

20 September 2019

Our Ref: 419750

Ngāi Tahu Property
PO Box 13-0060
Christchurch
New Zealand

Attention: Dean Christie

Geotechnical and Foundation Report: Lot 233 Miromiro Street, **Kākāpō** Neighbourhood - Karamū Subdivision, Riccarton, Christchurch

1 Introduction

This report provides the geotechnical appraisal and foundation recommendations for Lot 233 (LT 530544), Kākāpō Neighbourhood - Karamū Subdivision, Riccarton, Christchurch.

We anticipate the building will comprise a residential dwelling that is designed and constructed within the scope of NZS3604:2011. Buildings outside the scope of NZS3604:2011 require specific engineering design.

This report is intended to be used as technical supporting documentation for foundation design and Building Consent application purposes.

2 Ground Model

Our knowledge of the ground model is based on information from a number of sources, including:

Subdivision investigation¹ including shallow and deep testing. The subdivision report concluded "Based on our liquefaction assessment, we consider the site to behave similarly to MBIE Technical Category 1 (TC1)". The surface geology is Springston Formation alluvium, comprising mixtures of silt, sand and gravel. Groundwater is at approximately 10m depth.

Subdivision earthworks engineering undertaken with Eliot Sinclair as designer and Engineer to Contract, and works constructed by Blakely Construction Limited. All controlled fill placed across the subdivision area was supervised by an Engineer from Eliot Sinclair & Partners, and has been certified to NZS4431 as reported in the Inspecting Engineer's Report². The existing topsoil layer and any unsuitable material was removed down to clean insitu alluvium, followed by placement of controlled fill and finished with topsoil.

Site-specific testing - see details below.

1 Aurecon (2016): "Champions Mile – Geotechnical Investigation Report – Ngāi Tahu Property Limited", dated 23 September 2016; Revision: 1; Reference: 238331.

2 Eliot Sinclair (2019) "Inspecting Engineer's Report (NZS 4431:1989) – Kākāpō - Stage 2, Karamū Subdivision, Riccarton, Christchurch – Prepared for Ngāi Tahu Property Ltd – 419750" and dated 29 August 2019.

3 Site-Specific Testing

Following the completion of the earthworks, we undertook site-specific geotechnical testing across all residential lots within the subdivision. Testing within Lot 233 comprised 1 hand auger, 1 spade hole and 2 hand penetrometers.

The typical ground profile at the site is topsoil overlying sand/silt soil with sandy gravel at depth. The sand/silt soil may be the natural insitu subgrade, or controlled fill, or a combination of these across the lot area.

Some lots in the subdivision have no fill, but simply have topsoil placed over insitu subgrade. Where controlled fill is present it was largely sourced from other areas of the site (cut from the subgrade) so the fill has very similar appearance to the insitu soil; essentially being the same material. Some lots may have granular fill.

For foundation engineering purposes it may be assumed that the insitu sand/silt and the sand/silt fill are a single soil unit, so the actual thickness of fill is not relevant. The geotechnical properties (notably penetrometer resistance and, hence, bearing capacity) are the important characteristic to determine, which comes from the investigation logs.

Please refer to the attached site-specific investigation factual records and the test location plans that also include information on the depth of controlled fill placed on the lot.

4 Foundation Recommendations

The TC1 foundation design provisions of the MBIE residential guidelines³ apply to the site – refer to MBIE Section 5, Figure 5.1.

Typically, below the topsoil layer the penetrometer test results generally indicate a geotechnical ultimate bearing capacity >300 kPa. However, some results also indicate penetration resistances less than 300 kPa. Therefore, specific engineering design of foundations is required. Refer to MBIE Section 5.2 Overview of new foundations options.

Once the design, geometry and location of the dwelling is known, building plans should be reviewed by a CPEng Structural or Geotechnical Engineer to determine foundation pressures and a suitable foundation solution. Eliot Sinclair & Partners is able to undertake a review of building plans and design of foundations, along with the design and sizing of any other structural elements, if required.

For a more resilient design the TC2 raft foundations Options 2 – 4 are suitable for the site.

