



**THE LAKES DEVELOPMENT
STAGES 2I and 2N
Lakes Boulevard, Ellesmere Close
Pyes Pa, Tauranga**

Geotechnical Completion Report

Prepared for : **The Lakes (2012) Ltd**

Ref : 20302 R1

Date : 16 March 2013

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1.0 Introduction

This report refers to the site development earthworks completed for Stages 2I and 2N of The Lakes residential subdivision development at Pyes Pa.

The location of these stages of The Lakes development are shown on plans 132631-2IN-RC01 and DP 463737, both prepared by Harrison Grierson Consultants (HG). Copies of these plans are included in Appendix 1 of this report. These plans show the residential development for Stages 2I and 2N to comprise

- 7 residential lots numbered 661 to 667 incl. with frontage to Lakes Boulevard within Stage 2I
- 5 residential lots numbered 751 to 755 incl. with frontage to Lakes Boulevard within Stage 2N
- 16 residential lots numbered 756, 757 and 763 to 776 incl. with frontage to the new road of Ellesmere Close which was constructed as part of the development of Stage 2N
- 7 residential lots numbered 758 to 762 incl. with frontage to the existing formation of Kennedy Road within Stage 2N
- Lot 1061 located on the southern side of Kennedy Road between the intersections of Kennedy Road with Lakes Boulevard to the east and Takitimu Drive to the west. This lot is the site of a recently constructed wastewater transfer pumping station and is defined as Local Purpose Reserve (Drainage).
- Lot 1065 located adjacent to lot 1061 on the southern side of Kennedy Road.

Construction of the roading and reticulation to service these lots has been completed by the developer, The Lakes (2012) Ltd.

Approval for the Lakes Development was initially granted jointly by the Tauranga City Council and Western Bay of Plenty District Council on 24 May 2004 based on subdivision plan 16916 dated 20 April 2004 prepared by S&L Consultants Ltd (S&L). A variation was approved by the Tauranga City Council on 18 September 2007 for the proposed development on the area known as Stage 2 at The Lakes.

Construction of Stages 2I and 2N has been undertaken at two different times. Bulk earthworks were undertaken on all lots by Grasshopper Farms Ltd in 2008 and 2009. These stages of subdivision were then completed during January to April 2013 in accordance with resource consent RC 16807 dated 3 October 2012 issued by Tauranga City Council based on HG scheme plan 132631-2K-RC01 rev 2.

During the second January to April 2013 construction period minor modifications were only undertaken to lots 763 to 766 during the construction of Ellesmere Close.

Condition 12 of the approval required that

The Consent Holder shall provide to the Council a "Geotechnical Completion Report" compiled by a Category 1 Geo-Professional. The report shall

- *Comply with the Councils IDC QA4 requirements*

- *Display the position of all designated building platforms and building restriction lines where applicable;*
- *Provide recommendations for the ongoing development of the lots (i.e. maximum cut/fill heights, management of steep slopes, etc.);*
- *Confirm earthworks and/or building platforms have been constructed to comply with the New Zealand Building Code requirements;*
- *Certify that any residential settlement or differential settlement that may still occur shall not exceed the manufacturer's recommendations with respect to the installed underground pipe networks to be vested in Council or exceed accepted design techniques with respect to road settlement or long term deflection, or exceed the settlement limitations as detailed in the New Zealand Building Code.*

Pursuant to Section 128 of the Resource Management Act 1991, the Council may review this condition, upon receipt of the "Geotechnical Completion Report", and require a Consent Notice to be registered on the Certificate of Title of any allotments to which the recommendations of the "Geotechnical Completion Report" relate to.

This report has been prepared for the Section 224C Certificate application for DP 463737 and describes the earthworks undertaken in the formation of Stages 2I and 2N and summarises the suitability of the prepared ground in cut and fill for future urban housing development. The report states the relevant standards adopted for the placement of filling to support residential buildings and recommendations for developing future building sites.

2.0 Original Landform and Geology

The landform prior to the commencement of the Lakes development in 2004 comprised:

- Elevated areas along the eastern side as a central plateau described locally as the Te Ranga Tablelands. These areas have been variously used for farming and horticultural cropping. The existing Pyes Pa residential area further to the east had been established on similar level areas of the same elevation.
- Lower lying areas mainly along and adjacent to the Kopurererua Stream to the west and extending eastwards.
- Transitional slopes of varying steepness between the lower lying areas and the elevated central plateau. Re entrant erosion gullies were present on some of these slopes but most were uniform in slope gradient, albeit steep in some locations.

The geological setting for the development area can be derived from the publication:
Occasional Report 22 – Department of Earth Sciences University of Waikato
"Geology of the Tauranga Area" by Briggs et al – 1996

Stages 2I and 2N are located on the transitional and elevated areas within the eastern side of The Lakes development area and the original geology can be described from preconstruction subsoil investigations to comprise

- Taupo volcanic zone tephras comprising Rotoehu ash (light grey sand) overlaid by brown or yellow post Rotoehu ash being coarse grained silts, sandy silts and sands. These are collectively referred to as "younger ashes" and overlay
- "Older" ash derivative strongly weathered clay textured tephra beds and palaesols (Hamilton ash) overlaying

- Older terrestrial and estuarine sediments deposits of the Matua subgroup of the Tauranga formation. These may comprise a wide variety of lithologies
- Te Ranga ignimbrite being white-grey pumiceous sands and coarse silts.

3.0 Presubdivision Investigations

Prior to obtaining approval for the original development on 24 May 2004, a comprehensive geotechnical assessment was undertaken by S&L. The subsequent report that accompanied the consent application was titled "Pyes Pa West Urbanisation Development, Geotechnical Assessment Report, reference 16944" and was dated October 2003.

Fifty two machine drilled boreholes and twenty six excavated pits were used to identify the subsoils that are present on the development area.

Additional boreholes were put down during earthworks in 2008 to identify the continuity of the subsoils present in the upper ground and to provide data for stability analyses subsequently undertaken for the design of the slope profiles established by the site earthworks between the upper areas of Stages 2J and 2K and the lower areas within Stages 2I and 2N.

The presubdivision investigations concluded that:

- The soils to be obtained in areas of cut on the higher ground would be suitable for placement as filling to support future houses although some conditioning may be required so that placement would be near optimum moisture contents.
- Areas of higher ground away from the areas of peat and not to be disturbed by construction earthworks would be suitable for the support of future houses in accordance with NZS 3604.
- As the volcanic ash stratigraphy varies in type and relative strength, foundation bearing conditions may vary across building sites formed in areas of cut.
- Similar variations in soil type may be encountered in road subgrades and insitu testing would be required to determine pavement depths applicable to the subgrade conditions present.
- The peat soils can be removed to depths governed by the capability of the earthmoving machinery on the site and the cost effectiveness of removing the peat and undertaking its replacement with filling obtained from elsewhere within the subdivision development area.

4.0 Scope of Subdivision Earthworks

Large scale earthworks were undertaken in the Stage 2I and 2N areas in the 2008-2009 earthworks season by Hick Bros Earthmoving. As shown on 20302-01 in Appendix 1, the site development earthworks in cut removed a substantial volume of soil for placement elsewhere within The Lakes development. In the areas within the Stage 2J development above Stages 2I and 2N the original plateau was reduced in height by up to 8 to 10 m. In order to achieve the regular slope gradients of 1 in 2 that had been determined by analysis to provide adequate stability above Stages 2I and 2N, as shown on 20302-02, cut depths of up to 25 m took place. Significant depths of cut occurred on lot 759 (25 m), and on lots 769 and 770 (16 to 20 m).

As the cut depths range from 0 to 25 m on the Stage 2I and 2N areas, all of the soil types described in 2.0 above are likely to be present at various locations at the finished ground levels on the lots.

Filling was placed at the head of a former gully in 2008 as part of construction of Kennedy Road. This filling extended into lots 760 and 761 as indicated on 20302-01.

Subdivision filling was placed in 2009 within lots 665 to 667 and lots 751 and 766 to depths of up to 1.2 m as shown on 20302-01. This filling was mainly placed to provide cover to the realigned natural gas main which was installed in the reserve area between stages 2I and 2N.

These earthworks were undertaken in compliance with consent 62387 issued by the Bay of Plenty Regional Council.

Following detailed design of the Stage 2N development by HG, additional minor earthworks were undertaken during the construction of the Stage 2N roading and services by Higgins Contractors in the 2012-2013 earthworks season. These earthworks comprised

- (a) A further reduction in ground levels in cut by up to 1.5 m at the rear of lots 770 and 771
- (b) A further reduction in ground levels in cut by up to 0.75 m in lots 768, 769, 773, 774 and 775
- (c) A further reduction in cut of up to 1.25 m and down to design road subgrade levels at the cul de sac head of Ellesmere Close
- (d) The construction of retaining walls up to 1.2 m high along the roadside boundaries of lots 769, 770, and 772 to support cut faces.
- (e) The placement of minor depths of additional filling up to 0.75 m deep on lots 755 to 759

The extent of these earthworks is shown on HG drawing 132631-2N-AB220 contained in Appendix 1.

5.0 Earthworks Standards

The performance specification required of the contractors for the earthworks of 2008 and 2013 was based on the guidelines contained in NZS 4431:1989 "Code of Practice for Earthfill for Residential Development". Compliance with the compaction requirements listed below satisfies the standards listed in Section 7 of the NZS 4431.

Air voids percentage (as defined in NZS 4402: Part 1:1980)

- Average value less than 10% (any 10 tests)
- Maximum single value 12%

Undrained shear strength (measured by in situ vane)

- Average value not less than 150kPa (any 10 tests)
- Minimum single value 100kPa

The earthworks were observed by engineering staff from S&L for the work in 2008 and 2009 and from HG in 2012 - 2013. Compaction and strength control testing was undertaken by IANZ accredited Opus International Consultants Ltd and Coffey Geotechnical during the Lakes development, both on site and in their Tauranga laboratories. Tests were undertaken by Coffey in lots 760 and 761 and their test results are listed in Appendix 3. Opus tested filling placed in Lakes Boulevard opposite Stage 2I but no tests were undertaken by Opus in

the shallow filling placed on Stage 2I. For the filling placed in lots 665, 666, 667, 751, 756 and 766, S&L undertook tests in the post construction boreholes with a shear vane.

6.0 Recommendations for Development

6.1 Post Constructing Testing

Post construction machine drilled or handaugered boreholes were put down under the management of S&L on each lot at locations shown on drawing 20302-03 in Appendix 1. These boreholes were generally 2.0m deep in accordance with the recommendations in NZS 3604:2011 and were intended to show soil types and continuity and to confirm the ground bearing conditions for shallow building foundations.

As the boreholes were being drilled undrained shear strengths were recorded with a hand held shear vane pushed in advance of the auger. Where sandy soils were encountered, a Scala penetrometer was used to test the relative strengths of the cohesionless soils.

At some post construction borehole positions minor filling is noted on the borelog sheets in areas of cut. It is likely that the soils noted as filling may have either been placed to level areas of cut locally or may have been disturbed as natural soils from the passage of bulk earthmoving equipment. At all of these test positions the minor depths of filling were found to have been compacted to the construction standards listed in 5.0 above.

Summary logs of the soils found in the post construction boreholes are in Appendix 4. The soils found in the boreholes in areas of cut and their strengths determined in the boreholes are summarised in table 1 on page 8. The boreholes indicated the varying soil types that may be present at building foundation levels in the areas of subdivision cut.

In each post investigation borehole the undrained shear strengths in the cohesive soils (clayey silts and silts) were variable but were mainly very high. Where cohesionless soils (sands and silty sands) were present, the Scala penetrometer tests achieved blow counts that averaged 4 or more per 100mm of penetration.

The post construction boreholes showed that perched groundwater levels were present on lots 769 and 770 below 1.5m, while, on other lots, some of the subsoils in the boreholes were noted as being wet or saturated. If groundwater is encountered in excavations or as seepage from cut faces professional, engineering advice should be sought on methods to capture and reticulate away the surplus groundwater through the stormwater reticulation that serves each lot.

6.2 Subdivision Construction Filling

Supervised structural filling, as shown on S&L drawing 20302-01 in Appendix 1, was placed at the time of the bulk earthworks during 2009 and is present on lots 665 to 667, 751, 760, 761, 765 and 766. This filling was placed in accordance with the methods and standards quoted in NZS 4431 and discussed in Section 5.0.

Compaction testing on site confirmed that a high and uniform degree of compaction had been achieved and is therefore suitable for the support of buildings with shallow

surface foundations. Some post construction boreholes that encountered the filling also confirmed this suitability.

During the construction of Stages 2I and 2N in 2013, minor additional filling was placed on lots 755, 766 and 757. This filling is not more than 0.75 m deep as indicated on HG drawing 132631-2N-AB220 in Appendix 1. Testing showed this filling to be of adequate compaction to be suitable for the support of shallow foundations detailed to NZS 3604.

A statement in support of the suitability of the filled areas for the erection of buildings is contained in Appendix 2 of this report in the format of Form G2 of the Council Infrastructure Development Code. This statement meets the requirements of NZS 4431 and therefore the filled ground may be considered as good ground in terms of Section 3.1.3 of NZS 3604:2011.

However, within areas of structural filling on which buildings may be erected, the possibility of variations of soil type and strength may exist away from observation or compaction test locations. The normal inspection of foundation conditions during construction of buildings by competent tradesmen as described in NZS 3604 and/or by building inspectors should therefore be undertaken. If, for any reason, areas of low soil strength are found, professional geotechnical engineering advice should be sought.

Table 1

Summary of Subsoil Types As Determined from Post Construction Boreholes

<u>Lot No.</u>	<u>Depth of Cut (m) average over lot</u>	<u>Soil Type</u>	<u>Shear Strength or Scala Penetrometer Range Over Borehole Depth of 2.0m (kPa)</u>
661	1.0	Minor fill over silts, sands	101-162
662	1.0	Minor fill over clayey sandy silts #	87-200+
663	1.0	Minor fill over silts and sands	98-149
664	0	Clayey and sandy silts #	200+
665	0	Fill over clayey silts #	200+
666	0	Fill over clayey silts #	200+
667	0	Fill to 1.5m	200+ Scala 13-R/100
751	0	Fill to 1.5m	Scala 6+/100
752	0-2.0	Minor fill over sands, clayey silts	61-200+
753	2.0	Minor fill over silty sands, sands	Scala 2-7/100
754	2.0	Clayey silts #	200+
755	3.0	Minor fill over sandy silts, sands #	200+ Scala 2-3/100
756	4.0	Minor fill over silty sands #	Scala 2-11/100
757	7.0	Sands, silts	200+ Scala 6-8/100
758	15.0	Sands	Scala 5-8/100
759	20.0-25.0	Minor fill over sands #	Scala 9-R/100
760	0-22.0	Minor fill over sands #	200+ Scala 7-11/100
761	0-9.0	Clayey silts, sands	200+ Scala 5-9/100
762	0-6.0	Minor fill over sands #	200+
763	2.0	Silty sands	Scala 3-11/100
764	3.0	Sands, silts	Scala 13-R/100
765	0-7.0	Silty sands #	Scala 9-R/100
766	0-6.0	Fill to 0.9m over sands	200+ Scala 9-12/100
767	6.0	Sands	Scala 4-R/100
768	11.0	Sands #	Scala 15-R/100

769	13.0	Sands		Scala	6-R/100
770	15.0	Sands		Scala	5-R/100
771	15.0	Sands		Scala	3-9/100
772	12.0	Sands		Scala	6-R/100
773	4.0	Sands	#	Scala	2-11/100
774	4.0	Sands		Scala	3-5/100
775	4.0	Minor fill over sands		Scala	2-12/100
776	10.0	Sands		Scala	9-R/100

NOTE

based on boreholes 1m deep

soil types based on descriptions in Section 2.0 of this report

R = refusal at 15+ blows per 100mm

6.3 Areas of Cut

As shown on 20302-01 and described on table 1 and in the borehole logs, the varying depths of cut over most of the Stage 2I and 2N areas have exposed a number of different soil types and strengths immediately below the topsoil overlay. These soils vary from the more friable younger ashes (clayey silts and sandy silts) to the pumiceous sands and silts which are representative of the underlying weathered Te Ranga ignimbrite.

The recorded undrained shear strengths where cohesive soils are present (clayey and sandy silts) indicate that the soils at likely foundation depths in the areas of cut are generally of high strength but the ranges of undrained shear strengths listed on the borehole log sheets and summarised on table 1 indicate that variations in shear strengths may be present vertically and horizontally away from the test positions. Similarly, the Scala penetrometer results in the sands that are likely to be present at and below the foundation levels showed that while these soils may be compact, there are variations in the compaction densities and therefore differing ground bearing capacities would be applicable for the detailing of building foundations.

For all lots located in the areas of cut, the ultimate ground bearing capacity in the limit state may be taken at 300kPa for the detailing of surface foundations and this capacity meets the definition of "good ground" as defined in NZS 3604: 2011.

However, the possibility of variations of soil type and strength or compaction may exist away from observation or post construction borehole locations. If the subsoils at foundation excavation levels are found to be of lower strength or have been disturbed by earthworks machinery during any further site development, foundations detailed in accordance with NZS 3604:2011 may have to be deepened or widened under engineering advice. This may require additional on site testing specific to the building that is to be erected and the calculation of actual ground contact pressures under foundations by a structural engineer. It may be found that the actual ground bearing capacities determined by additional testing are not exceeded for foundations detailed to NZS 3604.

6.4 Land Stability Considerations

To assess the finished profiles that were formed on the steep sloping ground that rose above Stages 2G to the north and 2I and 2N up to the Stage 2J areas to the east, investigation boreholes were put down under the supervision of S & L Consultants Ltd by Perry Drilling Ltd during April 2007. These boreholes supplemented the original subsurface data that was available from machine drilled boreholes in September 2003 on the upper plateau.

The boreholes put down in April 2007 were located at the crests of the original slopes below Stage 2J and at intermediate lifts on the slope faces on the haul tracks for the bulk earthmoving equipment. From this borehole data and the existing slope geometry it was derived, by analysis, that the sloping ground between the upper and lower stages had to be reduced in gradient to not more than 26 degrees (1 on 2) to provide acceptable factors of safety against slope failure. In plotting these slope angles and providing for an intermediate berm for slope maintenance and also as an extension of the cycle and walkway through the subdivision, it was found that the surface ash soils would be removed by the recontouring earthworks leaving the Te Ranga ignimbrite to be mostly exposed on the cut faces.

The stability of the slopes, so formed in cut above Stages 2I and 2N, was discussed in the geotechnical completion report submitted to Council titled "The Lakes Development, Stages 2D, 2F, 2G, 2J, 2K, 2L and 2M inclusive – Report on Earthworks and Recommendations for Development," reference 18264 and dated August 2008. Slope cross 1 described in that report was analysed above Stage 2I. In that analysis the computed factors of safety were

Lower Slope		Upper Slope		Total Slope	
Fully Drained	Raised Ru	Fully Drained	Raised Ru	Fully Drained	Raised Ru
1.83	1.43	1.78	1.34	1.94	1.50

These stability factors of safety are in excess of conventionally accepted values.

The slopes that rise above lots 759 to 762 and 767 to 776 are of similar or lesser gradients and therefore these properties below those slopes within Stages 2I and 2N are considered to be unlikely to be the subject of a future natural hazard in the form of erosion or slippage. This degree of stability would be maintained by the Council in their role as the building consent issuing authority and also as the administrators of the reserve area above the lots by ensuring compliance with the recommendations in the geotechnical completion report for Stage 2J that stated that

- the slope faces in the reserve are maintained with a dense grass and plant cover.
- the properties above the slopes are developed so that no surface water flows can occur over the slope faces. Surface water should be collected and be piped to the stormwater outfalls on each lot that were installed as part of the subdivision development
- even though permeable soils may be present, ground soakage is not to be used as a means of disposing of stormwater runoff on the lots above the slopes

On lots 770, 771 and 772 minor earthworks were undertaken at the bases of the slopes during the subdivision construction to increase the near flat areas at the rear of those lots. These earthworks have not steepened or undercut the existing slopes above those lots and therefore the stability of the slopes has not been compromised.

On lots 769, 770 and 772 where retaining walls are present along their road frontages, buildings or any additional filling should not be located within 1.5m of the backs of those walls.

Surface water should be collected and be piped to the stormwater outfalls on each lot that were installed as part of the subdivision development. Even though permeable soils may be present' ground soakage is not to be used as a means of disposing of stormwater runoff on the lots.

7.0 Future Building on Sloping Ground

Sloping ground is present on all lots in Stages 2I and 2N. Level building sites may be developed by cutting and filling as required. Cut batters could expose soils that may be variable. Batters higher than 1.5 m or steeper than 45 degrees should be retained because the exposed soils may be subject to future erosion. Walls of that height require a specific design and approval by way of a building consent. The designer should check the subsoil conditions where vertical poles are to be embedded in drilled holes. It is not appropriate to construct walls that are not more than 1.5 m high when the cut batters that may be subject to future erosion are higher than 1.5 m.

Any filling shall be placed to comply with the definition of good ground in terms of NZS 3604. Such filling is to be placed under professional engineering management. The engineer would advise compaction standards to be adopted based on the soil types to be used as the filling material.

8.0 Lots 1061 and 1065

Lots 1061 and 1065 are located in the Stage 3 development area at The Lakes. Past earthworks in the area of lot 1065 were managed by Coffey Geotechnics NZ Ltd in 2008. At that time the area of lot 1065 was investigated by Coffey on behalf of Powerco who intended to erect a residential building structure in which a transformer was to be housed.

Coffey undertook a number of subsoil investigations on Lot 1065 and the scope of their investigations and conclusions reached were described in their investigation report of 9 December 2008, to Powerco. A copy of that report and attachments is within Appendix 5 of this report.

In their report Coffey advised that

- the subsoils comprised subdivision filling up to 3.0 m deep overlaying natural ground comprising stiff clayey and sandy silts. The filling had been placed under Coffey's management to replace surface peats and other low strength soils
- the risk of liquefaction at the site is low
- induced settlements under the mass of the transformer on a concrete pad would be in the range of 14 to 43 mm
- for the specific design of the transformer pad an ultimate bearing capacity in the limit stage of 150 kPa would be applicable, but for other residential type buildings an ultimate bearing capacity of 300 kPa would be applicable.
- while not stated in the text of the report Coffey showed a building restriction line along the southern and western sides of the lot as shown on their diagram 02 to position any future buildings away from underlying peat that was not removed during the site development earthworks as shown on Coffey drawing 03 in the report. The building restriction line is shown on DP 463737.

From the Coffey report it is reasonable to assume that proposed lot 1065 would be suitable for the support of buildings detailed to NZS 3604:2011 provided that the building restriction line is observed. If the property is to be used for specialist structures outside of the scope of NZS 3604, the Coffey site data should be reviewed by a geotechnical engineer. The engineer may undertake their own additional tests to verify the Coffey data or to address subdivision conditions that are applicable to the support of the intended structure.

