GEOTECHNICAL INVESTIGATION REPORT

FOR PROPOSED TAMAKI PATHWAY

Wai-o-Taiki Nature Reserve, Point England, Auckland

Client: ReNature Ltd

Project Reference: LTA23155

Revision: A

Date: 21 May 2024

Documentation Control:

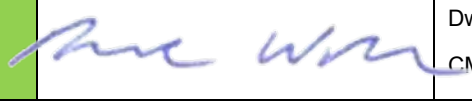
LandTech Consulting Ltd

Postal Address:
PO Box 104137
Lincoln North
Auckland 06544

Christchurch Address:
Unit 3, 16 Leslie Hills Drive
Riccarton
Christchurch 8011
P. 03 390 1371

Auckland Address:
15C Paramount Drive
Henderson
Auckland 0610
P. 09 930 9334

E. info@landtech.nz
W. www.landtech.nz

Document Title:	**Geotechnical Investigation Report for Proposed Tamaki Pathway**	
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	
Revision:	A	
Client:	**ReNature Ltd**	
Reference:	LTA23155	
Author:		Mustafa Al-Haidar, Principal Geotechnical Engineer BE(Hons) Civil, CMEngNZ, CPEng
Review & Authorised:		Dwayne Wilson, Director CMEngNZ, CPEng, IntPE(NZ)

REPORT DISTRIBUTION:

Recipient	Revision	Release Date	Description
ReNature Ltd	A	21 May 2024	Initial Report Issue
Consultants Name	A	21 May 2024	Initial Report Issue

Table of Contents:

1.0 Introduction & Scope 1
2.0 Site Description 1
2.1 Location 1
2.2 Topography 2
2.3 Site History 3
2.4 Vegetation 3
3.0 Proposed Development 4
4.0 Area Geology 4
5.0 Field Investigation 4
6.0 Subsurface Conditions 5
6.1 Topsoil and Fill 5
6.2 Natural Soils 6
6.2.1 Puketoka Formation Deposits 6
6.2.2 Residual ECBF Materials 6
6.3 Groundwater 6
6.4 Site Seismicity 7
7.0 Coastal Regression 7
8.0 Land Stability 10
9.0 Geotechnical Hazard Evaluation 11
9.1 Erosion 11
9.2 Falling Debris 11
9.3 Subsidence 11
9.4 Slippage 12
9.5 Inundation 12
10.0 Geotechnical Recommendations 12
10.1 Earthworks 12
10.1.1 Erosion 12
10.1.2 Subgrade Protection 12
10.1.3 Fill Compaction 13
10.2 Pavement 13
10.3 Retaining Walls 13
10.4 Boardwalk Foundations 14
11.0 Stormwater Control 15
12.0 Further Geotechnical Involvement 16
12.1 Geotechnical Review of Drawings 16
12.2 Construction Observations 16
13.0 Limitations 17

Appendices:

APPENDIX A: Drawings
APPENDIX B: Field Investigation Logs
APPENDIX C: Coastal Regression Calculations
APPENDIX D: Slope Stability Analysis

1.0 Introduction & Scope

LandTech Consulting Ltd (LandTech) were engaged by ReNature Ltd (the Client) to carry out a geotechnical investigation at Wai-o-Taiki Nature Reserve, Point England, Auckland (the site). Our investigation was in connection with the proposed walkway and bridges within the reserve, as part of the upgraded Tamaki Pathway.

The purpose of this report is to provide geotechnical information and recommendations with regards to the proposed Tamaki Pathway, as defined on the concept drawings provided by the client. We understand that this report will be used for design purposes and may be relied upon by Auckland Council for associated consent applications.

2.0 Site Description

2.1 Location

The reserve runs along the western banks of the Tamaki River situated in the residential suburb of Point England. The reserve is currently accessed from the north via Fernwood Place, Silverton Avenue, Kotae Road, Kiano Place, Taniwha Street and Elstree Avenue. The site location is shown in Figure 1 below, and within our attached *Test Location Plan* 01 & 02 - Appendix A.

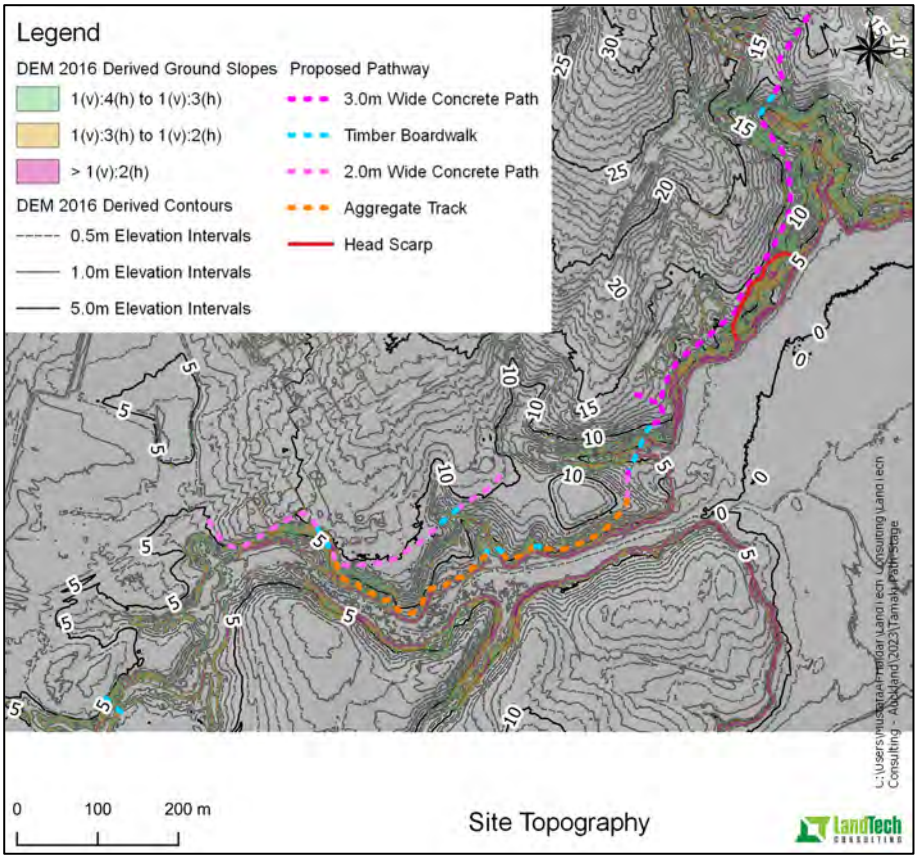
Figure 1: Site Location

(Source: Auckland council website Linz database, accessed on 16/04/2024)

2.2 Topography

Figure 2 showing the site topography[1,2] , indicates that ground slopes within the reserve are generally gentle, with localised steep slopes noted within the coastal area fronting Tamaki River and the valley where Omaru Creek and the connecting overland flow path valleys, having slopes greater than 1(v) in 4(h). Omaru Creek flows from the west to the east discharging into Tamaki River.

Figure 2: Site Topography



(Source: Auckland council website Linz database, accessed on 16/04/2024)

It should be noted that signs of instability were observed during our walkover inspection. The observed head scarp fronting the Tamaki River associated with historic instability has been shown within our attached *Test Location Plan 01* - Appendix A. The location of the head scarp has have been mapped based on a review of historic aerial photographs, topographic contours and our on-site observations.

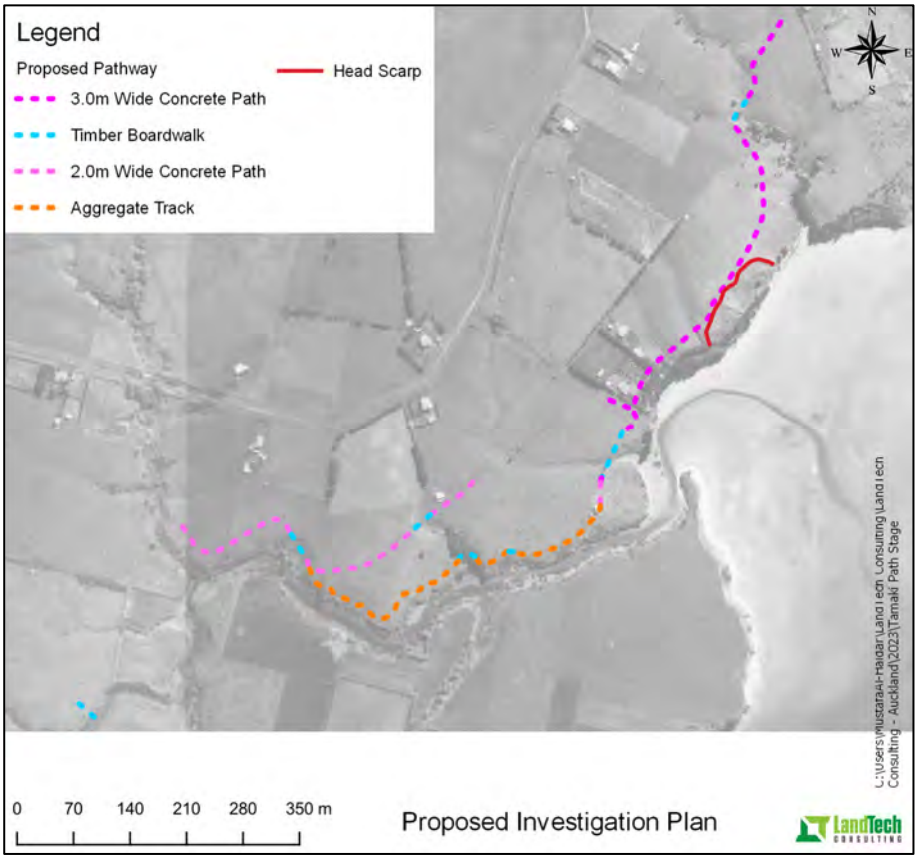
[1] Contours have been derived from the 2018 LINZ Digital Elevation Model (DEM) data with an indicated vertical accuracy of +/- 0.2m. While not as accurate as a detailed survey, it is very useful for showing topographical trends and characteristics within the area. The LiDAR data has been used for topographical analysis due to its comprehensive coverage of the global stability area and the relatively high-density points.

[2] Slopes have been derived from the LINZ Elevation Model (DEM) Data.

2.3 Site History

Aerial photography indicates that prior to 1941 the region was undeveloped and used as pastureland with meandering creeks running through it, as shown in Figure 3. From our review of the aerial photography signs of historic instability along the coastal cliff where noted. The more recent aerials from 2016 and 2017 google satellite imagery shows extensive development and densification surrounding the reserve.

Figure 3: 1941 Aerial Photo



(Source: Auckland council website: retrolens, accessed on 16/04/2024)

Furthermore, the aerial photos between 1941 and 2017 do indicate notable differences along the coastal cliff near the mouth opening of Omaru Creek within the 76 years between the aerial photos. The notable differences were erosion generally noted around the mouth opening of Omaru Creek

2.4 Vegetation

Scarce vegetation comprising of small to large trees are scattered across the grass covered reserve with vegetation generally being concentrated along the Creek banks and Coastal cliff.

3.0 Proposed Development

We have not been supplied with detailed drawings for this project, however, based on the conceptual plan[3] we understand that a new walkway will be constructed within the Wai-o-Taiki and Point England Reserve, predominantly comprising 2.0m to 3.0m wide concrete shared paths, aggregate tracks, and boardwalks / pedestrian footbridge where the pathways span over the creeks and overland flow paths. The location of the walkway has been annotated on the attached Test Location Plan 01 & 02, include in Appendix A.

4.0 Area Geology

The geological map[4] of the area indicates that the site is underlain by Puketoka Formation Late Pliocene to Middle Pleistocene pumiceous river deposits of the Tauranga Group. These deposits typically comprise of *"pumiceous mud, sand and gravel with muddy peat and lignite: rhyolite pumice, including non-welded ignimbrite, tephra and alluvia".*

The cohesive soils can be prone to shrink swell and downslope soil creep movements, and instabilities on steeper slopes where adverse shear strength, groundwater, and geometries exist in combination.

5.0 Field Investigation

The field investigation for the site took place on 3 April 2024 and comprised the following components:

- Detailed Walkover Inspection;
- Drilling of thirteen 5.0m hand auger holes (designated HA01 to HA13);
- Drilling of fourteen 1.0m hand auger holes (designated AH01 to AH14); and
- Shear vane and Dynamic Cone (Scala) Penetrometer testing.

The approximate location[5] of our investigation holes has been shown on the appended LandTech *Test Location Plan 01 & 02*, Drawing No. GEO/ 1 and GEO/ 2, attached in Appendix A. The interpreted geologic profiles through the proposed pathway areas are represented on the LandTech *Cross Sections A-A', B-B' and C-C'* shown on Drawing No. GEO/ 3 (Appendix A).

[3] ReNature Ltd – Tamaki Pathway Stage 2 – Concept Engineering drawing dated 30/01/2024.

[4] Reference has been made to the GNS New Zealand Geology Web Map, GNS Science, weblink: http://data.gns.cri.nz/geology/, accessed 7 September 2020.

[5] Field tests and sections were located using a hand-held GPS unit and a measuring tape without survey control and are therefore approximate only.

The soil conditions encountered are described[6] in detail on the appended field logs attached in Appendix B, together with the results of the various tests undertaken, plus the groundwater conditions determine during our time on site.

Soil shear strength and remould tests, factored in terms of BS1377, were performed in situ, at selected depths, using a hand-held shear vane[7]. Dynamic Cone (Scala) Penetrometer testing[8] was carried out from the base of all the auger holes to determine a soil density profile at depth.

Groundwater measurements were made on the day of drilling at the completion of the fieldwork. The hand auger holes were subsequently backfilled, and long-term groundwater monitoring did not take place.

6.0 Subsurface Conditions

The subsurface conditions encountered generally comprised of topsoil and fill with underlying Puketoka Formation deposits, as per the mapped geology, overlaying residually weathered East Coast Bays Formation (ECBF) soils. A subsurface summary is provided in Table 1, interpretive geologic profiles are shown on Cross Sections A-A', B-B' and C-C' and general descriptions outlined in the subsequent sections. Detailed descriptions are given on the attached logs.

Table 1: Subsurface summary

Description Layers	Depth
Topsoil	0.2 to 1.7
Puketoka Formation Deposits	1.6 to > 5.0*
Residual WECBF Materials	Base Material

Table Notes: Depths are meters (m) below present ground level (bpgl)
*Maximum Target depth reached without encountering base of layer

6.1 Topsoil and Fill

Topsoil and fill were encountered from the existing ground surface to depths between 0.2m and 1.7m. The depth of fill was unverified within the shallow one metre hand augers designated AH01, AH02, AH06 and AH07, as it extended below the 1.0m target depths of these auger holes.

[6] Soil was logged in accordance with New Zealand Geotechnical Society Guideline for the Description of Soil and Rock for Engineering Purposes (2005).

[7] In accordance with New Zealand Geotechnical Society Guideline for Handheld Shear Vane Test, (2001).

[8] In accordance with NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer.

Based on the variable and organic nature of the topsoil and fill, these are susceptible to differential settlement, and slope instability.

6.2 Natural Soils

6.2.1 Puketoka Formation Deposits

In the low laying areas of the reserve (within HA04 to HA06, HA11 and HA13) Puketoka deposits were encountered below the topsoil and fill to depths generally ranging between 1.6m to 4.1m. Deeper Puketoka deposits were also encountered the base of hand auger hole target depths, within AH03 to AH05, AH08 to AH14, HA01 to HA03 and HA08 to HA10.

These soils comprised non to slightly plastic SILTs and moderately to highly plastic Clayey SILTs. Peak vane shear strengths within these soils generally ranged between 100kPa to greater than 190kPa and the soils were correspondingly described as very stiff materials. Localised soft to firm deposits was noted within HA013 between 0.5m to 2.0m deep.

6.2.2 Residual ECBF Materials

Residually weathered ECBF soils were encountered below the Puketoka deposits, within HA04 to HA07 and HA11 to HA13. These soils comprised non to slightly plastic SILTs and Sandy SILTs and localised highly plastic Silty CLAYs (encountered within HA13).

Peak vane shear strengths within these soils generally ranged between 173kPa to greater than 200kPa and the soils were correspondingly described as very stiff to hard materials. Sensitivity ratios were generally between 2 and 3 (ie moderately sensitive).

Scala penetrometer tests carried out from the base of the deeper boreholes achieved effective refusal (defined as two increments of > 20 blows / 100mm penetration), at depths of between 2.2m to 6.9m bpgl. The depth of effective refusal encountered within HA04 to HA05, HA11 and HA13 is inferred to be the surface of the underlying moderately weathered sandstones and mudstones, while for the remainder of the hand augers it is inferred to be the build-up of skin friction.

6.3 Groundwater

Groundwater measurements were undertaken on the completion of fieldwork. The boreholes designated (HA02, HA03, HA05, HA08, HA10 and HA12) were generally dry (i.e the groundwater within each hole may not have had enough time to equalise), while within the remaining boreholes generally encountered groundwater between 1.5 to 4.8m. A groundwater level was encountered at 0.2m bpgl within HA06 but this hand auger was carried out in the base of the mangrove estuary.

It is considered likely that groundwater levels/pressures fluctuate seasonally and in response to local climatic conditions. For example, it is expected that levels rise during or following periods of prolonged and heavy rainfall. In contrast, there is potential for these levels to lower during drier periods (i.e. drought conditions).

6.4 Site Seismicity

As per NZS 1170.5:2004 the site subsoil is considered Class C – Shallow Soil Class. This classification is based on depths of the soils inferred to be within the limits of Table 3.2 of the reference standard. The Peak Ground Accelerations (PGAs) and corresponding earthquake magnitudes (Mw) for an importance level 1 structure (IL1) under Ultimate Limit State (ULS) loading were determined for the site based on Table A1 of the MBIE/NZGS Module 1 - Earthquake geotechnical engineering practice (November 2021), as below:

- ULS - PGA=0.09 & Mw=5.9

7.0 Coastal Regression

Coastal regression was assessed in accordance with Auckland Council's guideline document[9] 2021/010, titled *Coastal Hazard Assessment in the Auckland Region*. This document outlines a framework for estimating the potential loss of Auckland's coastlines due to costal erosion, and also attempts to factor in the likely increased rates of coastal erosion due to the expected rise in sea level as a result of climate change. The assessment was carried out to predict regression for the following timescales:

- Circa 30yrs from today (2050)
- 50yrs from today (2080)
- 100yrs from today (2130)

According to *Coastal Hazard Assessment in the Auckland Region* document the current and Future Areas Susceptible to Coastal Instability and Erosion (ASCIE) distances can be calculated through the following equations:

$$Current\ ASCIE = \left(\frac{hc_r}{tan\alpha_r}\right) + \left(\frac{hc_s}{tan\alpha_s}\right)$$

$$Future\ ASCIE = (LT_F \times T) + \left(\frac{hc_r}{tan\alpha_r}\right) + \left(\frac{hc_s}{tan\alpha_s}\right)$$

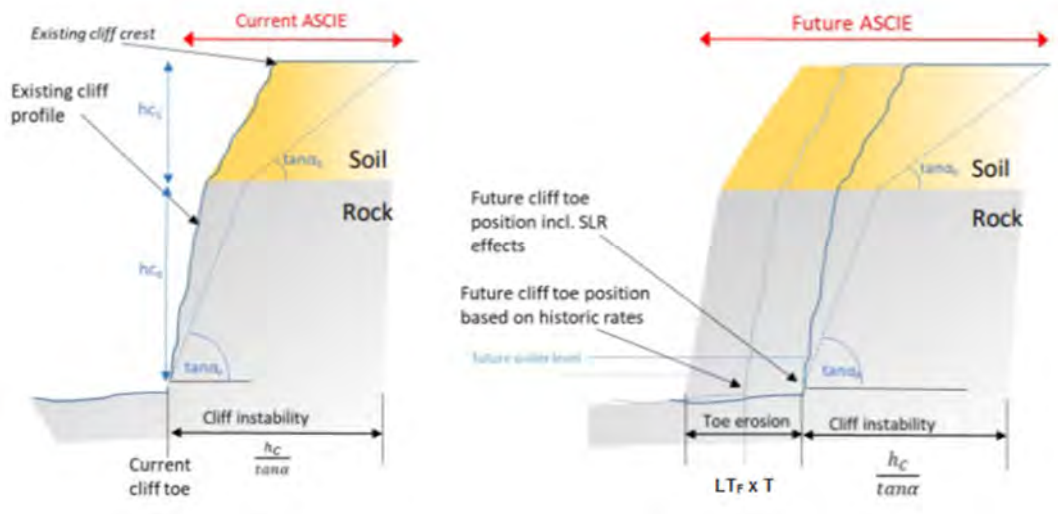
[9] Roberts, R., N Carpenter and P Klinac (2021). Predicting Auckland's exposure to costal instability and erosion, Auckland Council guideline document, GD2021/010.

Where:

h_{Cr} = Height (m) of the rock layer of the cliff
α_r = The slope angle (degrees) of the rock layer
h_{Cs} = Height (m) of the soil layer of the cliff
α_s = The slope angle (degrees) of the soil layer
LT_F = Factor for the potential increase in future, long-term retreat due to Sea Level Rise effects
T = Timeframe over which erosion occurs (yrs)

The current and future ASCIE distances are represented graphically in Figure 4. The Current ASCIE distance is considered to be the zone, which is presently susceptible to coastal erosion, and that any structures constructed within this area would potentially be at risk of being affected by erosion of the overlying soil mantle at some point in the future if no remediation measures are implemented.

Figure 4: Graphical Representation of Current ASCIE definition.