General foundation design and construction advice is as follows:

- 1 Foundations should be excavated through the topsoil layer and bear onto competent subgrade material.
- 2 Beneath the lightly loaded floor slab area, all turf and topsoil shall be removed to at least 100mm bgl, along with any deeper areas of soft or organic rich topsoil. The depth of the topsoil strip shall be confirmed at the time of inspection (as described in Section 5 below) to confirm a satisfactory surface is achieved. The subgrade will then need to be proof-rolled or compacted to achieve a firm uniform surface. The area can then be backfilled by placing and compacting AP40 sandy gravel in maximum 200mm thick loose layers to achieve a minimum dry density of 2150kg/m³ up to the underside of the floor slab.

³ Ministry of Business, Innovation & Employment "Guidance: Repairing and Rebuilding houses affected by the Canterbury earthquakes".

- 3 Internal floor slab thickenings and any other pads that are supporting concentrations of weight from roof trusses or columns shall be supported on, or be replaced with, mass concrete filled pads of the same area that are excavated through the topsoil and bear onto competent subgrade material.
- 4 Reinforcing in floor slabs shall be a minimum of 2.27kg/m² welded reinforcing mesh sheets (1.14kg/m² in each direction) and the reinforcing is to be Ductility Class E in accordance with NZS 4671.

5 Inspection Requirements

A suitably competent and experienced inspector should validate that the ground conditions exposed in the excavations are consistent with the findings of this report and the foundation design assumptions. Loose material should be removed from excavations. Foundations should bear onto competent subgrade material.

The inspection can be undertaken by Council personnel or a consultant's engineering personnel.

Please contact us with 48 hours' notice if you require Eliot Sinclair & Partners to undertake the inspection work. Following a satisfactory inspection, we will provide a 'Producer Statement - Construction Review' to validate the exposed ground conditions.

6 Disclaimer

Comments made in this report are based on reporting by others, our earthworks reporting, our soil investigations, and the Ministry of Business Innovation & Employment Guidelines.

Whilst every care was taken during our investigation and interpretation of subsurface conditions, there may well be subsoil strata and features that were not detected. Additionally, on-going seismicity in the general area may lead to deterioration or additional ground movement that could not have been anticipated at time of writing of this report.

The exposure of such conditions, or occurrence of additional strong seismicity, or any future update of MBIE's guidelines or the NZBC, may require a review of our recommendations. Eliot Sinclair & Partners should be contacted to confirm the validity of this report should this occur.

This report has been prepared for the benefit of Ngāi Tahu Property (or purchasers of the site from Ngāi Tahu Property), and the Christchurch City Council. No liability is accepted by this company or any employee of this company with respect to the use of this report by any other party.

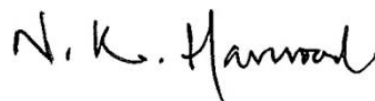
Yours sincerely
ELIOT SINCLAIR & PARTNERS LTD

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Principal
Senior Geotechnical Engineer

Encl.

- Site Investigation Records – 2 pages.
- Eliot Sinclair & Partners drawings: "Karamū Stage 2 Kākāpō - Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil", Project No. 419750, Set No. G4, Sheet No. 1 & 2; Rev. A.

SITE INVESTIGATION RECORD

Client **Ngāi Tahu Property** Site **Stage 2 (Kākāpō), Karamū Subdivision, Riccarton, Christchurch** Technical Category **TC1 Equivalent**

SCALA PENETROMETER TEST RESULTS														Depth (m)	SOIL PROFILE	
Number of Blows per 100mm															Test Location - Lot 233 A	Water
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
														0.2	Silty TOPSOIL; dark brown. Non-plastic; trace rootlets present.	Groundwater Not Encountered
														0.4	Sandy SILT; brown. Non-plastic; moist.	
														0.6		
														0.8	Fine to medium SAND; brown. Moist to wet; poorly graded.	
														1.0	1.05m: Grey. Wet; becoming fine to coarse grained, well graded.	
														1.2	SILT; grey. Non-plastic; minor iron staining present.	
														1.4		
														1.6		
														1.8	Fine to medium SAND; greyish brown. Moist to wet; poorly graded.	
														2.0	Sandy SILT; greyish brown. Wet; minor iron staining present.	
														2.2		
														2.4		
														2.6	SILT; grey. Saturated; minor iron staining present.	
														2.8	Sandy SILT; grey. Wet; minor iron staining present.	
														3.0	EOH: 3m - Stop - Target Depth Reached.	

