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22 June 2026

Horsham Downs Estate

Hamilton

APPLICATION FOR FAST TRACK REFERRAL

Horsham Downs Estate Limited

Job No. s 9(2)(b)(ii) | Version 2



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Review and Update History

Revision	Date	Comments
A	10 December 2025	Initial draft for internal review
0	12 December 2025	Draft issued to client
1	18 June 2026	Final report issued to client
2	22 June 2026	Revised following client comments

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1.0 INTRODUCTION

CMW Geosciences (CMW) was engaged by Horsham Downs Estate Limited (HDEL) to carry out a geotechnical desktop assessment for the site located at 319 Gordonton Road, Hamilton, which is being considered for the construction of a residential development with approximately 900 residential units (hereafter referred to as "the Project").

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2025-0046AA, Rev 1 dated 28 November 2025.

This report has been prepared to summarise expected ground conditions and provide preliminary recommendations for possible geohazards, foundations and site-specific geotechnical testing. The purpose of this report is to support a referral application via the 'fast-track' process (Fast Track Approvals Act 2024).

1.1 Statement of Qualifications and Experience

David MacPherson

I am a Associate Geotechnical Engineer at CMW Geotechnical NZ Limited, trading as CMW Geosciences. CMW Geosciences is a specialist geotechnical engineering and geological services consultancy with offices in New Zealand and Australia. I have been employed at CMW Geosciences since August 2017.

I hold the qualifications of MEngSc from The University of New South Wales, which I completed in 2022 as well as an MSc from the University of Waikato, which I completed in 2016. I am a Chartered Professional Engineer and a Chartered Member of Engineering New Zealand.

With over 8 years of experience, I am a seasoned geotechnical engineer skilled in project management, design solutions, and team leadership. My background includes extensive work in infrastructure projects. My experience includes managing and participating in site investigations, instrumentation and monitoring, slopes and geotechnical hazard assessments, and slope stability design for major infrastructure projects such as the Peacockes Bridge in Hamilton.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Kori Lentfer

I am a Principal Engineering Geologist at CMW Geotechnical NZ Limited, trading as CMW Geosciences. CMW Geosciences is a specialist geotechnical engineering and geological services consultancy with offices in New Zealand and Australia.

I hold the qualifications of MSc Geology (Hons) from the University of Auckland, which I completed in 2008, as well as a BSc Tech from the University of Waikato, which I completed in 1999. I am a Chartered Professional Engineering Geologist (PEngGeol, 2025) and a Chartered Member of Engineering New Zealand.

With over 20 years of experience, I am a seasoned engineering geologist skilled in geotechnical investigations, ground modelling, practical and cost-effective geotechnical design, client relationship management, and mentoring and staff development. My background includes extensive work on infrastructure and land development projects in New Zealand and internationally. My experience includes planning and managing site investigations, developing 2D and 3D engineering geological and geotechnical ground models, earthworks monitoring and design, slope stability assessment, and soft soil engineering for major projects such as the Peacockes Bridge in Hamilton, the Temple View development, the State Highway 3 rockfall response at Mokau, and Te Awa Lakes.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Andrew Linton

I am a Principal Geotechnical Engineer at CMW Geotechnical NZ Limited, trading as CMW Geosciences. CMW Geosciences is a specialist geotechnical engineering and geological services consultancy with offices in New Zealand and Australia. I have been employed at CMW Geosciences since August 2018.

I hold a Bachelor of Engineering (Civil) from the University of Auckland. I am a Chartered Professional Engineer, a Chartered Member of Engineering New Zealand, and a member of the New Zealand Geotechnical Society.

With over 30 years of experience, I am a highly experienced geotechnical engineer specialising in land development projects. My background includes extensive involvement in large residential and commercial developments across New Zealand. My experience includes leading and managing site investigations, developing ground models, undertaking slope stability analyses, designing ground improvement and remediation works, and providing construction monitoring and certification for a wide range of projects.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

2.0 SITE DESCRIPTION

2.1 Site Location

The proposed development is located at 319 Gordonton Road, Hamilton, as shown in ***Figure 1***. The project site comprises an area of approximately 54ha and is currently used for agriculture.

The site is bordered by the Waikato Expressway to the south, Gordonton Road to the east, and farmland to the north and west.

Figure 1: Site Location Plan. Source: OpenStreetMap



2.2 Landform

The landform is generally split into two zones. In the south-eastern portion, the site is characterised by three broad ridges ranging between RL34m and RL55m. The slopes range from 1V:3H to 1V:12H. In the north-western portion, the site is characterised by flat land ranging from RL29m to RL34m. The site has some existing dwellings and farm buildings, as well as a farm pond. Farm drains run along the flat area of the site which drain towards the north.

3.0 PROPOSED DEVELOPMENT

A high-level preliminary development plan has been provided by Earl Design. The plan shows a residential development with a yield of approximately 850-950 dwelling development, with a neighbourhood centre and an allowance for stormwater attenuation/treatment ponds and/or swales. The proposed development plan is presented in ***Appendix B***.

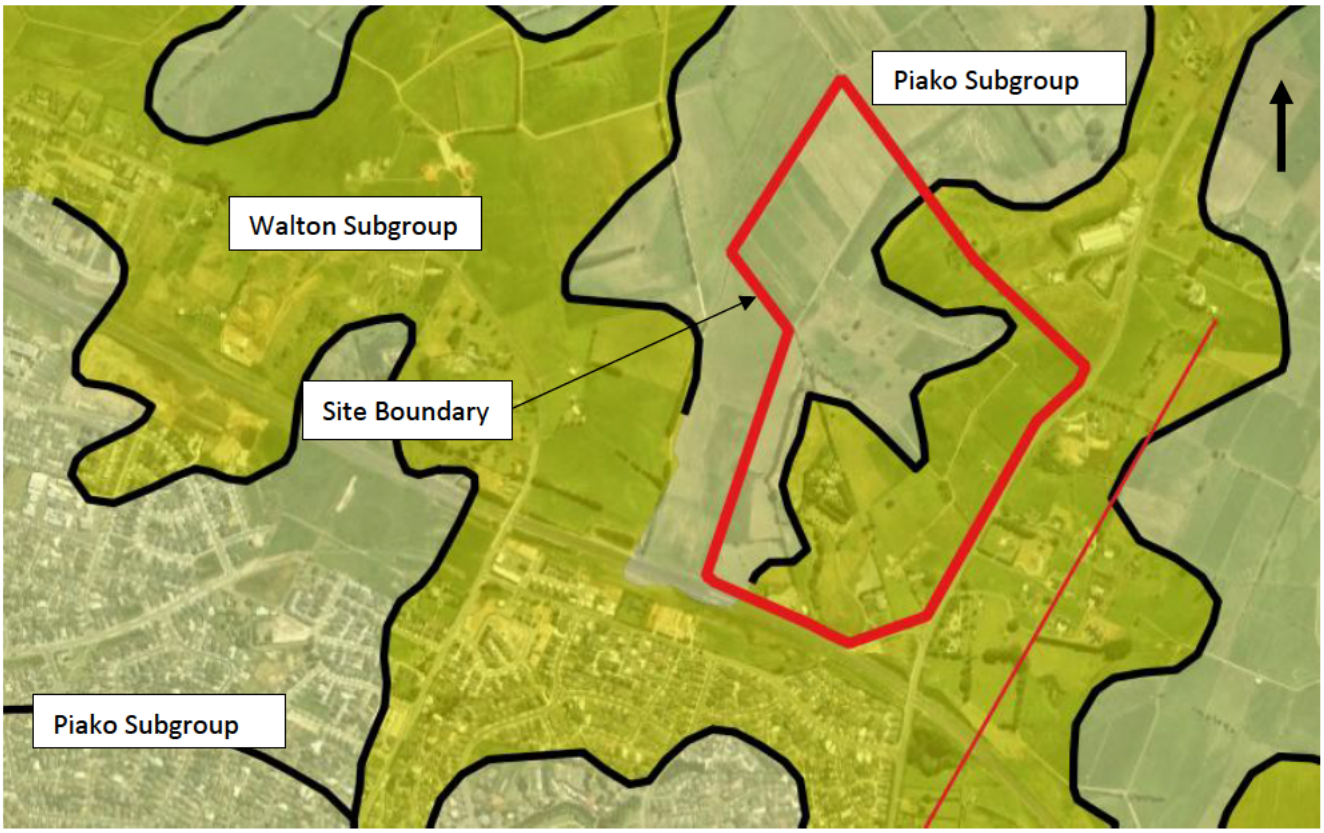
4.0 CONCEPTUAL GROUND MODEL

4.1 Geology

Published geological maps[1] for the area depict the elevated ridges as Walton Subgroup (Pliocene-Pleistocene aged) alluvium comprising pumiceous sands and silt with thin peat beds. Piako Subgroup (Late Pleistocene aged) comprising locally derived lacustrine mud, silt, gravel and peat is present in the low-lying flats.

[1] GNS Geological Map 1:250,000 scale Geological Map No 4 'Waikato'. SW Edbrooke et al.

Figure 2: Regional Geology. (GNS Geology Map[1]).



4.2 Available Geotechnical Data

4.2.1 New Zealand Geotechnical Database

A review of nearby geotechnical logs from the New Zealand Geotechnical Database (NZGD) confirms the geology present in the published geological maps. Fifteen hand auger boreholes have been completed within the site. In addition, several Cone Penetration Tests, Boreholes and Test Pits have been completed on nearby sites. Engineering logs are presented in ***Appendix C.***

4.2.2 Groundwater Bore Data

In October 2025, two groundwater monitoring bores MW01 and MW02 were drilled within the site with standpipe piezometers installed and the bores logged by a CMW Engineering Geologist. While no geotechnical strength testing was undertaken during drilling, the logs provide a soil profile which we have used to develop a ground model of the hills in ***Table 1***. The bore locations are shown on ***Drawing 01***. Geological logs are presented in ***Appendix D***.

Table 1: Ground Model Summary – Elevated Ridges

Description	Depth to Base (m)		Thickness (m)	
	Min	Max	Min	Max
Topsoil	0.2	0.3	0.2	0.3
Silty Clay (Hamilton Ash)	3.6	5.0	3.3	4.8
Clayey Silt (Kauroa Ashes)	7.5	7.5	2.5	3.9

Description	Depth to Base (m)		Thickness (m)	
	Min	Max	Min	Max
Sandy Silt (Puketoka Formation)	15.0	19.0	7.5+*	11.5+*
Note: *Base of unit not encountered.				

No geotechnical data is present in the flat lands of the site.

4.3 Groundwater

Groundwater was encountered in the NZGD logs at the following depths:

Table 2: NZGD Groundwater Summary

NZGD No.	Test Type	Date	Ground water Depth (mBGL)	Ground water Level (mRL)	NZGD No.	Test Type	Date	Ground water Depth (mBGL)	Ground water Level (mRL)
77070	BH	12/16/2014	5.4	51.71	219665	HA	04/03/2024	2	34
77083	BH	12/23/2014	4.2	52.23	219666	HA	04/03/2024	0.8	33.2
77097	BH	05/12/2015	0.6	54.55	219667	HA	04/03/2024	1.4	33.1
77098	BH	01/22/2015	0.27	31.89	219668	HA	04/04/2024	3	34.5
77118	BH	04/13/2015	1.93	47.16	219679	HA	04/05/2024	1.4	34.6
77119	BH	05/04/2015	0	64	219681	HA	04/05/2024	1.6	34.9
77155	BH	06/20/2011	4.4	50.63	219684	HA	04/04/2024	1.8	34.7
77306	TP	04/19/2015	6.3	14.1	219692	HA	04/05/2024	2.7	34.3
219663	HA	04/03/2024	1.4	34.1	219695	HA	04/04/2024	2.4	35.6
Notes: BH = Borehole, TP = Test Pit, HA = Hand Auger.									

Groundwater was encountered in the groundwater monitoring bores at the following depths:

Table 3: Groundwater Levels from Groundwater Monitoring Bores

Location ID	Date	Groundwater Depth (mBGL)	Groundwater Level (mRL)
MW01	13/10/2025	8.60	37.40
MW02	13/10/2025	10.06	34.44

5.0 DESKTOP FINDINGS

5.1 Historical Photos

Historical photographs dating back to 1952 have been reviewed and are attached in ***Appendix E***. The historical aerial photographs show that the site has been used for agriculture, with some additional dwellings developed by 1991. Additional buildings were built for the Morning Calm Lodge in 2008. Construction began on the Waikato Expressway in 2018 involving earthworks along the southern site margin.

5.2 Regional Hazards

A review of the Waikato Regional Council Natural Hazards Portal[2] was undertaken.

The Hazard Portal addresses potential flooding, coastal hazards, volcanic and seismic hazards for the Waikato region.

No river flooding risk had been identified, but the site is part of the Waikato Central Drainage Scheme and has an identified Waikato Regional Council drain. BBO has provided a separate analysis of stormwater management and flood risk.

Coastal hazards are not relevant to this site.

The nearest active volcanoes are Rotorua and Mayor Island, both of which are approximately 100km away and are currently at alert level 0. Hazard Maps have been presented in ***Appendix F***.

5.3 Fault Rupture

The site is not considered to be at risk of fault rupture. The nearest active fault is the Te Puninga Fault, approximately 26km from the site. This fault has a return period of 10,000 years.

The Community Fault Model[3] also maps the Kututaruhe Fault approximately 250m from the site. This fault has a return period of 100,000 years and is considered inactive. In addition, MfE[4] Guidelines allow buildings of up to Importance Level 4 to be built within a fault avoidance zone for a fault with this level of return period.

5.4 Liquefaction and Lateral Spread

Liquefaction occurs in loose saturated (below the groundwater table) cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-up, soil grains moving into suspension and temporary loss of strength causing vertical and lateral ground deformation. A liquefaction hazard map from the Waikato Regional Council is presented in ***Appendix F***. The majority of the site is classed as undetermined, and the hills are classed as unlikely or unclassified (considered non-liquefiable).

Based on the geological description and our local knowledge on nearby projects, the Piako Subgroup deposits have a low risk of liquefaction when below the groundwater table.

5.5 Cyclic Softening

While not liquefiable due to their high plasticity, the fine-grained soils in the Piako Subgroup and Walton Subgroup may be susceptible to some strength loss, during an Ultimate Limit State seismic event. On account of the typically high shear strengths of the Walton Subgroup soils, this is often not a significant geotechnical issue for land development projects. For the Piako Subgroup soils, some strength loss may occur, but this can be managed in geotechnical design.

[2] Waikato Regional Council. Waikato Regional Hazards Portal.
https://waikatoregion.maps.arcgis.com/apps/MapSeries/index.html?appid=f2b48398f93146e8a5cf0aa3fddce92c

[3] Seebeck H, Van Dissen RJ, Litchfield NJ, Barnes PM, Nicol A, Langridge RM, Barrell DJA, Villamor P, Ellis SM, Rattenbury MS, Bannister S, Gerstenberger MC, Ghisetti F, Sutherland R, Fraser J, Nodder SD, Stirling MW, Humphrey J, Bland KJ, Howell A, Mountjoy JJ, Moon V, Stahl T, Spinardi F, Townsend DB, Clark KJ, Hamling IJ, Cox SC, de Lange W, Wopereis P, Johnston M, Morgenstern R, Coffey GL, Eccles JD, Little TA, Fry B, Griffin J, Townend J, Mortimer N, Alcaraz SA, Massiot C, Rowland J, Muirhead J, Upton P, Hirschberg H, Lee JM. 2022. New Zealand Community Fault Model – version 1.0. Lower Hutt (NZ): GNS Science. 97 p. (GNS Science report; 2021/57). doi:10.21420/GA7S-BS61.

[4] Kerr, J., Nathan, S., Van Dissen, R., Webb, P., Brunsdon, D., & King, A. (2003). Planning for development of land on or close to active faults: A guideline to assist resource management planners in New Zealand (ME number 483). Ministry for the Environment.

5.6 Slope Stability

Based on the site topography, it is considered that the site is not generally considered to be at risk of slope instability. Slumping or subsidence has not been observed in the historical photographs, partially around the gully and hill slopes. Some hummocky ground can be observed around gully heads which may indicate shallow soil creep. A site walkover by experienced engineering geologist will be required to confirm slope stability conditions.

The inclusion of high or steep slopes for swales or cuts will need an assessment of slope stability as part of the design process.

5.7 Load Induced Settlement

In the lower area of the site, the Piako Subgroup soils are predominantly alluvial deposits and there may be zones of soft and compressible soils. In these instances, significant primary consolidation and long-term secondary creep settlements may occur as a response to the placement of fill and building loads. However much of this lower area is planned to be used for stormwater management wetlands.

Site specific geotechnical investigations will need to be carried out to better characterise the soils across the site and assess the extent and nature of compressible soils present.

Future reporting will provide advice concerning mitigation strategies for compressible soils along with frequency of site observations and monitoring requirements during construction to ensure soft areas are appropriately managed.

5.8 Earthworks

Hamilton Ash and Kauroa Ash clays are generally suitable for reuse as engineered fill with moisture conditioning during normal summer conditions. However, the Puketoka Formation silts can be sensitive and may lose strength with they are disturbed and allowed to get wet.

Soft or organic soils near the ground surface may be encountered during excavation particularly within the Piako Subgroup soils.

Geotechnical site investigation a future reporting undertaken as part of the substantive application will provide advice on how to treat soft soils. This may include removal and replacement or ground improvement methods, such as preloading or temporary surcharge filling. These are normal methods commonly applied to land development projects in the Hamilton area.

Groundwater may be encountered at shallow depth on the low-lying areas. Future reporting undertaken as part of the substantive application will consider the need for any underfill subsoil drains or granular drainage blanket layers as mitigation measures if high groundwater is an issue for development.

5.9 Preliminary Foundation Options

Depending on the magnitude of liquefaction induced settlement, engineered foundation solutions may be required. This may include foundation options such as TC2 or TC3 type raft foundations. Deep pile foundations may also be required for larger loads expected in commercial buildings.

Settlement magnitudes can be estimated once the required geotechnical investigation data is available and the earthworks design and building loads are known. Depending on the nature of the proposed development and the finished ground levels, ground improvement of some kind may be required to manage static load induced settlement.

Ground improvement options that could be considered (and will be detailed as part of the substantive application) include undercut and reworking of soft ground (static settlement only); temporary surcharge fills (static settlement only), deep soil mixing and/or vibro-stone columns (liquefaction and static settlement). These are all conventional land management techniques for larger development projects, such as this. Specific approaches across the site will be identified and proposed as part of a substantive resource consent application.

5.10 Stormwater Management

As is common on land development projects, stormwater basins and swales are proposed in the northern end of the development. These will require geotechnical assessment and design to mitigate hazards such as slope instability and groundwater drawdown. Base permeability and any liner requirements will be confirmed during the design process.

6.0 CONCLUSIONS

Based on the assessment presented in this report, there are no unusual features or geotechnical constraints observed for this site that would prevent urban residential development from proceeding.

Based on our experience with adjacent large-scale residential developments, earthworks and subdivision construction on this site are expected to be generally straightforward and manageable using conventional geotechnical and land development practices.

Subject to appropriately scoped geotechnical investigations that give due consideration to both known and potential subsurface conditions, the site is considered suitable for the proposed development

6.1 Further Work

To support a substantive consent application, the additional investigations analysis is recommended. This scope is standard for urban development projects of this scale and includes:

- Detailed geotechnical investigation to inform ground model development, refine geohazard assessment, select design parameters, and provide design and construction recommendations.
- Geotechnical analysis and reporting suitable for subsequent project stages, including substantive consent, detailed design, and building consent applications (if required).
- The conditions of consent for the substantive application should also reflect the need for:
    - Construction-phase geotechnical services, including observations, monitoring, and testing to verify compliance with design assumptions.
    - Completion reporting for subdivision earthworks and associated infrastructure to confirm performance and compliance.

7.0 CLOSURE

This report has been prepared for use by Horsham Downs Estate Limited, their appointed representatives, and those reviewing/evaluating the application for Referral under the FTAA according to their instructions in relation to the Horsham Downs Estate Project outlined in Section 1 of this report.

Where a party other than Horsham Downs Estate Limited or those listed in the preceding paragraph seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

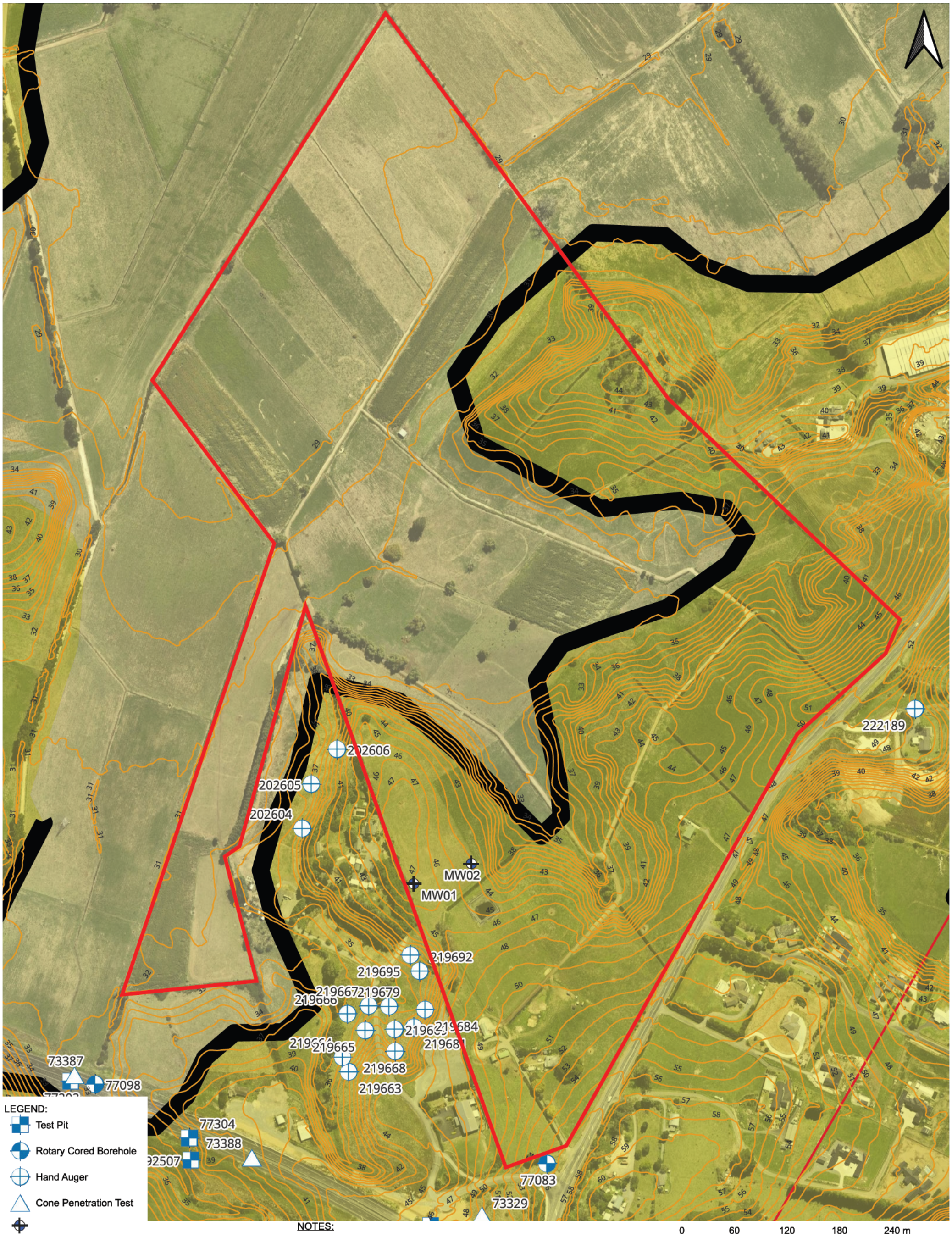
Environmental matters are not covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

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APPENDIX A
Drawings



CMW Geosciences
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CLIENT: EIEO LANDS LIMITED PARTNERSHIP		DRAWN: DM	PROJECT: HAM2025-0046
PROJECT: 319 GORDONTON ROAD		CHECKED: KL	DRAWING: 01
		REVISION:	SCALE: 1:5,000
TITLE: SITE INVESTIGATION PLAN		DATE: 12/12/2025	SHEET: A3 P

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APPENDIX B
Proposed Development Plans



Legend

- Site boundary
- Indicative roundabout
- Indicative SW wetland and open space
- Indicative Neighbourhood Park
- Indicative Neighbourhood Centre
- Indicative pedestrian connections
- Indicative streetscape plantings
- Indicative location for infrastructure
- Indicative residential buildings

Dwelling yield = 900

Gordonton Road FT

Masterplan Draft

For Discussion

Date.	21.04.2026
Scale.	1:5,000 at A3
Sheet.	1/1
Drawn by.	J.Earl
Revision.	Rev 3

Notes:

1. Streetscape layouts, building outlines, Haynes Place and the Gordonton Road layout are shown indicatively.

ED | EARL DESIGN
URBAN DESIGN + LANDSCAPE ARCHITECTURE

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APPENDIX C
Publicly Available Geotechnical Data

NZGD ID: 219669

SCALA PENETROMETER, SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	SP-07
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-07
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	04/04/24
Logged By:	BM	**Weather:**	Fine
Logged Date:	09/04/24	**Operator:**	BM
Checked By:	SBT	**Datum:**	Moturiki VD 1953
Checked Date:	15/04/24		

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Topsoil	0	36.5	Organic SILT (OL); dark brown. Moist; friable, [TOPSOIL].	TS	OL			UTP	2
Walton Subgroup	0.5	36.5	SILT (M); brown. Very stiff to hard, moist, non-plastic.					152/52	3
	1.0	36.0						182/58	5
	1.5	35.5	1.5m: Becomes light brown.					UTP	7
			Clayey SILT (M); light grey. Moist, low plasticity.					UTP	13
	2.0	35.0	Sandy SILT (M); brown. Stiff to very stiff, moist; sand, fine to coarse. 1.8m: Becomes grey. 1.9m: Becomes wet. 2.0m: Becomes moist and highly plastic. 2.2m: Contains minor silver sand; fine to medium. 2.4m: Contains some sand; fine to medium. 2.6m: Becomes wet.		M			61/19	20
	2.5	34.5						139/46	
	3.0	34.0						142/35	
								121/29	
								125/35	
			3.3m: Becomes light greyish brown.					203+	
	3.5	33.5	Sandy SILT (M); light greyish brown. Hard, moist, non-plastic; sand, medium to coarse. 3.6m: Becomes wet.					UTP	
			Silty SAND (S); light brown. Loose to dense, wet, non-plastic, sand, fine to coarse.		S	L			
	4.0	33.0	EOH: 4.10m 4.0m: Becomes sand; fine. 4.1m: Hand auger refusal.			MD			
	4.5	32.5				D			
	5.0	32.0							

Groundwater Not Encountered

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219679

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-08
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	05/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	09/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)
Topsoil	0	35.5	Organic SILT (OL); dark brown. Moist; friable, [TOPSOIL].	TS	OL			
Walton Subgroup	0.5	35.5	SILT (M), with some clay; brown. Very stiff to hard, moist, low plasticity.					163/55
			0.6m: Becomes wet.					148/73
			0.7m: Contains trace sand; medium.					
	1.0	35.0	0.9m: Groundwater measured at end of hole - 0.88 m				04/04/2024	UTP
								UTP
	1.5	34.5	1.4m: Groundwater strike at 1.4 m				04/04/2024	128/32
			Clayey SILT (M); grey. Very stiff, wet, high plasticity; moderately iron stained.		M			134/17
			1.8m: Becomes light grey.					
	2.0	34.0	2.0m: Becomes low plasticity and contains some sand; medium to coarse.					203+
	2.5	33.5	Clayey SILT (M); light greyish brown. Very stiff, moist, high plasticity; slightly iron stained.					163/41
			Sandy SILT (M); light greyish brown. Stiff to very stiff, wet, non-plastic; sand, medium to coarse; slightly iron stained.					203+
	3.0	33.0	EOH: 3.00m					84/17
			3.0m: Target depth achieved.					
	3.5	32.5						
	4.0	32.0						
	4.5	31.5						
	5.0	31.0						

Blows per 100 mm of Penetration: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219681

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-09
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	05/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	09/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Walton Subgroup	0.0	36.0	SILT (M); brown. Hard, moist, non-plastic; (Topsoil removed by client during landscaping).					UTP	
	0.5	36.0						UTP	
			SILT (M), with minor sand; light brown mottled light grey. Hard, dry, non-plastic; sand, fine to medium; slightly iron stained.					UTP	
	1.0	35.5	0.9m: Becomes light grey and slightly iron stained.					UTP	
			Clayey SILT (M); light grey. Very stiff, moist, high plasticity; moderately iron stained.					160/29	
	1.5	35.0	SILT (M), with some sand; light grey. Stiff, wet, non-plastic; sand, fine to coarse.		M		05/04/2024 05/04/2024	83/20	
			1.6m: Groundwater strike at 1.6 m. Becomes saturated.						
	2.0	34.5	Sandy SILT (M); whitish brown. Stiff, saturated, non-plastic; sand, fine to coarse.					64/17	
			1.8m: Groundwater measured at end of hole - 1.78 m					65/23	
	2.5	34.0	2.5m: Becomes light brown.					182/41	
								UTP	
	3.0	33.5	EOH: 3.00m					UTP	
			3.0m: Target depth achieved.						
	3.5	33.0							
	4.0	32.5							
	4.5	32.0							
	5.0	31.5							

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219692

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-11
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	05/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	09/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Topsoil	0	36.5	Organic SILT (OL); dark brown. Moist; friable, [TOPSOIL].	TS	OL				
Walton Subgroup	0.5	36.5	SILT (M); brown. Stiff to hard, moist, non-plastic.					UTP	
			0.6m: Becomes light brown.					UTP	
	1.0	36.0						203+	
								203+	
	1.5	35.5	1.4m: Becomes light brownish grey.						
			1.5m: Becomes wet.		M			171/22	
			1.7m: Contains minor black sand; fine to medium.					134/23	
	2.0	35.0	2.0m: Becomes light brown.					119/22	
			2.4m: Groundwater measured at end of hole - 2.35 m				05/04/2024		
	2.5	34.5						116/20	
			2.7m: Groundwater strike at 2.7 m				05/04/2024		
			EOH: 3.00m					109/26	
	3.0	34.0	2.9m: Contains some sand; medium.					87/23	
			3.0m: Target depth achieved.						
	3.5	33.5							
	4.0	33.0							
	4.5	32.5							
	5.0	32.0							

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

Ground Floor, 408 Anglesea Street, Hamilton Central, HAMILTON 3204

Generated with CORE-GS

NZGD ID: 219692

NZGD ID: 219695

SCALA PENETROMETER, SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	SP-12
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-12
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	04/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	09/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Topsoil	0	37.5	Organic SILT (OL); dark brown. Moist; friable, [TOPSOIL].	TS	OL				
Walton Subgroup	0.4	37.5	SILT (M); brown. Very stiff, moist, low plasticity.					110/52	
	0.5	37.5	0.4m: With some clay.					102/26	
	1.0	37.0	SILT (M), with minor sand; brown. Very stiff to hard, moist, non-plastic; sand, medium to coarse.					139/51	
	1.5	36.5	1.5m: Becomes wet.					UTP	
	2.0	36.0	2.2m: Groundwater measured at end of hole - 2.21 m		M		04/04/2024	UTP	
	2.4	36.0	2.4m: Groundwater strike at 2.4 m				04/04/2024	29/46	
	2.5	35.5	Clayey SILT (M); light brown mottled grey. Very stiff to hard, wet, high plasticity; slightly iron stained.					UTP	
	3.0	35.0						163/35	
	3.3	35.0	3.3m: Contains some black sand; fine to medium.					UTP	
	3.5	34.5	3.5m: Becomes saturated.					138/26	
	4.0	34.0						160/15	
	4.5	33.5	Silty SAND (S); greyish white. Very loose to medium dense, saturated, non-plastic, sand, fine to coarse.		S	VL		UTP	2
	5.0	33.0	EOH: 5.00m			L		97/38	3
	5.0	33.0	5.0m: Target depth achieved.			MD		157/46	3, 4, 7

Remarks:
Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
Elevation datum sourced from council GIS LiDAR contours.

