GEOTECHNICAL INVESTIGATION REPORT

PROPOSED NEW DWELLING

70 MOUNTAIN ROAD
HENDERSON VALLEY

QUANTUM CONSTRUCTION

Reference: GE305.1

Prepared: 3rd August 2021

Issued to: Bruce Sommerville

bruce@qcl.nz

Issued on: 13th August 2021

Geoconsult, P O Box 302 002, North Harbour, Auckland 0751
P: (09)836 5311 E: info@geoconsult.co.nz, W: www.geoconsult.co.nz

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED NEW DWELLING

70 MOUNTAIN ROAD, HENDERSON VALLEY

QUANTUM CONSTRUCTION

CONTENTS

REPORT: Pages 1 to 13

ATTACHMENTS:

Drawing Numbers: GE305.1/1 and GE305.1/2

Borehole Logs: HA1 to HA4

Slope Stability Analyses: 6 Sheets

1. INTRODUCTION

This report presents the findings of a geotechnical investigation carried out for the proposed new dwelling at 70 Mountain Road, Henderson Valley.

The purpose of our investigation was to assess subsoil conditions, analyse site stability and to provide recommendations for building foundations and the satisfactory development of the property.

This report has been prepared for Quantum Construction in accordance with our proposal letter dated 16th June 2021 and may be used in support of an application to Auckland Council for Resource Consent and/or Building Consent approval in respect of the proposed development as described herein.

2. SITE DESCRIPTION

The subject site (legally described as Lot 27, DP20694) is located on the southern side of Mountain Road accessed by a concrete driveway. It comprises a near rectangular shaped property with an area of 1,905 m^2.

The property slopes moderately down from the southern boundary toward Mountain Road, is currently bush covered and contains a number of medium to large trees.

An existing garage and shed are located at the northern end of the site. Auckland Council GeoMaps indicates that the site is not serviced by public sanitary sewer and stormwater systems.

A site plan is attached, drawing number GE305.1/1.

3. GEOLOGY

The Geological Map of Auckland[1] shows the subject site to be underlain by volcanogenic flysch – grey-brown, alternating, thick-bedded sandstone and thin-bedded mudstone - of the Cornwallis Formation, Waitemata Group of Miocene age. Weathering of these deposits close to the surface typically results in the formation of a mantle of residual soil comprising clays and silts of variable plasticity, with some interbedded sand layers, and typically of firm to very stiff strength.

4. EXISTING GEOTECHNICAL INFORMATION

Geoconsult provided a Geotechnical Investigation Report for "Proposed Dwelling at Lot 27, DP20694 - 70 Mountain Road, Henderson Valley" in March 2013. Three hand auger boreholes were drilled within the area of the proposed building platform and the subsoils encountered in the boreholes were found to comprise very stiff Cornwallis Formation Soils. Groundwater was not encountered in any of the boreholes.

[1] *Edbrooke S.W. (compiler) 2001. Geology of the Auckland Area. Institute of Geological and Nuclear Sciences 1:250 000 Geological Map 3. 1 Sheet + 74p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences limited*

5. PROPOSED DEVELOPMENT

We have been supplied with a set of drawings provided by Quantum Construction, numbered A001-A003 and A101-106, revision 3, reference 214 and dated 20/06/2021. Based on this information we understand that the proposed development will comprise:

- Proposed cut (up to 2.2 m) and fill earthwork to form a level building platform and retaining walls supporting cuts.
- Construction of a two storey lightweight timber frame dwelling on concrete foundations and floor slabs located at the northern area of the site.
- Construction of a timber deck attached to the northern side of the proposed dwelling.

The approximate location of the proposed dwelling is shown on the attached site plan drawing number GE305.1/1.

6. SITE PHOTOGRAPHS

	**Photograph 1:** Looking south toward the existing sloping ground. The proposed dwelling will be located within this area of the site. *Photograph taken: 15/07/2021*
	**Photograph 2:** Looking toward the existing garage from the approximate location of borehole HA4. *Photograph taken: 15/07/2021*

7. SITE INVESTIGATION

Our site investigation work comprised the following:

- A walk over visual appraisal of the site.
- The drilling of four hand auger boreholes to depths of 4.0 m and 5.0 m.
- The conducting of two Scala Penetrometer tests from the base of the boreholes HA2 and HA4.
- The measurement of groundwater levels in the boreholes.
- Installation of a standpipe piezometer to depth of 5.0 m within the location of borehole HA1 and groundwater monitoring over two weeks.
- The measurement of a cross section by tape and clinometer.

The approximate locations of the boreholes are shown on our attached site plan drawing number GE305.1/1. The borehole logs and Scala Penetrometer test results are also attached. The soil descriptions given on the logs are in general accordance with the New Zealand Geotechnical Society's "Field Description of Soil and Rock." The soil shear strength values given on the logs are 'Shear Vane Strengths', factored in accordance with the New Zealand Geotechnical Society Guidelines, not direct readings from the shear vane dial. The groundwater levels were measured following drilling and are indicated on the borehole logs.

The cross section is also attached as drawing number GE305.1/2.

8. SOIL MODEL

8.1 Subsoil Condition

Detailed descriptions of the subsoils encountered in the boreholes are given on the attached borehole logs. The subsoils were generally found to comprise:

- **Topsoil to between 100 mm and 200 mm depth**, overlying:
- **Cornwallis Formation Soils to the termination of all boreholes,** consisting of stiff to very stiff orange brown and pink silts and clays with shear vane strengths generally greater than 90 kPa.

The Scala Penetrometer tests carried out from the base of boreholes HA2 and HA4 indicated progressively greater resistance to penetration with increasing depth. No obvious horizon of hard less weathered material was encountered, and the increasing penetration resistance is inferred to be the result of side adhesion on the scala rod due to the nature of the soils encountered toward the base of the boreholes.

8.2 Groundwater

Groundwater was not encountered in any of the hand auger boreholes during our time on site. One standpipe piezometer was installed within borehole HA1 in the area of the deepest proposed excavation. The standpipe piezometer comprised a 24 mm diameter riser pipe installed to 5.0 m below existing ground level. The standpipe was slotted over the lower 3.5 m and the borehole backfilled with drainage media over this depth. The remainder of the borehole were backfilled and sealed to the ground surface with bentonite. The groundwater levels in the standpipe piezometer were monitored over the two weeks following the date of drilling.

The groundwater levels are summarised below:

Hand auger borehole I.D.	Instrument type	Response zone (b.e.g.l)	Groundwater level reading (below existing ground level)		
			15th July 2021	22nd July 2021	29th July 2021
HA1	Standpipe piezometer	1.5 m to 5.0 m	NGWE	NGWE	NGWE

A relatively deep water level is considered to be representative of typical winter groundwater conditions beneath the site, but groundwater levels may be higher following periods of heavy or prolonged rainfall and/or during wetter winter conditions.

Assessment Against Auckland Unitary Plan Operative – E7:

Clauses		Clause satisfied	Comment
E7.6.1.6	(1) The water take must not be geothermal water.	**Yes**	Site is not located within a geothermal area. **Complies**
	(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.	**Yes**	There are no peat soils onsite. **Complies**
	(3) The water take must only occur during construction.	**Yes**	Water take is not expected during construction. **Complies**
E7.6.1.10 (1)	All of the following activities are exempt from the Standards E7.6.1.10(2) – (6): (a) Pipes cables or tunnels including associated structures which are drilled or thrust and are less than 1.2 m in external diameter; (b) Pipes including associated structures up to 1.5 m in external diameter where a closed faced or earth pressure balanced machine is used; (c) Piles up to 1.5m in external diameter are exempt from these standards; (d) Diversions for no longer than 10 days; or (e) Diversions for network utilities and road network linear trenching activities that are progressively opened, closed and stabilized where the part of the trench that is open at any given time is no longer than 10 days.	**Yes**	Not applicable. **Complies**
E7.6.1.10(2)	Any excavation that extends below natural groundwater level must not exceed: (a) 1 ha in total area; and	**Yes**	Area is well below 1 ha and cut depth is less than 6 m. **Complies**

	(b) 6 m depth below the natural ground level.		
E7.6.1.10(3)	The natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining site.	**Yes**	Groundwater was monitored in winter time using a standpipe piezometer installed at 5.0 m depth. Groundwater was not encountered within the area of deepest cut excavation. We anticipate the natural groundwater level will not be reduced by 2.0 m even during winter season (seasonal high). **Complies**
E7.6.1.10(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: (a) Impede the flow of groundwater over a length of more than 20 m; and (b) extend more than 2 m below the natural groundwater level.	**Yes**	Not applicable. **Complies**
E7.6.1.10(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: (a) Trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation; (b) Tunnel or pipe with an external diameter of 0.2 – 1.5 m that extends below natural groundwater level must be 2m or greater; or (c) A tunnel or pipe with an external diameter of up to 0.2 m that extends below natural groundwater level has no separation requirement.	**Yes**	a) The distance of the proposed cut excavation to the closest neighboring dwelling is approximately 7.0 m from excavation edge on the eastern side of the property which is greater than the maximum cut excavation depth at this area (up to 2.2 m). **Complies** b), c) There are no adjacent tunnels or pipes that extend below the natural groundwater level. **Complies**
E7.6.1.10(6)	The distance from the edge of any excavation that extends below natural groundwater level, must not be less than: (a) 50 m from the Wetland Management Areas Overlay; (b) 10 m from a scheduled Historic Heritage Overlay; (c) 10 m from a lawful groundwater take.	**Yes**	The proposed excavation will not extend below natural groundwater. **Complies**

It is unlikely that the groundwater will rise to within the proposed excavation depths during worst case seasonal high groundwater conditions and even less so over the relatively short duration of the construction period. Based on our assessment against the Auckland Unitary Plan Operative - E7, we

consider that the likely extent of excavation required for the proposed development meets the permitted activity standards.

An Auckland Council Resource Consent for groundwater take or groundwater diversion is not required

9. LABORATORY TESTING

During our site investigation, soil samples were collected from hand auger borehole HA3 at between 0.5 m and 1.0 m depth. These samples were tested for Atterberg Limits and Linear Shrinkage, in accordance with NZS4402:1986, to assess the expansive soil classification for the site.

The results of the laboratory tests are as follow:

Natural Water Content (%)	**Liquid Limit** (%)	**Plastic Limit** (%)	**Plasticity Index** (%)	**Linear Shrinkage** (%)
75	130	53	77	25

Based on Unified Soil Classification System (USCS) the soil is classified as MH - SILT, high liquid limit.

NZS 3604:2011 states that expansive soils are those with a liquid limit more than 50% when tested in accordance with NZS4402 Test 2.2, and a linear shrinkage more than 15% when tested in accordance with NZS4402 Test 2.6 and are therefore excluded from the "Good Ground" definition. Based on the values of the liquid limit and linear shrinkage for the subject site, the subsoils at this site are considered to be outside the criteria of "Good Ground" given in NZS3604:2011.