A wastewater transfer pumping station has been constructed on lot 1061. Specific investigations were undertaken by Coffey and the results of these investigations were incorporated in the design and subsequent construction of the pump station.

9.0 Topsoil Thicknesses

During the subdivision earthworks areas of cut or fill were initially stripped of topsoil and this was then replaced to target depths of up to 300mm. No guarantee is implied or given that the topsoil on any part of any lot is 300mm deep or less and it is recommended that future owners or builders check topsoil depths when preparing site development plans and cost schedules.

10.0 Professional Opinion

A statement in the format of Councils Infrastructure Development Code (Form G2) that all lots are suitable for building is contained in Appendix 2. This statement is accompanied by Form G3 which summarises the information and recommendations within this report.

In accordance with subdivision consent condition 8, it is recommended that the content of this report is advised to future owners of the 33 lots within Stages 2I and 2N of the development at The Lakes by a consent notice on the certificates of title for all lots.

11.0 Applicability

Recommendations contained in this document are based on data from pre and post subdivision boreholes, observations of soil exposures during earthworks, and the results of tests in filling placed. Inferences about the nature and continuity of subsoils away from these locations are made but cannot be guaranteed.

In all circumstances, if variations in the subsoils occur which differ from those described or are assumed to exist, the site should be inspected by an engineer suitably qualified to make an informed judgement and provide advice on appropriate improvement measures.

This report has been prepared specifically for the proposed subdivision development on Stages 2I and 2N of The Lakes development as shown on DP 462245 and no responsibility is accepted by S & L Consultants Ltd for the use of any part of this report for other development sites without their written approval.

S & L Consultants Ltd
Consulting Engineers, Surveyors, Planners



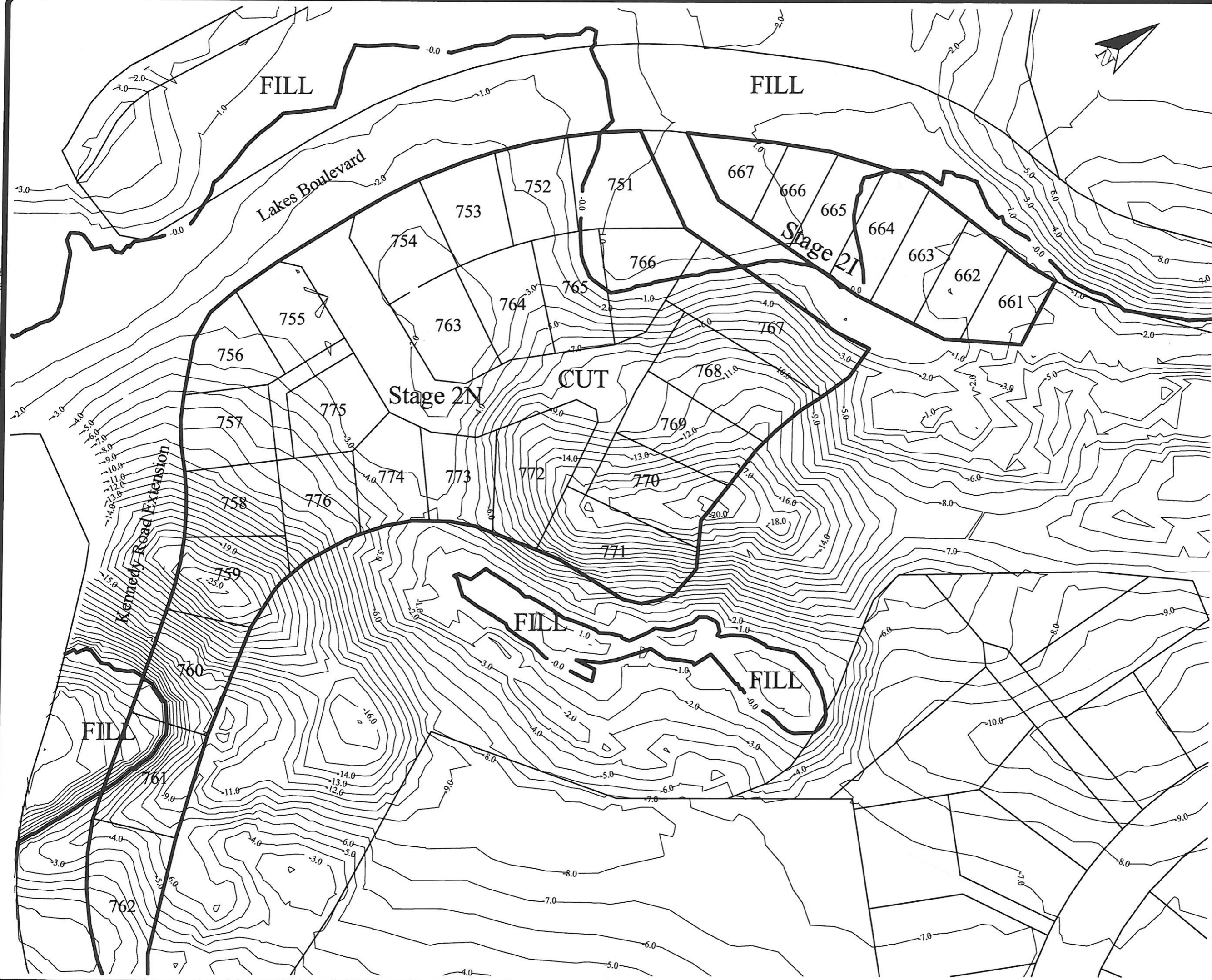
M W Hughes CPEng MIPENZ
Geotechnical Engineer

**Prequalified category one geotechnical
adviser with Tauranga City Council**

16 March 2013

Appendix 1 Reference Drawings

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Post Construction Borehole Location Plan 20302-03
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- Key**
- Fill Compaction Test
 - Pre-subdivision Test Site
 - Settlement Control Marker
 - Post Earthwork Borehole
 - Subsoil Drain
 - Building Restriction Line Lot 1
- FILL** Subdivision Cut and Fill Areas
- CUT**
- 1 — Fill Contour
 - 1 — Cut Contour


checked by	3	For Completion Report	05/13
Rev. No.	2	Issued for Consent	09/12
	1	Issued with Report	10/09
Description			
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NAME			
DATE			
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

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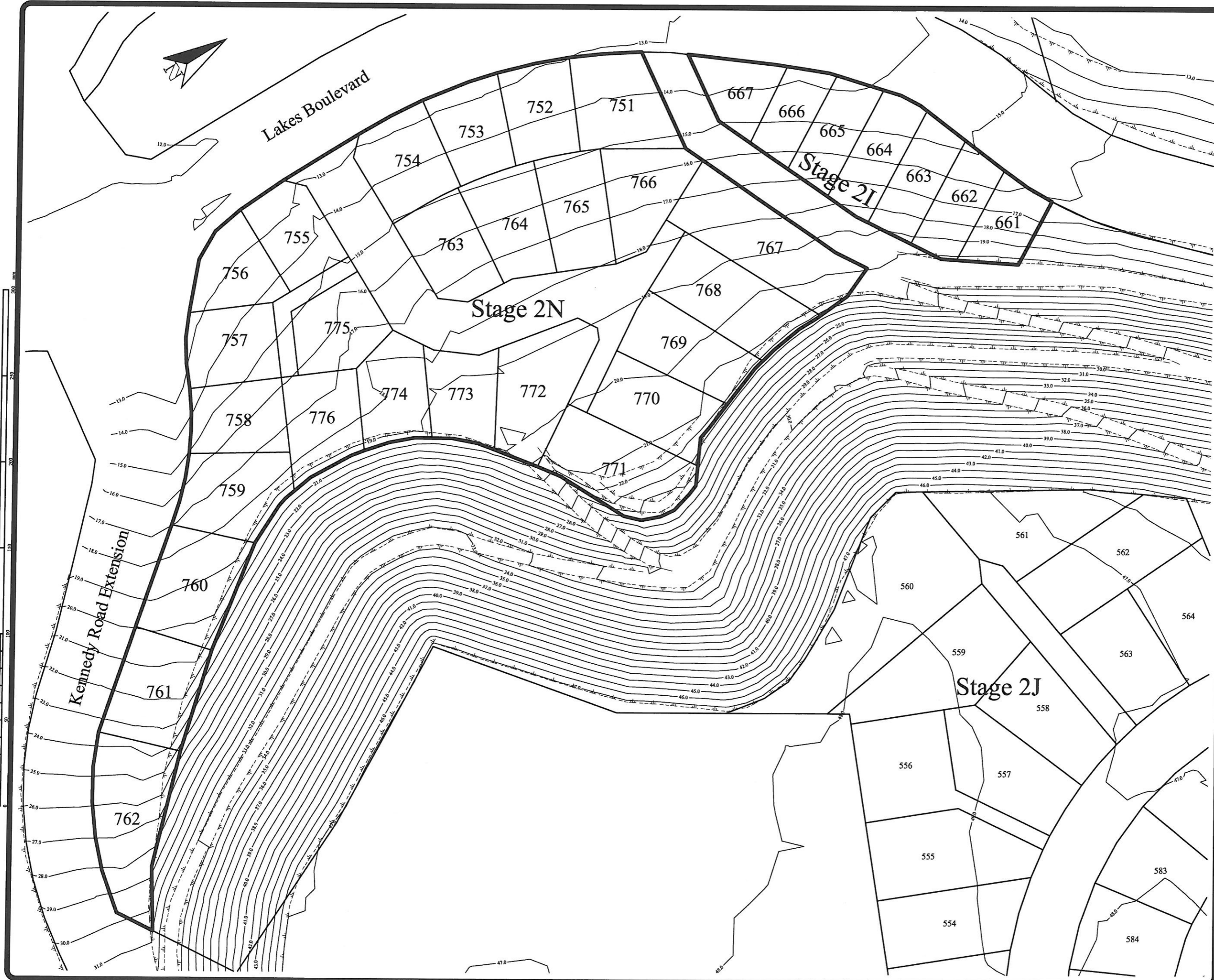
Stages 2I & 2N

Geotechnical Report
Reference Plan


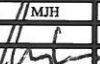
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ORIGINAL SCALES	DATE
1:1000 @ A3	09/12
DRAWING No	
20302 - 01	
Revision:	1 2 3





Levels are in terms of Moturiki Datum
Refer to Harrison Grierson drawing 132631-2N-AB220
for Earthworks details during construction 2013

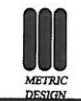
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	1	Issued for Consent		09/12
checked by	Rev. No.	Description		DATE
		NAME	DATE	SIGNED
Surveyed				
Designed		CJH	09/12	
Drawn		MJH	09/12	
Checked				
Approved				
REFERENCES				



S & L CONSULTANTS LTD
SURVEYORS - ENGINEERS - PLANNERS
111 Cameron Road, Tauranga, New Zealand
P.O. Box 231 Ph.(07)577-6069
Fax(07)577-6065
Email: slconsultants@slta.co.nz



TITLE	
Stages 2I & 2N	
Prior to Construction Contour Plan	
Copyright on this drawing is reserved	
ORIGINAL SCALES	DATE
1:1000 @ A3	09/12
DRAWING No	
20302 - 02	
Revision:	1 2





Key:

● Borehole Position

Lakes Boulevard

Kennedy Road Extension

Stage 2N

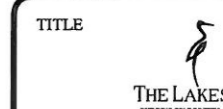
Stage 2I

Stage 2J

		2	For Completion Report	05/13
		1	Issued for Consent	09/12
CKD BY	REV No.	DESCRIPTION		DATE
		NAME	DATE	SIGNED
Surveyed				
Designed				
Drawn		MJH	09/12	
Checked				
Approved				
REFERENCE				



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TITLE
Stages 2I & 2N
Post Construction
Borehole Location Plan

Copyright on this drawing is reserved	
ORIGINAL SCALES	DATE
1:1000 @ A3	09/12
DRAWING No	
20302 - 03	
REVISION:	1 2



METRIC
DESIGN



NOTES:

1. CUT / FILL CONTOURS ARE SHOWN AT 0.25m INTERVALS.
2. CUT / FILL CONTOURS ARE THE DIFFERENCE BETWEEN THE PRE-DEVELOPED SURFACE AND THE FINISHED SURFACE.

LEGEND:

- CUT CONTOURS
- FILL CONTOURS
- ZERO CUT FILL CONTOURS
- TIMBER RETAINING WALL



Tauranga Office
Level 1 Harrison Grierson House
141 Cameron Road Tauranga 3110
P +64 7 578 0023
www.harrisongrierson.com

A	AS BUILT	HJD	08.05.13
REF	REVISIONS	BY	DATE

PROJECT:

THE LAKES (2012) LTD
TAURANGA

TITLE:

STAGE 2N
AS BUILT CUT/FILL
CONTOUR PLAN

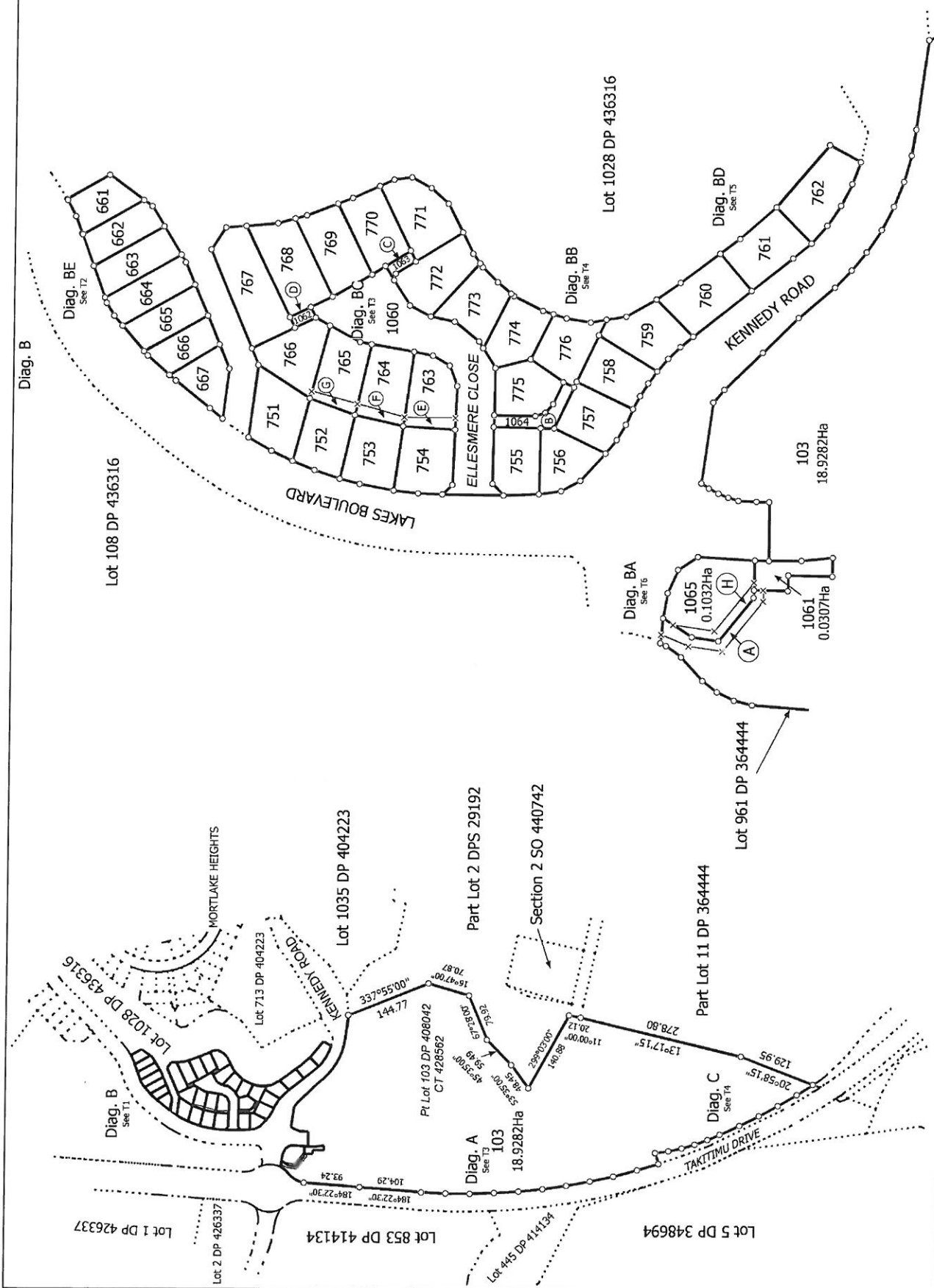
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DRAWN:	DATE:	SIGNED:	PLOT DATE:
HJD	08.05.13		08.05.13
CHECKED:	DATE:	SIGNED:	SURVEY BY:
RCH	08.05.13		
APPROVED:	DATE:	SIGNED:	SURVEY DATE:
GPR	08.05.13		

ISSUE STATUS:

AS BUILT

PROJECT No:	1520-132631-01	SCALES:	1:500 - A1 1:1000 - A3	A1
DRAWING No:				REV

132631-2N-AB220 A



T 1/6

Title Plan
LT 463737
DRAFT

Surveyor: Michael Peter Dawhirst
Firm: Harrison Grierson Consultants Ltd

Lots 103, 661-667, 751-776 and 1060-1065 being a subdivision of Lots 106 & 107
DP 436316 and Pt Lot 103 DP 408042

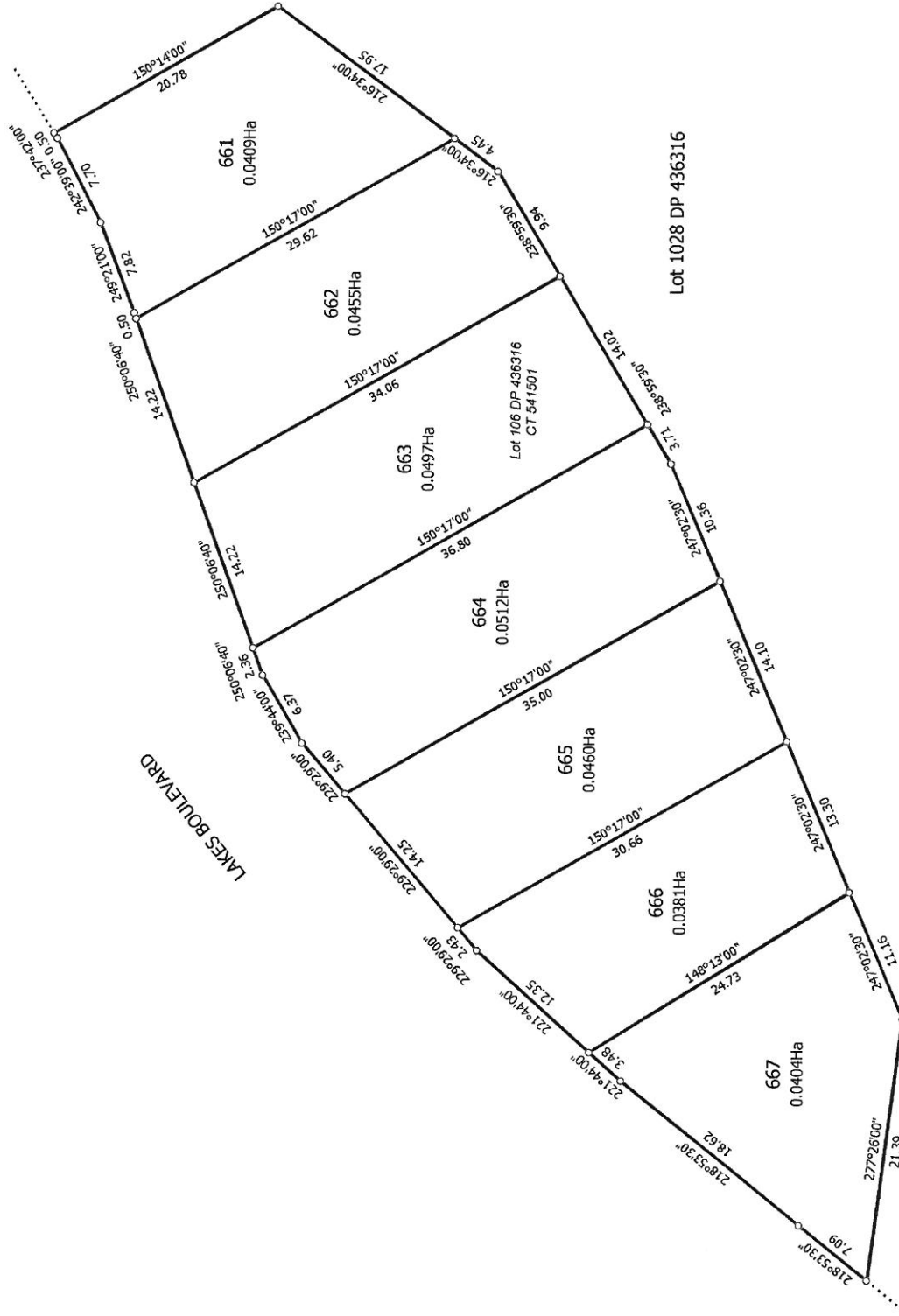
Land District South Auckland

Digitally Generated Plan

Generated on: 31/05/2013 3:17pm Page 4 of 9



Diag. BE



Lot 1028 DP 436316

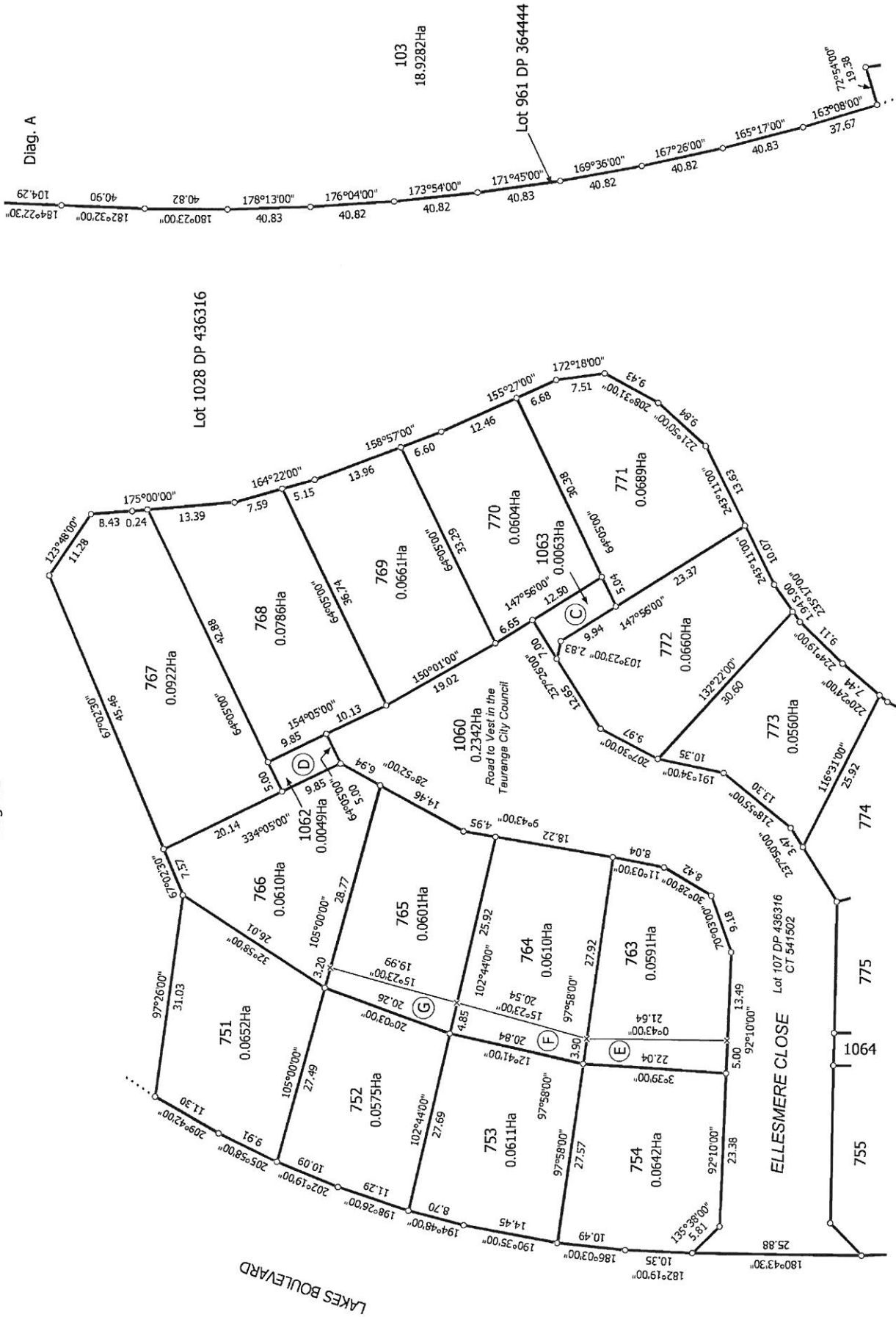
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CT 541501

