

21 February 2020

LAKESIDE DEVELOPMENT STAGES 1, 2 AND 3 GEOTECHNICAL COMPLETION REPORT No.2

Lakeside Developments 2017 Limited Ref. HAM2019-0062AF Rev 1

HAM2019-0062AF Rev 1							
Date	Revision	Comments					
18 December 2019	0	Draft report issued for review					
21 February 2020	1	Final report issued following peer review.					

	Name	Signature	Position
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Reviewed by	Ken Read	Med !	Principal Geotechnical Engineer
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1. INTRODUCTION

This Geotechnical Completion Report (GCR) has been prepared for Lakeside Developments 2017 Limited as part of the documentation to be submitted to Waikato District Council (WDC) to support the application of land titles for the following residential lots at 98 Scott Road, Te Kauwhata:

Stage 1: Lots 36, 287, 288, 327, 328, 334 and 335;

Stage 2: Lots 55 to 57, 59, 65, 78 to 83, 85, 86, 119, 278, 280;

Stage 3: Lots 4, 20, 21, 26, 27, 28* and 29*.

*Lots 28 and 29 were reported previously in GCR No1¹ however, since issue of that report these Lots have been re-orientated by 90° with additional fill being placed. They have therefore also been included in this report.

Earthfill placed in Lot 3000 (road reserve) and Lots 5001 and 5002 (drainage reserves) is also addressed in this report.

Subdivision construction was undertaken in accordance with Waikato District Council Resource Consent Conditions documents LUC0557/18 and LUC0315/18, the Regional Infrastructure Technical Specification (RITS) and the requirements of NZS 3604, NZS 4404 and NZS 4431.

This report contains our Suitability Statement and Lot Summary Report (*Appendix A*), as-built plans provided by Candor³ and specific geotechnical recommendations for building development.

Stormwater controls, roading and civil works carried out as part of the subdivision have been supervised by other parties therefore are outside the scope of this report.

2. DESCRIPTION OF SUBDIVISION

The original landform across Stages 1 to 6 of the Lakeside Development comprised rolling hill topography that graded gently to the northeast from RL27m (Moturiki Datum) at the western boundary to RL5m along the north-eastern boundary where a low-lying floodplain exists adjacent to Lake Waikare. Several of the northern-most lots in Stage 1 extend out over the former floodplain.

The contours of the original landform are presented on **Drawings 14 to 16**.

An early works earthworks package was undertaken during the 2017/18 season across the Sales Precinct within Stages 2 and 3 and nearby areas.

During the 2018/19 season bulk earthworks were carried out across Stages 1 to 3 but not completed. Minor earthworks were carried out early in the 2019/20 season in order to finish Stages 1 to 3.

As can be seen from the Cut-Fill Contour Plans (*Drawings 17 to 19*), ground levels within the subject area have been extensively modified by subdivision earthworks incorporating cut and fill depths of up to 3.0m and 7.0m respectively.

The as-built landform (*Drawings 20 to 22*) comprises a series of near level benched building platforms that generally step down towards the east, with each step separated by a gently graded bench. Engineer designed retaining walls as depicted on *Drawing 19* separate lots where a gentle grade could not be achieved.

An 8m high fill embankment is currently under construction in the north east of Stage 1 to support a future road (Road 201).

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¹ CMW Geotechnical Completion Report No.1, Lakeside Development Stage 1,2 and 3 (ref HAM2018-0106AM Rev 5) dated 05 August 2019

3. RELATED REPORTS

The following relevant geotechnical reports have been referenced and used as the basis for the earthworks construction at Lakeside:

- Earthtech Stage 1 Geotechnical Design Report (ref: 4036-3), dated December 2017;
- Earthtech Stage 2 Geotechnical Design Report (ref 4036-4), dated January 2017;
- Earthtech Rata Street Extension Geotechnical Design Report (ref 4036-5), dated February 2017;
- CMW Geotechnical Completion Report (ref HAM2017-0102 Rev 0) dated 05 May 2018;
- CMW Earthworks Specification (ref HAM2018-0106AB Rev 1) dated 17 October 2018;
- CMW Retaining Wall Design Report (ref HAM2018-0106Al Rev 1) dated 11 March 2019;
- CMW Geotechnical Completion Report No1, (ref HAM2018-0106AM Rev 5) dated 05 August 2019.

4. GROUND MODEL

4.1. Soil Profile

The landform over which the lots are situated was investigated in stages over the period October 2016 to November 2017. These comprised a combination of machine and hand auger boreholes, trial pits, Cone Penetration Tests (CPTs) and Machine Boreholes. Copies of the relevant site investigation plans, cross sections and test data is attached to this report (*Appendix B*).

A summary of the main geological units beneath the site is presented in Table 1 below:

Table 1: Summary of Geological Units									
Geological Unit	Description	Typical Thickness							
Topsoil	Stiff Organic SILT.	0.15m to 0.3m							
A. Alluvial Flats (Lots 335 and 334)									
Upper Holocene	Very soft to firm PEAT, SILT and CLAY, loose Silty Sand	1.0m to 6.0m							
Lower Holocene	Interbedded soft to firm SILT, CLAY and Sandy SILT; Loose to medium dense Silty SAND.	4.0m to 7.5m							
Whangamarino Formation	Very stiff Clayey SILT and Sandy SILT; Medium dense Silty SAND	4.0m to 8.0m							

Table 1 continued: Summary of Geological Units

B: Rolling Hills

Stage 1: Lots 36, 287, 288, 327, 328

Stage 2: Lots 55 to 57, 59, 65, 78 to 83, 85, 86, 119, 278, 280;

Stage 3: Lots 4, 20, 21, 26, 27, 28 and 29.

Geological Unit	Description	Typical Thickness
Brown Ash (Hamilton/Kauroa Ash)	Stiff to very stiff CLAY and Silty CLAY	0.0m to 3.7m
Gully floor Alluvium	Soft CLAY, SILT, organics and loose Silty SAND	0.0m to 3.3m
Whangamarino Silts and Clays	Stiff to very stiff CLAY, SILT, Silty CLAY, Clayey SILT, Sandy SILT; pumiceous.	1.0 to 4.0m
Whangamarino Sands	Medium dense to very dense pumiceous SAND and Silty SAND	0.5m to 2.0m
Whangamarino Lignite	Hard LIGNITE	0.5m to 3.0m

Ground conditions encountered during earthworks generally agreed with those described above. Of particular note is that within the soils of the Whangamarino formation, there is rapid lateral and vertical variation in composition and grain size between silty sands, sandy silts, clayey silts and silty clays.

4.2. Groundwater

Based on the investigation data and observations, the regional groundwater table on the Alluvial Flats is observed to vary between approximately 0.5 to 1.0m below the existing ground level. This is expected to rise close to ground level during winter rainfall conditions (RL5.0m).

The investigation data suggests perched groundwater conditions are present in the shallow Whangamarino sands in the rolling hills. A piezometer installed in BH2-02 at a depth of 10 to 15 metres measured Sub-artesian groundwater conditions at -0.1m below original ground level (approx. 10.5m RL).

5. DESCRIPTION OF EARTHWORKS

5.1. Plant

The main items of plant used by the contractor, Ross Reid Contractors Limited during bulk earthworks included:

- Motor scrapers
- Moxy dump trucks
- Excavators
- Bulldozers
- Sheepsfoot rollers

5.2. Construction Programme

Earthworks operations for the subject lots generally involved downcutting of the more elevated hills and the placement of fills within lower-lying gullies and the former floodplain within the northern part of Stage 1.

The main earthworks activities that were completed are summarised as follows:

- Topsoil stripping and across all bulk cut and fill earthworks surfaces;
- Over-excavation of the soft and compressible Upper Holocene Alluvium from beneath the lots across the northern floodplain to depths of up to 5m to expose a stiff to very stiff subgrade. Undercut depths have been accounted for on the cut/fill plan;
- Undercutting or benching of soils in the gully at the western side of Stage 1.
- Subsoil drains were installed at the locations shown on *Drawings 20 to 22* to intercept identified groundwater seepages from beneath the proposed gully and valley floor fills and to discharge them into open drains within the low-lying floodplain;
- Due to abundant groundwater seepage in the base of the northern undercut, a working surface was prepared by placing an initial granular starter fill layer to a typical depth of 0.5m between 2 layers of Bidim A14 geotextile;
- Bulk cut to fill earthworks were then undertaken and completed to the levels presented on *Drawings 20 to 22* by 28 November 2019.

6. GEOTECHNICAL QUALITY CONTROL

6.1. Construction Observations

Site observations were undertaken on a part time basis by CMW field staff during bulk earthworks to assess compliance with NZS 4431, the project specification and any other specific design recommendations.

Site visits were carried out to observe and confirm compliance relating to:

- Adequate topsoil stripping and underfill subsoil drainage;
- Removal of existing uncontrolled fill and/or unsuitable soft natural soils;
- Placement and compaction of engineered fill;
- Drilling hand auger boreholes across the as-built landform to verify soil shear strength and consistency.

The results of our observations and associated correspondence with the developer and earthworks contractor show that the works appear to have generally been carried out in accordance with the relevant codes, specifications and standards and our on-site recommendations.

6.2. Compaction Control

Prior to the earthworks being undertaken potential borrow materials were subjected to laboratory testing to determine the solid density and compaction properties for each of the soil types present.

During works blending of materials was undertaken to maximise the use of available soils.

Samples of the 'blended' fill were obtained subjected to laboratory testing to determine the solid density and compaction properties.

Copies of the laboratory compaction testing results are presented in Appendix C.

Regular earthfill compaction compliance testing comprising hand shear vane testing, and the determination of the placed fill dry density and air voids by the use of a Nuclear Density Meter, was carried out with respect to NZS 4431:1989, RITS and the CMW Subdivision Earthworks Specification. A copy of the earthworks specification is presented in **Appendix D**.

The compaction control criteria adopted for all engineered fills on this site were as follows:

Air voids percentage average value* less than Air voids percentage maximum single value 10 % Undrained shear strength average value* not less than 120 kPa Undrained shear strength minimum single value 100 kPa

Minimum Shear Strength (Measured by hand held shear vane calibrated using NZGS 2001 method) and Maximum Air Voids Method was as defined in NZS 4402.

A total of 407 compliance tests (56 retests) have been carried out on a certified fill volume of 428,137m³ placed to 27 November 2019. This equates to one fill test per 1051m³ of fill. The specification required 1 test every 1000m³ to 1500m³.

The locations of the respective earthfill quality control tests are presented on the attached *Drawings* 23 to 26.

6.3. Earthfill Suitability

Results of the earthfill quality control testing since issue of GCR No1 are provided in Appendix E.

Control tests carried out on the fill showed that on some occasions the required compaction standards were not being achieved, generally due to wetter than optimum soil moisture content or inadequate compaction effort.

Results of test failures were relayed to the contractor with instructions to rework or replace the affected areas of fill until compliance with the appropriate standards were achieved.

No geotechnical testing was carried out on the starter layer. Through visual observation of the fill placement and proof rolling we are confident the starter layer has been adequately compacted.

Based on the appended earthfill quality control test results the fill areas across the subject lots are considered to have been constructed in accordance with NZS4431:1989, the RITS and site-specific compaction control criteria.

6.4. Post Construction Investigations

Post-construction hand auger boreholes with in-situ shear vane and dynamic cone penetrometer tests were undertaken within the lots mentioned above to confirm geotechnical ultimate bearing capacities for building foundations. Test locations are presented on *Drawings 21 and 22*.

Copies of our borehole logs with detailed descriptions and depths of strata encountered during the post construction investigations are provided in Appendix F.

With respect to the post construction hand augers, particularly those in natural soils the lateral and vertical variation in composition of the Whangamarino soils has meant it is not possible to rely on a single test method (shear vane or DCP) to determine soil strength. In interbedded and transitional soils we have therefore assessed foundation conditions on review of both hand shear vane and dynamic penetrometer test results. In silt-rich sands and sand-rich silts we have considered both sets of data.

^{*}The average value is determined over any ten consecutive tests

Based on charts published by Stockwell² we have taken a minimum DCP test result of 3 blows/100mm as indicative of 300kPa ultimate bearing pressure in more sandy soils.

6.5. Contractors Work

CMW's site presence during earthworks construction for this project included periodic observations of specific elements of work as described herein.

As we were not on site at all times during construction, we have relied on the Contractor's diligence and construction observations to ensure that the works have been carried out in accordance with:

- a) The approved Contract drawings and design details;
- b) The approved Contract specifications;
- c) Authorised Variations during the execution of the works;
- d) The conditions of Resource, Earthworks and Building Consents where applicable;
- e) The relevant Geotechnical Investigation reports, recommendations and site instructions,

and that all as-built information and other details provided to the Client and/or CMW Geosciences are accurate and correct in all respects.

7. GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

7.1. Liquefaction

The liquefaction risk for the residential development has previously been assessed in the Stage 1 Stage 2 Investigation and Design reports (ref. 4036-3 & 4036-4). The liquefaction risk is low.

7.2. Slope Stability

Following bulk earthworks, the landform encompassed by this report comprises a series of terraced building platforms. Terraces between platforms are generally in the order of 0.5m in height formed at gradients of 1 vertical (v) to 3 horizontal (h) with global gradients across the site in the order of 1(v):20(h). Platforms where a local gradient of 1:3 was not able to be achieved the platforms are supported by specifically design retaining walls.

The northern edge of Stage 1 comprises a 7m high fill embankment currently under construction at a gradient of 1(v):3(h) from very stiff to hard silt and clay fill.

Lots near the fill embankment of Stage 1 are setback 20m from the crest of the slope.

Based on the presence of stiff to very stiff foundation subsoils and very stiff competent fill materials forming the embankment we consider there is a low risk of deep-seated land instability affecting the building platforms.

7.3. Retaining Walls

7.3.1. Location, Design and Construction Observation

Cantilever timber pole retaining walls have been constructed to a maximum height of 1.33m on the northern boundaries of Lots 65 (Wall B), Lots 86 and 119 (Wall C), and Lot 278 (Wall D) as shown on *Drawing 06* and Candor³ Drawing Nos 2-400,2-402,2-403 and 2-430 in *Appendix G*.

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² M J Stockwell, 'Determination of allowable bearing pressure under small structures' New Zealand Engineering, 15 June 1977.

All retaining walls were designed and subject to construction observations by CMW which included:

- Confirmation of hole diameter, depth, spacing and ground conditions;
- Confirmation of pile small end diameter (SED);
- Confirmation of timber density and treatment;
- Confirmation that where poles were cut the exposed surfaces were painted with wood preservative;
- Confirmation that a suitable drainage column was fully wrapped in non-woven geofabric (Bidim A19);
- Confirmation that a perforated drain coil was installed at the base of the drainage column and that these have a suitable outlet location.

Design details, as built plans and long sections for the retaining walls together with our PS4 for the wall construction are presented in *Appendix G*.

7.3.2. Building Restriction Lines

The wall design has been based on a minimum building set back of 1.5m from the top of the wall, with wall of less than that height designed for a 5kPa surcharge, and those over 1.5m for a 12kPa surcharge. A Building Restriction Line, 1.5m from the top of the wall has therefore been applied for all walls less than 1.5m in height. These are shown on **Drawing 19**.

All structures requiring building consent must be located entirely beyond the BRL unless supported by further geotechnical investigation and/or assessment by a Chartered Professional Geotechnical Engineer.

7.4. Fill Induced Settlement

Fill induced settlements in the over-consolidated stiff to very stiff and dense Whangamarino soils beneath the fill are expected to be negligible.

Where softer and compressible upper Holocene soils have been encountered these have been undercut and removed with the new structural fill being placed directly over the stiff to very stiff Whangamarino silts and clays.

As the specified degree of compaction has been achieved internal settlement of the fill is also expected to be negligible.

7.5. Post Construction Ground Profile

7.5.1. Post Construction Hand Auger Frequency

Based on the expected natural ground conditions of stiff to very stiff cohesive soils and medium dense granular soils, together with the very stiff nature of the controlled engineered fill, our post construction hand auger frequency was as follows;

- Where Lots sizes are less than 450m² one post construction hand auger was carried out for every second. This was usually on a shared lot boundary.
- Where Lot sizes are greater than 450m² one post construction hand auger was carried out near the centre of the Lot.

7.5.2. Lignite

In the geotechnical interpretative reports prepared for the subdivision various recommendations were made regarding undercutting lignite deposits where exposed at platform level to minimum depths of

CMW Geosciences

between 1.0m and 1.5m below final platform levels. During the earthworks consenting process a figure of 1.5m was recommended.

These recommendations to remove all lignite exposed at final level to a depth of 1.5m below platforms were based on the lignite being weak and compressible, thereby posing a risk of low bearing capacities and unacceptable settlement for standard NZS3604 based foundations, together with possible shrinkage on drying and possible acid soil conditions.

As the works have progressed the Lignite encountered has been hard, dry and of low compressibility.

In the Lots considered in this report lignite has not been exposed at platform level and is a minimum of 500mm below platform level.

From a geotechnical perspective, we have adopted a minimum of 500mm of soil cover to any hard lignite material present beneath design subgrade level subject to that material meeting bearing capacity requirements.

Should soft and compressible lignite be encountered in the future the depth of undercut required will be assessed on a case by case basis.

With respect to possible acid soil conditions no foundations will be in contact with the lignite and all services will be in gravel filled trenches. We therefore consider any risk posed by possible acid soil conditions to be low.

7.5.3. Sensitive Soils

Sensitive soils of the Whangamarino Formation exposed at finish level across Stage 1 cut areas have been found to be susceptible to significant shear strength loss upon repetitive vehicle and plant movements.

If not carefully managed the soils across these lots may become damaged beyond repair and require remedial works. To avoid disturbance, we recommend a 150mm of sand or hardfill be placed over the natural surface which is expected to provide suitable protection to the underlying subsoils.

7.6. Foundation Bearing Capacity

7.6.1. General Conditions

Post construction hand auger borehole results completed following earthworks combined with the fill test results indicate that for all lots covered by this report except those mentioned below in Section 7.5.2 a Geotechnical Ultimate Bearing Capacity of 300kPa should be available for the construction of shallow foundations (strip footings or pad foundations) and structures designed in accordance with NZS3604.

Should isolated lenses of soft or loose soils be encountered during construction, they must be over-excavated and replaced with suitably compacted granular fill or footings widened or deepened accordingly necessitating the involvement of a Chartered Professional Engineer.

Hard lignite has been proved 1200mm beneath final level of Lot 288. The surface soils comprise moderately sensitive very stiff silty clay. This depth is below the 500mm minimum adopted for the project.

7.6.2. Geotechnical Strength Reduction Factor

As required by section B1/VM4 of the New Zealand Building Code Handbook, a strength reduction factor of 0.5 and 0.8 must be applied to all recommended geotechnical ultimate soil capacities in conjunction with their use in factored design load cases for static and earthquake overload conditions respectively.

7.7. Lot 3000 Road Subgrade Bulk Fill

Structural fill placed beneath roads with the area covered by this report has been placed and tested as part of the bulk earthworks for the sub-division for the project Specification.

7.8. Lots 5001 and 5002 (Wetland 1) Drainage Reserves

Fill placed within Lot 5001 has been placed and tested as part of the bulk earthworks for the subdivision for the project Specification.

Fill placed to form the external (south) embankment in Lot 5002 (Wetland 1) has been placed and tested as part of the bulk earthworks for the sub-division for the project Specification. Topsoil, peat and tree stumps were undercut from internal and perimeter embankment and the subgrade inspected prior to placing fill.

Fill forming the internal berms were placed to reduced specification as primarily landscape fill. Visual monitoring and observations were undertaken to ensure that primarily cohesive soils were placed and tracked rolled.

7.9. Cut and Fill Restrictions

Level to very gently sloping building platforms have been formed during bulk earthworks therefore only minor site preparation works, comprising stripping of topsoil from with the building footprint, is expected prior to building construction.

If any earthworks are proposed they shall be subject to the normal topsoil stripping, fill conditioning and appropriate compaction of any fill in accordance with the requirements of NZS 4431, RITS and subject to engineer inspection and certification at the time.

7.10. Respread Topsoil

Topsoil has been placed across the lots following the post construction hand augers. Survey data provided by Candor³ indicates that the topsoil depths across these lots range from approximately **0.05m to 0.30m.**

7.11. Suitability Statement

A copy of our Statement of Professional Opinion as to the Suitability of Land for Building Consent, in the form of the Regional Infrastructure Technical Specification Schedule 2A, is provided in *Appendix* **A**

A summary of Geotechnical Data for individual lots, in the form of a lot summary spreadsheet is also provided in *Appendix A*.

8. LIMITATION

This report has been prepared for use by our Lakeside Developments 2017 Limited, their consultants and Waikato District Council. Liability for its use is limited to the scope of work for which it was prepared as it may not contain sufficient information for other parties or for other purposes.

Although regular site visits have been undertaken for observation, for providing guidance and instruction for testing purposed, the geotechnical services scope did not include full time site presence. To this end, our appended suitability statement also relies on the Contractors' work practices and assumes that when we have not been present to observe the work, it has been completed to high standard and in accordance with the drawings, instructions and consent conditions provided to them.

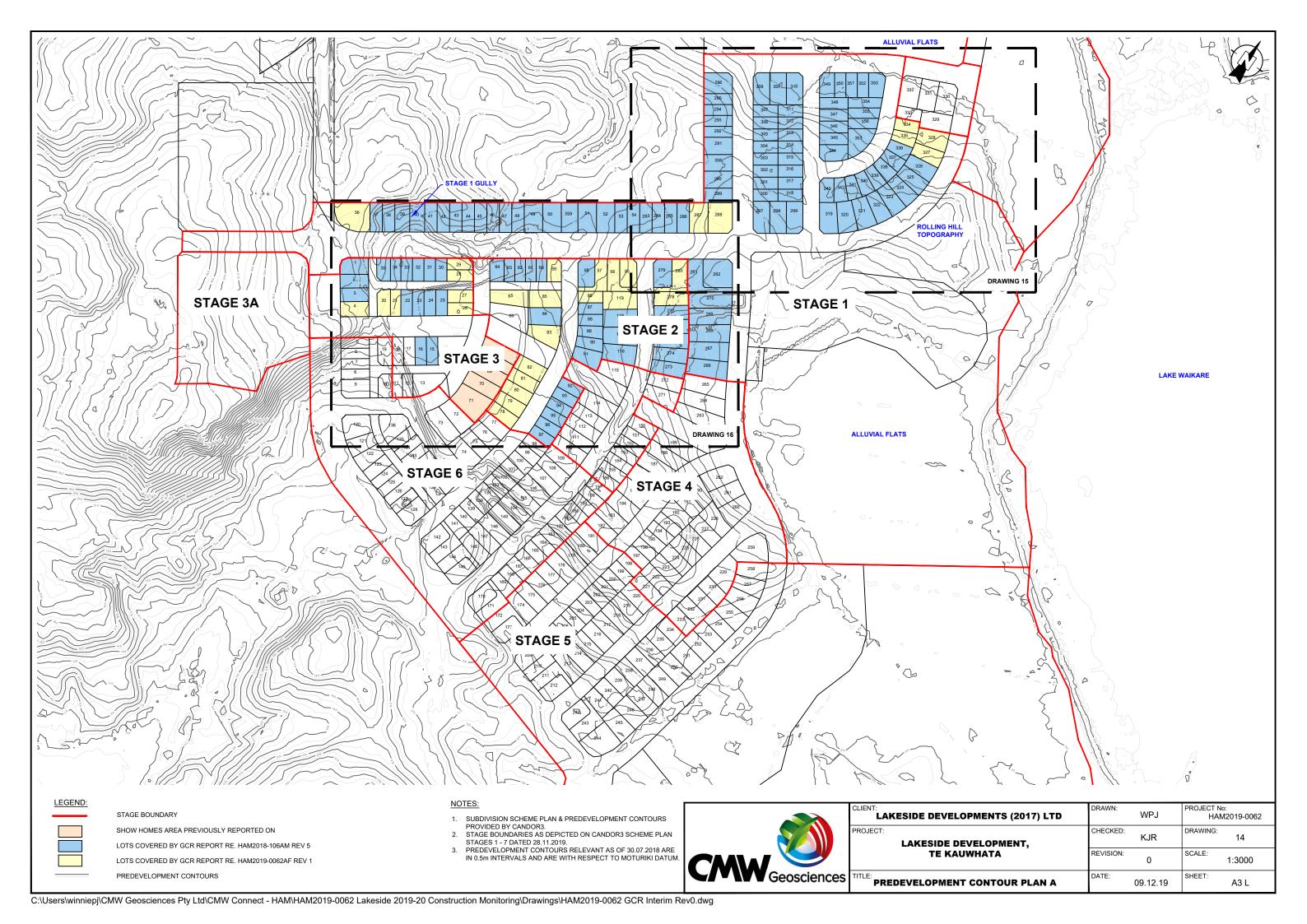
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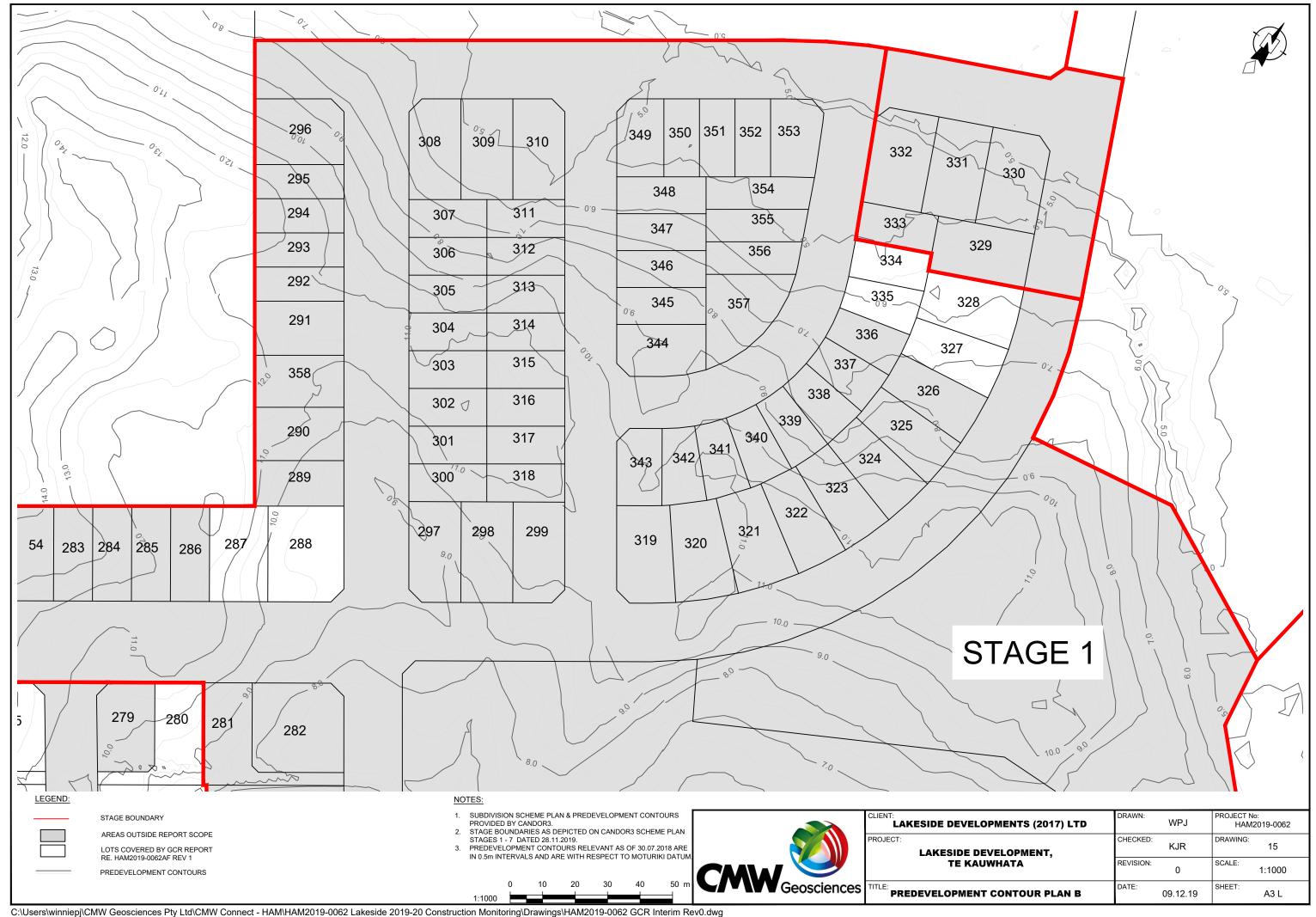
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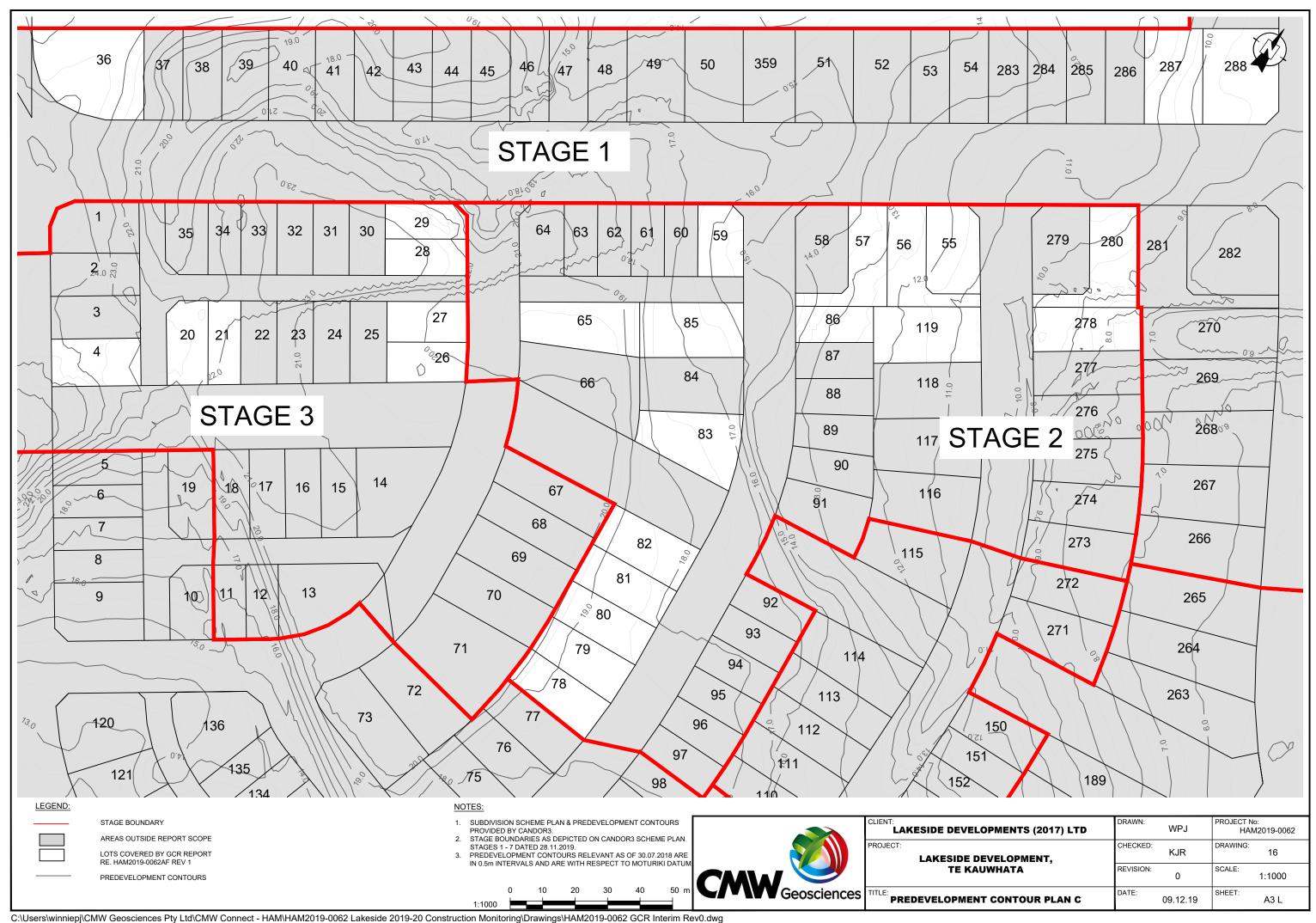
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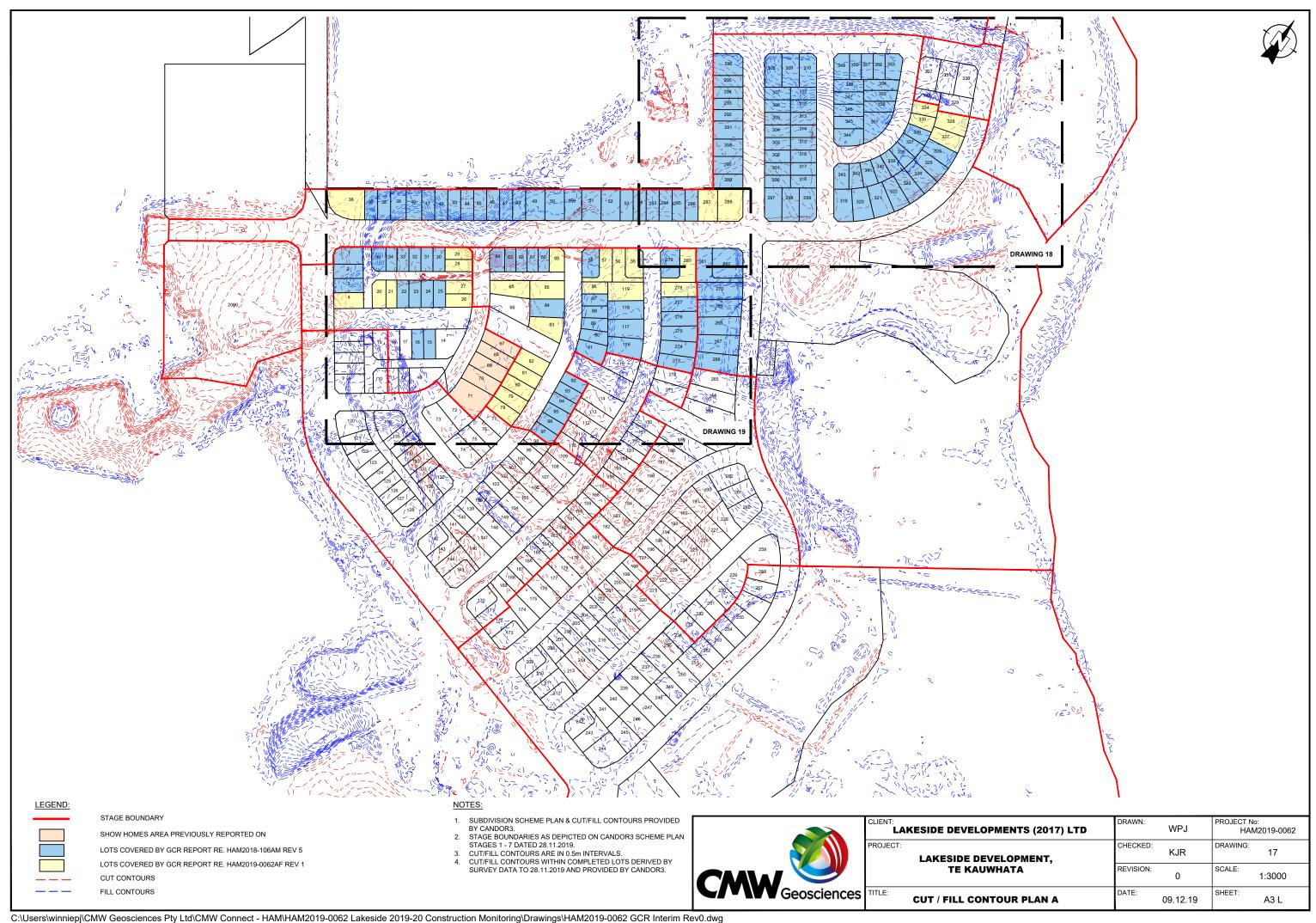
There may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist then the matter should be referred back to CMW immediately.