Based on the laboratory testing results, and with reference to site expansivity classification by BRANZ 2008 and MBIE for the New Zealand Building Code B1 Structure, November 2019, the subsoils at this site are considered to be classified as moderately to highly expansive.

Due to the presence of tress on the building site or adjacent site which remains in place in close proximity to proposed dwelling, removal of some trees prior to or after construction and potential shrink-swell effects due to the tree roots it is recommended that a subsoil classification of ***"Highly Expansive - H"*** is adopted for the subject site. Based on the MBIE highly expansive soils have an I_{SS} range of 3.8% to 6.5% and a 500 year design characteristic surface movement return (y_s) of 45 mm to 78 mm.

10. SITE STABILITY

The site shows no obvious visual signs indicating past or presently active instability. However, due to gradients exceeding 1 vertical in 4 horizontal, slope stability analyses were carried out to assess the stability of the site.

Two stability scenarios were considered as outlined below:

- Normal groundwater conditions – an assumed deeper ground water level based on the depths measured during our site investigation.
- Elevated groundwater conditions – a higher groundwater level assumed to be possible during wetter winter conditions following periods of heavy and/or prolonged rainfall.
- Seismic with estimated groundwater conditions and undrained conditions – Seismic loading conditions with 150 year event with our estimated groundwater conditions. (Seismic load coefficient calculated from NZS1170.5 Structural Design Actions, Part 5).

The slope stability analyses were conducted along our cross section A-A', measured through the site, using limited equilibrium software "Slide" version 6 by Rocscience.

The following soil parameters were assumed:

Soil Unit	Cohesion (c')	Soil Unit Weight (γb)	Angle of Internal Friction (ϕ')
Very Stiff Residual Soils	5 kPa	18 kN/m3	30^o

The results of the slope stability analyses are as follows:

Under assumed normal and elevated groundwater conditions and seismic loading conditions for both existing and proposed ground levels the site was assessed to have a minimum factor of safety of greater than 1.5, 1.3 and 1.2 required, respectively.

The stability analyses summary sheets for both groundwater conditions and seismic loading condition are attached.

Based on the results of our analyses, and provided that the recommendations outlined in this report are followed, we consider the site to be currently stable and generally suitable for construction of the proposed new dwelling. It is also considered that the proposed development is unlikely to adversely affect the existing stability of the site provided that the recommendations outlined in this report are followed.

11. RECOMMENDATIONS

11.1 Earthworks

11.1.1 Topsoil, Fill and Unsuitable Soils

All vegetation, topsoil, fill and any soft or otherwise unsuitable material should be removed from the building platform or earthworks area. The topsoil layer was found to depths of 100 mm to 200 mm at our test locations, but depths may vary elsewhere across the property. No fill or otherwise unsuitable soils were encountered in any of our boreholes but there may be deposits outside of our test locations.

If any part of the proposed dwelling such as proposed timber deck is to be constructed on a timber floor supported on timber piles, the existing topsoil and fill may remain in place to that area provided that all surface vegetation has been removed, the required sub floor clearance is provided, and the piles are embedded to the required minimum depths as discussed in the foundations section below.

All excavated topsoil and unsuitable material should be removed from site or stockpiled away from the building platform and/or earthworks area and clear of the steeper site slopes.

11.1.2 Site Excavation

Site excavation into the sloping land toward the southern part of the proposed building platform is required to form the building platform for the proposed new dwelling. The excavation is indicated to be up to approximately 2.2 m maximum depth in the southern side of the proposed building platform but is more typically between approximately 0.5 m and 1.5 m in height across the balance of the cut faces.

Boreholes HA1 and HA2 were drilled in the proximity of the proposed cut faces. These boreholes all encountered very stiff Cornwallis Formation soils over the proposed excavation depth and groundwater was encountered to be at a depth of greater than 5.0 m below the proposed excavated level. These deposits are considered to be relatively stable and not expected to be especially problematic within the typically modest cut depths.

In addition, the dwellings and other structures at number 68 and 74 Mountain Road, to the east and west respectively, are located well outside the 45 degree zone of influence from the base of the proposed excavations and are not considered to be at significant risk as a result of the proposed earthworks.

However, due to the close proximity of the proposed platform excavation to the property boundaries, caution should be exercised during site excavation works, particularly in the eastern part of the property where the excavation depths will be the greatest.

It is recommended that bulk excavation to form the building platforms is carried out stopping short of the boundaries with the cut faces formed at stable batter slopes, approximately 1 vertical in 1 horizontal is considered appropriate for temporary batters. The final excavation can then be carried out in a staged manner, initially in the presence of a geotechnical engineer, to form vertical cut faces with the retaining walls constructed in short stages with near full height retaining being completed prior to commencement of the next stage of the excavation and retaining wall construction.

To further help ensure that no cut face failure occurs, site earthworks and retaining wall construction should be carried out during a forecast period of fine weather only. The earthworks and retaining should involve final boundary excavation, installation of cut face protection and retaining wall construction being carried out in one continuous operation. Installation of drains and drainage media backfill to the walls should be completed as soon as possible following final vertical boundary excavation.

Groundwater was encountered well below the proposed excavation level, and we consider that the proposed earthworks will not affect the existing groundwater level or result in settlement of the neighbouring properties due to groundwater drawdown.

Provided the above recommendations are followed we anticipate no adverse effects on neighbouring properties as a result of the proposed site excavation.

11.1.3 Fills

The subsoils beneath the topsoil at this site should perform well as fill in cut to fill earthworks, provided that normal clay fill earthworks practice is exercised, and moisture conditioning undertaken where necessary.

In the area of the proposed building platform the groundwater was encountered well beneath the proposed cut depths so should not be problematic in earthworks operations.

All clay fill should be compacted in horizontal layers, of no greater than 250 mm thickness, placed on benched ground using a heavy pad-foot roller to achieve a minimum undrained shear strength of 130 kPa and a maximum 10 % air voids. It should be noted that if earthworks are carried out during winter or wet weather conditions higher soil water contents can be expected which is likely to affect the success of the earthworks. It is advisable that any clay fill earthworks be carried out during summer months and/or during an extended period of fine weather.

Fill batters less than 1.2 m in vertical height can be formed at gradients no steeper than 1V:2H with fill batters greater than 1.2 m in vertical height formed at gradients no steeper than 1V:3H. If batter slopes greater than the above recommendations are required retaining walls should be used. Fills of any height that are to be subject to surcharge loading of any sort should be supported using specifically designed retaining walls or battered to a suitable slope angle subject to specific geotechnical design recommendations.

Design recommendations for retaining walls are outlined in the Retaining Walls section below.

11.2 Foundations

11.2.1 General

The subsoils at this site were found to comprise stiff to very stiff natural soils. The soils have adequate bearing capacity, are of relatively low compressibility and are considered suitable foundation soils for the proposed new dwelling. They are however considered to be *highly expansive* and are therefore outside the criteria for "Good Ground" given in NZS3604:2011.

Two design zones are determined for the foundations for the proposed new dwelling as shown in our site plan drawing number GE305.1/1.

ZONE A:

Shallow foundations are considered to be generally appropriate for **Zone A**, however, foundation depths should allow for the ***highly expansive*** nature of the soils. Alternatively, a waffle raft floor slab will require specific structural design to allow for the expansive nature of the soils.

Specific recommendations are outlined below.

ZONE B:

Due to the moderately steep nature of part of the site within the northern area of the proposed new dwelling and deck, we recommend that the foundations be piled for **Zone B**.

Specific recommendations are outlined below.

11.2.2 Shallow Footings - ZONE A

Conventional shallow pad and strip footings, generally in accordance with the requirements of NZS3604:2011, should be embedded a minimum depth of **900 mm** below cleared ground level into stiff natural soils.

The following bearing capacities are considered appropriate for foundation design:

Ultimate Bearing Capacity	300 kPa
Allowable Bearing Pressure (F.O.S = 3)	100 kPa
Dependable Bearing Capacity (Φ = 0.5)	150 kPa

11.2.3 Waffle Raft Slabs - ZONE A

Waffle raft slabs should be designed for ***highly expansive*** soils in accordance with the requirements of AS2870:2011.

The following bearing capacities are considered appropriate for raft floor slab design:

Ultimate Bearing Capacity	300 kPa
Allowable Bearing Pressure (F.O.S = 3)	100 kPa
Dependable Bearing Capacity (Φ = 0.5)	150 kPa

11.2.4 Pile Foundations - ZONE B

Due to the moderately steep nature of part of the site within the northern area of the proposed new dwelling and deck, we recommend that the foundations be piled for **Zone B**.

Either bored and cast in situ reinforced concrete piles, bored and concrete encased timber piles or driven timber piles would be suitable. Driven piles should be installed to an appropriate driving set as determined by the Hiley Formula.

Piles should be embedded a minimum depth of 3.0 m below final ground level and at least 1.0 m below any fill into stiff natural ground. Greater pile depths may be required to satisfy structural design considerations.

The following soil parameters are considered appropriate for axial load design purposes:

	End Bearing	Side Adhesion*
Ultimate Capacity	810 kPa	30 kPa
Allowable Stress (F.O.S. = 3)	270 kPa	10 kPa
Dependable Capacity (Φ = 0.5)	405 kPa	15 kPa

** Side adhesion should be ignored over any portion of the pile shaft passing through fill and over the upper 1.5 m below ground level whichever is the greater depth.*

The piles should also be designed to resist lateral earth pressure over the upper 1.5 m below the ground surface. The magnitude of lateral loading acting on each pile should be calculated assuming at rest earth pressures over a width of 3 times the pile diameter to a depth of 1.5 m using a coefficient of lateral earth pressure Ko = 0.5 and a soil unit weight of 18 kN/m^3. Passive resistance in front of the piles below 1.5 m depth can be calculated using Broms method with a soil undrained shear strength C_u = 90 kPa.

The subsoils encountered beneath the site were found to comprise stiff or very stiff natural soils beneath a surficial layer of unsuitable topsoil/fill. These materials are likely to be relatively stable during pile hole drilling, but foundation contractors should, as a precaution, make allowance for potential pile hole collapse during construction. Pile construction should be carried out so that bored pile holes are not left open for longer than necessary, especially where groundwater is encountered within the bored pile depth.

11.2.5 Floor Slab

Either a conventional slab on grade concrete floor, in accordance with the requirements of NZS3604:2011, or a waffle raft slab designed for highly expansive soils in accordance with the requirements of AS2870:2011 is considered appropriate.

A conventional slab on grade should be founded on a layer of clean, well graded, compacted hardfill placed on ground stripped of vegetation, topsoil, fill and any soft or otherwise unsuitable material. The hardfill should be compacted using a vibrating plate compactor or roller and topped with a blinding layer of sand or other approved fines.