(Source: Coastal Hazard Assessment in the Auckland Region, Auckland Council 2021)

Historically, sea level rise (SLR) has been documented as 1.7mm per year within the Auckland Region. The Ministry of Environment 2022 document titled “Interim guidance on the use of new sea-level rise projections” publication, provides estimates on the potential future rates of SLR and Vertical Land Movement (VLM) in Auckland. As noted within the publication, the rate of SLR is anticipated to accelerate as a result of global warming and should also account for future land subsidence. The projections for SLR and VLM are obtained from Takiwa platform[10] and have been summarised in Table 2.

[10] https://www.searise .nz/maps

The Current ASCIE distance is considered to be the zone, which is presently susceptible to coastal erosion, and that any structures constructed within this area would potentially be at risk of being affected by erosion of the overlying soil mantle at some point in the future if no remediation measures are implemented. However, it should be noted that the ASCIE calculations do not take into account the effect of vegetation along the slope. Vegetation are nature barriers to slope instability, and we consider that this will likely retard the rate of erosion in the near future at least.

Historically, sea level rise (SLR) has been documented as 1.7mm per year within the Auckland Region, with the predicted increase in SLR and accounted for future VLM we have calculated the current and future ASCIE distances as summarised in Table 2:

Table 2: Erosion Rate form ASCIE Calculations

Timeframe	Predicted Rate of Future SLR + VLM (m)	Predicted Toe Erosion (m)	Cliff Instability Zone (m)	Total Predicted ASCIE Distance (m)
2050	0.47	~ 4 to 5	~ 8 to 19	~ 12 to 23
2080	1.15	~ 9 to 10	~ 11 to 19	~ 20 to 28
2130	3.02	~ 14 to 19	~ 18 to 24	~ 32 to 42

It is noted that the proposed walkway is situated within the 50- and 100-year regression lines. The approximate location of the 100-year ASCIE zone has been shown on our attached Test Location Plan.

The risk of losing land to ongoing regression caused by the harsh weathering is difficult to quantify and predicting when such failure events will occur is almost impossible. However, we do emphasis that there are general rules of thumb in helping the stability of a slope such as generally plating heavy vegetation helps the stability and erosion resistance via root binding action and reduction in soil moisture contents. Additional soft engineering measures can help reduce the rate of erosion, such the use of erosion protection matting and proprietary geotextile products, should the landowners wish to retain as much of the usable land as possible.

8.0 Land Stability

As discussed above in Section 2.2, the site shows visual signs indicating historical instability. Considering this information, a slope stability analysis along Sections A-A', B-B' and C-C' was undertaken under static and seismic conditions. The Analyses were carried out using Slide[11] in accordance with section 2 of Auckland Council's (AC) Code of Practise (CoP) for Land Development and Subdivision ver2.0 (July 2022). Three stability scenarios were considered as outlines below:

- Normal groundwater conditions – based on our groundwater measurements.
- Extreme groundwater conditions – an assumed elevated groundwater level.
- 0.09g peak ground acceleration for a 100-year earthquake event.

The following loads have been assumed for analysis purposes:

- 12kPa distributed surcharge load of neighbouring properties;
- 6kPa distributed surcharge load of proposed walkway within the site.

These analyses incorporated the following soil parameters outlined in Table 3 below:

Table 3: Soil strength parameters

Geologic Unit	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (°)	Undrained Shear Strength (kPa)
Existing Non-Engineered Fill / Topsoil (Fill)	16.0	3	28	50
TGM Deposits (TGM)	17.0	5	30	60
ECBF Materials (ECBF)	19.0	10	34	150
ECBF Sandstone / Siltstone (ECBF Rock)	20.0	20	36	200

A summary of the calculated factors of safety (F.O.S) against slope instability under the modelled conditions are shown in Table 4 below. The results of the slope stability analyses are appended to Appendix C.

The results of the analysis indicate that the site meets the minimum requirements set out in the AC COP. Given the topographical slope geometry, the material strength recorded and the results of our global stability analysis, we consider the risk of global slope instability to be low for the proposed development.

[11] The Limit equilibrium slope stability software package (v6, Rocscience)

Table 4: SLIDE stability analysis results

Model conditions	Guideline Minimum FoS Value	Modelled Minimum FoS Value		
		Section A-A'	Section B-B'	Section C-C'
Long-Term Groundwater	1.2	**1.4**	**1.5**	**3.6**
Raised Groundwater Level	1.1	**1.4**	**1.4**	**3.1**
Seismic Scenario	1.0	**1.3**	**1.2**	**2.7**

Table Notes: FoS = Factor of Safety

However, with regards to coastal erosion, it must be accepted that the pathway could potentially be effected and it would be uneconomical to carry out intensive large scale erosion protection works, indicating economic loss of the walkways to be likely in the future.

9.0 Geotechnical Hazard Evaluation

Based on the results of our field investigation, observations during walkover inspection, and natural hazard assessment, we conclude that the proposed walkway is suitable from a geotechnical perspective. This is on the condition that the following recommendations are adhered to.

9.1 Erosion

Auckland Council Areas Susceptible to Coastal Instability and Erosion (ASCIE) mapping indicates that the proposed walkway will be affected by coastal erosion. With regards to coastal erosion, it must be accepted that the pathway could potentially be affected, and it would be uneconomical to carry out intensive large scale erosion protection works, indicating economic loss of the walkways to be likely in the future. Soft measures for land fronting the watercourses could help decrease the extent and rate of erosion, such as heavy planting, riprap at the toe of slopes, matting and/or proprietary geotextile products, should Auckland Council wish to add resilience against coastal erosion.

9.2 Falling Debris

Due to no steep slopes being located above the site, the risk of falling debris from upslope land slippage or rockfall is considered negligible.

9.3 Subsidence

Based on the fine-grained nature of the site soils, and the low seismic hazard of the region, the soils are unlikely to be susceptible to liquefaction or corresponding ground deformations. However, the soils are considered prone to shrink swell movements. Design of new foundations in accordance with Section 10.4 of this report is considered likely to mitigate these potential foundation movements.

9.4 Slippage

As described in Section 8.0, a global stability analysis was carried out for the site and proposed development. The stability analyses show that the site is not considered to be at undue risk of global instability provided that the recommendations provided in Section 10.0 are adhered to and all earthworks are either suitably battered or supported by specifically designed retaining walls.

9.5 Inundation

Inundation of the walkway is a possible hazard for the section of the walkway running across the Mudflat, streams, and overland flow path valleys. We recommend that the design of the walkway take this into account.

10.0 Geotechnical Recommendations

Based on the results of our field investigation, observations during walkover inspection, and natural hazard assessment, we conclude that the proposed development is suitable from a geotechnical perspective. This is on the condition that the following recommendations are adhered to.

10.1 Earthworks

10.1.1 Erosion

Permanent erosion protection to completed earthworks can be achieved via turfing, planting, or covering with hardstands.

We recommend that excavations are carried out during the drier months. However, excavations should be carried out with appropriate erosion and sediment controls, and as required drainage channels to intercept any surface flows or groundwater ingress.

Steep soil slopes are noted below the proposed aggregate track running along the banks of a Omaru Creek, the track is at risk of soil creep and/or instability if it is situated within 1H:2V from the invert of the creek. We recommend that the banks that lack vegetation are stabilized with topsoil and/or root binding vegetation. This reduces the risk of failure as steep soil slopes are likely to regress with time.

10.1.2 Subgrade Protection

Once the suitability of the stripped subgrade has been confirmed by a geo-professional it should be covered by at least 100mm of granular fill such as GAP40 or GAP65 basecourse, as soon as possible. If the subgrade is left for considerable time after excavation and before pavement construction, it may need to be kept 200mm-300mm proud of design heights, and cut to grade shortly before foundation construction, due to potential desiccation and degradation of the soil conditions when left exposed to the elements.

Leaving the subgrade exposed for prolonged period results in soil degradation by either excessive drying (resulting in shrinkage cracking) or subgrade softening (after periods of wet weather). Dry subgrade will need to be re-hydrated or cut to waste if excessively cracked, while saturated soils will need to either be dried out as appropriate or be undercut if softened.

10.1.3 Fill Compaction

All fill should be placed on suitable subgrade, free of any topsoil or unsuitable materials. Fill placed should be appropriately monitored and tested during placement and compaction by a suitably qualified Geo-Professional. Recommendations for fill specifications have been provided below.

The compaction of the hardfill (ie GAP40 or GAP65) should be undertaken using a heavy plate compactor or steel wheeled roller with low frequency dynamic compaction. Filling should be placed in layers not exceeding 200mm lifts at a time. Hardfill specifications have been given in Table 5.

Table 5: Required CIV Values for hardfill compaction

Foundation Support	Equivalent Clegg Impact Value (CIV)	
	Minimum	Average*
Pavement	15	20

*The Average CIV required from all the tests carried out across pathway.

10.2 Pavement

Based on the results of our field investigation we consider that for the preliminary design of accessways and parking areas a CBR of 2% can be used can be used. We recommend that Scala penetrometer tests are carried out once the earthworks have been undertaken and completed to the trimmed.

We recommend a minimum 300mm compacted hardfill below the pathway, underlain by geotextile (Bidim A19). The hardfill may need to be locally deeper where revealed subgrade conditions are worse than a CBR of 2%. A Geo-professional shall inspect the subgrade (scala testing) and hardfill compaction (Clegg Hammer minimum value 15).

10.3 Retaining Walls

For the preliminary design of retaining walls, we recommend that the following soil parameters are adopted for insitu soil & engineered fill as per Table 6.

Free standing cantilever walls (i.e timber pole retaining walls) not supporting critical structures can be designed for active earth pressures (ka). Broms method can be used to determine the embedment depth of the poles, as specified in B1/VM4 using the appropriate strength reduction factors.

Table 6: Soil Parameters for Retaining Wall Design

Parameters	In-Situ Soils	Engineered Fill
Unit Weight (kN/m³)	17.5	18.5
Soil Friction Angle (°)	30	32
Undrained Shear strength (kPa)	60	
Ultimate Bearing Capacity (kPa)	300	
Ultimate Base Adhesion (kPa)	30	

For stiff, inflexible walls (i.e concrete and/or masonry block walls) that are incorporated within the structure, or walls that provide support for critical structures the at rest earth pressures (k_o) should be used for design, as these walls are unable to deflect to generate active earth pressures.

In determining the design earth pressures, the designer should carefully consider backslope inclinations, additional surcharges and the lateral load resistance taking into account any sloping ground in front of walls.

To avoid build-up of hydrostatic pressures, retaining walls must be constructed with appropriate behind-wall drainage comprising:

- a perforated drain coil wrapped in filtersock, located at the base of the walls, connected into an approved stormwater disposal system,
- followed by backfilling behind all retaining walls with lightly tamped, free draining granular backfill, such as scoria or 40/20 blue chip, extending up to within 0.3m of their full height with material, before being sealed with a clay cap, wrapped in geotextile.

10.4 Boardwalk Foundations

The following shallow foundations (defined as depth (L) to diameter ratio (D) less than 5) are considered appropriate in accordance with:

- Specifically designed shallow pad footings embedded a minimum of 600mm below cleared ground level into stiff natural soils.

We recommend that shallow foundations, subject to founding directly on or within competent engineered fill and/or natural ground, are designed for the following:

- 300kPa Ultimate Geotechnical Bearing Capacity

The structural engineer designing the foundations should check that all foundations lie outside the 45° envelopes rising from 0.5 metres below the invert of service trenches, or within 1(v):2(h) of any downslope retaining walls, or 1(v):4(h) of steep slopes, unless such foundation details are found by specific design, to be satisfactory.

It should be noted that localised alluvial deposits that are quite soft were encountered within HA13. Furthermore, hole collapse was experienced within HA01, HA04, HA07 and HA11. These hand augers were within proximity to Omaru Creek and mapped overland flow paths. Bored piles may suffer from pile hole collapse due to the soft soils and groundwater levels encountered, potentially necessitating temporary casing and dewatering. Therefore, should bored piles be pursued, we recommend attempting piling during periods of dry weather to reduce the likelihood of encountering groundwater.

Another option would be to support the boardwalk on drive piles, Suitable driving sets are expected to be encountered below 2.0m (deepest soft deposits encountered within HA13) and may extend deeper.

We recommend that driven timber piles, subject to being driven to depths exceeding 2.0m until suitable sets are achieved, are designed for the following:

- 540kPa Ultimate Geotechnical End Bearing Capacity;
- 30kPa Ultimate Geotechnical Skin Friction.

Skin friction should be ignored for the deeper of the upper 1.5m of pile length, or any length of pile within the zone of influence of services requiring bridging. Lateral load resistance may be based on cu=40kPa below depths of 1.5m.

Where foundations are in proximity to public underground services then piles will be required to provide services bridging designed in accordance with Auckland Council standard drawing SW22 for stormwater pipes and/or Watercare drawings WW53, 54 & 60 for sewer pipes.

Strength reduction factors of 0.5 and 0.6 for static and seismic load cases respectively, in accordance with the New Zealand Building Code, should be applied to the ultimate capacities given above. We recommend the structures be inspected by an Engineer following any future extreme weather or seismic events, to check for any corresponding damage. Should land damage or foundation movements be observed, foundation repairs or re-routing of walkway locations may be needed dependent on the extent of any movement/damage.

11.0 Stormwater Control

Where practical, we recommend collecting concentrated stormwater flows and diverting these away from walkway areas and steep slopes. The outfall of any stormwater should be considered with respect to energy dissipation and corresponding scour and erosion.

12.0 Further Geotechnical Involvement

12.1 Geotechnical Review of Drawings

A Geo-professional familiar with this report should be engaged to review the final drawings of the proposed development prior to submission to Auckland Council. This is to ensure the geotechnical recommendations of this report have been implemented correctly. Further geotechnical investigation, analysis, design or reporting may be warranted at this stage subject to the specifics of the proposal.

12.2 Construction Observations

A Geo-professional should be engaged to carry out observations during construction to confirm subsurface conditions are consistent with those described in this report.

- Inspections will not be carried out prior to the issue of Council Resource and/or Building Consents; unconsented works will not be inspected.
- We recommend that once received, the Consent be forwarded and reviewed by us. Following the Consent review a schedule of inspections can be issued to the Client.
- Without sufficient observations during the subgrade preparation prior to placement of fill or concrete, LandTech will not be in a position to provide engineering certification (i.e. Earthworks Completion Report, or Producer Statement PS4).

13.0 Limitations

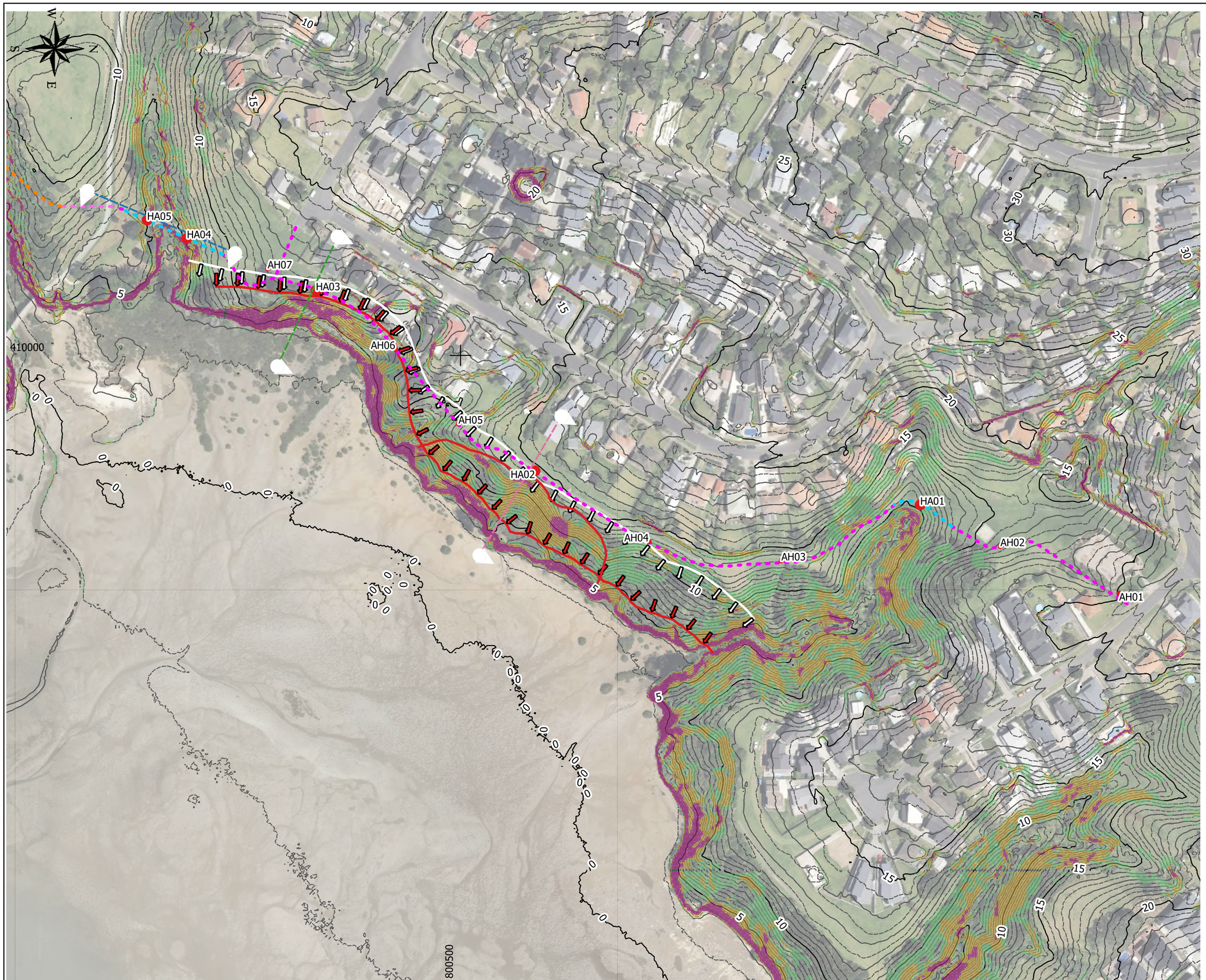
This geotechnical report has been prepared for our Client, ReNature Ltd, for the purposes of supporting consent applications for the proposed development described herein. This report may be used by our Clients appointed consultants for design purposes, and for supporting Consent applications to Council. This report shall not be extrapolated for other nearby sites, or by any other parties, or used for any other purposes without the express approval of LandTech and their Client.

This report has been based on the results of tests at point locations; therefore, conditions could vary away from the assumed geotechnical model. Should exposed soil conditions vary from those described herein we request to be informed to determine the continued applicability of our recommendations. We have attempted to conduct a thorough investigation of soil types across the site, within the agreed scope of works. However, variations still may exist as soils can vary naturally and due to previous human activities, which LandTech have no control over and should not be held accountable for.

The geotechnical investigation undertaken was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants. In addition, our investigation and analyses have also not taken into account possible fault rupture or volcanic eruption that may cause deformations and displacements of the ground directly below the site. This type of assessment is outside of the scope of our geotechnical engagement.