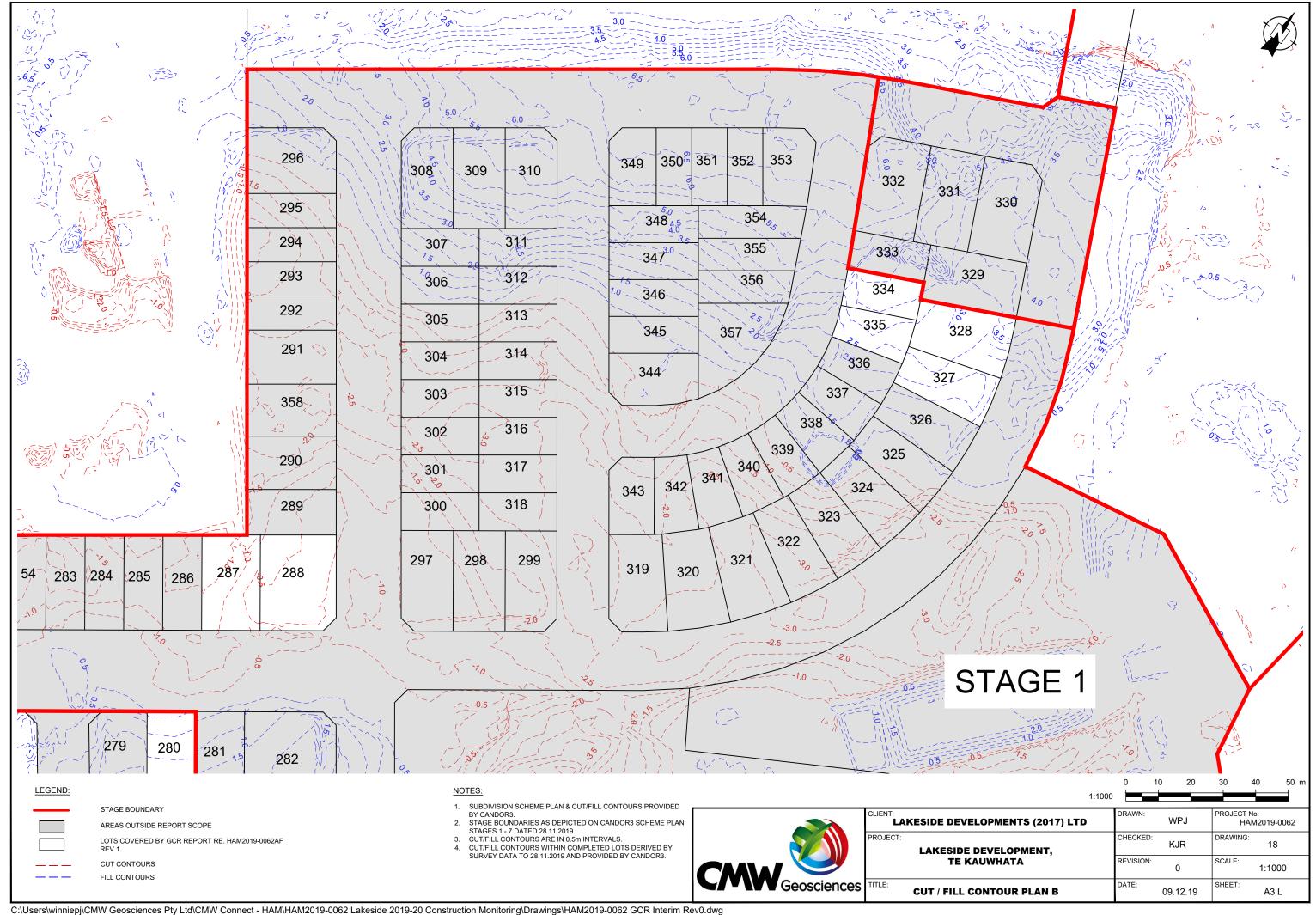
Drawings

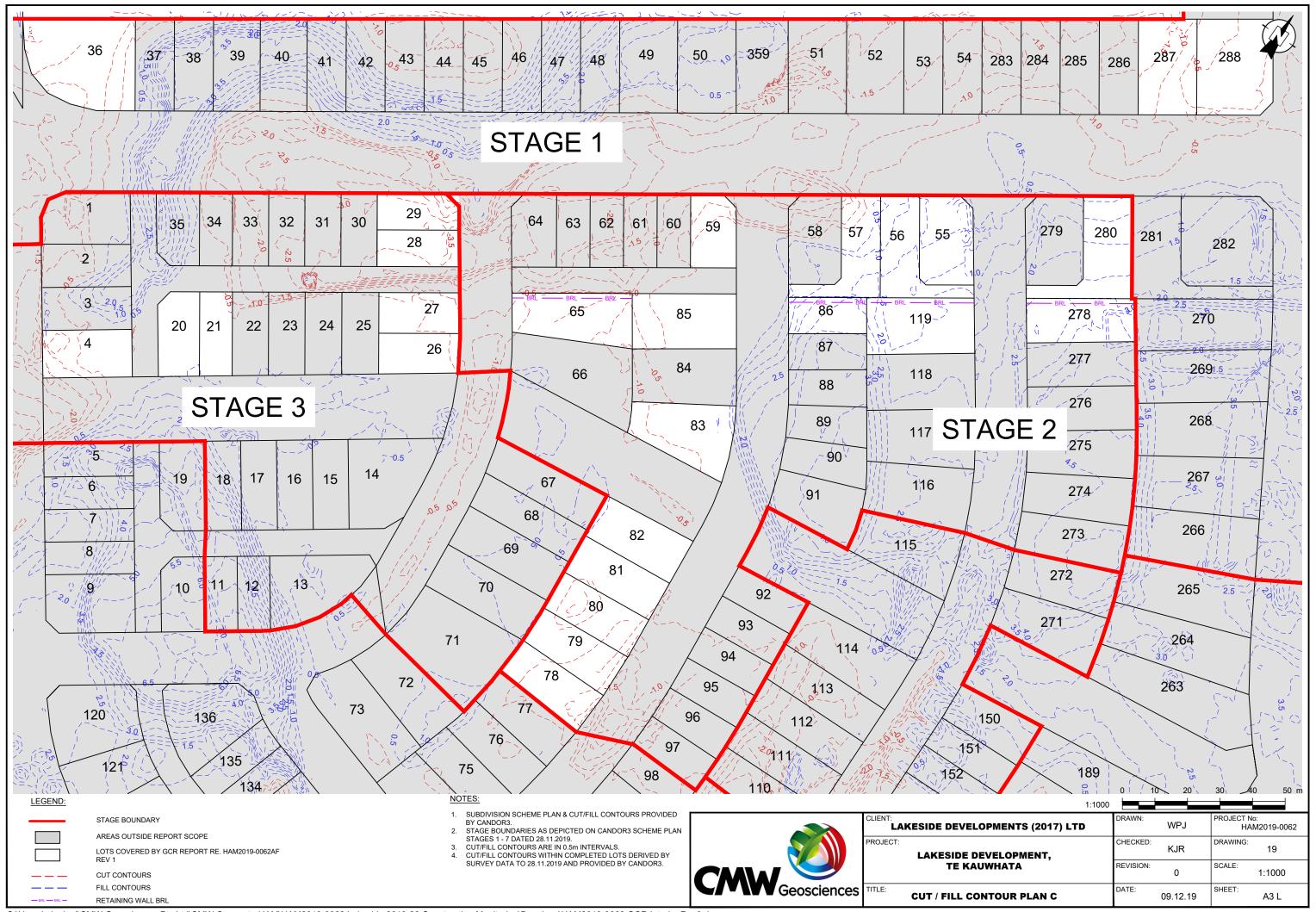


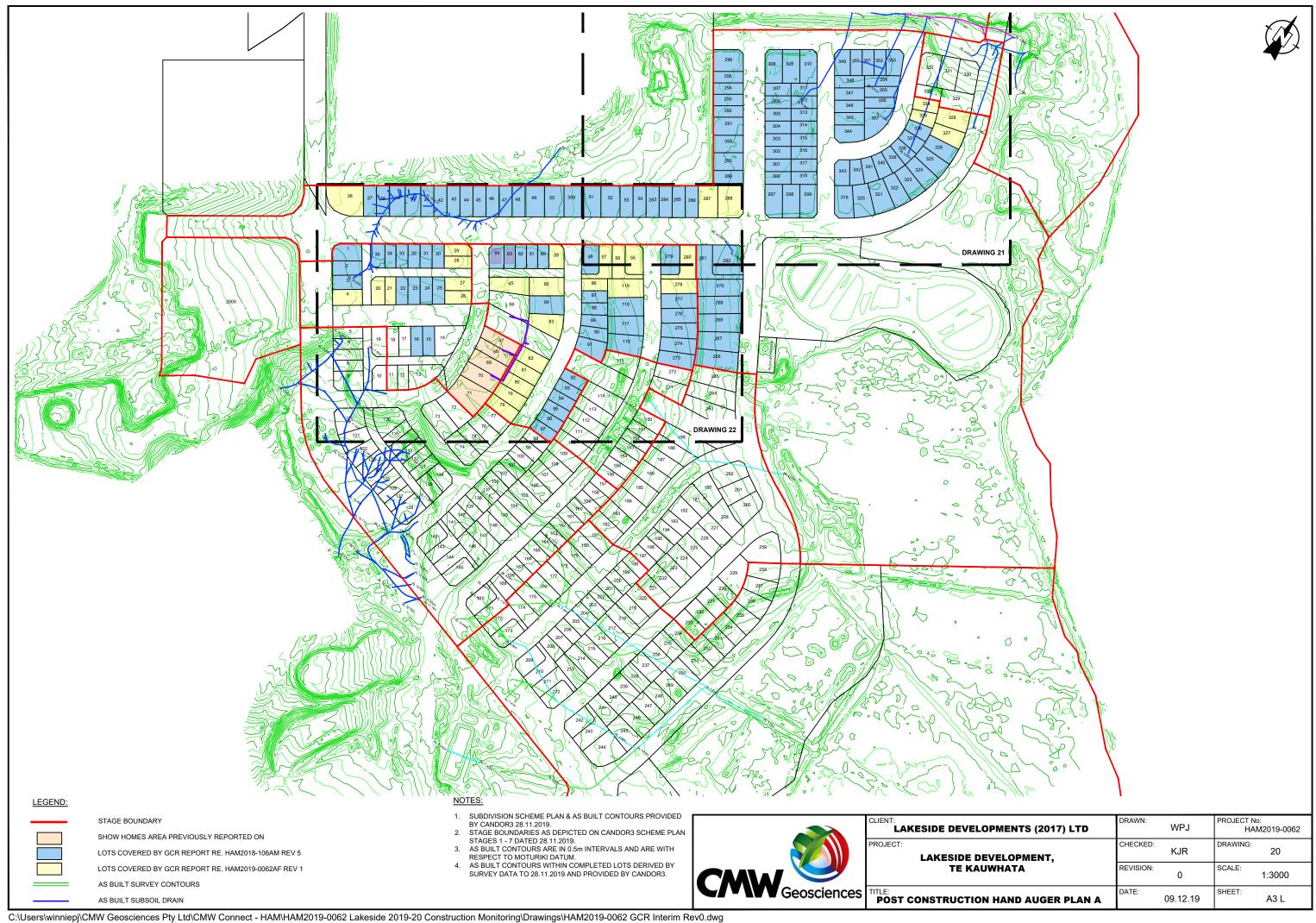


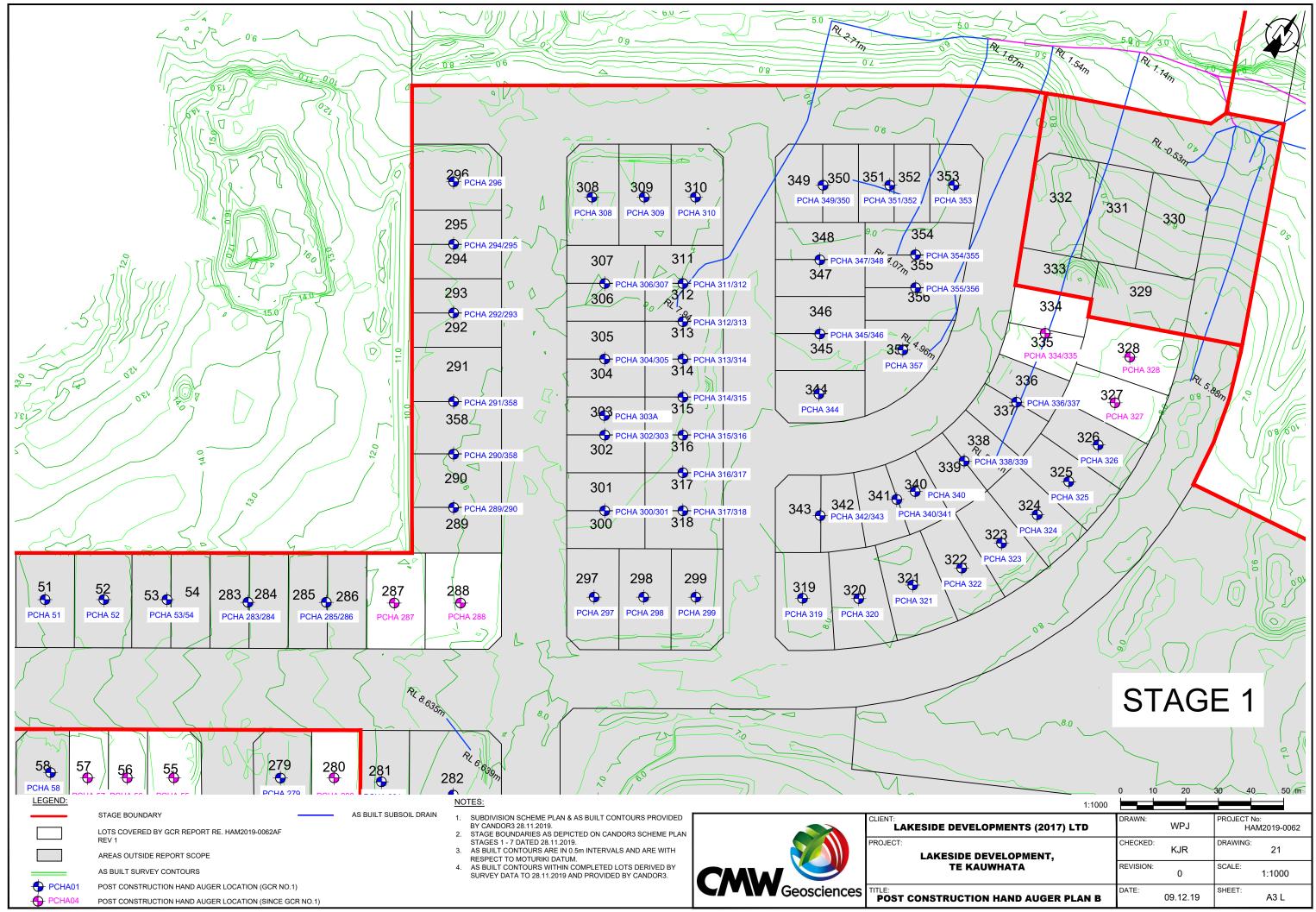


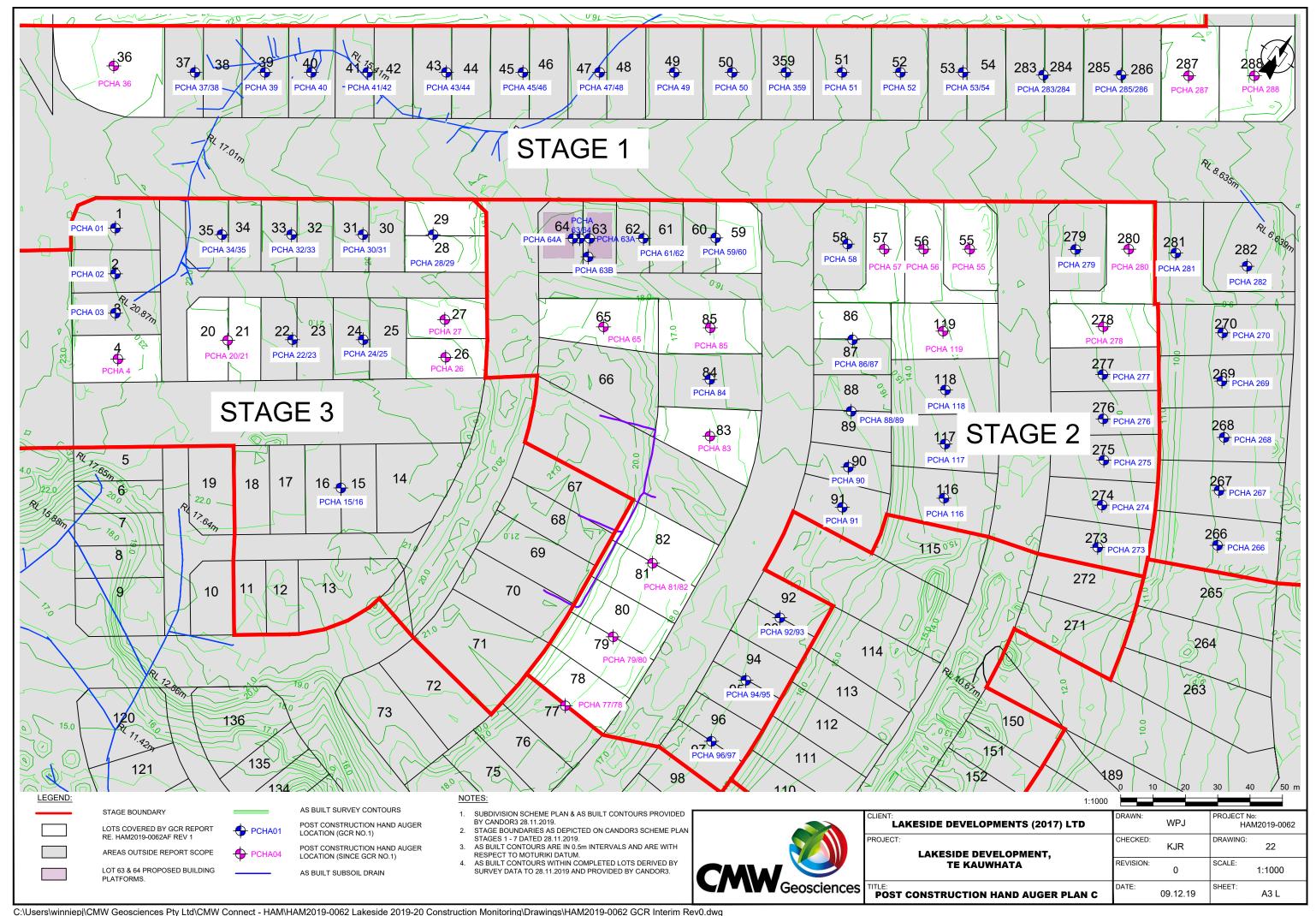


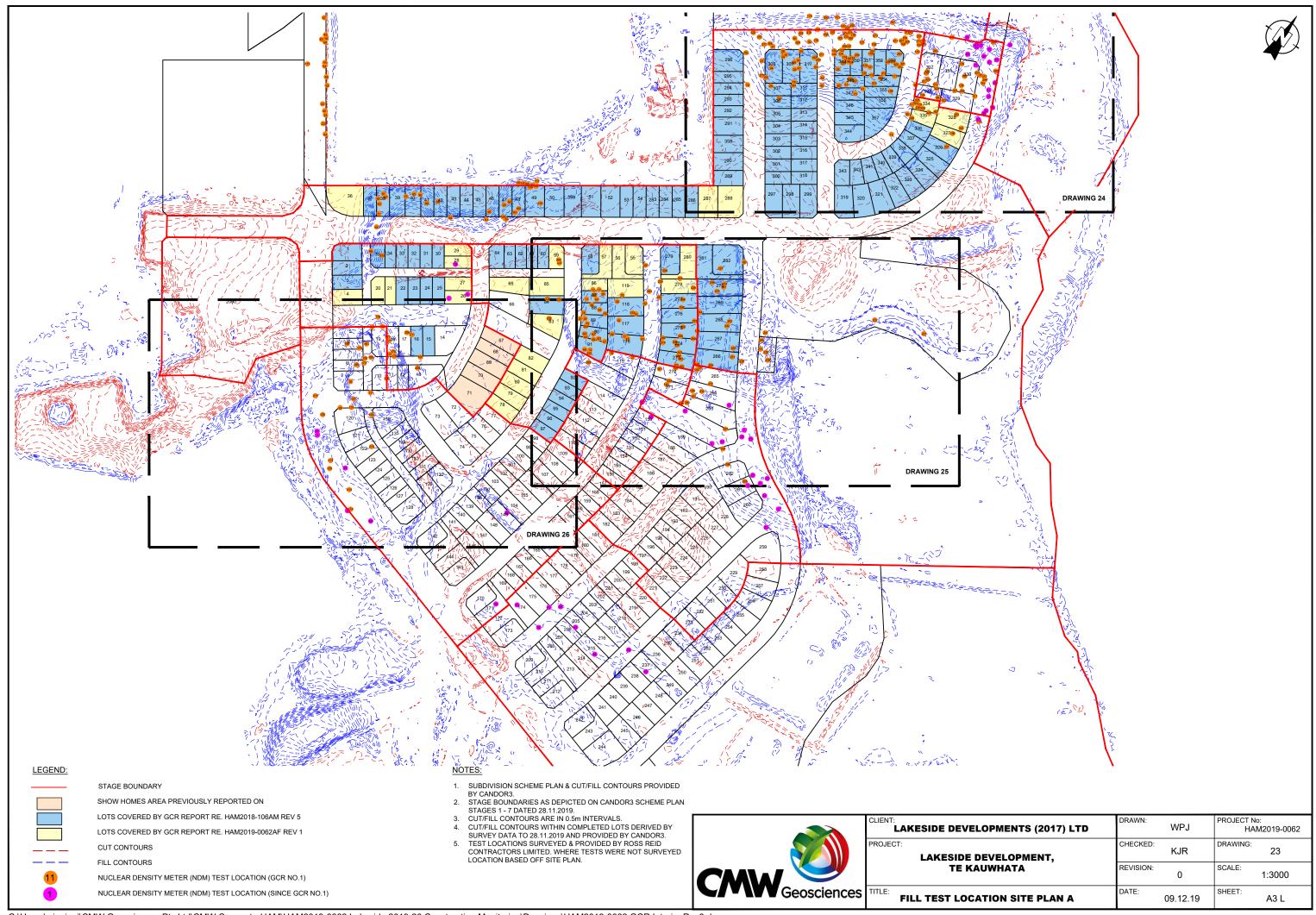


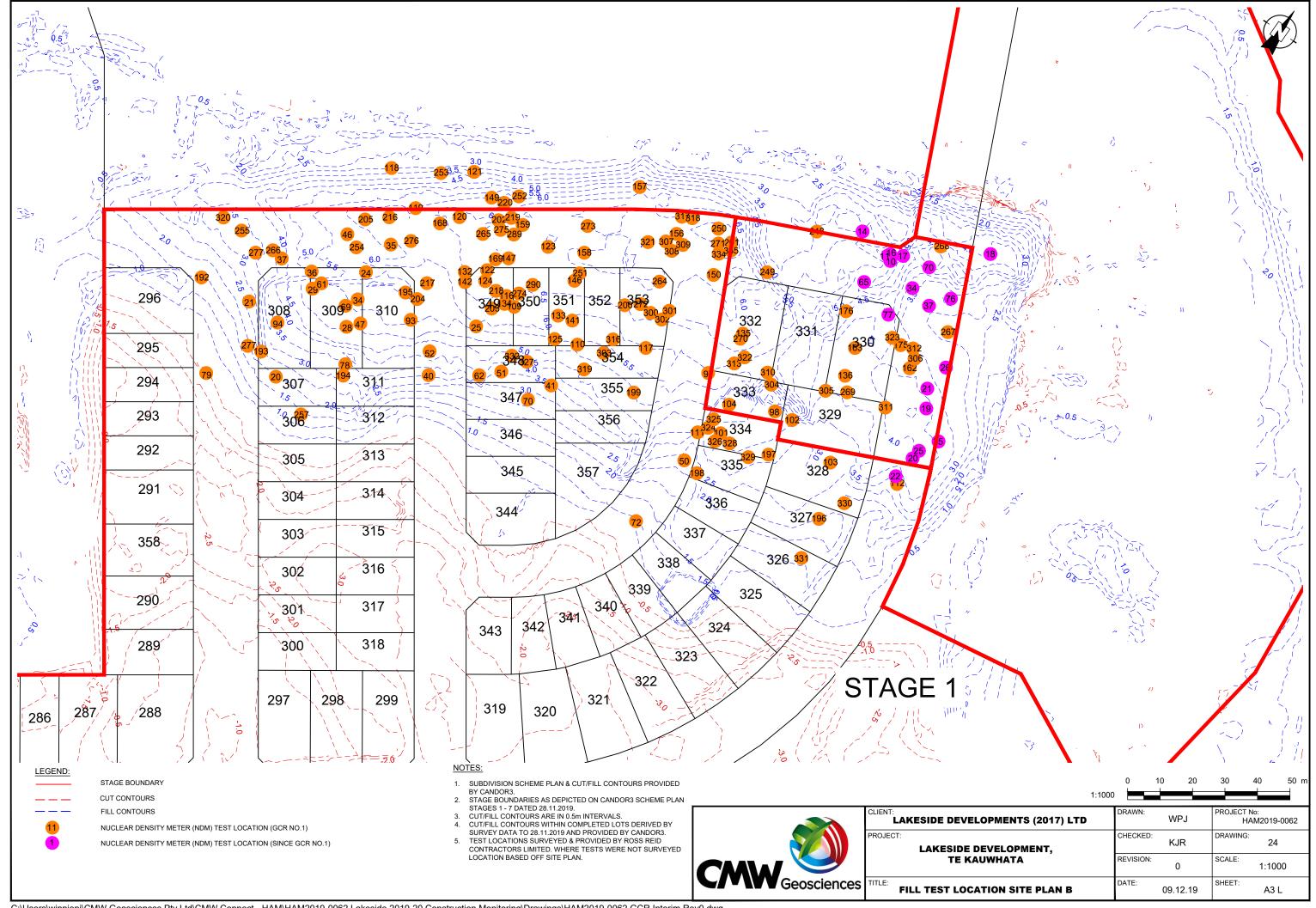


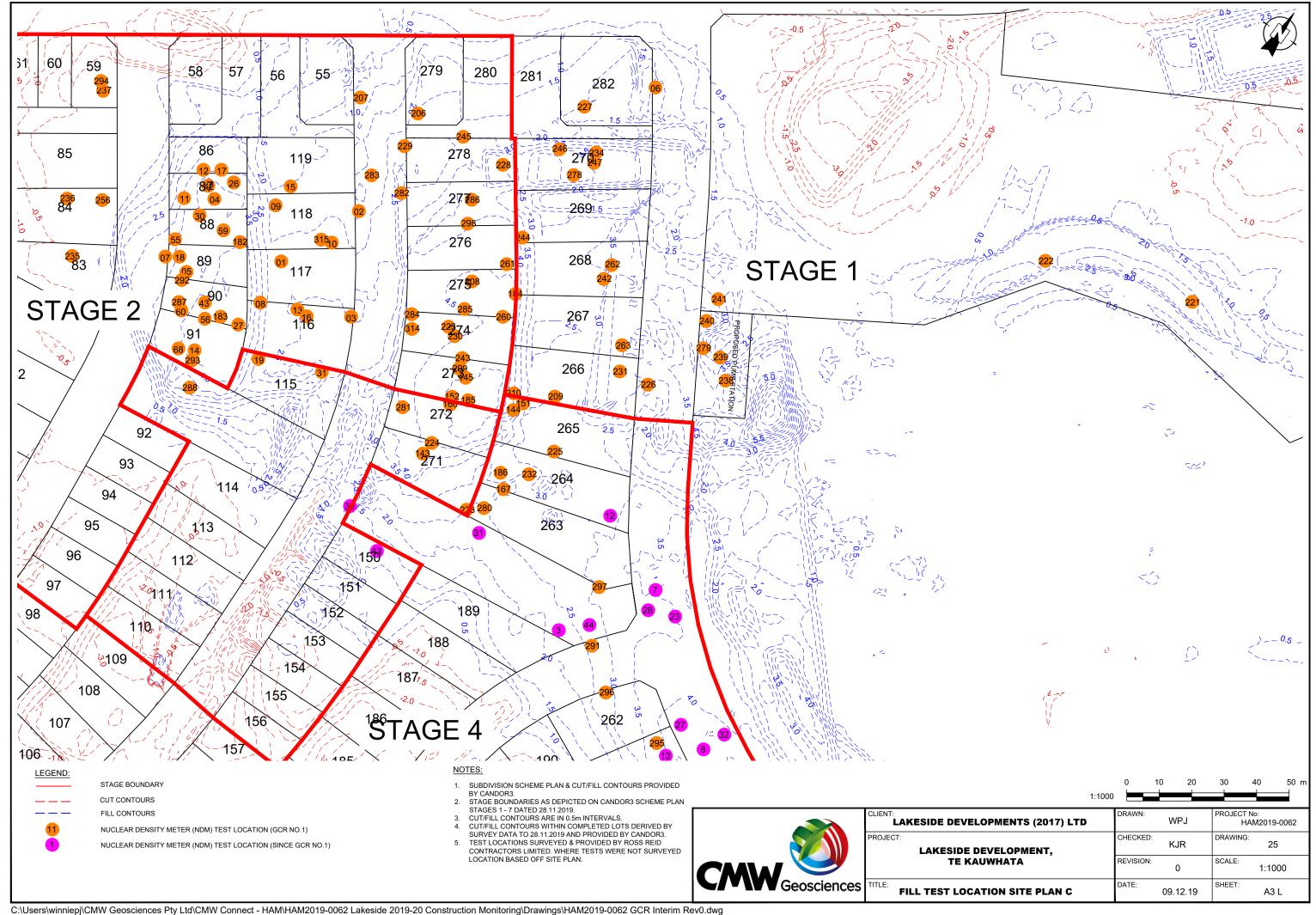


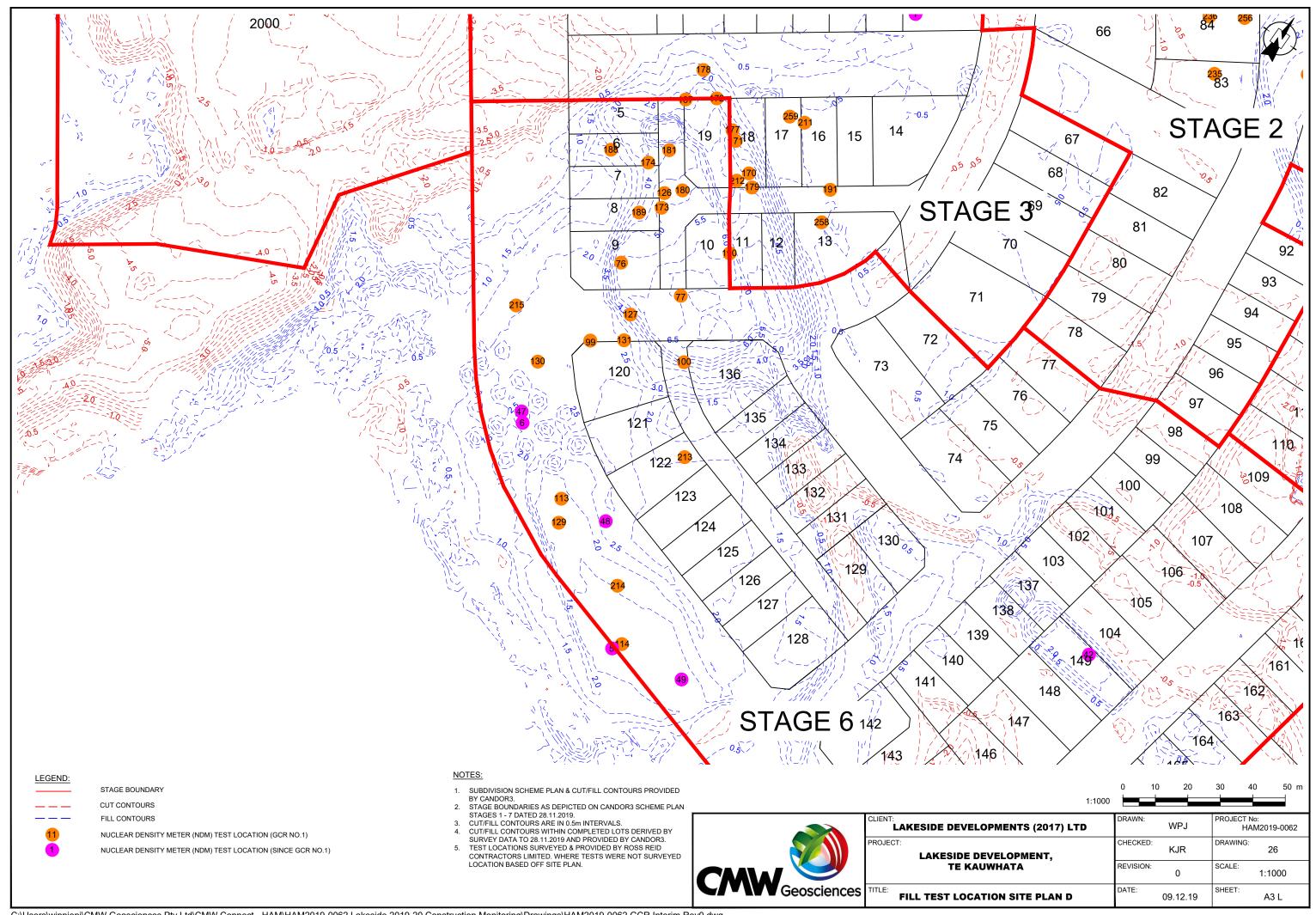












Appendix A: Suitability Statement & Lot Summary Report

APPENDIX 2A: SCHEDULE 2A (NZS 4404:2010) STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSENT

Development: Lakeside Development Staç	ges 1,2 and 3
Developer: Lakeside Developments (2017	7) Limited
Location: 98 Scott Street, Te Kauwhata	
I, Kenneth John Read (Full name)	of CMW Geosciences (NZ) Ltd Partnership, 5 Hill Street Hamilton
	(Name and address of firm)

Hereby confirm that:

- 1. I am a geo-professional as defined in Clause 1.3.3 of Section 1 (General Information) of the Regional Infrastructure Technical Specification (RITS) and was retained by the developer as the geo-professional on the above development.
- 2. The extent of my preliminary investigations are described in the following Report(s):

Earthtech Stage 1 Geotechnical Design Report (ref: 4036-3), December 2017; Earthtech Stage 2 Geotechnical Design Report (ref 4036-4), January 2017; Earthtech Rata Street Extension Geotechnical Design Report (ref 4036-5), February 2017

- and the conclusions and recommendations of those documents have been reevaluated in the preparation of this report.
- 3. The extent of my inspections during construction, and the results of all tests and/or reevaluations carried out are as described in my geotechnical completion report:

Number: HAM2019-0062AF Rev 1 Date: 21 February 2020

- 4. In my professional opinion, not to be construed as a guarantee, I consider that
 - (a) The earth fills shown on the attached Drawings Nos 04 to 06 within the subject Lots of the above report have been placed in compliance with the requirements of the Waikato District Council and the project specification.
 - (b) The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions (which should be read in conjunction with the appended final site contour plan).
 - Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for the erection of buildings designed according to NZS 3604 provided that:
 The recommendations and procedures given in Geotechnical Completion Report No. 2, Ref HAM2019-0062AF Rev 1, dated 21 February 2020 are followed.



- (d) Road subgrades have been formed with appropriate regard for slope stability and settlement risks.
- (e) The fill embankments for the wetland pond constructed in lot 5002 have been formed to standards appropriate for their intended usage.
- (f) This professional opinion is furnished to the TA and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.
- (e) This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

Signed: Date: 21/02/2020

Full name: Kenneth John Read

Title: Principal Geotechnical Engineer

Professional qualifications: BSc Geology, MSc Engineering Geology, CPEng, CMEngNZ

Copyright waived¹

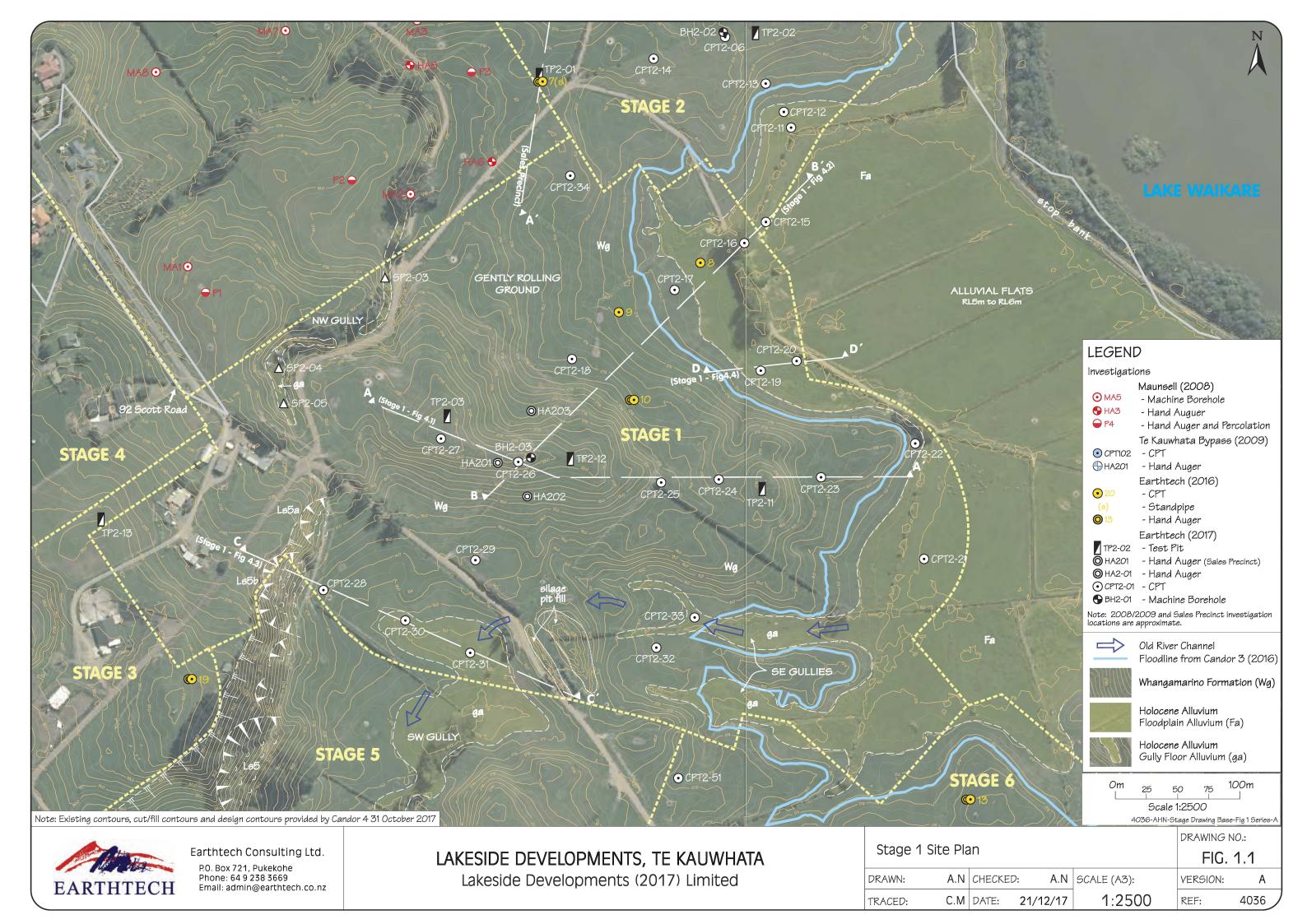
¹ Note: The above schedule is a copy of that included in NZS 4404:2010. The form is identical to Schedule 2A except in Clause 1 where the definition of a 'geo-professional' is referred to the definitions included in Section 1 of this RITS instead of the definitions included in NZS4404:2010.

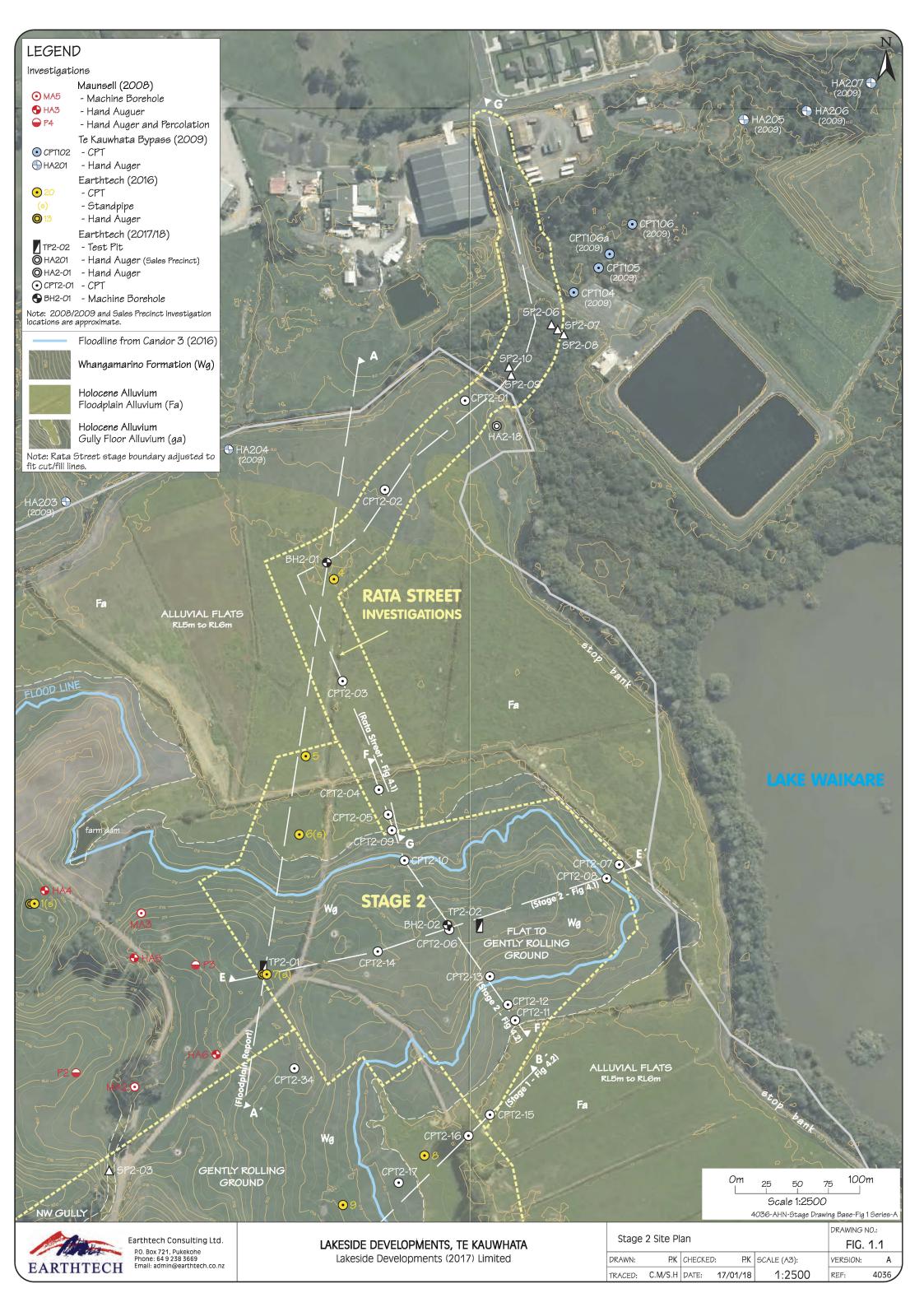


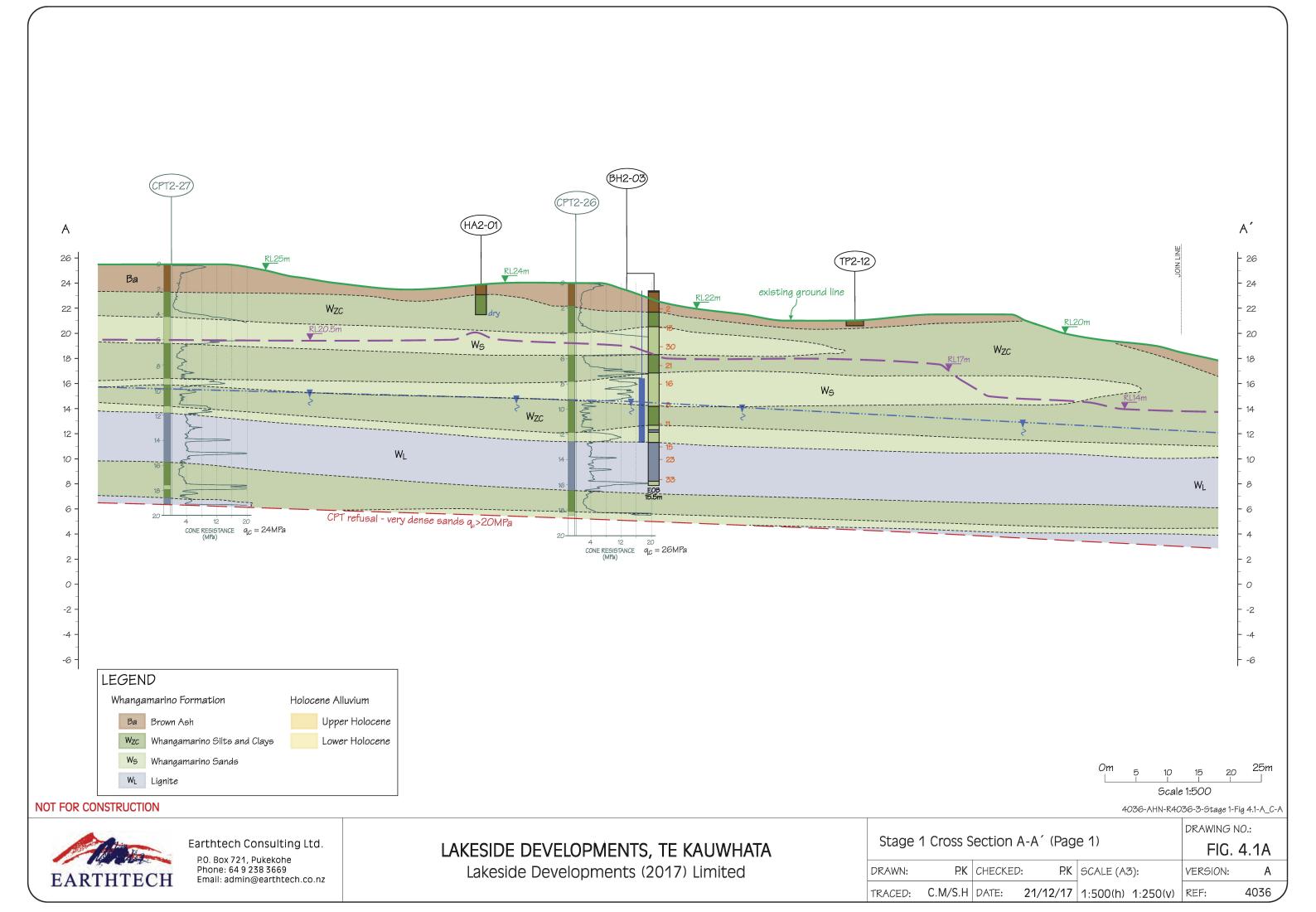
Table 1: Lot Summary Table : Lakeside GCR No2

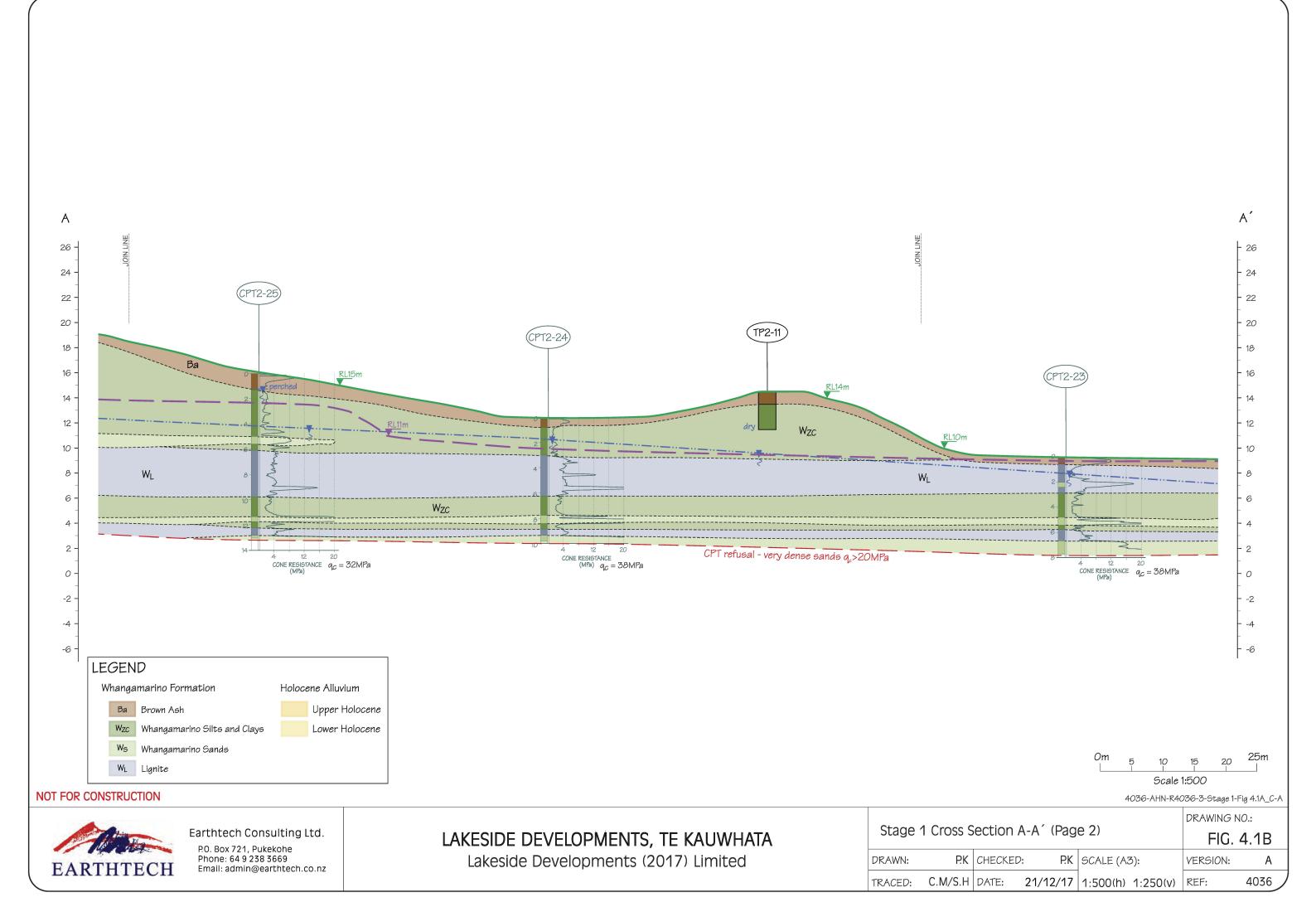
Subsurface Data Foundations											ARTS AT B					
			DCP	VSS		Fill	Jala		Cut		Conventional	Specific	Candor indicative topsoil thickness (Drone Topsoil to RRCL Clay). THICKNESS ABOVE CLAY 3/05/2019	opso	uildir	
			(average blows per	(average kPa over							Shallow Foundation to	Shallow Design		Topsoil Thickness from Hand Augers	Building Restriction Line	
Lot No:	Area (m²)		100mm)	upper 2m)							NZS 3604:2011		Dron Dron). TH AY 3	ckne	stric	Comments
		Stage											P Top ICKN	ss fro	tion L	
										I			psoil bsoil VESS	ы П	ine	
					Y/N	Depth (m)	Meet Spec Y/N	Y/N	Depth (m)	Meet Spec Y/N	Y/N/NA	Y/N/NA	ੰ ਰੋ	and		
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20	324	3	''	107	IN	-	-	l '		T T	T	N		0.3		
21	259	3	11	167	N			Y		Y	Y	N		0.3		
21	259	3	''	107	N	-	-	'		· ·	ī	l in		0.3		
26	285	3	13	143	Υ	0.1	Y	Υ		Υ	Υ	N	0.25	0.20		
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28	310	3	16	197	N	-	-	Y		Y	Υ	N	0.20	-		
29	250	3	16	197	N	-	-	Y		Υ	Υ	N	0.20	-		
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59	308	2	7	195	Υ	0.3	N	Y		Y	Υ	N	0.2	-		
- GE	E2E	2	8	0.5	NI.			Y			Y	N	0.15			
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328	279	1	-	198	Y	>2.0	Y	N N	-	-	Y	N N		-	\vdash	
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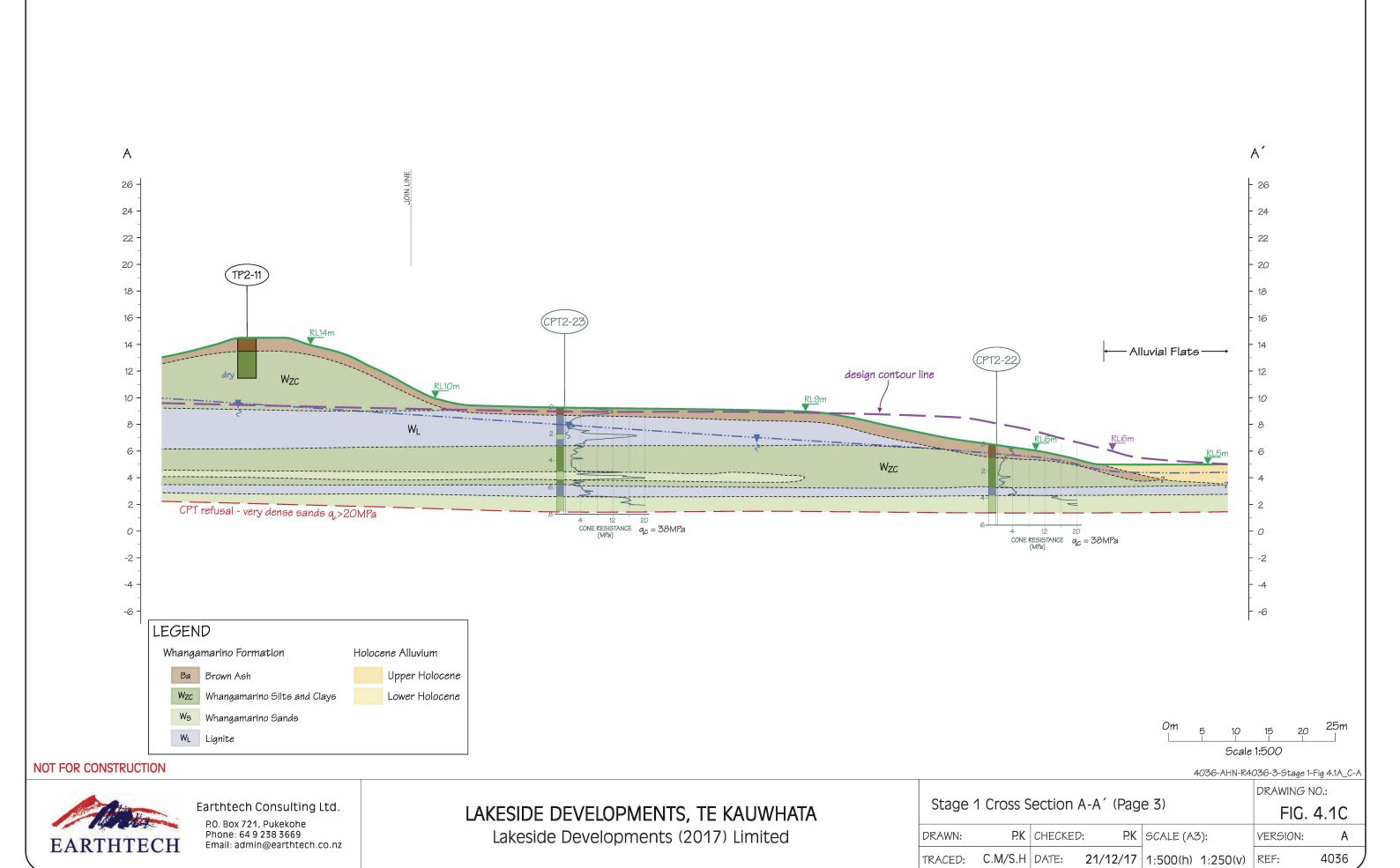
Appendix B: Relevant Pre-Development Field Investigation - Plans, Cross Sections and Data

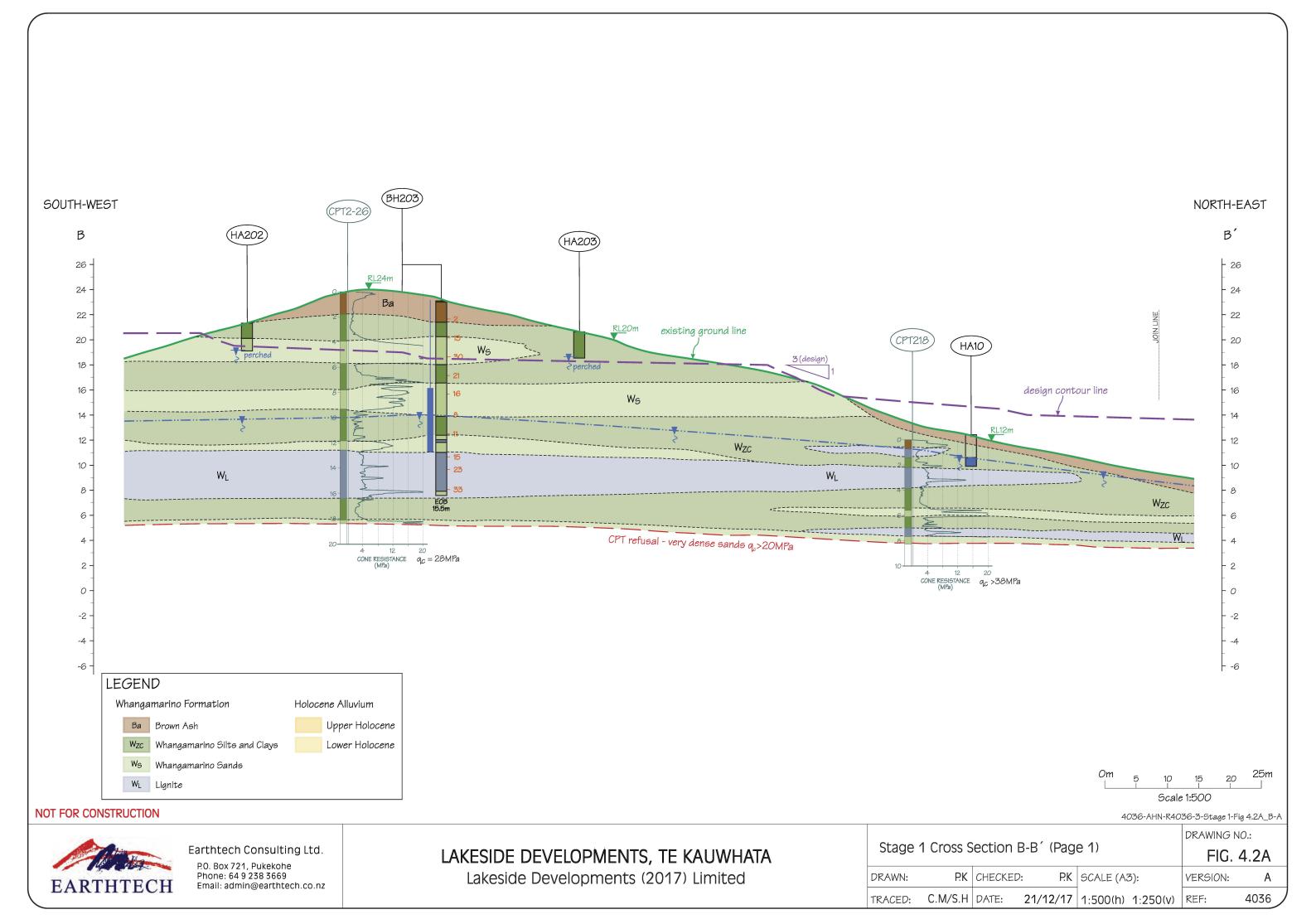


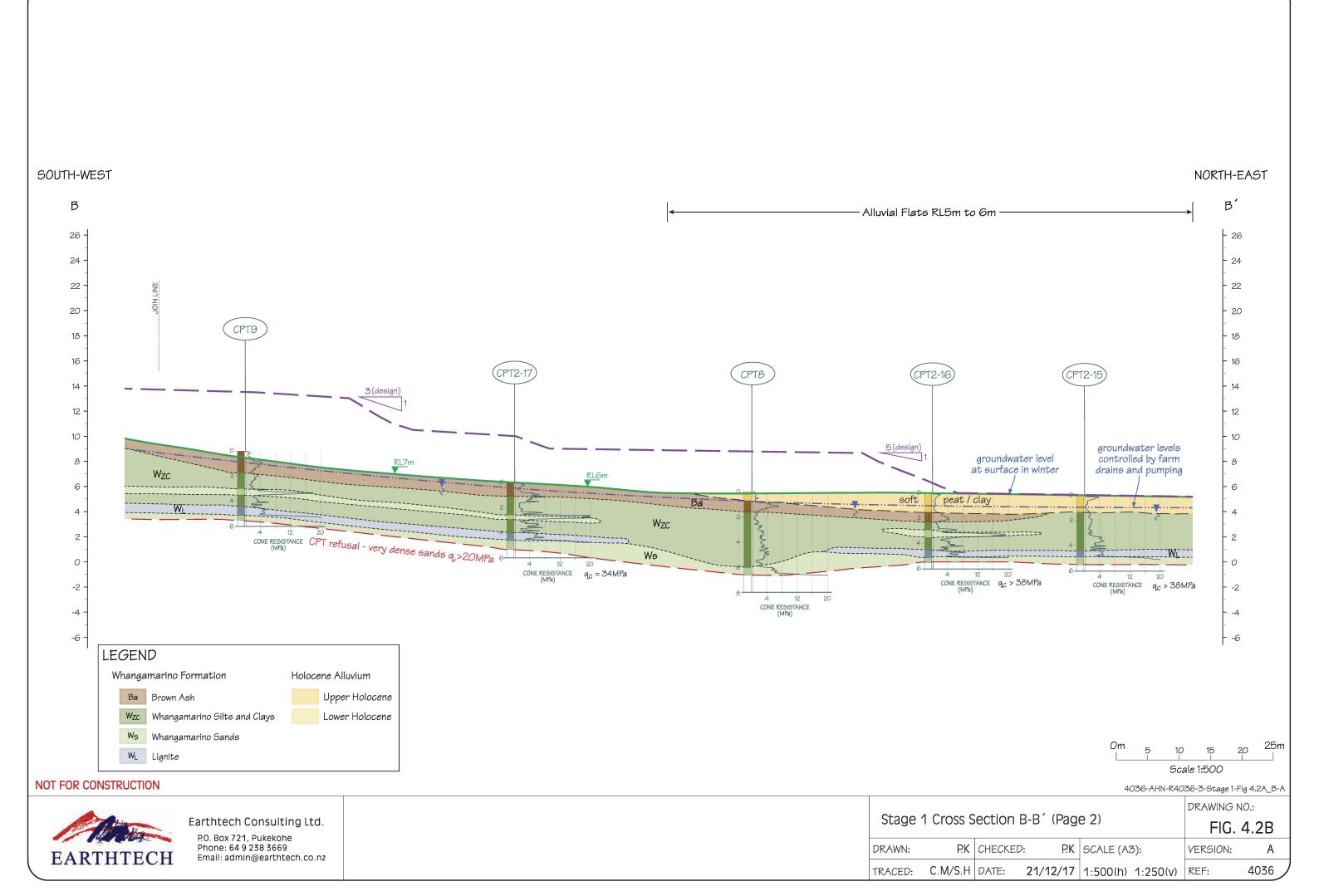


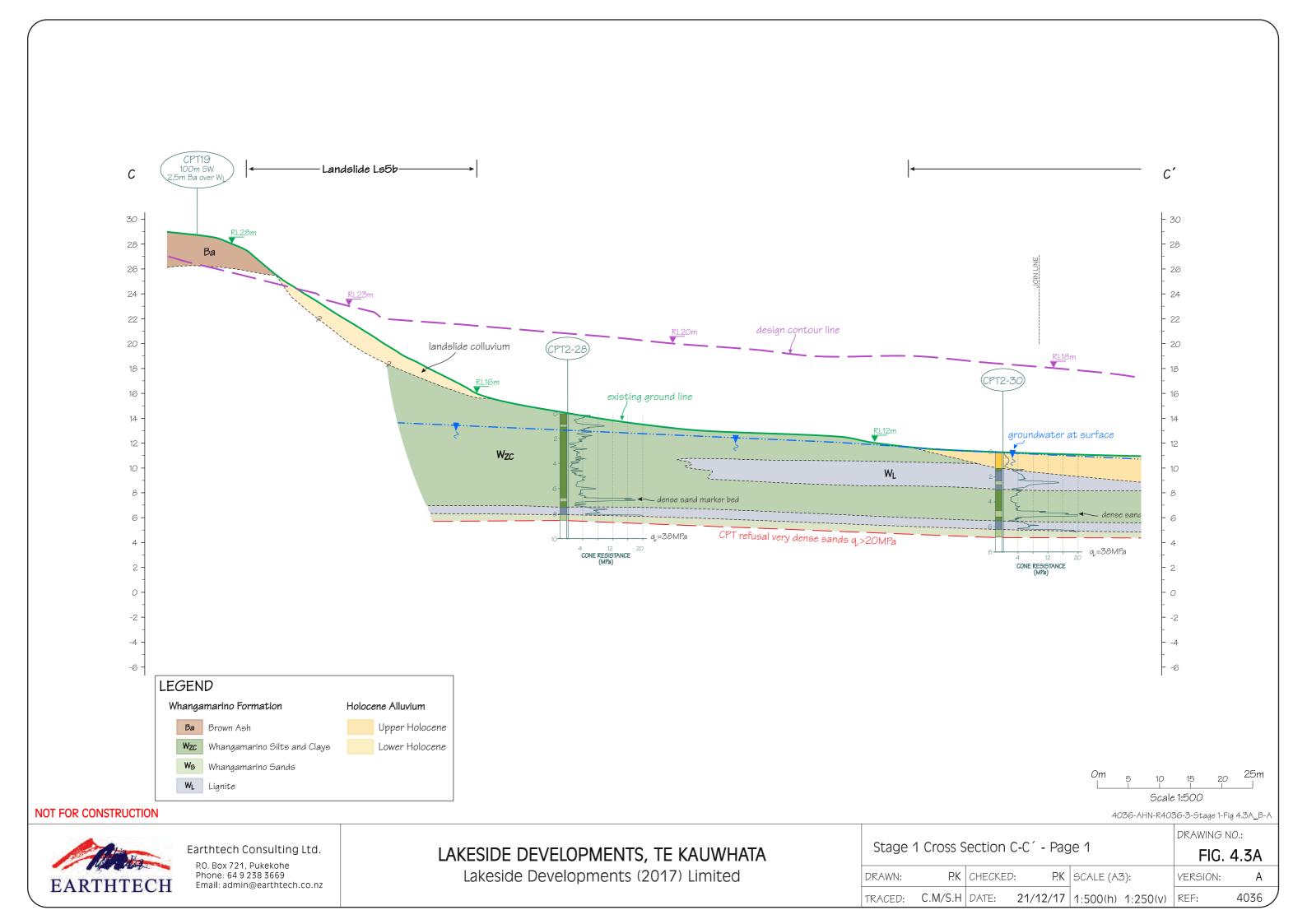


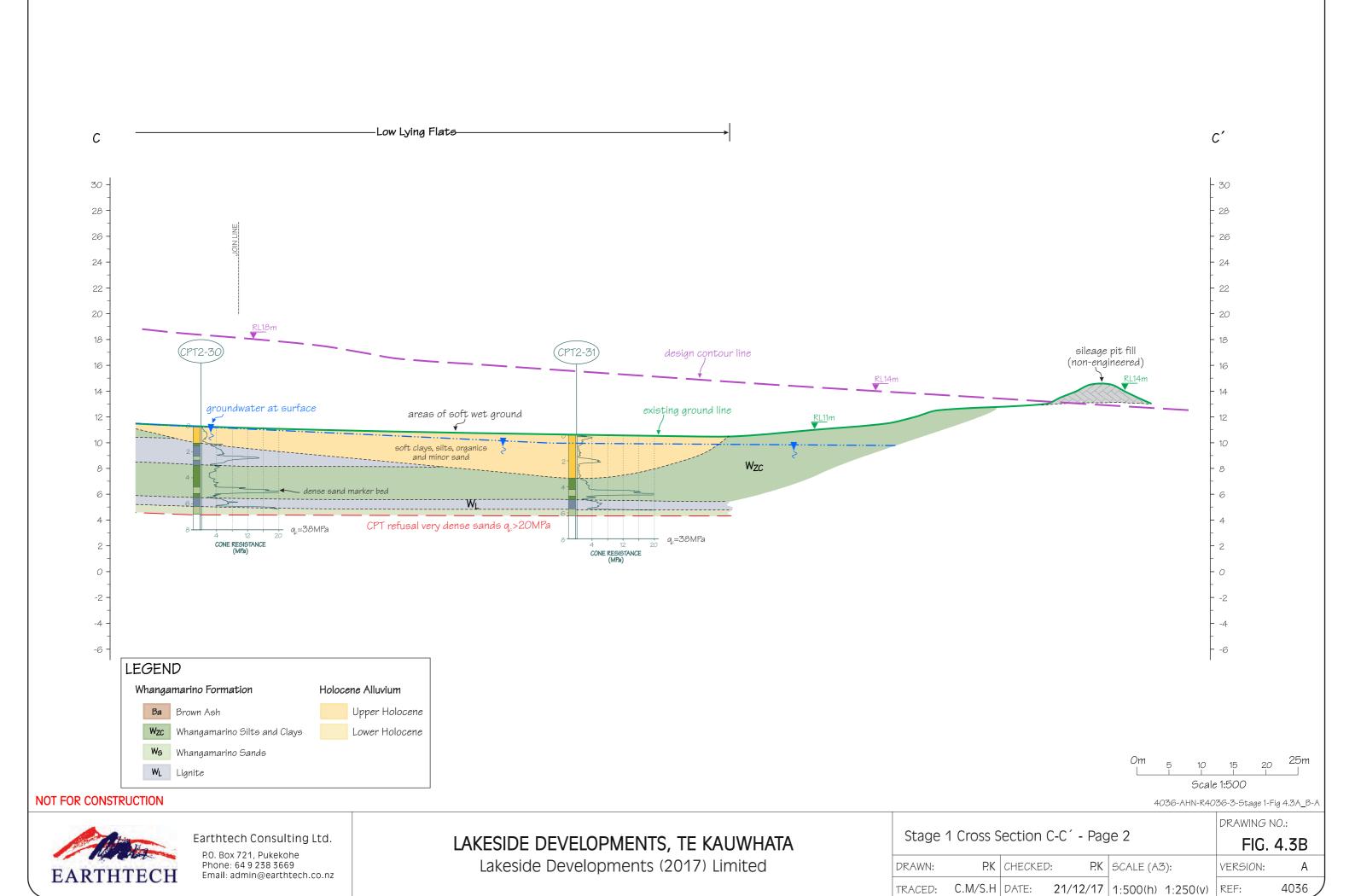




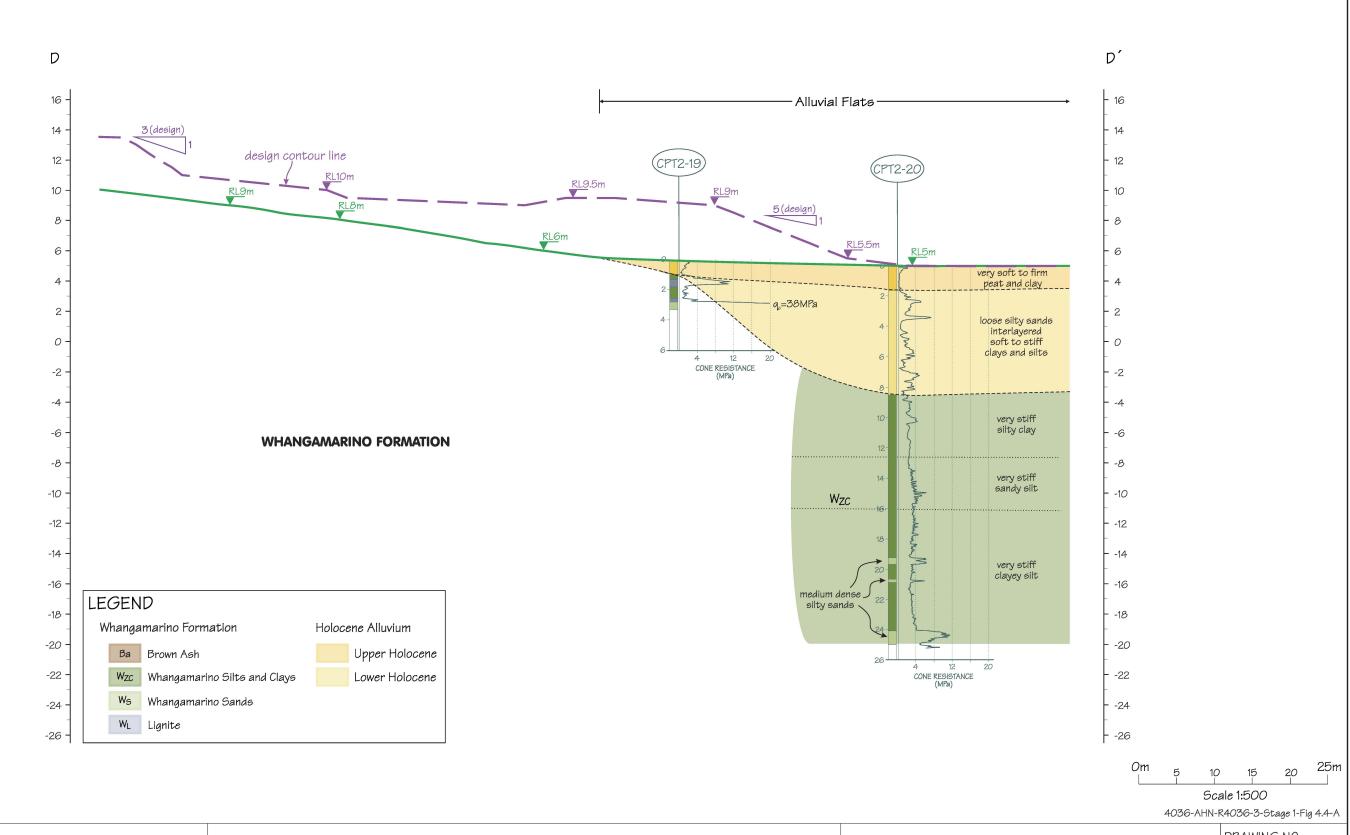








TRACED:



NOT FOR CONSTRUCTION

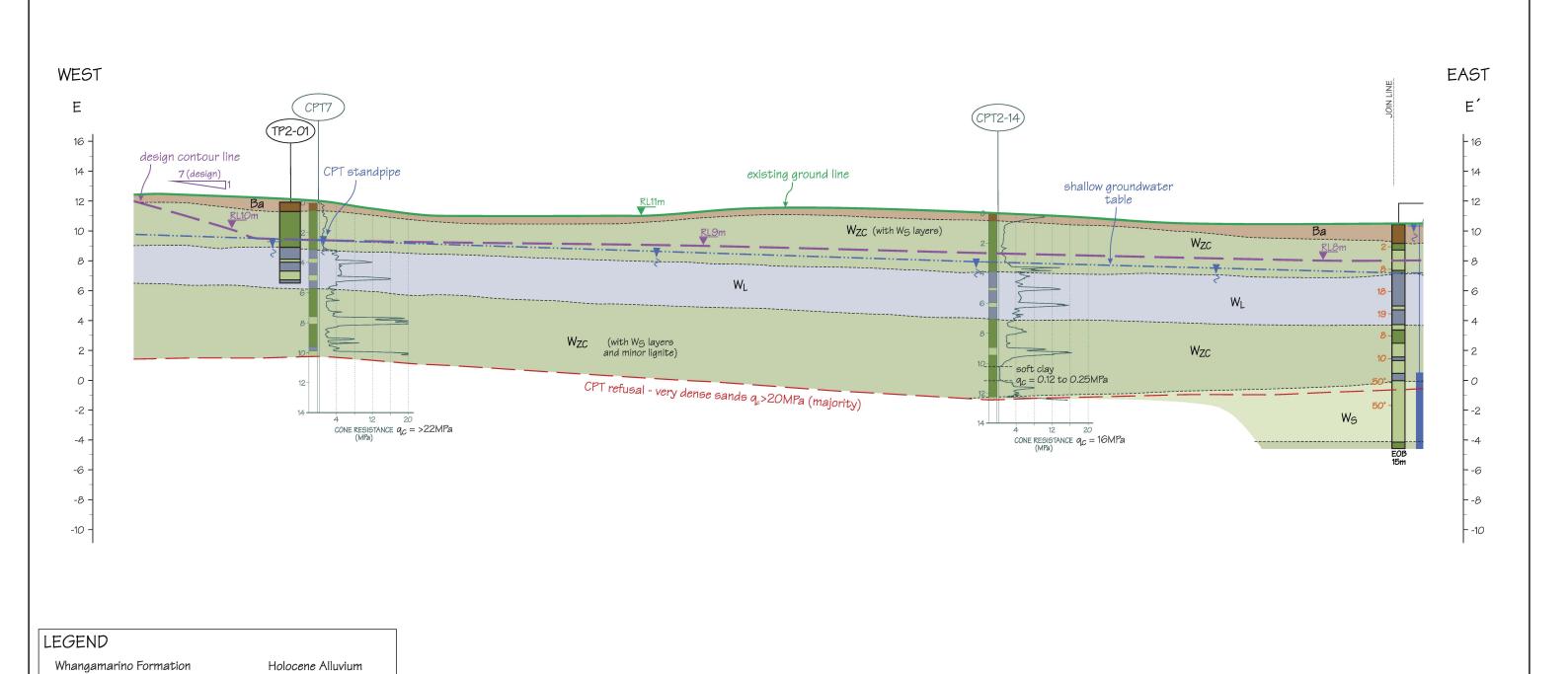
EARTHTECH

Earthtech Consulting Ltd.

P.O. Box 721, Pukekohe Phone: 64 9 238 3669 Email: admin@earthtech.co.nz

LAKESIDE DEVELOPMENTS, TE KAUWHATA Lakeside Developments (2017) Limited

04	4 0	N = 4.1 = F	D D'			DRAWING	10.:
Stage	1 Cross S	FIG. 4.4					
DRAWN:	P.K	CHECKED	P: P:K	SCALE (A3	3):	VERSION:	Α
TRACED:	C.M/S.H	DATE:	21/12/17	1:500(h)	1:250(v)	REF:	4036



EARTHTECH

Ba Brown Ash

W_L Lignite

NOT FOR CONSTRUCTION

Wzc Whangamarino Silts and Clays

Ws Whangamarino Sands

Earthtech Consulting Ltd.

