
Factual Report

Date Prepared: 24th January 2020

Prepared by: Max Davis

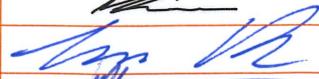
Northwest HIF - Trig Road Geotechnical Factual Report

Purpose

This Factual Report has been prepared in order to present geotechnical information from the preliminary investigation undertaken at Trig Road, Whenuapai.

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Document Status

Responsibility	Name	Signature
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Reviewer	James Burr	
Approver	Rob Mason	

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0.2		
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Disclaimer

This is a draft document for review by specified persons at Auckland Transport and the New Zealand Transport Agency. This draft will subsequently be updated following consideration of the comments from the persons at Auckland Transport and the New Zealand Transport Agency. This document is therefore still in a draft form and is subject to change. The document should not be disclosed in response to requests under the Official Information Act 1982 or Local Government Official Information and Meetings Act 1987 without seeking legal advice.

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1 Introduction

The Supporting Growth project aims to identify the transport networks required to connect Auckland's future growth areas over the next 30 years. A coordinated approach with land use development running in parallel with infrastructure planning is required.

An early indication of the viability of preferred networks is required to identify geotechnical opportunities and constraints to developing land.

The 'preferred networks' require the following criteria to be met:

- Include improved accessibility and transport options,
- Strong focus on public transport, including walking and cycling facilities,
- Connections to the wider strategic transport network, and
- Maximum benefit and value in management of existing network infrastructure

This report provides the factual results of the preliminary geotechnical site investigation for the proposed development of Trig Road in the Northwest area.

1.1 Object and Scope of the Investigation

The initial scope of this preliminary geotechnical investigation comprised two machine boreholes and four test pits along Trig Road. Due to constraints with land owner access along Trig Road, the investigation needed to be separated into stages with the first stage comprising just the machine boreholes, followed later by the test pits and a hand auger, which replaced one of the test pits. The investigation targeted areas along Trig Road where significant cut/fill is proposed.

This report presents the results of both stages of the geotechnical investigations undertaken between 23rd October 2019 and 13th November 2019.

1.2 Site Location and Description

The site is located along Trig Road, which trends in a north-west south-east direction from Hobsonville Road in the south to Brigham Creek Road in the north. The proposed Trig Road upgrade extends approximately 850m from Hobsonville Road in the south to Upper Harbour Highway in the North. The site is bound by residential properties to the south and grass paddocks to the east and west. Refer to the Location Plan shown in Figure 1 below. An overall Site Plan is also shown in Appendix 1.

Trig Road runs along a minor north to south trending ridge with slopes within the area considered flat to gently sloping, at less than 5°. Slopes up to 20° occur in localised areas immediately adjacent to the road alignment. Three streams are present within the site and exist on the eastern and western sides of Trig Road and are named Totara Stream, Trig Stream, and Rawiri Stream with various ephemeral water courses feeding into them. The proposed road alignment upgrade involves various cut and fill operations which will require retaining walls to support adjacent properties. Refer to Geometric Plans attached in Appendix 1.

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Figure 1: Trig Road Location Plan

1.3 Site Geology

The published 1:250,000 geological map (QMAP) of the Auckland area (Edbrooke, 2001) indicates that the area comprises two main geological units (Figure 2). Puketoka Formation alluvial deposits belonging to the Tauranga Group and comprising “pumiceous mud, sand and gravel” underly most of the site. Residually weathered soils of the East Coast Bays Formation (ECBF) belonging to the Waitemata Group and comprising “alternating sandstone and mudstone” are shown to the south and southwest of Trig Road.

The nearest mapped active fault in the GNS Active Faults Database is the Wairoa North fault, approximately 39 km south east of the site (GNS Science, 2019).

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Figure 2: Trig Road Geology (QMaps, 2019)

1.4 Previous Investigations

Several geotechnical investigations have been carried out along Upper Harbour Highway. A Beca investigation is shown in our reports database, however the locations of the individual investigation points are a long way from this Trig Road site. The New Zealand Geotechnical Database (NZGD) shows several investigation points at the northern end of the site adjacent to the Upper Harbour Highway (Figure 3). These are summarised below:

- Five machine boreholes and five Cone Penetrometer Tests (CPT's) at the northern end of the site
- Machine boreholes encounter varying amounts of fill ranging from 0.5m to 2.5m thick.
- Puketoka Formation alluvials underly the fill to approximately 5.6m below ground level (bgl) to 15mBGL and overly residual ECBF. The ECBF residual soil varies from approximately 5.6mBGL to 24mBGL and overlies ECBF Rock. ECBF rock varies from approximately 12mBGL to 35.3mBGL.
- CPT results indicate soft soils from ground level to around 8 – 13mBGL with cone resistance of 0 – 2 mPa.
- CPT's reach refusal from around 15 – 23mBGL.

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Figure 3 – Trig Road NZGD Investigation Points.

2 Site Investigation

As noted previously, the investigation was carried out in two stages, with the Machine Boreholes drilled on 23 and 24 October 2019, and the test pits and hand auger completed on 13 December 2019. The site investigations were observed full-time by a Beca Geotechnical Engineer. Unless otherwise stated, all soil and rock logging has been undertaken by a Beca Geotechnical Engineer. All logs have been verified by a Beca Senior Engineering Geologist.

2.1 Machine Boreholes

Machine boreholes were drilled by Pro Drill using a SLG 2 drilling rig. Drilling was undertaken using both Open Barrel and HQ Triple Tube drilling. A summary of all machine boreholes undertaken are given in Table 1 below.

Table 1: Summary of Boreholes Drilled

BH No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)	Borehole Inclination (degrees from horizontal)	Backfill Details
BH101/19	Trig Road Shoulder	1,744,858	5,924,484	68.0	12.95	-90	Gravel
BH102/19	Trig Road Land Reserve	1,744,732	5,924,611	58.0	21.88	-90	Gravel

Notes: All survey coordinates are given in NZTM2000

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Field testing undertaken during drilling of the machine boreholes comprised:

- Standard Penetration Tests were typically carried out at nominal 1.5m centres and the uncorrected N-values are recorded on the borehole logs. SPT hammer efficiencies are presented on the borehole log sheets.
- Hand held shear vane tests were carried out within the end of the core barrel in cohesive soils. The corrected and uncorrected shear vane values are reported on the machine borehole logs.
- Two push tubes were taken within BH101/19 at depths of 3.0 m and 6.0 m

All core samples were logged on site by a Beca Geotechnical Engineer. Machine borehole logs and core photographs are presented in Appendix 2. After the core samples had been logged, they were wrapped in plastic to reduce moisture loss and placed in labelled core boxes before being transferred to the Beca office for storage. Some natural desiccation and degradation of the core samples will occur through time following storage. Upon completion, all boreholes were backfilled with gravel and placed over with a topsoil and grass cover.

2.2 Hand Auger Hole

A hand auger was drilled and logged on site by Beca staff. The hand auger location is shown on the Site Plan in Appendix 1, the log and photographs are shown in Appendix 3.

In-situ testing comprised:

- Down-hole hand held shear vanes, undertaken at 500mm centres;
- Scala penetrometer tests were undertaken from the ground surface to 900mm below ground level (bgl), and from the base of the hand auger hole (3.5m bgl) to 4.4m bgl. The test was undertaken with a maximum of 1 rod length/900mm per test. Scala tests were carried out in general accordance with the methods described in NZS4402

A summary of the hand auger hole undertaken is given in Table 2 below.

Table 2: Summary of Hand Auger Hole

HA No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)
HA101/19	40 Trig Road	1,744,643	5,924,720	55.5	3.5
Notes: All survey coordinates are given in NZTM2000					

2.3 Test Pits

Abernethy Contractors Ltd. were contracted to excavate test pits using a 6T excavator. The pits were approximately 800mm wide in plan area and ranged from 2.3m to 3.5m depth. Material excavated from the test pit was logged and sampled by a Beca Engineering Geologist. The test pit logs and photographs are presented in Appendix 4.

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In-situ testing comprised:

- Hand-held shear vanes were undertaken using samples excavated from the test pits, at approximately 500mm centres.
- Scala penetrometer testing was carried out from the ground surface to 0.9m and from 1.0m to 1.9m depth.

A summary of the test pits undertaken are given in Table 3 below.

