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Geotechnical Investigation Report

Te Mataora Project – Greenacres Drive, Kawakawa

Rev A **15 February 2023** **Job No. NL220114**

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GEOTECHNICAL INVESTIGATION REPORT
TE MATAORA PROJECT
GREENACRES DRIVE, KAWAKAWA

Job Number:	NL220114
Name of Project:	Te Mataora Project – Greenacres Drive, Kawakawa
Client:	Ngā Kaingamaha o Ngāti Hine Charitable Trust
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Reviewer Signature:	
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Geotechnical Environmental Stormwater Hydrogeology

Table of Contents

Appendices:

Report Summary

The following summarises the findings of this report however is not to be taken in isolation. It is a requirement that any user of this report review the document in its entirety, including all appendices.

Feature	Commentary
RMA: Section106	No *geotechnical* natural hazards were identified (as listed in the Act) that are considered an undue impediment to subdivision or that cannot be reasonably addressed by typical engineering design and construction.
Further Geotechnical Requirements	Additional geotechnical investigation will be required during the Building Consent stage, primarily within the areas to the east (Stage 3) where access is limited and the ground surface slopes at steep to very steep inclinations. Refer to Section 17.0
Natural Soils	Stiff to hard weathered Te Kuiti Group soils underlain by weathered Waipapa Group soils and rock.
Unduly Weak, Sensitive, or Compressible Soils	The site soils are generally moderately sensitive and have the potential to exhibit a reduction in strength if overly disturbed or exposed to the weather during construction. Refer to Section 7.0.
Groundwater	Groundwater was measured in the machine boreholes following drilling at depths ranging from 3.5m to 4.8m below present ground level. It should be noted that these are not strictly representative of site groundwater conditions as the levels are usually affected by water introduced during drilling.
Seismic Site Class	Site Class C
Expansive Soils	Inferred as Moderately Expansive in accordance with B1/AS1. Laboratory-based soil expansivity testing is recommended prior to detailed design to confirm this classification.
Slope Stability	Slope stability is not considered a constraint to development of Stages 1 and 2. Shallow/local instability, as well as deep-seated 'global' instability will affect the proposed buildings within the Stage 3 area that are located on/near steeply inclined ground. Further stability analysis and confirmation of development design requirements and/or setback distances from the edge of the steep eastern slope are required in Stage 3. Refer to Section 9.0.
Foundations	Shallow foundations are suitable for the proposed Stage 1 and 2 buildings. Refer to Section 10.1. Stage 3 buildings located within 5.0m of ground steeper than 1V:3H require foundations capable of resisting lateral soil creep pressure and/or slope instability. Development in areas where the ground surface slope is steeper than 1V:2H will be difficult to construct and are likely to be economically unpalatable. Refer to Section 10.2.

Retaining	Refer to Section 13.0.
Drawing Review prior to Consent Application	Required
Construction Constraints	Refer to Section 16.0 of this report
Construction Observation	Required

1.0 Introduction

Soil & Rock Consultants (S&RC) were engaged by the Ngā Kaingamaha o Ngāti Hine Charitable Trust to carry out a geotechnical investigation for the proposed Te Mataora Project located on Greenacres Drive, Kawakawa.

Our investigation has been informed by Section 106 of the Resource Management Act which lists 'Natural Hazards' that must be considered by Council when assessing a Resource Consent application. Our assessment has also extended to consideration of the following:

- Provision of a seismic site class in accordance with NZS1170.5:2004.
- Provision of preliminary geotechnical recommendations related to foundation and retaining design requirements.

The primary purpose of this reporting is to identify the issues discussed above and provide associated remedial, mitigating, and design recommendations in order that Consent can be granted. Information and advice related to good construction practise are also provided.

1.1 Limitations

This report has been prepared by Soil & Rock Consultants for the sole benefit of Ngā Kaingamaha o Ngāti Hine Charitable Trust (the client) with respect to the proposed Te Mataora Project – Greenacres Drive, Kawakawa, and the brief given to us. It may be relied upon by client-appointed consultants for the purposes of design and by the Far North District Council to support Consent processing. The data and/or opinions contained in this report may not be used in other contexts, for any other purpose or by any other party without our prior review and agreement. This report may only be read or transmitted in its entirety, including the appendices.

The recommendations given in this report are based on data obtained from discrete locations and soil conditions between locations are inferred only. Our geotechnical models are based on those actual and inferred conditions however variations between test locations may occur and Soil & Rock Consultants should be contacted in this event.

Soil & Rock Consultants should also be contacted should the scope or scale of the development proposal vary from that currently indicated.

2.0 Site Description

The subject site, legally described as Sec 25 SBRS OF Kawakawa, is irregular in shape and covers an area of approximately 4.6 hectares. The property is located on Greenacres Drive, Kawakawa, adjacent to the Bay of Islands Hospital to the north (see Figure 1). An access driveway to the hospital traverses the site as shown on Figure 1 below.

The property currently comprises moderately to densely vegetated bush and the ground surface is generally gently to moderately sloping at inclinations in the order of approximately 3° to 15°. Towards the south-eastern site boundary, the ground surface descends steeply towards State Highway 1 (SH1) to the east. Contour data available on the Far North District Council (FNDC) website indicates this slope is inclined generally in the order of 20° to 40°. The slope extends into the south-eastern corner of the site at inclinations of up to 20°. Remnants of a demolished building are present in the north-west of the site.

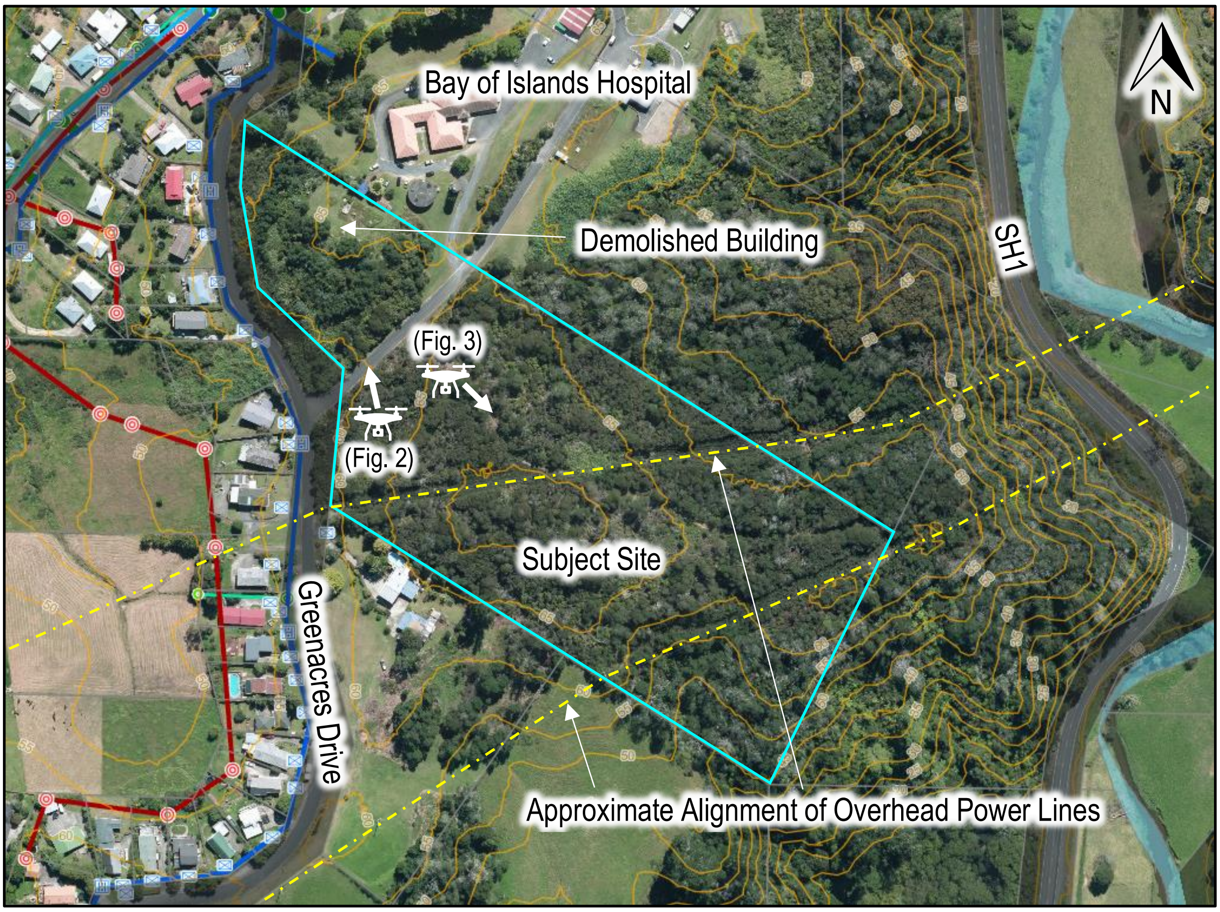


Figure 1: Aerial Image *(Source: Far North District Council GIS Website)*

Aerial (S&RC drone) images of the site recorded during our investigation are provided in Figures 2 and 3 overleaf. The location/orientation of each drone image is indicated on Figure 1.

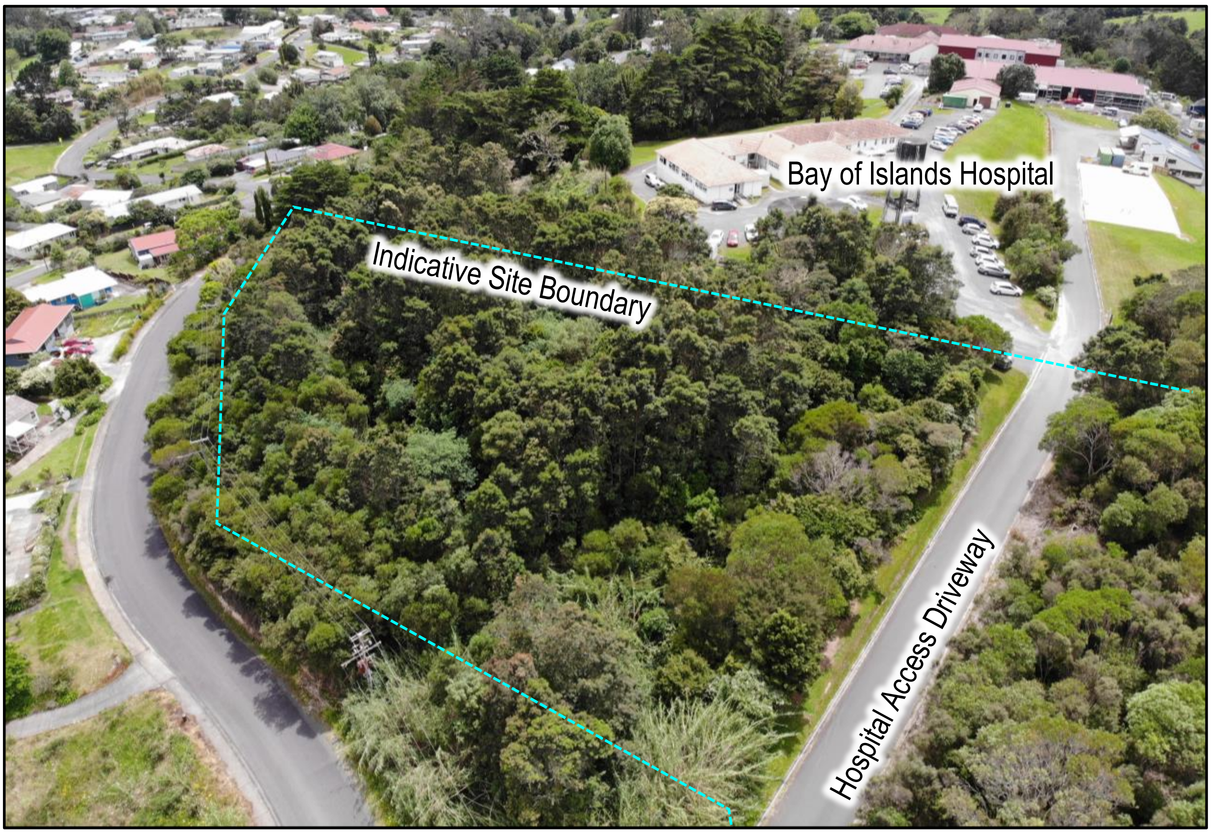


Figure 2: Drone Image 1 – Looking North-West

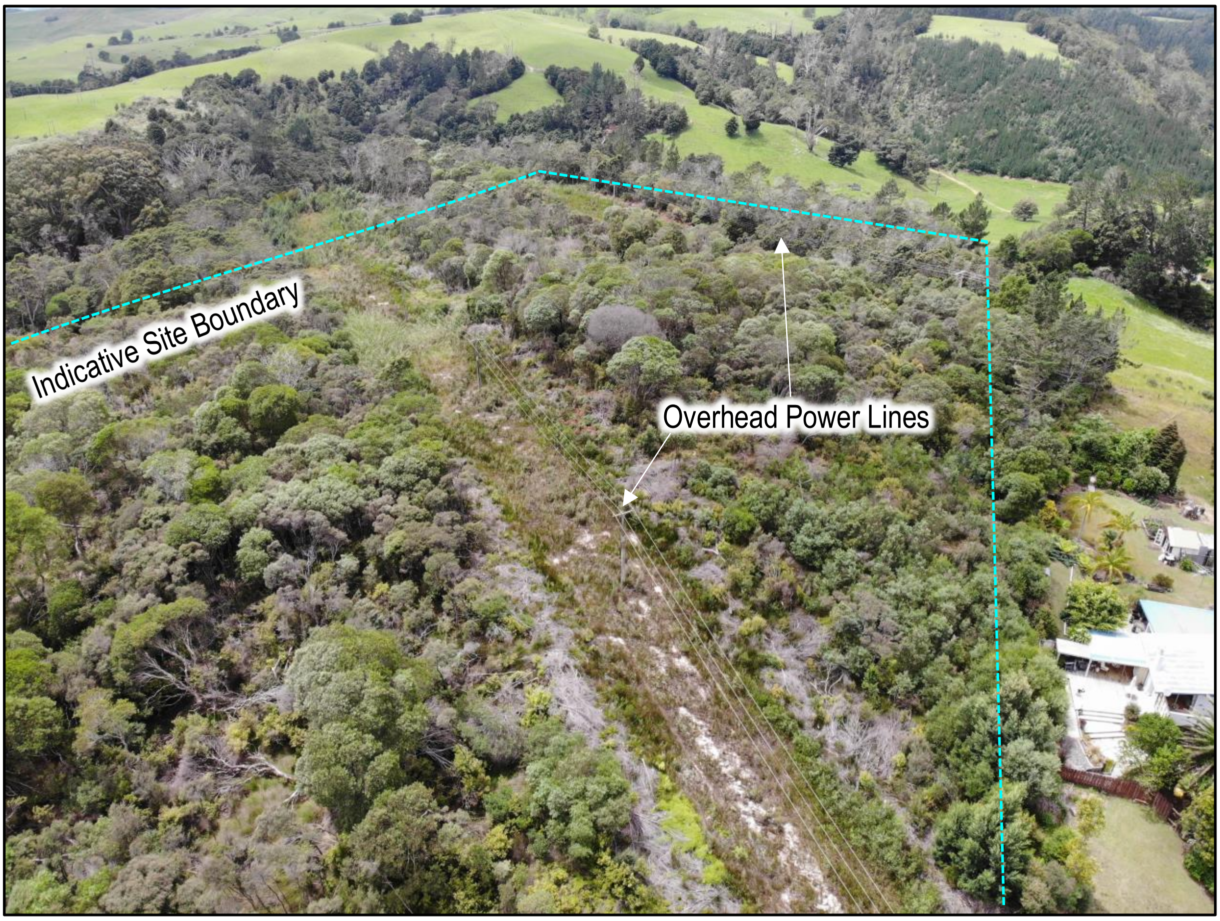


Figure 3: Drone Image 2 – Looking South-East

The FNDC website indicates that there are no public underground services within the site, however it is possible that underground services are present below/adjacent to the hospital access driveway (or elsewhere within the site). We note the presence of two overhead power lines that traverse the property, as shown on Figure 1. An approximately 10.0m wide strip of bush has been cleared below each line. It is our understanding these power lines may be re-routed as part of the proposed development.

The FNDC / Northland Regional Council websites indicate that there are no natural hazards associated with the site (i.e. coastal erosion, tsunami inundation, flooding, land hazards etc).

3.0 Desktop Study

3.1 Historic Regional Mining

S&RC have reviewed historic aerial imagery available on the Retrolens website, in conjunction with a historic Colliery Map (dated March 1894) obtained from GNS archives, and a report from the Ministry of Economic Development titled '*Coal Report Series CR195, Northland Coal Region, Kawakawa – Waiomio Coal Field*' dated 1974, published by the NZ Geological Survey in preparing this report.

The reviewed documents indicate coal mining began in the Kawakawa region in 1865 and continued until the early 1900's when the mines were closed due to flooding. During this period, Kawakawa became one of New Zealand's most prolific coal mining regions, with over one million tonnes of coal extracted from the Kawakawa and Waiomio mine to the south. Coal was transported via a specifically constructed rail network which transported the coal to Opua, approximately 10km to the north.

Coal was mined using the 'room and pillar' method. Tunnels (also known as roads or rooms) were mined through the coal seams in a series of parallel drives. A second series of parallel drives were mined perpendicular to the original drives. The result is the development of a network of drives in a grid pattern, with 'pillars' left in place to support the roof of the mine.

Based on the reviewed imagery, maps and reporting, we conclude that historic coal mine operations largely occurred in the hilly land located generally towards the south-western side of the Kawakawa township (in the general area of present-day Mill Road and Domain Road) – see Figure 4. Mine workings were shown as not extending below the subject site.

During our investigation no surface indications of past mining operations were observed or within the machine borehole cores.

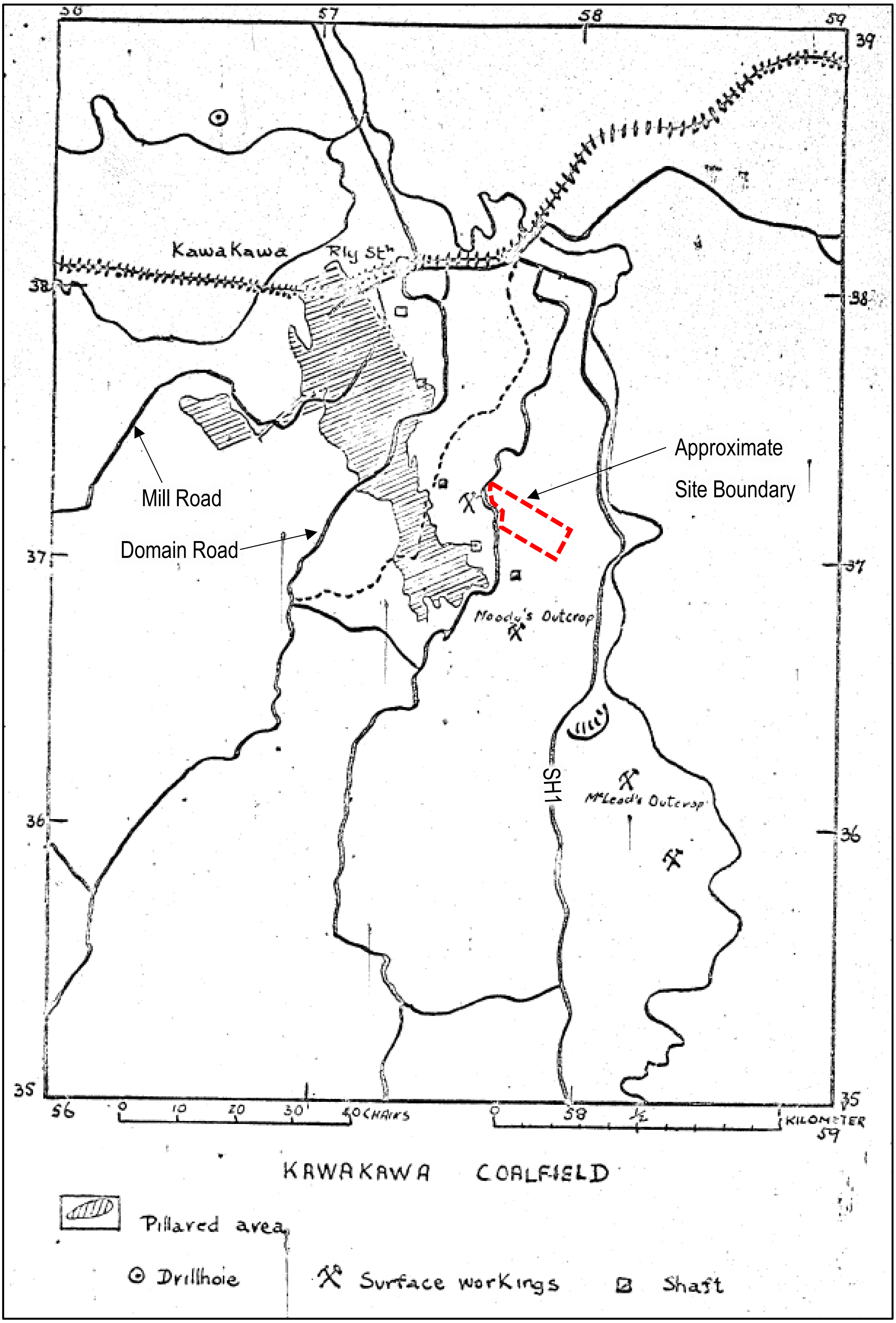


Figure 4: Kawakawa Coal Field (Source: Coal Report Series CR195, 1974)

3.2 Previous Geotechnical Investigation

S&RC carried out a geotechnical investigation in 2021 at 30 Greenacres Drive, adjacent to the subject site. This investigation comprised drilling three hand augerholes to depths of up to 3.3m below ground level, and Scala penetrometer testing from the base of the augerholes.

The augerhole logs indicate that the natural site soils comprise very stiff to hard silts of the Te Kuiti Group. Each augerhole was terminated before reaching target depth as the soils became too dense to drill, and penetrometer testing from the base of each augerholes encountered immediate refusal, indicative of dense to very dense soils.

S&RC is not authorised to distribute the above augerhole logs.

3.3 New Zealand Geotechnical Database

We have reviewed the New Zealand Geotechnical Database (NZGD) for geotechnical borelogs from previous investigations in vicinity of the subject site. There is no relevant data available.