END OF REPORT

Appendix A
Drawings



CLIENT/PROJECT

ReNature Limited
Tamami Stage Two Walkway
Wai-O-Taiki Nature Reserve

MAP TITLE

Test Location Plan 01

Legend

Geotechnical Investigation
- Hand Auger
- Hand Auger - 1.0m Deep

Geological Sections
- Section A-A'
- Section B-B'
- Section C-C'
- Head Scarp

Proposed Pathway
- 3.0m Wide Concrete Path
- Timber Boardwalk
- 2.0m Wide Concrete Path
- Aggregate Track

DEM 2016 Derived Ground Slopes
- 1(v):4(h) to 1(v):3(h)
- 1(v):3(h) to 1(v):2(h)
- >1(v):2(h)

DEM 2016 Derived Contours
- 0.5m Elevation Intervals
- 1.0m Elevation Intervals
- 5.0m Elevation Intervals

Coastal Regression
- ASCIE 2050
- ASCIE 2130

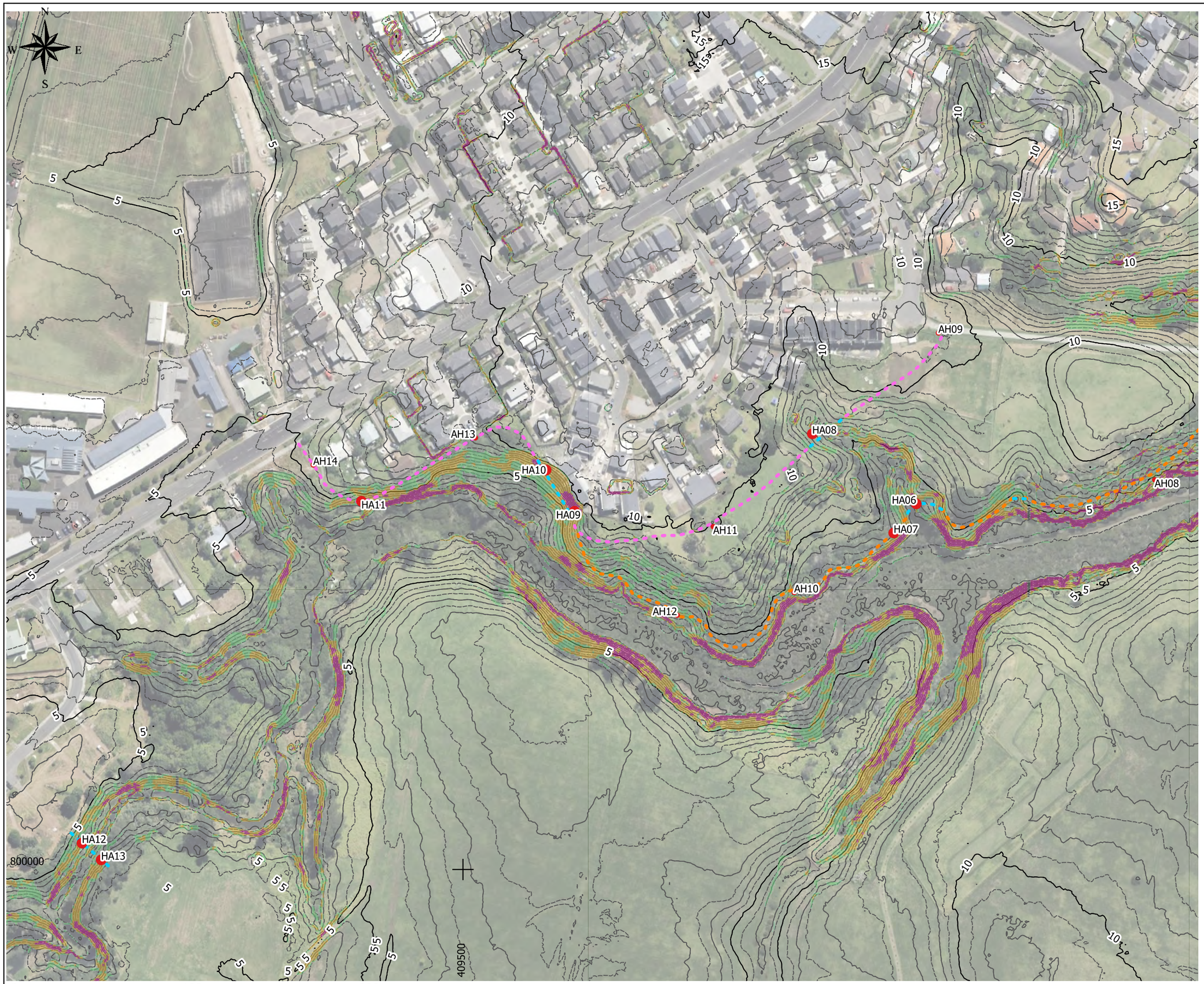
NOTES

Sources:
Auckland Council GIS
LINZ Online Database
Mt Eden 2000

SCALE @ A3

1:2,000

PROJECT NO.	MAP NO.	REV NO.
LTA23155	**GEO01**	**Rev 0**



LandTech CONSULTING

CLIENT/PROJECT

ReNature Limited
Tamami Stage Two Walkway
Wai-O-Taiki Nature Reserve

MAP TITLE

Test Location Plan 02

Legend

Geotechnical Investigation
- Hand Auger
- Hand Auger - 1.0m Deep

Geological Sections
- Section A-A'
- Section B-B'
- Section C-C'
- Head Scarp

Proposed Pathway
- 3.0m Wide Concrete Path
- Timber Boardwalk
- 2.0m Wide Concrete Path
- Aggregate Track

DEM 2016 Derived Ground Slopes
- 1(v):4(h) to 1(v):3(h)
- 1(v):3(h) to 1(v):2(h)
- >1(v):2(h)

DEM 2016 Derived Contours
- 0.5m Elevation Intervals
- 1.0m Elevation Intervals
- 5.0m Elevation Intervals

Coastal Regression
- ASCIE 2050
- ASCIE 2130

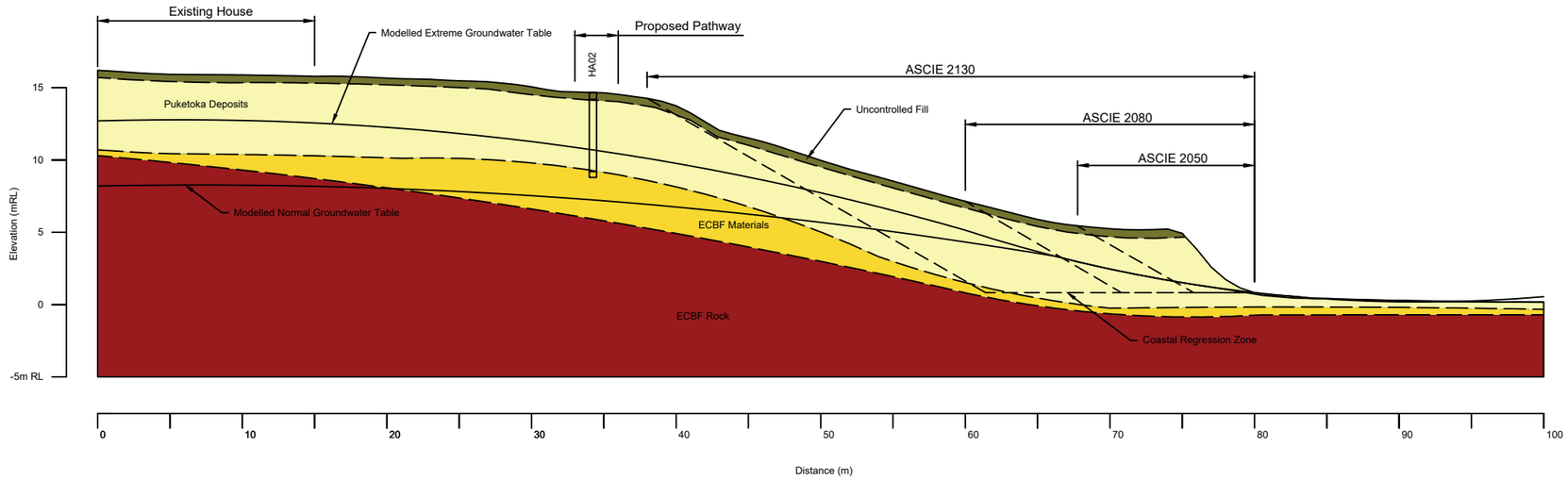
NOTES

Sources:
Auckland Council GIS
LINZ Online Database
Mt Eden 2000

SCALE @ A3

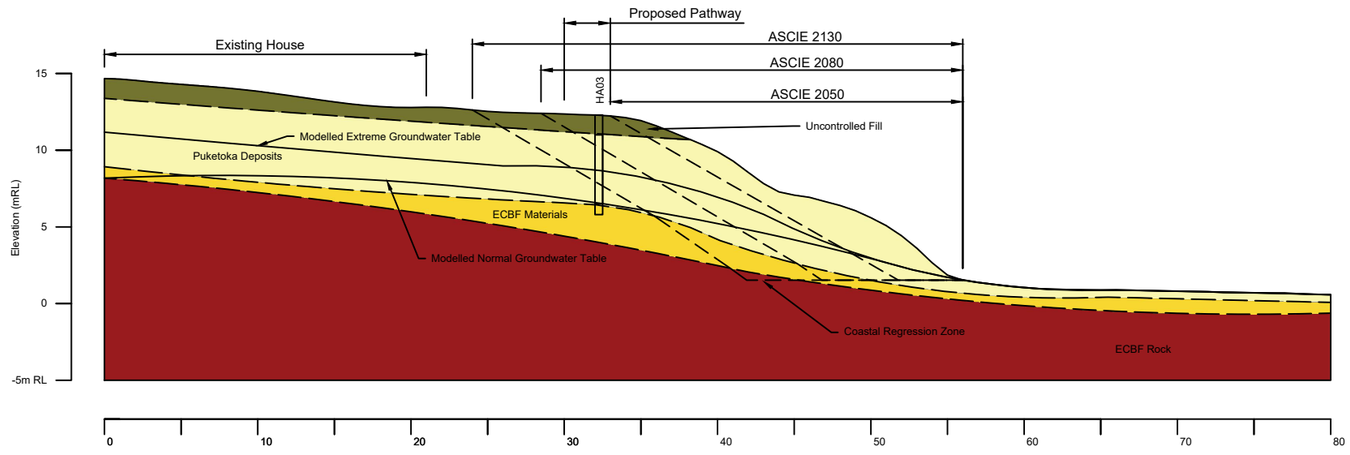
1:2,000

PROJECT NO.	MAP NO.	REV NO.
LTA23155	**GEO01**	**Rev 0**

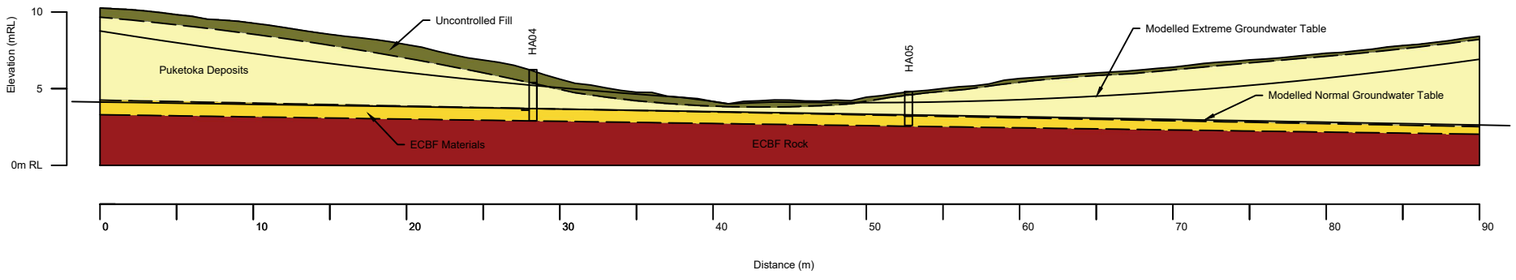


SECTION A-A'

ECBF = East Coast Bays Formation



SECTION B-B'



SECTION C-C'

LANDTECH LIMITED P: 09 930 9334 W: www.landtech.nz
15C PARAMOUNT DRIVE, HENDERSON, AUCKLAND 0610

SKETCH REVISIONS

REV	DATE	DESCRIPTION
0	24.04.2024	First Issue

	DATE	INITIAL
DRAWN	24.04.2024	M.A.H
SKETCH CHECK	24.04.2024	D.W

CLIENT / PROJECT

ReNature Ltd
Tamaki Pathway Stage Two
Wai-o-Taiki Nature Reserve

SKETCH TITLE

Geological Cross Sections

SCALE

1:400

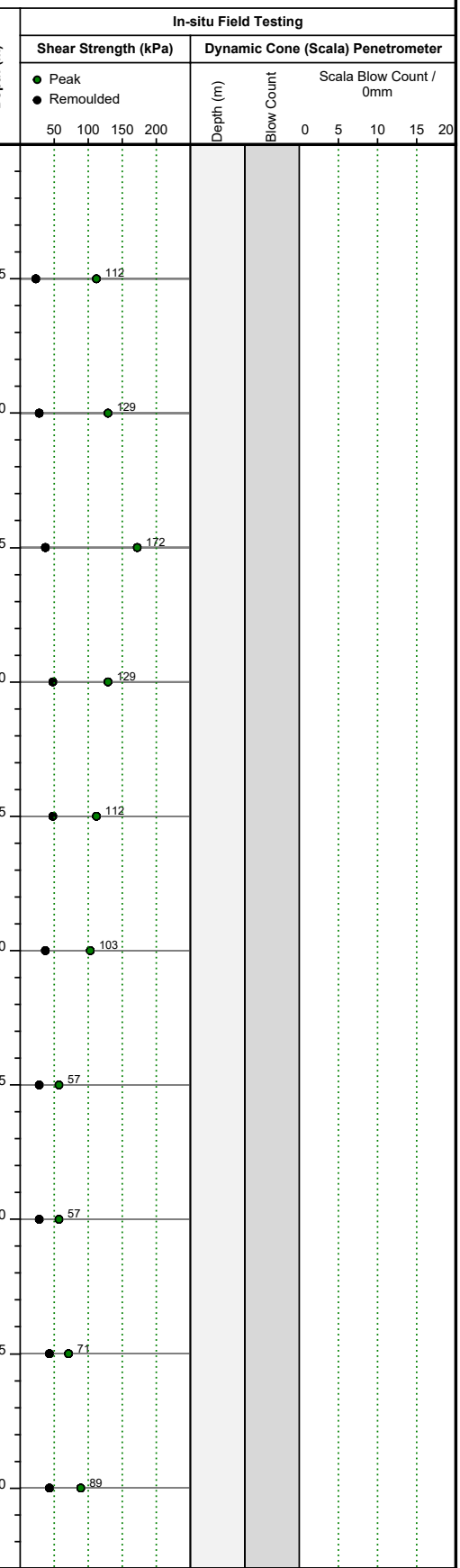
SKETCH NO.	SHEET NO.	REV.
LTA23155	03	0

Appendix B
Field Investigation Logs

Client:	reNature	**Augerhole No.:**	HA01
Project:	Proposed Walkway and Bridges	**Sheet No.:**	1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767314.33, N5917591.22	**Logged By:**	JPU
Drill Type:	50mm Hand Auger	**Reduced Level:**	10.40m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	2.2m (05-Apr-24)	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.5	SILT, minor fine - medium gravel, dark brown, orange streaks, very stiff, non plastic	
		0.7m: minor fine sand	
	1.0	1.0m: trace clay, minor fine sand	
	1.5		
PUKETOKA FORMATION	2.0	SILT, trace fine sand, minor clay, light brownish grey, orange streaks, very stiff, moist, slightly plastic	GW = 2.2m (05-Apr-24)
		2.2m: black streaks	
	2.5	2.5m: minor clay, minor fine sand	
		2.7m: minor silt clast, light grey light brownish grey and orange, black streaks	
	3.0	3.2m - 5.0m: poor recovery <5%	
	3.5	3.7m: some clay	
	4.0		
	4.5		
	5.0	End of Augerhole: 5.0m	
		[TARGET DEPTH]	



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client:	reNature	**Augerhole No.:** HA02
Project:	Proposed Walkway and Bridges	**Sheet No.:** 1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	

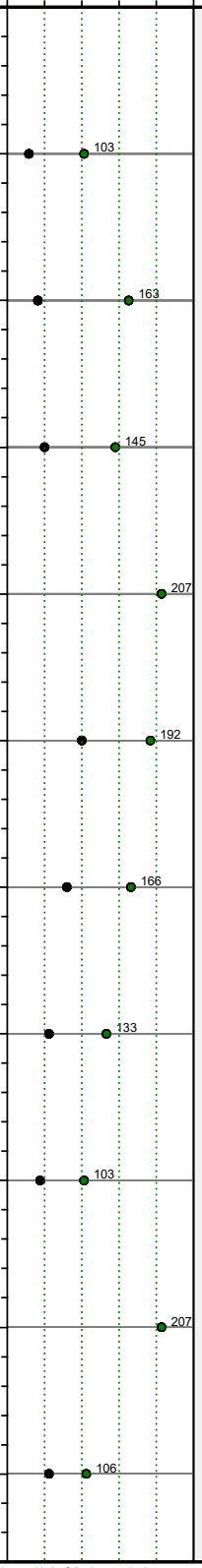
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767295.22, N5917374.54	**Logged By:**	KL
Drill Type:	50mm Hand Auger	**Reduced Level:**	14.70m (NZVD2016)	**Shear Vane No.:**	3240
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.483
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	18-Jul-23

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, trace rootlets, dark brown, stiff, dry, non plastic	
	0.5	SILT, minor clay, orangish brown, grey streaks, very stiff, moist, slightly plastic	
PUKETOKA FORMATION	1.0	Clayey SILT, light grey, orange streaks, very stiff, moist, moderately plastic	
	4.5	SILT, trace clay, light grey, orange streaks, very stiff, moist, slightly plastic	
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 0mm
		0 5 10 15 20

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

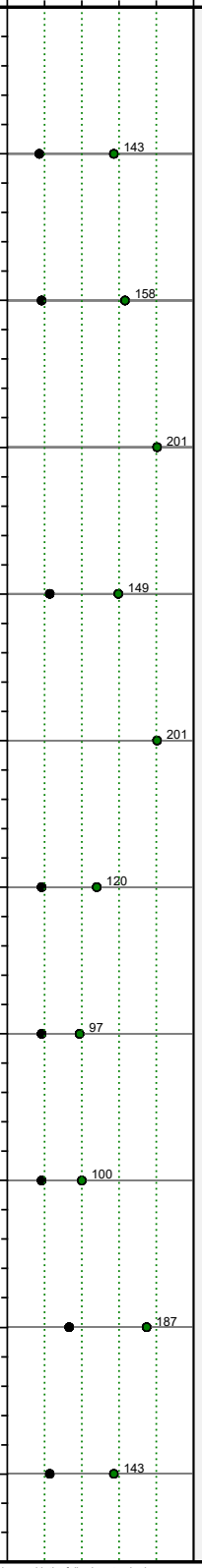
Client:	reNature	**Augerhole No.:** HA03
Project:	Proposed Walkway and Bridges	**Sheet No.:** 1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767193.73, N5917250.83	**Logged By:**	JPU
Drill Type:	50mm Hand Auger	**Reduced Level:**	12.10m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

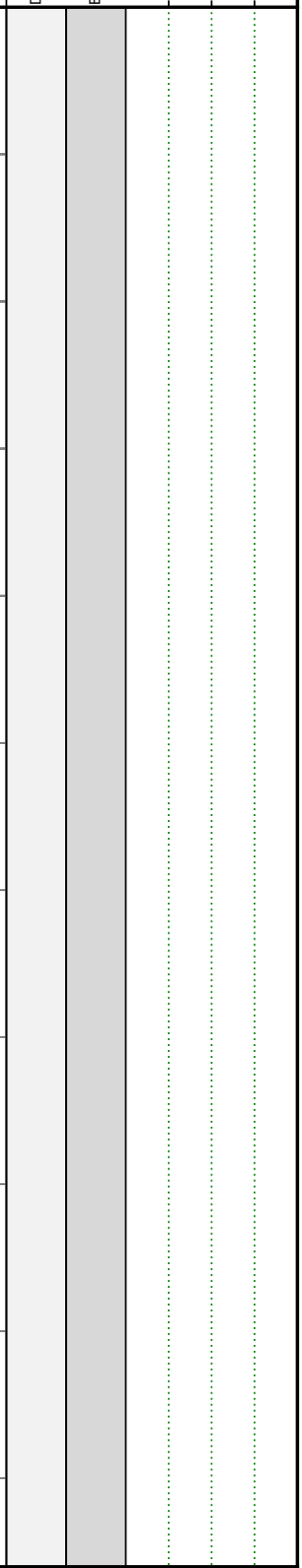
Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, minor clay, minor fine sand, brown, orange streaks, very stiff, moist, slightly plastic	
FILL	0.5	SILT, minor clay, minor fine sand, light brownish grey, orange streaks, very stiff, moist, slightly plastic	
		0.8m: brown, orange streaks	
	1.0		
PUKETOKA FORMATION	1.5	SILT, minor clay, light grey, orange streaks, very stiff, moist, slightly plastic	
	2.0	2.0m: some clay	
	2.5	2.5m: minor clay, minor fine sand	
	3.0	3.2m: orange and red streaks	
	3.5	3.4m: trace wood inclusions	
		3.8m: reddish pink, light grey streaks	
	4.0	4.2m: some clay, orangish brown, light grey streaks	
	4.5		
	5.0	End of Augerhole: 5.0m	
		[TARGET DEPTH]	

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334 Email: info@landtech.nz Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: HA04
Sheet No.: 1 of 1

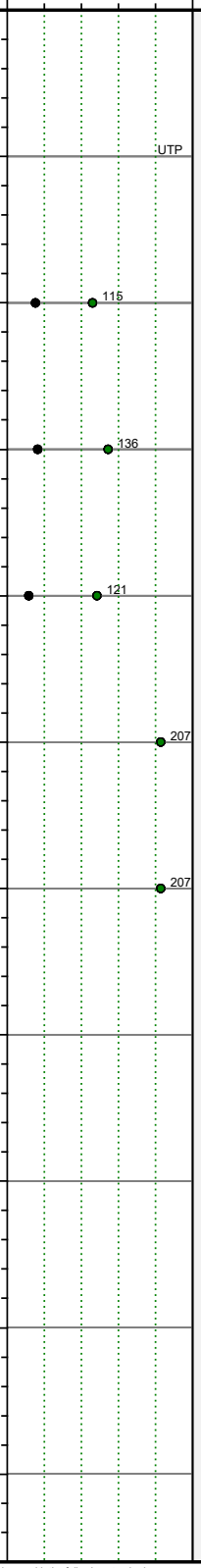
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767164.40, N5917178.41	**Logged By:**	KL
Drill Type:	50mm Hand Auger	**Reduced Level:**	5.50m (NZVD2016)	**Shear Vane No.:**	3240
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.483
Date Finished:	03-Apr-24	**Groundwater Level (m):**	2.6m (05-Apr-24)	**Calibration Date:**	18-Jul-23

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.5	Fine Gravelly SILT, trace rootlets, dark brown, stiff, moist, non plastic 0.5m - 2.5m: hole collapse	
PUKETOKA FORMATION	1.0 1.5 2.0 2.5	SILT, minor clay, minor fine gravel, dark brownish grey, dark brown and orange streaks, very stiff, moist, slightly plastic	
EAST COAST BAYS FORMATION	3.0	SILT, trace fine sand, orangish brown, light grey streaks, hard, moist, non plastic End of Augerhole: 3.0m [HOLE COLLAPSE]	GW = 2.6m (05-Apr-24)

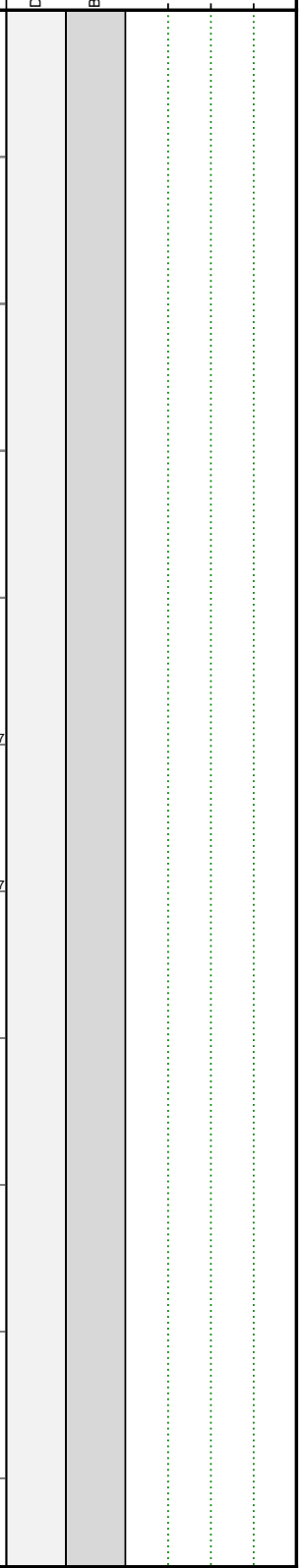
Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