Table 3 - Summary of Test Pits

HA No.	Location	Easting	Northing	R.L. ground (m)	Total Depth (m)
TP101/19	1 Trig Road	1,744,898	5,924,477	64.75	3.5
TP102/19	9 Trig Road	1,744,741	5,924,679	47.2	3.5
TP103/19	19 Trig Road	1,744,588	5,924,899	52.25	2.3

Notes: All survey coordinates are given in NZTM2000

2.4 Groundwater

Both boreholes were dipped following completion of drilling. At the time of the measurements the boreholes were fully open. Only borehole BH101/19 was able to be left to allow for dissipation of drilling muds or other fluids. Borehole BH102/19 was dipped following completion of drilling. The water level is indicative only and does not allow for the interpretation of water levels or vertical gradients between individual units.

Test pit 101/19 encountered groundwater at approximately 800mm depth. This test pit is located adjacent to an ephemeral watercourse and groundwater will likely be elevated at this location. Groundwater was measured at 3.0m below ground level in borehole BH101/19, and 2.5m below ground level in borehole BH102/19. Table 4 below summarises these observations

Table 4: Groundwater Measurements

Borehole/ Piezometer ID	Date of measurement	Depth to water (mBGL)	Level of water (mRL)	Type of Measurement (Borehole or Piezometer)
BH101/19	24/10/2019	3.0m	65.0 mRL	Borehole
BH102/19	24/10/2019	2.5m	55.5 mRL	Borehole
TP101/19	13/12/2019	0.8m	62.2	-

3 Laboratory Testing

Two undisturbed push tube samples were collected from machine borehole BH101/19 and SPT samples were taken from both boreholes for testing.

Beca carried out testing of these samples. The tests undertaken, and the testing specifications, were as follows:

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- Natural Moisture Content: NZS4402, 1986; test 2.1
- Atterberg Limits: NZS4402, 1986; tests 2.2, 2.3 and 2.4
- Hydrometer Grading: NZS4402, 1986, test 2.8.4
- Consolidation Test: NZS4402, 1986; test 7.1

The results of the laboratory testing are given in Appendix 5 together with a summary of the tests carried out.

4 Applicability Statement

This report has been prepared on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which we have not given its prior written consent, is at that person's own risk.

This is a factual report of site investigation and laboratory testing. The site investigation has been undertaken at discrete locations and no inferences about the nature and continuity of ground conditions away from the investigation locations are made. Furthermore, logs are provided presenting description of the soils and geology based on our observation of the samples recovered in the fieldwork and may not be truly representative of the actual underlying conditions.

No interpretation of the investigation results has been made in this report. Should you be in any doubt as to the applicability of this report for the proposed development described herein, it is essential that you carry out independent investigations to satisfy your needs.

5 References

ASTM D 1586-11 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

British Standard (BS1377: 1990 Part 9, 4.4) (in situ – geonor vane)

NZ Geotechnical Society, 2005: Field Description for Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes.

NZ Geotechnical Society, 2001: Guidelines for the Hand Held Shear Vane Test

NZ Standard 4402, 1986, Methods of Testing Soils for Civil Engineering Purposes

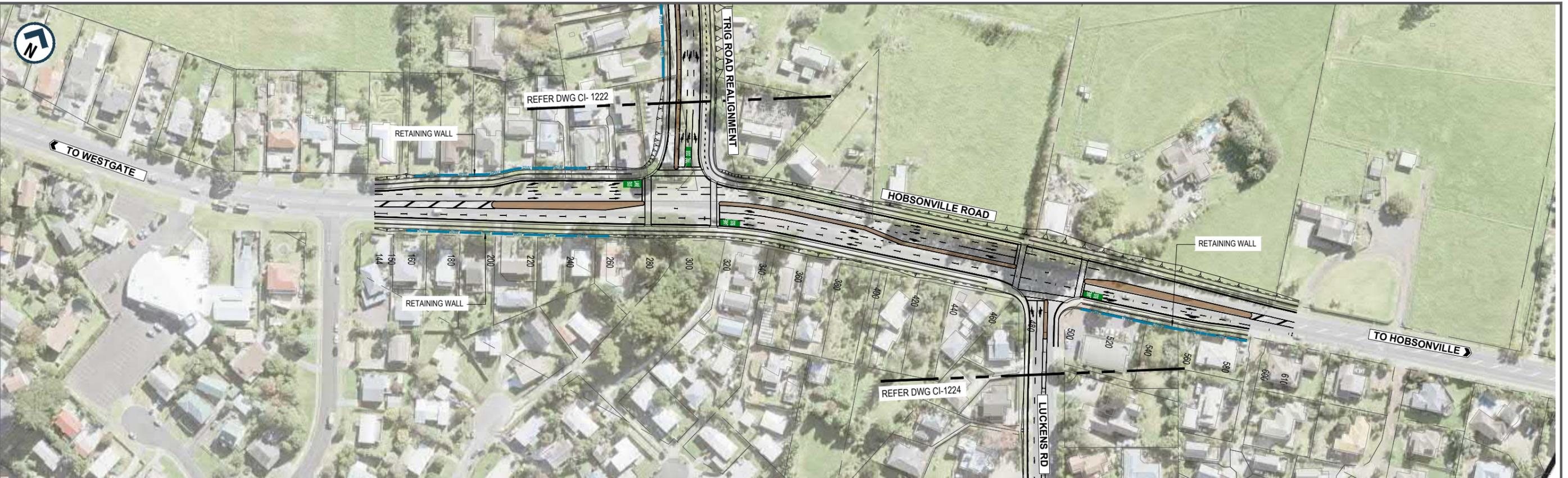
Appendix 1. Figures



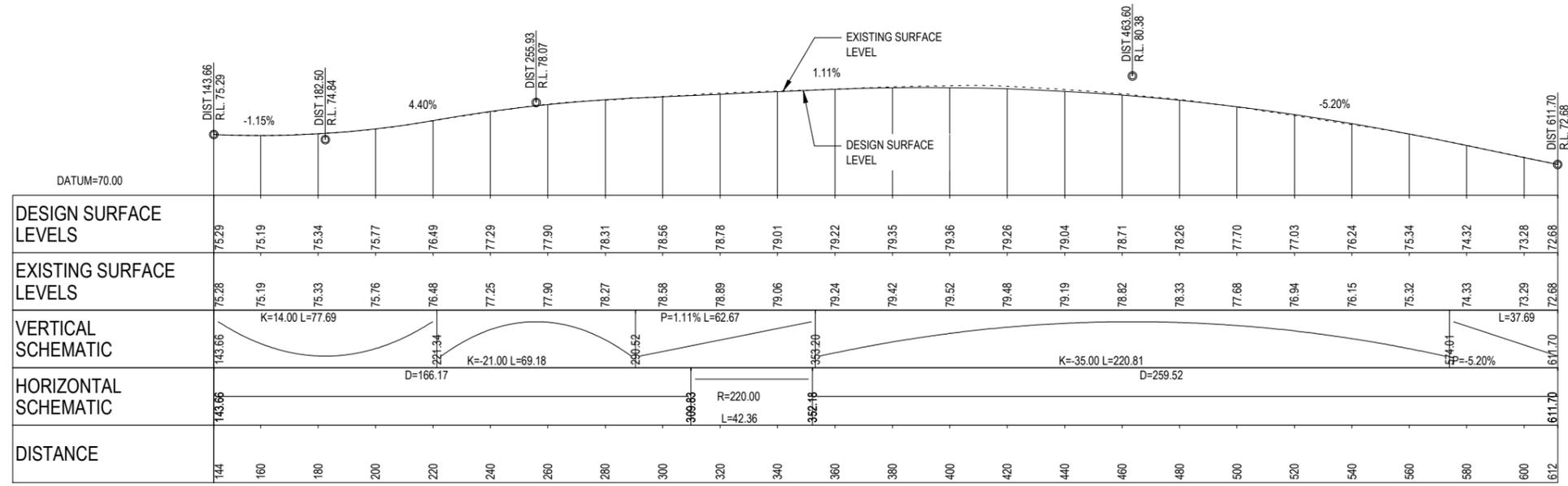
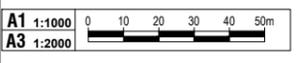
Overall Site Plan



3810934/100



PLAN VIEW: HOBSONVILLE ROAD



LONGITUDINAL SECTION ON CONTROL STRING MCHO
SCALE HORIZ=1:1000 VERT=1:250

Rev	Description	Drawn	Date
C	FOR DRAFT DETAILED BUSINESS CASE	VDLT	25.07.19
B	FOR AT INTERNAL REVIEW	VDLT	17.04.19
A	FOR SAFETY AUDIT	VDLT	05.04.19