Hu Upper Holocene

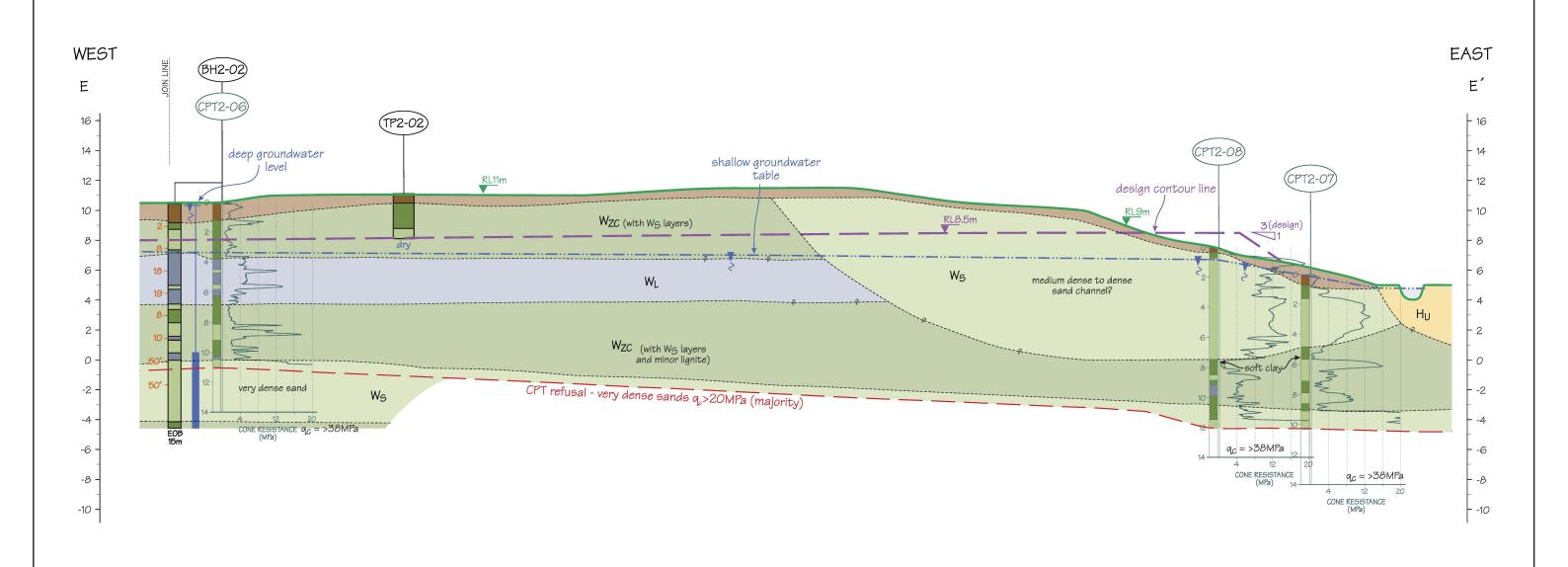
H_L Lower Holocene

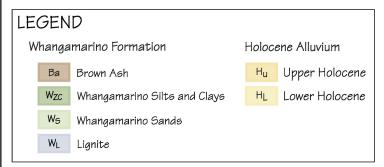
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	0.0		DRAWING NO.:						
Stage	2 Cross S	Section E	-E´(Pag	e 1)		FIG. 4.1A			
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Scale 1:500

4036-AHN-R4036-4-Stage 2-Fig 4.1A_B-A





Om 5 10 15 20 25m Scale 1:500

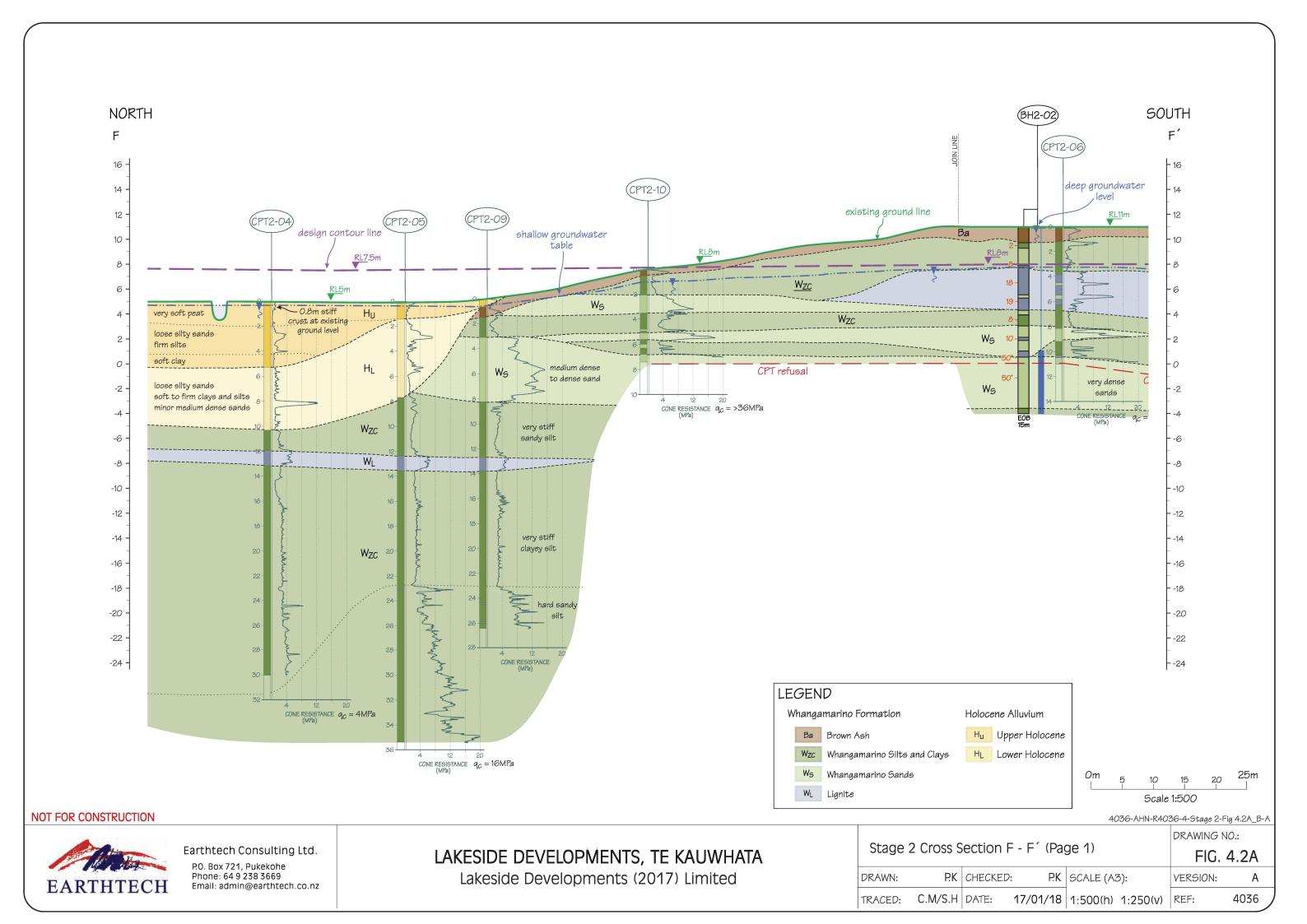
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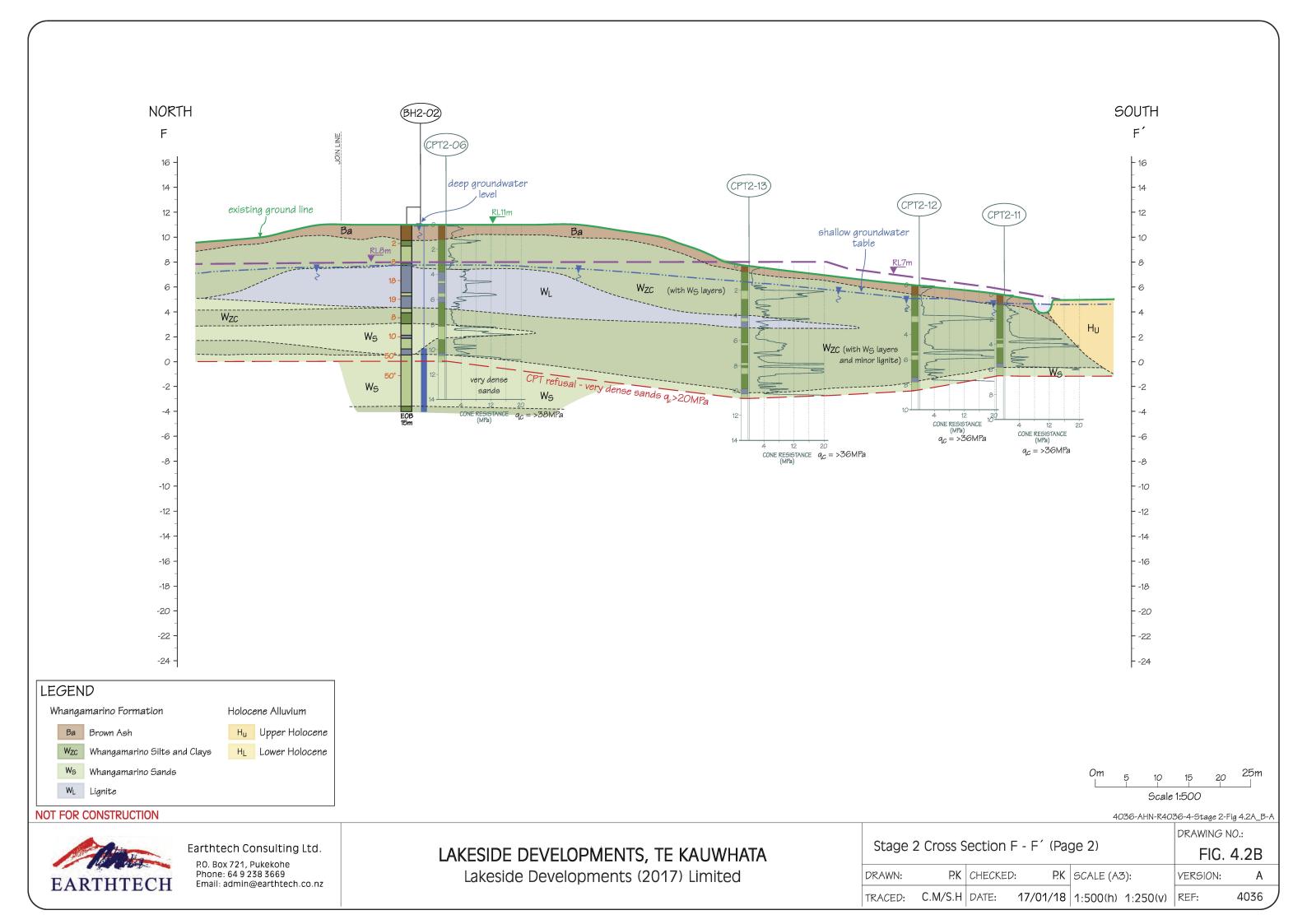
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				4	1036-AHN-R40)36-4-Stage 2-	-Fig 4.1A_B-	-A
		DRAWING NO.:						
Stage	2 Cross S	Section E	E-E' (Page	e 2)		FIG.	4.1B	
DRAWN:	P.K	CHECKED	: P.K	SCALE (A	3):	VERSION:	Α	
TRACED:	C.M/S.H	DATE:	17/01/18	1:500(h)	1:250(v)	REF:	4036	





HA07 Bore No.: **HAND-AUGER LOG** Project: Scott Road, Te Kauwhata Augered by: MW/SLH Checked by: MW 11/10/2016 Date:

Ref: 4036

\supset		1			T	
Geology	Soil Description	Soil Symbol	Depth (m)	Water Level	Undrained Shear Strength	Scala Penetrometer Blows/100mm 0 0 1 2 3 4 5 6 7 8 9 10111213
TOP	SILT with minor fine sand; dark brown. Stiff; moist. Minor live rootlets. SILT with trace fine sand; brown. Very stiff; moist;	× × × × × × × × × × × × × × × × × × ×	- - - - - - - - - - - -		131/44kPa 135/38kPa 131/38kPa	
BROWN ASH	CLAY; mottled orange and grey. Very stiff; moist; highly plastic (not pumiceous). Becoming light grey with light orange mottles.	x x x x x x x x x x x x x x x x x x x	- 1.5		153/50kPa 138/53kPa 149/68kPa 136/47kPa 153/74kPa 173/77kPa 109/56kPa 91/56kPa 153/68kPa	
WHANGAMARINO	SILT with minor pumiceous fine-coarse sand and trace fine pumice gravel; greyish white with orange iron oxide staining. Stiff; wet. 2.2m: Orange 2.6m onwards, firm.		2.0	* ~	157/59kPa 161/68kPa 200/53kPa 149/26kPa 115/24kPa 115/24kPa 104/26kPa 124/44kPa 121/41kPa 104/47kPa 92/34kPa	
WH/	Organic CLAY with trace pumice sand; black. Saturated. Organic LIGNITE; black. Hard; dry; numerous wood fragments.	× × × × × × × × × × × × × × × × × × ×	3.0		41/18kPa	
	EOH = 3.7m bgl Target depth reached. Groundwater encountered at 2.6m. PK Shear Vane.		4.0			0 2 4 6 8 10 13 16 18 20 23 26 28 30 Inferred CBR 10%

HAND-AUGER LOG

HA10 Bore No.:

Project: Scott Road, Te Kauwhata

Checked by: MW 12/10/2016 Augered by: MW/SLH Date: Ref: 4036

Geology	Soil Description	Soil Symbol	Depth (m)	Water Level		drained Strength	Scala Penetrometer
-	SILT with minor sand; brown. Stiff; moist. Minor live	85	8	×	0	100 200	0 1 2 3 4 5 6 7 8 9 10 11 12 13
TOP SOIL	rootlets.	× × × × × × × × × × × × × × × × × × ×	F				
Z	SILT; light brown. Very stiff; moist; highly plastic.	* * * * * * * * * * * * * * * * * * *	F			102/37kPa	
BROWN ASH	0.5m: Minor pumice sand with light grey mottles.	× × × × × × × × × × × × × × × × × × ×	0.5			124/62kPa 173/59kPa	
	SILT with minor pumice sand; white/grey with orange mottles. Very stiff; moist.	×. · · ×. × · · · × · · × · · × ·	-			157/41kPa 127/41kPa	
	1.0m: Becoming wet and stiff.	× · × · × · × · × · × · × · × · × · × ·	1.0			131/50kPa 144/47kPa 140/47kPa 123/41kPa	
WHANGAMARINO	Medium-coarse sandy pumiceous SILT; light brown. Hard; wet.	× · · · × · × · × · × · × · × · × · × ·	1.5			144/41kPa >219kPa 192/47kPa UTP	
WHA	CLAY; mottled orange with grey/white. Very stiff; moist; low plasticity.		2.0	₹		192/38kPa 217/34kPa	
	Highly organic HCNITE, block, Hard, caturated	 	<u>-</u>			192/41kPa 71/24kPa UTP	
	Highly organic LIGNITE; black. Hard; saturated.		_ - - - 2.5				
	EOH = 2.5m bgl Target depth. Groundwater encountered at 1.8m. PK Shear Vane.						
			 3.0 				
			_ _ _ _ _ _				
			- 3.5 - - - -				
			4.0				
			- - - -				
			- - 4.5 -				
			- - - - 5.0				
			3.0			•	0 2 4 6 8 10 13 16 18 20 23 26 28 30 Inferred CBR 10%



HA201 Bore No.: **HAND-AUGER LOG** Project: Scott Road, Te Kauwhata Augered by: AHN/SH Checked by: AHN 07/03/2017 Date: Ref: 4036

	ered by: AHN/SH Checked by: AHN	Date:			//05/201/	Ref: 4036
Geology	Soil Description	Soil	Depth (m)	Water Level	Undrained Shear Strength	Scala Penetrometer Blows/100mm 9 1 2 3 4 5 6 7 8 9 10 11 12 13
HAMILTON- KAUROA ASH	TOPSOIL; dry. Sandy SILT; light brown. Hard; dry.	~~~~~ ~~~~~ ~~~~~ 	- - - - - -		UTP	
HAM KAUR	Sandy CLAY; dark orange brown. Hard; slightly moist; plastic.		- - 0.5 -			
MUI	Clayey SAND; mottled yellow and white. Hard; slightly moist; slightly plastic.		- - - - - 1.0		UTP	
PUKETOKA ALLUVIUM	Sandy CLAY; mottled orange and yellow, flecked red. Moist; plastic.		- - - 1.5 - - - -		>219/104kPa	
P	Clayey SILT (ignimbrite silt?); pale yellow white. Wet; plastic.	X — X X - X — X X -	- - - 2.0		>219/89kPa 192/62kPa >219/62kPa	
	No auger recovery below 2.4m	?	- - - - 2.5 - - - -		192/93kPa 192/83kPa	
	EOH =2.4m bgl No recovery. Groundwater not encountered. PK Shear Vane.		- - - - - - - - - - - - - - - - - - -			
			- - - - - - - - - - - - - - - - - - -			
			- 4.0 			
			- - - - - - 5.0			0 2 4 6 8 10 13 16 18 20 23 26 28 30 Inferred CBR 10%

HAND-AUGER LOG

HA202 Bore No.:

Project: Scott Road, Te Kauwhata

Checked by: AHN 07/03/2017 Augered by: AHN/SH Date: Ref: 4036

Geology	Soil Description	Soil Symbol	Depth (m)	Water Level	(kPa)	Scala Penetrometer Blows/100mm 0 1 2 3 4 5 6 7 8 9 10 11 12 13
	TOPSOIL; dry.	~~~~	_			
	Sandy SILT; pale yellow brown. Hard; slightly moist.	× · × · × · ×			UTP	
		× · × · × · × · × · × · × · × · × · × ·	0.5		UTP	
_	Const. CUT. and the description of the const. Many	× · × · × · × · ×	_			
PUKETOKA ALLUVIUM	Sandy SILT; mottled yellow, orange and brown. Very stiff; moist; plastic.	· × · × · × · × · × · × · × · × · × · ×			UTP	
A ALL		× . · · · · · · · · · · · · · · · · · ·	1.0		>219/59kPa	
ETOK	Fine clean SAND; pale yellow white. Medium dense; non plastic; becomes grey white with occasional orange		_ _ _			
PUK	staining.		_ _ 1.5			
			_ _ _			
	Wet below 2.1m		2.0	_		
			_	7		
	EOH =2.2m bgl Target depth reached.		_			
	Groundwater encountered at 2.1m. PK Shear Vane.		2.5			
			_ _ _			
			_			
			3.0			
			_ _ _			
			_ - - 3.5			
			_ _ _			
			<u>-</u> -			
			4.0			
			_ - -			
			4.5			
			<u>-</u> -			
	3.47 PY 4.16					
	CONSTRUCTION OF THE PARTY OF		- 5.0			0 2 4 6 8 10 13 16 18 20 23 26 28 30 Inferred CBR 10%
						Interior obt 10%
						J

HAND-AUGER LOG

HA203 Bore No.:

Project: Scott Road, Te Kauwhata

Ref: 4036

Checked by: AHN 07/03/2017 Augered by: AHN/SH Date:

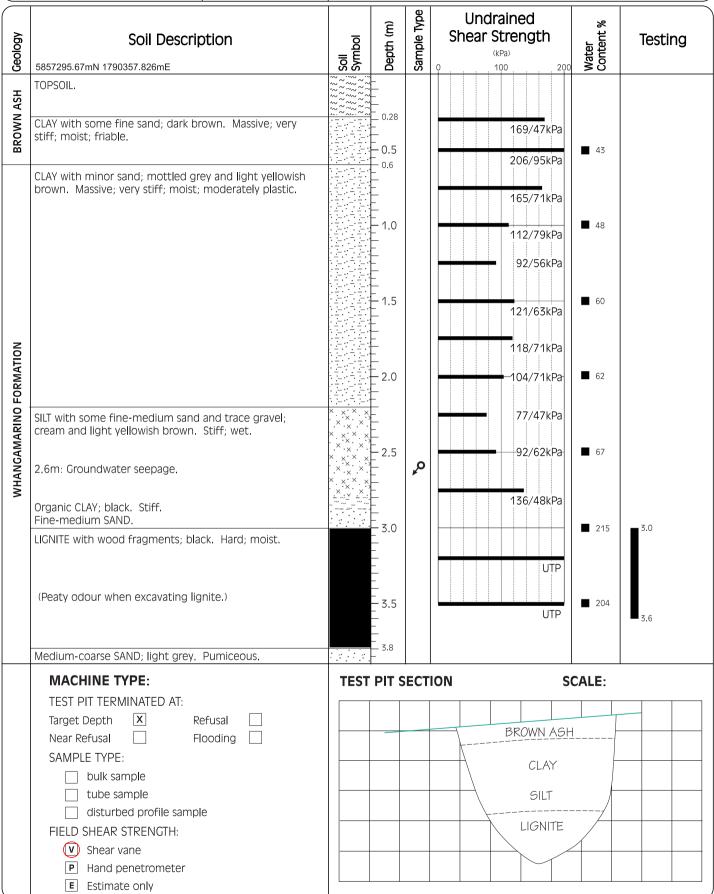
Geology	Soil Description	Soil	Depth (m)	Water Level	Undrained Shear Strength	Scala Penetrometer Blows/100mm 0 1 2 3 4 5 6 7 8 9 10111213
	TOPSOIL; dry.	~~~~				
	Sandy SILT; light orange brown. Stiff; slightly moist; moderately plastic; minor grit from hardpan layers. Becomes more sandy with depth.	× · · · × · · · · · · · · · · · · · · ·	- - - - - 0.5		UTP	
UVIUM		× · × · × · × · × · × · × · × · × · × ·	_ _ _ _		131/29kPa	
PUKETOKA ALLUVIUM	Silty SAND; yellow, white and orange. Medium dense; slightly moist; slightly plastic.	× · × · × · × · × · × · × · × · × · × ·	- 1.0 		UTP	
PUKE	Sandy CLAY; pale yellow and white. Very stiff; moist; highly plastic.	× · · × · · · · · · · · · · · · · · · ·	1.5		UTP	
	Tilgrily plastic.				199/95kPa	
	Wet below 2.1m; poor recovery; purplish brown; possibly top of lignite?		2.0	—	>219/62kPa	
	EOH =2.1m bgl Poor recovery. Groundwater encountered at 2.1m. PK Shear Vane.		3.5	→ ~		
			4.5			0 2 4 6 8 10 13 16 18 20 23 26 28 30 Inferred CBR 10%

SCALA PENETROMET	ER TEST SHEET	Project: Lakeside Developments						
Augered By: NH/JP	Checked By: NH	Date:	27-11-17	Job No.:	4036			

<u> </u>				<u>I</u>									
Test	No.	SP2	2-03	SP2	2-04	SP2	2-05						
0.05	2.05						5						
0.10	2.10						5						
0.15	2.15	Duah					4						
0.20	2.20	Push					4						
0.25	2.25						5						
0.30	2.30						7						
0.35	2.35	1				Push	7						
0.40	2.40	1					7						
0.45	2.45	1		Push			9						
0.50	2.50	1					E S						
0.55	2.55						2.45m						
0.60	2.60	1											
0.65	2.65	1		1									
0.70	2.70	2				1							
0.75	2.75	1				1							
0.80	2.80	1				1							
0.85	2.85	1				1							
0.90	2.90	1		1		1							
0.95	2.95	1		1		1							
1.00	3.00	3		1		2							
1.05	3.05	1		1		3							
1.10	3.10	2		1		2							
1.15	3.15	2		1		2							
1.20	3.20	2		3		1							
1.25	3.25	2		4		2							
1.30	3.30	2		3		2							
1.35	3.35	5		3		4							
1.40	3.40	4		2		3							
1.45	3.45	3		1		3							
1.50	3.50	5		1		3							
1.55	3.55	6		3		3							
1.60	3.60	7		2		4							
1.65	3.65	7		4		4							
1.70	3.70	8		6		5							
1.75	3.75	E S		3		5							
1.80	3.80	1.7m		8		7							
1.85	3.85			9		4							
1.90	3.90			E S		3							
1.95	3.95			1.85m		4							
2.00	4.00					7							
	· <u></u>			· <u></u>		· <u> </u>		· <u> </u>	 	· <u> </u>	 · <u> </u>	· <u> </u>	

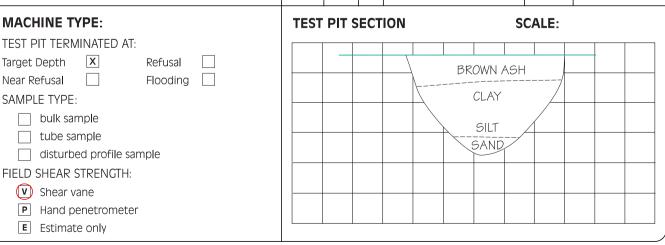
EARTHTECH CONSULTING LIMITED

TEST PIT LOG Test Pit No.: TP2-01 Project: Lakeside Developments (Stage 2) Excavator: 12t - SB Logged by: PK Date: 09/11/17 Ref: 4036



Test Pit No.: **TP2-01 -** Page 2 **TEST PIT LOG** Project: Lakeside Developments (Stage 2) Excavator: 12t - SB Logged by: PK Date: 09/11/17 Ref: 4036 Sample Type Undrained Water Content % Depth (m) **Shear Strength** Soil Description Geology **Testing** (kPa) 200 100 LIGNITE; black. Hard; moist. 241 WHANGAMARINO FORMATION UTP - 4.5 233 UTP Fine-medium SAND with trace silt. Medium dense; pumiceous. 45 - 5.0 LIGNITE; black. Hard; moist. 168 - 5.5 EOP = 5.4mTarget depth reached. Groundwater encountered at 2.6m PK shear vane. 6.0 - 6.5 7.0 F 7.5 **MACHINE TYPE: TEST PIT SECTION SCALE:** TEST PIT TERMINATED AT: X Target Depth Refusal **BROWN ASH** Flooding [Near Refusal SAMPLE TYPE: CLAY bulk sample tube sample SILT disturbed profile sample LIGNITE FIELD SHEAR STRENGTH: (V) Shear vane P Hand penetrometer **E** Estimate only

Test Pit No.: TP2-02 **TEST PIT LOG** Project: Lakeside Developments (Stage 2) Date: 09/11/17 Excavator: 12t - SB Logged by: PK Ref: 4036 Sample Type Undrained Water Content % Depth (m) Shear Strength Geology Soil Description **Testing** (kPa) 5857325.593mN 1790533.163mE 100 200 TOPSOIL. **BROWN ASH** 0.25 CLAY with minor fine sand; light yellowish brown. 169/53kPa Massive; very stiff; moist; friable. - 0.5 33 149/83kPa CLAY with some fine sand and trace fine grayl; mottled grey and light yellowish brown. Massive; stiff; moist. 0.6m-2.6m 126/79kPa NZ standard compaction OWC=49% 48 1.0 NWC=64% 123/63kPa MDD=1.03t/m3 S.. (OWC) = 162kPa 131/48kPa Av (OWC)=9 % Silty CLAY; light greyish brown. Massive; stiff; wet; low $sd=2.54t/m^{3}$ plasticity. F 1.5 **5**5 114/44kPa 1.6 FORMATION 106/41kPa **1** 76 -2.0 114/59kPa ×× Layered SILT; light grey. Stiff; moist; pumiceous; low WHANGAMARINO plasticity. - 2.3 115/48kPa Fine SAND with trace silt; light grey. Medium dense; moist; pumiceous. 2.5 **8**1 - 3.0 72 EOP = 3.0mTarget depth reached. Groundwater not encountered. PK shear vane. - 3.5 **MACHINE TYPE: TEST PIT SECTION** SCALE: TEST PIT TERMINATED AT: X Target Depth Refusal



Near Refusal

SAMPLE TYPE:

bulk sample

tube sample

(V) Shear vane

E Estimate only

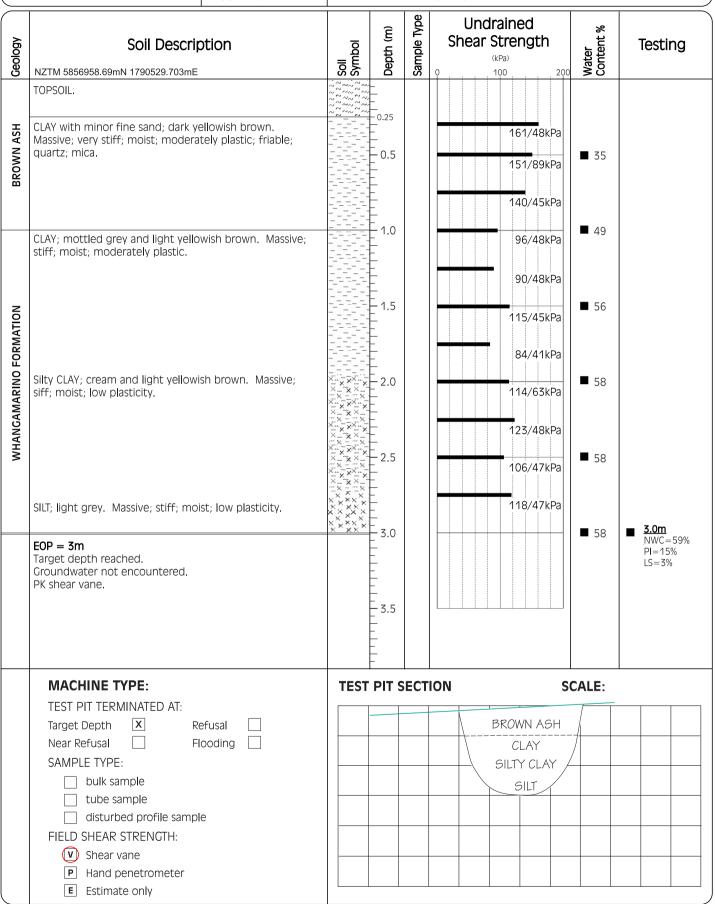
	TEST PIT	1.00	Test F	Pit No).: T	P2-03				
	IESI PII	LOG	Proje	ct:	La	ikeside D	evelopme	ents - S	tage 1	
Exca	avator: 12t SB	Logged by: PK	Date:		90	3/11/17			Ref: 4036	
Geology	Soil Descrip NZTM 5857023.034mN 1790277.810mB		Soil	Depth (m)	Sample Type	Shear S	rained Strength ^(kPa)	Water Content %	Testing	
BROWN ASH	TOPSOIL. CLAY with trace fine sand; light ye Massive; very stiff; moist; friable;	llowish brown.		0.25			UTP 213/59kPa 165/86kPa 184/101kPa 192/109kPa 202/83kPa	■ 46 ■ 47 ■ 46	■ 0.3 0.3m-1.7m NZ standard compaction MDD=1.17t/ OWC=44% NWC=42% ■ 1.0 S _u (OWC)=162k Av (OWC)=5% sd=2.71t/m³ CBR (OWC)=5% PI=46% LS=13% ■ 1.7	кРа
NO FORMATION	CLAY; light grey and light yellowish stiff; moist; moderately plastic. Silty CLAY; light grey and reddish the stiff; moist.			- 1.8 - 2.0 - 2.3 - 2.5 - 2.5			151/83kPa 147/63kPa 149/71kPa	■ 51 ■ 68	1.7m-3.4m NZ standard compaction MDD=1.14t/ OWC=45% NWC=57% S _u (OWC)=162k Av (OWC)=5%	
WHANGAMARIN	Clayey SILT; light grey. Massive; st Silty medium-coarse SAND; light g dense; wet.		X X X X X X X X X X X X X X X X X X X	- 2.9 - 3.0 3.4 - 3.5 			71/38kPa 120/45kPa	■ 52 ■ 68	— 3.4	
		efusal	TEST	PIT S	ECTIO	ON	S	SCALE:		-



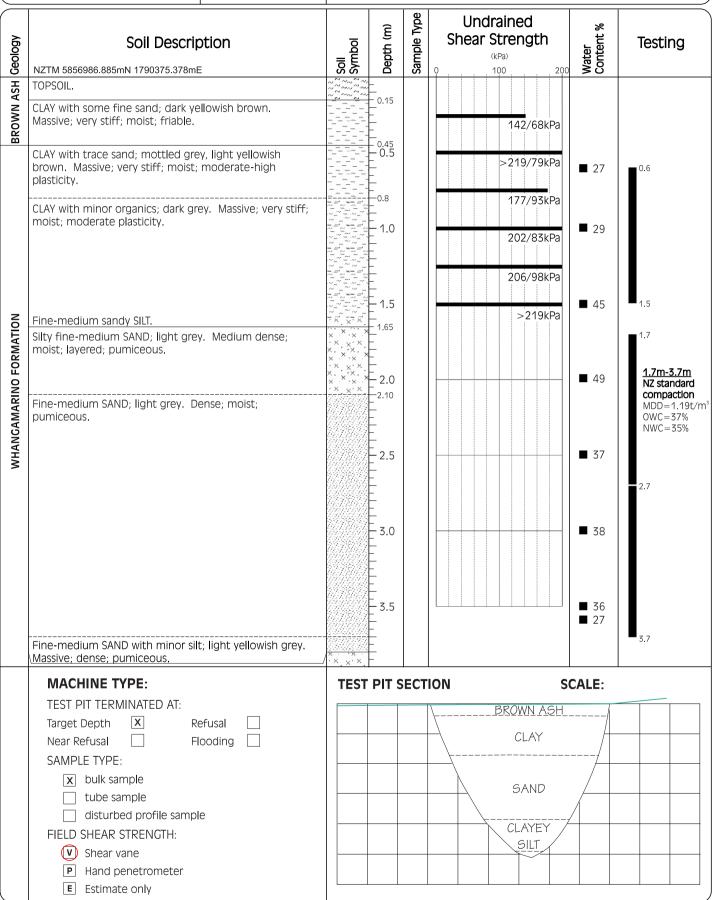
P Hand penetrometerE Estimate only

	TEST PIT	100	Test F	Pit No).: T	P2-03	- Page 2		
	IESI PII	LOG	Proje	ct:	La	keside	Developn	nents	
xca	vator:	Logged by: PK	Date:		30	3/11/17	,		Ref: 4036
Geology	Soil Descri 5857023.034mN 1790277.810mE	otion	Soil Symbol	Depth (m)	Sample Type		Irained Strength	Water Content %	Testing
WHANGAMARINO FORMATION	Silty medium- coarse SAND; light medium dense; wet. Medium-coarse SAND; light grey.	4.8	X	- - - - - - - - - - - - - - - - - - -				■ 63 ■ 50	4.4
WHANGA	dense; wet.			-5.0 -5.0 				■ 51	
	EOP = 5.4m Target depth reached. Groundwater not encountered. PK shear vane.		TEST	5.5 	ECT	ON		SCALE	
	MACHINE TYPE: TEST PIT TERMINATED AT:		TEST	PIT S	ECTI	ON		SCALE:	
		efusal							

TEST PIT LOG Test Pit No.: TP2-11 Project: Lakeside Developments - Stage 1 Excavator: 12t - SB Logged by: PK Date: 09/11/17 Ref: 4036



TEST PIT LOG Test Pit No.: TP2-12 Project: Lakeside Developments - Stage 1 Excavator: 12t - SB Logged by: PK Date: 09/11/17 Ref: 4036



TEST DIT	1.00	Test Pit No	D.: TP2-12 - Page 2	
TEST PIT	LUG	Project:	Lakeside Developments	
Excavator:	Logged by: PK	Date:	09/11/17	Ref: 4036
			Ψ Use almatic and	

	Ivator: Logged by: PK	Date:		19/11/17		Ref: 4036
Geology	Soil Description 5856986.885mN 1790375.378mE	Soll Symbol Depth (m)	Sample Type	Undrained Shear Strength	Water 62 Content %	Testing
WHANGAMARINO FORMATION	Clayey SILT; light brownish grey. Massive; very stiff; moist; low plasticity.	X X X X X X X X X X X X X X X X X X X		151/48kPa	■ 42 ■ 83	
WHANGA	Fine-medium SAND; light grey. Massive; medium dense, moist.	5.0			■ 63	
	EOP = 5.2m Target depth reached. Groundwater not encountered. PK shear vane.	- 5.5 - 6.0 - 6.5 - 7.0				
	MACHINE TYPE:	TEST PIT S	SECT	TION S	CALE:	
	TEST PIT TERMINATED AT: Target Depth X Refusal Near Refusal Flooding SAMPLE TYPE: x bulk sample tube sample disturbed profile sample FIELD SHEAR STRENGTH: v Shear vane P Hand penetrometer E Estimate only			SAND CLAYEY SILT		

	TEST DIT	1.00	Test I	Test Pit No.: TP2-13								
	TEST PIT	LUG	Proje	ect:	L	akeside De	evelopme	nts - 9	Stage	1		
Exca	avator: 12t - SB	Logged by: PK	Date		0	9/11/17			R	ef: 4036		
Geology	Soil Descrip NZTM 5856946.089mN 1790000.557mB		Soil Symbol	Depth (m)	Sample Type	Undra Shear St	rength	Water Content %	Tes	sting		
	TOPSOIL.	-			0,							
BROWN ASH	CLAY with some fine sand; dark br stiff; moist; friable; quartz; mica.	own. Massive; very		0.23			115/60kPa 138/81kPa 155/98kPa	■ 41 ■ 52				
	CLAY with trace sand; mottled gre brown. Massive; very stiff; moist;					\ \ \	83/48kPa 219/101kPa					
z	SILT with trace sand; dark yellowish stiff; wet; friable.	n brown. Massive; very	~ × × × × × × × × × × × × × × × × ×	- 1.5 - 1.5			142/48kPa	■ 64	•			
WHANGAMARINO FORMATION	SILT with some fine sand; light yell Massive; stiff; wet; low plasticity.	lowish brown.	** * * * * * * * * * * * * * * * * * *	- 2.0 - 2.5 - 3.0 - 3.5 - 3.95			115/48kPa 131/71kPa 93/48kPa 109/50kPa 98/47kPa 93/48kPa 86/44kPa	■ 88 ■ 95 ■ 79	on 649	nsitive soil basis NWC % to 95% 82%		
	MACHINE TYPE:		TEST	PIT S	ECT	ION	S	CALE:				
		efusal ooding e				Le soils subho	evel site rizontally la	yered				



P Hand penetrometerE Estimate only

	TEST PIT	100	Test Pit No.: TP2-13 - Page 2									
	TEST PIT	LOG	Proje	ct:	La	akeside D	Developme	nts				
Exca	vator:	Logged by: PK	Date:		09	9/11/17			Ref: 4036			
Geology	Soil Descrip NZTM 5856946.089mN 1790000.557mB		Soil Symbol	Depth (m)	Sample Type	Shear S	rained Strength 100 200		Testing			
WHANGAMARINO FORMATION	CLAY with minor sand; cream. Ma moderate plasticity; mica. SILT with some fine sand; cream a moist; low plasticity; pumiceous.						153/93kPa 127/95kPa 121/74kPa	■ 42 ■ 50	■ 5.0m			
7HM	EOP = 5.2m Target depth reached. Groundwater not encountered. PK shear vane.		****** ****** *****					■ 58	NWC=58% PI=40% LS=15%			
	MACHINE TYPE: TEST PIT TERMINATED AT:		TEST	PIT S	ECTI	ON	S	CALE:				
		efusal ooding efusal					Level site norizontally la	yered				

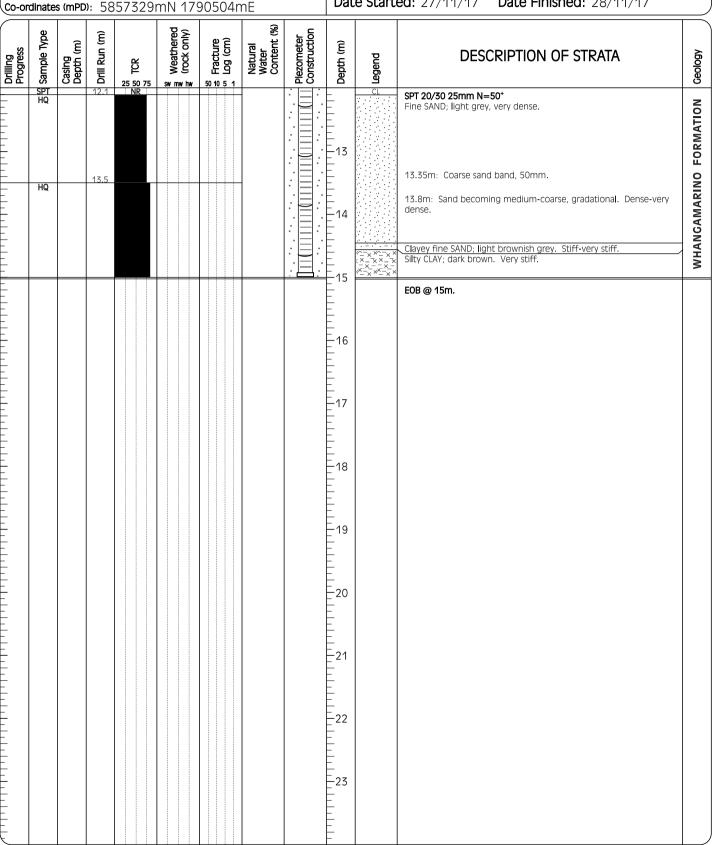


Bore No.: BH2-02 Sheet 1 of 2 **DRILL HOLE LOG** Client: WINTON PARTNERS Drilled by: DrillForce Project: LAKESIDE, TE KAUWHATA Ref: 4036 Collar Level: Date Started: 27/11/17 Date Finished: 28/11/17 (mPD): 5857329mN 179050/mF

Co-on	dinate	s (mPD): 58	57329n	<u>nN 179</u>	0504r	nE			Da	LE Starti	ed: 2//11/1/	
Drilling Progress	Sample Type	Casing Depth (m)	Drill Run (m)	알 25 50 75	wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww	Practure Log (cm)	Natural Water Content (%)	Diozometer	Construction	Depth (m)	Legend	DESCRIPTION OF STRATA	Geology
_	HQ									E	(×-×^-×^	TOPSOIL: Slightly sandy SILT with minor clay; brown.	Ξ
-										1	X-XX-XX 	Slightly silty (1 AV with trace mica: light vellowish brown - Very stitt - I	BROWN ASH
E			4.5							E		Fine SAND with some silt; light yellowish grey. Very stiff.	_
	SPT		1.5				†			Ł	×_~×_~×	1.4m-1.45m: Medium SAND. SPT 1/1//1/0/1/0 N=2	
E			1.95							£		Silty CLAY; mottled yellowish brown.	
_	HQ		1.33				1			- 2		Medium SAND; light grey. Trace fine disseminated blackish brown	
												flecks. 1.95m: clay clasts to 100mmØ; medium dense-dense. Trace black and dark yellowish orange ferruginous staining.	
_	SPT		3				-			<u></u>	,	SPT 0/0//1/2/2/3 N=8	
F	01 1									Ӻ	x=_\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	SILT with minor clay; yellowish orange. Fe oxide on irregular fracture	
- - - - -	HQ		3.45							4		olanes. LIGNITE; black, hard. 3.5m-3.55m: Coarse SAND; grey. 3.65m: 50mm SILT clast; dark brown.	
E										E		4.5m-4.55m: medium SAND; grey.	
	SPT		4.5				1			E		SPT 1/2//2/5/4/7 N=18	
- 1			4.95							"		Core fractures on 85° to core axis (bedding).	
	HQ		4.33				1			- 5			_
										‡			<u> </u>
F										F		Medium SAND; light grey. Veinlets of organic black material.	-
Εl										E		- I some start and start a	RMATION
	CDT		6				1	\leq		_6		LIGNITE; black, hard. SPT 2/4//4/5/4/6 N=19	R
F I	SPT									‡		6.15m: 10mm sand band; medium with clasts in lignite above sand	<u>Б</u>
	HQ		6.45				-			E		horizon.	
F	ПЫ							\geq		}			2 2
F									-	F ,		Medium SAND with minor clay; graduating to fine SAND.	ARIN
E										£′	;_x_^;_x_^	SILT with minor clay; brownish grey. Very stiff.	۷
⊨ I			7.5							‡	KX-XX-X		Ā
E	SPT									ŧ	X_XX_X XX_XX_X XX_XX_X XX_XX_X	SPT 1/1//1/2/2/3 N=8 Thin black organic flecks disseminated throughout (1%-2%); wood fragments (2mm-3mmØ twigs).	ANGAM
	HQ		7.95				†			[8	- x - x	Coarse pumiceous SAND; light grey with brown organic flecks.	¥
F										1		LOOSE.	>
F										丰	* 1 v 1 v	8.25m: 100mm lignite band.	
E										E		Fine SAND; light grey. Medium dense. Black disseminated organic	
<u> </u>	CDT		9				1		-	<u></u> ‡9		material.	
E	SPT							K	K	ŧ		SPT 3/4//2/2/4 N=10	
	HQ		9.45				1			F		\& 8.85m: Lignite, 250mm Slightly clayey fine SAND. Medium dense. Black organic segregations.	
-	1162									#	[설문설문]	9.8m: Clayey SILT band.	
E									7.7 2.5	E ₁₀	1.00	Coarse SAND; grey. Medium dense.	
E								:	:	Ε'n		LIGNITE; black, hard. 10.2m: 30mm lignite band	
 			10.5							Ė			
	SPT		10.5				1	٠.	[·]	.E		SPT 4/7//7/10/15/18 35mm N=50 ⁺ Fine SAND with slight silt; light grey. Localised banding due to	
F			10.95					:	_ :	F		fine/very fine sand bands 3mm-5mm width. Very dense.	
F	HQ						1			<u>-</u> 11			
F									\equiv	F			
E									= :	Έ			
 									∄'.	Ŀ			
			12				<u></u>		<u> </u>	<u> </u>	<u> </u>		_/
Rema	rks.							Loc	ged	Bv:		NH Water Level Observations During Drilling	

Remarks:	Logged By:	NH	Water Level Observations During Drilling					
	Date:		Date	Time	Depth	Depth	Depth	
	Checked By:	PIK	Date	Tille	of Hole	of Casing	of Water	
	Scale:							
	Hole Length:	15m						
	Core Boxes:							





Remarks:	Logged By: NH		Water Level Observations During Drilling					
	Date:	Date	Time	Depth	Depth	Depth		
	Checked By: PIK	Date	IIIIIe	of Hole	of Casing	of Water		
	Scale:							
	Hole Length: 15m							
	Core Boxes:							





0.0m-2.6m



2.6m-5.5m

BOREHOLE BH2-02

Page 1 of 3



5.5m-8.6m



8.6m-11.9m

BOREHOLE BH2-02

Page 2 of 3



11.7m-15m

DRILL HOLE LOG Bore No.: BH203 Sheet 1 of 2 Client: WINTON PARTNERS Drilled by: DrillForce Project: LAKESIDE, TE KAUWHATA Collar Level: Co-ordinates (mPD): 5856989mN 1790343mE Date Started: 25/11/17 Date Started: 25/11/17 Date Finished: 25/11/17

(00-01	un lace.	3 (ITIFD	, JO	303031	11111 173	<u> 1034311</u>	<u> </u>		Date started: 23/11/17 Date Finished: 23/11/17				
Drilling Progress	Sample Type	Casing Depth (m)	Drill Run (m)	25 25 50 75	¥ Weathered ₹ (rock only)	Fracture tog (cm)	Orlli Water Loss (%)	Plezometer		Depth (m)	Legend	DESCRIPTION OF STRATA	Geology
	HQ							\$\$\$\$\$\$\$\$.1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	TOPSOIL. Clayey SILT; dark yellowish orange. Loose; firm-soft; Fe mottles; rootlets. Clayey SILT; light grey with orange Fe mottles. Loose. Becoming hematitic brown below 1.2m	АЅН
	SPT		1.5 1.95							. 2		SPT 0/1//1/0/0/1 N=2 1.6m: oxides; dark yellowish orange staining. Black MnO ₂ disseminated; fine grained. Slightly sandy SILT with trace clay; pale yellowish brown. Stiff; clasts, quartz dominated.	BROWN
-	SPT		3					XXXX			X X X X X X X X X X X X X X X X X X X	Increasing sand towards base, flakes of black organic material. SPT 2/2//3/4/4 N=13 Slightly silty SAND; light grey. Medium dense-dense; fine-medium	
	HQ		3.45	LC LC				0.0000			X: X: X X: X: X X: X: X	grained. Trace veinlets of organic material, clear quartz; sand with trace pumice fragments; 1% disseminated black mineral.	
-	SPT		4.5 4.95							· · ·5	X X X X	SPT 6/7//7/8/8 N=30	
	SPT		6								X X X X X X X X X X X X X X X X X X X	CLAY; light brown with Greenish brown disseminated mottles. Stiffvery stiff; moderately plastic lacustrine clay. SILT with trace sand; greenish brown. Medium dense-dense; fine grained. SPT 4/5//5/4/5/7 N=21	RMATION
	HQ		6.45							· · · · 7	× × × × ×	Silty SAND with decreasing silt; light yellowish brown. Medium dense; black fine grained disseminated material; fine grained sand. Fine-medium grained SAND; grey. Medium-dense.	0 F0
	SPT		7.5 7.95									SPT 2/3//4/5/4/3 N=16 Fine grained SAND; grey. Medium dense. Medium grained SAND; grey.	NGAMARIN
										. 9		Fine grained SAND, slightly silty; light grey to light brownish grey; medium dense; clean sand. Silty SAND; light grey. Medium dense; very fine grained; becoming organic. SDT 1/2/2/1/2/3 N=8	WHAN
	SPT		9.15								X	SPT 1/2//2/1/2/3 N=8 Sandy SILT; brown. Medium dense; very fine grained sand; organic.	
			10.7							· ·10 ·	**************************************	SILT with trace sand; brown. Medium dense; organic with thin lignite bands. 9.9m: 10mm lignite band 10.2m: 30mm lignite band SPT 2/2//3/2/2/4 N=11	
-	SPT		11.15							11		Slightly silty SAND; grey. Medium dense; very fine grained. LIGNITE; black; hard. SAND with trace silt; brownish grey. Medium dense; clean;	
			12									medium-coarse grained.	

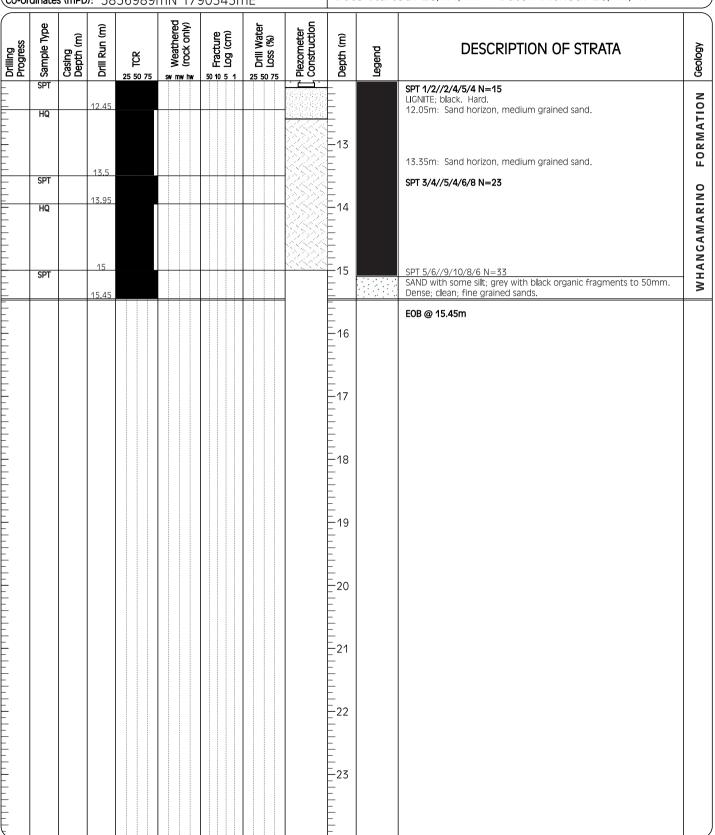
Remarks:

Note: Soil strengths from core, SPT and adjacent CPT2-26.

Logged By:	NH		Water Level Observations During Drilling									
Date:		Date	Time	Depth	Depth	Depth of Water						
Checked By:	PIK	Date	HILLE	of Hole	of Casing							
Scale:	14/12/17											
Hole Length:	15.45m											
Core Boxes:						ر ا						

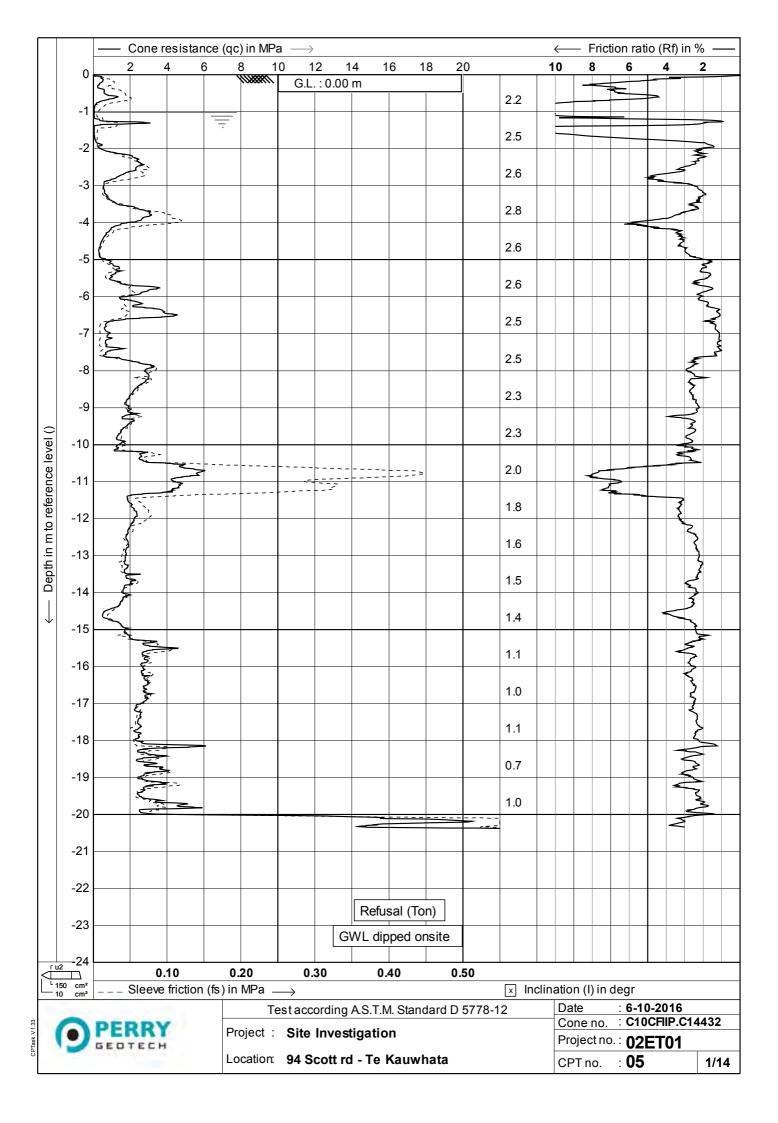


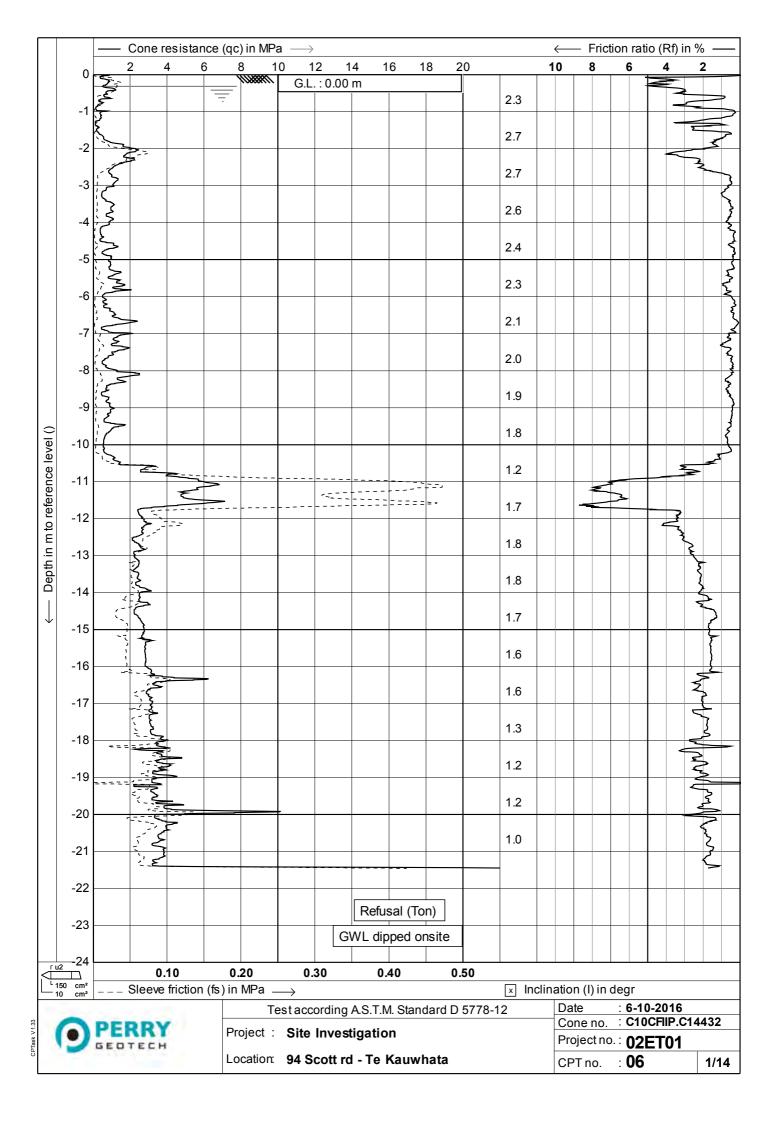
Bore No.: BH203 Sheet 2 of 2 **DRILL HOLE LOG** Client: WINTON PARTNERS Drilled by: DrillForce Project: LAKESIDE, TE KAUWHATA Ref: 4036 Collar Level: **Date Started**: 25/11/17 Date Finished: 25/11/17 Co-ordinates (mPD): 5856989mN 1790343mE

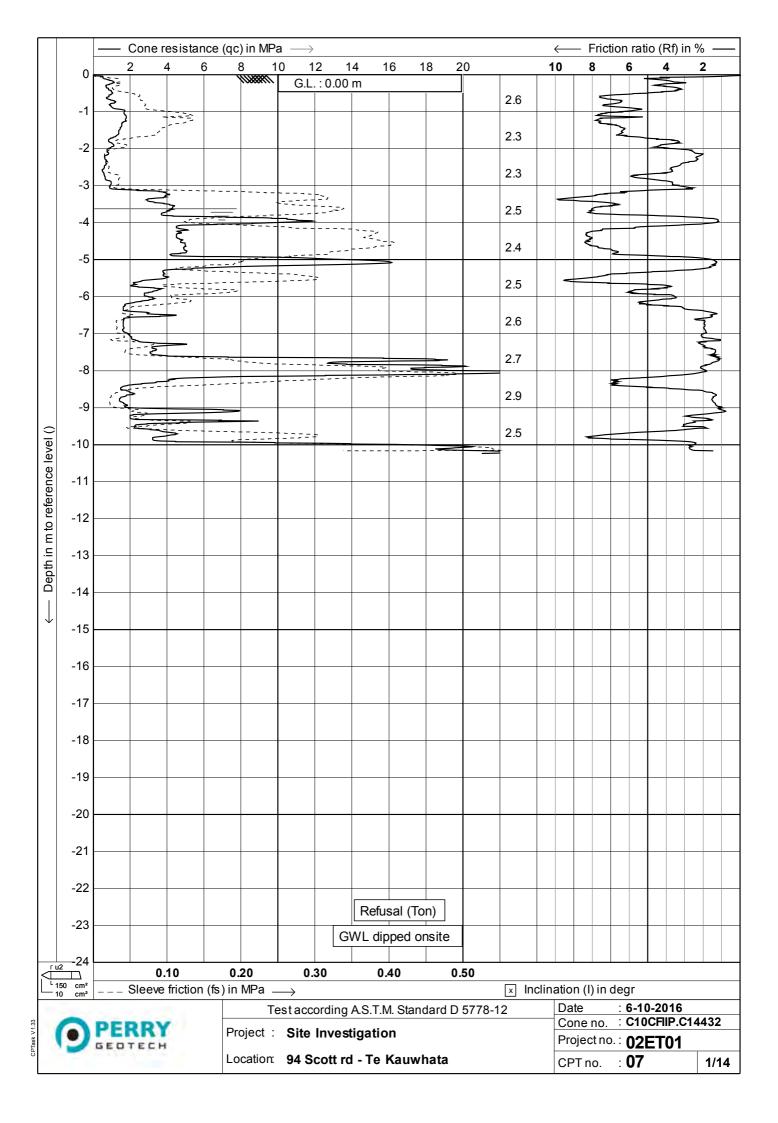


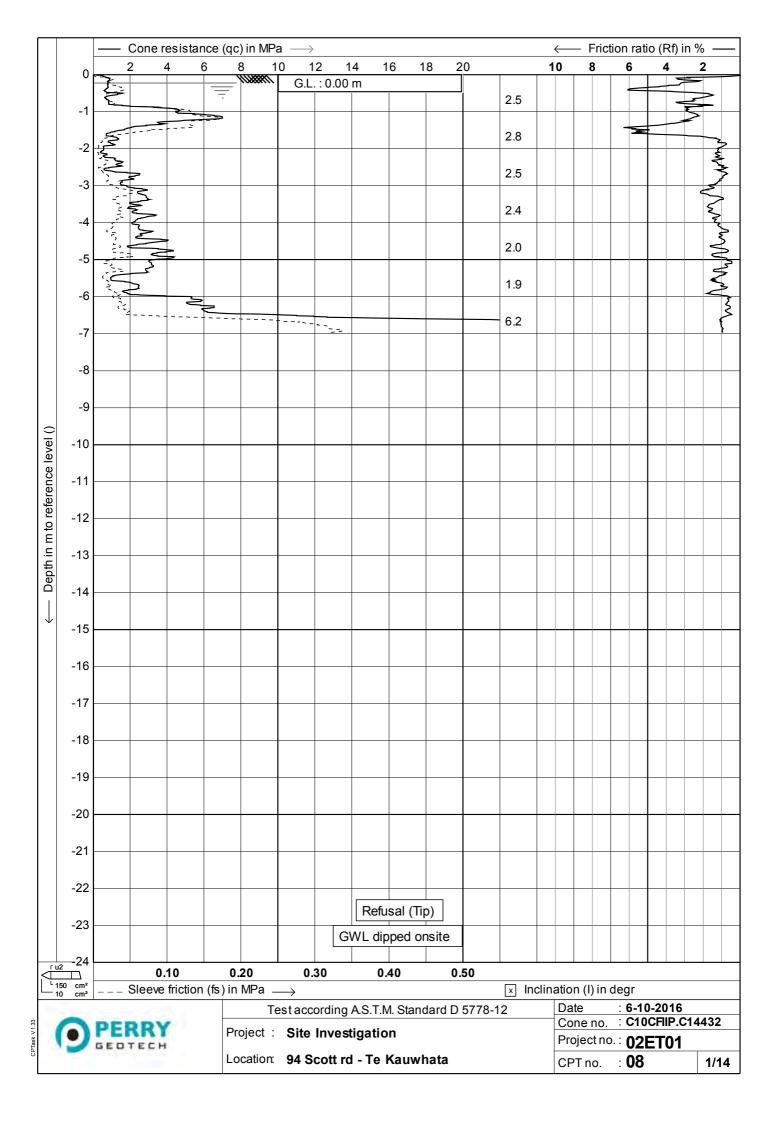
Remarks:	Logged By:	NH	Water Level Observations During Drilling					
	Date:		Date	Time	Depth	Depth	Depth	
	Checked By:	NH	Date	IIIIIe	of Hole	of Casing	of Water	
	Scale:							
	Hole Length:	15.45m						
	Core Boxes:							