Generated with CORE-GS

NZGD ID: 219695

NZGD ID: 222189

INVESTIGATION LOG

HOLE NO.: 3 AS1

CLIENT: MZ Building Supplies & Services Limited
PROJECT: Lot3 - 376 Gordonton Road
JOB NO.: G24-H0034

SITE LOCATION: Hamilton
START DATE: 05/04/2024
CO-ORDINATES: 1802200mE, 5823083mN
ELEVATION: Ground
END DATE: 05/04/2024
CONTRACTOR: Internal
RIG: Hand Auger
DRILLER: JK
LOGGED BY: JK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: Geovane	Values	WATER
Clayey SILT; dark brown. Stiff, moist, low plasticity, moderately sensitive (TOPSOIL).		0.2	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		
Clayey SILT; brown. Very stiff, moist, low plasticity, moderately sensitive (FILL).		0.4				143	
CLAY with minor to some silt; light reddish brown. Very stiff to hard, moist, high plasticity, moderately sensitive (HAMILTON ASH FORMATION).		0.6				77	
		0.8				200+	
		1.0				-	
		1.2					
		1.4				200+	
		1.6				-	
		1.8					
		2.0				174	
		2.2				74	
		2.4					
		2.6				163	
		2.8				23	
EOH: 3.00m		3.0				200+	
		3.2				-	
		3.4					

Groundwater Not Encountered

PHOTO(S)



REMARKS

Test Methods:
Field Description of Soil and Rock, NZ Geotechnical Society, 2005
Determination of Penetration Resistance of a Soil, NZS 4402 Test 6.5.2: 1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Society, 2001
Shear Vane No. 2913, Cert.No M720645
*Shear vane limit 200kPa

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

Generated with CORE-GS by Geroc - Hand Auger - scala & vane bars - 9/04/2024 3:43:37 pm

NZGD ID: 222189

NZGD ID: 222189

INVESTIGATION LOG

HOLE NO.: 3 AS2

CLIENT: MZ Building Supplies & Services Limited
PROJECT: Lot3 - 376 Gordonton Road
JOB NO.: G24-H0034

SITE LOCATION: Hamilton
START DATE: 05/04/2024
CO-ORDINATES: 1802206mE, 5823090mN
ELEVATION: Ground
END DATE: 05/04/2024
CONTRACTOR: Internal
RIG: Hand Auger
DRILLER: JK
LOGGED BY: JK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: Geovane	WATER
Clayey SILT; dark brown. Stiff, moist, low plasticity, moderately sensitive (TOPSOIL).		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	Groundwater Not Encountered
Clayey SILT; brown. Hard, moist, low plasticity, moderately sensitive (FILL).		0.2			200+ -	
CLAY with minor to some silt; light reddish brown. Very stiff to hard, moist, high plasticity, moderately sensitive (HAMILTON ASH FORMATION).		0.4			114 43	
		0.6				
		0.8				
		1.0			143 71	
		1.2				
		1.4				
		1.6			200+ -	
		1.8				
		2.0				
		2.2				
		2.4			200+ -	
		2.6				
		2.8				
EOH: 3.00m		3.0			200+ -	
		3.2				
		3.4				

PHOTO(S)



REMARKS

Test Methods:
Field Description of Soil and Rock, NZ Geotechnical Society, 2005
Determination of Penetration Resistance of a Soil, NZS 4402 Test 6.5.2: 1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Society, 2001
Shear Vane No. 2913, Cert.No M720645
*Shear vane limit 200kPa

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

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NZGD ID: 222189

NZGD ID: 222189

INVESTIGATION LOG

HOLE NO.: 3 AS3

CLIENT: MZ Building Supplies & Services Limited

PROJECT: Lot3 - 376 Gordonton Road

JOB NO.: G24-H0034

SITE LOCATION: Hamilton

START DATE: 05/04/2024

CO-ORDINATES: 1802195mE, 5823094mN

ELEVATION: Ground

END DATE: 05/04/2024

CONTRACTOR: Internal

RIG: Hand Auger

DRILLER: JK

LOGGED BY: JK

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: Geovane	Values	WATER
Clayey SILT; dark brown. Stiff, moist, low plasticity, moderately sensitive (TOPSOIL).		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		Groundwater Not Encountered
Clayey SILT; brown. Hard, moist, low plasticity, moderately sensitive (FILL).		0.2 – 0.6				200+	
CLAY with minor to some silt; light reddish brown. Very stiff to hard, moist, high plasticity, moderately sensitive (HAMILTON ASH FORMATION).		0.8 – 2.8				200+ / 200+ / 171 / 86 / 185 / 71	
EOH: 3.00m		3.0 – 3.4				200+	

PHOTO(S)



REMARKS

Test Methods:
Field Description of Soil and Rock, NZ Geotechnical Society, 2005
Determination of Penetration Resistance of a Soil, NZS 4402 Test 6.5.2: 1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Society, 2001
Shear Vane No. 2913, Cert.No M720645
*Shear vane limit 200kPa

WATER

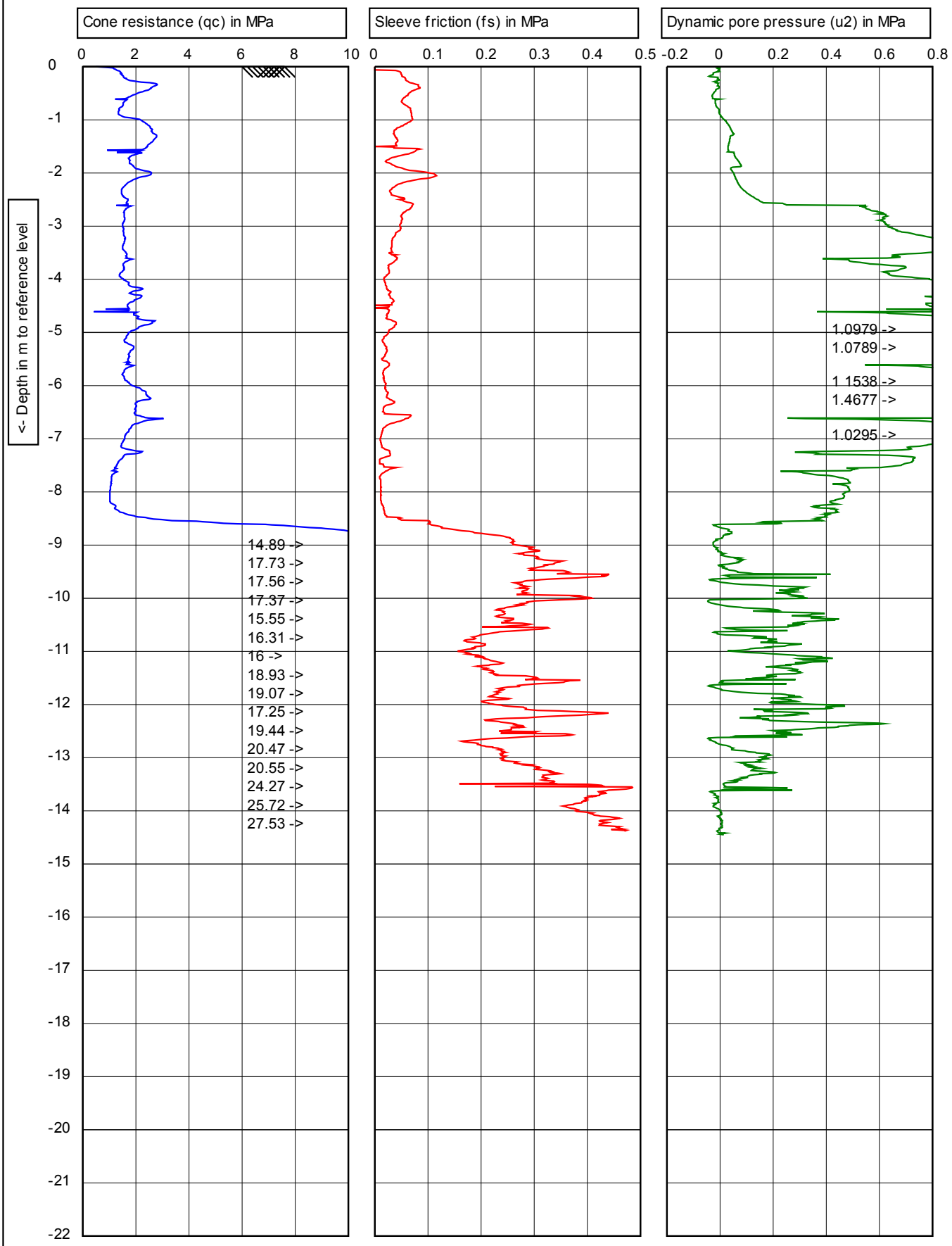
- ▼ Standing Water Level
- ▷ Out flow
- ◁ In flow

INVESTIGATION TYPE

- ☑ Hand Auger
- ☐ Test Pit

Generated with CORE-GS by Geroc - Hand Auger - scala & vane bars - 9/04/2024 3:43:40 pm

NZGD ID: 222189

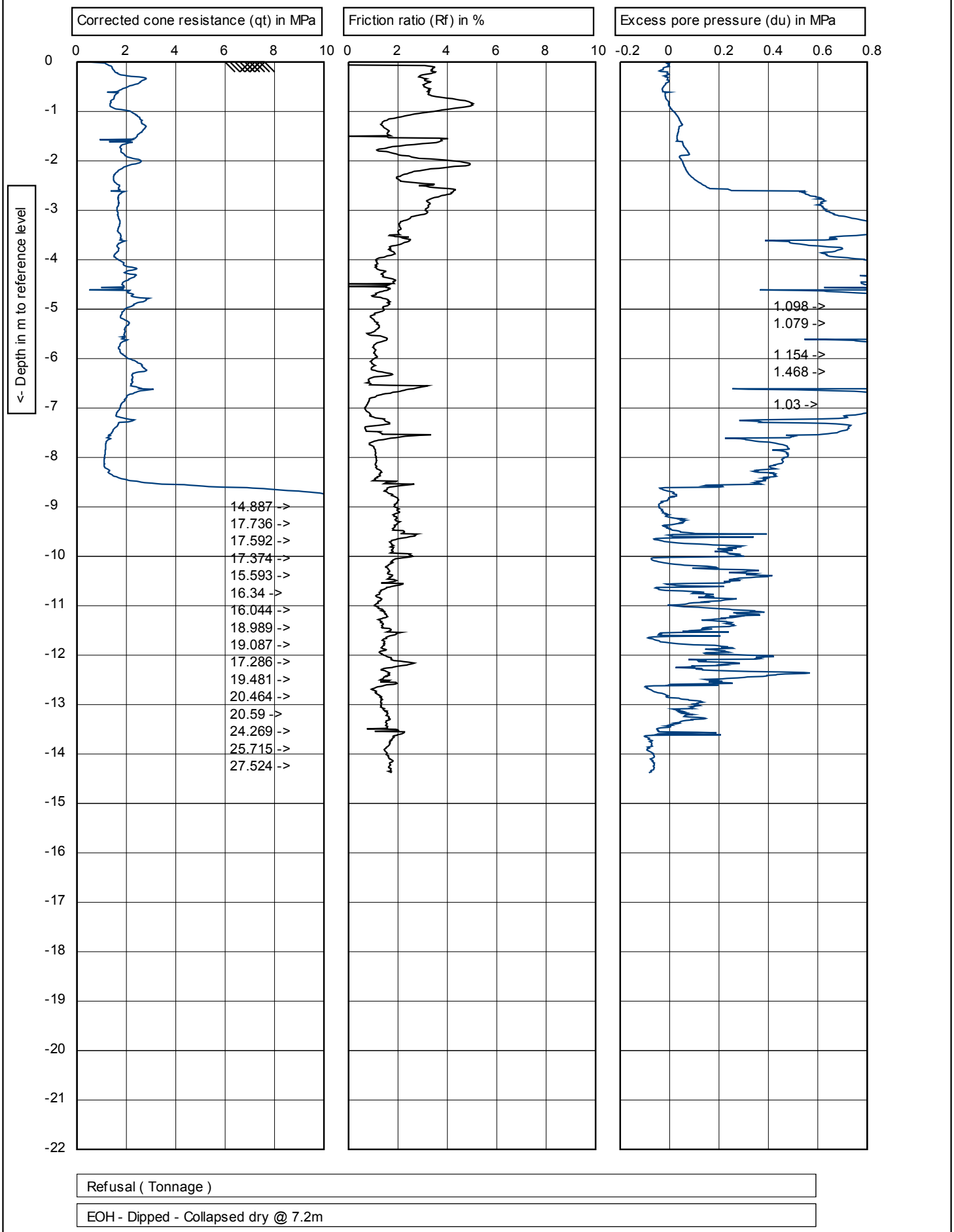


Refusal (Tonnage)

EOH - Dipped - Collapsed dry @ 7.2m

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-7.2**	Date:	**16/12/14**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Gordonton Rd**	Project no.:	**231695.00_027**
Position:	**5822519, 1801691 NZTM**	CPT no.:	**736** 1/6

1.40



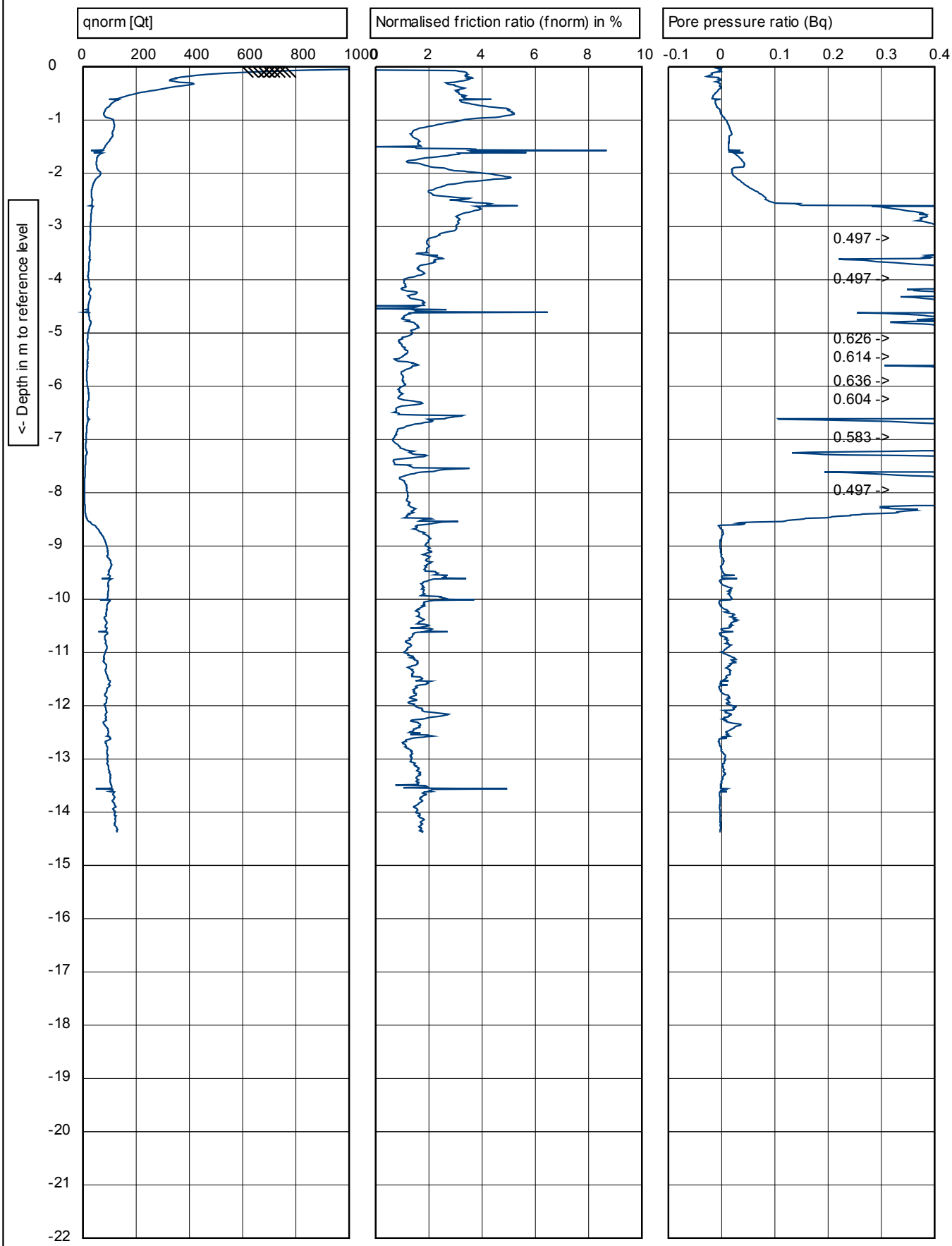
OPUS

Graphs on this page are not IANZ accredited

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r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-7.2**	Date:	**16/12/14**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Gordonton Rd**	Project no.:	**231695.00_027**
Position:	**5822519, 1801691 NZTM**	CPT no.:	**736** **2/6**

NZGD ID: 73329



Refusal (Tonnage)

EOH - Dipped - Collapsed dry @ 7.2m

OPUS

Graphs on this page are not IANZ accredited

1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-7.2**

Project: **Waikato Expressway:Hamilton Sect.**

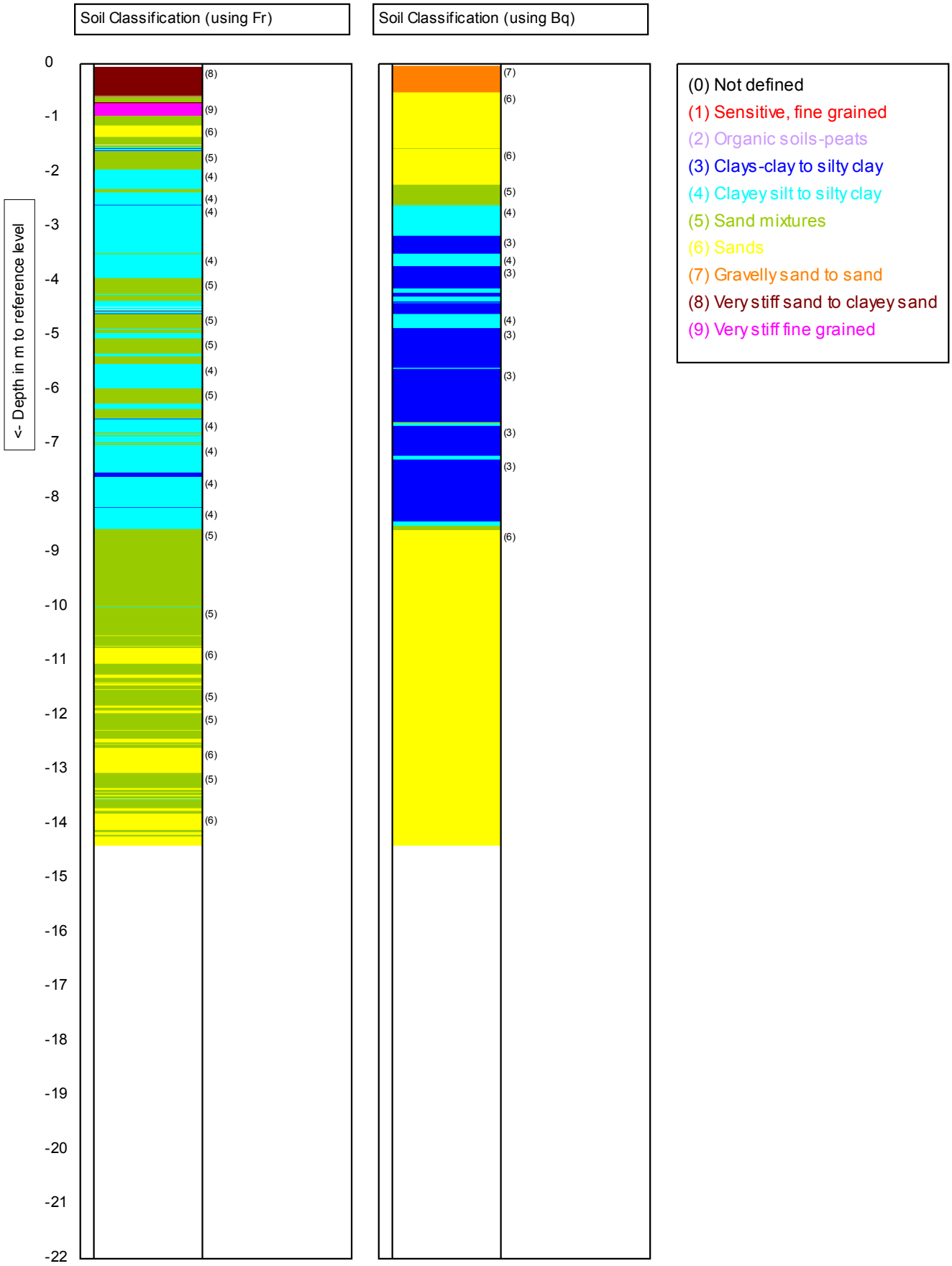
Location: **Gordonton Rd**

Position: **5822519, 1801691 NZTM**

Predrill :	**0 m Predrilled**
Date:	**16/12/14**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**736** 3/6

NZGD ID: 73329

NZGD ID: 73329



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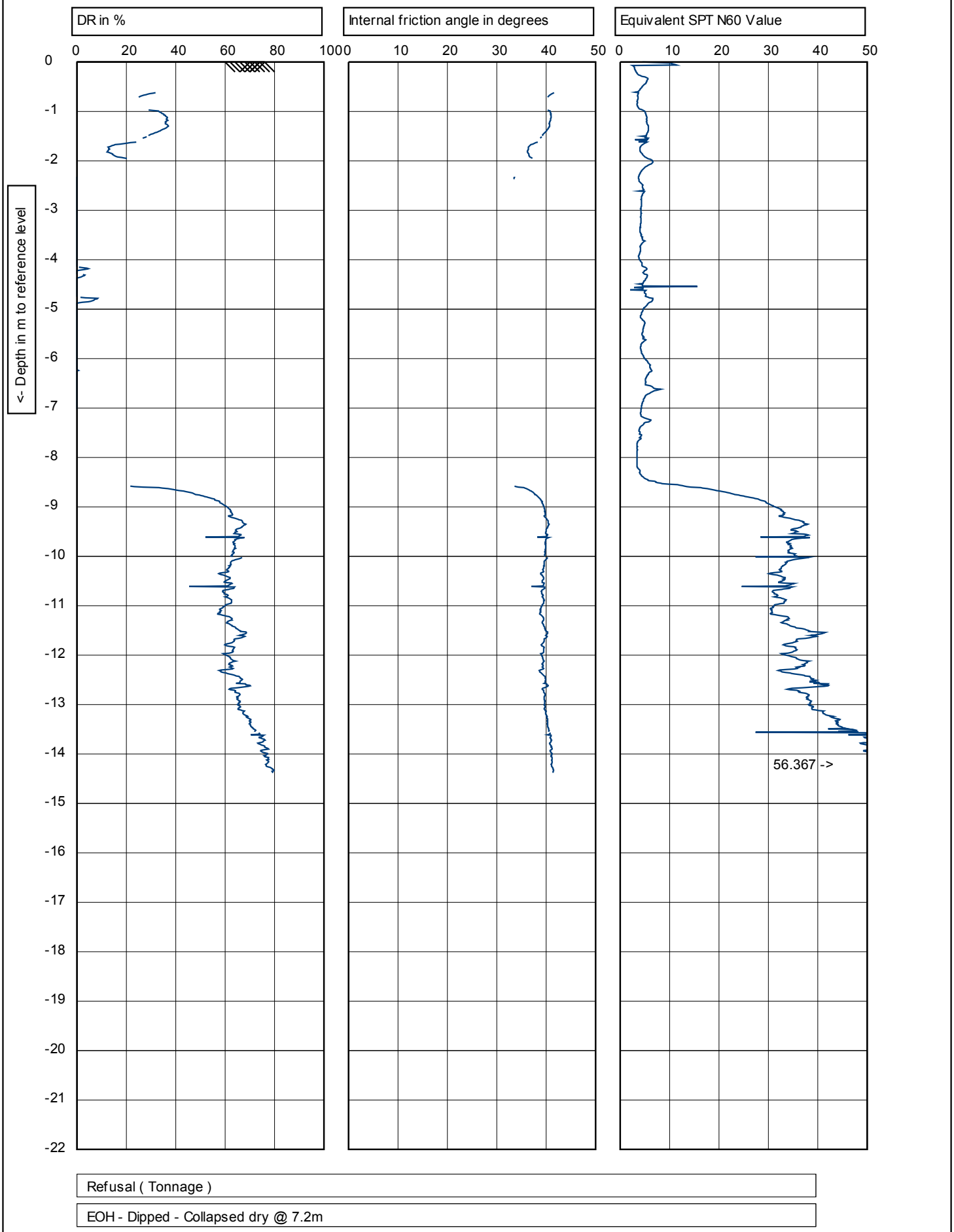
Graphs on this page are not IANZ accredited