T 2/6



Diag. BC

Diag. A



T 3/6

Land District South Auckland

Digitally Generated Plan

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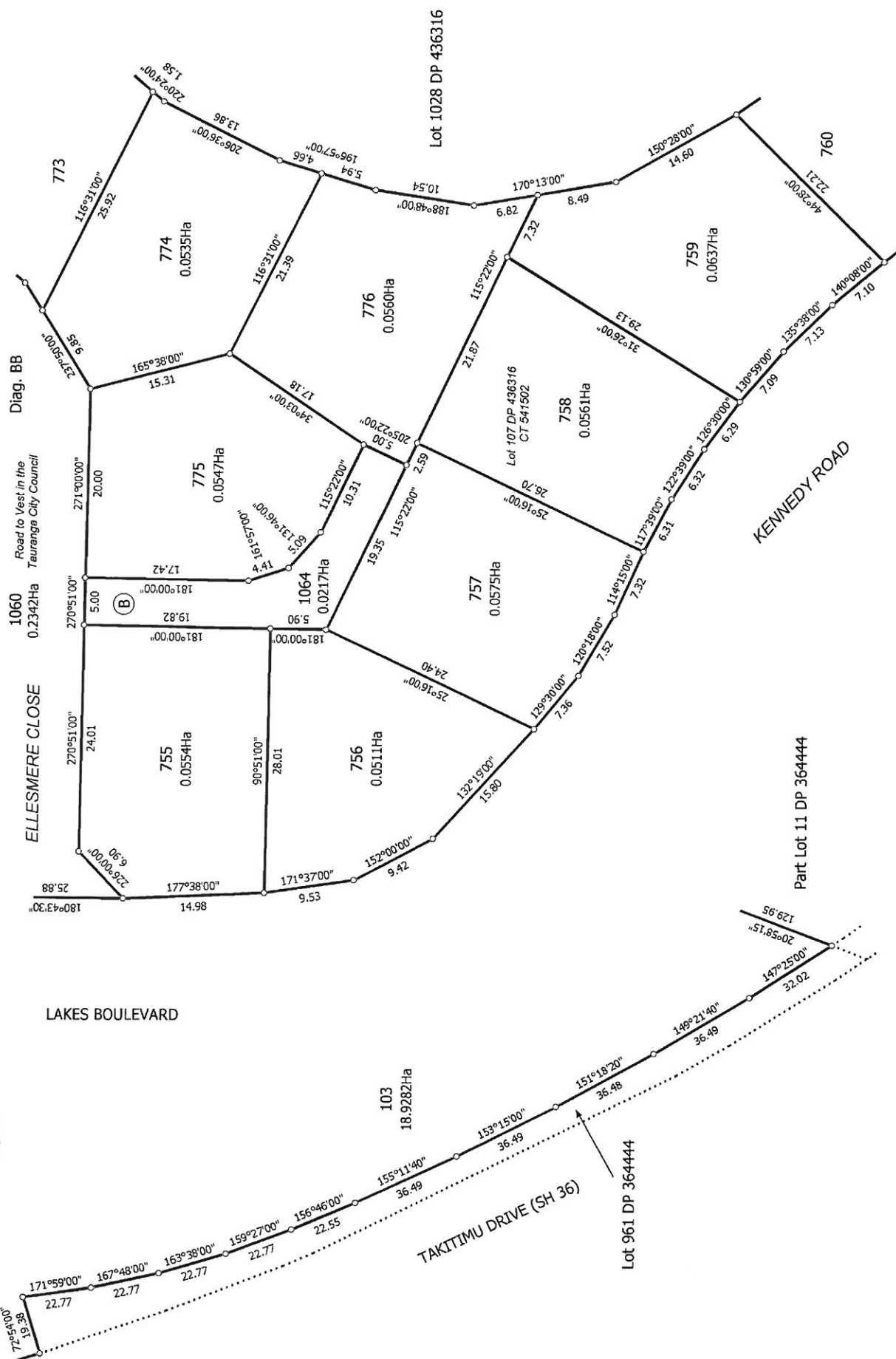
Lots 103, 661-667, 751-776 and 1060-1065 being a subdivision of Lots 106 & 107
DP 436316 and Pt Lot 103 DP 408042

Surveyor: Michael Peter Dewhirst
Firm: Harrison Grierson Consultants Ltd

Title Plan
LT 463737
DRAFT



Diag. C

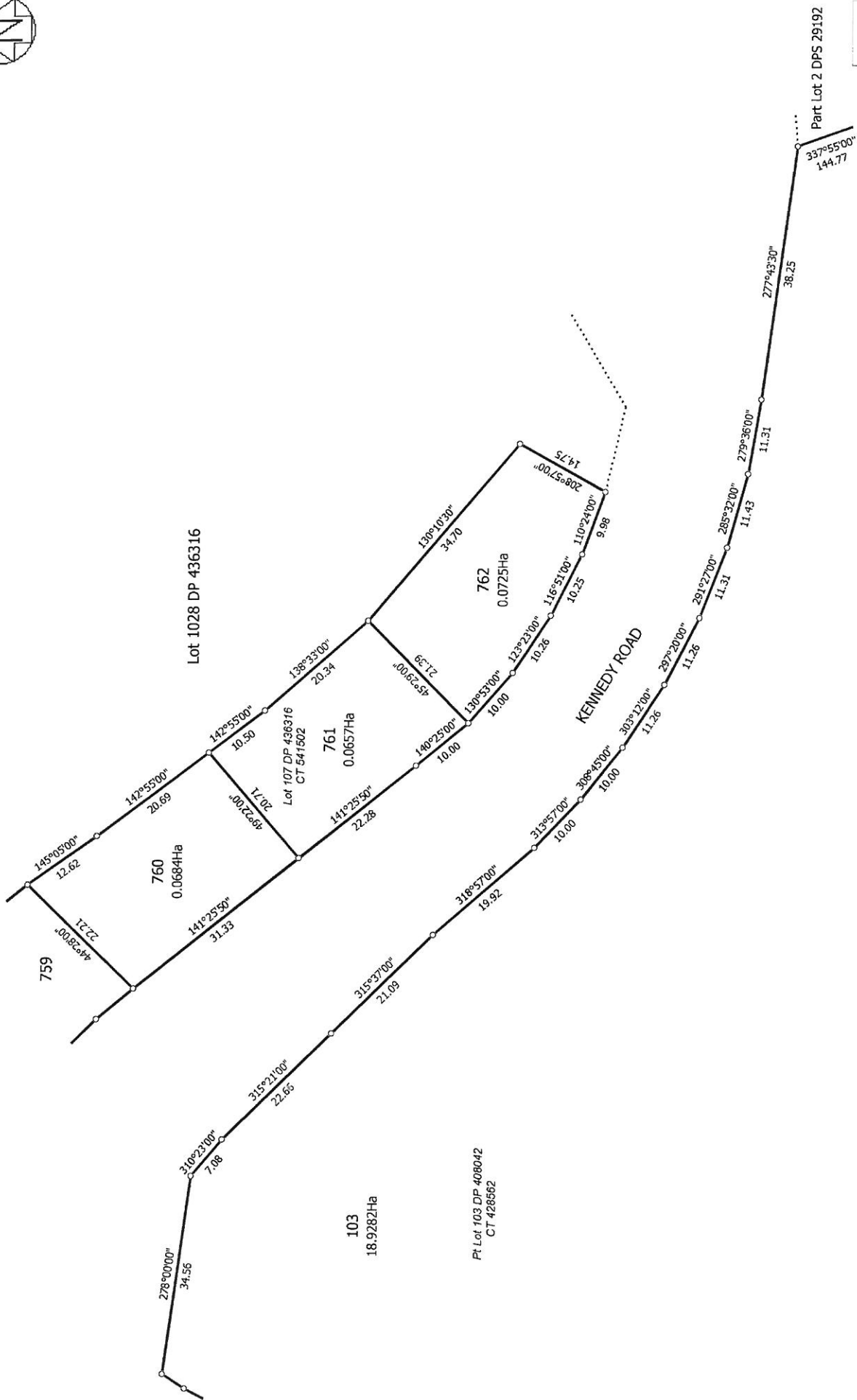


T 4/6

Land District South Auckland	Lots 103, 661-667, 751-776 and 1060-1065 being a subdivision of Lots 106 & 107 DP 436316 and Pt Lot 103 DP 408042	Surveyor: Michael Peter Dewhurst Firm: Harrison Grierson Consultants Ltd	Title Plan LT 463737 DRAFT
Digitally Generated Plan Generated on: 31/05/2013 3:17pm Page 7 of 9			

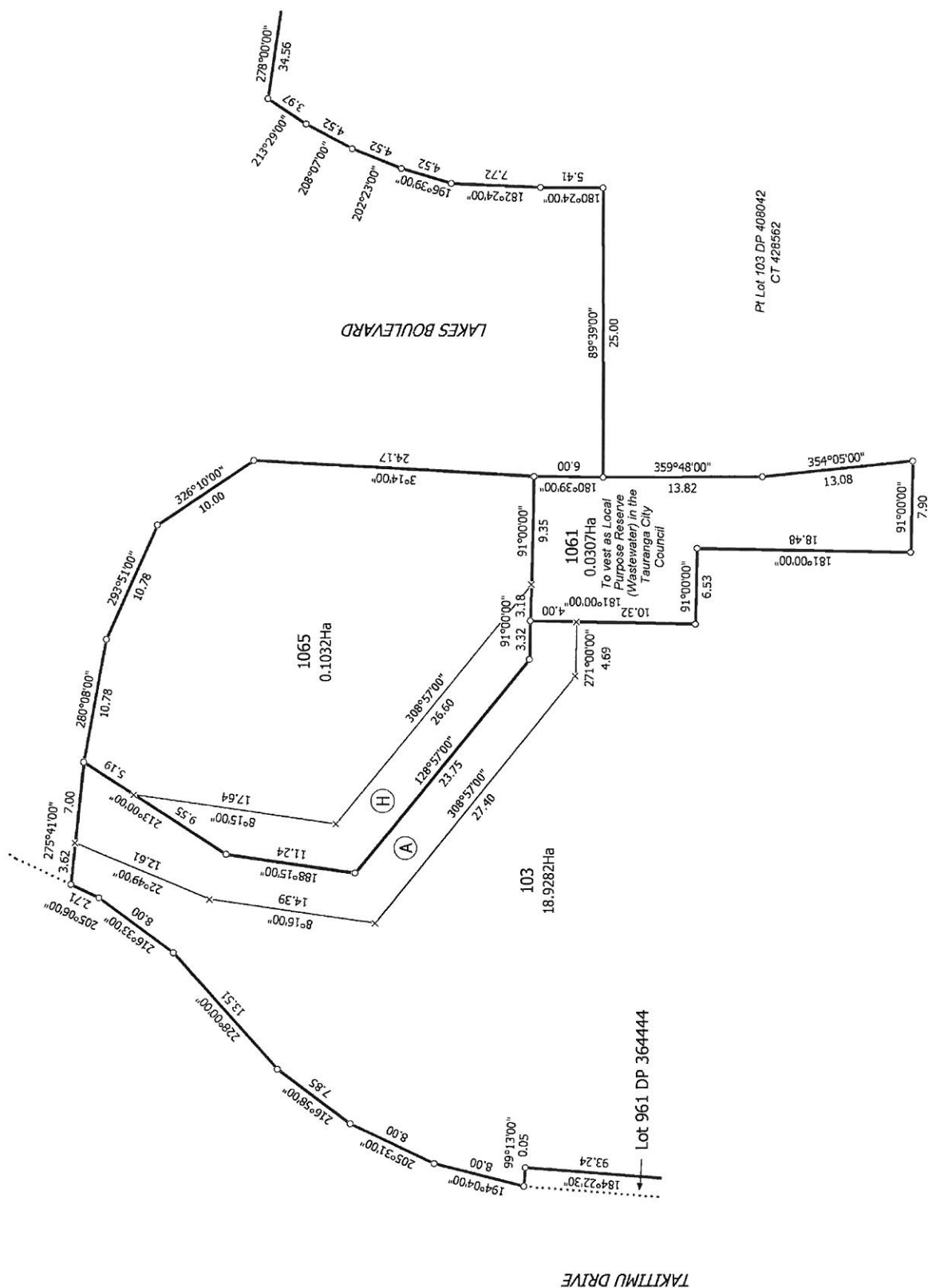


Diag. BD



T 5/6

Land District South Auckland	Lots 103, 661-667, 751-776 and 1060-1065 being a subdivision of Lots 106 & 107 DP 436316 and Pt Lot 103 DP 408042		Surveyor: Michael Peter Dewhirst Firm: Harrison Grierson Consultants Ltd	Title Plan LT 463737 DRAFT
Digitally Generated Plan Generated on: 31/05/2013 3:17pm Page 8 of 9				



9/9 L

Land District: South Auckland

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Lots 103, 661-667, 751-776 and 1060-1065 being a subdivision of Lots 106 & 107
DP 436316 and Pt Lot 103 DP 408042

Surveyor: Michael Peter Dewhurst
Firm: Harrison Grierson Consultants Ltd

Title Plan
LT 463737
DRAFT

Appendix 2 Certificates

Infrastructure Development Code Form G2
Infrastructure Development Code Form G3

CERTIFICATION**G2****STATEMENT OF PROFESSIONAL OPINION AS TO THE
GEOTECHNICAL SUITABILITY OF LAND FOR BUILDING**

NAME OF SUBDIVISION	The Lakes Stages 2I and 2N
COUNCIL FILE NUMBER RC No:	16807
ENGR RESPONSIBLE FOR INVESTIGATION:	M W Hughes
QUALIFICATIONS:	BE CPEng MIPENZ

I Michael William Hughes of S & L Consultants Ltd

Hereby confirm that;

I am a professional person, appropriately qualified with experience in geotechnical engineering to ascertain the suitability of the land for building development and was retained as the Soils Engineer to the above development.

1. An appropriate level of site investigation and construction supervision has been carried out under my direction and is described in my development evaluation report dated 16 March 2013.
2. In my professional opinion, not to be construed as a guarantee, I consider that;
 - a) The areas shown in my report dated 16 March 2013 of each new allotment are suitable for the erection thereon of the building types appropriate to the zoning of the land, provided that, buildings are set back from easements, slopes or retaining walls as described in my report.
 - b) The earth fills shown on the attached Plans No. 20302-01 and 132631-2N-AB220 have been placed in accordance with the requirements of the Infrastructure Development Code.
 - c) The completed works give due regard to all land slope and foundation stability considerations.
 - d) The filled ground is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZS 3604:2011 and related documents based on data from specific test sites.
 - e) The original ground not affected by filling is suitable for the erection of residential buildings not requiring specific design in terms of NZS 3604:2011 and related documents based on data from specific test sites but ground conditions may vary away from these test sites.
3. This professional opinion is furnished to the Council and the owner for their purposes alone, on the express condition that it will not be relieved upon by any other person and does not remove the necessity for normal inspections of foundation conditions at the time of erection for any dwelling.

Signed: Date: 16 March 2013

**PRODUCER STATEMENT**
SUITABILITY OF LAND FOR BUILDING DEVELOPMENT**G2**Version 1
July 2011

SUMMARY OF GEOTECHNICAL DATA/RECOMMENDATIONS FOR INDIVIDUAL LOTS

FROM IDC _ G3

Subdivision:

The Lakes St ages 21 and 2N

Location:

Lakes Boulevard, Ellesmere Close, Kennedy Road, Pyes Pa

TCC Ref: RC 16807
S&L Ref: 20302

The comments and notations included on this summary sheet are outlined in the support documents. These shall be read in conjunction with this summary.

Lot No.	Area (m2)	Subsurface Data						Building Restriction Line	S/W Specific Design	S/W Soakage	S/W Reticulate	Designated Building Platform	Minimum Building Platform	Compressible Soils	on-site effluent disposal	consent notice	Recommendations /Restrictions		
		Shear Strength	Subdivision Filling		Natural Topography Unworked	Natural Topography earthworked												Foundations	
			Y/N	Depth (m)		Y/N	Depth (m)											Conventional shallow	Specific Design
661	409	101	N		N	1.0-2.0	Y	N			Y	N				Y			
662	455	87-200	N		N	1.0	Y	N			Y	N				Y			
663	497	98-149	N		N	1.0	Y	N			Y	N				Y			
664	512	200+	N		N	0-1.0	Y	N			Y	N				Y			
665	460	200+	Y	0-1.0	Y		Y	N			Y	N				Y			
666	381	200+	Y	1	Y		Y	N			Y	N				Y			
667	404	200+	Y	1	Y		Y	N			Y	N				Y			
751	652	sand	Y	0-1.0	Y		Y	N			Y	N				Y			
752	575	61-200+	N		N		Y	N			Y	N				Y			
753	611	sand	N		N		Y	N			Y	N				Y			
754	642	200+	N		N		Y	N			Y	N				Y			
755	554	200+	N		N		Y	N			Y	N				Y			
756	511	sands	N		N		Y	N			Y	N				Y			
757	575	200+	N		N		Y	N			Y	N				Y			
758	561	sands	N		N		Y	N			Y	N				Y			
759	637	sands	N		N		Y	N			Y	N				Y			
760	684	200+	Y	0-3.0	N		Y	N			Y	N				Y			
761	657	200+	Y	0-5.0	N		Y	N			Y	N				Y			
762	725	200+	N		N		Y	N			Y	N				Y			
763	591	sands	N		N		Y	N			Y	N				Y			
764	610	sands	N		N		Y	N			Y	N				Y			
765	601	sands	Y	0-5.0	N		Y	N			Y	N				Y			
766	610	200+	Y	0-5.0	N		Y	N			Y	N				Y			
767	922	sands	N		N		Y	N			Y	N				Y			
768	786	sands	N		N		Y	N			Y	N				Y			
769	661	sands	N		N		Y	N			Y	N				Y			
770	604	sands	N		N		Y	N			Y	N				Y			
771	689	sands	N		N		Y	N			Y	N				Y			
772	660	sands	N		N		Y	N			Y	N				Y			
773	560	sands	N		N		Y	N			Y	N				Y			
774	535	sands	N		N		Y	N			Y	N				Y			
775	547	sands	N		N		Y	N			Y	N				Y			
776	560	sands	N		N		Y	N			Y	N				Y			
1065	1032	150+	Y	2.5-3.2	Y		Y	N			Y	N				Y			

Scala penetrometer tests in sands described in report by S & L Consultants Ltd of 16 March 2013



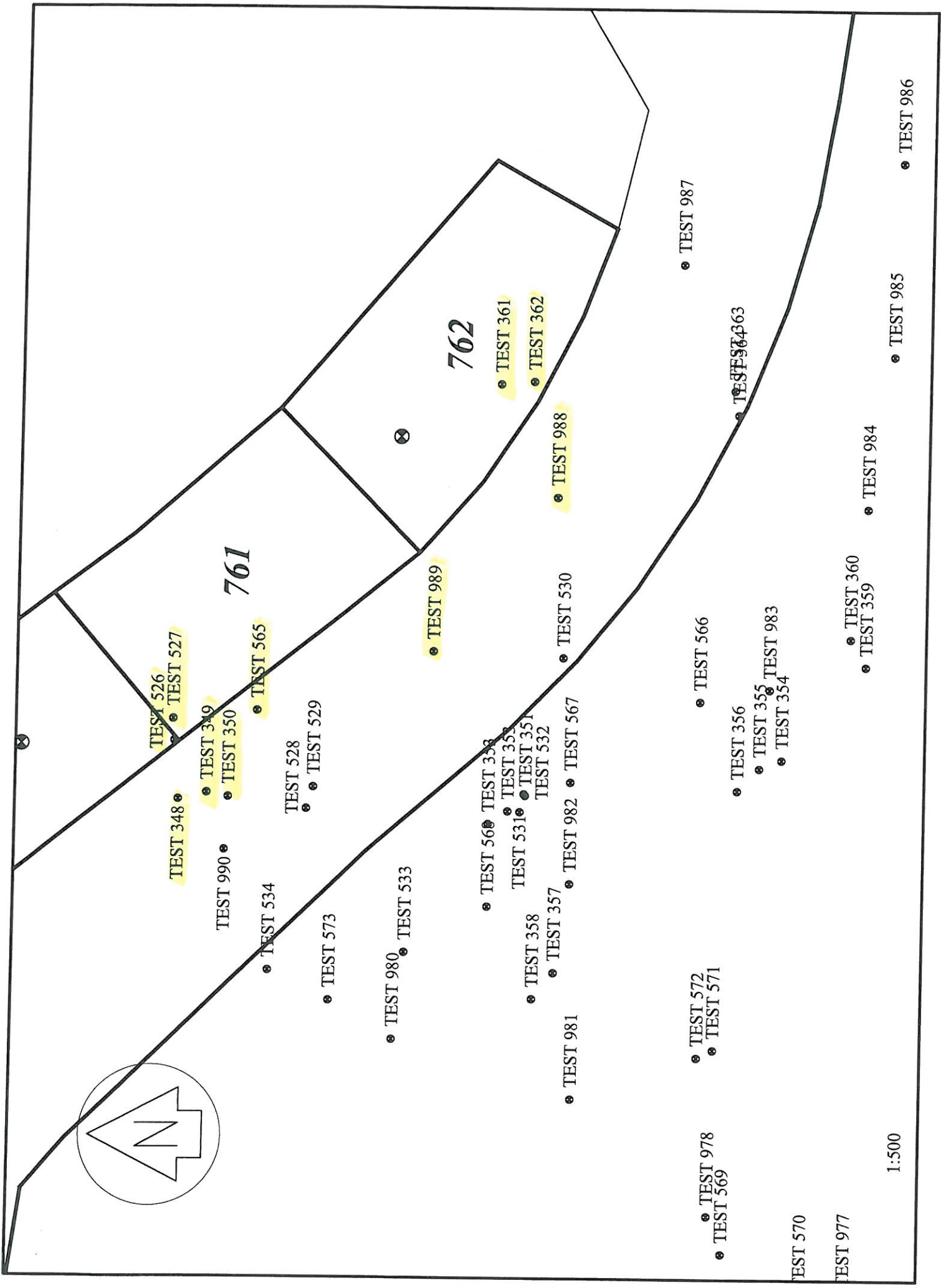
SUMMARY OF GEOTECHNICAL DATA FOR INDIVIDUAL LOTS

INFRASTRUCTURE DEVELOPMENT CODE

G3
VERSION 1/1

Appendix 3 Test Results

Coffey Geotechnical 2008.