COMMENTS

Auger test Lot 233 A carried out prior to final topsoil reshaping.

SITE PLAN (Not to Scale)

Eliot Sinclair & Partners drawings: "Karamu Stage 2 Kakapo - Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil", Project No. 419750, Set No. G4, Sheet No. 1 & 2; Rev. A.

Field Staff: LBW/JSF/SH	Prepared By: LBW	Investigation Type
Job Manager: MAA	Approved By: NKH	<input checked="" type="checkbox"/> Hand Auger <input type="checkbox"/> Spade Hole <input type="checkbox"/> Test Pit

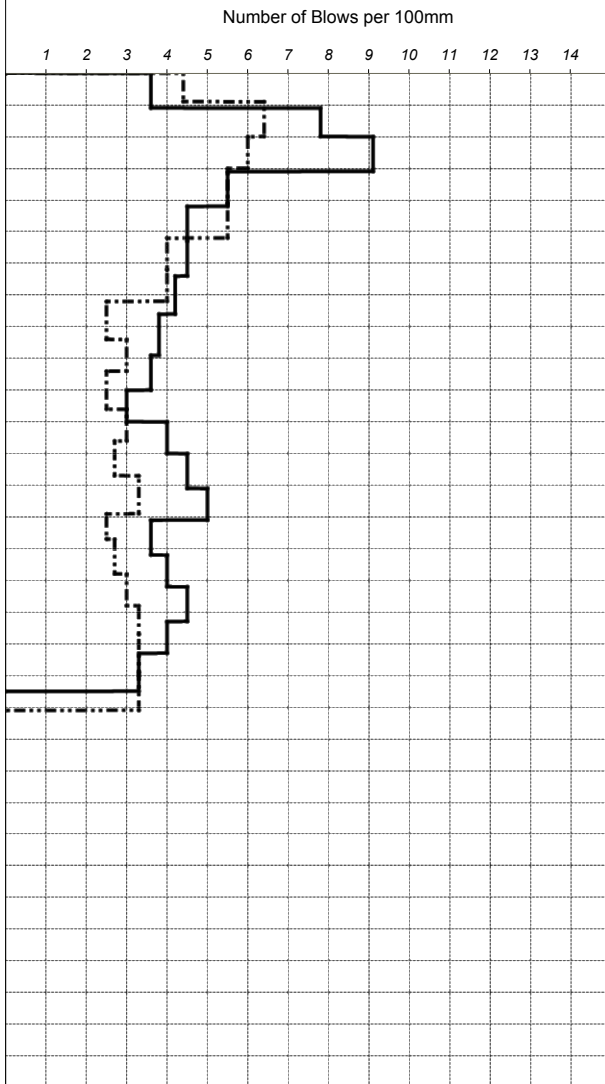
SITE INVESTIGATION RECORD

Client **Ngāi Tahu Property**

Site **Stage 2 (Kākāpō), Karamū Subdivision, Riccarton, Christchurch**

Technical Category
TC1 Equivalent

SCALA PENETROMETER TEST RESULTS



— Lot 233 P01 - - - Lot 233 P02

SOIL PROFILE

Depth (m)	Test Location - Lot 233 SHB	Water
0.0 - 0.2	FILL: silty TOPSOIL; dark brown. Trace rootlets.	Groundwater Not Encountered
0.2 - 0.4	SILT; light brown. EOH: 0.45m	
0.4 - 3.0		

