WENTZ - PACIFIC
GEOTECHNICAL ENGINEERS

GEOTECHNICAL INVESTIGATION REPORT FOR NOTICE OF REQUIREMENT APPLICATION

Waitākere District Courthouse

14 Edmonton Road
Henderson, Auckland

Prepared by:

[redacted]

04 April 2025

Project Number: 1496-01-24

Prepared for:

MINISTRY OF JUSTICE
Justice Centre
19 Aitken Street
Wellington

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1.0 INTRODUCTION

This report has been prepared to support a Substantive Application made by Ministry of Justice (on behalf of the Requiring Authority - Minister of Justice) under the Fast Track Approval Acts 2024 in accordance with the requirements of Section 42. The proposal is a Referred Project and this report has been prepared to support a Notice of Requirement Application to designate the site at 14 Edmonton Road, Henderson for 'Judicial and Court purposes' known as the Waitakere District Courthouse - New Courthouse project. Under s42(4)(d), this substantive application is giving notice of a requirement to designate the site that would otherwise be applied for under the Resource Management Act 1991. Section 43 of the Fast Track Approval Act sets out the information to be included in a substantive application, which includes an assessment of adverse effects of the project on the environment. This report has been prepared to assess the potential geotechnical hazard risks of the project, and presents the findings, conclusions and recommendations from Wentz-Pacific Ltd's (WP's) geotechnical investigation of the site.

The work described herein was commissioned by the Ministry of Justice (MoJ) and was completed in general accordance with WP's agreement with MoJ dated 21 August 2024.

1.1 PROJECT DESCRIPTION

The MoJ has purchased the site located at 14 Edmonton Road in the Henderson suburb of Auckland (refer to Plate A-1, Appendix A) in anticipation of building a new 'Justice Facility'. Given the proposal is for Notice of Requirement Application and the development proposal for a future building is not confirmed or known, the investigation and assessment provided in this report is based on the concept development scheme for a future building envelope.

In particular, this includes a six-storey courthouse with 10 courtrooms, four hearing rooms and associated spaces. [redacted] and no basement or below ground parking is proposed. The indicative gross floor area (GFA) for the building is circa 12,000 m^2, and the ground floor structure footprint (including parking) will encompass circa 3,000 m^2. No major earthworks are anticipated to support the construction of a future building on the site.

WP's understanding of the project is based on our discussions with [redacted] and on our review of Concept Design drawings by Architectus. The indicative building footprint on the site is shown on the concept design landscape plan dated April 2025 by Architectus (refer Appendix B).

1.2 PURPOSE OF INVESTIGATION

The purpose of WP's geotechnical site investigation was to:

- characterise (from a geotechnical standpoint) the ground and groundwater conditions across the site;
- identify potential geotechnical hazards / constraints that may impact development; and,
- provide high-level comment on geotechnical recommendations / mitigation measures that are likely to be required for building foundation support or to address identified geotechnical constraints.

2.0 INVESTIGATIONS

2.1 DESKTOP STUDY

A review of select and available information pertaining to the site and/or surrounding vicinity was conducted. Specifically, this information included:

- Aerial photographs contained on the Auckland Council (AC) and Retrolens websites.
- Natural hazard information contained on the AC website.
- Regional geological information published by the Institute of Geological & Nuclear Sciences Limited (GNS).
- Data from several shallow geotechnical investigations undertaken across the site by others and provided to WP by the MoJ.
- Data from various deep geotechnical investigations undertaken in the general vicinity of the site obtained from the NZ Geotechnical Database.

2.2 FIELD INVESTIGATIONS

Deep Investigations

Four cone penetrometer tests (CPTs) were performed at the site on 03 September 2024 at the approximate locations shown in Plate A-2 in Appendix A. The CPTs were advanced to depths of between about 6.7 and 13.4 m below existing ground (bgl). All of CPT soundings were pushed into the inferred top of the East Coast Bays geologic formation where practical refusal was encountered. The CPT investigation results are presented in Appendix C.

Two machine (deep) boreholes were drilled at the site on 03 September 2024 at the approximate locations shown in Plate A-2 in Appendix A. The boreholes were drilled to depths of 10.7 and 13.7 m bgl and terminated in confirmed East Coast Bays Formation rock.

A 3 m deep standpipe piezometer was installed in MH01 to allow periodic measurement of shallow groundwater at this location. The logs of the boreholes are presented in Appendix C.

Previous Shallow Investigations

A previous geotechnical investigation by Soil & Rock Consultants (2023) included five hand auger boreholes across the site to depths of 3 to 5 m bgl. The boreholes were drilled in 2018 and inferred to have been done as part of the investigation of a larger development. Dynamic cone penetrometer (DCP) testing was carried out of the base of the boreholes to depths of 3.9 to 6.8 m bgl where practical test refusal was encountered. The locations of the previous investigations are shown on Plate A-2 in Appendix A, and the logs of the boreholes and DCP tests are contained in Appendix D.

3.0
SITE AND GROUND CONDITIONS

3.1 SITE CONDITIONS

The roughly rectangular-shaped and flat-lying site encompasses 4435 m^2. The majority of the site is paved car parking, and part of the parking appears to be used for a bicycle track. A few established trees occupy parts of the perimeter of the site.

The site is bordered the north by the Oratia stream, the Alderman restaurant and Falls Park. Alderman Drive and Edmonton Road run along the west and south sides of the site, respectively. To the east, the site is bounded by the driveway into the Korean Presbyterian Church and primary residential properties beyond.