1.40

r u2 / 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill :	**0 m Predrilled**
	G.L. 0 MSL / W.L.: **-7.2**	Date:	**16/12/14**
Project:	**Waikato Expressway:Hamilton Sect.**	Cone no.:	**C10CFIIP.C11284**
Location:	**Gordonton Rd**	Project no.:	**231695.00_027**
Position:	**5822519, 1801691 NZTM**	CPT no.:	**736** **4/6**

NZGD ID: 73329

NZGD ID: 73329



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1.40

r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-7.2**

Project: **Waikato Expressway:Hamilton Sect.**

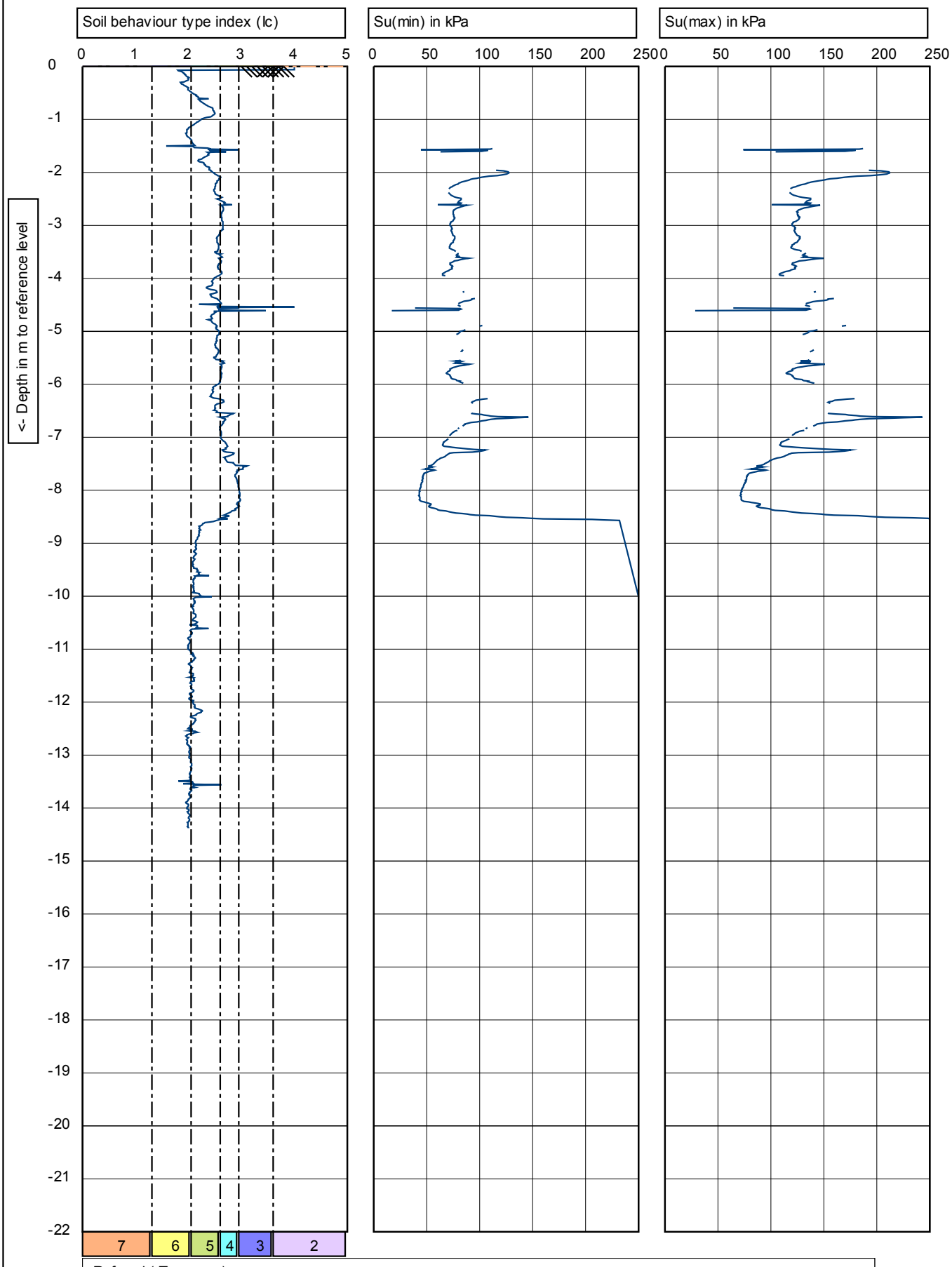
Location: **Gordonton Rd**

Position: **5822519, 1801691 NZTM**

Predrill :	**0 m Predrilled**
Date:	**16/12/14**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**736** 5/6

NZGD ID: 73329

NZGD ID: 73329



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r u2
L 150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L. 0 MSL | W.L.: **-7.2**

Project: **Waikato Expressway:Hamilton Sect.**

Location: **Gordonton Rd**

Position: **5822519, 1801691 NZTM**

Predrill :	**0 m Predrilled**
Date:	**16/12/14**
Cone no.:	**C10CFIIP.C11284**
Project no.:	**231695.00_027**
CPT no.:	**736** 6/6

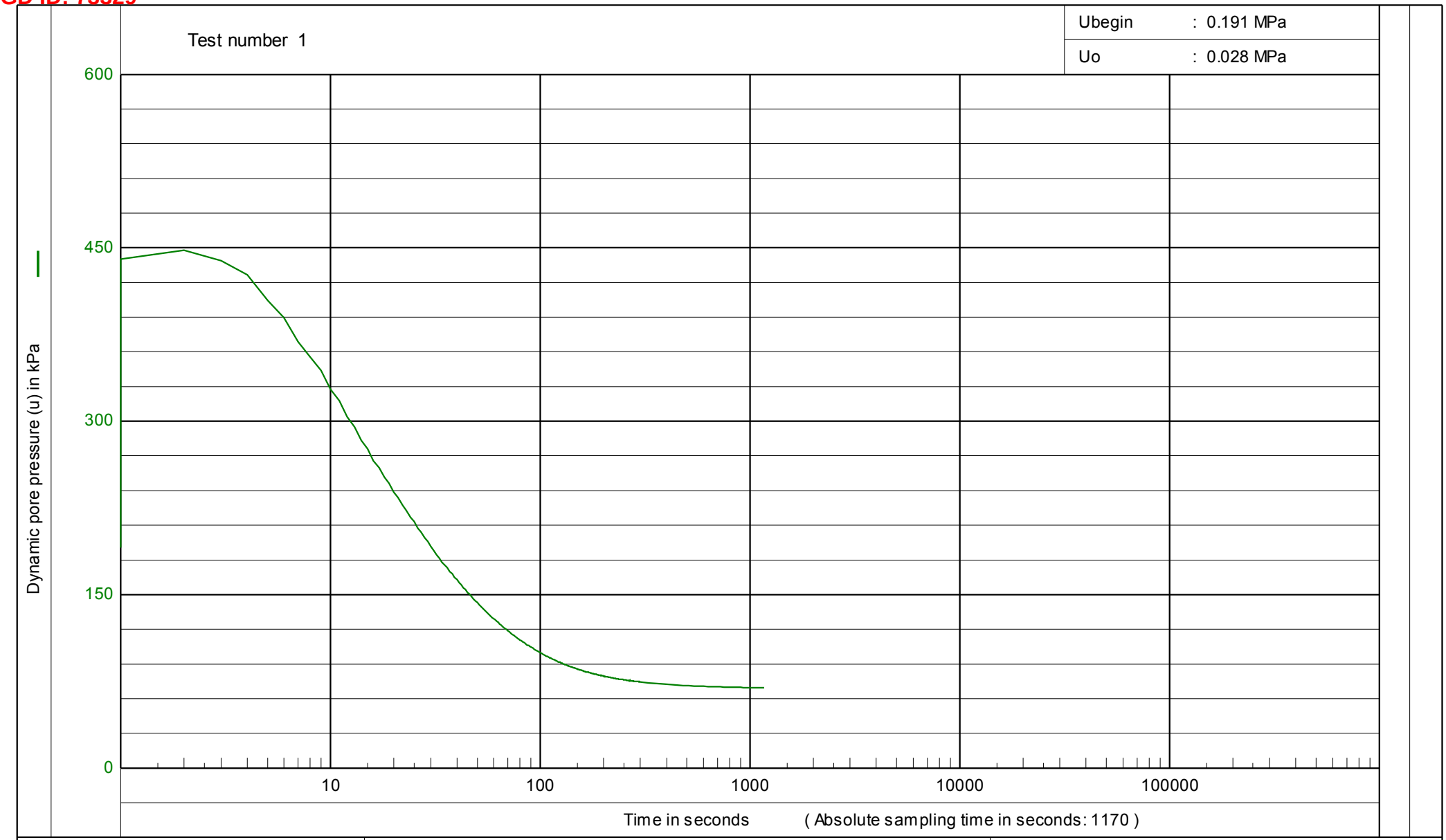
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NZGD ID: 73329

NZGD ID: 73329

Test number 1

Ubegin	: 0.191 MPa
Uo	: 0.028 MPa



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Test according ASTM D5778-12 & ISO 22476-1:2012

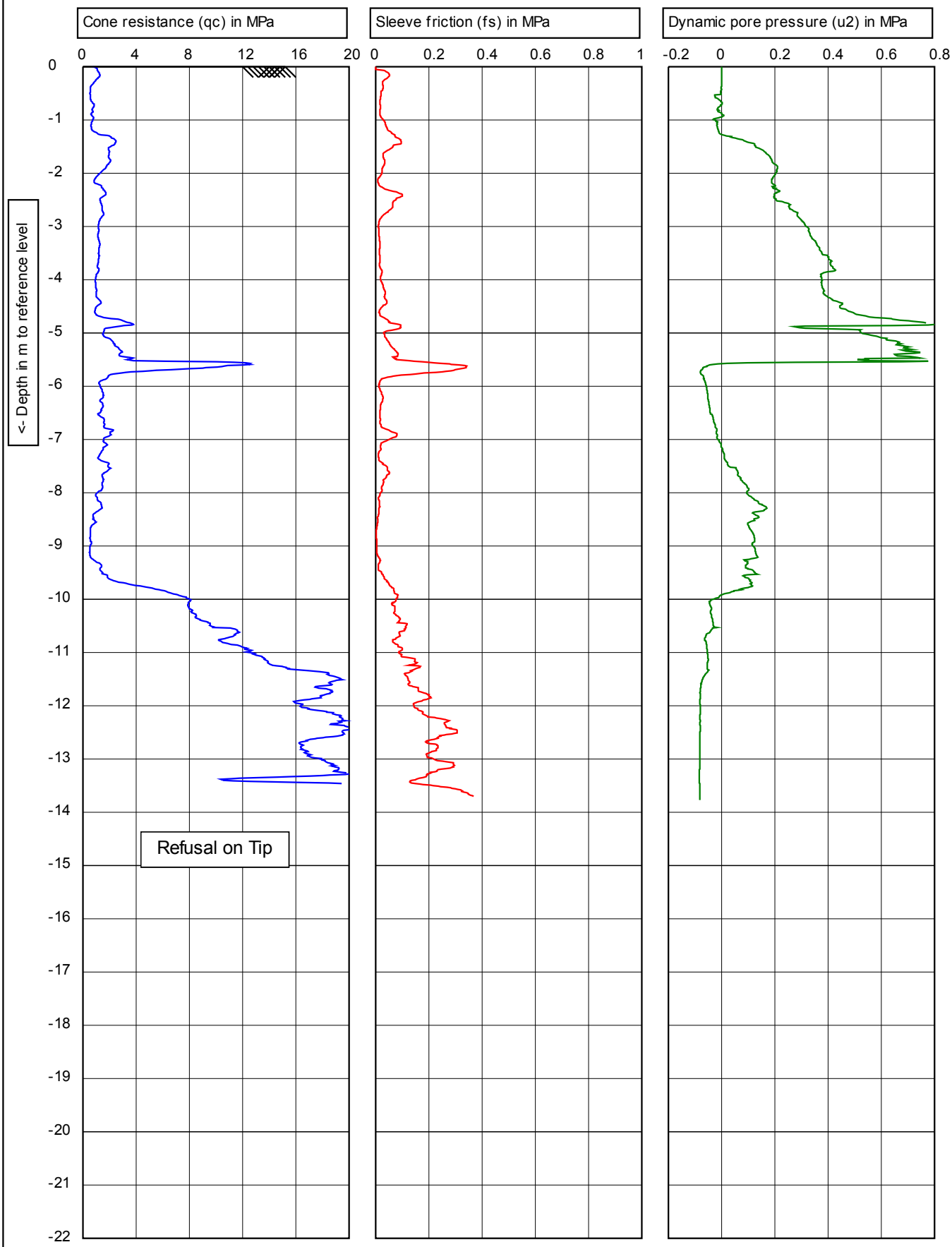
Project : Waikato Expressway:Hamilton Sect.

Location : Gordonton Rd

Date	: 16/12/14	
Project no.	: 231695.00_027	
CPT no.	: 736	
Test depth	: -10	[m] - G.L.
Water level	: -7.2	[m] - G.L.

NZGD ID: 73329

NZGD ID: 73388



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HAMILTON LABORATORIES

CPTask V1.20

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

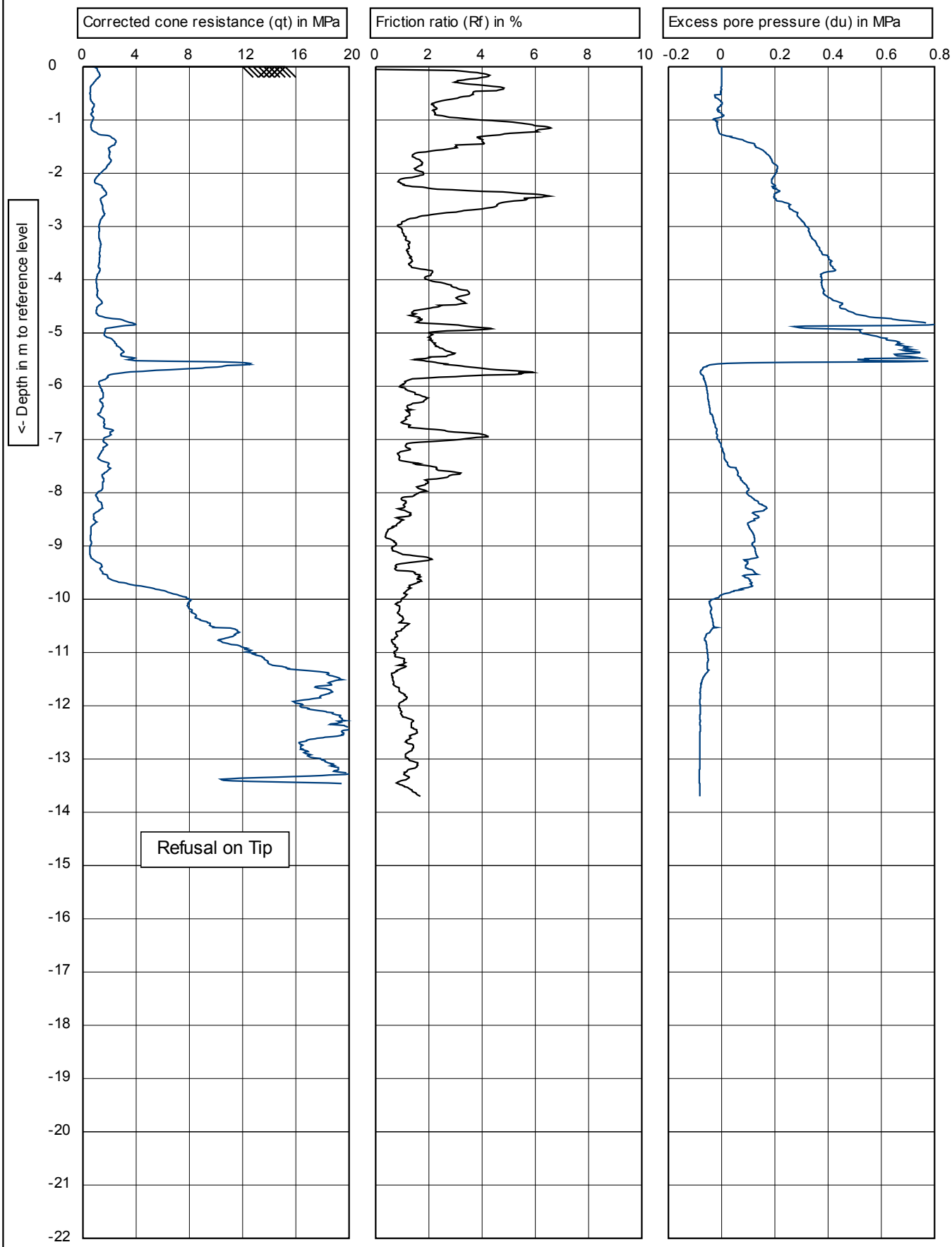
G.L. **0** W.L.: **-30**

Project: **Hamilton Sections**
Location: **GPS: E2711685 N6384217**
Position:

Predrill :	**-30**
Date:	**8/03/2011**
Cone no.:	**C10CFIIP.E09**
Project no.:	**2-31695.00**
CPT no.:	**CPT251** 1/6

NZGD ID: 73388

NZGD ID: 73388



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HAMILTON LABORATORIES

CPTask V1.20

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

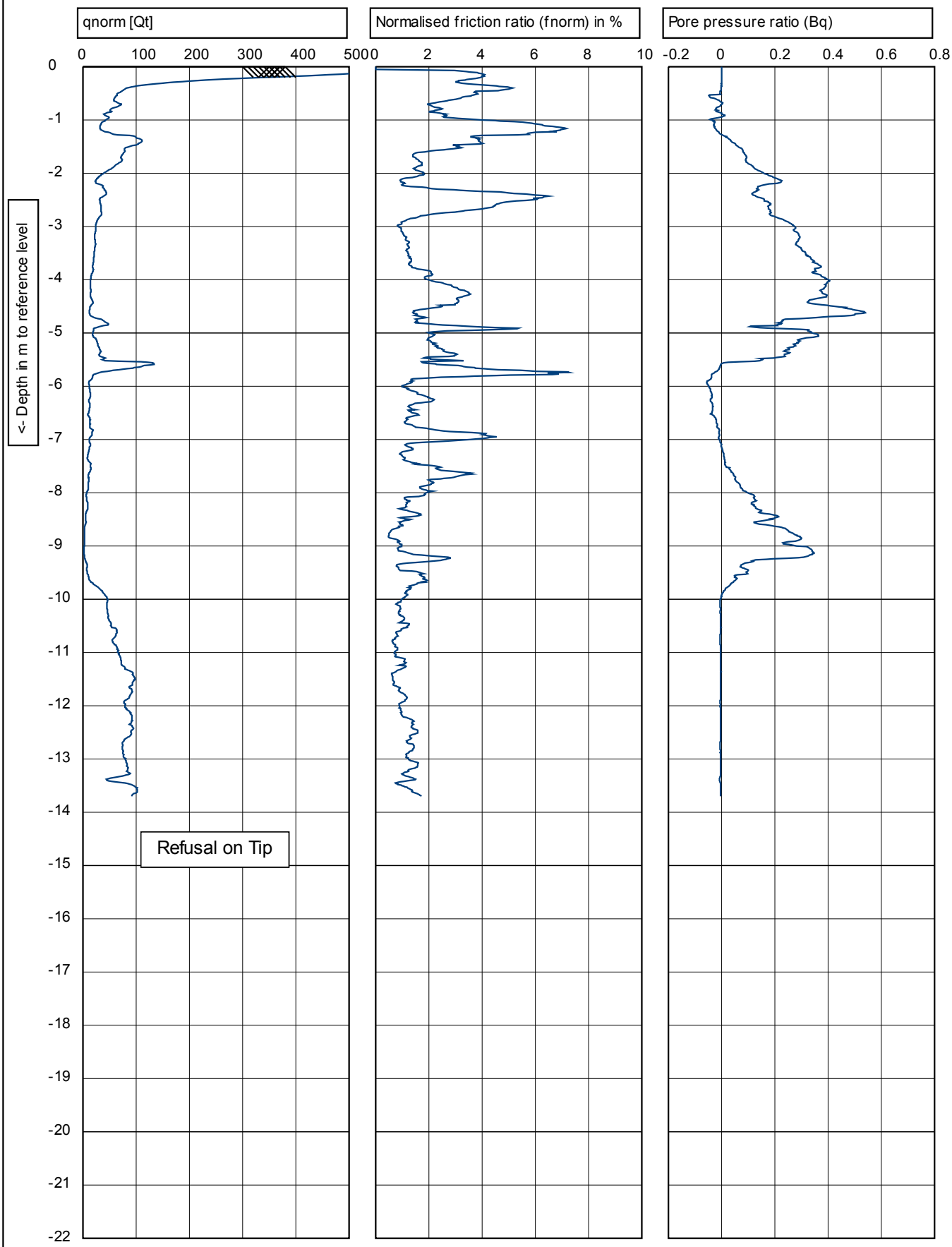
G.L. **0** W.L.: **-30**

Project: **Hamilton Sections**
Location: **GPS: E2711685 N6384217**
Position:

Predrill :	**-30**
Date:	**8/03/2011**
Cone no.:	**C10CFIIP.E09**
Project no.:	**2-31695.00**
CPT no.:	**CPT251** **2/6**

NZGD ID: 73388

NZGD ID: 73388



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HAMILTON LABORATORIES

CPTask V1.20

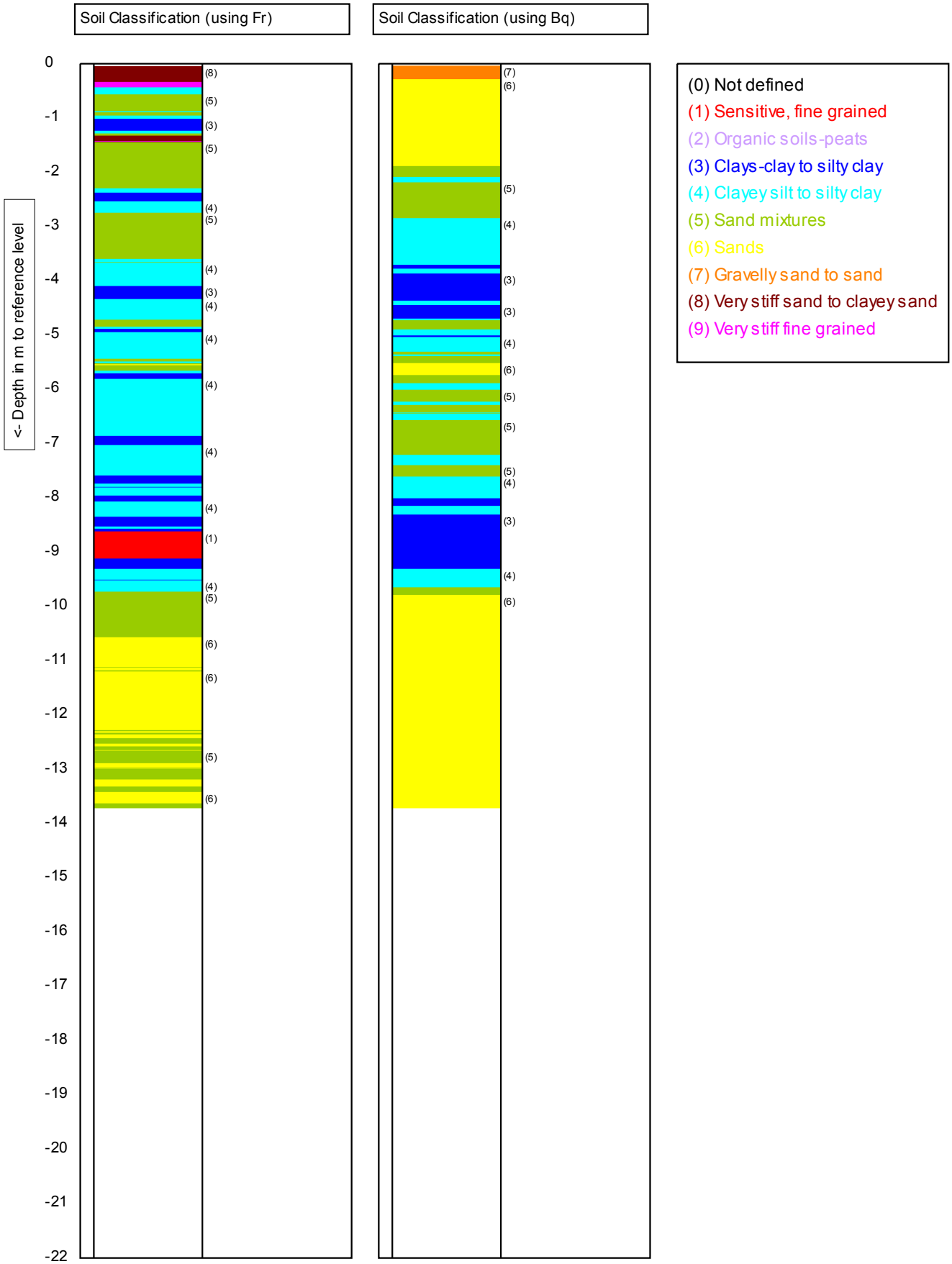
Test according to A.S.T.M. Standard D-5778-95

G.L. **0** W.L.: **-30**

Project: **Hamilton Sections**
Location: **GPS: E2711685 N6384217**
Position:

Predrill :	**-30**
Date:	**8/03/2011**
Cone no.:	**C10CFIIP.E09**
Project no.:	**2-31695.00**
CPT no.:	**CPT251** 3/6

NZGD ID: 73388

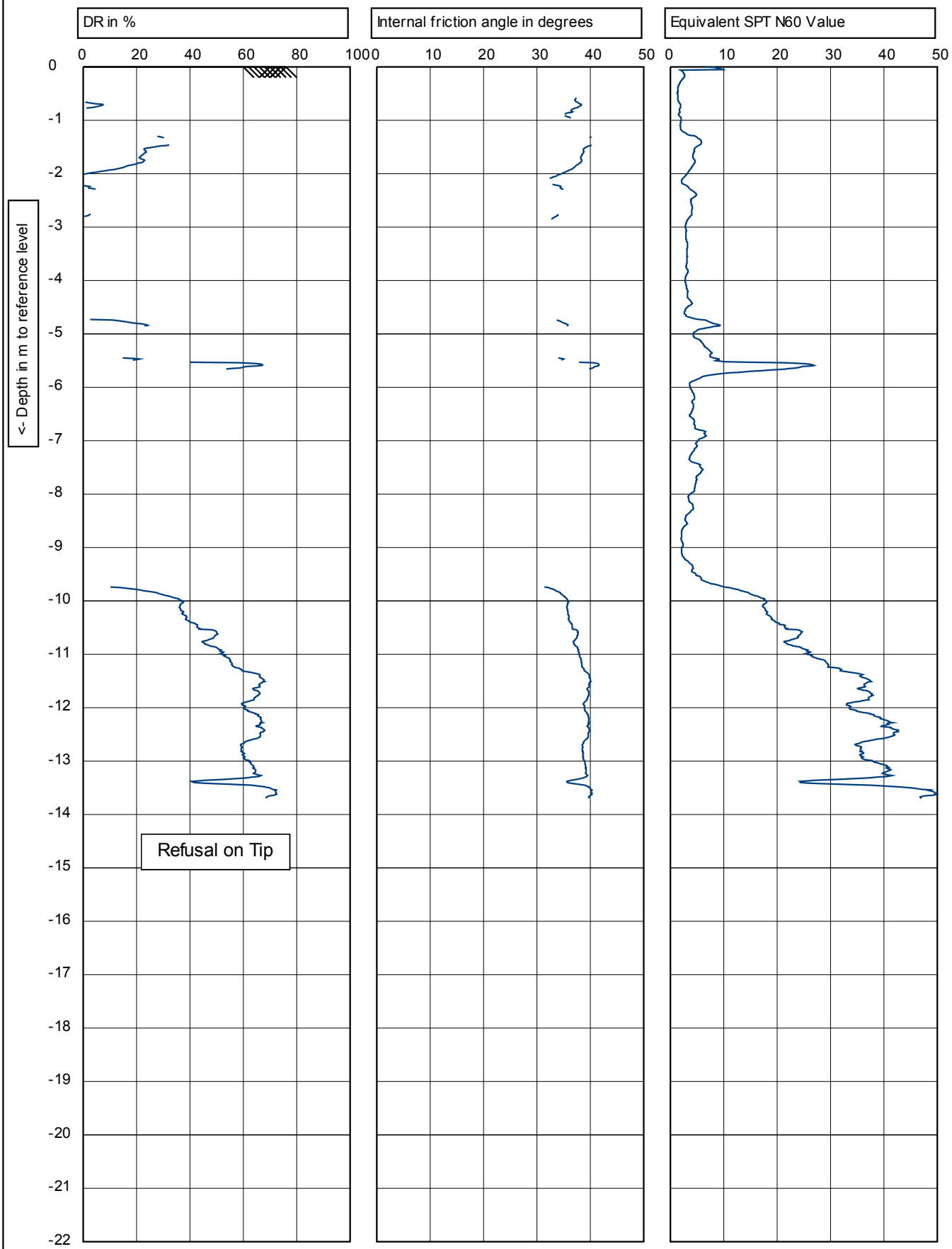


OPUS
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CPTask V1.20

Test according to A.S.T.M. Standard D-5778-95		Predrill :	-30
G.L. 0	W.L.: -30	Date:	8/03/2011
Project: Hamilton Sections		Cone no.:	C10CFIIP.E09
Location: GPS: E2711685 N6384217		Project no.:	2-31695.00
Position:		CPT no.:	CPT251 4/6

