Project Reference: 17850

17 July 2020

Zhann m Tracey

PO Box 8

Omapere

C/- Gumboots Consulting Engineers

SLOPE STABILITY ANALYSIS OF ACCESS ROAD
NEWTON ROAD, OMAPERE

1 INTRODUCTION

LDE Limited has been engaged to carry out a geotechnical investigation and slope stability analysis of the existing farm race access road through the location of a historic slip. The slip is understood to have occurred approximately 15 to 20 years ago.

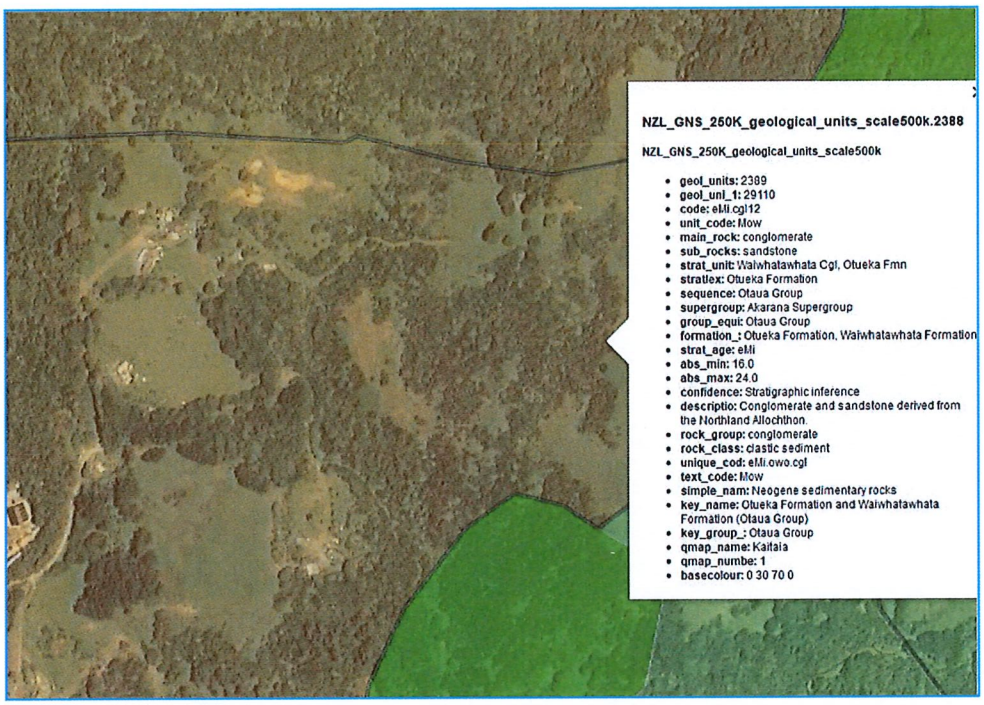
2 INVESTIGATION SUMMARY

Our investigation of the site included a desktop study, stereoscopic geomorphological mapping, site walkover with the client (Zhann Tracey) on 11th June 2020, logging exposed faces and a single hand augered borehole. Our analysis included slope stability modelling with Slide2 software from Rocscience and we have provided a recommendation that the access road be realigned to the north and cut into the batter slope approximately 3m above the current elevation to divert surface water away from the headscarp.

The locations of the test sites, cross section for stability analysis, and new recommended alignment are shown on the appended site plan.

2.1 Site Geology

The geology of the site is conglomerate and sandstone of the Otueka Formation of the Otaua Group derived from the Northland Allochthon. This geological unit is notorious within Northland for being unstable at even low slope angles, being highly expansive during variations in moisture content and having perched water tables due to the very low permeability of the clay. Several locations of current and historic land movement within the conglomerate that covers much of the southern headland of the Hokianga Harbour are known to be currently monitored and under investigation.



2.2 Hand Testing and Face Logging

A hand auger was undertaken within the access road immediately above the slip. The exposed faces of the slip headscarp (2.5m high) and the cut face (2.5m high) of the proposed building platform were logged. The hand augered borehole and face logs showed a consistent soil profile of low strength clay and silt soil with variable quantities of gravel, cobble and boulder content. Refusal was met at 1.0m in HA01, against impenetrable material inferred to be a boulder.

