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PROPOSED FILL FACILITY
DEVELOPMENT AT
362 JONES ROAD,
HUNUA

GEOTECHNICAL INVESTIGATION REPORT

Scarbro Environmental Ltd

PROPOSED FILL FACILITY DEVELOPMENT AT 362 JONES ROAD, HUNUA

GEOTECHNICAL INVESTIGATION REPORT

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Author	C A Webster		
Reviewer	A G J Stuart	Date	14 October 2024

Fraser Thomas Limited
Consulting Engineers, Licensed Surveyors
Planners & Resource Managers
Level 1, 21 El Kobar Drive, Highbrook
PO Box 204006, Highbrook, Manukau 2161
Auckland, New Zealand
Tel : +64 9 278-7078 : Fax : +64 9 278-3697
Email: astuart@ftl.co.nz

SUMMARY

The visual appraisal and geotechnical investigation reported herein address the geotechnical considerations, with particular regard to subsurface considerations, relating to the proposed Fill Facility development at 362 Jones Road, Hunua.

The borehole logs, presented in Appendix A of this report, indicate that the subject site is, in general, underlain by material inferred to be residual soils of the Waipapa Group of Jurassic age. A veneer of material, inferred to be Recent alluvial sediments and controlled fill, was also encountered.

In general terms and within the limits of the investigation as outlined and reported herein, and provided proper control of any future proposed earthworks is exercised, no unusual problems are anticipated with the proposed Fill Facility development.

The site is, in general, considered suitable for its intended use with satisfactory conditions for the proposed Fill Facility development, subject to the recommendations and qualifications reported herein, provided the works are carried out as would be done under normal circumstances in accordance with the requirements of the relevant New Zealand Standard Codes of Practice.

It is recommended that further geotechnical investigation, appraisal and reporting be undertaken, specific to the proposed South Filling area and bridge development, in order to provide recommendations on slope stability, settlement considerations and foundation bearing pressures specific to the proposed developments, prior to any filling operations occurring within the South Filling area and, in the case of the proposed bridge structure, at detailed design/Building Consent application stage.

Conclusions and recommendations arising from the investigation are presented in Section 13.0 of this report.

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED FILL FACILITY DEVELOPMENT AT 362 JONES ROAD, HUNUA

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation undertaken for a proposed Fill Facility development at 362 Jones Road, Hunua. The proposed Fill Facility is referred to as a 'Managed Fill' based on definitions set out in the Auckland Unitary Plan – Operative in Part (AUP:OP) while under the WasteMINZ Disposal to Land Guidelines (September 2023), the proposed Fill Facility would be classified as a Cleanfill. For the purposes of this Geotechnical Investigation Report, the proposed fill material will be referred to as 'cleanfill'.

The Fraser Thomas Ltd drawing set, reference 33250, indicate that filling operations will be undertaken in two separate areas, i.e. the North Filling area and South Filling area, separated by an east/west trending ridge feature that runs through the centre of the site. The extent of the filling areas and the proposed final contours are shown on the appended Fraser Thomas Ltd drawings G00417/1, G00417/2 and G00417/3.

It is understood that the proposed Fill Facility development will occupy a total area of approximately 12 ha, including associated sediment ponds and drains, and have an approximate capacity of 790,000 m^3. It is understood that filling will take place over a period of up to 5 to 10 years and that resource consent is being sought for a total period of 10 years.

The subsurface conditions at the site have been investigated by means of twenty three hand augered boreholes, with associated dynamic cone (Scala) penetrometer (DCP) tests, and fourteen shallow DCP tests. A visual appraisal of the site and a study of geological maps have also been undertaken.

The purpose of the geotechnical investigation reported herein was to determine the subsoil conditions beneath the subject site as they may affect the proposed Fill Facility development, with particular regard to slope stability considerations, and to determine the suitability of the subject site for the proposed development, in support of an application for resource consent.

2.0 PROPOSED DEVELOPMENT

As discussed in Section 1.0 of this report, the Fraser Thomas Ltd drawing set, reference 33250, indicate that filling operations will be undertaken in two separate areas, i.e. the North Filling area and South Filling area, separated by an east/west trending ridge feature that runs through the centre of the site. The extent of the filling areas and the proposed final contours are shown on the appended Fraser Thomas Ltd drawings G00417/1, G00417/2 and G00417/3.

It is understood that, from communication with Auckland Council, a resource consent condition will be applied to the South Filling area which states that additional geotechnical investigation,

appraisal and reporting is required to determine the suitability of the area prior to commencement of any filling operations within the southern part of the site.

It is understood that the proposed cleanfill end slopes are to be battered to a gradient of up to approximately 18° to the horizontal (1V:3H). It is also understood that it is proposed to form 4 m wide benches at appropriate vertical intervals of 1 bench per 10 m vertical height. The benches will generally run along contour to aid in minimising the concentration of stormwater runoff.

It is understood that, in order to provide vehicular access to the proposed cleanfill areas, it is proposed to construct a haul road, northward from Hunua Road, into the site at the alignment shown on the appended Fraser Thomas Ltd drawing G00417/1.

It is understood that cut and fill earthworks in the order of 2.0 m and 1.0 m depth respectively are proposed to form the proposed haul road.

It is also understood that the existing farm track and associated culvert, located in the southern part of the site, that provides vehicular access across an unnamed stream will be replaced as part of the construction of the haul road with a bridge, likely to be supported on deep piled foundations.

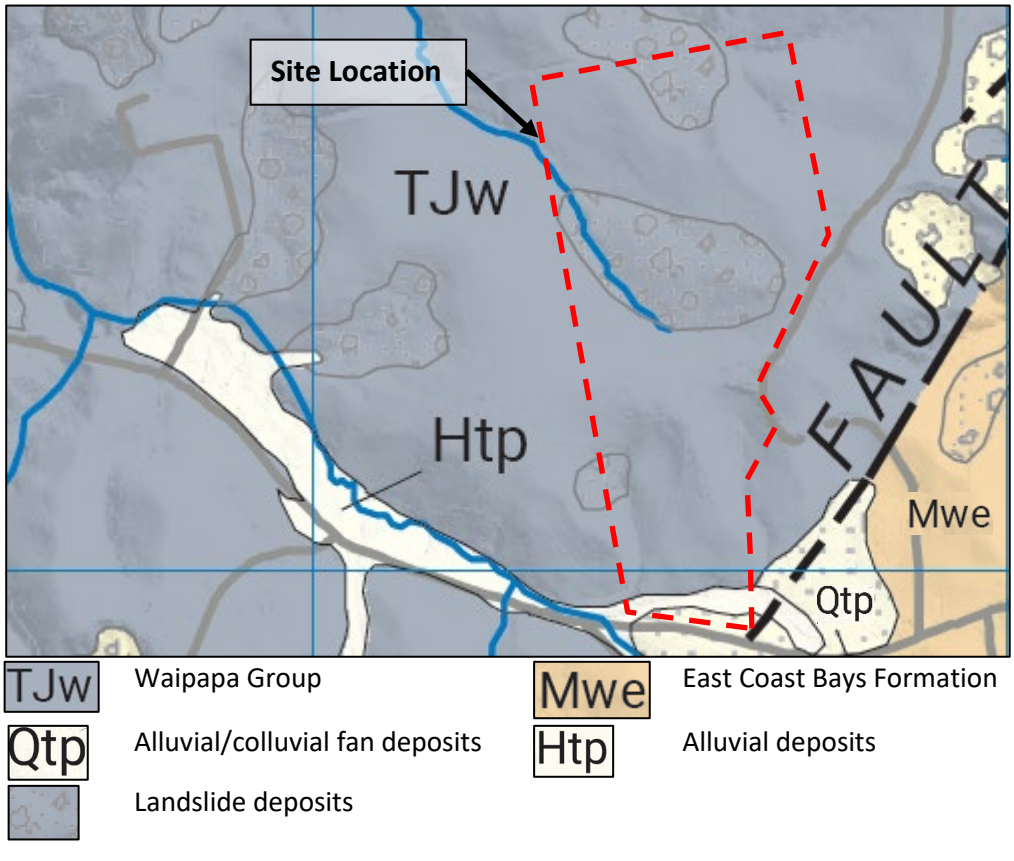
3.0 GEOLOGY

In carrying out the appraisal of the site, reference has been made to the GNS Science Geological Map 12B, scale 1:50,000, Geology of the Pukekohe Area.

This geological map indicates that the site is generally underlain by residual soils of the Waipapa Group of Jurassic age. It is noted that the southern part of the site is mapped as being underlain my alluvial/colluvial deposits of the Tauranga Group of Quaternary age. The site is also mapped as containing landslide deposits within the Waipapa Group residual soils.

An excerpt from the geological map showing the site location is presented in Figure 1 of this report.

FIGURE 1: EXCERPT FROM GEOLOGY MAP SHOWING SITE LOCATION



The results of the borehole investigation, as reported herein, generally confirm the stratigraphy as indicated by the geological map. A veneer of material, inferred to be Recent alluvial sediments and controlled fill, was also encountered.

The north-east trending Hunua Fault is mapped in close proximity to the eastern site boundary. This fault is generally considered to be inactive and is therefore unlikely to require additional consideration.

4.0 FIELD INVESTIGATION

4.1 GENERAL

The field investigation comprised a visual appraisal, twenty three hand augered boreholes with associated DCP tests, numbered H1 to H23 inclusive, and fourteen DCP tests, numbered S1 to S10 inclusive, S7N, S7E, S7S and S7W.

4.2 RESULTS OF VISUAL APPRAISAL

4.2.1 General

A visual appraisal of the site was undertaken by a Fraser Thomas Ltd engineering geologist on 20 March 2024.

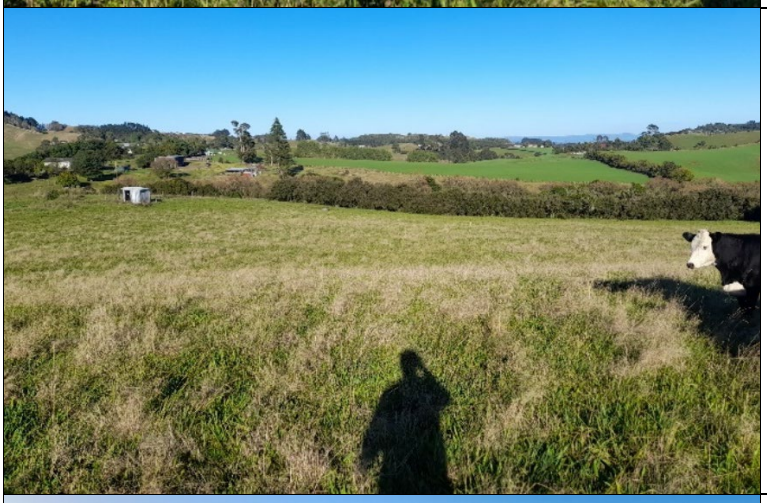
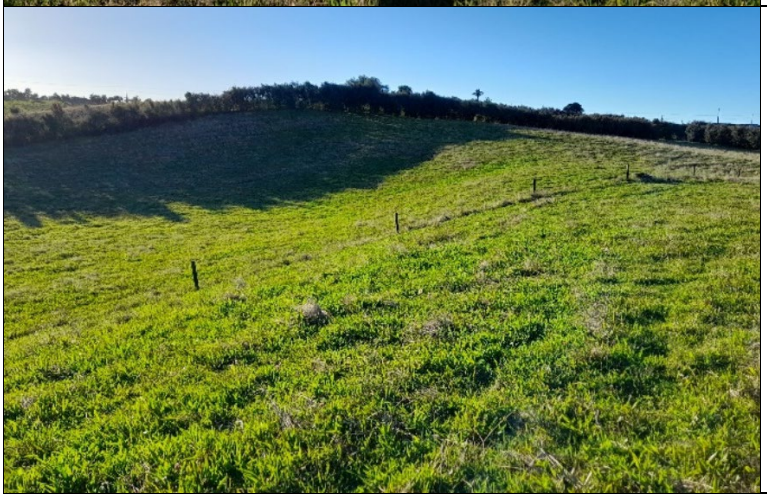
The topography of the subject site generally comprises an east-west trending ridge located in the central part of the site with accompanying broad north/south trending spurs and gullies. The gully side slopes generally comprised moderately steep to steep, up to 21° to the horizontal (1V:2.6H), slopes.

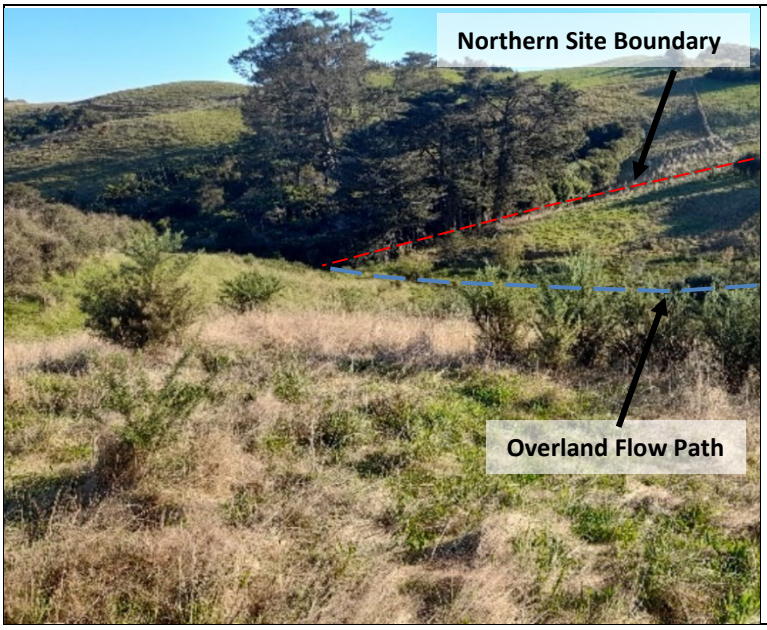
The north-eastern, north-western parts of the site generally comprised south-east to north-west trending watercourses, flowing to the north-eastern and north-western corners of the site respectively. The south-eastern and south-western parts of the site generally comprised north to south trending watercourses, discharging to the south-eastern and south-western corners of the site, respectively.

The southern part of the site generally comprises an east to west trending unnamed stream, discharging to the south-western corner of the site.

4.2.2 Northern Part of the Site

The following features were observed as part of the visual appraisal reported herein with the approximate location and orientation of the photographs, referenced below, shown on the appended Fraser Thomas Ltd drawing G00417/2:

	**Photograph 1:** Looking south-west, towards the existing east-west trending ridge separating the northern and southern parts of the site and associated up to circa 12 m high, moderately steep, northerly aspect gully side slope, with an overall slope angle of circa 17° to the horizontal (1V:3.3H). Note: benched and hummocky topography, inferred to be indicative of historic shallow seated slope instability, was noted within the moderately steep, gully side slope.
	**Photograph 2:** Looking west, from the eastern site boundary. The site topography generally sloped gently, at up to circa 7° to the horizontal (1V:8.1H).
	**Photograph 3:** Looking south-east, from the northern part of the site, towards an up to an approximately 8 m high, moderately steep, up to 19° to the horizontal (1V:2.9H), north-westerly aspect slope.



Photograph 4:

Looking north, towards an, up to circa 12 m high, gully side slope and overland flow path, located in the north-eastern part of the site.

The gully generally comprised, moderately steep, up to circa 20° to the horizontal (1V:2.75H), north-easterly aspect, side slopes.

Note: benched and hummocky topography, inferred to be indicative of historic shallow seated slope instability, was noted within the gully side slope.

4.2.3 Southern Part of the Site

The following features were observed as part of the visual appraisal reported herein with the approximate location and orientation of the photographs, referenced below, shown on the appended Fraser Thomas Ltd drawing G00417/3:

Photograph 5:

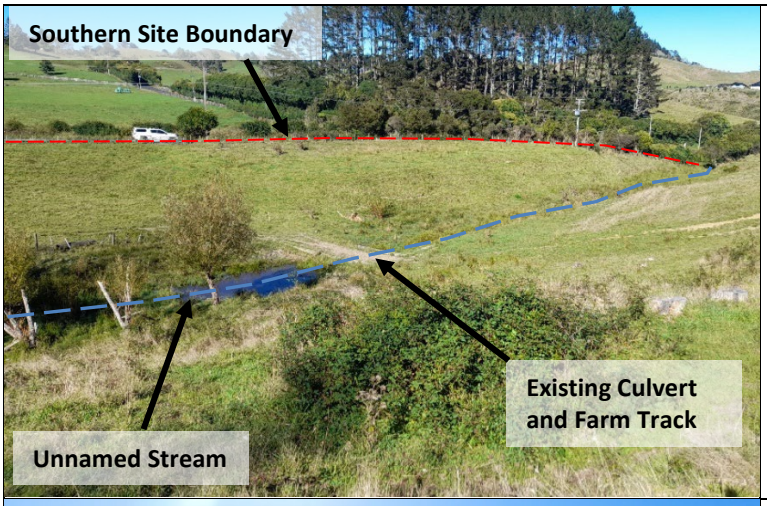
Looking south-east from the central part of the site.

Note: up to 25 m wide arcuate head scarp feature, inferred to be indicative of historic shallow seated slope instability, was noted within the gully side slope at the time of the visual appraisal.

Photograph 6:

Looking north-east from the western part of the site.

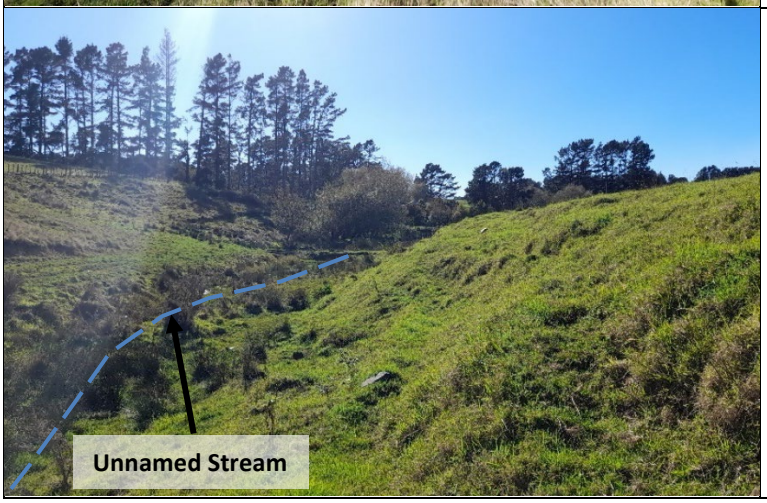
Note: up to 65 m wide, arcuate head scarp feature and reeds, inferred to be indicative of historic deep seated slope instability and perched groundwater, were noted within the gully side slope at the time of the visual appraisal.



Photograph 7:

Looking south-west from the spur located in the southern part of the site.

Note: existing culvert and farm track enabling vehicular access across the east-west trending unnamed stream.



Photograph 8:

Looking east from the south-western corner of the site.

Note: the southern stream 'terrace' was up to 4 m high and generally comprised moderately steep to steep, up to circa 30° to the horizontal (1V:1.7H), side slopes.

4.3 HAND AUGERED BOREHOLE INVESTIGATION

Twenty three hand augered boreholes, numbered H1 to H23 inclusive, were put down at the site in order to investigate the subsurface conditions. The approximate borehole locations are shown on the appended Fraser Thomas Ltd drawings G00417/2 and G00417/3.

The boreholes were put down by a qualified Fraser Thomas Ltd geotechnical engineer and engineering geologist and logged following the methods and procedures in the NZ Geotechnical Society 'Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes'. The boreholes logs are presented in Appendix A of this report.

Boreholes H1 to H9 inclusive, H11 to H20 inclusive, H22 and H23 were terminated at target depths ranging between approximately 1.3 m and 5.0 m below the existing ground surface existing at the time of the investigation reported herein (the existing ground surface).

Borehole H21 was terminated when the soils became too hard to auger further, at a depth of approximately 2.3 m below the existing ground surface. Borehole H10 was terminated when the soils became too difficult to auger further due to the soils squeezing, at a depth of approximately 2.5 m below the existing ground surface.

In situ undrained shear strength measurements were carried out in the boreholes at approximately 0.5 m intervals of depth using hand held field shear vane equipment in accordance with the NZ Geotechnical Society 'Test Method for Determining the Vane Shear Strength of a

Cohesive Soil using a Hand Held Shear Vane, August 2001'. These tests were carried out down the boreholes, enabling a strength profile of cohesive soils to be obtained from the boreholes.