761

762

TEST 348 • TEST 526 • TEST 527

TEST 990 • TEST 349 • TEST 350

TEST 565

TEST 528 • TEST 529

TEST 534

TEST 573

TEST 980 • TEST 533

TEST 989

TEST 560 • TEST 333 • TEST 353 • TEST 531 • TEST 351 • TEST 532

TEST 358

TEST 357

TEST 982 • TEST 567

TEST 530

TEST 988

TEST 361

TEST 362

TEST 987

TEST 572 • TEST 571

TEST 978 • TEST 569

TEST 356

TEST 355 • TEST 983 • TEST 354

TEST 363

TEST 360 • TEST 359

TEST 984

TEST 985

TEST 986

TEST 570

TEST 977

1:500

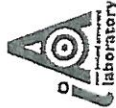


SPECIALISTS MANAGING THE EARTH

141 Cameron Road
TAURANGA 3110
www.coffey.com

FIELD DENSITY TEST RESULTS

NZS 4407:1991 Test 4.2.1, NZS 4402:1986 Test 2.1, NZGS 8-2001



Tests / comments indicated ^{NE} are outside the scope of the laboratory's accreditation

Michael

M.J.J. Packard Approved Signatory

JOB NO
PROJECT
CLIENT
MATERIAL

13685

Stage 3 The Lakes, Slate Highway 29, Tauriko
Grasshopper Farms Limited

Compacted Fill

DATE	TEST NO	TEST LOCATION			FIELD TESTS				FIELD DENSITY GAUGE READINGS										Oven Dried Water Content			Solid Density (Assumed) t/m ³	COMMENTS ^{NE}
		Surveyed by client			Soil Class	Vane Shear Strengths kPa <i>Note: ++'s indicate UTP</i>						BS or Depth mm	Wet Density t/m ³	Dry Density t/m ³	Water Content %	Air Voids ^{NE} %	Dry Density t/m ³	Water Content %	Air Voids ^{NE} %				
		Northing m	Easting m	RL m		Individual Values			kPa	Average													
7.1.08	345	800748.1	368442.3	47.2	ML	243+	243+	243+	243+	243+	243+	250	1.74	1.21	43.0	1.2	1.22	42.3	1.5	2.60			
	346	800682.6	368357.7	41.6	ML	243+	243+	243+	243+	243+	243+	250	1.71	1.29	32.0	8.7	1.22	40.5	4.0	2.60			
	347	800685.4	368360.9	41.1	ML	243+	243+	243+	243+	243+	243+	250	1.66	1.18	41.0	6.4	1.13	46.4	3.7	2.60			
	348	800697.0	368180.8	15.4	SM							250	1.53	1.25	22.5	20	1.20	28.2	16	2.40	SAND		
	349	800694.0	368181.5	14.4	SM	185	172	199	156	178	178	250	1.66	1.19	39.5	3.7	1.25	32.1	7.5	2.40			
	350	800691.7	368181.1	13.7	ML	194	202	243+	243+	221+	221+	250	1.65	1.20	38.0	8.3	1.14	45.4	4.7	2.60			
	351	800660.4	368181.6	16.4	ML	226	185	243+	223	219+	219+	250	1.76	1.33	32.5	5.6	1.29	36.6	3.1	2.60			
	352	800662.1	368179.7	15.4	ML	243+	243+	243+	223	238+	238+	250	1.73	1.27	36.5	5.2	1.20	43.8	1.1	2.60			
	353	800664.2	368178.4	14.4	SM							250	1.34	1.06	26.0	28	1.03	29.2	27	2.40			
	354	800633.0	368185.4	17.6	ML	243+	243+	243+	223	238+	238+	250	1.66	1.19	40.0	7.0	1.15	44.8	4.6	2.60			
	355	800635.4	368184.4	17.1	ML	243+	243+	243+	223	238+	238+	250	1.70	1.20	42.0	3.5	1.22	39.9	4.6	2.60			
	356	800637.7	368182.1	15.4	ML	165	185	223	243+	204+	204+	250	1.65	1.19	39.5	7.6	1.20	38.2	8.3	2.60			
	357	800656.9	368182.6	15.0	ML	172	165	165	182	176	176	250	1.63	1.12	45.5	6.0	1.18	38.0	10	2.60			
	358	800659.2	368159.8	13.8	ML	243+	243+	243+	243+	243+	243+	250	1.72	1.25	37.5	5.3	1.20	42.6	2.5	2.60			
	359	800624.2	368195.3	20.1	ML	182	213	243+	243+	220+	220+	250	1.66	1.23	35.0	10	1.17	41.3	6.5	2.60			
	360	800625.9	368198.3	19.4	ML	213	215	223	243+	224+	224+	250	1.71	1.22	40.5	3.7	1.23	39.1	4.5	2.60			
	361	800663.6	368225.1	26.2	ML	185	177	194	243+	200+	200+	250	1.67	1.23	35.5	9.1	1.20	38.4	7.6	2.60			
	362	800660.1	368225.4	25.3	ML	221	194	185	228	207	207	250	1.68	1.26	33.5	9.4	1.23	37.0	7.3	2.60			
	363	800638.7	368244.6	24.8	ML	243+	243+	243+	243+	243+	243+	250	1.66	1.19	39.5	7.1	1.16	43.4	5.1	2.60			
	364	800638.3	368222.0	23.6	SM	243+	243+	243+	243+	243+	243+	250	1.51	1.08	40.5	12	1.02	48.4	8.2	2.40			
Date	14.1.08	Checked <i>and</i>																					

Checked

14.1.08

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FIELD DENSITY TEST RESULTS

NZS 4407:1991 Test 4.2.1, NZS 4402:1986 Test 2.1, NZGS 8-2001

Tests / comments indicated ^{NE} are outside the scope of the laboratory's accreditation

Black

JOB NO	PROJEC	CLIENT
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JOB NO	PROJECT	CLIENT
--------	---------	--------

Compacted Fill

13685

Stage 3 The Lakes, State Highway 29, Tauriko
Grasshopper Farms Limited

[illegible]

Date 15.1.08.

Checked

copy

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NZS 4407:1991 Test 4.2.1, NZS 4402:1986 Test 2.1, NZGS 8-2001

JOB NO.
PROJECT
CLIENT

13685

Stage 3 The Lakes, State Highway 29, Tauriko
Grasshopper Farms Limited

M.J. Packard Approved Signatory

Date 22.1.08

Checked

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466
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SPECIALISTS MANAGING THE EARTH

141 Cameron Road
TAURANGA 3110
www.coffey.com

FIELD DENSITY TEST RESULTS

NZS 4407:1991 Test 4.2.1, NZS 4402:1986 Test 2.1, NZGS 8-2001



Tests / comments indicated ^{NE} are outside the scope of the laboratory's accreditation

[Signature]

JOB NO
PROJECT
CLIENT

13685

Stage 3 The Lakes, State Highway 29, Tauriko
Grasshopper Farms Limited

MATERIAL

Compacted Fill

M.J. Packard Approved Signatory

DATE	TEST NO	TEST LOCATION			FIELD TESTS				FIELD DENSITY GAUGE READINGS								Oven Dried Water Content				Solid Density (Assumed) t/m ³	COMMENTS ^{NE}
		Surveyed by client			Soil Class	Vane Shear Strengths kPa				BS or Depth mm	Wet Density t/m ³	Dry Density t/m ³	Water Content %	Air Voids ^{NE} %	Dry Density t/m ³	Water Content %	Air Voids ^{NE} %					
		Northing m	Easting m	RL m		Note: ++s Indicate UTP																
						Individual Values kPa																
07.04.08	972	800587.9	368203.4	16.6	ML	214+	214+	214+	214+	214+	250	1.86	1.44	29.5	2.3	1.43	30.0	1.9		2.60		
	973	800576.8	368194.5	15.7	ML	214+	214+	214+	214+	214+	250	1.83	1.36	35.0	0.2	1.32	38.6	0		2.60		
	974	800574.6	368175.6	14.7	ML	214+	214+	214+	214+	214+	250	1.79	1.34	33.0	3.8	1.36	31.6	4.8		2.60		
	975	800589.3	368152.6	13.8	ML	214+	214+	214+	214+	214+	250	1.71	1.23	39.5	4.3	1.12	52.7	0		2.60		
	976	800591.5	368125.1	12.2	ML	214+	214+	214+	214+	214+	250	1.74	1.25	39.0	3.1	1.23	41.5	1.9		2.60		
	977	800625.6	368128.3	11.8	ML	214+	214+	214+	214+	214+	250	1.82	1.35	34.5	0.9	1.41	29.3	4.5		2.60		
	978	800640.2	368136.9	13.3	ML	214+	214+	214+	214+	214+	250	1.84	1.40	31.5	2.1	1.28	43.7	0		2.60		
	979	800644.4	368110.6	11.1	ML	214+	214+	214+	214+	214+	250	1.81	1.38	31.5	3.4	1.36	33.2	2.4		2.60		
	980	800674.0	368155.5	17.2	ML	214+	214+	214+	214+	214+	250	1.82	1.38	31.5	3.2	1.38	31.9	2.9		2.60		
	981	800654.9	368149.2	14.8	ML	214+	214+	214+	214+	214+	250	1.84	1.35	36.5	0	1.27	45.3	0		2.60		
	982	800655.4	368172.1	18.8	ML	214+	214+	214+	214+	214+	250	1.77	1.31	35.5	3.2	1.28	37.8	2.1		2.60		
	983	800634.4	368192.8	21.0	ML	214+	214+	214+	214+	214+	250	1.76	1.29	36.5	3.2	1.25	41.2	0.5		2.60		
	984	800624.3	368212.1	22.9	ML	214+	214+	214+	214+	214+	250	1.78	1.32	34.5	3.3	1.26	41.9	0		2.60		
	985	800621.7	368228.4	24.9	ML	214+	214+	214+	214+	214+	250	1.72	1.28	34.5	6.8	1.22	40.3	3.5		2.60		
	986	800621.1	368249.0	28.2	ML	214+	214+	214+	214+	214+	250	1.69	1.24	36.5	7.0	1.22	38.7	5.9		2.60		
	987	800644.4	368238.0	27.5	ML	214+	214+	214+	214+	214+	250	1.76	1.33	32.0	6.4	1.32	32.7	5.9		2.60		
	988	800657.4	368213.1	24.7	ML	214+	214+	214+	214+	214+	250	1.87	1.42	31.5	0.9	1.43	30.8	1.2		2.60		
	989	800670.3	368196.7	22.3	ML	214+	214+	214+	214+	214+	250	1.85	1.37	35.0	0	1.35	37.3	0		2.60		
	990	800692.1	368175.5	19.3	ML	214+	214+	214+	214+	214+	250	1.75	1.38	27.0	10	1.32	32.9	5.9		2.60		
Date	23.04.08	Checked			C.V./M.V				This report must be used in accordance with the terms and conditions of the contract.													

Date 23.04.08

Checked C.K.W./M.P.

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Report No 8092 Sheet 1 of 1

Appendix 4 Borehole Logs

S & L Consultants Ltd 2008 and 2013

Site: The Lakes (2012) Ltd., Stage 2 I, The Lakes Subdivision, Pyes Pa

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 18.0 (661) 16.5 (663) m Moturiki

i | Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)
BH 661						50 100 150
TOPSOIL 200 mm		0.5		not found	179	
SILT; clayey; slightly sandy; hard; dry; friable; mixed orange brown, light grey and dark brown FILL						
SILT; sandy; very stiff; moist; friable; brown						
SILT; very stiff; saturated; slightly cohesive; light grey						
SAND (f-m); medium dense; saturated; grey						
SILT; very stiff; saturated; slightly cohesive; light grey						
SAND (f-m); medium dense; saturated; light grey						
End of borehole 2.0 m						
BH 663						
TOPSOIL 100 mm		0.5		not found	149	
SAND (f-m) silty; dense; dry; brown orange brown and dark brown mottles FILL						
SILT; clayey; very stiff; moist; moderately plastic; orange brown						
becomes stiff; slightly sandy						
End of borehole 2.0 m						

EXCAVATION METHOD: 150mm Diameter Machine Auger



BH 662A&B

Site: The Lakes; Stage 2 I

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: MWH

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)										
						50	100	150								
BH 662A																
TOPSOIL				not found												
SILT; slightly sandy; very stiff to hard; dry; friable; mixed brown FILL		0.5			utp	>										
SILT; slightly clayey; stiff; moist; slightly friable; light brown					134											
					112											
					87											
End of borehole 1.0 m		1.0														
		1.5														
		2.0														
BH 662B																
TOPSOIL				not found												
SILT; slightly sandy; very stiff to hard; dry; friable; mixed brown FILL		0.5			200+	>										
SILT; slightly sandy; very stff; slightly cohesive; light brown becomes very moist becomes sandy					200+	>										
					159											
					132											
End of borehole 1.0 m		1.0														
		1.5														
		2.0														

EXCAVATION METHOD: 50mm Diameter Hand Auger

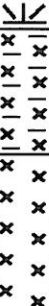

Site:The Lakes; Stage 2 I

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: MWH

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)															
BH 664A							50	100	150													
TOPSOIL			0.5		not found	utp																
SILT; clayey; very stiff; dry; friable; mixed light brown yellow																						
SILT; stiff; friable; sl. moist; brown becomes light brown orange			1.0					200+														
End of borehole 1.0 m				1.5																		
			2.0																			
BH 664B																						
TOPSOIL			0.5		not found	200+																
SILT; slightly sandy; very stiff; dry; friable; brown grey																						
			1.0					200+														
End of borehole 1.0 m				1.5																		
			2.0																			

EXCAVATION METHOD: 50mm Diameter Hand Auger

Site: The Lakes; Stage 2 I

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

Logged By: MWH

[illegible]

EXCAVATION METHOD: 50mm Diameter Hand Auger



BH 667&751

Site: The Lakes (2012) Ltd., Stages 2 I and 2N, The Lakes Subdivision, Pyes Pa



Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 14.0 m Moturiki Datum

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
BH 667							50	100	150
TOPSOIL 100 mm				R	not found	utp			
SAND (f-m) silty; dense; dry; brown orange brown and dark brown mottles FILL			0.5						
			1.0	13 R					
				R					
			1.5						
			2.0						
SAND (f-m) silty; dense; dry; brown orange brown mottles									
End of borehole 2.0 m									
BH 751									
TOPSOIL 100 mm				10 R	not found				
SILT; clayey; slightly sandy; hard; dry; friable; mixed orange brown, light grey and dark brown FILL			0.5						
			1.0	9 11 7 6 11					
			1.5	10					
				7					
			2.0						
SAND (f-m) silty; medium dense; dry; brown orange brown mottles									
End of borehole 2.0 m									

EXCAVATION METHOD: 150mm Diameter Machine Auger



BH 752&753

Site: The Lakes (2012) Ltd., Stage 2N, The Lakes Subdivision, Pyes Pa



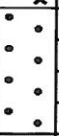

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 13.0 (752) 14.0 (753) m Moturiki

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
BH 752							50	100	150
TOPSOIL 100 mm			0.5		not found	utp			
SILT; clayey; slightly sandy; hard; dry; friable; mixed orange brown, light grey and dark brown FILL									
SAND (f-m); medium dense; dry; orange brown									
SILT; clayey; very stiff; moist; moderately plastic; orange brown becomes stiff; wet; low plasticity									
becomes slightly sandy									
End of borehole 2.0 m									
BH 753									
TOPSOIL 100 mm			0.5		not found				
SILT; clayey; slightly sandy; hard; dry; friable; mixed orange brown, light grey and dark brown FILL									
SAND (f-m) silty; medium dense; dry; light grey brown									
SILT; stiff; very moist; low plasticity; yellow brown			1.0	3					
SAND (f-m); loose; slightly moist; light grey brown									
SILT; stiff; wet; slightly cohesive; light grey			2.0			74			
SAND (f-m); loose; moist; grey brown									
End of borehole 2.0 m									

EXCAVATION METHOD: 150mm Diameter Machine Auger



BH 754&756A

Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
BH 754							50	100	150																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
TOPSOIL			0.5		not found	utp																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

EXCAVATION METHOD: 50mm Diameter Hand Auger



BH 755A&757

Site: The Lakes (2012) Ltd., Stage 2N, The Lakes Subdivision, Pyes Pa

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 13.0 (755) 14.5 (757) m Moturiki

Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)			
						50	100	150	
BH 755 A									
TOPSOIL 100 mm		0.5		not found	200+				
SILT; sandy; hard; dry; friable; light yellow brown									
SAND (f-m) silty; loose; dry light yellow brown									
becomes light brown grey		1.0	3						
			3						
			3						
			2						
SILT; sandy; stiff; wet; low plasticity; light brown grey		1.5	2						
			2						
SAND (f-m); loose; wet; light brown grey	2.0								
End of borehole 2.0 m									
BH 757									
TOPSOIL 200 mm		0.5	6	not found	utp				
SAND (f-m); medium dense; dry; light grey			11						
			7						
			8						
SILT; hard; moist; slightly cohesive; light grey		1.0	6						
SILT; hard; moist; slightly cohesive; light grey	1.5								
SILT; hard; moist; slightly cohesive; light grey	2.0								
End of borehole 2.0 m									

EXCAVATION METHOD: 150mm Diameter Machine Auger



BH 755B&756B

Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)									
BH 755B							50	100	150							
TOPSOIL 300 mm		Fill		0	not found	193										
				1												
				1												
				3												
SAND (f-m) silty; medium dense; moist; pumiceous; light brown; dark brown and light grey mottles FILL				6												
				12												
				8												
SILT; slightly sandy; very stiff; moist; slightly cohesive; light yellow				8												
becomes sandy; hard				8												
End of borehole 1.0 m				1.0					200+							
			1.5													
			2.0													
BH 756B																
TOPSOIL 200 mm		Fill		0	not found	193										
				1												
				3												
				3												
SAND (f-m) silty; medium dense; moist; pumiceous; light brown; dark brown and light grey mottles FILL				6												
				8												
				8												
SILT; slightly sandy; very stiff; moist; slightly cohesive; light yellow				5												
				5												
End of borehole 1.0 m				1.0					utp							
			1.5													
			2.0													

EXCAVATION METHOD: 50mm Diameter Hand Auger

Site: The Lakes (2012) Ltd., Stage 2N, The Lakes Subdivision, Pyes Pa

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 15.0 (758) 22.0 (761) m Moturiki

Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
						50	100	150
BH 758								
TOPSOIL 200 mm			11	not found	utp			
SAND (f-m); dense; dry; light yellow			R					
		0.5						
becomes medium dense			8					
			7					
			7					
		1.0	7					
			4					
			6					
			6					
GRAVEL (c) sandy (f-c); medium dense; slightly moist; orange brown		1.5	6					
			5					
		2.0						
End of borehole 2.0 m								
BH 761								
TOPSOIL 200 mm				not found	utp			
SILT; clayey; hard; dry; friable; orange brown								
		0.5						
SAND (f-m) silty; medium dense; dry; light brown								
			7					
			5					
		1.0	5					
			5					
			5					
SAND (f-m); dense; dry; pumiceous; light grey			8					
			9					
		1.5	8					
			8					
		2.0						
End of borehole 2.0 m								

EXCAVATION METHOD: 150mm Diameter Machine Auger

Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: N.I

[illegible]

EXCAVATION METHOD: 50mm Diameter Hand Auger



BH 762


Site: Grasshopper; The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
BH 762							50	100	150																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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EXCAVATION METHOD: 50mm Diameter Hand Auger



BH 763&764

Site: The Lakes (2012) Ltd., Stage 2N, The Lakes Subdivision, Pyes Pa

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 17.0 (763) 16.0 (764) m Moturiki

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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TOPSOIL 200 mm					not found	149																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

EXCAVATION METHOD: 150mm Diameter Machine Auger

BH	765&768
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Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)								
BH 768							50	100	150						
SAND (f) silty; moist; very dense; pumiceous; light brown light grey wet		19	0.5	19	not found										
		15		15											
		19		19											
		20		20											
		R		R											
		1.0													
End of borehole 1.0 m															
		1.5													
		2.0													
BH 765															
TOPSOIL				11	not found										
SAND (f) silty; moist; dense; light brown greenish grey very dense			9												
			11												
			10												
		0.5	10												
			R												
End of borehole 1.0 m		1.0													
		1.5													
		2.0													

EXCAVATION METHOD: 50mm Diameter Hand Auger

EXCAVATION METHOD: 150mm Diameter Machine Auger



BH 771&773

Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 8/2012

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
							50	100	150
BH 773		Fill		10	not found				
SAND (f-m) silty; moist; dense; light greyish brown dark brown mottles FILL				11					
SAND (f) silty; moist; dense; pumiceous; light grey (f-c)				8					
medium dense				7					
gravelly; saturated; loose				4					
				2					
				2					
				3					
				1.0					
				1.5					
				2.0					
End of borehole 1.0 m									
BH 771				2					
TOPSOIL				3					
SAND (f) silty; moist; dense; pumiceous; light grey				3					
becomes grey				4					
becomes dense				5					
				6					
				8					
				9					
				1.0					
				1.5					
				2.0					
End of borehole 1.0 m									

EXCAVATION METHOD: 50mm Diameter Hand Auger

BH 772&774

Site: The Lakes (2012) Ltd., Stage 2N, The Lakes Subdivision, Pyes Pa

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

RL 19.5 (772) 18.5 (774) m Moturiki

Logged By: N.I

Description of Soil		Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
							50	100	150
BH 772									
SAND (m-c) dense; dry; pumiceous; light grey rare pumice gravels	•••••			6	not found				
				6					
				11					
				R					
		0.5							
		1.0		R					
		1.5							
		2.0							
		End of borehole 2.0 m							
BH 774									
SAND (f-m); medium dense; dry; light yellow orange brown orange mottles	•••••			12	not found				
				R					
		0.5							
		1.0							
				4					
				4					
				3					
				3					
		1.5		5					
				3					
				4					
		2.0							
becomes medium dense									
becomes moist									
becomes wet									
End of borehole 2.0 m									
EXCAVATION METHOD: 150mm Diameter Machine Auger									

Site: The Lakes; Stage 2N

Sheet: 1 Of: 1

Job No. 20302

Date Excavated: 27/2/2013

Logged By: N.I

Description of Soil	Soil Symbol	Depth (m)	Scala blows/100 mm	Groundwater	Undrained Shear Strength (kPa)	Undrained Shear Strength (kPa)		
						50	100	150
BH 775								
TOPSOIL 200 mm			1					
SAND (f-m); medium dense; slightly moist; light grey orange and brown mottles FILL			4					
SAND (f-m) silty; medium dense; moist; pumiceous; light brown		0.5	12					
			7					
becomes mixed light brown and light grey			5					
			4					
			6					
			4					
			3					
		1.0	3					
			2					
SILT; sandy; stiff; moist; slightly cohesive; pumiceous; light yellow			3		92			
			1					
			2		83			
SAND (f-m) silty; loose; moist; pumiceous; light yellow		1.5	2					
			2		83			
			2					
					95			
		2.0			59			
End of borehole 2.0 m								

EXCAVATION METHOD: 50mm Diameter Hand Auger



Sheet: 1 Of: 1

Logged By: N.I

EXCAVATION METHOD: 150mm Diameter Machine Auger

Appendix 5 Coffey Geotechnical Report - Lot 1065 (2008)

9 December 2008

Attention: Mr J Kingsford
PowerCo
PO Box 10-116
Mount Maunganui

Email. jon.kingsford@powerco.co.nz

Dear Jon

**RE: Geotechnical Investigation Report for Proposed Substation
Kennedy Road, Grasshopper Farms, Tauranga**

1 INTRODUCTION AND SCOPE

Further to your instructions and in accordance with our agreed services proposal dated 15 August 2008, we have now completed our investigations into the subsurface conditions at the above site where it is proposed to establish a substation housing electrical equipment and a large transformer.