NZGD ID: 73388



OPUS
HAMILTON LABORATORIES

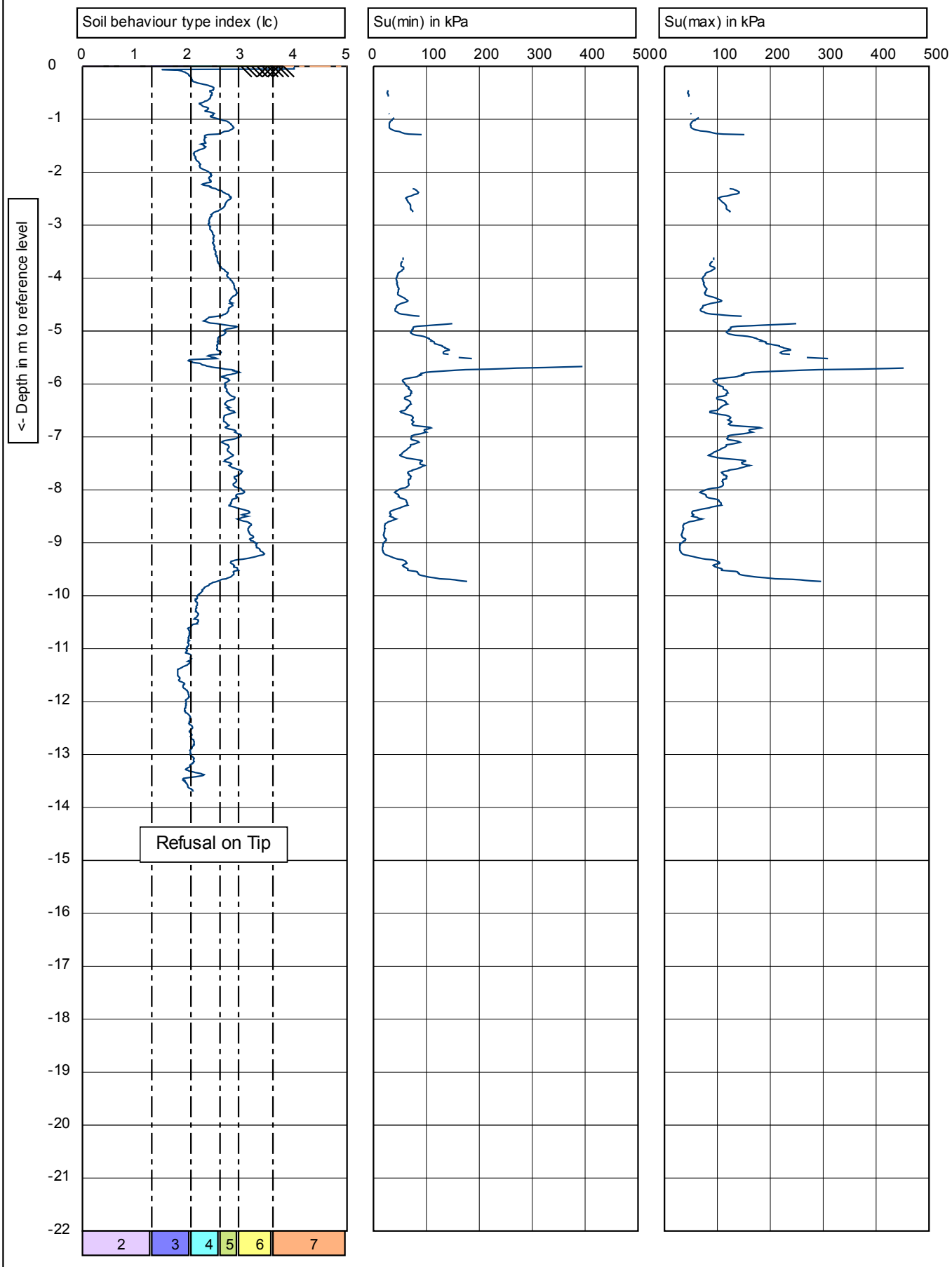
CPTask V1.20

Test according to A.S.T.M. Standard D-5778-95		Predrill :	-30
G.L. 0	W.L.: -30	Date:	8/03/2011
Project: Hamilton Sections		Cone no.:	C10CFIIP.E09
Location: GPS: E2711685 N6384217		Project no.:	2-31695.00
Position:		CPT no.:	CPT251 5/6

u2 150 cm² 10 cm²

NZGD ID: 73388

NZGD ID: 73388



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HAMILTON LABORATORIES

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

G.L. **0** W.L.: **-30**

Project: **Hamilton Sections**
Location: **GPS: E2711685 N6384217**
Position:

Predrill :	**-30**
Date:	**8/03/2011**
Cone no.:	**C10CFIIP.E09**
Project no.:	**2-31695.00**
CPT no.:	**CPT251** 6/6

CPTask V1.20

NZGD ID: 73388

NZGD ID: 77083

Borehole No. BH 793A

OPUS

Project: **Waikato Expressway: Hamilton Section**
Client: **NZ Transport Agency**
Location: **Borman Road / Gordonton Road**

Co-ord.: **1801766.72 E 5822576.09 N**
Grid: **NZTM**
R.L.: **56.43 m** *Depth:* **27.45 m**
Datum:
Inclination / Azimuth: **Vertical; n/a**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: DRILLING METHOD	DRILLING: CASING	DRILLING: BASE OF HOLE & WATER LEVEL	NOTES	INSTALLATION DETAILS
	SILT, minor sand, dark brown. Soft, moist to wet, slightly plastic. Rootlets. Sand is fine. (TOPSOIL)												
	From 0.06m, minor fine gravel, angular.												
	From 0.36m, trace of medium gravel, angular.	56											
	CLAY, orange. Firm, wet, slightly plastic, slightly sensitive.		1				38	HQ					
			2				68	HQ		HW Casing run to 3.0m			
		54	3		4	2// 1/1/1/1	129	SPT					
	From 3.30m, some silt.						100	HQ					
	Sandy SILT, orange, pink mottles. Soft to firm, wet, moderately plastic. Sand is fine to coarse.	52	4									Sand breaks down when worked.	24/12/2014
			5				95	HQ					23/02/2015
	CLAY, minor silt. white, orange mottles. Firm, moist to wet, moderately plastic.												
	Sandy SILT, orange, white and black mottles. Soft to firm, wet, slightly plastic. Sand is fine to coarse.		6		3	1// 1/0/1/1	140	SPT	HQ Size, Triple Tube, Wireline Rotary Coring			Sand breaks down when worked.	
	Clayey SILT, minor sand, white, orange mottles. Soft, wet, moderately plastic. Sand is fine.	50	7				100	HQ					
	CLAY, minor silt. white, reddish orange mottles. Soft, wet, moderately plastic, slightly sensitive. From 7.50m, light brown. From 7.60m, grey, some silt.												
	Silty CLAY, minor sand, dark grey. Firm, wet, moderately plastic. Sand is fine.		8				100	HQ					
	Silty fine to medium SAND, greyish white. 'Loose', wet, poorly graded, non plastic.	48											
	Silty CLAY, minor sand, grey. Very soft, wet, slightly plastic. Sand is fine. Interbedded with closely spaced moderately thin beds of **Silty fine to medium SAND**, grey. Very loose, wet, poorly graded, non plastic.		9		0	1// 0/0/0/0	0	SPT					
							100	HQ					
	Fine to coarse SAND, trace gravel, grey. 'Loose', wet, well graded, non plastic.												

Cement / Flush Toby

Bentonite Seal

Remarks:
Water level troll installed 24/12/14

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS
LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY GUIDELINES (2005)

Started: **9/12/2014**
Finished: **10/12/2014**
Drilling Co.: **Perry Geotech**
Drilling Rig: **Tractor**
Logged: **J Mackinnon**
Checked: **N Jokhan**
Lab Ref.: 14/821/026
Project No.: **2-31695.00**

Scale 1:50 @ A4

NZGD ID: 77083

NZGD ID: 77083

Borehole No. BH 793A

OPUS

Project: **Waikato Expressway: Hamilton Section**
Client: **NZ Transport Agency**
Location: **Borman Road / Gordonton Road**

Co-ord.: **1801766.72 E 5822576.09 N**
Grid: **NZTM**
R.L.: **56.43 m** *Depth:* **27.45 m**
Datum:
Inclination / Azimuth: **Vertical; n/a**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: DRILLING METHOD	DRILLING: CASING	DRILLING: BASE OF HOLE & WATER LEVEL	NOTES	INSTALLATION DETAILS
	Gravel is fine, subrounded to rounded. **Silty CLAY**, minor sand, grey. Very soft, wet, slightly plastic. Sand is fine. Interbedded with closely spaced very thin beds of **Silty fine to medium SAND**, grey. Very loose, wet, poorly graded, non plastic. *(continued)*						100	HQ	HQ Size, Triple Tube, Wireline Rotary Coring				Bentonite Seal
	Fine to coarse SAND, trace gravel, light grey. 'Loose', wet, well graded, non plastic. Gravel is fine, subrounded to rounded.		46										
	SILT, grey. Firm, wet, slightly plastic, slightly sensitive.		11				103	HQ					
	Fine to coarse SAND, trace to minor gravel, greyish white. 'Loose to medium dense", wet, well graded, non plastic. Gravel is fine, subrounded to rounded, pumice.												
	Silty fine to medium SAND, trace gravel. Dense, wet, poorly graded, non plastic. Gravel is fine to medium, subrounded to rounded pumice.		12		37	10// 9/8/8/12	80	SPT					
			44										
			13				100	HQ					
	From 14.01m, trace of medium pumice gravel, subrounded to rounded.		14										
	From 14.20m, no gravel.		42				100	HQ					
			15		34	9// 7/7/9/11	100	SPT					
	From 15.47m, trace to minor fine pumice gravel, subrounded to rounded.												
	From 16.01m, trace of medium pumice gravel, subrounded to rounded.		16				100	HQ					
			40										
	From 17.47m, minor gravel.		17				100	HQ					
	Silty fine to coarse SAND, minor gravel, light brown. Dense, wet, well graded, non plastic. Gravel is fine with trace of medium, subrounded to rounded pumice.		18		42	13// 9/10/10/13	100	SPT					
			38										
			19				100	HQ					
							100	HQ					

Remarks:
Water level troll installed 24/12/14

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS
LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY GUIDELINES (2005)

Started: **9/12/2014**
Finished: **10/12/2014**
Drilling Co.: **Perry Geotech**
Drilling Rig: **Tractor**
Logged: **J Mackinnon**
Checked: **N Jokhan**
Lab Ref.: 14/821/026
Project No.: **2-31695.00**

Scale 1:50 @ A4

NZGD ID: 77083

NZGD ID: 77083

Borehole No. BH 793A

OPUS

Project: **Waikato Expressway: Hamilton Section**
Client: **NZ Transport Agency**
Location: **Borman Road / Gordonton Road**

Co-ord.: **1801766.72 E 5822576.09 N**
Grid: **NZTM**
R.L.: **56.43 m** *Depth:* **27.45 m**
Datum:
Inclination / Azimuth: **Vertical; n/a**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: DRILLING METHOD	DRILLING: CASING	DRILLING: BASE OF HOLE & WATER LEVEL	NOTES	INSTALLATION DETAILS
	Silty fine to coarse SAND, minor gravel, light brown. Dense, wet, well graded, non plastic. Gravel is fine with trace of medium, subrounded to rounded pumice. *(continued)*	36					100	HQ	HQ Size, Triple Tube, Wireline Rotary Coring				32mm PVC Slotted Pipe, Walton Park Filter
			21		47	12// 10/10/12/15	100	SPT					
			22				100	HQ					
		34											
	At 22.70m, pumice cobble.												
	Fine to coarse SAND, minor gravel and silt, light brown. Dense, wet, well graded, non plastic. Gravel is fine with trace of medium, subrounded to rounded pumice.		23				98	HQ					
			24		45	15// 11/9/9/16	100	SPT					
		32											
	SILT, some sand, orange brown. Stiff to hard, moist to wet, slightly plastic. Sand is fine.		25				87	HQ					
	Clayey SILT, light brown. Stiff to hard, moist to wet, moderately plastic.												
	CLAY, minor silt, greyish brown. Hard, wet, moderately plastic.												
	Sandy SILT, light orange. Hard, wet, slightly plastic. Sand is fine to medium.		26				100	HQ					
		30											
	SILT, minor sand, light brown, orange mottles. Firm, moist to wet, slightly plastic. Sand is fine to medium.		27										
					14	4// 4/3/4/3	102	SPT			27.45m 10/12		
	END OF BOREHOLE AT 27.45m		28										
		28											
			29										

Remarks:
Water level troll installed 24/12/14

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS
LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY GUIDELINES (2005)

Started: **9/12/2014** *Drilling Co.:* **Perry Geotech**
Finished: **10/12/2014** *Drilling Rig:* **Tractor**
Logged: **J Mackinnon**
Checked: **N Jokhan**
Lab Ref.: 14/821/026 *Project No.:* **2-31695.00**

Scale 1:50 @ A4

NZGD ID: 77083

NZGD ID: 77083

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 14/821/026



BH-793a

Core Photos

NZGD ID: 77083

NZGD ID: 77083

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 14/821/026



BH-793a

Core Photos

NZGD ID: 77083

NZGD ID: 77083

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 14/821/026



BH-793a

Core Photos

NZGD ID: 77083

NZGD ID: 77083

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 14/821/026





BH-793a

Site Photos

NZGD ID: 77083

NZGD ID: 77098

Borehole No. BH 829

OPUS

Project: **Waikato Expressway: Hamilton Section**
Client: **NZ Transport Agency**
Location: **Borman Road to Gordonton Road Embankment**

Co-ord.: **1801252.96 E 5822678.92 N**
Grid: **NZTM**
R.L.: **32.16 m** *Depth:* **15 m**
Datum:
Inclination / Azimuth: **Vertical; n/a**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: DRILLING METHOD	DRILLING: CASING	DRILLING: BASE OF HOLE & WATER LEVEL	NOTES	INSTALLATION DETAILS
	SILT, trace sand, black. Soft, wet, slightly plastic. Rootlets. (TOPSOIL)	32	0										Cement / Upstand
	Silty CLAY, light brown, orange mottled. Firm, wet, slightly to moderately plastic.		1				73	PQ			0.27m 23/01		
	Organic SILT, trace sand, trace to minor wood, black to dark grey. Very soft, wet, slightly plastic.	30	2		0	1// 0/0/0/0	67	SPT					
			3				100	PQ					
							100	PT					Bentonite Seal
			4		?	SV: 13/3 kPa	100	SPT					
	Fine to medium SAND, grey. 'Loose to medium dense', wet, poorly graded, non plastic.	28					10	PQ					
	Silty fine SAND, light brown. Medium dense, wet, poorly graded, non plastic.		5		18	6// 4/5/5/4	96	SPT					
	Fine to coarse SAND, light brown. 'Loose', wet, well graded, non plastic.												
	SILT, brown. Firm, wet, slightly plastic.						96	PQ					
	Silty fine to medium SAND, light brown. Medium dense, wet, poorly graded, non plastic.	26	6		27	11// 6/6/7/8	93	SPT	PQ Size, Triple Tube, Wireline Rotary Coring				
	Fine to coarse SAND, trace to minor gravel, light brown. Dense, wet, well graded, non plastic. Gravel is fine, subrounded to rounded pumice.		7				100	PQ					
					33	11// 7/7/9/10	100	SPT					
	Silty fine to medium SAND, minor coarse sand, minor gravel, light brown. Dense, wet, poorly graded, non plastic. Gravel is fine, subrounded to rounded, pumice.	24	8				100	PQ					
	From 9.23m, orange light brown mottle.		9		46	13// 10/10/12/14	111	SPT					32mm PVC Slotted Pipe, Walton Park Filter
							95	PQ					

Remarks:
SV: Shear Vane DR3332a, const. 1.46
Artesian water level 24/02/2015: 0.40m above ground level.

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS
LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY GUIDELINES (2005)

Started: **23/01/2015** *Drilling Co.:* **Perry Geotech**
Finished: **23/01/2015** *Drilling Rig:* **Morooka**
Logged: **J Mackinnon**
Checked: **N Jokhan**
Lab Ref.: 15/803/002 *Project No.:* **2-31695.00**

Scale 1:50 @ A4

NZGD ID: 77098

NZGD ID: 77098

Borehole No. BH 829

OPUS

Project: **Waikato Expressway: Hamilton Section**
Client: **NZ Transport Agency**
Location: **Borman Road to Gordonton Road Embankment**

Co-ord.: **1801252.96 E 5822678.92 N**
Grid: **NZTM**
R.L.: **32.16 m** *Depth:* **15 m**
Datum:
Inclination / Azimuth: **Vertical; n/a**

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: TOTAL CORE RECOVERY (%)	CORE: SAMPLE TYPE	DRILLING: DRILLING METHOD	DRILLING: CASING	DRILLING: BASE OF HOLE & WATER LEVEL	NOTES	INSTALLATION DETAILS
	Silty fine to medium SAND, minor coarse sand, minor gravel, orange light brown mottle. Dense, wet, poorly graded, non plastic. Gravel is fine, subrounded to rounded, pumice. *(continued)*	22					95	PQ	PQ Size, Triple Tube, Wireline Rotary Coring				Bentonite Seal
			11		37	12// 9/9/9/10	71	SPT					
							100	PQ					
	From 12.07m to 12.17m, **coarse SAND**, grey. Loose, wet, uniformly graded. (Possible fallback)	20	12		50+	15// 10/15/18/7 for 35mm	107	SPT					
			13				96	PQ					
	Coarse SAND, grey. Loose, wet, uniformly graded. (Possible fallback)				50+	7// 13/12/24/1 for 0mm	155	SPT					
	Silty fine to medium SAND, light brown. Very dense, moist to wet, poorly graded, non plastic. From 14.05m, trace coarse gravel, subrounded to rounded, pumice.	18	14				96	PQ			15m 23/01		
	END OF BOREHOLE AT 15m		15										
		16	16										
			17										
		14	18										
			19										

Remarks:
SV: Shear Vane DR3332a, const. 1.46
Artesian water level 24/02/2015: 0.40m above ground level.

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS
LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY GUIDELINES (2005)

Started: **23/01/2015** *Drilling Co.:* **Perry Geotech**
Finished: **23/01/2015** *Drilling Rig:* **Morooka**
Logged: **J Mackinnon**
Checked: **N Jokhan**
Lab Ref.: 15/803/002 *Project No.:* **2-31695.00**

Scale 1:50 @ A4

NZGD ID: 77098

NZGD ID: 77098

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 15/803/002



BH-829

Core Photos

NZGD ID: 77098

NZGD ID: 77098

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 15/803/002



BH-829

Core Photos

NZGD ID: 77098

NZGD ID: 77098



BH-829

Core Photos

NZGD ID: 77098

NZGD ID: 77098

OPUS

Waikato Expressway: Hamilton Section

Project No: 2-31695.00
Lab Ref No: 15/803/002





BH-829

Site Photos

NZGD ID: 77098

NZGD ID: 77098

PLASTICITY INDEX FOR SOILS TEST REPORT

OPUS

Project :	**Waikato Expressway Hamilton Section**
Location :	**See Below**
Client :	**Opus Hamilton**
Contractor :	-
Sampled by :	**Opus Hamilton**
Date received :	**January 2015**
Sampling method :	**See Below**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/004**
Client Ref No :	

Test Results

Location:	Horsham Downs Link		Resolution Drive Intechange		CH7300 Borman
Sampling method:	Pushtube	Pushtube	Pushtube	Pushtube	Pushtube
Soil Fraction Tested:	-425um	-425um	Whole	-425um	Whole
Borehole :	BH816	BH816	BH817	BH817	BH829
Depth (m) :	4.5-5.0	6.0-6.5	3.0-3.5	6.0-6.5	3.0-3.5
Liquid Limit :	74	66	120	78	69
Plastic Limit :	47	41	52	43	34
Plasticity Index :	27	25	68	35	35
Natural Water Content (%):	86.6	73.1	114.4	63.4	55.8

Sample Description:
BH816 4.5-5.0m : Sandy clayey SILT.
BH816 6.0-6.5m : Clayey sandy SILT.
BH817 3.0-3.5m : Sandy CLAY wit minor sand.
BH817 6.0-6.5m : Clayey SILT with some sand.
BH829 3.0-3.5m : Silty CLAY with minor sand.

Test Methods		Notes
Water Content	NZS 4402 : 1986, Test 2.1	Soil Fraction Tested as shown
Liquid Limit	NZS 4402 : 1986, Test 2.2	1. Unable to form groove and/or sample slipping in bowl.
Plastic Limit	NZS 4402 : 1986, Test 2.3	2. Unable to roll to specified dimensions.(Sandy sample)
Plasticity Index	NZS 4402 : 1986, Test 2.4	3. **N.P.** denotes **Non Plastic**
		4. Where applicable the sample was rubbed through the 425um sieve.

Date tested : 16-24/02/15
Date reported : 27/02/2015

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 27/02/2015

Testing is covered by IANZ Accreditation
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IANZ ACCREDITED LABORATORY

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

CSF 2004 (22/08/03)
Opus International Consultants Limited
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Quality Management Systems Certified to ISO 9001

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w: www.opus.co.nz

NZGD ID: 77098

NZGD ID: 77098

PLASTICITY INDEX FOR SOILS TEST REPORT

OPUS

Project :	**Waikato Expressway Hamilton Section**
Location :	**See Below**
Client :	**Opus Hamilton**
Contractor :	-
Sampled by :	**Opus Hamilton**
Date received :	**January 2015**
Sampling method :	**See Below**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/004**
Client Ref No :	

Test Results

Location:	CH7300 Borman Rd	Gordonton Bridge			
Sampling method:	Core	SPT	Core	SPT	SPT
Soil Fraction Tested:	Whole	Whole	-425um	-425um	-425um
Borehole :	BH829	BH830	BH830	BH830	BH830
Depth (m) :	9.5-10.5	5.5-6.0	8.0-9.0	10.5-11.0	12.0-12.5
Liquid Limit :	See Note 1	93	78	50	See Note 1
Plastic Limit :	See Note 2	38	43	30	See Note 2
Plasticity Index :	N.P.	55	35	20	N.P.
Natural Water Content (%):	37.2	48.3	71.3	50.5	31.1

Sample Description: **BH829 9.5-10.5m :** Clayey/Silty SAND with minor gravel.
BH830 5.5-6.0m : Silty CLAY with minor sand.
BH830 8.0-9.0m : Sandy CLAY/SILT
BH830 10.5-11.0m : Clayey/Silty SAND.
BH830 12.0-12.5m : SAND with minor gravel and minor silt/clay.

Test Methods		Notes
Water Content	NZS 4402 : 1986, Test 2.1	Soil Fraction Tested as shown
Liquid Limit	NZS 4402 : 1986, Test 2.2	1. Unable to form groove and/or sample slipping in bowl.
Plastic Limit	NZS 4402 : 1986, Test 2.3	2. Unable to roll to specified dimensions.(Sandy sample)
Plasticity Index	NZS 4402 : 1986, Test 2.4	3. **N.P.** denotes **Non Plastic**
		4. Where applicable the sample was rubbed through the 425um sieve.

Date tested : 16-24/02/15
Date reported : 27/02/2015

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 27/02/2015

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w: www.opus.co.nz

NZGD ID: 77098

NZGD ID: 77098

CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

OPUS

Project: **Waikato Expressway Hamilton Section**
Location: **ch7300 Borman Road**
Client: **Opus Hamilton**
Borehole No: **BH 829** Depth: **9.5-10.5m** Sample type: **Core**
Sampled By: **Opus Hamilton** Date: **Jan 2015**
Description: **silty f-m SAND**
Sample Condition: **Saturated test - trimmed from core sample at as received condition.**

Comments

Consolidated Drained Test

Initial Sample Dimensions: **Diameter=49.68 (mm), Ht=25.26 (mm).**

Sheared at a constant rate of strain (mm/min)= **0.1691**

Project No: **2-31695.00**
Lab Ref No: **15/803/004**
Client Ref:

	Initial Sample Properties							Consolidated
Sample No	Normal Stress (kPa)	Water Content (%)	Wet Density (t/m^3)	Dry Density (t/m^3)	Void Ratio (e_0)	Deg Saturation (%)	Solid Density (t/m^3)	Void Ratio (e_f)
1	50	36.0	1.61	1.18	1.24	77	2.65 Assumed	1.22
2	101	36.0	1.62	1.19	1.22	78		1.15
3	202	36.0	1.59	1.17	1.27	75		1.17

Final Sample Properties			Maximum Stresses		
Water Content (%)	Wet Density (t/m^3)	Dry Density (t/m^3)	Normal Stress (kPa)	Max Shear Stress (kPa)	Displacement (mm)
46.7	1.75	1.20	50	182.3	2.39
45.9	1.80	1.23	101	218.5	2.96
46.5	1.79	1.22	202	335.5	2.98

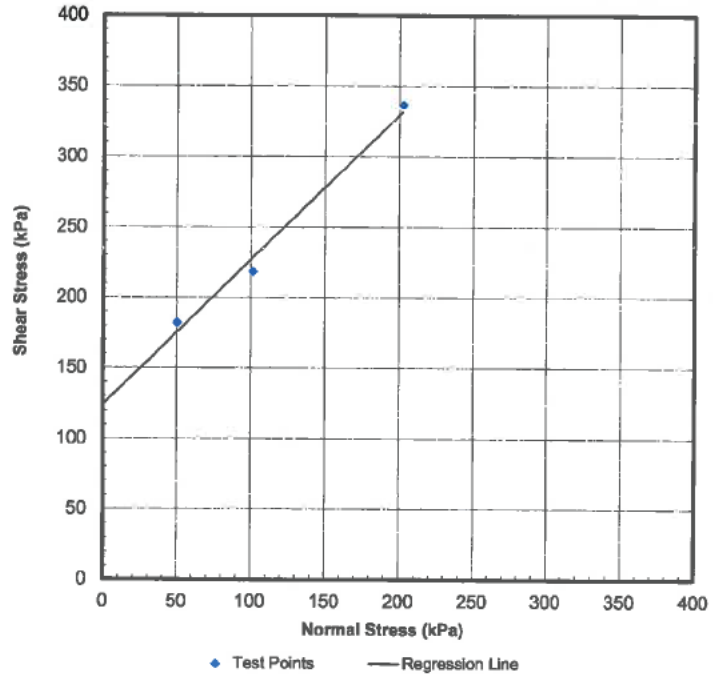
Shear Rate: (Time to Failure (t_f)) (mins)

Sample No	Calculated t_f	t_f @ Shr Rate (mm/min)
1		60 min @ 0.1691
2		60 min @ 0.1691
3		60 min @ 0.1691

Consolidated Drained Direct Shear Test
Plot - Shear Stress (kPa) vs Normal Stress (kPa)
Result at **MAXIMUM SHEAR STRESS**

Shear Strength Parameters @ Max Shear Stress

Phi (∅)	46	Degrees
Cohesion (c)	124	kPa
Correl Coeff	0.9879	r^2



Test Method	Notes
ASTM D 3080-04 Direct Shear Test of Soils Under Consolidated Drained Conditions	**W/C= Water Content. OWC=Optimum Water Content** **DD= Dry Density**

Date Tested : 20/02/15

Date Reported : 27/02/15

Signatory:

Designation : *Senior Civil Engineering Technician*
Date : 27/02/15

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NZGD ID: 77098

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CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