DCP tests were carried out within Boreholes H2, H15 and H21 and beyond the base of Boreholes H2, H4, H7, H21, in accordance with NZS 4402: 1986 Test 6.5.2 1988. The DCP test results are annotated on the borehole logs presented in Appendix A of this report.

4.4 DYNAMIC CONE (SCALA) PENETROMETER (DCP) TESTS

Fourteen shallow DCP tests, numbered S1 to S10 inclusive, S7N, S7E, S7S and S7W, were undertaken in accordance with NZS 4402:1988, Test 6.5.2, from the ground surface to a depth of approximately 0.9 m below the existing ground surface, to determine the California Bearing Ratio (CBR) value of the site soils for preliminary pavement design purposes.

The approximate DCP test locations are shown on the appended Fraser Thomas Ltd drawings G00417/2 and G00417/3.

The DCP test results are presented in Appendix B of this report.

5.0 SUBSURFACE CONDITIONS

5.1 GENERAL

The borehole logs, presented in Appendix A of this report, indicate that the subject site is, in general, underlain by material inferred to be residual soils of the Waipapa Group of Jurassic age. A veneer of material, inferred to be Recent alluvial sediments and controlled fill, was also encountered.

It has been assumed that even though the various subsoil strata, their depths and thicknesses and the locations of groundwater levels have been determined only at the locations and within the depths of the various boreholes recorded herein, these various subsurface features can be projected between the various boreholes. Even though such inference is made, no guarantee can be given as to the validity of this inference or of the nature and continuity of these various subsurface features.

5.2 TOPSOIL

Topsoil was encountered in Boreholes H1 to H9 inclusive, H11, H13, H15 to H18 inclusive and H20 to H23 inclusive to depths of between approximately 0.1 m to 0.4 m below the existing ground surface.

Topsoil was not encountered in Boreholes H10, H12, H14 and H19.

5.3 RECENT ALLUVIAL SEDIMENTS

Material, generally comprising organic silts, clayey silts, silty clays and peat, inferred to be Recent alluvial sediments of Holocene age, was encountered from the existing ground surface in Boreholes H10, H12, H14 and H19 to depths of between approximately 1.8 m and 3.0 m below the existing ground surface.

In situ undrained shear strength values measured in the Recent alluvial sediments ranged between approximately 18 kPa and 122 kPa, corresponding to a soft to very stiff consistency.

The Recent alluvial sediments are inferred to be highly compressible.

5.4 CONTROLLED FILL MATERIAL

Fill material, generally comprising gravelly silts and clayey silts, was encountered beneath the surficial topsoil material in Boreholes H15, H18, H21, H22 and H23, to depths of between 0.6 m and 1.5 m, and to the extent of Borehole H21.

In situ undrained shear strength values measured in the fill material generally ranged between approximately 37 kPa and 196 kPa, corresponding to a firm to very stiff consistency.

DCP tests were carried out within Boreholes H15 and H21 and beneath the base of Borehole H21. The DCP tests obtained blow counts ranging between approximately 2 and 9 blows per 100 mm penetration, corresponding to a firm to very stiff consistency for cohesive material and a loose to dense consistency for granular material.

It is our opinion that the fill material is inferred to be associated with the formation of the Hunua Road carriageway and, as we have not been provided with any certification documents, the fill material is inferred to be non-engineered.

It is however noted that, whilst the fill material may be inferred to be non-engineered, i.e. not placed under the observation of a geotechnical engineer and compacted to an engineered standard, the fill material is inferred to be sidling fill associated with the formation of the Hunua Road carriageway and did appear to have been subject to some level of compaction during placement and has therefore been classified as ‘controlled’ fill.

5.5 PALAEOSOL

Material, generally comprising clayey silts, inferred to be a palaeosol (buried topsoil), was encountered below the controlled fill material in Boreholes H15, H22 and H23 to a depth of approximately 1.5 m, 1.7 m and 0.8 m below the existing ground surface respectively.

5.6 WAIPAPA GROUP RESIDUAL SOIL

Material, generally comprising silty clays, clays and clayey silts with variable sand and gravel content, inferred to be residual soils of the Waipapa Group, was encountered beneath the surficial topsoil material in Boreholes H1 to H9 inclusive, H11, H13, H16, H17 and H20, beneath the Recent alluvial sediments material in Boreholes H10, H12, H14 and H19, beneath controlled fill material in Boreholes H18 and beneath the buried topsoil in Boreholes H15, H22 and H23, to the extent of the boreholes.

In-situ undrained shear strength values measured in the residual soils ranged between approximately 55 kPa and greater than 200 kPa, corresponding to a stiff to hard consistency. In general, the measured shear strengths were greater than 100 kPa, corresponding to a very stiff consistency.

DCP tests were carried out within Borehole H2 and beneath the base of Boreholes H2, H4 and H7. The DCP tests obtained blow counts ranging between approximately 1 and 13 blows per 100 mm penetration, corresponding to a firm to very stiff consistency for cohesive material.

5.7 WAIPAPA GROUP BEDROCK

It is usual to take a DCP blow count of about 10 to 20 blows per 100 mm penetration as being

indicative of the level of the highly to slightly weathered argillite and sandstone of the Waipapa Group.

From the DCP test results, the depth to the level of the highly to slightly weathered argillite and sandstone at the locations of Boreholes H2, H4 and H7 has been inferred, at the time of the investigation reported herein, to be approximately 6.6 m, 6.0 m and 5.8 m below the existing ground surface, respectively.

5.8 GROUNDWATER LEVELS

Groundwater strikes were recorded in Boreholes H3, H8, H10, H12, H14 and H17 to H20 inclusive, at depths ranging between approximately 0.4 m and 2.6 m below the existing ground surface.

Standing groundwater was measured following the completion of drilling Boreholes H8, H10, H12, H14 and H17 to H20 inclusive, at depths ranging between approximately 0.3 m and 2.4 m below the existing ground surface.

Groundwater was not encountered in the remaining boreholes at the time of investigation reported herein.

6.0 SEISMIC SITE SUBSOIL CATEGORY

Based on the available subsoil data, it is our opinion that the site subsoil category for seismic design actions, in terms of NZS 1170.5, should be taken as "*Class C - Shallow Soil Site*".

7.0 SLOPE STABILITY APPRAISAL

7.1 GENERAL

As discussed in Section 2.0 of this report, it is understood that the proposed cleanfill end slopes are to be battered to a gradient of up to approximately 18° to the horizontal (1V:3H). It is also understood that it is proposed to form 4 m wide benches at appropriate vertical intervals of 1 bench per 10 m vertical height. The benches will generally run along contour to aid in minimising the concentration of stormwater runoff.

Slope stability analyses have been undertaken for the proposed fill profiles represented by Cross Sections AA, BB and CC, located as shown on the appended Fraser Thomas Ltd drawing G00417/2.

7.2 METHOD OF ANALYSIS

7.2.1 General

The stability of the proposed cleanfill slope profiles at Cross Sections AA, BB and CC have been analysed using the computer programme Slope/W for various potential slip surfaces within the soil veneer and for two groundwater conditions under static load conditions, corresponding to the estimated "wet winter" and assumed "extreme transient" cases, and "wet winter" groundwater conditions under seismic load conditions.

Slope/W is a computer programme that uses the limit equilibrium theory to solve for the theoretical factor of safety of earth and rock slopes. The comprehensive formulation of Slope/W makes it possible to select a variety of methods for computing the factor of safety, and to analyse both simple and complex geometric, stratigraphic, and loading conditions. Slope/W allows slope stability to be analysed by up to nine methods, including the more mathematically rigorous

Morgenstern- Price and Generalised Limit Equilibrium methods. For the purposes of the analyses reported herein, the theoretical factor of safety values derived from the Morgenstern-Price method of analysis have been adopted for the potential circular slip surfaces.

The proposed slope profile has been analysed for circular slip surfaces, as appropriate to the slope geometry and stratigraphy, using the computer programme Slope/W. The assumed design effective strength parameters for the different soil lithologies are provided in Table 1 of this report.

TABLE 1: SLOPE/W DESIGN EFFECTIVE STRENGTH PARAMETERS

Soil Type	Unit Weight (kN/m^3)	Effective Cohesion – c' (kPa)	Effective Friction Angle – ϕ' (deg)
Proposed Cleanfill	17.5	2	22
Waipapa Group Residual Soils	18	3	30
Waipapa Group Bedrock	21	15	38

7.2.2 Groundwater Conditions

Slope/W analyses were carried out under two different inferred groundwater surfaces, estimated to represent wet winter and extreme transient groundwater conditions. Wet winter groundwater conditions were based on the assumption that the underlying natural ground is fully saturated. Extreme transient groundwater conditions were based on the conservative assumption that the lower 3 m of cleanfill material will become fully saturated during periods of prolonged intense rainfall.

7.3 RISK CATEGORIES

7.3.1 General Load Conditions

Chapter 2 of the Auckland Council Code of Practice for Land Development and Subdivision, Version 2.0, dated May 2023, provides a table of minimum factor of safety values that must be achieved for slope stability for given development scenarios and groundwater conditions.

The table of minimum factor of safety values has been reproduced below:

TABLE 2: MINIMUM FACTORS OF SAFETY VALUES FOR SLOPE STABILITY FOR GIVEN DEVELOPMENT SCENARIOS AND GROUNDWATER CONDITIONS

Development Scenario / Load Case	Residential Subdivision			Roads and buried services	Works within Influencing distance of a neighbouring lot[2]	Low risk parks, bush
	Building Platform	Services and maintenance access area[1]	Amenity Area[1]			
Normal groundwater	**1.5**	1.4	1.2	1.5	Either as per Building Platform requirements (where a building is present in influencing distance) or no decrease on pre-existing Factor of Safety	1.2
Worst credible groundwater[3]	**1.3**	1.2	1.1	1.3		1.1
Pseudo-static seismic loading using ULS PGA	**1.0**	1.0	N/A	1.0		1.0

Notes: *1) For definition refer to the glossary* [provided in Chapter 2 of the Auckland Council Code of Practice for Land Development and Subdivision, Version 2.0, dated May 2023].
2) Any earthworks which can potentially influence stability of the neighbouring lot.
3) This should reflect design life of the proposed development.

It is our opinion that, should a failure of the proposed Fill Facility occur, the neighbouring site may be adversely affected. Therefore, minimum factor of safety values of approximately 1.5, 1.3 and 1.0 should be adopted for the conventional stability analyses relating to wet winter, extreme transient groundwater conditions and seismic load conditions, respectively.

7.3.2 Seismic Load Conditions

For analysis of seismic slope stability using limit equilibrium methods, such as SLOPE/W, the inertia forces due to earthquake shaking are represented by a constant horizontal force (equal to the weight of the potential sliding mass multiplied by the seismic coefficient). Such seismic slope stability analyses are commonly referred to as pseudo-static analyses. Provided a dramatic loss in soil strength does not result from the earthquake shaking, the literature indicates that, as the peak ground acceleration acts only momentarily in any one direction, the seismic coefficient that is used for the analyses may be taken to be a fraction of the peak ground acceleration.

For the purposes of the analyses reported herein, the estimation of ground shaking for assumed earthquake events has been undertaken using "Method 1", as suggested by the MBIE/New Zealand Geotechnical Society Guideline, Module 1, dated November 2021.

Method 1 involves using the elastic site spectral analyses results presented in NZTA Bridge Manual (2004) and NZS 1170.5:2004-Structural Design Actions- Earthquake Actions- New Zealand to determine theoretical peak ground acceleration (pga) values for the site.

The following design earthquake events have been assessed for the site for the purposes of the analyses reported herein:

(a) Ultimate Limit State (ULS) – 500 year return period event

Page 26 of the MBIE Module 1 (November 2021) states that:

> *"For RP* [Return Period] *≥ 500 yr, the higher or more critical load from:*
>
> *1 a_{max} and M_w values based on the NZTA Bridge Manual hazard (2018), or*
>
> *2 a_{max} = 0.19 g and M_w 6.5 (ie lower bound ULS load recommended in NZTA, 2018) … is recommended for use."*

Based on the foregoing, the peak ground acceleration (a_{max}) and earthquake Moment Magnitudes (M_w) for analysis purposes are presented in MBIE Module 1, Appendix A, Table A1 for ULS design earthquakes and are reproduced in Table 3 of this report.

TABLE 3: DESIGN PEAK HORIZONTAL GROUND ACCELERATION (PGA) AND CORRESPONDING EARTHQUAKE MOMENT MAGNITUDE (M_w) VALUES FOR ASSUMED DESIGN CONDITIONS

Design Condition	Closest Town/City	Return Period (years)	Peak Ground Acceleration (a_{max}) (proportion of gravity acceleration (m/s^2))	Earthquake Moment Magnitude (M_w)
ULS	Auckland	500	0.19g	6.5

However, based on the literature (Seed, HB (1979), Pyke (1991) and Kramer, SL (1996), (after Hynes-Griffin and Franklin (1984)), if an acceleration ratio of 0.5 times the peak ground acceleration

is adopted for pseudo-static slope stability analyses, for earthquake magnitudes of up to 8.25 Richter, non-failure conditions are indicated and the slope involved can generally be considered to be safe from failure. A seismic coefficient of 0.095 g (0.5 x 0.19 = 0.095g) is therefore considered to be applicable for the subject site for seismic slope stability analyses.

In order to take account of possible amplification of ground motion on sloping ground, the seismic coefficient for the subject site has, however, been increased by 25% from 0.095g to 0.12g for pseudo-static slope stability analysis.

7.4 RESULTS

7.4.1 Cross Section AA

7.4.1.1 Static Load Conditions

Theoretical factor of safety values of 1.48 and 1.30 were obtained for the assumed wet winter and extreme transient (saturated) groundwater conditions respectively, for the proposed cleanfill slope profile at Cross Section AA. These factor of safety values are considered to be satisfactory, approximating and being equal to the limiting values of 1.5 and 1.3 for wet winter and extreme transient (saturated) groundwater conditions respectively.

The Slope/W computer output for Cross Section AA is presented in Appendix C of this report, numbered Figure 1 for wet winter ground water conditions and Figure 2 for extreme transient groundwater conditions.

7.4.1.2 Seismic Load Conditions

A theoretical factor of safety value of 1.02 was obtained for the assumed wet winter groundwater conditions, under seismic load conditions. The foregoing factor of safety value for the seismic case is considered to be satisfactory, being greater than the limiting value of 1.0.

The Slope/W computer output for Cross Section AA, for seismic load conditions, is presented in Appendix C of this report, numbered Figure 3.

7.4.2 Cross Section BB

7.4.2.1 Static Load Conditions

Theoretical factor of safety values of 1.51 and 1.33 were obtained for the assumed wet winter and extreme transient (saturated) groundwater conditions respectively, for the proposed cleanfill slope profile at Cross Section BB. These factor of safety values are considered to be satisfactory, being greater than the limiting values of 1.5 and 1.3 for wet winter and extreme transient (saturated) groundwater conditions respectively.

The Slope/W computer output for Cross Section BB is presented in Appendix C of this report, numbered Figure 4 for wet winter ground water conditions and Figure 5 for extreme transient groundwater conditions.

7.4.2.2 Seismic Load Conditions

A theoretical factor of safety value of 1.06 was obtained for the assumed wet winter groundwater conditions, under seismic load conditions. The foregoing factor of safety value for the seismic case is considered to be satisfactory, being greater than the limiting value of 1.0.

The Slope/W computer output for Cross Section BB, for seismic load conditions, is presented in Appendix C of this report, numbered Figure 6.

7.4.3 Cross Section CC

7.4.3.1 Static Load Conditions

Theoretical factor of safety values of 1.52 and 1.34 were obtained for the assumed wet winter and extreme transient (saturated) groundwater conditions respectively, for the proposed cleanfill profile at Cross Section CC. These factor of safety values are considered to be satisfactory, being greater than the limiting values of 1.5 and 1.3 for wet winter and extreme transient (saturated) groundwater conditions respectively.

The Slope/W computer output for Cross Section CC is presented in Appendix C of this report, numbered Figure 7 for wet winter ground water conditions and Figure 8 for extreme transient groundwater conditions.

7.4.3.2 Seismic Load Conditions

A theoretical factor of safety value of 1.05 was obtained for the assumed wet winter groundwater conditions, under seismic load conditions. The foregoing factor of safety value for the seismic case is considered to be satisfactory, being greater than the limiting value of 1.0.

The Slope/W computer output for Cross Section CC, for seismic load conditions, is presented in Appendix C of this report, numbered Figure 9.

8.0 ACCESS ROAD SUBGRADE

As discussed in Section 4.4 of this report, fourteen DCP tests were carried out from the ground surface to a depth of approximately 0.9 m, as shown on the appended Fraser Thomas Ltd drawings G00417/2 and G00417/3. These tests were undertaken along an alignment that was provided at the time of undertaking the ground investigation, resulting in DCP tests S7-S8 being offset from the final adopted access road alignment.

The DCP blow counts, in general, ranged between 1 to 5 blows per 100 mm penetration, corresponding to a firm to very stiff consistency.

Based on the foregoing DCP data, our experience of type of soils encountered at the subject site and our experience of residual soils in this area, it is our opinion that, following stripping of surficial topsoil, the proposed access road subgrade should be assumed to have a preliminary minimum CBR value of 4% for access road design purposes.

It is recommended that Fraser Thomas Ltd be engaged to undertake further geotechnical investigation in order to confirm the subgrade CBR values and design requirements during construction.

9.0 EARTHWORKS CONSIDERATIONS

9.1 GENERAL

It is recommended that any engineered fill and cleanfill material be placed in accordance with the relevant recommended fill specifications presented in Section 10.0 of this report.

It is our opinion, based on our earthworks experience with similar soils encountered elsewhere in the greater Auckland area, that the proposed cleanfill material will, in some places, require to be dried and/or mixed with other materials prior to placement as engineered cleanfill, in order to obtain the minimum compaction standards as presented in Section 10.0 of this report.

It should be anticipated that the proposed fill material may be sensitive to disturbance by earthworks plant and inclement weather. These two factors together could result in plant trafficability problems, and which may result in the artificial creation, by virtue of ill-conceived construction efforts, of excessive quantities of unsuitable (i.e. unworkable) materials, unless earthworks construction activities and the nature of the earthmoving plant used in the site development are selected and controlled in cognisance of the particular characteristics of the site materials.

Soils with a significant sand component and pumiceous soils may be problematic for compaction and moisture conditioning may be required.

It is recommended that Fraser Thomas Ltd be engaged to observe the placement and compaction of any proposed engineered fill and cleanfill material to confirm that the fill has been placed in accordance with the recommended fill specifications presented in Section 10.0 of this report.

9.2 UNDERCUTTING OF UNSUITABLE MATERIAL

As discussed in Section 5.0 of this report, Recent alluvial sediments were encountered in the base of the existing gully features, to depths ranging between approximately 1.8 m and 3.0 m below the existing ground surface.

It is recommended that all Recent alluvial sediments and topsoil material be appropriately undercut from beneath any proposed engineered fill or cleanfill footprint prior to placement of fill.

It is recommended that Fraser Thomas Ltd be engaged to inspect any undercutting of Recent alluvial sediments and topsoil material in order to confirm that the subgrade is founded in competent natural ground.

9.3 SITE PREPARATION

Preparation prior to placing and compacting engineered fill or cleanfill should involve the stripping of all topsoil and/or unsuitable material to stockpile.

Engineered fill and cleanfill should only be placed on ground which has been properly stripped of topsoil and unsuitable materials (e.g. “mullock”, non-engineered fill and organics), benched and under drained. Topsoil should be stockpiled well clear of the works on suitable areas of natural ground. Stripping of cut and fill areas should be inspected prior to filling operations commencing. Approved fill should then be placed at acceptable water contents and compacted in thin layers to meet the earthworks specification. Placement of fill should be under the control of a suitably qualified engineer.

It is recommended that any filling proposed on slopes greater than 11° to the horizontal (1V:5H) be placed and compacted on benches cut into the slopes at the site. It is recommended the benches be slightly sloping into the existing natural slope, and that the surface of the benches be scarified prior to placement of any fill material in order to improve the bond between the bench subgrade and the proposed fill material.