Activity	Name	Date
Surveyed	-	-
Drawn	V. DELA TORRE	27.03.19
Drawing Check	P. ISON	27.03.19
Drawing Review	-	-
Design	-	-
Design check	-	-



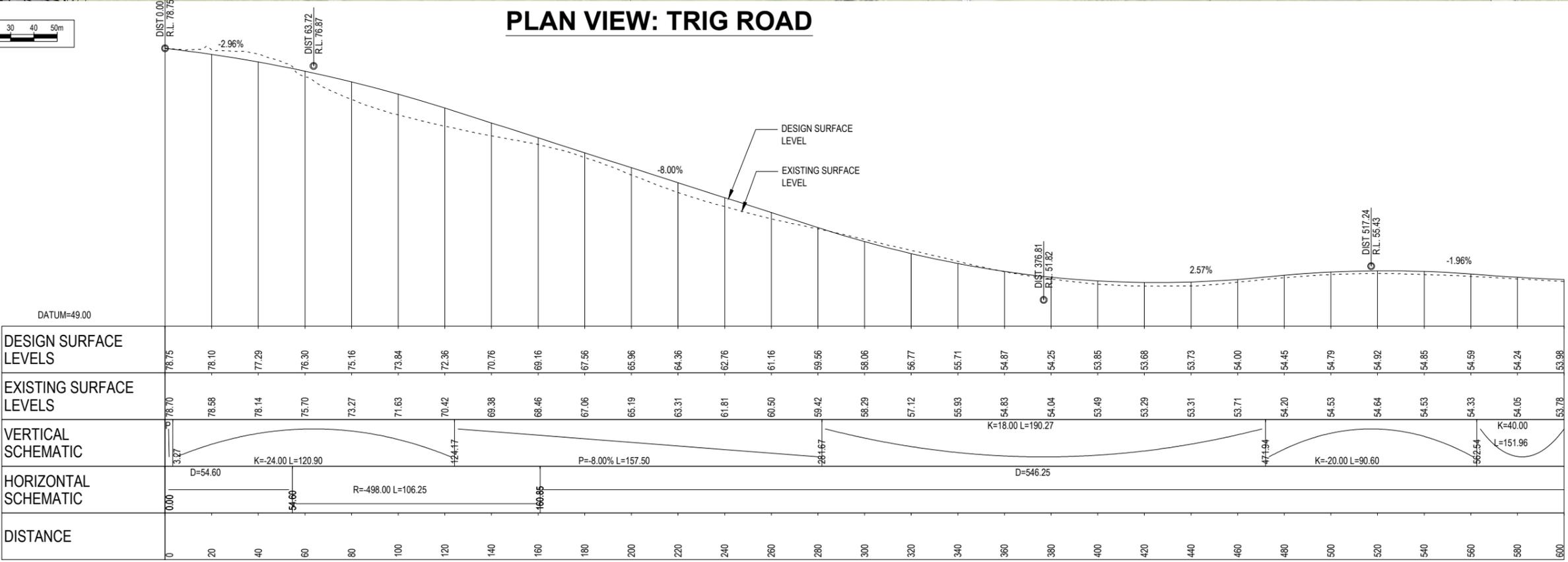
Project: AUCKLAND COUNCIL
NORTHWEST HOUSING INFRASTRUCTURE FUNDING-PROPOSED ARTERIAL ROADS
Drawing Title: PLAN AND LONG SECTION - HOBSONVILLE ROAD
SHEET 1 OF 4

Drawing Status: DRAFT DETAILED BUSINESS CASE			
Drawing Date: 25.07.19			
A1	1:1000	A3	1:2000
Contract Number: 0000000			
Drawing No: SGA-DRG-NWE-002-CI-1221			Revision: C



PLAN VIEW: TRIG ROAD

A1 1:1000
A3 1:2000



LONGITUDINAL SECTION ON CONTROL STRING MCT0
SCALE HORIZ=1:1000 VERT=1:250

Rev	Revisions	Drawn	Date
C	FOR DRAFT DETAILED BUSINESS CASE	VDLT	25.07.19
B	FOR AT INTERNAL REVIEW	VDLT	17.04.19
A	FOR SAFETY AUDIT	VDLT	05.04.19

Surveyed	-	-
Drawn	V. DELA TORRE	27.03.19
Drawing Check	P. ISON	27.03.19
Drawing Review	-	-
Design	-	-
Design check	-	-



Project: AUCKLAND COUNCIL
NORTHWEST HOUSING INFRASTRUCTURE FUNDING-PROPOSED ARTERIAL ROADS
Drawing Title: PLAN AND LONG SECTION - TRIG ROAD
SHEET 2 OF 4

Drawing Status: DRAFT DETAILED BUSINESS CASE			
Drawing Date: 25.07.19			
A1	1:1000	A3	1:2000
Contract Number: 0000000			
Drawing No: SGA-DRG-NWE-002-CI-1222			Revision: C

Appendix 2. Machine Borehole Logs and Photographs

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF **JOB NUMBER:** 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland **CLIENT:** Supporting Growth Alliance

CIRCUIT: NZTM **BOREHOLE LOCATION:** Trig Road RP 0.191 opposite 16 Trig Road
COORDINATES: N 5,924,484.43 m **R L:** 68 m **COORDINATE ORIGIN:** hhGPS
 E 1,744,858.19 m **DATUM:** NZVD2016 **ACCURACY:** ±5m

DRILLING										IN-SITU TESTS			DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'	SAMPLES								
		0 %	VE			58/38	84/54	0 1 1 1 1 2 N=5		1		0.00 - 1.50m: no recovery - vacuum extracted.				67	
		100 %	SPT					1 1 1 1 2 N=5		2		Stiff, clayey SILT, trace organics; orange mottled white; moist, high plasticity. Organics: amorphous and fibrous (rootlets). 1.95m: no organics; bands of white.				66	
		71 %	OB					1 0 1 1 1 2 N=5		3		3.00 - 3.50m: no recovery - undisturbed tube.				65	
		100 %	PT					1 0 1 1 1 2 N=5		4		Stiff, clayey SILT, trace organics; orange with white bands; moist, high plasticity. Organics: fibrous (wood). 4.40m: orange.				64	
		100 %	OB					0 1 0 1 1 1 1 N=3		5		4.70m: alternating bands of orange and white <5mm. 4.90m: red oxide staining. 4.95m: trace coarse sand, trace fine gravel. Gravel: highly weathered, subangular, SILTSTONE.				63	
		100 %	OB			30/8	43/12	1 1 1 1 1 2 N=5		6		5.50m: red mottled white, flecks of iron oxide. Firm, SILT, some clay, trace fine sand, trace fine gravel; red mottled white; moist, high plasticity. Gravel: highly weathered, subangular, SILTSTONE.				62	
		100 %	PT					1 1 1 1 1 2 N=5		7		6.00 - 6.50m: no recovery - undisturbed tube. Firm, clayey SILT, trace fine gravels; grey mottled white; moist, high plasticity. Gravel: slightly weathered, subrounded, greywacke.				61	
		100 %	OB					1 1 1 1 1 2 N=5		8		6.70m: no gravel; grey. 7.50m: trace fine sand.				60	
		100 %	SPT			38/20	54/30	1 1 1 1 2 2 N=6		9		Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, completely weathered, grey, SILTSTONE].				59	
		100 %	TT					3 3 4 6 7 7 N=24		9		Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, completely weathered, grey, fine to medium SANDSTONE]. 9.45m: [moderately weathered].				59	

DATE STARTED: 24/10/19 **DRILLED BY:** Pro-Drill **COMMENTS:**
DATE FINISHED: 24/10/19 **EQUIPMENT:** SLG-02
LOGGED BY: RLR **DRILL METHOD:** OB/PT/SPT/TT/VE
SHEAR VANE No: GEO613 **DRILL FLUID:** Water
DIAMETER/INCLINATION: -/90°

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE TRIG ROAD INVESTIGATIONS 2020/120 1201.GPJ <<DrawingFile>> 20/10/2020 14:08 8.30.004 D:\git\Lab\and\in\Site\Tech\DCD [Lib: Bece 1.07.4.2016-01-15] Pjt: Bece 1.07.2014-12-16

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF **JOB NUMBER:** 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland **CLIENT:** Supporting Growth Alliance