LandTech CONSULTING

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: HA05
Sheet No.: 1 of 1

Project No.: LTA23155	**Coordinates:** NZTM2000: E1767154.04, N5917156.27	**Logged By:**	JPU
Drill Type: 50mm Hand Auger	**Reduced Level:** 4.80m (NZVD2016)	**Shear Vane No.:**	2486
Date Started: 03-Apr-24	**Ground Conditions:** Near Level, Grass	**Calibration Factor:**	1.439
Date Finished: 03-Apr-24	**Groundwater Level (m):** Not Encountered	**Calibration Date:**	21-Jun-23

Description

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

Stratigraphy	Depth (m)	Description
TS/FILL	0.0 – 0.3	SILT, minor fine sand, dark brown, very stiff, moist, non plastic
PUKETOKA FORMATION	0.3 – 1.6	SILT, minor fine sand, light grey, orange streak, very stiff, moist, non plastic 1.0m: some fine sand
EAST COAST BAYS FORMATION	1.6 – 2.0	SILT, some fine sand, dark grey, orange streaks, hard, moist, non plastic

End of Augerhole: 2.0m

[TOO DENSE TO AUGER]

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded (scale 50, 100, 150, 200)

Depth (m)	Shear Strength (Peak)
0.5	UTP
1.0	UTP
1.5	UTP
2.0	UTP

Dynamic Cone (Scala) Penetrometer — Depth (m), Blow Count, Scala Blow Count / 0mm (scale 0, 5, 10, 15, 20)

Groundwater Level (m)

<u>In- situ testing inaccordance with the following standards:</u>

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

Client:	reNature	**Augerhole No.:**	**HA06**
Project:	Proposed Walkway and Bridges	**Sheet No.:**	**1 of 1**
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766976.68, N5917047.85	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	1.50m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	0.2m (04-Apr-24)	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0–0.3	SILT, some clay, dark brown, soft, wet, slightly plastic	GW = 0.2m (04-Apr-24)
PUKETOKA FORMATION	0.3–1.7	SILT, some clay, trace fine sand, light grey, stiff to very stiff, saturated, slightly plastic	
ECBF	1.7–2.0	SILT, some clay, some fine silt clasts, trace fine sand, light grey, hard, saturated, slightly plastic	
	2.0	End of Augerhole: 2.0m [TOO DENSE TO AUGER]	

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) (● Peak, ● Remoulded; scale 50, 100, 150, 200)

Depth (m)	Peak
0.5	65
1.0	84
1.5	132
2.0	UTP

Dynamic Cone (Scala) Penetrometer — Depth (m), Blow Count, Scala Blow Count / 0mm (0, 5, 10, 15, 20)

In- situ testing inaccordance with the following standards:

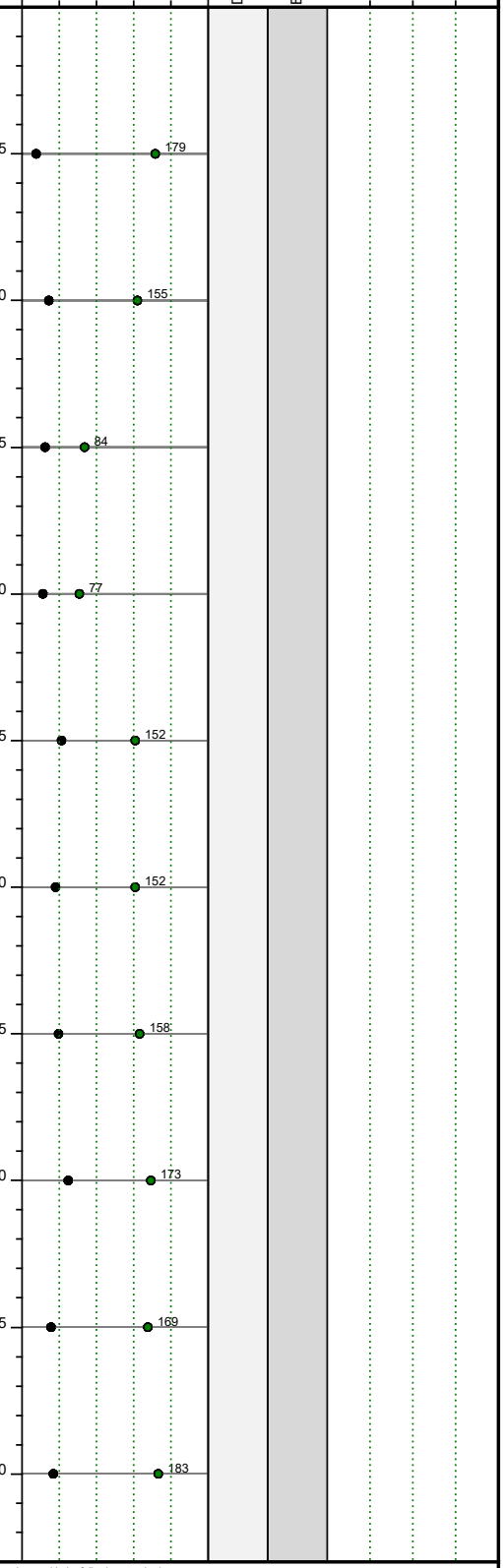
Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

Client:	reNature	**Augerhole No.:**	**HA07**
Project:	Proposed Walkway and Bridges	**Sheet No.:**	**1 of 1**
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766963.95, N5917031.41	**Logged By:**	MB
Drill Type:	50mm Hand Auger	**Reduced Level:**	3.90m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	2.7m (04-Apr-24)	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, brown, stiff, dry, non plastic	
PUKETOKA FORMATION	0.5	SILT, minor clay, light grey, orange and yellow mottles and streaks, moist, stiff, slightly plastic	
	1.8	1.8m: wet	
	2.4	2.4m: minor fine sand	
	2.6	2.6m: grey with orange and yellow mottles	GW = 2.7m (04-Apr-24)
	2.8	2.8m - 3.5m: hole collapsing	
EAST COAST BAYS FORMATION	3.5	SILT, minor clay, dark grey, very stiff, saturated, slightly plastic	
	4.5	4.5m: some fine sand	
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: HA08
Sheet No.: 1 of 1

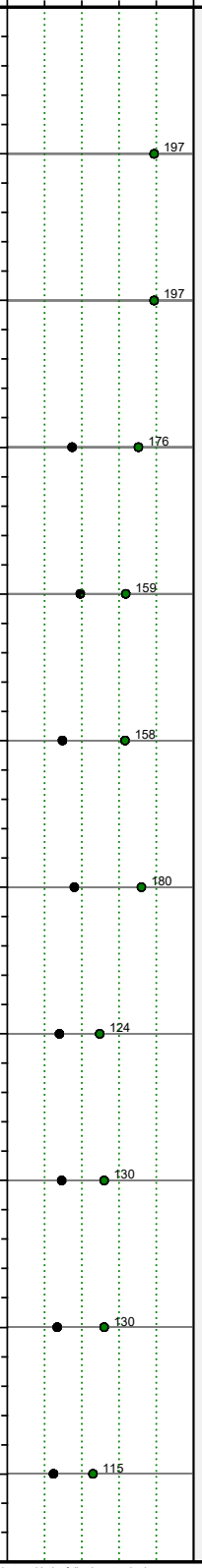
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766918.19, N5917087.49	**Logged By:**	MB
Drill Type:	50mm Hand Auger	**Reduced Level:**	6.70m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, dark brown, very stiff, dry, non plastic	
PUKETOKA FORMATION	0.5	SILT, trace clay, light grey with orange and yellow mottles, very stiff, moist, non - slightly plastic	
	1.0	1.1m: minor clay, trace rootlets, dark grey and brown, black and orange mottles	
	1.5		
	2.0	1.8m: some clay	
	2.5	2.4m: minor fine sand 2.5m: grey with black stains	
	3.0		
	3.5		
	4.0	3.9m: wet, light bluish grey with black stains	
	4.5	4.3m: organics	
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	

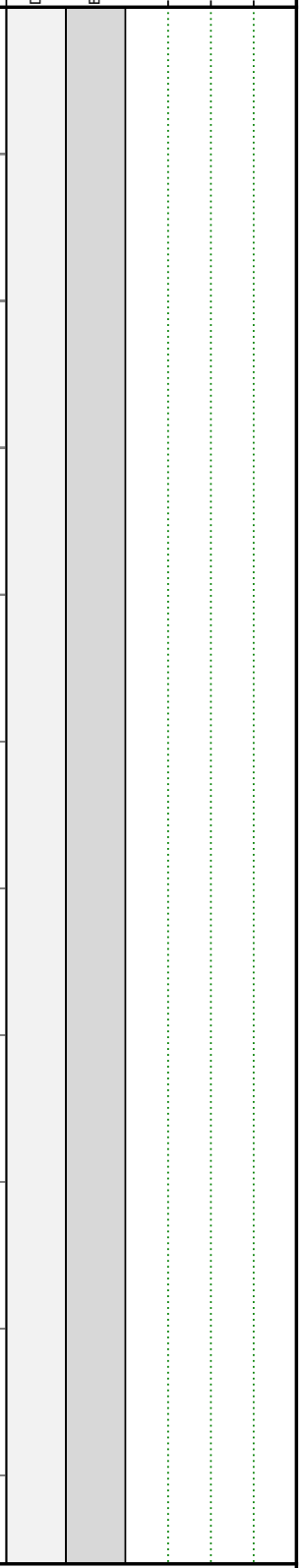
Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature		**Augerhole No.: HA09**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766784.02, N5917043.66	**Logged By:**	MB
Drill Type:	50mm Hand Auger	**Reduced Level:**	7.40m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	1.5m (04-Apr-24)	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.5	SILT, dark brown, very stiff, dry, non plastic	
PUKETOKA FORMATION	1.0	SILT, brown with orange mottles, stiff to very stiff, moist, non plastic	
	1.5	1.2m: minor clay	GW = 1.5m (04-Apr-24)
	2.0	2.0m: wet 2.1m: saturated	
	2.5	Clayey SILT, grey with yellow and orange mottles, stiff to very stiff, saturated, highly plastic	
	3.0	3.2m: blackish grey	
	3.5	3.4m: black and grey	
	4.0		
	4.5	4.5m: minor fine sand	
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded

Depth (m)	Peak	Remoulded
0.5	UTP	
1.0	169	
1.5	120	
2.0	123	
2.5	138	
3.0	135	
3.5	169	
4.0	130	
4.5	192	
5.0	176	

Dynamic Cone (Scala) Penetrometer

Depth (m) | Blow Count | Scala Blow Count / 0mm

In-situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test,NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334 Email: info@landtech.nz Website: www.landtech.nz

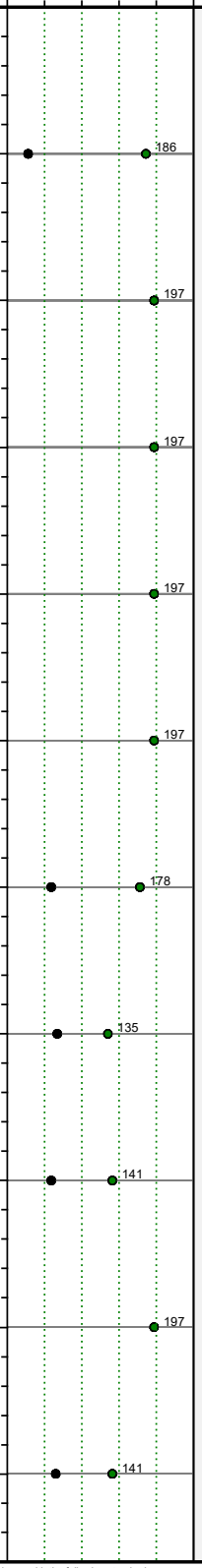
Client: reNature		**Augerhole No.:** HA10
Project: Proposed Walkway and Bridges		**Sheet No.:** 1 of 1
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766768.21, N5917066.94	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	8.10m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, dark orangish brown, very stiff, dry, non plastic	
		0.3m: trace fine gravel	
FILL	0.5	Clayey SILT, grey, orange streak, very stiff, dry, slightly plastic to moderately plastic	
	1.0	SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	1.5	SILT, dark orange, very stiff, dry, non plastic	
		SILT, trace clay, light grey, yellowish orange streaks, very stiff to hard, moist, non to slightly plastic	
	2.0	2.1m: pink streaks	
		2.3m: dark purplish grey	
	2.5	2.6m: dark grey	
	3.0	Clayey SILT, dark purplish grey, very stiff, moist, slightly to moderately plastic	
	3.5	3.8m: blackish grey	
	4.0	4.3m: black streaks	
	4.5		
	5.0	End of Augerhole: 5.0m	
		[TARGET DEPTH]	

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 0mm
		0 5 10 15 20

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334 Email: info@landtech.nz Website: www.landtech.nz

Client: reNature		**Augerhole No.:** HA11
Project: Proposed Walkway and Bridges		**Sheet No.:** 1 of 1
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766663.90, N5917049.33	**Logged By:**	JPU
Drill Type:	50mm Hand Auger	**Reduced Level:**	3.60m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	4.8m (04-Apr-24)	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, minor fine sand, dark brown, very stiff, moist, non plastic	
PUKETOKA FORMATION	0.5	SILT, minor fine sand, light grey, orange mottles, very stiff, moist, non plastic	
	1.5	1.5m: trace clay, minor fine sand	
	2.0	Clayey SILT, light brownish grey, orange and black streaks, very stiff, moist, moderately plastic	
	2.5	SILT, some fine sand, light grey, orange mottles, very stiff, moist, non plastic	
		2.7m: minor clay, wet	
	3.0	3.0m: some fine sand, grey	
		3.1m - 4.1m: poor recovery <30%	
	3.5	3.5m - 4.1m: hole collapse	
	4.0		
EAST COAST BAYS FORMATION	4.5	SILT, minor clay, dark grey, very stiff to hard, moist, non plastic	GW = 4.8m (04-Apr-24)
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded

Depth (m)	Peak	Remoulded
0.5	201	
1.0	201	
1.5	201	
2.0	143	
2.5	172	
3.0	115	
3.5	129	
4.0	132	
4.5	172	
5.0	201	

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 0mm
0.0	0	0
0.5	5	5
1.0	10	10
1.5	15	15
2.0	20	20

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

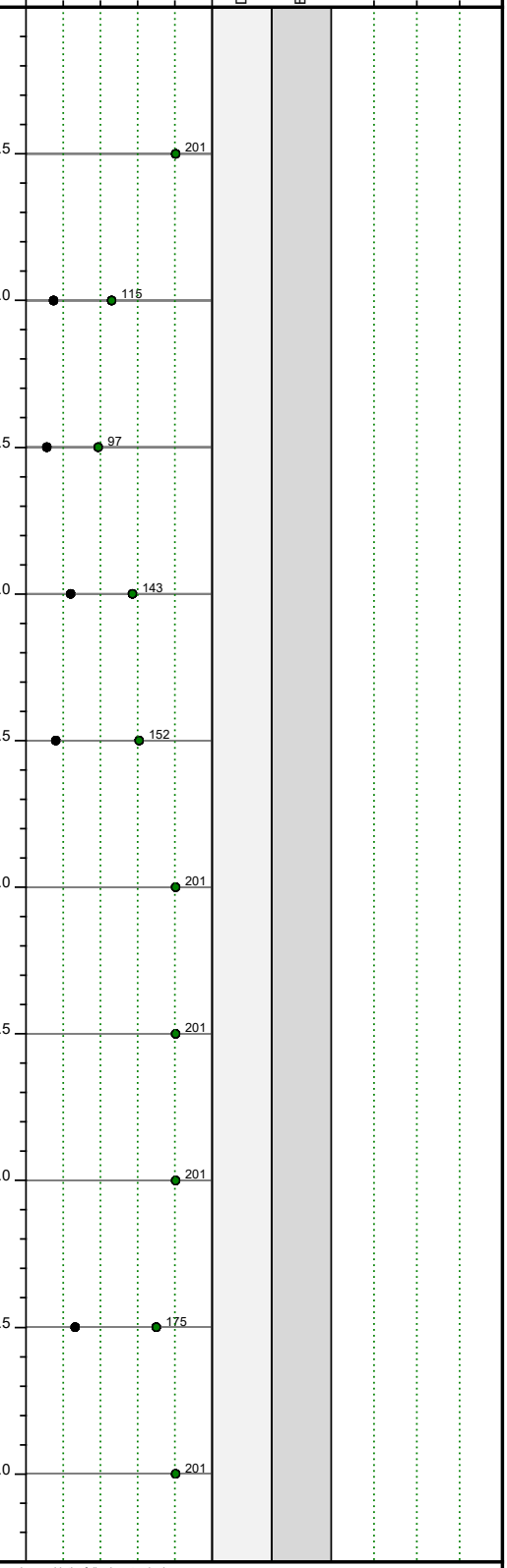
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

Client:	reNature	**Augerhole No.:**	HA12
Project:	Proposed Walkway and Bridges	**Sheet No.:**	1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766506.42, N5916856.87	**Logged By:**	JPU
Drill Type:	50mm Hand Auger	**Reduced Level:**	3.10m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Description	Groundwater Level (m)
TS/FILL	0.0	SILT, minor fine sand, brown, very stiff, moist, non plastic	
PUKETOKA FORMATION	0.5	SILT, minor fine sand, dark brown, black streaks, very stiff, moist, non plastic 0.6m: minor clay, light grey, orange mottles 0.8m: some clay	
	1.0	Silty CLAY, light brownish grey, orange streaks, stiff to very stiff, moist ,highly plastic	
	1.5	1.6m: trace wood inclusions, purple staining, black streaks	
	2.0		
	2.5	SILT, some fine sand, trace clay, light grey, orange mottles, very stiff to hard, moist, slightly plastic	
EAST COAST BAYS FORMATION	3.0	3.1m: brownish grey, black streaks 3.3m: some clay	
	3.5		
	4.0	4.2m: grey	
	4.5		
	5.0	End of Augerhole: 5.0m [TARGET DEPTH]	



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: HA13
Sheet No.: 1 of 1

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766517.38, N5916847.32	**Logged By:**	KL
Drill Type:	50mm Hand Auger	**Reduced Level:**	2.50m (NZVD2016)	**Shear Vane No.:**	3240
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.483
Date Finished:	03-Apr-24	**Groundwater Level (m):**	1.5m (04-Apr-24)	**Calibration Date:**	18-Jul-23

Description

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

Stratigraphy	Depth (m)	Description
TS/FILL	0.0 – 0.4	SILT, dark brown, stiff, moist, non plastic
PUKETOKA FORMATION	0.4 – 0.7	SILT, minor clay, purplish grey, orange streaks, hard, moist, slightly plastic
PUKETOKA FORMATION	0.7 – 1.4	Clayey SILT, light grey, orange and organic streaks, hard, moderately to highly plastic 0.9m: minor wood inclusions
PUKETOKA FORMATION	1.4 – 2.0	SILT, minor clay, light grey, orange and organic streaks, firm, moist, slightly plastic 1.9m: wet
EAST COAST BAYS FORMATION	2.0 – 2.3	Sandy SILT, light grey, hard, wet, non plastic
EAST COAST BAYS FORMATION	2.3 – 2.5	Silty CLAY, light grey, hard, wet, highly plastic

End of Augerhole: 2.5m

[TOO DENSE TO AUGER]

Groundwater Level (m): GW = 1.5m (04-Apr-24)

In-situ Field Testing

Shear Strength (kPa) (● Peak, ● Remoulded)

Depth (m)	Shear Strength (kPa)
0.5	UTP
1.0	23
1.5	35
2.0	207
2.5	207

Dynamic Cone (Scala) Penetrometer — Depth (m), Blow Count, Scala Blow Count / 0mm (0, 5, 10, 15, 20)

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: AH01 - 1m
Sheet No.: 1 of 1

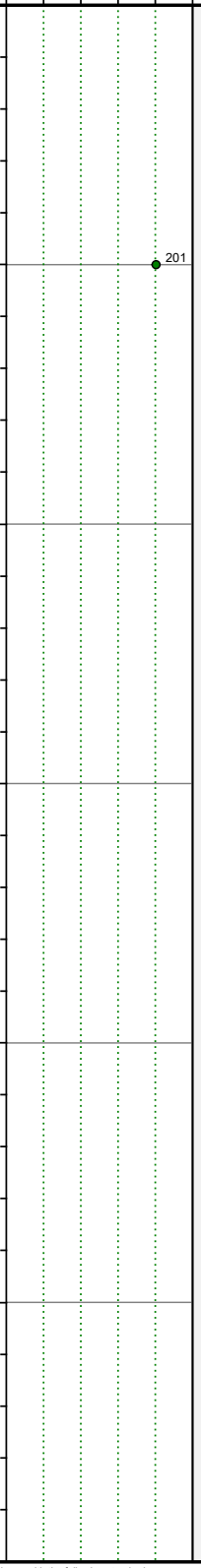
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767364.19, N5917703.08	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	20.10m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.5		SILT, some fine to medium gravel, dark brown, stiff, dry, non plastic	
	1.0		End of Augerhole: 0.6m [ROCK OBSTRUCTION]	
	1.5			
	2.0			
	2.5			