4.0 Proposed Development

S&RC have received a preliminary scheme plan which indicates the project will comprise a 3-stage development involving the following. Indicative building locations are shown on Figure 5 below.

<u>Stage 1:</u>

- Construction of 20 residential dwellings for Ngāti Hine Iwi

<u>Stage 2:</u>

- Construction of 18 residential apartments. The apartments will be terraced and up to three storeys in height
- Construction of 48 aged-care apartments
- Construction of an approximately 1,000m^2 Wellness Centre

<u>Stage 3:</u>

- Construction of 48 residential apartments
- Construction of 48 aged-care apartments

Figure 5: Indicative Proposed Development

In total, the development will comprise construction of 182 new dwellings, new roads & parking areas, and various additional utility/service upgrades. The exact location of the proposed structures, extent of proposed earthworks, and extent of proposed retaining wall construction has not yet been determined. We anticipate the proposed buildings will be located on terraced and/or retained level building platforms, potentially requiring significant earthworks in some areas of the site.

It is our understanding that the Stage 3 development is currently preliminary, with the major focus currently being on completing development of Stages 1 and 2.

5.0 Geology

Reference to the GNS New Zealand Geological Web Map 1:250,000 Geology map, indicates the site is underlain by deposits of the Kamo Coal Measures (see Figure 6).

The Kamo Coal Measures are a coal bearing formation of the Te Kuiti Group, comprising carbonaceous mudstone, sandstone, conglomerate and coal seams, however no coal seams were encountered during our investigation. The weathered soil mantle typically comprises firm to very stiff clays, silts, and sands of variable plasticity.

The GNS website also shows that Waipapa Group sandstone and siltstones underlie the eastern end of the site (see Figure 6). During our investigation Waipapa Group deposits were generally encountered below weathered Te Kuiti Group soils.

The Waipapa Group comprises predominantly thin-bedded alternating fine-grained sandstone and argillite, massive, poorly bedded or laminated argillite and massive, jointed 'greywacke' sandstone, in beds or composite beds up to tens of metres thick. The rocks are typically hard to very hard, closely fractured and sheared.

Waipapa Group rocks weather to a soft, white to yellow-brown clay, locally extending to depths of 20m.

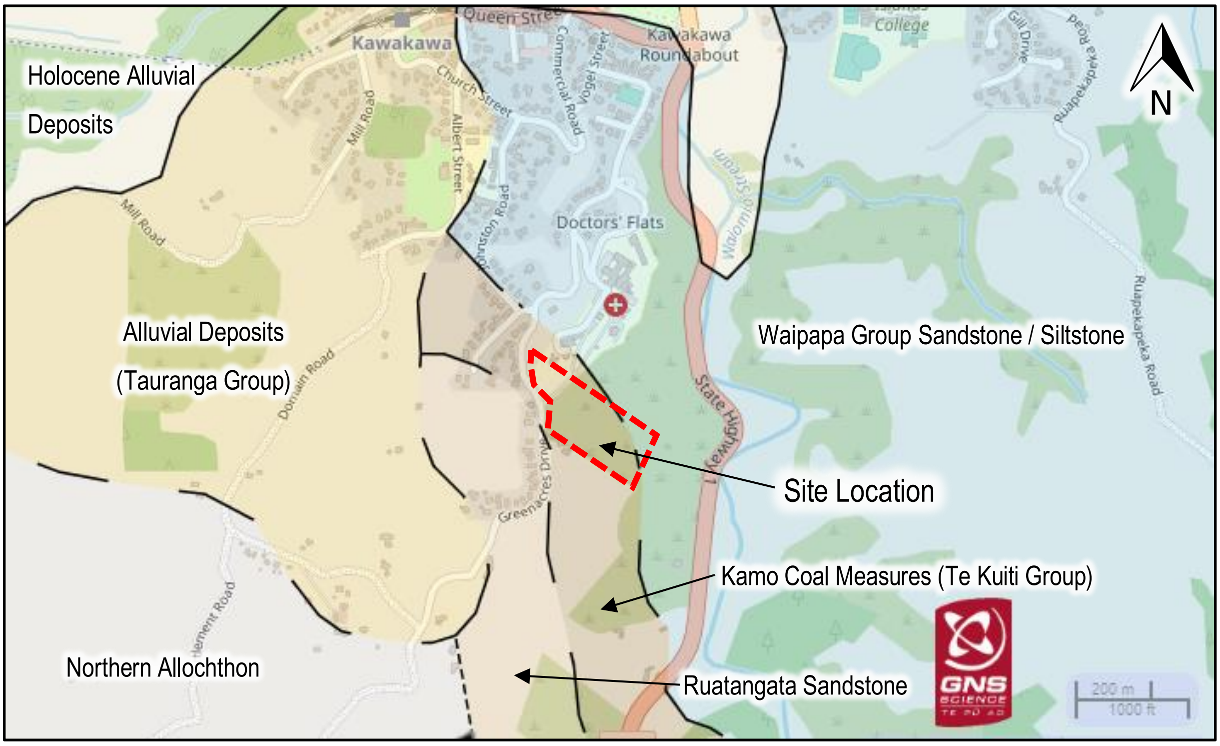


Figure 6: Geological Map *(Source: GNS WebMaps Website)*

6.0 Field Investigation

The field investigation carried out from the 5th – 9th December 2022 comprised the following components:

- Visual appraisal of the site, including aerial drone reconnaissance
- Drilling of twenty hand augerholes (AH01 – AH20 inclusive) – Appendix B
- Drilling of five machine boreholes (MB01 – MB05 inclusive) – Appendix B
  (Note: The machine drill rig was unable to access the south-eastern area of the site at the time of our investigation due to the dense bush).

In addition, two cross sections (A-A' and B-B') were produced using FNDC contour data for preliminary stability analysis. The test locations and cross section alignments are shown on the attached Site Plan, Drawing No NL220114/1 (Appendix A). The test locations were recorded using a hand-held GPS unit and are therefore approximate only.

Measurements of undrained shear strength were undertaken in the augerholes (and machine boreholes where shown on the logs) at intervals of depth using a handheld shear vane in accordance with the New Zealand Geotechnical Society Guidelines for Handheld Shear Vane Tests, dated August 2001. Peak and remoulded vane shear strengths shown on the attached augerhole logs represent dial readings off the shear vane adjusted using the BS 1377 calibration correction factor given on the log.

A visual-tactile field classification of the soils encountered during drilling was carried out in accordance with "Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes", issued by the New Zealand Geotechnical Society Inc. (2005).

Dynamic Cone (Scala) Penetrometer testing was carried out in-lieu of shear vane testing where soils became sand-dominated, and from the base of selected augerholes until refusal was reached. Refusal is defined as five consecutive blow counts of 10 or greater per 50mm penetration or a blow count of 20 for 50mm penetration. The results are given on the attached sheet (Appendix B).

Standard Penetration Testing (SPT) was carried out at 1.5m intervals within the machine boreholes. The testing returns an N-value (up to a maximum of 60 blows) which corresponds to penetration resistance of the in-situ soil; taken as the number of hammer blows required to advance the sampler 300mm (after an initial seating run of 150mm). If 60 blows are reached without achieving the full sampler penetration, the result is recorded as an N count of '60+'.

6.1 Subsurface Conditions

Subsurface conditions have been interpolated between the test locations and localised variations between and away from the test locations will exist.

In general, the soils encountered comprised topsoil underlain by weathered Te Kuiti Group soils. Weathered Waipapa Group soils were encountered underlying the Te Kuiti Group soils at depths ranging from 9.0m to 12.0m below present ground level (bpgl), with Waipapa Group rock (siltstone) present at depths ranging from 14.0m to 14.9m bpgl. Note – Waipapa Group deposits were not encountered in MB04 which was drilled to a depth of 15.5m bpgl.

An outline of the soil conditions and investigation results are given below and summarised in Tables 1 & 2, and detailed descriptions of the soils are given on the attached logs (Appendix B).

- **Topsoil.** Topsoil was encountered at each test location (excluding AH06 and AH17 to a maximum depth of 0.6m bpgl, although generally present at depths in the order of 0.2m to 0.3m bpgl. Topsoil is unsuitable for the support of permanent structures (i.e. building foundations, floor slabs, pavements etc).

- **Weathered Te Kuiti Group.** Weathered Te Kuiti Group soils (Kamo Coal Measures) were encountered at each test location underlying the topsoil to depths ranging from 9.0m (MB05) to greater than 15.5m bpgl (MB04). These soils typically comprised very stiff to hard silts with lesser amounts of clay and sand, and occasional dense sand zones. No coal deposits were encountered at the test locations. As noted on Table 1 below and the attached logs, several augerholes were terminated before reaching target depth due to the soils becoming too hard/dense to auger.

  Vane shear strengths recorded within the Te Kuiti Group material ranged from 72kPa to greater than 200kPa where the soil strength was in excess of the shear vane dial capacity or was 'UTP' – Unable to Penetrate into the soil.

  SPT 'N' values recorded within the Te Kuiti Group soils generally ranged from N=4 to N=23, with outlier values of N=34 to N=45 recorded in MB05 from 4.5m to 7.5m bpgl.

- **Waipapa Group.** Weathered Waipapa Group soils were encountered underlying the weathered Te Kuiti Group soils from depths of 9.0m to 12.0m bpgl (excluding MB03 which encountered shallow refusal, and MB04 where Te Kuiti Group soil was present to the termination depth at 15.5m bpgl). The weathered Waipapa Group soils typically comprised very stiff to hard silts with lesser amounts of clay and sand. SPT 'N' values recorded within the weathered Waipapa Group soils ranged from N=29 to N=60.

Waipapa Group rock (siltstone) was encountered at depths ranging from 14.0m to 14.9m bpgl to the termination depth of the boreholes (excluding MB03 which encountered shallow refusal, and MB04 where Te Kuiti Group soil was present to the termination depth at 15.5m bpgl). The siltstone was typically slightly to moderately weathered, very weak to weak, and extremely closely fractured. SPT 'N' values recorded within the siltstone achieved blow counts of N=60+.

- **Scala Penetrometer Testing.** Scala penetrometer testing was carried out from the base of selected augerholes, and from the base of MB03 which terminated at a depth of 1.6m due to contact with a solid obstruction. Refusal was encountered at depths ranging from 0.4m to 6.8m bpgl.
- **Groundwater.** Groundwater was not encountered within the augerholes on the day of drilling. While measurements taken during drilling are not always an accurate portrayal of the actual long-term groundwater table as groundwater levels can take time to stabilise within the augerhole following drilling, groundwater levels are likely to be deep considering the location of the site being the top of a ridge, albeit broad. Soils were logged as 'wet' at depths of 2.9m and 3.0m bpgl in AH20 and AH11 respectively, which may be representative of localised zones of sandier and more water-bearing soil.

  In addition, the machine boreholes were dipped following drilling, with groundwater encountered at depths ranging from 3.5m to 4.8m bpgl, as indicated in Table 2. It should be noted that these are not strictly representative of site groundwater conditions as the levels are usually affected by water introduced during drilling.

Table 1 – Summary of Subsurface Conditions (Augerholes)

Test ID	Termination Depth	Depth of Topsoil	Vane Shear Strength Range (kPa)	Scala Penetrometer Termination	Groundwater
All depths measured in (m) below present ground level. (Rounded to 1 DP)					
AH01	4.6*	0.2	132 – 200+	4.7	NE
AH02	3.1*	0.6	200+	NT	NE
AH03	1.8*	0.5	200+	4.0	NE
AH04	4.0	0.4	150 – 200+	NT	NE
AH05	0.4*	0.2	-	0.5	NE
AH06	0.3*	NE	-	0.4	NE
AH07	3.0*	0.1	150 – 200+	3.7	NE
AH08	3.2*	0.2	144 – 200+	4.3	NE

Test ID	Termination Depth	Depth of Topsoil	Vane Shear Strength Range (kPa)	Scala Penetrometer Termination	Groundwater
AH09	0.4*	0.2	-	0.5	NE
AH10	0.4*	0.2	-	0.5	NE
AH11	5.0	0.2	121 – 200+	6.1	NE
AH12	3.0	0.2	147 – 200+	NT	NE
AH13	4.0	0.2	106 – 200+	NT	NE
AH14	3.0	0.1	118 – 200+	NT	NE
AH15	3.3*	0.2	165 – 179	3.9	NE
AH16	0.9*	0.1	200+	1.0	NE
AH17	5.0	NE	118 – 200+	6.8	NE
AH18	0.2*	0.1	-	0.3	NE
AH19	0.2*	0.1	-	NT	NE
AH20	5.0	0.2	188 – 200+	5.1	NE

Table 1 Notes: NE = Not Encountered NT = Not Tested * Augerhole terminated as soil became too hard/dense to drill

Table 2 – Summary of Subsurface Conditions (Machine Boreholes)

Test ID	Termination Depth	Depth of Topsoil	Depth of Waipapa Group Rock	Vane Shear Strength Range (kPa)	SPT 'N' Value Range	Groundwater Depth
All depths measured in (m) below present ground level. (Rounded to 1 DP)						
MB01	15.4	0.3	14.9	101 – 200+	4 – 60+	4.8
MB02	15.4	0.2	14.9	-	11 – 60+	3.5
MB03	1.6 [1]	0.2	NE	134 – 200+	-	NE
MB04	15.5	0.2	NE	72 – 200+	4 – 22	N/A [2]
MB05	15.3	0.3	14.0	-	14 – 60+	3.5

Table 2 Notes: NE = Not Encountered 1 - Solid obstruction encountered 2 – Water at surface due to rain / surface runoff

7.0 Expansive Soils

Our visual and tactile assessment of the near-surface site soils indicate the soils typically lie in 'Expansive Soil Class M – Moderately Expansive' with reference to B1/AS1 and AS2870:2011.

We recommend laboratory-based soil expansivity testing be undertaken at the design stage in order to refine the soil expansivity characteristics across the site, which will inform foundation design.

8.0 Sensitive Soils

The ratio of peak to remoulded vane shear strength values recorded during our investigation ranges approximately between 2 and 4, indicative of a 'moderately sensitive' subgrade. These soils are potentially susceptible to mechanical disturbance and/or exposure to the elements and soils that test well in-situ can perform poorly when construction is underway. Care is therefore required during construction to ensure the soils are protected to ensure favourable short and long-term subgrade and foundation performance.

Practical means of protecting the soils include avoidance of vibration-based compaction equipment, protecting the subgrade following initial site clearance, minimising the passage of heavy or vibrating construction plant, and extra care during foundation excavations, particularly any pile excavations. Further subgrade protection measures are provided in Section 12.0 of this report.

9.0 Seismic Design Parameters

The site is considered a Class C – 'Shallow Soil Site' as defined by NZS 1170.5:2004.

The Peak Ground Acceleration (PGA) value for structures of Importance Level 2 (proposed Stage 3 buildings), adopted for stability analysis of the site is 0.15g (ULS) with an effective earthquake magnitude of 5.75.

10.0 Slope Stability

Qualitative Assessment

The ground surface within the Stage 1 area of the site (west of the Hospital access road) typically descends towards Greenacres Drive (towards the west/south-west) at inclinations in the order of 3°to 9° with isolated areas at steeper inclinations.

Within the Stage 2 area (east of the Hospital access road) the ground surface typically descends from the crest of a hill located at the approximate centre of the site at inclinations in the order of approximately 5° to 13°. Approximately 35m beyond the north-eastern boundary slopes steepen to approximately 20°, and continue to steepen with increasing distance from the site.

At the south-eastern end of the site, within the Stage 3 area, the ground surface descends towards the south/south-east at inclinations in the order of approximately 8° to 20°. A steeply inclined slope is present to the east of the site, which slopes down to SH1 (towards the south-east) at inclinations generally in the order of approximately 25° to 40°, becoming extremely steep immediately adjacent to SH1 in some areas (see Figure 7 below). As shown in Figure 7, Waipapa Group rock appears to outcrop at the base of the slope adjacent to SH1. The crest of this steeply inclined slope runs approximately parallel to the south-eastern site boundary.

Figure 7: Slope Adjacent to SH1 (South-East of Site) – Looking North-East *(Source: Google Maps)*

At the time of our investigation no visual evidence of major, deep-seated instability was identified within the site, however the steeply inclined slope beyond the south-eastern site boundary could not be safely accessed during our investigation.

Soil Creep is likely to be operating on the slopes within the Stage 3 area, around the south-eastern corner of the site. Soil creep is the slow downslope movement of upper soil horizons, usually confined to the uppermost 1.5m of soil and generally in the order of millimetres per year. Soil creep is exacerbated by slope length, slope angle, inundation, groundwater fluctuations, soil expansivity, vegetation, and various surcharge loads.

Presently, as the area is densely vegetated soil creep movement is inferred to be minimal, however once significant areas of bush are cleared as part of the proposed development, the potential for soil creep movement will increase.

Preliminary Quantitative Assessment

To quantitatively check the overall stability of the slopes in the south-eastern parts of the site (Stage 3 development area), stability analyses have been undertaken for the existing topography through cross sections A-A’ and B-B’ as indicated on the attached Site Plan, Drawing No. NL220114/1 (Appendix A). Cross section topography has been adopted from FNDC contour data. This assessment should be considered preliminary only – further stability analysis will be required once the proposed Stage 3 development has been refined (i.e. locations of proposed buildings, proposed cuts/fills and retaining), further geotechnical testing has been completed in this area (i.e. machine drilling), and if possible, the area is surveyed to provide accurate topographic data allowing an accurate analysis of slope stability.

The computer program SLIDE Version 2018 for slope stability analysis, developed by RocScience Inc. was used for stability calculations. Stability of theoretical translational failure surfaces was assessed using the Spencer method.

Stability analyses have been undertaken for the inferred long-term groundwater condition, extreme (worst credible) groundwater condition and seismic conditions. The inferred long-term groundwater condition has been adopted for the seismic condition. Peak Ground Acceleration (PGA) values for the Kawakawa Region have been determined as per Section 8.0 of this report.

Lower-bound effective stress strength parameters used for our analyses are summarised in Tables 3 and 4. These have been developed from the soil description, in-situ strength testing, limited back analysis, and our experience with these soil types in both the immediate area and the wider region. The parameters for the Waipapa Group rock layer have been determined using generalized Hoek-Brown strength values determined for a representative siltstone rock unit (see Table 4).

Table 3 – Effective Stress Parameters (Soil)

Soil Type	Estimated Unit Weight γ (kN/m³)	Effective Cohesion on the Failure Plane c’ (kPa)	Effective Angle of Internal Friction ø’ (°)
Weathered Te Kuiti Group Soils	18	7	32
Weathered Waipapa Group Soils	18	8	34

Table 4 – Effective Stress Parameters (Rock)

Soil Type	Estimated Unit Weight γ (kN/m³)	Intact UCS (MPa)	Geological Strength Index GSI	Intact Rock Constant mi	Disturbance Factor
Waipapa Group Rock	20	5	50	7	0

The ratio of resisting forces to disturbing forces is presented as a 'Factor of Safety' (FOS) against slope instability occurring. A FOS of 1 indicates a slope near or at equilibrium.

As there is no national standard available, reference has been made to Table 2.C.1 of the '*Auckland Council Code of Practice for Land Development and Subdivision, Section 2, Earthworks and Geotechnical Requirements*', Version 1.6, dated 24 September 2013, which lists the minimum Factor of Safety acceptable to Auckland Council. These are provided in the 'Required' column in Table 5 alongside the calculated FOS results.

Table 5 – Stability Analysis Results

Section	Modelled Conditions	Global Factor of Safety	
		Required	Calculated
A-A'	Inferred Long-Term Groundwater	1.5	1.1
	Extreme (Worst Credible) Groundwater	1.3	0.9
	Seismic Loading	1.2	0.9
B-B'	Inferred Long-Term Groundwater	1.5	1.2
	Extreme (Worst Credible) Groundwater	1.3	1.1
	Seismic Loading	1.2	0.9

Preliminary Stability Conclusions

Stages 1 & 2

We consider the proposed building platforms for Stages 1 and 2 to be suited to the construction of the proposed buildings from a global land stability point of view, contingent upon the recommendations of this report being adopted in design and construction.

Stage 3

The global minimum FOS results in Table 5 are less than the Auckland Council requirements for each analysed condition – refer to attached Stability printouts (Appendix C).

The potential failure surfaces shown within sections A-A’ and B-B’ are primarily located beyond the south-eastern site boundary, over the steep slope which descends to the south/south-east towards SH1. Failure surfaces also extend into the site, however are limited to the residual weathered Te Kuiti Group soil mantle.

The two proposed south-eastern-most buildings within the Stage 3 development area (see Figure 5) will either:

A) Need to be located away from any potential failure surfaces, with Building Restriction Zones identified after additional investigation and assessment,

B) Have specifically designed foundations that comprise deep piles embedded into Waipapa Group rock, or

C) Be located on building platforms that are retained by a barrier pile/palisade wall (mostly likely incorporating tie-back anchors) specifically designed to account for potential downslope instability. Such walls would need to be located along the south-eastern site boundary, and partially along the southern boundary where instability is expected (see Figure 8.0 below).

Figure 8: Indicative Stage 3 Barrier Pile Wall Extent

In addition, buildings located on/near ground inclined steeper than 1V:3H will need to have foundations designed to account for downslope soil creep movement. Soil creep is a shallow 'local' movement and is a separate issue to the deep 'global' issues discussed above. We anticipate the buildings will be located on terraced and/or retained level building platforms, in which case design to account for soil creep will not be required.

As previously noted, the Stage 3 recommendations should be considered preliminary only until further stability analysis can be carried out following additional geotechnical investigation in the area.

11.0 Foundation Design Recommendations

S&RC should inspect all foundation excavations to determine whether the exposed soil and foundation conditions are consistent with those described in this report.

11.1 Shallow Foundations

For the buildings in Stages 1 and 2, the natural site soils are considered suitable for the use of shallow foundations which may comprise a ‘waffle’ or ‘rib-raft’ slab (surface-supported, no embedment) or traditional strip/pad/Senton footings embedded a minimum of 600mm into stiff natural ground or engineered fill and designed to accommodate the inferred expansivity characteristics of the soils, classified as per Section 7.0 of this report. Prior to detailed design, laboratory-based soil expansivity testing should be carried out to confirm the expansivity classification as this will inform the required embedment depth for shallow foundations.