OPUS

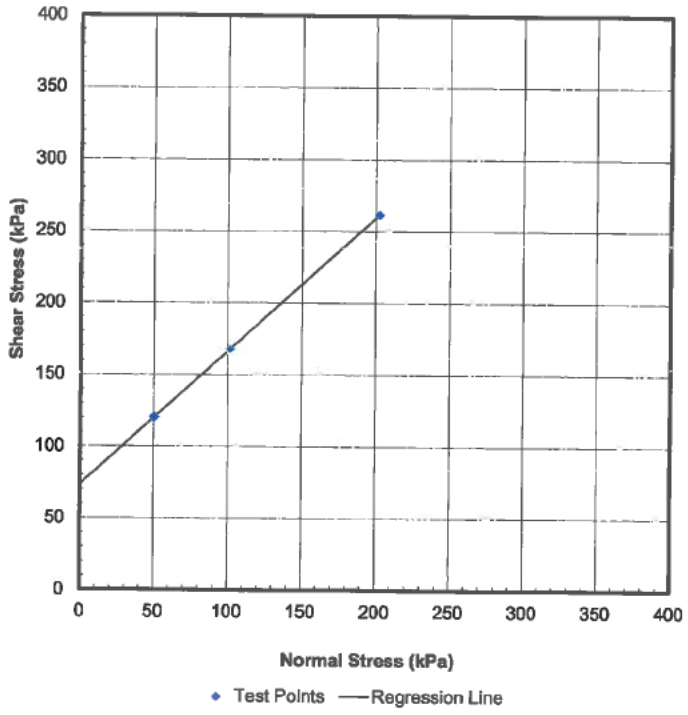
Project: **Waikato Expressway Hamilton Section**
Location: **ch7300 Borman Road**
Client: **Opus Hamilton**
Borehole No: **BH 829** Depth: **9.5-10.5m** Sample type: **Core**
Sampled By: **Opus Hamilton** Date: **Jan 2015**
Description: **silty f-m SAND**
Sample Condition: **Saturated test - trimmed from core sample at as received condition.**

Comments
Consolidated Drained Test
Initial Sample Dimensions: **Diameter=49.68 (mm), Ht=25.26 (mm).**
Sheared at a constant rate of strain (mm/min)= 0.1691

Project No: **2-31695.00**
Lab Ref No: **15/803/004**
Client Ref:

Test Values			Sample Properties at test			Result at RESIDUAL SHEAR STRESS		
Sample No	Normal Stress (kPa)	Shear Stress (kPa)	Water Content at Test (%)	Wet Density (t/m^3)	Dry Density (t/m^3)			
1	50	120.7	36.0	1.61	1.18	Phi' (∅')	43	Degrees
2	101	167.0	36.0	1.62	1.19	Cohesion (c')	73	kPa
3	202	261.9	36.0	1.59	1.17	Correl Coeff	0.9999	r^2

Consolidated Drained Direct Shear Test Result at RESIDUAL SHEAR STRESS
Normal Stress vs Shear Stress Plot
Result at RESIDUAL SHEAR STRESS



Test Method	Notes
ASTM D 3080-04 Direct Shear Test of Soils Under Consolidated Drained Conditions	

Date Tested: 20/02/15

Date Reported : 27/02/15

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Date : 27/02/15

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CONSOLIDATED DRAINED DIRECT SHEAR
Stress Path Plot TEST REPORT

OPUS

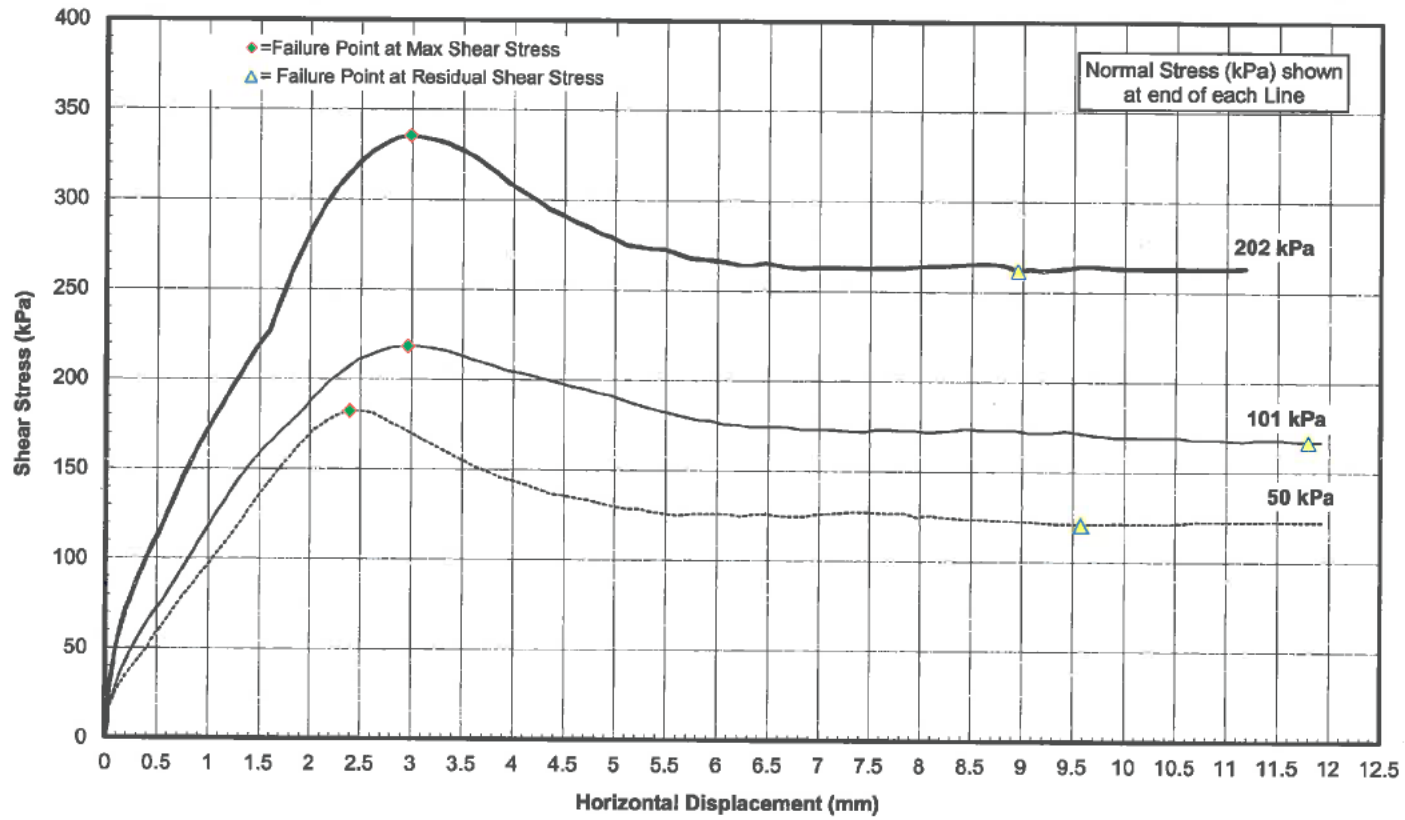
Project:	**Waikato Expressway Hamilton Section**
Location:	**ch7300 Borman Road**
Client:	**Opus Hamilton**
Borehole No:	**BH 829** Depth: **9.5-10.5m** Sample type: **Core**
Sampled By:	**Opus Hamilton** Date: **Jan 2015**
Description:	**silty f-m SAND**
Sample Condition:	**Saturated test - trimmed from core sample at as received condition.**

Consolidated Drained Test

Project No:	**2-31695.00**
Lab Ref No:	**15/803/004**
Client Ref:	

Consolidated Drained Direct Shear Test Result

Stress Path Plot - Shear Stress (kPa) vs Horizontal Displacement (mm) during shearing.



Note: The 'RESIDUAL Shear Stress' is taken at the lowest reading after the PEAK.

*Tested using the **NON-RECIPROCATING** Direct Shear Apparatus.*

Test Method	Notes
ASTM D 3080-04 Direct Shear Test of Soils Under Consolidated Drained Conditions	

Date Tested : 20/02/15

Note: Result has been forced to zero

Date Reported : 27/02/15

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Date : 27/02/15

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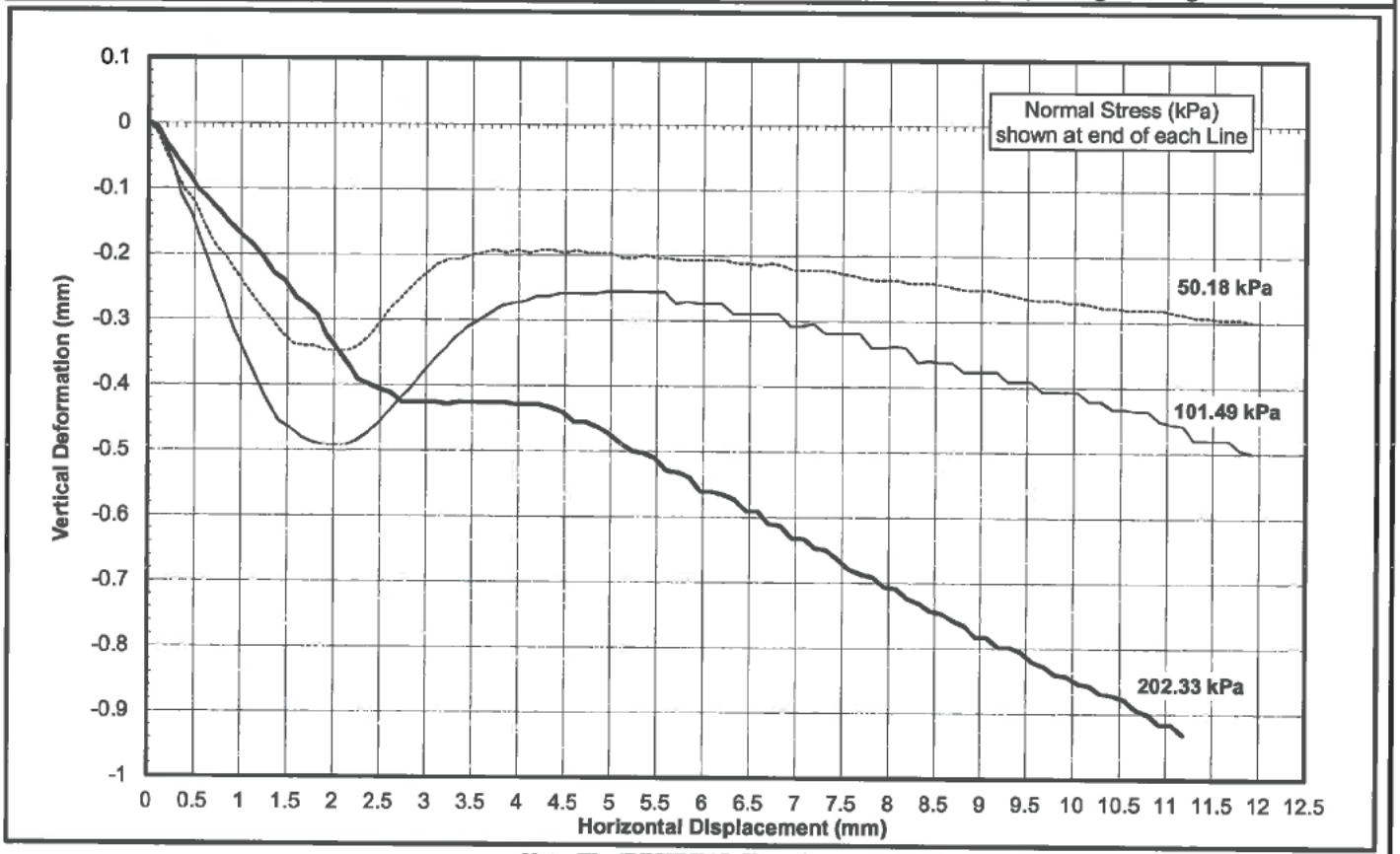
CONSOLIDATED DRAINED DIRECT SHEAR
Stress Path Plot TEST REPORT

OPUS

Project: **Waikato Expressway Hamilton Section**
Location: **ch7300 Borman Road**
Client: **Opus Hamilton**
Borehole No: **BH 829** Depth: **9.5-10.5m** Sample type: **Core**
Sampled By: **Opus Ham** Date: **Jan 2015**
Description: **silty f-m SAND**
Sample Condition: **Saturated test - trimmed from core sample at as received condition.**

Project No:	**2-31695.00**
Lab Ref No:	**15/803/004**
Client Ref:	

Consolidated Drained Direct Shear Test Result
Stress Path Plot - Vertical Deformation (mm) against Horizontal Displacement (mm) during shearing.



Note: The 'RESIDUAL Shear Stress' is taken at the lowest reading after the PEAK.
*Tested using the **NON-RECIPROCATING** Direct Shear Apparatus.*

Test Method	Notes
ASTM D 3080-04 Direct Shear Test of Soils Under Consolidated Drained Conditions	

Date Tested : 20/02/15

Date Reported : 27/02/15

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Signatory:

Designation : *Civil Engineering Technician*
Date : 27/02/15

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES TEST RESULT REPORT

OPUS

Project : **Waikato Expressway Hamilton Section**
Location: **ch7300 Borman Rd**
Client : **Opus Hamilton**

Sample No :
BH/TP/Sample ID: **BH 829** Depth: **3.0-3.5m**
Sampled by : **Opus, Hamilton** Date: **Jan 2015**

Sampling method : **Pushtube**
Sample description : **Greyish brown organic SILT. V.soft.**
Black organic speckles throughout.
Sample condition : **As received**
OEDOMETER APPARATUS No: Four

Project No: **2-31695.00**
Lab Ref No **15/803/004**
Client Ref:

SOIL PROPERTIES

Specimen Dimensions:	
Diameter (mm):	50.05
Initial height (mm):	18.96
Final height (mm):	15.21
Initial mass of sample (g):	57.49

Initial Wet Density	pbi (t/m³)	1.54
Initial Dry Density	pdi (t/m³)	0.91
Final Dry Density	pdf (t/m³)	1.13
Initial Void Ratio	eo	1.92
Final Void Ratio	ef	1.34
Initial Degree of Saturation	Si (%)	96
Final Degree of Saturation	Sf (%)	95
Solid Particle Density (Assumed)	Gs (t/m³)	2.65
INITIAL Water Content	Wi (%)	69.7
FINAL Water Content	Wf (%)	47.9

CONSOLIDATION PROPERTIES

PRESSURE RANGE (kPa)	Pressure Increment (dp)	Void Ratio (e)	Intercept t90 (min)	Volume Compressibilty Mv=m²/MN	Coeff. of Consolidation Cv=m²/year	Coeff. of Permeability k=m/year	
0 - 10	10	1.913	-	-	-	-	
10 - 25	15	1.891	19.364	0.51	2.1	1.0×10^{-2}	
25 - 50	25	1.844	31.582	0.65	1.2	7.9×10^{-3}	
50 - 100	50	1.717	58.526	0.89	0.65	5.7×10^{-3}	
100 - 200	100	1.539	65.929	0.66	0.52	3.4×10^{-3}	
200 - 400	200	1.377	44.220	0.32	0.68	2.1×10^{-3}	
400 - 800	400	1.250	28.413	0.13	0.93	1.2×10^{-3}	
800 - 10	-	1.341	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	
-	-	-	-	-	-	-	

Test Methods:	
One Dimensional Consolidation Test.	NZS 4402:1986 Test 7.1
Water Content	NZS 4402:1986 Test 2.1

Notes:
Sample is saturated during test.
Load Increments applied at 2hr intervals

Date tested : 19/02/15
Date reported : 25/02/15

IANZ Approved Signatory
Designation : Senior Civil Engineering Technician
Date : 25/02/15

Testing is covered by IANZ Accreditation
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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Applied Pressure vs Void Ratio TEST REPORT

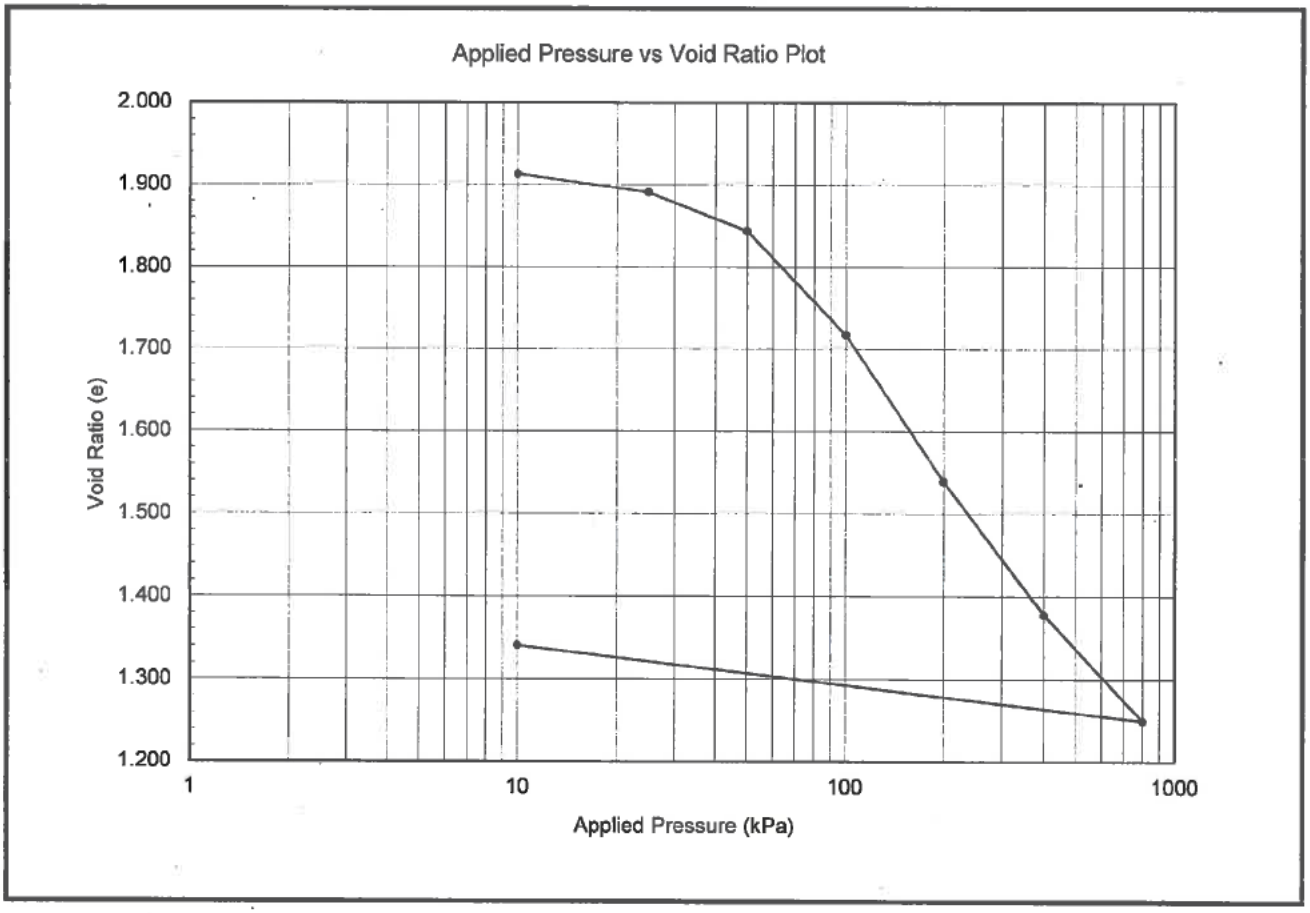
OPUS

Project : **Waikato Expressway Hamilton Section**
Location: **ch7300 Borman Rd**
Client : **Opus Hamilton**

Sample No :
BH/TP/Sample ID: **BH 829** Depth: **3.0-3.5m**
Sampled by : **Opus, Hamilton** Date: **Jan 2015**
Sample description : **Greyish brown organic SILT. V.soft. Black organic speckles throughout.**
Sampling method : **Pushtube**
Sample condition : **As received**

Project No:	**2-31695.00**
Lab Ref No:	**15/803/004**
Client Ref:	

OEDOMETER APPARATUS No: Four



Test Method:		Notes:
One Dimensional Consolidation Test:	NZS 4402:1986 Test 7.1	Load Increments applied at 2hr intervals

Date tested : 19/02/15

Date reported : 25/02/15

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
Date : 25/02/15

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

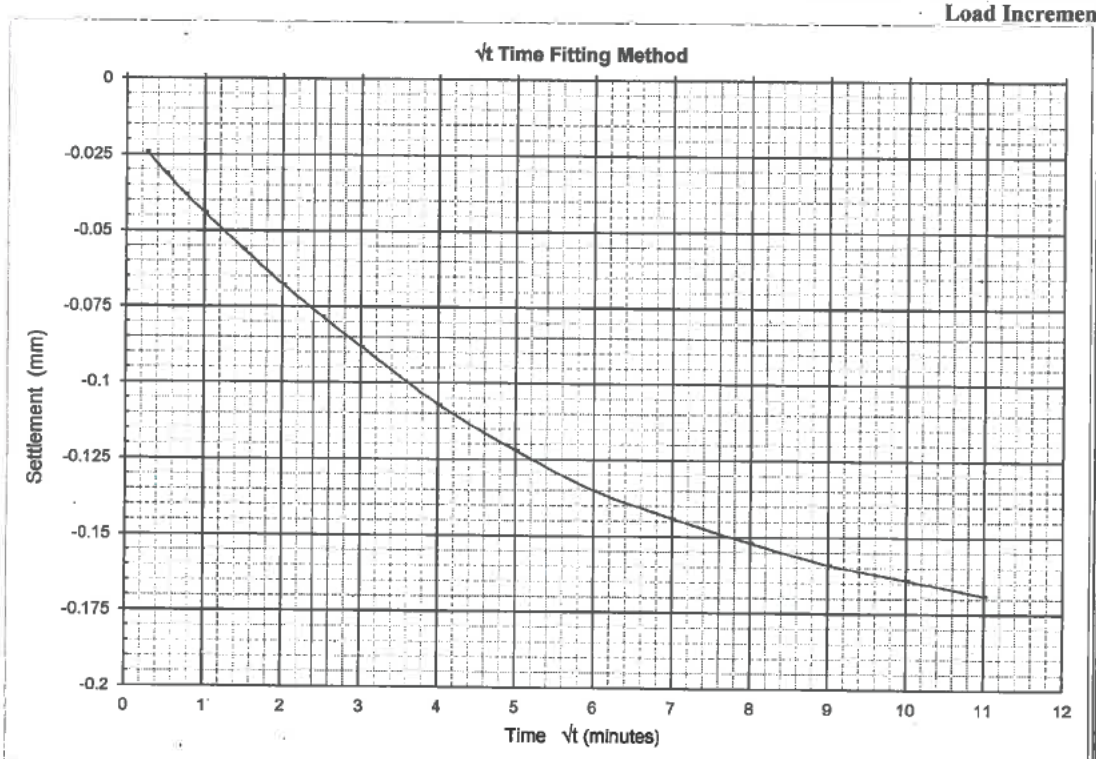
Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.

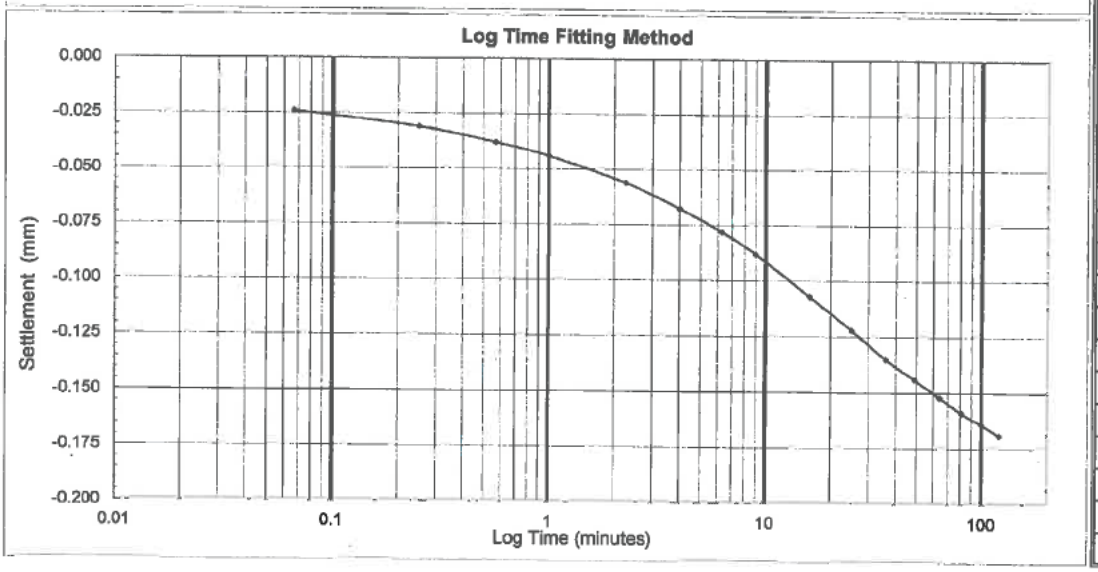
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No: Four
Load (kPa): 25

√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.024
0.25	0.50	-0.031
0.567	0.75	-0.038
1	1.00	-0.044
2.25	1.50	-0.056
4	2.00	-0.068
6.25	2.50	-0.078
9	3.00	-0.088
16	4.00	-0.107
25	5.00	-0.122
36	6.00	-0.135
49	7.00	-0.144
64	8.00	-0.152
81	9.00	-0.159
100	10.00	-0.164
121	11.00	-0.169

Test Method:
NZS 4402:1986 Test 7.1

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

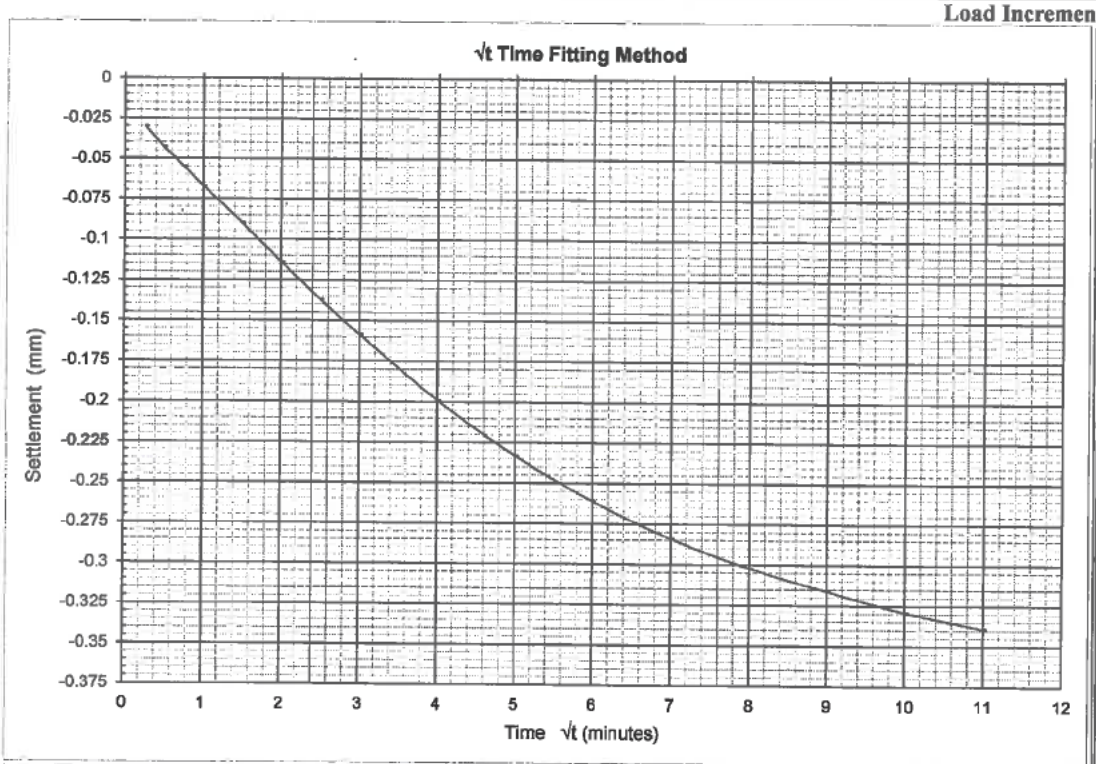
Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.