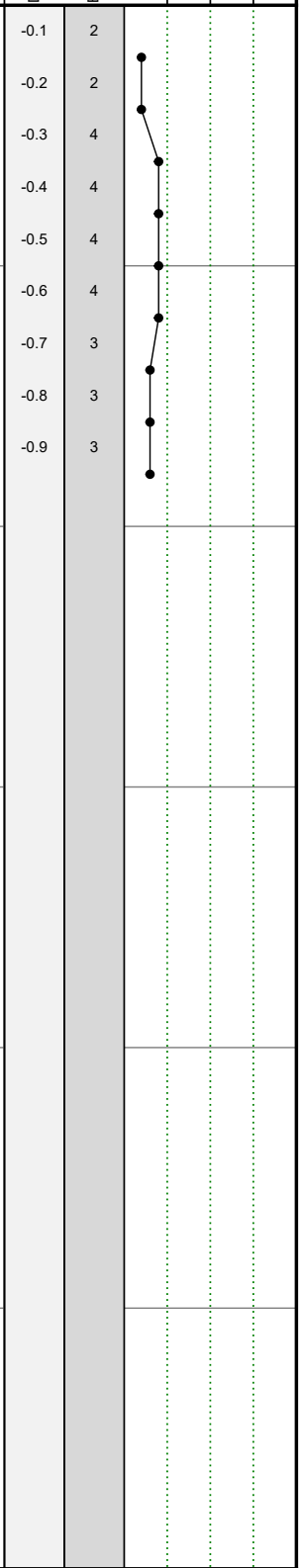
Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa)



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

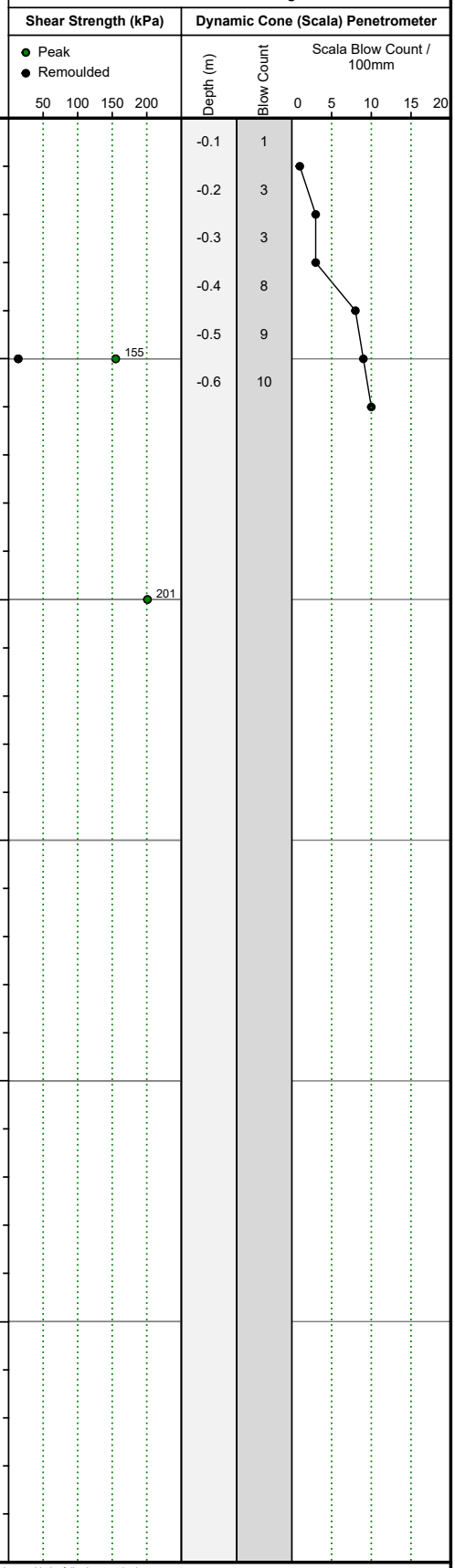
Client:	reNature	**Augerhole No.:** AH02 - 1m
Project:	Proposed Walkway and Bridges	**Sheet No.:** 1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767337.90, N5917636.30	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	16.20m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, trace roots, dark brown, stiff, moist, non plastic	
FILL	0.5		SILT, minor clay and fine gravel, some rubbish, dark brown, orange streaks, very stiff, moist, slightly plastic	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

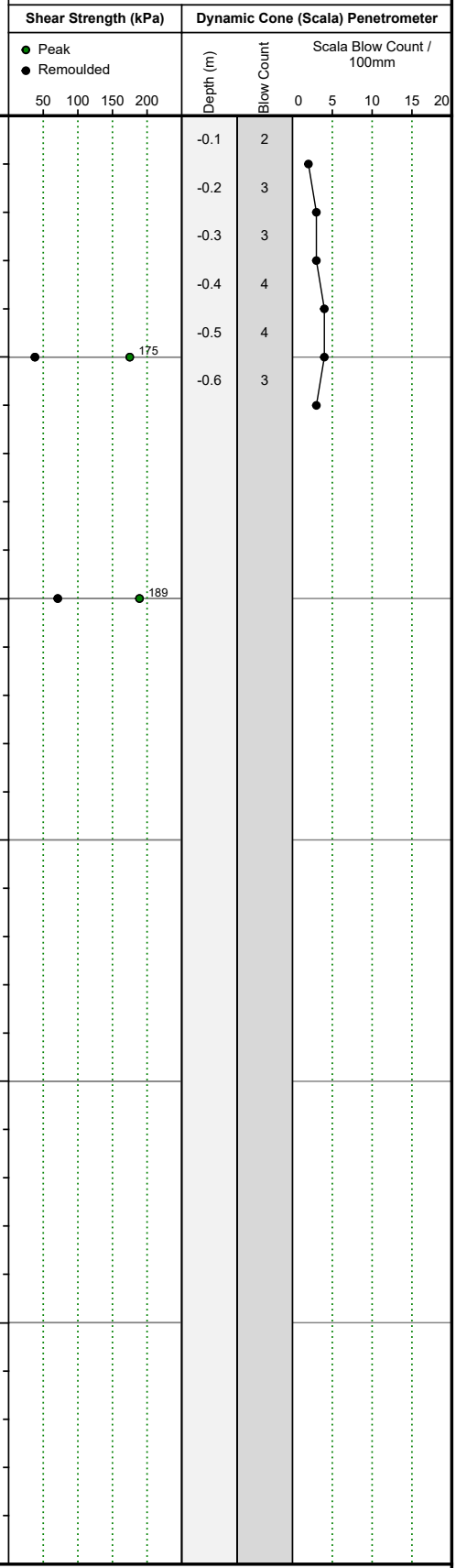
Client:	reNature	**Augerhole No.:** AH03 - 1m
Project:	Proposed Walkway and Bridges	**Sheet No.:** 1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767345.75, N5917513.24	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	15.40m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0		SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, minor clay, light brownish yellow, orange streaks, yellow pumice specs, very stiff, moist, slightly plastic	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



Dynamic Cone (Scala) Penetrometer

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

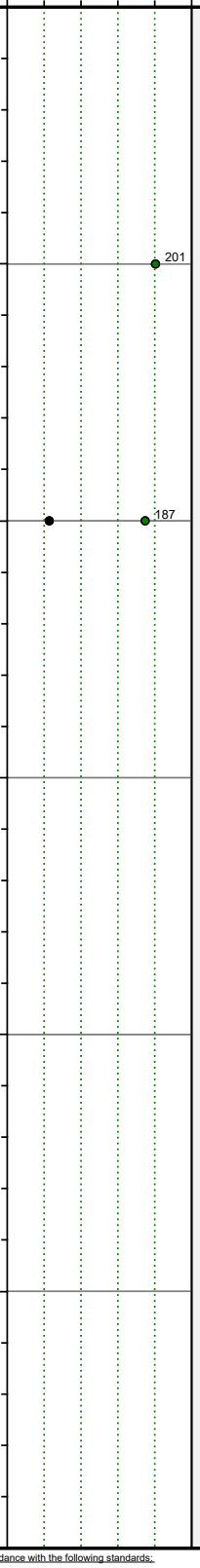
Client:	reNature	**Augerhole No.:**	**AH04 - 1m**
Project:	Proposed Walkway and Bridges	**Sheet No.:**	**1 of 1**
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767335.16, N5917438.47	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	17.00m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

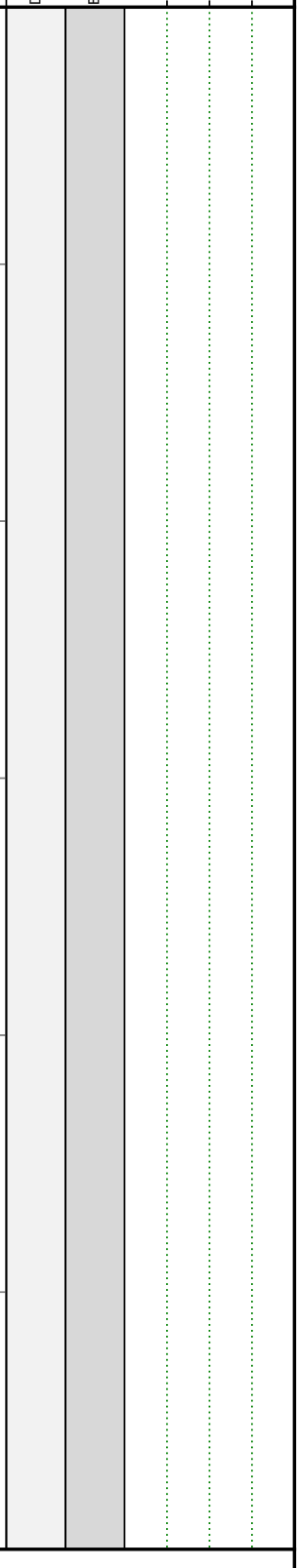
Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0		SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, minor clay, light brownish yellow, orange streaks, yellow pumice specs, very stiff, moist, slightly plastic	
			0.8m: light grey	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610 Ph: 09 930 9334 Email: info@landtech.nz Website: www.landtech.nz

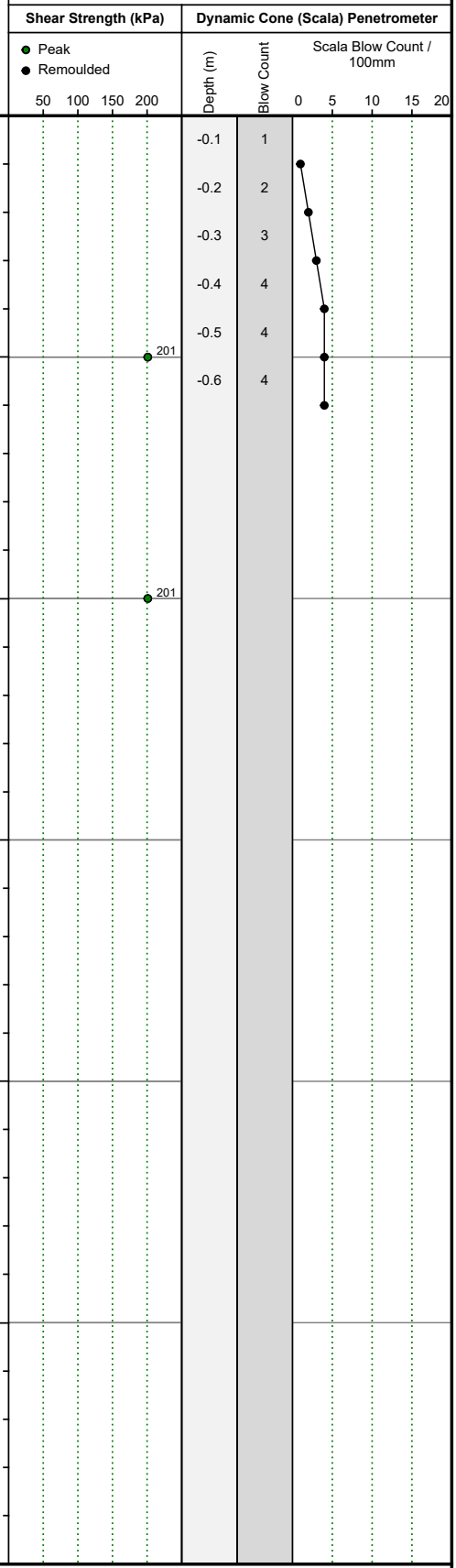
LandTech CONSULTING	**Client:** reNature **Project:** Proposed Walkway and Bridges **Address:** Wai-o-Taiki Nature Reserve, Point England, Auckland		**Augerhole No.:** AH05- 1m **Sheet No.:** 1 of 1

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767268.89, N5917331.38	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	12.00m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, fine to medium angular gravel, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, trace clay, dark orangish brown, very stiff, moist. non plastic to slightly plastic 0.7m: trace rootlets, grey, dark orange streaks	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test,NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

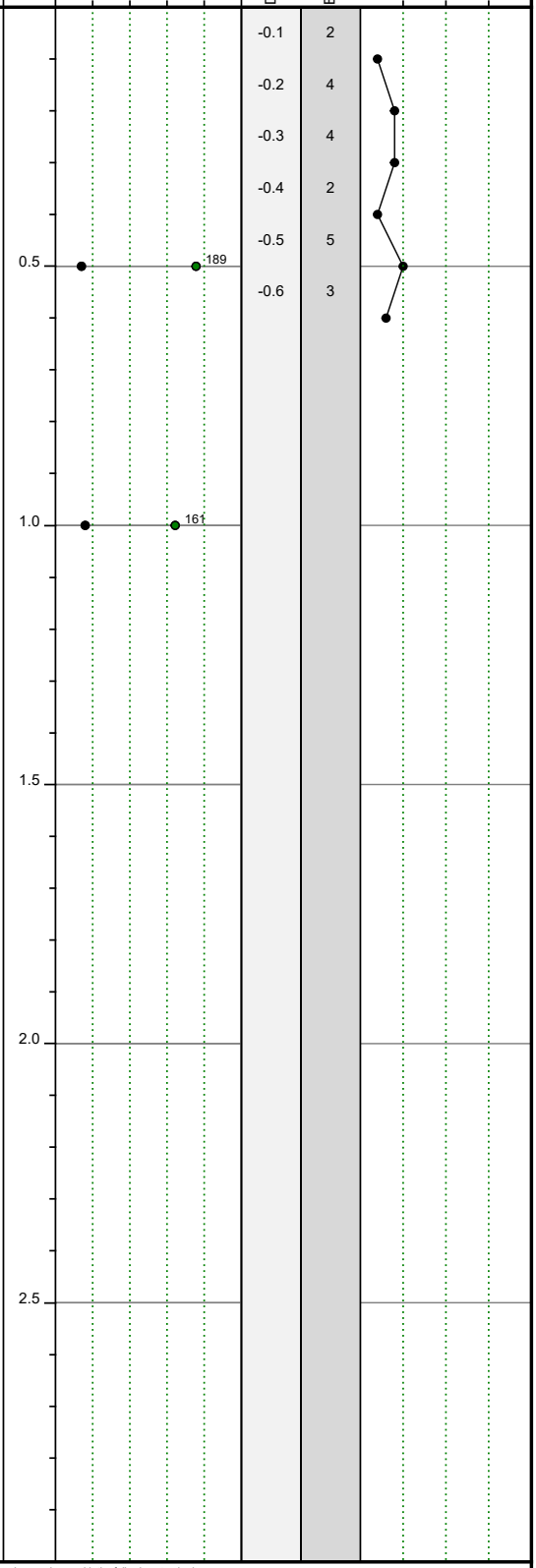
Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature		**Augerhole No.: AH06 - 1m**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767227.02, N5917296.03	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	8.10m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, dark brown, stiff, moist, non plastic	
			0.3m: some black fine gravel, brown intermixed with grey	
	0.5		0.6m: trace rootlets, reddish brown inclusion	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

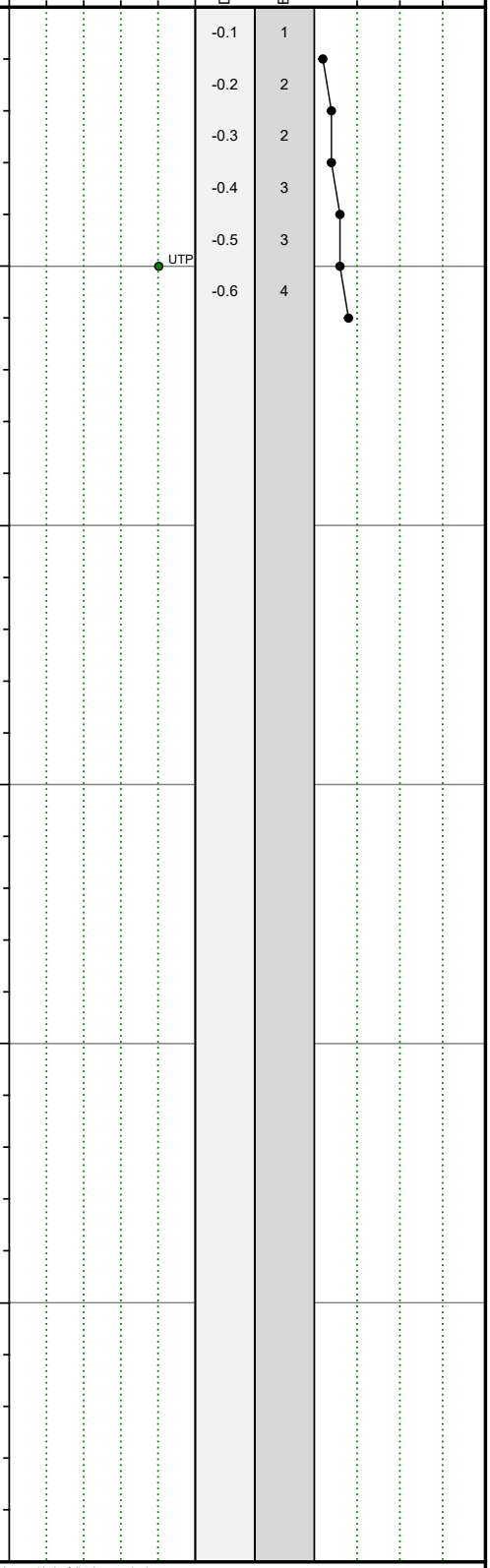
Email: info@landtech.nz
Website: www.landtech.nz

Client:	reNature	**Augerhole No.:** AH07 - 1m
Project:	Proposed Walkway and Bridges	**Sheet No.:** 1 of 1
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland	

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767181.71, N5917224.21	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	12.00m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, trace fine to medium angular gravel, dark brown, stiff, moist, non plastic	
	0.5		0.5m: grey intermixed with brown	
			End of Augerhole: 0.6m	
			[ROCK OBSTUCTION]	
	1.0			
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

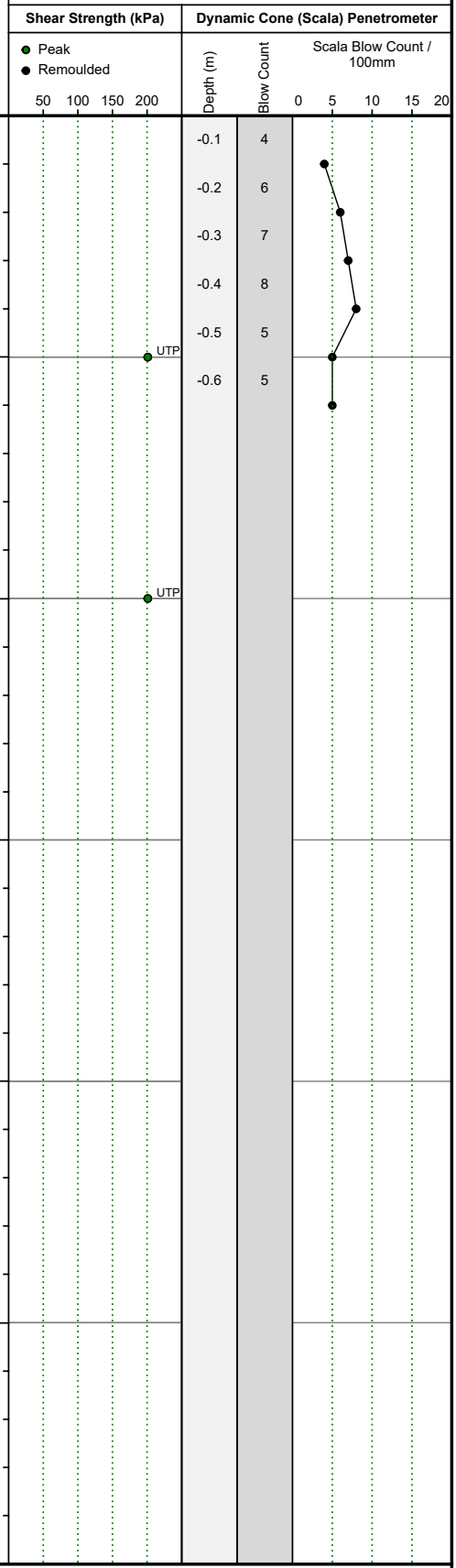
Client: reNature		**Augerhole No.: AH08 - 1m**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1767111.01, N5917061.50	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	4.50m (NZVD2016)	**Shear Vane No.:**	2486
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.439
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	21-Jun-23

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, grey, orange streaks, very stiff, dry, non plastic 0.6m: light grey, yellow and orange mottles 0.8m: trace clay	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



Dynamic Cone (Scala) Penetrometer

In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client:	reNature	**Augerhole No.:**	**AH09 - 1m**
Project:	Proposed Walkway and Bridges	**Sheet No.:**	**1 of 1**
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland		