10.0 COMPACTION STANDARDS

10.1 GENERAL

The proposed fill materials should be brought to an appropriate water content prior to compaction by either wetting or drying as is necessary, and be spread uniformly in layers of not greater than 150 mm loose thickness for engineered fill material and 300 mm loose thickness for cleanfill material, unless the Contractor can demonstrate to the Engineer that compaction to the required standards is achieved with layers of greater thickness. Compacted fill which does not meet the specified requirements shall be excavated, disced and dried or moistened as may be necessary prior to re-compaction. Any fill surface which has been steel wheel rolled at the completion of a day's work must be scarified and brought to the appropriate water content prior to continuing filling operations.

Compaction must be carried out using approved equipment. Equipment used in the transportation and spreading of fill will not be permitted as compaction equipment. Compaction plant shall cover the entire area of each layer of fill and give each layer a uniform degree of compactive effort to the procedures agreed with the Engineer and as set out in the contract documents.

Optimum water content, optimum density, field water content and density will be determined by the methods of NZS 4402:1986; Methods of Testing Soils for Civil Engineering Purposes and BS 1377:1975; Methods of Test for Soils for Civil Engineering Purposes, where these are appropriate.

At any time either prior to or during the course of construction, the following compaction criteria may be modified by us, with the object of ensuring that the optimum compaction criteria for the particular materials and conditions being encountered or likely to be encountered are achieved.

10.2 ENGINEERED FILL COMPACTION SPECIFICATION

Fill shall be broken up and placed in uniform layers not greater than 150 mm loose thickness. Compaction on each layer of fill materials so placed shall be sufficient to obtain the following minimum standards:

(a) **Air Voids Percentage** (as defined in NZS 4402)

An average value of not more than **8%** and any one-test site value of not more than **10%.**

The air voids value at any one test site shall be taken as the mean of the results of a minimum of two individual tests made within an area of 0.5 m² that has been carefully trimmed to below the compacted surface.

The average value of the air voids shall be taken as the mean of any ten consecutive test site values. If less than ten test sites have been tested, the average air voids value should be taken as the mean of the test site values obtained up to that time.

(b) Undrained Shear Strength
(as measured by hand held field vane calibrated in accordance with the procedures of BS 1377 and as adopted by IANZ).

An average value of not less than **150 kPa** and any one-test site value of not less than **120 kPa**.

The test site value of undrained shear strength shall be taken as the mean of six field measurements made within an area of 0.5 m² at a single test site and two laboratory measurements, one on each of two "undisturbed" test samples taken from the test site. If no "undisturbed" test samples are taken, the test site value of undrained shear strength shall be taken as the mean of six field measurements.

The average value of the undrained shear strength shall be taken as the mean of any ten consecutive test site values.

In addition to the foregoing criteria, if the variation of the strength values in any one fill area are, in the judgement of the controlling engineer, sufficiently large so as to bring into question the uniformity of the fill materials as placed, the Engineer shall reject the fill so affected.

10.3 CLEANFILL MATERIAL COMPACTION SPECIFICATION

Fill shall be broken up and placed in uniform layers not greater than 300 mm loose thickness. Compaction on each layer of fill materials so placed shall be sufficient to obtain the following minimum standards:

(a) Air Voids Percentage (as defined in NZS 4402)

An average value of not more than **12%** and any one-test site value of not more than **14%.**

The air voids value at any one test site shall be taken as the mean of the results of a minimum of two individual tests made within an area of 0.5 m² that has been carefully trimmed to below the compacted surface.

The average value of the air voids shall be taken as the mean of any ten consecutive test site values. If less than ten test sites have been tested, the average air voids value should be taken as the mean of the test site values obtained up to that time.

(b) Undrained Shear Strength
(as measured by hand held field vane calibrated in accordance with the procedures of BS 1377 and as adopted by IANZ).

An average value of not less than **80 kPa** and any one-test site value of not less than **50 kPa**.

The test site value of undrained shear strength shall be taken as the mean of six field measurements made within an area of 0.5 m² at a single test site and two laboratory measurements, one on each of two "undisturbed" test samples taken from the test site. If no "undisturbed" test samples are taken, the test site value of undrained shear strength shall be taken as the mean of six field measurements.

The average value of the undrained shear strength shall be taken as the mean of any ten consecutive test site values.

In addition to the foregoing criteria, if the variation of the strength values in any one fill area are, in the judgement of the controlling engineer, sufficiently large so as to bring into question the uniformity of the fill materials as placed, the Engineer shall reject the fill so affected.

10.4 TESTING

10.4.1 General

Testing shall be carried out as and where required by the controlling engineer in accordance with the relevant requirements of NZS 4431:2022, where applicable.

10.4.2 Test Results

Interim IANZ accredited compaction control test results shall be made available to the controlling engineer, the Contractor and the Local Authority's representative immediately the results come to hand.

11.0 UNDERFILL STRIP DRAINS

It is recommended that underfill strip drains be constructed in the base of the gullies prior to the placement of cleanfill material to accommodate groundwater seepage and intercept any localised springs that may be encountered.

The underfill strip drains should comprise suitable drainage aggregate meeting Transit F/2 specifications or suitable approved equivalent, placed in a minimum 300 mm deep x 900 mm wide trench. The drainage aggregate should be fully wrapped in Bidim A29 geotextile fabric or approved equivalent.

The drains are also proposed in order to ensure that the groundwater levels during extreme transient conditions within the lower parts of the slope do not rise above the levels assumed for the stability analyses reported herein.

The locations of the proposed underfill strip drains are shown on the appended Fraser Thomas Ltd drawings 33250/350, Revision A and 33250/351, Revision A.

The underfill strip drains should be directed in a controlled manner to suitable outlets.

It may, in our opinion, be necessary to install additional underfill drainage or a drainage blanket where groundwater seepage is encountered. Any further underfill drainage should be installed in accordance with geotechnical recommendations and advice as the work progresses.

12.0 FUTURE WORK

12.1 SOUTH FILLING AREA

As discussed in Section 4.2.3 of this report, an up to 65 m wide, arcuate head scarp feature and reeds, inferred to be indicative of historic deep seated slope instability and perched groundwater,

were noted within the gully side slope, located in the southern part of the site, at the time of the visual appraisal.

It is our opinion that, given the presence of an arcuate headscarp and perched groundwater within the proposed South Filling area footprint, the proposed South Filling area development may be adversely affected by ongoing or future slope instability events.

As discussed in Section 2.0 of this report, it is understood that, from communication with Auckland Council, a resource consent condition will be applied to the South Filling area which states that additional geotechnical investigation, appraisal and reporting is required to determine the suitability of the area prior to commencement of any filling operations within the southern part of the site.

It is therefore recommended that further geotechnical investigation, appraisal and reporting be undertaken, specific to the proposed cleanfill profiles, in order to provide recommendations on slope stability and settlement considerations specific to the proposed South Filling area development, prior to any filling operations occurring within the South Filling area.

12.2 PROPOSED BRIDGE FOUNDATIONS

As discussed in Section 2.0 of this report, it is understood that the existing farm track and associated culvert, located in the southern part of the site, that provides vehicular access across an unnamed stream will be replaced as part of the construction of the haul road with a bridge, likely to be supported on deep piled foundations.

As discussed in Section 4.3 of this report, Boreholes H17, H18, H19 and H20, undertaken within the general vicinity of the proposed bridge, were terminated at target depths of between approximately 2.0 m and 3.0 m below the existing ground surface.

As discussed in Section 5.3 of this report, soft to very stiff Recent alluvial sediments were encountered in Borehole H19 to a depth of approximately 1.8 m below the existing ground surface. It is our opinion that the Recent alluvial sediments will not be a suitable founding stratum for any proposed bridge foundations.

It is anticipated that, depending on traffic loads and foundation configurations, bridge piles may be require to be founded beneath a depth of 3.0 m or socketed into the underlying Waipapa Group bedrock.

It is therefore noted that further geotechnical investigation, comprising machine boreholes, appraisal and reporting will be required to be undertaken, specific to the proposed foundation configurations, in order to provide recommendations on foundation bearing pressures and settlement considerations specific to the proposed bridge development at the detailed design/Building Consent application stage.

13.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations should be read together and not be taken in isolation.

13.1 CONCLUSIONS

Our conclusions based on the field data obtained from the site and as presented in this report, our study of the geological maps relating to the area and our professional judgement and opinions, are as follows:

(a) In general terms and within the limits of the investigation as outlined and reported herein, and provided proper control of any proposed earthworks is exercised, no unusual problems are anticipated with the proposed development at the site.

The site is, in general, considered suitable for its intended use with satisfactory conditions for the proposed development, subject to the recommendations and qualifications reported herein, provided the design and inspection of foundations are carried out as would be done under normal circumstances in accordance with the requirements of the relevant New Zealand Standard Codes of Practice.

In arriving at this conclusion and expressing this opinion, reliance has been based on the various topographical data as discussed herein and on subsoil strata, their depths and thicknesses, and the locations of groundwater levels, which have only been obtained at the locations and within the depths of the boreholes reported herein. It has been assumed that these subsoil features can be projected between the various borehole locations. Even though such inference is made and forms the basis of the conclusions and opinions expressed herein, no guarantee can be given as to the validity of this inference or of the nature and continuity of the subsoil features underlying the proposed development.

(b) The purpose of the geotechnical investigation reported herein was to determine the subsoil conditions beneath the subject site as they may affect the proposed Fill Facility development, with particular regard to slope stability considerations, and to determine the suitability of the subject site for the proposed development, in support of an application for resource consent.

(c) The borehole logs, presented in Appendix A of this report, indicate that the subject site is, in general, underlain by material inferred to be residual soils of the Waipapa Group of Jurassic age. A veneer of material, inferred to be Recent alluvial sediments and controlled fill, was also encountered.

(d) The results of the slope stability appraisal for the proposed North Filling area development indicate that, the proposed cleanfill slope profiles, at a maximum gradient of approximately 18° to the horizontal (1V:3H), and 4 m wide benches installed at 1 bench per 10 m vertical height, achieves adequate factors of safety with respect to slope stability, as presented in Section 7.0 of this report.

(e) It is our opinion that, following stripping of surficial topsoil, the proposed access road subgrade should be assumed to have a preliminary minimum CBR value of 4% for pavement design purposes.

(f) Topsoil should be stockpiled well clear of the works on suitable areas of natural ground. Stripping of cut and fill areas should be inspected prior to filling operations commencing. Approved fill should then be placed at acceptable water contents and compacted in thin layers to meet the earthworks specification. Placement of fill should be under the control of a suitably qualified engineer.

(g) It is our opinion, based on our earthworks experience with similar soils encountered elsewhere in the greater Auckland area, that the proposed cleanfill material will, in some places, require to be dried and/or mixed with other materials prior to placement as engineered cleanfill, in order to obtain the minimum compaction standards as presented in Section 10.0 of this report.

(h) Underfill strip drains should comprise suitable drainage aggregate meeting Transit F/2 specifications or suitable approved equivalent, placed in a minimum 300 mm deep x 900 mm wide trench. The drainage aggregate should be fully wrapped in Bidim A29 geotextile fabric or approved equivalent.

(i) It may, in our opinion, be necessary to install additional underfill drainage or a drainage blanket where groundwater seepage is encountered. Any further underfill drainage should be installed in accordance with geotechnical recommendations and advice as the work progresses.

13.2 RECOMMENDATIONS

Our recommendations based on the field data obtained from the site and as presented in this report, our study of the geological maps relating to the area and our professional judgement and opinions, are as follows:

(a) That Fraser Thomas Ltd be engaged to undertake further geotechnical investigation in order to confirm the subgrade CBR values and design requirements during construction.

(b) That, prior to placement of any engineered fill and cleanfill material, all Recent alluvial sediments and topsoil material be appropriately undercut from beneath the footprint of any proposed filling prior to placement of fill as discussed in Section 9.0 of this report.

(c) That any filling proposed on slopes greater than 11° to the horizontal (1V:5H) be placed and compacted on benches cut into the slopes at the site. It is recommended the benches be slightly sloping into the existing natural slope, and that the surface of the benches be scarified prior to placement of any fill material in order to improve the bond between the bench subgrade and the proposed fill material.

(d) That any engineered fill and cleanfill material be placed and tested in accordance with the relevant recommended fill specifications presented in Section 10.0 of this report.

(e) That underfill strip drains be constructed in the base of the gullies prior to the placement of cleanfill material to accommodate groundwater seepage and intercept any localised springs that may be encountered.

(f) That further geotechnical investigation, appraisal and reporting be undertaken, specific to the proposed cleanfill profiles, in order to provide recommendations on slope stability and settlement considerations specific to the proposed South Filling area development, prior to any filling operations occurring within the South Filling area.

(g) That further geotechnical investigation, comprising machine boreholes, appraisal and reporting will be required to be undertaken, specific to the proposed foundation configurations, in order to provide recommendations on foundation bearing pressures and settlement considerations specific to the proposed bridge development at the detailed design/Building Consent application stage.

14.0 LIMITATION

The professional opinion expressed herein has been prepared solely for, and is furnished to our client, Scarbro Environmental Ltd, for their purposes only with respect to the particular brief given to us, on the express condition that it will not be relied upon by any other person or for any other purposes without our prior written agreement.

No liability is accepted by this firm or by any principal, or director, or any servant or agent of this firm, in respect of its use by any other person, and any other person who relies upon any matter contained in this report does so entirely at its own risk. This disclaimer shall apply notwithstanding that this report may be made available to any person by any person in connection with any application for permission or approval, or pursuant to any requirement of law.

Notwithstanding the foregoing, if the circumstances at the subject site change with respect to topography or the proposed development concept, or if a period of more than three years has elapsed since the date of this report, this report should not be used without our prior review and written agreement.

These conclusions and recommendations should be read in conjunction with the remainder of this Geotechnical Investigation Report and should not be referred to out of context with the remainder of this report.

Report prepared by:
FRASER THOMAS LTD.

C A WEBSTER
Engineering Geologist
G00417 SCA rep 241011 CAWcaw

Report reviewed and approved by:

A G J STUART
Director – Geotechnical Engineering
Chartered Professional Engineering Geologist

Appendix A

FIELD TEST RESULTS

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BOREHOLE AND TEST PIT LOGS SYMBOLS AND TERMS

SYMBOLS AND ABBREVIATIONS

RL	Reduced Level
EOH	End of Hole
•	Shear vane test result
UTP	Unable to Penetrate
TDTA	Too Difficult to Auger
SPT	Standard Penetration Test
N	SPT blows per 300mm penetration
35/90	35 blows per 90mm penetration after seating for SPT
(s)	Inclusive of seating blow count for SPT
GWL	Ground Water Level

Wf	Field water content
Wp	Plastic limit (%)
WL	Liquid Limit (%)
RQD	Rock Quality Designation
SG	Specific Gravity
%F	Percentage fines (<75 microns)
PSD	Particle size distribution
CONS	Consolidation test
COMP	Compaction test
UCS	Unconfined Compressive Strength
k	Permeability coefficient (m/s)
LS	Linear Shrinkage (%)
OC	Organic Content (%)

SOIL


TOPSOIL


CLAY


SILT


SAND


GRAVEL


COBBLES


BOULDERS


PEAT


FILL

CONSISTENCY TERMS

Cohesive Description	Undrained Shear Strength (kPa)
Very Soft	<12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	>200

RELATIVE DENSITY

Non-cohesive Description	SPT "N" Value
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

ROCK


LIMESTONE


MUDSTONE


SANDSTONE


CONGLOMERATE


BRECCIA


RYHOLITE


ANDESITE


BASALT

STRENGTH

Description	Unconfined Compressive Strength MPa
Extremely Weak	< 1
Very Weak	1 - 5
Weak	5 - 20
Moderately Strong	20 - 50
Strong	50 - 100
Very Strong	100 - 250
Extremely Strong	> 250

WEATHERING

UW - Unweathered (fresh rock)
SW - Slightly Weathered
MW - Moderately Weathered
HW - Highly Weathered
CW - Completely Weathered
RS - Residual Soil

SPACING OF DISCONTINUITIES

Term	Aperture (mm)
Very widely spaced	>2000
Widely spaced	600 - 2000
Moderately widely spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	<20

DEFECTS/DISCONTINUITIES AND ABBREVIATIONS

Defect/Discontinuity

Jt - Joint
Fr - Fracture

Infill

cl - Clay
cn - Clean

Roughness

r - Rough
sm - Smooth
sl - Slickensided
st - Stepped
un - Undulating
pl - Planar

Aperture

ti - Tight
vn - Very Narrow
n - Narrow
mn - Moderately Narrow
mw - Moderately Wide
w - Wide
vw - Very Wide

Notes

1. Based on New Zealand Geotechnical Society " Field Description of Soil and Rock,Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes" December 2005
2. Composite soil types are signified by combined symbols

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HAND AUGER LOG

Hole No: H1

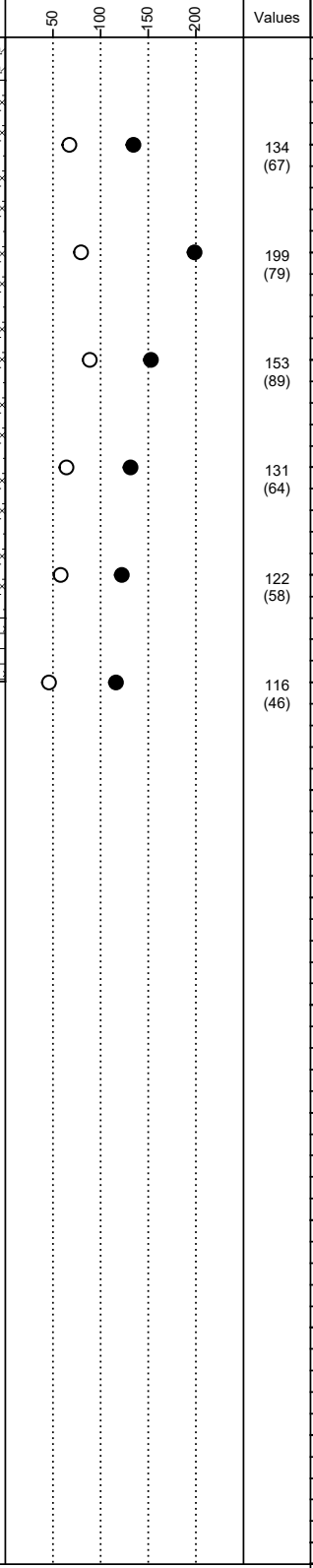
Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	20/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS TS
0.4	SILT, clayey, brown streaked orange, very stiff, moist, moderately plastic [RESIDUAL SOILS]	Waipapa Group	
0.6			
0.8	0.8 m: becomes orange/brown		
1.0			
1.2			
1.4			
1.6			
1.8			
2.0			
2.2			
2.4			
2.6			
2.8	CLAY, silty, light grey streaked orange, very stiff, moist, highly plastic		
3.0	EOH: 3.00 m TARGET DEPTH		
3.2			
3.4			
3.6			
3.8			
4.0			
4.2			
4.4			
4.6			
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			
7.0			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

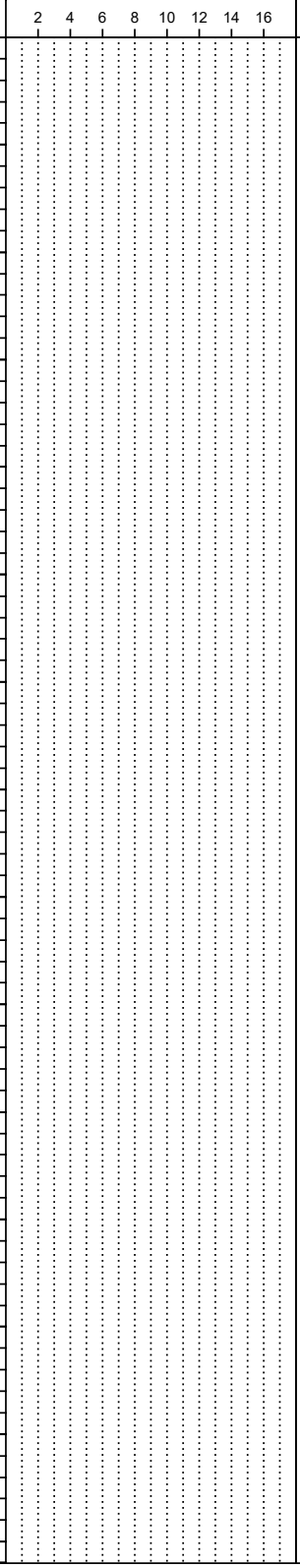


Values
134 (67)
199 (79)
153 (89)
131 (64)
122 (58)
116 (46)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100 mm)



