4.8.4 Drainage Outlets and Inspection Points

Outlets for subsurface drainage shall be provided at regular intervals shown on the drawings or as determined on site by the Geotechnical Engineer. Pipe outlets shall be specifically formed structures with adequate protection such as a headwall and/or rock rip rap. The position of all outlets shall be recorded on the asbuilt drawings.

Where possible it is good practice to include additional inspection and/or flushing points in the subsoil drainage system in the event that their performance needs to be confirmed in the future.

In any event, at least one temporary flush point is required for each subsoil drainage system to enable flushing of the system once the earthworks are substantially complete.

The flushing of the subsoil drainage system must be witnessed by the Geotechnical Engineer.

4.9 Finishing Works and Topsoil Respread

4.9.1 Overcut

All areas cut to below finished level should be reinstated with engineered filling to the satisfaction of the Geotechnical Engineer.

4.9.2 Topsoil Depth

Topsoil respread depth should be between 100mm and 300mm, or as directed by the Engineer to the contract. On ground steeper than 1V:3H the surface should be roughened under the supervision of the Geotechnical Engineer prior to topsoil placement.

4.9.3 Unsuitable Materials

At the conclusion of earthworks all surplus unsuitable materials should be removed from site or placed in designated permanent stockpiles. The size and location of such stockpiles must be approved by the Geotechnical Engineer and recorded on the asbuilt drawings.

4.9.4 Road Subgrades

Testing and formation of road subgrades will be carried out as part of the subdivision civil works package.

5 MONITORING

5.1 Settlement

Where filling is placed over materials suspected to be of a compressible nature or where a significant depth of filling is to be placed, then settlement monitoring points should be installed on the stripped surface prior to filling and on finished surface of the filling and monitored during and post construction to ensure ongoing settlement rates are within acceptable guidelines for residential building development.

The number and position of monitoring points and the frequency of post construction settlement monitoring is to be agreed with the Geotechnical Engineer during construction.

It is the contractor’s responsibility to ensure the integrity of the monitoring points is maintained during the works.

6 ASBUILT INFORMATION REQUIREMENTS

In order to provide a Geotechnical Completion Report (GCR) certain as-built information must be provided to CMW. It is the contractor’s responsibility to ensure that all of the following items are surveyed prior to placing filling. The survey of these items should therefore form a hold point in the construction sequence.