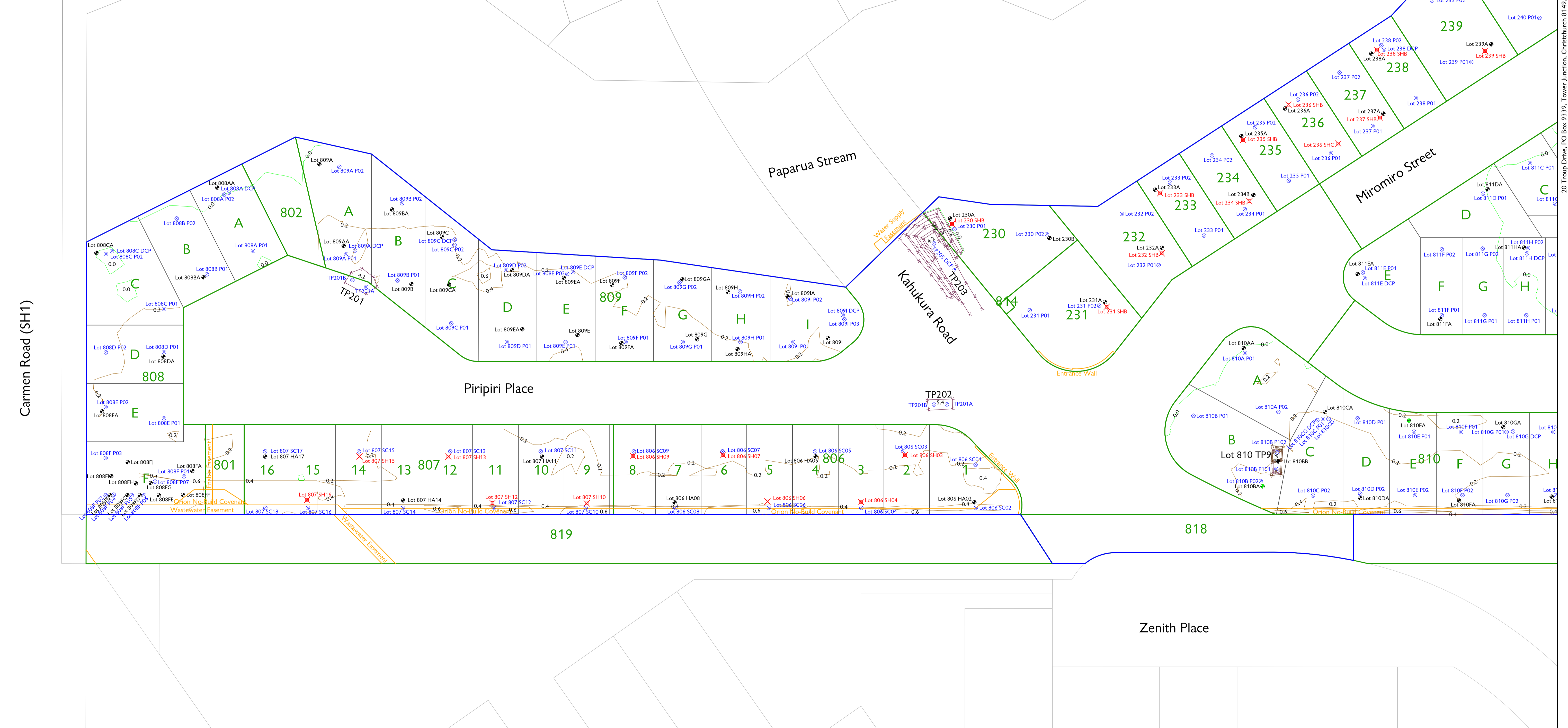
COMMENTS

SITE PLAN (Not to Scale)