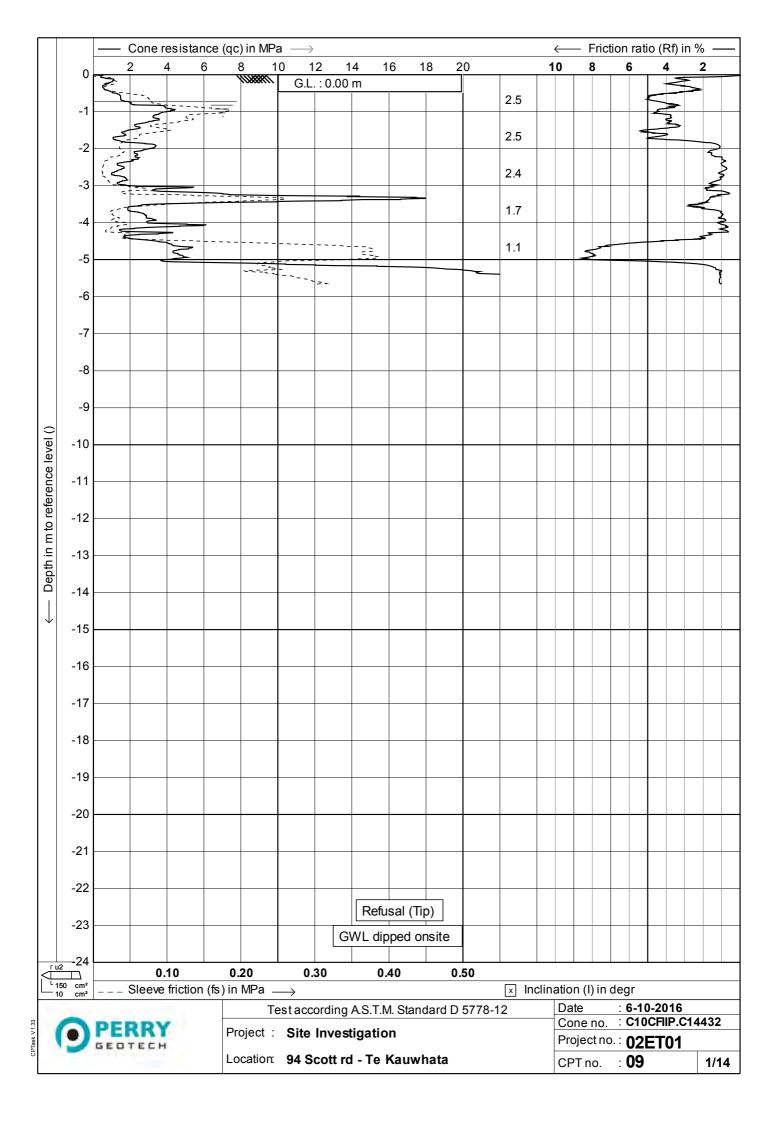


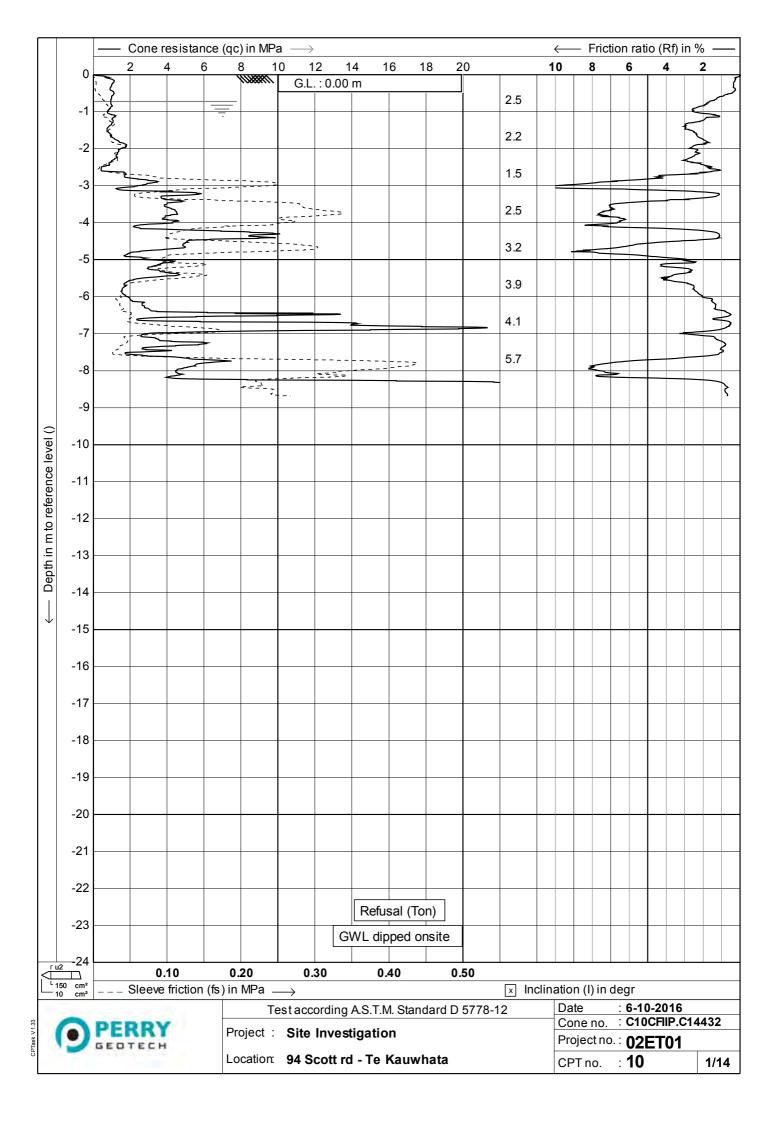


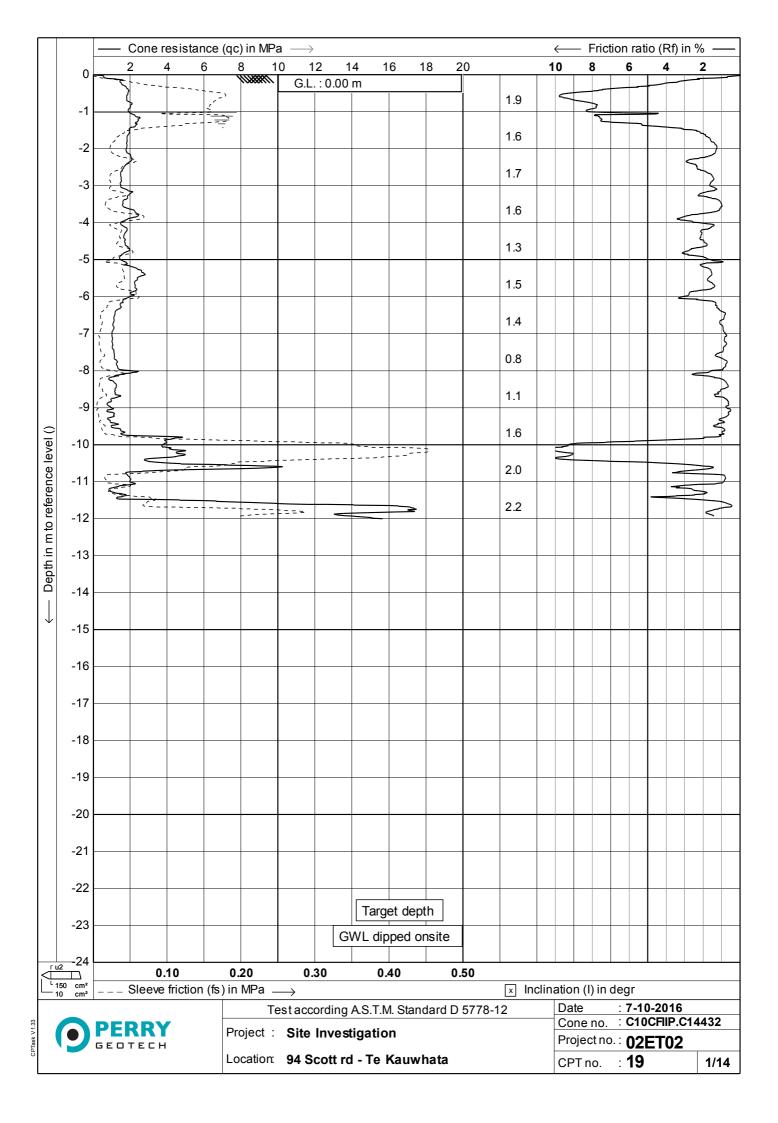


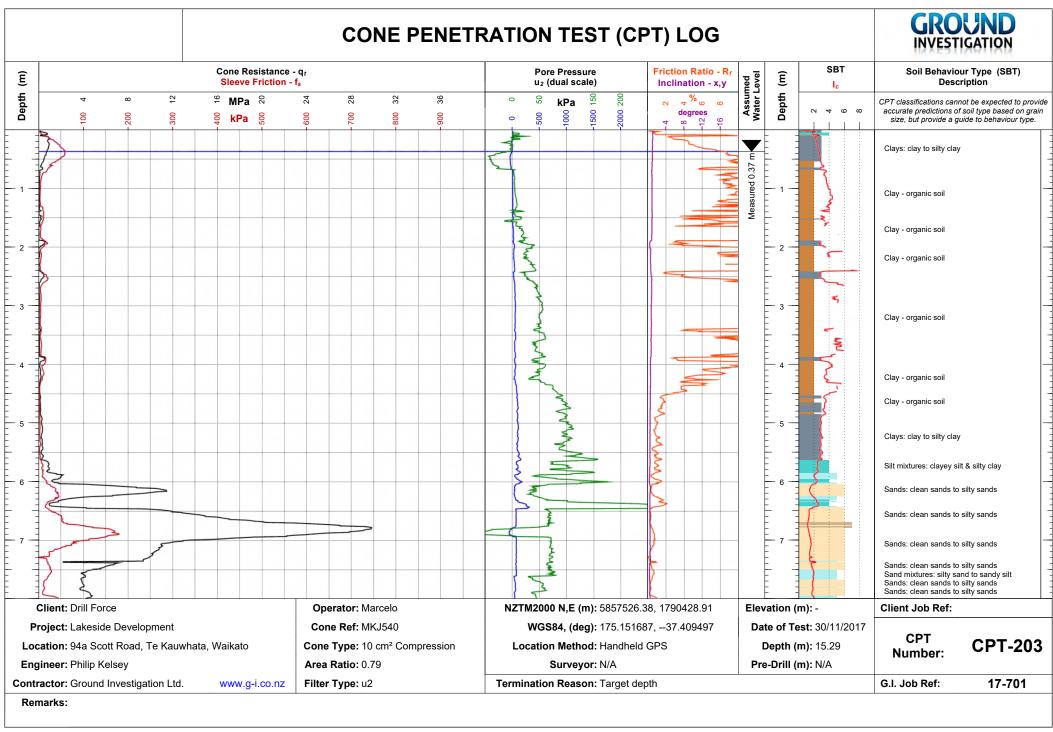


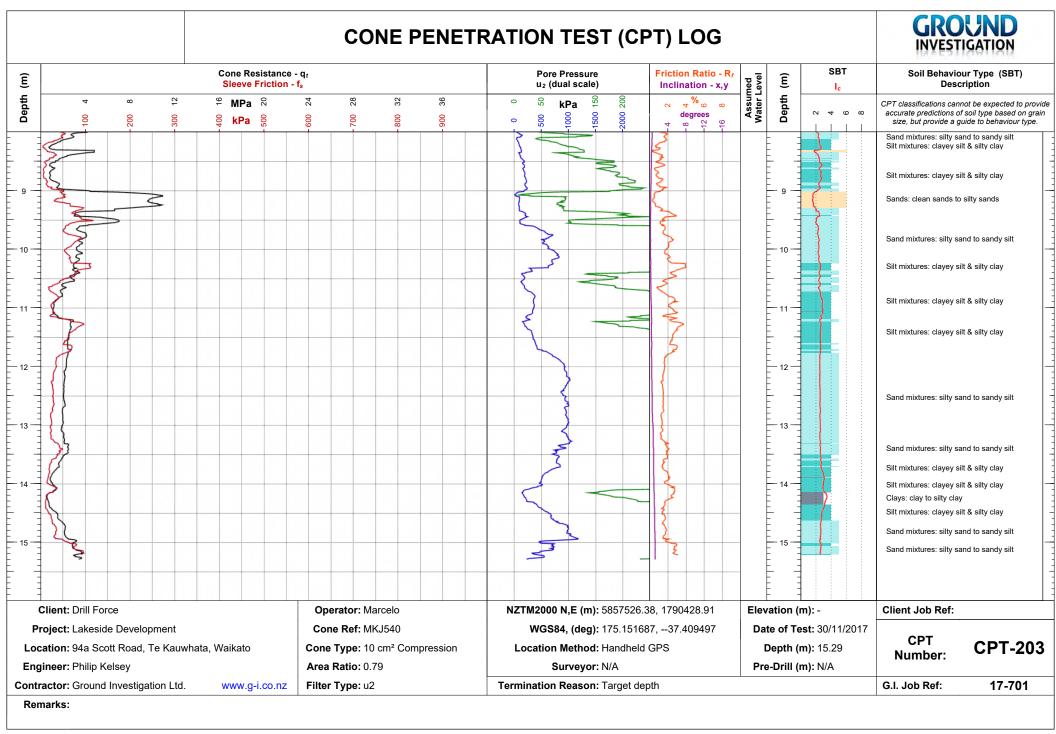


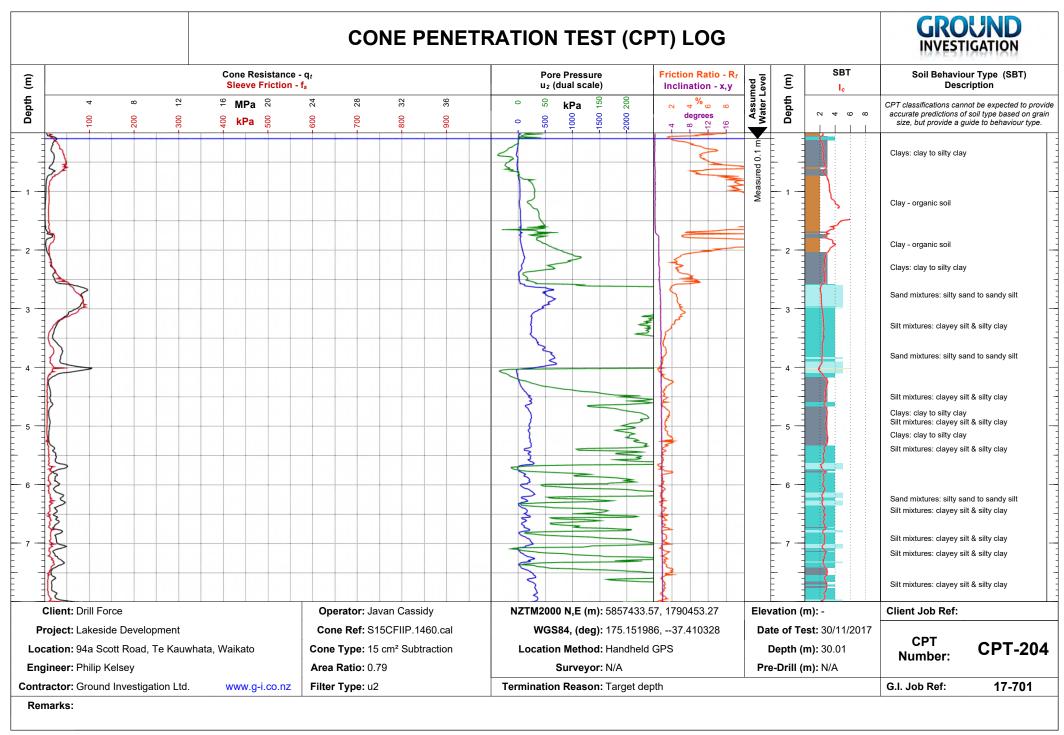


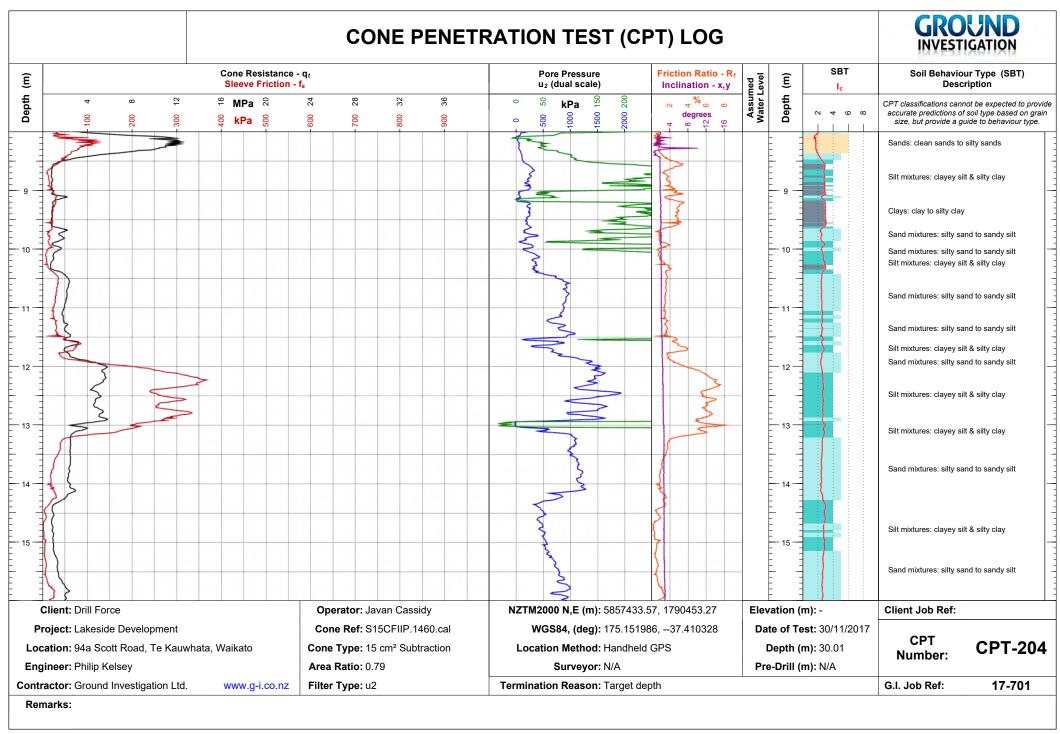


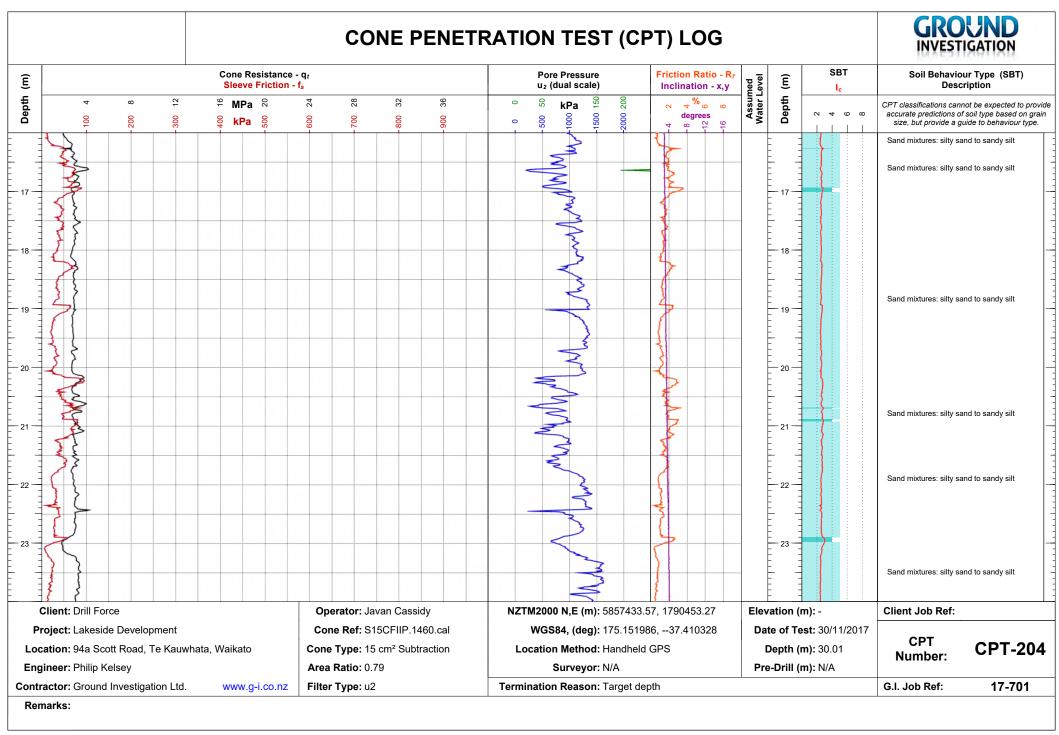


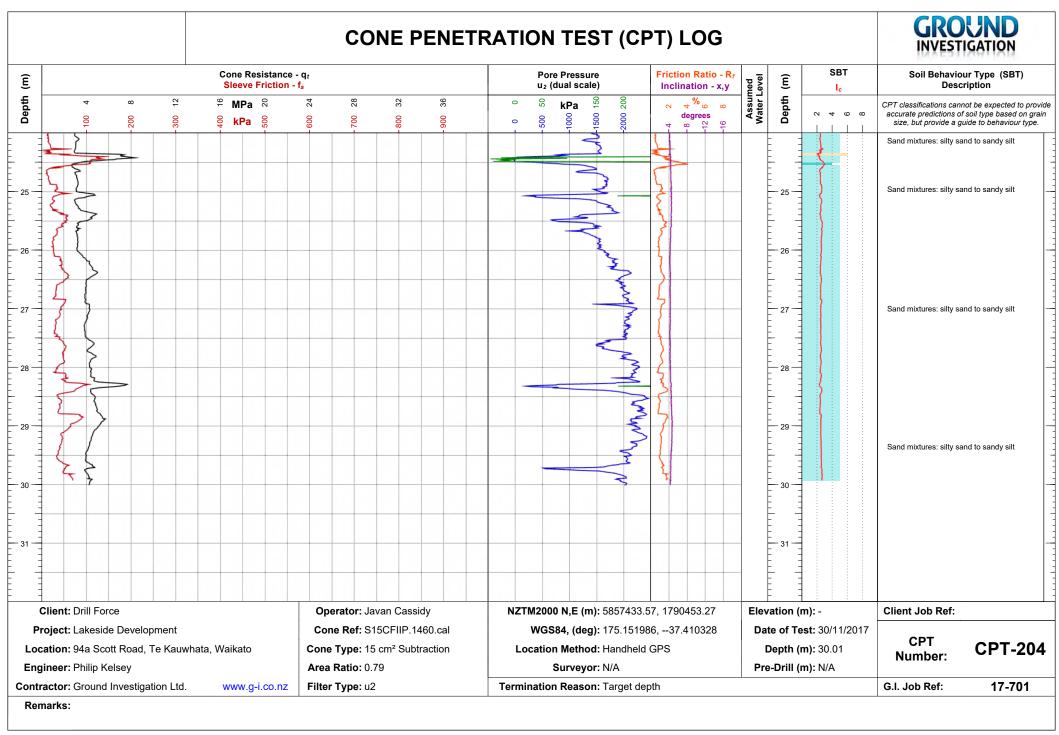


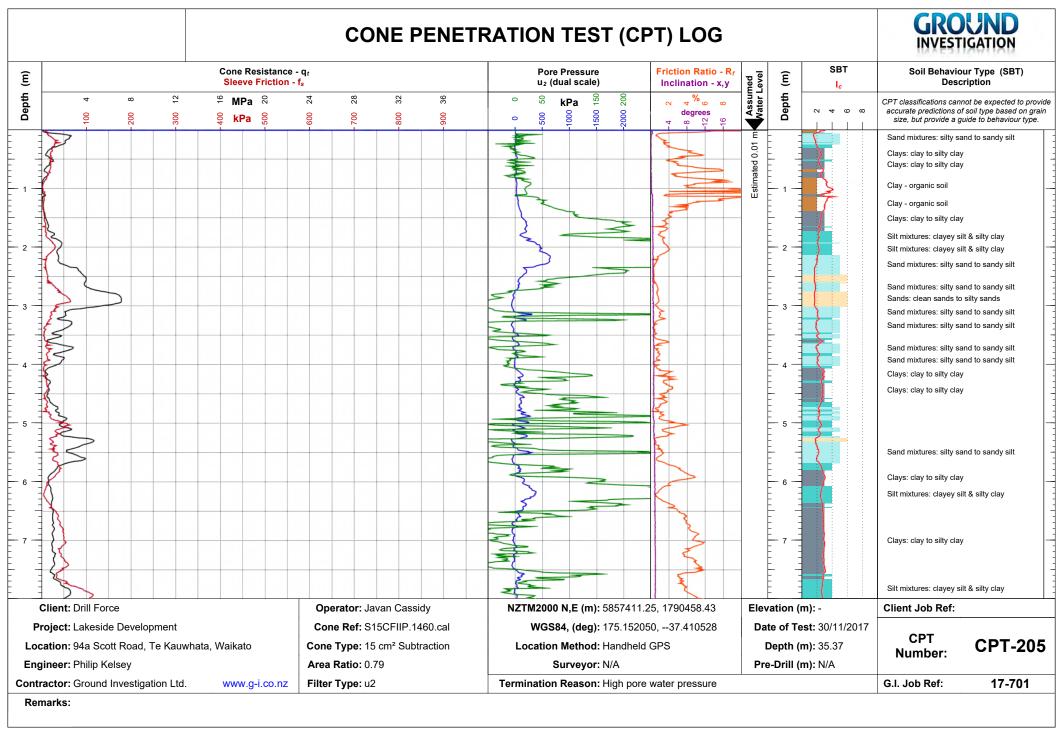


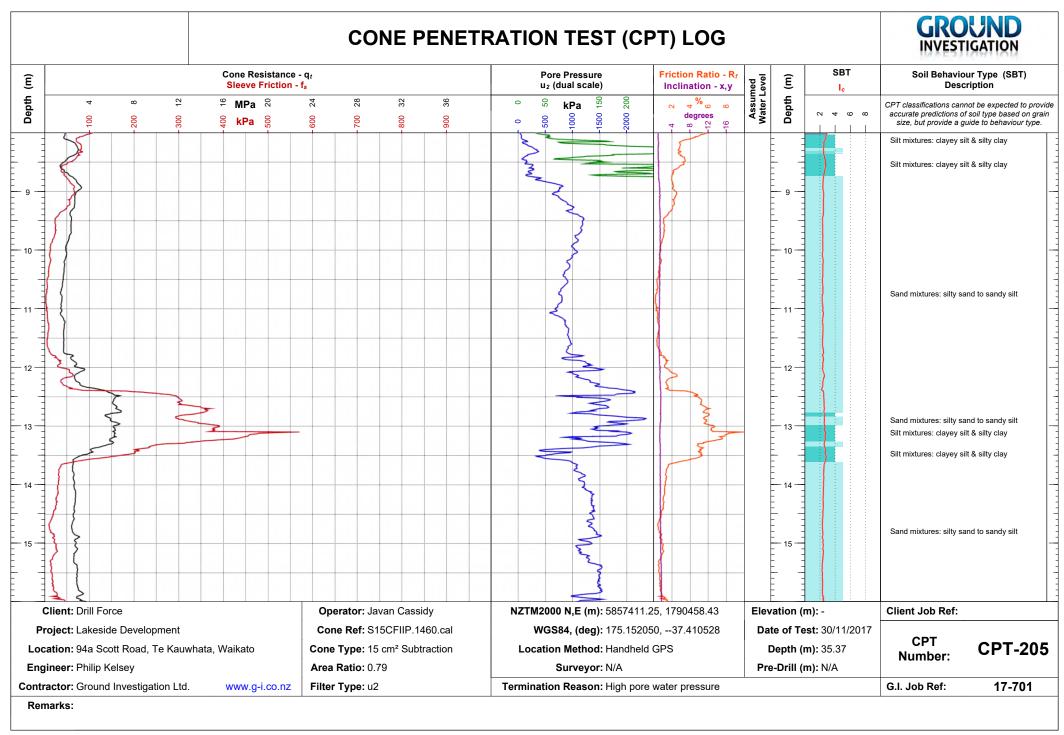


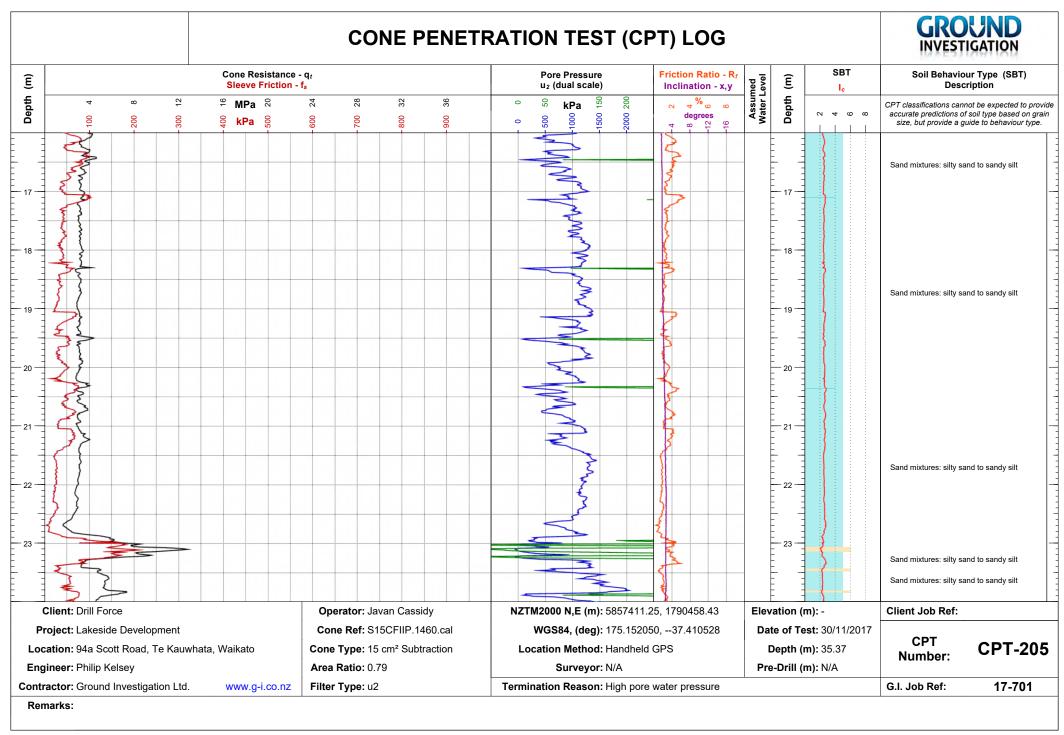


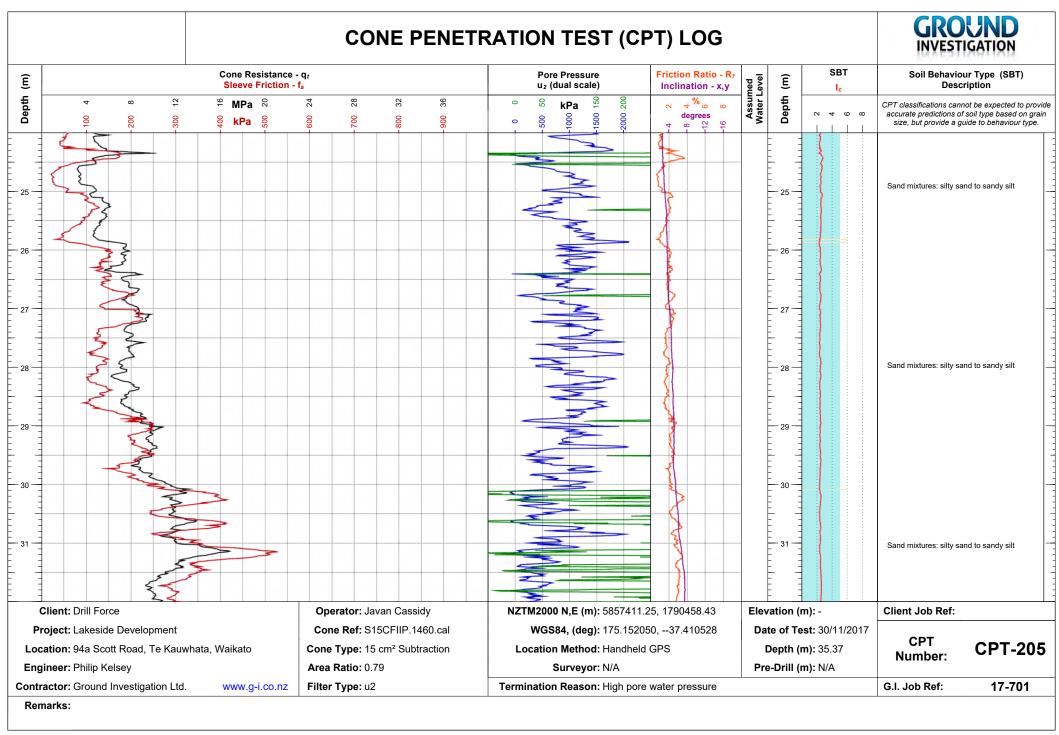


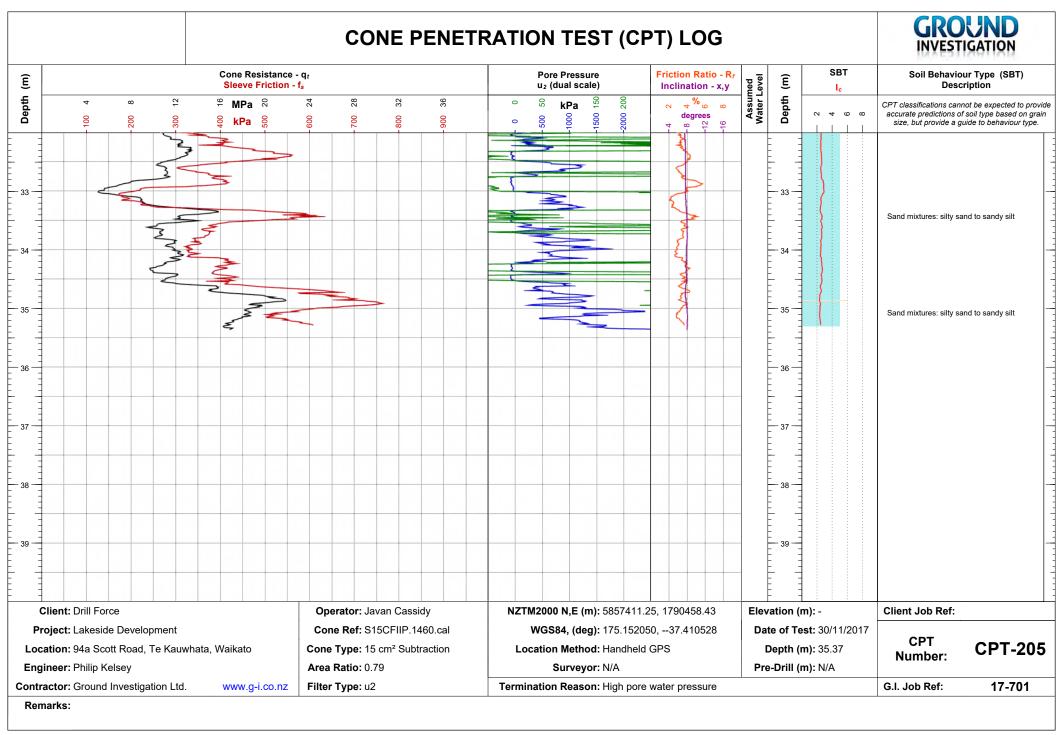


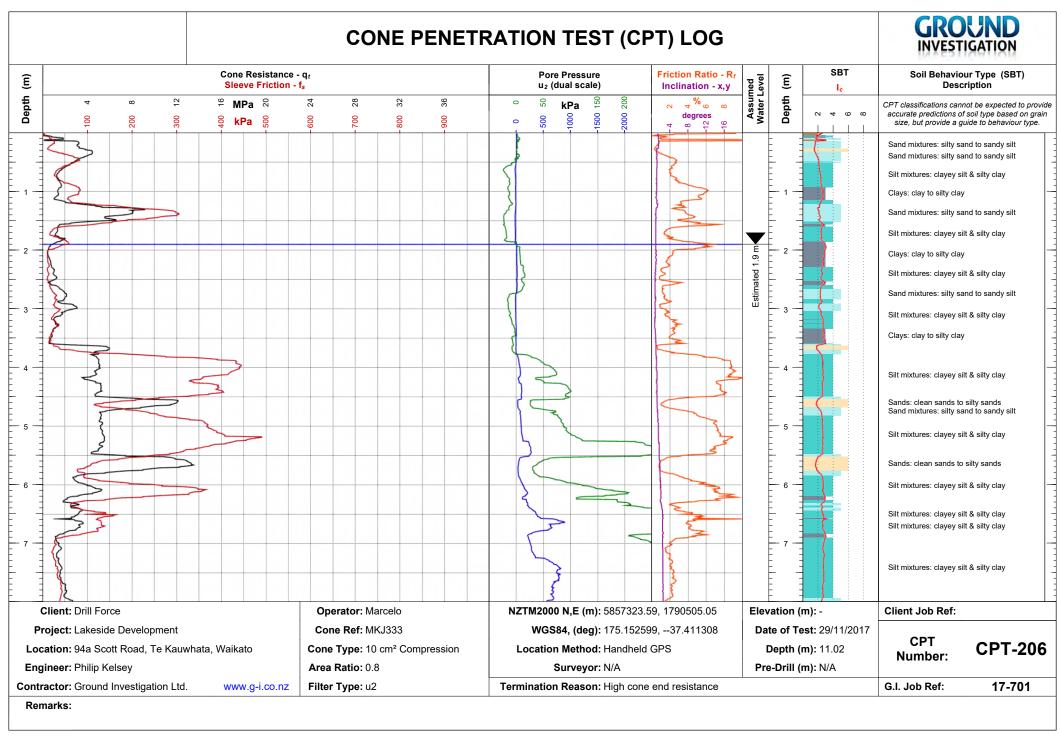


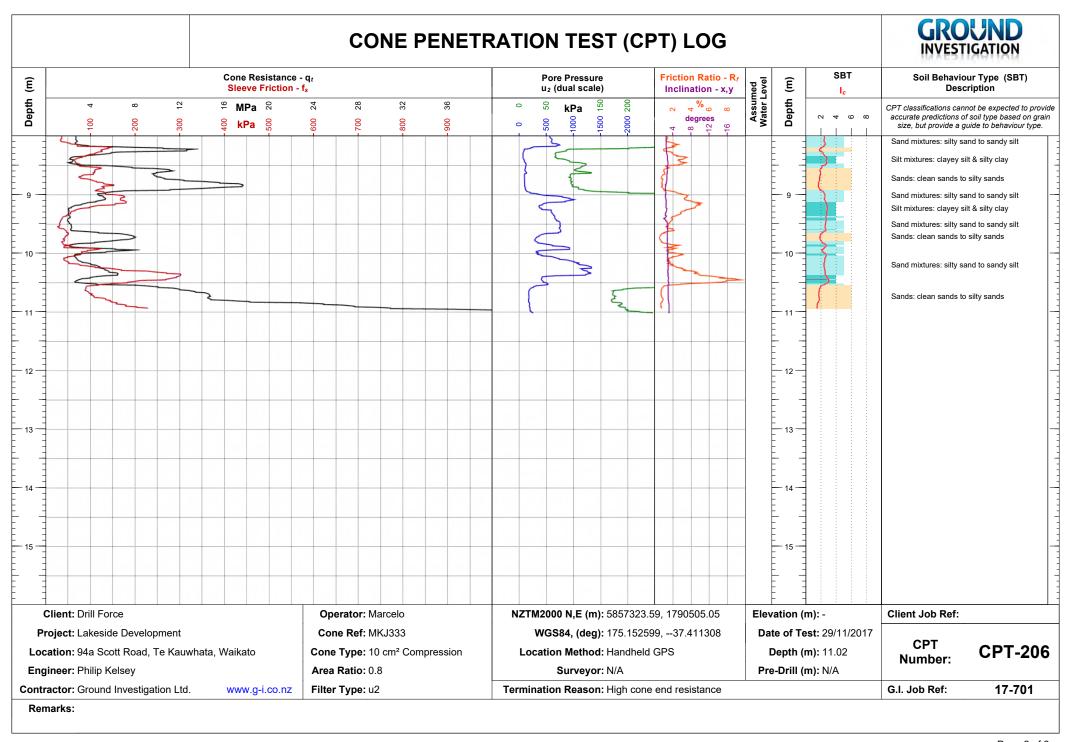


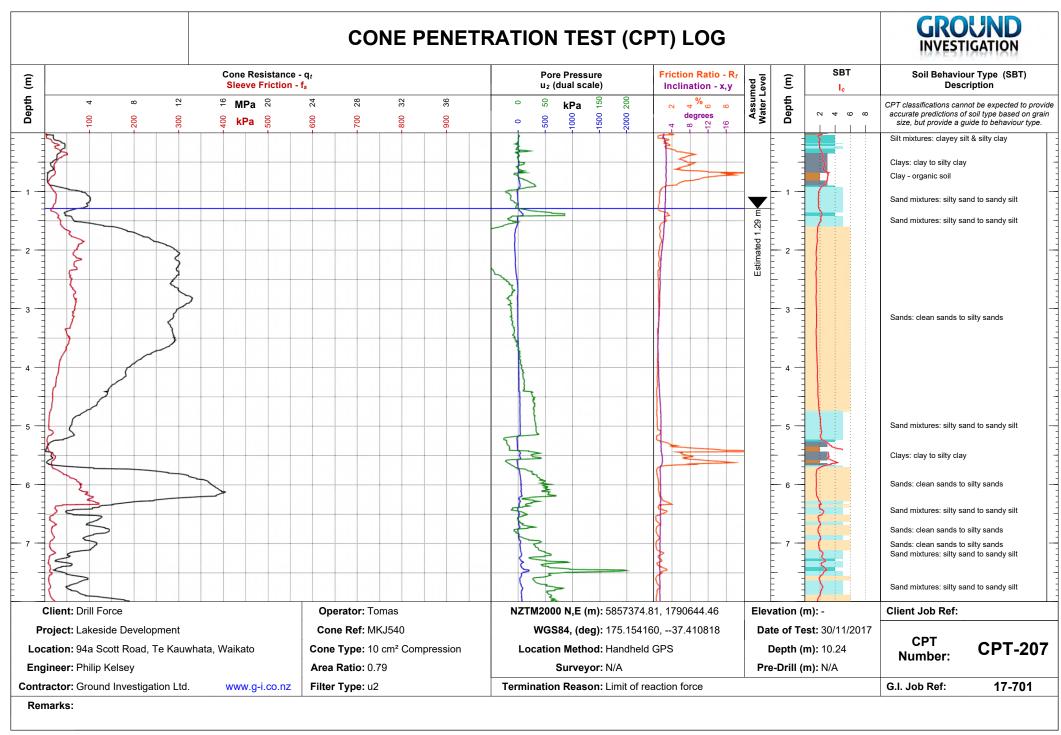


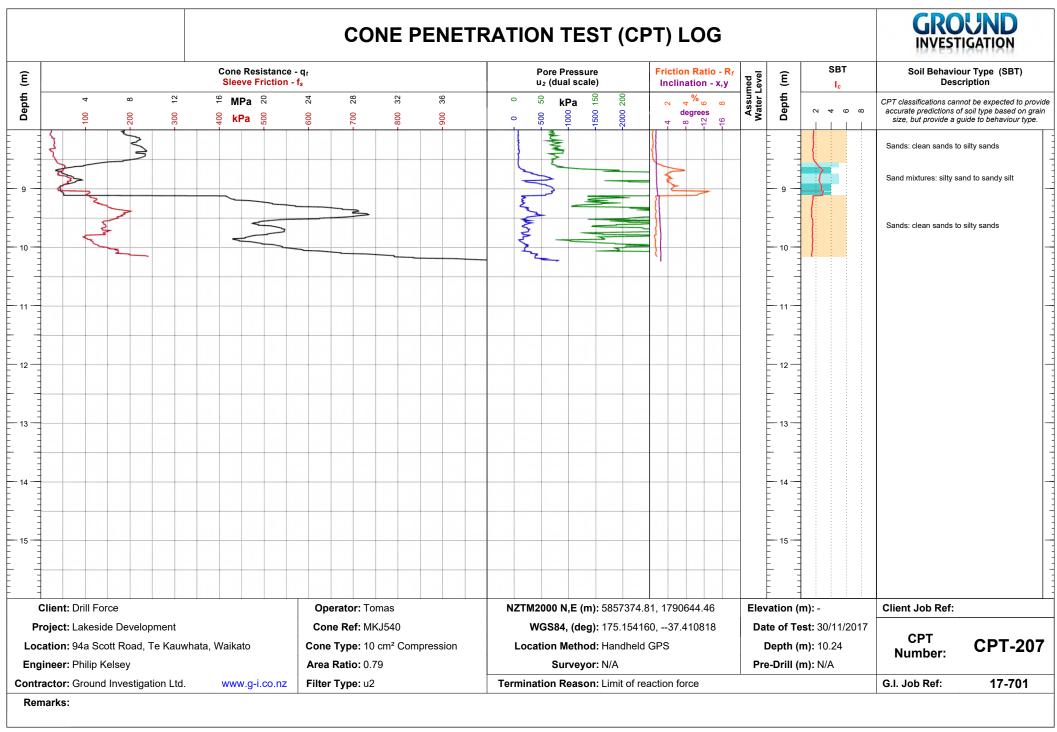


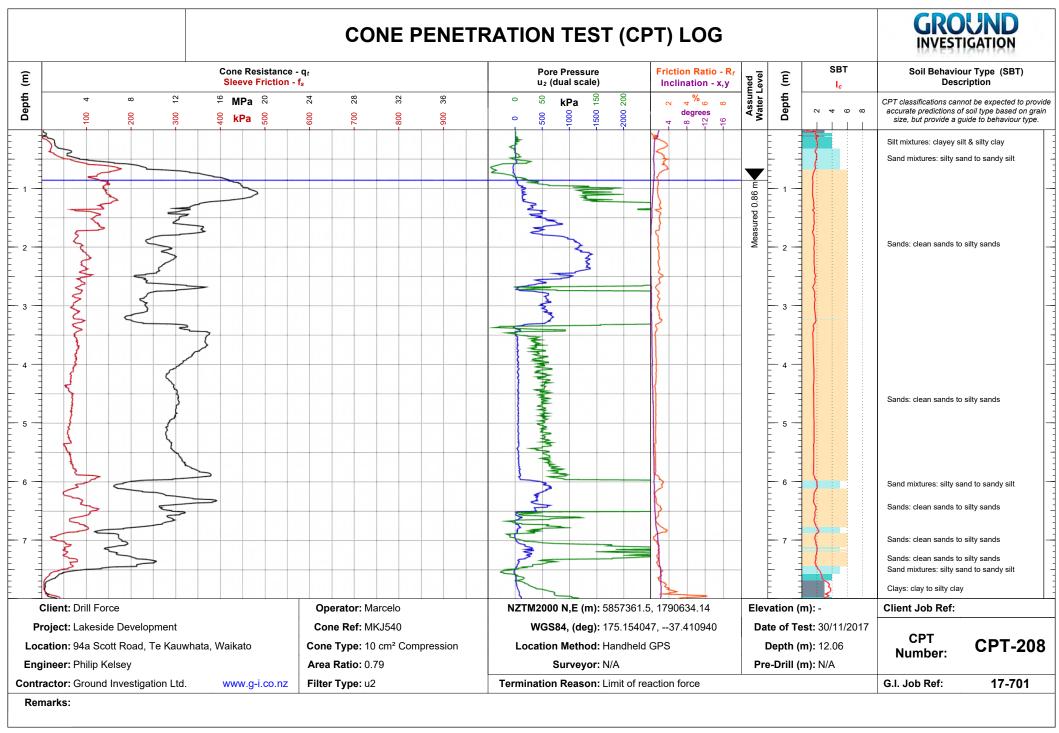


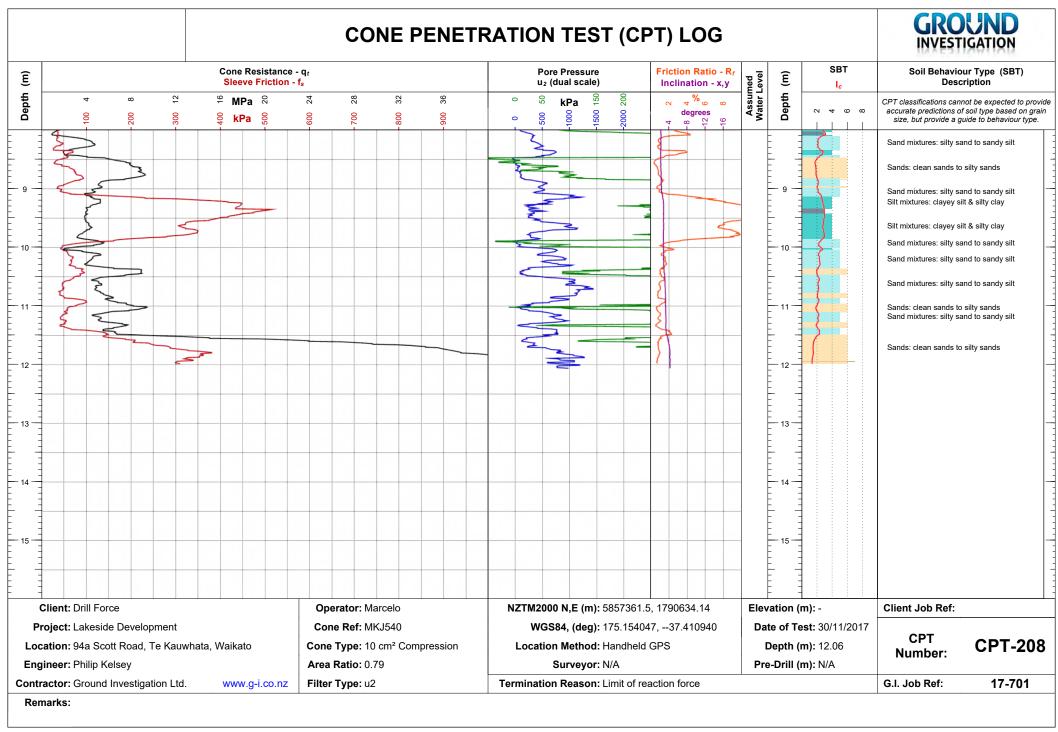


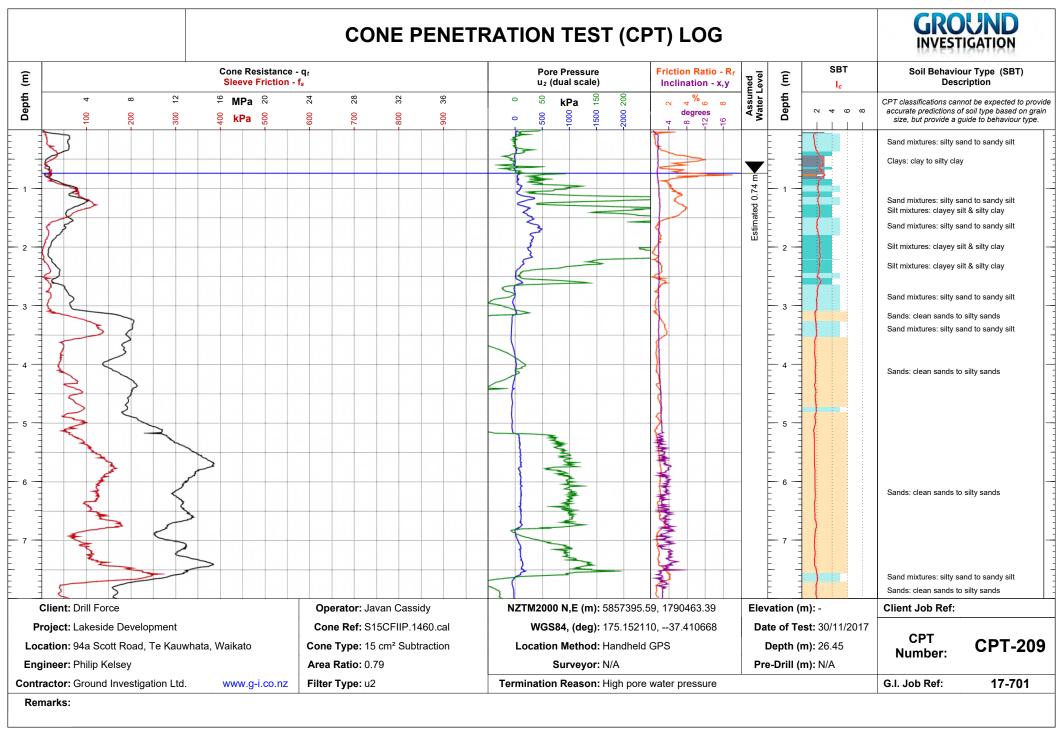


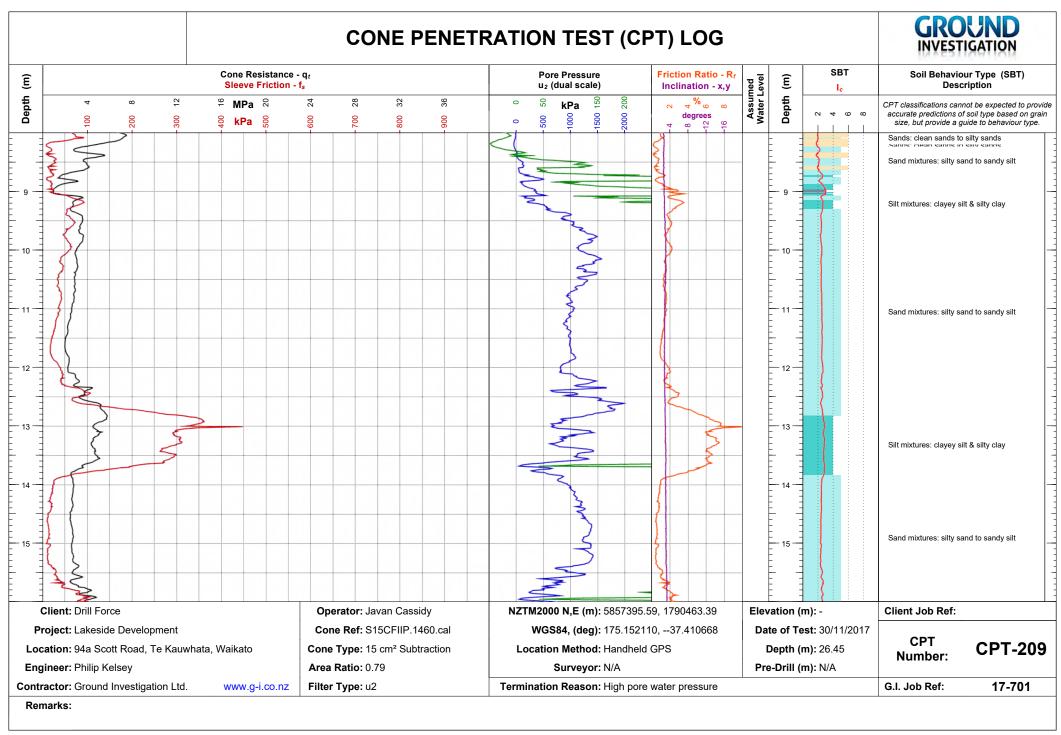


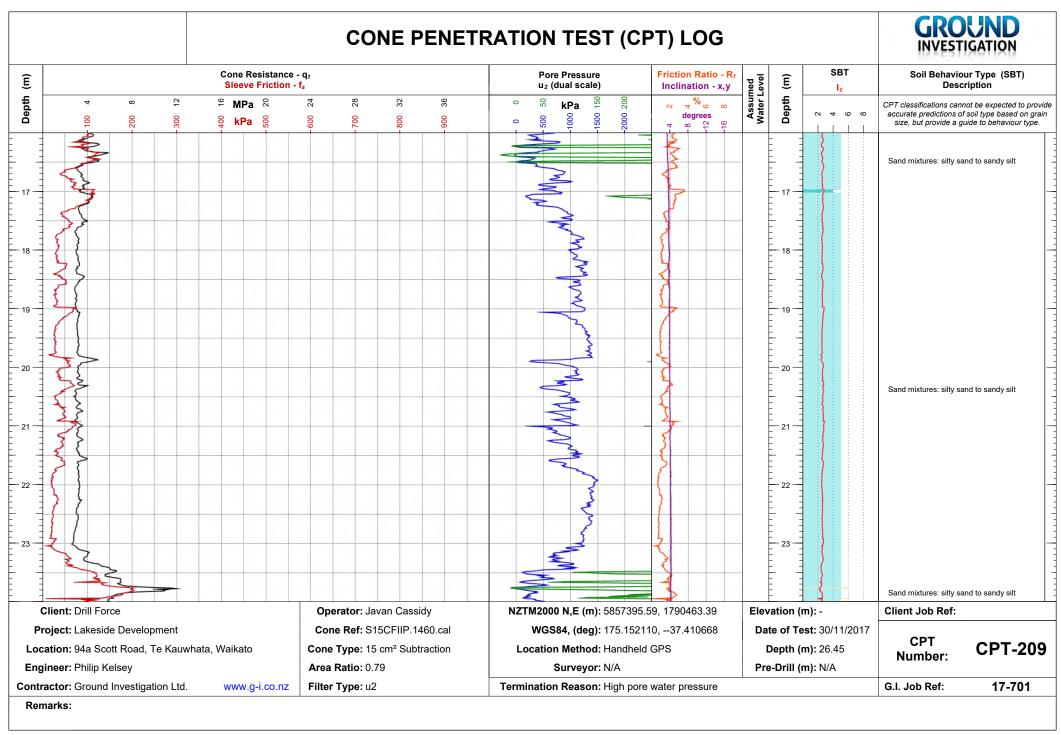


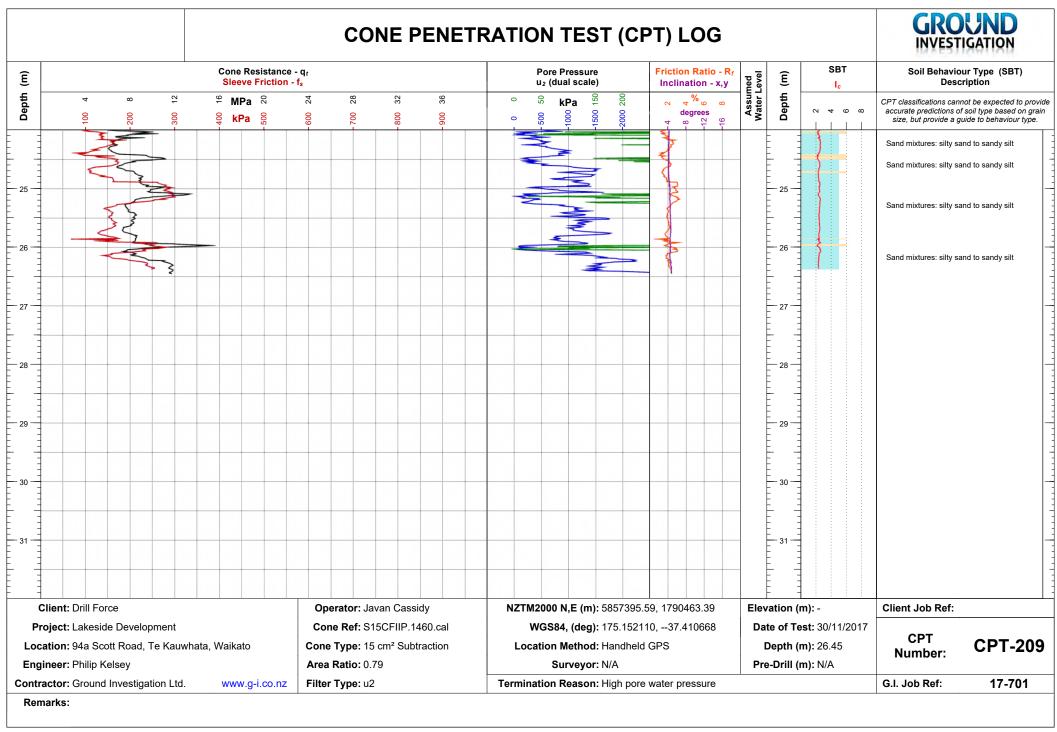


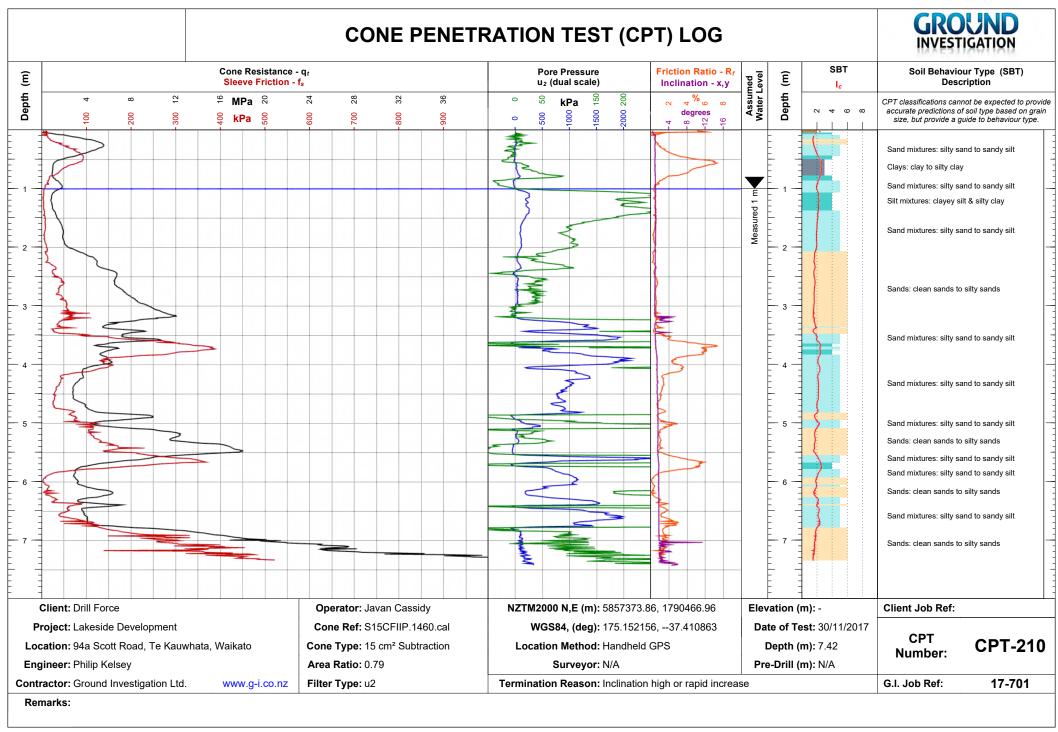


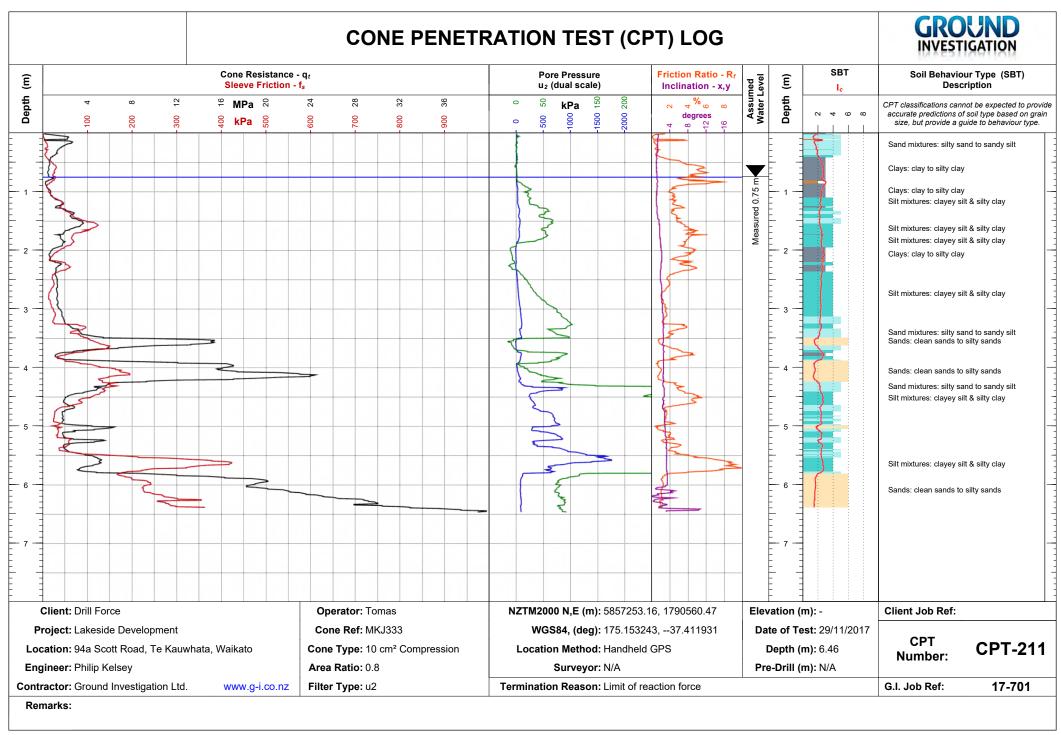


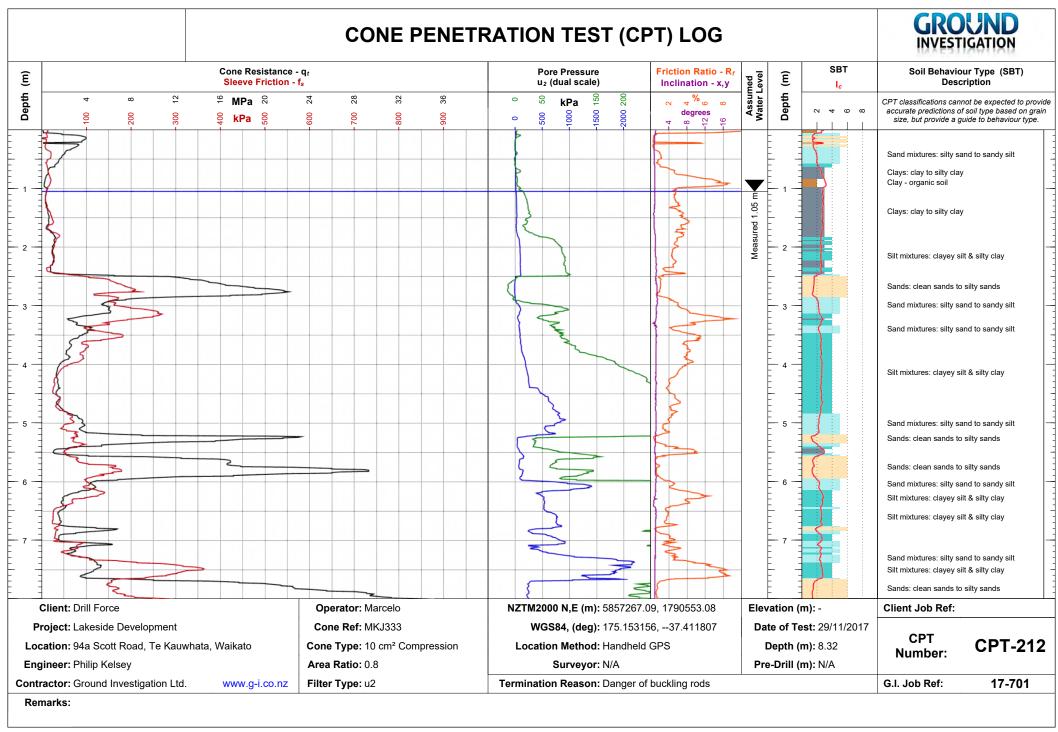


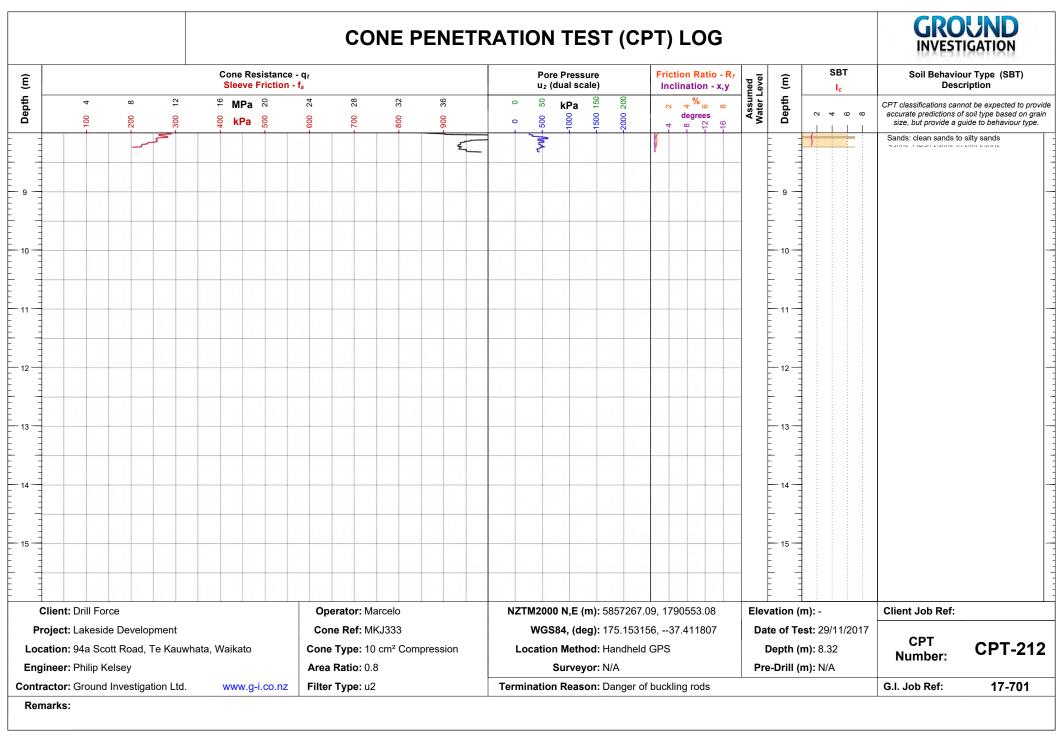


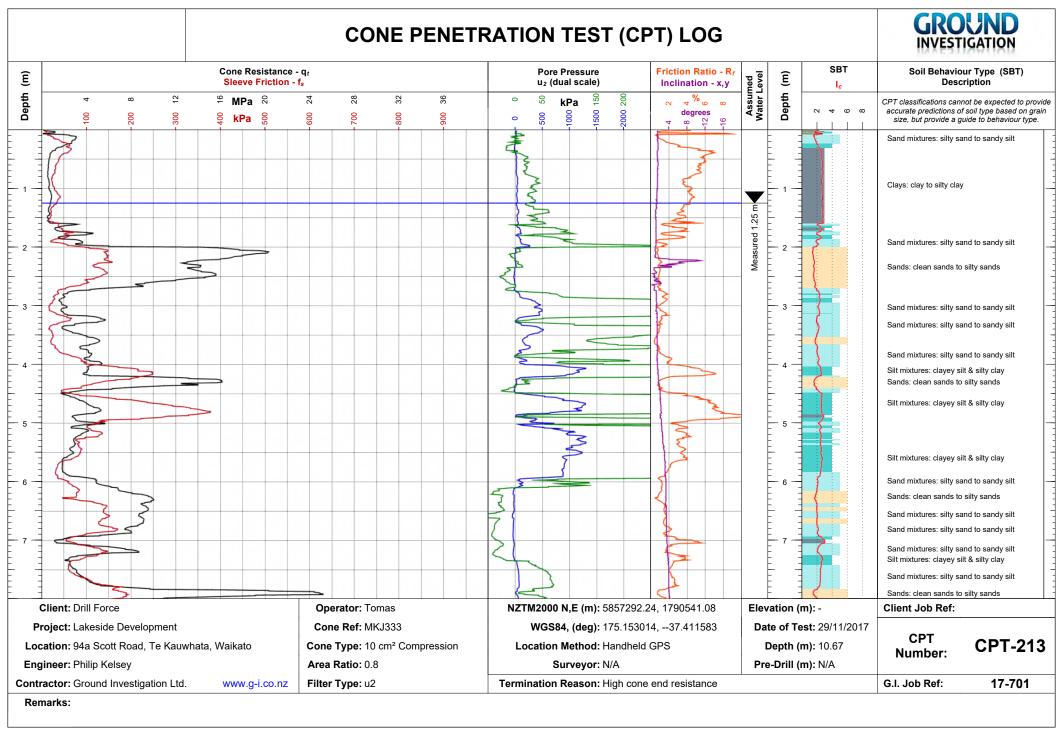


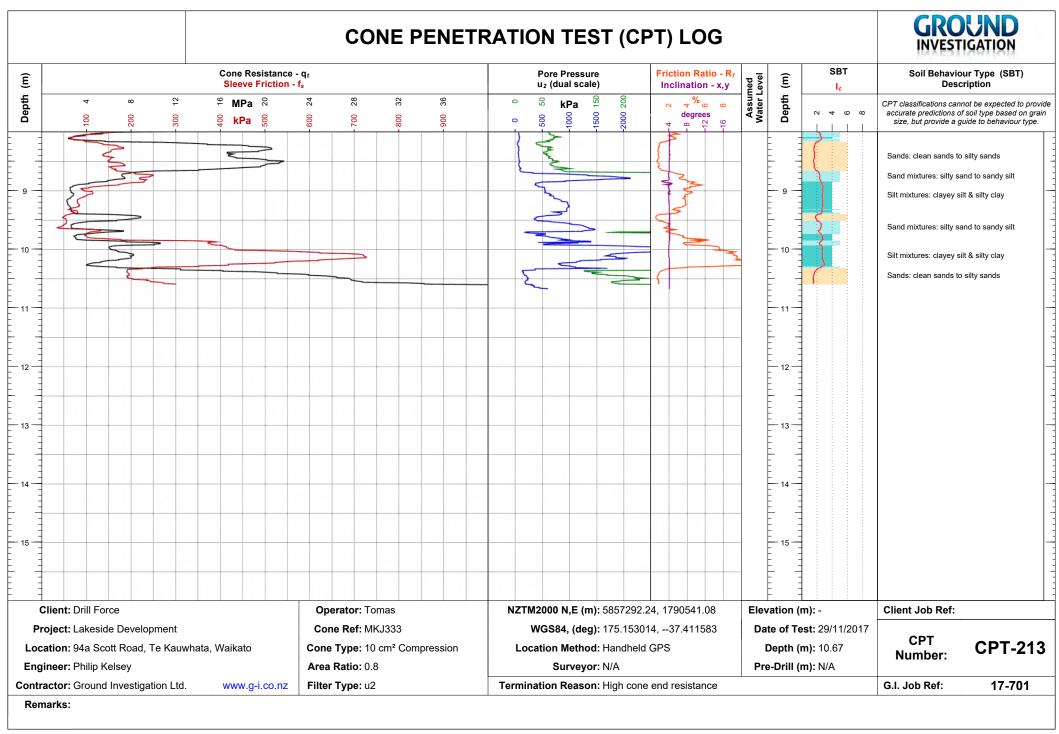


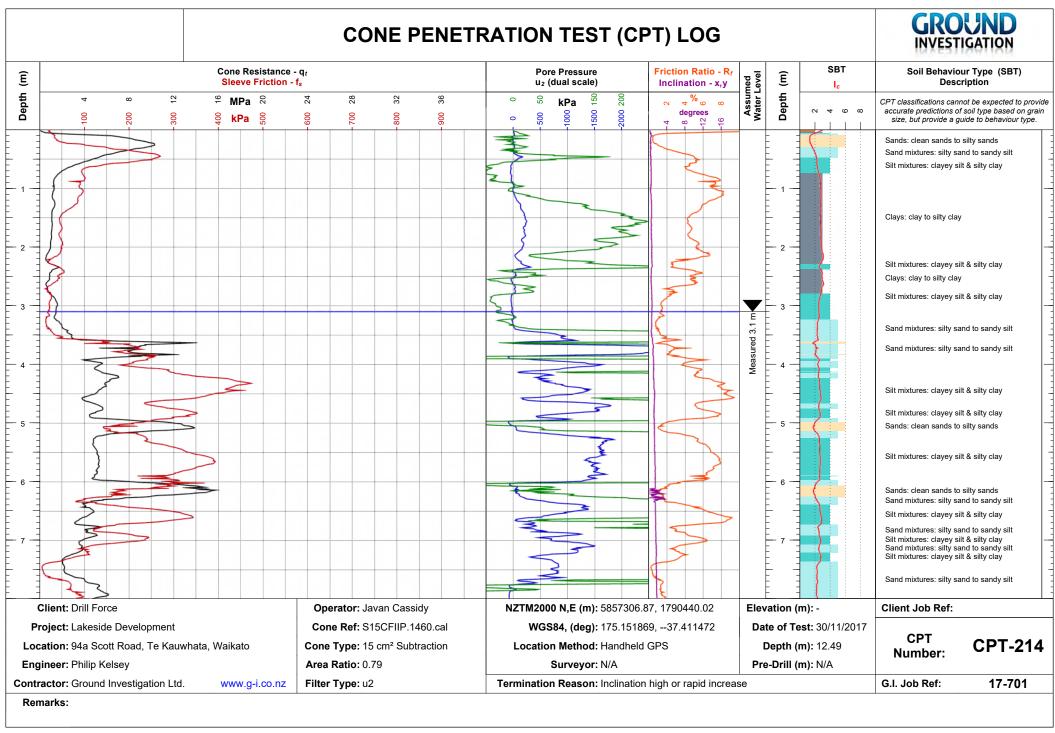


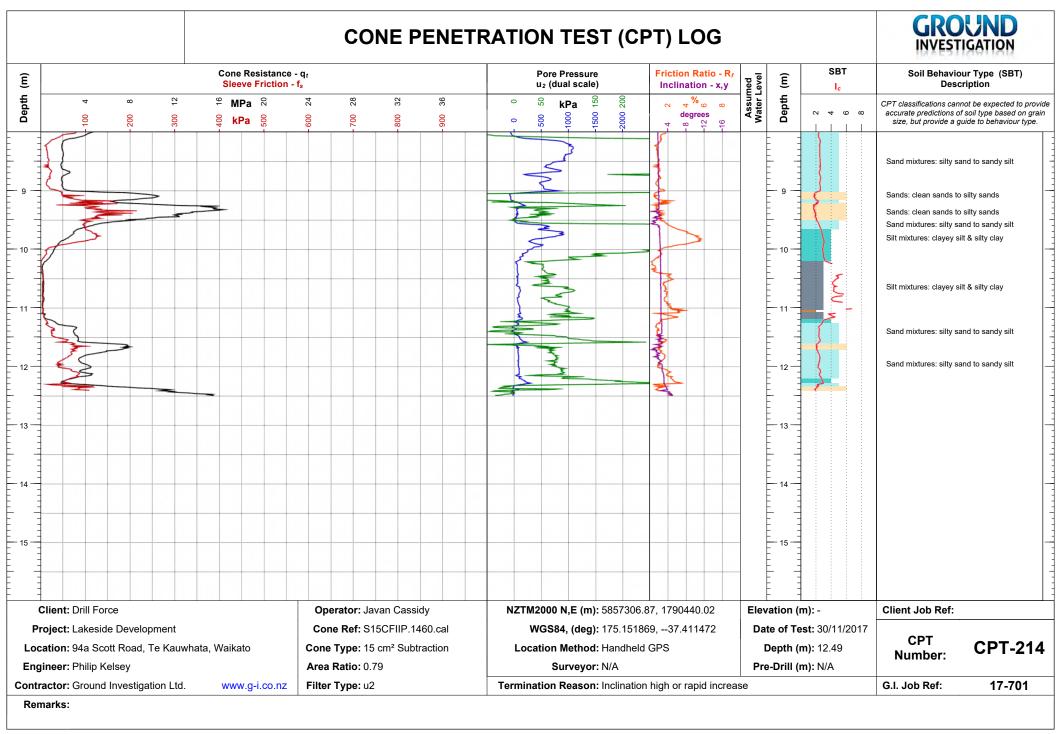


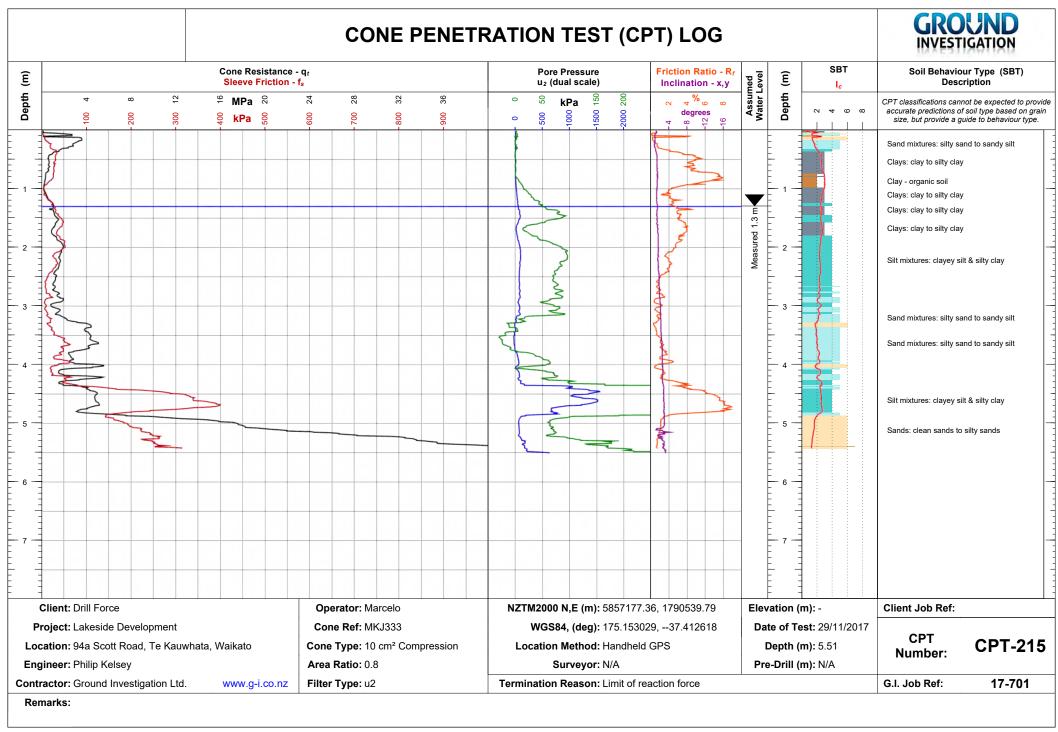


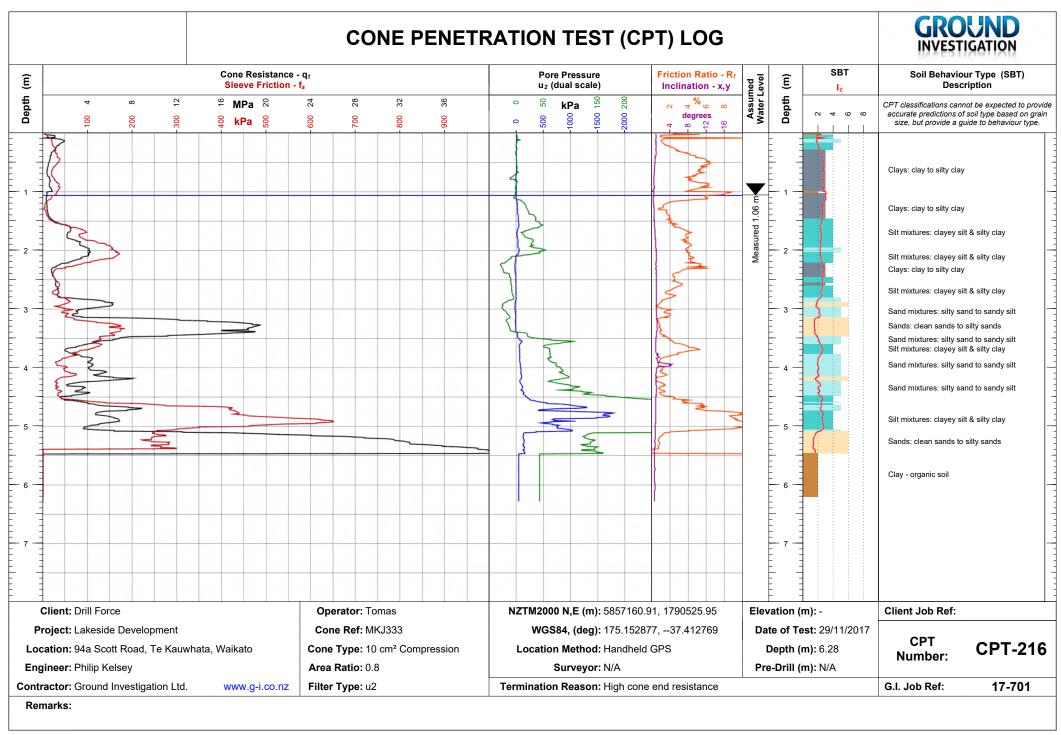


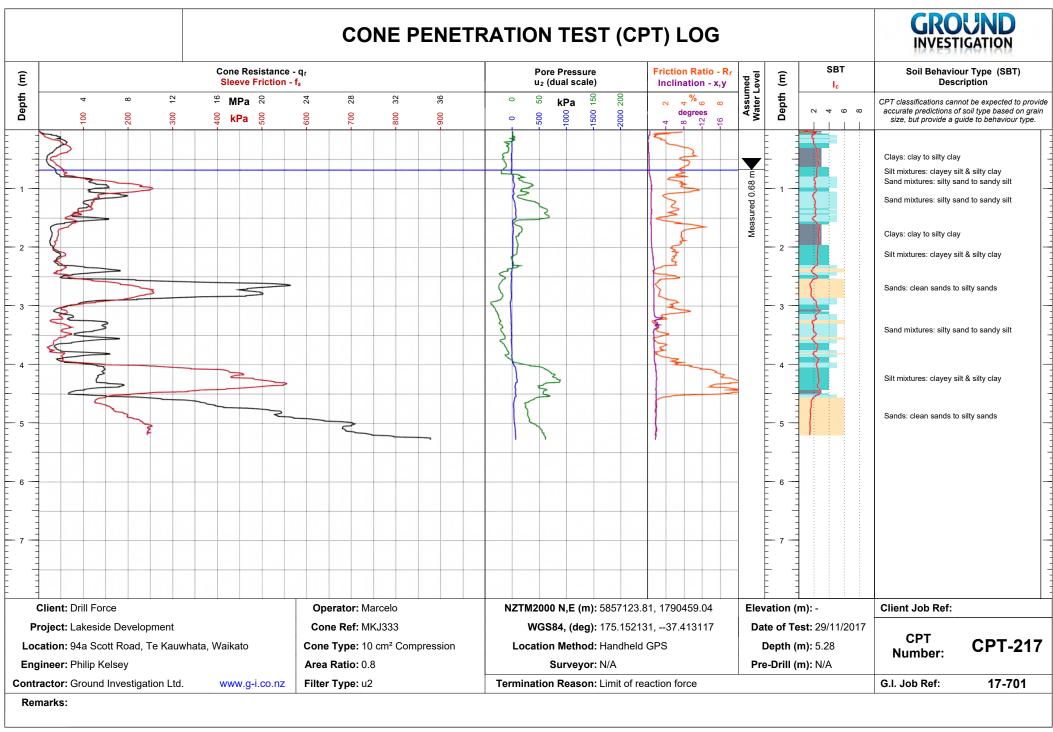


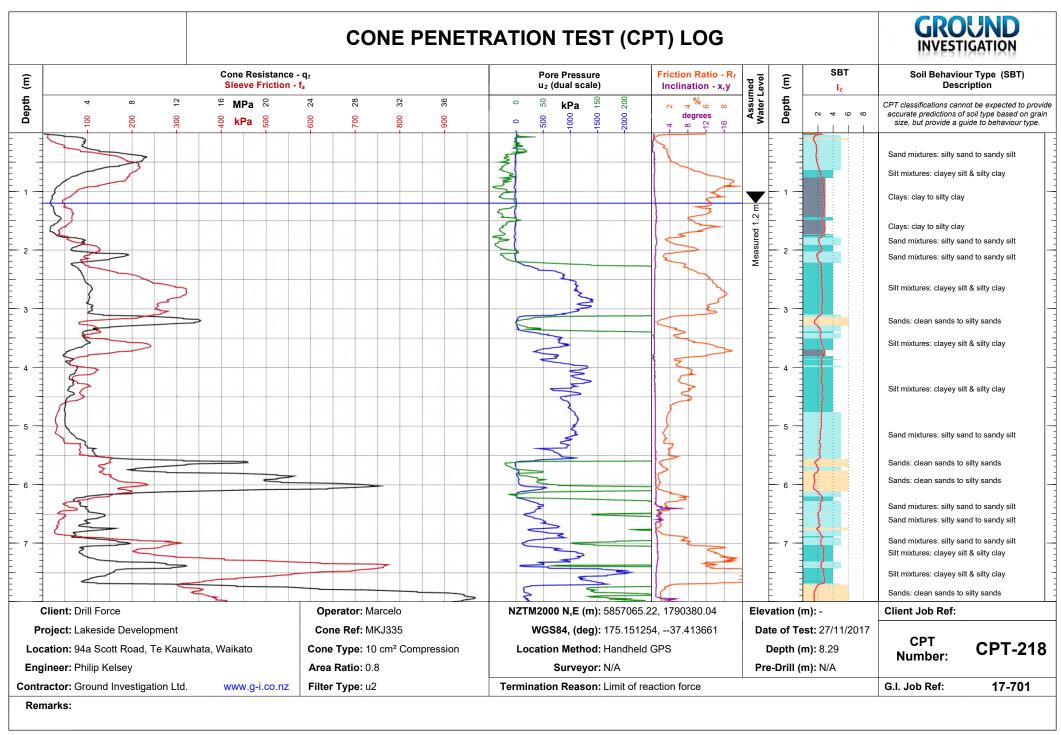


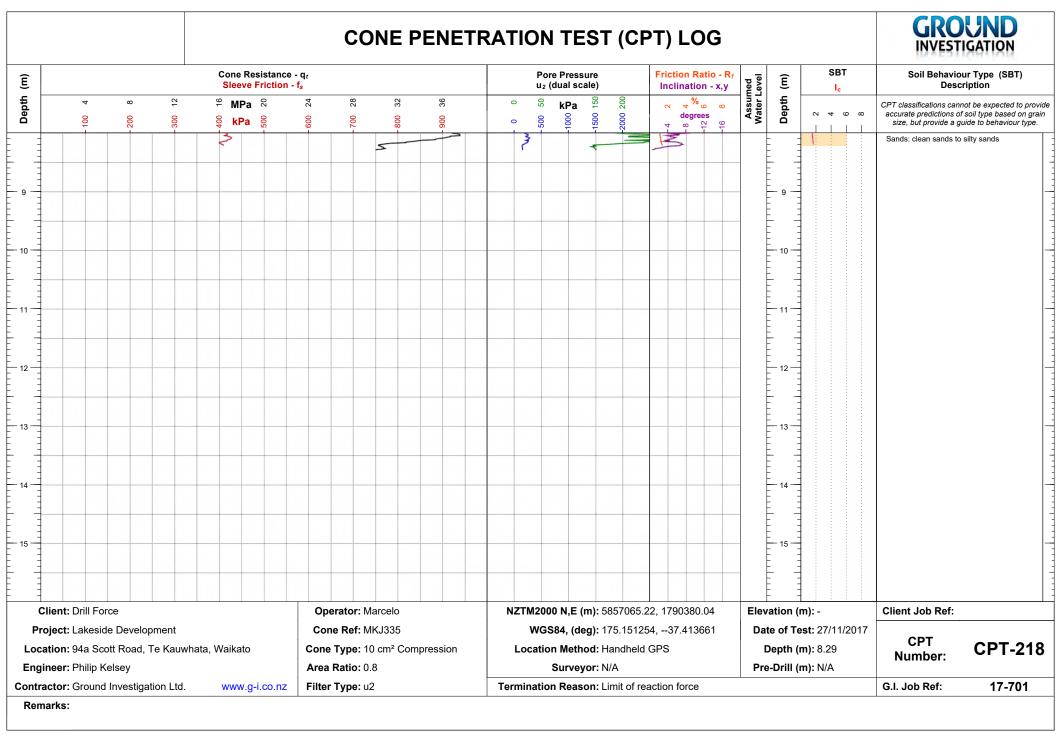


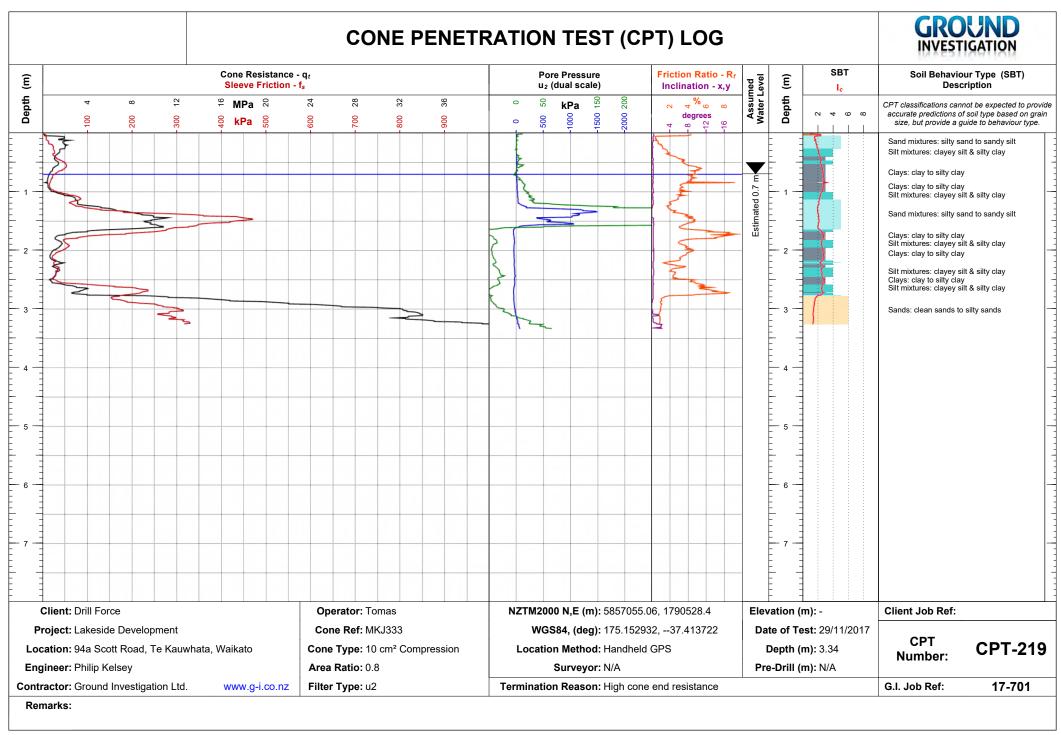


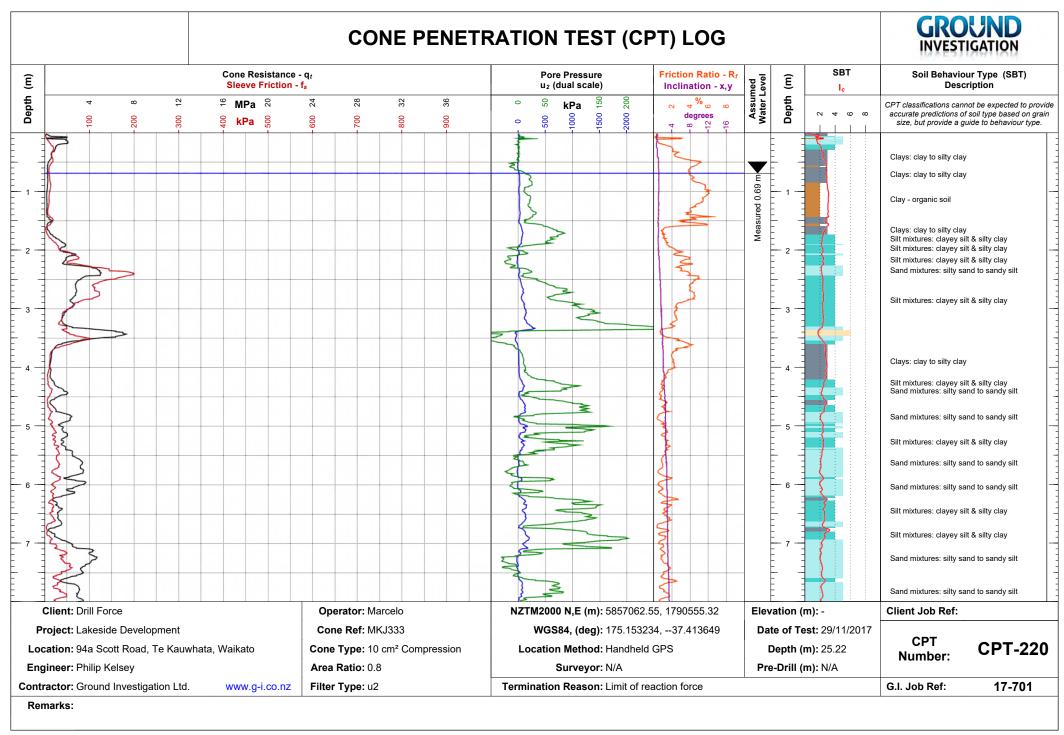


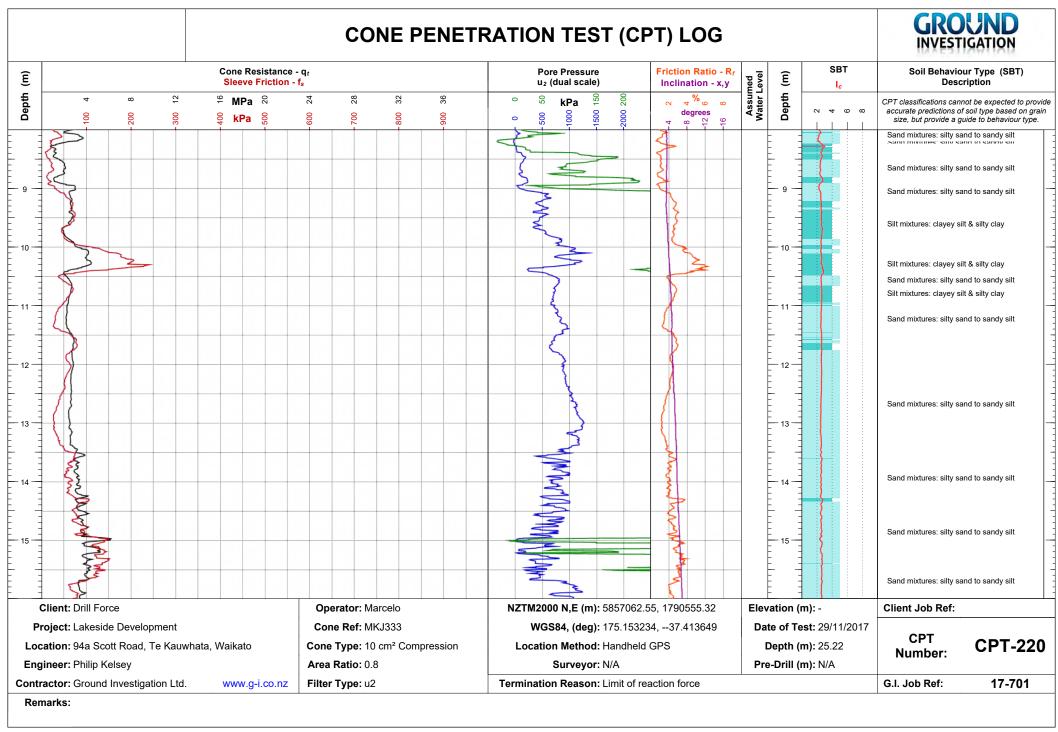


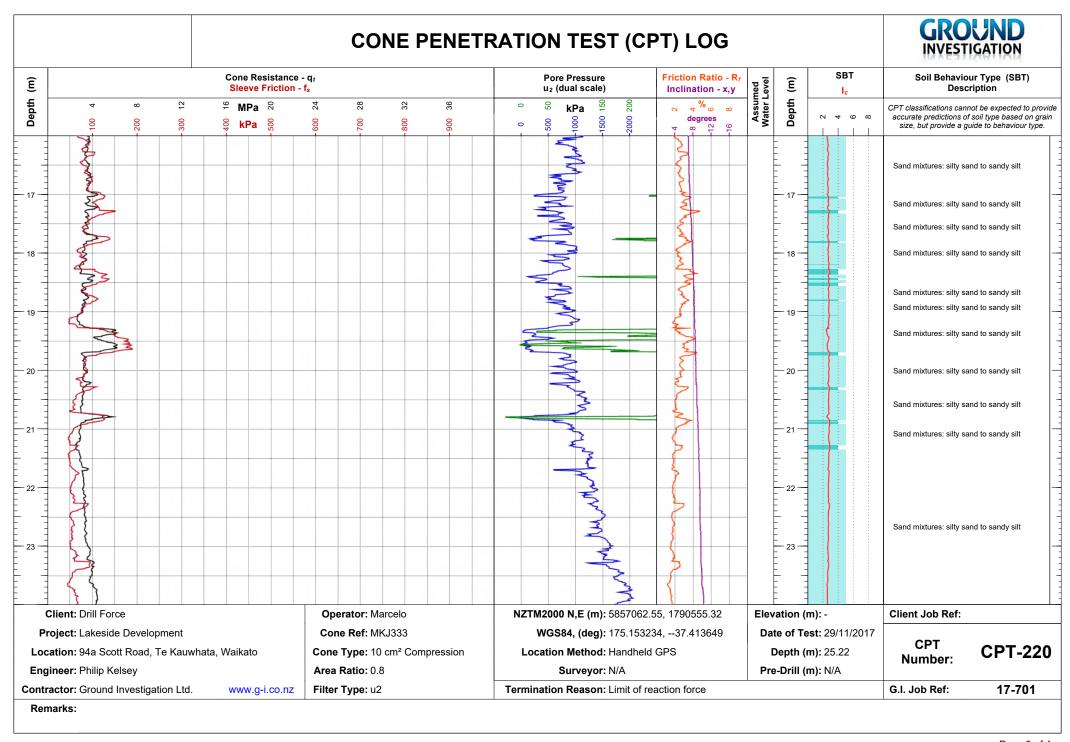


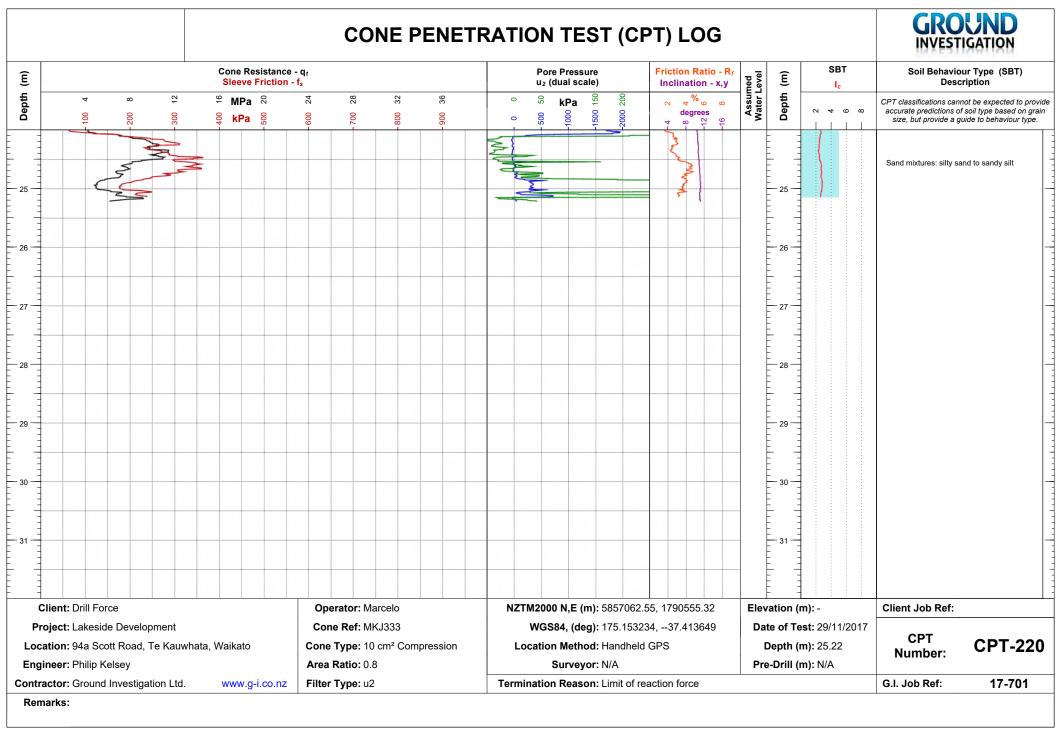


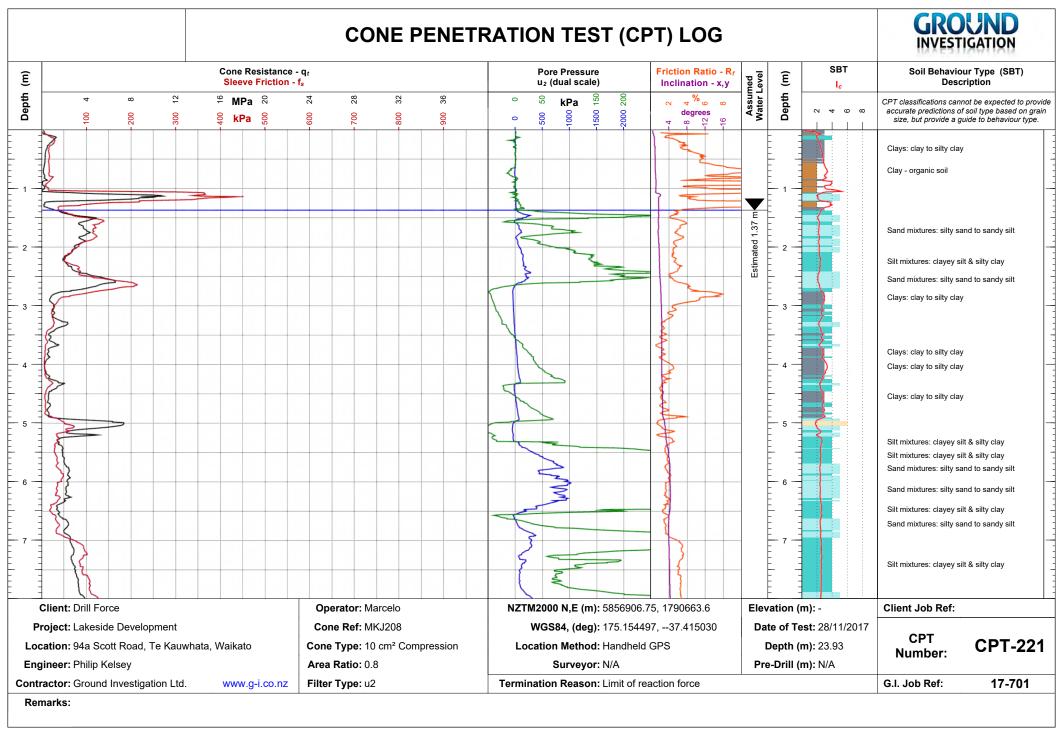


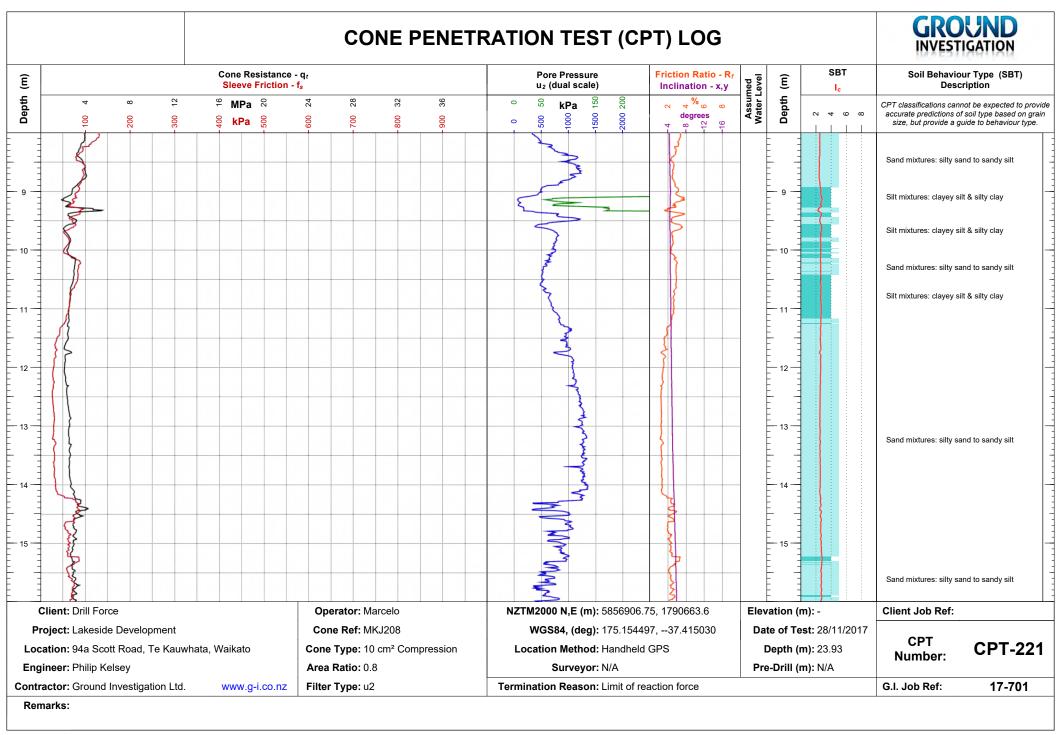


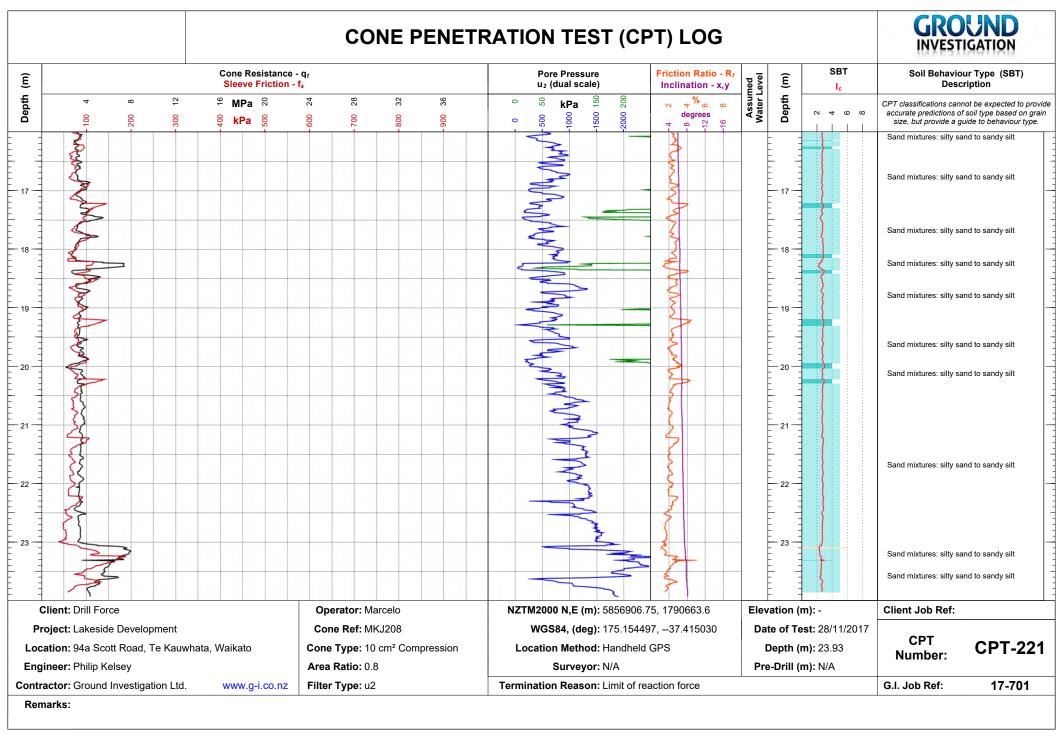


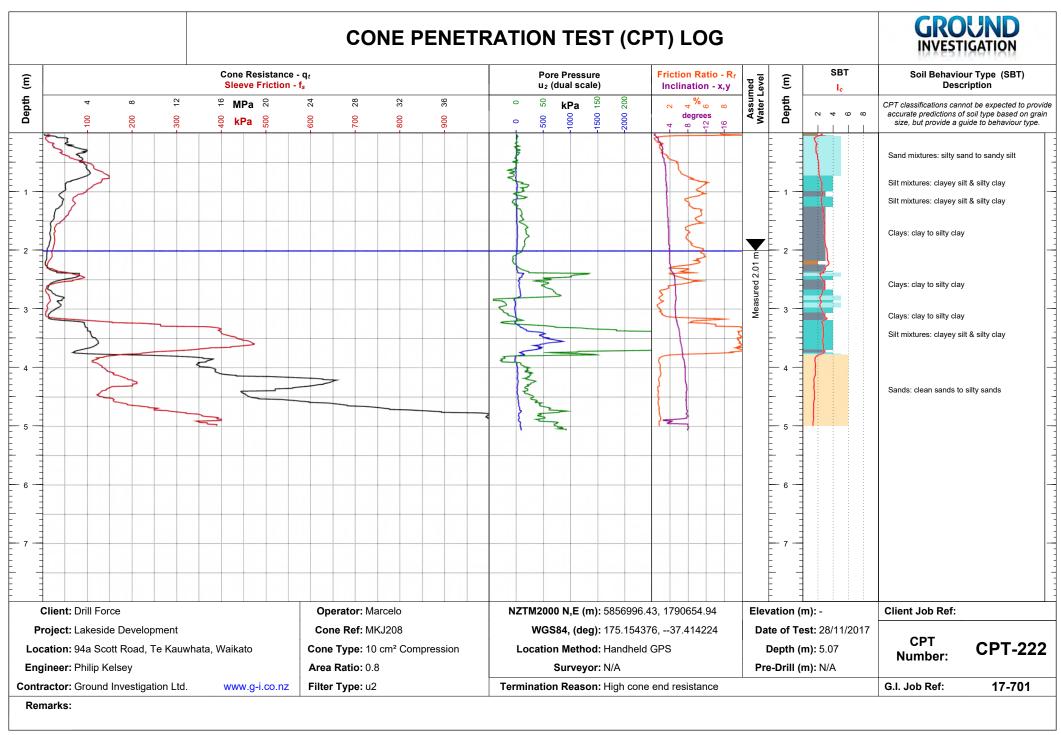


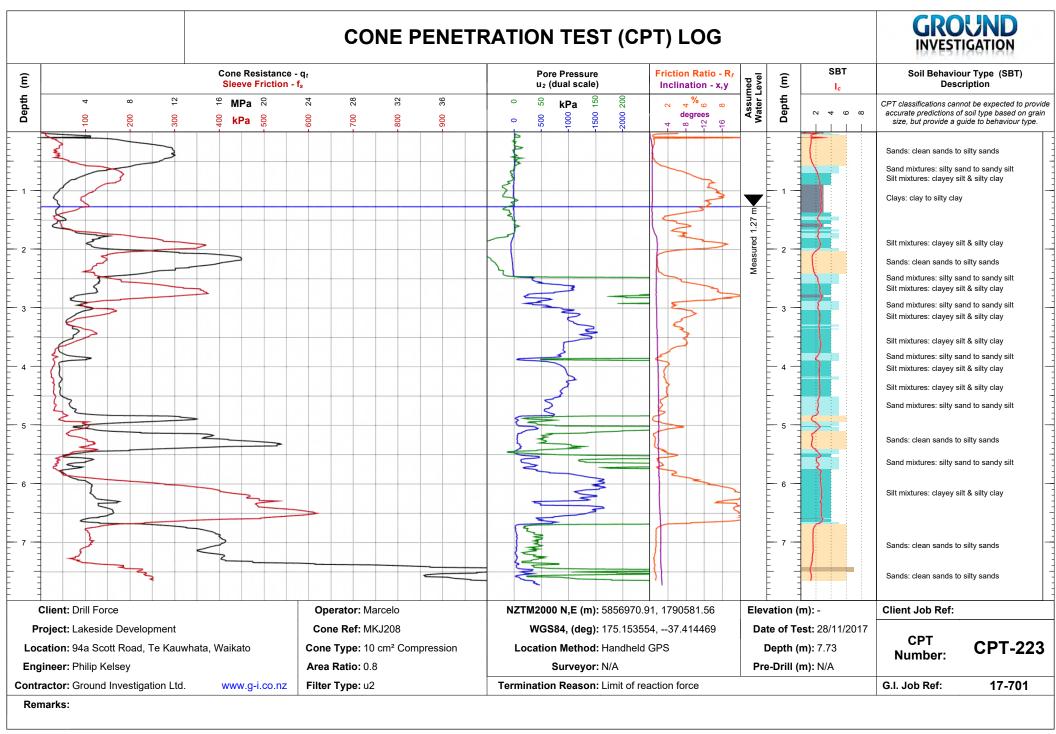


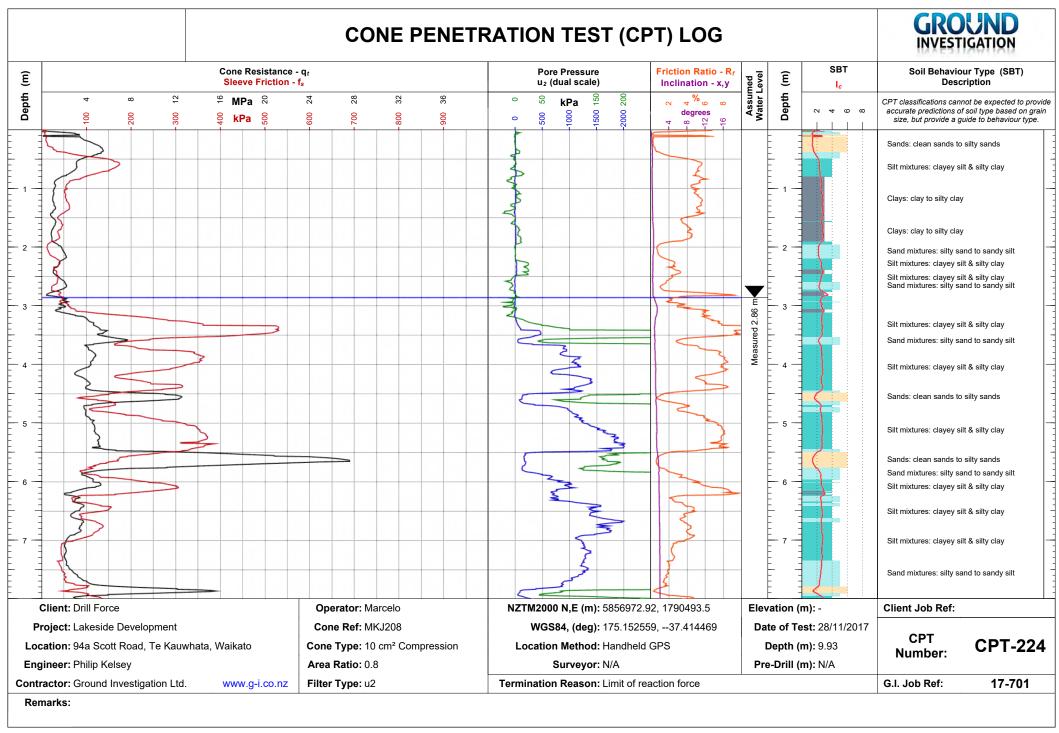


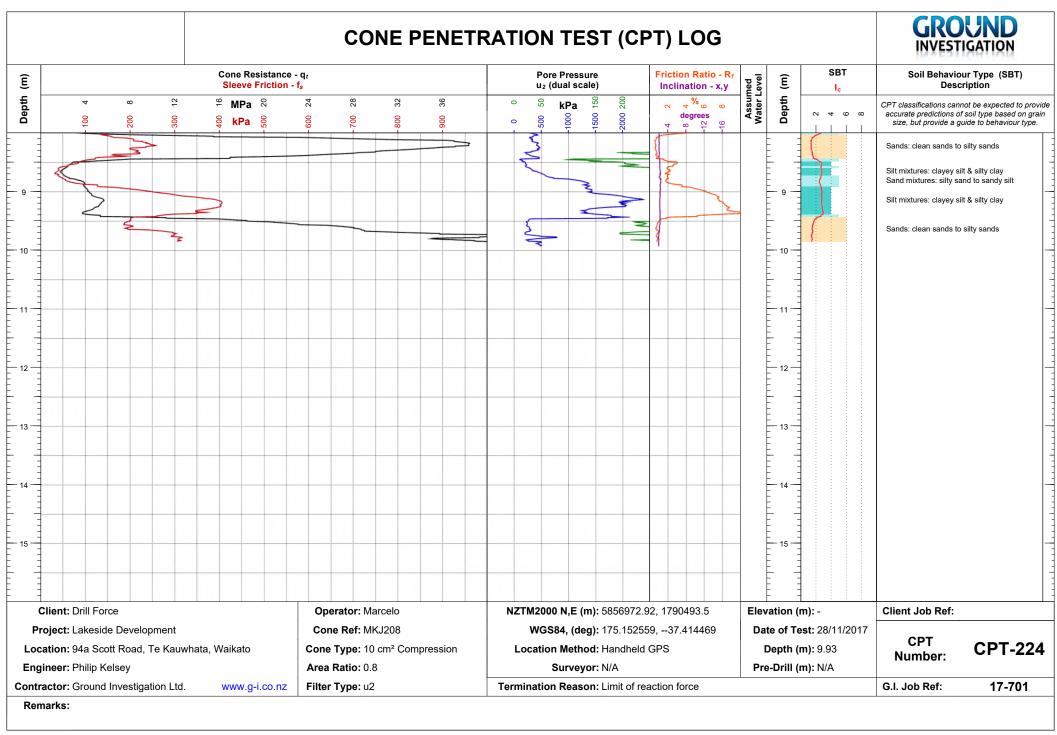


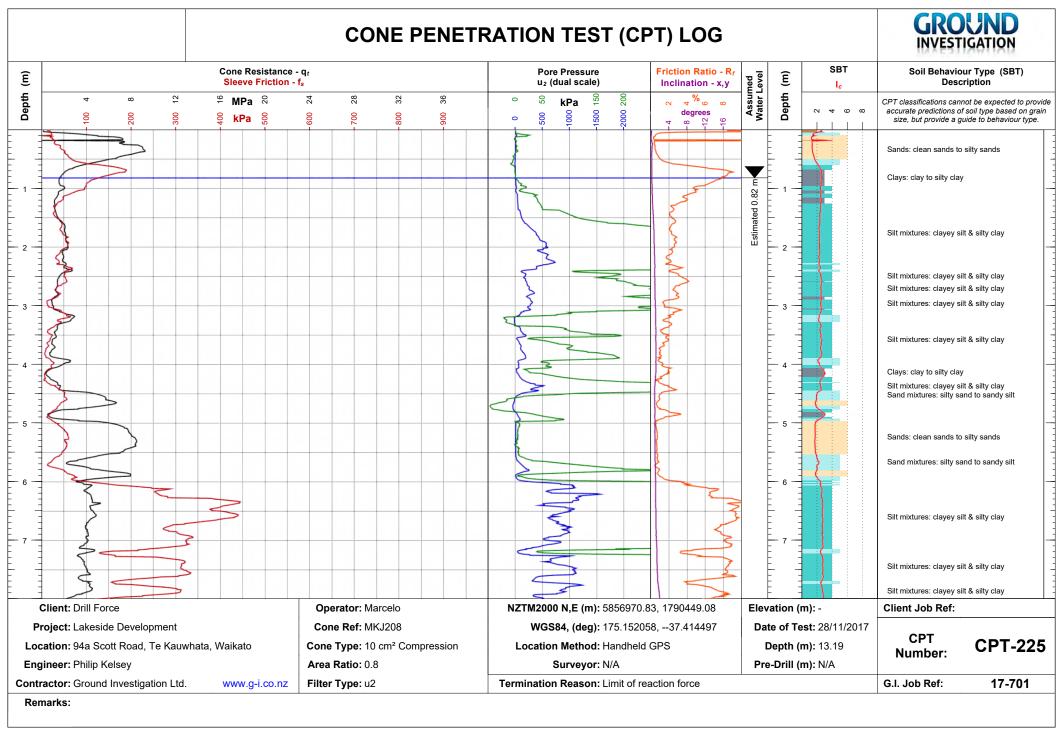


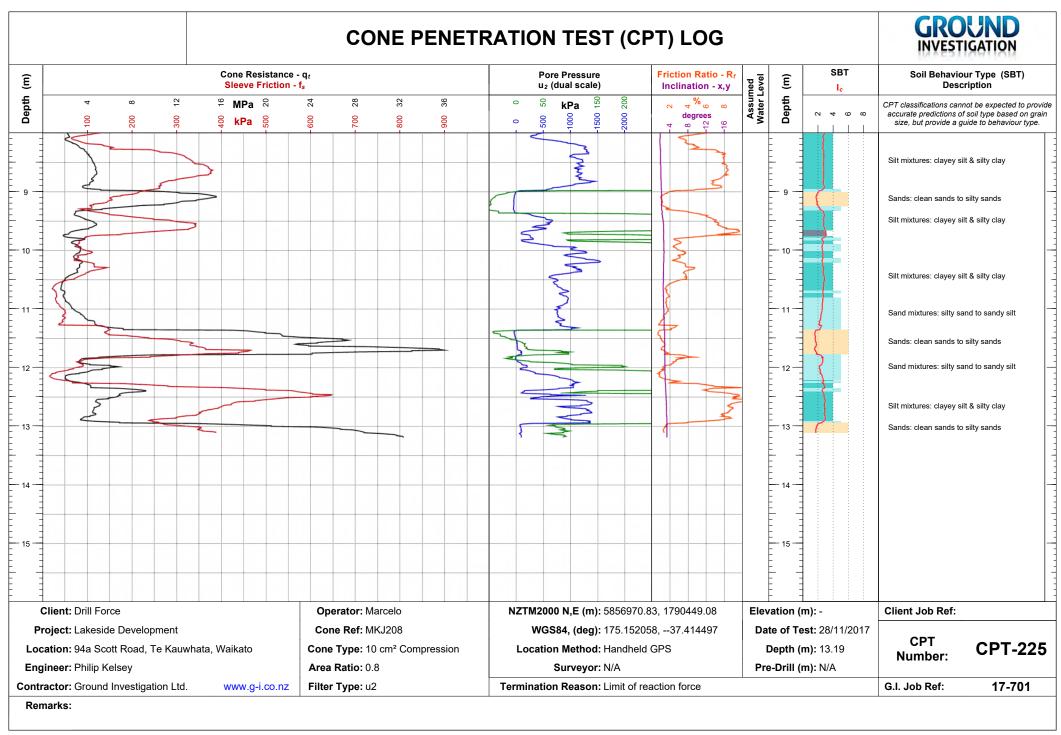


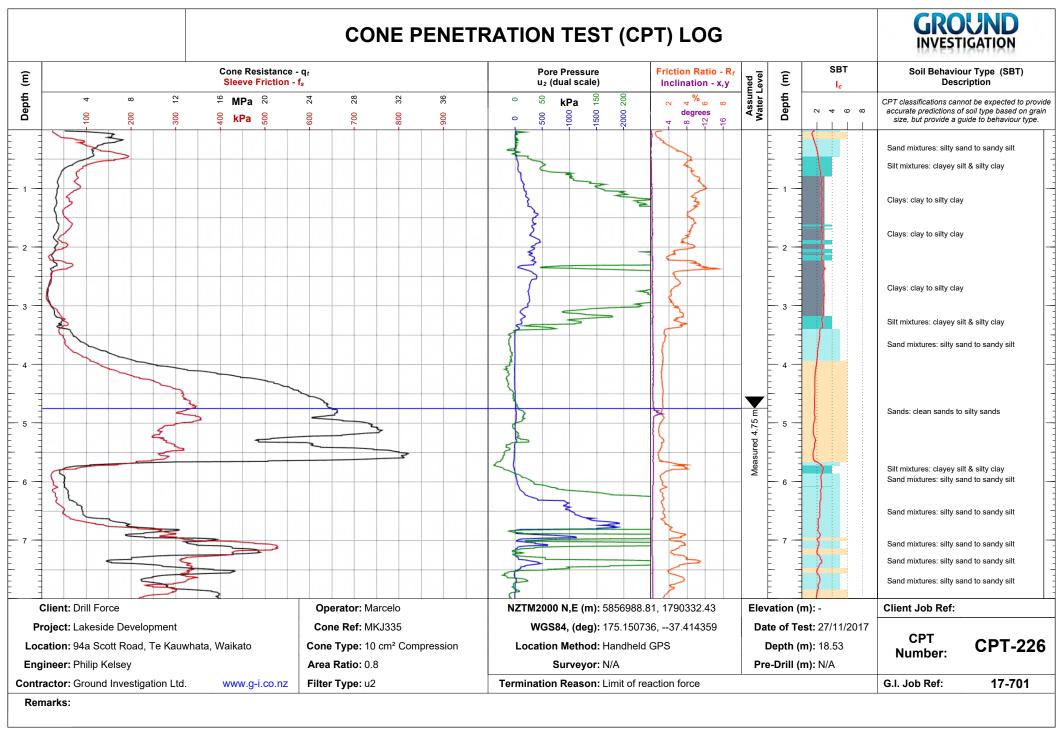


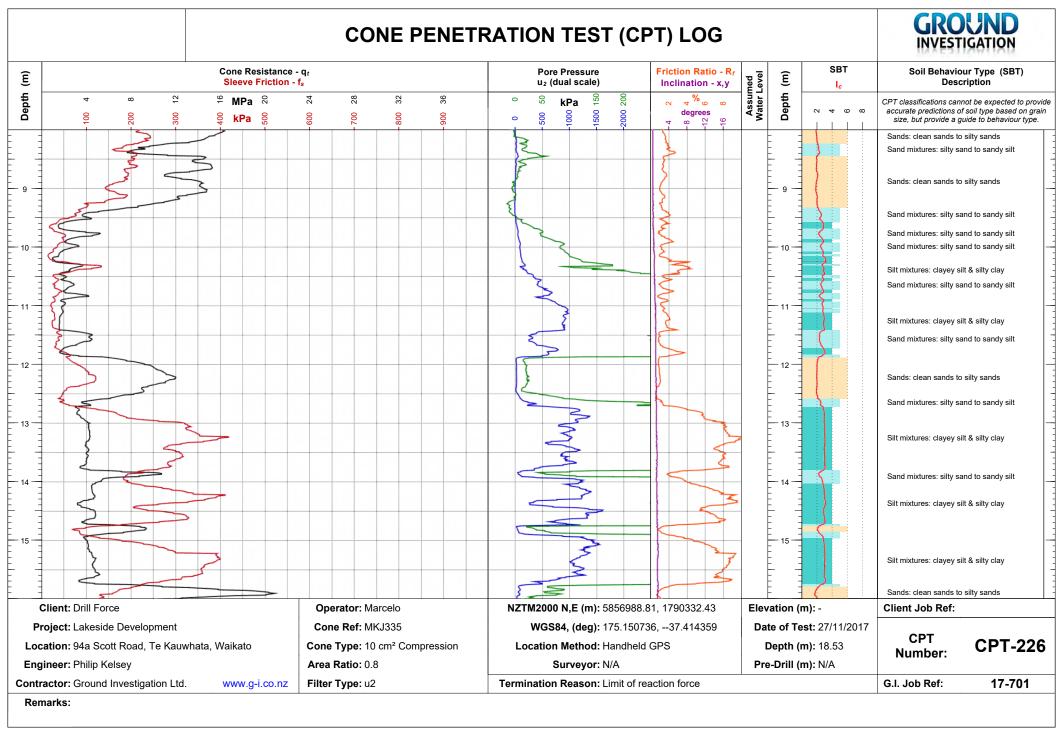


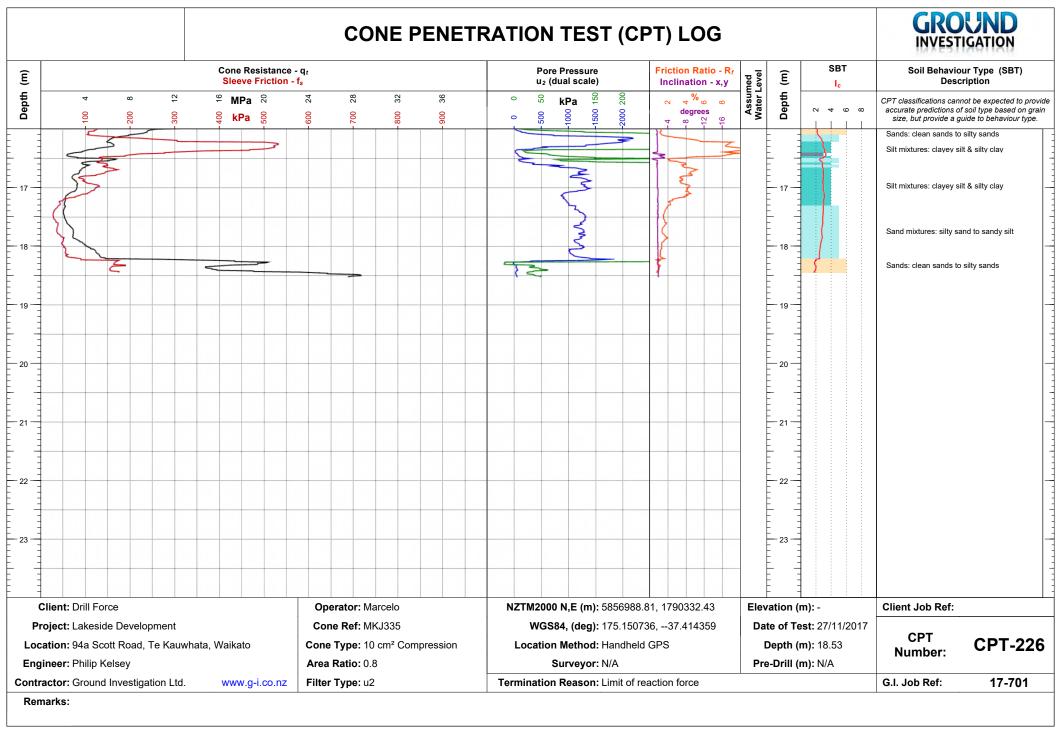


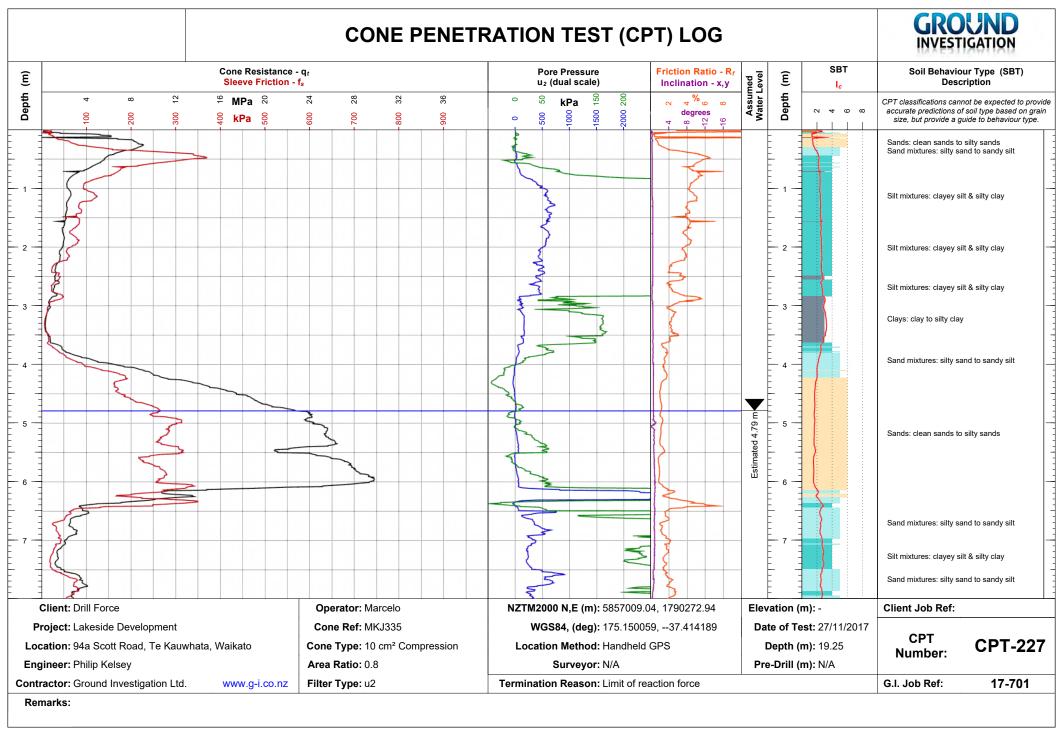


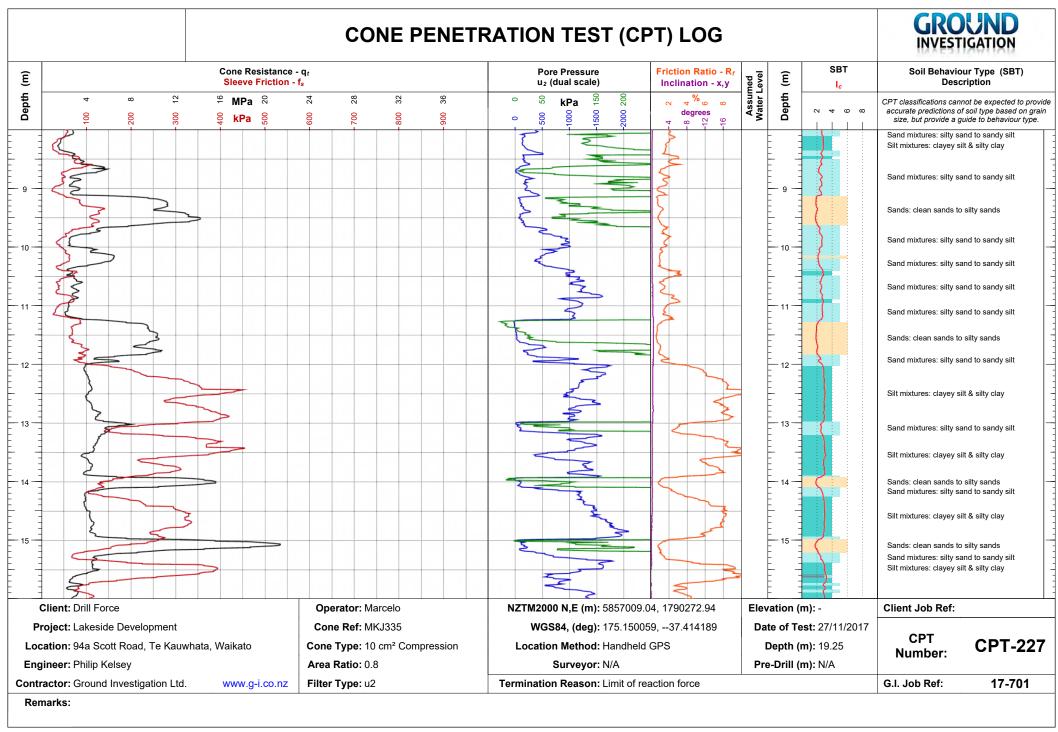


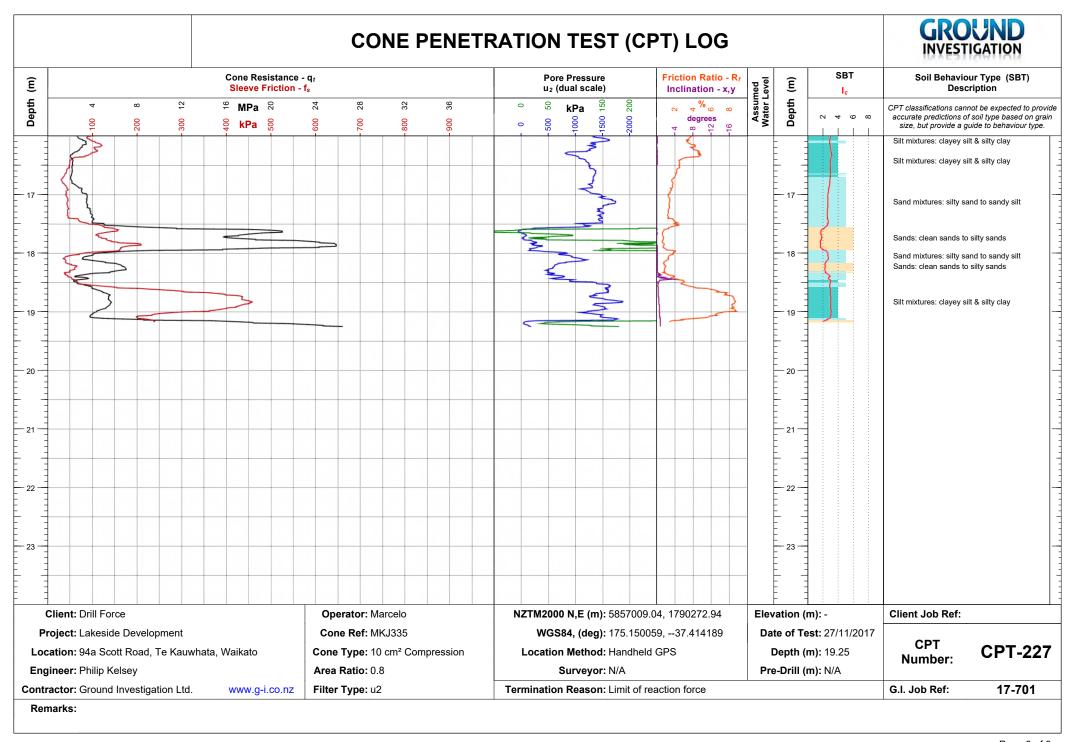


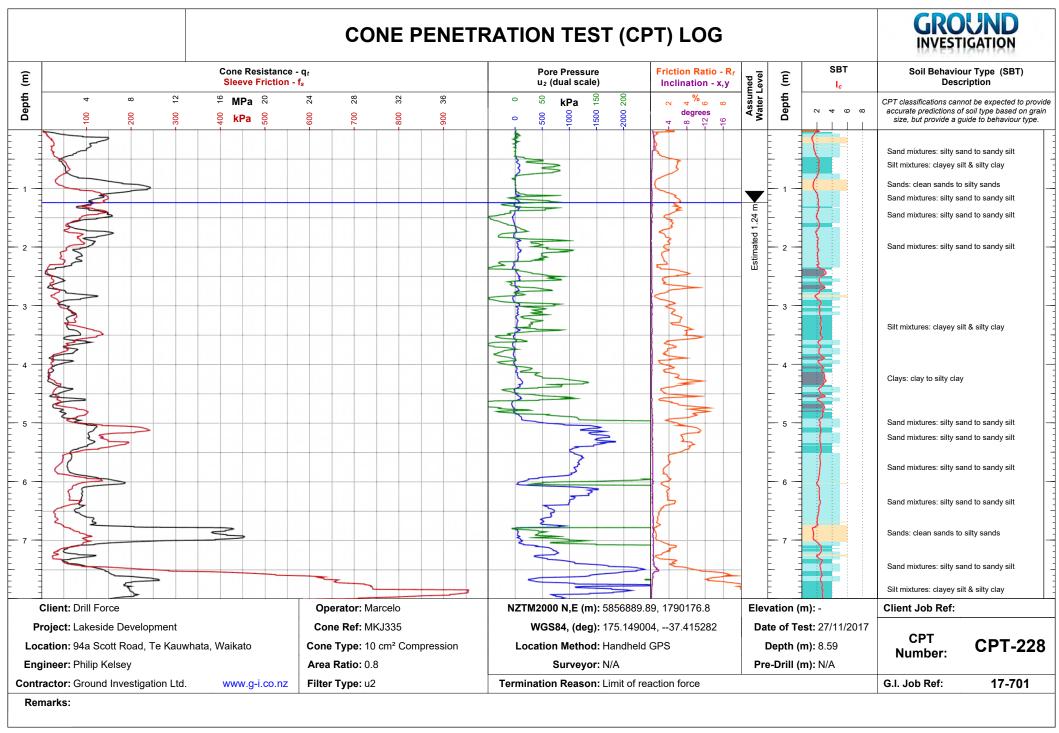


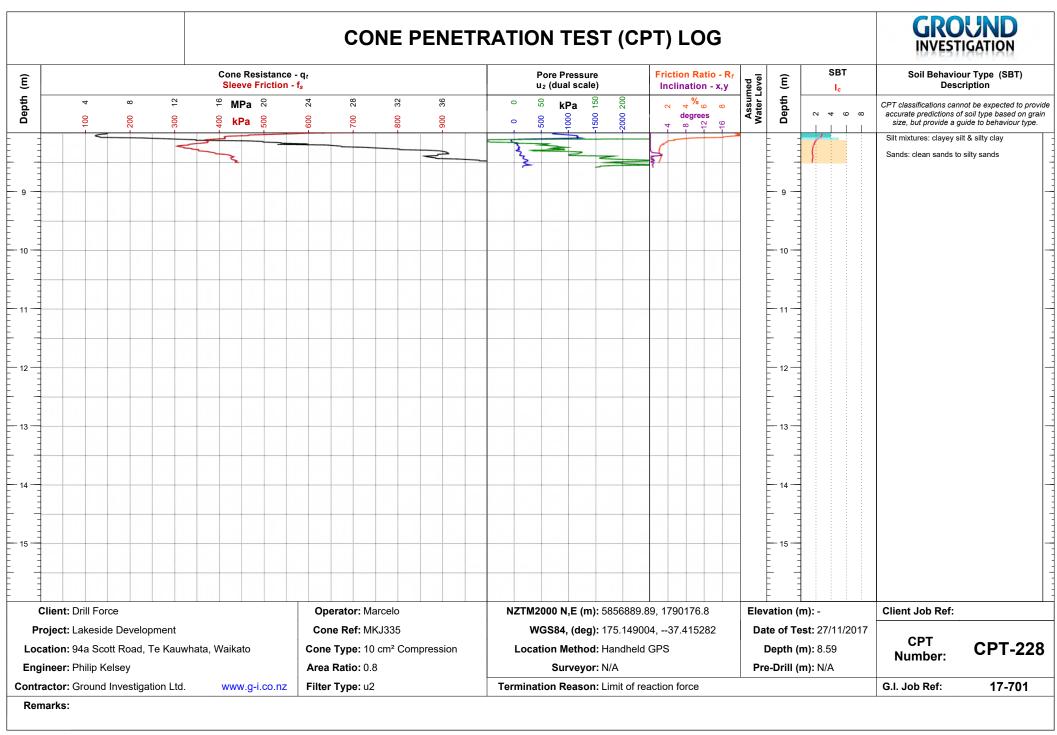


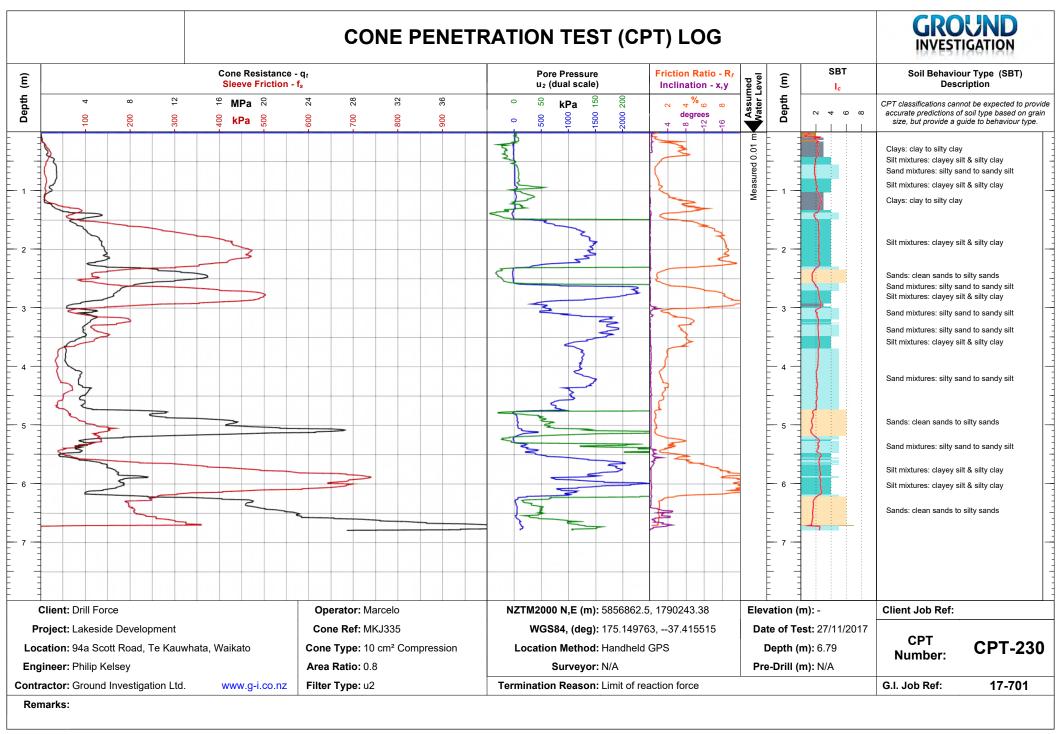


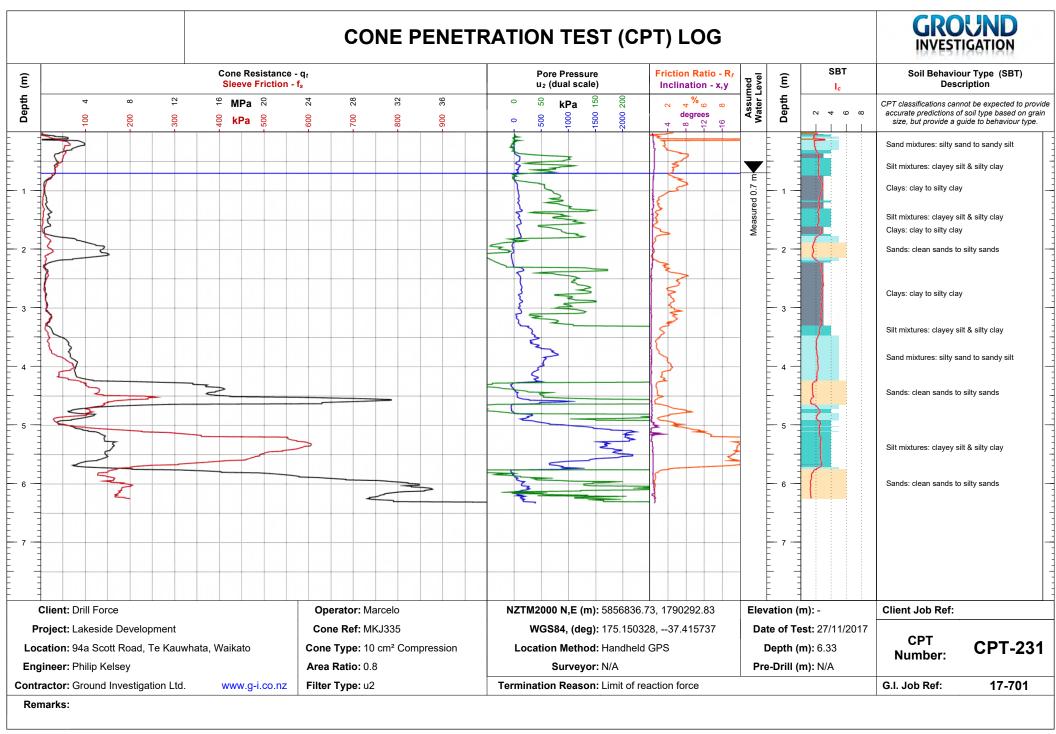


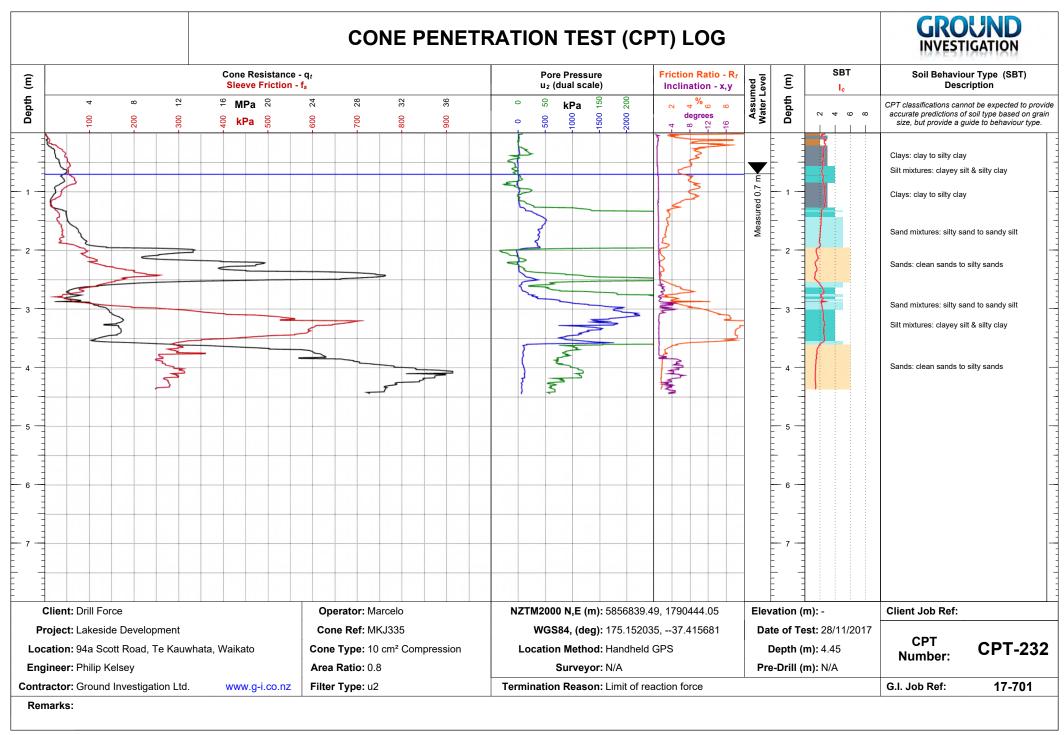


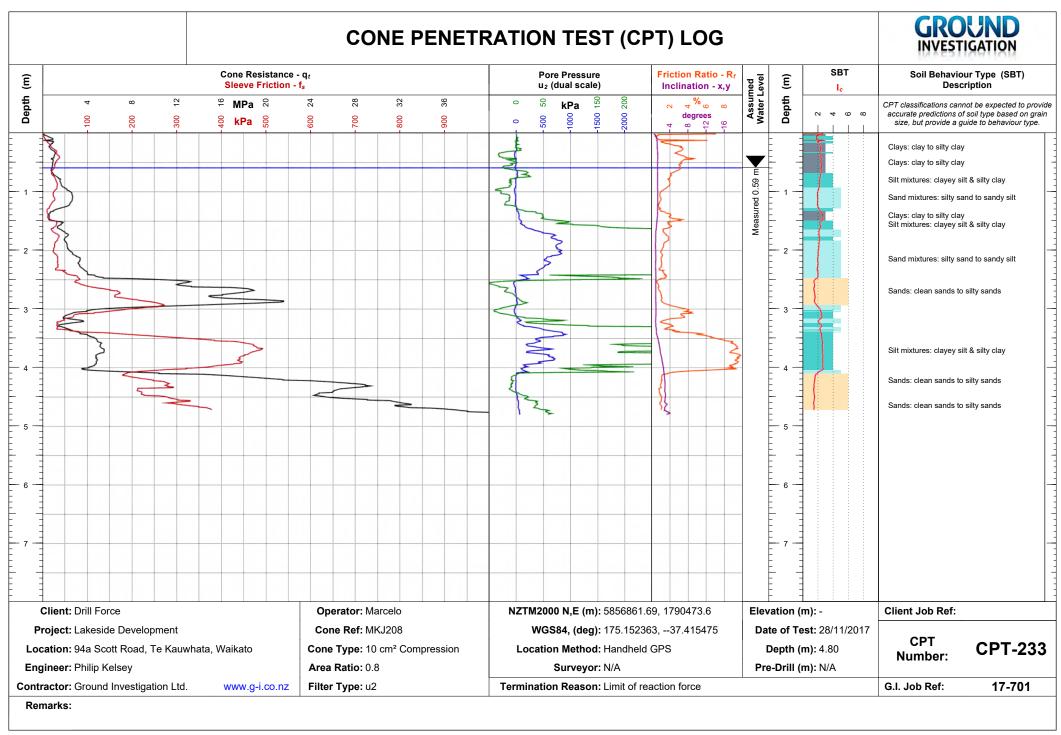


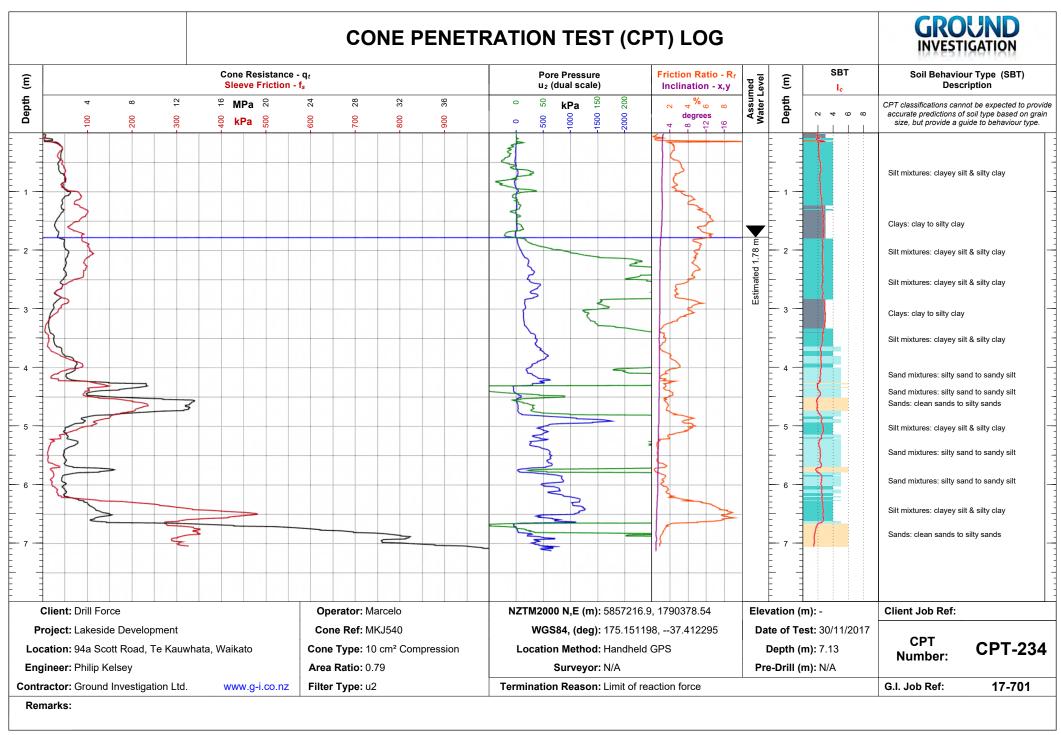












Appendix C: Laboratory Solid Density and Compaction Test Results



STEVENSON CONSTRUCTION MATERIALS LIMITED

Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172767

Report Number:

28802T

Date of Issue:

23rd November 2017

Page 1 of 2 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.7.2: Determination of the Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

9th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP202 (0.6 - 1.6 & 1.6 - 2.6m), Puketoka Silt/Clay

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

TEST RESULTS

Material:

Job:

TP202 (0.6 - 1.6 & 1.6 - 2.6m), Puketoka Silt/Clay

Source:

Lakeside Developments Te Kauwhata

Lakeside Developments

Test No.:

172767

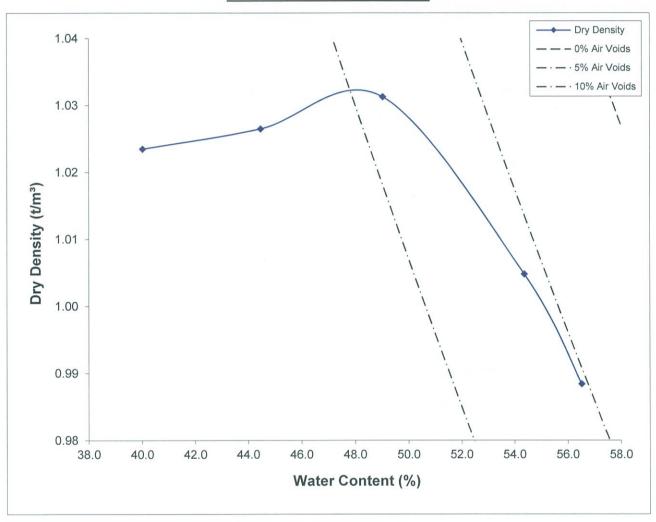
Date Sampled:

9th November 2017

Reference No.:

4036

NZ STANDARD COMPACTION



Maximum Dry Density (t/m³)	Density Content		Natural Water Content %	
1.03	49.0	2.54	63.6	

Water Content	(%)	40.0	44.5	49.0	54.4	56.5
Dry Density	(t/m³)	1.02	1.03	1.03	1.00	0.99
Shear Strength	(kPa)	UTP	UTP	162	112	59
Remoulded Shear Strength	(kPa)	UTP	UTP	18	9	3

Notes:

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



STEVENSON CONSTRUCTION MATERIALS LIMITED

Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172768

Report Number:

28876T

Date of Issue:

30th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.2: Determination of Liquid Limit

2.3: Determination of Plastic Limit

2.4: Determination of Plasticity Index

2.6: Determination of Linear Shrinkage

2.7.2: Determination of Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

8th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP203 (0.3 - 1.0 & 1.0 to 1.7m) Brown Ash

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE
IANZ APPROVED SIGNATORY



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

TEST RESULTS

Material:	TP203 (0.3 - 1.0 & 1.0 to 1.7m) Brown Ash	Test No.:	172768
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	8 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

TEST METHOD	RESULT	SPECIFICATION	