CIRCUIT: NZTM **BOREHOLE LOCATION:** Trig Road RP 0.191 opposite 16 Trig Road
COORDINATES: N 5,924,484.43 m **R L:** 68 m **COORDINATE ORIGIN:** hhGPS
 E 1,744,858.19 m **DATUM:** NZVD2016 **ACCURACY:** ±5m

DRILLING						IN-SITU TESTS			SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R.L (m)
FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'						
		100 %	TT					5	5 5 6 7 9 9 Nc=31	11	x x x Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, completely weathered, grey, fine to medium SANDSTONE]. Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, grey, SILTSTONE]. Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, moderately weathered, grey, fine to medium SANDSTONE].	Waitemata Group	57	
		0 %	SPT					6		11.00 - 11.45m: no recovery - solid SPT.				
		100 %	TT					8		12	x x x Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, moderately weathered, grey, fine to coarse SANDSTONE]. Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, grey, SILTSTONE].			56
		0 %	SPT					8		12.50 - 12.95m: no recovery - solid SPT.				
								12						
								12						
								15						
								15						
								Nc=47		13	END OF LOG @ 12.95 m			
									14				54	
									15				53	
									16				52	
									17				51	
									18				50	
									19				49	

DATE STARTED: 24/10/19 **DRILLED BY:** Pro-Drill
DATE FINISHED: 24/10/19 **EQUIPMENT:** SLG-02
LOGGED BY: RLR **DRILL METHOD:** OB/PT/SPT/TT/VE
SHEAR VANE No: GEO613 **DRILL FLUID:** Water
DIAMETER/INCLINATION: -/90°

COMMENTS:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BECA LIB 1.07.4.GLB Log BECA MACHINE BOREHOLE TRIG ROAD INVESTIGATIONS 2020/120 1201.GPJ --DrawingFile--> 20/10/2020 14:08 8:30:04 Digital Lab and In Situ Tech - DCD [Lib: BeCa 1.07.4.2016-01-15] Proj: BeCa 1.07.2014-12-16

Trig Road



BOX: 1

DEPTH: 0.0 to 4.50m



BOX: 2

DEPTH: 4.50 to 7.20m

Trig Road



BOX: 3

DEPTH: 7.20 to 9.70m



BOX: 4

DEPTH: 9.70 to 12.95m

MACHINE BOREHOLE LOG

PROJECT: Northwest HIF **JOB NUMBER:** 3810934
SITE LOCATION: Trig Road, Whenuapai, Auckland **CLIENT:** Supporting Growth Alliance

CIRCUIT: NZTM **BOREHOLE LOCATION:** Trig Road RP 0.338 Council Reserve on Ryan's Road
COORDINATES: N 5,924,611 m **R L:** 58 m **COORDINATE ORIGIN:** hhGPS
 E 1,744,732 m **DATUM:** NZVD2016 **ACCURACY:** ±5m

DRILLING						IN-SITU TESTS			SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	R L (m)
FLUID LOSS	DAILY WATER LEVEL	CORE RECOVERY	METHOD	CASING	RQD	SV	τ (kPa)	SPT 'N'						
		100 %	OB			UTP	UTP	2	11	[X pattern]	Hard, clayey SILT, grey, moist, high plasticity. 10.20m: minor fine sand.	Waitemata Group	47	
		100 %	SPT					2						
		100 %	OB					3						
		100 %	SPT					4						
		100 %	OB					5						
		100 %	SPT					6						
		86 %	TT			UTP	UTP	3	12	[X pattern]	11.50m: 50mm bed of black clayey SILT; trace organics. Hard, silty fine to medium SAND, some clay; grey, moist, high plasticity. [Extremely weak, grey, SANDSTONE]. 12.00m: closely spaced 10mm thick carbonaceous bands.	46		
		100 %	SPT					4						
		100 %	TT					5						
		100 %	SPT					6						
		100 %	TT					7						
		100 %	SPT					7						
		100 %	TT					7	13	[X pattern]	Very stiff, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE]. Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak to very weak, grey, fine SANDSTONE].	45		
		100 %	SPT					3						
		100 %	TT					4						
		100 %	SPT					4						
		100 %	TT					7						
		100 %	SPT					9						
		90 %	TT					9	14	[X pattern]	Very stiff, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE]. Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE].	44		
		100 %	SPT					4						
		100 %	TT					4						
		100 %	SPT					4						
		100 %	TT					7						
		100 %	SPT					9						
		100 %	TT					9	15	[X pattern]	Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE].	43		
		100 %	SPT					5						
		100 %	TT					4						
		100 %	SPT					4						
		100 %	TT					11						
		100 %	SPT					12						
		100 %	TT					12	16	[X pattern]	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, moderately weathered, SILTSTONE]. Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE]. Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE].	42		
		100 %	SPT					5						
		100 %	TT					4						
		100 %	SPT					4						
		100 %	TT					11						
		100 %	SPT					12						
		3878 %	SPT					11	17	[X pattern]	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE]. Medium dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine to medium SANDSTONE]. 17.00 - 17.45m: no recovery.	41		
		100 %	TT					4						
		100 %	SPT					5						
		100 %	TT					6						
		100 %	SPT					7						
		100 %	TT					8						
		100 %	SPT					10	18	[X pattern]	Hard, clayey SILT; grey; moist, high plasticity. [Extremely weak, grey, SILTSTONE]. Dense, silty fine SAND; grey; moist, non plastic. [Extremely weak, grey, fine SANDSTONE]. 20mm bed of black bands. 18.30m: 50mm bed of SILTSTONE.	40		
		100 %	TT					4						
		100 %	SPT					5						
		100 %	TT					6						
		100 %	SPT					7						
		100 %	TT					8						
		100 %	SPT					14	19	[X pattern]	Extremely weak, moderately weathered, grey, SILTSTONE. Extremely weak to very weak, moderately weathered, grey, fine to coarse SANDSTONE. Extremely weak to very weak, moderately weathered, grey, fine SANDSTONE.	39		
		100 %	TT					9						
		100 %	SPT					9						
		100 %	TT					12						
		100 %	SPT					14						
		90 %	TT					15						
		90 %	TT					15	7	[X pattern]				
		90 %	TT					7						

DATE STARTED: 23/10/19 **DRILLED BY:** Pro-Drill
DATE FINISHED: 23/10/19 **EQUIPMENT:** SLG-02
LOGGED BY: RLR **DRILL METHOD:** OB/SPT/TT/VE
SHEAR VANE No: GEO613 **DRILL FLUID:** Water
DIAMETER/INCLINATION: -/90°

COMMENTS:
 Hole terminated at target depth.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Trig Road



BOX: 1

DEPTH: 0.0 to 4.95m



BOX: 2

DEPTH: 4.95 to 7.95m

Trig Road



BOX: 3

DEPTH: 7.95 to 10.50m



BOX: 4

DEPTH: 10.5 to 13.95m

Trig Road



BOX: 5

DEPTH: 13.05 to 16.25m



BOX: 6

DEPTH: 16.25 to 20.00

Trig Road



BOX: 7

DEPTH: 20.0 to 22.375m

Appendix 3. Hand Auger Logs and Photographs

HAND AUGER LOG

PROJECT: Trig Road Investigations, Kumeu JOB NUMBER: 3810934
 SITE LOCATION: Trig Road CLIENT: Supporting Growth Alliance

CIRCUIT: NZTM AUGER LOCATION: 40 Trig Rd - RP00/0.500 COORDINATE ORIGIN: AKL Council GIS
 COORDINATES: N 5,924,720.77 m R L: 55.5 m ACCURACY: ±5m
 E 1,744,643.39 m DATUM: MSL