A Design (Dependable) Bearing Capacity of 175kPa is available for Ultimate Limit State Design of shallow foundations carried out in accordance with B1/AS1 or AS2870:2011, B1/VM4 and AS/NZS 1170:2002. A Strength Reduction Factor ($Ø_{bc}$) of 0.5 has been applied to the Geotechnical Ultimate Bearing Capacity value to determine the Design Bearing Capacity.

11.2 Pile Foundations

Pile foundations are likely to be required:

- Where bearing capacity requirements are greater than those given for shallow foundations
- Within the Stage 3 area where proposed buildings are located within 5.0m of ground steeper than 1V:3H (to account for potential soil creep movement within the upper soil layers)
- On the two proposed south-easternmost buildings within the Stage 3 area where potential deep-seated slope instability is expected.

We recommend any pile foundations take the form of bored, concrete-encased timber, or steel-reinforced concrete piles embedded into stiff natural ground.

Pile excavations that penetrate groundwater, which may be expected from approximately 3.5m depth bpgl (although likely deeper), will require pumps capable of handling slurry-rich material during construction.

Soil strength parameters applicable to Ultimate Limit State Design in accordance with AS/NZS 1170:2002 are given in Table 6. These parameters may only be adopted for piles with a length-to-diameter ratio greater than five (L/D > 5), and that are embedded into stiff natural ground.

Table 6 – Ultimate Limit State Pile Design Parameters

Material	Ultimate End Bearing Capacity	Ultimate Skin Friction
Weathered Te Kuiti Group soils (Approx. embedment <10.0m)	630kPa	20kPa
Weathered Waipapa Group soils (Approx. embedment 10.0m to 14.0m)	900kPa	40kPa
Waipapa Group rock (Typical embedment >14.0m)	6MPa	250kPa

A Strength Reduction Factor not greater than $Ø_{pc} = 0.5$ should be applied to the Geotechnical Ultimate Capacity values to determine the Design (Dependable) Capacity values.

Skin friction should be ignored:

A) Over the upper 0.6m of pile length to account for soil expansivity movement

B) Over the upper 0.8m of pile length (or 4D, whichever is deeper) where piles are located within 5.0m of ground inclined steeper than 1V:3H to account for potential soil creep movement. Note – Refer to Section 14.0 for advice regarding calculations of lateral loads (resulting from soil creep) on piles.

12.0 Floor Slabs and Pavements

All topsoil, non-engineered fill (if encountered), vegetation, organic or otherwise unsuitable material should be removed from under floor-slab and pavement areas prior to construction.

For preliminary design a CBR value of 3% or a modulus of subgrade reaction of 20kPa/mm are considered appropriate for flexible and rigid pavements respectively. These values should be confirmed by specific testing by S&RC following preparation of the subgrade.

Maintaining the natural moisture content of a subgrade prior to construction is important. The subgrade should be protected from desiccation, rain damage, and plant-trafficking by placing a protective layer of granular fill immediately upon excavating or filling to grade following inspection by the Geotechnical Engineer. The granular fill can later be left in-situ as a construction sub-base or basecourse if managed well and protected from damage. We recommend watering the subgrade approximately 48 hours prior to concrete placement to return the subgrade to its inferred pre-excavation moisture content.

Any concrete floor-slab or pavement should be underlain by a basecourse of clean, free-draining granular fill as specified by the designer and should be subjected to compaction by a device of appropriate weight and energy. Silty or sandy subgrades are generally sensitive to disturbance and ‘static’ rolling only (no vibration) is recommended.

13.0 Site Formation / Earthworks

At the time of preparation of this report the extent of proposed earthworks is unknown. We anticipate that the proposed buildings will be located on terraced and/or retained level building platforms, potentially requiring significant cuts and fills.

A project-specific earthworks specification should be supplied to the contractor prior to commencing earthworks. That specification should, among other things, adopt the following recommendations:

- Earthworks activities should be scheduled for drier months. While earthworks can also be carried out in winter, undertaking a successful earthworks operation in winter can be onerous considering the additional factors that the Contractor is likely to face such as inclement weather conditions, high soil moisture content, requirement for drying the fill material (adequate space for drying, plant and material costs) and management of stockpiles. The project can quickly run into time delays and cost overruns if the above factors are not considered and managed carefully during earthworks.
- All unsuitable materials (i.e. topsoil, vegetation, organic material etc) should be stripped from areas of proposed earthworks.
- All earthworks should be carried out in accordance with NZS 4431:2022 with respect to subgrade preparation and standard of fill compaction.
- All sloping ground to receive fill should be suitably benched to allow access for compaction plant and to ensure the fill is effectively keyed into the surrounding ground.
- Compaction of cohesive fill should be carried out using pad foot compaction plant of a minimum 8 tonne static weight, in loose layers no greater than 200mm thickness. All fill materials should be clear of unsuitable materials as outlined above. The cohesive soils should be suitably moisture conditioned prior to compaction.
- The geotechnical acceptance criteria for compacted cohesive fill should be a minimum vane shear strength of 140kPa (average) and maximum air voids of 10% (average) for areas of general

earthworks. Areas within 0.5m of roadway subgrade level should have a minimum vane shear strength of 150kPa (average) and maximum air voids of 8% (average). A geotechnical engineer should carry out compaction testing during construction to ensure the correct level of compaction is being achieved.

- Undue vibration and/or disturbance of the natural soils should be avoided.
- Following completion of the earthworks the fill materials and natural ground should be covered as soon as practical with a layer of granular fill or topsoil, dependent on whether the fill is within areas of pavement/building platforms or grassed lawns, respectively. Any soils (fill and natural ground) left open to the elements can become excessively cracked due to dry weather or excessively softened during wet weather,and will therefore be unsuitable for its intended purpose.
- Cuts or fills may be battered no steeper than 1V:3H. Where this cannot be achieved, they should be supported by suitable retaining walls.
- Any proposal to create cuts or fills greater than 0.6m in height should be the subject of specific geotechnical design advice. If significant cuts/fills are proposed, particularly on sloping ground, additional stability assessment may be required.

Temporary Stability

It is the responsibility of the earthworks contractor to ensure the site is safe during the construction period. Particular care should be taken during the construction phase with respect to excavations to form benches for building platforms, access driveways, retaining walls etc. The full extent of any retaining or temporary excavation works was not known at the time of our investigation. We recommend to the designer of any site earthworks that involve cutting or filling, that the final proposal be discussed with a geotechnical engineer at the design stage. Some general guidelines are given below, however, where possible site-specific advice should be sought from an experienced geotechnical engineer.

Care must be taken during the construction phase to protect unsupported and over-steepened ground. Cut faces (e.g. for retaining walls) are at risk of instability during the construction phase and measures should be taken to protect the faces. We recommend that all temporary cuts up to 1.5m in height and located at least 3.0m away from property boundaries, other structures (e.g. buildings, retaining walls, etc) or steep slopes (greater than 1V:4H) be battered at angles no greater than 1V:1.5H. Where this is not possible to achieve, the cut face should be supported with an Engineer-designed retaining wall.

All cut faces should be covered with heavy PVC sheeting which is suitably battened and anchored to protect the exposed soils from the elements. In addition, runoff from higher ground should be intercepted by means of shallow surface drains or small bunds to protect the building platforms from saturation and erosion. Water collected in the interceptor drains should be diverted away from the building platforms to a safe disposal point.

Sediment Control

Prior to commencing earthworks, a sediment control system must be constructed to ensure the Council requirements are met. Typical details can be found in the Auckland Council publication GD05 (June 2016) however we expect this will be the subject of a specific design by others.

14.0 Retaining Structures

The extent of proposed retaining is unknown at the time of preparation of this report, however we anticipate the proposed buildings will be located on terraced and/or retained building platforms.

Factors of safety and surcharge loadings appropriate to the conditions should be in accordance with ‘Limit State Design of Retaining Walls and Foundations for Geotechnical and Structural Engineers’ SESOC Seminar Series 2005.

All retaining systems must be Engineer-designed and consider both the local and global stability of the site, and any surcharge applicable to the wall. Particular attention should be paid to the influence of building surcharges above, and sloping ground above and below, any retaining wall. Geotechnical retaining wall design parameters are provided in Table 7.

Table 7 – Retaining Wall Design Parameters

Parameter	Value
Effective Cohesion c’ (kPa)	0
Internal Friction Angle (Stiff Natural Ground / Engineered Fill Only)	32°
Bulk Density (kN/m^3)	18
C_u for Broms (kPa) (Stiff Natural Ground / Engineered Fill Only)	80

For the design of ‘stand-alone’ timber pole retaining walls, soil pressures should be determined for active pressure conditions (K_a). For the design of rigid retaining walls or those that are integrated into any building structure, soil pressures should be determined for ‘at-rest’ pressure conditions (K_o).

Sliding resistance for a gravity wall may be calculated using a wall/ground (no plastic membrane) friction angle of 20° and the bulk density provided in Table 7.

No passive resistance should be inferred until the horizontal buttress of stiff natural soil at the downslope side of the retaining pole is at least 4D in width, where ‘D’ is the diameter of the bored hole.

Retaining walls located within 5.0m of ground inclined steeper than 1V:3H need to be designed to account for potential soil creep movement. The site soils should not be relied upon to provide any lateral resistance over the upper 0.8m of pile length (or 4D, whichever is deeper) to account for a potential loss of lateral support. Lateral loads (resulting from soil creep) acting on the upper 0.8m of pile length should be calculated as follows:

- γ = 18kN/m^3
- K_o or K_a calculated using an internal friction angle of 32°
- A width of 3D (where D = bored hole diameter) centred on the pile (Note: this does not connote a barrier pile configuration, it is the width of the tributary plane acting on the individual pile).

As described in Section 10.0, depending on the final location of the proposed south-easternmost buildings within the Stage 3 area, a barrier pile/palisade wall may be required along the south-eastern boundary, and partially along the southern boundary. The design parameters provided in Table 7.0 are not suitable for design of such a wall – Design parameters and recommendations for a barrier pile/palisade wall will be provided following additional geotechnical investigation and stability analysis within the Stage 3 area.

15.0 Stormwater

Concentrated stormwater flows must not be allowed to run onto or over slopes or saturate the ground as this could adversely affect slope stability or foundation conditions. Flows from all impermeable areas must be collected and carried in sealed pipes to a disposal point approved by Council.

16.0 Underground Services

Underground services, public or private, mapped or unmapped, of any type (gas, pipelines, fibre, electricity etc) may be present within the site. A thorough service-search should be carried out prior to commencement of excavations.

In addition, care must be taken when any works occur below or adjacent to the existing overhead power lines that traverse the site. We understand these lines may be diverted as part of the proposed development.

17.0 Construction Constraints

Geotechnical aspects of construction that are anticipated to require special attention by the Contractor and inspecting Geotechnical Engineer include (but are not necessarily limited to) the following:

- Pile or Foundation bores potentially penetrating the groundwater table. Pumps capable of handling slurry-rich material will be required for any proposed deep piles.
- Temporary unsupported cuts – Refer to Section 13.0.
- The site soils are generally moderately sensitive and have the potential to exhibit a significant strength reduction when disturbed or exposed to the weather. Care is therefore required to protect the exposed soils during construction. Refer to Section 8.0.
- Existing overhead power lines traverse the site.

18.0 Further Geotechnical Investigation Requirements

Further geotechnical investigation and analysis is recommended prior to detailed design, as summarised below:

- Laboratory-based soil expansivity testing should be carried out on soil samples retrieved from across the site in order to confirm the soil expansivity classification inferred in Section 7.0. This testing will inform embedment depth requirements of shallow foundations.
- Further geotechnical investigation involving machine drilling is required within the proposed Stage 3 area, once access to this area is possible following clearance of the dense bush. This will allow a refined stability analysis to be carried out which will inform foundation and retaining requirements for the proposed Stage 3 buildings.
- If significant cuts are proposed (e.g. >3.5m) which may penetrate the natural groundwater level, installation of piezometers at these locations, monitoring of groundwater levels, and subsequent groundwater drawdown and settlement analysis may be required.

19.0 Drawing Review

No detailed drawings of the proposed development were provided at the time of preparation of this report. We recommend once initial plans are available that they be submitted to S&RC so that the applicability and implementation of the recommendations made in this report can be confirmed prior to application for Building Consent for Stages 1 and 2. Stage 3 requires further geotechnical investigation and stability analysis prior to design – Refer to Section 18.0.

20.0 Observation of Construction

The recommendations given in this report are based on limited site data from discrete locations and it is in the nature of geotechnical engineering that variations in ground conditions will exist across a site. S&RC should be engaged to inspect excavations and foundation conditions exposed during construction so that ‘actual’ ground conditions can be compared with those assumed in formulating this report.

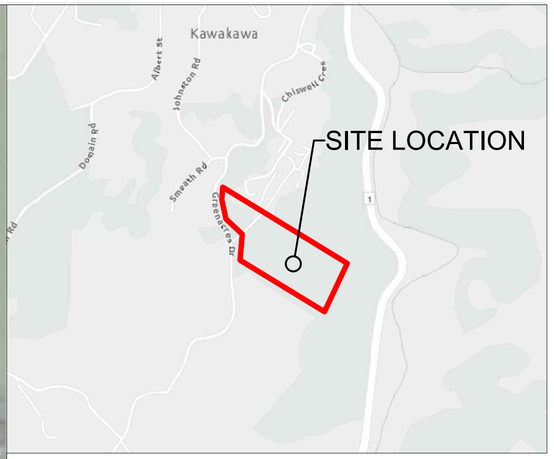
The aspects of the development that require geotechnical observation, testing, and final certification will be determined by Council and given in the Special Conditions of the Consent. The Contractor should make themselves familiar with those conditions and ensure adequate observations are carried out. In any case, the contractor should notify S&RC should ground conditions encountered during construction vary from those described in this report.

Any ground covered by fill or concrete prior to geotechnical inspection will be specifically excluded from completion certification (PS4).

End of Report Text – Appendices Follow

Appendix A

S&RC Site Plan



LOCATION MAP

NOTES:

1. Locations of features approximate only.
2. Location of all buried services to be verified prior to construction.
3. Original sheet size A3.
4. Boundary information on this Site plan adapted from Council Aerial Photographs and/or GIS/LINZ Data.

KEY:

▬	Site Boundary
⊕ AH01	Approximate Hand Augerhole Locations Soil & Rock Consultants, 5 Dec 2022
⊕ MB01	Approximate Machine Borehole Locations Soil & Rock Consultants, 5 Dec 2022
A ▬ — — ▬ A'	Approximate Soil & Rock Consultants Cross Section Alignments

AMENDMENTS		
DATE	REV	DESCRIPTION

Soil&Rock Consultants
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Level 1, 131 Lincoln Road, Waitakere
PO Box 21-424 Henderson, Waitakere 0650
Ph 09 835 1740 Fax 09 835 1847
www.soilandrock.co.nz

Check all dimensions and levels on site before commencing construction.
This drawing and design remains the property of Geotechnical Engineering Ltd. and may not be reproduced without the written permission of Geotechnical Engineering Ltd.

TE MATAORA PROJECT

GREENACRES DRIVE, KAWAKAWA, NORTHLAND

SITE PLAN

NL220114 / 1	DRAWN: SV	DATE: Jan2023	
SCALES: 1: 1500 AT A3	CHECKED:		REV.
	DESIGNED:		
Filename: nl220114 - site plan final - jan2023.dwg			

Appendix B

Investigation Logs

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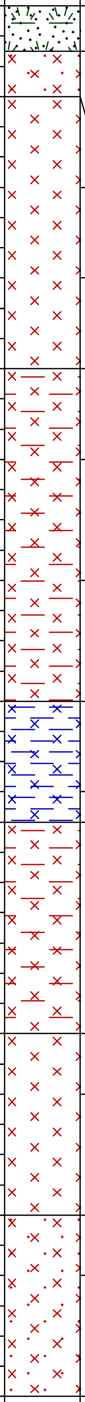
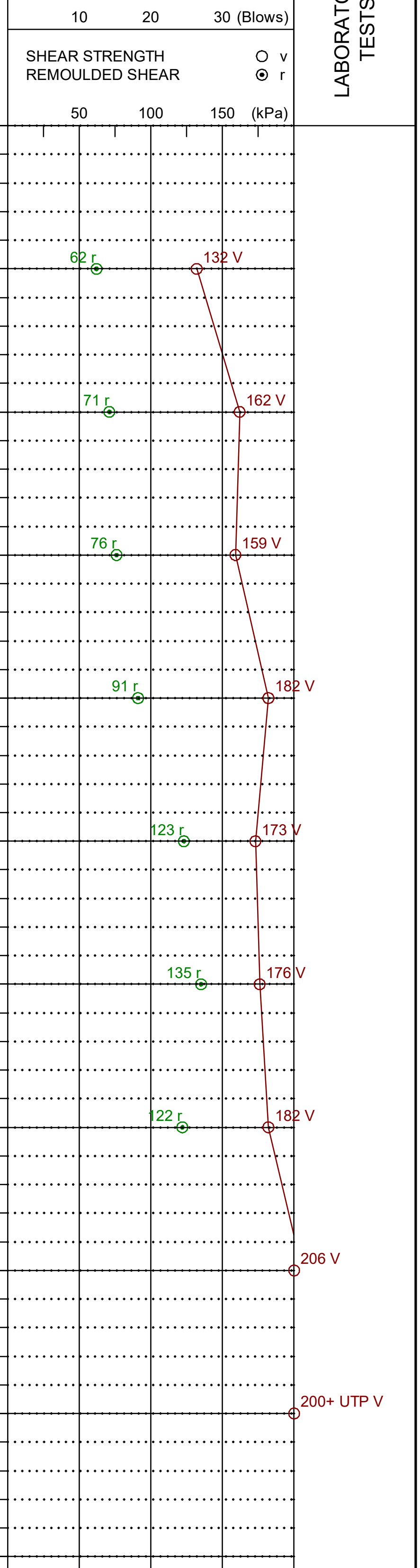
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH01
Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	5/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Grass
Date Finished:	5/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) ● / SHEAR STRENGTH ○ v / REMOULDED SHEAR ⊙ r	LABORATORY TESTS
TS	0.0		TOPSOIL		0.0		
TE KUITI GROUP			fine to coarse sandy SILT, trace clay, white, brown speckles, very stiff, moist, non plastic (WEATHERED KAMO COAL MEASURES SOILS)				
	0.5		SILT, some clay, some fine to medium sand, yellowish orange, light grey speckles, very stiff, moist, slightly plastic		0.5		
			black speckles				
	1.0		light orange mottles		1.0		
			clayey SILT, minor fine sand, white, orange white, very stiff, moist, moderately plastic				
	1.5		black speckles		1.5		
	2.0		fine to medium sand		2.0		
	2.5		silty CLAY, trace fine sand, light orange, white speckles, reddish pink streaks, very stiff, moist, highly plastic		2.5		
			no reddish pink				
	3.0		clayey SILT, minor fine sand, light orange, white streaks, very stiff, moist, moderately plastic		3.0		
	3.5		SILT, some clay, some fine to medium sand, orange, white and reddish pink streaks, very stiff, moist, slightly plastic		3.5		
			no reddish pink streaks				
	4.0		fine to coarse sandy SILT, minor clay, orange, white streaks, hard, moist, slightly plastic		4.0		
	4.5		white speckles		4.5		
			END OF BORE. 4.60 METRES. (TOO HARD TO AUGER)				
	5.0				5.0		





HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Auger Hole No:	AH02
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet	1 of 1

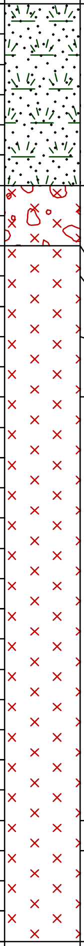
Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO3565 - 20/05/2022
Date Started:	5/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	5/12/22	Water Level:	NOT ENCOUNTERED		

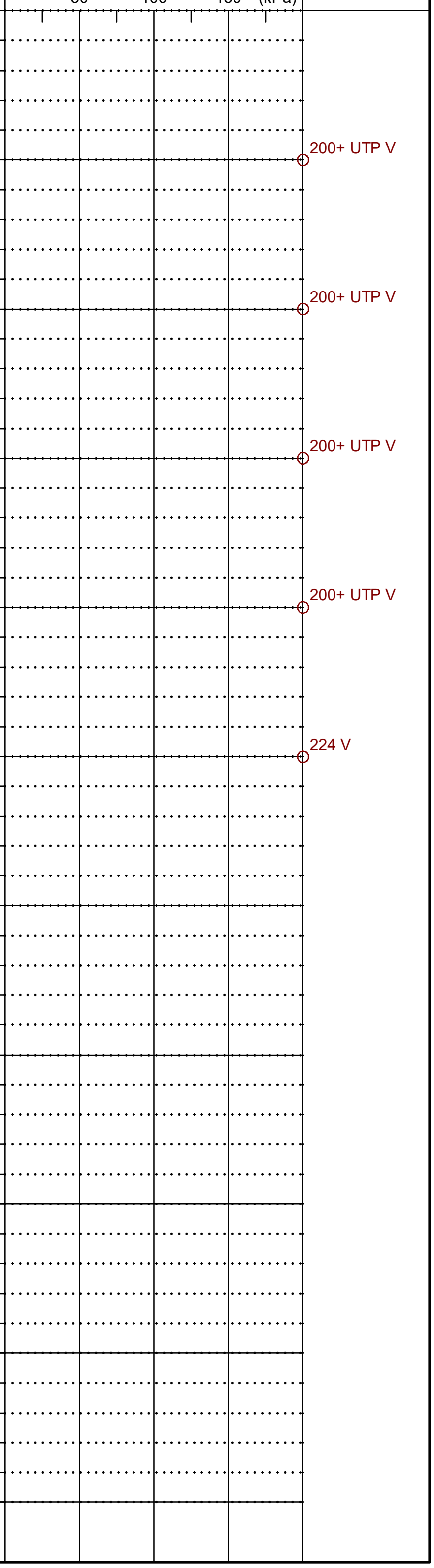
Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r
50 100 150 (kPa)

STRATIGRAPHY	DEPTH (m)	Soil description	LABORATORY TESTS
TS	0.0	TOPSOIL	
TE KUITI GROUP	0.6	fine to coarse gravelly SILT, some clay, trace fine sand, orange, light brown grey, white mottles, hard, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)	
	0.8	SILT, some fine to coarse angular gravel, some clay, trace fine sand, orange brown trace grey mottles, hard, moist, slightly plastic	
		minor fine to coarse angular gravel, minor fine sand	
		some fine to coarse angular gravel	
	1.3	trace fine to coarse angular gravel, some fine to medium sand	
	2.7	minor clay, grey	
	2.8	grey, pink streaks	
	3.1	END OF BORE. 3.10 METRES. (TOO HARD TO AUGER)	