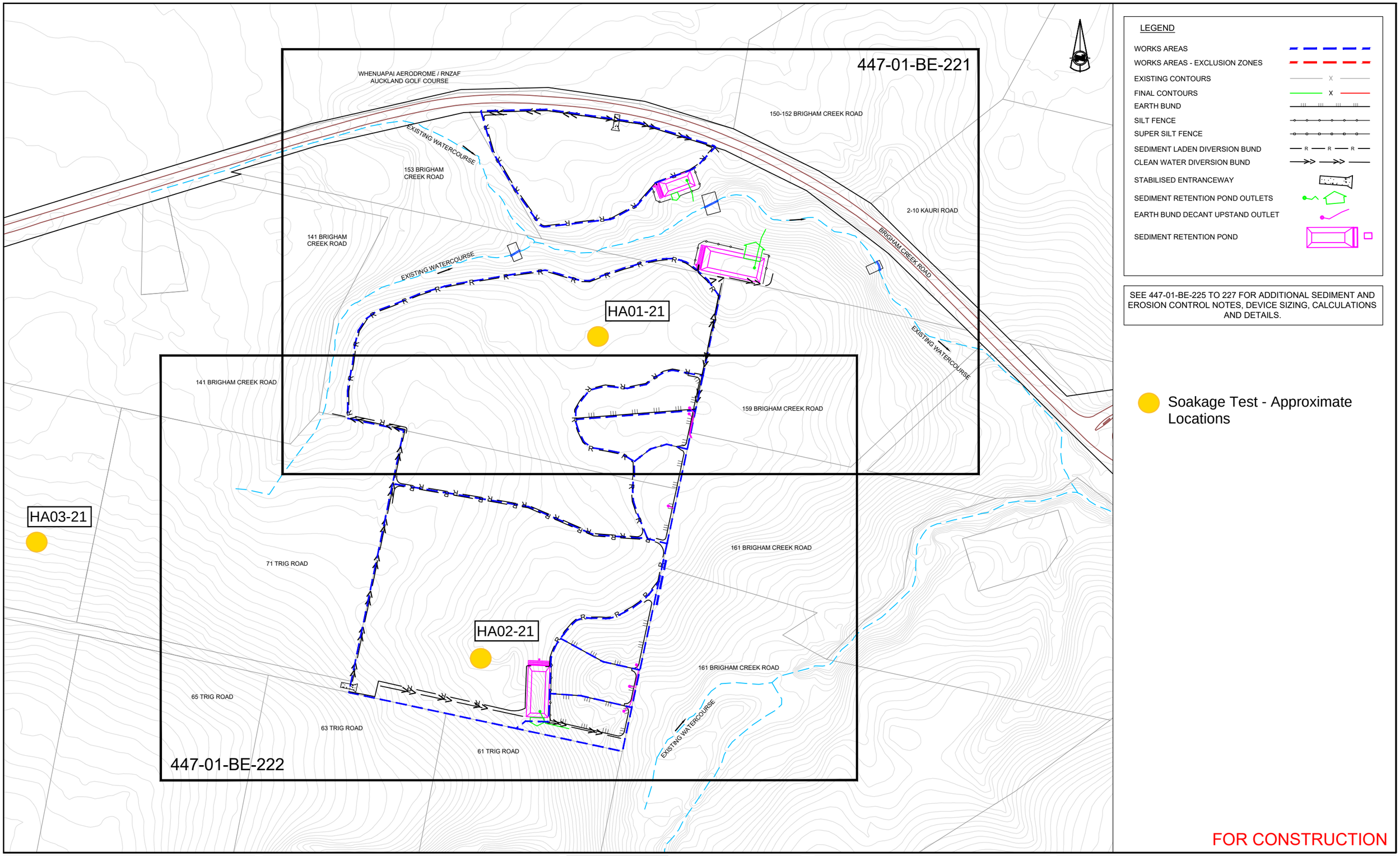
1. The location and invert of all sub surface drainage; and,
2. The depth of filling placed including all benching, undercuts, shear or fill drainage keys and temporary ponds which have been backfilled.

CMW require the following as-built information to be provided for the GCR:

1. Cut and fill depth plan (including undercuts and shear keys);
2. Final contour plan;
3. Drainage locations and inverts (surface and subsurface);
4. Drainage outlet locations (surface and subsurface);
5. Details of any defined overland flow paths;

6. Location and heights of any retaining walls;
7. Material data for imported products used such as draincoils, aggregates and geofabrics as well as confirmation that products installed comply with the requirements of the project drawings and this specification; and,
8. Any settlement Monitoring Data.

Appendix I: Soakage Testing Results



LEGEND

- WORKS AREAS
- WORKS AREAS - EXCLUSION ZONES
- EXISTING CONTOURS
- FINAL CONTOURS
- EARTH BUND
- SILT FENCE
- SUPER SILT FENCE
- SEDIMENT LADEN DIVERSION BUND
- CLEAN WATER DIVERSION BUND
- STABILISED ENTRANCEWAY
- SEDIMENT RETENTION POND OUTLETS
- EARTH BUND DECANT UPSTAND OUTLET
- SEDIMENT RETENTION POND

SEE 447-01-BE-225 TO 227 FOR ADDITIONAL SEDIMENT AND EROSION CONTROL NOTES, DEVICE SIZING, CALCULATIONS AND DETAILS.