2.3 Generalised Ground Profile

Based on the investigation data the generalised ground profile at the site is as follows:

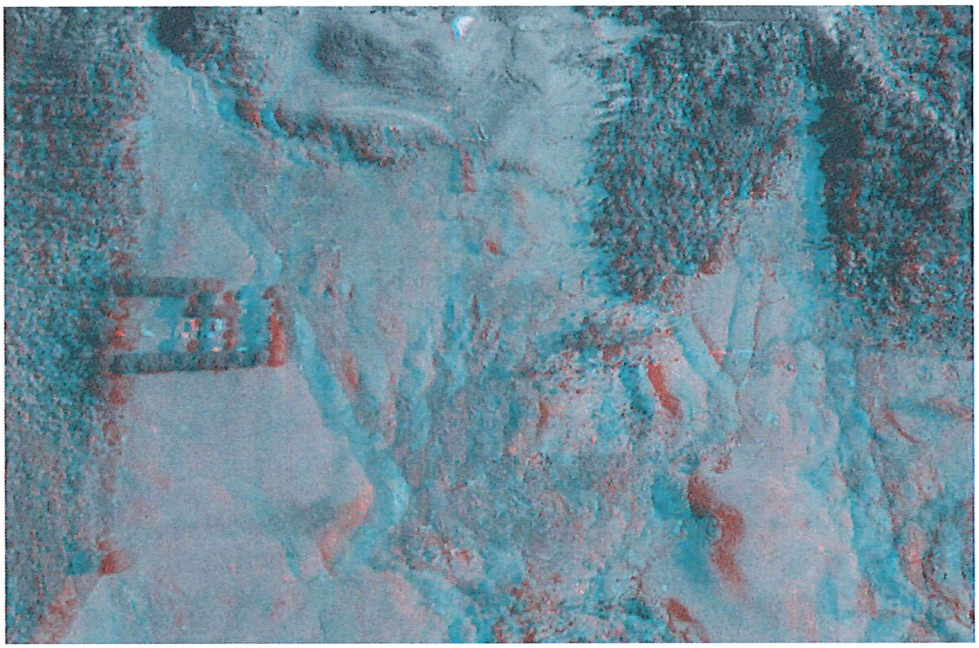
Depth (m)	Peak/Residual Undrained Shear strength (kPa)	Description
0	81/10	Topsoil (200mm) overlying Silty CLAY, orange/ brown, soft, wet, high plasticity
0.5	115/27	Silty CLAY with occasional cobbles, grey brown, soft, dry, high plasticity
1.0	136/19	Silty CLAY, orange brown, many gravels, some cobbles, and occasional boulders up to 300mm dia., soft, moist, high plasticity

1.5	111/27	Clayey SILT, grey brown, many gravels, some cobbles, and occasional boulders up to 300mm dia., soft, moist, high plasticity
2.0	170/68	CLAY with some cobbles and occasional boulders up to 300mm dia., light brown, soft, moist, high plasticity
2.5	141/57	Silty CLAY, orange brown, many gravels, some cobbles, and occasional boulders up to 300mm dia., soft, moist, high plasticity

*Shear vane readings may be falsely high due to gravels

2.4 Stereographic Interpretation

Stereographic interpretation was made of the 1942 aerial photos using StereoPhoto Maker Pro Ver6.02, for the purpose of geomorphological mapping. An extract of which is shown below. 3D visualisation shows a clear demarcation of a large historic land movement within the valley below the access road moving in a southerly direction. The age of this movement is at least 78 years prior to now, with the debris being unvegetated but no indication of recent movement at the time of the aerial photo. Earlier aerial photos were viewed but conclusions could not be drawn, due to the high altitude and low resolution of the photos.