Groundwater: GWNE

Remarks:

1. Groundwater not encountered on 20/03/2024.

Datum:

Coordinates:

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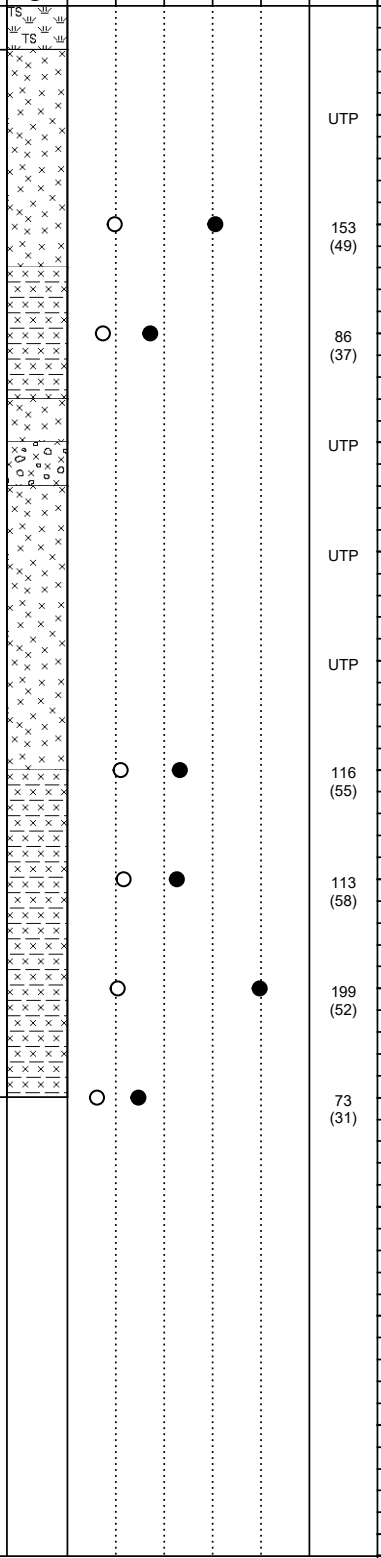
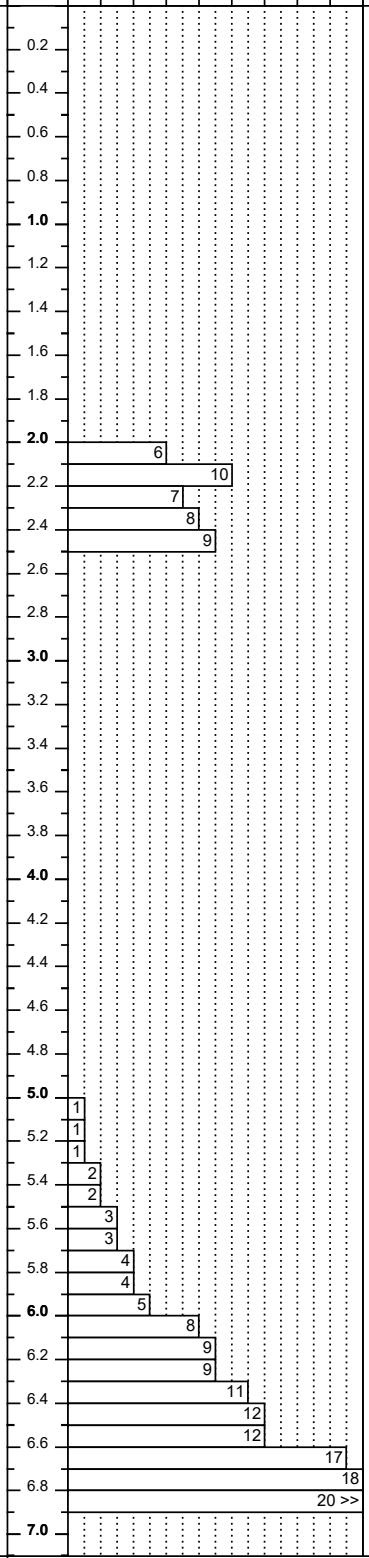
HAND AUGER LOG

Hole No: H2

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	20/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4	SILT, orange/brown, hard, moist, non-plastic [RESIDUAL SOILS]	Waipapa Group
0.6	0.6 m: contains trace clay	
1.0	1.0 m: becomes very stiff	
1.2	SILT, clayey, orange/brown, stiff, moist, moderately plastic	
1.8	SILT, trace sand (fine to medium) and clay, orange/brown, hard, moist, slightly plastic	
2.0	SILT, gravelly (fine to medium, subangular), minor sand (fine to medium), grey, hard, moist, non-plastic	
2.6	SILT, trace gravel (fine, subangular) and clay, orange/brown, hard, moist, slightly plastic	
2.7	2.7 m: becomes brown	
3.2	3.2 m: contains minor clay, no longer contains trace gravel	
3.6	SILT, clayey, orange/brown, very stiff, moist, moderately plastic	
4.3	4.3 m: becomes light grey streaked orange/light pink	
4.8	4.8 m: becomes stiff, moist to wet	
5.0	EOH: 5.00 m TARGET DEPTH	





Remarks:

1. Groundwater not encountered on 20/03/2024.
2. DCP tests undertaken from 2.05 m to 2.5 m and from 5.0 m to 6.9 m BGL.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H3

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	20/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0 – 0.4	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4 – 1.8	SILT, clayey, brown streaked orange, very stiff, moist, moderately plastic [RESIDUAL SOILS] 1.0 m: becomes grey/brown streaked orange 1.3 m: becomes orange/brown streaked light grey	Waipapa Group
1.8 – 3.0	CLAY, silty, orange/brown, very stiff, moist, highly plastic 2.5 m: becomes stiff, moist to wet	Waipapa Group
3.0	EOH: 3.00 m TARGET DEPTH	

Graphic Log: TS

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane

Depth (m)	Values
0.6	153 (46)
1.0	107 (55)
1.6	113 (61)
2.0	104 (40)
2.6	95 (46)
3.0	67 (31)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)

Groundwater: ▽ 20/03/2024

Remarks:
1. Groundwater strike recorded at 2.5 m BGL on 20/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H4

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	20/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4	SILT, clayey, orange/brown, very stiff, moist, moderately plastic [RESIDUAL SOILS]	Waipapa Group
0.6		
0.8	0.7 m: becomes light grey streaked orange/light brown	
1.0		
1.2		
1.4	1.4 m: becomes light grey streaked orange/pink	
1.6		
1.8		
2.0	2.0 m: becomes light grey streaked orange	
2.2		
2.4		
2.6		
2.8		
3.0	3.0 m: becomes pink, hard	
3.2	SILT, minor sand (fine), trace clay, dark orange/brown, hard, moist, moderately plastic	
3.4		
3.6	3.3 m: contains minor gravel (fine, subangular), trace sand (fine to medium), becomes dark orange/brown/light grey	
3.8		
4.0	4.1 m: no longer contains minor gravel and trace sand	
4.2	4.3 m: becomes dark orange/pink	
4.4		
4.6	SILT, gravelly (fine to medium, subangular), dark orange/brown, hard, moist, non-plastic	
4.8	SILT, trace clay, pink/orange/brown, very stiff, moist, slightly plastic	
5.0	EOH: 5.00 m TARGET DEPTH	
5.2		
5.4		
5.6		
5.8		
6.0		
6.2		
6.4		
6.6		
6.8		
7.0		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.6	138 (67)
1.0	122 (67)
1.6	141 (61)
2.0	144 (70)
2.6	156 (73)
3.0	202 (61)
3.4	UTP
4.0	UTP
4.4	UTP
5.0	168 (61)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Depth (m)	Blows / 100 mm
5.0	3
5.2	4
5.4	7
5.6	7
5.8	8
6.0	7
6.2	9
6.4	11
6.6	11
6.8	13
7.0	18
	20 >>
	23 >>

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 20/03/2024.
2. DCP test undertaken from 5.0 m to 6.3 m BGL.
3. DCP test refused at 6.3 m BGL.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H5

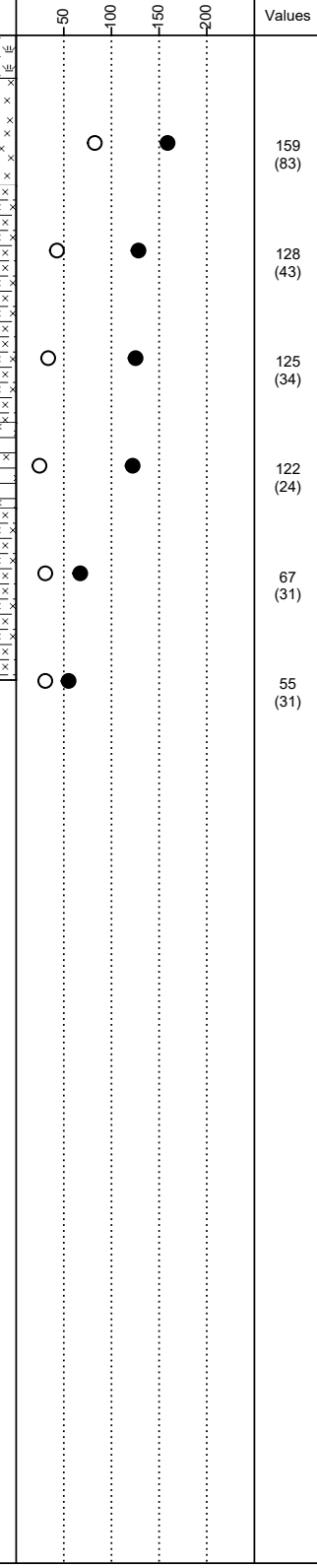
Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS
0.4	SILT, trace clay, orange/brown, very stiff, moist, slightly plastic [RESIDUAL SOILS]	Waipapa Group	
0.6			
0.8	SILT, clayey, orange/brown, very stiff, moist, moderately plastic		
1.0			
1.2			
1.4			
1.6			
1.8	CLAY, silty, orange/brown, very stiff, moist, highly plastic		
2.0			
2.2	SILT, clayey, trace gravel (fine to medium, subangular) and sand (fine to medium), orange/brown, stiff, moist, moderately plastic		
2.4			
2.6			
2.8	2.7 m: contains minor sand (fine to medium)		
3.0	EOH: 3.00 m TARGET DEPTH		
3.2			
3.4			
3.6			
3.8			
4.0			
4.2			
4.4			
4.6			
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			
7.0			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

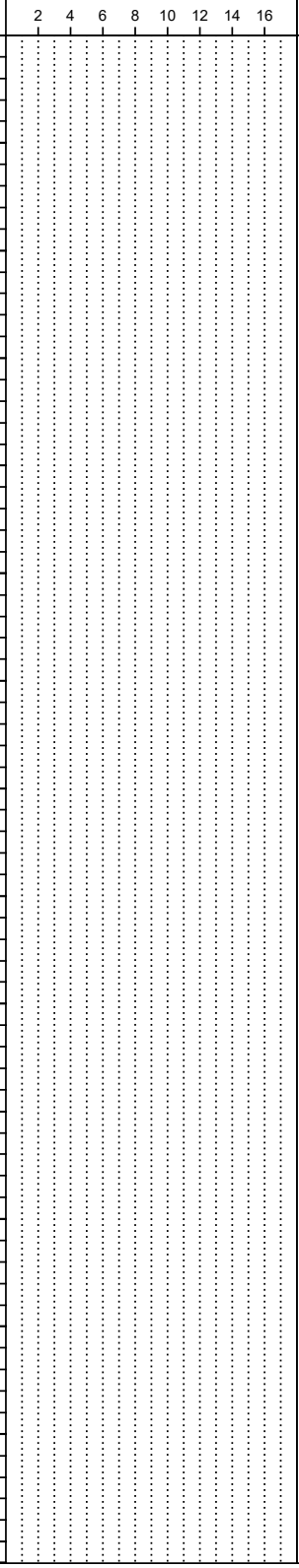


Depth (m)	Values
0.6	159 (83)
1.0	128 (43)
1.6	125 (34)
2.0	122 (24)
2.6	67 (31)
3.0	55 (31)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100 mm)



Groundwater: GWNE

Remarks:

1. Groundwater not encountered on 21/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H6

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO1830	20/03/2024	C. Webster	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS
0.4	SILT, clayey, orange/brown, very stiff, moist, moderately plastic [RESIDUAL SOILS]	Waipapa Group	
1.0	0.9 m: becomes brown speckled red, hard		
2.0	1.9 m: contains minor sand (fine to medium), becomes orange/brown speckled white		
2.6	2.6 m: becomes orange/brown streaked light grey		
3.0	EOH: 3.00 m TARGET DEPTH		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.6	100 (51)
1.0	>200
1.6	>200
2.0	>200
2.6	>200
3.0	>200

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 20/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H7

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO1830	20/03/2024	C. Webster	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.2	SILT, clayey, orange/brown, stiff, moist, moderately plastic [RESIDUAL SOILS]	
0.8	CLAY, silty, orange/brown, very stiff, moist, highly plastic	
1.1	1.1 m: becomes orange/brown streaked red	
1.7	1.7 m: becomes orange/brown streaked light grey/red	
2.0	2.0 m: becomes white speckled red streaked orange/brown	
2.2	SILT, clayey, minor sand (fine to medium), orange/brown streaked light grey/red, very stiff, moist, moderately plastic	Waipapa Group
3.1	3.1 m: contains minor gravel (fine, subangular)	
3.9	3.9 m - 4.1 m: 200 mm CLAY, silty, pink streaked white, very stiff, moist, highly plastic	
5.0	EOH: 5.00 m TARGET DEPTH	

Graphic Log: TS, TS

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.6	94 (43)
1.0	163 (86)
1.6	171 (114)
2.0	186 (97)
2.6	160 (100)
3.0	143 (80)
3.6	114 (69)
4.0	103 (63)
4.6	114 (63)
5.0	109 (57)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

5, 4, 5, 7, 9, 10, 12, 16, 21 >>, 25 >>

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 20/03/2024.
2. DCP test undertaken from 5.0 m to 6.0 m BGL.
3. DCP test refused at 6.0 m BGL.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H8

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO1830	20/03/2024	C. Webster	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.2	CLAY, silty, brown streaked orange/brown, stiff, moist, highly plastic [RESIDUAL SOILS]	
0.8	0.8 m: becomes brown streaked grey/orange/brown	
1.2	SILT, clayey, orange/brown, hard, moist, moderately plastic	Waipapa Group
1.8	1.8 m: becomes orange/brown streaked light grey/red	
2.2	2.2 m: becomes wet	
3.0	EOH: 3.00 m TARGET DEPTH	

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane

Depth (m)	Values
0.6	89 (46)
1.0	89 (46)
1.6	>200
2.0	137 (43)
2.4	126 (57)
3.0	140 (71)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)

Groundwater
20/03/2024 20/03/2024

Remarks:
1. Groundwater strike recorded at 2.2 m BGL on 20/03/2024.
2. Standing groundwater measured at 2.4 m BGL following completion of drilling on 20/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H9

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4	SILT, minor clay, orange/brown, very stiff, moist, slightly plastic [RESIDUAL SOILS]	Waipapa Group
0.8	SILT, clayey, orange/brown, stiff, moist, moderately plastic	
2.4	2.5 m: becomes very stiff	
2.6	2.6 m: contains trace gravel (fine, subangular)	
2.8	SILT, gravelly (fine, subangular), brown speckled orange, hard, moist, non-plastic	
3.0	CLAY, minor silt, orange/brown streaked light grey, very stiff, moist, highly plastic	
3.0	EOH: 3.00 m TARGET DEPTH	

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.6	138 (55)
1.0	92 (28)
1.6	95 (34)
2.0	86 (21)
2.6	141 (37)
3.0	128 (79)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 21/03/2024.

Datum:

Coordinates:

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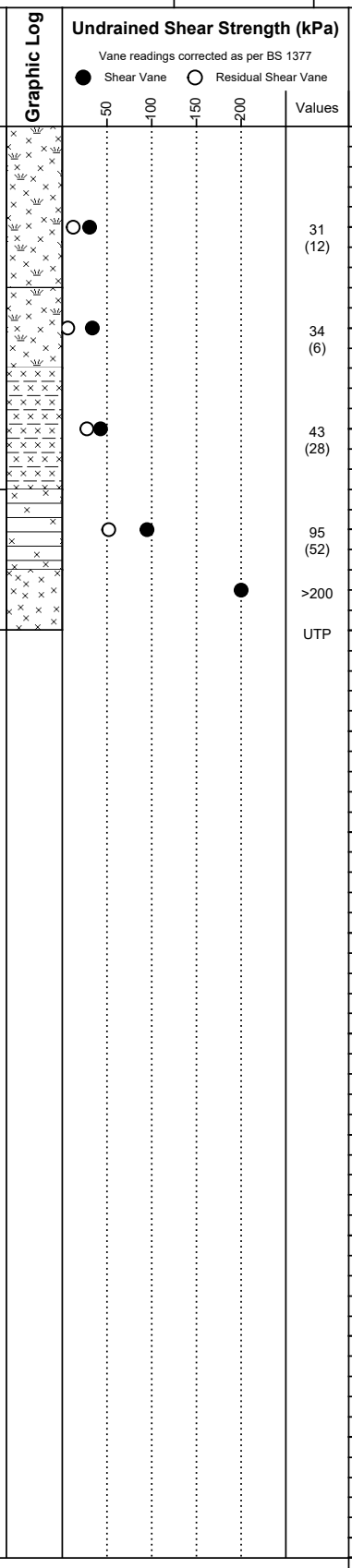
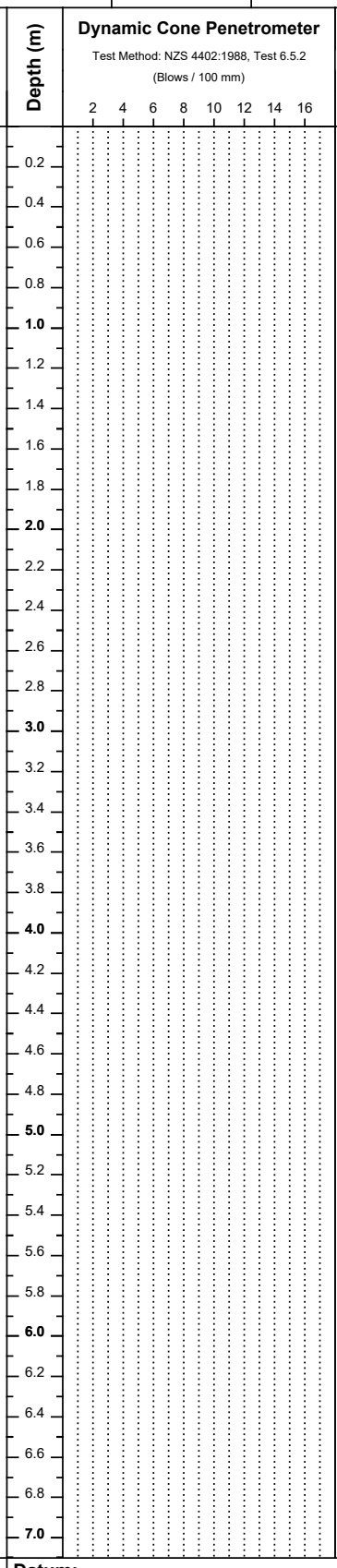
HAND AUGER LOG

Hole No: H10

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0 – 0.8	Organic SILT, clayey, some rootlets, dark brown, firm, moist, moderately plastic [RECENT ALLUVIAL SEDIMENTS] 0.4 m: becomes wet	Recent Alluvial Sediments
0.8 – 1.2	Organic SILT, sandy (fine to medium), trace clay, dark brown/grey, firm, wet, slightly plastic	Recent Alluvial Sediments
1.2 – 1.8	SILT, clayey, trace sand (fine to medium), light grey, firm, wet, moderately plastic	Recent Alluvial Sediments
1.8 – 2.2	CLAY, silty, blue/light grey, stiff, wet, highly plastic [RESIDUAL SOILS]	Waipapa Group
2.2 – 2.5	SILT, minor sand (fine to medium), dark grey/blue, hard, wet, non-plastic	Waipapa Group
2.5	EOH: 2.50 m TOO DIFFICULT TO AUGER - BOREHOLE SQUEEZING	