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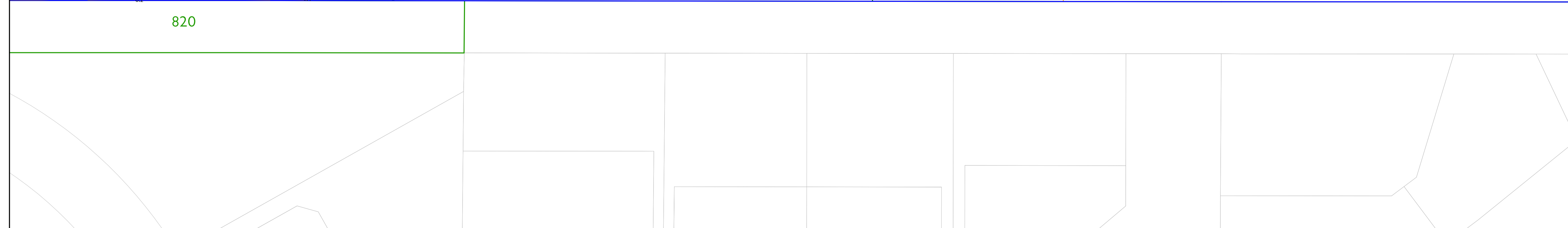
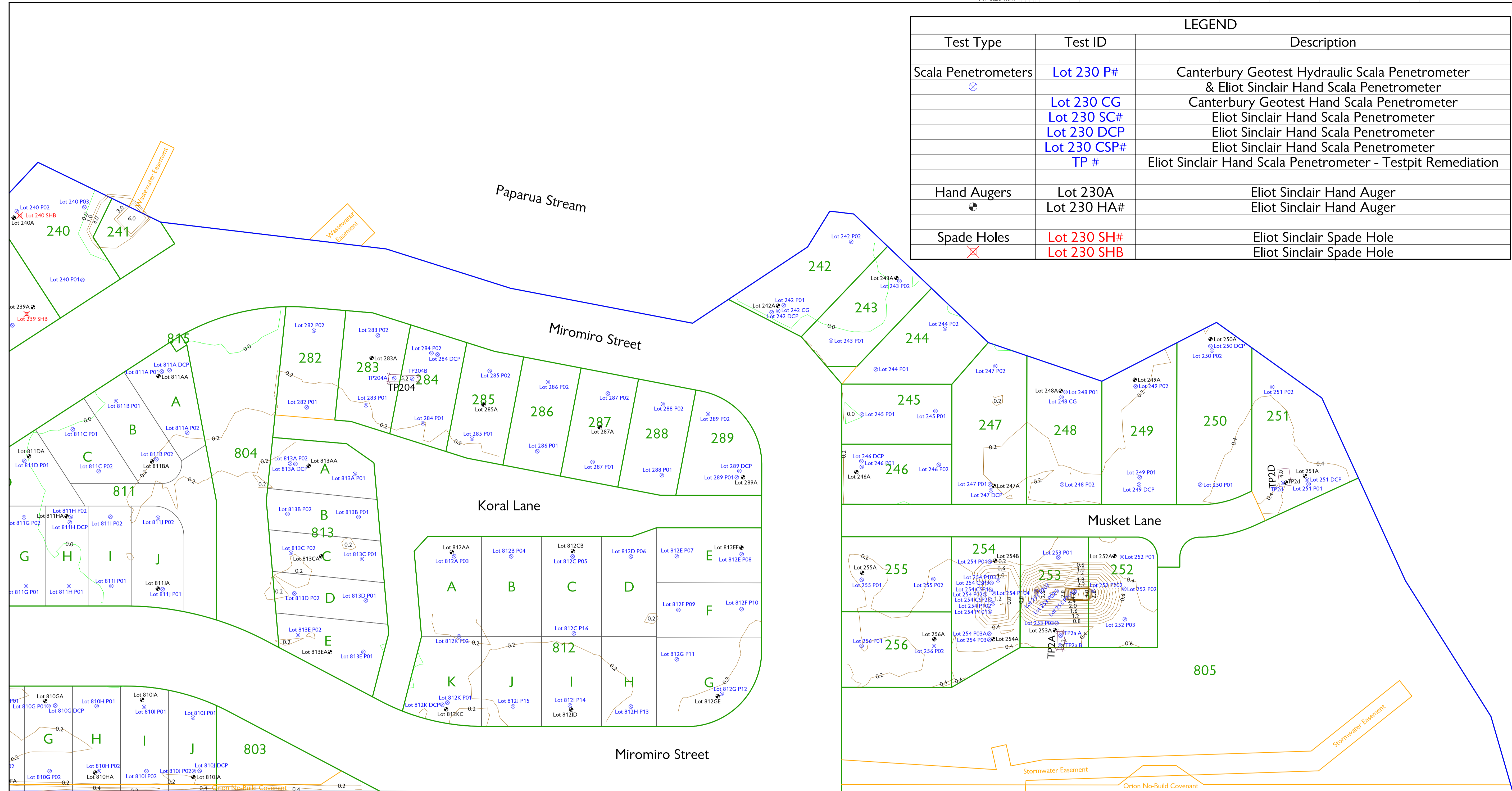
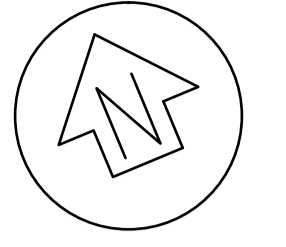
Field Staff: JSF	Prepared By: JSF	Investigation Type
Job Manager: MAA	Approved By: NKH	<input type="checkbox"/> Hand Auger <input checked="" type="checkbox"/> Spade Hole <input type="checkbox"/> Test Pit