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	SPT		WATER LEVEL	R L (m)
					Scale (Blows/100mm)	τ (kPa)		
0.5	[X pattern]	[Hatched pattern]	Stiff fine sandy SILT, some organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil	4			55.0
			Very stiff fine sandy SILT, trace organics; orange-brown; moist, low plasticity. Organics: rootlets		4			
			Very stiff clayey SILT; orange; moist, high plasticity.		3			
1.0	[X pattern]	[X pattern]	Very stiff clayey SILT; light brown streaked white and pink; moist, high plasticity; pumiceous texture.	Puketoka Formation	2	112/42	154/59	54.5
					3			
1.5	[X pattern]	[X pattern]	Very stiff clayey SILT; light brown streaked white and pink; moist, high plasticity; pumiceous texture.	Puketoka Formation	2			54.0
					2			
2.0	[X pattern]	[X pattern]	Very stiff clayey SILT; light orange-brown speckled white; moist, high plasticity; pumiceous texture.	Puketoka Formation	2	90/36	124/51	53.5
					2			
2.5	[X pattern]	[X pattern]	Very stiff clayey SILT; light orange-brown speckled white; moist, high plasticity; pumiceous texture.	Puketoka Formation	2	104/54	143/75	53.0
					2			
3.0	[X pattern]	[X pattern]	Very stiff clayey SILT; light orange-brown speckled white; moist, high plasticity; pumiceous texture.	Puketoka Formation	2	98/50	135/70	52.5
					2			
3.5	[X pattern]	[X pattern]	END OF LOG @ 3.5 m	Puketoka Formation	2	80/40	110/56	52.0
					2			
4.0	[X pattern]	[X pattern]	END OF LOG @ 3.5 m	Puketoka Formation	3	90/52	124/73	51.5
					3			
4.5	[X pattern]	[X pattern]	END OF LOG @ 3.5 m	Puketoka Formation	3	84/46	116/64	51.0
					3			

DATE AUGERED: 13/12/19 DIAMETER: 50 mm COMMENTS: No groundwater encountered
 LOGGED BY: GH METHOD: HA
 SHEAR VANE No: GEO1509

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BECA LIB 1.074.GLB Log BECA HAND AUGER TRIG ROAD INVESTIGATIONS 20200722 1000CPJ <DrawingFile> 24/01/2020 13:58 P.30.004 D:\gei\lib and is\lib\Tool_DGD\Lib_Beca 1.07.4.2016-01-15 Pj\Beca 1.07.2014-12-16

SGA Trig Rd Geotechnical Investigation. HA101/19



BOX: 1

Depth: 0.00 m to 3.50 m

Appendix 4. Test Pit Logs and Photographs

SGA Trig Rd Geotechnical Investigation TP101/19



Depth: 0.00 m to 3.5 m



Depth: 0.00 m to 3.5 m

TP101/19

TEST PIT LOG

PROJECT: Trig Road Investigations, Kumeu	JOB NUMBER: 3810934
SITE LOCATION: Trig Road	CLIENT: Supporting Growth Alliance
CIRCUIT: NZTM	TEST PIT LOCATION: 9 Trig Rd - RP00/0.410
COORDINATES: N 5,924,679.89 m E 1,744,741.58 m	R L: 47.2 m DATUM: MSL
	COORDINATE ORIGIN: AKL Council GIS ACCURACY: ±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	S _{scale} (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
		[Diagonal Hatching]	Stiff fine SAND; trace clay, trace organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil	2	96/35	132/49		
		[Diagonal Hatching]	Stiff clayey SILT; light grey; moist, high plasticity. Fines content increasing with depth		3				47.0
0.5		[X's]			4				
		[X's]			4				
		[X's]			2				
		[X's]			1	60/18	83/27		
		[X's]			2				
		[X's]			3				46.5
		[X's]			2				
1.0		[X's]	1.2m - Very stiff		3	93/40	128/56		
		[X's]			4				
		[X's]			6				46.0
		[X's]			4				
		[X's]			4				
1.5		[X's]			6	88/38	121/54		
		[X's]			6				
		[X's]			7				45.5
		[X's]			7				
2.0		[X's]	Very stiff silty CLAY; light grey; moist, high plasticity.	Puketoka Formation		86/25	118/36		45.0
		[X's]							
2.5		[X's]	2.5m- Streaked yellow			140+	191+		44.5
		[X's]							
3.0		[X's]				105/45	144/63		44.0
		[X's]							
3.5		[X's]	END OF LOG @ 3.5 m			94/46	129/64		43.5
		[X's]							
4.0		[X's]							43.0
		[X's]							
4.5		[X's]							42.5

DATE EXCAVATED: 13/12/19	CONTRACTOR: Abernathy	COMMENTS: No groundwater encountered Shear vanes undertaken within bulk samples from the pits below 1.4m depth
LOGGED BY: GH	EQUIPMENT: 14T Excavator	
SHEAR VANE No: GEO1509	METHOD: E	

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

SGA Trig Rd Geotechnical Investigation TP102/19



BOX: 1

Depth: 0.00 m to 3.5 m



BOX: 2

Depth: 0.00 m to 3.5 m

TP102/19

TEST PIT LOG

PROJECT: Trig Road Investigations, Kumeu	JOB NUMBER: 3810934
SITE LOCATION: Trig Road	CLIENT: Supporting Growth Alliance
CIRCUIT: NZTM	TEST PIT LOCATION: 19 Trig Rd - RP00/0.650
COORDINATES: N 5,924,899.03 m E 1,744,588.22 m	R L: 52.25 m DATUM: MSL
	COORDINATE ORIGIN: AKL Council GIS ACCURACY: ±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	S _{caia} (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)	
			Stiff silty fine SAND, minor clay, minor organics; dark brown; dry, low plasticity. Organics: rootlets [Topsoil]	Topsoil	1	52/30	73/43			
0.5			Very stiff silty fine SAND, minor clay, minor fine gravel; reddish orange, moist, low plasticity.	Puketoka Formation	2				52.0	
					2					
					2	112/45	154/63			
					2					
					3					
1.0			Very stiff clayey SILT, trace organics; light greyish yellow; moist, high plasticity. Organics: rootlets.		2					51.5
					3					
					3	140+	191+			
					2					
					2					51.0
1.5				3						
				6	140+	191+				
				4						
				5						
				3					50.5	
2.0				8	132/50	181/70				
									50.0	
2.5			END OF LOG @ 2.3 m							
									49.5	
									49.0	
									48.5	
									48.0	
									47.5	
DATE EXCAVATED: 13/12/19 CONTRACTOR: Abernathy LOGGED BY: GH EQUIPMENT: 14T Excavator SHEAR VANE No: GEO1509 METHOD: E				COMMENTS: No groundwater encountered Shear vanes undertaken within bulk samples from the pits below 1.4m depth						
FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET										

BECA LIB 1.074.GLB Log BECA TEST PIT TRIG ROAD INVESTIGATIONS 2020/12 1000.GPJ <<DrawingFile>> 24/01/2020 14:01 8.30.004 Dwgpl Lib and In Situ Test - DGD [Lib:Bea 1.074.2016-01-15 Pit:Bea 1.07.2014-12-16]

SGA Trig Rd Geotechnical Investigation TP103/19



BOX: 1

Depth: 0.00 m to 2.3 m



BOX: 2

Depth: 0.00 m to 2.3 m

TP103/19

Appendix 5. Laboratory Testing

GEOTEST

Sheet 1 of 9

 21 Pitt Street
 P O Box 6345
 Auckland 1141
 Ph. 300-9380

SUMMARY OF TEST RESULTS

Report:
 2057L:01

Job Name: Supporting Group Alliance

Job No: 3810934/1000

Client: Auckland Transport

Date: 13 December 2019

Bore hole No.	Sample No.	Depth (m)	Sample Type	Sample Description	Natural		Atterberg Limits		Grading	Pg $\frac{t}{m^3}$	Clay Index	Consol	CBR	Compaction	Perm $\frac{k}{m/s}$	Triaxial CU/PP
					WC%	Bulk Density $\frac{t}{m^3}$	LL/CPL	PL								
BH101/19	S836	1.5	SD	Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.	43.4		X	X	X							
BH102/19	S837	3.0	SD	Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.	47.5		X	X	X							
BH101/19	S846	3.8	PT	Clayey SILT, minor sand; bluish grey mottled orange brown; moist, highly plastic.	43.8							X				
BH101/19	S835	4.5	SD	Clayey SILT, minor sand; orange brown, mottled blueish grey; moist, highly plastic.	56.5											
BH101/19	S847	6.0	PT	Clayey SILT, minor sand, trace fine gravel; reddish brown mottled yellowish grey; moist, highly plastic.	81.5							X				
BH102/19	S838	6.0	SD	Clayey SILT, minor sand; orange brown, mottled blueish grey; moist, highly plastic.	43.1											
BH102/19	S839	7.5-7.95	SD	Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.	40.7		X	X	X							



ENVIROLAB GEOTEST IS ACCREDITED BY INTERNATIONAL ACCREDITATION NEW ZEALAND. ALL TESTS REPORTED HEREIN HAVE BEEN PERFORMED IN ACCORDANCE WITH THE LABORATORY'S SCOPE OF ACCREDITATION. THIS REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL.
 NOTE: IANZ ENDORSEMENT DOES NOT COVER SOIL DESCRIPTIONS.