WATER LEVEL (m)

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CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH03

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO3565 - 20/05/2022
Date Started:	5/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	5/12/22	Water Level:	NOT ENCOUNTERED		

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r
50 100 150 (kPa)

STRATIGRAPHY	DEPTH (m)	Soil description	WATER LEVEL (m)	SHEAR STRENGTH	LABORATORY TESTS
TS	0.0	TOPSOIL			
		some fine to medium angular gravel inclusions			
TE KUITI GROUP	0.5	SILT, some fine to medium angular gravel, some clay, minor fine sand, yellowish orange, light grey mottles, brown speckles, hard, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)		200+ UTP V	
		light grey, yellowish brown mottles			
	1.0			200+ UTP V	
		some clay, minor fine sand			
	1.5			200+ UTP V	
		some fine to coarse sand, orange			
		END OF BORE. 1.80 METRES. (TOO HARD TO AUGER)			
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				

HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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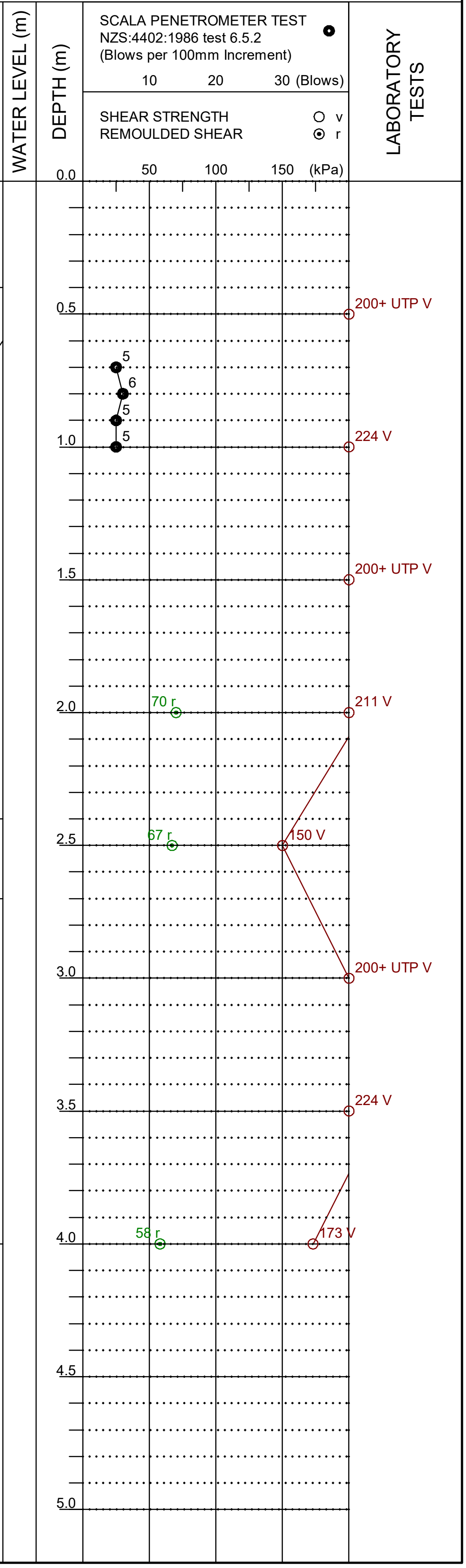
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH04
Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO3565 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
TS	TOPSOIL
TE KUITI GROUP	fine to medium SAND, some silt, yellowish white speckles, medium dense, moist, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)
	SILT, trace clay, some fine sand, orangish brown, yellowish white speckles, hard, moist, slightly plastic, non-plastic
	minor clay, slightly plastic
	light grey, orange streaks
	minor fine to medium sand
	some clay
	orange streaks
	clayey SILT, minor fine sand, grey, orange streaks, hard, moist, moderately plastic
	SILT, some clay, minor fine sand, light grey, orange streaks, hard, moist, slightly plastic
	fine to medium angular gravel
	some fine to medium sand
	END OF BORE. 4.00 METRES. (TARGET DEPTH)



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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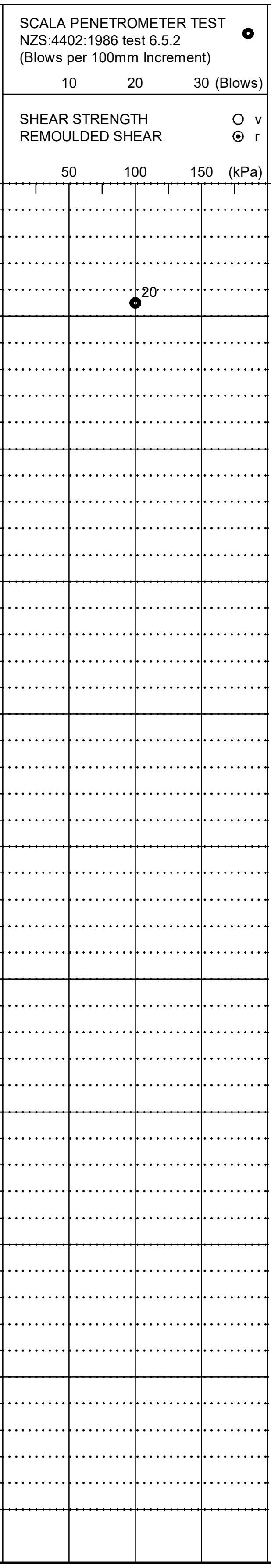
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH05
Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Near Level, Soil
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	LABORATORY TESTS
T	0.0		TOPSOIL		0.0	
TK G			fine to coarse SAND, minor silt, white, very dense, moist, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)			
	0.5		END OF BORE. 0.40 METRES. (TOO DENSE TO AUGER)		0.5	
	1.0				1.0	
	1.5				1.5	
	2.0				2.0	
	2.5				2.5	
	3.0				3.0	
	3.5				3.5	
	4.0				4.0	
	4.5				4.5	
	5.0				5.0	



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

Soil&Rock Consultants
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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

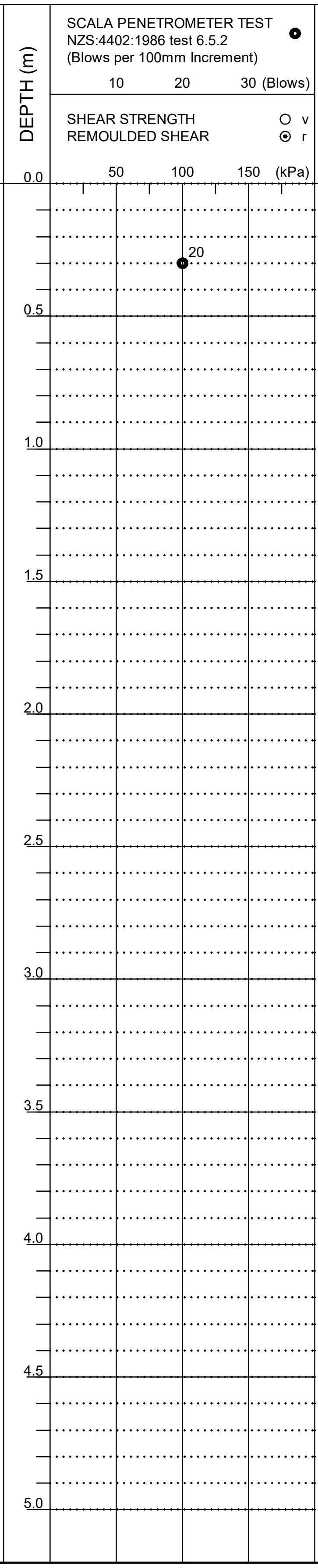
PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH06

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO3565 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	LABORATORY TESTS
TK	0.0		SILT, some clay, trace fine sand, brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)		
			fine to medium SAND, minor silt, minor clay, grey, dark brown speckles, very dense, moist		
			END OF BORE. 0.30 METRES. (TOO DENSE TO AUGER)		



Soil&Rock Consultants
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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

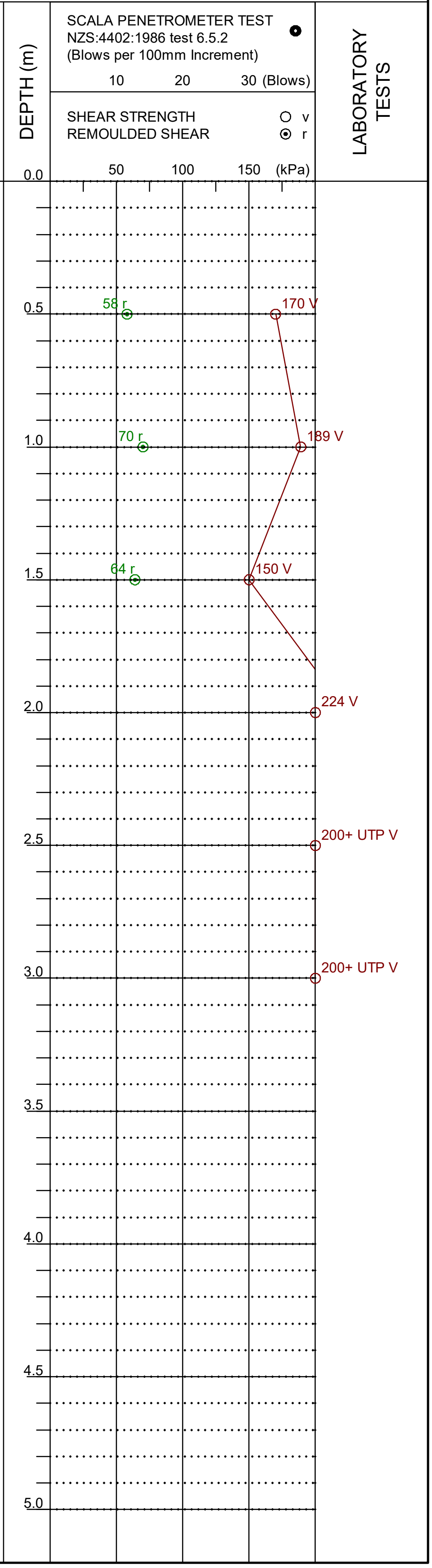
Auger Hole No: AH07

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO3565 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
	TOPSOIL
TE KUITI GROUP	SILT, some clay, minor fine sand, brown, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS) minor clay, some fine to medium angular gravel, yellowish orange, white mottles minor fine to medium angular gravel trace fine to medium angular gravel
	clayey SILT, minor fine sand, trace fine to medium angular gravel, yellowish orange, very stiff, moist, moderately plastic minor fine to coarse sand, white specks
	SILT, some clay, trace fine sand, minor silt inclusions, light grey, orangish brown streaks, very stiff, moist, slightly plastic
	clayey SILT, trace fine sand, orange, light grey streaks, very stiff, moist, moderately plastic stiff
	SILT, some clay, trace fine sand, minor fine to medium angular gravel, light grey, yellowish orange streaks, moist, slightly plastic minor fine to medium sand some fine to medium sand, some fine to medium angular gravel minor fine to medium sand, minor fine to medium angular gravel
	END OF BORE. 3.00 METRES. (TOO HARD TO AUGER)

WATER LEVEL (m)



LABORATORY TESTS

HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

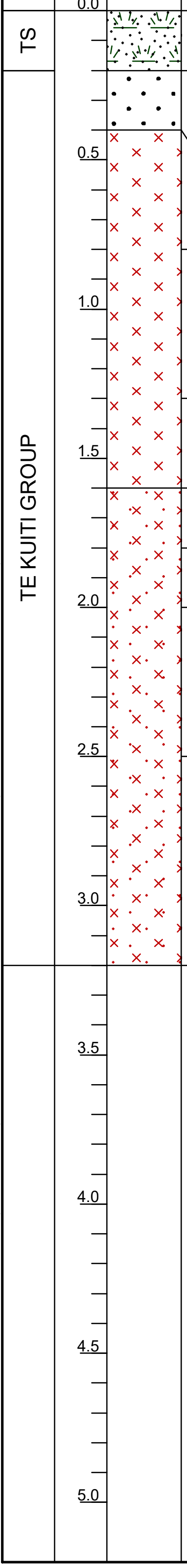
Auger Hole No: AH08

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

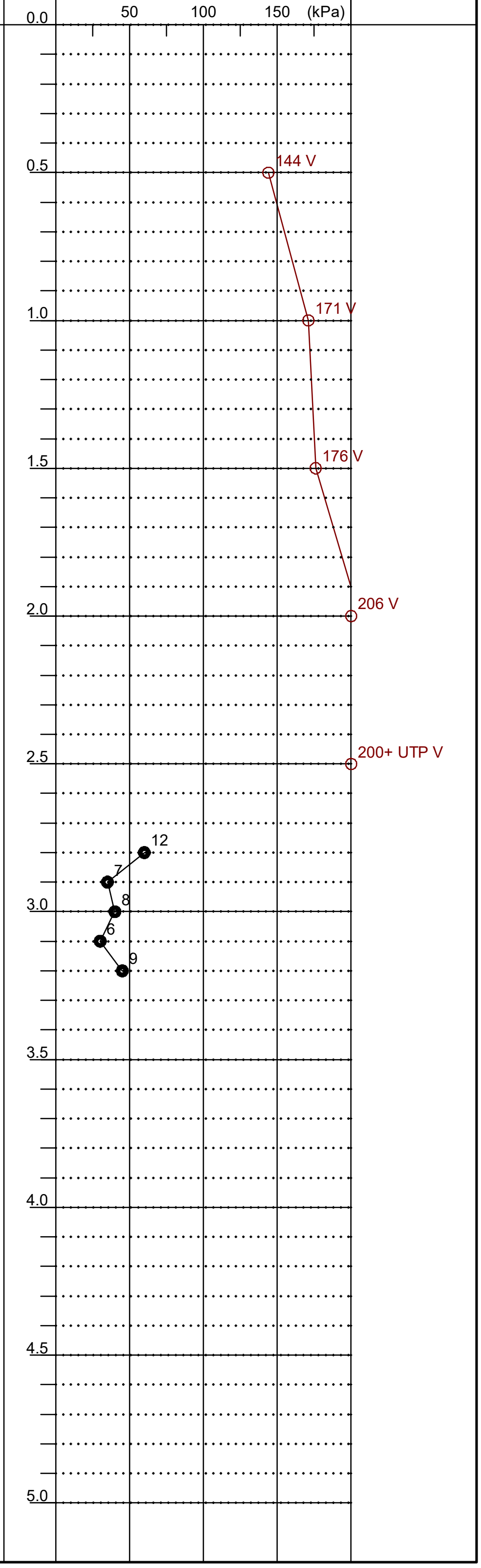
STRATIGRAPHY	Soil description
TS	TOPSOIL
TE KUITI GROUP	fine to medium SAND, some silt, white, light grey, medium dense, moist, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)
	SILT, some clay, some fine to medium sand, light grayish orange, very stiff, moist, slightly plastic
	orange patches
	whitish grey mottles
	fine to medium sandy SILT, minor clay, white, orange streaks, very stiff, moist
	orange patches
	some fine to coarse sub-rounded angular gravel, whitish grey
	hard
	END OF BORE. 3.20 METRES. (TOO HARD TO AUGER)



WATER LEVEL (m)

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r



LABORATORY TESTS

HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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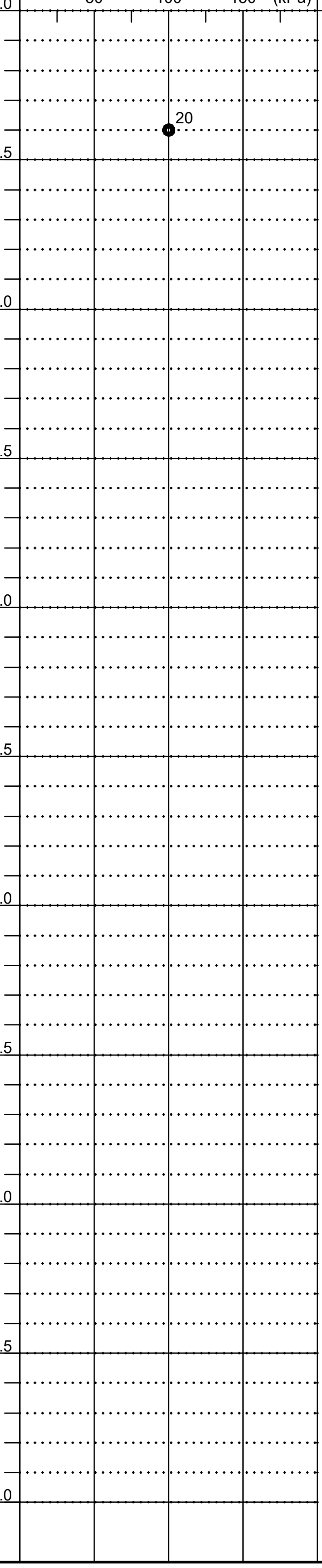
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Auger Hole No: AH09
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Near Level, Grass
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	LABORATORY TESTS
T	0.0		TOPSOIL		0.0	
TK G			fine to course SAND, minor silt, white, very dense, dry, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)			
	0.5		END OF BORE. 0.40 METRES. (TOO DENSE TO AUGER)		0.5	
	1.0				1.0	
	1.5				1.5	
	2.0				2.0	
	2.5				2.5	
	3.0				3.0	
	3.5				3.5	
	4.0				4.0	
	4.5				4.5	
	5.0				5.0	

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r
50 100 150 (kPa)



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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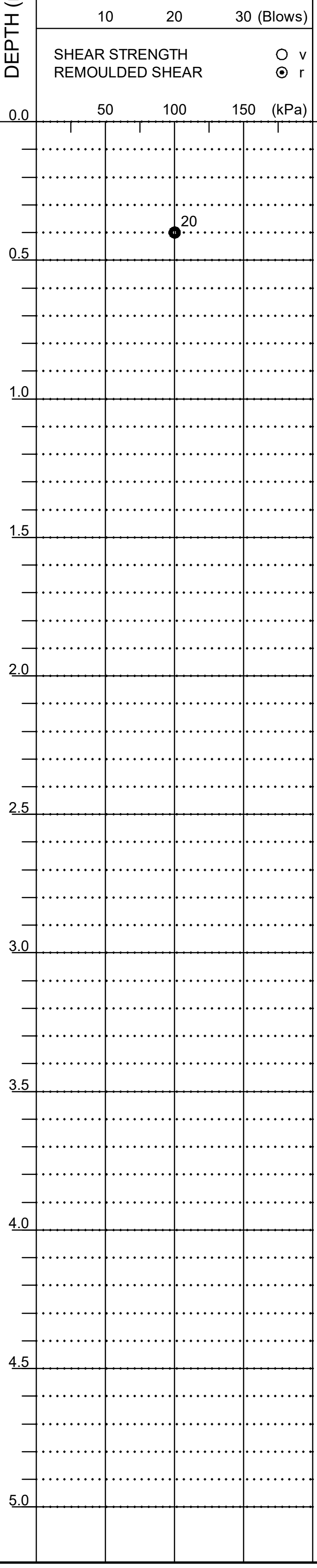
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Auger Hole No: AH10
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Grass
Date Finished:	6/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	LABORATORY TESTS
TS	0.0		TOPSOIL		
TK			fine to coarse SAND, minor silt, white, light grey speckles, very dense, dry, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)		
	0.5		END OF BORE. 0.40 METRES. (TOO DENSE TO AUGER)		
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r



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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH11

Sheet 1 of 1

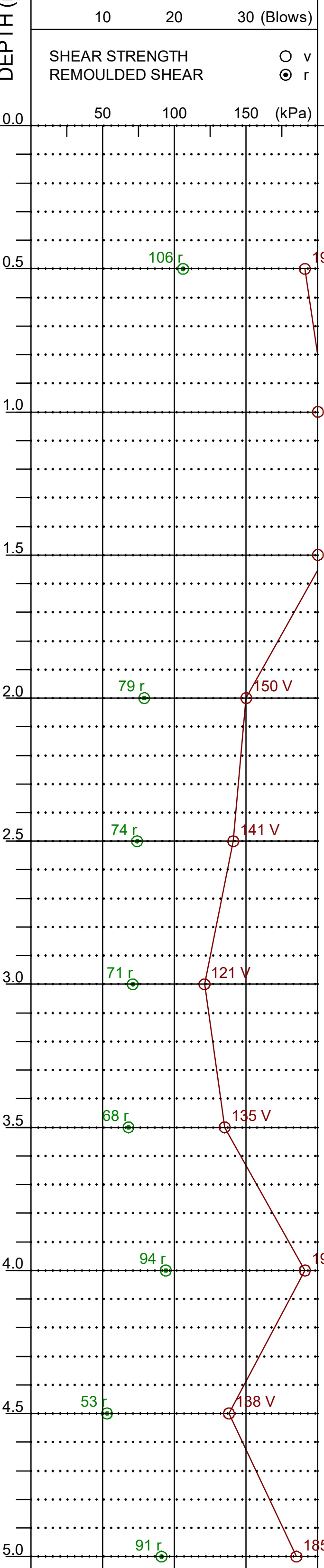
Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Grass
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
TS	0.0		TOPSOIL	
TE KUITI GROUP			SILT, some fine to medium sand, minor clay, orange, white speckles, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)	
	0.5		clayey SILT, some fine sand, orange, very stiff, moist, moderately plastic	
			yellowish orange speckles	
	1.0			
			SILT, some clay, some fine to medium sand, orange, white streaks, very stiff, moist, slightly plastic	
			white and dark orange mottles	
	1.5			
			some fine to medium sand	
			white with pink streaks	
	2.0		clayey SILT, minor fine sand, white, pink streaks, very stiff, moist, moderately plastic	
	2.5			
			some fine to medium sand, light orange speckles	
	3.0		wet	
			silty CLAY, trace fine sand, white, pink mottles. very stiff, wet, highly plastic	
	3.5		clayey SILT, minor fine sand, yellowish orange, white streaks, very stiff, wet, moderately plastic	
	4.0			
	4.5			
			reddish pink	
	5.0		END OF BORE. 5.00 METRES. (TARGET DEPTH)	