Groundwater
22/03/2024
22/03/2024

Remarks:
1. Groundwater strike recorded at 0.4 m BGL on 22/03/2024.
2. Standing groundwater measured at 0.6 m BGL following completion of drilling on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H11

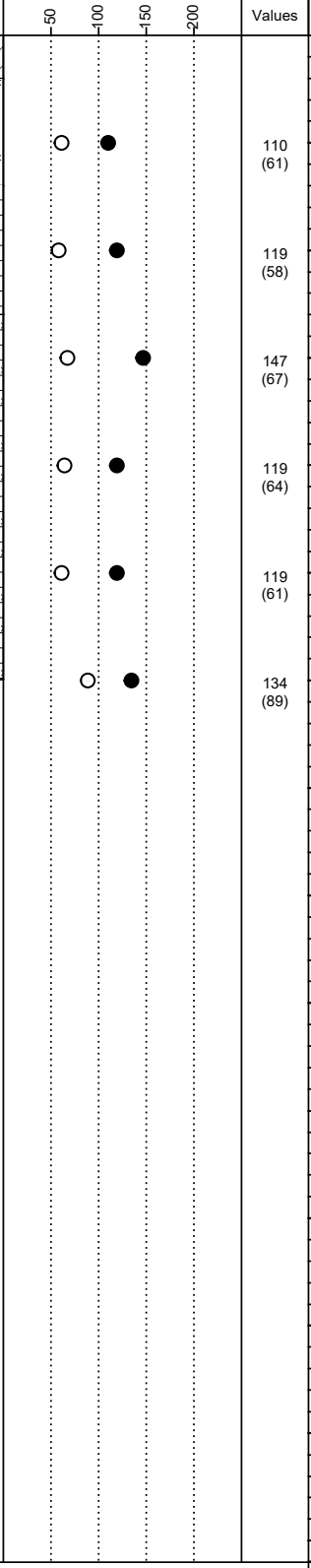
Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS TS
0.4	SILT, minor clay, orange/brown streaked dark orange, very stiff, moist, slightly plastic [RESIDUAL SOILS]	Waipapa Group	
0.6			
0.8	CLAY, minor silt, orange/brown, very stiff, moist, highly plastic		
1.0			
1.2			
1.4	CLAY, silty, orange/brown, very stiff, moist, highly plastic		
1.6			
1.8	1.7 m: becomes pink/dark orange streaked light grey		
2.0			
2.2			
2.4	2.3 m: contains trace sand (fine)		
2.6	2.5 m: becomes pink/dark orange streaked light grey/orange		
2.8			
3.0	EOH: 3.00 m TARGET DEPTH		
3.2			
3.4			
3.6			
3.8			
4.0			
4.2			
4.4			
4.6			
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			
7.0			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

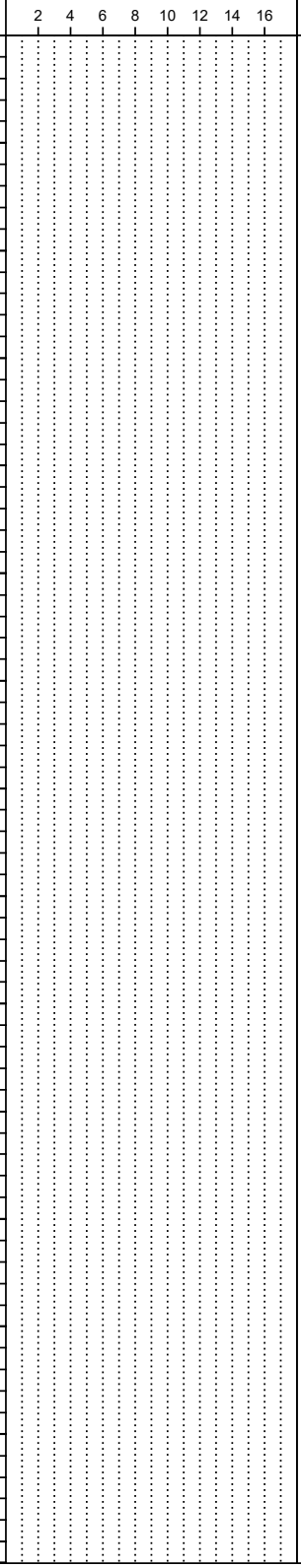


Values
110 (61)
119 (58)
147 (67)
119 (64)
119 (61)
134 (89)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100 mm)



Groundwater: GWNE

Remarks:

1. Groundwater not encountered on 21/03/2024.

Datum:

Coordinates:

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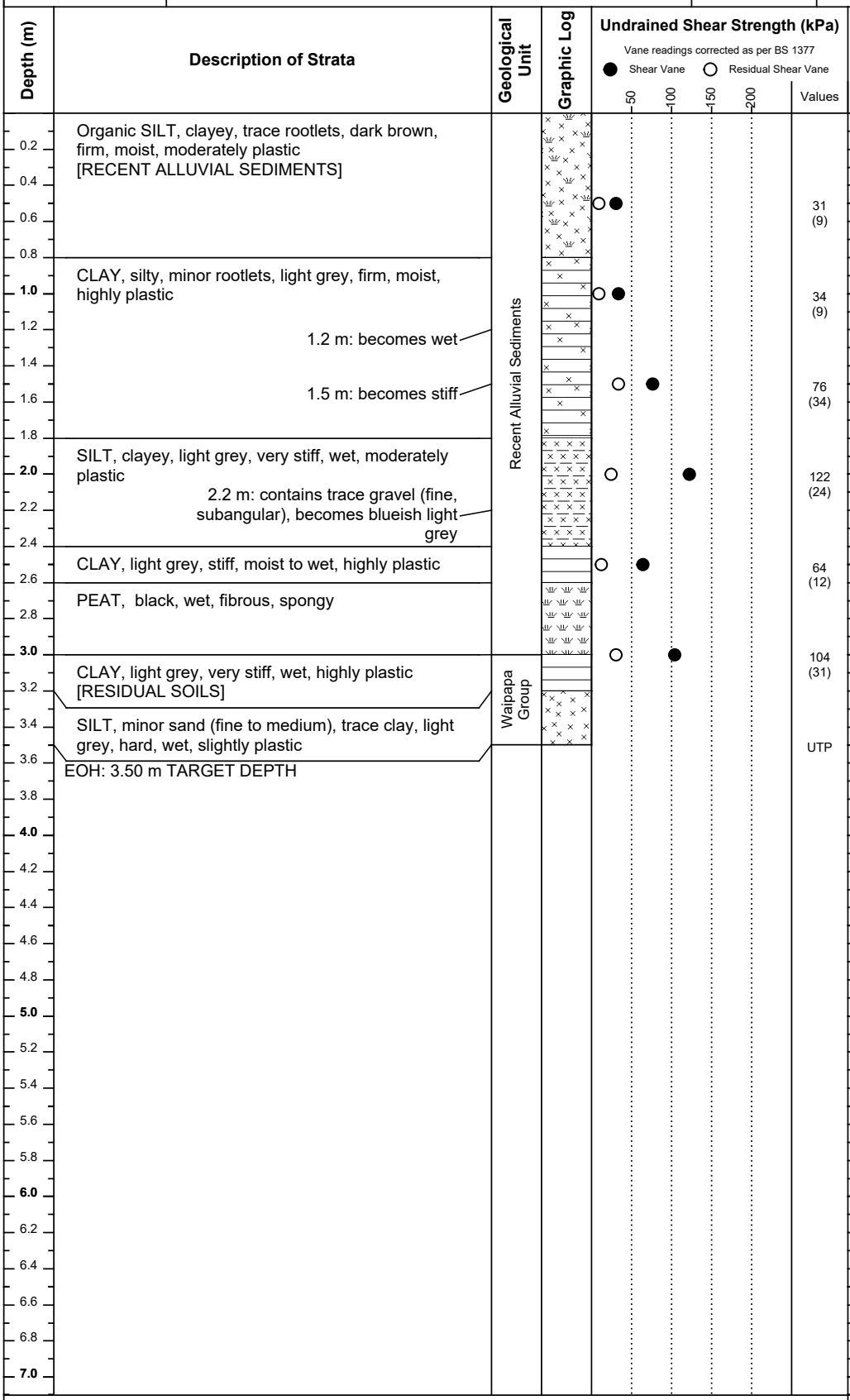
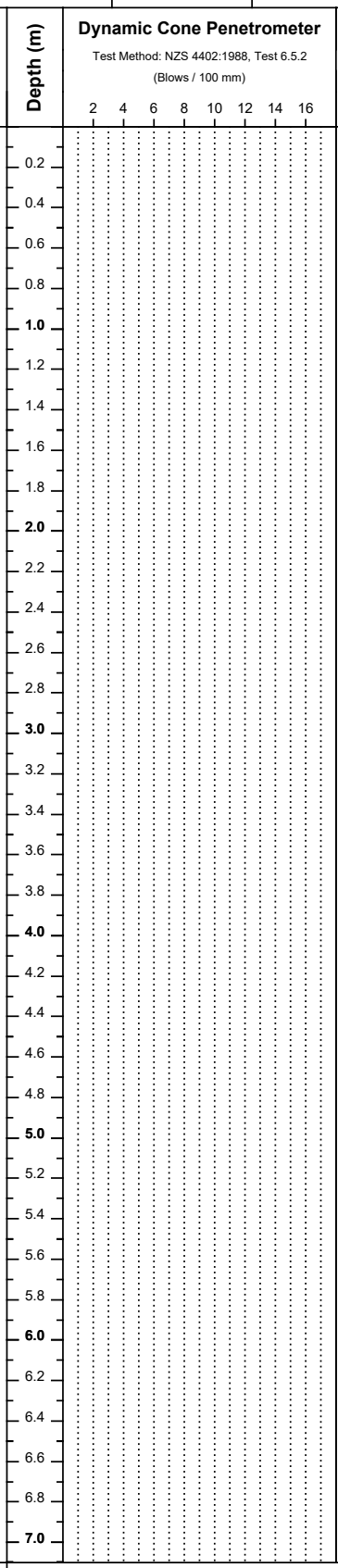
HAND AUGER LOG

Hole No: H12

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0	Organic SILT, clayey, trace rootlets, dark brown, firm, moist, moderately plastic [RECENT ALLUVIAL SEDIMENTS]	Recent Alluvial Sediments
1.0	CLAY, silty, minor rootlets, light grey, firm, moist, highly plastic	
1.2	1.2 m: becomes wet	
1.5	1.5 m: becomes stiff	
2.0	SILT, clayey, light grey, very stiff, wet, moderately plastic	
2.2	2.2 m: contains trace gravel (fine, subangular), becomes blueish light grey	
2.5	CLAY, light grey, stiff, moist to wet, highly plastic	
2.6	PEAT, black, wet, fibrous, spongy	
3.0	CLAY, light grey, very stiff, wet, highly plastic [RESIDUAL SOILS]	Waipapa Group
3.4	SILT, minor sand (fine to medium), trace clay, light grey, hard, wet, slightly plastic	
3.5	EOH: 3.50 m TARGET DEPTH	





Groundwater
21/03/2024
21/03/2024

Remarks:
1. Groundwater strike recorded at 1.2 m BGL on 21/03/2024.
2. Standing groundwater measured at 3.0 m BGL following completion of drilling on 21/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H13

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log	Undrained Shear Strength (kPa)	Values	Depth (m)	Dynamic Cone Penetrometer	Groundwater
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T / S	TS	Vane readings corrected as per BS 1377 ● Shear Vane ○ Residual Shear Vane 50 100 150 200		0.0	Test Method: NZS 4402:1988, Test 6.5.2 (Blows / 100 mm) 2 4 6 8 10 12 14 16	
0.2	SILT, brown, hard, moist, non-plastic [RESIDUAL SOILS]					0.2		
0.4	0.4 m: contains trace clay, becomes slightly plastic				UTP	0.4		
0.6						0.6		
0.8						0.8		
1.0	SILT, clayey, orange/brown, very stiff, moist, moderately plastic			○ ●	138 (64)	1.0		
1.2						1.2		
1.4	SILT, minor sand (fine to coarse), trace clay, orange/brown, very stiff, moist, slightly plastic	Waipapa Group				1.4		
1.6				○ ●	138 (49)	1.6		
1.8						1.8		
2.0				○ ●	107 (43)	2.0		
2.2						2.2		
2.4						2.4		
2.6				○ ●	128 (49)	2.6		
2.8						2.8		
3.0	EOH: 3.00 m TARGET DEPTH			○ ●	165 (61)	3.0		
3.2						3.2		
3.4						3.4		
3.6						3.6		
3.8						3.8		
4.0						4.0		
4.2						4.2		
4.4						4.4		
4.6						4.6		
4.8						4.8		
5.0						5.0		
5.2						5.2		
5.4						5.4		
5.6						5.6		
5.8						5.8		
6.0						6.0		
6.2						6.2		
6.4						6.4		
6.6						6.6		
6.8						6.8		
7.0						7.0		

GWNE

Remarks:
1. Groundwater not encountered on 21/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H14

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.0	Organic SILT, clayey, dark brown, stiff, moist, moderately plastic [RECENT ALLUVIAL SEDIMENTS]	Recent Alluvial Sediments
0.6	Organic SILT, trace clay, dark brown mottled orange, firm, moist, slightly plastic	
0.8	CLAY, trace silt, light grey streaked orange, stiff, wet, highly plastic	
1.6	1.6 m: contains trace organic material (fibrous, spongy), becomes grey/brown	
1.8	SILT, minor clay, trace sand (fine to medium), light grey, very stiff, wet, slightly plastic [RESIDUAL SOILS]	Waipapa Group
2.5	2.5 m: becomes stiff	
2.8	CLAY, silty, light grey, stiff, wet, highly plastic	
3.0	EOH: 3.00 m TARGET DEPTH	

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane

Depth (m)	Values
0.8	31 (12)
1.0	55 (9)
1.6	73 (15)
2.0	101 (18)
2.6	76 (31)
3.0	61 (34)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)

Groundwater
21/03/2024 21/03/2024

Remarks:
1. Groundwater strike recorded at 0.8 m BGL on 21/03/2024.
2. Standing groundwater measured at 0.9 m BGL following completion of drilling on 21/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H15

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	21/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T / S	TS
0.2	SILT, gravelly (fine to medium, subangular), trace clay, dark brown/grey speckled orange, hard, moist, slightly plastic [CONTROLLED FILL]	Fill	
1.4	SILT, clayey, dark brown streaked dark orange, very stiff, moist, moderately plastic [PALAEOSOL]	T/S	TS
1.6	CLAY, silty, orange/brown streaked dark orange, stiff, moist, highly plastic [RESIDUAL SOILS]	Waipapa Group	
2.0	2.0 m: becomes very stiff		
2.4	2.4 m: becomes light grey streaked orange		
2.8	SILT, clayey, light grey streaked orange, very stiff, moist, moderately plastic		
3.0	EOH: 3.00 m TARGET DEPTH		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.2	
0.4	
0.6	UTP
0.8	
1.0	UTP
1.2	
1.4	98 (37)
1.6	
1.8	
2.0	122 (46)
2.2	
2.4	134 (58)
2.6	
2.8	
3.0	128 (61)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Depth (m)	Blows / 100 mm
1.0	2
1.1	3
1.2	3
1.3	2
1.4	2

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 21/03/2024.
2. DCP test undertaken from 1.05 m to 1.5 m BGL.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H16

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS TS
0.4	SILT, trace clay, brown streaked orange, very stiff, moist, slightly plastic [RESIDUAL SOILS]	Waipapa Group	
0.6			
0.8	CLAY, minor silt, orange/brown streaked light grey, very stiff, moist, highly plastic		
1.0	CLAY, silty, light grey streaked light orange, hard, moist, highly plastic		
1.2	SILT, minor sand (fine), trace clay, light grey streaked light orange, hard, moist, slightly plastic		
1.4			
1.6	1.6 m: contains some clay		
1.8	1.8 m: becomes light grey streaked orange/pink		
2.0	2.0 m: becomes very stiff		
2.2	2.3 m: contains trace sand (fine) and clay, becomes light grey streaked orange, hard		
2.4			
2.6	SILT, sandy (fine to medium), light grey streaked light orange, very stiff, moist, non-plastic		
2.8			
3.0	EOH: 3.00 m TARGET DEPTH		
3.2			
3.4			
3.6			
3.8			
4.0			
4.2			
4.4			
4.6			
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			
7.0			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

50 100 150 200

Depth (m)	Values
0.6	150 (37)
1.0	UTP
1.4	UTP
2.0	153 (76)
2.6	>200
3.0	125 (55)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100 mm)

2 4 6 8 10 12 14 16

Groundwater: GWNE

Remarks:

1. Groundwater not encountered on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H17

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4	CLAY, minor silt, light grey streaked orange, stiff, moist, highly plastic [RESIDUAL SOILS]	Waipapa Group
1.0	SILT, sandy (fine to medium), minor clay, light grey streaked orange, very stiff, moist, slightly plastic	
1.5	1.5 m: becomes stiff, wet	
2.4	CLAY, minor silt, grey, stiff, wet, highly plastic	
3.0	EOH: 3.00 m TARGET DEPTH	

Graphic Log: TS, TS

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.6	89 (46)
1.0	122 (21)
1.6	76 (24)
2.0	61 (24)
2.6	55 (24)
3.0	61 (28)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Groundwater
22/03/2024 22/03/2024

Remarks:
1. Groundwater strike recorded at 1.5 m BGL on 22/03/2024.
2. Standing groundwater measured at 1.5 m BGL following completion of drilling on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H18

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T / S	TS
0.2	SILT, gravelly (fine to coarse, subangular), minor clay, dark brown streaked orange, hard, moist, slightly plastic [CONTROLLED FILL]	Fill	
1.0	CLAY, light grey streaked orange, stiff, moist, highly plastic [RESIDUAL SOILS]	Waipapa Group	
1.4	SILT, clayey, light grey streaked orange, stiff, wet, moderately plastic		
1.8	CLAY, silty, light grey, stiff, wet, highly plastic		
2.4	SILT, clayey, minor sand (fine to medium), light grey, stiff, wet, moderately plastic		
2.6	SILT, sandy (fine to medium), light grey, hard, wet, non-plastic		
2.8	CLAY, silty, trace sand (fine), blueish grey, stiff, wet, highly plastic		
3.0	EOH: 3.00 m TARGET DEPTH		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
1.0	UTP
1.0	86 (40)
1.4	95 (34)
2.0	79 (18)
2.6	83 (40)
3.0	79 (40)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Groundwater
22/03/2024 22/03/2024

Remarks:
1. Groundwater strike recorded at 1.3 m BGL on 22/03/2024.
2. Standing groundwater measured at 1.2 m BGL following completion of drilling on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H19

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log	Undrained Shear Strength (kPa)	Values	Depth (m)	Dynamic Cone Penetrometer	Groundwater
0.2	Organic SILT, clayey, dark brown, soft, moist, moderately plastic [RECENT ALLUVIAL SEDIMENTS]	Recent Alluvial Sediments		Vane readings corrected as per BS 1377 ● Shear Vane ○ Residual Shear Vane 50 100 150 200		0.2	Test Method: NZS 4402:1988, Test 6.5.2 (Blows / 100 mm) 2 4 6 8 10 12 14 16	22/03/2024 22/03/2024
0.4						0.4		
0.6	0.5 m: becomes wet			● ○	18 (6)	0.6		
0.8						0.8		
1.0	CLAY, light grey, soft, wet, highly plastic			● ○	18 (3)	1.0		
1.2						1.2		
1.4						1.4		
1.6	1.5 m: becomes stiff			● ○	61 (28)	1.6		
1.8						1.8		
2.0	SILT, sandy (fine to medium), trace clay, light grey, very stiff, wet, slightly plastic [RESIDUAL SOILS]	WG		● ○	122 (43)	2.0		
2.2	EOH: 2.00 m TARGET DEPTH					2.2		
2.4						2.4		
2.6						2.6		
2.8						2.8		
3.0						3.0		
3.2						3.2		
3.4						3.4		
3.6						3.6		
3.8						3.8		
4.0						4.0		
4.2						4.2		
4.4						4.4		
4.6						4.6		
4.8						4.8		
5.0						5.0		
5.2						5.2		
5.4						5.4		
5.6						5.6		
5.8						5.8		
6.0						6.0		
6.2						6.2		
6.4						6.4		
6.6						6.6		
6.8						6.8		
7.0						7.0		