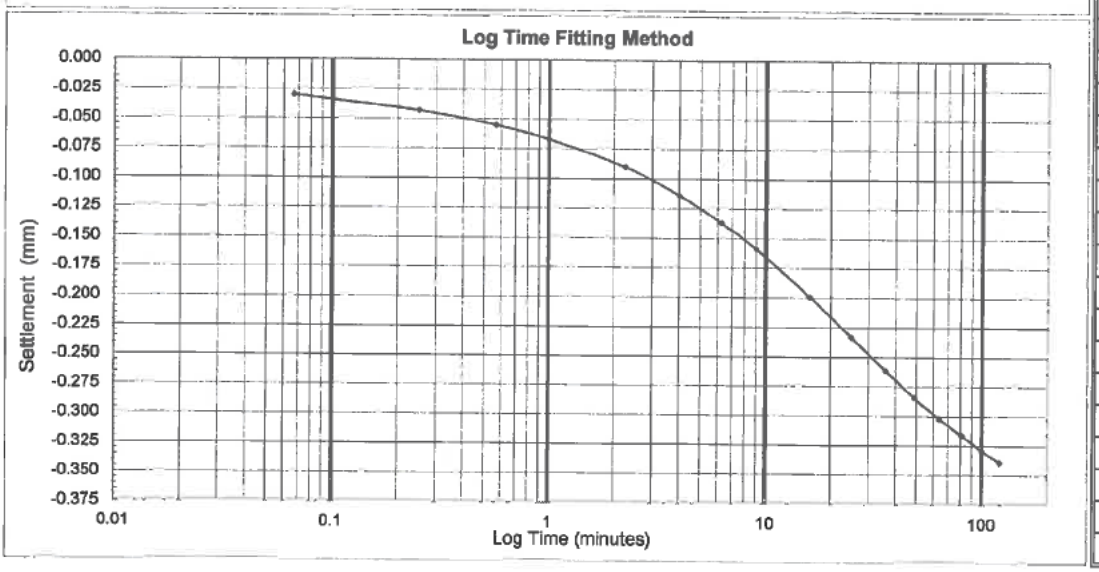
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No: Four
Load (kPa): 50

√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.030
0.25	0.50	-0.043
0.567	0.75	-0.055
1	1.00	-0.067
2.25	1.50	-0.090
4	2.00	-0.114
6.25	2.50	-0.137
9	3.00	-0.159
16	4.00	-0.199
25	5.00	-0.233
36	6.00	-0.261
49	7.00	-0.284
64	8.00	-0.302
81	9.00	-0.316
100	10.00	-0.329
121	11.00	-0.339

Test Method:
NZS 4402:1986 Test 7.1

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

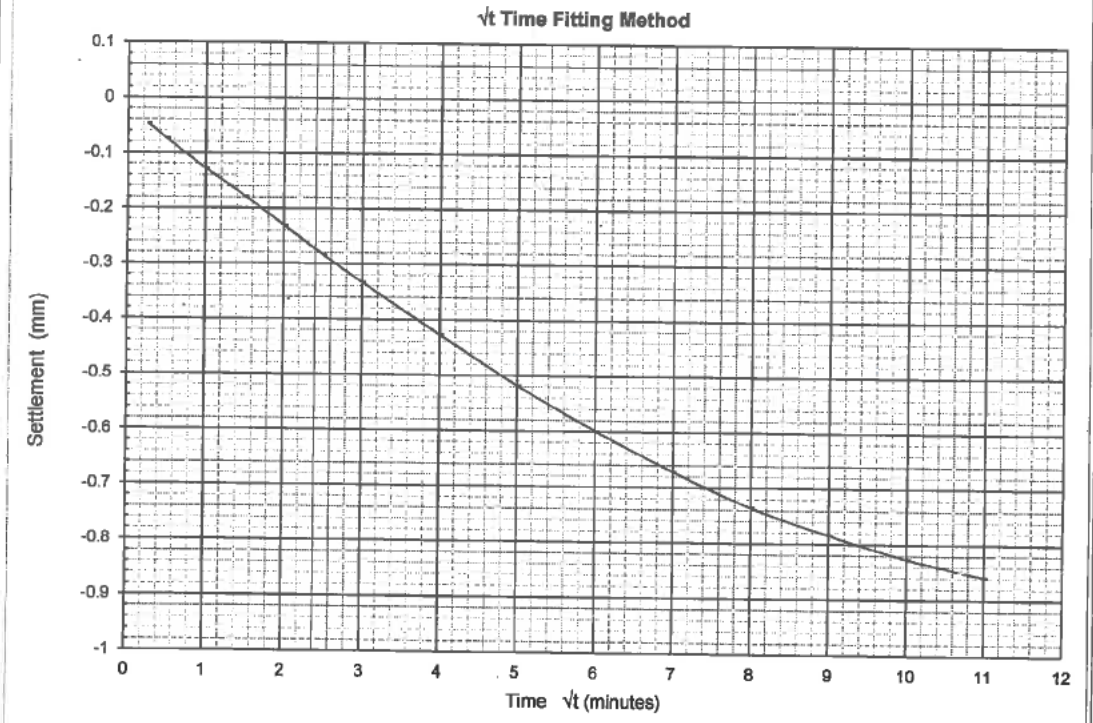
Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

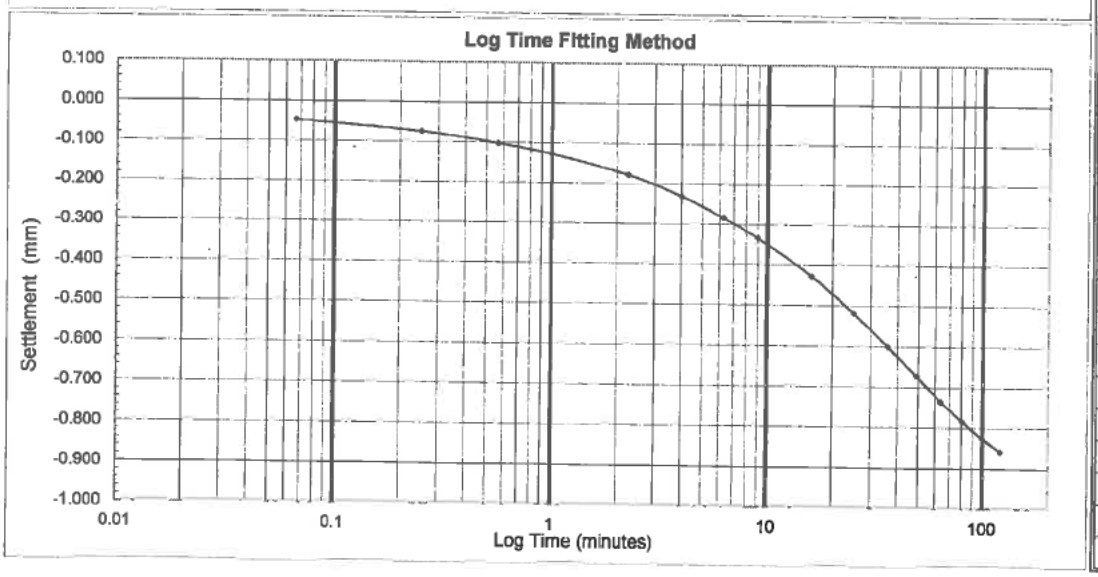
Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No: Four
Load (kPa): 100

√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.047
0.25	0.50	-0.074
0.567	0.75	-0.102
1	1.00	-0.128
2.25	1.50	-0.178
4	2.00	-0.231
6.25	2.50	-0.284
9	3.00	-0.333
16	4.00	-0.427
25	5.00	-0.518
36	6.00	-0.599
49	7.00	-0.671
64	8.00	-0.735
81	9.00	-0.784
100	10.00	-0.826
121	11.00	-0.858

Test Method:
NZS 4402:1986 Test 7.1

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

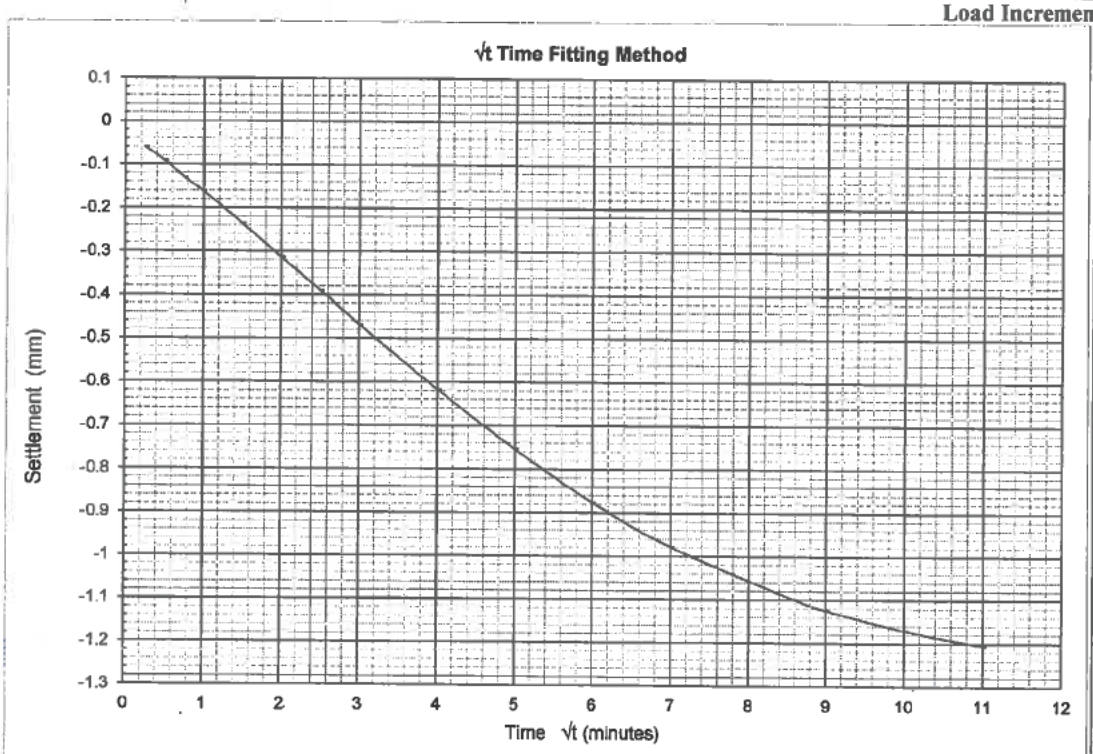
Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

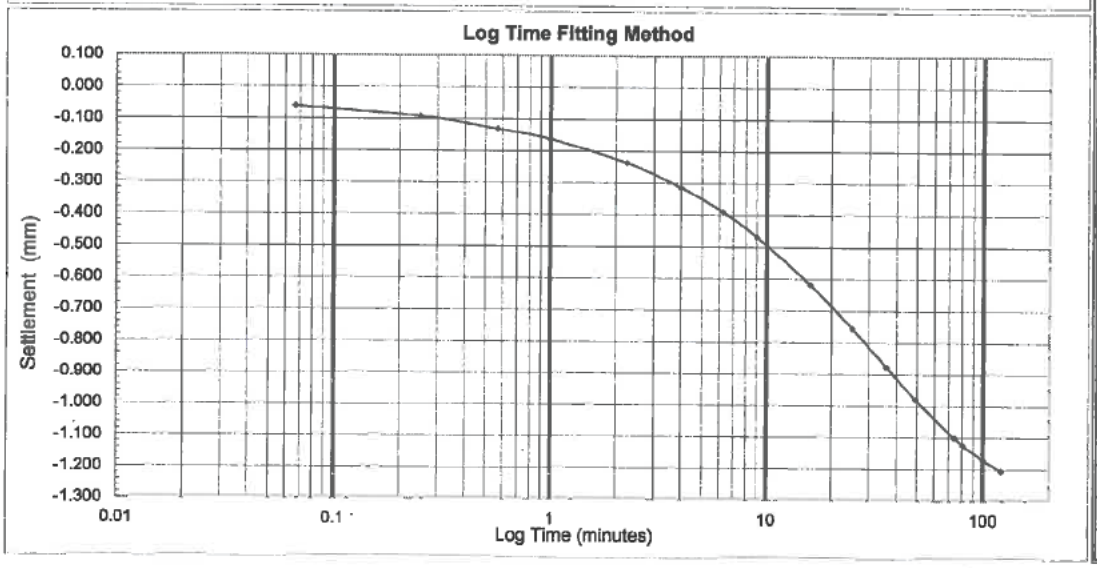
Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No:	Four
Load (kPa):	200

√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.060
0.25	0.50	-0.091
0.567	0.75	-0.130
1	1.00	-0.162
2.25	1.50	-0.236
4	2.00	-0.314
6.25	2.50	-0.389
9	3.00	-0.468
16	4.00	-0.617
25	5.00	-0.754
36	6.00	-0.876
49	7.00	-0.978
74	8.60	-1.100
81	9.00	-1.124
100	10.00	-1.170
121	11.00	-1.205

Test Method:
NZS 4402:1986 Test 7.1

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

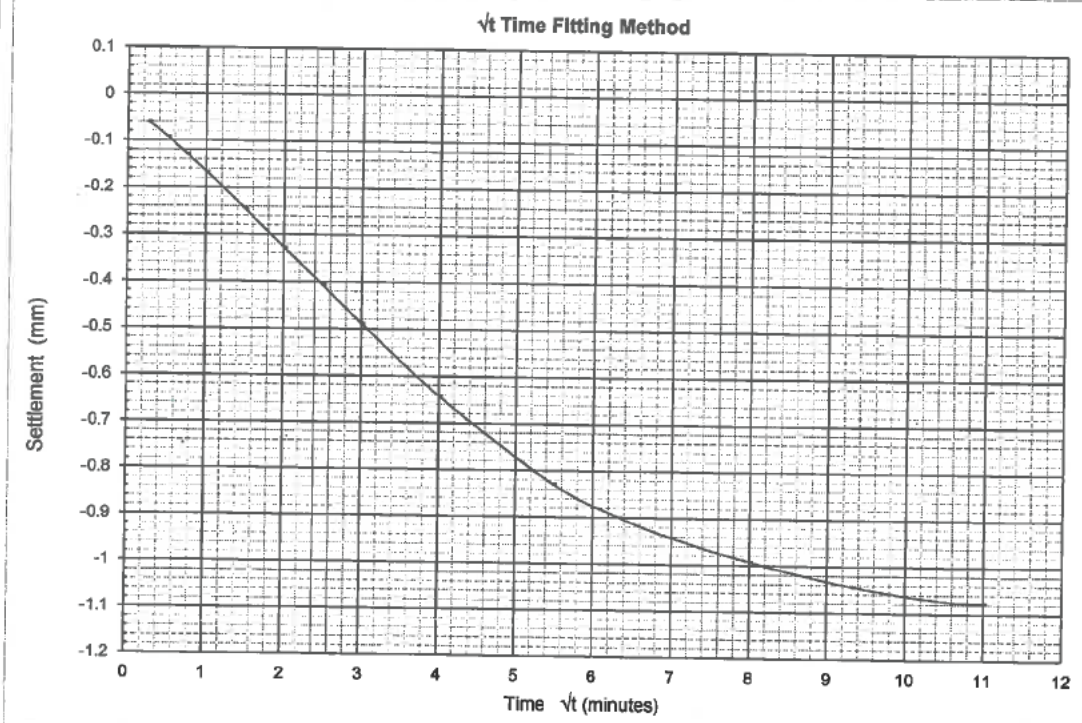
Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

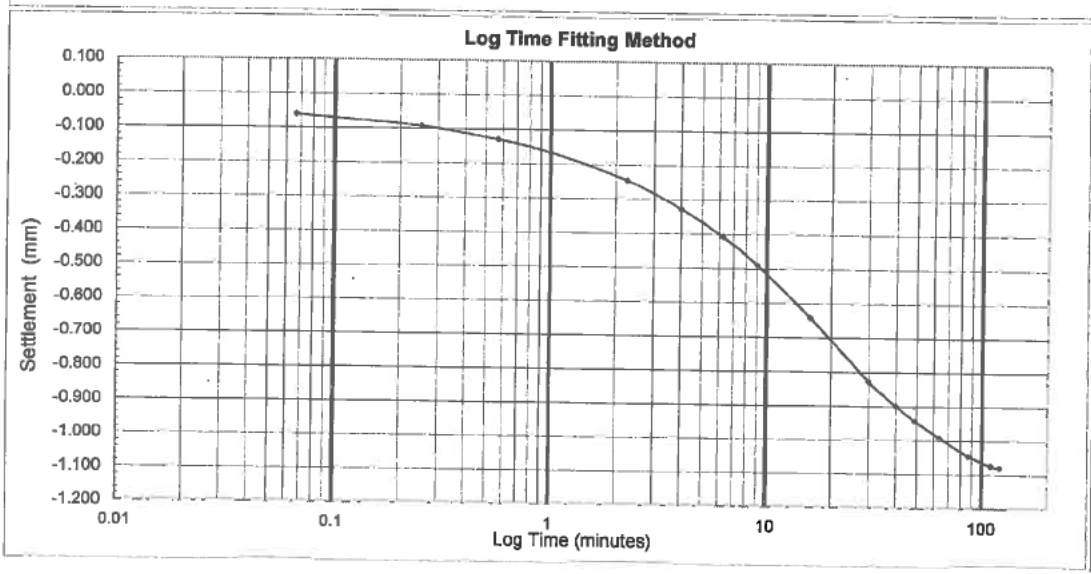
Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No: Four
Load (kPa): 400

√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.060
0.25	0.50	-0.092
0.567	0.75	-0.129
1	1.00	-0.166
2.25	1.50	-0.245
4	2.00	-0.327
6.25	2.50	-0.407
9	3.00	-0.488
16	4.00	-0.642
30	5.48	-0.828
40	6.32	-0.899
49	7.00	-0.942
64	8.00	-0.992
87	9.33	-1.044
110	10.49	-1.073
121	11.00	-1.078

Test Method:
NZS 4402:1986 Test 7.1

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NZGD ID: 77098

NZGD ID: 77098

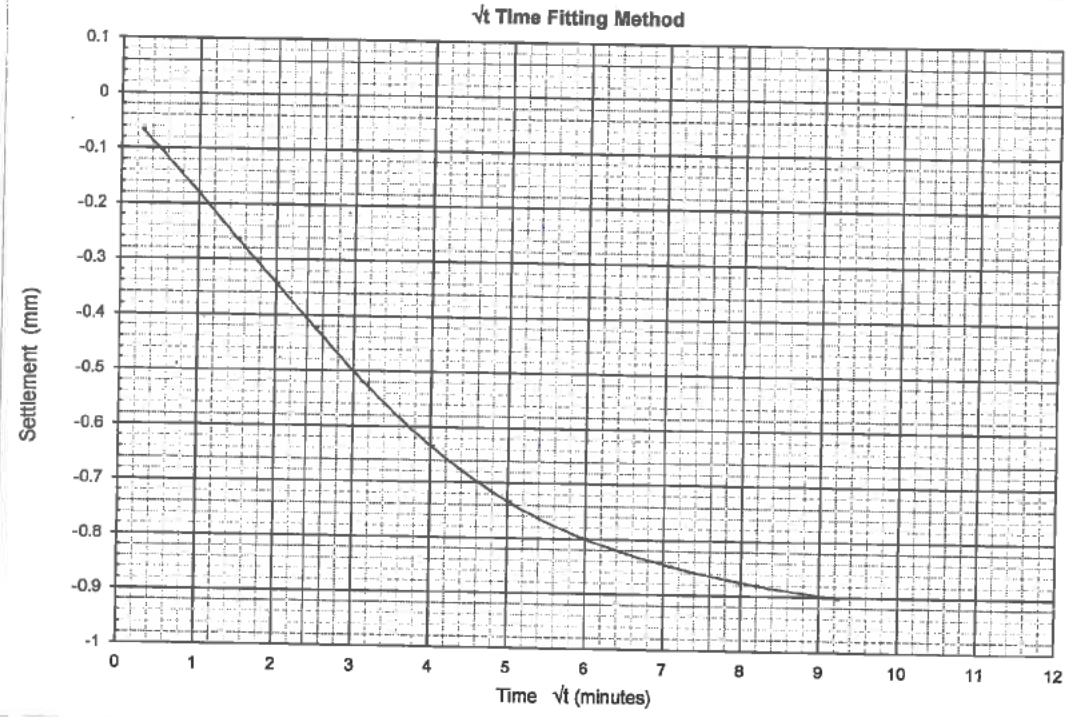
ONE DIMENSIONAL CONSOLIDATION PROPERTIES
Determination of t_{90} (Square Root time method)
Time vs Displacement Plot

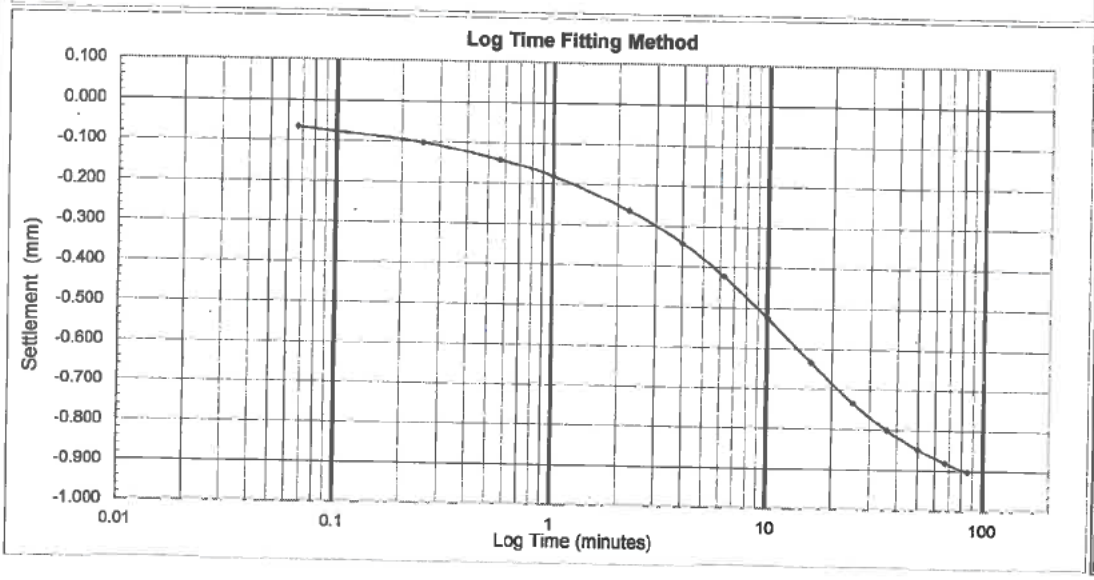
Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

Project : Waikato Expressway Hamilton Section
Location: ch7300 Borman Rd
Client : Opus Hamilton
BH/TP/Sample ID: BH 829 Depth: 3.0-3.5m
Sampled by : Opus, Hamilton Date rec'd: Jan 2015
Sample description : Greyish brown organic SILT. V.soft.
Black organic speckles throughout.
Tested by : S W Lim Date : 19/02/15
Checked by : Date : 26/2/15

Apparatus No:	Four			
Load (kPa):	800			
√(t) method	√t=		t_{90}=	
Log(t) method	t_{50}=		t_{100}=	

Load Increments applied at 2 hr intervals





Time (min)	√time (min)	Gauge (mm)
0	0.00	0.00
0.067	0.26	-0.066
0.25	0.50	-0.102
0.567	0.75	-0.142
1	1.00	-0.180
2.25	1.50	-0.263
4	2.00	-0.342
6.25	2.50	-0.422
10	3.16	-0.524
16	4.00	-0.634
25	5.00	-0.734
36	6.00	-0.800
50	7.07	-0.847
67	8.19	-0.880
85	9.22	-0.902

Test Method:
NZS 4402:1986 Test 7.1

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ORGANIC MATTER CONTENT TEST REPORT

OPUS

Project :	**Waikato Expressway - Hamilton Section**
Location :	**CH7300 Borman Rd**
Client :	**Opus Hamilton**
Contractor :	-
Sampled by :	**Opus Hamilton**
Date received :	**30/01/2015**
Sampling method :	**Pushtube**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/004**
Client Ref No :	

Test Results

Sample Description:	Silty CLAY with minor sand.
Borehole No (BH):	**BH829**
Depth (m):	**3.0-3.5**
Organic Matter (%):	**8**
As received Water Content of Sample (%) :	**55.8**

NOTE 1 of the Test Method states:

While the loss on ignition method will give quantitative oxidation of organic matter, thus avoiding the problem of conversion from organic carbon to organic matter, many inorganic soil constituents are also modified by heating which leads to mass loss in excess of the actual organic content.

For highly organic soils, the method is sufficiently accurate for day to day purposes, but it should not be relied on for organic contents less than about 15%.