The scope of this report is specifically limited to the development of geological model for the site to enable an assessment to be made of the ground suitability for the proposed construction including foundation bearing capacity and settlement characteristics.

2 LANDFORM

Prior to recent earthworks development associated with Stage 3 of the Grasshopper Farms residential subdivision, the site was positioned over the toe of a fluvial terrace surface that dipped gently from RL12 metres (Moturiki Datum) at the eastern boundary onto a low-lying valley floor (RL7 metres) at the western boundary. The terrace deposits are typically underlain by firm to stiff in-situ volcanic ash and reworked volcanic sediments (silts and sands) while the valley floor is underlain by weak fibrous peat deposits and recent alluvium.

Earthworks have been completed, which involved the cleaning out of any peat from within the boundaries of the former lower-lying western part of the site and backfilling with engineer certified Filling. The balance of the site was stripped of Topsoil and filled with engineer certified Filling to achieve a finished ground surface elevation at approximately RL11.5 metres (Moturiki Datum). The western edge of the embankment currently sits on or just inside the lot boundary but is to be extended by Grasshopper Farms within the next few months.

3 DEVELOPMENT PROPOSAL

We understand that the site is to maintain its current level to support the construction of a proposed single level residential type building structure occupying the majority of the building footprint and that the footprint will be confirmed pending receipt of this report.

The building is to house a large transformer weighing 35,300kg sitting on a reinforced concrete foundation measuring 2.5 x 4.5 metres in area. No other significant heavy structures or unusual loading conditions are proposed to our knowledge.

4 SITE INVESTIGATIONS

The subsurface conditions within the site were investigated by drilling a series of 5 hand auger boreholes in conjunction with in-situ shear vane tests to depths of up to 5 metres below the current ground surface. These tests were followed by putting down a series of 8 Cone Penetrometer Tests (CPT's) using a Geoprobe rig supplied by Perry Drilling Limited.

The test locations are presented on the appended site plan and a copy of soil test results together with detailed descriptions and depths of strata encountered are appended.

5 SUBSURFACE MODEL

The geological conditions below the site, as encountered at our borehole and CPT locations and giving consideration to the local geological setting are presented on the appended long section and summarised as follows:

- Filling was encountered at all borehole locations and comprised clean compacted ash and pumice that returned vane shear strengths (corrected) exceeding 150 kPa and thereby meeting the project earthfill specification. CPT cone resistances within the Filling ranged from $q_c = 1$ to 16 MPa and averaging 2 to 4 MPa.
- Four of the boreholes terminated in dense Fill materials at depths of between 1.3 and 2.5 metres. Fill depths across the site have therefore been determined from the remaining two boreholes (borehole 05 and 06) and CPT data where they ranged from 0.5 to 3.5 metres (average 2.3 metres). The Fill depth generally increased from east to west.
- As observed in boreholes 05 and 06, the fill was underlain by variable clayey silts (reworked volcanics) with thin organic lenses, which were well consolidated returning vane shear strengths (corrected) of 150 to 180 kPa. CPT data shows that these deposits extend to depths of 6 to 10 metres (average 8 metres) and returned cone resistances of $q_c = 1$ to 2 MPa.
- These were underlain by medium dense to dense sands with cone resistances of 10 to 20 MPa but with inter-bedded 1 to 2 metre thick silt lenses ($q_c = 1$ to 2 MPa) to depths of 20 metres.
- Standing groundwater levels were recorded in the open CPT holes on completion at depths of between 3.6 and 4.7 metres below the current ground surface.

6 EVALUATION AND RECOMMENDATIONS

6.1 Liquefaction

Liquefaction is an occurrence in predominantly loose saturated sandy and low plasticity silty soils that are subject to intense cyclic (earthquake) loading involving the reversal of shear stresses. The process involves the transfer of effective stresses to the pore water resulting in a total loss of strength, re-compaction of the soil grains to a more dense state and subsequent strain or settlement as excess pore water pressures are released.

At this site, the weaker reworked volcanics that were encountered below the water table were typically of a cohesive nature such that they would have a low potential to exhibit liquefaction based on grain size criteria. The sand layers that are typically susceptible to the liquefaction process were predominantly medium dense to dense such that they would resist the typical cyclic stress ratios produced during the design 500 year return period earthquake event. Any potentially liquefiable loose sand layers are generally of limited thickness (less than 1 metre).

Based on this and the fact that the site also contains a dense / very stiff crust of unsaturated Filling, any surf manifestations associated with liquefaction of any deeper thin loose soil layers should be minimal and should not warrant further design considerations.

6.2 Fill Induced Settlements

The placement of a compacted fill raft across the site has increased the loading conditions on the underlying natural soils such that they could have exhibited some settlement. The most settlement prone materials were however over-excavated from below the recently constructed fill embankment to expose a relatively stiff subgrade.

Preliminary fill induced settlement predictions were completed based on available CPT information by calculating stress increases below a superimposed 3.5 metre deep embankment load and adopting correlations with soil modulus following the method of Schmertmann.

Settlements predicted by this method ranged from 96 to 209mm, the average value being approximately 150mm.

The embankment has been in place for several months and it is our experience with the bedded fluvial volcanic soils that dissipation of excess pore water pressures occurs rapidly such that t_{90} or the time at which the majority of the settlement has occurred is typically no more than 6 months. We also note that a temporary 2 to 3 metre high stockpile of soil was recently placed across the western part of the site for storage purposes, which would have also had a pre-load effect on the underlying subgrade.

The potential for ongoing fill induced settlements affecting the proposed building construction are therefore considered negligible.

6.3 Foundation Settlement

The proposed 35.3 tonne transformer is to sit on an 11.25 m² pad foundation producing a foundation load of 35.3 kPa. The potential for settlement of this foundation was assessed following the CPT based soil modulus correlation method described above with results summarised as follows:

Estimated Foundation Settlements due to a Net Allowable Foundation Load of 35.3 kPa	
CPT #	Settlement (mm)
01	17
02	22
03	14
04	19
05	14
06	33
07	29
08	43

Results show that where fill depths exceed 2 metres, predicted settlements range from 14 to 22mm, which are relatively low and expected to be within the structural designers tolerances. Greater settlements of up to 43mm are predicted across the eastern part of the site where fill depths are reduced and therefore positioning of the heavy transformer away from these areas would be advisable to minimise any foundation settlements.

We understand that the remaining building structure will be supported on shallow strip and pad foundations similar to conventional residential buildings. Stress increases associated with foundation loads on these footings should therefore be restricted to the dense / very stiff fill crust such that differential settlements should be negligible.

6.4 Foundation Bearing Capacity

Subject to verification of the structural designers settlement tolerances and assuming that the proposed transformer will be positioned over the deeper stiff crust of engineer certified Filling within the central and western parts of the site, these soils should provide a geotechnical ultimate bearing capacity of 150 kPa for this proposed footing dimension (2.5 x 4.5 metres).

Elsewhere, a geotechnical ultimate bearing capacity of 300 kPa should be available for shallow strip and pad foundations containing a minimum plan dimension of no greater than 500mm.

6.5 Strength Reduction Factor

As required by Section B1/VM1 of the NZ Building Code Handbook, a strength reduction factor of 0.5 or 0.8 must be applied to any recommended ultimate soil capacity in conjunction with its use in factored design load cases for static and earthquake overload conditions respectively.

7 LIMITATION

This report has been prepared solely for the use of our client, Maunsell Limited, their professional advisers and the relevant territorial authorities in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future users of this information should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from boreholes and CPT's, which by their nature only provide information about a relatively small volume of subsoils, 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.

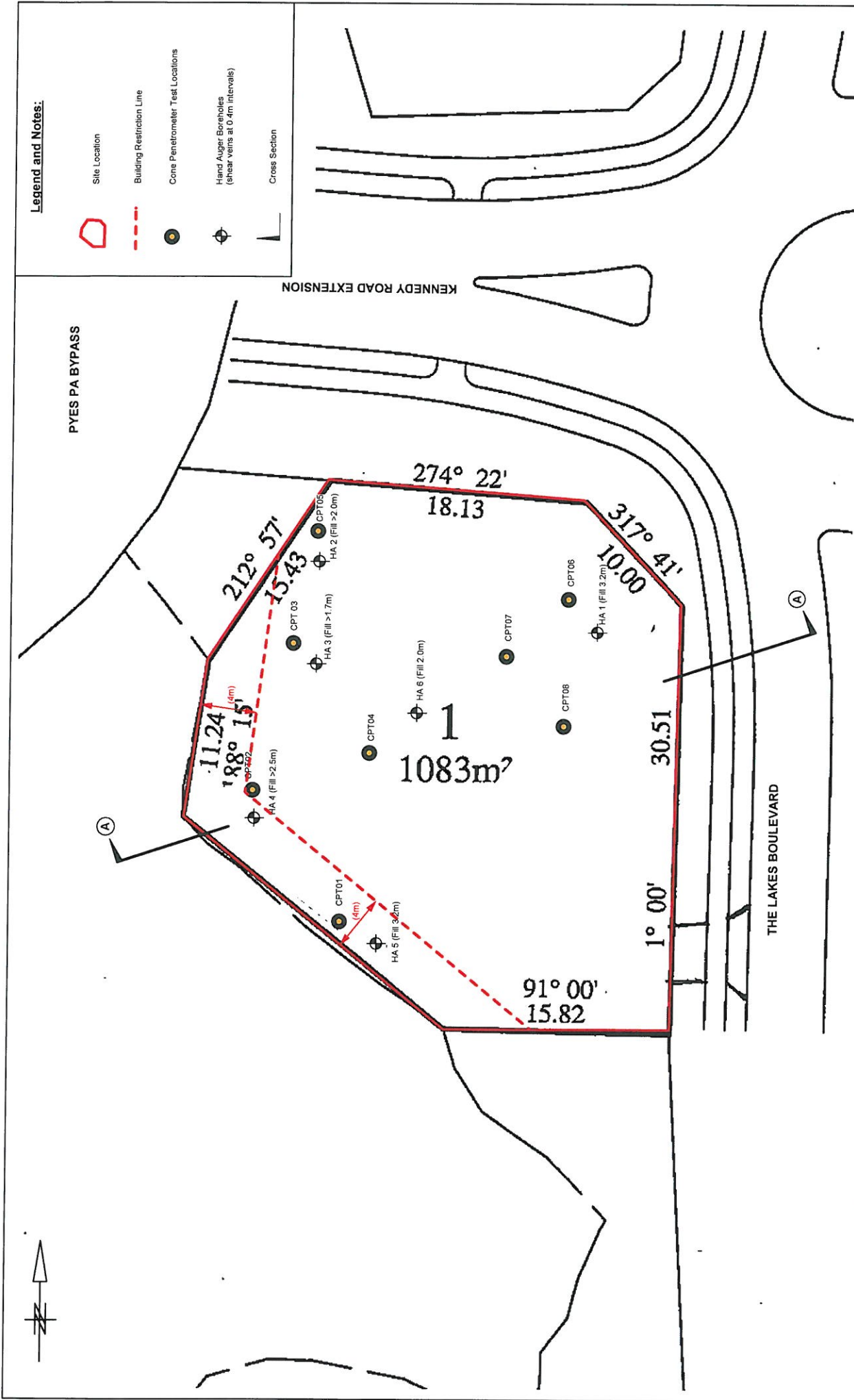
If variations in the subsoils occur from those described or assumed to exist then the matter should be referred back to us immediately.

For and on behalf of Coffey Geotechnics (NZ) Limited



DJ MORTON

Principal Geotechnical Engineer, MIPENZ (Geotechnical), CPEng



revision		description		drawn	approved	date

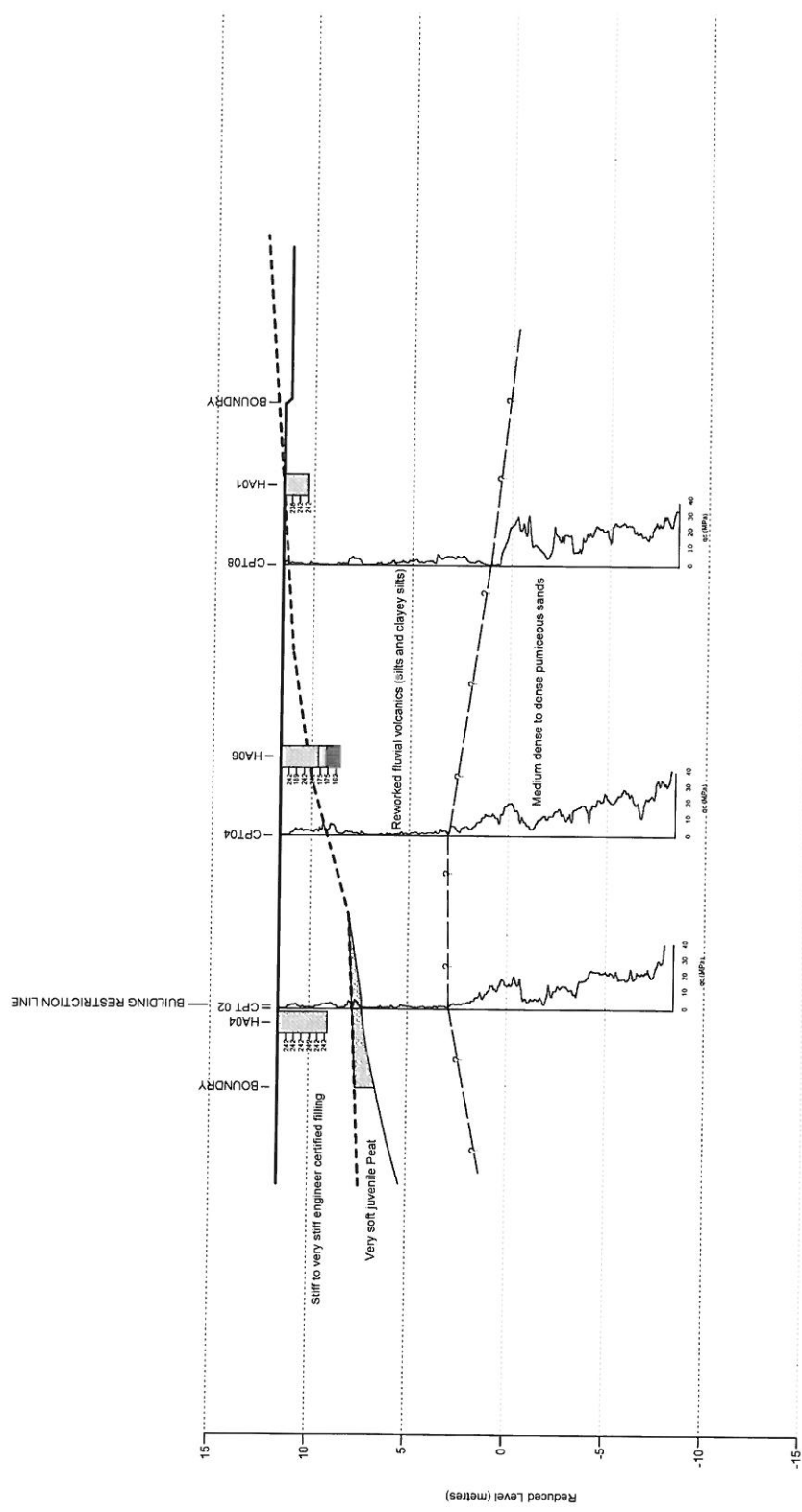
client:		POWERCO	
project:		KENNEDY ROAD SUBSTATION	
title:		TEST LOCATION PLAN	
project no:		GENZTAUC14078	
figure no:		02	

coffey geotechnics
SPECIALISTS MANAGING
THE EARTH

drawn	MW
approved	Δ/M
date	01/12/08
scale	1:250
original size	A3

Horizontal Scale (metres)

Vertical Scale (metres)



revision		description		drawn	approved	date	<div><div><div>05000</div><div>10000</div><div>15000</div></div><div>Horizontal Scale (metres)</div><div><div>0</div><div>5.0</div><div>10.0</div><div>15.0</div></div><div>Vertical Scale (metres)</div></div>	MW		client:	
								drawn	approved	project:	POWERCO
								date	ΔT/M	project:	KENNEDY ROAD SUBSTATION
								scale	03/12/08	title:	CROSS SECTION A
								original size	1:250	project no:	GENZTAUC14078
								A3		figure no:	03



Engineering Log - Hand Auger

Client: **Power Co**
Principal:
Project: **Kennedy Road Substation**
Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA1**
Sheet 1 of 1
Project No: **14078**
Date started: **29.10.2008**
Date completed: **29.10.2008**
Logged by: **MA**
Checked by: **MW**

Vane No: 963/iiiivii		Easting: m		Slope: -90°		R.L. Surface: m	
Hole diameter: 50 mm		Northing: m		Bearing:		Datum:	
drilling information				material substance			
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.
Fill	Ground water not observed			0.5		ML	Sandy SILT; light brown/ orange, slightly plastic, hard with minor angular gravel and firm pumiceous sand.
				1.0			
				1.5			Borehole HA1 terminated at 1.2 metres.
				2.0			
				2.5			
				3.0			
classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005				vane shear (kPa) ● remoulded X peak >>X peak greater than 200kPa UTP unable to penetrate		water ▽ 10/1/98 water level on date shown ▶ water inflow ◀ water outflow	
				moisture D dry M moist W wet S saturated		consistency/ density index VS very soft S soft F firm St stiff VSt very stiff H hard	
				VL very loose L loose MD medium dense D dense VD very dense			

Engineering Log - Hand Auger

Client: **Power Co**
Principal:
Project: **Kennedy Road Substation**
Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA2**
Sheet 1 of 1
Project No: **14078**
Date started: **29.10.2008**
Date completed: **29.10.2008**
Logged by: **MA**
Checked by: **MW**

Vane No: 963/iiivii Easting: m Slope: -90° R.L. Surface: m
Hole diameter: 50 mm Northing: m Bearing: Datum:

drilling information				material substance							
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.	moisture condition	consistency/ density index	vane shear (remoulded /peak) kPa	structure and additional observations
Fill	Ground water not observed			0.5		ML	Sandy SILT; Light brown/ orange, slightly plastic with minor angular gravel and pumiceous firm sand.	D			
				1.0		SM	Pumiceous SAND; light brown/ orange with fine gravel and inclusions of orange brown silt.	M			
				1.5							
				2.0							
				2.5							
				3.0							
							Borehole HA2 terminated at 2 metres.				

classification symbols and
soil description
based on Field Description of Soil
and Rock, New Zealand
Geotechnical Society Inc 2005

vane shear (kPa)
● remoulded
X peak
>>X peak greater than 200kPa
UTP unable to penetrate

water
▽ 10/1/98 water level
▽ on date shown
▽ water inflow
▽ water outflow

moisture
D dry
M moist
W wet
S saturated

consistency/ density index
VS very soft VL very loose
S soft L loose
F firm MD medium dense
St stiff D dense
VSt very stiff VD very dense
H hard

Engineering Log - Hand Auger

Client: **Power Co**

Principal:

Project: **Kennedy Road Substation**

Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA3**

Sheet 1 of 1
Project No: **14078**

Date started: **25.11.2008**

Date completed: **25.11.2008**

Logged by: **MA**

Checked by: **MW**

Vane No: 963/iiivii		Easting: m		Slope: -90°		R.L. Surface: m					
Hole diameter: 50 mm		Northing: m		Bearing:		Datum:					
drilling information				material substance							
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.	moisture condition	consistency/ density index	vane shear (remoulded peak) kPa	structure and additional observations
Fill	Ground water not observed			0.5			SILT; brown, low plasticity.	M		>>X	
							Pumiceous SAND; light grey.				
				1.0			SILT; brown, low plasticity.			>>X	
							Fine to medium grained pumiceous SAND; white.			>>X	
				1.5			SILT; brown, low plasticity.			>>X	
				2.0			Borehole HA3 terminated at 1.7 metres.				Hard surface encountered, unable to auger.
				2.5							
				3.0							

classification symbols and soil description
based on Field Description of Soil and Rock, New Zealand
Geotechnical Society Inc 2005

vane shear (kPa)
● remoulded
X peak
>>X peak greater than 200kPa
UTP unable to penetrate

water
▽ 10/1/98 water level on date shown
▶ water inflow
◀ water outflow

moisture
D dry
M moist
W wet
S saturated

consistency/ density index

VS very soft	VL very loose
S soft	L loose
F firm	MD medium dense
St stiff	D dense
VSt very stiff	VD very dense
H hard	

Engineering Log - Hand Auger

Client: **Power Co**
Principal:
Project: **Kennedy Road Substation**
Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA4**
Sheet 1 of 1
Project No: **14078**
Date started: **25.11.2008**
Date completed: **25.11.2008**
Logged by: **MA**
Checked by: **MW**