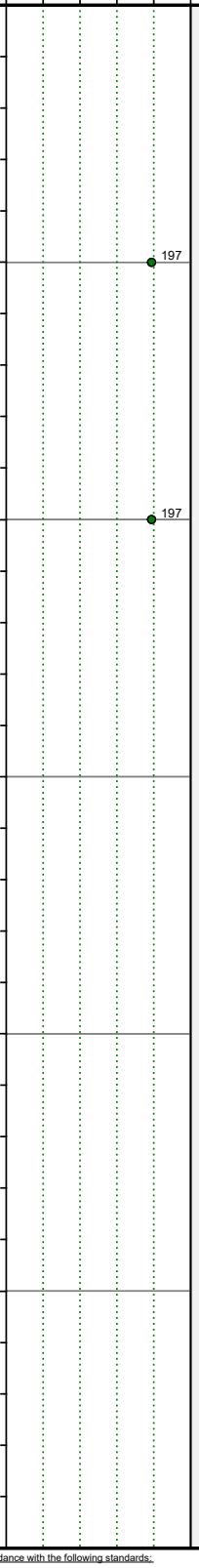
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766989.23, N5917144.16	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	10.60m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		Gravelly SILT, dark brown, very stiff to hard, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, grey, dark orange streaks, very stiff to hard, dry, non plastic	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

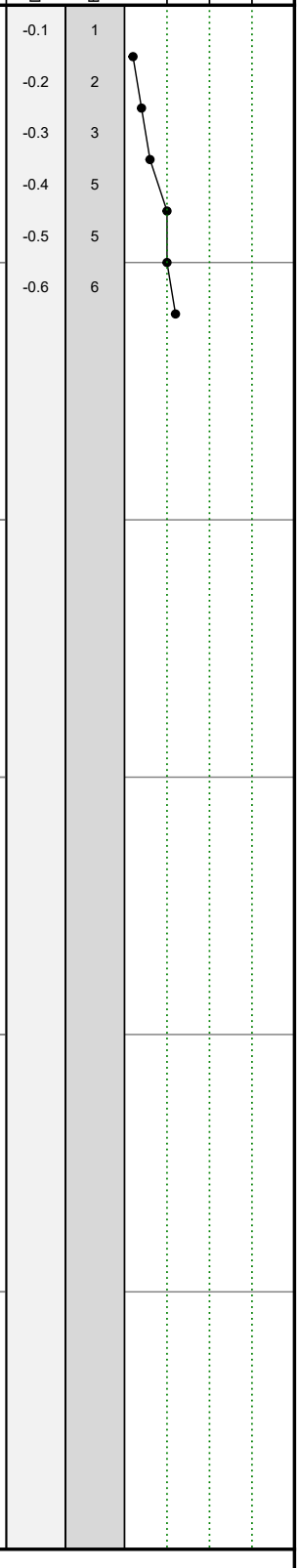
Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa)



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

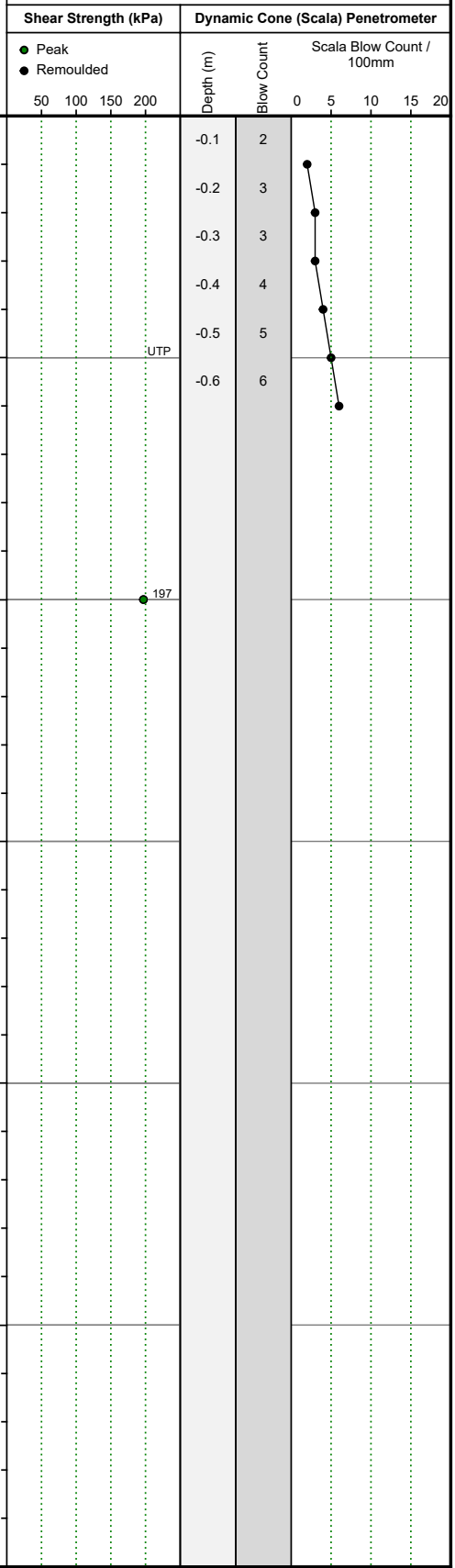
Client: reNature		**Augerhole No.: AH10 - 1m**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766907.87, N5916997.86	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	3.40m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, trace clay, yellowish brown, very stiff, dry, non to slightly plastic	
	1.0		0.9m: moist	
			End of Augerhole: 1.0m	
			[TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature		**Augerhole No.: AH11 - 1m**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

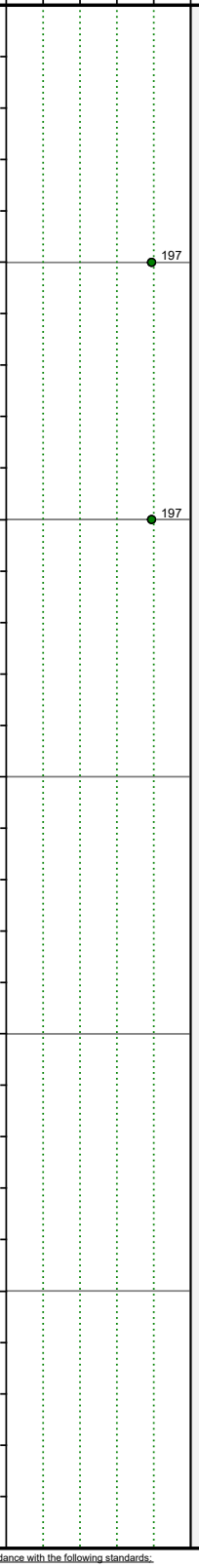
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766862.00, N5917034.89	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	10.00m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, dark brown, very stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, grey, dark orange streaks, very stiff to hard, dry, non plastic	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

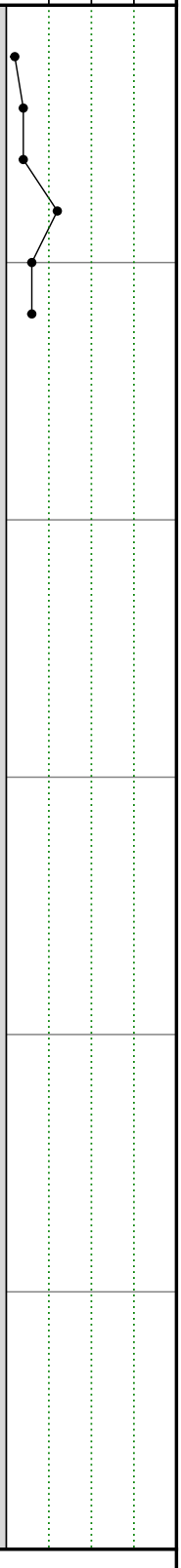
In-situ Field Testing

Shear Strength (kPa)



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count
-0.1	1
-0.2	2
-0.3	2
-0.4	6
-0.5	3
-0.6	3



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: AH12 - 1m
Sheet No.: 1 of 1

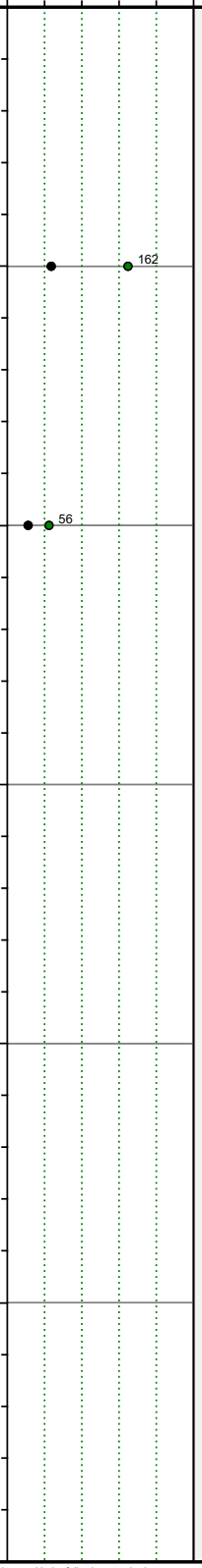
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766841.87, N5916985.06	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	2.90m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0		SILT, dark brown, stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, some clay, grey, yellow streaks, very stiff, moist, slightly plastic	
			0.8m: yellow pumice specs	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

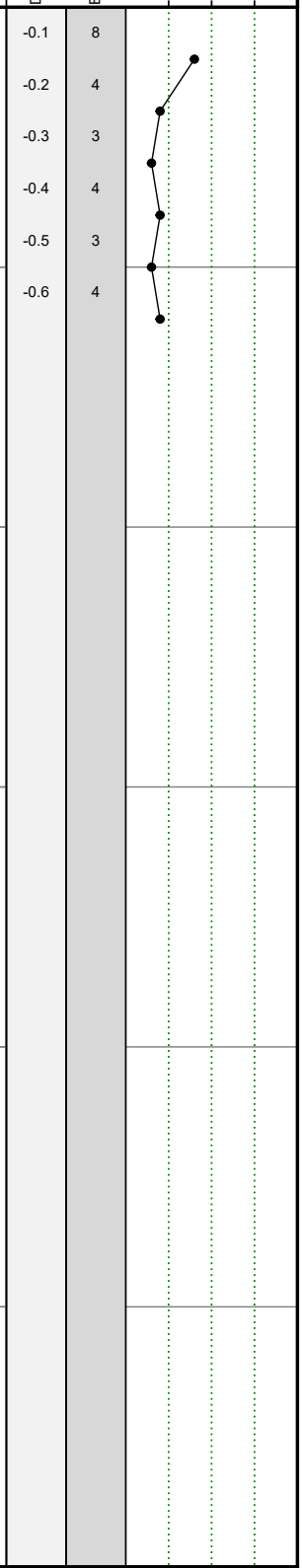
Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

Shear Strength (kPa) — ● Peak ● Remoulded



Dynamic Cone (Scala) Penetrometer



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Augerhole No.: AH13 - 1m
Sheet No.: 1 of 1

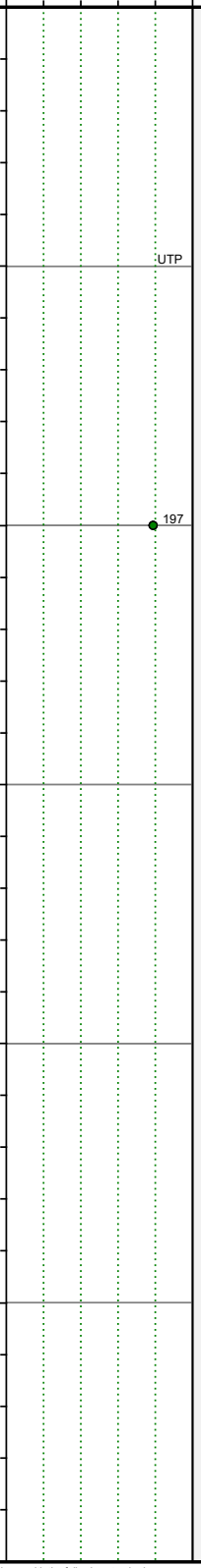
Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766728.26, N5917085.03	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	9.20m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		Fine gravelly SILT, dark brown, very stiff, moist, non plastic	
PUKETOKA FORMATION	0.5		SILT, trace clay, grey, orange and brown streaks, very stiff to hard, moist, slightly plastic	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing

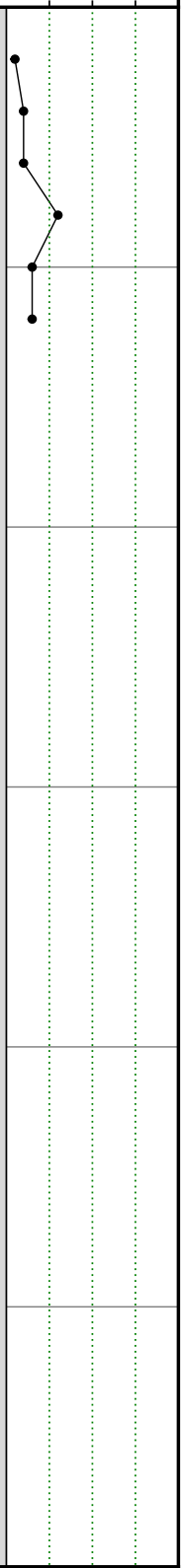
Shear Strength (kPa) — Peak, Remoulded



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count
-0.1	1
-0.2	2
-0.3	2
-0.4	6
-0.5	3
-0.6	3

Scala Blow Count / 100mm



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

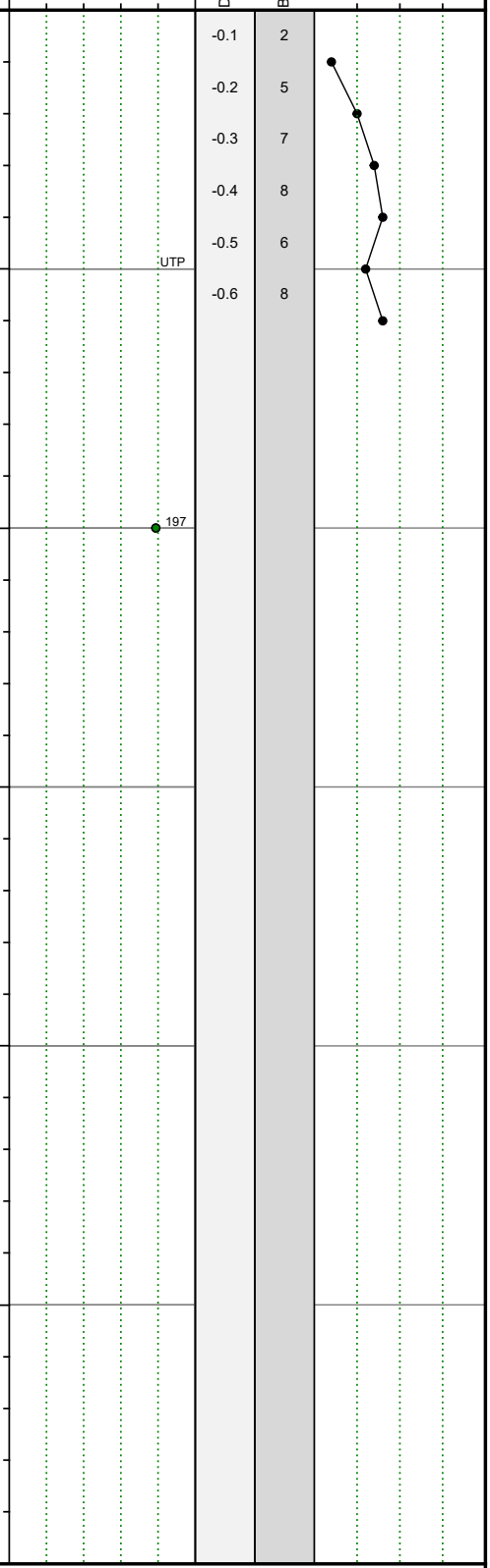
Client: reNature		**Augerhole No.: AH14 - 1m**
Project: Proposed Walkway and Bridges		**Sheet No.: 1 of 1**
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland		

Project No.:	LTA23155	**Coordinates:**	NZTM2000: E1766636.94, N5917069.81	**Logged By:**	KK
Drill Type:	50mm Hand Auger	**Reduced Level:**	5.50m (NZVD2016)	**Shear Vane No.:**	2915
Date Started:	03-Apr-24	**Ground Conditions:**	Near Level, Grass	**Calibration Factor:**	1.414
Date Finished:	03-Apr-24	**Groundwater Level (m):**	Not Encountered	**Calibration Date:**	10-Jan-24

Stratigraphy	Depth (m)	Graphic Log	Description	Groundwater Level (m)
TS/FILL	0.0		SILT, trace rootlets, dark brown, very stiff, dry, non plastic	
PUKETOKA FORMATION	0.5		SILT, dark orangish brown, orange streaks, very stiff, dry, non plastic 0.6m: dark orange streaks	
	1.0		End of Augerhole: 1.0m [TARGET DEPTH]	
	1.5			
	2.0			
	2.5			

Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005

In-situ Field Testing



In- situ testing inaccordance with the following standards:

Scala Penetrometer Testing: NZS 4402: 1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd: 15C Paramount Drive, Henderson, Auckland, 0610

Ph: 09 930 9334

Email: info@landtech.nz
Website: www.landtech.nz

Client: reNature
Project: Proposed Walkway and Bridges
Address: Wai-o-Taiki Nature Reserve, Point England, Auckland

Scala Penetrometer Testing

Date tested: 03/04/2024 and 04/04/2024

Tested By: MB + KL + KK + JPU

Test ID	HA01	HA02	HA03	HA04	HA05	HA06	HA07	HA08	HA09	HA10
Test from (m)	5.0	5.0	5.0	3.0	2.0	2.0	5.0	5.0	5.0	5.0
Depth (m)										
0.1	0.5	3	3	8	20	5	2	1	1	3
0.2	0.5	4	5	20	20	5	3	3	2	5
0.3	0.5	5	5	20		6	4	5	2	7
0.4	10	7	5			8	5	4	4	9
0.5	10	10	8			11	6	5	5	12
0.6	8	12	9			14	9	5	5	12
0.7	11	15	9			20	9	6	7	14
0.8	17	20	10			20	9	7	7	20
0.9	20	20	13				10	7	11	20
1.0	20		14				12	10	14	
1.1			14				15	12	20	
1.2			13				20	13	20	
1.3			18				20	11		
1.4			20					13		
1.5			20					14		
1.6								13		
1.7								15		
1.8								20		
1.9								20		
2.0										
Test depth (m)	6.0	5.9	6.5	3.3	2.2	2.8	6.3	6.9	6.2	5.9

In-situ field testing in accordance with Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Client:	reNature
Project:	Proposed Walkway and Bridges
Address:	Wai-o-Taiki Nature Reserve, Point England, Auckland

Scala Penetrometer Testing

Date tested: 03/04/2024 and 04/04/2024

Tested By: MB + KL + KK + JPU

Test ID	HA11	HA12	HA13							
Test from (m)	5.0	5.0	2.5							
Depth (m)										
0.1	6	7	3							
0.2	9	9	4							
0.3	12	9	4							
0.4	14	9	4							
0.5	20	9	5							
0.6	20	9	5							
0.7		9	5							
0.8		14	16							
0.9		14	20							
1.0		10	20							
1.1		12								
1.2		16								
1.3		11								
1.4		13								
1.5		18								
1.6		16								
1.7		20								
1.8		20								
1.9										
2.0										
Test depth (m)	5.7	6.8	3.5							

In-situ field testing in accordance with Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Appendix C
Coastal Regression Calculations

JOB NAME:	Tamaki Pathway	**DATE:**	23/04/2024
JOB NO:	LTA23155	**BY:**	MAH
SUBJECT:	A - Coastal Erosion	**PAGE:**	1

Design Calculations For Cliff Coastal Regression

Calculations undertaken in accordance with Coastal Hazard Assessment in the Auckland Region Guideline document 2021/010

The following sections summaries the coastal erosion calculations

Input Parameters:

Cliff Geometry

Factor		Quantity	Units	Notes
h_{Cr}	=	0.0	(m)	Height (m) of the rock layer of the cliff
h_{Cs}	=	13.5	(m)	Height (m) of the soil layer of the cliff
α_r	=	180.0	(deg)	The slope angle (degrees) of the rock layer
α_s	=	30.0	(deg)	The slope angle (degrees) of the soil layer

Regression Rate

Current Year	2024
Shoreline Response Factor (m)	0.2

Shoreline Response Factor is obtained Table 5.6 From "*Predicting Auckland's Exposure to Coastal Instability & Erosion* ", 2021 - Auckland Council

Historic Rates

LT_H	=	0.10	(m/yr)	Historical long-term retreat (regression rate)
S_H	=	1.7	(mm/yr)	Historical rate of Sea Level Rise (SLR)

Estimate future rate of SLR

Future SLR estimate fare in accordance with Ministry for the Environment 2022 document titled *Interim guidance on the use of new sea-level rise projections.*

NZSeaRise Maps provides data set for SLR and Vertical Land Movement (VLM)

Site Name = 1253

		2050	2080	2130	yr	Assesment Timeframe
SLR+VLM	=	0.47	1.15	3.02	m	SLR + VLM
T	=	26	56	106	yr	Timeframe over which erosion occurs
S_F	=	18.08	20.54	28.49	mm/yr	Estimated future rate of SLR + VLM

Eq 5.3 Long Term Future Regression Rate (LT_F [or R]) = $R = LT_H * (S_F / S_H)^m$

		2050	2080	2130	(year)	Assesment Timeframe
LT_F (or R)	=	0.160	0.165	0.176	(m/year)	Future retreat rate due to SLR + VLM effects

JOB NAME:	Tamaki Pathway		**DATE:** 23/04/2024
JOB NO:	LTA23155		**BY:** MAH
SUBJECT:	A - Coastal Erosion		**PAGE:** 2

Output Parameters:

	Assesment Timeframe				
	2050	2080	2130		
Cliff Instability		23.4		Eq 4.1	Cliff Instability = $(h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$
Cliff Toe Erosion	4.2	9.2	18.6	Eq 4.2	Cliff Toe Erosion = $(LT_F \times T)$