Remarks:

1. Groundwater strike recorded at 0.5 m BGL on 22/03/2024.
2. Standing groundwater measured at 0.3 m BGL following completion of drilling on 22/03/2024.
3. WG - Waipapa Group

Datum:

Coordinates:

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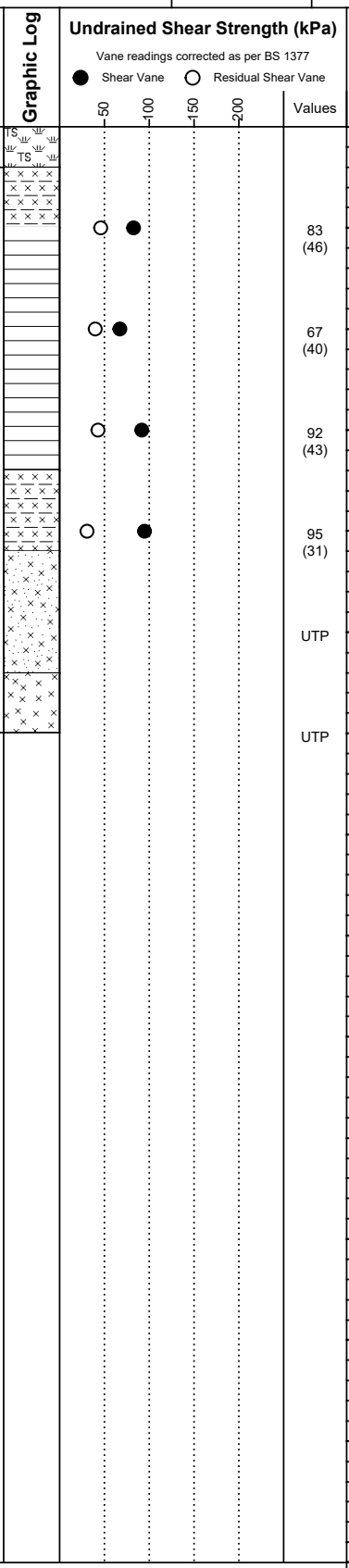
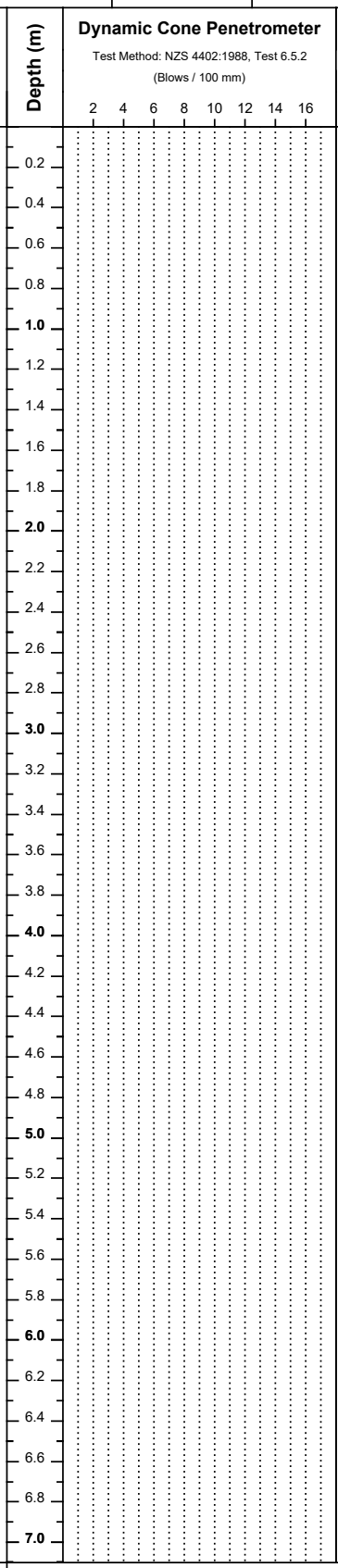
HAND AUGER LOG

Hole No: H20

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S
0.4	SILT, clayey, minor rootlets, trace gravel (fine to medium, subangular), dark brown, stiff, moist, moderately plastic [RESIDUAL SOILS]	Waipapa Group
0.6		
0.8	CLAY, grey/brown streaked orange, stiff, moist, highly plastic	
1.0		
1.2	1.2 m: becomes light grey streaked orange	
1.4		
1.6		
1.8	SILT, clayey, blue light grey streaked orange, stiff, moist, moderately plastic	
2.0		
2.2	SILT, sandy (fine to medium), blue/light grey streaked orange, hard, moist, non-plastic	
2.4	2.3 m: becomes sandy (fine to coarse), orange/brown	
2.6	2.5 m: becomes wet	
2.8	SILT, minor sand (fine to coarse) and clay, orange/brown streaked light grey, hard, wet, slightly plastic	
3.0	EOH: 3.00 m TARGET DEPTH	
3.2		
3.4		
3.6		
3.8		
4.0		
4.2		
4.4		
4.6		
4.8		
5.0		
5.2		
5.4		
5.6		
5.8		
6.0		
6.2		
6.4		
6.6		
6.8		
7.0		





Remarks:

1. Groundwater strike recorded at 2.5 m BGL on 22/03/2024.
2. Standing groundwater measured at 2.0 m BGL following completion of drilling on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H21

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T / S	TS
0.2	SILT, gravelly (fine to coarse, subangular), trace clay, dark brown speckled orange, hard, moist, slightly plastic [CONTROLLED FILL]	Fill	
1.0	SILT, clayey, orange/brown streaked dark orange, very stiff, moist, moderately plastic		
1.2	SILT, gravelly (fine to coarse, subangular), trace clay, dark brown speckled orange, hard, moist, slightly plastic		
2.25	EOH: 2.25 m TOO HARD TO AUGER		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Values
UTP
122 (40)
UTP
UTP
UTP

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Depth (m)	Blows / 100 mm
0.4	2
0.6	5
0.8	2, 1
2.2	6
2.4	9
2.6	3, 2
2.8	2, 2, 2
3.0	2, 4
3.2	3, 4
3.4	4, 4
3.6	5, 5
3.8	5, 6
4.0	7, 8
4.2	10, 11
4.4	6

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 22/03/2024.
2. DCP tests undertaken from 0.45 m to 0.8 m and 2.25 m to 4.25 m BGL.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H22

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL] SILT, dark brown, moist, friable	T/S	TS TS
0.4	SILT, gravelly (fine to medium, subangular), trace clay, dark brown/grey speckled orange, hard, moist, slightly plastic [CONTROLLED FILL]	Fill	
0.6			
0.8			
1.0			
1.2			
1.4			
1.6	SILT, clayey, dark brown streaked dark orange, very stiff, moist, moderately plastic [PALAEOSOL]	T/S	TS TS
1.8		Waipapa Group	
2.0	CLAY, minor silt, orange/brown streaked dark orange, very stiff, moist, highly plastic [RESIDUAL SOILS]		
2.2	EOH: 2.20 m TARGET DEPTH		
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			
4.2			
4.4			
4.6			
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			
7.0			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

50 100 150 200

Values

UTP (1.0)

UTP (1.6)

144 (64) (1.8)

119 (43) (2.2)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100 mm)

2 4 6 8 10 12 14 16

Groundwater

GWNE (1.0)

Remarks:

1. Groundwater not encountered on 22/03/2024.

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H23

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
G00417	Scarbro Environmental Ltd 362 Jones Road, Hunua	GEO703	22/03/2024	C. Brown	A. Stuart

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.0	[TOPSOIL] SILT, dark brown, moist, friable	T / S	TS
0.4	SILT, gravelly (fine to medium, subangular), light brown mottled dark brown/grey, hard, moist, non-plastic [CONTROLLED FILL]	Fill	
0.8	SILT, clayey, dark brown streaked dark orange, very stiff, moist, moderately plastic [PALAEOSOL]	T/S	TS
1.0	CLAY, silty, orange/brown, very stiff, moist, highly plastic [RESIDUAL SOILS] 1.3 m: becomes stiff	Waipapa Group	
1.4	EOH: 1.30 m TARGET DEPTH		

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Values
UTP
113 (61)
95 (46)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100 mm)
2 4 6 8 10 12 14 16

Groundwater: GWNE

Remarks:
1. Groundwater not encountered on 22/03/2024.

Datum:

Coordinates:

Appendix B

DCP TEST RESULTS

DYNAMIC CONE PENETROMETER TEST

TEST METHOD : NZS 4402 : 1988, TEST 6.5.2.

PROJECT NAME: **Scarbro Environmental Ltd**
362 Jones Road
Hunua

PROJECT No.: **G00417**

Sheet 1 of 1

Date tested: 20/03/2024

Tested by: C. Webster/C. Brown

Checked by: A. Stuart

TABLE OF BLOWS PER PENETRATION INCREMENT

Test No.	S1		S2		S3		S4		S5		S6		S7	
Depth (mm)	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]
100	4	8	7	15	2	4	2	4	2	4	3	6	1	2
200	3	6	4	8	3	6	4	8	3	6	4	8	2	4
300	2	4	3	6	3	6	4	8	3	6	2	4	0	0
400	2	4	2	4	4	8	3	6	3	6	3	6	0	0
500	2	4	2	4	4	8	4	8	4	8	3	6	0	0
600	2	4	2	4	4	8	5	10	4	8	4	8	0	0
700	2	4	3	6	4	8	4	8	3	6	3	6	0	0
800	3	6	2	4	4	8	4	8	3	6	2	4	0	0
900	2	4	2	4	4	8	3	6	3	6	2	4	0	0
Test No.	S8		S9		S10		S7N		S7E		S7S		S7W	
Depth (mm)	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]
100	3	6	2	4	4	8	2	4	1	2	3	6	1	2
200	3	6	2	4	3	6	2	4	3	6	2	4	3	6
300	2	4	3	6	3	6	2	4	2	4	2	4	3	6
400	3	6	3	6	3	6	1	2	3	6	3	6	2	4
500	2	4	3	6	5	10	2	4	3	6	2	4	2	4
600	2	4	3	6	4	8	3	6	4	8	3	6	2	4
700	3	6	2	4	4	8	3	6	4	8	4	8	4	8
800	3	6	3	6	4	8	3	6	4	8	4	8	4	8
900	3	6	3	6	4	8	3	6	4	8	4	8	4	8
Test No.														
Depth (mm)	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]	DCP	CBR[(a)]
100														
200														
300														
400														
500														
600														
700														
800														
900														

Remarks: R= Refusal

(a) CBR values are approximate only and have been inferred from the correlation between DCP blow counts and CBR given on Figure 5.3, Austroads (April 2004)

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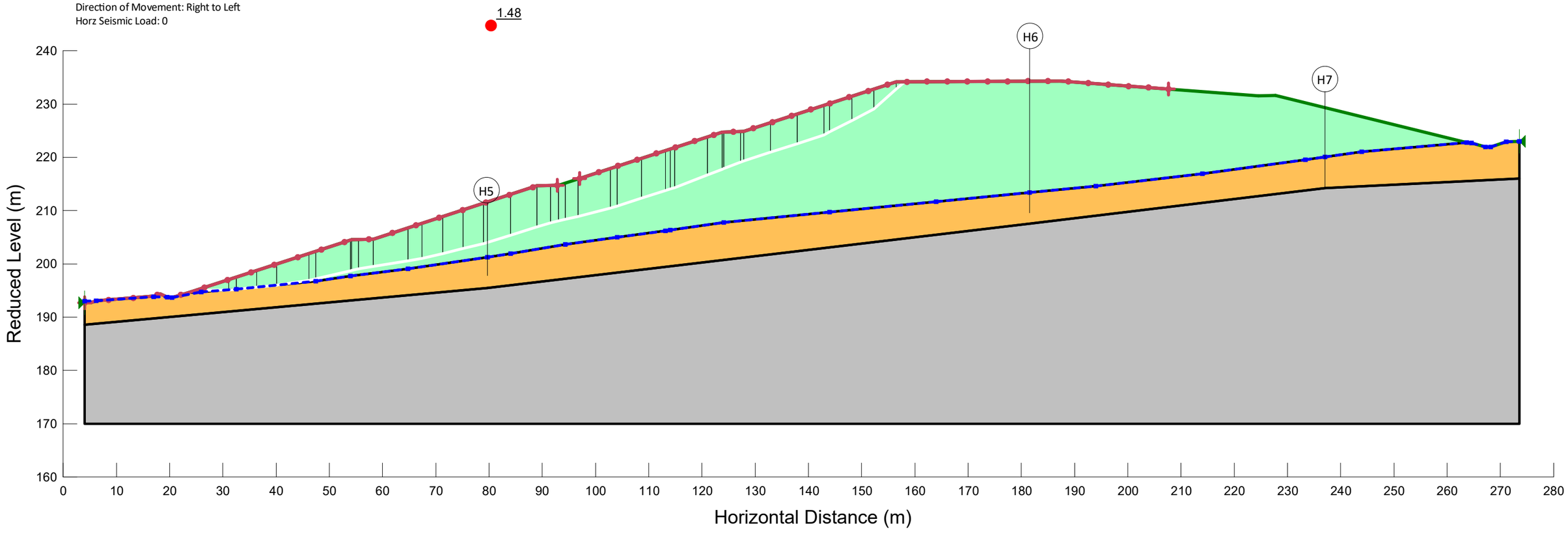
Appendix C

SLOPE STABILITY ANALYSES

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 1 - CROSS SECTION AA - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

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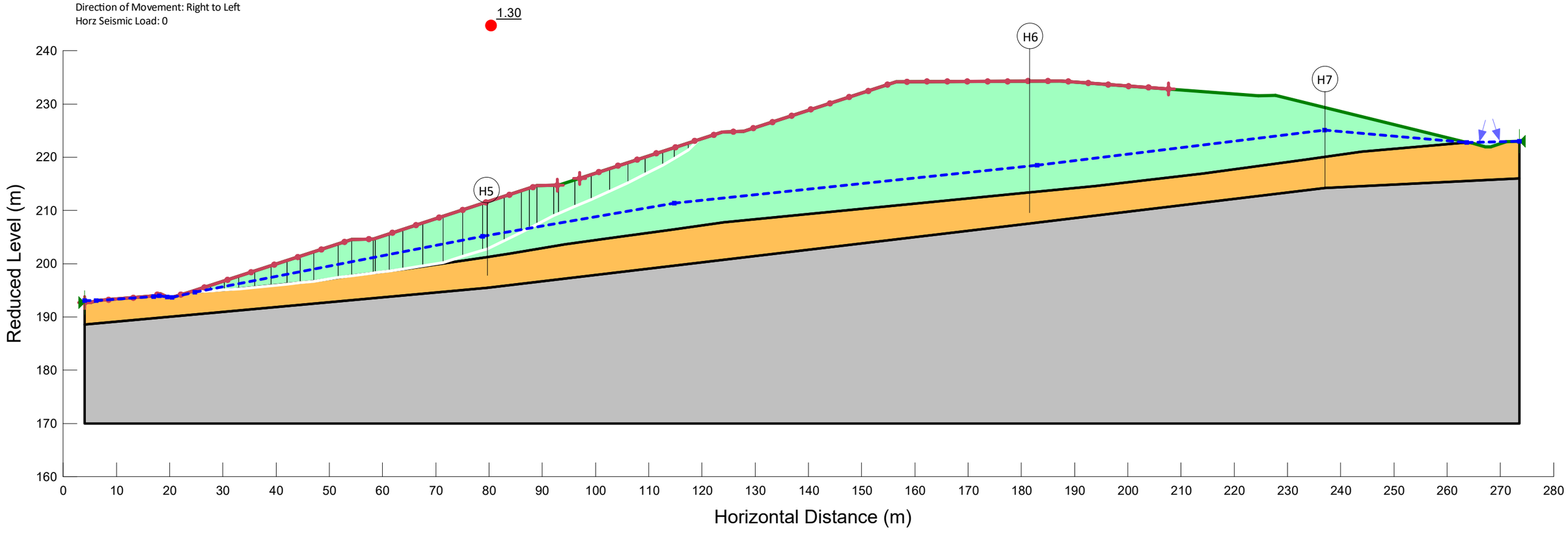
PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:750 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-AA 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 2 - CROSS SECTION AA - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(EXTREME TRANSIENT GROUNDWATER CONDITIONS)

Over 50 Years
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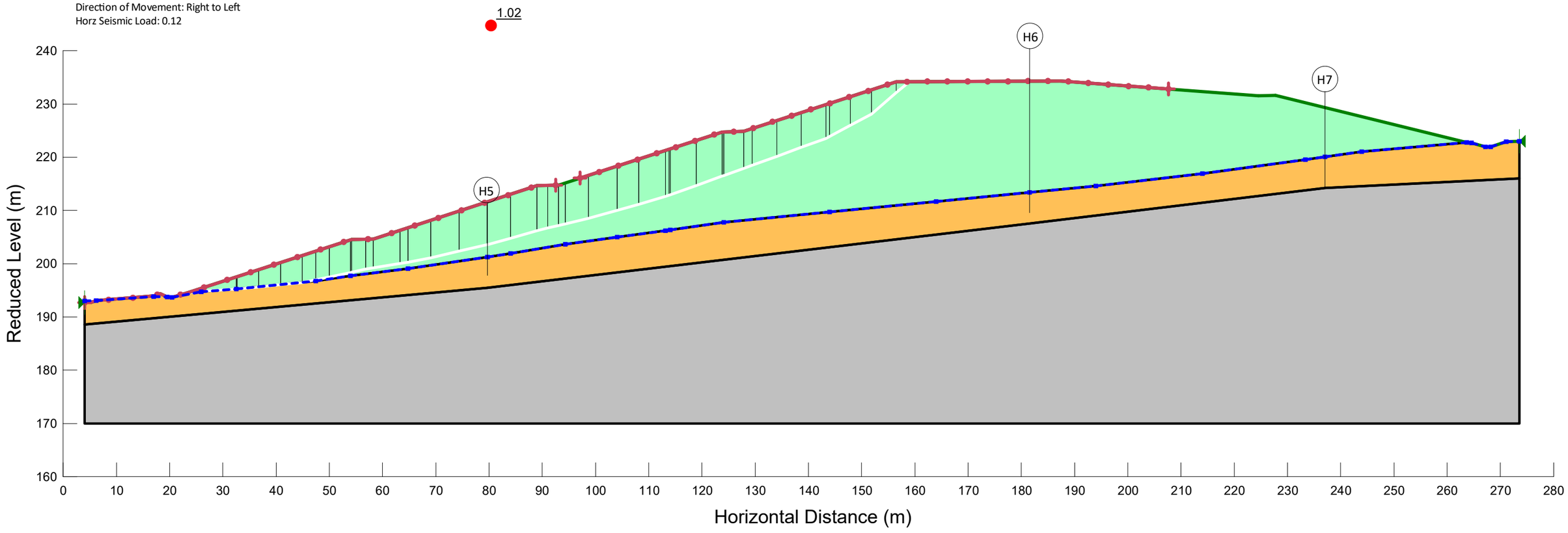
PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:750 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-AA 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0.12