Vane No: 963/iiivii		Easting: m		Slope: -90°		R.L. Surface: m						
Hole diameter: 50 mm		Northing: m		Bearing:		Datum:						
drilling information				material substance								
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.	moisture condition	consistency/ density index	vane shear (remoulded /peak) kPa	structure and additional observations	
Fill	Ground water not observed			0.5			SILT; brown.	M				
				1.0			Fine to medium grained SAND; grey.			>>X		
				1.5			SILT; brown.			>>X		
				2.0			Fine to medium grained SAND; grey.			>>X		
				2.5			SILT; brown.			>>X		
				3.0			Medium grained pumiceous SAND; white.			>>X		
											Borehole HA4 terminated at 2.5 metres.	Hard surface encountered, unable to auger.
classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005				vane shear (kPa) ● remoulded X peak >>X peak greater than 200kPa UTP unable to penetrate		water ▽ 10/1/98 water level on date shown ▴ water inflow ▾ water outflow		moisture D dry M moist W wet S saturated		consistency/ density index VS very soft S soft F firm St stiff VSt very stiff H hard VL very loose L loose MD medium dense D dense VD very dense		

Engineering Log - Hand Auger

Client: **Power Co**

Principal:

Project: **Kennedy Road Substation**

Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA5**

Sheet 1 of 1
Project No: **14078**

Date started: **29.10.2008**

Date completed: **29.10.2008**

Logged by: **MA**

Checked by: **MW**

Vane No: 963/iiivii		Easting: m		Slope: -90°		R.L. Surface: m	
Hole diameter: 50 mm		Northing: m		Bearing:		Datum:	
drilling information				material substance			
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.
Fill				1		ML	Sandy SILT; light brown/ orange, slightly plastic with minor angular gravel and pumiceous firm sand.
				2		SM	Pumiceous fine to coarse SAND; light brown/ pale orange, fine to medium gravel with orange brown silt inclusions.
				3			Becomes more silty.
Natural				4		ML	Firm to medium sandy SILT; grey/ light brown speckled black and dark brown, cream streaked, lenses of organic material, very stiff.
				5		ML	SILT; light grey/ light brown with black/ brown streaks, very stiff.
				6		ML	SILT; white with orange streaks, non plastic, very stiff.
				Borehole HA5 terminated at 5 metres.			
classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005				vane shear (kPa) ● remoulded X peak XX peak greater than 200kPa UTP unable to penetrate		water ▽ 10/1/98 water level on date shown ▶ water inflow ◀ water outflow	
moisture D dry M moist W wet S saturated		consistency/ density index VS very soft S soft F firm St stiff VSt very stiff H hard		VL very loose L loose MD medium dense D dense VD very dense			

Engineering Log - Hand Auger

Client: **Power Co**

Principal:

Project: **Kennedy Road Substation**

Hand Auger Location: **Refer to site plan**

Hand Auger No. **HA6**

Sheet 1 of 1

Project No: **14078**

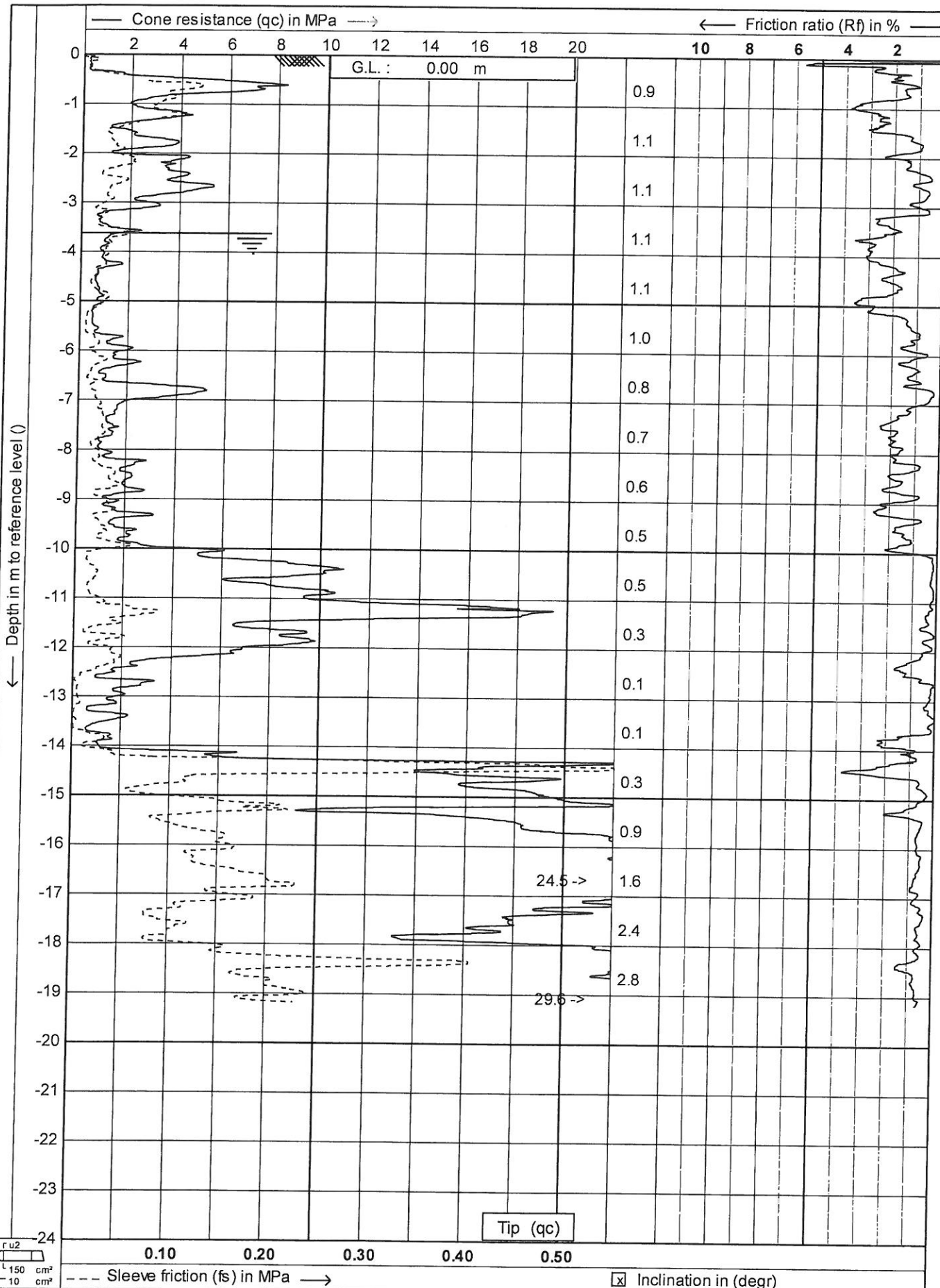
Date started: **23.10.2008**

Date completed: **23.10.2008**

Logged by: **MA**

Checked by: **MW**

Vane No: 963/iiivii		Easting: m		Slope: -90°		R.L. Surface: m						
Hole diameter: 50 mm		Northing: m		Bearing:		Datum:						
drilling information				material substance								
stratigraphy	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material Soil type; colour, structure. Grading; bedding; plasticity, sensitivity. Secondary and minor components, additional information.	moisture condition	consistency/ density index	vane shear (remoulded peak) kPa	structure and additional observations	
Fill	Ground water not observed			0.5		ML	Sandy SILT; light/ brown orange, slightly plastic with minor angular gravel and pumiceous firm sand.	M				
				1.0								
Natural				1.5								
				2.0		ML	SILT, grey brown, slightly plastic, very stiff.					
				2.5		MH	Clayey SILT; grey/ brown and pale orange/ brown, moderately plastic, stiff to very stiff.					
				3.0								
				3.5			Borehole HA6 terminated at 3 metres.					
				4.0								
classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005				vane shear (kPa) ● remoulded X peak XX peak greater than 200kPa UTP unable to penetrate		water ▽ 10/1/98 water level on date shown ▶ water inflow ◀ water outflow		moisture D dry M moist W wet S saturated		consistency/ density index VS very soft VL very loose S soft L loose F firm MD medium dense St stiff D dense VSt very stiff VD very dense H hard		



Test according A.S.T.M. Standard D 5778-95

Project : **Kennedy Road - Powerco Substation**

Location: **Tauriko Lakes - Tauriko**

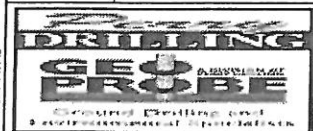
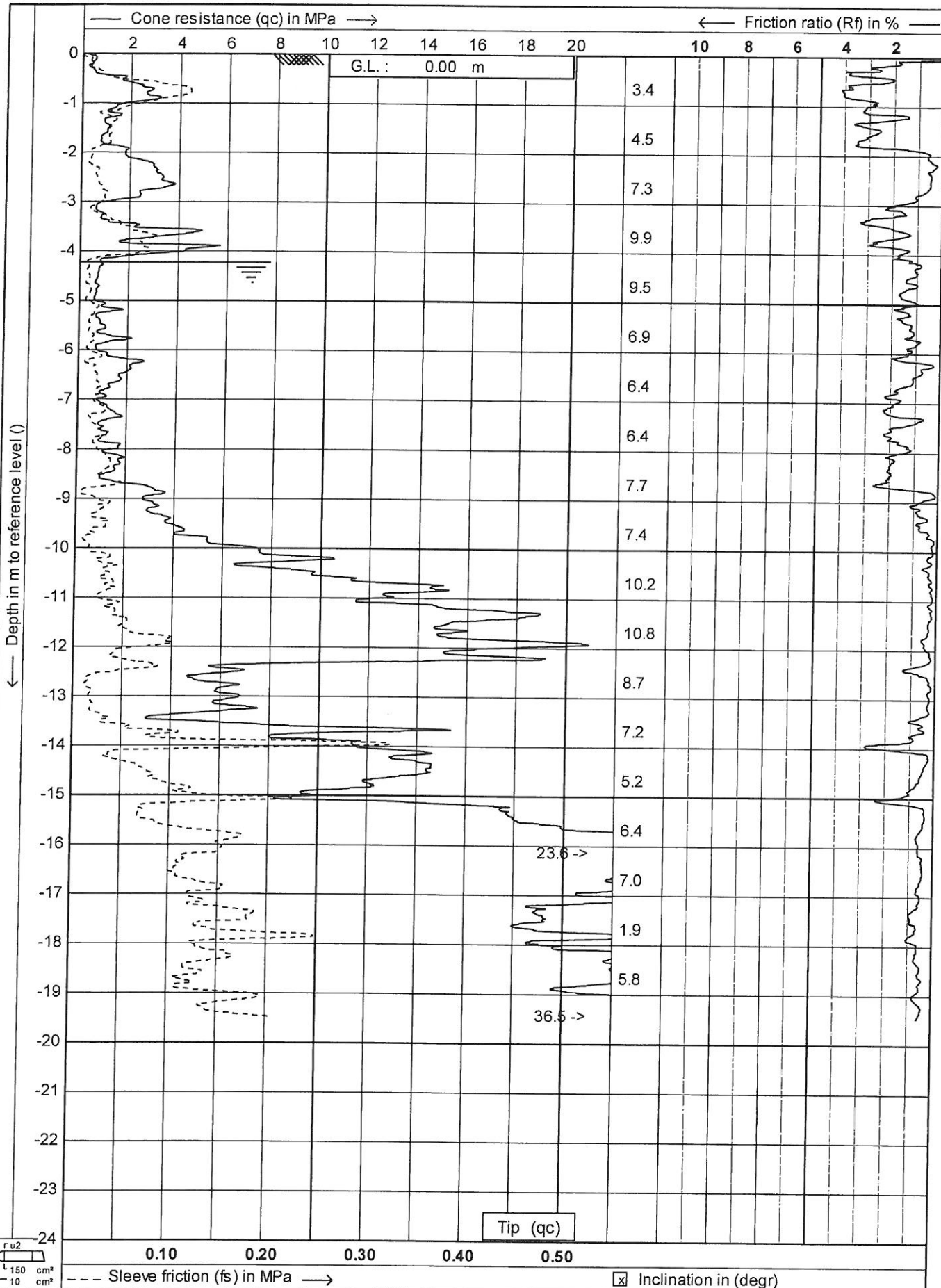
Date : **24-9-2008**