REPORT RELATES ONLY TO SAMPLES TESTED. SAMPLING WAS UNDERTAKEN BY OTHERS.

X = DATA ATTACHED, UT = UNDISTURBED TUBE SAMPLES, SD = SMALL DISTURBED SAMPLES

TEST STANDARDS:

NZS 4402: 1986; Test 2.1.2.2.3.2.4.2.8.4, 7.1

AUTHORISED SIGNATORY

Al Agarkova - Authorised Signatory

Sheet 1 of 9

ATTERBERG LIMITS

Job Name: Supporting Group Alliance

Date: 13 December 2019

Job No: 3810934/1000

Report No: 2057L:01

Client: Auckland Transport

Tested By: S.Shah/B.Alves

Sample Type: Small Disturbed

Checked By: C.Oey

Test Standard: NZS 4402: 1986, Test 2.1,2.2,2.3,2.4

History: As Received

Test Performed On: Sub 425µm

Bore No.	Sample No.	Depth (m)	Sample Description	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
BH101/19	S836	1.5	Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.	43.4	67	30	37
BH102/19	S837	3.0	Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.	47.5	79	37	42
BH102/19	S839	7.5-7.95	Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.	40.7	71	25	46

Comments:



21 Pitt St
 PO Box 6345
 Auckland 1141
 Ph: (09) 300-9380

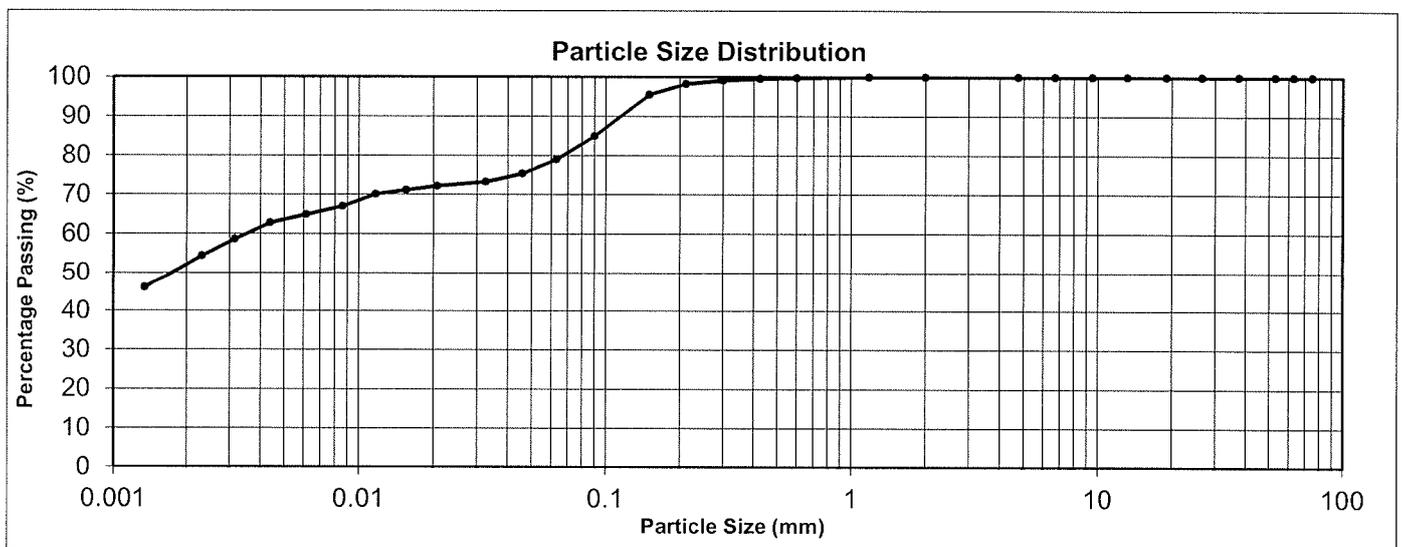
PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019
Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey
Bore No.: BH101/19 **Sample No.:** S836 **Depth (m):** 1.5
Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Fine to medium sandy silty CLAY, trace organics; yellowish brown, speckled dark greyish brown; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.046	75	0.001	46
63	100	1.18	100	0.033	73		
53	100	0.600	100	0.021	72		
37.5	100	0.425	100	0.015	71		
26.5	100	0.300	99	0.012	70		
19	100	0.212	98	0.009	67		
13.2	100	0.150	96	0.006	65		
9.5	100	0.090	85	0.004	63		
6.7	100	0.063	79	0.003	59		
4.75	100			0.002	54		



% Clay	% Silt	% Sand	% Gravel	Max. size:
52	27	21	0	300µm



Authorised Signatory.....
 N. Agarkova - Authorised Signatory



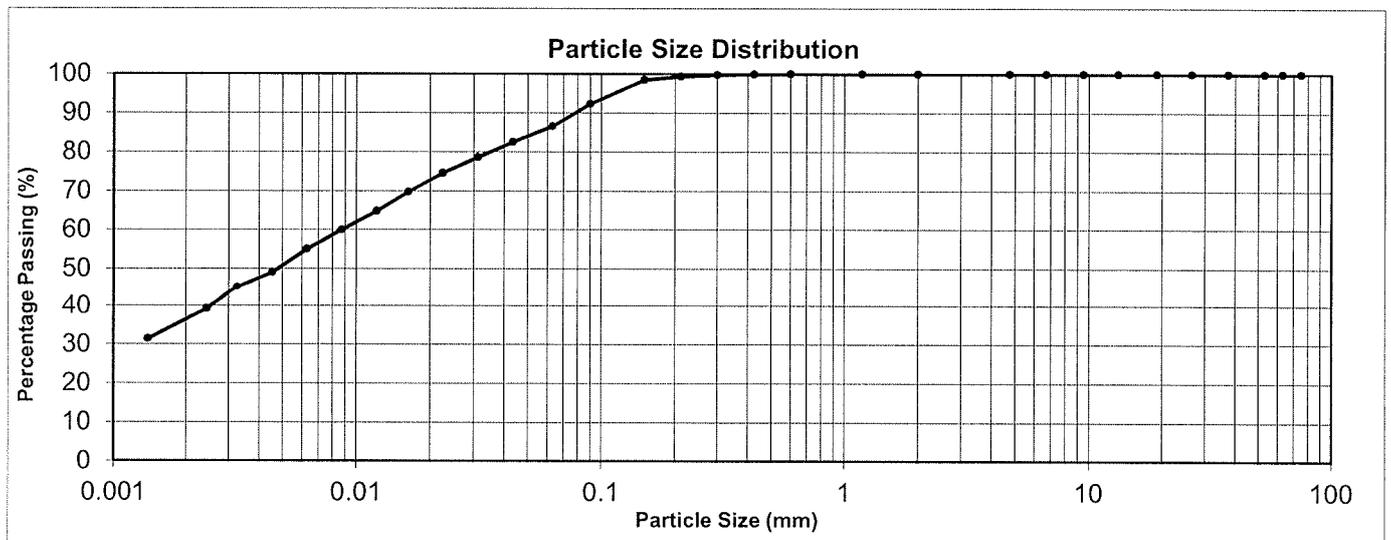
PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019
Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey
Bore No.: BH102/19 **Sample No.:** S837 **Depth (m):** 3.0
Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Clayey SILT, some fine sand; orange brown, mottled light blueish grey; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.043	82	0.001	31
63	100	1.18	100	0.031	79		
53	100	0.600	100	0.022	75		
37.5	100	0.425	100	0.016	70		
26.5	100	0.300	100	0.012	65		
19	100	0.212	99	0.009	60		
13.2	100	0.150	98	0.006	55		
9.5	100	0.090	92	0.005	49		
6.7	100	0.063	87	0.003	45		
4.75	100			0.002	39		