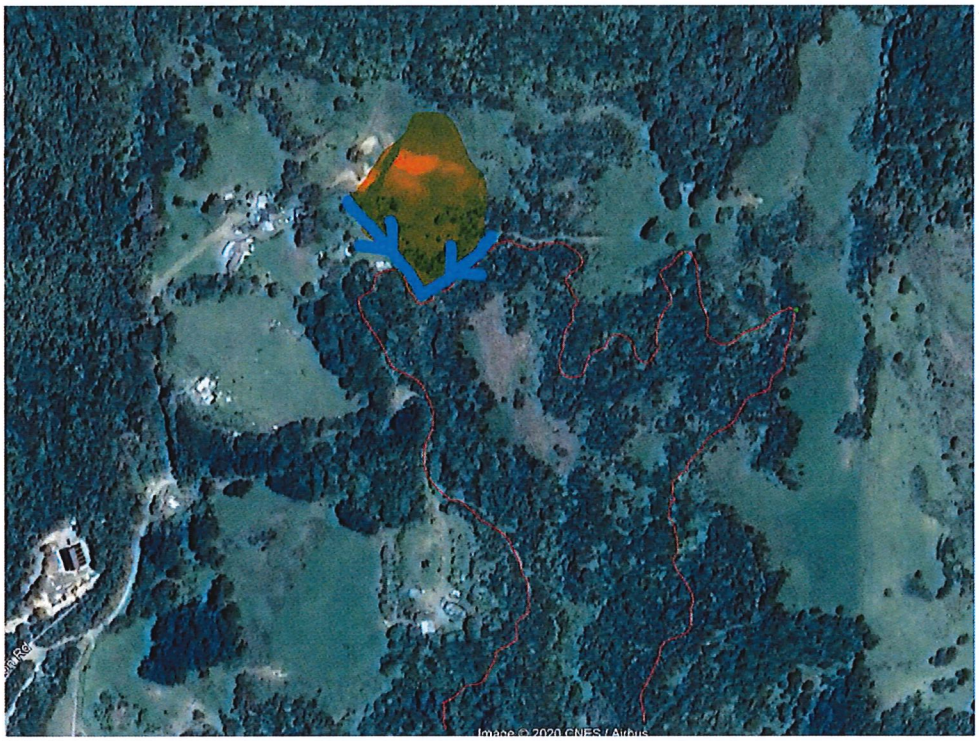


3 GEOMORPHOLOGICAL INTERPRETATION

The approximate extent of the large area of instability is shown by the red line in the figure below. The extent generally follows the watercourses and incised gullies. No evidence of new headscarps are visible in more recent aerial photography and no recent movement was observed during the site visit, apart from the 15 to 20 year old feature that is the subject of this investigation. The debris flow is now heavily vegetated, which is expected to have an overall

stabilising effect on the landslide. The general topography of the site is relatively gentle, and the incidence of unstable land demonstrates the very weak nature of the soils.

It is our interpretation that the headscarp below the access road has been caused by the construction of the access road altering the natural drainage patterns within the slope. The headscarp is at a low point along the access road alignment, which has intercepted the surface runoff and directed it to the low point where the slippage has occurred. Culverts were absent or ineffective, along this section of road, allowing runoff to flow towards the slip which is not a natural watercourse. The figure below shows the approximate catchment area (orange) and drainage paths (blue) directed towards the slip.



4 GEOTECHNICAL PARAMETERS FOR ANALYSIS

The following parameters were used for the analysis of the access road. Material strength parameters for the upper residual soil layer were calculated from a back analysis of the existing failed slope. Parameters for the underlying weathered Allochthon material are conservatively estimated based on our assumptions about the soil mass characteristics and previous experience with this unit.

	Residual soil	Weathered Northland Allochthon
Effective friction angle (φ')	20°	28°
Effective cohesion (c')	4 kPa	5 kPa
Unit weight (γ)	18kN/m^3	18kN/m^3

A remodelled surface was then analysed, with the access road and associated table drains, shifted approximately 3m in elevation up the slope to the north to direct runoff away from the slip and towards the natural watercourses. This has an effect of lowering the watertable at the location of the slip and allowing sufficient setback from the instability that it will not impose a load on the marginal strength ground. A new Factor of Safety of 1.3 was calculated for this remodelled surface. Slide outputs are included in the appendices.

5 RECOMMENDATIONS

The access road should be realigned to the north as shown on the appended Scheme Plan (dated 28.04.20) and cut into the batter slope approximately 3m above the current elevation to divert surface runoff away from the headscarp. Culverts and table drains should be utilised to divert surface water into the natural watercourses either side of the headscarp.

The new road alignment should be cut entirely into the existing natural slope with no filling allowed. The cut slope should be battered at a maximum gradient of 2H:1V.

Waterpipes within existing easements should be inspected for leaks on a regular basis and repaired immediately to prevent changes to the natural drainage pattern of the hillside.

Following these recommendations, the access road is expected to be stable and suitable as a ROW access road. The access road will have a sufficient setback from the existing headscarp that hard engineering structures will not be required to stabilise the slip.