Soakage Test - Approximate Locations

FOR CONSTRUCTION

Rev	Description	By	Date
0	ISSUED FOR CONSTRUCTION	CK	10–20

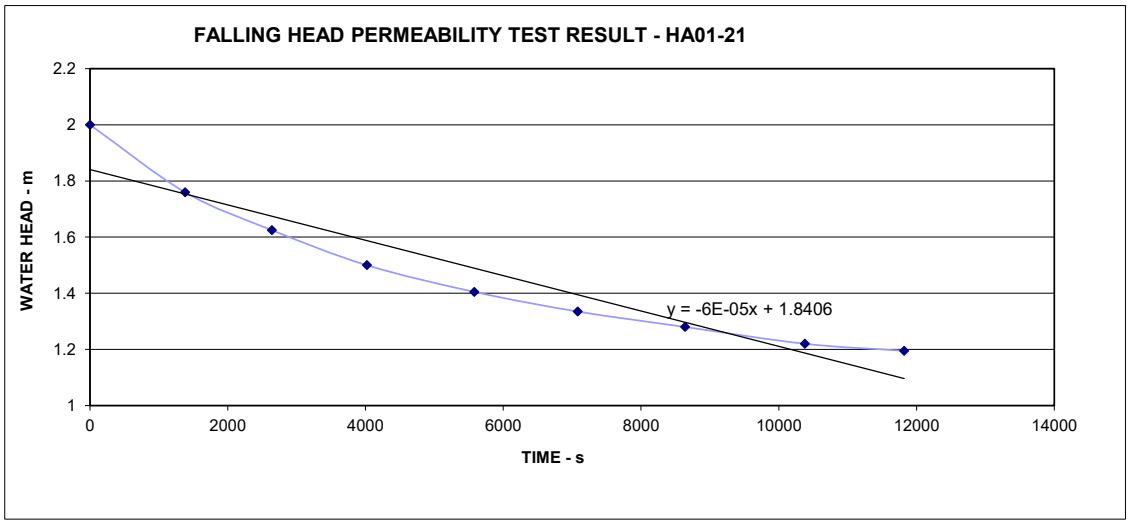
NEIL CONSTRUCTION LIMITED
LAND DEVELOPERS
THE NEIL GROUP LIMITED
LEVEL 3, BUILDING B
8 NUGENT STREET
GRAFTON
PO BOX 8751, SYMONDS STREET
AUCKLAND, NEW ZEALAND
TELEPHONE: +64 9 918 6565
FACSIMILE: +64 9 918 6567
WEB: www.neilgroup.co.nz

Job Title
BRIGHAM CREEK & TRIG ROAD
WHENUAPAI

Drawing Title
BULK EARTHWORKS
SEDIMENT AND EROSION
CONTROL – LOCATION PLAN

	By	Date	Scale	Job No. 447–01	
Surveyed:	DS		1: 3000@A3	Drawing No. 447–01–BE–220	Rev 0
Designed:	CK				
Drawn:	CK	11/19			
Approved:	CK				
CAD FILE	F:_PROJECTS\BRIGHAM CREEK TRIG\DWG\ENG\BULK EW\FOR CONSTRUCTION\447–01–BE–220.dwg				

CLIENT: Neil Construction Limited
PROJECT: Brigham Creek and Trig Road
LOCATION: Whenuapai
JOB NUMBER: AKL2019-0040
TEST DATE: 26/05/2021



STRATIGRAPHIC LOG

Silty CLAY (Natural)

Bottom of soakage test hole= 2.0m

Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h_2}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h_2 + 1}\right)}{(t_2 - t_1)}\right) \times I$

where I = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

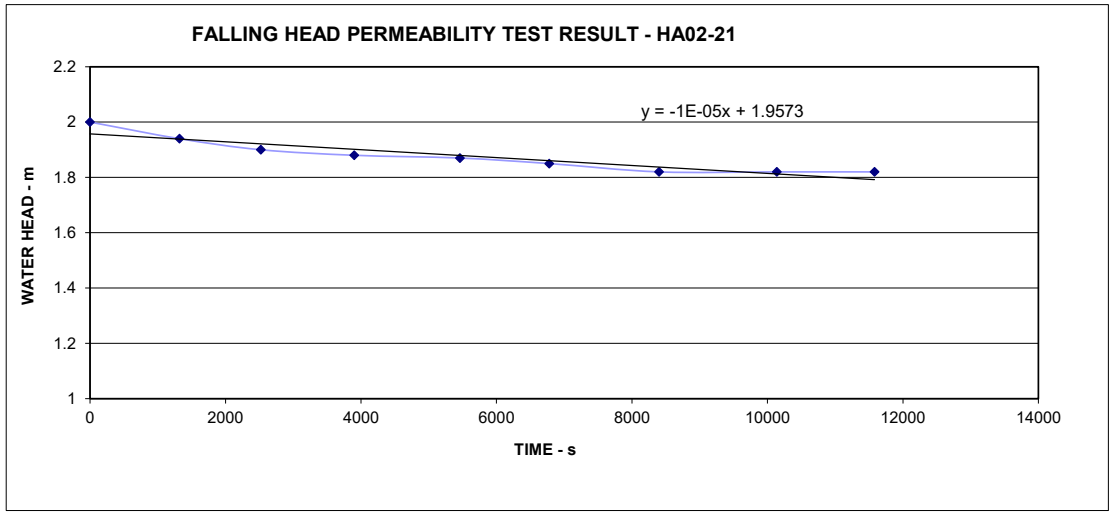
h_2 = piezometric head at end of chosen interval (m)