% Clay	% Silt	% Sand	% Gravel	Max. size:
36	51	13	0	212µm



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 Auckland 1141
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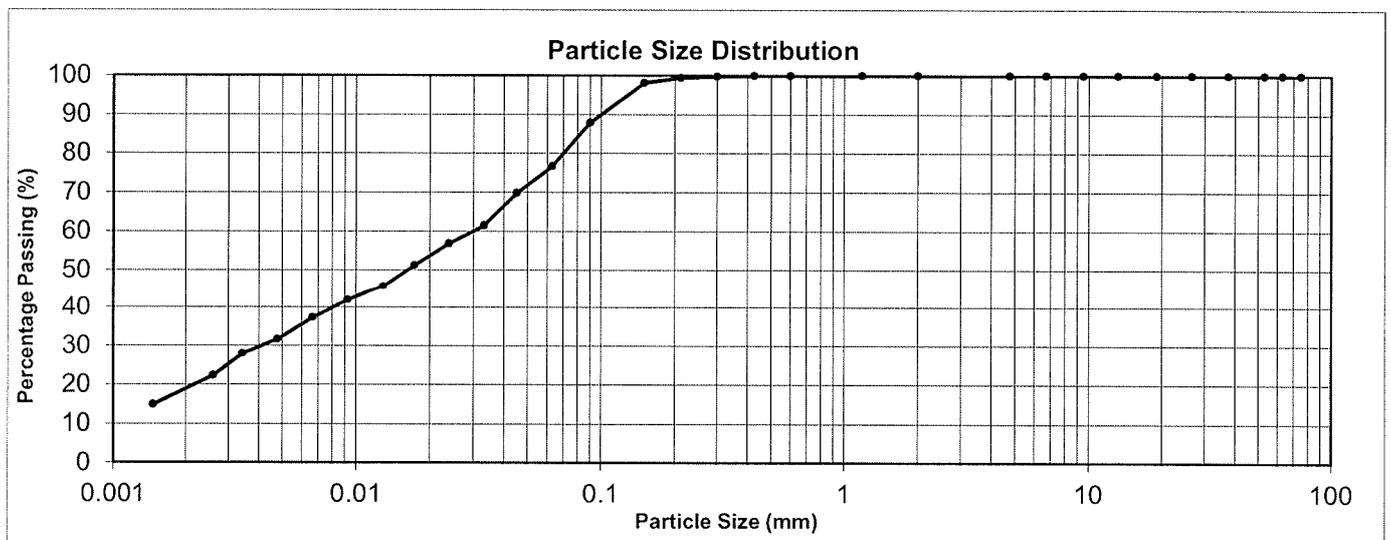
PARTICLE SIZE DISTRIBUTION - WET SIEVE/HYDROMETER METHOD

Job Name: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019
Job No.: 3810934/1000 **Tested By:** S.Shah **Checked By:** C.Oey
Bore No.: BH102/19 **Sample No.:** S839 **Depth (m):** 7.5-7.95
Sample Type: Small Disturbed **History:** As Received **Report No.:** 2057L:01

Sample Description: Fine to medium sandy SILT, some clay; greyish brown, speckled orange brown; moist, highly plastic.

Test Standard: NZS4402: 1986, Test 2.8.4 **Dispersion:** Sodium hexametaphosphate, pH = 9.0

Fraction Determined by Sieving				Fraction Determined by Hydrometer			
Sieve Size mm	% Passing	Sieve Size mm	% Passing	Part. Size mm	% Passing	Part. Size mm	% Passing
75	100	2.0	100	0.045	70	0.001	15
63	100	1.18	100	0.033	61		
53	100	0.600	100	0.024	57		
37.5	100	0.425	100	0.017	51		
26.5	100	0.300	100	0.013	46		
19	100	0.212	99	0.009	42		
13.2	100	0.150	98	0.007	37		
9.5	100	0.090	88	0.005	32		
6.7	100	0.063	77	0.003	28		
4.75	100			0.003	22		



% Clay	% Silt	% Sand	% Gravel	Max. size:
18	59	23	0	212µm



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N.Agarkova - Authorised Signatory

ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019

Job No: 3810934/1000 **Location:** - **Depth (m):** 3.8

Bore/Test Pit No.: BH101/19 **Sample No.:** S846 **Report No:** 2048L:01

Sample Type: Undisturbed Tube **History:** Natural

Sample Description: Clayey SILT, minor sand; bluish grey mottled orange brown; moist, highly plastic.

Test Standard: NZS 4402:1986, Test 7.1 **Tested By:** N. Agarkova **Checked By:** S. Shah

Test Condition: Inundated at 1 minute interval on initial load sequence

Initial Water Content (%)	43.8	Solid Density (assumed) (t/m ³)	2.77
Initial Bulk Density (t/m ³)	1.75	Saturation Ratio (Initial)	0.95
Initial Dry Density (t/m ³)	1.22	Saturation Ratio (Final)	1.0
Cycle Time (Ave) (Hrs)	4	Temperature Range (°C)	19.5-23
Area of Ring (mm ²)	1960	Initial Void Ratio (e)	1.28
Height of Ring (mm)	14.9	Date Tested	21 - 25 November 2019

Applied Pressure (kPa)	6	12.5	25	50	100	200	400	800	200	50
Compression (%)	0.0	0.0	0.4	1.2	2.7	5.6	9.6	14.4	13.1	11.4
Void Ratio (e)	1.28	1.28	1.27	1.25	1.22	1.15	1.06	0.95	0.98	1.02
Coefficient of consolidation Cv Log (m ² /yr)	-	5.1	15	9.5	9.6	7.9	8.1	8.5	-	-
Coefficient of volume compressibility Mv (m ² /MN)	-	0.05	0.31	0.31	0.31	0.29	0.21	0.13	-	-

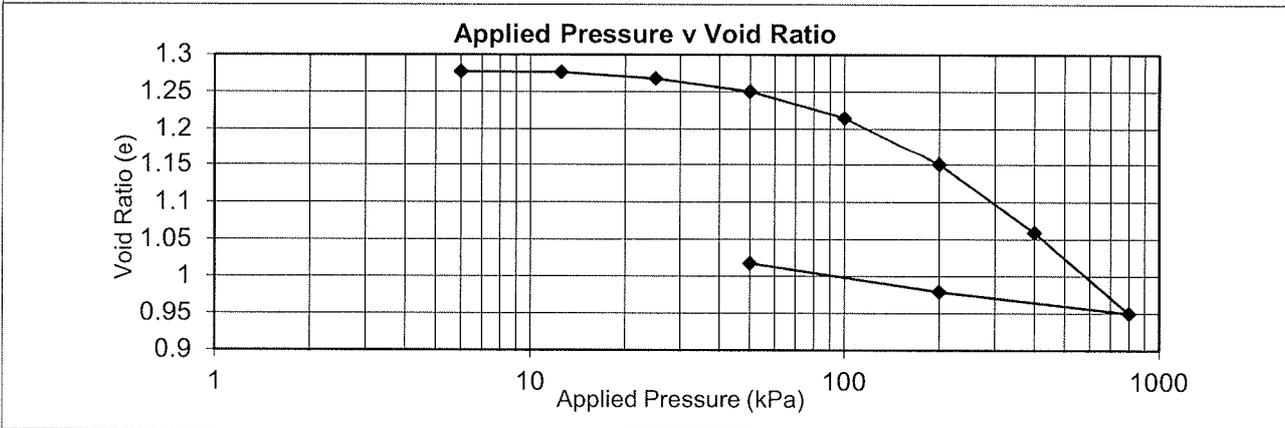
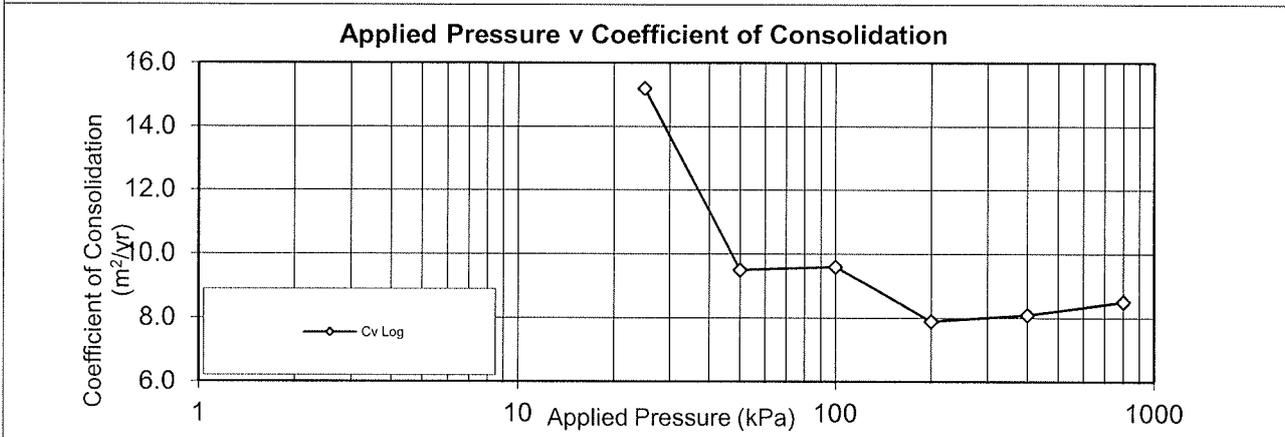
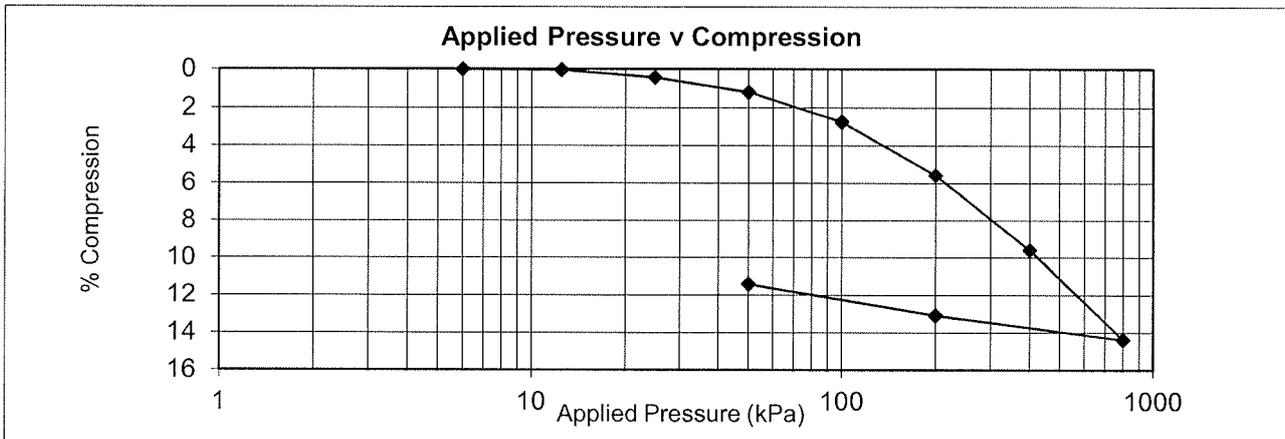
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ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance Client:Auckland Transport Date: 13 December 2019
 Job No: 3810934/1000 Location: - Depth (m): 3.8
 Bore/Test Pit No.: BH101/19 Sample No.: S846 Report No: 2048L:01