Liquid Limit	85	-	
Plastic Limit	39	-	
Plasticity Index	46	-	
Linear Shrinkage	13%	-	

Notes: i. Plasticity Index Tests performed on material passing 0.425mm sieve.

CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.18
Compacted water content	(%)	44.1
Soaked water content	(%)	46.6
Swell	(%)	0.0
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	2.5 & 5.0
California Bearing Ratio	CBR	5%

Notes:

- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

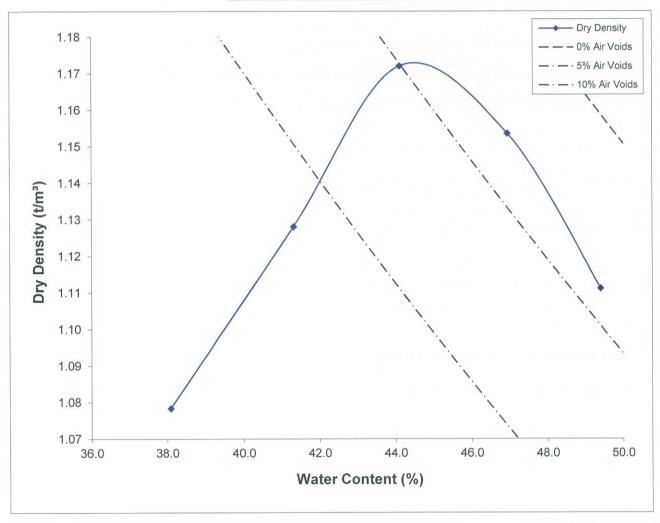
TEST RESULTS

Material: TP203 (0.3 – 1.0 & 1.0 to 1.7m) Brown Ash

Source: Lakeside Developments Te Kauwhata Date Sampled: 8th November 2017

Job: Lakeside Developments Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry Density (t/m³)	Density Content		Natural Water Content %
1.17	44.0	2.71	41.6

Water Content	(%)	38.1	41.3	44.1	46.9	49.4
Dry Density	(t/m³)	1.08	1.13	1.17	1.15	1.11
Shear Strength	(kPa)	UTP	UTP	162	65	38
Remoulded Shear Strength	(kPa)	UTP	UTP	80	32	15

Notes:

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172769

Report Number:

28803T - Amendment One

Date of Issue:

5th December 2017

Page 1 of 2 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

8th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP203 (1.7 - 2.7 & 2.7 - 3.4m), Puketoka Silt/Clay

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsey of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY





Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172770

Report Number:

28877T

Date of Issue:

30th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.2: Determination of Liquid Limit2.3: Determination of Plastic Limit

2.4: Determination of Plasticity Index2.6: Determination of Linear Shrinkage

2.7.2: Determination of Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

7th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP204 (1.0 - 2.0 & 2.0 to 3.0m) Puketoka Silt/Clay

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD





Material:	TP204 (1.0 – 2.0 & 2.0 to 3.0m) Puketoka Silt/Clay	Test No.:	172770
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	7 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

TEST METHOD	RESULT	SPECIFICATION
Liquid Limit	70	_
Plastic Limit	29	-
Plasticity Index	41	-
Linear Shrinkage	12%	-

Notes: i. Plasticity Index Tests performed on material passing 0.425mm sieve.

CALIFORNIAN BEARING RATIO

		Resulf
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.22
Compacted water content	(%)	38.7
Soaked water content	(%)	41.5
Swell	(%)	1.2
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	2.5 & 5.0
California Bearing Ratio	CBR	6%

- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

Material: Source: TP204 (1.0 - 2.0 & 2.0 to 3.0m) Puketoka Silt/Clay

Source: Lakeside D Job: Lakeside D

Lakeside Developments Te Kauwhata

Lakeside Developments

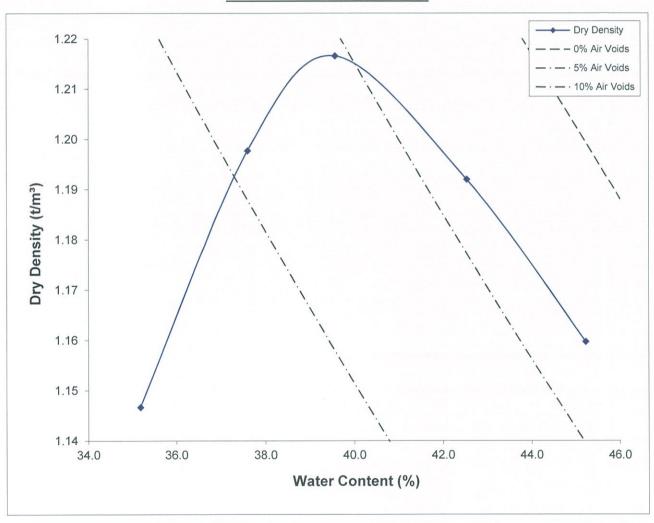
Test No.: 172770

Date Sampled: 7th N

7th November 2017

Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density (t/m³)	Content (%)	Measured t/m³	Water Content %
1.22	40.0	2.62	47.0

Water Content	(%)	35.2	37.6	39.6	42.5	45.2
Dry Density	(t/m³)	1.15	1.20	1.22	1.19	1.16
Shear Strength	(kPa)	UTP	201	133	74	21
Remoulded Shear Strength	(kPa)	UTP	53	21	15	6

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172772

Report Number:

28858T

Date of Issue:

28th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.7.2: Determination of the Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

8th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP205 (2.3 – 3.3 & 3.3 – 4.3m), Puketoka Sand

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



Material:	TP205 (2.3 – 3.3 & 3.3 – 4.3m), Puketoka Sand	Test No.:	172772
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	8 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

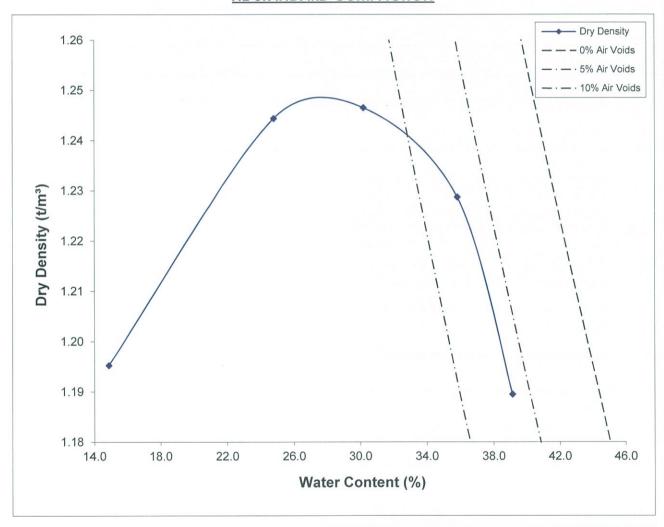
CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(†/m³)	1.24
Compacted water content	(%)	29.7
Soaked water content	(%)	35.3
Swell	(%)	0.0
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	5.0
California Bearing Ratio	CBR	25%

- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

Material:TP205 (2.3 – 3.3 & 3.3 – 4.3m), Puketoka SandTest No.:172772Source:Lakeside Developments Te KauwhataDate Sampled:8th November 2017Job:Lakeside DevelopmentsReference No.:4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density	Content	Measured	Water Content
(t/m³)	(%)	(t/m³)	%
1.25	30.0	2.52	36.7

Water Content	(%)	14.9	24.8	30.2	35.8	39.1
Dry Density	(t/m³)	1.20	1.24	1.25	1.23	1.19
Shear Strength	(kPa)	UTP	UTP	UTP	UTP	18
Remoulded Shear Strength	(kPa)	UTP	UTP	UTP	UTP	0

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172773

Report Number:

28856T

Date of Issue:

23rd November 2017