Cone no. : **C10CFIIP.E60**

Project no. : **02CGL11**

CPT no. : **01**

1/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

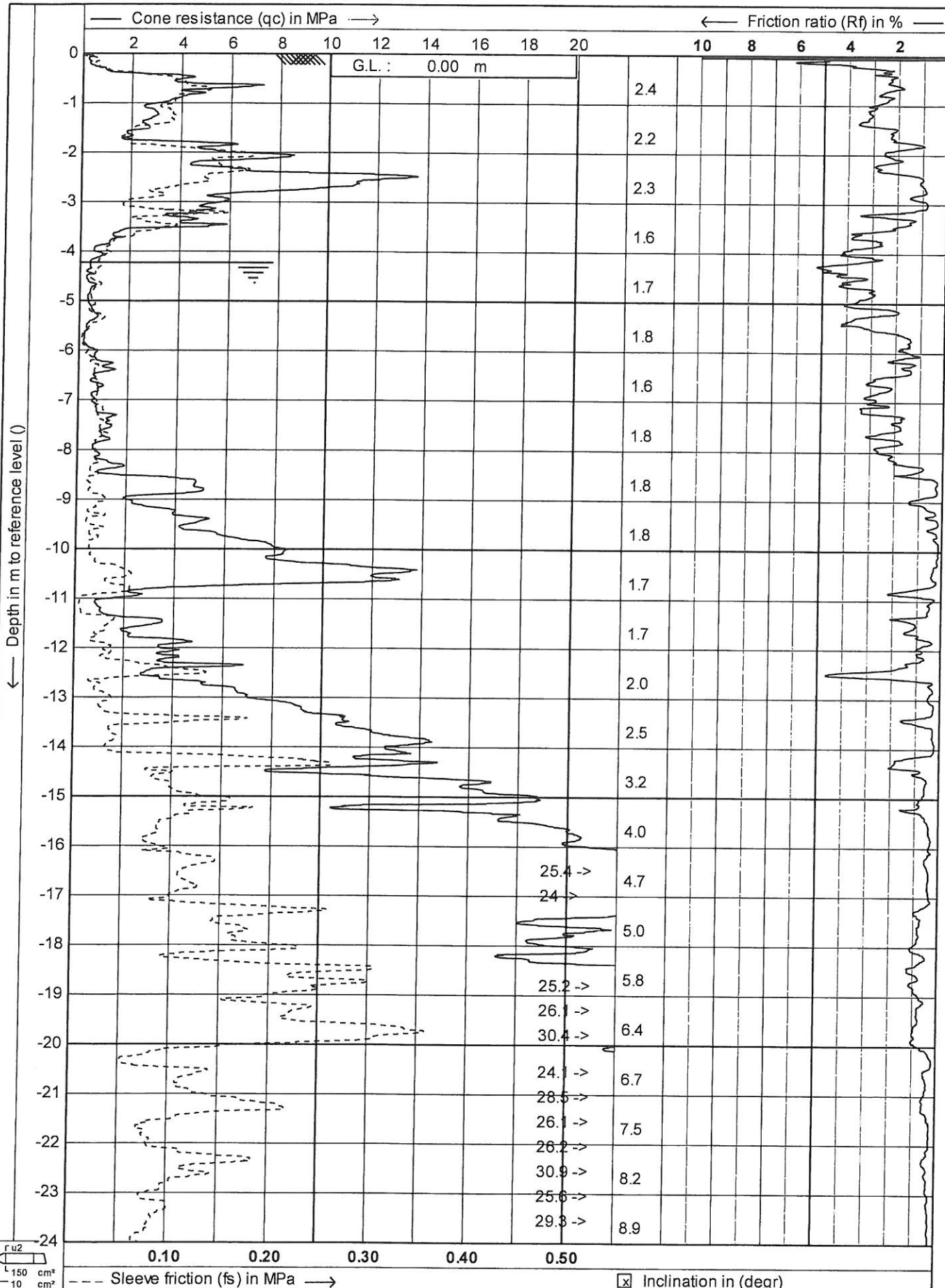
Date : 24-9-2008

Cone no. : C10CFIP.E60

Project no. : 02CGL11

CPT no. : 02a

1/14



Test according A.S.T.M. Standard D 5778-95

Project : **Kennedy Road - Powerco Substation**

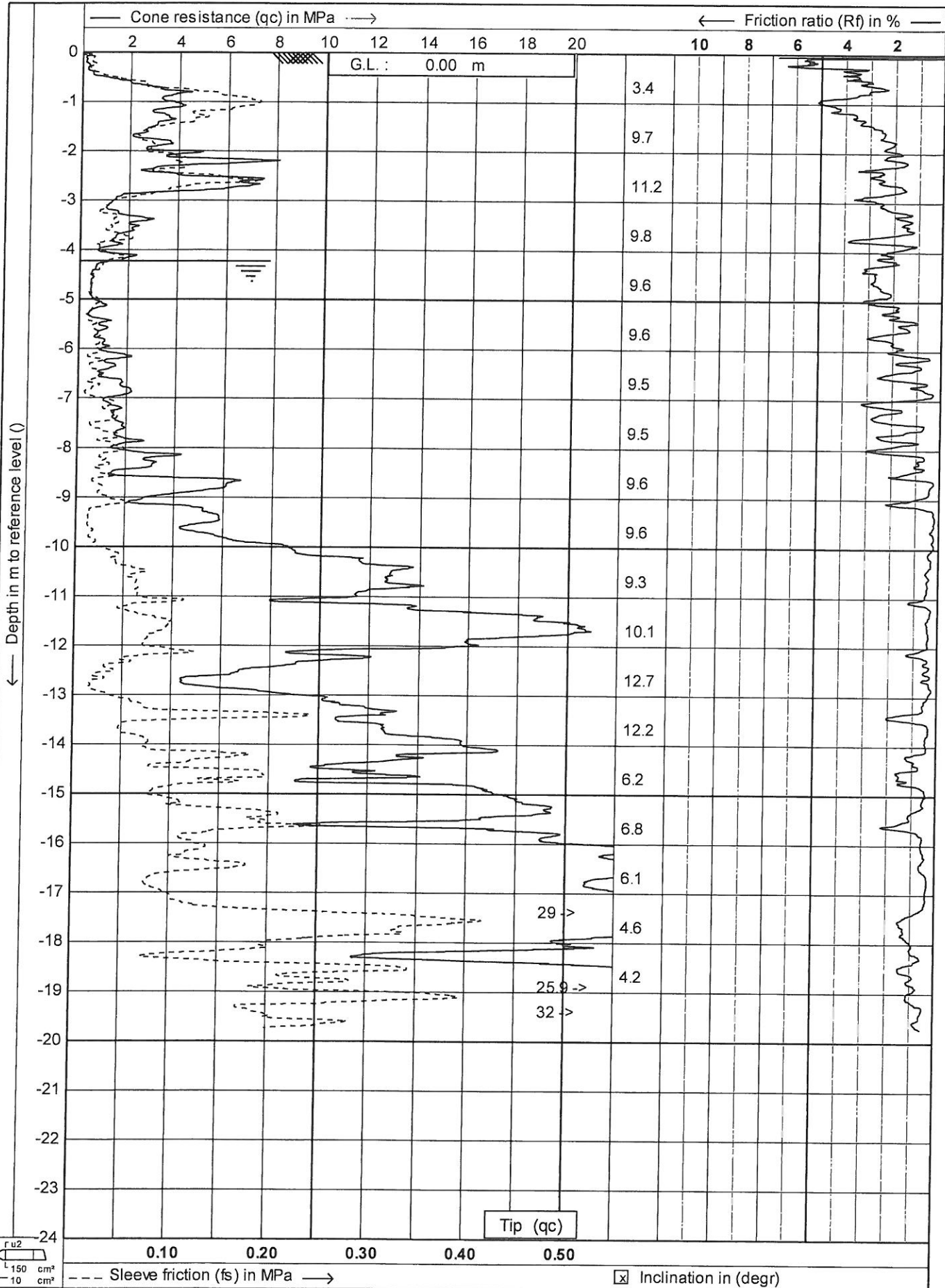
Location: **Tauriko Lakes - Tauriko**

Date : **24-9-2008**

Cone no. : **C10CFIIP.E60**

Project no. : **02CGL11**

CPT no. : **03** 1/28



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

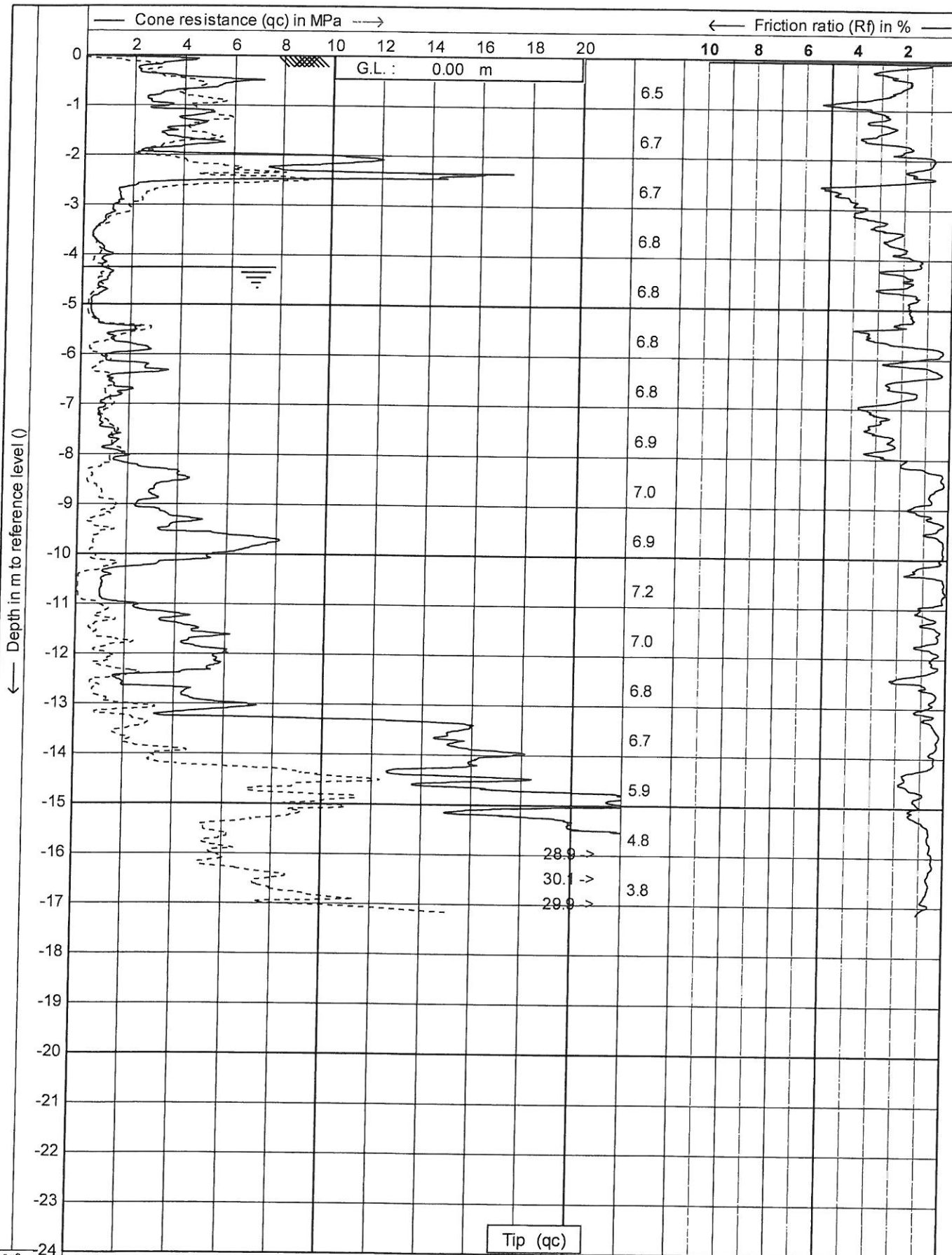
Date : 25-9-2008

Cone no. : C10CFIIP.E60

Project no. : 02CGL11

CPT no. : 04

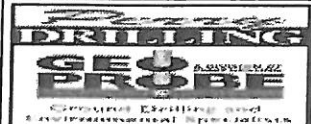
1/14



150 cm²
10 cm²

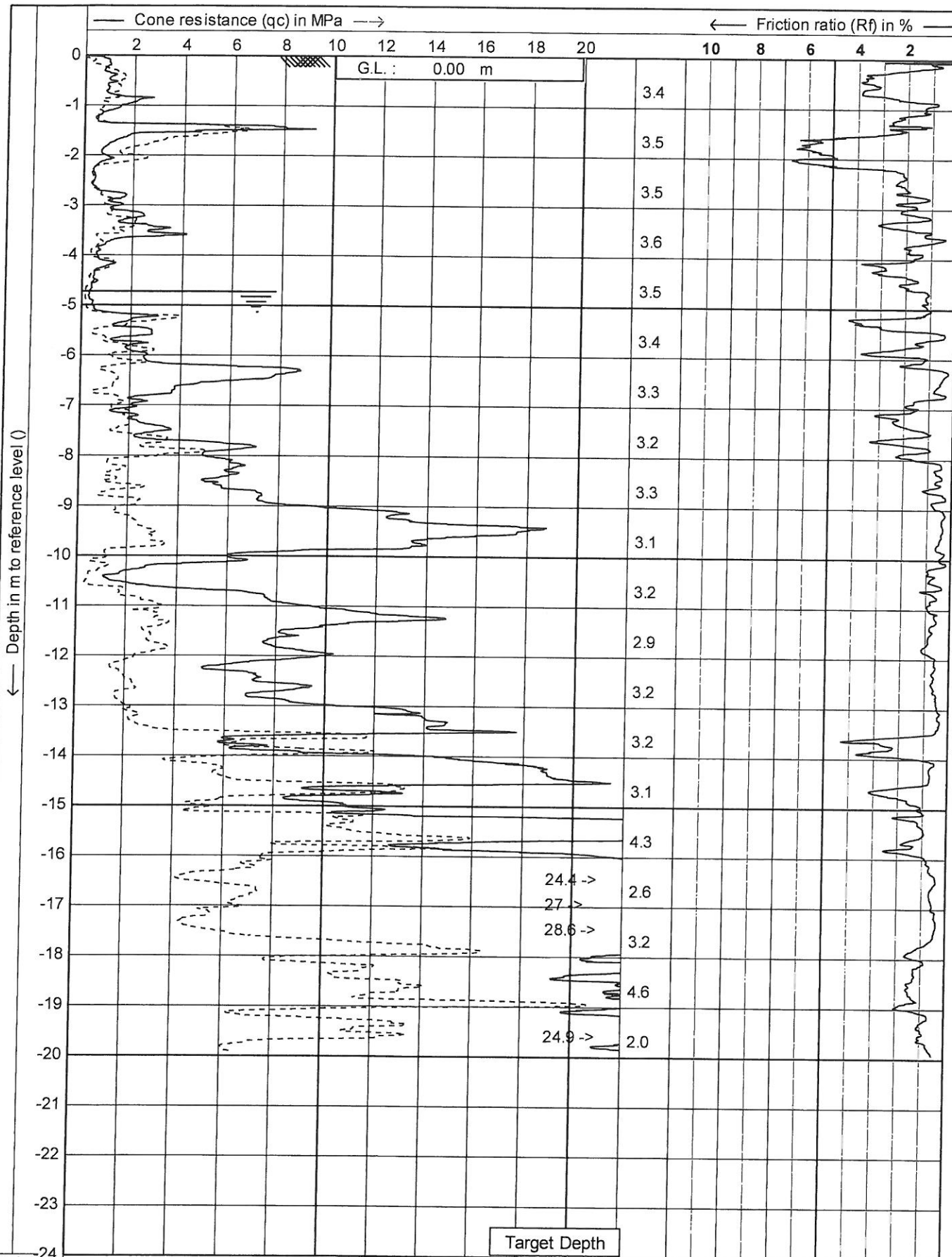
— Sleeve friction (fs) in MPa —→

☒ Inclination in (degr)

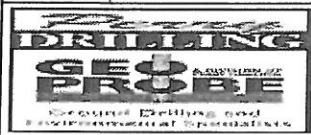
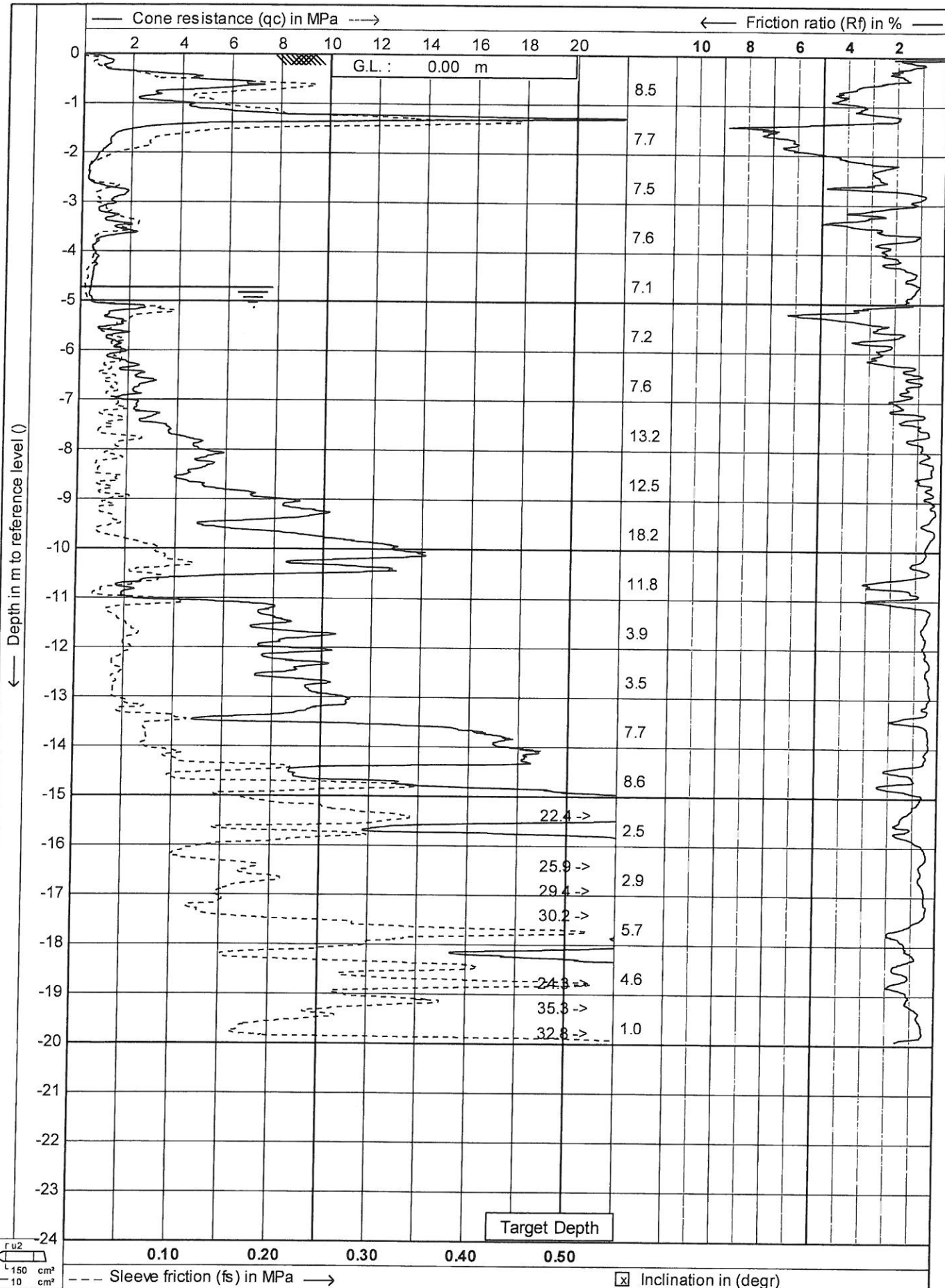


Test according A.S.T.M. Standard D 5778-95
 Project : Kennedy Road - Powerco Substation
 Location: Tauriko Lakes - Tauriko

Date : 25-9-2008
 Cone no. : C10CFIP.E60
 Project no. : 02CGL11
 CPT no. : 05



Test according A.S.T.M. Standard D 5778-95		Date : 25-9-2008
Project : Kennedy Road - Powerco Substation		Cone no. : C10CFIIP.E60
Location: Tauriko Lakes - Tauriko		Project no. : 02CGL11
		CPT no. : 06
		1/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

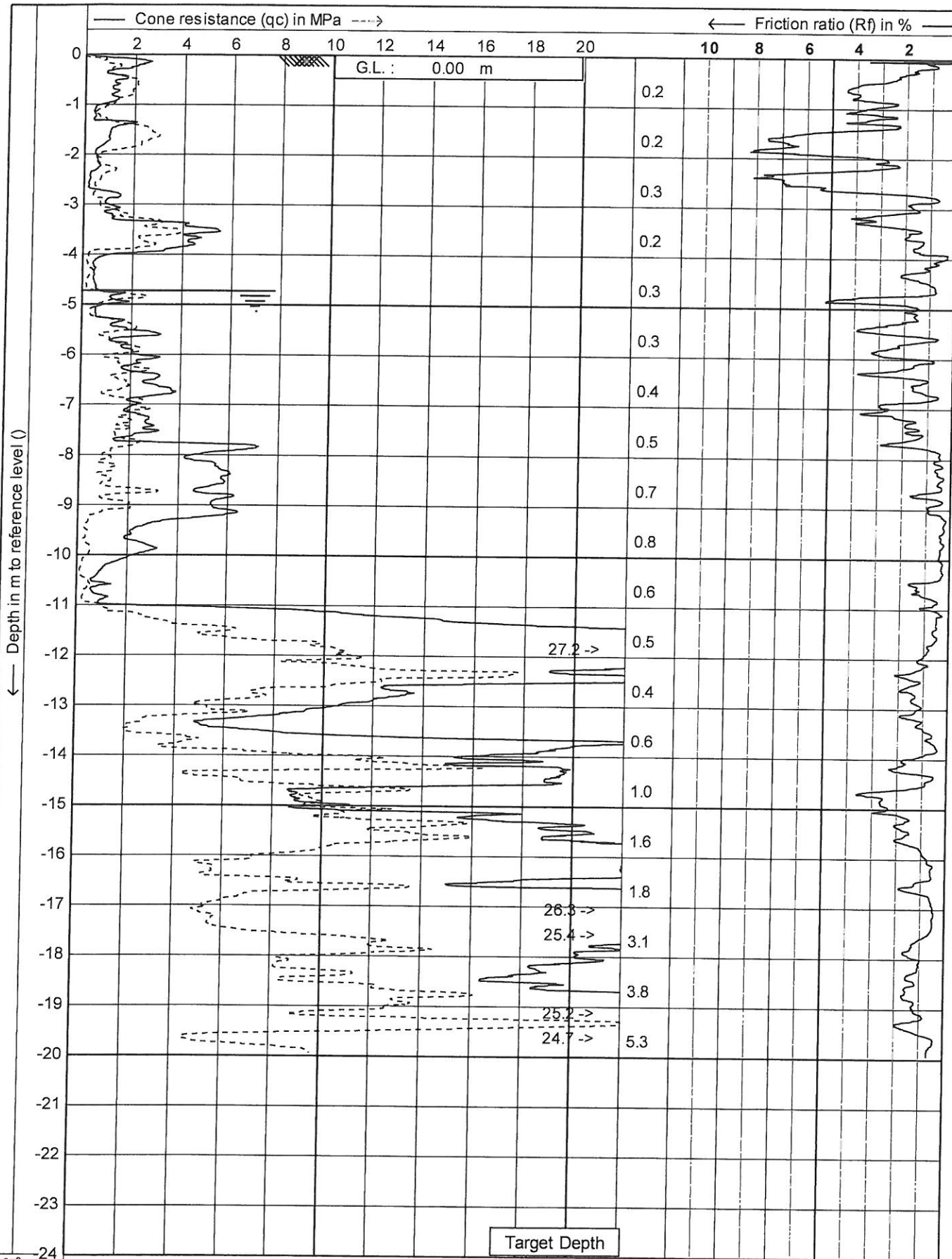
Location: Tauriko Lakes - Tauriko

Date : 25-9-2008

Cone no. : C10CFIP.E60

Project no. : 02CGL11

CPT no. : 07



150 cm²
10 cm²

--- Sleeve friction (fs) in MPa →

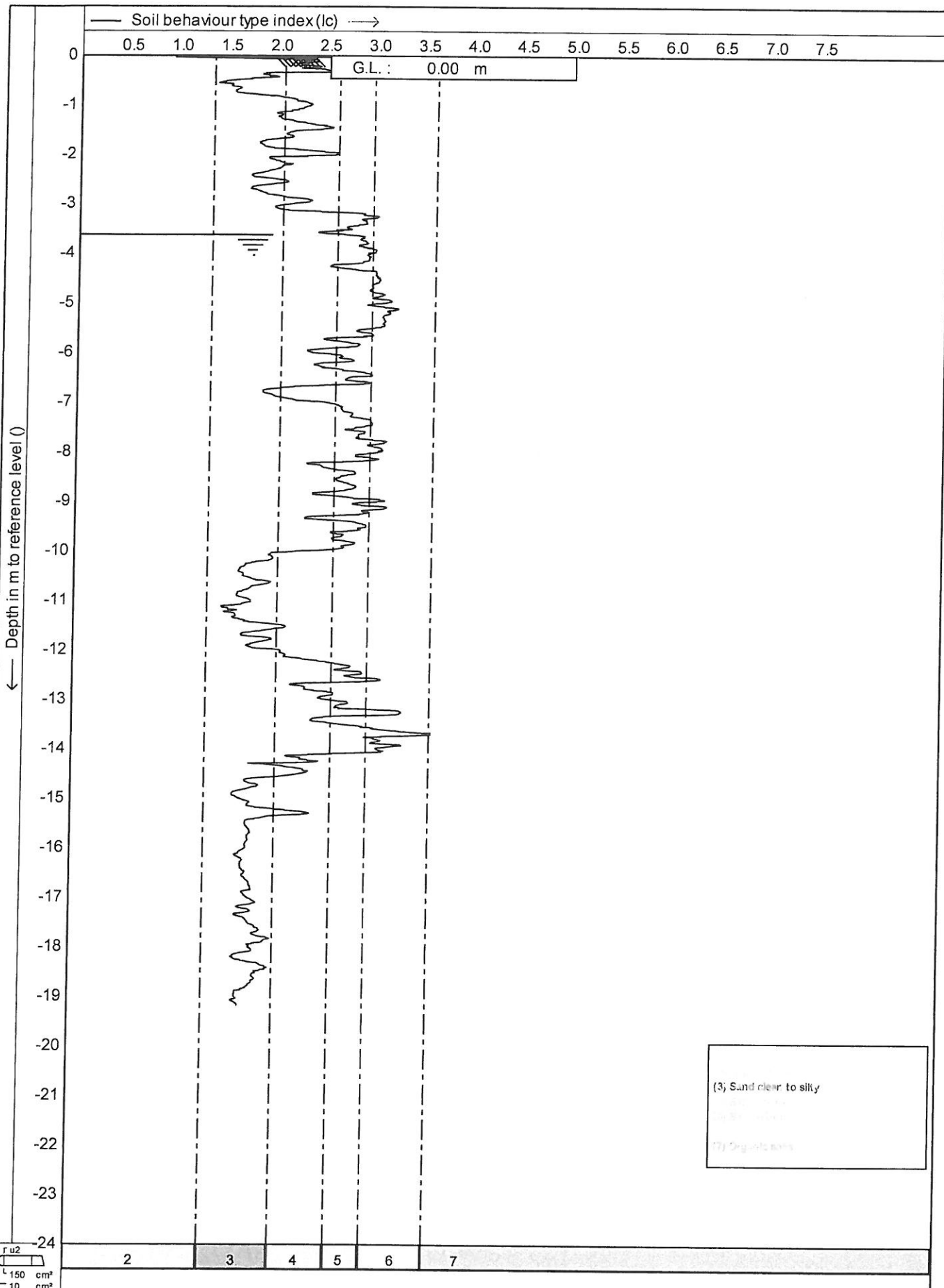
☒ Inclination in (degr)



Test according A.S.T.M. Standard D 5778-95
 Project : Kennedy Road - Powerco Substation
 Location: Tauriko Lakes - Tauriko