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⦿ r

LABORATORY TESTS



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www.soilandrock.co.nz

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH12

Sheet 1 of 1

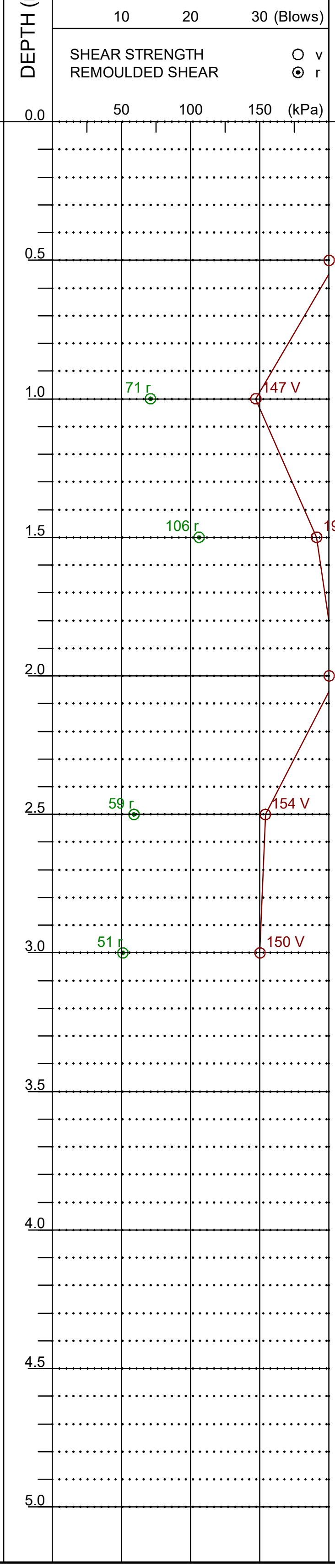
Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	DEG
Drilled By:	DEG	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Near Level, Grass
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
TS	TOPSOIL
TE KUITI GROUP	SILT, some fine sand, some clay, dark orange, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS) orange, dark orange
	clayey SILT, minor fine sand, orange, very stiff, moist, moderately plastic trace fine sand
	orange, yellowish orange
	orange, yellow, pink trace fine to coarse sand
	SILT, some clay, some fine to medium sand, trace coarse sand, trace fine to medium angular gravel, orange, yellow, pink, very stiff, moist, slightly plastic
	END OF BORE. 3.00 METRES. (TARGET DEPTH)

DEPTH (m): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r



LABORATORY TESTS

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH13

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	DEG
Drilled By:	DEG	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	8/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Grass
Date Finished:	8/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY | DEPTH (m) | GRAPHIC LOG | Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use" | WATER LEVEL (m) | DEPTH (m) | LABORATORY TESTS

TS

TOPSOIL

TE KUITI GROUP

fine to coarse SAND, some silt, dark orangish brown, hard, moist, non-plastic (WEATHERED KAMO COAL MEASURES SOILS)

SILT, some clay, minor fine sand, dark orange, hard, moist, slightly plastic
very stiff

clayey SILT, trace fine to coarse sand, yellow, orangish yellow, very stiff, moist, moderately plastic
trace fine angular gravel
no gravel, light orange, yellow

minor fine sand, orange, pink, yellow, dark orange

SILT, some fine to medium sand, some clay, light grey, orange, pink, yellow, very stiff, moist, slightly plastic

some clayey SILT, trace fine sand, moderately plastic (layers to 20mm thick)

clayey SILT, trace fine sand, alternating with SILT, some fine sand, some clay, orange, pink, dark orange, very stiff, moist, slightly plastic

pink, some orange streaks

SILT, some clay, minor fine sand, some layers of clayey SILT to 20mm thick, pink, some light grey streaks, very stiff, moist, slightly plastic

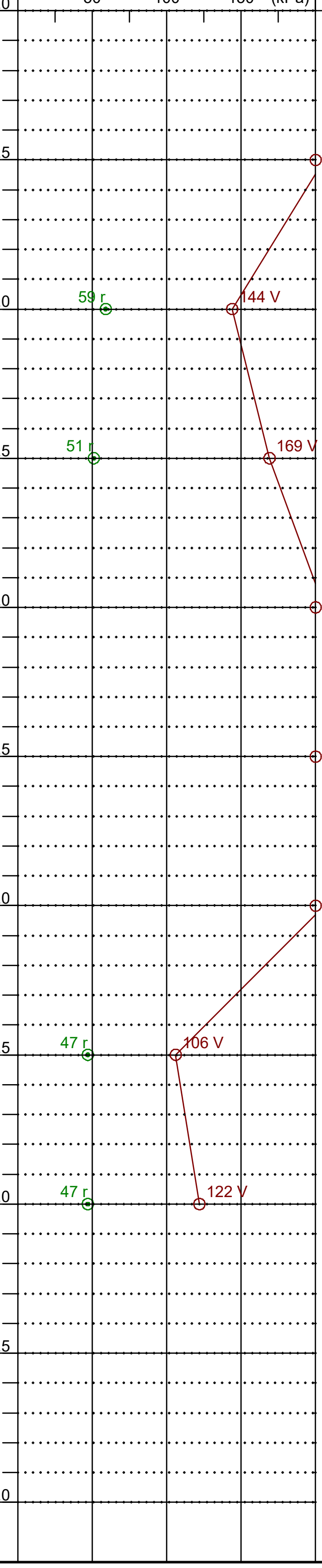
orange, dark orange, pink

trace fine to coarse sand

END OF BORE. 4.00 METRES.
(TARGET DEPTH)

SCALA PENETROMETER TEST ●
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH ○ v
REMOULDED SHEAR ⊙ r
50 100 150 (kPa)



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH14

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Near Level, Soil
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY | DEPTH (m) | GRAPHIC LOG | Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use" | WATER LEVEL (m) | DEPTH (m) | LABORATORY TESTS

TE KUITI GROUP

TOPSOIL

SILT, some clay, minor fine sand, grayish brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)

yellowish orange mottles

light grey, yellowish orange streaks

minor fine to medium angular gravel, orange mottles

pink streaks

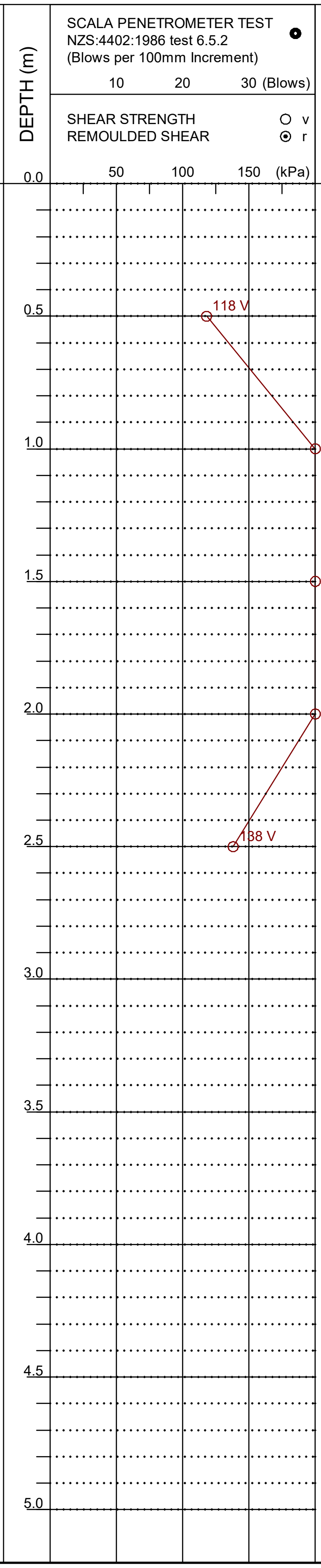
some fine to medium sand

orangish brown patches

fine to medium sandy SILT, minor clay, light grey, orange speckles, hard, moist, slightly plastic

SILT, minor fine to medium sand, some clay, light grey, orangish brown, hard, moist, slightly plastic

END OF BORE. 3.00 METRES.
(TARGET DEPTH)



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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

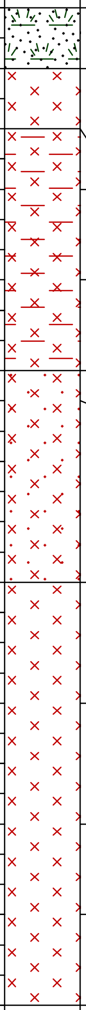
PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

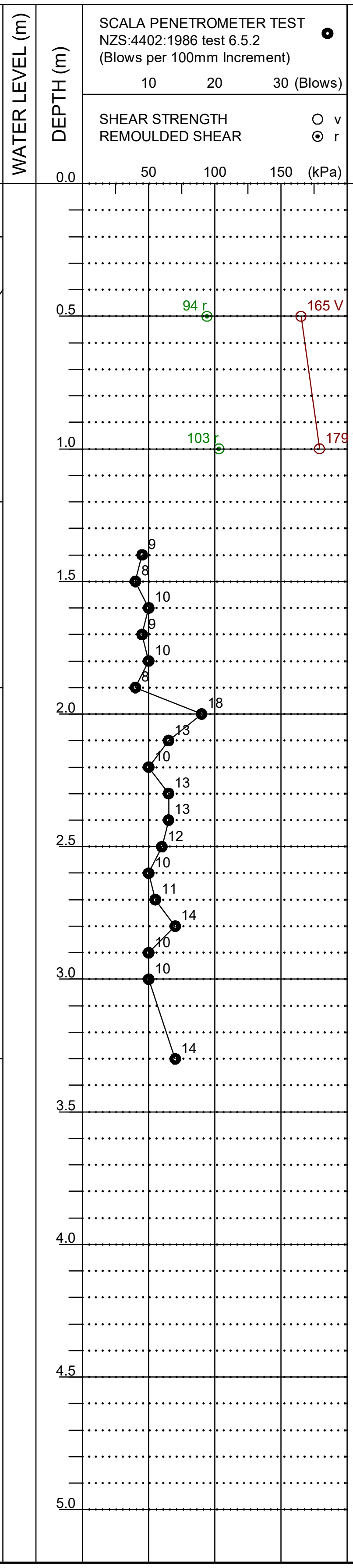
Auger Hole No: AH15

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Grass
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
TS	TOPSOIL
TE KUITI GROUP	SILT, some fine to medium sand, minor clay, dark grayish brown,orange streaks, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)
	clayey SILT, some fine sand, orange, yellowish orange streaks, very stiff, moist, moderately plastic white speckles some fine to coarse sub-rounded angular gravel, light grey
	fine to medium sandy SILT, minor clay, whitish orange, light grey streaks, very stiff, moist, slightly plastic light orange mottles
	SILT, some clay, some fine to medium sand, some fine to coarse sub-rounded angular gravel, white, orange streaks, light grey speckles, very stiff, moist, slightly plastic light orange, white patches white, reddish pink streaks greenish grey streaks
	END OF BORE. 3.30 METRES. (TOO DENSE TO AUGER)





LABORATORY TESTS

Soil&Rock Consultants
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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH16

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	8/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	8/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) ● 10 20 30 (Blows) SHEAR STRENGTH ○ v REMOULDED SHEAR ⊙ r 50 100 150 (kPa)	LABORATORY TESTS
	0.0	TOPSOIL			
TE KUITI GROUP		SILT, some clay, trace fine sand, grayish brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS) yellowish grey, grey			
	0.5	fine to medium sandy SILT, trace clay, orange, orangish brown, white speckles, hard, moist, non-plastic		200+ UTP V	
	1.0	END OF BORE. 0.85 METRES. (TOO HARD TO AUGER)			
	1.5				
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				

HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH17

Sheet 1 of 1

Drill Type: 50mm Hand Auger
Drilled By: KMAC
Date Started: 8/12/22
Date Finished: 8/12/22

Project No: NL220114
Coordinates:
Ground Elevation:
Water Level: NOT ENCOUNTERED

Logged By: KMAC
Shear Vane No - Calibration Date: GEO2239 - 20/09/2022
Surface Conditions: Near Level, Soil

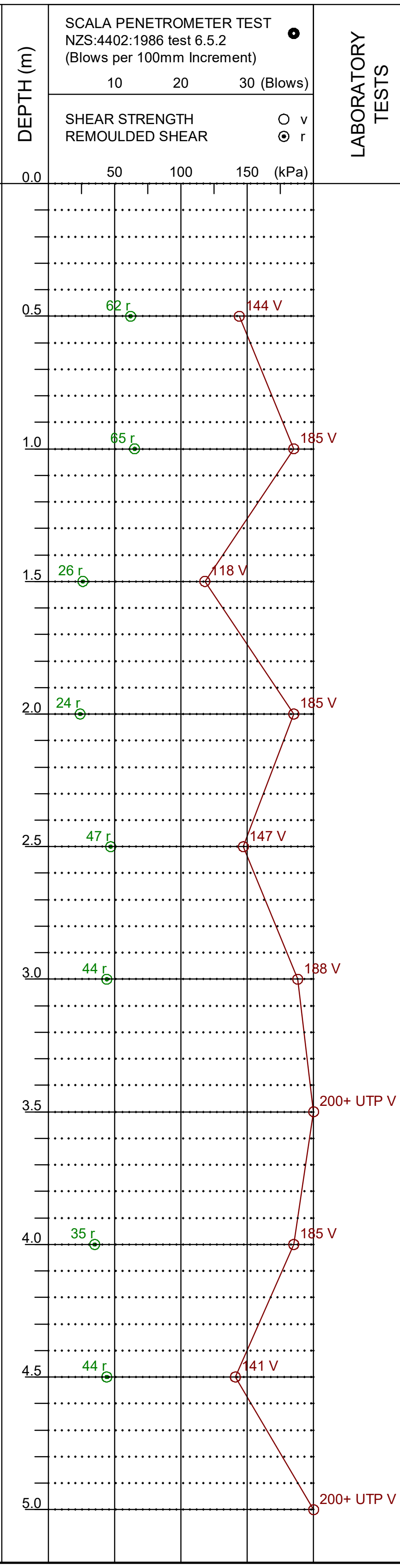
STRATIGRAPHY | DEPTH (m) | GRAPHIC LOG | Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use" | WATER LEVEL (m) | DEPTH (m) | LABORATORY TESTS

TE KIUTI GROUP

0.0 – 5.0

SILT, some clay, trace fine sand, grayish brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)
yellowish orange mottles, grey mottles
minor fine sand, yellowish orange
pinkish red streaks
light orange mottles, very stiff
pinkish red, light orange mottles
white mottles
orange, light pinkish red streaks, stiff
pink, white specks, light orange, mottles
light grey, orange mottles
pink, white mottles, orangish brown mottles
minor clay, some fine sand, very stiff
some clay
brown streaks
orangish pink, orangish brown streaks
minor clay, orangish brown, light grey streaks
minor fine sand inclusions
link pink streaks
pinkish red
brown streaks

END OF BORE. 5.00 METRES.
(TARGET DEPTH)



0.5	62 r	144 V
1.0	65 r	185 V
1.5	26 r	118 V
2.0	24 r	185 V
2.5	47 r	147 V
3.0	44 r	188 V
3.5		200+ UTP V
4.0	35 r	185 V
4.5	44 r	141 V
5.0		200+ UTP V

HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

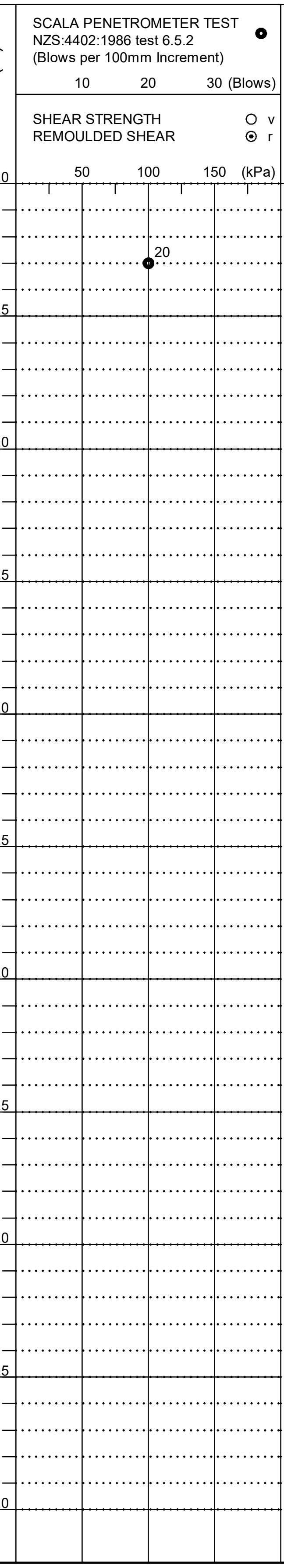
PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH18

Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	LABORATORY TESTS
	0.0		TOPSOIL		
TK			SILT, some fine sand, some clay, minor fine sand, brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)		
			fine to medium gravelly SILT, some fine sand, trace clay, grey, brown, white speckles, hard, moist, slightly plastic		
			END OF BORE. 0.20 METRES. (TOO HARD TO AUGER)		



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

Soil&Rock Consultants
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CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH19
Sheet 1 of 1

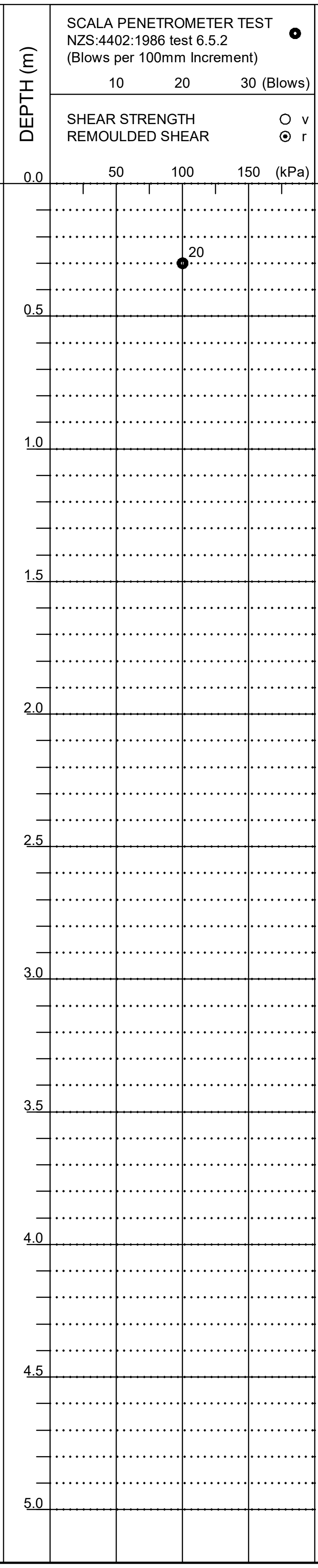
Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	KMAC
Drilled By:	KMAC	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	7/12/22	Water Level:	NOT ENCOUNTERED		

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

STRATIGRAPHY	DEPTH (m)	Soil description
	0.0	TOPSOIL
TK		SILT, some clay, minor fine sand, trace fine angular gravel, grayish brown streaks, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS) some fine to medium sand, hard
		END OF BORE. 0.20 METRES. (TOO HARD TO AUGER)
	0.5	
	1.0	
	1.5	
	2.0	
	2.5	
	3.0	
	3.5	
	4.0	
	4.5	
	5.0	

WATER LEVEL (m)

LABORATORY TESTS



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Auger Hole No: AH20

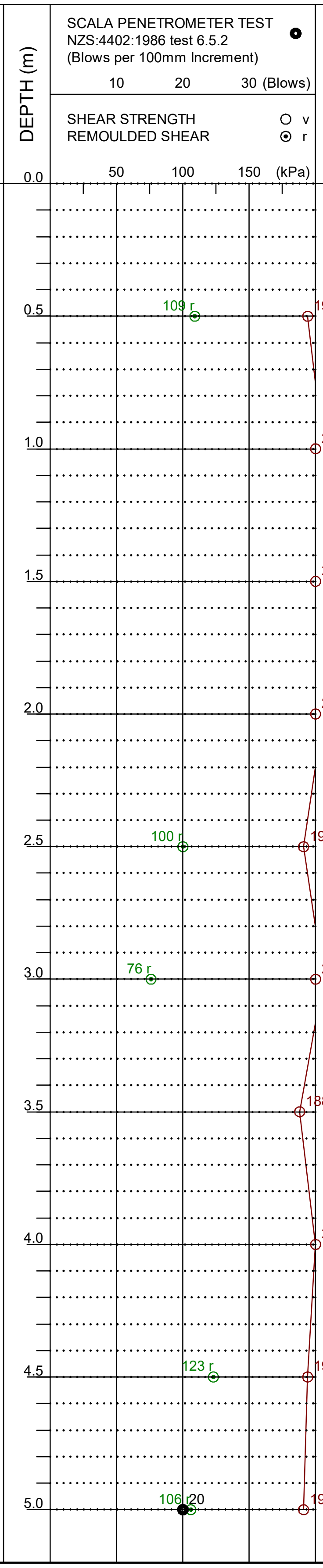
Sheet 1 of 1

Drill Type:	50mm Hand Auger	Project No:	NL220114	Logged By:	SMB
Drilled By:	SMB	Coordinates:		Shear Vane No - Calibration Date:	GEO2239 - 20/09/2022
Date Started:	8/12/22	Ground Elevation:		Surface Conditions:	Slightly Sloping, Soil
Date Finished:	8/12/22	Water Level:	NOT ENCOUNTERED		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
T	TOPSOIL
TE KUITI GROUP	SILT, some fine to medium sand, minor clay, dark orange, light orange speckles, very stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS) some clay, light orange, white speckles
	fine to medium sandy SILT, minor clay, reddish orange, dark orange streaks, very stiff, moist, slightly plastic white patches
	SILT, some fine to medium sand, minor clay, reddish orange, very stiff, moist, slightly plastic
	fine to medium sandy SILT, minor clay, light orange, white speckles, very stiff, moist, slightly plastic light grey and black speckles light yellowish orange speckles
	SILT, some fine to medium sand, some clay, white, light orange streaks, dark brown speckles, very stiff, moist slightly plastic wet yellowish orange, white speckles dark orange speckles light grey streaks hard
	fine to medium sandy SILT, trace clay, yellowish orange, dark orange speckles, very stiff, wet, non-plastic
	END OF BORE. 5.00 METRES. (TARGET DEPTH)

WATER LEVEL (m)