Page 1 of 2 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

8th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP 205 (4.8 – 5.5m) Puketoka Silt (Sensitive)

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsey of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



TP 205 (4.8 – 5.5m) Puketoka Silt (Sensitive) Material: Source:

Lakeside Developments Te Kauwhata

Lakeside Developments

Job:

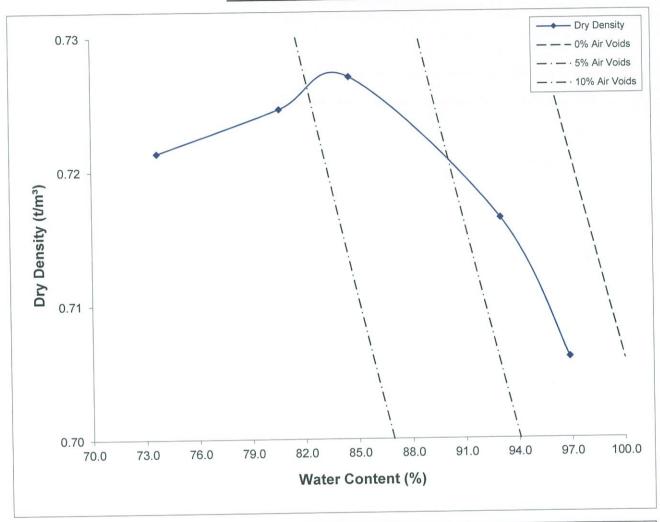
172773 Test No.:

Date Sampled:

8th November 2017

4036 Reference No.:

NZ STANDARD COMPACTION



Maximum Dry Density (t/m³)	Optimum Water	Solid Density	Natural	
	Content	Assumed	Water Content	
	(%)	t/m³	%	
0.73	85.0	2.40	94.1	

Water Content	(%)	73.7	80.6	84.6	93.0	96.9
Dry Density	(t/m³)	0.72	0.72	0.73	0.72	0.71
Shear Strength	(kPa)	201	162	145	59	38
Remoulded Shear Streng	jth (kPa)	12	27	24	3	0

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172774

Report Number:

28859T - Amendment One

Date of Issue:

5th December 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

7th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP206 (0.3 - 1.5 & 1.5 - 3.0m), Puketoka Silt & Sand

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



Material: TP206 (0.3 – 1.5 & 1.5 – 3.0m), Puketoka Silt & Sand Test No.: 172774

Source: Lakeside Developments Te Kauwhata Date Sampled: 7th November 2017

Job: Lakeside Developments Reference No.: 4036

CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.16
Compacted water content	(%)	39.4
Soaked water content	(%)	42.5
Swell	(%)	0.0
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	5.0
California Bearing Ratio	CBR	13%

- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

Material:

TP206 (0.3 – 1.5 & 1.5 – 3.0m), Puketoka Silt & Sand

Test No.:

172774

Source: Job: Lakeside Developments Te Kauwhata

Lakeside Developments

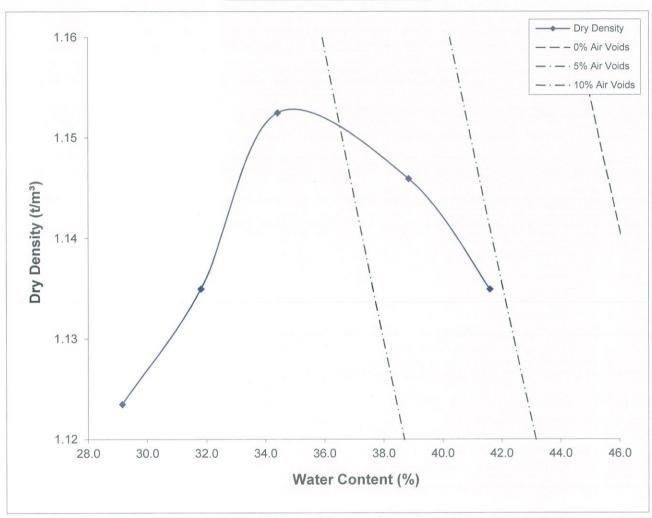
Date Sampled:

7th November 2017

Reference No.:

4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density	Content	Assumed	Water Content
(t/m³)	(%)	t/m³	%
1.15	34.0	2.40	48.0

Water Content	(%)	29.2	31.8	34.4	38.8	41.6
Dry Density	(t/m³)	1.12	1.13	1.15	1.15	1.13
Shear Strength	(kPa)	UTP	UTP	UTP	UTP	130
Remoulded Shear Strength	(kPa)	UTP	UTP	UTP	UTP	15

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172775

Report Number:

28860T

Date of Issue:

28th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.7.2: Determination of the Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

7th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP206 (4.0 - 5.0 & 5.0 - 5.6m), Puketoka Sand

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



Material:	TP206 (4.0 – 5.0 & 5.0 – 5.6m), Puketoka Sand	Test No.:	172775
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	7 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.00
Compacted water content	(%)	51.2
Soaked water content	(%)	47.8
Swell	(%)	-0.2
Rate of penetration	(mm/min)]
Depth CBR recorded	(mm)	5.0
California Bearing Ratio	CBR	18%

- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

Material:

TP206 (4.0 – 5.0 & 5.0 – 5.6m), Puketoka Sand

Source:

Lakeside Developments Te Kauwhata

Job: Lakeside Developments

Test No.:

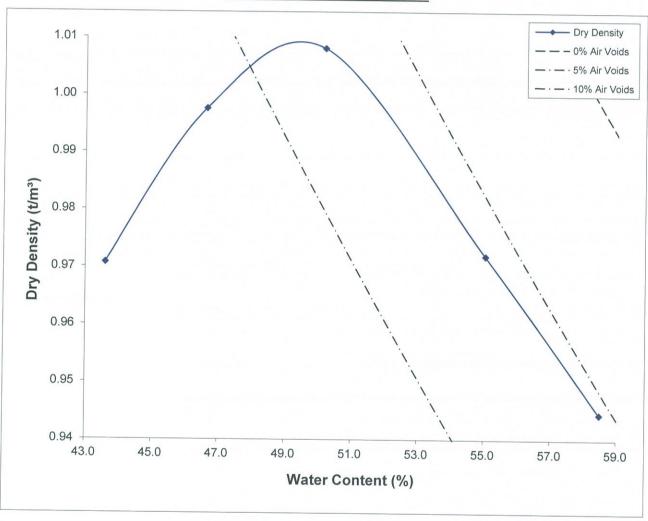
172775

Date Sampled:

7th November 2017

Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry Density (t/m³)	Optimum Water Content (%)	Solid Density Measured (t/m³)	Natural Water Content
1.01	50.0	2.40	31.1

Water Content	(%)	43.6	46.7	50.2	55.0	58.5
Dry Density	(t/m³)	0.97	1.00	1.01	0.97	0.94
Shear Strength	(kPa)	UTP	UTP	UTP	27	15
Remoulded Shear Strength	(kPa)	UTP	UTP	UTP	9	3

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172776

Report Number:

28878T

Date of Issue:

30th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

- 1. NZS4402: 1986:Test
 - 2.1: Determination of the Water Content
 - 2.2: Determination of Liquid Limit
 - 2.3: Determination of Plastic Limit
 - 2.4: Determination of Plasticity Index
 - 2.6: Determination of Linear Shrinkage2.7.2: Determination of Solid Density of Soil Particles
 - 4.1.1: Dry Density/Water Content Relationship
 - NZ Standard Compaction
 - 6.1.1: Determination of the California Bearing Ratio
- 2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

7th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP208 (0.35 - 1.5 & 1.5 & 2.5m) Brown Ash

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

t a whitmore Ianz approved signatory



Material:	TP208 (0.35 – 1.5 & 1.5 & 2.5m) Brown Ash	Test No.:	172776
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	7 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

TEST METHOD	RESULT	SPECIFICATION
Liquid Limit	76	<u>.</u>
Plastic Limit	34	-
Plasticity Index	42	-
Linear Shrinkage	13%	-

Notes: i. Plasticity Index Tests performed on material passing 0.425mm sieve.

CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.24
Compacted water content	(%)	40.6
Soaked water content	(%)	41.8
Swell	(%)	0.0
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	2.5
California Bearing Ratio	CBR	4%

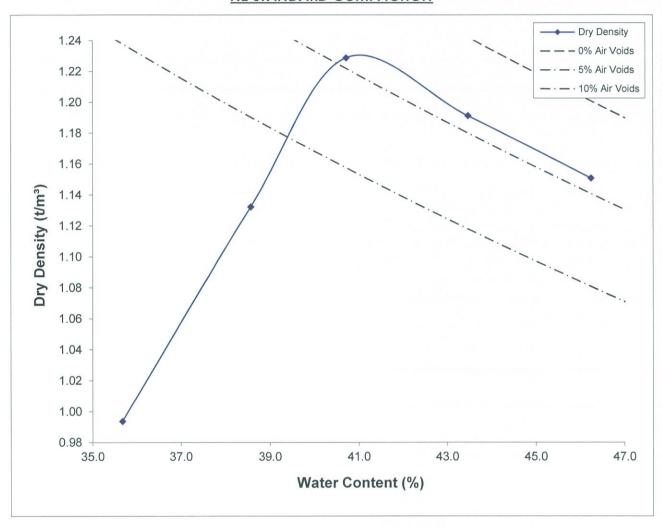
- i. Negative Swell implies shrinkage.
- ii. Test performed on material passing the 19.0mm Test Sieve (100%).

Material: TP208 (0.35 – 1.5 & 1.5 & 2.5m) Brown Ash Test No.: 172776

Source: Lakeside Developments Te Kauwhata Date Sampled: 7th November 2017

Job: Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry Density (t/m³)	Optimum Water Content (%)	Solid Density Measured t/m³	Natural Water Content
1.23	41.0	2.70	45.1

Water Content	(%)	35.7	38.6	40.7	43.5	46.2
Dry Density	(t/m³)	0.99	1.13	1.23	1.19	1.15
Shear Strength	(kPa)	UTP	UTP	115	47	27
Remoulded Shear Strength	(kPa)	UTP	UTP	56	30	12

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172777

Report Number:

28861T

Date of Issue:

28th November 2017

Page 1 of 3 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.7.2: Determination of the Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

6.1.1: Determination of the California Bearing Ratio

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

7th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP208 (2.5 - 3.6 & 3.6 - 4.6m), Puketoka Silt/Clay

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsley of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY



Material:	TP208 (2.5 – 3.6 & 3.6 – 4.6m), Puketoka Silt/Clay	Test No.:	172777
Source:	Lakeside Developments Te Kauwhata	Date Sampled:	7 th November 2017
Job:	Lakeside Developments	Reference No.:	4036

CALIFORNIAN BEARING RATIO

		Result
Compaction effort		NZ Standard Compaction
Sample condition		Soaked
Surcharge mass	(kg)	6.7
Period of Soaking	(Days)	4
Compacted dry density	(t/m³)	1.00
Compacted water content	(%)	51.8
Soaked water content	(%)	57.2
Swell	(%)	0.2
Rate of penetration	(mm/min)	1
Depth CBR recorded	(mm)	2.5 & 5.0
California Bearing Ratio	CBR	1%

- i. ii.
- Negative Swell implies shrinkage. Test performed on material passing the 19.0mm Test Sieve (100%).

Material: TP208 (2.5 - 3.6 & 3.6 - 4.6m), Puketoka Silt/Clay

Lakeside Developments Te Kauwhata

Job: Lakeside Developments

Source:

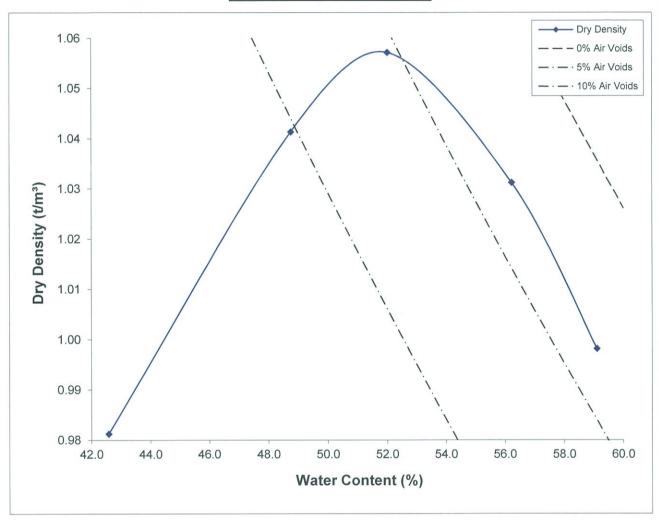
Test No.: 172777

7th November 2017 Date Sampled:

Reference No.:

4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density	Content	Measured	Water Content
(t/m³)	(%)	(t/m³)	%
1.06	52.0	2.67	

Water Content	(%)	42.6	48.8	52.0	56.2	59.1
Dry Density	(t/m³)	0.98	1.04	1.06	1.03	1.00
Shear Strength	(kPa)	UTP	198	94	59	18
Remoulded Shear Strength	(kPa)	UTP	50	27	12	3

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172778

Report Number:

28804T

Date of Issue:

23rd November 2017

Page 1 of 2 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

8th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP210 (1.9 – 2.5 & 2.5 – 3.0m), Puketoka Sand/Silty Sand

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsey of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY

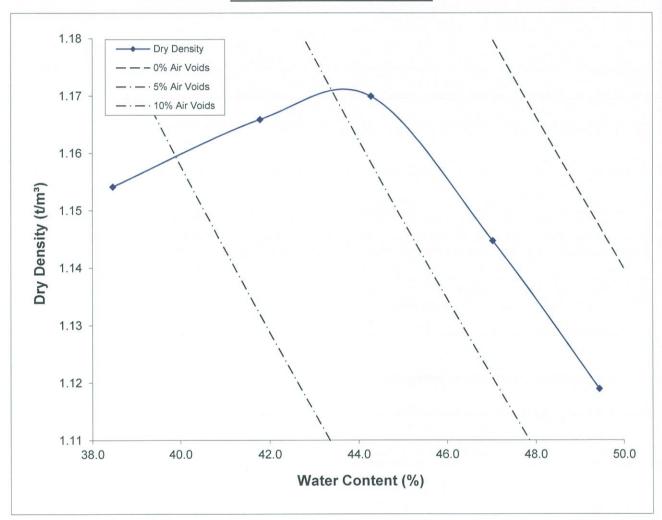


Material: TP210 (1.9 – 2.5 & 2.5 – 3.0m), Puketoka Sand/Silty Sand Test No.: 172778

Source: Lakeside Developments Te Kauwhata Date Sampled: 8th November 2017

Job: Lakeside Developments Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density	Content	Assumed	Water Content
(t/m³)	(%)	t/m³	%
1.17	44.0	2.65	37.8

Water Content	(%)	38.5	41.8	44.3	47.0	49.4
Dry Density	(t/m³)	1.15	1.17	1.17	1.14	1.12
Shear Strength	(kPa)	UTP	174	94	35	21
Remoulded Shear Streng	th (kPa)	UTP	27	18	12	3

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.



Private Bag 94000, Manukau City, Auckland 2241 www.stevenson.co.nz

Test Number:

172780

Report Number:

28805T

Date of Issue:

23rd November 2017

Page 1 of 2 Pages

FINAL REPORT FOR EARTHTECH CONSULTING LTD

Clients Address:

PO Box 721

PUKEKOHE 2340

Attention:

Philip Kelsey

Reference:

No. 4036

Subject:

SOIL TESTING

Clients Instructions:

Conduct the tests as detailed below on the soil sample received.

Test Methods:

1. NZS4402: 1986:Test

2.1: Determination of the Water Content

2.7.2: Determination of the Solid Density of Soil Particles

4.1.1: Dry Density/Water Content Relationship

- NZ Standard Compaction

2. NZ Geotechnical Society, Guideline

Determining the Shear Strength of a Cohesive Soil using a Hand Held

Shear Vane

Date Sampled:

9th November 2017

Date Received:

10th November 2017

Date of Test:

November 2017

Description of Sample:

TP212 (1.7 - 2.7 & 2.7 - 3.7m), Puketoka Sand

Source:

Lakeside Developments Te Kauwhata

Notes:

i. Field sample received in its natural state.

ii. Sample taken by P.Kelsey of Earthtech Consulting Ltd by an unknown method.

iii. Sampling of soil is not covered by this report.

for STEVENSON CONSTRUCTION MATERIALS LTD

T A WHITMORE

IANZ APPROVED SIGNATORY

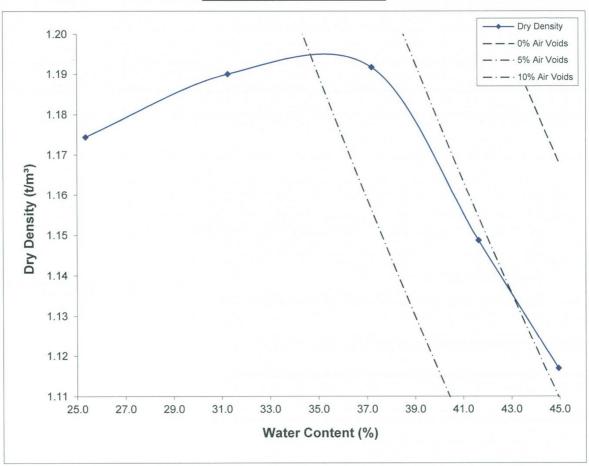


Material: TP212 (1.7 – 2.7 & 2.7 – 3.7m), Puketoka Sand Test No.: 172780

Source: Lakeside Developments Te Kauwhata Date Sampled: 9th November 2017

Job: Lakeside Developments Reference No.: 4036

NZ STANDARD COMPACTION



Maximum Dry	Optimum Water	Solid Density	Natural
Density	Content	Measured	Water Content
(t/m³)	(%)	t/m³	%
1.19	37.0	2.46	35.5

Water Content	(%)	25.3	31.3	37.2	41.6	44.9
Dry Density	(t/m³)	1.17	1.19	1.19	1.15	1.12
Shear Strength	(kPa)	UTP	UTP	UTP	18	12
Remoulded Shear Strength	(kPa)	UTP	UTP	UTP	3	0

- i. Test performed on material passing 19.0mm sieve (100%).
- ii. UTP = Unable to Penetrate.
- iii. Natural water content performed on whole sample.

DRY DENSITY / WATER CONTENT RELATIONSHIP STANDARD COMPACTION



Project:

Lakeside Developments

Location:

Lakeside Developments

Client:

CMW (NZ) Limited

Contractor:

-

Sampled by:
Date sampled:

Client Unknown

Sampling method:

Bulk Sample (as received)

Sampling method: Sample description:

SILT with some clay

S01 (Stage 1 Bulk Fill)

Sample condition:

As received

Solid density:

Source:

As received

2.60

t/m³ (Tested)

Project No : Lab Ref No : 2-68014.00

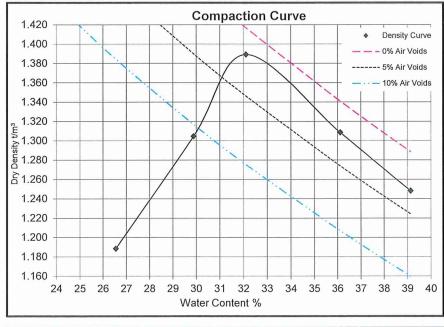
Kei No:

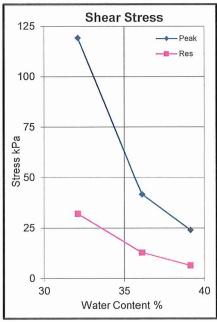
HA3889_1_MDD

Client Ref No:

HAM2018-0106

Test Results								
Maximum dry den	sity	1.39	t/m³		Natural wate	r content	32.1	%
Optimum water co	ntent	32	%		Fraction teste	ed 10	0% Passing 19	mm
Sample ID		-180	-120	-60	NAT	60	120	
Bulk density	t/m³	1.473	1.504	1.694	1.835	1.781	1.737	
Water content	%	23.6	26.5	29.9	32.1	36.1	39.1	
Dry density	t/m³	1.192	1.188	1.305	1.389	1.309	1.248	
Sample condition		Very Stiff	Stiff	Stiff	Firm	Soft	Very Soft	
•		Dry	Dry	Dry-Moist	Moist	Moist	Wet	
Peak stress	kPa	Refusal	Refusal	Refusal	119	42	24	
Remoulded stress	kPa	Refusal	Refusal	Refusal	32	13	6	





Test Methods	Notes	
Compaction NZS 4402 : 1986 Test 4.1.1 (Standard)		
Shear Strength using a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001		

Date tested:

30/01/19

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date reported:

04/02/19

This report may only be reproduced in full

IANZ Approved Signatory

Designation: Senior Civil Engineering Technician

Date:

04/02/19

ACCREDITED LABORATORY

Tests indicated as not accredited are outside the scope of the laboratory's

PF-LAB-025 (19/03/2018)

Page 1 of 1

DRY DENSITY / WATER CONTENT RELATIONSHIP STANDARD COMPACTION



Project:

Lakeside

Location:

Lakeside

Client:

CMW (NZ) Limited

Contractor:

Sampled by:

Client

Date sampled:

Unknown

Sampling method:

Bulk Sample (As received)

Sample description:

CLAY (Ash mix)

Sample condition:

As received

S02 Stage 1 fill

Solid density:

Source:

2.72

t/m³ (Tested)

Project No:

2-68014.00

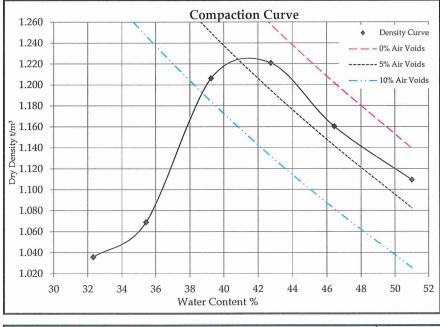
Lab Ref No:

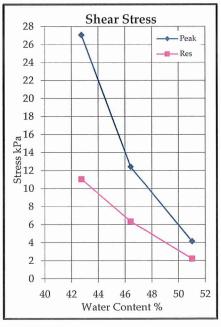
HA4413 MDD

Client Ref No:

HAM2018-0106

Maximum dry dens	itx	1.22	t/m³	Cest Results	Matural water	content	42.7	%
Optimum water co		41	%		Natural water content 42.7 Fraction tested 100% passing 19mn			
Sample ID		-180	-120	-60	Nat	60	120	
Bulk density	t/m³	1.370	1.448	1.679	1.743	1.699	1.675	
Water content	%	32.3	35.4	39.2	42.7	46.4	51.0	
Dry density	t/m³	1.036	1.069	1.206	1.221	1.160	1.109	
Sample condition		V.Stiff	V.Stiff	Stiff	Firm	Soft	Soft	
*:		Dry	Dry - Moist	Moist	Moist	Moist	Moist-wet	
Peak stress	kPa	Refusal	Refusal	Refusal	27	12	4	
Remoulded stress	kPa	Refusal	Refusal	Refusal	11	6	2	





Test Methods		Notes	
Compaction	NZS 4402: 1986 Test 4.1.1 (Standard)		
Shear Strength usir	g a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001		

Date tested:

16/05/19

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date reported:

20/05/19

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IANZ Approved Signatory

Designation:

Senior Civil Engineering Technician

Date:

20/05/19

Tests indicated as not accredited are outside the scope of the laboratory's

PF-LAB-025 (19/03/2018)

Page 1 of 1

WSP Opus

Hamilton Laboratory

Quality Management Systems Certified to ISO 9001

Fox Street

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Appendix D: Subdivision Earthworks Specification



17 October 2018 Document Ref: HAM2018-0106AB Rev 1

Land Development Earthworks Specification For: Stages 1 to 7 Lakeside Residential Development, Scott Road, Te Kauwhata

1 INTRODUCTION AND SCOPE

This specification covers compaction control criteria for the cut-to-fill material at the above site. This is based on and cut-to-fill workability trials carried out on site by the earthworks contractor, use of the material during placement on the 80,000m³ site, suitability of the cut to fill materials on site, compaction testing carried out by CMW Geosciences (CMW) and our review of the compaction test results provided in the Earthtech Limited report referenced R4036-2-Rev B, dated 30 March 2017. It provides detail on the required specification for:

- Cut to fill earthworks operations;
- Fill materials and testing requirements;
- · Earthworks finishing and respread of topsoil; and,
- As-built records.

Excluded from the scope are site clearance and preparation, geotextile reinforced slopes, subsoil drainage installation or retaining structures covered by a building consent.

Unless varied onsite by the Geotechnical Engineer, the following specification requirements must be met in order for CMW to provide a Geotechnical Completion Report for the works. Where there is any conflict or discrepancy in the requirements of this specification and the documents listed above the matter shall be referred to the Geotechnical Engineer (CMW) for clarification.

2 RELEVANT DOCUMENTS

2.1 Standards, Guidelines and Consents

The works shall comply with the relevant sections of the following standards, guidelines and consents:

- 1. Health and Safety at Work Act 2015 and Regulations 2016;
- 2. All Project Resource Consent Conditions and Engineering Works Approvals;
- 3. Waikato District Council Development and Subdivision Manual 2012;

- 4. The Waikato Regional Council, Erosion and Sediment Control Guidelines Technical Report No. 2009/02:
- 5. NZS 4431:1989 Code of Practice for Earth Fill for Residential Development;
- 6. NZS 4402: 1986 Methods of Testing Soils for Civil Engineering Purposes; and,
- 7. NZS 4404: 2010 Code of Practice for Urban Land Subdivision.

3 GEOTECHNICAL OBSERVATION REQUIREMENTS

3.1 Fill Materials and Conditioning

3.1.1 Soil Fill, Rock Fill or Soil and Rock Mixed Fill

Site won materials used as engineered filling shall be free of topsoil, organic matter and other unsuitable materials. The maximum particle size for soil and rock blended fill shall be 200mm and mixing and/ or crushing shall be carried in a manner that ensures that significant voids are not present in the filling between rock fragments.

For rock fill without soil blending, crushing is to occur to comply with the requirements for blended fills and needs to ensure that uniform compaction can occur without significant voids between particles in the absence of the soil fill.

3.1.2 Blending of Unsuitable Material to Create Acceptable Fill

The blending of 'unsuitable material' into structural fills may be undertaken only at the discretion of the Geotechnical Engineer following a request by the contractor and with sufficient time for appropriate consideration and onsite trials to demonstrate effectiveness of proposed blending

Approval for any such blending must be sought from and provided by the Geotechnical Engineer in writing prior to the commencement of any blending or trial.

Hardfill used as structural fill shall be a well graded, unweathered, durable, crushed rock product approved by the Geotechnical Engineer, with a grading suitable for compaction.

3.1.3 Material Conditioning

The cut materials on site may require some drying or wetting prior to compaction to achieve the required specification. This may be done by harrowing (such as with discs) and air drying when conditions permit or by the addition of hydrated lime.

Should the material require drying the addition of cement to engineered filling in concentrations greater than 3% requires the approval of the Geotechnical Engineer.

All additives such as cement proposed for use in backfill materials in contact with geosynthetics must be approved and monitored by the Geotechnical Engineer.

3.2 Fill Placement, Compaction and Testing Requirements

3.2.1 Site Won Cohesive Fill

Attention is drawn to the blending of cohesive and granular material. The appropriate testing method will be determined by the Geotechnical Engineer on-site.

The test criteria and frequency for cohesive materials (Clays & Silts) are set out in Table 1 and 2 below.

CMW Geosciences

Table 1 – Cohesive Materials Compaction Test Criteria for Engineered Filling:

	Air Voids (1)		Shear Vane	Strength ⁽²⁾
	Average	Maximum Single Value	Average	Minimum Single Value
General Fill (cohesive)	8%	10%	120 kPa	100 kPa
Landscape Fill	TBC by Geotechnical Engineer in case by case basis			

⁽¹⁾ Air Voids Percentage (as defined in NZS 4402:1986)

Table 2 – Cohesive Materials Compaction Testing Frequencies for Engineered Filling:

Soil Type	Field Density & Air Voids %	Vane Shear Strength	Solid Density	Compaction Curve				
General Fill (cohesive)	1 test per 1000m³ to 1500m³ of fill placed (subject to width and depth of fill) with not less than 1 test per 500mm lift of fill and for each 50m length of shear key excavation.	1 set of tests (4 readings within 1 metre of each other) per 1000m³ to 1500m³ of filling placed with not less than 1 set of tests per 500mm lift of fill for each fill area	Testing at CMW's discretion during the first month of earthworks and where different / unique soils conditions are exposed.	Testing at CMW's discretion during the first month of earthworks and where different / unique soils conditions are exposed.				
Landscape Filling	TBC by Geotechnical E	Engineer of case by ca	se basis					

The test criteria and/or frequency may be modified (relaxed or made more stringent) at the discretion of the Geotechnical Engineer (CMW) for the project or in a discrete fill area subject to the consistency of the results achieved being acceptable over a specified period of time.

3.2.2 Granular Fill or Hardfill

Granular fill and/or hardfill shall be placed and compacted to 95% of the MDD determined from the laboratory MDD. If these conditions are not able to be met then appropriate adjustment of the moisture content or compaction equipment will be required. The Geotechnical Engineer may at their discretion, alter the compaction specification to a method compaction specification based on the compaction trial result for materials with a maximum particle size greater than 65mm.

Test frequencies and criteria for granular fill/hardfill are presented in Tables 3 and 4.

Table 3 – Granular Fill Compaction Test Criteria for Engineered Filling:

Fill Type	Air Voids (1)	Dry Density ⁽¹⁾	Scala Penetrometer
i iii i ype	Maximum Single Value	Minimum	Minimum
General Fill (Granular)	20%	95% MDD	5 blows per 100mm penetration

CMW Geosciences Ref. HAM2018-0106AB REV 1

⁽²⁾ Undrained Shear Strength (Measured by hand shear vane – calibrated using NZGS 2001 method)

Table 4 - Granular Fill Compaction Testing Frequencies for Engineered Filling:

Test	Frequency
Nuclear Densometer (NDM) OR Density Tube	Minimum 1 test per 1,000m³ to 1500m³ (subject to width and depth of fill). To be distributed over extent and depth of filling and tests recorded at least every 0.5 metre depth of filling, where practical.
Moisture Content	Minimum 1 test per 1,000m³ to 1500m³ (subject to width and depth of fill). To be distributed over extent and depth of filling and tests recorded at least every 0.5 metre depth of filling, where practical.
Scala Penetrometer	Minimum 1 x 0.8 metre deep test per 1,000m³ of filling to 1500m³ (subject to width and depth of fill), at least every 0.5 metre depth of filling, where practical.
Compaction Curve (NZ Standard Compaction) and Solid Density Test	Testing at CMW's discretion during the first month of earthworks and where different / unique soils conditions are exposed.

The test frequency may be modified (relaxed or made more stringent) at the discretion of the Geotechnical Engineer (CMW) for the project or in a discrete fill area subject to the consistency of the results achieved being acceptable over a specified period of time.

3.2.3 Compaction Trials

Compaction trials may be carried out to determine the optimum layer thickness, number of passes and material condition for the proposed plant in order to meet the specified degree of compaction.

The contractor shall construct a pad such that on one side there are layers of one constant thickness, and on the other side layers of a different constant thickness. Both sides shall be subjected to increasing passes of the roller and sequentially tested until no further benefit of rolling is obtained.

If the required compaction criteria cannot be achieved the test shall be repeated after appropriate conditioning of the soil. The Contractor shall agree with the Geotechnical engineer the most appropriate soil conditioning before proceeding.

3.2.4 Compaction Testing Reporting Requirements

- 1 All test location coordinates are to be recorded by GPS survey using the Moturiki 1953 Datum. Test location coordinates, with date and test number reference are to be provided to the Geotechnical Engineer in electronic (excel) format on a weekly basis). Alternatively, the Geotechnical Engineer may approve the use of site plans to mark the location of tests in lieu of GPS location.
- 2. The level within the fill of each test location is to be recorded.
- 3. The volume of fill placed for each progress claim month (typically ending 20th of the month) including all fill placed (undercut and cut to fill) are to be provided to the Geotechnical Engineer monthly by the contractor or Engineer to the Contract to allow assessment of test frequency adequacy.

3.3 Finishing Works and Topsoil Respread

3.3.1 Overcut

All areas cut to below finished level shall be reinstated with engineered filling to the satisfaction of the Geotechnical Engineer.

CMW Geosciences Ref. HAM2018-0106AB REV 1

⁽¹⁾ Minimum dry density non-compliance may be accepted on site by the Geotechnical Engineer on a case by case basis depending on the nature of the material and the other criteria results.

3.3.2 **Topsoil Depth**

Topsoil respread depth shall be between 100mm and 300mm, or as directed by the Engineer to the contractor. On ground steeper than 1V:3H the surface shall be roughened under the supervision of the Geotechnical Engineer prior to topsoil placement.

3.3.3 **Unsuitable Materials**

At the conclusion of earthworks all surplus unsuitable materials shall be removed from site or placed in designated reserve areas. The size and location of such stockpiles must be approved by the Geotechnical Engineer and recorded on the asbuilt drawings.

3.3.4 **Road Subgrades**

Testing and formation of road subgrades will be carried out as part of the subdivision civil works package.

4 ASBUILT INFORMATION REQUIREMENTS

In order to provide a Geotechnical Completion Report (GCR) certain asbuilt information must be provided to CMW. It is the contractor's responsibility to ensure that all of the following items are surveyed prior to placing filling. The survey of these items shall therefore form a hold point in the construction sequence.

- 1. The location and invert of all subsoil drainage; and,
- 2. The depth of filling placed including all benching, undercuts, and temporary ponds which have been backfilled.

CMW require the following asbuilt information to be provided for the GCR:

- 1. Cut and fill depth plan (including undercuts);
- 2. Final contour plan;
- 3. Drainage locations and inverts (surface and subsurface);
- 4. Drainage outlet locations (surface and subsurface);
- 5. Details of any defined overland flow paths;
- 6. Material data for imported products used such as draincoils, aggregates and geofabrics as well as confirmation that products installed comply with the requirements of the project drawings and this specification; and,
- 7. Any settlement monitoring data.

CMW Geosciences

Appendix E: Earth Fill Quality Control Data



Lakeside Development

98 Scott Road, Te Kauwhata

Lakeside Developments (2017) Limited

HAM2019-0062LAA Rev.0

HAM2019-0062

11/12/2019

Project:

Project No:

Location:

Client:

Report No:

Report Date:

Client Address:

LF11 Rev.10 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Hamilton Laboratory CMW Geosciences (NZ) Ltd Partnership

Suite 2, 5 Hill Street, Hamilton 3204

PO Box 995, Waikato Mail Centre, Hamilton 3240

Phone: +64 (07) 2820 039

Test Methods: NZS 4402.2.1:1986

Solid Density:

Assumed

NZS 4407.4.2.2:2015

Solid Density Data Source: Testing Locations Selected By:

N/A CMW Field Staff

NZGS:August 2001

1 Blade size of 19mm used.

Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

1		Test Location*				Van	e ID	- 1	n-situ Va	ne Shea	Strengtl	ns	Field and Laboratory Testing Data								
Date Sampled	Sample No.	Location	RL	Soil Description*	Solid Density (t/m³) *	Head #	Blade #	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	_	Gauge Probe Depth (mm)		Oven Dry Density (t/m³)	Calculated Air Voids (%)	Comments
23/09/2019	N1	Lot 27	-	CLAY	2.70	1914	1914	122	122	119	215	145	1.73	1.17	47.0	1	300	42.4	1.21	4	
	N2	Lot 26	-	CLAY	2.70	1914	1914	UTP	UTP	UTP	UTP	UTP	1.71	1.18	45.7	3	300	43.0	1.20	4	
22/10/2019	N3	Stage 4	0.5m lift	CLAY	2.70	1911	1911	154	139	169	157	155	1.85	1.41	31.4	4	300	24.3	1.49	9	
	N4	Stage 4	0.5m lift	CLAY	2.70	1911	1911	UTP	UTP	UTP	182	182+	1.88	1.44	30.1	3	300	28.6	1.46	4	
29/10/2019	N5	Stage 6	-	Clayey SILT	2.62	2087	2087	179	237+	213	UTP	210+	1.79	1.26	42.0	-1	300	37.7	1.30	1	
	N6	Stage 6	-	CLAY	2.70	2087	2087	UTP	UTP	UTP	UTP	UTP	1.82	1.32	38.1	1	300	33.7	1.36	4	
	N7	Stage 4	-	CLAY	2.70	2087	2087	UTP	227	UTP	UTP	227+	1.76	1.25	40.3	3	200	32.5	1.33	8	
	N8	Stage 4	-	CLAY	2.70	2087	2087	UTP	UTP	UTP	UTP	UTP	1.82	1.35	34.5	3	300	27.0	1.43	8	
	N9	Stage 1	-	CLAY	2.70	2087	2087	UTP	UTP	UTP	UTP	UTP	2.04	1.72	18.0	5	300	26.2	1.61	-2	
30/10/2019	N10	Stage 1A	-	CLAY	2.70	2560	2560	123	191	164	UTP	159+	1.72	1.25	37.6	7	300	36.5	1.26	7	
	N11	Stage 1A	-	CLAY	2.70	2560	2560	UTP	142	UTP	UTP	142+	1.77	1.34	31.9	7	250	27.2	1.39	11	See N15 for retest.
31/10/2019	N12	Stage 4	-	CLAY	2.70	2560	2560	UTP	UTP	UTP	UTP	UTP	1.82	1.31	39.4	0	300	34.1	1.36	3	
	N13	Stage 4	-	CLAY	2.70	2560	2560	UTP	UTP	UTP	191+	191+	1.78	1.27	40.1	2	300	35.5	1.32	5	
	N14	Stage 1A	-	CLAY	2.70	2560	2560	68	109	139	109	106									No sample taken. See N16 for retest.
	N15	Stage 1A	-	CLAY	2.70	2560	2560	191+	131	142	104	142	1.88	1.37	37.0	-1	300	37.2	1.37	-2	Retest of N11.

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Created By: JLM

Checked By: JLM

Date: 14/10/2019 Date: 11/12/2019

Authorised Signatory: AWDC 16/12/2019 Date:

1 of 5

Page:



LF11 Rev.12 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Hamilton Laboratory

CMW Geosciences (NZ) Ltd Partnership Suite 2, 5 Hill Street, Hamilton 3204

PO Box 995, Waikato Mail Centre, Hamilton 3240

Phone: +64 (07) 2820 039

Project: Lakeside Development

Project No: HAM2019-0062
Location: 98 Scott Road, To

Location: 98 Scott Road, Te Kauwhata
Report No: HAM2019-0062LAB Rev.0

Report Date: 11/12/2019

Client: Lakeside Developments (2017) Limited

Client Address:

Test Methods: Notes: Solid Density: NZS 4402 1986 Test 2.1 Solid Density

NZS 4407 2015 Test 3.1

15 Test 3.1 Testing Locations Selected By:

Solid Density Data Source: N/A
Testing Locations Selected By: CMW Field Staff

NZS 4407 2015 Test 4.2 NZS 4407 2015 Test 4.3

NZGS:August 2001 (1) Blade size of 19mm used.



Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

2 of 5

Page:

Assumed

		Test Location*				Van	e ID	ı	n-situ Va	ne Shear	Strength	ıs	Field and Laboratory Testing Data								
Date Sampled	Sample No.	Location	RL	Soil Description*	Solid Density (t/m³) *	Head #	Blade #	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)		Oven Dry Density (t/m³)	Oven Calculated Air Voids (%)	Comments
1/11/2019	N16	Stage 1A	-	CLAY	2.70	2087	2087	173	135	149	176	158	1.68	1.19	41.2	7	300	31.8	1.28	12	Retest of N14.
	N17	Stage 1A	-	CLAY	2.70	2087	2087	186	203	122	237+	187+	1.85	1.40	32.7	3	300	30.1	1.42	4	
	N18	Stage 1A	-	CLAY	2.70	2087	2087	223	223	UTP	UTP	223+	1.78	1.27	39.6	3	300	33.1	1.33	6	
	N19	Stage 1A	-	CLAY	2.70	2087	2087	UTP	UTP	UTP	UTP	UTP	1.96	1.47	33.6	-4	300	27.4	1.54	1	
	N20	Stage 1A	-	CLAY	2.70	2087	2087	119	149	UTP	166	145+	1.87	1.39	33.9	1	300	28.0	1.46	5	
4/11/2019	N21	Stage 1A	-	CLAY	2.70	2087	2087	51	68	76	81	69									No sample taken. See N27 for retest.
	N22	Stage 1A	-	CLAY	2.70	2087	2087	237+	UTP	UTP	217	227+	1.89	1.44	31.4	2	300	30.5	1.45	2	
	N23	Stage 4	=	Clayey SILT	2.62	2087	2087	UTP	UTP	210	UTP	210+	1.79	1.35	32.3	5	300	34.5	1.33	3	
	N24	Stage 4	=	CLAY	2.70	2087	2087	UTP	UTP	UTP	UTP	UTP	1.86	1.37	35.8		300	41.0	1.32		
7/11/2019	N25	Stage 1A	-	CLAY	2.62	2560	2560	150	164	156	191	165	1.84	1.41	30.6		300	21.1	1.52	10	
	N26	Stage 1A		CLAY	2.70	2560	2560	137	139	112	131	130	1.88	1.42	32.6	1	300	30.3	1.44	3	
	N27	Stage 1A	=	CLAY	2.62	2560	2560	UTP	UTP	UTP	150	150+	1.85	1.42	30.2	3	300	26.7	1.46	5	Retest of N21.
	N28	Stage 4	=	CLAY	2.70	2560	2560	191	191	UTP	UTP	191+	1.81	1.36	32.3		300	33.8	1.35		
	N29	Stage 4		CLAY	2.70	2560	2560	191	191	UTP	UTP	191+	1.80	1.32	35.9		300	34.8	1.34	4	
13/11/2019	N30	Stage 4		CLAY	2.70	2349	2349	UTP	UTP	UTP	UTP	UTP	1.83	1.33	37.3		300	32.8	1.38	4	
	N31	Stage 4	-	CLAY	2.62	2349	2349	UTP	UTP	140	160	150+	1.76	1.33	32.2		300	32.3	1.33	6	
	N32	Stage 4	-	CLAY	2.70	2349	2349	204+	204+	UTP	UTP	204+	1.80	1.30	39.0		300	38.2	1.30	2	
	N33	Stage 4	-	CLAY	2.70	2349	2349	204	204	204	204	204	1.84	1.37	34.3	2	300	31.4	1.40	4	
	N34	Stage 1A	-	CLAY	2.70	2349	2349	UTP	175	160	172	169+	1.86	1.41	31.7	3	300	27.9	1.45	6	
	N35	Stage 1A	-	CLAY	2.62	2349	2349		58	55	131	87	1.87	1.45	29.0		300	33.1	1.41		See N36 for retest.
21/11/2019		Stage 1A		CLAY	2.70	1785	1785		199	202	202	201	1.83	1.42	29.5	6	300	27.3	1.44	7	Retest of N35.
	N37	Stage 1A		CLAY	2.70	1785	1785	UTP	UTP	UTP	202	202+	1.88	1.44	30.3	3	300	28.7	1.46	4	
	N38	Stage 5		CLAY	2.70	1785	1785	UTP	187	173	UTP	180+	1.82	1.30	39.3	0	300	31.8	1.38	5	
	N39	Stage 5		CLAY	2.70	1785	1785		144	115	118	130	1.75	1.18	47.7		300	47.3	1.19	0	
22/11/2019		Stage 5		CLAY	2.70	1785	1785	202	121	187	133	161	1.86	1.34	38.5	-1		41.4	1.31	-3	
	N41	Stage 5 - DEB		CLAY	2.70	1785	1785	121	202	202	UTP	175+	1.85	1.36	36.2	0	300	29.6	1.43	5	
	N42	Stage 5	-	CLAY	2.70	1785	1785	147	147	UTP	138	144+	1.82	1.36	33.2		300	29.8			scope of accreditation

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** Gauge Wet Densities outside of the calibrated range of 1.728 to 2.756 t/m³ are not accredited and are outside the laboratories scope of accreditation.

 Created By:
 JLM
 Date:
 13/11/2019

 Checked By:
 JLM
 Date:
 11/12/2019

 Authorised Signatory:
 AWDC
 Date:
 16/12/2019



LF11 Rev.12 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Hamilton Laboratory

CMW Geosciences (NZ) Ltd Partnership Suite 2, 5 Hill Street, Hamilton 3204

PO Box 995, Waikato Mail Centre, Hamilton 3240

Phone: +64 (07) 2820 039

Test Methods:

Notes:

Assumed N/A

Location: 98 Scott Road, Te Kauwhata

Lakeside Development

HAM2019-0062

NZS 4402 1986 Test 2.1 NZS 4407 2015 Test 3.1 NZS 4407 2015 Test 4.2 Solid Density Data Source: Testing Locations Selected By:

CMW Field Staff

 Report No:
 HAM2019-0062LAC Rev.0

 Report Date:
 11/12/2019

Project:

Project No:

Client Address:

NZS 4407 2015 Test 4.3 NZGS:August 2001

(1) Blade size of 19mm used.

Report Date: 11/12/2019
Client: Lakeside Dev

Lakeside Developments (2017) Limited

ACCREDITED LABORATORY

Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Solid Density:

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

		Test Location	*			Van	e ID	li	n-situ Va	ne Shear	Strength	ıs	Field and Laboratory Testing Data								
Date Sampled	Sample No.	Location	RL	Soil Description*	Solid Density (t/m³) *	Head #	Blade #	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)	Oven Water Content (%)	Oven Dry Density (t/m³)	Oven Calculated Air Voids (%)	Comments
25/11/2019	N43	Stage 2	-	CLAY	2.70	1785	1785	164	138	173	167	161	1.78	1.27	40.0	2	300	37.9	1.29	3	
	N44	Stage 4	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	202	202+	1.87	1.35	38.9	-2	300	31.1	1.43	3	
	N45	Stage 5	-	CLAY	2.62	1785	1785	UTP	UTP	UTP	UTP	UTP	1.65	1.13	45.7	5	300	40.6	1.17	8	
	N46	Stage 5	-	CLAY	2.70	1785	1785	46	104	130	118	100	1.75	1.28	36.5	6	300	34.7	1.30	7	See N52 for retest.
	N47	Stage 5	-	CLAY	2.70	1785	1785	124	121	63	75	96	1.85	1.40	32.7	3	300	30.1	1.42	4	See N51 for retest.
	N48	Stage 6	-	CLAY	2.62	1785	1785	UTP	UTP	202+	202+	202+	1.83	1.40	30.8	3	300	24.5	1.47	8	
	N49	Stage 6	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.87	1.42	31.8	2	300	23.6	1.51	8	
	N50	Stage 6	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.86	1.44	29.6	4	300	24.9	1.49	8	
26/11/2019	N51	Stage 5	-	CLAY	2.62	1785	1785	121	173	164	144	151	1.82	1.33	36.5	1	300	22.5	1.48	10	Retets of N47.
	N52	Stage 5	-	CLAY	2.62	1785	1785	UTP	UTP	UTP	UTP	UTP	1.73	1.25	38.5	4	300	31.0	1.32	9	Retest of N46.
27/11/2019	N53	Stage 5	-	CLAY	2.62	1785	1785	UTP	UTP	202+	202+	202+	1.79	1.34	33.4	4	300	31.3	1.36	5	
	N54	Stage 5	-	CLAY	2.62	1785	1785	202+	202+	202+	UTP	202+	1.74	1.28	36.4	5	300	31.6	1.32	8	
	N55	Stage 5	-	CLAY	2.62	1785	1785	UTP	UTP	UTP	UTP	UTP	1.85	1.39	33.3	1	300	21.1	1.53	9	
	N56	Stage 5	-	CLAY	2.62	1785	1785	202+	202+	202+	202+	202+	1.72	1.24	38.2	5	300	38.3	1.24	5	
28/11/2019	N57	Stage 6	-	CLAY	2.70	1785	1785	202	UTP	UTP	UTP	202+	1.90	1.47	29.2	3	300	22.9	1.54	8	
	N58	Stage 6	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.90	1.47	29.1	3	300	21.5	1.56	9	
	N59	Stage 6	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.87	1.48	26.2	6	300	21.3	1.54	10	
	N60	Stage 5	-	CLAY	2.70	1785	1785	130	138	159	150	144	1.89	1.44	31.1	2	300	39.3	1.35	-3	
	N61	Stage 5	-	CLAY	2.70	1785	1785	58	159	202	63	121	1.75	1.29	35.4	6	300	27.3	1.38	11	
29/11/2019	N62	Stage 4	-	CLAY	2.62	1785	1785	UTP	UTP	144	150	147+	1.76	1.32	33.8	5	300	31.2	1.34	7	
	N63	Stage 4	-	CLAY	2.62	1785	1785	UTP	UTP	182	202+	192+	1.76	1.31	33.8	5	300	30.2	1.35	8	
	N64	Stage 5	-	CLAY	2.70	1785	1785	43	61	86	52	61	1.84	1.39	32.8	3	300	26.7	1.45	7	Retest of N61.
	N65	Stage 1A	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	202	202+	1.92	1.56	22.8	7	300	23.0	1.56	6	
2/12/2019	N66	Stage 5	-	CLAY	2.70	1785	1785	173	159	164	UTP	165+	1.83	1.39	31.3	5	300	25.9	1.45	9	Retest of N64.
	N67	Stage 5	-	CLAY	2.70	1785	1785	173	173	164	159	167	1.89	1.44	31.2	1	300	28.7	1.47	3	
	N68	Stage 4	-	CLAY	2.62	1785	1785	202	UTP	202	202	202+	1.78	1.31	35.4	3	300	35.4	1.31	3	
	N69	Stage 4	-	CLAY	2.62	1785	1785	190	187	190	193	190	1.77	1.33	32.5	6	300	29.9	1.36	8	
	N70	Stage 1A	-	CLAY	2.72	1785	1785	202	173	UTP	202	192+	2.00	1.68	18.8	6	300	19.9	1.67	6	

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** Gauge Wet Densities outside of the calibrated range of 1.728 to 2.756 t/m³ are not accredited and are outside the laboratories scope of accreditation.

 Created By:
 JLM
 Date:
 9/12/2019

 Checked By:
 JLM
 Date:
 11/12/2019

 Authorised Signatory:
 AWDC
 Date:
 16/12/2019

Page: 3 of 5



LF11 Rev.12 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Hamilton Laboratory

CMW Geosciences (NZ) Ltd Partnership

Suite 2, 5 Hill Street, Hamilton 3204 PO Box 995, Waikato Mail Centre, Hamilton 3240

Phone: +64 (07) 2820 039

Project: Lakeside Development

Project No: HAM2019-0062
Location: 98 Scott Road, Te

Location: 98 Scott Road, Te Kauwhata
Report No: HAM2019-0062LAD Rev.0

Report Date: 11/12/2019

Client: Lakeside Developments (2017) Limited

Client Address:

Test Methods: Notes: Solid Density:

NZS 4402 1986 Test 2.1 Solid Density Data Source: N/A
NZS 4407 2015 Test 3.1 Testing Locations Selected By: CMW Field Staff

NZS 4407 2015 Test 4.2 NZS 4407 2015 Test 4.3

NZGS:August 2001 ① Blade size of 19mm used.

** Gauge Wet Densities outside of the calibrated range of 1.728 to 2.756 t/m³ are not accredited and are outside the laboratories scope of accreditation.

ACCREDITED LABORATORY

Tests indicated as not accredited are outside the scope of the laboratory's accreditation

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

Assumed

		Test Location*				Van	e ID		In-situ Va	ne Shea	r Strength	ıs			Fic	eld and Labora	tory Testing D	ata			
Date Sampled	Sample No.	Location	RL	Soil Description*	Solid Density (t/m³) *	Head #	Blade #	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)		Gauge Probe Depth (mm)		Oven Dry Density (t/m³)	Oven Calculated Air Voids (%) *	Comments
5/12/2019	N71	Stage 6	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.92	1.52	26.0	4	300	23.7	1.55	6	
	N72	Stage 6	-	CLAY	2.70	1785	1785	184	UTP	UTP	UTP	184+	1.81	1.32	37.4	2	300	32.6	1.37	5	
	N73	Stage 6	-	CLAY	2.70	1785	1785	144	UTP	144	UTP	144+	1.93	1.56	23.6	6	300	20.5	1.60	8	
	N74	Stage 5	-	CLAY	2.70	1785	1785	202	202	202	UTP	202+	1.79	1.27	40.9	1	300	37.0	1.30	3	
	N75	Stage 5	-	CLAY	2.70	1785	1785	147	202	UTP	138	162+	1.77	1.26	39.8	3	300	29.1	1.37	10	
	N76	Stage 1A	-	CLAY	2.72	1785	1785	UTP	UTP	UTP	UTP	UTP	2.05	1.84	11.6	11	300	12.5	1.82	10	
	N77	Stage 1A	-	CLAY	2.72	1785	1785	UTP	UTP	UTP	UTP	UTP	2.10	1.86	12.6	8	300	12.8	1.86	8	
9/12/2019	N78	Lot 28/29	-	CLAY	2.62	1785	1785	130	138	144	202	154	1.62	1.03	56.9	2	300	40.7	1.15	10	
11/12/2019	N79	Lot 59	-	CLAY	2.70	1785	1785	UTP	UTP	UTP	UTP	UTP	1.85	1.36	35.7	1	300	25.3	1.48	8	Retest of N294 from HAM2018-0106

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Checked By: JLM

Date: 11/12/2019 Date: 16/12/2019

Authorised Signatory: AWDC Date: 16/12/2019 Page: 4 of 5

Appendix F: Post-Construction Hand Auger Borehole Logs

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 09/12/2019

Logged by: AS Checked by: KR Scale: Borehole Location: Stage 3 - Lot 4 Sheet 1 of 1 Position: 438096.7mE; 707702.3mN Projection: Mount Eden Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth ML: SILT: dark brown. No plasticity. (Topsoil) 0.3 Peak = UTP CH: CLAY: orange brown. High plasticity. D to M (Fill) Peak = >200kPa Residual = 34kPa 0.5 Н Peak = >200kPa Residual = 34kPa 0.8 ML: SILT: with minor fine sand; light grey. Low plasticity, sensitive. (Whangamarino Formation) Peak = >200kPa Residual = 31kPa 1.0 M ML: SILT: with some fine sand; light grey. Low plasticity, moderately sensitive to sensitive. Peak = 160kPa Residual = 31kPa 1.2 (Whangamarino Formation) VSt to 1.6 Peak = >200kPa Residual = 40kPa Н Peak = 148kPa Residual = 52kPa 2.0 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached
Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane #1911.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 08/12/2019



Borehole Location: Stage 3 - Lot 20/21 Logged by: IP Scale: Sheet 1 of 1 Position: Projection: Mount Eden Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Moisture Condition Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth OL: SILT: dark brown. No plasticity. 2 (Topsoil) 7 D 4 SM: Silty fine SAND: white. Poorly graded. 5 (Whangamarino Formation) 10 12 MH: SILT: dark grey. High plasticity, sensitive. Peak = 134kPa Residual = 26kPa (Whangamarino Formation) 1.1 Н 1.5 Peak = >200kPa Residual = 32kPa SM: Silty fine SAND: light grey. Poorly graded. (Whangamarino Formation) 6 6 MD 2 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane #2532

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019

Borehole Location: Stage 3 Logged by: LK Checked by: KR Scale: 1:25 Sheet 1 of 1

Position: 434118.8mE; 740656.6mN Projection: WGS84

						Datum: Moturiki Survey Source: H	andheld	d Gl	PS			
Sa Deptr	mples & Insitu Tests	RL (m)	1	Deptin (m)	alapilic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	_ 3	ative Density	Dynam Penetr (Blows/	omete	er im)
Бери	Type a results			- 3/3		Organic SILT: black. Low plasticity. (Topsoil)	D	0	<u>ה</u>			
0.2	Peak = 143kPa					CL: Silty CLAY: brown mottled greyish orange. Low plasticity. (Fill) CH: CLAY: light grey. High plasticity. (Whangamarino Formation)	M W	vs	t			
				- × - × - ×	\times	ML: Sandy SILT: light grey. Low plasticity. (Whangamarino Formation) SM: Silty Fine SAND: light grey. (Whangamarino Formation)	M to					1
				× X X	× × × ×							
			1	ıΔî×.	× × ×			D				
				Ŷ	×	GP: Fine GRAVEL: with some fine to coarse sand, minor silt; brownish grey. Poorly graded, subrounded. (Whangamarino Formation)	w					
												Ι
				× × ·	× × × ×	GP: Silty Fine GRAVEL: bluish grey. Poorly graded, subrounded. (Whangamarino Formation)		D to)			T
			2	2	Χ.	Borehole terminated at 2.0 m						
				-								
			3									
				-								
			4	- - -								
				-								
				-								
			5	; <u>-</u>]								1

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019

Checked by: KR Scale: Borehole Location: Stage 3 Logged by: LK Sheet 1 of 1 Position: 434123.5mE; 740652.0mN Projection: WGS84 Datum: Moturiki Survey Source: Handheld GPS Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Moisture Condition Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 15 Type & Results Depth Organic SILT: black. Low plasticity. D (Topsoil)
CL: Silty CLAY: brown mottled greyish orange. Low plasticity. St to VSt 0.2 Peak = 120kPa W (Fill) SP: Fine SAND: with minor silt; white. Poorly graded. (Whangamarino Formation) M to W Borehole terminated at 0.6 m 2

Termination Reason: Equipment refusal

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

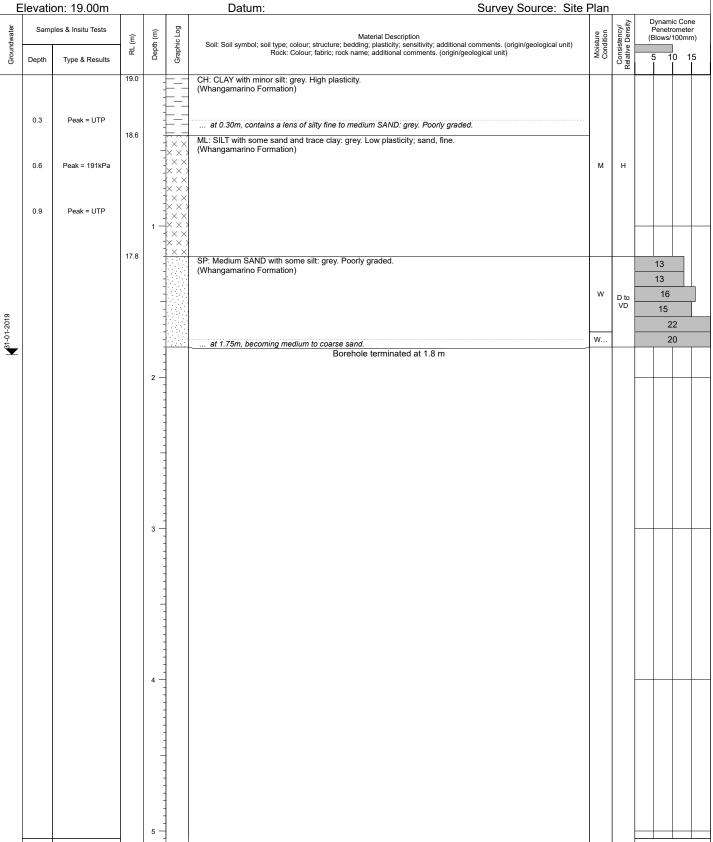
Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 31/01/2019

Borehole Location: Stage 3 - Lot 28/29 Boundary Logged by: YSL Checked by: LYK Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden



Termination Reason: No recovery due to hole collapse.

Shear Vane No: DCP No:

Remarks: Groundwater encountered at 1.85m. Shear vane no. 2560.



Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019

Borehole Location: Stage 1 Logged by: LK Checked by: KR Scale: 1:25 Sheet 1 of 1

						Datum: Motunki Survey Source: Hand	111010				
Groundwater	Samp	oles & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	(E	Oynamic C Penetrom Blows/100	eter (mm)
Grot	Depth	Type & Results	ır.	De	G	OL: Organic SILT: brown. Low plasticity	žő	Con		5 10	$\perp \!\!\! \perp \!\!\! \perp$
				-		(Topsoil)	D				8 4
	0.3	Peak = >200kPa Residual = 46kPa		-	(ML: Clayey SILT: with minor fine to coarse sand; grey mottled orange. Sensitive (Whangamarino Formation)					3
				-	(3
	0.6	Peak = 161kPa Residual = 29kPa		-	× × > (× ×)		М	VSt			4 5
	0.9	Peak = 159kPa		-	(5
		Residual = 14kPa		1 -	X X X X X X X X						9
	1.2	Peak = 127kPa Residual = 37kPa		-	X X X X X X	SP: Silty fine to coarse SAND: light grey mottled brown. poorly graded. Moderately sensitive. (Whangamarino Formation)					9 8
				-	× ×						8
	1.6	Peak = UTP		-	x			н			9
					× × × × ×		W to				11 14
				2 —	X . × > . ×	Borehole terminated at 2.0 m					
				-							
				-							
				-							
				-	-						
				-							
				3 —							
				-							
				-							
				-							
				4 -	-						
				-							
				-							
				-							
				5 —							
			L								

Termination Reason: Target depth

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 09/05/2019

Borehole Location: Stage 1 - Lot 55 Logged by: LYK Checked by: YSL Scale: Sheet 1 of 1 Position: Projection: Mount Eden Datum: Survey Source: Site Plan Consistency/ Relative Density Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth CL: CLAY: brown, mottled grey and pink. Low plasticity. (Fill) н 0.3 Peak = UTP ML: Clayey SILT with minor sand: grey, mottled brown and white. Low plasticity; sand, fine. М 0.6 Peak = 191kPa VSt Peak = 139kPa Residual = 41kPa 0.9 MH: Clayey SILT with trace sand: grey, mottled orange. High plasticity, moderately sensitive; sand, fine to coarse. (Whangamarino Formation) Peak = 183kPa Residual = 41kPa 1.2 VSt to W 1.6 Peak = UTP Peak = UTP 2.0 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached
Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 09/05/2019

Borehole Location: Stage 1 - Lot 56 Logged by: LYK Checked by: YSL Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden

						Datum: Survey Source: Site	Plan					
Groundwater	Samp	oles & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	F (E	Oynami Penetro Blows/1	c Cor omete 00m	ne er m)
Grou	Depth	Type & Results	교	Dep	Grap	Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Cor	Cons Relativ		5 1 	0 1	15
	0.3	Peak = UTP Peak = UTP				CL: CLAY: brown, mottled grey and orange. Low plasticity. (Fill) ML: Clayey SILT with minor sand: grey, mottled brown. Low plasticity. (Fill)	- м					
	0.9	Peak = UTP		1 -		ML: Clayey SILT with trace sand: grey, mottled orange. Low plasticity; sand, fine.		н				
	1.2	Peak = UTP				ML: Clayey SILT with trace sand: grey, mottled orange. Low plasticity; sand, fine. (Whangamarino Formation)	D					
	1.6	Peak = UTP		-			М					
	2.0	Peak = UTP		2 -	X	Borehole terminated at 2.0 m						
					- - - - - - - - - - - - - - - - - - -							
				-	-							
				4 -								
				-								
				5 -	- - -							

DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 05/04/2019

Borehole Location: Stage 1 - Lot 57 Logged by: AS Checked by: LYK Scale: Sheet 1 of 1 Position: Projection: Mount Eden Elevation: 14.00m Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Moisture Condition Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth 귐 10 15 Type & Results Depth 14 0 OL: Organic SILT: dark brown. Non plastic. D to M 13.8 CL: Silty CLAY: yellowish grey, mottled light brown. Low plasticity. 0.3 Peak = UTP ... at 0.50m, contains some fine sand 0.6 Peak = UTP D 0.9 Peak = UTP ... at 0.90m, becoming yellowish brown mottled grey. 1.2 Peak = UTP Peak = UTP 1.5 ... at 1.70m, becoming mottled dark brown. Peak = >200kPa 1.8 ... at 1.80m, becoming brown mottled dark brown. Peak = >200kPa 2.0 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 1911.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 21/03/2019

Borehole Location: Stage 2 - Lot 59/60 Boundary Logged by: YSL Checked by: LYK Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden Survey Source: Site Plan Elevation: 16.00m Datum: Dynamic Cone Penetrometer Samples & Insitu Tests Graphic Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) Ξ (Blows/100mm) Depth 귐 10 Type & Results Depth 16.0 CH: CLAY with minor silt: Yellow streaked white. High plasticity. 9 (Whangamarino Formation) 5 0.3 Peak = UTP 6 D to M 15.4 6 SP: Fine to medium SAND with some silt and minor clay: Grey, mottled yellow. Poorly graded. 0.6 Peak = UTP (Whangamarino Formation) 15.3 MH: Clayey SILT with trace fine sand: Grey, streaked yellow. High plasticity. 6 (Whangamarino Formation) Peak = UTP 0.9 15.0 SP: Fine to medium SAND with some silt minor clay: Grey. Poorly graded. (Whangamarino Formation)
CH: CLAY with minor silt: Light whitish grey, mottled yellow. High plasticity. 14.9 Peak = UTP 1.2 (Whangamarino Formation) 5 5 8 Peak = 170kPa 1.5 6 14.4 Residual = 41kPa ML: Sandy SILT: Light grey, mottled yellow. Low plasticity, sensitive; sand, fine. (Whangamarino Formation) VSt 9 Peak = UTP 1.8 14.2 ML: SILT with minor clay and trace sand: Grey, mottled greenish yellow. Low plasticity; sand, fine (Whangamarino Formation) 12 н 11 14 Borehole terminated at 2.0 m 10 9 9 9

Termination Reason: Hand Auger Refusal on hard silt.

Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 22/03/2019

Borehole Location: Stage 2 - Lot 65 Logged by: YSL Checked by: LYK Scale: Sheet 1 of 1

Position: Projection: Mount Eden

Survey Source: Site Plan Elevation: 19.00m Datum: Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth 귐 10 Type & Results Depth 19.0 SP: Fine to medium SAND with some silt: Yellow, mottled dark brown. Poorly graded. D to. (Whangamarino Formation)
MH: Clayey SILT: light greyish white. High plasticity, sensitive. 18.9 3 (Whangamarino Formation) 3 Peak = 71kPa Residual = 8kPa 0.3 2 St ... from 0.50m to 0.70m, mottled yellow. 3 М Peak = 98kPa Residual = 8kPa 0.6 5 18.3 ML: SILT with some sand and minor clay: Grey mottled yellow. Low plasticity; sand, fine. 10 (Whangamarino Formation)
SW: Fine to coarse SAND with minor silt: Grey mottled yellow. Well graded. 18.2 9 (Whangamarino Formation) ... at 0.90m, becoming white 9 9 ... at 1.05m, contains some silt, becoming mottled yellow. 6 6 ... at 1.30m, becoming white 5 MD 6 6 6 8 s 2 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater encountered at 1.85m. Shear vane no. 2560.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019

Borehole Location: Stage 6 Logged by: LK Checked by: KR Scale: Sheet 1 of 1 Position: 434217.2mE; 740580.4mN Projection: WGS84 Datum: Moturiki Survey Source: Handheld GPS Dynamic Cone Penetrometer Samples & Insitu Tests Groundwater Moisture Condition Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Graphic L Depth 귐 10 Depth Type & Results Organic SILT: black. Low plasticity. D (Topsoil)
ML: SILT: white. Low plasticity, extra sensitive. (Whangamarino Formation) M to VSt Peak = 175kPa Residual = 15kPa 0.3 ... at 0.30m, Becoming mottled brown. SP: Silty Fine SAND: light grey. Poorly graded. (Whangamarino Formation) TP 3 ML: Sandy SILT: light grey. Low plasticity, Sand, fine. (Whangamarino Formation) 0.9 Peak = UTP SP: Silty Fine SAND: light grey. Poorly graded. 1.2 Peak = UTP (Whangamarino Formation) 11 М 12 10 ... from 1.50m to 1.70m, Contains a lense of silty fine sand. 8 M to W 8 D 14 10 2 Μ Borehole terminated at 2.3 m

Termination Reason: Target depth

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019



Position: 434221.8mE; 740602.7mN Projection: WGS84

					Datum: Moturiki Survey Source: Han	dhelo	GP.	S			
Sam	pples & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	_ ≥	(E	Oynamio Penetro Blows/1	omete 00mr	er m)
Depth	Type & Results					20	Rela	L	5 10) 1	5
0.3	Peak = 199kPa Residual = 20kPa			X X _ X _ X _ X _ X _ X _ X _ X _	CH: Silty CLAY: light grey. High plasticity, extra sensitive. (Whangamarino Formation)	M	VSt				
0.6	Peak = 196kPa Residual = 12kPa			X X X X X X X X X X X X X X X X X X X	ML: SILT: with some clay, trace fine to coarse sand; light brown mottled dark green. Low plasticity, quick. (Whangamarino Formation)						
0.9	Peak = 170kPa Residual = 9kPa			(w	VSt				
1.2	Peak = UTP			X X X X X X X X X X X	ML: SILT: with minor fine to coarse sand; greenish brown. Low plasticity. (Whangamarino Formation)		н	-			
				X	SM: Silty Fine SAND: grey. (Whangamarino Formation)	D	D				
			2 -	× · · ·	Borehole terminated at 2.0 m						ļ
			3 -								
			-								
			4 -								
			5 -							_	

Termination Reason: Target depth

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 07/11/2019



Position: 434214.2mE; 740624.0mN Projection: WGS84

Datum: Moturiki Survey Source: Handheld GPS

					Datum: Moturiki Survey Source: Har	dhelo	<u>GP</u>	<u>s_</u>			_
Sam	nples & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	F (E	oynamic Penetro Blows/10	meter	•
Depth	Type & Results	"	De	Gra	Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	≥3	Con		5 10 I I) 15 	5
0.3	Peak = 143kPa				CL: Silty CLAY: light grey mottled brownish white. Low plasticity. (Fill) CH: CLAY: grey. High plasticity, sensitive.	D to M					_
0.6	Peak = 144kPa Residual = 29kPa		-		(Whangamarino Formation) MH: Clayey SILT: with trace fine sand; light grey. High plasticity, sensitive to extra sensitive	М	- VSt				
0.9	Peak = 146kPa Residual = 27kPa		1 -	X	(Whangamarino Formation) at 1.00m, Becoming mottled yellow.	-				_	_
1.2	Peak = 160kPa Residual = 15kPa			(w					
1.6	Peak = 146kPa Residual = 18kPa		_	××× ××× ×××× ××××	ML: SILT: with some clay, trace fine to coarse sand; light brown mottled dark green. Low plasticity, extra sensitive. (Whangamarino Formation)		VSt to H				
2.0	Peak = >200kPa Residual = 18kPa		2 -	X X X -X X X	Borehole terminated at 2.0 m					_	
			-								
			3 -								
			4 -								-
			-								
			5 -								

Termination Reason: Target depth

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

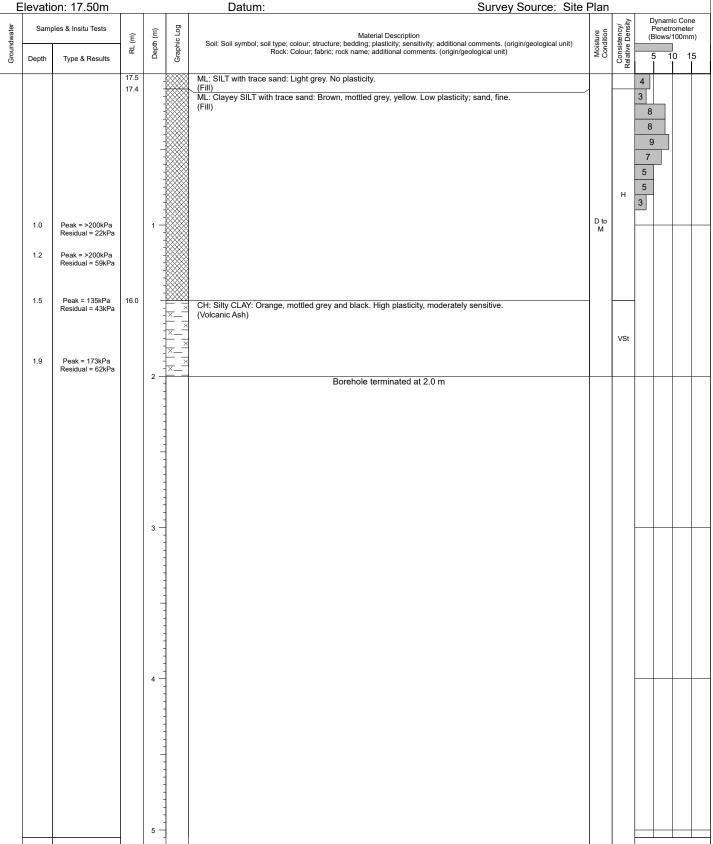
Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 27/03/2019

Borehole Location: Stage 2 - Lot 83 Logged by: ES Checked by: LYK Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden



Termination Reason: Target Depth Reached
Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2087



Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 22/03/2019

Borehole Location: Stage 2 - Lot 85 Logged by: ES Checked by: LYK Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden Survey Source: Site Plan Elevation: 16.50m Datum: Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth 귐 10 Type & Results Depth 16.5 16.4 SW: Fine to coarse SAND with minor silt: Yellow. Well graded. D (Whangamarino Formation)
ML: Clayey SILT with minor fine sand: light greyish white. Low plasticity. 3 16.4 (Whangamarino Formation)
ML: Clayey SILT: White, mottled yellow and orange. Low plasticity, extra sensitive. Peak = 170kPa Residual = 16kPa 0.3 (Whangamarino Formation) 3 VSt to H 3 D to M 5 Peak = 191kPa Residual = 22kPa 0.6 5 15.8 SP: Fine SAND with some silt: White, mottled yellow. Poorly graded. (Whangamarino Formation) MD to 15.6 9 SM: Silty fine SAND: White. Poorly graded. (Whangamarino Formation) 8 Borehole terminated at 1.1 m 2

Termination Reason: Hand Auger Refusal on dense sands.

Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560



Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 24/04/2019

Checked by: LYK Scale: Borehole Location: Stage 2 - Lot 86/87 Boundary Logged by: AS Sheet 1 of 1 1:25

Position: Projection: Mount Eden

Survey Source: Site Plan Elevation: 16.00m Datum: Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth 귐 10 Type & Results Depth ML: SILT with trace clay : Greyish brown. Low plasticity, sensitive (Fill) 16.0 D Peak = >200kPa Residual = 46kPa 0.3 ... at 0.40m, contains minor clay and trace fine sand. Becoming brown, mottled grey. D to. 15.5 ML: SILT with some sand and trace clay: Grey. Low plasticity, sensitive; sand, medium to coarse. (Fill) CL: Silty CLAY with trace sand: Grey mottled brown. Low plasticity; sand, medium to coarse. 0.6 Peak = UTP 15.4 (Fill) ... at 0.60m, becoming silty CLAY with trace sand: brown, grey Н ... at 0.85m, contains minor sand. Peak = >200kPa Residual = 56kPa 0.9 Peak = UTP 1.2 14.8 ML: Sandy SILT: Grey. Low plasticity; sand, fine to coarse. (Fill)
CH: Silty CLAY: Light brown, mottled dark brown. High plasticity. 14.6 (Fill)
ML: SILT with minor sand and clay: Grey, mottled light brown. Low plasticity, moderately sensitive; sand, Μ Peak = >200kPa 1.5 14.5 Residual = 83kPa fine to coarse. (Fill) 14.3 CL: CLAY with minor sand: Brown, mottled grey. Low plasticity, moderately sensitive; sand, fine to coarse. Peak = 152kPa Residual = 50kPa 1.8 VSt 14.0 2 ML: Sandy SILT: Grey. Low plasticity, moderately sensitive; sand, fine 2.1 Peak = >200kPa Residual = 112kPa н ... at 2.20m, contains trace inclusions of brown clay. 2.4 Peak = UTP Borehole terminated at 2.4 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 1785.



Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 06/05/2019

Borehole Location: Stage 2 - Lot 119 Logged by: LYK Checked by: YSL Scale: 1:25 Sheet 1 of 1

Projection: Mount Eden Position: Elevation: 13.00m Datum: Survey Source: Site Plan

Elevation: 13.00m Datum: Survey Source: Site Plan Survey Source: Site Plan Survey Source: Site Plan Material Description Depth Type & Results Depth Type & Results Depth Type & Results Depth Type & Results Datum: Survey Source: Site Plan Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; additional comments. (origin/geological unit) Soil: Soil symbol; soil type; colour; fabric; rock name; additional comments. (origin/geological unit) Survey Source: Site Plan Dynamic Color Penetromete (Blows/100m) Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; and ditional comments. (origin/geological unit) Soil: Soil symbol; soil type; colour; fabric; rock name; additional comments. (origin/geological unit)
0.3 Peak = UTP CL: CLAY: Brown, mottled dark brown and grey. Low plasticity. (Fill)
0.6 Peak = UTP 12.3 ML: Clayey SILT with minor silt : Greyish brown, mottled white and brown. Low plasticity. (Fill)
0.9 Peak = UTP 1 1 1 H
1.2 Peak = UTP
1.6 Peak = >200kPa
2.0 Peak = UTP 2 Borehole terminated at 2.0 m
Termination Reason: Target Depth Reached

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2349

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106 Date: 07/05/2019 Borehole Location: Stage 2 - Lot 278 Logged by: LYK Checked by: YSL Scale: Sheet 1 of 1 Position: Projection: Mount Eden Elevation: 12.00m Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **Graphic Log** Groundwater Moisture Condition Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 15 Type & Results Depth CL: CLAY: brown, mottled white. Low plasticity. (Fill) 12.0 D М 0.3 Peak = 145kPa w 0.6 Peak = 191kPa ... at 0.60m, becoming mottled grey, pink and orange. 0.9 Peak = 191kPa

1.2 Peak = UTP 1.6 Peak = 148kPa W М Peak = UTP 2.0 2 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached
Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 09/05/2019

Borehole Location: Stage 2 - Lot 280 Logged by: LYK Checked by: YSL Scale: Sheet 1 of 1

Position: Projection: Mount Eden

Elevation: 10.50m Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth CL: CLAY: brown, mottled grey and pink. Low plasticity. (Fill) 10.5 0.3 Peak = UTP 0.6 Peak = UTP M 0.9 Peak = UTP 9.6 ML: Clayey SILT with minor sand: grey, mottled brown. Low plasticity; sand, fine. (Fill)
... from 1.00m to 1.20m, contains a lens of fine sand. 1.2 Peak = UTP 9.1 CH: Silty CLAY: grey, mottled orange. High plasticity. (Whangamarino Formation) 1.6 Peak = UTP w Peak = UTP 2.0 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached

Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 22/10/2019

Borehole Location: Stage 1 Logged by: AS Checked by: LK Scale: 1:25 Sheet 1 of 1

Position: 434263.5mE; 740451.5mN Projection: WGS84

1			1			Datum: Moturiki Survey Source: Han	dheld					_
	Sampl	es & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	l F	Oynamio Penetro Blows/1	omete	te
Dep	oth	Type & Results	R	Dep	Grap		O O	Cons Relativ	5	5 10	0 1	1
						CH: CLAY: with some silt; light brown mottled orange. High plasticity. Moderately sensitive to sensitive (Volcanic Ash)						
0.	3	Peak = 126kPa										
_		Residual = 43kPa			=							
0.	5	Peak = 200kPa Residual = 49kPa										
0.	8	Peak = >200kPa					м					
		Residual = 46kPa										
				1 -	+-	at 1.00m, becoming greyish brown.		VSt				1
1.	2	Peak = 139kPa Residual = 58kPa			==							
1.	6	Peak = 185kPa				MH: Clavey SILT: light grey. High plasticity, sensitive						
		Residual = 46kPa			× × × × × × × × × × × × × × × × × × ×	MH: Clayey SILT: light grey. High plasticity, sensitive (Whangamarino Formation)	W to					
					× ^ × × × × × × × × × × × × × × × × × ×		S					
2.	0	Peak = 169kPa Residual = 22kPa		2 -	-	Borehole terminated at 2.0 m						
					-							
]							
					-							
				3 -]							
					-							
					1							
]							
				4 -	-							-
					-							
					-							
	4			5 -	-					\equiv	_	_

Termination Reason: Target depth

Shear Vane No: 1911 DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments 2017 Ltd Project: Lakeside Earthworks 2019/20 Site Location: 95 Scott Road Te Kauwhata

Project No.: HAM2019-0062

Date: 22/10/2019



Position: Projection: Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth OL: Organic SILT: (Topsoil) ML: SILT: with some fine sand; light grey. No plasticity. (Whangamarino Formation) 0.3 Peak = UTP D н 0.6 Peak = UTP ML: SILT: with trace fine sand; light grey mottled light brown. Low plasticity. Peak = 164kPa Residual = 73kPa 0.9 (Whangamarino Formation) VSt Peak = 172kPa Residual = 88kPa 1.2 LIGNITE: black, no plasticity (Whangamarino Formation) M Н 1.6 Peak = UTP ML: SILT: with minor fine sand; light grey, homogeneous. Low plasticity. (Whangamarino Formation) Н w Peak = UTP 2.0 Borehole terminated at 2.0 m

Termination Reason: Target depth

Shear Vane No: DCP No:

Remarks: Groundwater not encountered.

Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

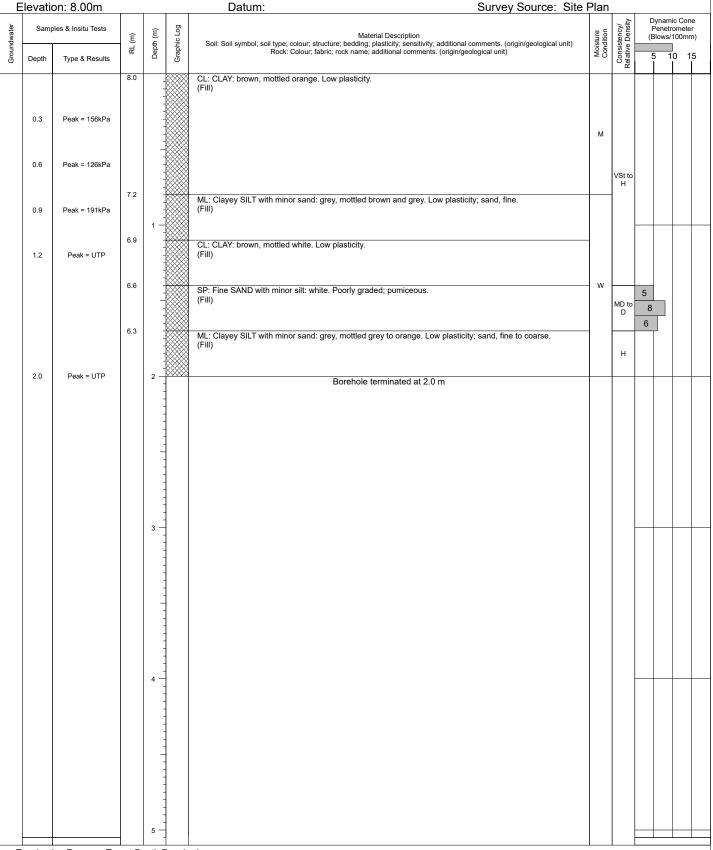
Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 14/05/2019

Borehole Location: Stage 1 - Lot 327 Logged by: LYK Checked by: YSL Scale: 1:25 Sheet 1 of 1

Position: Projection: Mount Eden



Termination Reason: Target Depth Reached
Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.



Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 15/05/2019

Checked by: LYK Scale: Borehole Location: Stage 1 - Lot 328 Logged by: RP Sheet 1 of 1 1:25

Position: Projection: Mount Eden

Elevation: 8.00m Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth (귐 10 Type & Results Depth CH: Silty CLAY: brown mottled white and orange. High plasticity. (Fill) 8.0 0.3 Peak = 191kPa 0.6 Peak = UTP 0.9 Peak = UTP 7.0 Н ML: Sandy SILT: grey. Non plastic; sand, fine to coarse. 1.2 Peak = UTP 6.7 ML: Clayey SILT with some sand: brown mottled white and orange. Low plasticity. 1.6 Peak = UTP Peak = UTP 2.0 2 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560.



Client: Lakeside Developments (2017) Limited

Project: Lakeside Developments

Site Location: 98 Scott Road, Te Kauwhata

Project No.: HAM2018-0106

Date: 15/05/2019 Borehole Location: Stage 1 - Lot 334/335

Logged by: RP Checked by: LYK Scale:

Sheet 1 of 1

Boundary Position: Projection: Mount Eden

Datum: Survey Source: Site Plan Dynamic Cone Penetrometer Samples & Insitu Tests **3raphic** Log Groundwater Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) $\widehat{\Xi}$ (Blows/100mm) Depth 귐 10 Type & Results Depth CL: CLAY with some silt: brown, mottled white and orange. Low plasticity. (Fill) 0.3 Peak = UTP Н 0.6 Peak = UTP ML: Sandy SILT: grey. Low plasticity; sand, fine to medium. (Fill) 0.9 Peak = UTP ML: Clayey SILT: brownish grey. Low plasticity. 1.2 Peak = 150kPa VSt to 1.6 Peak = UTP ML: Sandy SILT: white, mottled orange. Non plastic; sand, fine to medium. Н Peak = UTP 2.0 Borehole terminated at 2.0 m

Termination Reason: Target Depth Reached Shear Vane No: DCP No:

Remarks: Groundwater not encountered. Shear vane no. 2560

Appendix G: Retaining Wall Design, Asbuilt plans, Sections and PS4



5 February 2020 Document Ref: HAM2018-0106AU Rev 0

Lakeside Developments 2017 Ltd PO Box 105526, Auckland, 1143

Attention: David Osborne

Dear David

RE: CONSTRUCTION REVIEW FOR TIMBER POLE CANTILEVER RETAINING WALLS B, C AND D LAKESIDE DEVELOPMENT, TE KAUWHATA.

CMW Geosciences (CMW) has visited site at 95 Scott Road, Te Kauwhata on several occasions between July 2019 and January 2020 to observe the site works for the construction of three timber pole cantilever retaining walls, referred to as Walls B, C and D.

Our work has included review of the following documents and drawings:

- CMW Geosciences Retaining Wall A, B, C and D Design Report, Lakeside Development, referenced HAM2018-0106Al Rev 1, dated 11 March 2019;
- Candor3 as-built drawings titled Lakeside, Te Kauwhata, Retaining Walls Stages 1 7 project no. 1239, drawing no. 2-400 to 2-403 and 2-430 dated January 2020.

The site works observed and/or tested by CMW staff incorporated construction observations to confirm the following with respect to the design drawings;

- Depth and spacing of pile holes, soil conditions exposed within the base and side of the pile holes and retaining soil with respect to the design assumptions;
- Verification of timber pile upright heights, diameters and treatment levels, and
- Installation of drainage column including, filter fabric, perforated draincoil, drainage aggregate and placement of geotextile over the drainage column prior to the placement of topsoil.

A total of 2 variations were made to the original design provided in the above CMW report during the construction phase. The variations and outcomes are summarised as follows:

 Wall B – during construction an area of loose granular soils was identified within the natural foundation soils for a 5m section of the wall as detailed in email sent 12/07/2019. Following further calculations, the minimum embedment depth and pile diameter (SED) was increased from 1.3m to 2.4m and 175mm to 225mm respectively for this section of the wall. • Wall B – the collapse of a bench supporting the foundation soils increased the retained height to greater than that provided by the original design. Further calculations were carried out and design parameters for a retained height of up to 2.0 metres were provided as detailed in the email sent 17/07/2019.

From our observations of the construction of the retaining walls B, C and D we consider that the construction of the retaining walls was in accordance with the CMW Retaining Wall Design Report and authorised design variations (see attached email correspondence) and provides the basis for our attached PS4 Construction Review Producer Statement.

For and on behalf of CMW Geosciences

Prepared by: Reviewed and authorised by:

Lance Knauf Ken Read

Engineering Geologist Principal Geotechnical Engineer CMEngNZ

Distribution: 1 electronic copy to Lakeside Developments 2017

Original held at CMW Geosciences

Attachments: Appendix A – Producer Statement

Appendix B - Candor3 As-built Location Plan

Appendix C – Design Drawings and Variation Correspondence









Appendix A: Producer Statement







Duilding Code	Claussia	.,	В1					
Building Code	Clause(s	·)		 	 	٠.	 ٠.	٠.

PRODUCER STATEMENT – PS4 – CONSTRUCTION REVIEW

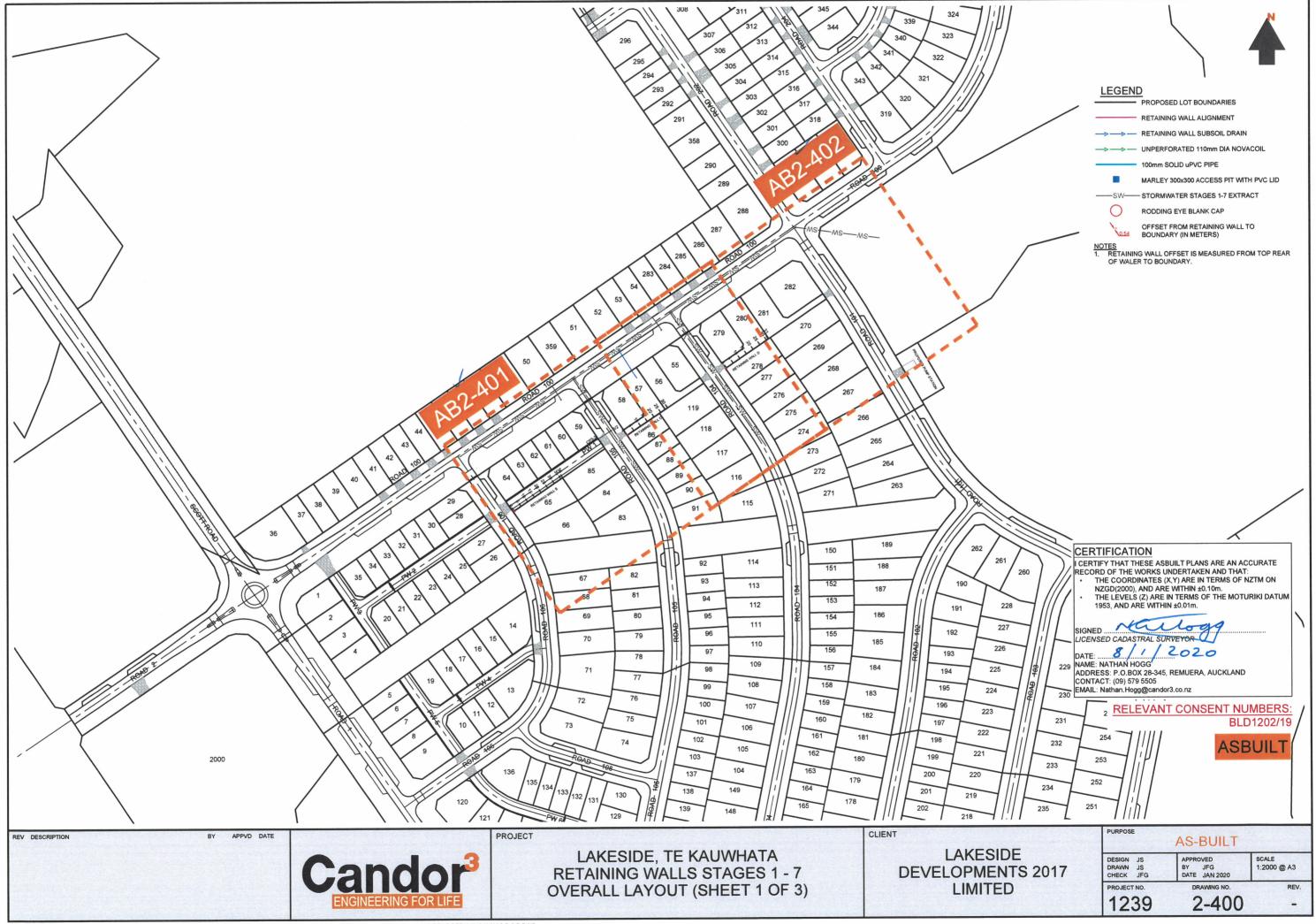
ISSUED BY:	VM Geosciences (NZ) Limited Partne (Construction Review Firm)	ership	
то:	Lakeside Developments 2017	Limited	
	(Owner/Developer)		
TO BE SUPPLIED TO:	Waikato District Council (Building Consent Authority)		
IN RESPECT OF:	, ,	ruction	
AT:	95 Scott Road, Te Kauwhata		
	(Address)		
Town/City: Te Kauwhata (Address)	LOT	DP	. SO
· · · ·	ciences (NZ). have been engaged by		
To provide ☐CM1 ☐CM2 ■CM3	CM4 CM5 (Engineering Categor		s per agreement with
owner/developer	Lakeside Develop	ments 2017 Limited	
or other			services
	(Extent of Engagement)		
in respect of clause(s) .B1	of the B	uilding Code for the build	ng work described in
documents relating to Building Consen	t No. BLD1202/19		and those relating to
Building Consent Amendment(s) Nos. course of the works. We have sighted t	0043/020 hese Building Consents and the cond	ditions of attached to then	issued during the n.
Authorised instructions/variations(s) No or by the attached Schedule have b			(copies attached)
On the basis of this review the the and on behalf of the firm undertaking All or Part only of the building v	this Construction Review, I believe of	on reasonable grounds i	hat
Building Consent and Building Consent of the Building Code. I also believe on the necessary competency to do so.	t Amendments identified above, with reasonable grounds that the persons	respect to Clause(s).B1 who have undertaken this	s construction review have
(Name of Construction Rev		_	
I am a member of: Engineering New The Construction Review Firm issuing th \$200,000*.	Zealand NZIA and hold the follo nis statement holds a current policy of	wing qualifications BSc C Professional Indemnity In	Geology, MSc Eng.Geology surance no less than
The Construction Review Firm is a mer	mber of ACENZ:		
		`	Rea
(Name of Co	onstruction Review Professional)		
ON BEHALF OF	CWM Geosciences (NZ) Limited P	artnership	Date. ^{23/01/2020}

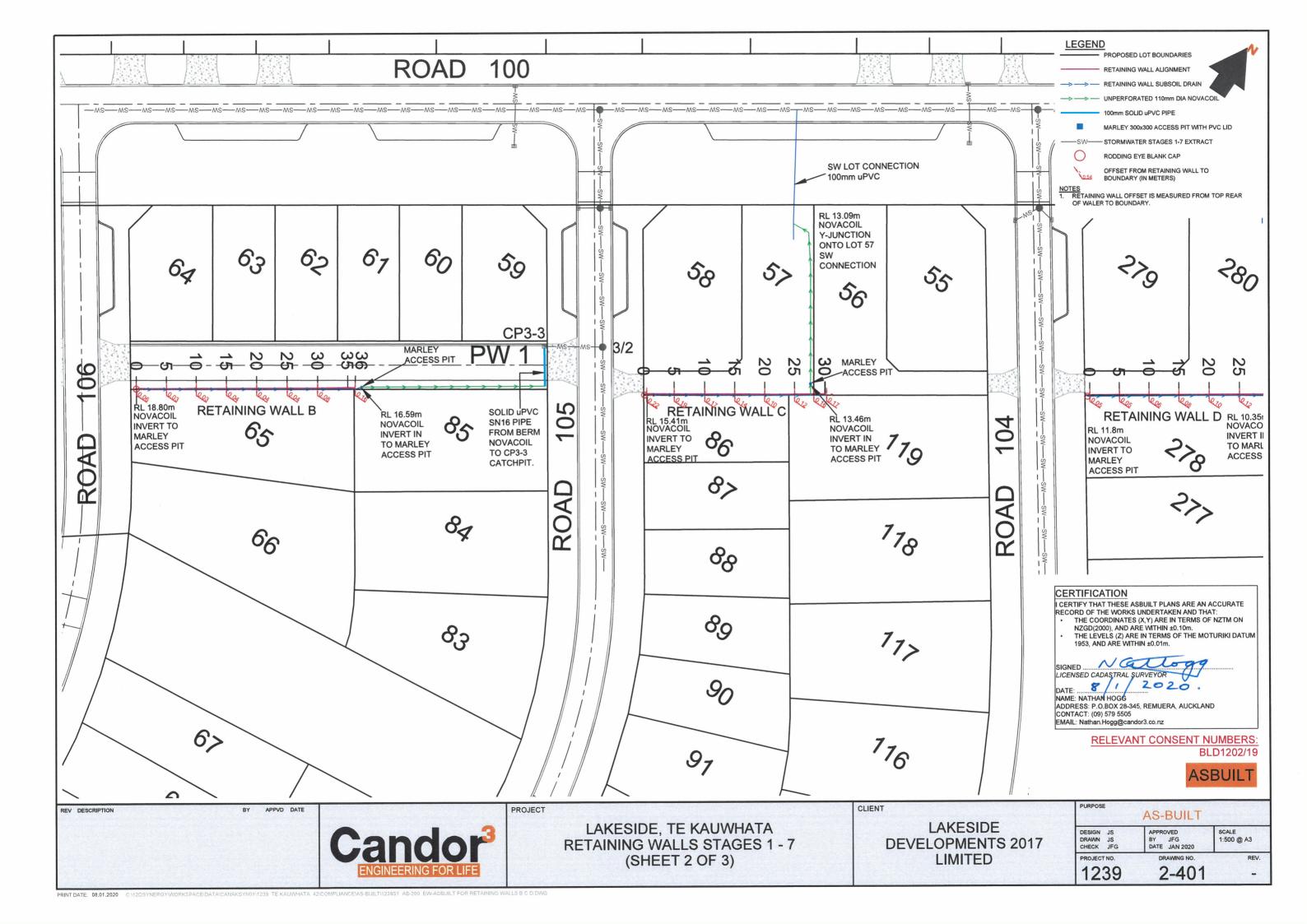
Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000*.

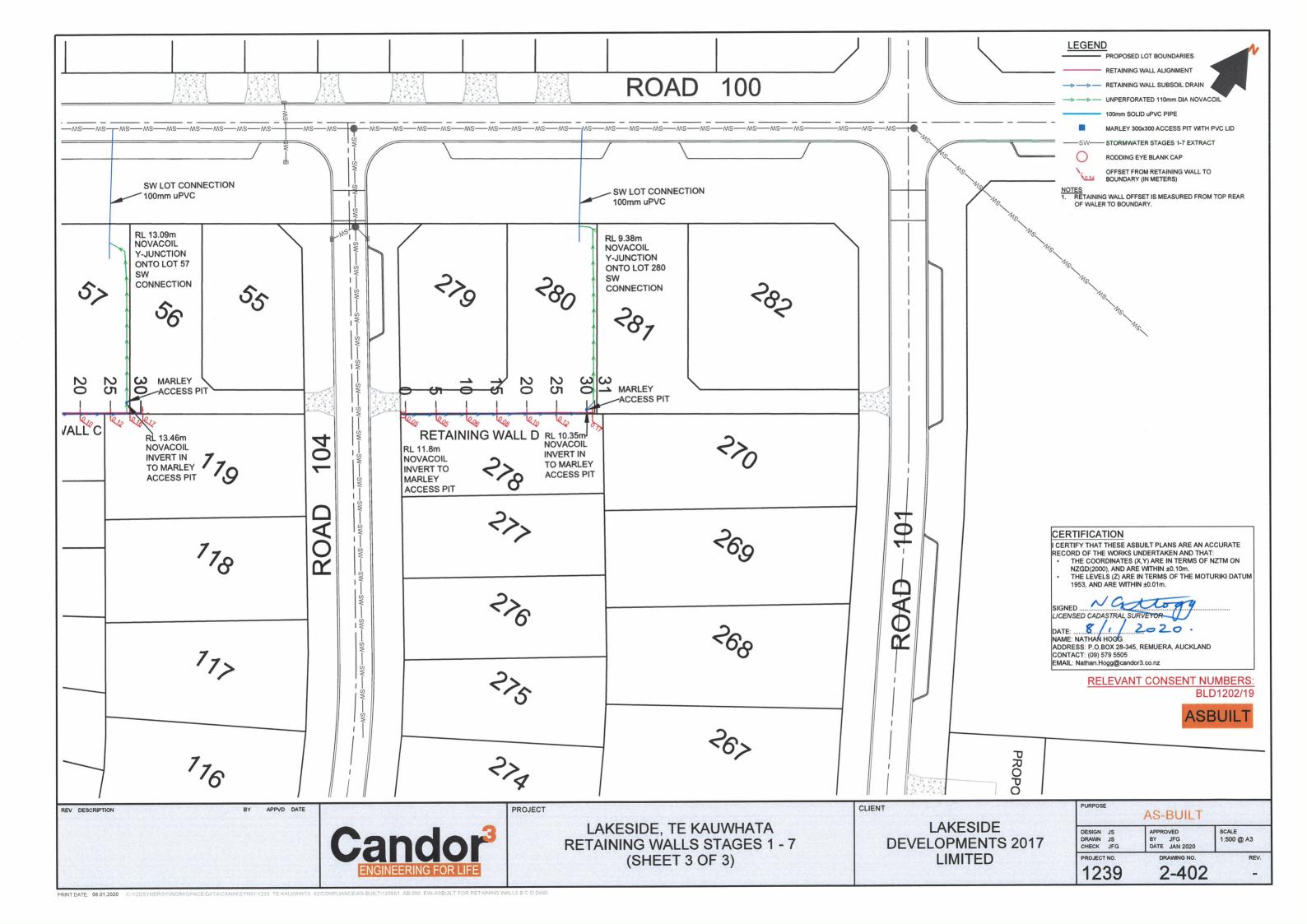
This form is to accompany Forms 6 or 8 of the Building (Form) Regulations 2004 for the issue of a Code Compliance Certificate.

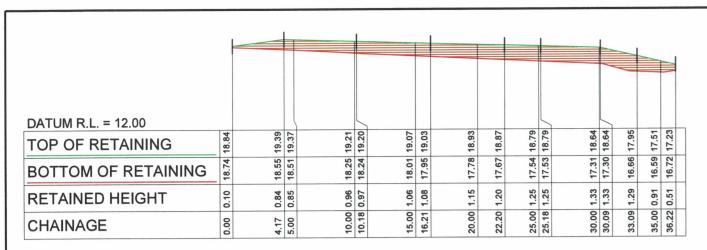
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CONSTRUCTION REVIEW – RETAINING WALL B, C AND D, LAKESIDE DEVELOPMENT, TE KAUWHATA	5 FEBRUARY 2020
Appendix B: Candor3 As-built Locatio	n Plan

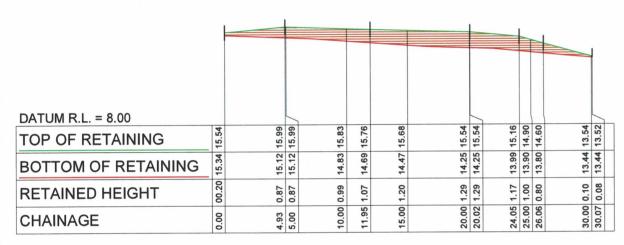




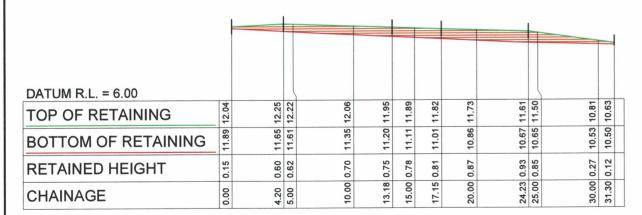




RETAINING WALL B LONG SECTION



RETAINING WALL C LONG SECTION



RETAINING WALL D LONG SECTION

PROJECT

CERTIFICATION

I CERTIFY THAT THESE ASBUILT PLANS ARE AN ACCURATE RECORD OF THE WORKS UNDERTAKEN AND THAT:

• THE COORDINATES (X,Y) ARE IN TERMS OF NZTM ON

 THE COORDINATES (X, Y) ARE IN TERMS OF NZTM ON NZGD(2000), AND ARE WITHIN ±0.10m.
 THE LEVELS (2) ARE IN TERMS OF THE MOTURIKI DATUM

1953 AND ARE WITHIN +0.01m

NAME: NATHAN HOGG ADDRESS: P.O.BOX 28-345, REMUERA, AUCKLAND CONTACT: (09) 579 5505 EMAIL: Nathan.Hogg@candor3.co.nz

RELEVANT CONSENT NUMBERS: BLD1202/19



REV DESCRIPTION

BY APPVD DATE

Candor

ENGINEERING FOR LIFE

LAKESIDE, TE KAUWHATA RETAINING WALLS STAGES 1 - 7 LONG SECTIONS (SHEET 1 OF 1) LAKESIDE DEVELOPMENTS 2017 LIMITED

CLIENT

PURPOSE	AS-BUILT	
DESIGN JS DRAWN JS CHECK JFG	APPROVED BY JFG DATE JAN 2020	SCALE 1:150 @ A3
PROJECT NO.	DRAWING NO.	REV.
1239	2-430	-

NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RETAINING WALL DESIGN REPORT REFERENCE: HAM2018-0106AI REV 0.

SPECIFICATION

1. MATERIAL PROPERTIES

CONCRETE: CHARACTERISTIC COMPRESSIVE STRENGTH F'C = 17.5 MPa UNLESS OTHERWISE NOTED.

TIMBER POLES: H5 TREATED RADIATA PINE, HIGH DENSITY IN ACCORDANCE WITH NZS 3603 UNLESS OTHERWISE SPECIFIED.

TIMBER RAILINGS: H4 TREATED RADIATA PINE

RAILING FIXINGS: GALVANISED NAILS

DRAIN COIL: 110mm DIAMETER

DRAINAGE AGGREGATE: APPROVED DRAINAGE-GRADED AGGREGATE OR SCORIA

(USE OF COMPOSITE DRAINAGE PRODUCTS OR POLYSTYRENE NOT APPROVED)

- 2. FOR LOCATION AND EXTENT OF TIMBER POLE WALLS REFER TO PROJECT ENGINEERING DRAWINGS. SET OUT LOCATIONS TO BE PROVIDED BY OTHERS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION
- 3. MINIMUM CONCRETE COVER TO TIMBER POLES IS 75mm WITH A MINIMUM COVER OF 100mm AT THE PILE BASE. THIS WILL REQUIRE EITHER A PACKER OR POURING OF A PUNCH PAD TO ACHIEVE DESIGN. POLE HOLE DIAMETER MAY ONLY BE VARIED BY DESIGNER IN WRITING.
- 4. RAILS SHOULD BE CONTINUOUS OVER 3 SPANS WITH STAGGERED JOINTS. CUTTING OF TIMBERS SHALL BE AVOIDED WHEREVER POSSIBLE. TONGUE AND GROOVE BOARDS ARE NOT TO BE USED FOR RAILS. USE A NAIL WIDTH GAP BETWEEN RAILS.
- 5. IF CUTTING OF POLES OR RAILS IS NECESSARY THE EXPOSED SURFACES SHALL BE FLOODED WITH A COPPER NAPTHENATE TYPE WOOD PRESERVATIVE.
- 6. THE MAXIMUM RETAINING HEIGHT, TOE SLOPE AND SURCHARGE SLOPE SHALL BE AS SPECIFIED ON THE DESIGN AND SHALL NOT BE EXCEEDED UNLESS APPROVED BY THE DESIGN ENGINEER IN WRITING.
- THE EXTENT OF EXCAVATION REQUIRED SHALL BE MARKED OUT ON THE GROUND HAVING REGARD TO THE POSITIONS OF POLES, WORKING SPACE FOR CONSTRUCTION, BACKFILL AND DRAINAGE PROVISIONS.
- 8. ALL PILE HOLES TO BE AUGERED AND DRILLING SPOIL DISPOSED OF AWAY FROM THE RETAINING WALL.
- 9. A PERFORATED SUBSOIL DRAIN WITHOUT FILTER SOCK SHALL BE LAID AND SURROUNDED IN APPROVED DRAINAGE-GRADED AGGREGATE OR SCORIA WITH INVERT 100mm BELOW DESIGN TOE SUBGRADE LEVELS CONNECTED TO A FREE OUTLET AT A POINT OF SAFE DISCHARGE OR CONNECTED TO STORMWATER SYSTEM.
- 10. THE CONTRACTOR SHALL REFER TO THE DESIGN ENGINEER AS SOON AS POSSIBLE FOR FURTHER INSTRUCTION SHOULD ANY UNFORESEEN CIRCUMSTANCE OR ABNORMAL SITE CONDITION BE ENCOUNTERED DURING CONSTRUCTION.
- 11. WHERE EXCAVATIONS ARE UNDERTAKEN MORE THAN A FEW DAYS IN ADVANCE OF WALL CONSTRUCTION, THE CUT FACE MUST BE COVERED WITH POLYTHENE TO PREVENT IT DRYING OUT AND CRACKING, ESPECIALLY WHERE EXPANSIVE CLAY SOILS ARE PRESENT. SIMILARLY DURING PERIODS OF WET WEATHER THE EXCAVATION FACE SHOULD BE PROTECTED WITH POLYTHENE AND SURFACE WATER DIRECTED AWAY FROM THE CREST AND TOE OF THE EXCAVATION.
- 12. CONTRACTOR IS RESPONSIBLE FOR ENSURING EXCAVATIONS ARE STAGED SO THAT EXCAVATED FACES ARE NOT LEFT UNSUPPORTED FOR ANY SIGNIFICANT LENGTH OF TIME. THIS IS ESPECIALLY CRITICAL FOR BOUNDARY CUT FACES.

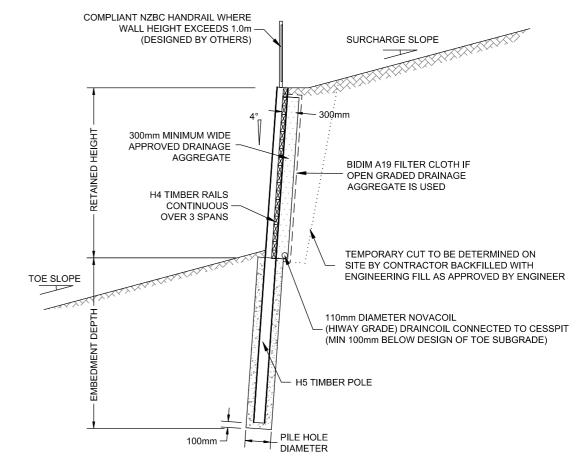
INSPECTION HOLD POINTS:

- 1. GROUND CONDITIONS IN PILE HOLES PRIOR TO INSERTING POLES.
- 2. DRAINCOIL PLACEMENT PRIOR TO RAILING UP.
- DRAINAGE AGGREGATE QUALITY AND RAILING PRIOR TO BACKFILL WITH DRAINAGE AGGREGATE.
- 4. FINAL INSPECTION AND DRAINAGE CONNECTIONS.

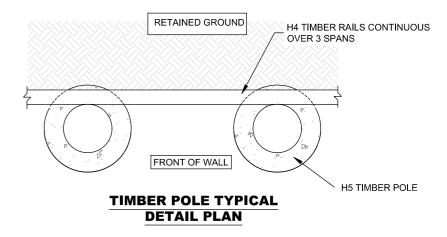
TABLE 1

	MAXIMUM SURCH	A RGE SLOPE		5	•
	MAXIMUM TOE SLOPE 5 °			•	
	FACTORED SURC	HARGE LOADING		12	kPa
	RETAINED SOIL FRICTION ANGLE 30 °			0	
	FOUNDATION SOI	IL UNDRAINED SHE	AR STRENGTH	100	kPa
	TIMBER GRADE			HIGH	
Maximum		Minimum	Minimum		
retained	Pile spacing	embedment	pile hole	Pole size	
height	C/C	depth	diameter	SED	Rail thickness
(m)	(m)	(m)	(mm)	(mm)	(mm)
1.00	1	1.3	300	150	1 x 50
1.50	1	1.9	350	225	1 x 50
2.00	1	2.5	425	275	1 x 50
2.50				350	1 x 75*

TIMBER POLE RETAINING WALL A, C AND D



TYPICAL RETAINING WALL DETAIL



Α	14/02/2019	FOR INTERNAL REVIEW	FMS
0	19/02/2019	ISSUED FOR CONSENT APPLICATION	FMS
1	11/03/2019	ISSUED FOR CONSENT APPLICATION	WPJ
REV	DATE	DESCRIPTION	BY



CLIENT: LAKESIDE DEVELOPMENTS (2017) LTD	DRAWN:	FMS	PROJECT: HAM2	2018-0106
PROJECT: LAKESIDE,	CHECKED:	DP	DRAWING:	02
TE KAUWHATA	REVISION:	1	SCALE:	NTS
TITLE: TIMBER POLE RETAINING WALL DESIGN (WALL A, C & D)	DATE:	11/03/2019	SHEET:	A3

^{* 50}mm THICK RAILS CAN BE USED FOR THE UPPER 1.0m OF THE RETAINING WALL

NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RETAINING WALL DESIGN REPORT REFERENCE: HAM2018-0106AI REV 0.

SPECIFICATION

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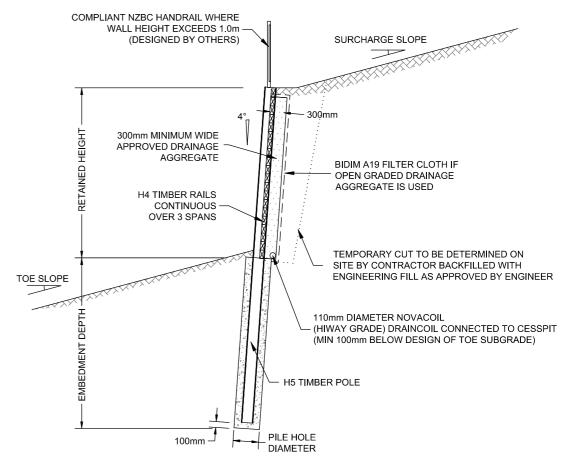
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- 1. GROUND CONDITIONS IN PILE HOLES PRIOR TO INSERTING POLES.
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- DRAINAGE AGGREGATE QUALITY AND RAILING PRIOR TO BACKFILL WITH DRAINAGE AGGREGATE.
- 4. FINAL INSPECTION AND DRAINAGE CONNECTIONS.

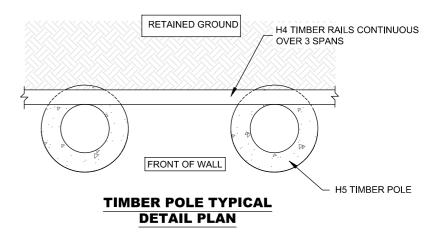
TABLE 2

TIMBER FOLE RETAINING WALL B							
	MAXIMUM SURCH	ARGE SLOPE		5	•		
	MAXIMUM TOE SL	OPE .		5	0		
	FACTORED SURC		12	kPa			
	RETAINED SOIL FI		30	0			
	FOUNDATION SOI	L UNDRA NED SHE	AR STRENGTH	120	kPa		
	TIMBER GRADE			HIGH			
Maximum		Minimum	Minimum				
retained	Pile spacing	embedment	pile hole	Pole size			
height	C/C	depth	diameter	SED	Rail thickness		
(m)	(m)	(m)	(mm)	(mm)	(mm)		
1.00	1	1.3	300	150	1 x 50		
1.50	1	1.9	350	225	1 x 50		

TIMBER POLE RETAINING WALL B



TYPICAL RETAINING WALL DETAIL



Α	14/02/2019	FOR INTERNAL REVIEW	FMS
0	19/02/2019	ISSUED FOR CONSENT APPLICATION	FMS
1	11/03/2019	ISSUED FOR CONSENT APPLICATION	WPJ
REV	DATE	DESCRIPTION	BY



CLIENT: LAKESIDE DEVELOPMENTS (2017) LTD	DRAWN:	FMS	PROJECT: HAM2	018-0106
PROJECT: LAKESIDE,	CHECKED:	DP	DRAWING:	03
TE KAUWHATA	REVISION:	1	SCALE:	NTS
TITLE: TIMBER POLE RETAINING WALL DESIGN (WALL B)	DATE:	11/03/2019	SHEET:	A3

Lance Knauf

From: Lance Knauf

Sent: Friday, 12 July 2019 1:36 PM

To: Arran Pickard

Cc: Arun Rana; Paea Manu; Jarrad Reid; David Osborne; Duncan Elley; John Sia; Ross

Moore; Ken Read

Subject: Lakeside Retaining Wall B

Attachments: IMG_1480.JPG

Good afternoon,

Following yesterday's construction inspection of Wall B more concerns have been identified.

Loose foundation soils were identified in an isolated ~5m section of the retaining wall. These soils do not meet our design assumptions therefore the requirements for the poles affected (as marked on site) was increased as per below.

	Maximum Retained	Pile Space	Minimum Embedment	Minimum Borehole	Pole Size (SED)	Rail Thickness
	Height		Depth	Diameter		
Original Design	1.0	1.0	1.3	300	175	1x50
Revised Design	1.0	1.0	2.4	350	225	1x50

The revised design only applies to the poles within the soft area as marked on site. Construction shall continue as per the original design specification for other sections of the wall.

Today's inspection confirmed in the section where the loose foundation soils were identified that the embedment depth has been increased to a minimum of 2.4m. The poles were not yet placed while we were on site although the change to a 225mm pole has been stressed to the subcontractor multiple times.

As seen in the attached picture the retained soil has not been battered back at 45 degrees from the base as per instruction. Further excavation is required. Also once suitably battered back polythene is required to be placed across the batter to prevent scour.

Thanks, Lance.

From: Lance Knauf < <u>LanceK@cmwgeo.com</u>> Sent: Wednesday, 10 July 2019 3:58 p.m.

To: Arran Pickard < <u>Arran.Pickard@candor3.co.nz</u>>

Cc: Arun Rana < Arun.Rana@rossreid.co.nz >; Paea Manu < Paea.Manu@rossreid.co.nz >; Jarrad Reid

<Jarrad.Reid@rossreid.co.nz>; Duncan Elley <duncan.elley@winton.nz>; David Osborne

<david.osborne@winton.nz>; John Sia <John.Sia@candor3.co.nz>; Ross Moore <Ross.Moore@candor3.co.nz>; Ken

Read < KenR@cmwgeo.com **Subject:** Lakeside Retaining Wall B

Following the preconstruction meeting earlier this afternoon CMW have some concerns around Wall B.

The retaining wall calculations assume level ground above and below the wall. Currently the right of way (ROW) below the wall has been excavated ~0.5m to subgrade level reducing overturning resistance. Discussions on site suggest that the ROW will not be filled to finish level for some time.

Options include:

- 1. Increase hole depth and pole size to account for this by adding this undercut depth on to the retained height. This will increase costs so is not recommended.
- 2. Construct the wall based on the finished level retained height. Do not backfill the wall but rather batter the retained soils back to an angle of 45 degrees such that no load is applied to the wall. The batter will require to be covered with polythene to protect it from scour with a subsoil placed behind the retaining wall to remove any water which accumulates behind the wall. Once the ROW is filled to finish level the retaining wall can be backfilled. This can either be done entirely with drainage material or engineered fill with a minimum 300mm drainage column behind the wall. (Refer to sketch attached).
- 3. Contractors start construction of other retaining walls to allow time for CMW to carry out further analysis to determine the required factors of safety are present with the current excavation.

Option 2 is our most preferred option as it allows construction to continue. We understand that it is only an issue with Wall B which has the undercut in front of the wall.

Arun based on the above can you please confirm whether CMW will be required on site tomorrow for inspection has previously discussed.

Thanks, Lance.

Lance Knauf | Engineering Geologist Mobile: +64 (0) 27 548 7287 | Hamilton

Lance Knauf

From: Lance Knauf

Sent: Wednesday, 17 July 2019 2:50 PM

To: Arran Pickard

Cc: Arun Rana; Paea Manu; Jarrad Reid; David Osborne; Duncan Elley; John Sia; Ross

Moore; Ken Read

Subject: RE: Lakeside Retaining Wall B **Attachments:** 20190717130106864.pdf

Good Afternoon,

Following a phone conversation with Arun yesterday we understand that the bank of the subgrade excavation at the eastern end of Wall B has collapsed such that there is insufficient width for the poles to be supported along the current alignment. We understand that in this section of the wall retained heights vary from 1.2m to 0.0m.

Due to the current wet weather we understand that fresh engineered fill cannot be practically placed in the small area to make up the level prior to drilling. We also understand that once the poles are installed it would be difficult to suitably compact fill around the poles.

We therefore recommend that the collapsed material be removed down to the level of the adjacent excavation and the wall effectively designed to accommodate an increased retained height equal to the additional depth of excavation (approximately 0.5m we understand).

Embedment depth will also be measured from the new excavation level and concrete would be expected to meet this level as a minimum.

Where retained heights increase to greater 1.5 (current limit of design) the table below indicates the required pole sizes, depths of embedment and railing details.

	Maximum	Pile Space	Minimum	Minimum	Pole Size	Rail
	Retained		Embedment	Borehole	(SED)	Thickness
	Height		Depth	Diameter		
Design details	2.0m	1.0m	2.5m	425mm	275mm	1x50mm

Two construction options are discussed below.

If the wall is proposed to be backfilled prior to the ROW reaching finished level then lagging will need to be placed down to the new excavated surface such that the backfill does not escape under the wall. In this case the lower ~4 boards will later be buried once the ROW reaches finish level and therefore will require to be H5 treated. This case also requires a check that the subsoil drains has suitable fall towards the outlet.

If the ROW reaches finish level prior to the retaining wall being backfilled then the area around the poles can also be filled up to ROW level using granular material. This means that's the wall would only need rails down to the finished ROW level.

This section of the wall could be fully constructed and backfilled subject to the comments mentioned above although it could be awkward tying it into the other sections of the wall which are not backfilled. If the wall is not going to be backfilled immediately then the slope should be battered back at 45 degrees and covered as requested for other sections of the wall.

Thanks,

Lance.

		Chapman Morton Woodward	MALL B - Eastern End Area can be backfilled or saitably battered alepading on when it is to be backfilled.		
Designed:	_	Page: 1/1 Chapr	Collapsed loose sand on bank surface.	New Returned Height	
Project: Lake sille	Client: Lakside Ocuelopmuh (2017) Ltd	Project No: #Am2018-0106 Date: 17/7/19	Finished ROW level Comment Subgreate Execution! Collapse of the cart banks I for retained height increasing this great can either be drilled through or angle or excavated to provide lavel working area.	New Ebedrat Depth New R. Subgrad excern him level	NTS