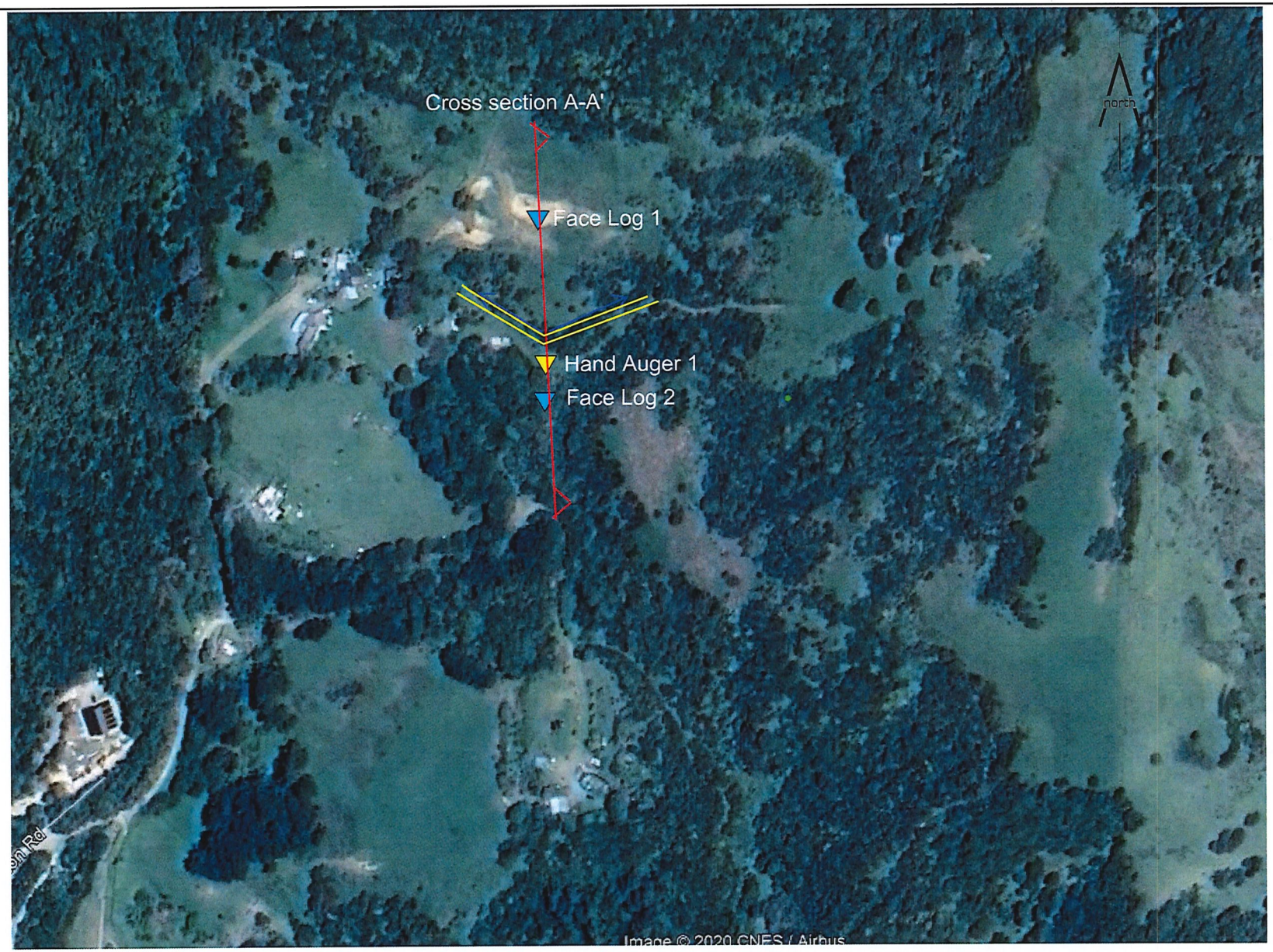
For and on behalf of LDE Ltd

Report prepared by:

Find out more about LDE professionals

Attached:

-Site Plan
-Slide Slope Stability outputs
-Scheme Plan

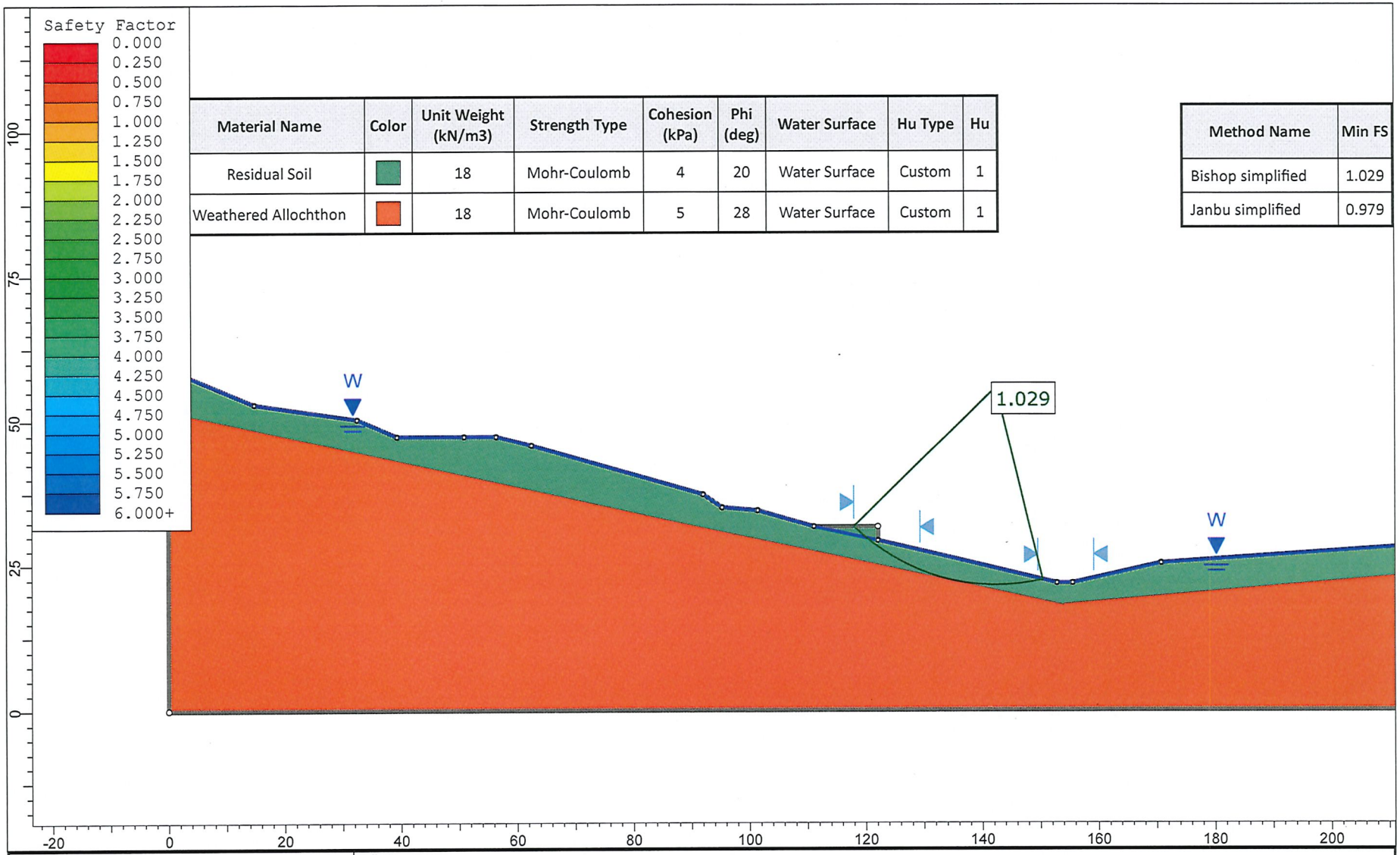


LDE LAND DEVELOPMENT & ENGINEERING LTD.