Eq 4.3 Current ASCIE = $(h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$

	Assesment Timeframe			
	2050	2080	2130	
Clif Instability	7.8	10.8	23.4	Cliff Instability taking into account geometry

Eq 4.4 Future ASCIE = $(LT_F \times T) + (h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$

	Assessment Timeframe		
	2050	**2080**	**2130**
Future ASCIE (m)	**12.0**	**20.0**	**42.0**

Horizontal distance (m) of estimated cliff retreat, as measured from the current cliff toe position

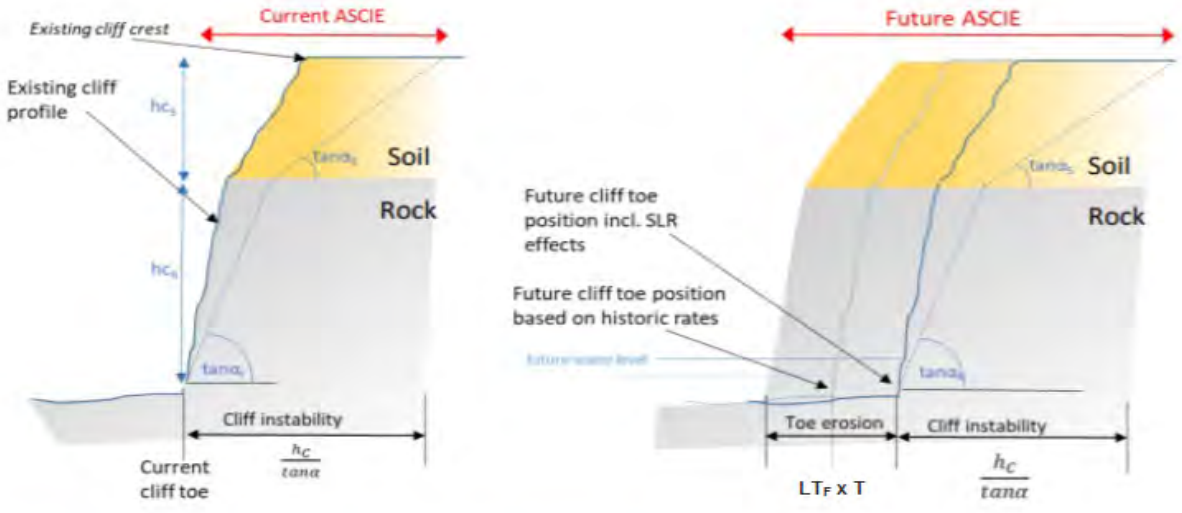


Figure 2: Definition sketch of areas susceptible to coastal instability and erosion on cliff shorelines

JOB NAME:	Tamaki Pathway		**DATE:** 23/04/2024
JOB NO:	LTA23155		**BY:** MAH
SUBJECT:	B - Coastal Erosion		**PAGE:** 1

Design Calculations For Cliff Coastal Regression

Calculations undertaken in accordance with Coastal Hazard Assessment in the Auckland Region Guideline document 2021/010

The following sections summaries the coastal erosion calculations

Input Parameters:

Cliff Geometry

Factor		Quantity	Units	Notes
h_{Cr}	=	6.8	(m)	Height (m) of the rock layer of the cliff
h_{Cs}	=	12.6	(m)	Height (m) of the soil layer of the cliff
α_r	=	34.0	(deg)	The slope angle (degrees) of the rock layer
α_s	=	30.0	(deg)	The slope angle (degrees) of the soil layer

Regression Rate

Current Year	2024
Shoreline Response Factor (m)	0.2

Shoreline Response Factor is obtained Table 5.6 From "*Predicting Auckland's Exposure to Coastal Instability & Erosion* ", 2021 - Auckland Council

Historic Rates

LT_H	=	0.10	(m/yr)	Historical long-term retreat (regression rate)
S_H	=	1.7	(mm/yr)	Historical rate of Sea Level Rise (SLR)

Estimate future rate of SLR

Future SLR estimate fare in accordance with Ministry for the Environment 2022 document titled *Interim guidance on the use of new sea-level rise projections.*

NZSeaRise Maps provides data set for SLR and Vertical Land Movement (VLM)

Site Name = 1253

		2050	2080	2130	yr	Assesment Timeframe
SLR+VLM	=	0.47	1.15	3.02	m	SLR + VLM
T	=	26	56	106	yr	Timeframe over which erosion occurs
S_F	=	18.08	20.54	28.49	mm/yr	Estimated future rate of SLR + VLM

Eq 5.3 Long Term Future Regression Rate (LT_F [or R]) = $R = LT_H * (S_F / S_H)^m$

		2050	2080	2130	(year)	Assesment Timeframe
LT_F (or R)	=	0.160	0.165	0.176	(m/year)	Future retreat rate due to SLR + VLM effects

JOB NAME:	Tamaki Pathway		**DATE:** 23/04/2024
JOB NO:	LTA23155		**BY:** MAH
SUBJECT:	B - Coastal Erosion		**PAGE:** 2

Output Parameters:

	Assesment Timeframe				
	2050	2080	2130		
Cliff Instability		31.9		Eq 4.1	Cliff Instability = $(h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$
Cliff Toe Erosion	4.2	9.2	14.1	Eq 4.2	Cliff Toe Erosion = $(LT_F \times T)$

Eq 4.3 Current ASCIE = $(h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$

	Assesment Timeframe			
	2050	2080	2130	
Clif Instability	18.8	18.3	17.9	Cliff Instability taking into account geometry

Eq 4.4 Future ASCIE = $(LT_F \times T) + (h_{Cr} / \tan \alpha_r) + (h_{Cs} / \tan \alpha_s)$

	Assessment Timeframe		
	2050	**2080**	**2130**
Future ASCIE (m)	**23.0**	**27.5**	**32.0**

Horizontal distance (m) of estimated cliff retreat, as measured from the current cliff toe position

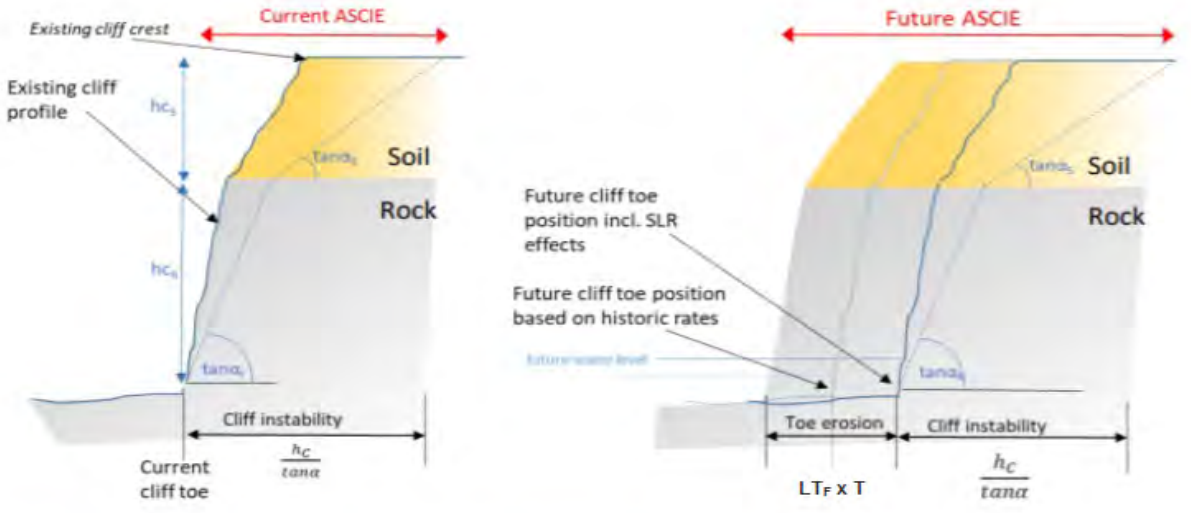
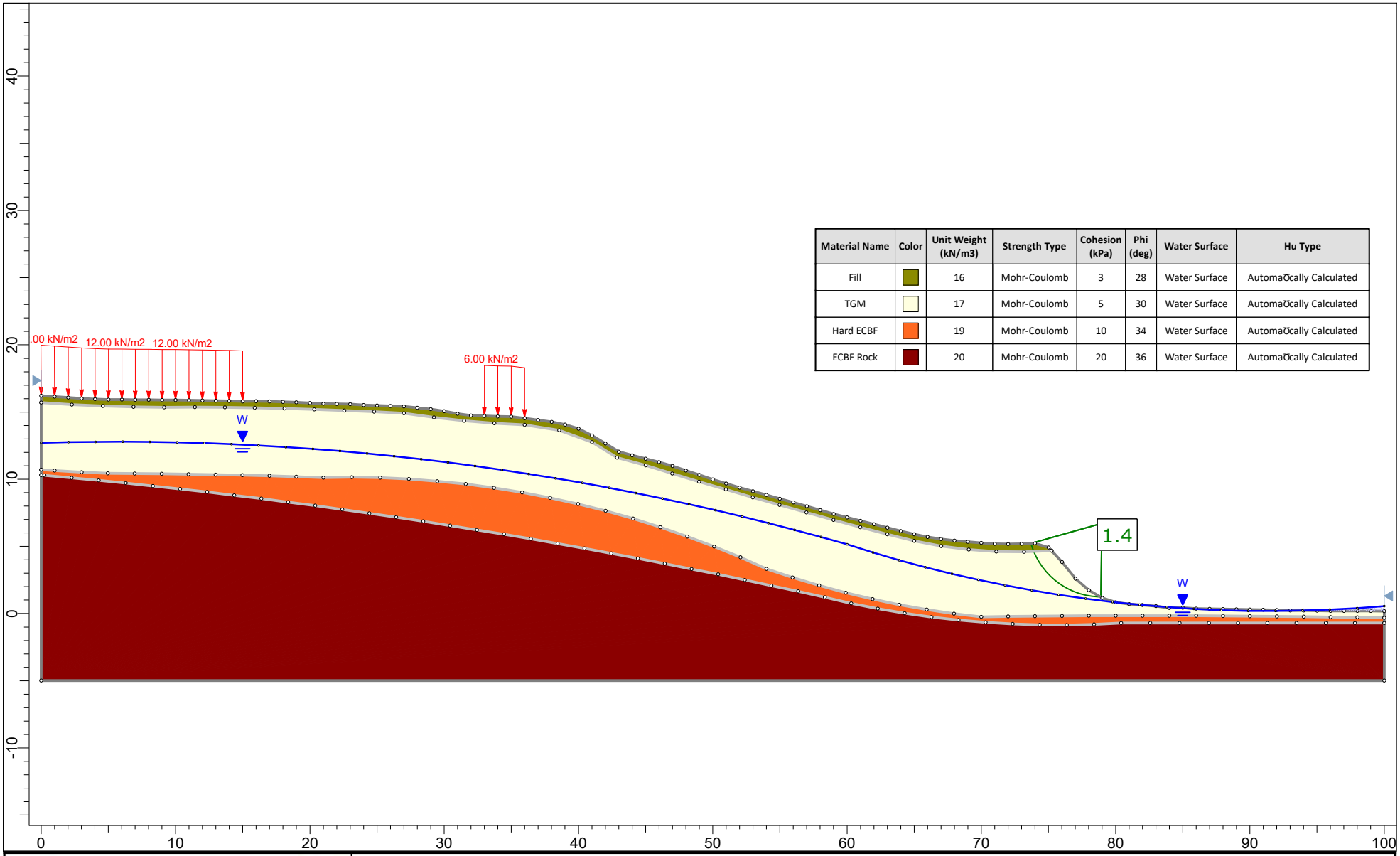


Figure 2: Definition sketch of areas susceptible to coastal instability and erosion on cliff shorelines

Appendix D
Slope Stability Analysis

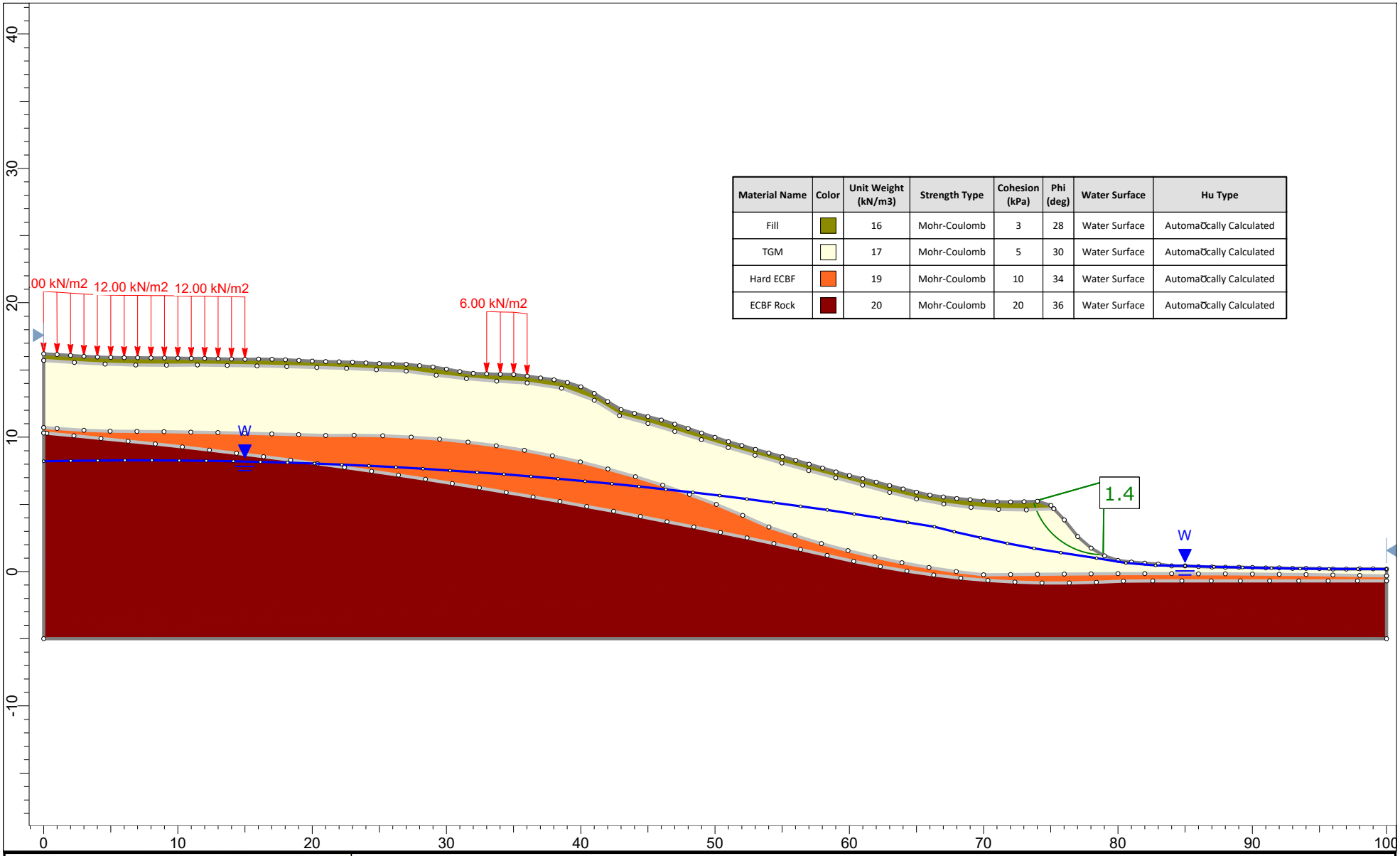


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section A: Extreme Groundwater Conditions			
Drawn By	MAH	*Scale*	1:400	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd

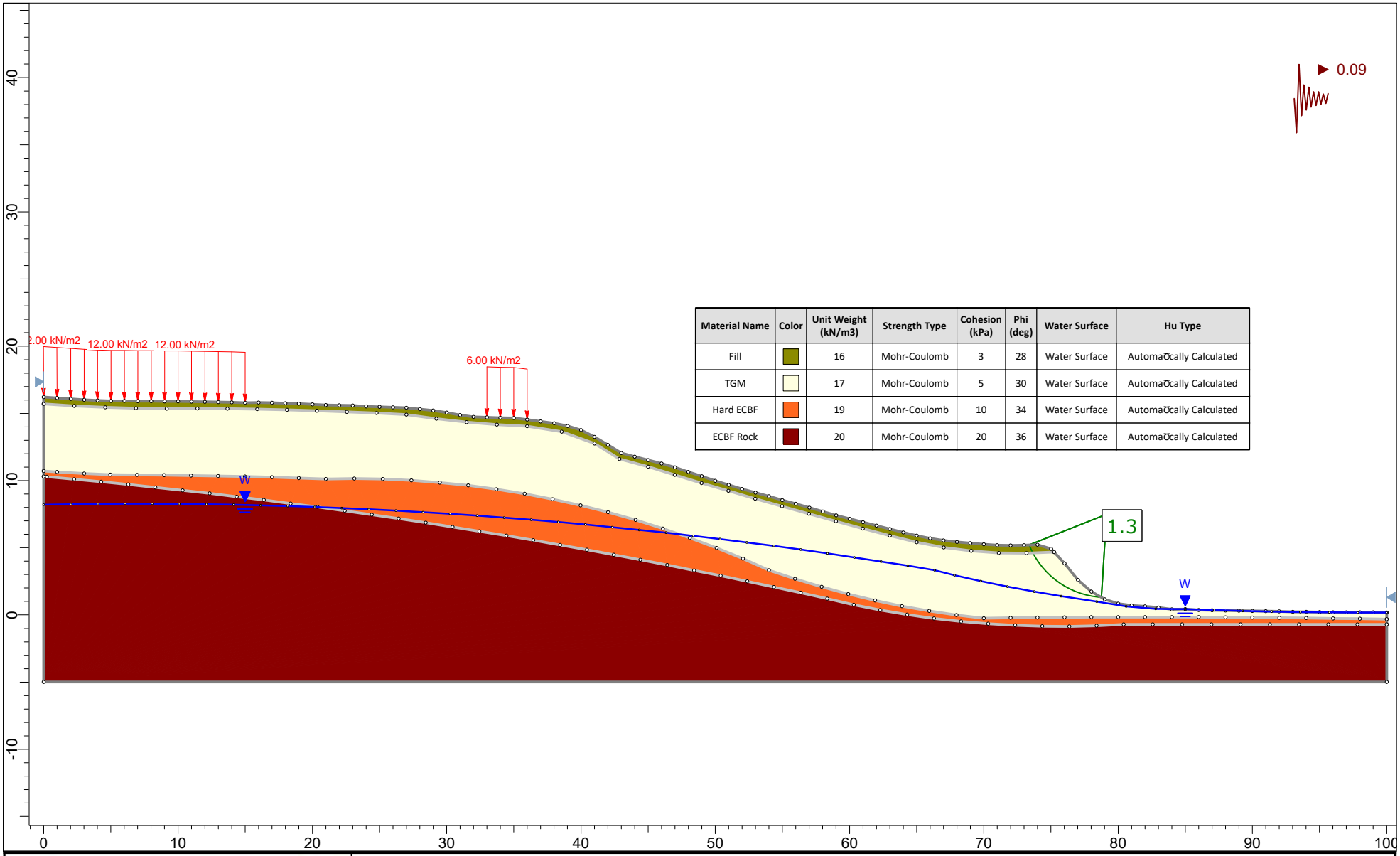


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section A: Normal Groundwater Conditions			
Drawn By	MAH	*Scale*	1:400	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd



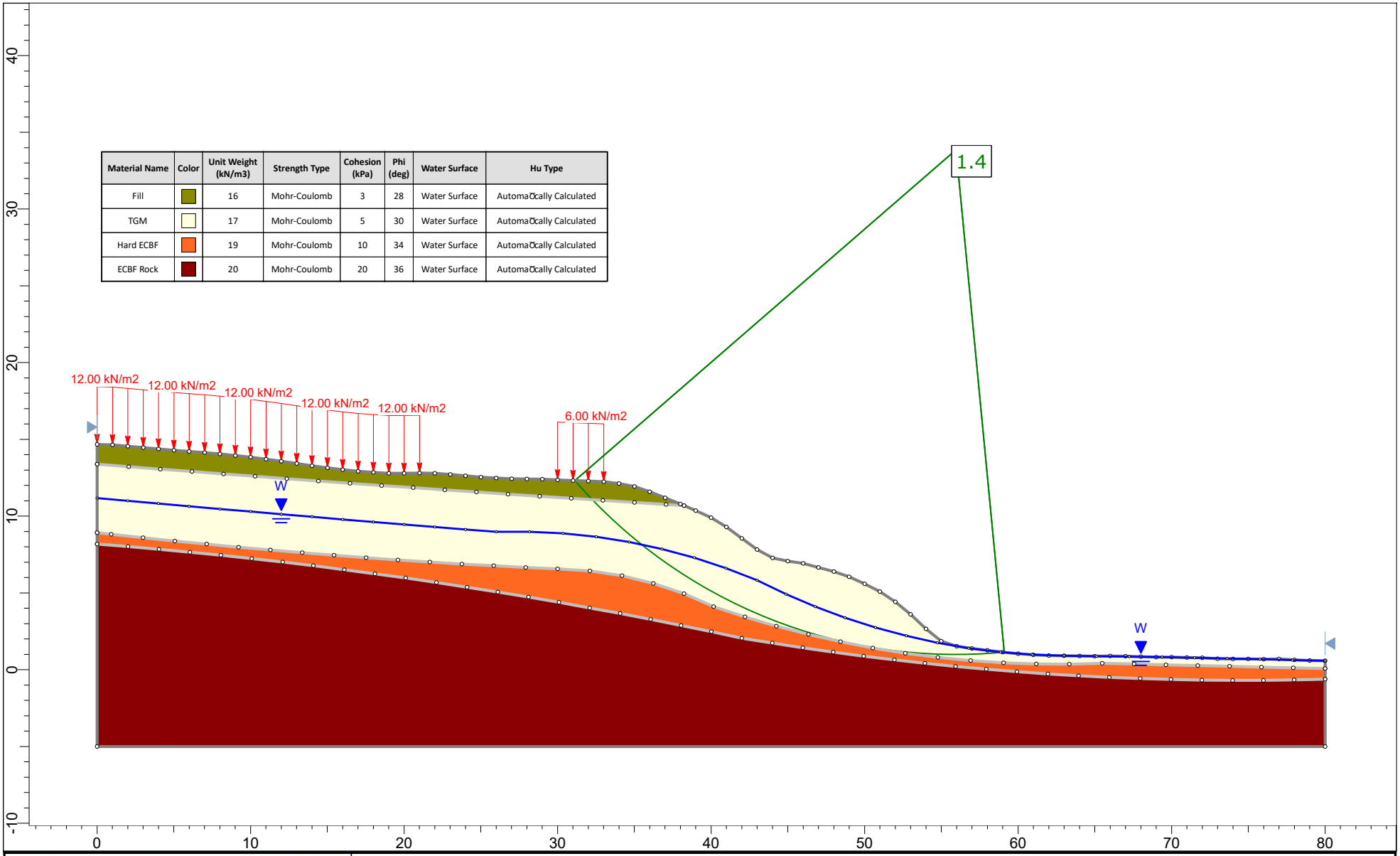
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two				
Analysis Description	Section A: Seismic Conditions				
Drawn By	MAH	*Scale*	1:400	*Company*	LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name*	Global.slmd