LABORATORY TESTS



HAND AUGER LOG WITH SCALA AH01-AH20 (GINT LOGS) - NL220114 - BAY OF ISLANDS HOSPITAL (OPP. 32 GREENACRES DRIVE) KAWAKAWA - 2022-12-05.GPJ S+R_2013.GDT 2/7/23

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www.soilandrock.co.nz

SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NO: NL220114
JOB NAME: Te Mataora Project, Kawakawa

TESTED BY: KMAC / SMB
DATE: 5-8/12/22

Depth of Penetration [mm]	AH01	AH03	cont…	AH05	AH06	AH07	AH08	AH09	AH10	AH11	AH15	AH16
DEPTH START[m] ➡	4.60	1.80	3.80	0.40	0.30	3.00	3.20	0.40	0.40	5.00	3.30	0.85
50 mm	20+	2	3	20+	20+	7	5	20+	20+	2	6	12
100		2	4			3	5			2	5	20+
150		1	13			4	5			2	5	
200		2	20+			5	3			1	5	
250		2				5	5			2	5	
300		2				7	3			3	7	
350		2				7	5			3	7	
400		2				9	5			3	9	
450		3				8	3			4	10	
500		3				10	3			4	12	
550		4				10	4			4	15	
600		3				10	3			4	20+	
650		3				10	4			4		
700		3				8	4			4		
750		4					3			5		
800		4					4			5		
850		4					5			5		
900		3					11			5		
950		2					10			7		
1000		3					10			9		
1050		3					10			20+		
1100		4					10					
1150		4										
1200		4										
1250		4										
1300		4										
1350		4										
1400		3										
1450		3										
1500		4										
1550		4										
1600		4										
1650		4										
1700		3										
1750		3										
1800		4										
1850		4										
1900		4										
1950		5										
2000		5										
DEPTH END [m] ➡	4.65	3.80	4.00	0.45	0.35	3.70	4.30	0.45	0.45	6.05	3.90	0.95

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

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SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NO: NL220114
JOB NAME: Te Mataora Project, Kawakawa

TESTED BY: KMAC / SMB
DATE: 5-8/12/22

Depth of Penetration [mm]	AH17	AH18	AH20		MB03							
DEPTH START[m]	5.00	0.20	5.00		1.60							
50 mm	4	20+	7		12							
100	3		20+		8							
150	4				3							
200	3				5							
250	4				3							
300	3				2							
350	4				3							
400	4				6							
450	3				3							
500	3				6							
550	3				10							
600	3				10							
650	6				19							
700	5				10							
750	4				10							
800	5											
850	5											
900	5											
950	5											
1000	5											
1050	7											
1100	7											
1150	4											
1200	2											
1250	2											
1300	6											
1350	7											
1400	9											
1450	7											
1500	7											
1550	8											
1600	12											
1650	10											
1700	12											
1750	12											
1800	14											
1850												
1900												
1950												
2000												
DEPTH END [m]	6.80	0.25	5.10		2.35							

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

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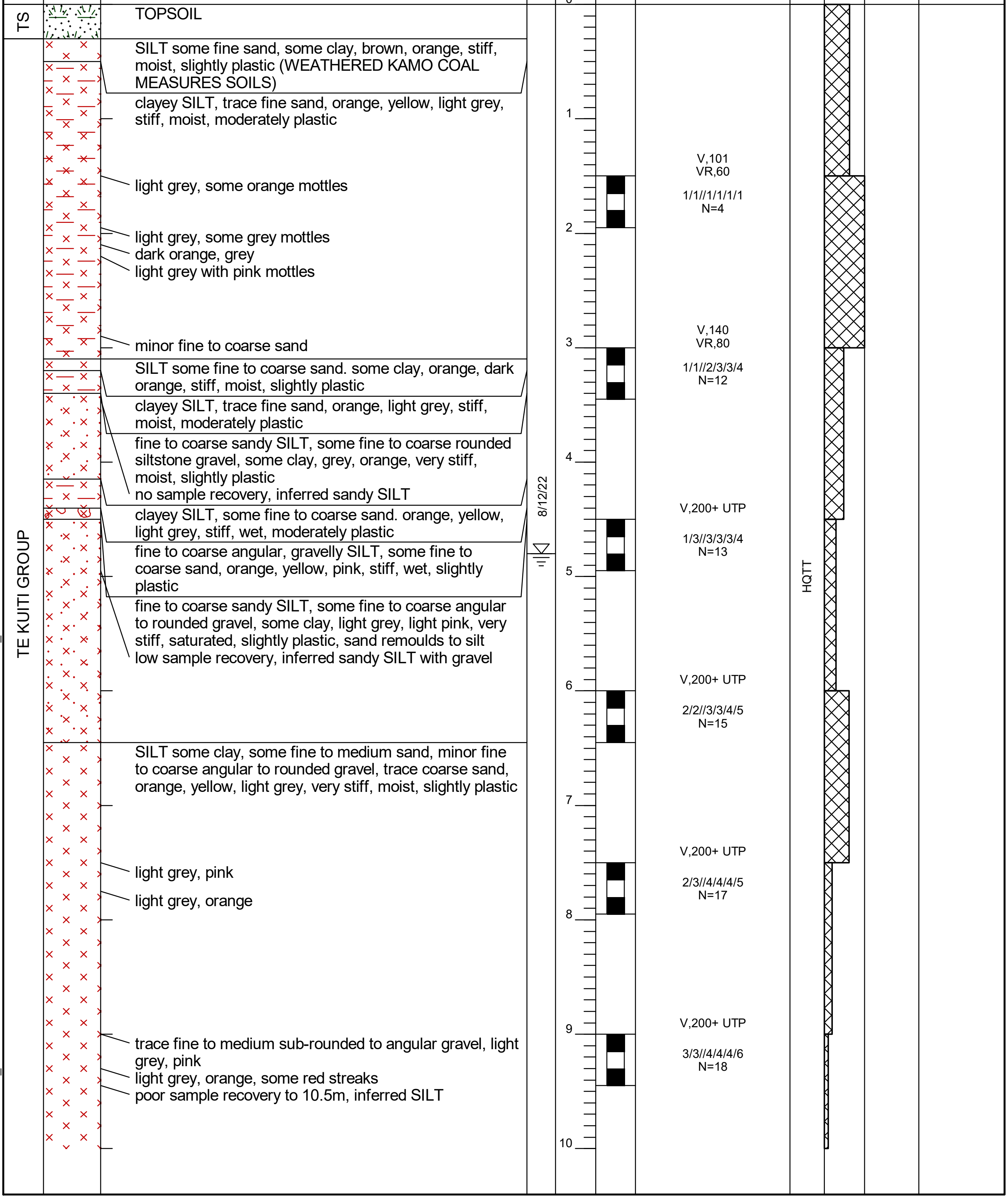
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Machine Borehole No:	MB01
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet	1 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	5/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Grass
Date Finished:	5/12/22	Water Level:	4.8m 8/12/22		

STRATIGRAPHY | GRAPHIC LOG | Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use" | WATER LEVEL (m) | DEPTH (m) | SAMPLE TYPE | C_u (kPa) / SPT (blows/300mm) | DRILLING METHOD | RECOVERY (%) | WATER CONTENT | FRACTURE DESCRIPTION



TOPSOIL

SILT some fine sand, some clay, brown, orange, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)

clayey SILT, trace fine sand, orange, yellow, light grey, stiff, moist, moderately plastic

light grey, some orange mottles

light grey, some grey mottles

dark orange, grey

light grey with pink mottles

minor fine to coarse sand

SILT some fine to coarse sand. some clay, orange, dark orange, stiff, moist, slightly plastic

clayey SILT, trace fine sand, orange, light grey, stiff, moist, moderately plastic

fine to coarse sandy SILT, some fine to coarse rounded siltstone gravel, some clay, grey, orange, very stiff, moist, slightly plastic

no sample recovery, inferred sandy SILT

clayey SILT, some fine to coarse sand. orange, yellow, light grey, stiff, wet, moderately plastic

fine to coarse angular, gravelly SILT, some fine to coarse sand, orange, yellow, pink, stiff, wet, slightly plastic

fine to coarse sandy SILT, some fine to coarse angular to rounded gravel, some clay, light grey, light pink, very stiff, saturated, slightly plastic, sand remoulds to silt

low sample recovery, inferred sandy SILT with gravel

SILT some clay, some fine to medium sand, minor fine to coarse angular to rounded gravel, trace coarse sand, orange, yellow, light grey, very stiff, moist, slightly plastic

light grey, pink

light grey, orange

trace fine to medium sub-rounded to angular gravel, light grey, pink

light grey, orange, some red streaks

poor sample recovery to 10.5m, inferred SILT

V,101
VR,60
1/1//1/1/1/1
N=4

V,140
VR,80
1/1//2/3/3/4
N=12

V,200+ UTP
1/3//3/3/3/4
N=13

V,200+ UTP
2/2//3/3/4/5
N=15

V,200+ UTP
2/3//4/4/4/5
N=17

V,200+ UTP
3/3//4/4/4/6
N=18

MACHINE LOG-FULL_SPT NL220014 MB01 - MB05 BAY OF ISLAND HOSPITAL DEC22.GPJ S+R_2013.GDT 2/7/23

CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Machine Borehole No:	MB01
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet	2 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	5/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Grass
Date Finished:	5/12/22	Water Level:	4.8m 8/12/22		

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

STRATIGRAPHY	Soil description	DRILLING METHOD
TE KUITI GROUP	SILT some clay, some fine to medium sand, minor fine to coarse angular to rounded gravel, trace coarse sand, orange, yellow, light grey, very stiff, moist, slightly plastic	
	SILT some fine to coarse sand to sandy, some clay, trace fine rounded to angular gravel, orange, light grey, very stiff, wet, slightly plastic	
	SILT some clay, some fine sand, orange, yellow, light grey, very stiff, moist, slightly plastic, sand remoulds to silt orange, yellow, light grey, red orange, yellow, light grey	
WAIPAPA GROUP	SILT some fine to coarse sand, trace clay, trace fine to medium angular gravel, orange with light grey streaks, hard, wet, non plastic, light grey streaks are extremely closely spaced relict rock fractures, fractures have random orientation (WEATHERED WAIPAPA GROUP SOILS)	HQTT
	SILT some fine to medium sand, some clay, trace coarse sand, orange, yellow, light grey, very stiff, wet, slightly plastic	
	clayey SILT, minor fine to coarse sand, orange, dark orange, yellow orange, very stiff, moist, moderately plastic for 80mm; fine to coarse sandy SILT, dark orange, orange, non plastic	
	SILT some fine to coarse sand, trace clay, trace fine to medium angular gravel, orange with light grey streaks, hard, wet, non plastic, light blue grey, orange streaks, orange streaks are extremely closely spaced relict rock fractures, fractures have random orientation	
	slightly to moderately weathered, light grey, grey, blue grey, orange, SILTSTONE, weak, extremely closely fractured, apertures tight, smooth, no infill, fractures have random orientation, core can be broken apart across fractures with handling (WAIPAPA GROUP ROCK)	SPT

END OF BORE. 15.42 METRES.
(TARGET DEPTH)

DEPTH (m): 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

C_u (kPa) / SPT (blows/300mm)
1/1//2/2/3/3 N=10
3/4//5/6/9/11 N=31
3/5//6/7/8/8 N=29
1/5//7/10/17/20 for 45mm 60 blows for 420mm penetration

WATER LEVEL (m) | SAMPLE TYPE | RECOVERY (%) | WATER CONTENT | FRACTURE DESCRIPTION

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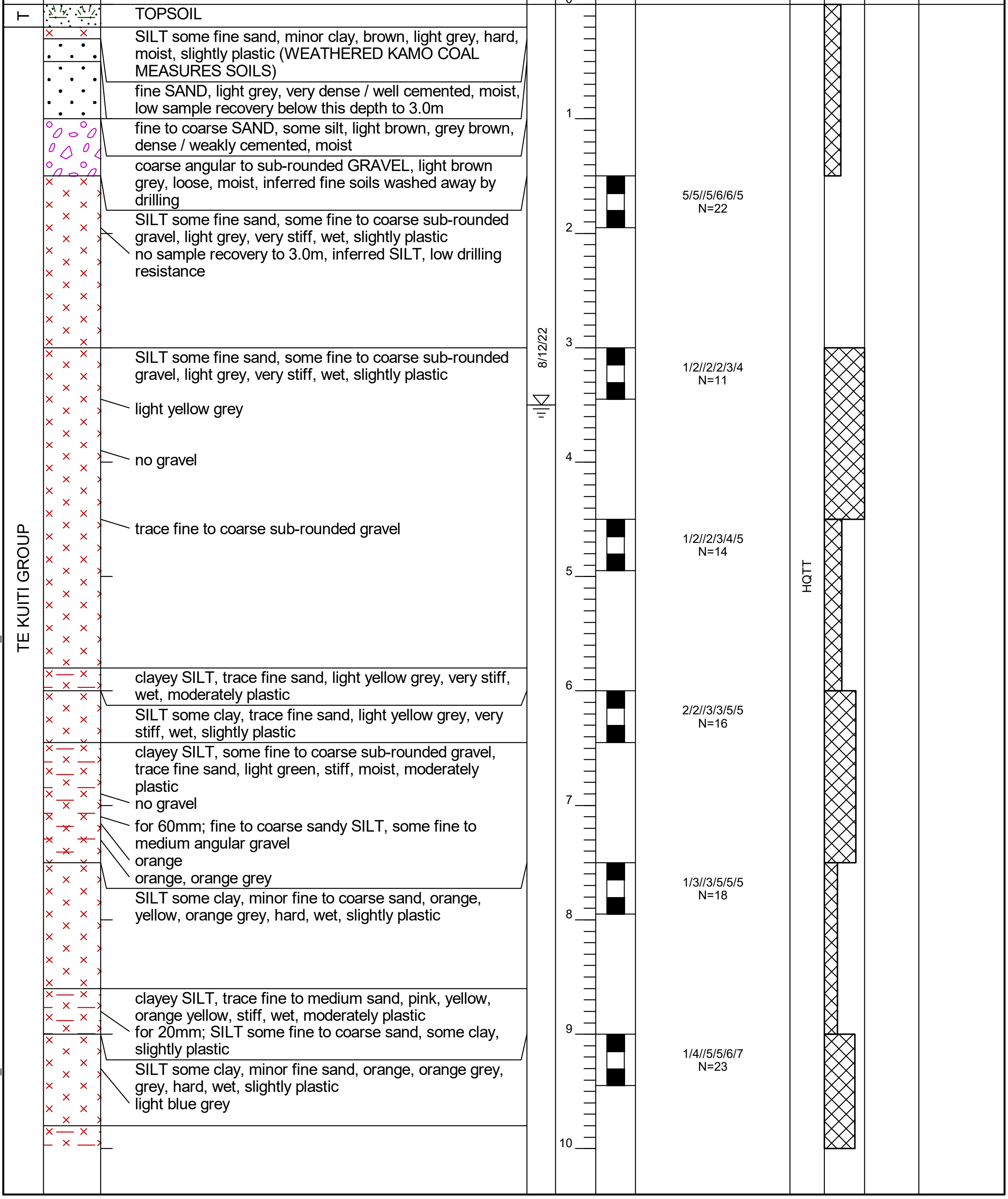
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Machine Borehole No: MB02
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet 1 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Soil
Date Finished:	6/12/22	Water Level:	3.5m 8/12/22		

STRATIGRAPHY	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	C_u (kPa) / SPT (blows/300mm)	DRILLING METHOD	RECOVERY (%)	WATER CONTENT	FRACTURE DESCRIPTION



TOPSOIL

SILT some fine sand, minor clay, brown, light grey, hard, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)

fine SAND, light grey, very dense / well cemented, moist, low sample recovery below this depth to 3.0m

fine to coarse SAND, some silt, light brown, grey brown, dense / weakly cemented, moist

coarse angular to sub-rounded GRAVEL, light brown grey, loose, moist, inferred fine soils washed away by drilling

SILT some fine sand, some fine to coarse sub-rounded gravel, light grey, very stiff, wet, slightly plastic
no sample recovery to 3.0m, inferred SILT, low drilling resistance

SILT some fine sand, some fine to coarse sub-rounded gravel, light grey, very stiff, wet, slightly plastic

light yellow grey

no gravel

trace fine to coarse sub-rounded gravel

clayey SILT, trace fine sand, light yellow grey, very stiff, wet, moderately plastic

SILT some clay, trace fine sand, light yellow grey, very stiff, wet, slightly plastic

clayey SILT, some fine to coarse sub-rounded gravel, trace fine sand, light green, stiff, moist, moderately plastic
no gravel
for 60mm; fine to coarse sandy SILT, some fine to medium angular gravel
orange
orange, orange grey

SILT some clay, minor fine to coarse sand, orange, yellow, orange grey, hard, wet, slightly plastic

clayey SILT, trace fine to medium sand, pink, yellow, orange yellow, stiff, wet, moderately plastic
for 20mm; SILT some fine to coarse sand, some clay, slightly plastic

SILT some clay, minor fine sand, orange, orange grey, grey, hard, wet, slightly plastic
light blue grey

5/5//5/6/6/5
N=22

1/2//2/2/3/4
N=11

1/2//2/3/4/5
N=14

2/2//3/3/5/5
N=16

1/3//3/5/5/5
N=18

1/4//5/5/6/7
N=23

MACHINE LOG-FULL_SPT NL220014 MB01 - MB05 BAY OF ISLAND HOSPITAL DEC22.GPJ S+R_2013.GDT 2/7/23

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CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

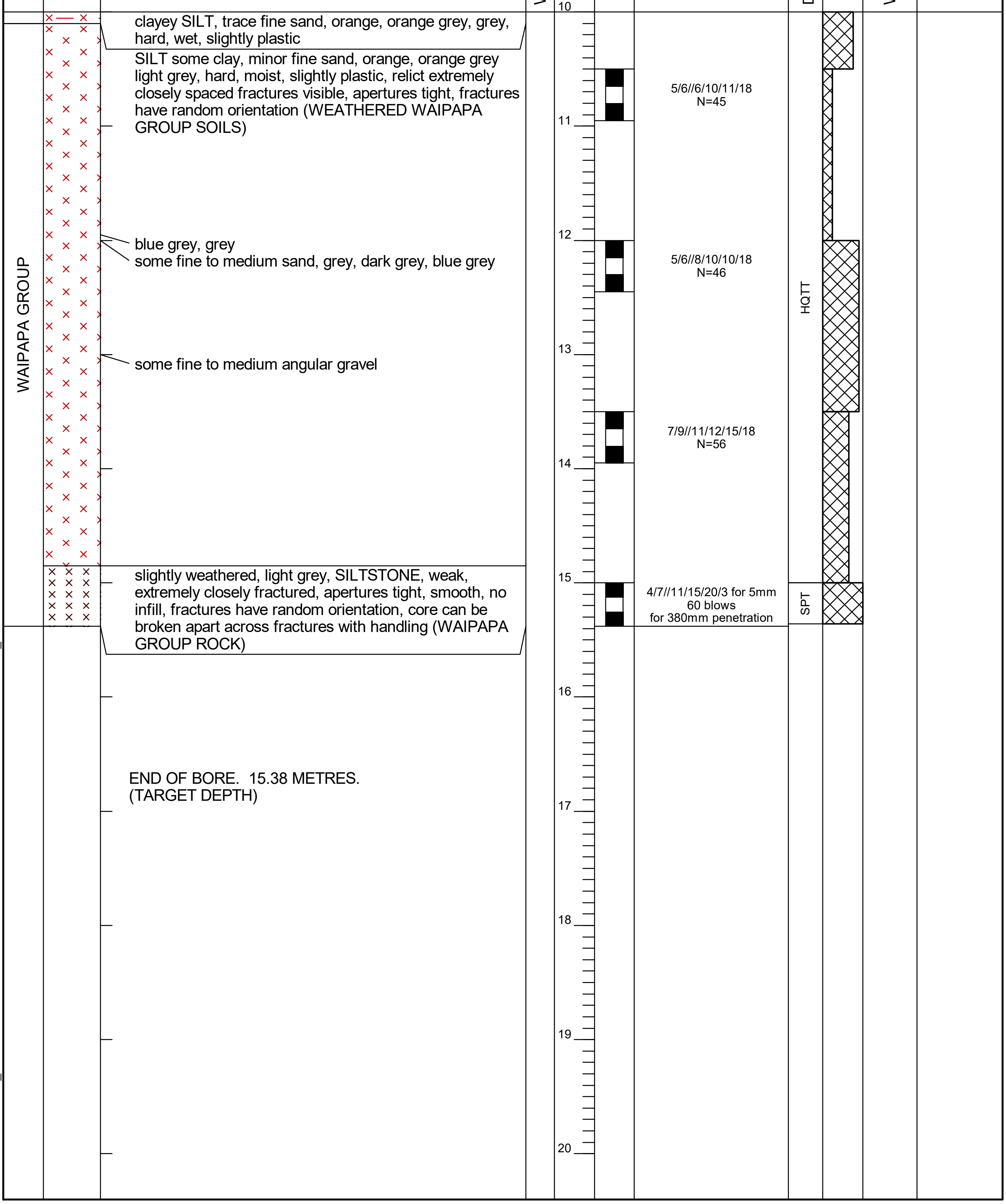
PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Machine Borehole No: MB02

Sheet 2 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Soil
Date Finished:	6/12/22	Water Level:	3.5m 8/12/22		

STRATIGRAPHY | GRAPHIC LOG | Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use" | WATER LEVEL (m) | DEPTH (m) | SAMPLE TYPE | C_u (kPa) / SPT (blows/300mm) | DRILLING METHOD | RECOVERY (%) | WATER CONTENT | FRACTURE DESCRIPTION



clayey SILT, trace fine sand, orange, orange grey, grey, hard, wet, slightly plastic

SILT some clay, minor fine sand, orange, orange grey light grey, hard, moist, slightly plastic, relict extremely closely spaced fractures visible, apertures tight, fractures have random orientation (WEATHERED WAIPAPA GROUP SOILS)

5/6//6/10/11/18
N=45

blue grey, grey

some fine to medium sand, grey, dark grey, blue grey

5/6//8/10/10/18
N=46

some fine to medium angular gravel

7/9//11/12/15/18
N=56

slightly weathered, light grey, SILTSTONE, weak, extremely closely fractured, apertures tight, smooth, no infill, fractures have random orientation, core can be broken apart across fractures with handling (WAIPAPA GROUP ROCK)