Geotechnical Investigation Site Plan

Lot 2 DP 184528 Newton Road, Omapere

DRAWN	GH
CHECKED	GH
DATE	9/07/2020
PROJECT	17850



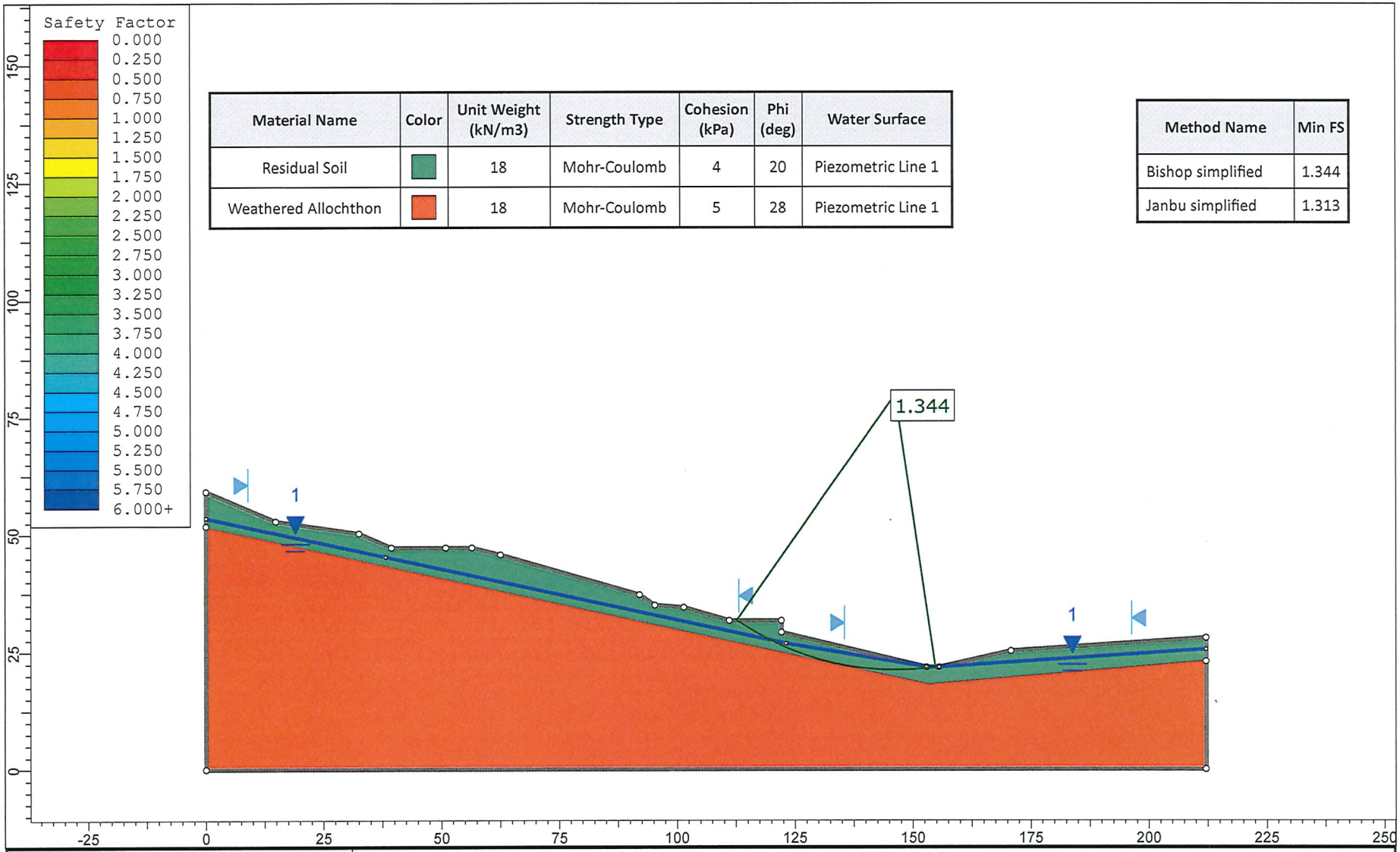
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Residual Soil		18	Mohr-Coulomb	4	20	Water Surface	Custom	1
Weathered Allochthon		18	Mohr-Coulomb	5	28	Water Surface	Custom	1

Method Name	Min FS
Bishop simplified	1.029
Janbu simplified	0.979

rocscience

SLIDEINTERPRET 8.032

Project	17850 - Newton Road, Omapere				
Analysis	Back analysis				
Drawn By	G. Harding	*Scale*	1:922	*Company*	LDE Ltd
Date	18/06/2020, 3:21:37 PM			*File Name*	Slide1.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	4	20	Piezometric Line 1
Weathered Allochthon		18	Mohr-Coulomb	5	28	Piezometric Line 1

Method Name	Min FS
Bishop simplified	1.344
Janbu simplified	1.313

rocscience

SLIDEINTERPRET 8.032

Project	17850 - Newton Road, Omapere				
Analysis	Remodelled surface				
Drawn By	G. Harding	Scale	1:1138	Company	LDE Ltd
Date	18/06/2020, 3:21:37 PM			File Name	Slide1.slmd