Care should be taken in the preparation of the slab subgrade so that the soil does not dry out or become excessively wet prior to pouring of the floor slab. In this respect some moisture conditioning or protection of the subgrade may be required prior to placing hardfill and/or pouring the slab.

If fill or otherwise unsuitable material is encountered beneath the floor slab the unsuitable soils can be removed and replaced with well compacted GAP65 hardfill or alternatively the floor slab can also be supported on piles over the unsuitable material.

11.3 Retaining Walls

Where required, retaining walls should be provided to support cut or fill faces. Free standing cantilever walls can be designed for active earth pressures, walls that are incorporated within the structure of the dwelling should be designed for at rest earth pressures

The following soil parameters are considered appropriate for retaining wall design:

Cohesion (c')	0 kPa
Angle of Internal Friction (ϕ')	30°
Soil Unit Weight (γ)	18 kN/m^3

For timber pole walls an undrained shear strength C_u = 90 kPa can be assumed for the soil in front of the poles when calculating lateral soil resistance.

For masonry block cantilever walls and gravity walls the foundation bearing capacity may be calculated using the above soil parameters and an unfactored soil shear strength C_u = 90 kPa.

When calculating sliding resistance an undrained shear strength of C_u = 90 kPa can be assumed for the soil at the base of the wall. This should be reduced by an adhesion factor of 0.5, giving a geotechnical ultimate base adhesion of 45 kPa. These values should be reduced by a factor of 0.5 for limit state design.

The effects of sloping ground above and/or below the walls should be considered in wall design along with boundary and any other surcharges that may apply. Walls of any height which carry any type of surcharge load will require specific structural design and a building consent.

Free draining granular backfill and a perforated drain coil should be provided behind all retaining walls. Retaining walls should be constructed as soon as possible following excavation of steep site cuts. Steep cut faces left unprotected may be detrimental to the stability of the site and neighbouring sections.

11.4 Seismic Subsoil Classification

The sites subsoil classification has been assessed based on our site investigation results and the known geology of the area, in accordance with New Zealand Standard for Structural Design Actions NZS1170.5:2004. The site subsoil classification is considered to be Class C - shallow soil sites.

11.5 Specific Structural Design

A suitably qualified structural engineer, familiar with the contents of this report, should be engaged to design the retaining walls, foundations, piles and floor slab for the proposed dwelling.

11.6 Vegetation

Vegetation should be maintained as much as possible or further planted over the steeper slopes after completion of the development works. Vegetation reduces surface water and groundwater effects and assists in maintaining slope stability through root binding action.

11.7 Stormwater Control

Stormwater from paved areas, roofs, tank overflows and all other sources should be collected in sealed pipes and discharged to a safe disposal point away from the development area with an energy dissipater fitted at its outlet. Concentrated stormwater flows should not be allowed to discharge onto or into the ground close to the dwelling or on sloping ground as this would be detrimental to foundation conditions and site stability.

A specific stormwater disposal assessment would be required for this site.

11.8 Wastewater

A specific on-site wastewater disposal assessment would be required for this site.

11.9 Site Inspections during Construction

It is recommended that Geoconsult is engaged to inspect earthworks, foundation excavations and retaining wall excavations during construction. This is to confirm expected ground conditions and to ensure compliance with the recommendations contained in this report.

Council is likely to require geotechnical inspections during construction, and receipt of a Producer Statement - Geotechnical Review (PS4), as a condition of Building Consent.

It is the Client's responsibility to ensure that we are notified of any required inspections and that we are given adequate notice to carry out the inspections (at least 24 hours).

We will issue a Producer Statement - Geotechnical Review (PS4) upon successful completion of the inspected works. The inspections and preparation of the Producer Statement will be at additional cost to that of preparing this report.

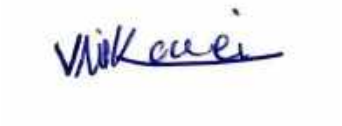
If driven timber piles are to be used your structural engineer should be engaged to carry out inspections of the pile driving operations, record driving sets, and to provide appropriate as built certification.

12. LIMITATIONS

The recommendations and opinions contained in this report are based on the subsoils encountered at discrete test locations. We have made assumptions about the nature of the ground conditions across the site based on this limited subsoil information and actual ground conditions may vary from those assumed in this report. If any variations from the assumed ground conditions are found to exist during construction the matter should be referred back to Geoconsult.

This report has been prepared solely for the benefit of Quantum Construction as our client and their nominated agents for the purposes of the specific brief as stated in this report. Geoconsult accepts no liability in respect to any matters arising from the use of the information given in this report by any other person or organisation or for any other purpose except that it may be relied upon by Auckland Council in support of an application for Resource Consent and/or Building Consent approval for the proposed development as described herein.

GEOCONSULT

Author:	**Vahid Nikouei** **Geotechnical Engineer**	**Signed:**	
Reviewed:	**Kevin Pearson** **Senior Geotechnical Engineer**	**Signed:**	
Authorised:	**Phil Williams** **Geotechnical Team Leader**	**Signed:**	

Notes:

1. LOCATIONS OF ALL FEATURES ARE APPROXIMATE ONLY.
2. THIS DRAWING IS BASED ON AUCKLAND COUNCIL GIS PHOTOGRAPHY AND A SITE PLAN PROVIDED BY QUANTUM CONSTRUCTION, DRAWING NUMBER A001, REVISION 3, ISSUE NUMBER 214 AND DATED 20/06/2021.
3. DRAWING NOT TO BE USED FOR CONSTRUCTION PURPOSES.

Key:

- HAND AUGER BOREHOLE LOCATION
- STANDPIPE PIEZOMETER LOCATION
- CROSS SECTION
- PROPOSED DWELLING - ZONE A SHALLOW FOUNDATION REFER TO REPORT SECTION 11.2
- PROPOSED DWELLING - ZONE B PILE FOUNDATION REFER TO REPORT SECTION 11.2

REV:	DESCRIPTION:	BY:	DATE:
-	-	-	-

STATUS: NOT FOR CONSTRUCTION

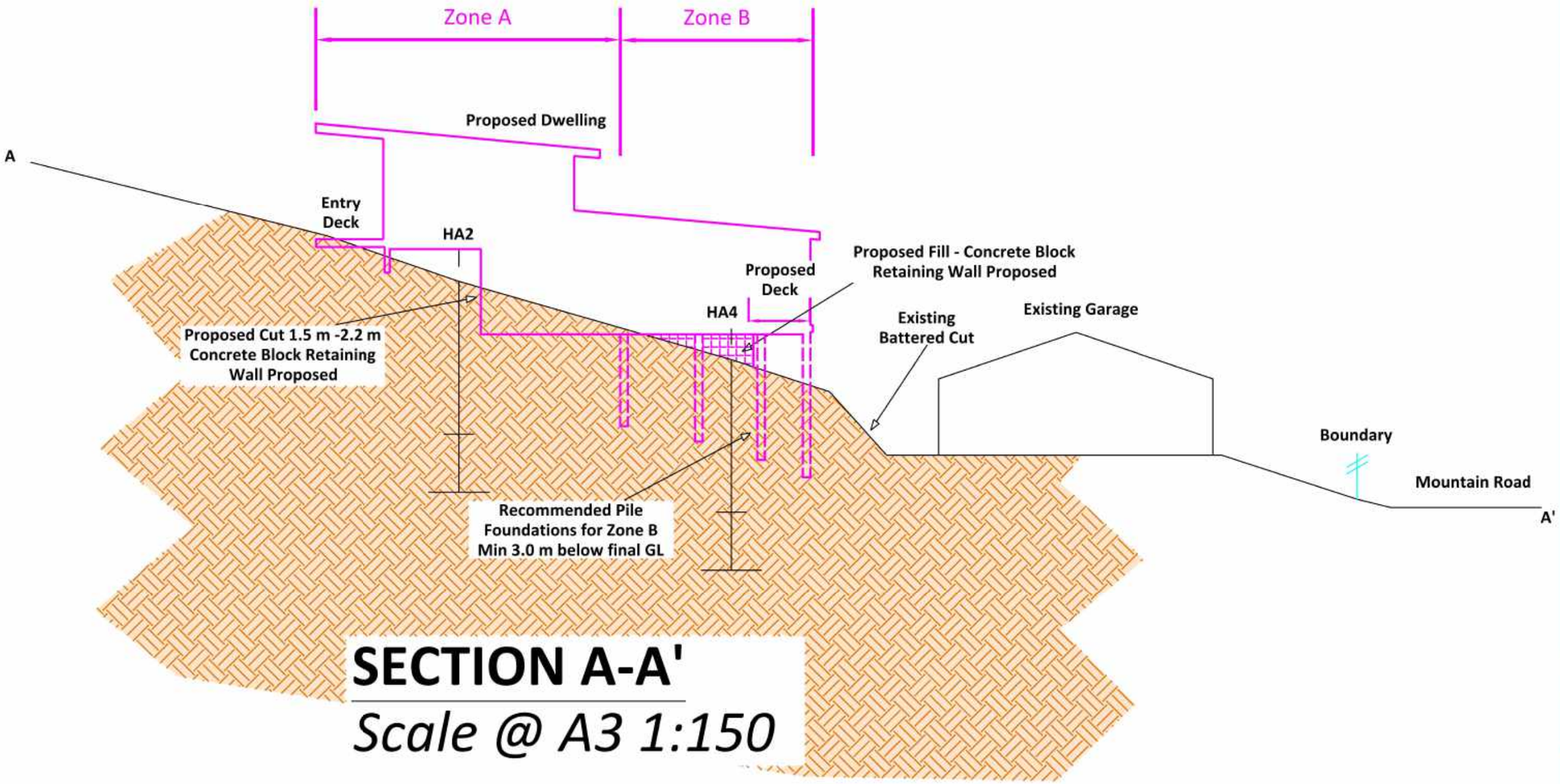
GEOCONSULT
2 PIERMARK DRIVE, ROSEDALE, AUCKLAND
PO BOX 302002, NORTH HARBOUR, AUCKLAND 0751
P: 09 836 5311 W: www.geoconsult.co.nz

PROJECT: BRUCE SOMMERVILLE PROPOSED BUILDING DEVELOPMENT

SITE: 70 MOUNTAIN ROAD HENDERSON VALLEY

TITLE: SITE PLAN

SCALE AT A3:	DATE:	DRAWN:	CHECKED:
1 : 250	JULY 2021	VN	PW
SHEET NO:	DRAWING NO:		REVISION:
1 OF 1	GE305.1/1		-



SECTION A-A'

Scale @ A3 1:150

Notes:

1. THIS DRAWING IS BASED ON A TAPE AND CLINOMETER SURVEY AND IS APPROXIMATE ONLY.
2. THE SUBSOIL PROFILE HAS BEEN INFERRED FROM THE BOREHOLE INFORMATION, ACTUAL CONDITIONS MAY VARY DUE TO THE INHERENT VARIABILITY OF SOIL DEPOSITS.
3. DRAWING NOT TO BE USED FOR CONSTRUCTION PURPOSES.