4/7//11/15/20/3 for 5mm
60 blows
for 380mm penetration

END OF BORE. 15.38 METRES.
(TARGET DEPTH)

MACHINE LOG-FULL_SPT NL220014 MB01 - MB05 BAY OF ISLAND HOSPITAL DEC22.GPJ S+R_2013.GDT 2/7/23

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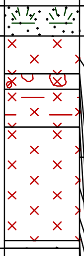
CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Machine Borehole No: MB03

Sheet 1 of 1

Drill Type: 50mm Hand Auger
Drilled By: DEG
Date Started: 7/12/22
Date Finished: 7/12/22
Project No: NL220014
Coordinates:
Ground Elevation:
Water Level: Groundwater Not Encountered
Logged By: DEG
Shear Vane No - Calibration Date: GEO3563 - 20/05/2022
Surface Conditions: Slight Slope, Weeds



STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SAMPLE TYPE	C_u (kPa) / SPT (blows/300mm)	DRILLING METHOD	RECOVERY (%)	WATER CONTENT	FRACTURE DESCRIPTION
TS	TOPSOIL		0						
TE KUITI GROUP	SILT some fine sand, brown, dark grey, stiff, wet, non plastic (WEATHERED KAMO COAL MEASURES SOILS) minor fine to coarse angular gravel, minor clay, very stiff, slightly plastic				V,134 VR,48				
	fine to coarse angular gravelly, fine to coarse SAND, white, grey, medium dense, wet		1		V,167 VR,45				
	clayey SILT, trace fine to coarse sand, dark orange, orange, very stiff, moist, moderately plastic				V,200+ UTP				
	SILT some fine sand, some clay, orange, yellow, very stiff, moist, slightly plastic some light green mottles some 20mm diameter inclusions of white fine to medium SAND, hard trace fine to coarse angular gravel		2						
	fine to coarse SAND, white, yellow, very dense, moist								
	END OF BORE. 1.60 METRES. (SOILD OBSTRUCTION)		3						
			4						
			5						
			6						
			7						
			8						
			9						
			10						

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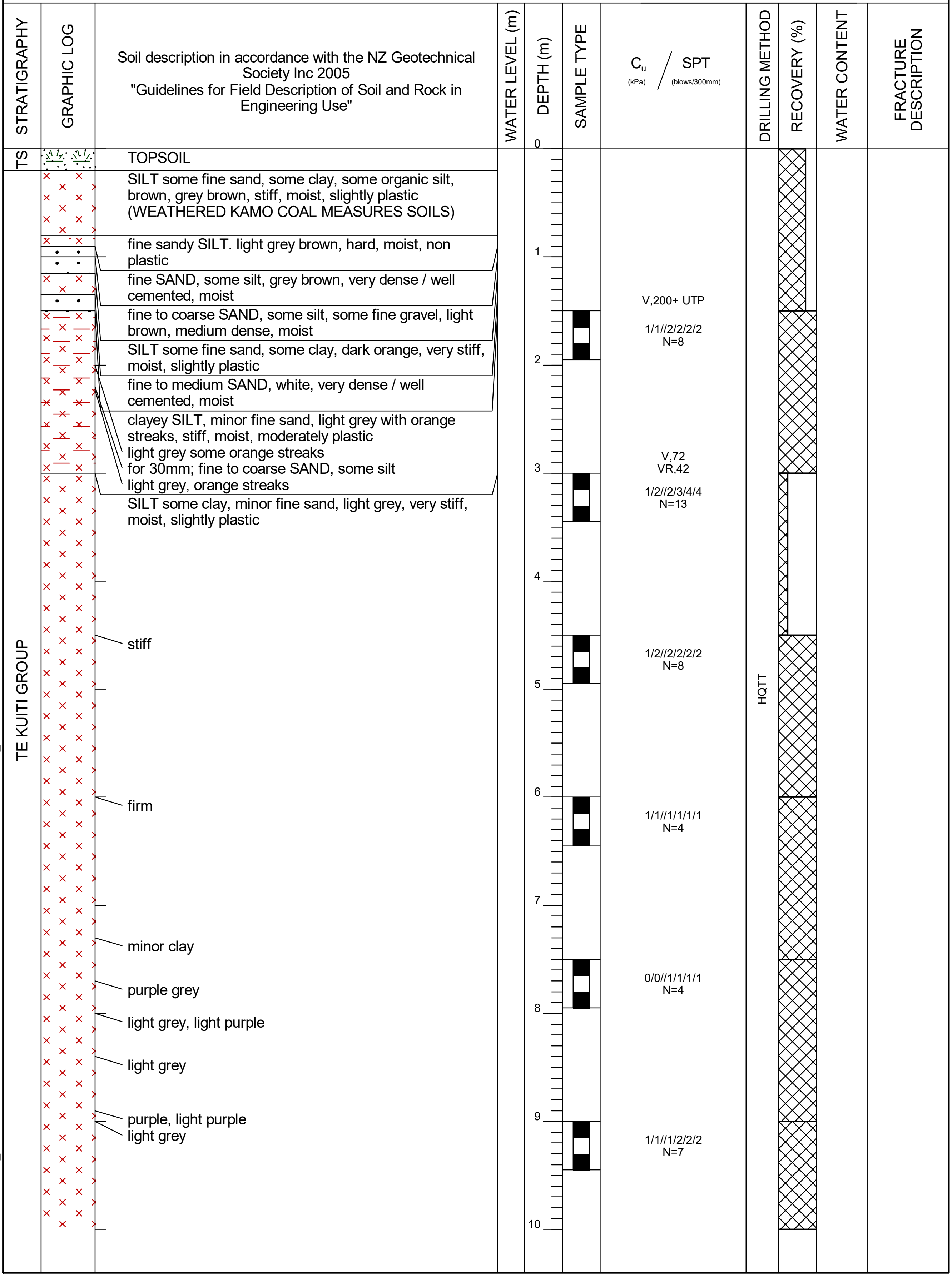
CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Machine Borehole No: MB04

Sheet 1 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	6/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Weeds
Date Finished:	6/12/22	Water Level:	Groundwater At Surface From Slope Runoff and Rain		



Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

TOPSOIL

SILT some fine sand, some clay, some organic silt, brown, grey brown, stiff, moist, slightly plastic (WEATHERED KAMO COAL MEASURES SOILS)

fine sandy SILT. light grey brown, hard, moist, non plastic

fine SAND, some silt, grey brown, very dense / well cemented, moist

fine to coarse SAND, some silt, some fine gravel, light brown, medium dense, moist

SILT some fine sand, some clay, dark orange, very stiff, moist, slightly plastic

fine to medium SAND, white, very dense / well cemented, moist

clayey SILT, minor fine sand, light grey with orange streaks, stiff, moist, moderately plastic

light grey some orange streaks

for 30mm; fine to coarse SAND, some silt

light grey, orange streaks

SILT some clay, minor fine sand, light grey, very stiff, moist, slightly plastic

stiff

firm

minor clay

purple grey

light grey, light purple

light grey

purple, light purple

light grey

C_u (kPa) / SPT (blows/300mm)

V,200+ UTP

1/1//2/2/2/2
N=8

V,72
VR,42

1/2//2/3/4/4
N=13

1/2//2/2/2/2
N=8

1/1//1/1/1/1
N=4

0/0//1/1/1/1
N=4

1/1//1/2/2/2
N=7

Drill Type:	Rotary Machine Rig	Project No:	NL220014
Drilled By:	DCN DRILLING LTD	Coordinates:	
Date Started:	6/12/22	Ground Elevation:	
Date Finished:	6/12/22	Water Level:	Groundwater At Surface From Slope Runoff and Rain
Logged By:	DEG		
Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022		
Surface Conditions:	Slight Slope, Weeds		

STRATIGRAPHY	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	DEPTH (m)	C_u (kPa) / SPT (blows/300mm)	DRILLING METHOD
TE KUITI GROUP	SILT some clay, minor fine sand, light grey, very stiff, moist, slightly plastic minor fine to coarse sand light grey, dark grey no coarse sand, very stiff some layers of clayey SILT, trace fine sand, to 80mm thick orange, dark orange, orange grey some fine to coarse angular gravel no gravel light grey, stiff some fine to coarse sand, trace fine angular gravel light grey, dark orange	10 – 13.35	1/2//2/2/3/4 N=11 (10.5) 2/2//2/2/2/2 N=8 (12.0)	HQTT
	fine sandy SILT, minor clay, orange, dark orange, stiff, wet, slightly plastic hard	13.35 – 14.6	2/5//5/5/5/7 N=22 (13.5)	HQTT
	SILT some fine sand, some clay, light grey, stiff, wet, slightly plastic	14.6 – 15.0		HQTT
	fine to coarse, angular gravelly SILT, some fine to coarse sand, light grey, light purple grey, firm, saturated, non plastic	15.0 – 15.45	1/1//1/1/1/2 N=5	SPT

END OF BORE. 15.45 METRES.
(TARGET DEPTH)

Column headings: STRATIGRAPHY, GRAPHIC LOG, WATER LEVEL (m), DEPTH (m), SAMPLE TYPE, Cu (kPa) / SPT (blows/300mm), DRILLING METHOD, RECOVERY (%), WATER CONTENT, FRACTURE DESCRIPTION

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

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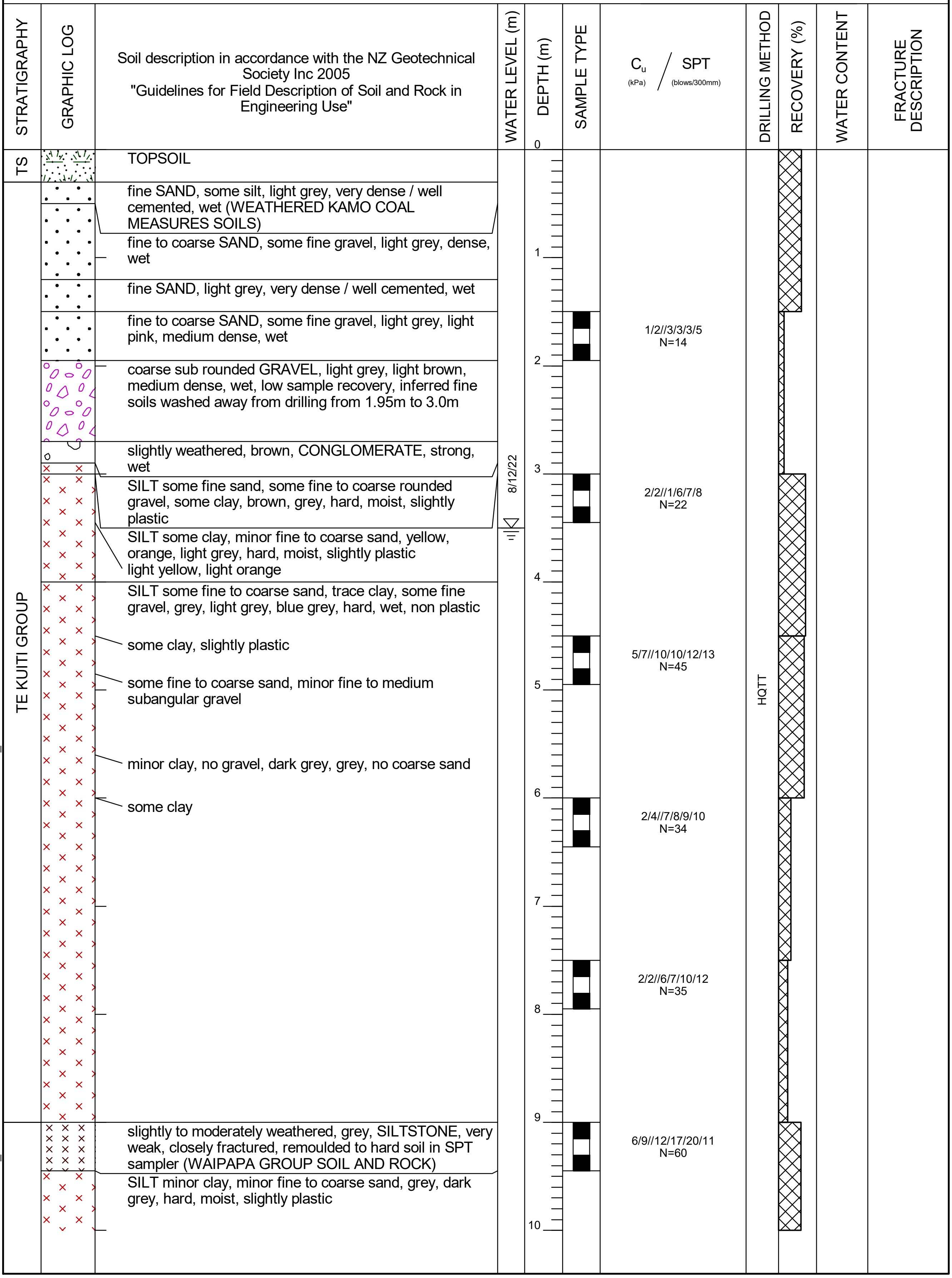
CLIENT:	Nga Kaingamaha o Ngati Hine Charitable Trust	Machine Borehole No: MB05
PROJECT:	Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa	Sheet 1 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Grass
Date Finished:	7/12/22	Water Level:	3.5m 8/12/22		



Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

TOPSOIL

fine SAND, some silt, light grey, very dense / well cemented, wet (WEATHERED KAMO COAL MEASURES SOILS)

fine to coarse SAND, some fine gravel, light grey, dense, wet

fine SAND, light grey, very dense / well cemented, wet

fine to coarse SAND, some fine gravel, light grey, light pink, medium dense, wet

coarse sub rounded GRAVEL, light grey, light brown, medium dense, wet, low sample recovery, inferred fine soils washed away from drilling from 1.95m to 3.0m

slightly weathered, brown, CONGLOMERATE, strong, wet

SILT some fine sand, some fine to coarse rounded gravel, some clay, brown, grey, hard, moist, slightly plastic

SILT some clay, minor fine to coarse sand, yellow, orange, light grey, hard, moist, slightly plastic
light yellow, light orange

SILT some fine to coarse sand, trace clay, some fine gravel, grey, light grey, blue grey, hard, wet, non plastic

some clay, slightly plastic

some fine to coarse sand, minor fine to medium subangular gravel

minor clay, no gravel, dark grey, grey, no coarse sand

some clay

slightly to moderately weathered, grey, SILTSTONE, very weak, closely fractured, remoulded to hard soil in SPT sampler (WAIPAPA GROUP SOIL AND ROCK)

SILT minor clay, minor fine to coarse sand, dark grey, grey, hard, moist, slightly plastic

C_u (kPa) / SPT (blows/300mm)
1/2//3/3/3/5 N=14
2/2//1/6/7/8 N=22
5/7//10/10/12/13 N=45
2/4//7/8/9/10 N=34
2/2//6/7/10/12 N=35
6/9//12/17/20/11 N=60

MACHINE LOG-FULL_SPT NL220014 MB01 - MB05 BAY OF ISLAND HOSPITAL DEC22.GPJ S+R_2013.GDT 2/7/23

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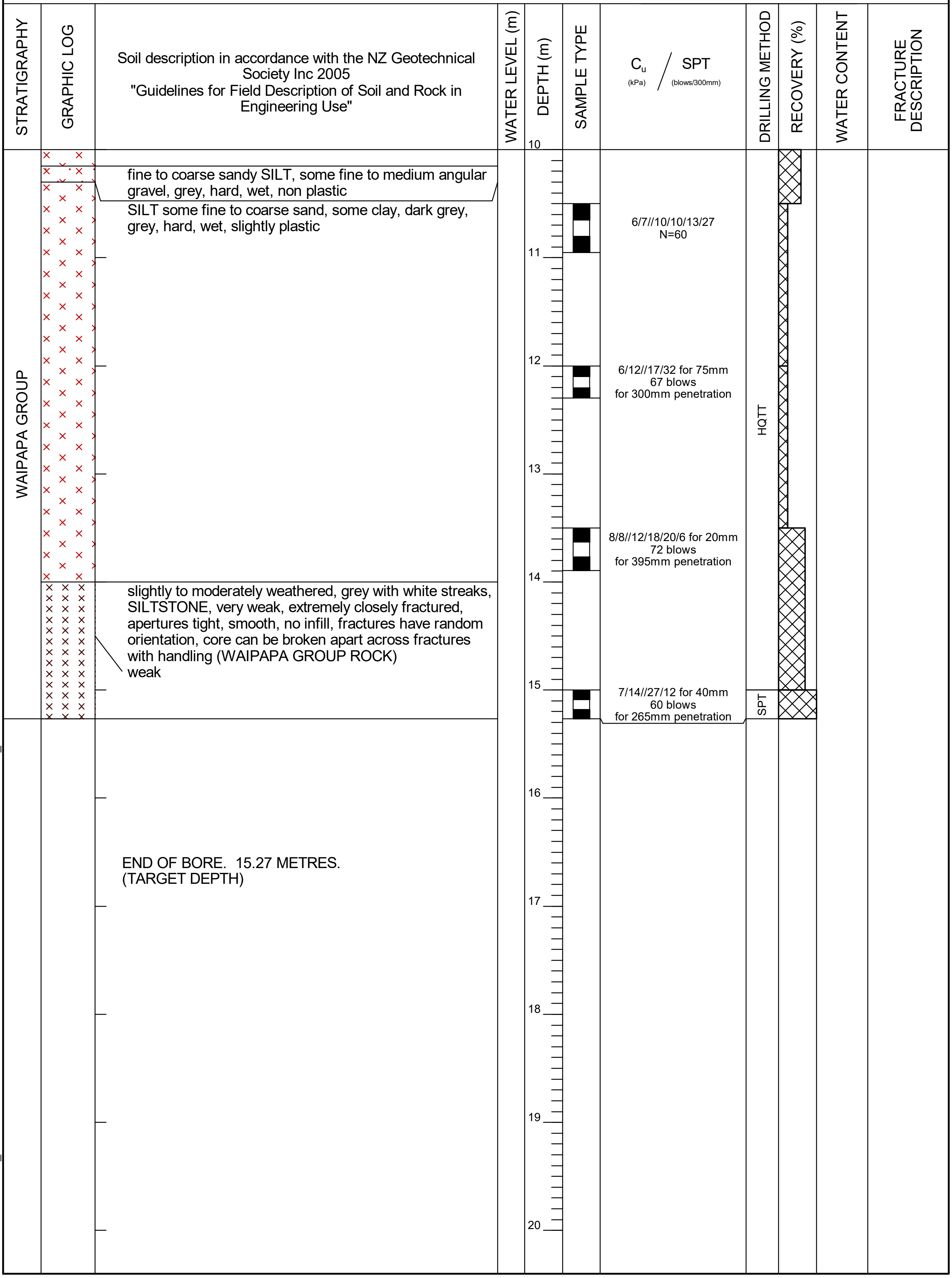
CLIENT: Nga Kaingamaha o Ngati Hine Charitable Trust

PROJECT: Geotechnical Investigation, Te Mataora Project, Greenacres Drive, Kawakawa

Machine Borehole No: MB05

Sheet 2 of 2

Drill Type:	Rotary Machine Rig	Project No:	NL220014	Logged By:	DEG
Drilled By:	DCN DRILLING LTD	Coordinates:		Shear Vane No - Calibration Date:	GEO3563 - 20/05/2022
Date Started:	7/12/22	Ground Elevation:		Surface Conditions:	Slight Slope, Grass
Date Finished:	7/12/22	Water Level:	3.5m 8/12/22		



Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"

C_u (kPa) / SPT (blows/300mm)

fine to coarse sandy SILT, some fine to medium angular gravel, grey, hard, wet, non plastic

SILT some fine to coarse sand, some clay, dark grey, grey, hard, wet, slightly plastic

6/7//10/10/13/27
N=60

6/12//17/32 for 75mm
67 blows
for 300mm penetration

8/8//12/18/20/6 for 20mm
72 blows
for 395mm penetration

slightly to moderately weathered, grey with white streaks, SILTSTONE, very weak, extremely closely fractured, apertures tight, smooth, no infill, fractures have random orientation, core can be broken apart across fractures with handling (WAIPAPA GROUP ROCK)
weak

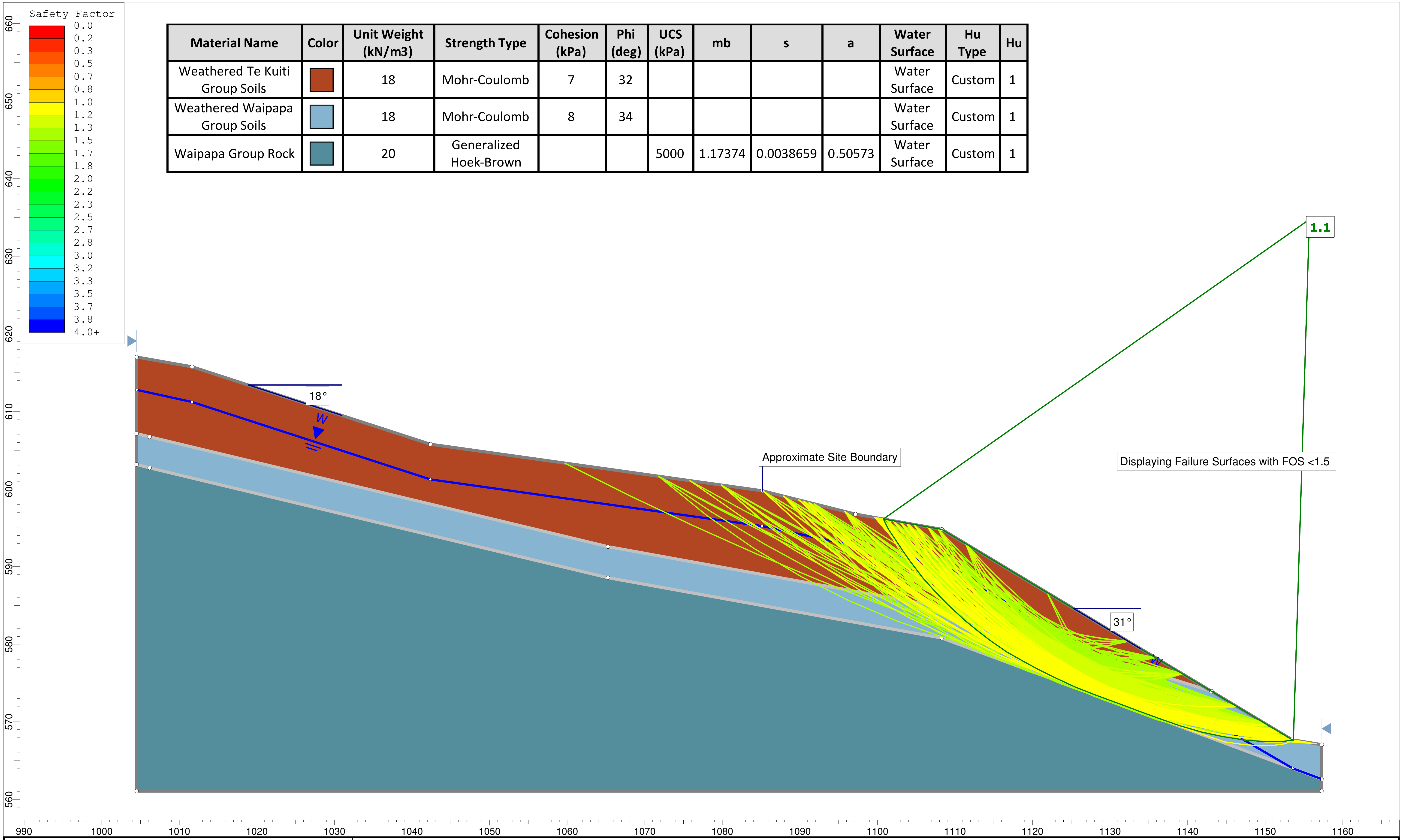
7/14//27/12 for 40mm
60 blows
for 265mm penetration