LEGEND		
Test Type	Test ID	Description
Scala Penetrometers ⊗	Lot 230 P#	Canterbury Geotest Hydraulic Scala Penetrometer & Eliot Sinclair Hand Scala Penetrometer
	Lot 230 CG	Canterbury Geotest Hand Scala Penetrometer
	Lot 230 SC#	Eliot Sinclair Hand Scala Penetrometer
	Lot 230 DCP	Eliot Sinclair Hand Scala Penetrometer
	Lot 230 CSP#	Eliot Sinclair Hand Scala Penetrometer
	TP #	Eliot Sinclair Hand Scala Penetrometer - Testpit Remediation
Hand Augers ⊕	Lot 230A	Eliot Sinclair Hand Auger
	Lot 230 HA#	Eliot Sinclair Hand Auger
Spade Holes ⊗	Lot 230 SH#	Eliot Sinclair Spade Hole
	Lot 230 SHB	Eliot Sinclair Spade Hole



Rev. A	Description	Drawn WFP	Date 26.08.2019	Surveyed: R Paulsen	Survey Date: to July 2019	Name	Date	Client	Project Title	Project No.	Set No.	Sht No.	Rev.	
				Coord System: NZGD 2000 Mt Pleasant		Designed	-		Karamū Stage 2 Kākāpō	419750	G4	1	A	
				Calibration: CDD City 2014		Drawn	W Paulsen		26.08.2019	Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil	surveyors engineers planners			
				Origin of Levels: EHCH	Datum: CDD 2014	Dr. Chk	J Fleming		26.08.2019					
				Masonry nail & washer in kerb 148 Yaldhurst Road R.L. 31.287m		Proj. Mgr	M A Allan		-					
						Design Review	-		-					
						Approved	-	-	Scales	1:400 [A1] 1:800 [A3]				

LEGEND		
Test Type	Test ID	Description
Scala Penetrometers ⊗	Lot 230 P#	Canterbury Geotest Hydraulic Scala Penetrometer & Eliot Sinclair Hand Scala Penetrometer
	Lot 230 CG	Canterbury Geotest Hand Scala Penetrometer
	Lot 230 SC#	Eliot Sinclair Hand Scala Penetrometer
	Lot 230 DCP	Eliot Sinclair Hand Scala Penetrometer
	Lot 230 CSP#	Eliot Sinclair Hand Scala Penetrometer
	TP #	Eliot Sinclair Hand Scala Penetrometer - Testpit Remediation
Hand Augers ⊕	Lot 230A	Eliot Sinclair Hand Auger
	Lot 230 HA#	Eliot Sinclair Hand Auger
Spade Holes ⊗	Lot 230 SH#	Eliot Sinclair Spade Hole
	Lot 230 SHB	Eliot Sinclair Spade Hole



Rev. A	Description	Drawn WFP	Date 26.08.2019	Surveyed: R Paulsen	Survey Date: to July 2019	Name	Date	Client	Project Title	Project No.	Set No.	Sht No.	Rev.		
				Coord System: NZGD 2000 Mt Pleasant		Designed -	-		Karamū Stage 2 Kākāpō	419750	G4	2	A		
				Calibration: CDD City 2014		Drawn W Paulsen	26.08.2019		Drawing Title	Eliot Sinclair surveyors engineers planners					
				Origin of Levels: EHCH	Datum: CDD 2014	Dr. Chk J Fleming	26.08.2019		Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil						
				Masonry nail & washer in kerb 148 Yaldhurst Road R.L. 31.287m		Proj. Mgr M A Allan	-		Scales		1:400 [A1] 1:800 [A3]				
						Design Review -	-								
						Approved -	-								