Key:

VERY STIFF RESIDUAL SOILS
CORNWALLIS FORMATION

REV:	DESCRIPTION:	BY:	DATE:
-	-	-	-

STATUS: NOT FOR CONSTRUCTION

GEOCONSULT
2 PIERMARK DRIVE, ROSEDALE, AUCKLAND
PO BOX 302002, NORTH HARBOUR, AUCKLAND 0751
P: 09 836 5311 W: www.geoconsult.co.nz

PROJECT: BRUCE SOMMERVILLE PROPOSED BUILDING DEVELOPMENT

SITE: 70 MOUNTAIN ROAD HENDERSON VALLEY

TITLE: CROSS SECTION A-A'

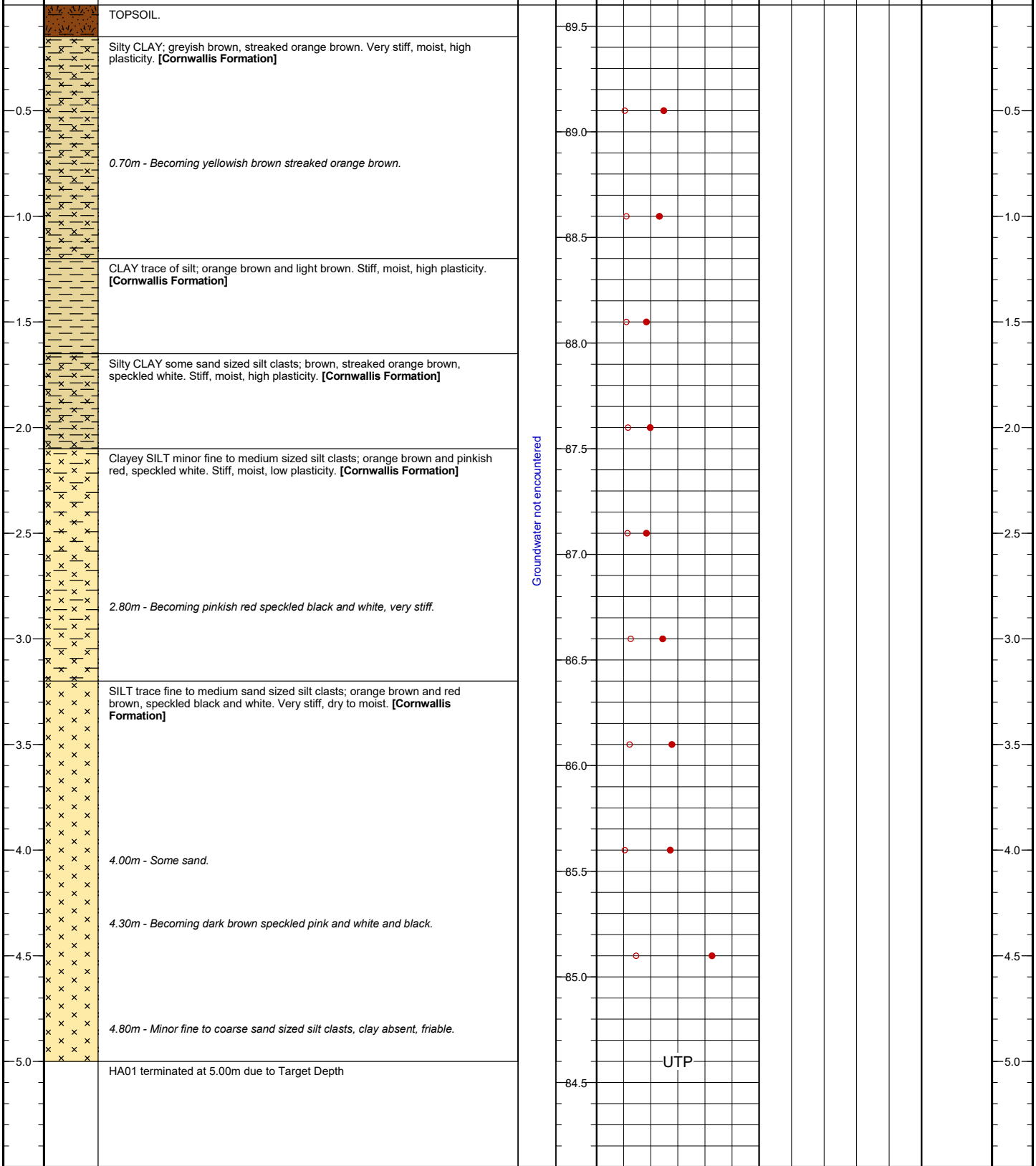
SCALE AT A3:	DATE:	DRAWN:	CHECKED:
1 : 150	JULY 2021	VN	PW

SHEET NO:	DRAWING NO:	REVISION:
2 OF 2	GE305.1/2	-

HAND AUGER LOG

Geoconsult GEOTECHNICAL CONSULTANTS

GROUND INVESTIGATION



Project: 70 Mountain Road	**NZTM N,E (m):** 5915057.78, 1739527.16	**Logged By:** BT (15/07/2021)	**Hand Auger Number:**
	Location Method: GIS\Web map viewer	**Checked By:** ROT (2/08/2021)	**HA01**
Location: Henderson Valley, Auckland	**Elevation (m):** 89.60	**Client Ref:** GE305	
	Final Depth (m): 5.00	**G.I. Job Ref:** 210913	

Comments:

HAND AUGER LOG

Geoconsult GEOTECHNICAL CONSULTANTS

GROUND INVESTIGATION

Depth (m)	Description
0.0	TOPSOIL.
	Clayey SILT; dark brown. Stiff, moist, low plasticity. **[Cornwallis Formation]**
	0.40m - Becoming light brown mottled black.
	0.60m - Becoming streaked dark orange, black absent.
	1.00m - Speckled white, streaked pinkish grey.
	1.20m - Becoming pinkish brown speckled white streaked light brown.
	1.60m - Some fine to medium sand sized silt clasts.
2.0	SILT some clay, some fine to medium sand sized silt clasts; pinkish brown, speckled white. Stiff, moist. **[Cornwallis Formation]**
2.5	Sandy SILT; pinkish grey, speckled light brown and white. Stiff, moist. **[Cornwallis Formation]**
3.0	SILT, some clay; pinkish orange, speckled white. Stiff, moist. The sand is fine grained. **[Cornwallis Formation]**
	3.10m - Some fine to medium sand.
	3.80m - Becoming orange pink.
	3.90m - Some clay.
5.0	Silty SAND; pinkish orange, streaked orange brown. Dry, poorly graded. **[Cornwallis Formation]**

Water Level: Groundwater not encountered

Vane Shear Strength, s_u (kPa): 50, 100, 150, 200, 250

Scala Penetration (Blows/ 50mm): 4, 8, 12, 16

Installation: UTP (at 86.0, 85.0, 84.5)

Elevation (m): 89.0, 88.5, 88.0, 87.5, 87.0, 86.5, 86.0, 85.5, 85.0, 84.5, 84.0

Project: 70 Mountain Road	**NZTM N,E (m):** 5915059.37, 1739517.55	**Logged By:** CR (15/07/2021)	**Hand Auger Number:**
	Location Method: GIS\Web map viewer	**Checked By:** ROT (2/08/2021)	**HA02**
Location: Henderson Valley, Auckland	**Elevation (m):** 89.40	**Client Ref:** GE305	
	Final Depth (m): 6.90	**G.I. Job Ref:** 210913	

Comments:

HAND AUGER LOG

Geoconsult GEOTECHNICAL CONSULTANTS

GROUND INVESTIGATION

Depth, (m)	Profile	Description	Water Level	Elevation, (m)	Vane Shear Strength, s_u (kPa)	Scala Penetration (Blows/ 50mm)	Installation	Depth, (m)
6.0				83.5	50 100 150 200 250	4 8 12 16		6.0
6.5				83.0				6.5
7.0		HA02 terminated at 6.90m due to Target Depth		82.5				7.0
7.5				82.0				7.5
8.0				81.5				8.0
8.5				81.0				8.5
9.0				80.5				9.0
9.5				80.0				9.5
10.0				79.5				10.0
10.5				79.0				10.5
				78.5				

Project: 70 Mountain Road

Location: Henderson Valley, Auckland

NZTM N,E (m): 5915059.37, 1739517.55

Location Method: GIS\Web map viewer

Elevation (m): 89.40

Final Depth (m): 6.90

Logged By: CR (15/07/2021)

Checked By: ROT (2/08/2021)

Client Ref: GE305

G.I. Job Ref: 210913

Hand Auger Number:

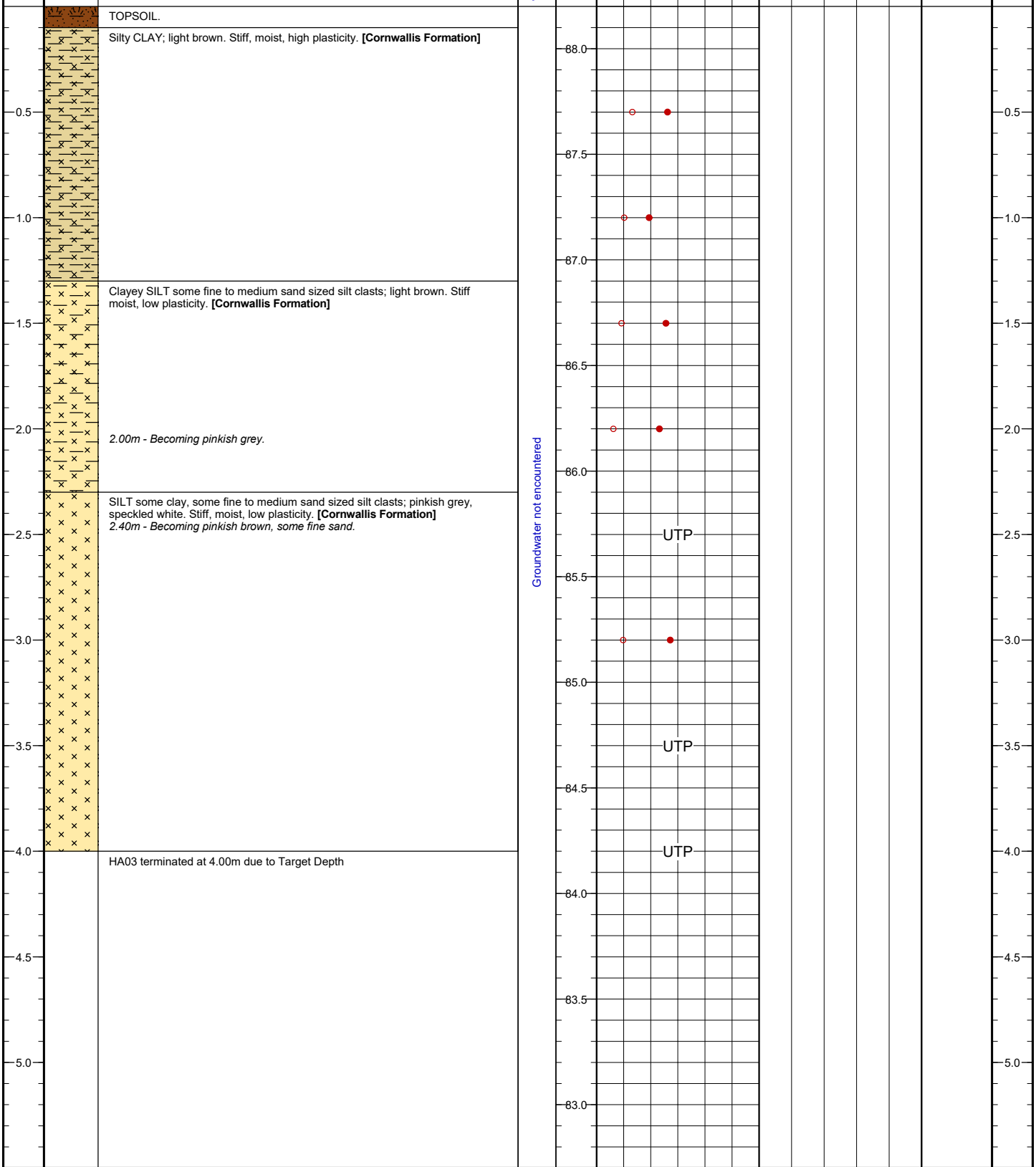
HA02

Comments:

HAND AUGER LOG

Geoconsult GEOTECHNICAL CONSULTANTS

GROUND INVESTIGATION



Project: 70 Mountain Road	**NZTM N,E (m):** 5915062.55, 1739526.41	**Logged By:** CR (15/07/2021)	**Hand Auger Number:**
	Location Method: GIS\Web map viewer	**Checked By:** ROT (2/08/2021)	**HA03**
Location: Henderson Valley, Auckland	**Elevation (m):** 88.20	**Client Ref:** GE305	
	Final Depth (m): 4.00	**G.I. Job Ref:** 210913	

Comments:

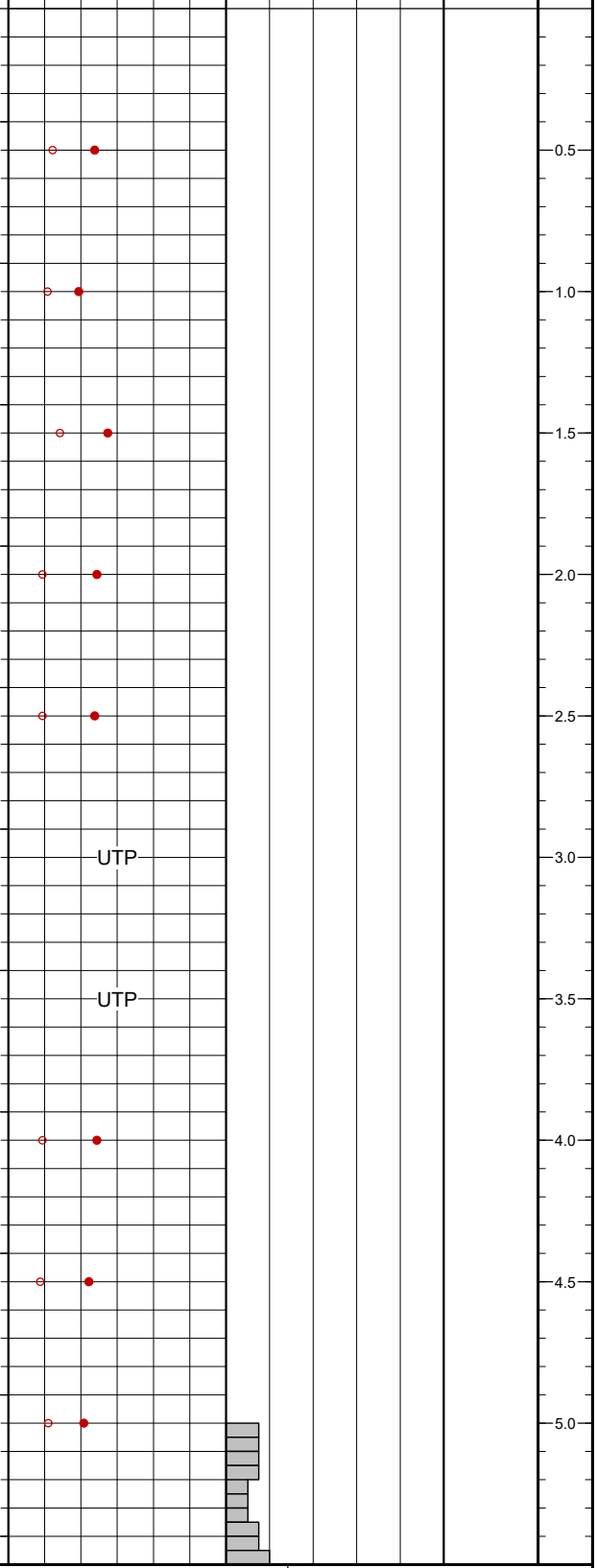
Geoconsult GEOTECHNICAL CONSULTANTS

HAND AUGER LOG

GROUND INVESTIGATION

Depth, (m)	Description
0.0	TOPSOIL.
0.5	Clayey SILT; light brown, streaked orange brown. Stiff, moist, high plasticity. Trace rootlets. **[Cornwallis Formation]**
0.9	*0.90m - Trace organics.*
1.0	Clayey SILT minor fine sand; light brown, streaked orange brown, speckled white. Stiff, moist, low plasticity. Trace rootlets. **[Cornwallis Formation]**
1.5	*1.50m - Becoming orange brown, streaked light grey and pinkish red.*
1.7	SILT some clay, trace fine sand; pinkish red mottled light grey. Stiff, moist. **[Cornwallis Formation]**
2.0	*2.00m - Becoming pinkish red mottled grey, speckled white, fine to medium sand sized silt clasts.*
2.8	*2.80m - Becoming pinkish red mottled grey and speckled white. Trace organics.*
3.0	*3.00m - Minor clay, some fine sand sized silt clasts, trace fine sand.*
3.8	*3.80m - Becoming brownish pink, streaked grey, silt clasts absent.*
4.0	*4.00m - Minor fine sand.*
4.4	*4.40m - Some fine sand.*
5.0	

Groundwater not encountered

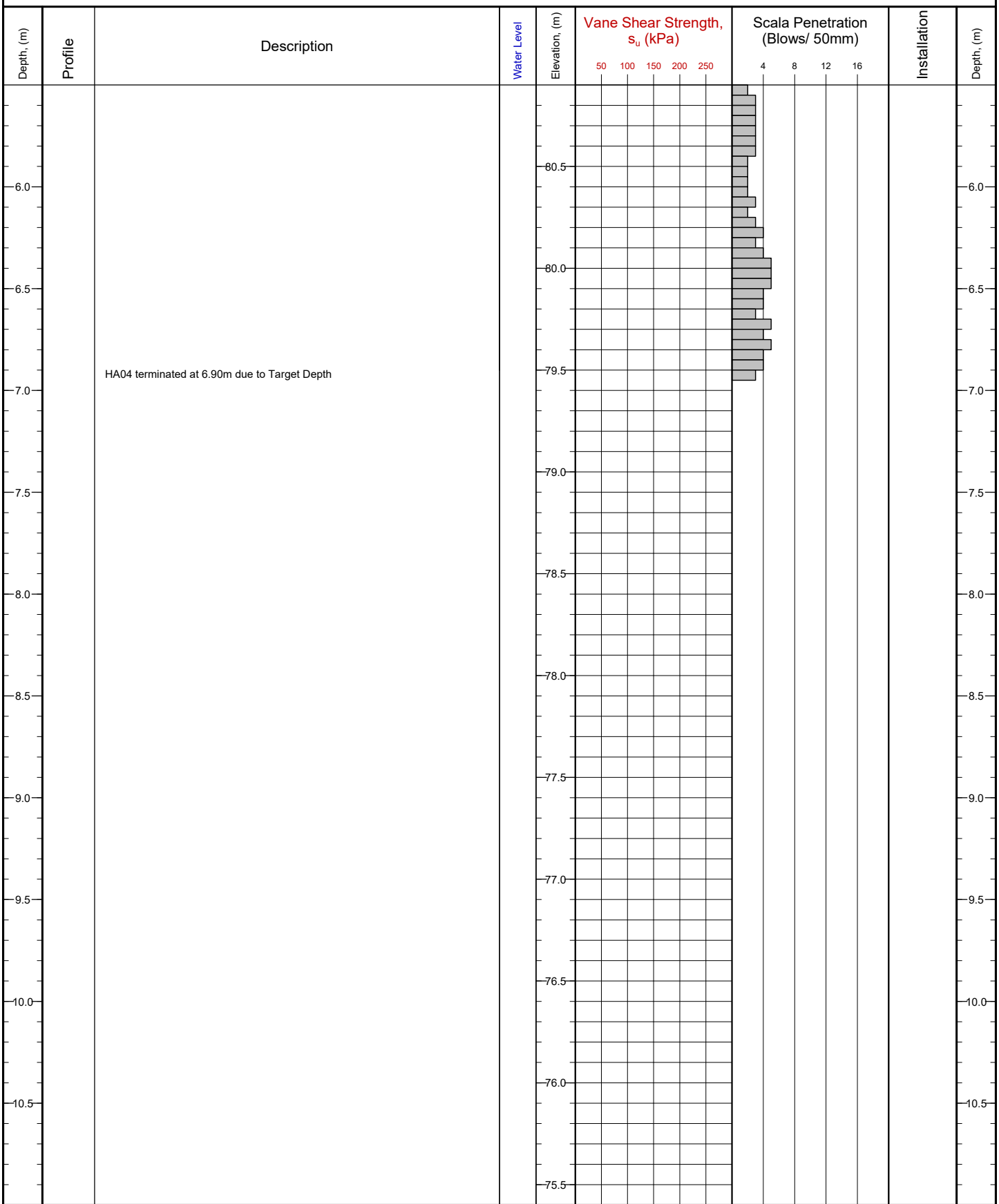


Installation

Project: 70 Mountain Road	**NZTM N,E (m):** 5915066.19, 1739516.69	**Logged By:** MA (15/07/2021)	**Hand Auger Number:**
	Location Method: GIS\Web map viewer	**Checked By:** ROT (2/08/2021)	**HA04**
Location: Henderson Valley, Auckland	**Elevation (m):** 86.40	**Client Ref:** GE305	
	Final Depth (m): 6.90	**G.I. Job Ref:** 210913	

Comments:

HAND AUGER LOG



Project: 70 Mountain Road	**NZTM N,E (m):** 5915066.19, 1739516.69	**Logged By:** MA (15/07/2021)	**Hand Auger Number:**
	Location Method: GIS\Web map viewer	**Checked By:** ROT (2/08/2021)	**HA04**
Location: Henderson Valley, Auckland	**Elevation (m):** 86.40	**Client Ref:** GE305	
	Final Depth (m): 6.90	**G.I. Job Ref:** 210913	

Comments:

Geoconsult GEOTECHNICAL CONSULTANTS

INDEX TESTING SUMMARY

GROUND INVESTIGATION

Borehole Number	Testing Depth, (m)	SHEAR STRENGTH TESTING				LABORATORY TESTING					Remarks
		Pocket Penetrometer, (kPa)	Hand Shear Vane			Natural Moisture Content, (%)	Atterberg Limits			Linear Shrinkage, (%)	
			Peak, (kPa)	Remoulded, (kPa)	Sensitivity		Liquid Limit, (%)	Plastic Limit, (%)	Plasticty Index		
HA01	0.50		124	52	2.38						
HA01	1.00		116	55	2.11						
HA01	1.50		92	55	1.67						
HA01	2.00		99	58	1.71						
HA01	2.50		92	57	1.61						
HA01	3.00		122	63	1.94						
HA01	3.50		139	61	2.28						
HA01	4.00		136	52	2.62						
HA01	4.50		213	73	2.92						
HA01	5.00		UTP								
HA02	0.50		128	59	2.17						
HA02	1.00		148	82	1.80						
HA02	1.50		139	43	3.23						
HA02	2.00		146	48	3.04						
HA02	2.50		164	44	3.73						
HA02	3.00		169	64	2.64						
HA02	3.50		UTP								
HA02	4.00		103	38	2.71						
HA02	4.50		UTP								
HA02	5.00		UTP								
HA03	0.50		131	66	1.98						
HA03	0.75					75	130	53	77	25	
HA03	1.00		97	51	1.90						
HA03	1.50		128	46	2.78						
HA03	2.00		116	31	3.74						
HA03	2.50		UTP								
HA03	3.00		136	49	2.78						

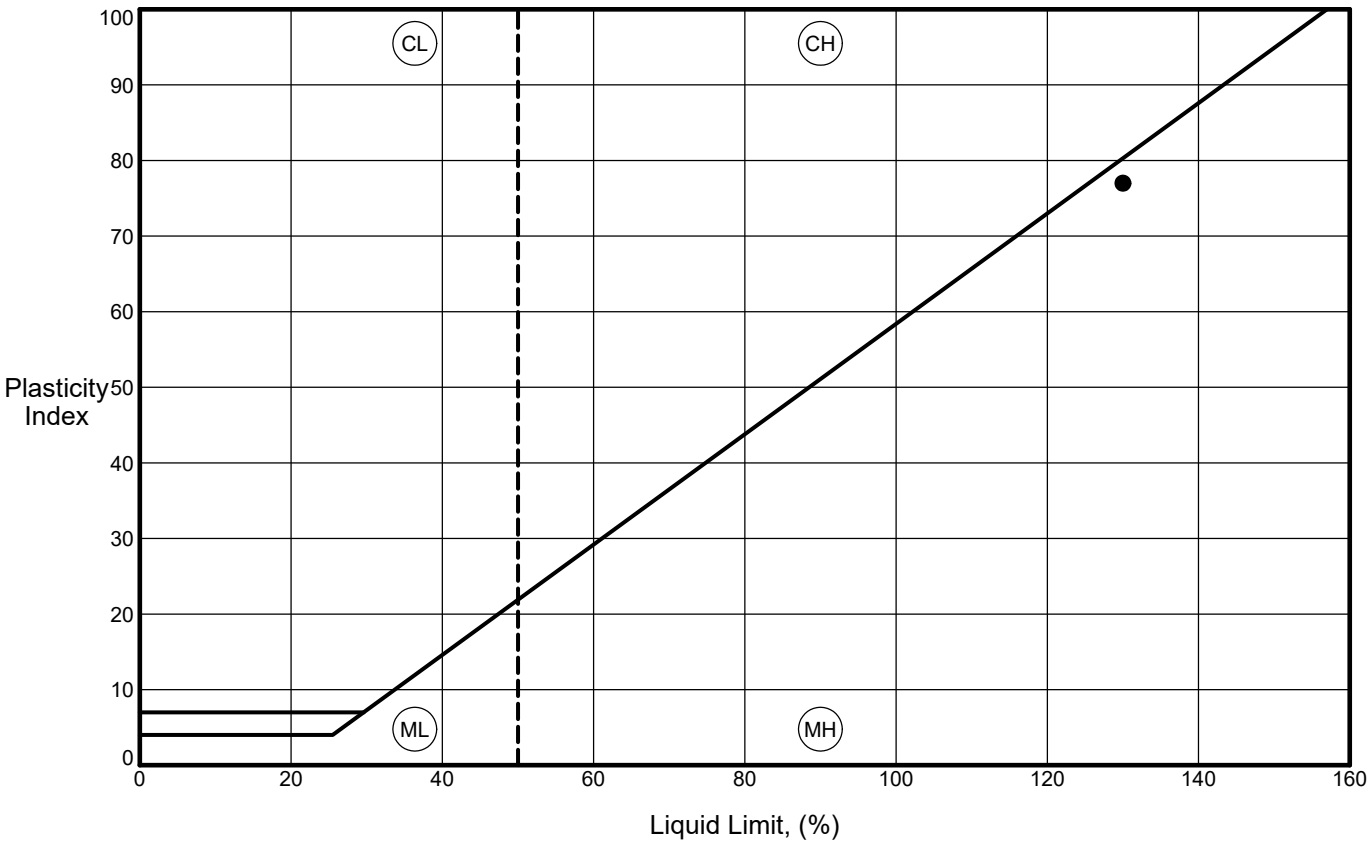
Location: Henderson Valley, Auckland
Client: Geoconsult
Engineer: Vahid Nikouei
G.I. Job Ref: 210913
Project: 70 Mountain Road

INDEX TESTING SUMMARY

Borehole Number	Testing Depth, (m)	SHEAR STRENGTH TESTING				LABORATORY TESTING					Remarks
		Pocket Penetrometer, (kPa)	Hand Shear Vane			Natural Moisture Content, (%)	Atterberg Limits			Linear Shrinkage, (%)	
			Peak, (kPa)	Remoulded, (kPa)	Sensitivity		Liquid Limit, (%)	Plastic Limit, (%)	Plasticty Index		
HA03	3.50		UTP								
HA03	4.00		UTP								
HA04	0.50		119	61	1.95						
HA04	1.00		97	54	1.80						
HA04	1.50		137	71	1.93						
HA04	2.00		122	47	2.60						
HA04	2.50		119	47	2.53						
HA04	3.00		UTP								
HA04	3.50		UTP								
HA04	4.00		122	47	2.60						
HA04	4.50		111	44	2.52						
HA04	5.00		104	55	1.89						

Location: Henderson Valley, Auckland
Engineer: Vahid Nikouei
G.I. Job Ref: 210913
Client: Geoconsult
Project: 70 Mountain Road

ATTERBERG LIMITS & LINEAR SHRINKAGE TESTING

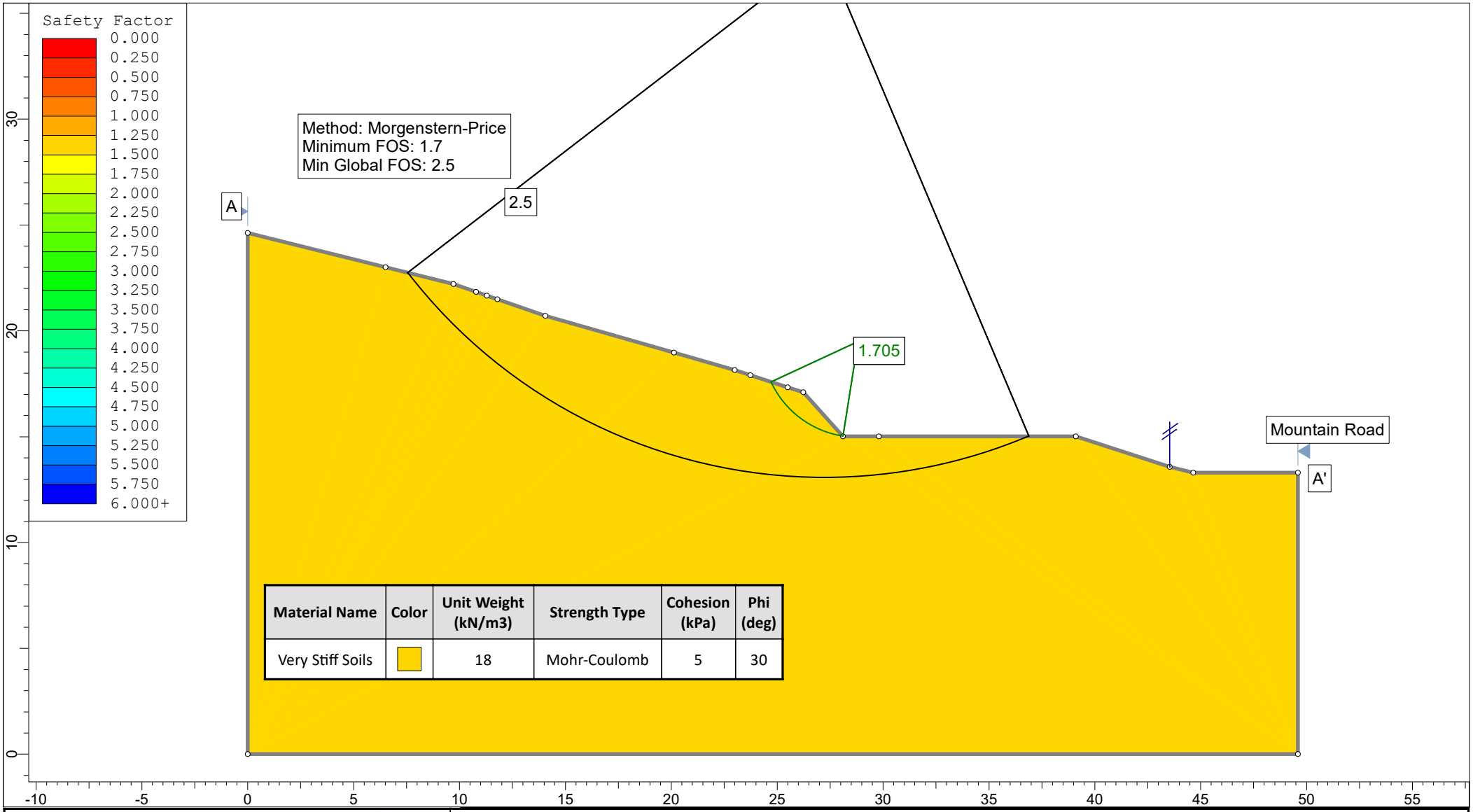


CL: CLAY, low liquid limit
ML: SILT, low liquid limit
CH: CLAY, high liquid limit
MH: SILT, high liquid limit

Borehole Number	Depth, (m)	Moisture Content, (%)	Liquid Limit, (%)	Plastic Limit, (%)	Plasticity Index	Linear Shrinkage, (%)
● HA03	0.75	75	130	53	77	25

The chart and soil classification terminology above is for reference only; it is taken from ASTM D2487-17 "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classicisation System)", January 2018 which are based on the classification scheme developed by A. Casagrande in the 1940's (Casagrande, A., 1948: Classification and identification of soil. Transactions of the American Society of Civil Engineers, v113, p.901-930).