362 Jones Road, Hunua

FIGURE 3 - CROSS SECTION AA - SLOPE/W ANALYSIS FOR SEISMIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

Over 50 Years
Fraser Thomas
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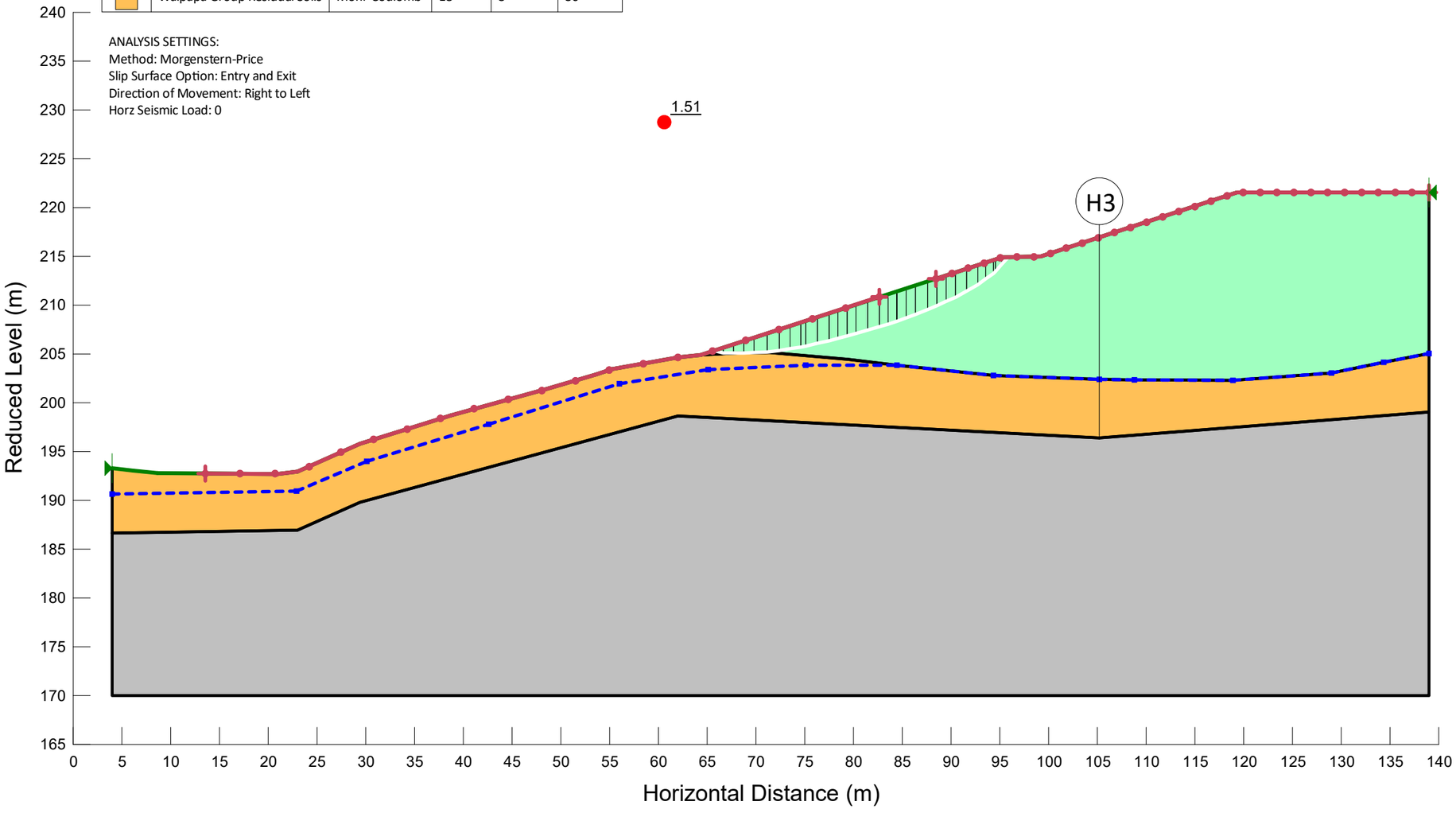
PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:750 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-AA 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 4 - CROSS SECTION BB - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

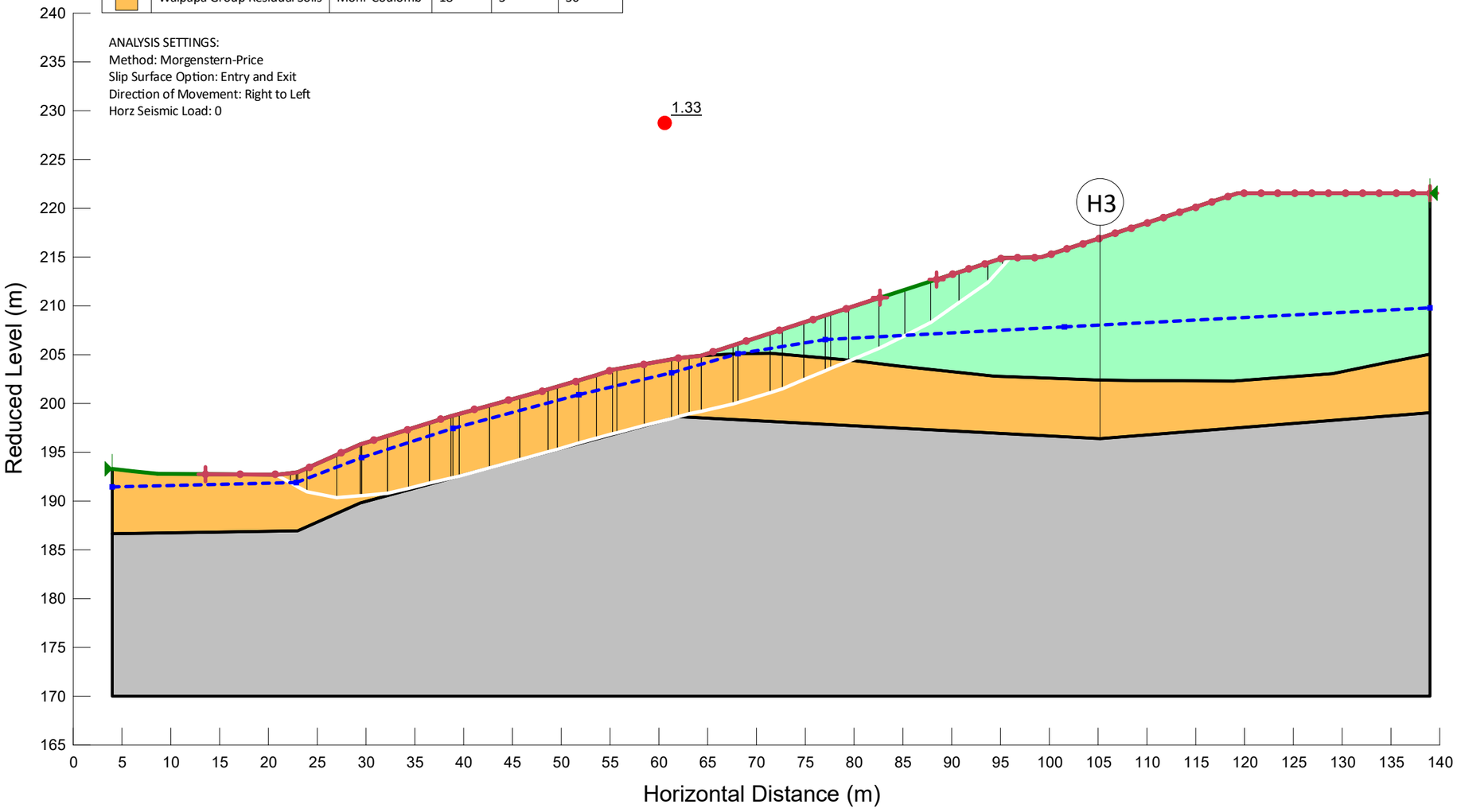
Over 50 Years
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-BB 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 5 - CROSS SECTION BB - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(EXTREME TRANSIENT GROUNDWATER CONDITIONS)

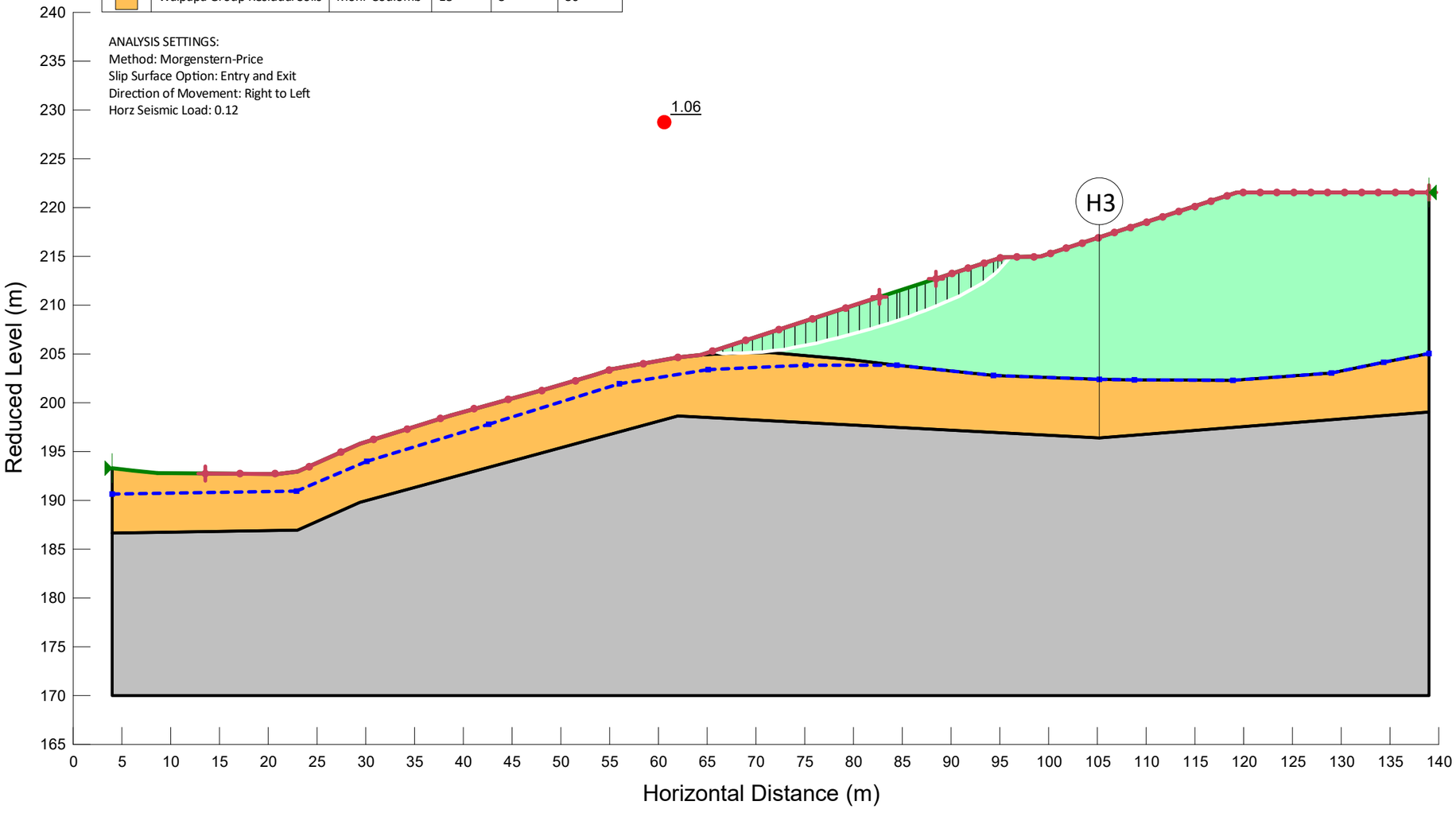
Fraser Thomas
Over 50 Years
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-BB 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0.12



362 Jones Road, Hunua

FIGURE 6 - CROSS SECTION BB - SLOPE/W ANALYSIS FOR SEISMIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

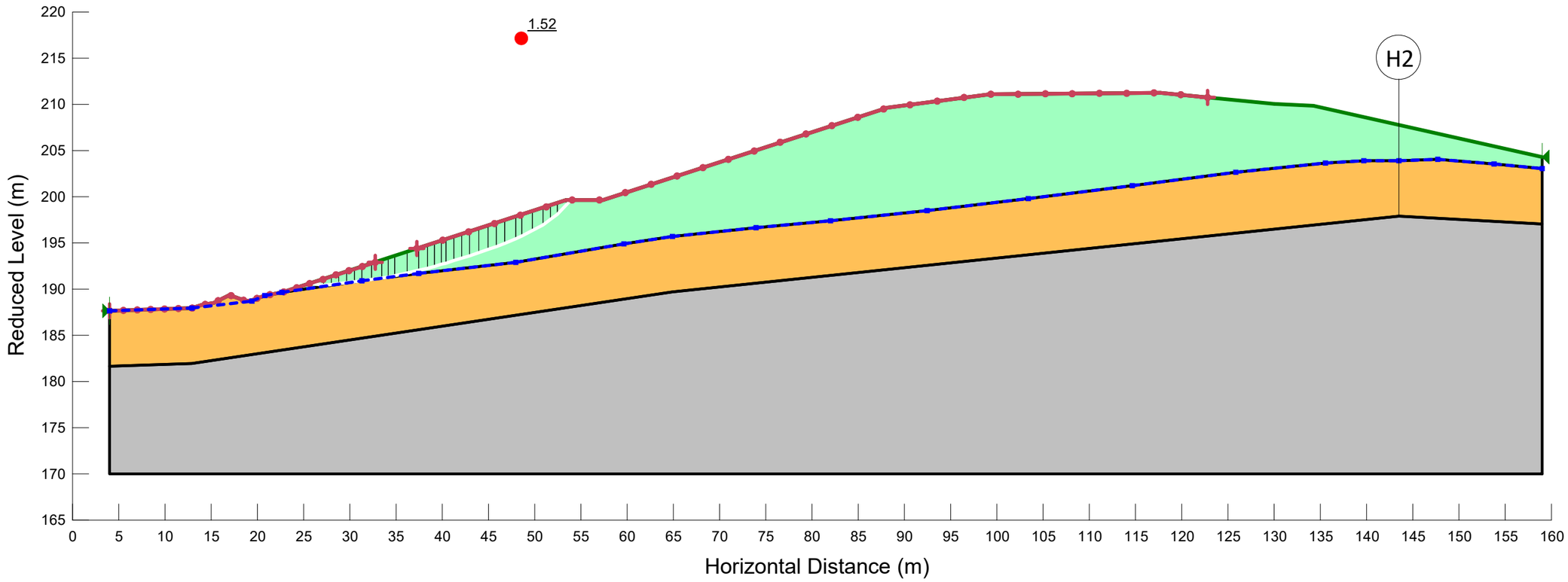
Over 50 Years
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-BB 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 7 - CROSS SECTION CC - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

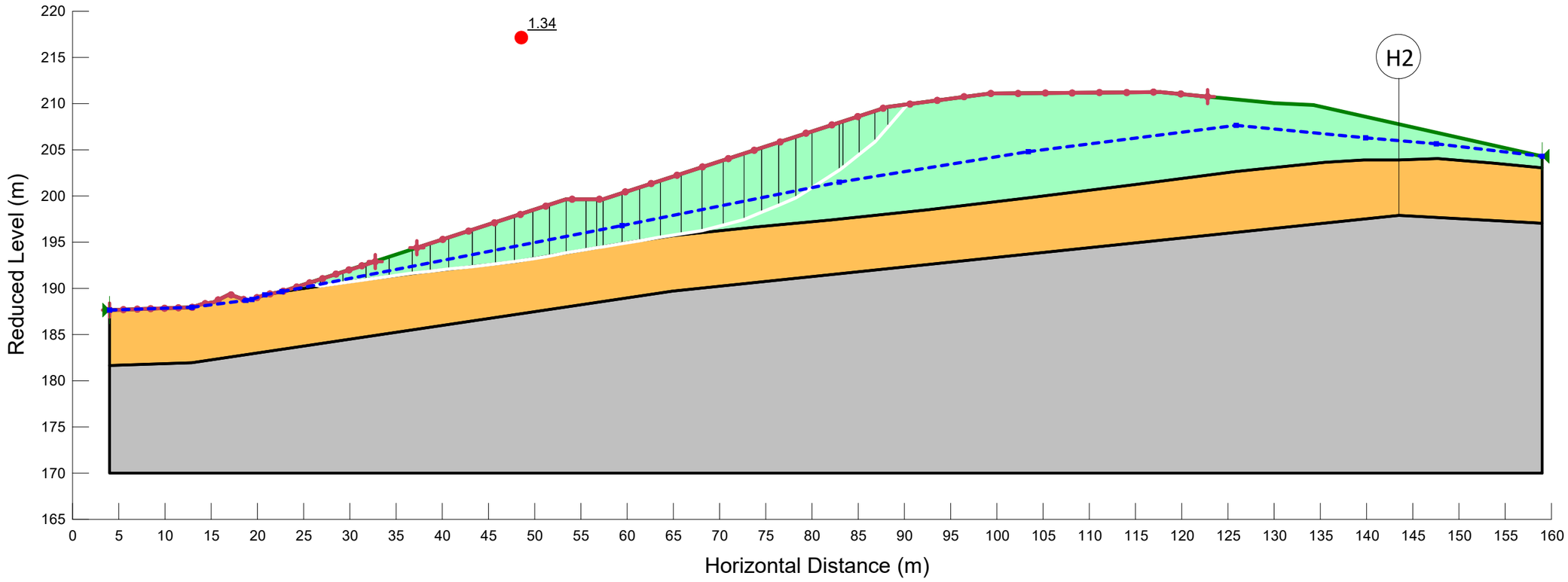
Over 50 Years
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-CC 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0



362 Jones Road, Hunua

FIGURE 8 - CROSS SECTION CC - SLOPE/W ANALYSIS FOR STATIC LOAD CONDITIONS - NORTH FILLING AREA
(EXTREME TRANSIENT GROUNDWATER CONDITIONS)

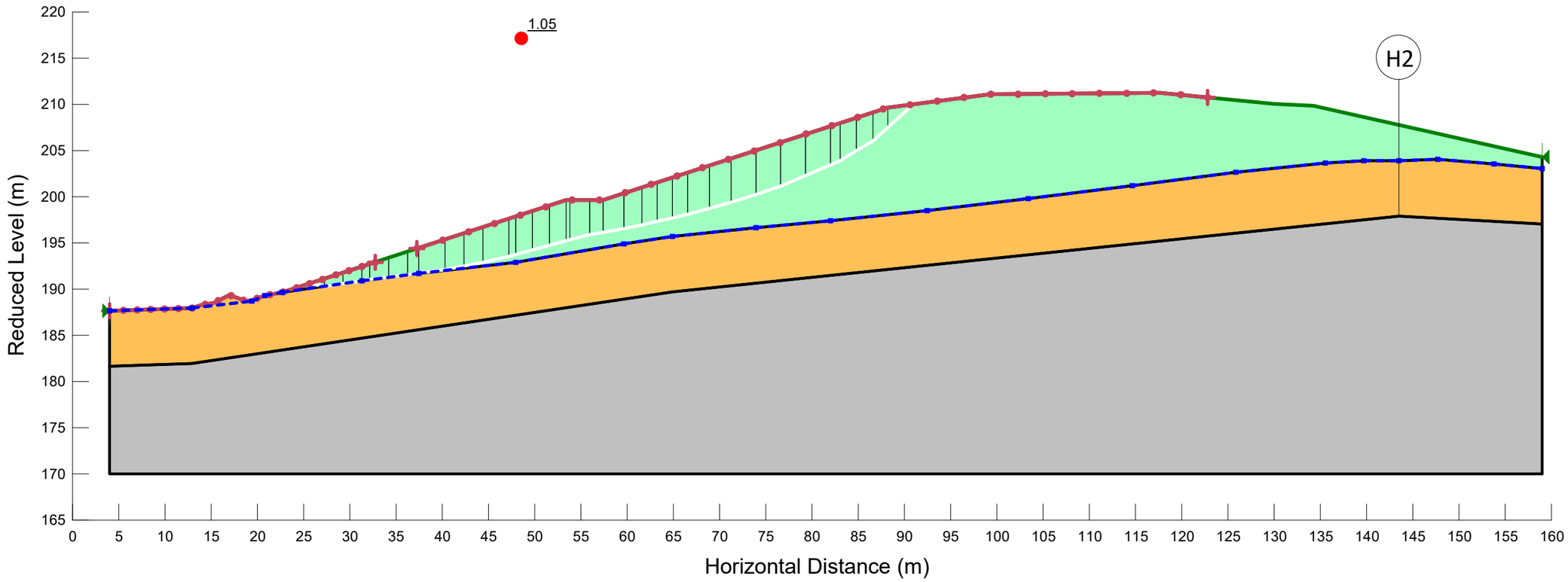
Over 50 Years
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-CC 241010 CAWcaw.gsz

Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Proposed Cleanfill	Mohr-Coulomb	17.5	2	22
	Waipapa Group Bedrock	Mohr-Coulomb	21	15	38
	Waipapa Group Residual Soils	Mohr-Coulomb	18	3	30

ANALYSIS SETTINGS:
Method: Morgenstern-Price
Slip Surface Option: Entry and Exit
Direction of Movement: Right to Left
Horz Seismic Load: 0.12