MEMORANDUM OF EASEMENTS

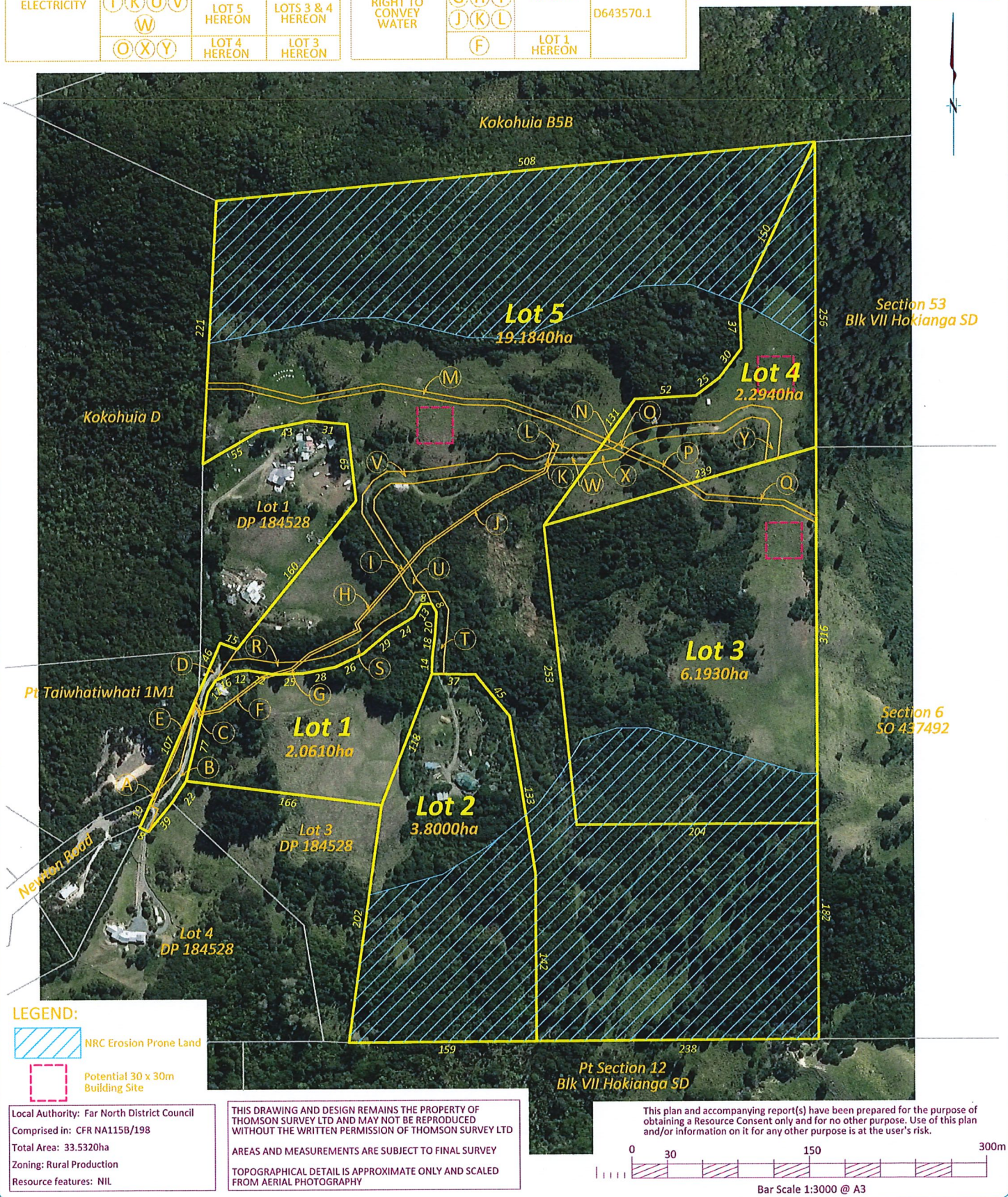
PURPOSE	SHOWN	SERVIENT TENEMENT	DOMINANT TENEMENT
RIGHT OF WAY, TELECOMMUNICATIONS & ELECTRICITY	(A) (B) (C) (D) (G) (R) (S)	LOT 5 HEREON	LOTS 1 - 3 HEREON
	(T)	LOT 5 HEREON	LOT 2 HEREON
	(I) (K) (U) (V) (W)	LOT 5 HEREON	LOTS 3 & 4 HEREON
	(O) (X) (Y)	LOT 4 HEREON	LOT 3 HEREON

EXISTING EASEMENTS

PURPOSE	SHOWN	SERVIENT TENEMENT	CREATED BY
RIGHT OF WAY, TELECOMMUNICATIONS & ELECTRICITY	(A) (B) (C) (D)	LOT 5 HEREON	E.C. 224879.5
RIGHT TO CONVEY WATER	(A) (C) (E) (G) (H) (I) (J) (K) (L)	LOT 5 HEREON	D643570.1
	(F)	LOT 1 HEREON	

EXISTING EASEMENTS IN GROSS

PURPOSE	SHOWN	SERVIENT TENEMENT	CREATED BY
RIGHT TO CONVEY WATER	(M)	LOT 5 HEREON	E.I. 8936241.1
	(N) (O) (P)	LOT 4 HEREON	
	(Q)	LOT 3 HEREON	



LEGEND:

NRC Erosion Prone Land

Potential 30 x 30m Building Site

Local Authority: Far North District Council
Comprised in: CFR NA115B/198
Total Area: 33.5320ha
Zoning: Rural Production
Resource features: NIL

AREAS AND MEASUREMENTS ARE SUBJECT TO FINAL SURVEY

TOPOGRAPHICAL DETAIL IS APPROXIMATE ONLY AND SCALED FROM AERIAL PHOTOGRAPHY

0 30 150 300m

Bar Scale 1:3000 @ A3

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www.tsurvey.co.nz
Registered Land Surveyors, Planners & Land Development Consultants