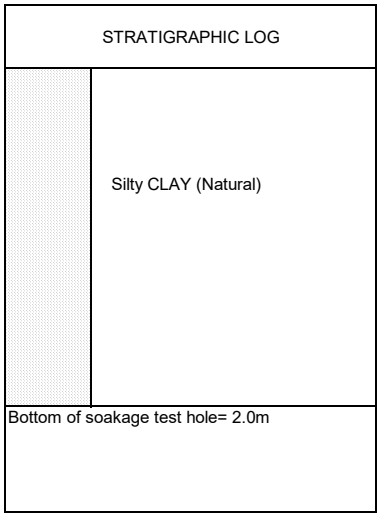
$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20.0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1380	1380	1.76	1.88	0.06	1.96E-06	1.70E-01
2640	1260	1.625	1.69	0.03	1.34E-06	1.16E-01
4020	1380	1.5	1.56	0.03	1.22E-06	1.06E-01
5580	1560	1.405	1.45	0.03	8.81E-07	7.61E-02
7080	1500	1.335	1.37	0.02	7.14E-07	6.17E-02
8640	1560	1.28	1.31	0.02	5.64E-07	4.87E-02
10380	1740	1.22	1.25	0.02	5.76E-07	4.98E-02
11820	1440	1.195	1.21	0.01	3.00E-07	2.59E-02
13260	1440	1.175	1.19	0.01	2.44E-07	2.11E-02
				Average =	8.67E-07	8.16E-02

CLIENT: Neil Construction Limited
PROJECT: Brigham Creek and Trig Road
LOCATION: Whenuapai
JOB NUMBER: AKL2019-0040
TEST DATE: 26/05/2021





Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h_2}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h_2 + 1}\right)}{(t_2 - t_1)} \right) \times I$

where I = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

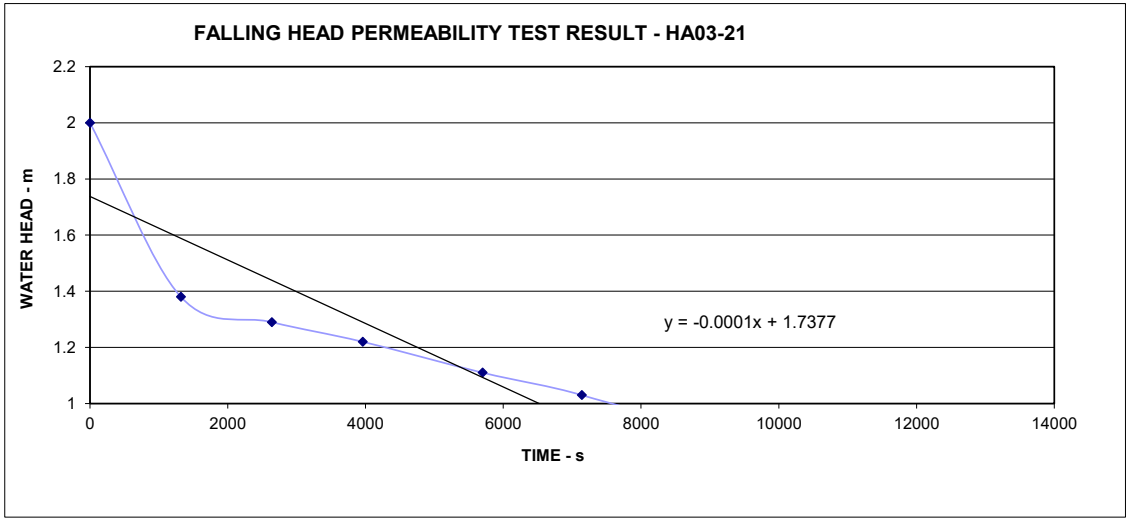
h_2 = piezometric head at end of chosen interval (m)