362 Jones Road, Hunua

FIGURE 9 - CROSS SECTION CC - SLOPE/W ANALYSIS FOR SEISMIC LOAD CONDITIONS - NORTH FILLING AREA
(WET WINTER GROUNDWATER CONDITIONS)

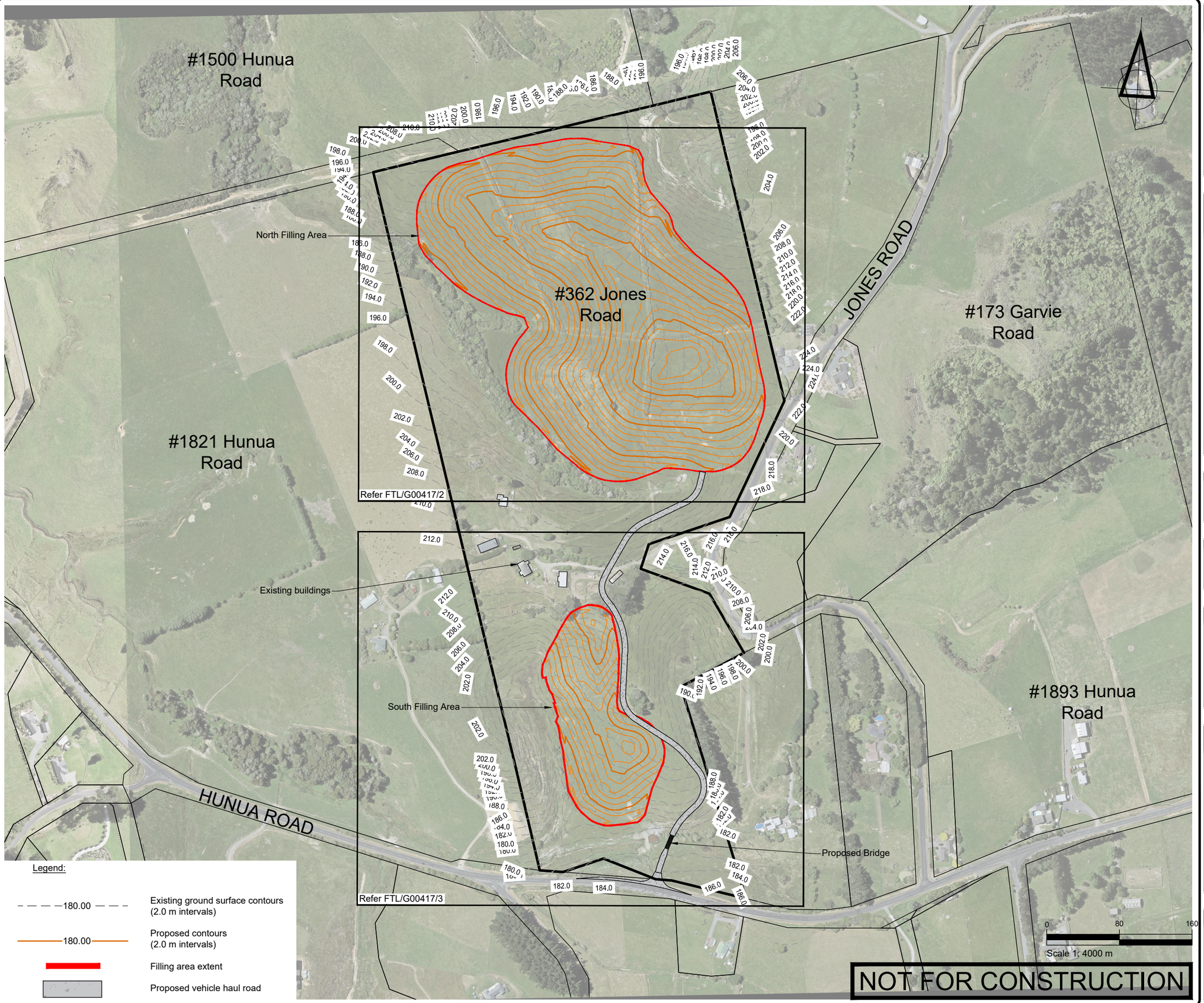
Over 50 Years
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

PROJECT NO: G00417
ANALYSED BY: C. Webster
SCALE: 1:500 (A3)
DATE: 10/10/2024

J:_G Series\G00417 - 362 Jones Rd\SlopeW\\G00417 CS-CC 241010 CAWcaw.gsz

Drawings

G00417/1	*OVERALL SITE PLAN*
G00417/2	*PROPOSED NORTH FILLING AREA SITE PLAN*
G00417/3	*PROPOSED SOUTH FILLING AREA SITE PLAN*
33250/350, Revision A	*PROPOSED NORTHERN UNDERFILL STRIP DRAIN*
33250/351, Revision A	*PROPOSED SOUTHERN UNDERFILL STRIP DRAIN*



SURVEYED			APPROVED DATE
DESIGNED	CW	APRIL 2024	AGJS
DRAWN	CJR	APRIL 2024	APRIL 2024
CHECKED			

REVISION	CHANGES	CHECKED	DATE

NOTES

1. This plan is adopted from Fraser Thomas Ltd survey, reference 74118, dated 04/04/2024.
2. The land contours shown on this plan are adopted from a combination of Fraser Thomas Ltd survey, reference 74118, dated 04/04/2024, and Auckland council GIS database and are based on LiDAR data.

CLIENT

SCARBRO ENVIRONMENTAL LTD

PROJECT

PROPOSED FILL FACILITY DEVELOPMENT AT 362 JONES ROAD, HUNUA

TITLE

OVERALL SITE PLAN

Fraser Thomas

ENGINEERS ● RESOURCE MANAGERS ● SURVEYORS

AUCKLAND	09 278 7078
HAWKE'S BAY	06 211 2766
CHRISTCHURCH	03 358 5936
BLENHEIM	03 428 3292
NELSON	03 222 1132
TAURANGA	020 4118 9465

www.fraserthomas.co.nz

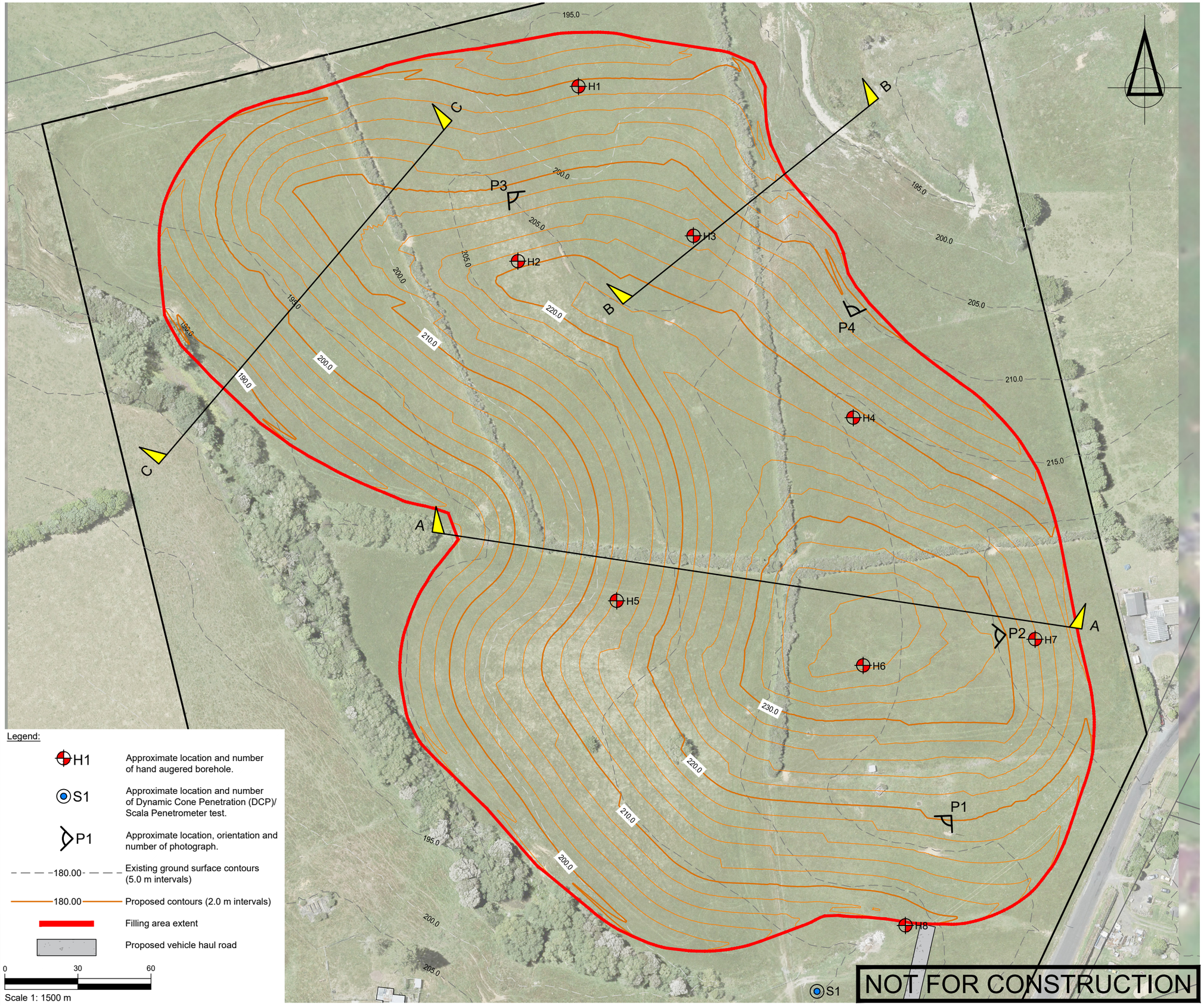
STATUS

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:4000 (A3)

DRAWING No G00417/1 REVISION -

P:\00 G Series\G00417\03 Drawings\G00417-1.dwg, cwebster, 14/10/2024 11:02:19 am



Legend:

- H1 — Approximate location and number of hand augered borehole.
- S1 — Approximate location and number of Dynamic Cone Penetration (DCP)/ Scala Penetrometer test.
- P1 — Approximate location, orientation and number of photograph.
- 180.00 — Existing ground surface contours (5.0 m intervals)
- 180.00 — Proposed contours (2.0 m intervals)
- Filling area extent
- Proposed vehicle haul road

0 30 60

Scale 1: 1500 m

P:\00 G Series\G00417\03 Drawings\G00417-2.dwg, cwebster, 14/10/2024 11:02 am

SURVEYED			APPROVED AGJS SEPT 2024 DATE
DESIGNED	CW	APRIL 2024	
DRAWN	CJR	APRIL 2024	
CHECKED			

REVISION	CHANGES	CHECKED	DATE

NOTES

PROJECT DATUMS:

LEVEL: Auckland Vertical Datum 1946

COORDINATE: NZGD2000 / Mount Eden 2000

CLIENT

SCARBRO ENVIRONMENTAL LTD

PROJECT

PROPOSED FILL FACILITY
DEVELOPMENT AT
362 JONES ROAD, HUNUA

TITLE

PROPOSED
NORTH FILLING AREA
SITE PLAN

Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

AUCKLAND 09 278 7078
HAWKE'S BAY 06 211 2766
CHRISTCHURCH 03 358 5936
BLENHEIM 03 428 3292
NELSON 03 222 1132
TAURANGA 020 4118 9465

www.fraserthomas.co.nz

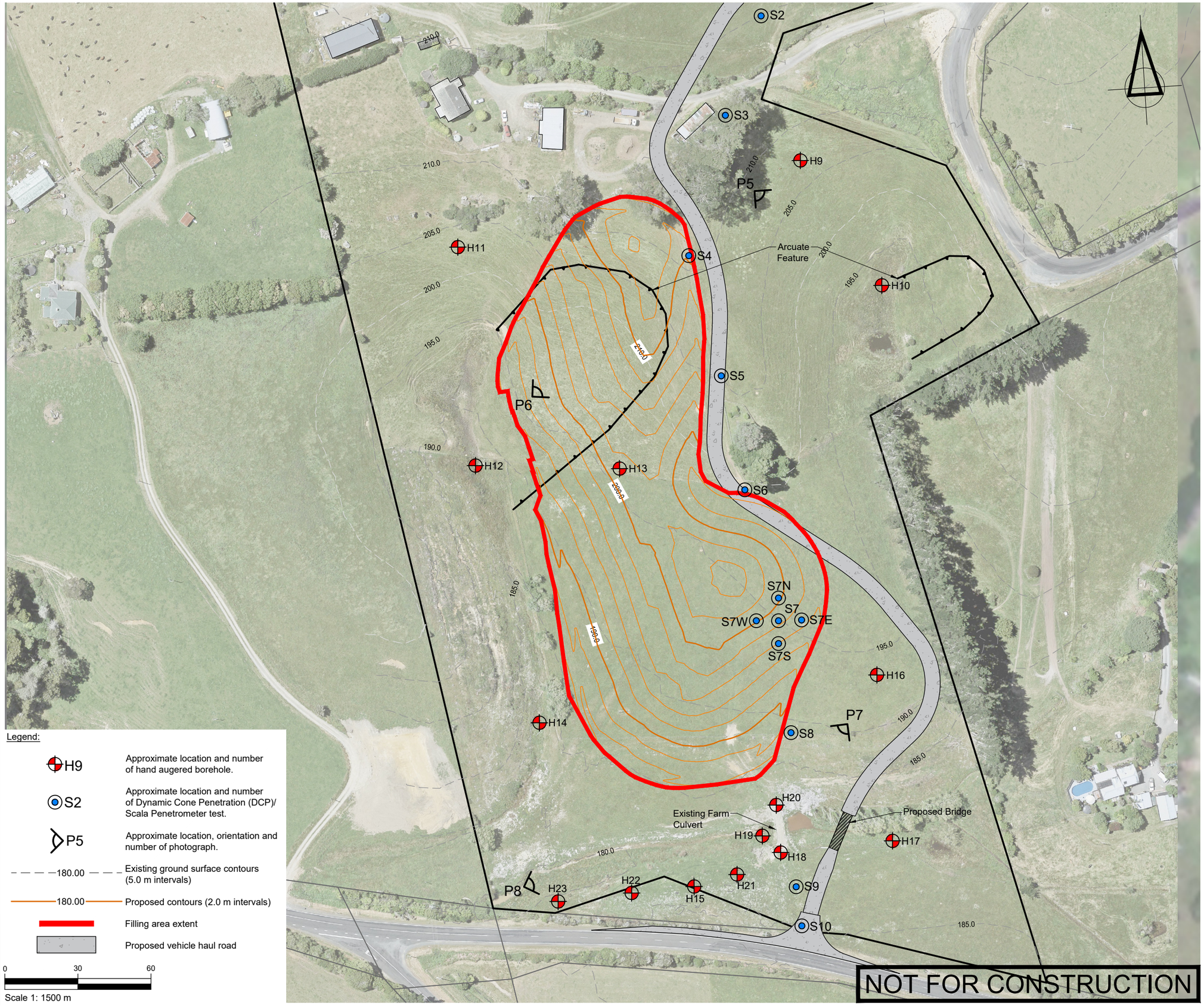
STATUS

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:1500 (A3)

DRAWING No G00417/2

REVISION -



Legend:

- H9 — Approximate location and number of hand augered borehole.
- S2 — Approximate location and number of Dynamic Cone Penetration (DCP)/ Scala Penetrometer test.
- P5 — Approximate location, orientation and number of photograph.
- 180.00 — Existing ground surface contours (5.0 m intervals)
- 180.00 — Proposed contours (2.0 m intervals)
- Filling area extent
- Proposed vehicle haul road

0 30 60

Scale 1: 1500 m

NOT FOR CONSTRUCTION

P:\00 G Series\G00417\03 Drawings\G00417-3.dwg, cwebster, 14/10/2024 11:03 am

SURVEYED			APPROVED DATE
DESIGNED	CW	APRIL 2024	AGJS
DRAWN	CJR	APRIL 2024	SEPT 2024
CHECKED			

REVISION	CHANGES	CHECKED	DATE

NOTES

PROJECT DATUMS:

LEVEL: Auckland Vertical Datum 1946

COORDINATE: NZGD2000 / Mount Eden 2000

CLIENT

SCARBRO ENVIRONMENTAL LTD

PROJECT

PROPOSED FILL FACILITY
DEVELOPMENT AT
362 JONES ROAD, HUNUA

TITLE

PROPOSED
SOUTH FILLING AREA
SITE PLAN

Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

AUCKLAND	09 278 7078
HAWKE'S BAY	06 211 2766
CHRISTCHURCH	03 358 5936
BLENHEIM	03 428 3292
NELSON	03 222 1132
TAURANGA	020 4118 9465

www.fraserthomas.co.nz

STATUS

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:1500 (A3)

DRAWING No G00417/3

REVISION -

Underfill strip drain stops at dirty water drain

Underfill strip drain as per detail shown on FTL DWG 33250/181

North Filling Area

Underfill strip drain stops at dirty water drain

Property boundary

Underfill strip drain as per detail shown on FTL DWG 33250/181

Legend

- Existing contours (@5m intervals)
- Proposed contours (@2m intervals)
- Property boundary
- Permanent / intermittent stream
- Stream setback
- Wetland
- Pond
- Extent of Filling Area
- Proposed underfill strip drain

0 30 60

Scale 1: 1500 m

NOT FOR CONSTRUCTION

P:\33 series\33250\003 Drawings\33250-350.dwg, fvohra, 14/10/2024 1:28 pm

			APPROVED	DATE
SURVEYED			SF	
DESIGNED	TB	06.09.24	27.09.24	
DRAWN	FV	06.09.24		
CHECKED	TB	06.09.24		

REVISION	CHANGES	CHECKED	DATE
A	MINOR TEXT AMENDMENTS	TB	14.10.24

NOTES

Existing Ground Contour data obtained from LiDAR 2016.

PROJECT DATUMS:

LEVEL: Auckland Vertical Datum 1946

COORDINATE: NZGD2000 / Mount Eden 2000

CLIENT

SCARBRO ENVIRONMENTAL LTD

PROJECT

362 JONES RD, HUNUA

TITLE

PROPOSED NORTHERN UNDERFILL STRIP DRAIN

Fraser Thomas

ENGINEERS • RESOURCE MANAGERS • SURVEYORS

AUCKLAND 09 278 7078
HAWKE'S BAY 06 211 2766
CHRISTCHURCH 03 358 5936
BLENHEIM 03 428 3292
NELSON 03 222 1132
TAURANGA 020 4118 9465

www.fraserthomas.co.nz

STATUS

FOR RESOURCE CONSENT

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:1500 (A3)

DRAWING No 33250/350

REVISION A

Underfill strip drain stops at dirty water drain

Underfill strip drain as per detail shown on FTL DWG 33250/181

Underfill strip drain stops at dirty water drain

Southern Filling Area

Property boundary

Legend

- Existing contours (@5m intervals)
- Proposed contours (@2m intervals)
- Property boundary
- Permanent / intermittent stream
- Stream setback
- Wetland
- Pond
- Extent of Filling Area
- Proposed underfill strip drain

0 30 60

Scale 1: 1500 m

NOT FOR CONSTRUCTION

P:\33 series\33250\003 Drawings\33250-351.dwg, fvohra, 14/10/2024 1:29 pm

			APPROVED	DATE
SURVEYED			SF	
DESIGNED	TB	06.09.24	27.09.24	
DRAWN	FV	06.09.24		
CHECKED	TB	06.09.24		

REVISION	CHANGES	CHECKED	DATE
A	MINOR TEXT AMENDMENTS	TB	14.10.24

NOTES

Existing Ground Contour data obtained from LiDAR 2016.

PROJECT DATUMS:

LEVEL: Auckland Vertical Datum 1946

COORDINATE: NZGD2000 / Mount Eden 2000

CLIENT

SCARBRO ENVIRONMENTAL LTD

PROJECT

362 JONES RD, HUNUA

TITLE

PROPOSED SOUTHERN UNDERFILL STRIP DRAIN

Fraser Thomas

ENGINEERS • RESOURCE MANAGERS • SURVEYORS

AUCKLAND 09 278 7078
HAWKE'S BAY 06 211 2766
CHRISTCHURCH 03 358 5936
BLENHEIM 03 428 3292
NELSON 03 222 1132
TAURANGA 020 4118 9465

www.fraserthomas.co.nz

STATUS

FOR RESOURCE CONSENT

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:1500 (A3)

DRAWING No 33250/351

REVISION A