PROPOSED SUBDIVISION OF LOT 2 DP 184528

PREPARED FOR: Z. TRACEY

	Name	Date
Survey		
Design		
Drawn	KY	02.09.19
Approved		
Rev	KY	28.04.20

ORIGINAL
SCALE 1:3000
SHEET SIZE A3

9554 20200428 Scheme.lcd

Surveyors Ref. No: 9554

Sheet 1 of 1

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	(T)	LOT 5 HEREON	LOT 2 HEREON
	(I)(K)(U)(V)(W)	LOT 5 HEREON	LOTS 3 & 4 HEREON
	(O)(X)(Y)	LOT 4 HEREON	LOT 3 HEREON

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RIGHT TO CONVEY WATER	(A)(C)(E)(G)(H)(I)(J)(K)(L)	LOT 5 HEREON	D643570.1
	(F)	LOT 1 HEREON	

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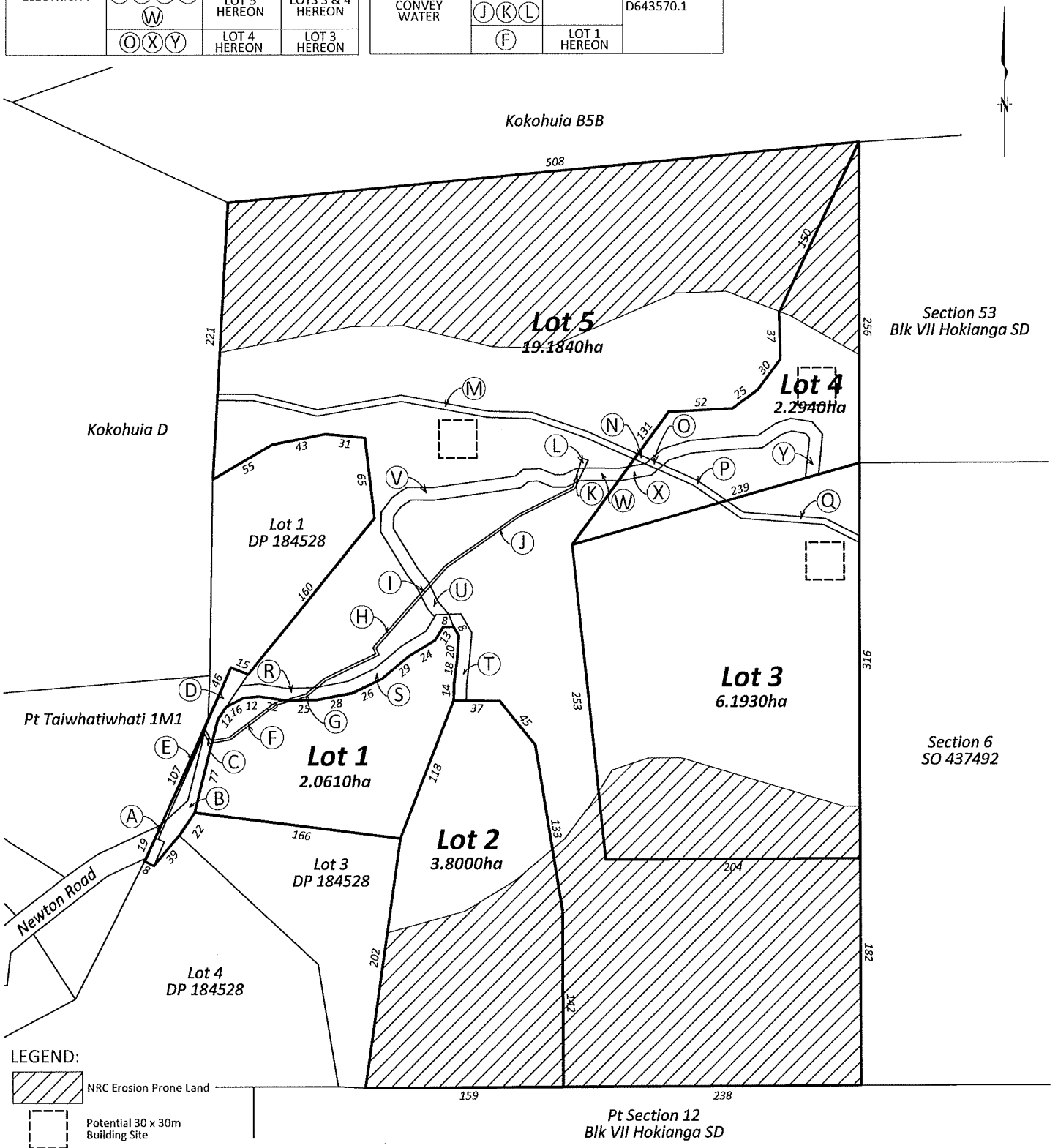
	(Q)	LOT 3 HEREON	



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