END OF BORE. 15.27 METRES.
(TARGET DEPTH)

Appendix C

Slope Stability Results

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	🟦	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1



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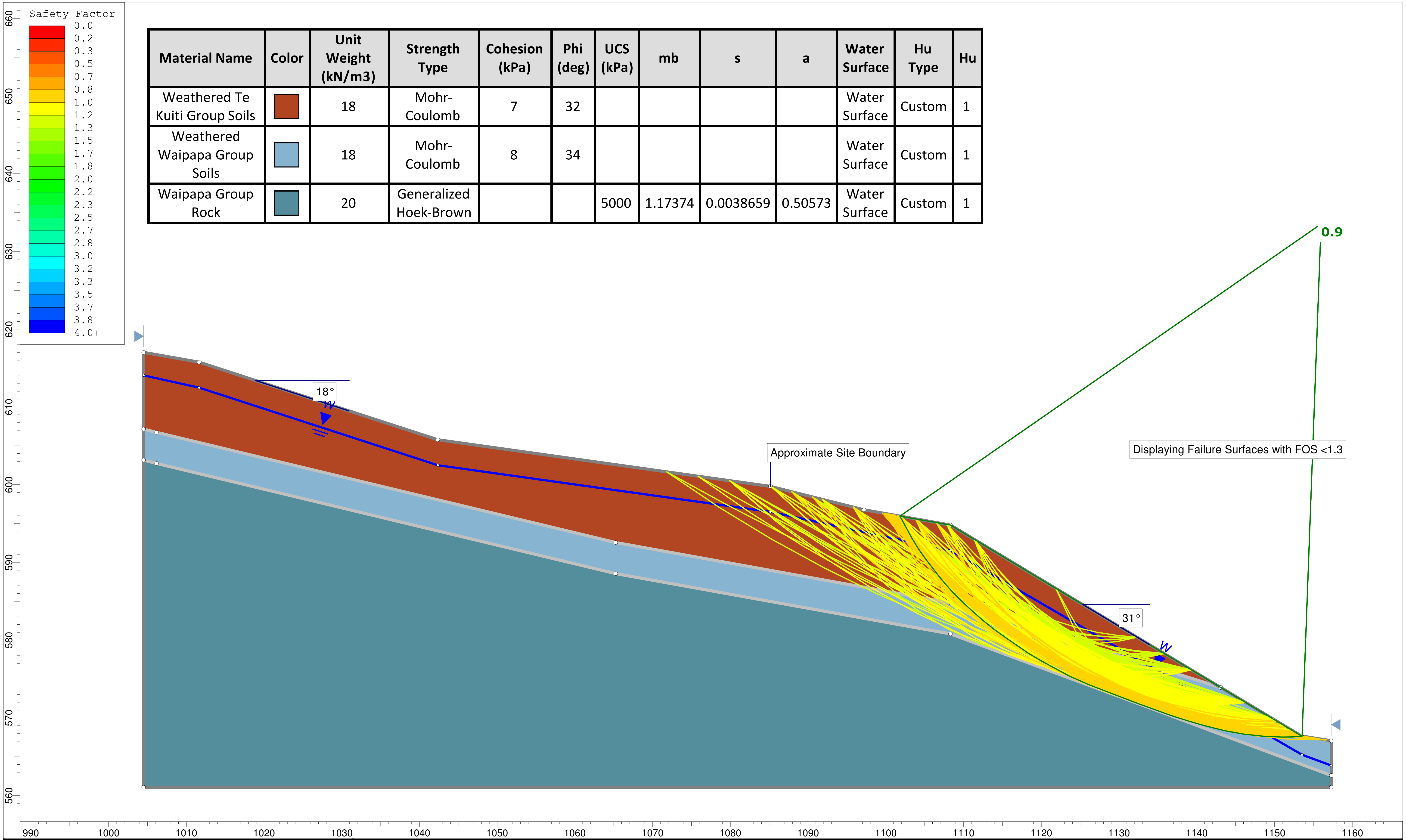
SLIDEINTERPRET 9.012

Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section A-A'	*Scenario*	Inferred Long-Term GW
Drawn By	S.VERRYT	*Company*	Soil & Rock Consultants
Date	Jan 2023	*File Name*	NL220114 - Stability Sections - Jan2023.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	🟦	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1

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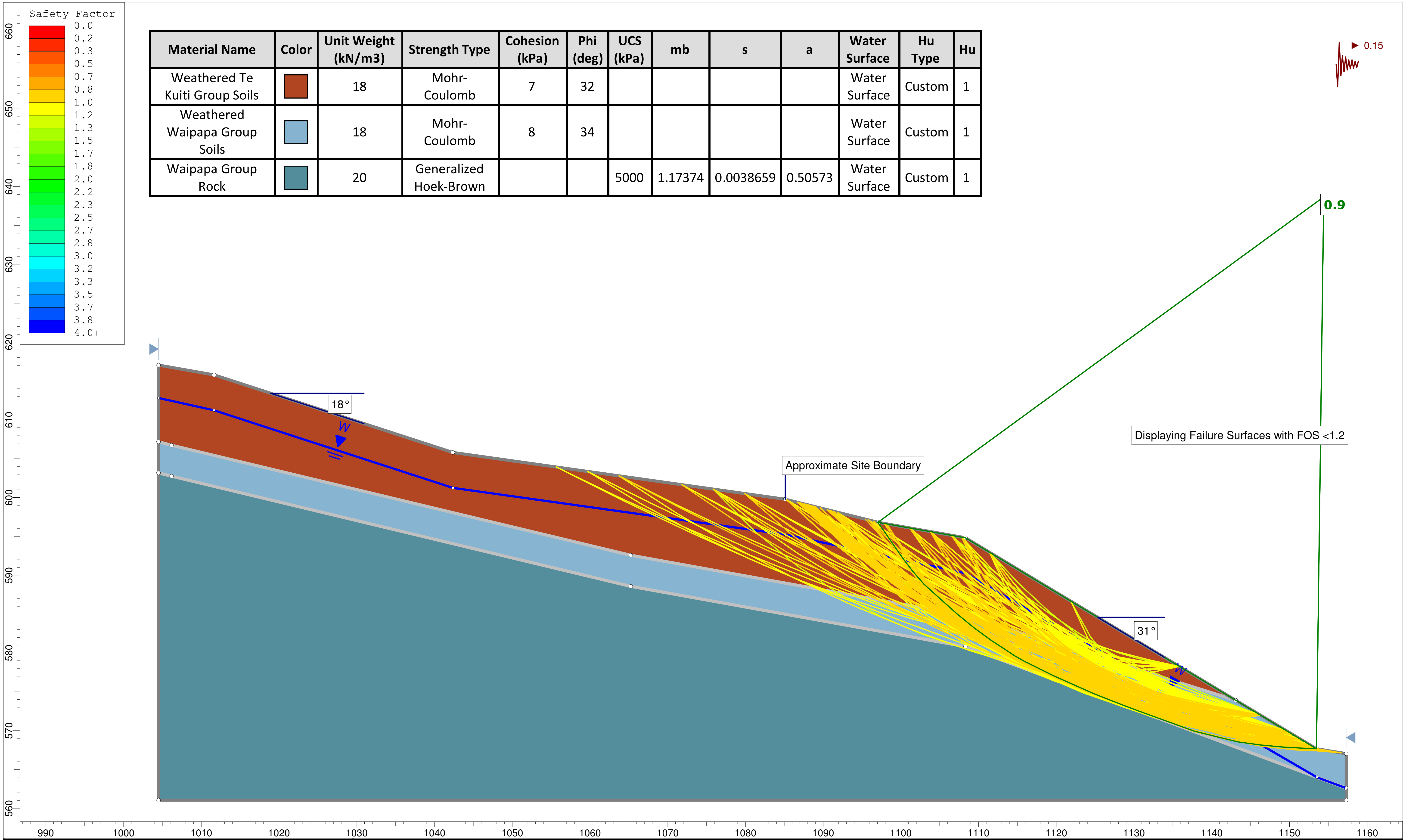
SLIDEINTERPRET 9.012

Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section A-A'	*Scenario*	Extreme GW
Drawn By	S.VERRYT	*Company*	Soil & Rock Consultants
Date	Jan 2023	*File Name*	NL220114 - Stability Sections - Jan2023.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	■	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1



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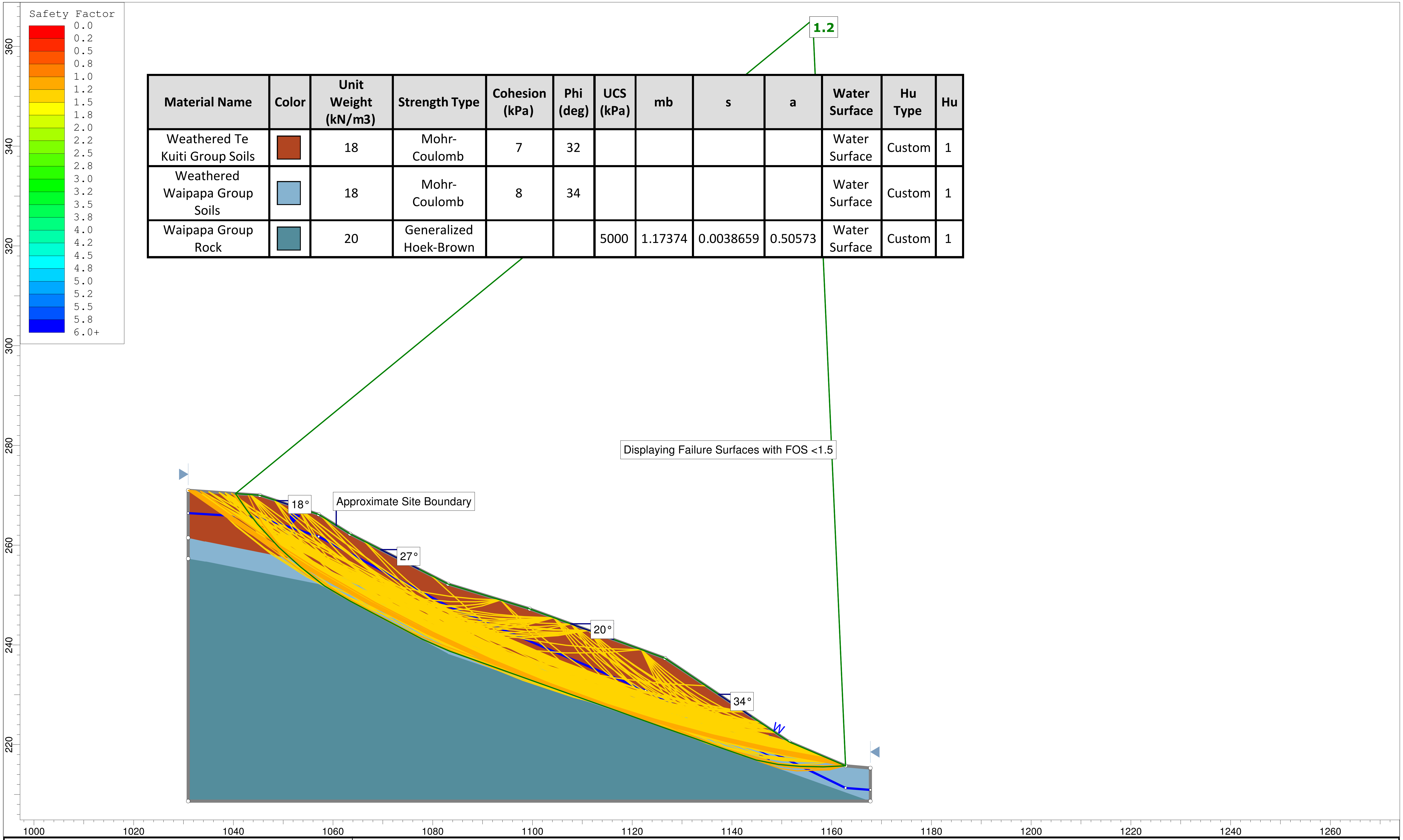
Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section A-A'	*Scenario*	Seismic
Drawn By	S.VERRYT	*Company*	Soil & Rock Consultants
Date	Jan 2023	*File Name*	NL220114 - Stability Sections - Jan2023.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	🟦	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1

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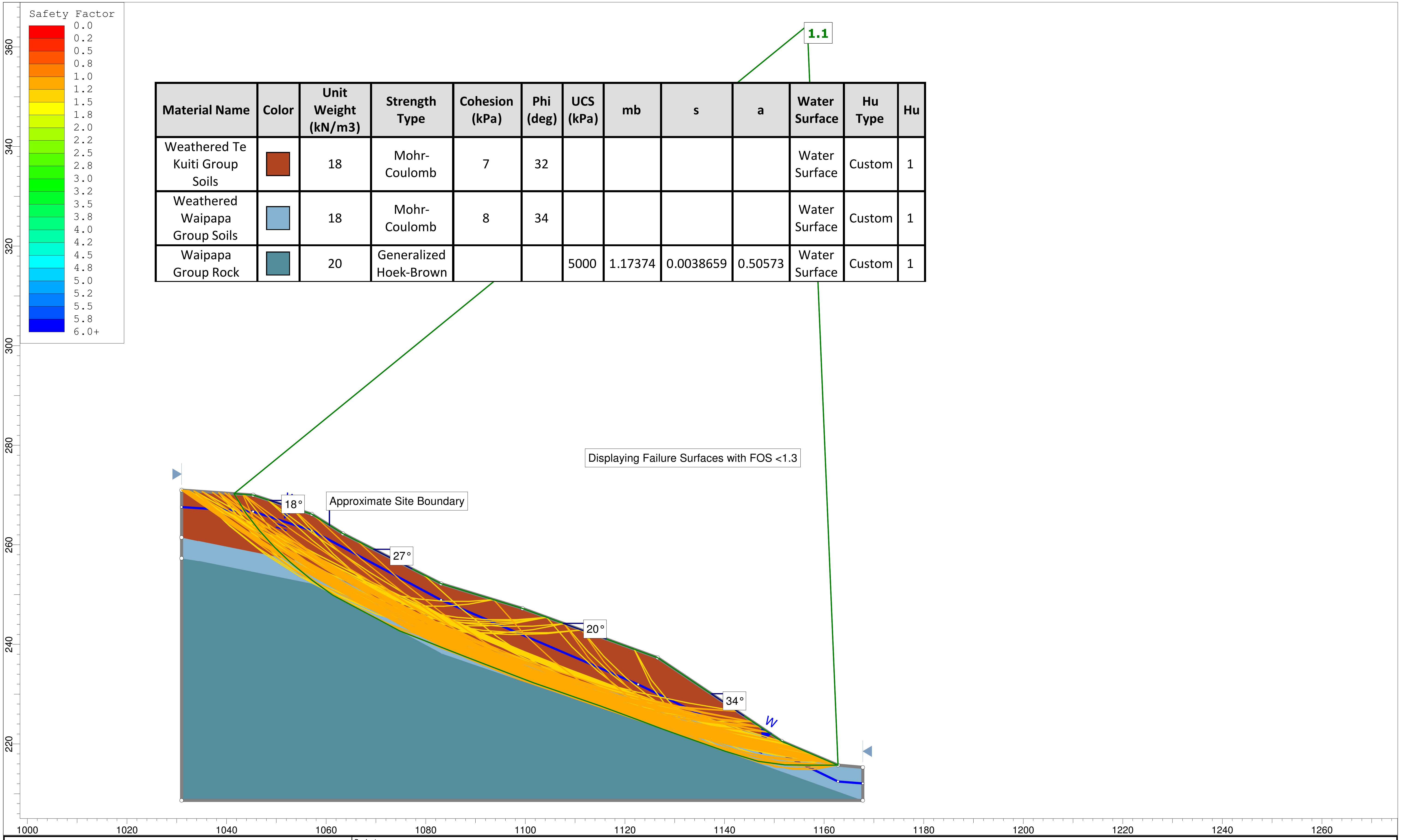
Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section B-B'	*Scenario*	Inferred Long-Term GW
Drawn By	S.VERRYT	*Company*	Soil & Rock Consultants
Date	Jan 2023	*File Name*	NL220114 - Stability Sections - Jan2023.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	🟦	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1

Displaying Failure Surfaces with FOS <1.3

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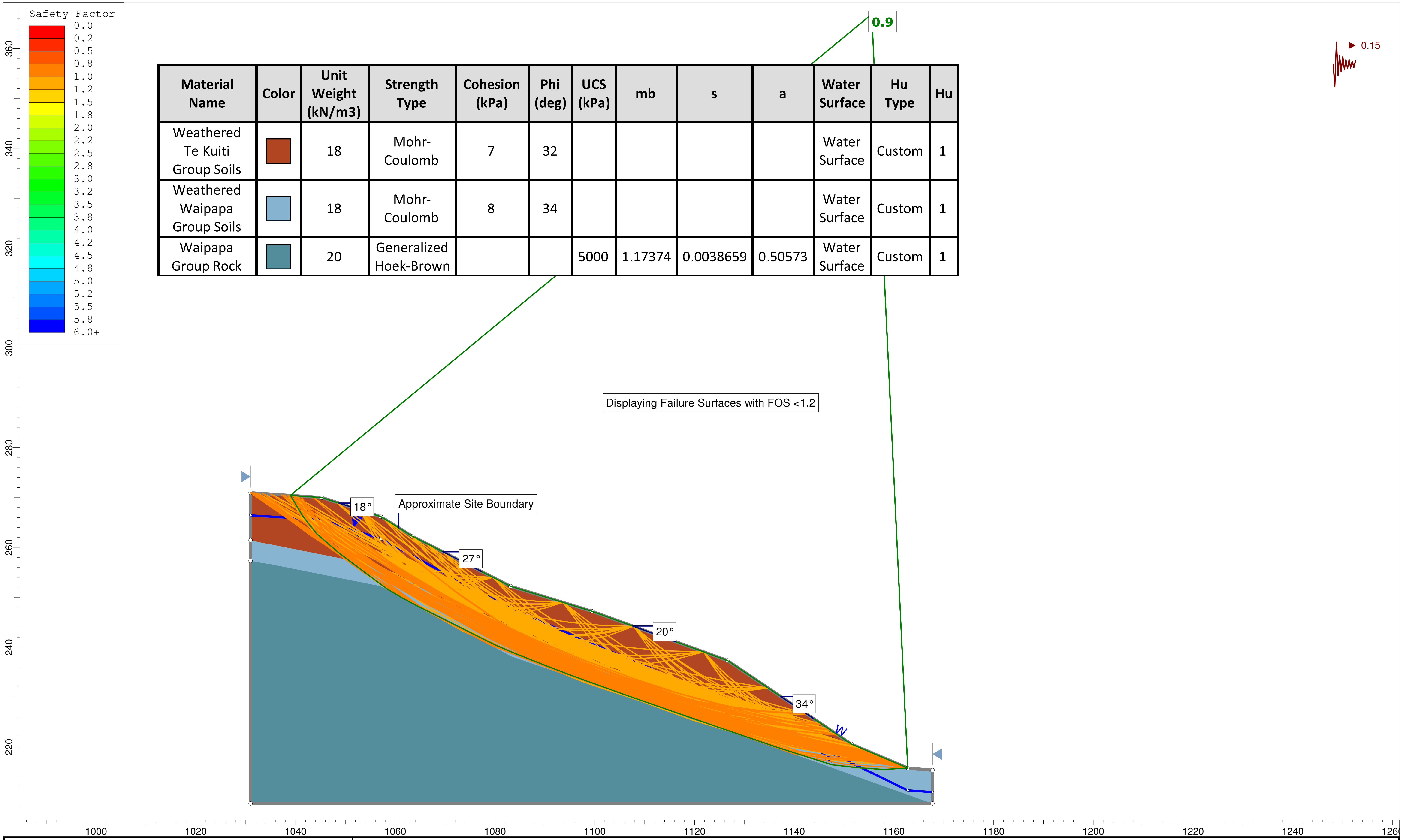
Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section B-B'	Scenario	Extreme GW
Drawn By	S.VERRYT	Company	Soil & Rock Consultants
Date	Jan 2023	File Name	NL220114 - Stability Sections - Jan2023.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	UCS (kPa)	mb	s	a	Water Surface	Hu Type	Hu
Weathered Te Kuiti Group Soils	🟫	18	Mohr-Coulomb	7	32					Water Surface	Custom	1
Weathered Waipapa Group Soils	🟦	18	Mohr-Coulomb	8	34					Water Surface	Custom	1
Waipapa Group Rock	🟦	20	Generalized Hoek-Brown			5000	1.17374	0.0038659	0.50573	Water Surface	Custom	1

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Project	TE MATAORA PROJECT, KAWAKAWA		
Group	NL220114 - Cross Section B-B'	*Scenario*	Seismic
Drawn By	S.VERRYT	*Company*	Soil & Rock Consultants
Date	Jan 2023	*File Name*	NL220114 - Stability Sections - Jan2023.slmd