Project:	70 Mountain Road	**G.I. Job Ref:**	210913	**Client:**	Geoconsult
Location:	Henderson Valley, Auckland	**Client Ref:**	GE305	**Engineer:**	Vahid Nikouei

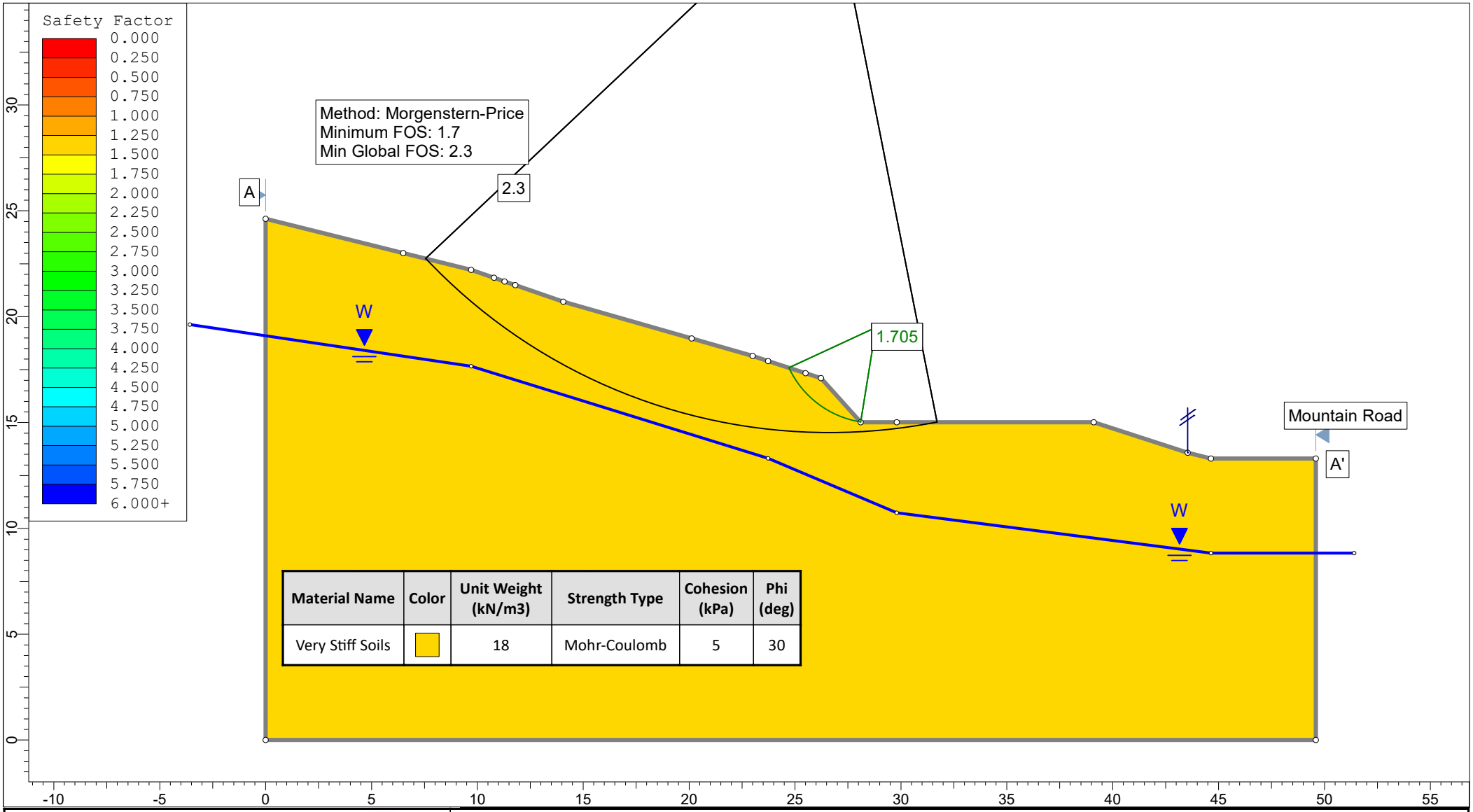


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Very Stiff Soils		18	Mohr-Coulomb	5	30

Geoconsult

SLIDEINTERPRET 6.039

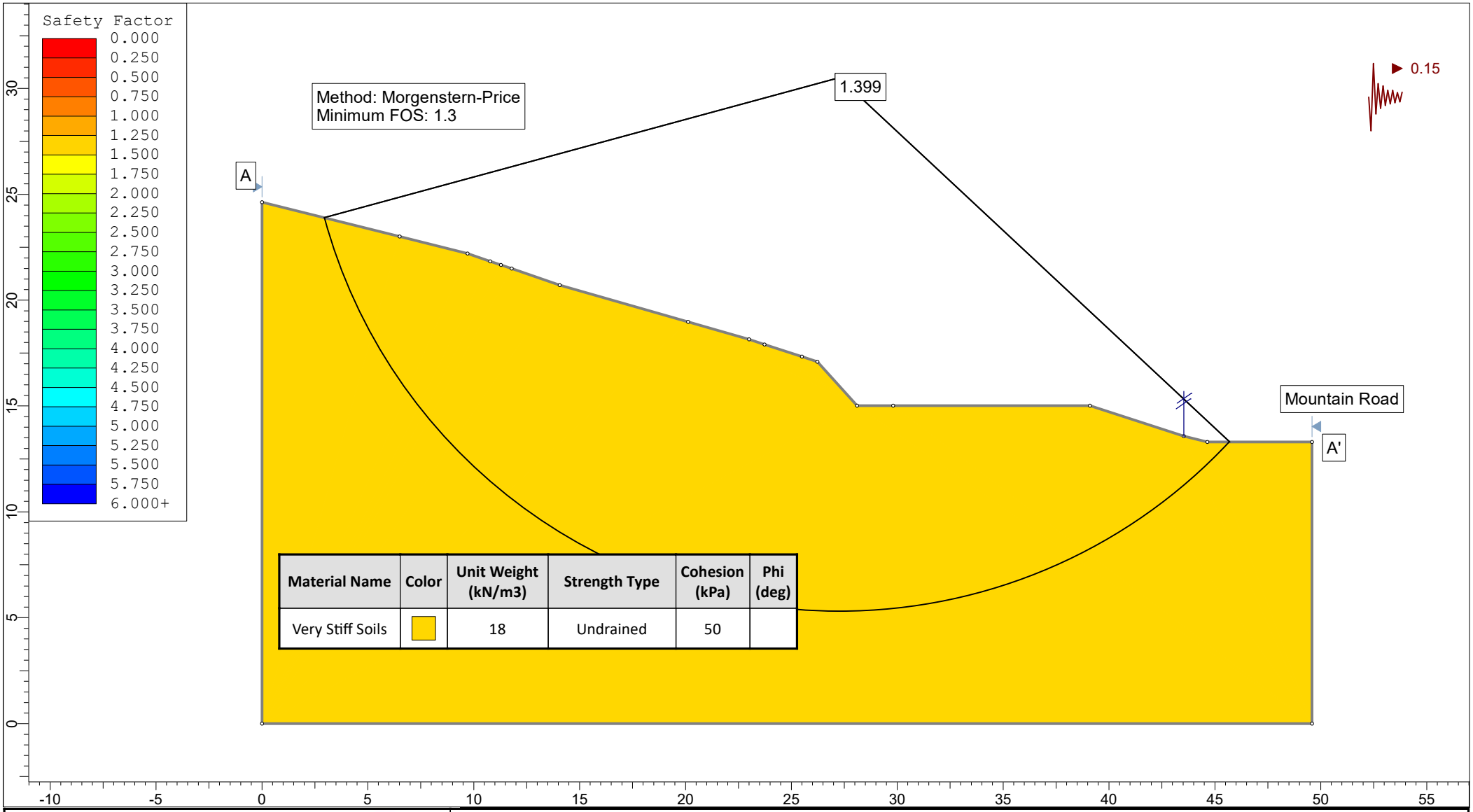
Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Existing - Normal GW		
Drawn By VN	*Scale* 1:250	*Company*	Geoconsult
Date 2/08/2021		*File Name*	Section A-A' - Ext - NGW.slim