Test Method		Notes
Organic Matter	NZS 4402 : 1986, Test 3.1.2 (subsidiary method by ignition)	1) whole soil tested
Water Content :	NZS 4402 : 1986 Test 2.1	

Date tested : 25/02/2015

Date reported : 27/02/2015

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Designation : Senior Civil Engineering Technician
Date : 27/02/2015

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PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

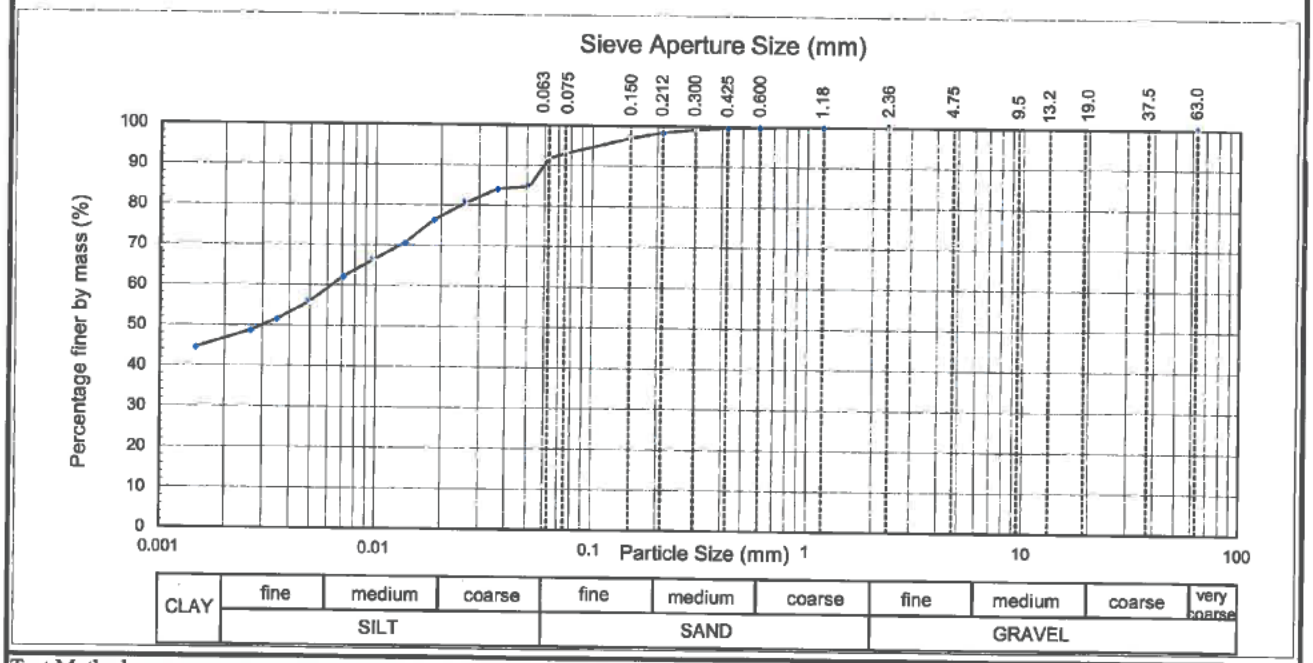
OPUS

Project : **Waikato Expressway**
Location : **Hamilton Section**
Client : **OPUS Hamilton**

Sample No:
BH/TP/Sample ID: **BH829** Depth: 3.0-3.5 metres
Sampled by : **Opus Hamilton** Date: Jan-15
Date received : **30/01/15**
Sampling method : **Pushtube**
Sample condition : **As Received**
Sample description : **Silty CLAY with minor Sand**
Solid Particle Density (t/m^3): **2.65** **Assumed**
Water Content (as received): **55.8** **%**

Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	0.0515	85	0.0071	62
37.5	--	2.36	100	0.212	98	0.0364	84	0.0049	56
19.0	--	1.18	100	0.150	97	0.0259	81	0.0035	52
13.2	--	0.600	100	0.075	93	0.0185	76	0.0027	49
9.5	--	0.425	100	0.063	92	0.0136	71	0.0015	45
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0097	66		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	Fraction Passing finest sieve is included in Hydrometer test
Water Content: NZS 4402: 1986 Test 2.1	pH of suspension : 8.0 (Whatmans Full Range pH Indicator paper)

Date Tested: 25/02/15
Date Reported: 27/02/15

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Designation : Senior Civil Engineering Technician
Date : 27/02/15

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PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

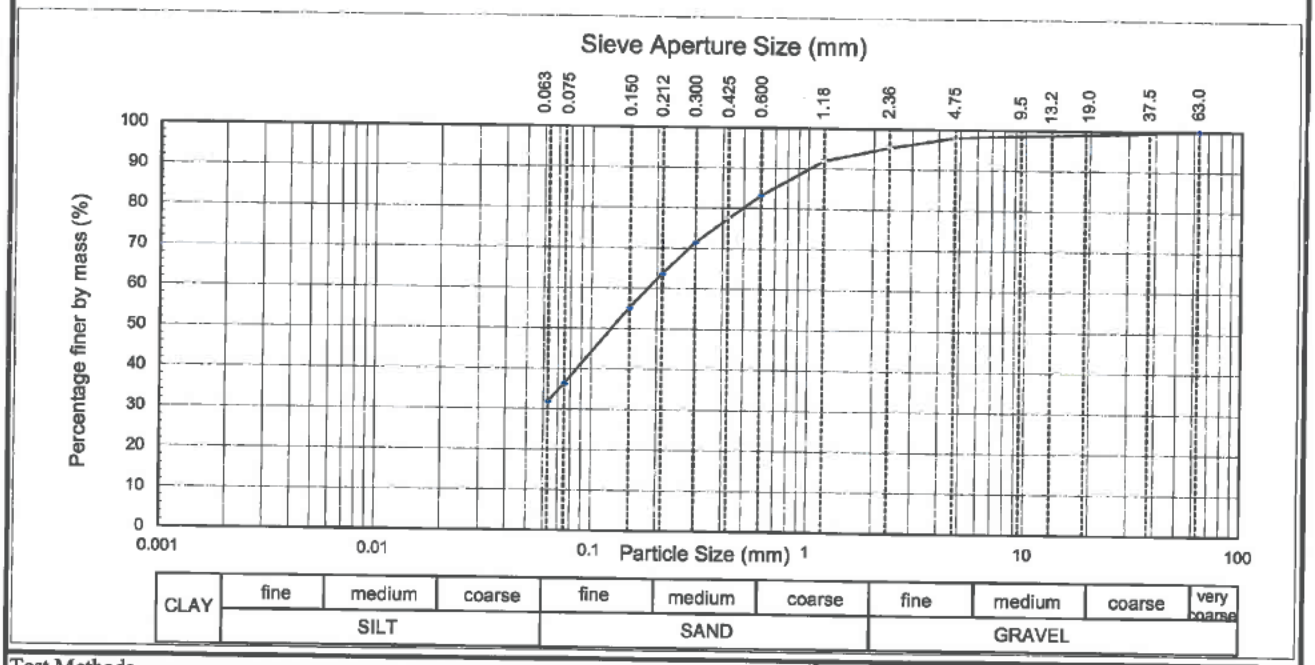
OPUS

Project : **Waikato Expressway**
Location : **Hamilton Section**
Client : **OPUS Hamilton**

Sample No:
BH/TP/Sample ID: **BH829** Depth: 9.5-10.5 metres
Sampled by : **Opus Hamilton** Date: Jan-15
Date received : **30/01/15**
Sampling method : **Core**
Sample condition : **As Received**
Sample description : **Clayey/Silty SAND with minor Gravel**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **37.2 %**

Project No: 2-31695.00
Lab Ref No: 15/803/004
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	98	0.300	72	--	--	--	--
37.5	--	2.36	95	0.212	64	--	--	--	--
19.0	--	1.18	92	0.150	55	--	--	--	--
13.2	--	0.600	83	0.075	36	--	--	--	--
9.5	--	0.425	77	0.063	32	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 25/02/15
Date Reported: 27/02/15

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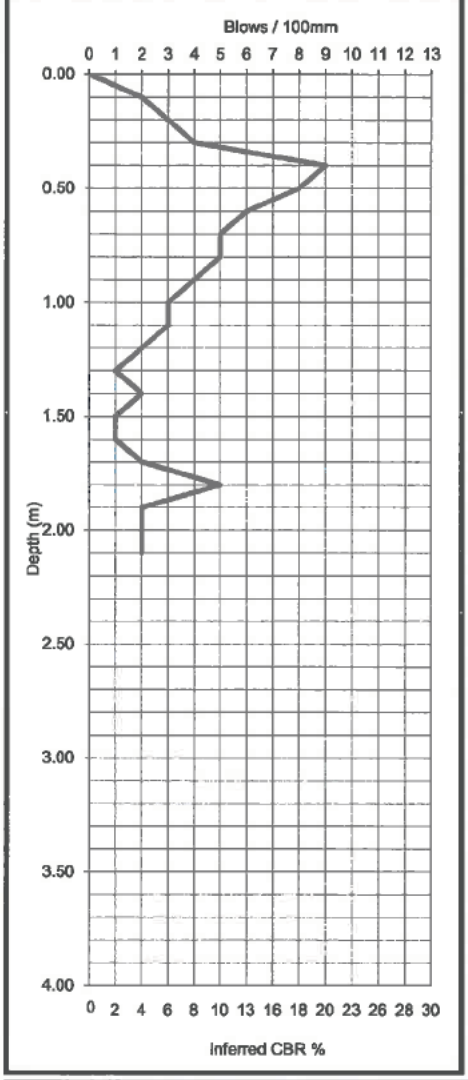
TEST PIT / SCALA PENETROMETER TEST REPORT

OPUS

Project :	**Waikato Expressway - Hamilton Section**
Location :	**Borman Road CH 7400**
Client :	**NZ Transport Agency**
Sampled by :	**S Amoore**
Test number :	**TP 935**
Shear vane number :	**DR 270**
Shear vane correction :	**Refer to Calibration Sheet**
Coordinates (NZTM) :	**N 5822615**
	E 1801359
Water level (m) :	

Project No :	**2-31695.00**
Lab Ref No :	**15/803/009**
Client Ref No :	**TP 935**

Scala Penetrometer



Test Results

Depth (m)	Shear Strength (kPa)	Sample Details	Soil Description
0.00			SILT, (Topsoil), brown, firm, dry, slightly plastic.
0.22			Silt, brown, stiff, moist, slightly plastic.
0.70	Refusal	Bulk	
1.40			SILT, trace to some fine sand, firm-stiff, moist to wet, slightly to moderately plastic, sensitive.
1.60	66/11		
1.70		Bulk	
1.90			SILT, grey, soft-firm, very wet, moderately plastic.
2.40		Bulk	SILT, light pinkish grey white, firm, moist to wet, non plastic, sensitive.
2.90			Silty CLAY, some fine sand, orange, firm, moist, slightly to moderately plastic.
3.10		Bulk	
3.30			SILT, (completely weathered pumiceous sand?), white orange / yellow mottled, stiff, moist, moderately plastic, sensitive.
4.00		Bulk	Becoming moist to wet.
4.40			*End of Pit.*

Test Methods

Determination of Penetration Resistance of a Soil, NZS 4402 : 1988, Test 6.5.2	Field Descriptions of Soils and Rocks by NZ Geotechnical Society Dec 2005.
Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001	Field Descriptions, Inferred CBR values and Scala Penetrometer values
Inferred CBR values taken from Austroads Pavement Design Manual 2004	greater than 1.5m depth are not IANZ accredited.

Date tested : 10/04/15
Date reported : 13/04/15

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IANZ Approved Signatory

Designation : *Laboratory Manager*
Date : 13/04/15

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Website www.opus.co.nz

NZGD ID: 77304

WAIKATO EXPRESSWAY – HAMILTON SECTION



Project No: 2-31695.00
Lab Ref No: 15/803/009

Borman Rd CH 7400
Test Pit 935
(Pit Photo)

Borman Rd CH 7400 Test Pit 935 *(Site Photo)*



NZGD ID: 77304

PLASTICITY INDEX FOR SOILS TEST REPORT

OPUS

Project :	**Waikato Expressway Hamilton Section**
Location :	**See Below**
Client :	**NZ Transport Agency**
Contractor :	**Opus Hamilton**
Sampled by :	**Opus Hamilton**
Date received :	**May 2015**
Sampling method :	**See Below**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/011**
Client Ref No :	

Test Results

Sampling method:	Bulk Sample	Bulk Sample
Soil Fraction Tested:	-425um	-425um
Sample Location :	**TP935**	**TP935**
Depth (m) :	1.7	4.0
Liquid Limit :	52	92
Plastic Limit :	31	50
Plasticity Index :	**21**	**42**
Natural Water Content (%):	**44.3**	**68.8**

Sample Description : **TP935 1.70m :** CLAY/SILT with minor sand.
TP935 4.0m : Silty sandy CLAY.

Test Methods		Notes
Water Content	NZS 4402 : 1986, Test 2.1	Soil Fraction Tested as shown
Liquid Limit	NZS 4402 : 1986, Test 2.2	1. Unable to form groove and/or sample slipping in bowl.
Plastic Limit	NZS 4402 : 1986, Test 2.3	2. Unable to roll to specified dimensions.(Sandy sample)
Plasticity Index	NZS 4402 : 1986, Test 2.4	3. **N.P.** denotes **Non Plastic**
		4. Where applicable the sample was rubbed through the 425um sieve.

Date tested : 18-22/05/15
Date reported : 10/06/2015

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 10/06/2015

Testing is covered by IANZ Accreditation
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NZGD ID: 77304

NZGD ID: 77304

CALIFORNIA BEARING RATIO (REMOULDED) TEST REPORT

OPUS

Project :	**Waikato Expressway (Hamilton Section)**
Location :	**TP 935**
Client :	**NZ Transport Agency**
Contractor :	**OPUS (Hamilton)**
Sampled by :	**S. Amoore (OPUS)**
Date sampled :	**April 2015**
Sampling method :	**Bulk Sample (ex test pit)**
Sample description :	**SILT, some sand**
Sample condition :	**As received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/011**
Client Ref No :	**TP 935 (Depth 1.7m)**

Test Results

Location		TP 935				
Depth		1.7m				
Sample condition at compaction		Natural (As Received)	Dried to Optimum W/C	Natural (Stabilised)		
Sample condition at test		Soaked	Soaked	Soaked	Soaked	
Sample description		SILT, some sand				
Curing time	days	-	-	3	3	
Soaking time	days	4	4	4	4	
Passing 19mm	%	100				
Surcharge mass	kg	4.9	4.9	5.0	4.9	
Lime additive	%	-	-	**5**	-	
Cement additive	%	-	-	-	**5**	
Swell	%	0	0.4	0	0	
Penetration	mm	2.5	5	2.5	2.5	
Water content as received	%	41.7	41.7	41.7		
Water content as compacted	%	42.0	34.2	39.2	40.0	
Water content after testing	%	40.9	38.1	39.5	39.8	
Dry density	t/m³	1.24	1.34	1.26	1.26	
CBR value	%	**0.5**	9	20	25	

Test Methods		**Notes**	
CBR	NZS : 4402 : 1986 : 6.1.1	Material Used	Whole Soil
Water Content	NZS : 4402 : 1986 : 2.1	Rate of penetration	1mm/min
Compaction	NZS : 4402 : 1986 : 4.1.1 (Standard)		

Date tested : 29/05/15 & 02/06/15
Date reported : 08/06/15

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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Designation : *Senior Civil Engineering Technician*
Date : 08/06/15

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PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT

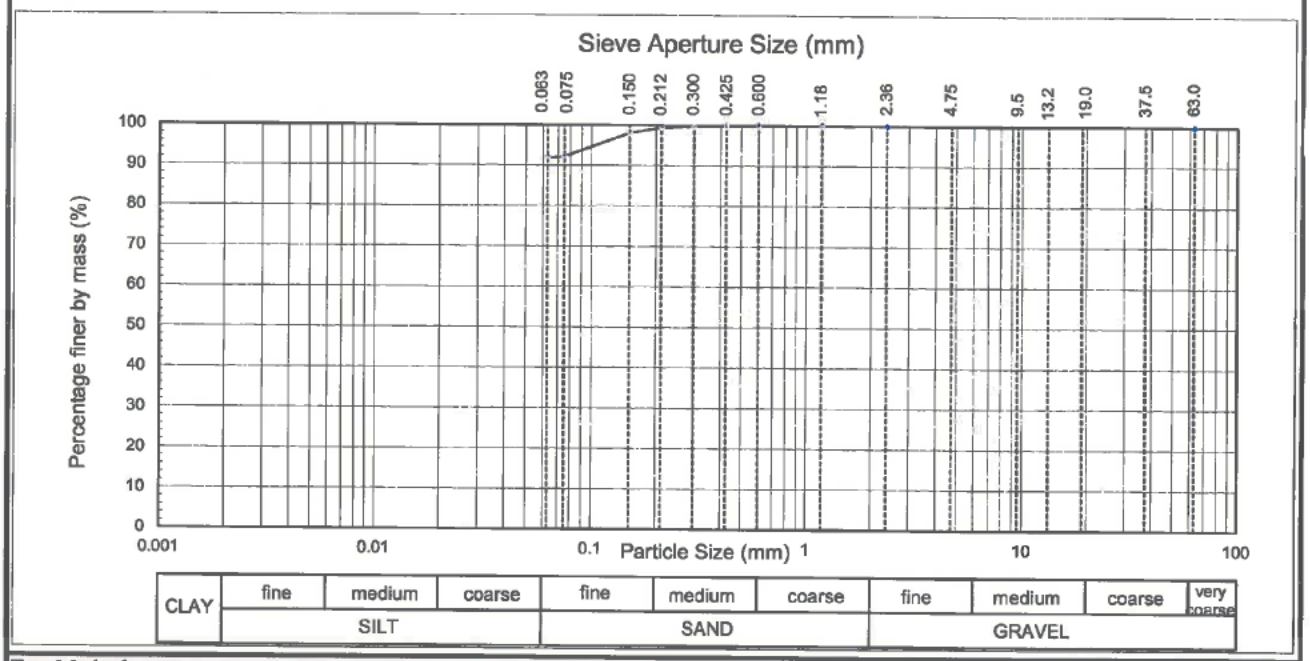
OPUS

Project : **Waikato Expressway**
Location : **Hamilton Section**
Client : ` **Opus Hamilton**

Sample No:
BH/TP/Sample ID: **TP935** Depth: 1.7 metres
Sampled by : **Client** Date: 2015
Date received : **28/04/15**
Sampling method : **Bulk**
Sample condition : **As received**
Sample description : **CLAY/SILT with minor Sand**
Solid Particle Density (t/m^3): **NA**
Water Content (as received): **44.3 %**

Project No: 2-31695.00
Lab Ref No: 15/803/011
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	99	--	--	--	--
19.0	--	1.18	100	0.150	98	--	--	--	--
13.2	--	0.600	100	0.075	92	--	--	--	--
9.5	--	0.425	100	0.063	92	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.1 (Wet Sieve Method)	Fraction Passing finest sieve is by difference
Water Content: NZS 4402: 1986 Test 2.1	

Date Tested: 13/05/15
Date Reported: 19/05/15

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IANZ Approved Signatory
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Date : 19/05/15

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NZGD ID: 77304

NZGD ID: 77304

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

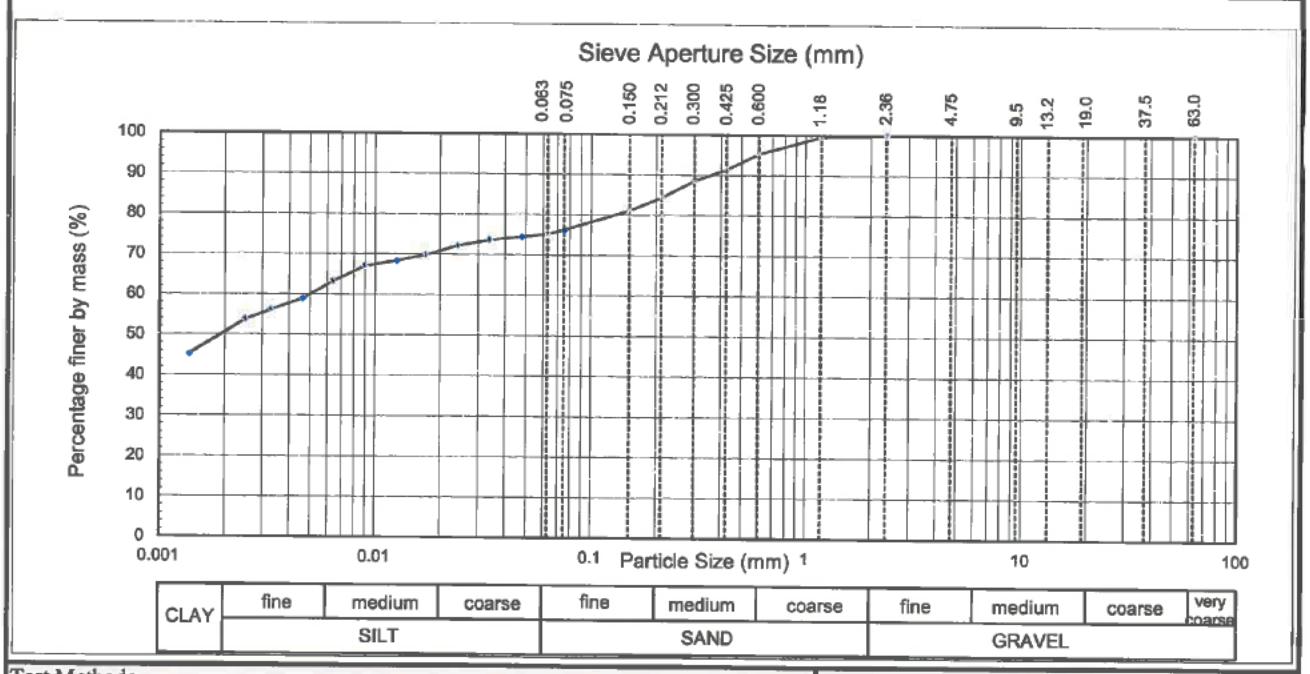
OPUS

Project : **Waikato Expressway**
Location : **Hamilton Section**
Client : **Opus Hamilton**

Sample No:
BH/TP/Sample ID: **TP935** Depth: 4.0 metres
Sampled by : **Client** Date: 2015
Date received : **28/04/15**
Sampling method : **Bulk**
Sample condition : **As received**
Sample description : **Silty Sandy CLAY**
Solid Particle Density (t/m^3): **2.70 Assumed**
Water Content (as received): **68.8 %**

Project No: 2-31695.00
Lab Ref No: 15/803/011
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	89	0.0479	75	0.0064	63
37.5	--	2.36	100	0.212	84	0.0340	74	0.0046	59
19.0	--	1.18	100	0.150	81	0.0241	72	0.0033	56
13.2	--	0.600	95	0.075	76	0.0172	70	0.0025	54
9.5	--	0.425	91	0.063	75	0.0126	68	0.0014	45
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0090	67		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	Fraction Passing finest sieve is included in Hydrometer test
Water Content: NZS 4402: 1986 Test 2.1	pH of suspension : 8.0 (Whatmans Full Range pH Indicator paper)

Date Tested: 12/05/15
Date Reported: 19/05/15

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SOLID PARTICLE DENSITY TEST REPORT

OPUS

Project :	**Waikato Expressway**
Location :	**Hamilton Section**
Client :	**Opus Hamilton**
Contractor :	
Sampled by :	**Hamilton Lab**
Date sampled :	**2015**
Sampling method :	**Bulk**
Sample description :	**see below**
Sample condition :	**As Received**

Project No :	**2-31695.00**
Lab Ref No :	**15/803/011**
Client Ref No :	

Test Results

Sample No:	**TP903**	**TP908**	**TP935**
Depth (m):	**4.0**	**3.7**	**1.7**
Solid Particle Density (t/m^3):	**2.67**	**2.43**	**2.68**

TP903 4.0m: SAND with minor Gravel and minor Clay/Silt
TP908 3.7m: SAND with some Clay/Silt
TP935 1.7m: CLAY/SILT with minor Sand

Test Method		Notes
Solid Particle Density:	NZS 4402 : 1986 Test 2.7.2	1) whole soil tested

Date tested : 08/05/15
Date reported : 19/05/15

Testing is covered by IANZ Accreditation
This report may only be reproduced in full

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*
Date : 19/05/15

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

CSF 2004 (22/08/03)

Opus International Consultants Limited
Hamilton Laboratory
Quality Management Systems Certified to ISO 9001

Fox Street
Private Bag 3057, Waikato Mail Centre
Hamilton, New Zealand

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w: www.opus.co.nz

NZGD ID: 77304

NZGD ID: 92507

Hamilton Section

NZ TRANSPORT AGENCY | Fletcher | Higgins | BECA | coffey | Tetra Tech

Engineering Log - Excavation

Excavation ID.	***TPPAA15***
sheet:	1 of 1
project no.	***GENZAUCK16545AD***
client:	***NZ Transport Agency***
date excavated:	***30 Apr 2016***
principal:	***FBHC***
date completed:	***30 Apr 2016***
project:	***SH1 Waikato Expressway Hamilton: Hamilton Expressway***
logged by:	***AWDC***
location:	***CH7400***
checked by:	***MA***

position: E: 1,801,360; N: 5,822,590 (NZGD2000) | surface elevation: NR | pit orientation: N-S | DCP id.: NR

equipment type: 12t Excavator Track | excavation method: Excavator Bucket | excavation dimensions: 4.0 m long 1.5 m wide | vane id.: 1447

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	VS ⊕ remoulded ⊙ peak / TV ▲ torvane (kPa) (50 100 150 200)	DCP (blows/ 100 mm) (2 4 6 8 10)	structure and additional observations
E	N		▶			0.0		CL	**TOPSOIL: Silty CLAY**: low plasticity, dark brown, with trace of rootlets.	M				**FILL**
								CL	**Silty CLAY**: low plasticity, brown, with minor fine grained sand.			⊕⊙		VS 46/ 14 kPa; Uncorrected SV result
								CH	**CLAY**: high plasticity, reddish brown.					
						1.0		CL	**Silty CLAY**: low plasticity, pale grey with reddish brown streaking, with minor fine to medium grained pumiceous sand.		St	⊕⊙		VS 58/ 17 kPa; Uncorrected SV result
														WALTON SUB GROUP
												⊕⊙		VS 92/ 24 kPa; Uncorrected SV result
						2.0						⊕⊙		VS 79/ 28 kPa; Uncorrected SV result
						3.0				W				
						4.0								
						5.0			Test pit TPPAA15 terminated at 5.0 m Target depth Backfilled with spoil on completion.					

CDF_0_9_06_LIBRARY.GLB rev:AM Log_COF EXCAVATION + PSP/DCP_16545AD_MASTER.GPJ <<Drawngf e>> 31/07/2016 13:37

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

NZGD ID: 92507



TPPAA15



TPPAA15

drawn	AWDC	Hamilton Section	client:	NZ Transport Agency
approved	MA		project:	SH1 Waikato Expressway: Hamilton Section Hamilton
date	27/07/2016		title:	**CORE PHOTOGRAPH TPPAA15**
scale	AS SHOWN		project no: GENZAUCK16545AD	fig no: **FIGURE 1** rev: A
original size	A4			

CDF_0_9_06_LIBRARY.GLB GrfcTb COF PHOTO TEST PIT PHOTO 2 PER PAGE 16545AD_MASTER.GPJ <<Draw ngF e>> 27/07/2016 17:21

NZGD ID: 202604

TITUS CONSULTING ENGINEERS

Log: 1 of 1

HA1

Address: 14c Haynes Place
Date: 28/03/2023
Testers: ToyG, JacobV

Project №: 14484

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: 5 10 15	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
Not Found	100	Undefined		Topsoil				
	200							
	300			SILT with minor sand, orange, low plasticity, moist				
	400							
	500							
	600							
	700			SILT with some clay, orange, low plasticity, moist				
	800							
	900			Clayey SILT, greyish brownish orange, low plasticity, moist				
	1000							
	1100							
	1200			*End of Borehole @1200mm*				
	1300							
	1400							
	1500							
	1600							
	1700							
	1800							
	1900							
	2000							
	2100							

NZGD ID: 202604

NZGD ID: 202605

TITUS CONSULTING ENGINEERS

Log: 1 of 1

HA2

Address: 14c Haynes Place
Date: 28/03/2023
Testers: ToyG, JacobV

Project №: 14484

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: 5 10 15	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
Not Found	100	Undefined		Topsoil				
	200							
	300			Clayey SILT, brownish orange mottled grey, low plasticity, moist				
	400							
	500							
	600							
	700			Clayey SILT, brownish orange mottled grey, low plasticity, moist				
	800			Silty CLAY, brownish orange mottled grey, high plasticity, moist				
	900							
	1000			CLAY, brownish orange mottled grey, high plasticity, moist				
	1100							
	1200							
	1300			*End of Borehole @1200mm*				
	1400							
	1500							
	1600							
	1700							
	1800							
	1900							
	2000							
	2100							

NZGD ID: 202605

NZGD ID: 202606

TITUS CONSULTING ENGINEERS

Log: 1 of 1

HA3

Address: 14c Haynes Place
Date: 28/03/2023
Testers: ToyG, JacobV

Project №: 14484

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: 5 10 15	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
Not Found	100	Undefined		Topsoil				
	200							
	300							
	400							
	500			Clayey SILT, brownish orange, low plasticity, moist				
	600							
	700							
	800							
	900							
	1000							
	1100			Clayey SILT, brownish orange mottled grey, low plasticity, moist				
	1200			*End of Borehole @1200mm*				
	1300							
	1400							
	1500							
	1600							
	1700							
	1800							
	1900							
	2000							
	2100							

NZGD ID: 202606

NZGD ID: 219663

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-01
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	03/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	08/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Topsoil	0	35.0	Organic SILT (OL); dark brown. Moist; friable, TOPSOIL.	TS	OL				
Walton Subgroup	0.5	35.0	SILT (M), with some clay; brown. Stiff to very stiff, moist, low plasticity.					177/54	
	1.0	34.5	1.0m: Becomes brown mottled grey.					200/102	
			1.2m: Groundwater measured at end of hole - 1.23 m				03/04/2024	122/46	
			1.4m: Groundwater strike at 1.4 m				03/04/2024	90/20	
	1.5	34.0	SILT (M), with minor sand; greyish white. Stiff to very stiff, wet, non-plastic; sand, medium to coarse.		M			116/12	
			1.7m: Becomes sandy.					73/15	
	2.0	33.5	1.8m: Becomes saturated and no core retrieval.					70/10	
	2.5	33.0	Sandy SILT (M); grey. Hard, saturated, non-plastic; sand, fine to coarse.					203+	
			2.8m: Becomes brown.					UTP	
	3.0	32.5	EOH: 3.20m					UTP	
			3.2m: Hand auger refusal.					UTP	
	3.5	32.0							
	4.0	31.5							
	4.5	31.0							
	5.0	30.5							

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219665

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-03
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	03/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	08/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Topsoil	0	35.5	Organic SILT (OL); dark brown. Dry; friable, TOPSOIL.	TS TS	OL				
Walton Subgroup	0.5	35.5	SILT (M); brown. Stiff to hard, moist, non-plastic.					UTP	
								203+	
			0.8m: Becomes brown mottled whitish grey and wet.					189/25	
	1.0	35.0						148/15	
	1.5	34.5			M			131/15	
								96/15	
			1.9m: Groundwater measured at end of hole - 1.86 m				03/04/2024 03/04/2024		
	2.0	34.0	1.9m: Becomes saturated.					167/17	
			2.0m: Groundwater strike at 2.0 m						
			SILT (M), with minor sand; dark reddish brown. Hard, moist; sand, fine; friable.					UTP	
	2.5	33.5	Clayey SILT (M); light grey. Stiff to very stiff, moist, high plasticity.					121/23	
			EOH: 3.00m					64/15	
	3.0	33.0	3.0m: Target depth achieved.						
	3.5	32.5							
	4.0	32.0							
	4.5	31.5							
	5.0	31.0							

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219667

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-05
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	03/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	08/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
Walton Subgroup	0.0	34.0	Clayey SILT (M); orange brown mottled grey. Stiff to very stiff, moist, low plasticity; (Topsoil removed by client during landscaping).					102/25	
	0.5							131/41	
	1.0	33.5	1.3m: Groundwater measured at end of hole - 1.25 m					87/19	
	1.5	33.0	SILT (M), with minor clay; brown. Stiff to hard, moist, low plasticity. 1.4m: Groundwater strike at 1.4 m				03/04/2024 03/04/2024	105/33	
	2.0	32.5	2.1m: Becomes orange brown mottled grey.					192/51	
	2.5	32.0			M			UTP	
	3.0	31.5	Clayey SILT (M); grey. Firm to very stiff, saturated, low plasticity.					UTP	
	3.5	31.0						160/36	
	4.0	30.5	Sandy SILT (M); grey. Very stiff, wet; sand, fine.					96/26	
	4.5	30.0	SILT (M); brownish grey. Hard, moist, non-plastic. 4.5m: Becomes grey. 4.7m: Becomes brown.					39/23	
	5.0	29.5	SILT (M); dark green. Hard, moist; friable. 5.0m: Target depth achieved. EOH: 5.00m					44/26	
								48/20	
								174/33	
								123/22	
								UTP	
								UTP	
								UTP	
								UTP	

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

NZGD ID: 219668

SHEAR VANE & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING

Client:	Morning Calm Lodge	**Scala Penetrometer:**	
Site Address:	14C Haynes Place, Huntington	**Hand Auger No.**	HA-06
Town/City:	Hamilton	**Job No.:**	2450023
		Date:	04/04/24
Logged By:	BM	**Checked By:**	SBT	**Weather:**	Fine
Logged Date:	08/04/24	**Checked Date:**	15/04/24	**Operator:**	BM
				Datum:	Moturiki VD 1953

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)
Topsoil	0.0	37.0	Organic SILT (OL); dark brown. Moist; friable, [TOPSOIL].		OL			
Walton Subgroup	0.5	36.5	SILT (M); brown. Very stiff to hard, moist, non-plastic.		M			157/32
			0.8m: Becomes dark brown.					
	1.0							UTP
			1.1m: Becomes brown.					
	1.5	36.0						148/41
			1.6m: Becomes brown mottled grey.					
			1.7m: Becomes moderately iron stained and wet.					150/46
	2.0	35.5	Silty SAND (S); light brown. Wet, non-plastic, sand, medium to coarse.		S			148/32
			Clayey SILT (M), with some sand; light grey. Very stiff, moist, high plasticity.		M			182/19
	2.5	35.0						135/39
			EOH: 3.00m				▽ 04/04/2024	113/19
	3.0	34.5	3.0m: Target depth achieved. Groundwater measured at end of hole - 3.0 m					
	3.5	34.0						
	4.0	33.5						
	4.5	33.0						
	5.0	32.5						

Blows per 100 mm of Penetration: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Elevation datum sourced from council GIS LiDAR contours.