GS-362R-462-F01
 Rev. No. 10

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N. Agarkova - Authorised Signatory

ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance **Client:** Auckland Transport **Date:** 13 December 2019
Job No: 3810934/1000 **Location:** - **Depth (m):** 6.0
Bore/Test Pit No.: BH101/19 **Sample No.:** S847 **Report No:** 2048L:01
Sample Type: Undisturbed Tube **History:** Natural

Sample Description: Clayey SILT, minor sand, trace fine gravel; reddish brown mottled yellowish grey; moist, highly plastic.

Test Standard: NZS 4402:1986, Test 7.1 **Tested By:** N. Agarkova **Checked By:** S. Shah

Test Condition: Inundated at 1 minute interval on initial load sequence

Initial Water Content (%)	81.5	Solid Density (assumed) (t/m ³)	2.77
Initial Bulk Density (t/m ³)	1.51	Saturation Ratio (Initial)	0.97
Initial Dry Density (t/m ³)	0.83	Saturation Ratio (Final)	1.0
Cycle Time (Ave) (Hrs)	4	Temperature Range (°C)	19.5-23
Area of Ring (mm ²)	1960	Initial Void Ratio (e)	2.32
Height of Ring (mm)	15	Date Tested	21 - 25 November 2019

Applied Pressure (kPa)	6	12.5	25	50	100	200	400	800	200	50
Compression (%)	0.2	0.5	1.0	1.6	2.7	4.9	10.6	19.5	18.0	16.2
Void Ratio (e)	2.31	2.30	2.29	2.27	2.23	2.16	1.97	1.67	1.72	1.78
Coefficient of consolidation Cv Log (m ² /yr)	-	-	28	25	34	30	15	6.1	-	-
Coefficient of volume compressibility Mv (m ² /MN)	-	0.45	0.41	0.28	0.22	0.22	0.30	0.25	-	-

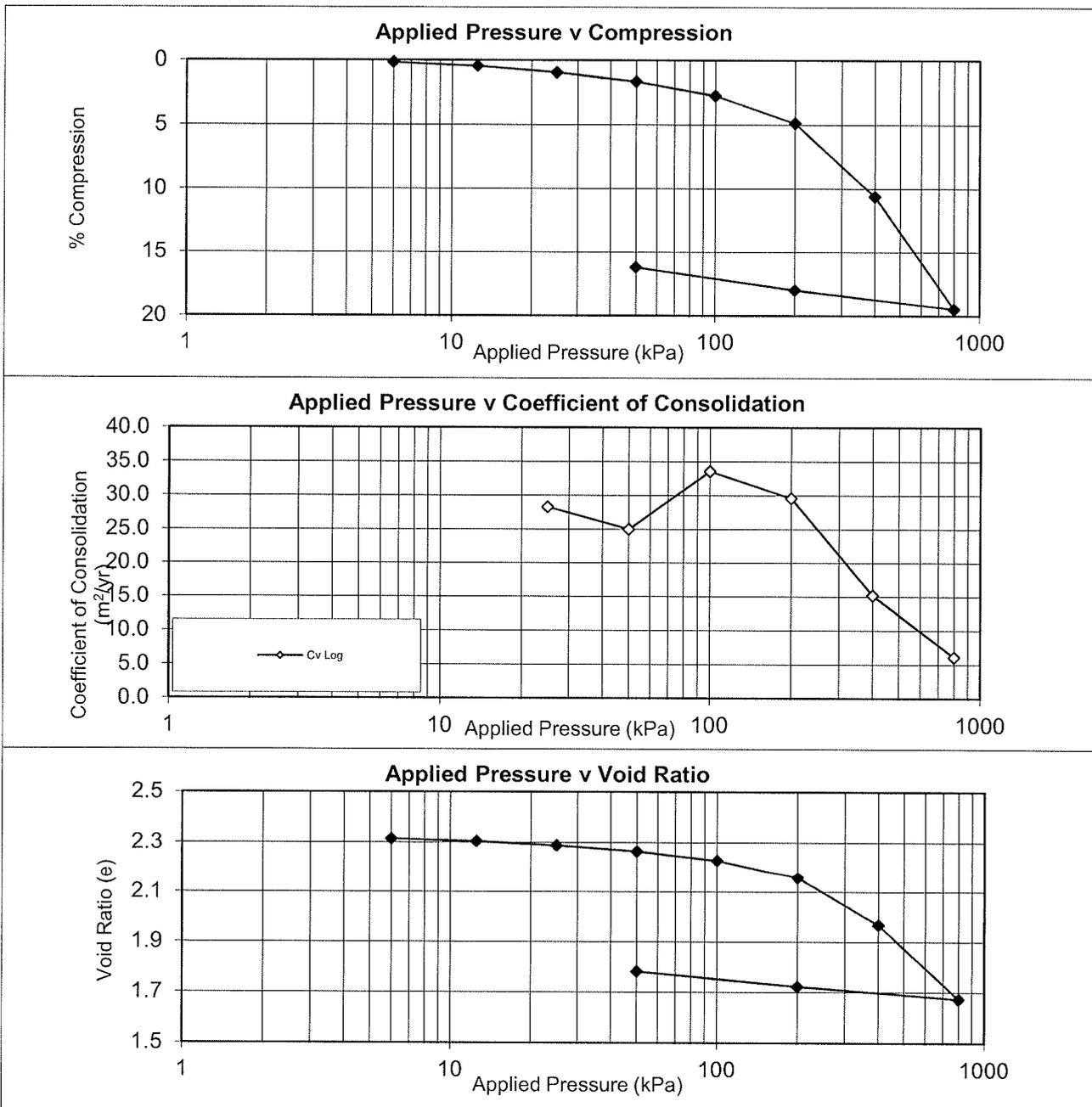
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ONE DIMENSIONAL CONSOLIDATION (OEDOMETER) TEST

Project: Supporting Group Alliance Client:Auckland Transport Date: 13 December 2019
 Job No: 3810934/1000 Location: - Depth (m): 6.0
 Bore/Test Pit No.: BH101/19 Sample No.: S847 Report No: 2048L:01



GS-362R-462-F01
 Rev. No. 10

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