Date : 25-9-2008
 Cone no. : C10CFIIP.E60
 Project no. : 02CGL11
 CPT no. : 08

1/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

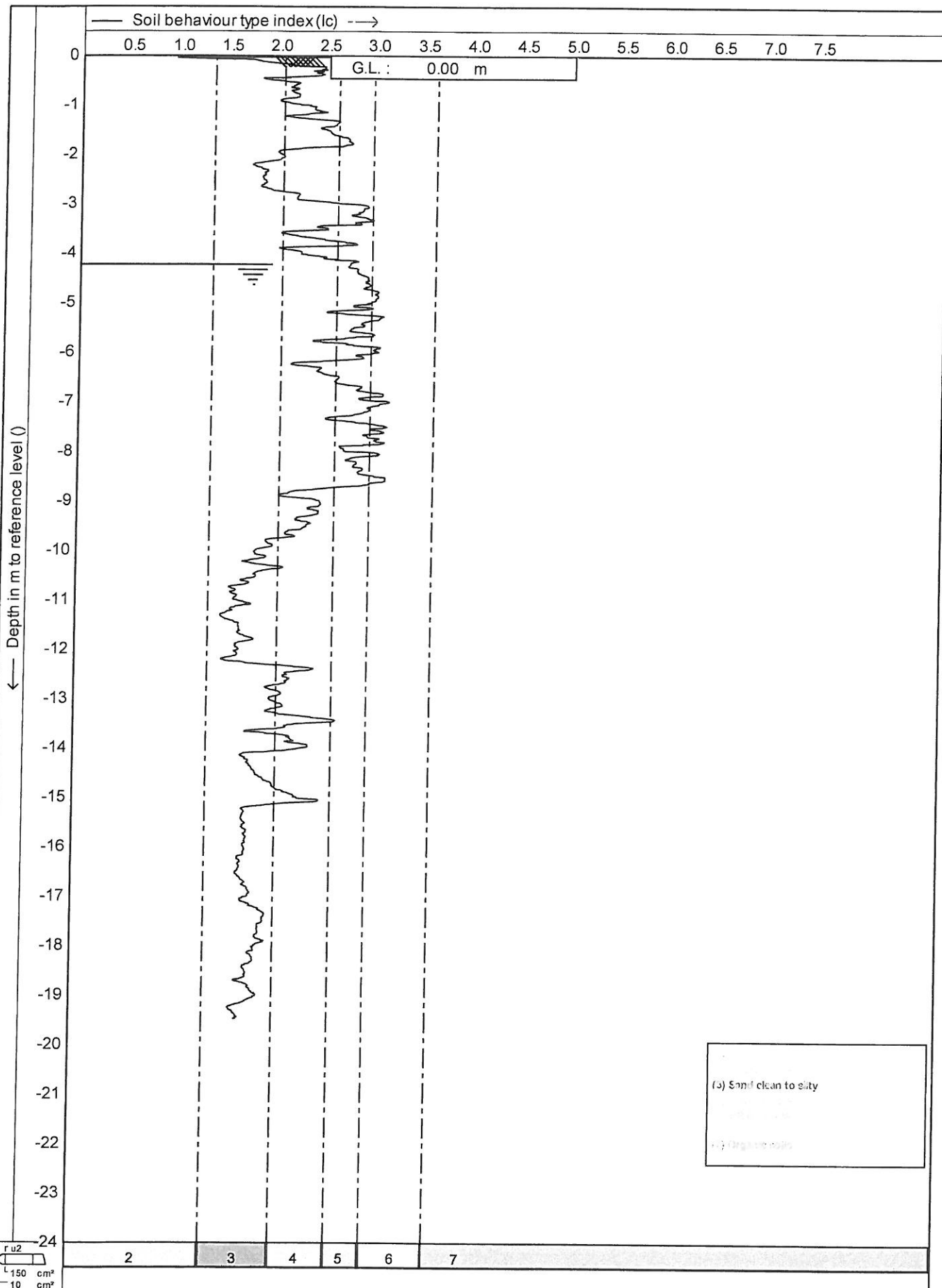
Date : 24-9-2008

Cone no. : C10CFIP.E60

Project no. : 02CGL11

CPT no. : 01

9/14



(a) Sand clean to silty

(b) Silty sand

Test according A.S.T.M. Standard D 5778-95

Date : 24-9-2008

Project : Kennedy Road - Powerco Substation

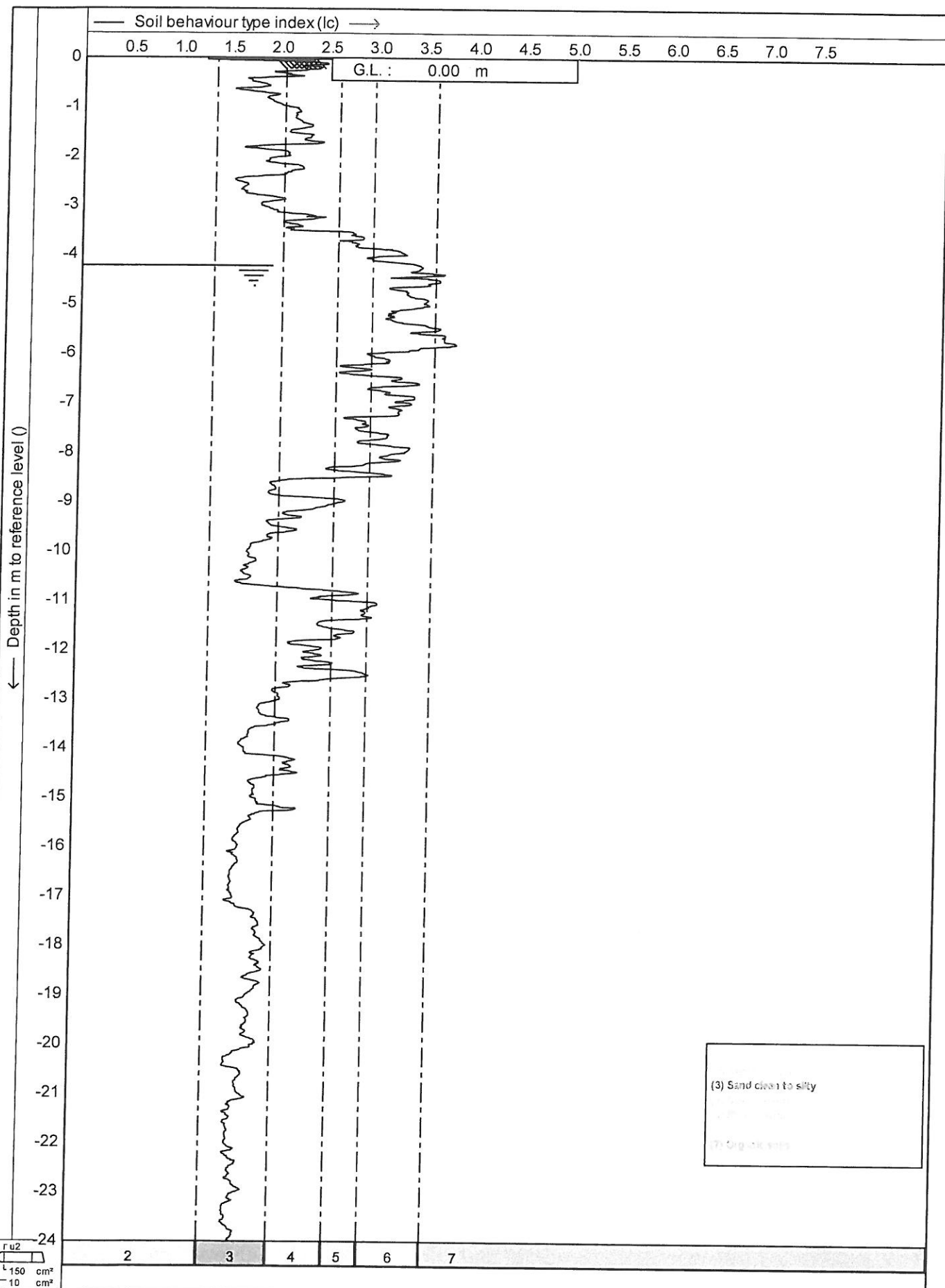
Cone no. : C10CFIIP.E60

Location: Tauriko Lakes - Tauriko

Project no. : 02CGL11

CPT no. : 02a

9/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

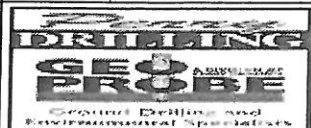
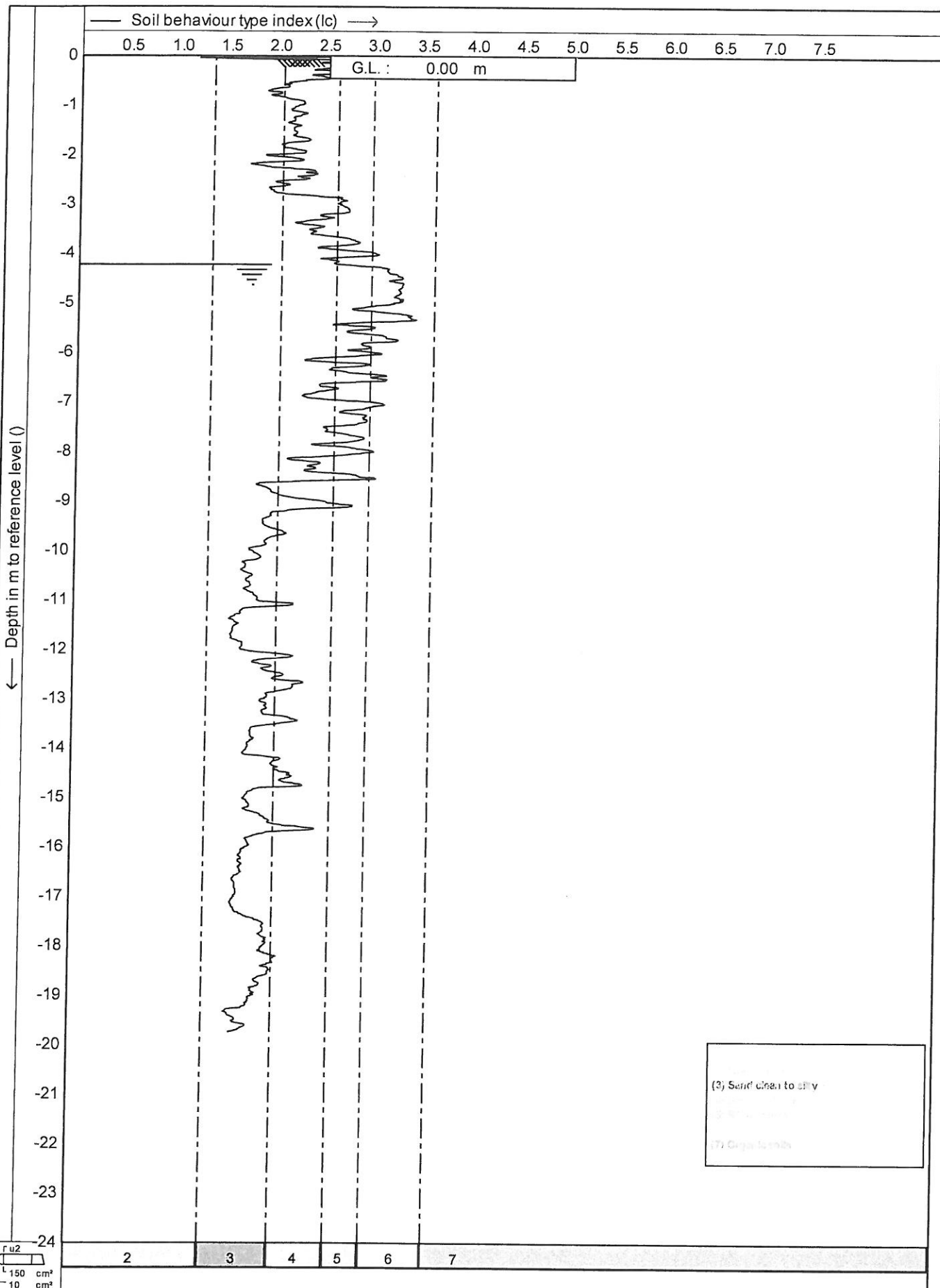
Date : 24-9-2008

Cone no. : C10CFIIP.E60

Project no. : 02CGL11

CPT no. : 03

17/28



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

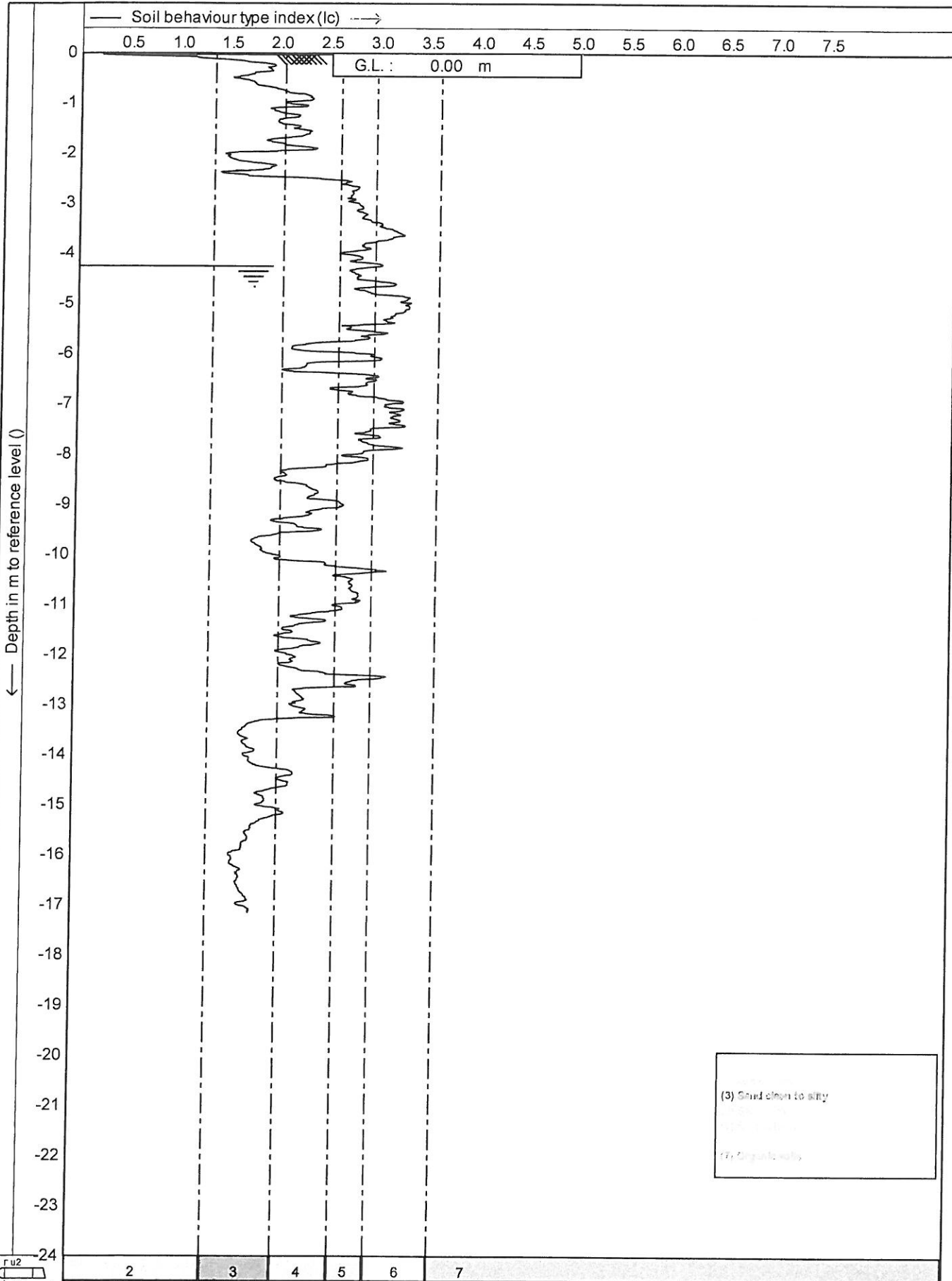
Date : 25-9-2008

Cone no. : C10CFIP.E60

Project no. : 02CGL11

CPT no. : 04

9/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

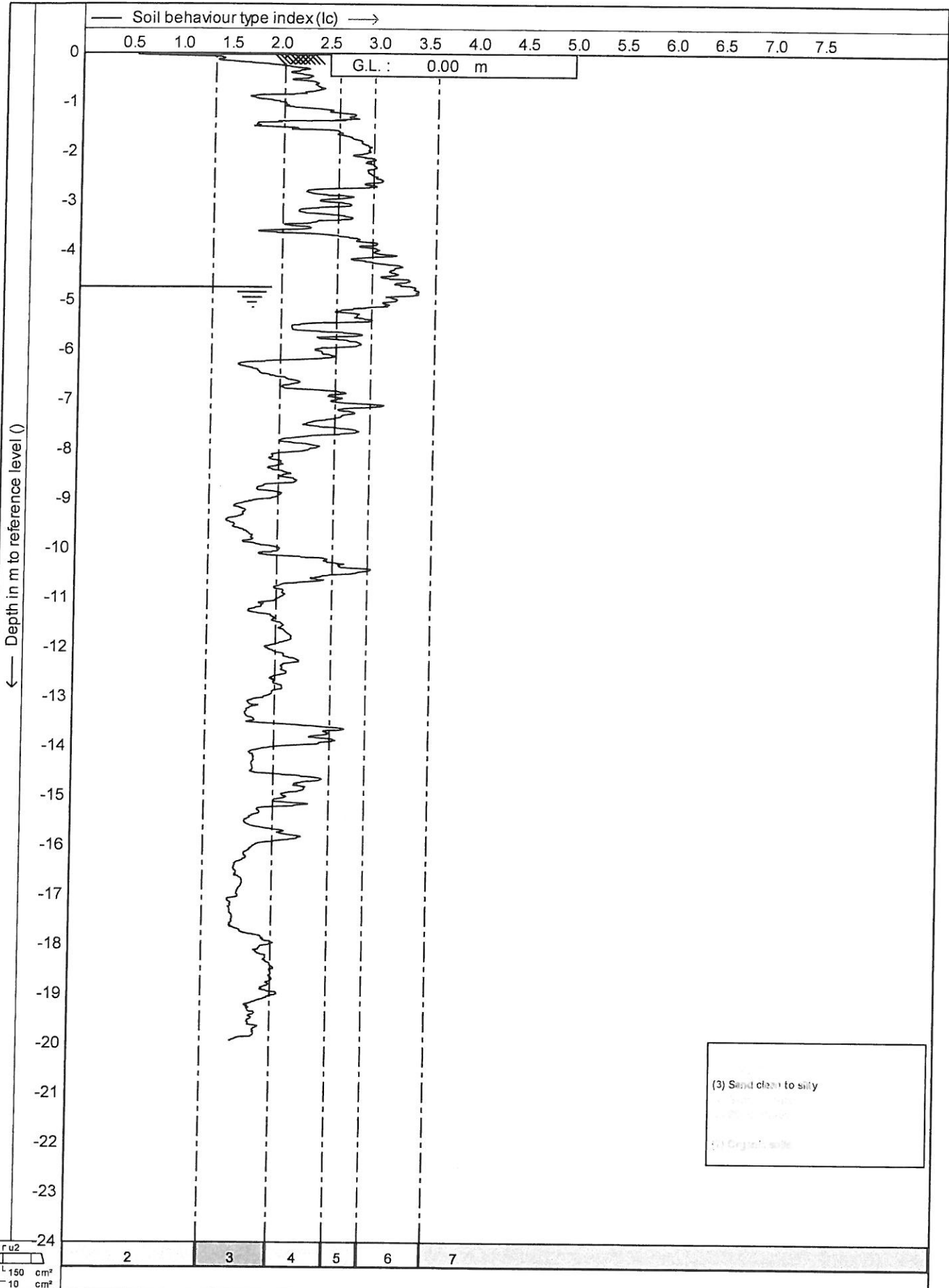
Date : 25-9-2008

Cone no. : C10CFIP.E60

Project no. : 02CGL11

CPT no. : 05

9/14



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

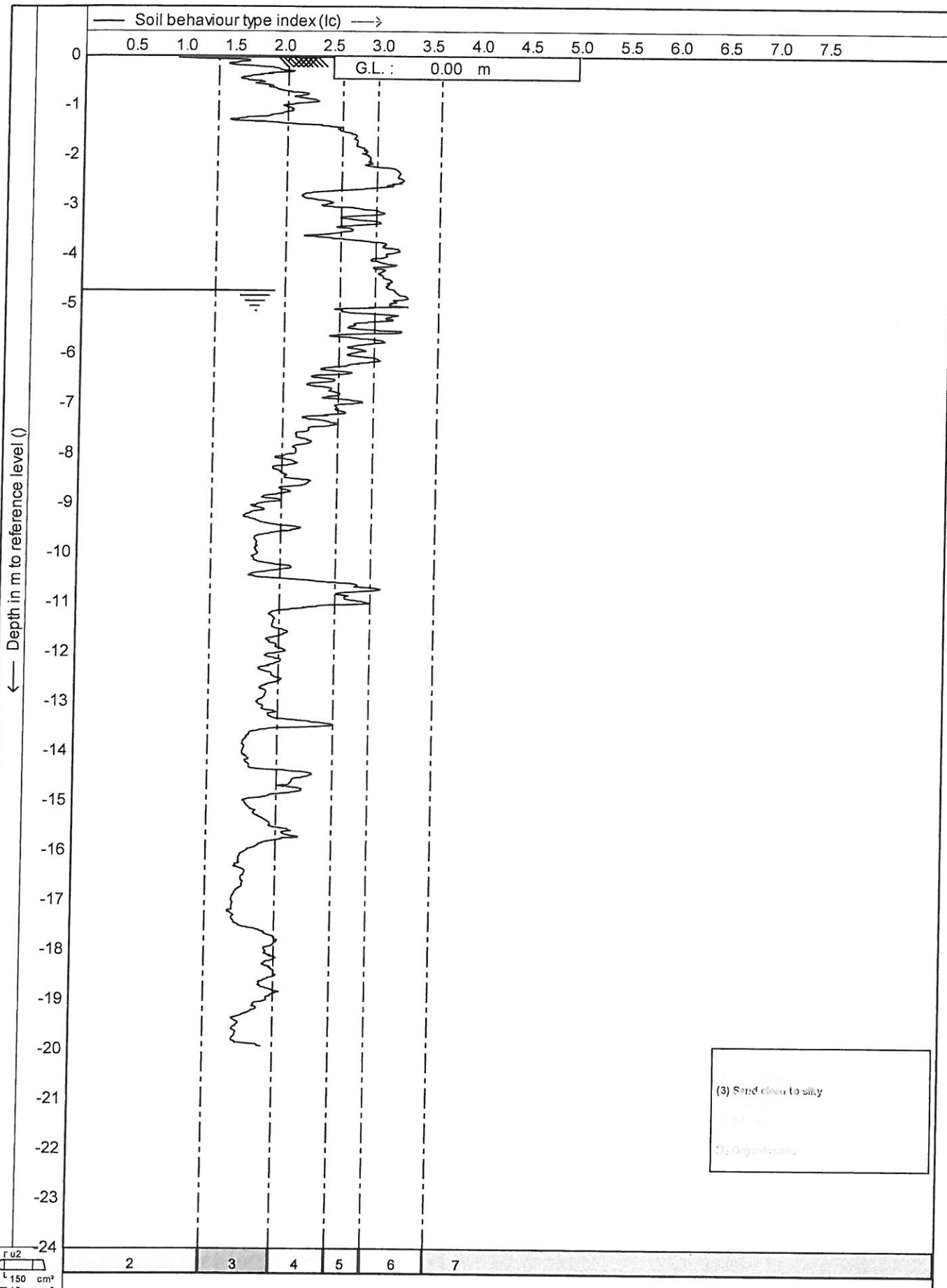
Date : 25-9-2008

Cone no. : C10CFIIP.E60

Project no. : 02CGL11

CPT no. : 06

9/14



u2
150 cm²
10 cm²



Test according A.S.T.M. Standard D 5778-95

Project : Kennedy Road - Powerco Substation

Location: Tauriko Lakes - Tauriko

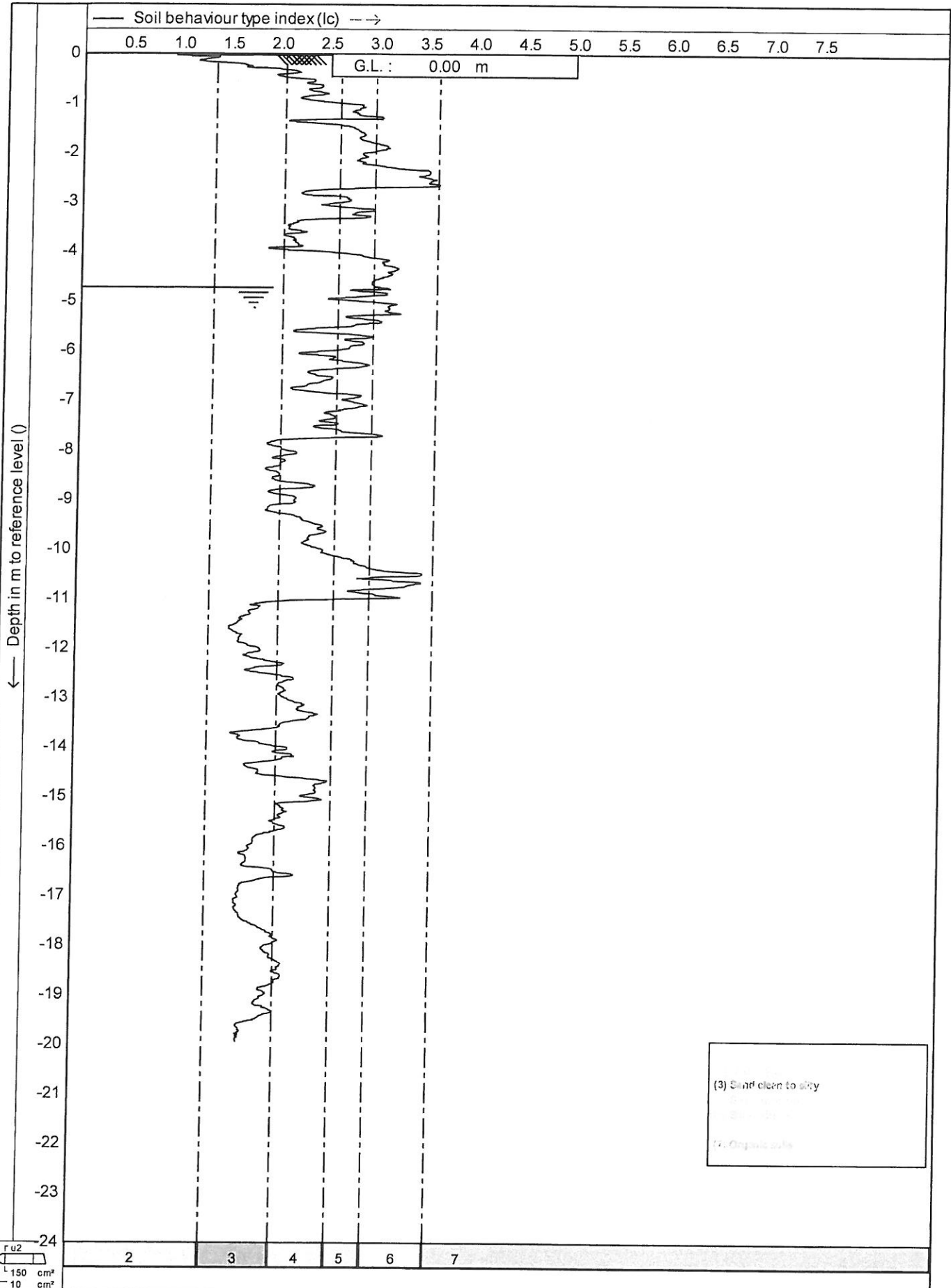
Date : 25-9-2008

Cone no. : C10CFIIP.E60

Project no. : 02CGL11

CPT no. : 07

9/14



Test according A.S.T.M. Standard D 5778-95		Date : 25-9-2008	
Project : Kennedy Road - Powerco Substation		Cone no. : C10CFIIP.E60	
Location: Tauriko Lakes - Tauriko		Project no. : 02CGL11	
		CPT no. : 08	9/14