Ground Floor, 408 Anglesea Street, Hamilton Central, HAMILTON 3204

Generated with CORE-GS

NZGD ID: 219668

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APPENDIX D
Groundwater Bore Logs

BOREHOLE LOG - MW01

Client: EIEIO Land Development
Project: 319 Gordonton Road
Site Location: 319 Gordonton Road, Hamilton
Project No.: HAM2025-0046
Date: 13/10/2025
Borehole Location: Refer to Site Plan Logged by: KL Checked by:AS Scale: 1:50 Sheet 1 of 2

CMW Geosciences
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Position: Projection:
Datum: Survey Source: Site Plan

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
					0		OL: Organic SILT: dark brown. No plasticity. (Topsoil)						
							CH: Silty CLAY: orange brown. High plasticity. (Hamilton Ash)						
					1								
					2								
					3								
					4								
					5		ML: Clayey SILT: brown. Low plasticity. (Kauroa Ashes)				HA		
					6								
					7								
					8		ML: Fine Sandy SILT: cream. Low plasticity. (Puketoka Formation)						
					9								
					10		SP: Silty Fine SAND: light grey. Poorly graded. Pumiceous (Puketoka Formation)						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

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

Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MW01

Client: EIEIO Land Development
Project: 319 Gordonton Road
Site Location: 319 Gordonton Road, Hamilton
Project No.: HAM2025-0046
Date: 13/10/2025
Borehole Location: Refer to Site Plan Logged by: KL Checked by:AS Scale: 1:50 Sheet 2 of 2

CMW Geosciences
Great People | Practical Solutions

Position: Projection:
Datum: Survey Source: Site Plan

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
					11		SP: Silty Fine Gravelly SAND: light grey. Poorly graded. Pumiceous. (Puketoka Formation)					5 10 15	
					12								
					13								
					14								
							CH: Fine Sandy CLAY: orange brown. High plasticity. (Puketoka Formation)						
					15		Borehole terminated at 15.0 m						
					16								
					17								
					18								
					19								
					20								

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

Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MW02

Client: EIEIO Land Development
Project: 319 Gordonton Road
Site Location: 319 Gordonton Road, Hamilton
Project No.: HAM2025-0046
Date: 13/10/2025
Borehole Location: Refer to Site Plan Logged by: DB Checked by: AS Scale: 1:50 Sheet 1 of 2

CMW Geosciences
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Position: Projection:
Datum: Survey Source: Site Plan

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
					0		OL: Organic SILT: dark brown. Low plasticity. (Topsoil)						
							CH: CLAY: dark brown. High plasticity. (Hamilton Ash)						
							... at 0.80m, Becoming brown.						
					1								
					2		... at 2.00m, Becoming light brown.						
					3								
							ML: SILT: with trace fine sand and clay. Light brownish grey. Low plastcity						
							ML: SILT: with some fine to medium sand. Light brown. Low plasticity. (Kauroa Ashes)						
					4		CH: CLAY: with some silt. Brown mottled red and black. High plasticity. (Kauroa Ashes)						
							... at 4.16m, Becoming brown speckled black. Silt becoming absent.						
							ML: SILT: with some fine to medium sand and clay. Light brownish grey. Low plasticity. (Kauroa Ashes)						
					5		... at 4.71m, Becoming white streaked pink.						
							ML: Fine to medium sandy SILT: light pink. Low plasticity. (Kauroa Ashes)						
							ML: Silty CLAY: reddish brown streaked light brown speckled white. High plasticity. (Kauroa Ashes)						
					6		ML: Clayey SILT: with minor fine sand. Light brown streaked red. Low plasticity. (Kauroa Ashes)						
							... at 6.30m, Becoming speckled black.						
					7								
							ML: Fine to coarse Sandy SILT: light grey. Low plasticity. (Puketoka Formation)						
							SP: Silty fine to medium SAND: light grey speckled black. Poorly graded. (Puketoka Formation)						
					8								
							... at 8.51m, containing trace fine pumiceous gravel.						
					9								
							SW: Fine to coarse SAND: with some silt and minor fine to medium pumiceous gravel. Light grey. Well graded. Gravel: rounded. (Puketoka Formation)						
	14-10-2025				10								

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

Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

BOREHOLE LOG - MW02

Client: EIEIO Land Development
Project: 319 Gordonton Road
Site Location: 319 Gordonton Road, Hamilton
Project No.: HAM2025-0046
Date: 13/10/2025
Borehole Location: Refer to Site Plan

PRELIMINARY

CMW Geosciences
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Logged by: DB Checked by: Scale: 1:50 Sheet 2 of 2

Position: Projection:
Datum: Survey Source: Site Plan

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Recovery	Drilling Method/ Support	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
					11							5 10 15	
					12		SW: Fine to coarse SAND: with trace fine gravel. Yellowish grey. Well graded. Gravel: subrounded (Puketoka Formation) ... at 11.64m, heavy iron staining. SW: Silty fine to coarse SAND: with trace fine pumiceous gravel. Light brown. Well graded. gravel: subrounded. (Puketoka Formation) ... from 12.20m to 12.24m, moderate iron staining. ... at 12.55m, Becoming orange mottled black. ... at 12.59m, sand becoming fine.						
					13		CH: Silty CLAY: greyish brown. High plasticity. (Puketoka Formation) ... at 13.15m, Becoming light orange. ... at 13.32m, Becoming speckled black. ... from 13.48m to 13.55m, Becoming light grey mottled black.						
					14		... at 14.07m, Becoming light brown.						
					15		ML: SILT: White. Low plastcity. (Puketoka Formation) ... from 15.10m to 15.20m, Becoming light brown.						
					16		... from 16.51m to 16.55m, Becoming mottled green. MH: Clayey SILT: white streaked light orange. High plastcity, (Puketoka Formation) ... at 17.00m, minor iron staining.						
					17								
					18		SP: Silty fine SAND: grey. Poorly graded. (Puketoka Formation)						
					19		Borehole terminated at 19.0 m						
					20								

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

Remarks:

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

CMW Geosciences
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APPENDIX E
Historical Aerial Photos

Date and source	Key Features
1952 Retrolens	 • **The site (boundary marked in red) is used for** agricultural **purposes** with some buildings present along the southern boundary**.**
1991 Retrolens	 • Additional dwellings have been built (circled in blue), and existing building has been upgraded (circled in yellow).

Date and source	Key Features
2008 Google Earth	 • Additional buildings built for the Morning Calm Lodge (circled in blue). • Subdivision across Borman Road has been developed.

Date and source	Key Features
2014 Google Earth	 • Northgate Community Church has been fully constructed. • Effluent pond has been constructed (circled in blue)

Date and source	Key Features
2018 Google Earth	 • Construction begins on the Waikato Expressway along the southern border.

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APPENDIX F
WRC Hazard Portal

Waikato Regional Hazards Portal

Visit our regional hazards and emergency management page

Waikato Regional Council

Overview | River flooding | Flood Management | Waikato District Defended areas | Coastal Hazards | Coastal Inundation | Earthquakes and landslides | Volcanoes and Geothermal | Karāpiro Dam Break | Emergency Management | Waikato Regio

River Flooding

Floods are New Zealand's number one hazard in terms of frequency, losses, and declared Civil Defence emergencies. River floods occur due to heavy rain that causes rivers to overflow their banks. Other types of flooding include ponding, contributed to by poorly drained soils and/or high water tables, and urban flooding caused by street drains becoming blocked or overcome.

The Waikato region has 20 large rivers and about 1400 small river systems. Many of the region's river systems are prone to flooding and flooding is frequent because of steep terrain, low lying flood plains and areas of high rainfall.

To see a map with local scale flood depth data (instead of hazard) from the same scenario, click on the big arrow to the right side of the map.

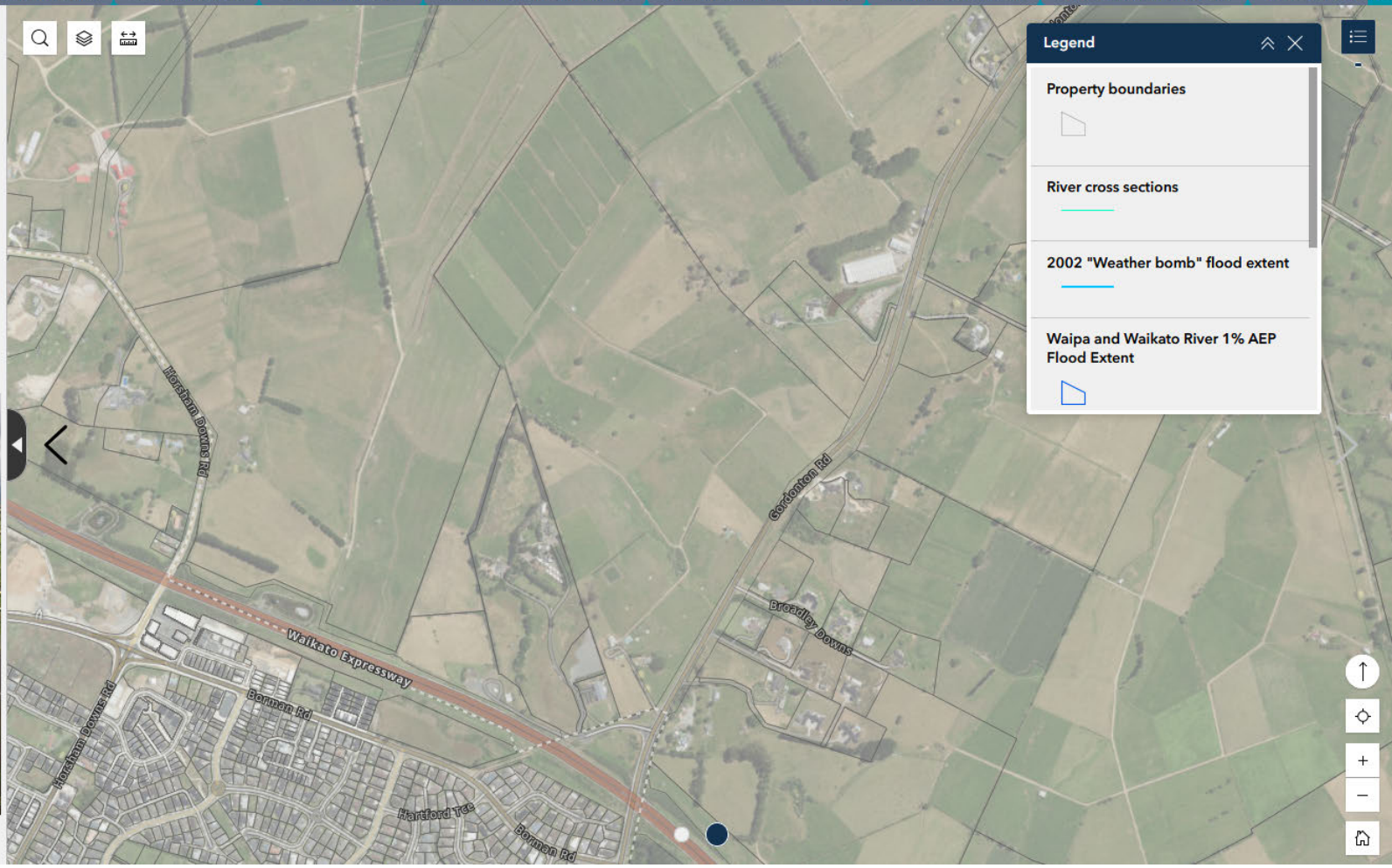
For more information on flooding, click here.

For flood warnings and updates for the Waikato, visit WRC's Flood Room.

For what to do in the event of a flood, click here.



Waitakaruru flooding, 2017



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Flood Management

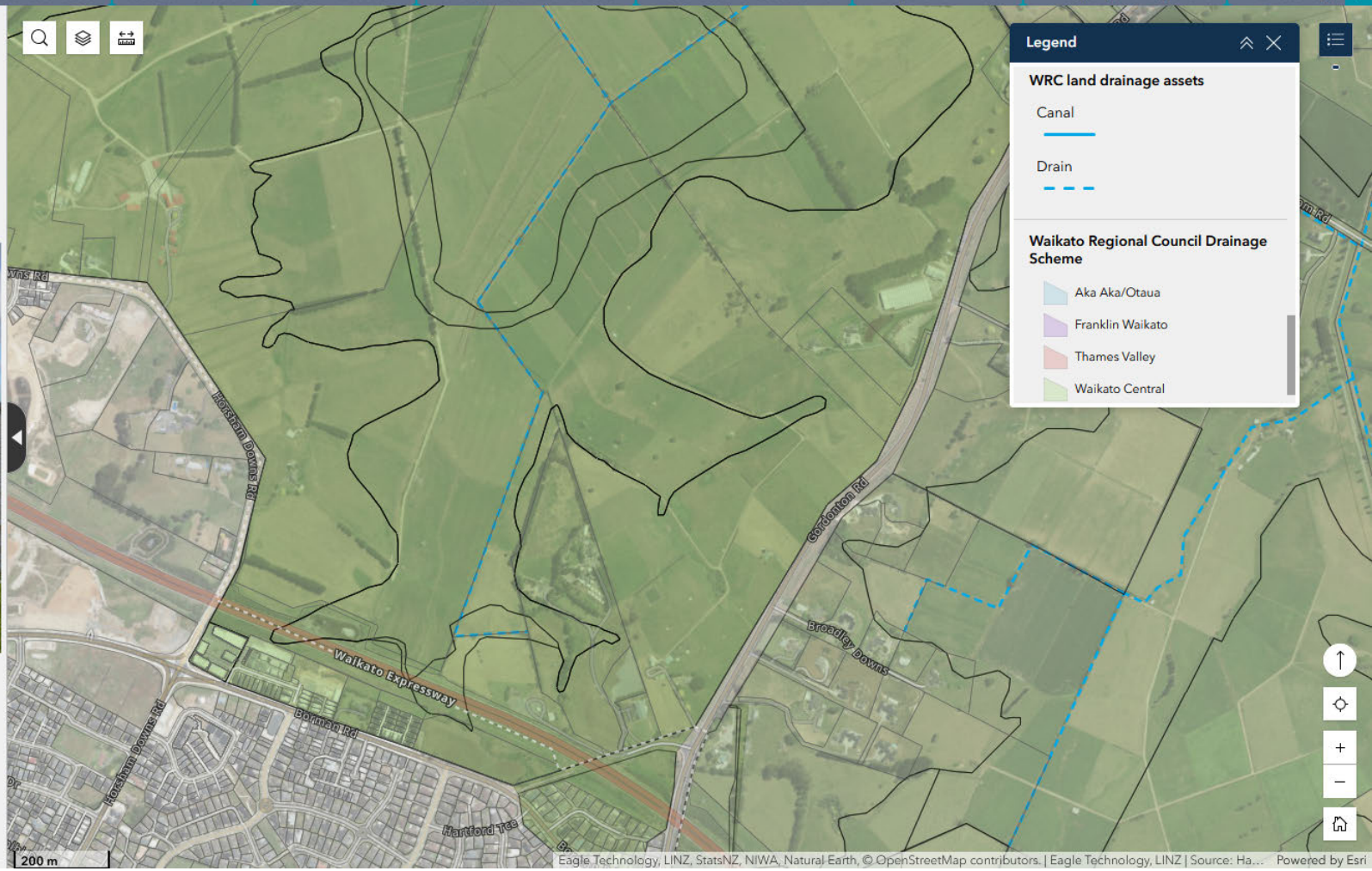
Waikato Regional Council owns and maintains many flood protection schemes. These schemes significantly reduce the risk of river flooding to many low lying areas, through measures such as stopbanks, floodgates and channel maintenance. Each stopbank is designed to provide a certain level of protection - this may be to the 1% AEP event, or it may only be to the 10% AEP event. When a flood event occurs that is greater than the design level, the river may overtop the stopbank and cause flooding. In addition, there is always a small chance that a stopbank will fail (breach). The level of risk that remains for defended properties is known as "residual risk".



Stopbank

Land Drainage

Waikato Regional Council also own and maintain land drainage schemes. The level of service for the open drains and culverts of these schemes is generally to drain water from a 10% AEP rainfall event within 3 days. This is intended to remove ponding from rural areas prior to pasture damage occurring, rather than to prevent inundation. Different Drainage Differentials receive different levels of benefit. This table provides the benefit description for each class type (in pop-up).



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Earthquakes

New Zealand lies on the boundary of the Pacific and Australian tectonic plates. These plates are colliding with huge force, causing one to slowly grind over, under or alongside the other. This results in many faults (cracks extending deep within the earth), including in the Waikato. An earthquake occurs when stress builds up on these faults and is then released suddenly, causing the earth to vibrate as energy radiates away from the fault.

There are thousands of earthquakes in New Zealand every year, however many are not felt. Earthquakes can result in secondary hazards such as ground shaking, liquefaction (see below), land instability and tsunami (tsunami are caused by offshore faults).

To view ground shaking susceptibility data for the Waikato Region in this map, click here or select the large arrow to the right of the map.

For more information, click here.

For what to do in an earthquake, click here.

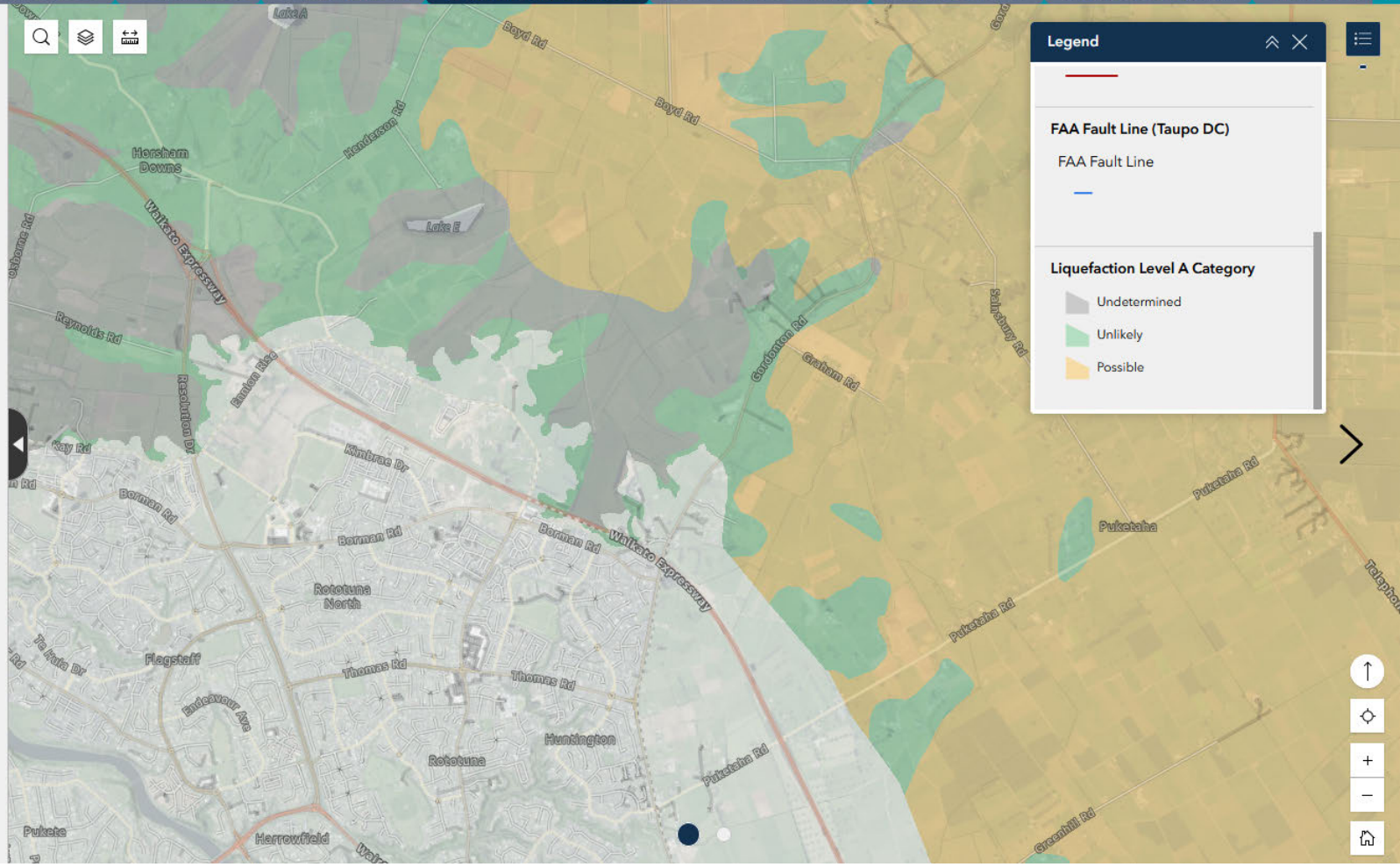
For information on recent earthquakes, visit GeoNet



Damage caused by a fault trace during 1987 Edgecumbe earthquake (Earth Sciences NZ)

Liquefaction Vulnerability Assessment - Level A Desktop Study

Liquefaction is a natural process where earthquake shaking increases the water pressure in the ground in some types of soil, resulting in temporary loss of soil



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Volcanoes

The Waikato region is exposed to volcanic risk from many volcanic centres, both within and outside of the region. These volcanic centres vary in type, risk, and activity (e.g. dormant, unrest, eruption). There are three main types of volcano:

1. Cone volcanoes (e.g. Mt Ruapehu);
2. Caldera volcanoes (e.g. Lake Taupō); and
3. Volcanic fields (e.g. Auckland area).

The different types can produce a wide variety of volcanic hazards including ashfall, pyroclastic flows, bombs and blocks (flying rocks), lahars and lava flows. These hazards are more or less likely to occur in an eruption, depending on the volcano type.

The volcanic hazard most likely to impact the Waikato region is volcanic ash, which is carried by the wind, and can adversely affect agriculture, infrastructure, air transport, human health, etc. Lake Taupō poses the biggest volcanic threat to our region; however, the probability of a large eruption is extremely low.

For more information, click here.

For what to do in a volcanic eruption, click here.

For more detailed information on volcano status, visit GeoNet.

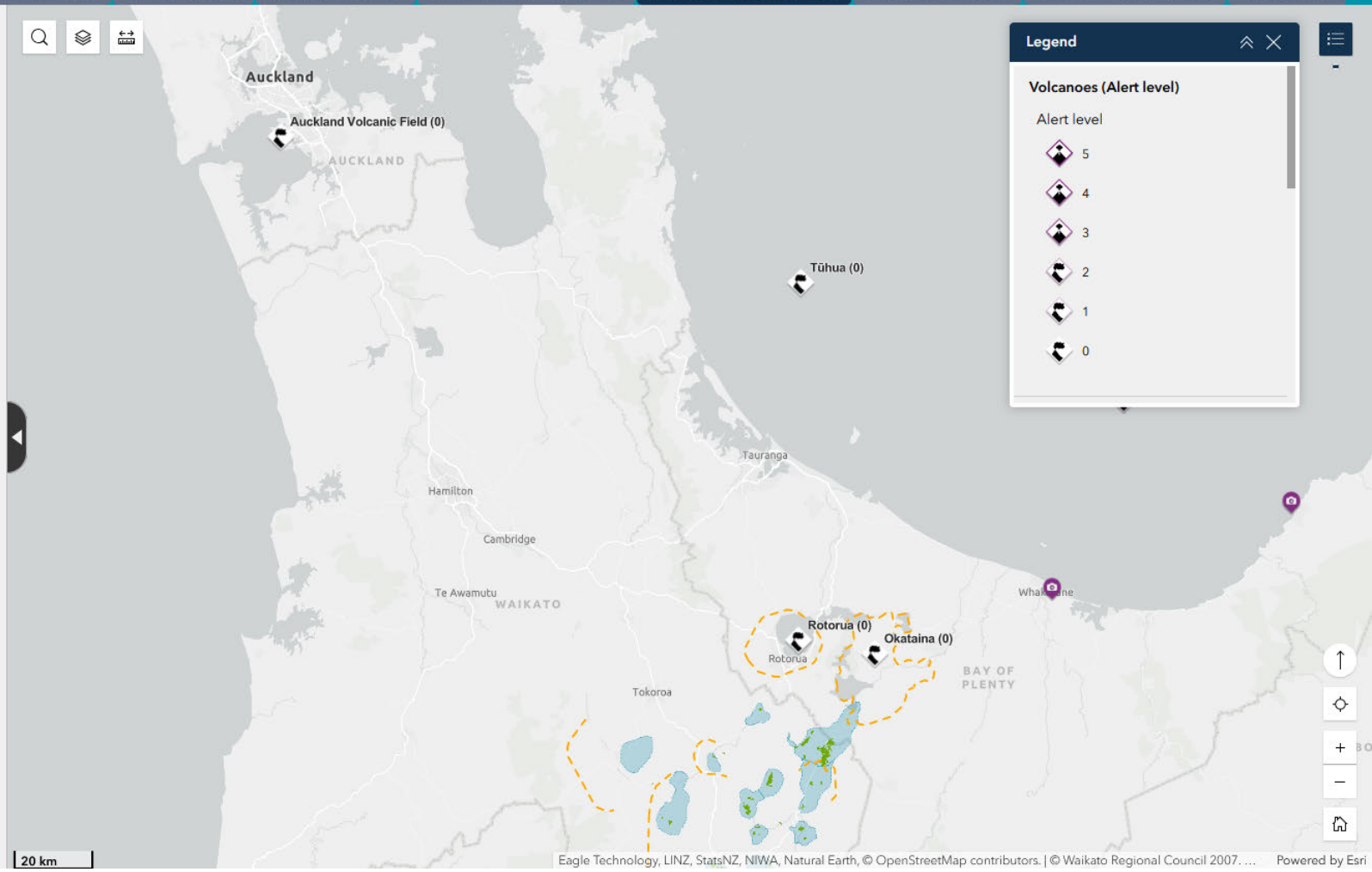


Mt Ruapehu erupts, 1995

Geothermal

The Waikato region contains about 70% of New Zealand's geothermal resource. Geothermal areas contain natural hazards such as hot springs, boiling mud pools and unstable ground, and can produce hydrothermal eruptions.

Geothermal areas are valuable as tourist attractions, energy sources and unique habitats. Geothermal systems are places where the earth is hotter than surrounding areas, due to hot rock or magma near the earth's surface. Most of





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