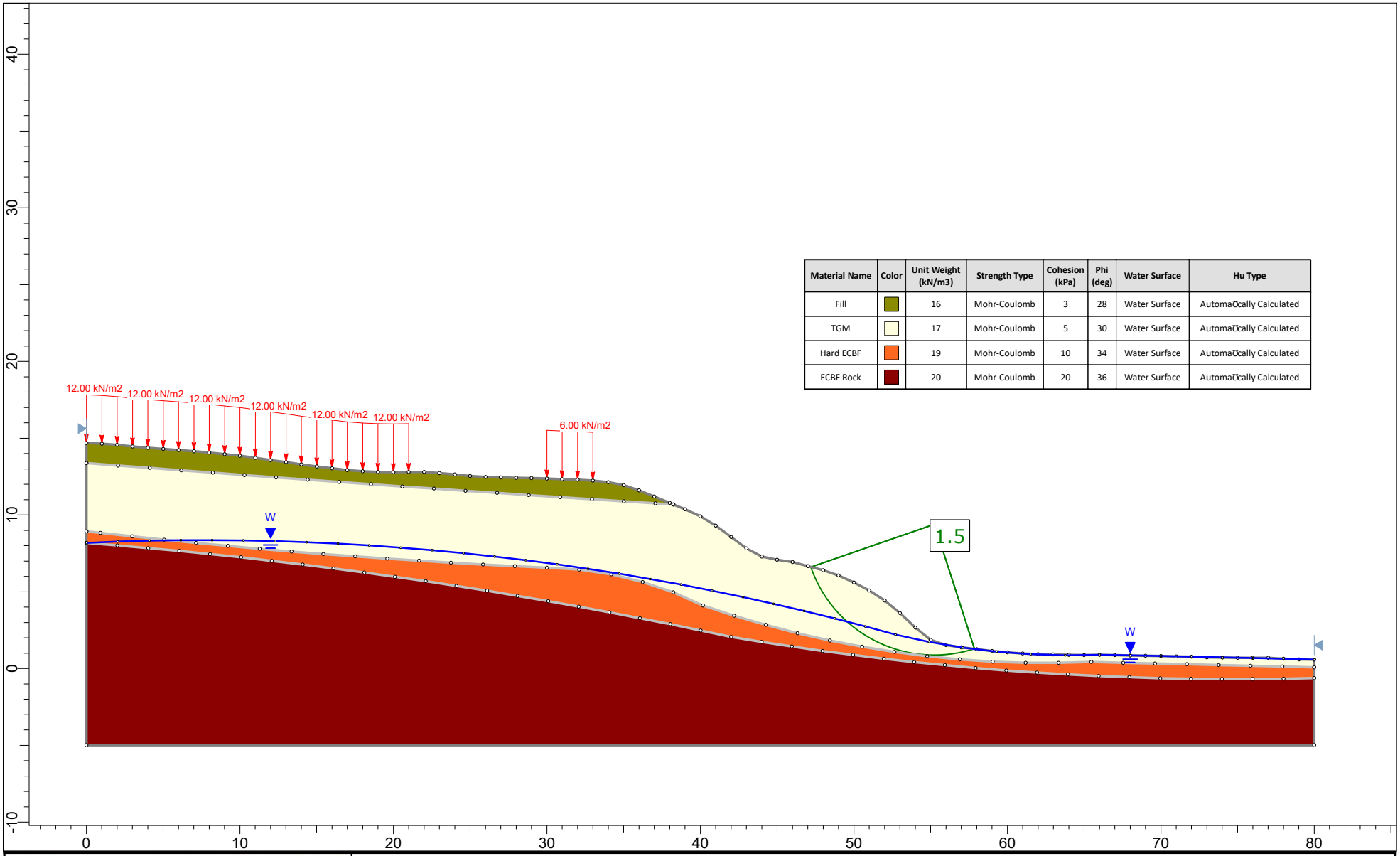
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated



LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two				
Analysis Description	Section B: Extreme Groundwater Conditions				
Drawn By	MAH	*Scale*	1:350	*Company*	LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name*	Global.slmd



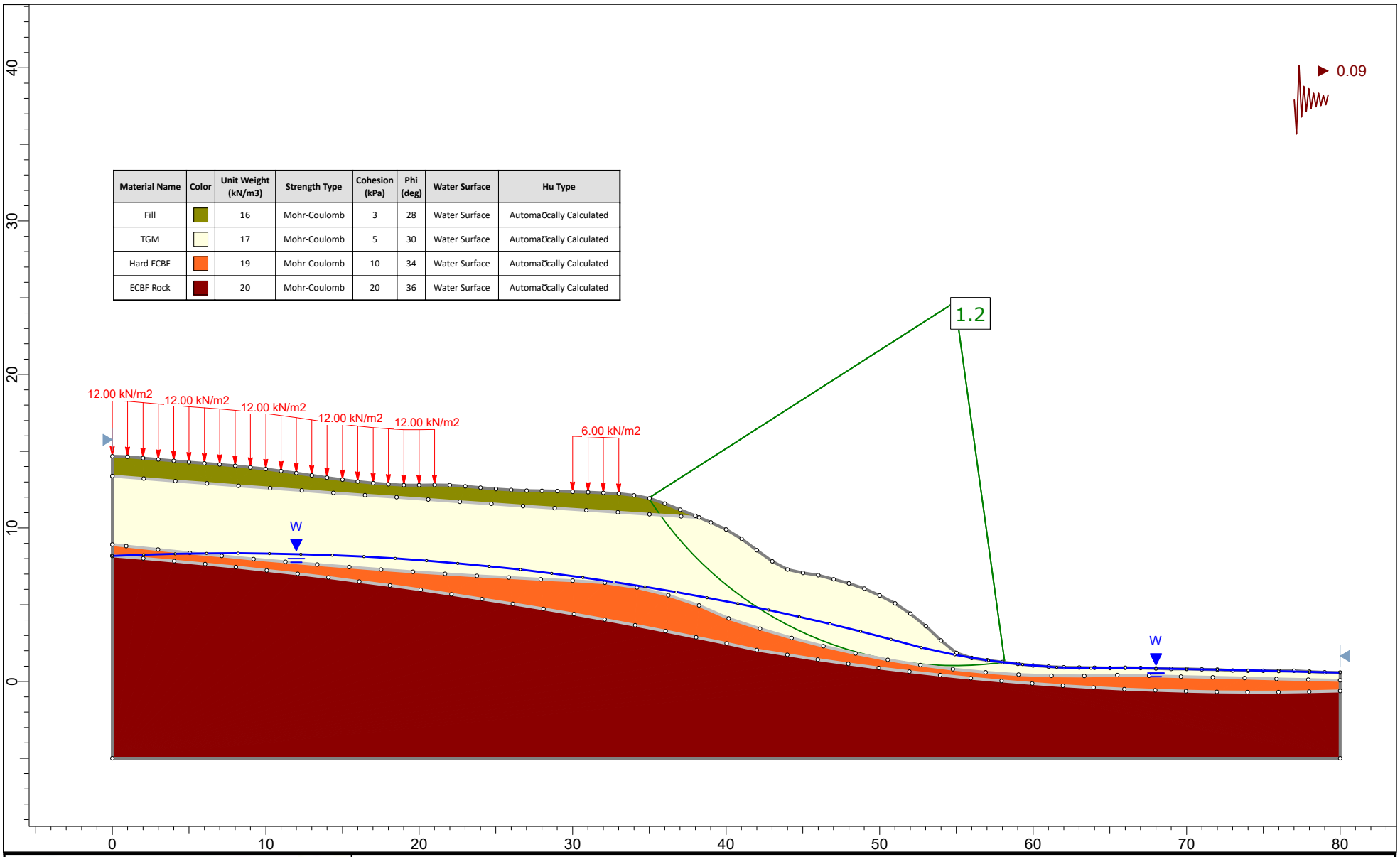
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section B: Normal Groundwater Conditions			
Drawn By	MAH	*Scale*	1:350	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd

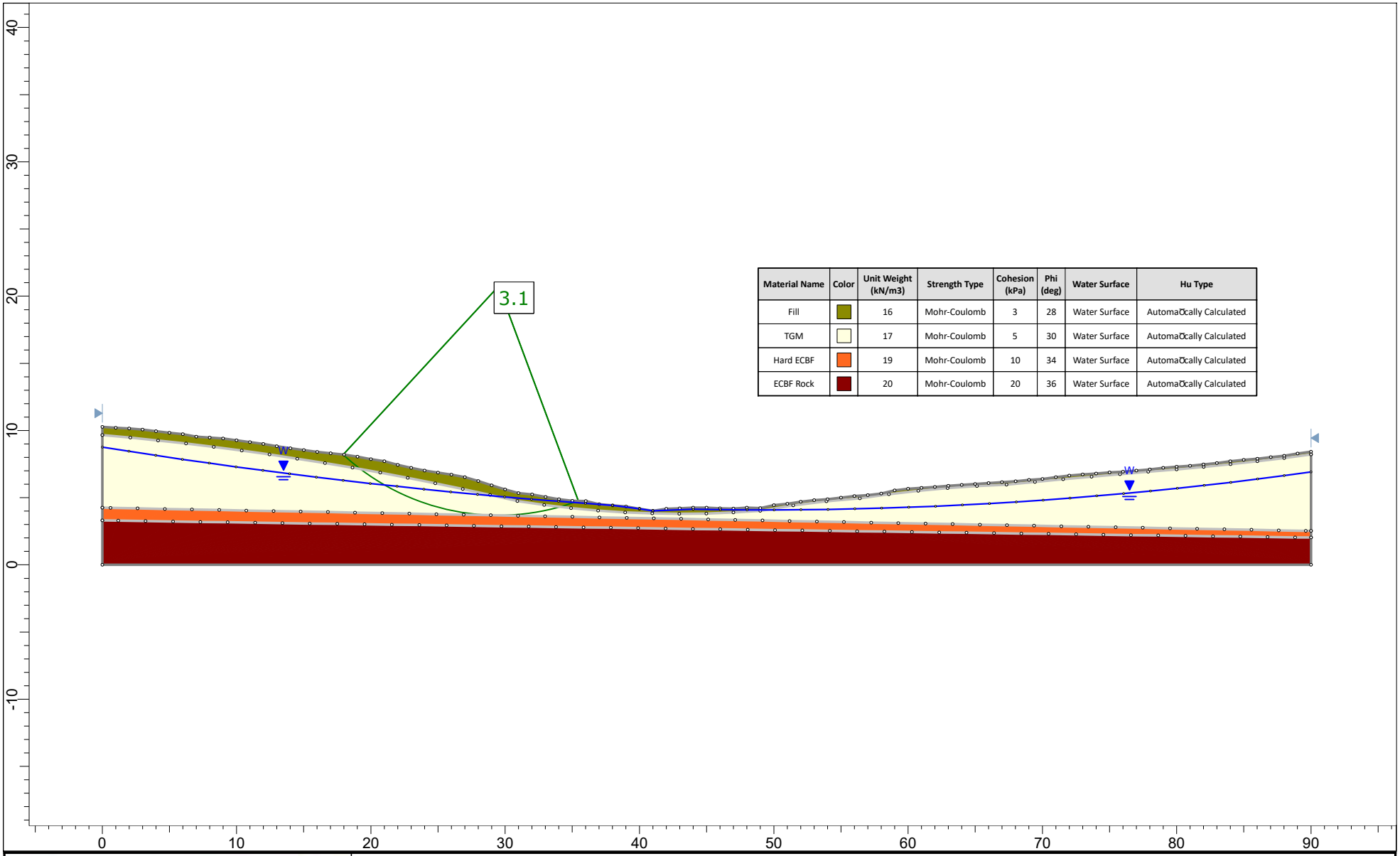
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated



LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section B: Normal Groundwater Conditions			
Drawn By	MAH	*Scale*	1:350	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd



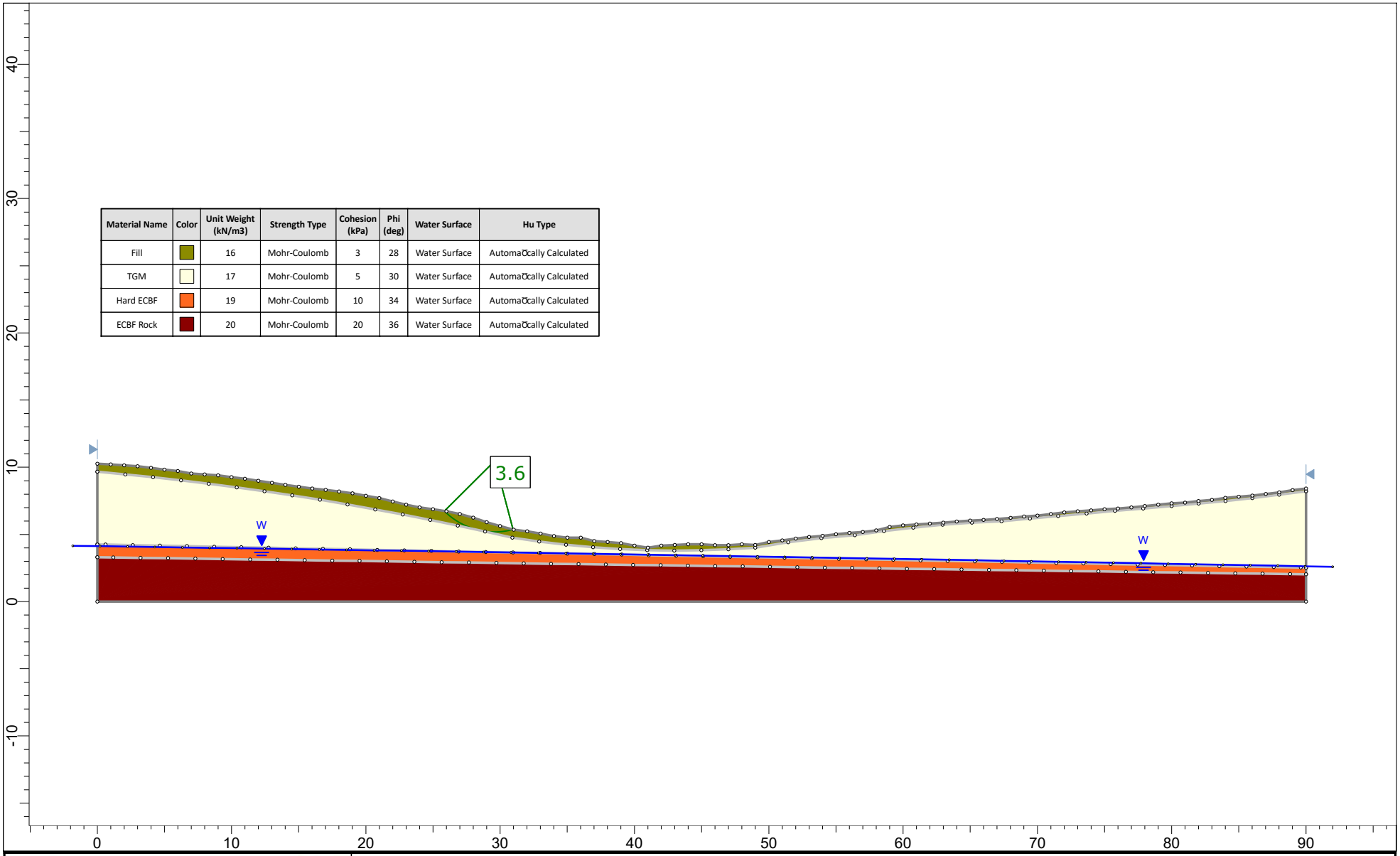
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section C: Extreme Groundwater Conditions			
Drawn By	MAH	*Scale*	1:400	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd

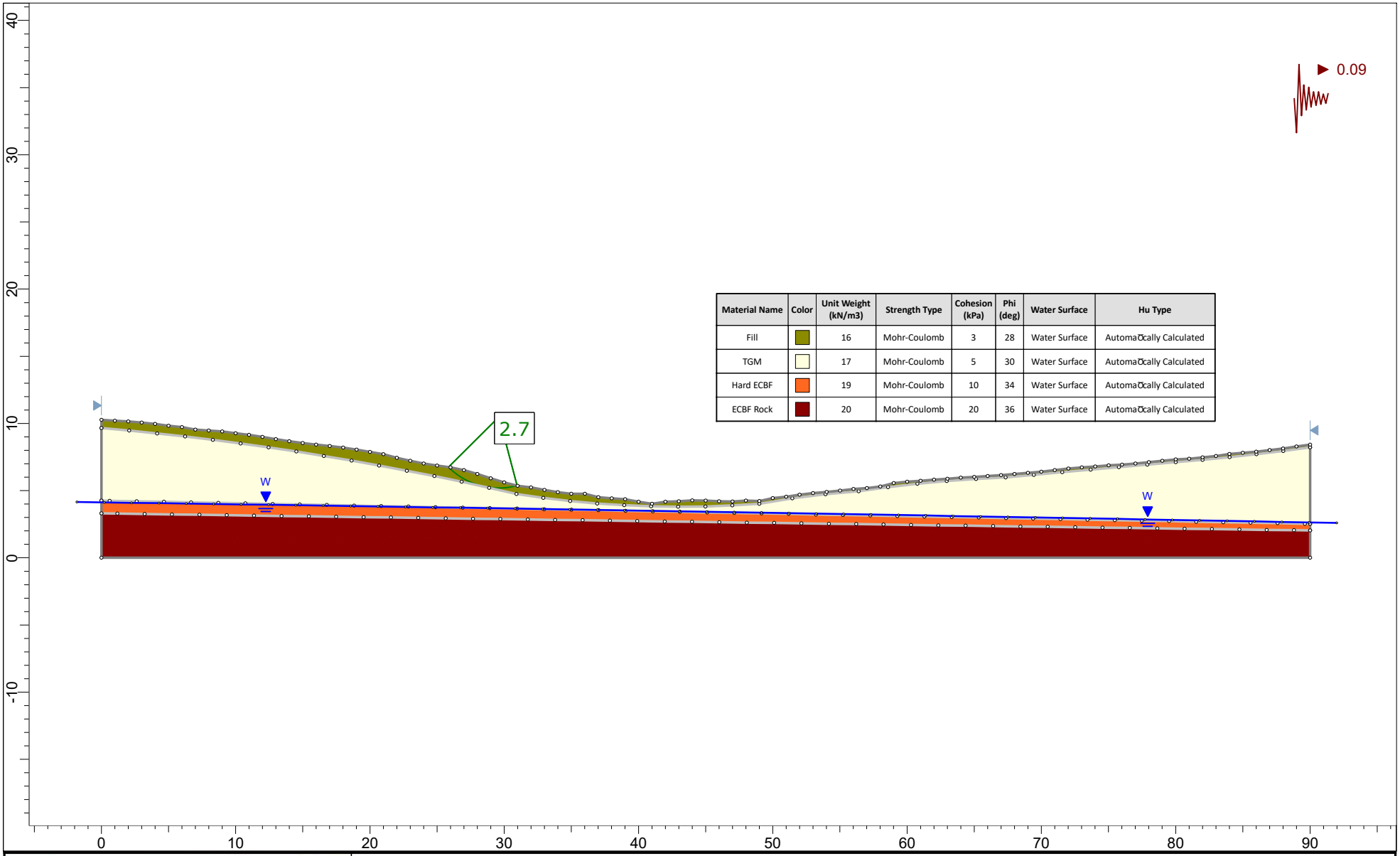
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated



LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two				
Analysis Description	Section C: Normal Groundwater Conditions				
Drawn By	MAH	*Scale*	1:400	*Company*	LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name*	Global.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type
Fill		16	Mohr-Coulomb	3	28	Water Surface	Automatically Calculated
TGM		17	Mohr-Coulomb	5	30	Water Surface	Automatically Calculated
Hard ECBF		19	Mohr-Coulomb	10	34	Water Surface	Automatically Calculated
ECBF Rock		20	Mohr-Coulomb	20	36	Water Surface	Automatically Calculated

LandTech CONSULTING

SLIDEINTERPRET 7.022

Project	Tamaki Pathway Stage Two			
Analysis Description	Section C: Seismic Conditions			
Drawn By	MAH	*Scale*	1:400	*Company* LandTech Ltd
Date	23/04/2024, 8:41:58 am			*File Name* Global.slmd