Geoconsult

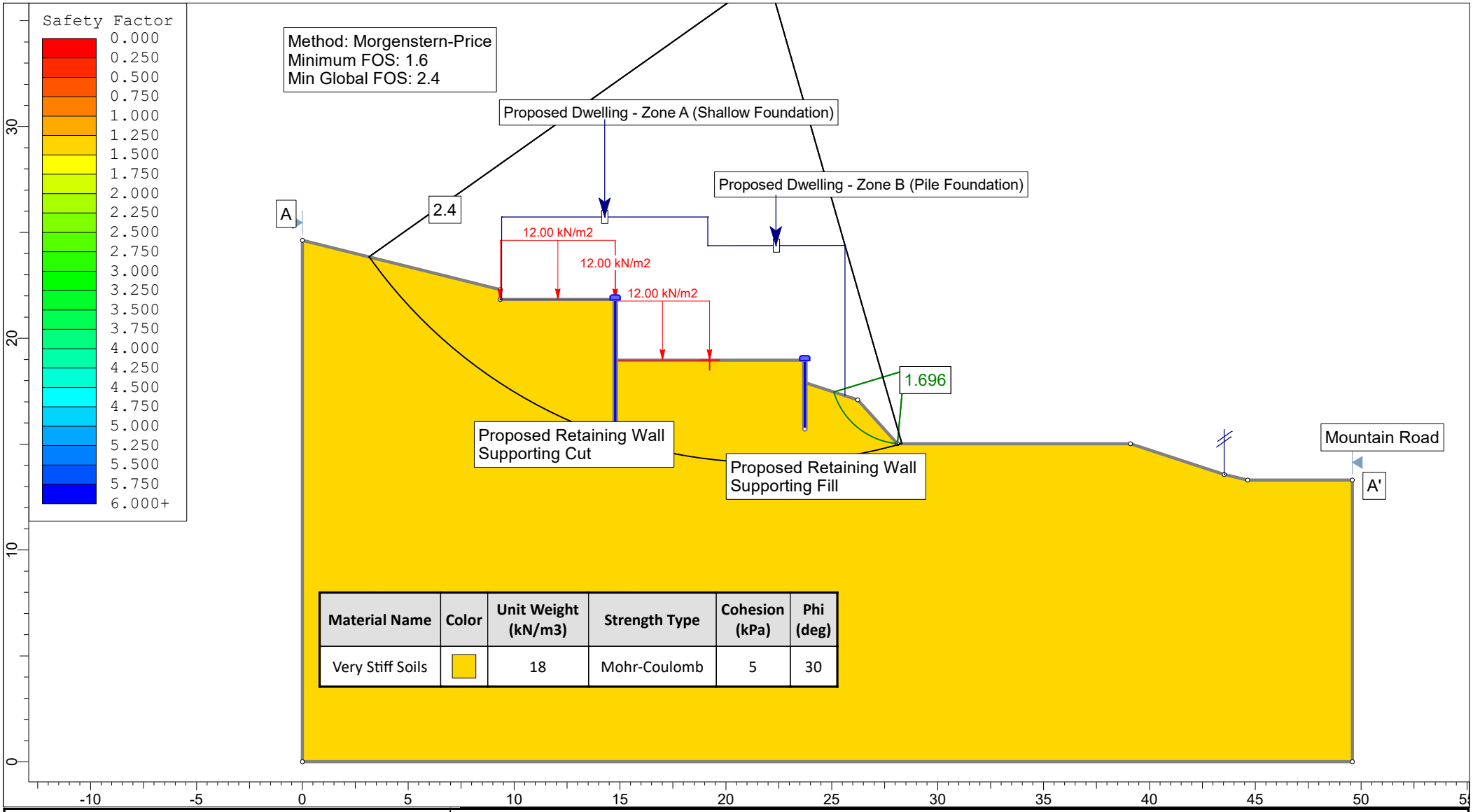
SLIDEINTERPRET 6.039

Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Existing - Elevated GW		
Drawn By VN	*Scale* 1:250	*Company* Geoconsult	
Date 2/08/2021		*File Name* Section A-A' - Ext - Elv GW.slim	



Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Existing - Seismic 0.15g (Undrained)		
Drawn By	VN	Scale	1:250
Company	Geoconsult		
Date	2/08/2021	File Name	Section A-A' - Ext - seismic.slim

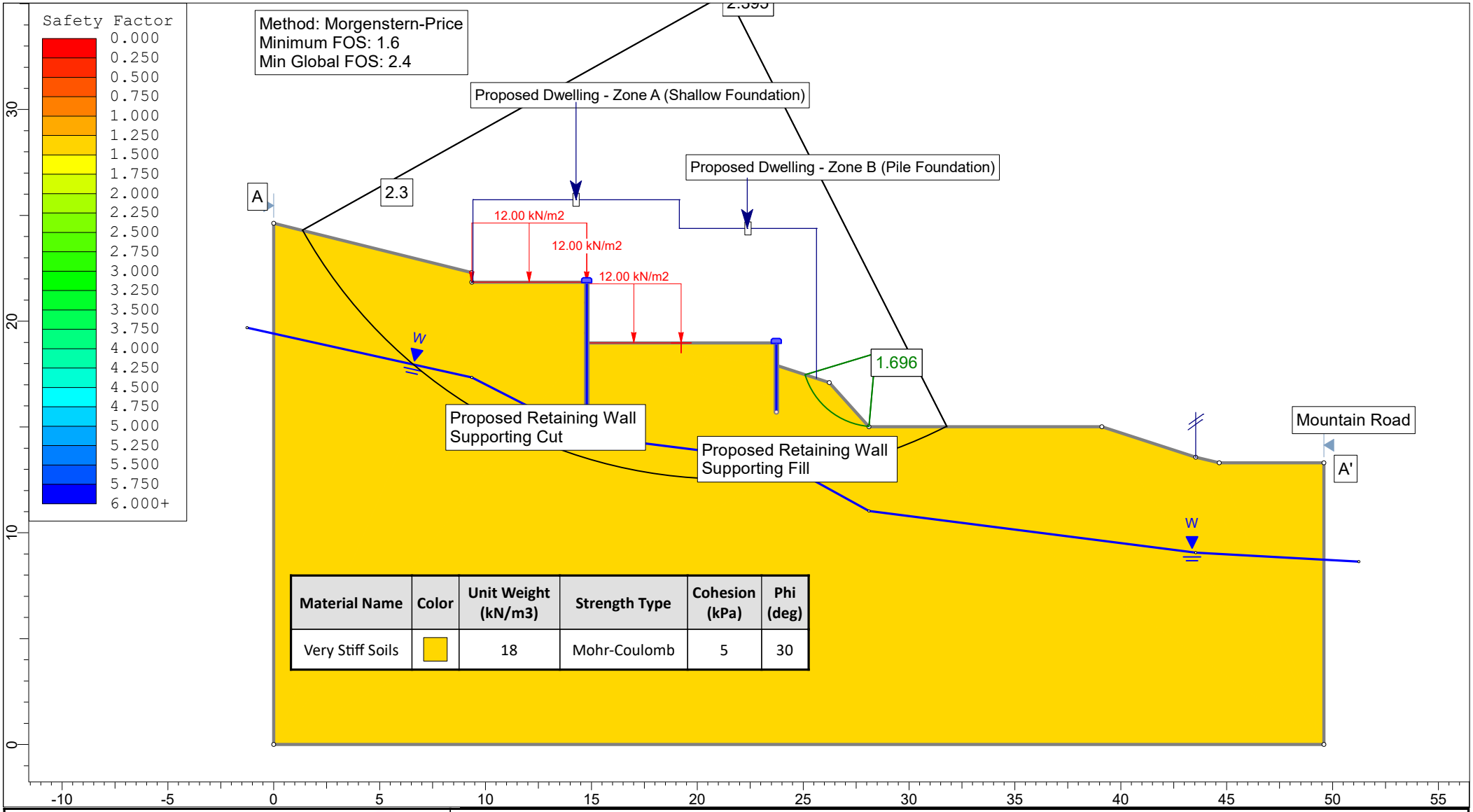
SLIDEINTERPRET 6.039



Geoconsult

SLIDEINTERPRET 6.039

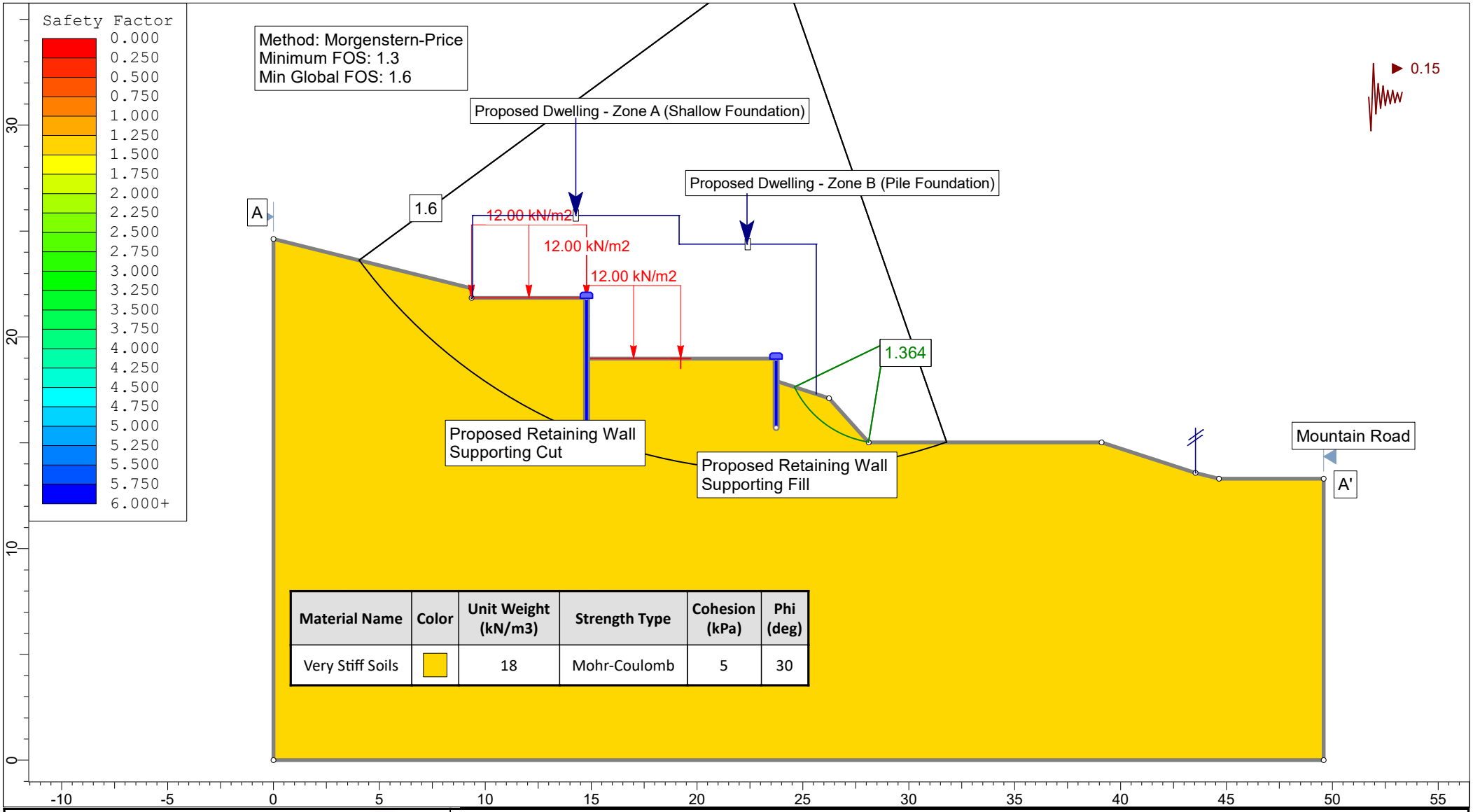
Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Proposed - Normal GW		
Drawn By VN	*Scale* 1:250	*Company* Geoconsult	
Date 2/08/2021		*File Name* Section A-A' - Proposed - NGW.slim	



Geoconsult

SLIDEINTERPRET 6.039

Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Proposed - Elevated GW		
Drawn By	VN	*Scale* 1:250	*Company* Geoconsult
Date	2/08/2021	*File Name*	Section A-A' - Proposed - ElvGW.slim



Geoconsult

SLIDEINTERPRET 6.039

Project	GE305.1 - 70 Mountain Road, Henderson Valley		
Analysis Description	Slope Stability Analysis - Section A-A' - Proposed - Seismic 0.15g (Undrained)		
Drawn By	VN	*Scale* 1:250	*Company* Geoconsult
Date	2/08/2021	*File Name*	Section A-A' - Proposed - Seismic.slim