$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20.0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1320	1320	1.94	1.97	0.01	4.89E-07	4.22E-02
2520	1200	1.9	1.92	0.01	3.67E-07	3.17E-02
3900	1380	1.88	1.89	0.00	1.62E-07	1.40E-02
5460	1560	1.87	1.88	0.00	7.23E-08	6.25E-03
6780	1320	1.85	1.86	0.00	1.72E-07	1.49E-02
8400	1620	1.82	1.84	0.01	2.13E-07	1.84E-02
10140	1740	1.82	1.82	0.00	0.00E+00	0.00E+00
11580	1440	1.82	1.82	0.00	0.00E+00	0.00E+00
12960	1380	1.805	1.81	0.00	1.27E-07	1.09E-02
14280	1320	1.8	1.80	0.00	4.44E-08	3.84E-03
				Average =	1.65E-07	1.59E-02

CLIENT: Neil Construction Limited
PROJECT: Brigham Creek and Trig Road
LOCATION: Whenuapai
JOB NUMBER: AKL2019-0040
TEST DATE: 26/05/2021



STRATIGRAPHIC LOG

Silty CLAY (Natural)

Bottom of soakage test hole= 2.0m

Reference: Appendix 4, Control of Groundwater for Temporary Works (CIRIA Report No. 113)

Borehole diameter = 100 mm

Hydraulic conductivity $k = \left(\frac{log\left(\frac{h_1}{h_2}\right) - log\left(\frac{\alpha h_1 + 1}{\alpha h_2 + 1}\right)}{(t_2 - t_1)}\right) \times I$

where I = average piezometric head over chosen time interval

$= \frac{(h_1 + h_2)}{2}$

h_1 = piezometric head at start of chosen interval (m)

h_2 = piezometric head at end of chosen interval (m)

$t_2 - t_1$ = chosen time interval (seconds)

$\alpha = \frac{\pi d}{\left(\frac{\pi d^2}{2}\right)}$ = 20.0

Elapsed Time (s)	t2 - t1 (secs)	Piezometric Head h (m)	I (m)	log (h_1/h_2)	Hydraulic Conductivity k (m/sec)	k (m/day)
0		2				
1320	1320	1.38	1.69	0.16	6.06E-06	5.24E-01
2640	1320	1.29	1.34	0.03	1.07E-06	9.25E-02
3960	1320	1.22	1.26	0.02	8.83E-07	7.63E-02
5700	1740	1.11	1.17	0.04	1.13E-06	9.78E-02
7140	1440	1.03	1.07	0.03	1.08E-06	9.32E-02
8580	1440	0.9	0.97	0.06	1.94E-06	1.68E-01
10320	1740	0.57	0.74	0.20	5.51E-06	4.76E-01
11880	1560	0.31	0.44	0.26	8.02E-06	6.93E-01
13260	1380	0.2	0.26	0.19	5.91E-06	5.10E-01
				Average =	3.51E-06	2.77E-01

Project:	Designed:
Brigham Creek & Trig Road	JW
Client:	Checked:
Neil Construction Limited	
Project No: / Date:	Page:
AKL2019-0040 / 28|5|21	1 of 1

CMW Geosciences

Percolation Rate Estimate - Auckland Council Method

$$P_1 = \frac{D \times gradient \times 1000}{4 \times d}$$

D = diameter of borehole

d = distance between the midpoint of the last two readings and the base of the borehole.

HA01-21(P) = $\frac{0.1 \times 2.38E^{-3} \times 1000}{4 \times 1.1725}$

= $5.07E^{-3}$ L/m²/min

= $8.457E^{-7}$ m/s = 3.04 mm/hr

HA02-21(P) = $\frac{0.1 \times 2.27E^{-3} \times 1000}{4 \times 1.8025}$

= $3.15E^{-3}$ L/m²/min = $5.25E^{-7}$ m/s

= ~~0.189~~ 1.89 mm/hr

HA03-21(P) = $\frac{0.1 \times 4.23E^{-3} \times 1000}{4 \times 0.255}$

= 0.415 L/m²/min

= $6.912E^{-6}$ m/s = 24.9 mm/hr