3.2 SUBSURFACE CONDITIONS

3.2.1 Geology

Published geological information (Edbrooke, 2001) shows the site to be surfaced with late Pliocene to middle Pleistocene-age alluvial sediments of the Puketoka Formation (Pup). These sediments are described as “pumiceous mud, sand and gravel with muddy peat and lignite: rhyolite pumice, including non-welded ignimbrite, tephra and alluvial deposits; massive micaceous sand”. This formation is known to contain significant deposits of estuarine peat and organic soils – including fibrous root masses and timber – as well as methane and hydrogen sulphide gas accumulations (Boyd and Macklin, 2017).

The deep investigations confirmed that the Pup sediments are underlain by residual soil and sedimentary rock of the Miocene-age East Coast Bays Formation (Mwe). This formation is described by Edbrooke (2001) as “alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits”.

3.2.2 Generalised Ground Conditions

The two hand auger boreholes located in landscape / grass strips (AH09 and AH11) encountered about 200 to 600 mm of topsoil and / or undocumented fill. The three hand augers located in asphalt areas (AH10, -12 and -13) encountered gravel fill basecourse in the order of 300 to 350 mm thick directly beneath the asphalt.

The topsoil and fill were underlain by the alluvial soils of the Puketoka Formation extending to a depth of about 6 m bgl. These soils generally comprised of stiff to very stiff, low to moderate plasticity silt / clayey silt interbedded with occasional layers of soft to very stiff, highly plastic clay. Undrained shear strengths in these materials generally ranged from approximately 40 kPa to greater than 150 kPa.

A noticeably weaker layer of clayey material was noted between a depth of about 2.5 and 4 m in the hand auger boreholes located in the central and eastern part of the site. CPT-03, located in the southeastern part of the site, identified a layer of notably softer soil (undrained shear strengths between about 20-40 kPa) from a depth of about 2.5 to 5 m bgl.

DCP testing out of the base of the hand auger boreholes reached effective refusal (defined as a blowcount ≥ 20/100 mm) at depths of 6.4 and 6.8 m in boreholes AH09 and AH10, and near refusal at depths of 3.9 to 5.9 m in AH11 through AH13.

The inferred depth to East Coast Bays formation (ECBF) residual soil based on the results of the CPT soundings ranges from approximately 5 to 6 m across the site, and this depth was confirmed in the machine boreholes.

The depth to slightly weathered ECBF rock was proven in the machine boreholes at a depth of about 12 m in BH01 in the northeastern corner of the site, and about 8 m in BH02 in the southwestern corner of the site.

3.2.3 Groundwater

Groundwater was measured (at the time of drilling) in three of the 2018 hand auger boreholes located in the central and eastern half of the site, at depths ranging from 0.8 m to 2.6 m. A 3 m deep piezometer was installed in borehole MH01, located in the northeast corner of the site relatively close to Oratia Stream.

The groundwater levels measured to date in the piezometer were:

- 05 September 2024: 2.4 m
- 12 September 2024: 2.3 m
- 19 September 2024: 2.0 m

Wet to saturated soils were logged in both of the deep boreholes at a depth of about 4 m.

The invert of the Oratia Stream north of the site boundary was visually estimated to be about 6 m lower than the car park where the piezometer is located. Topographic contour information on the Auckland Council website (AC Geomaps 2025) shows the invert to be about 5 m lower than the car park.

Based on the above information, it is inferred that there is a perched water layer across the site at a depth of around 2 m, and possibly shallower in some areas, but that the “permanent” groundwater level is deeper – around 4 m (i.e., closer to the level of the nearby Oratia Stream). This will need to be confirmed by further measurements and possibly installation of a second piezometer should the depth to groundwater be required for design and / or construction.

Groundwater levels at the site may fluctuate over time from those reported herein due to variations in rainfall, irrigation practices (both on- and off-site), runoff conditions, tidal fluctuations in the nearby estuary, and other factors.

4.0
GEOLOGIC, SEISMIC AND OTHER HAZARDS

4.1 LANDSLIDING, EROSION, SUBSIDENCE

The site is essentially level and not bordered by steeply sloping terrain or ground that otherwise appears to be potentially unstable or prone to slippage. At the time of our site investigation, no evidence of significant erosion or ground subsidence was observed – including along Oratia stream near the northern site boundary. The risk of slope instability to the site is considered to be very low.

4.2 FALLING DEBRIS

There are no uphill sources of debris that can impact this site.

4.3 SURFACE FAULT RUPTURE

The Active Faults Database (2025) does not show any active faults (generally defined as faults which have deformed the ground surface within the past 125,000 years) running through, or close to the site.

4.5 LIQUEFACTION

Based on the results of our site-specific deep investigations, the site soils are not considered susceptible to liquefaction due to:

- the cohesive and / or cemented nature of the fine-grained soils; and,
- the dense to very dense state of the coarse-grained soils.

WP considers the liquefaction hazard at the site to be very low, and no specific liquefaction mitigation measures are considered necessary for the proposed development.

4.6 LATERAL SPREADING

Lateral spreading occurs during or shortly after an earthquake when liquefied soil moves laterally toward a free face (e.g., stream bank or slope of an open channel), or when a non-liquefied “crust” moves laterally toward a free face on an underlying layer of liquefied soil. The greatest displacements typically occur near to the free face and gradually reduce with increasing distance from the free face.

While there is an approximately 5 to 6 high slope of the Oratia streambank located within about 20 m of part of the northern site boundary, the probability of the site being affected by lateral spreading during either a SLS or ULS event is considered to be very low because the site soils are not considered susceptible to liquefaction.

4.7 HIGHLY COMPRESSIBLE SOILS

The alluvial Puketoka Formation soils at the site vary in strength and stiffness both vertically and horizontally across the site. However, the site investigations to date have not identified any peat, highly organic, or otherwise very weak and/or compressible soils.

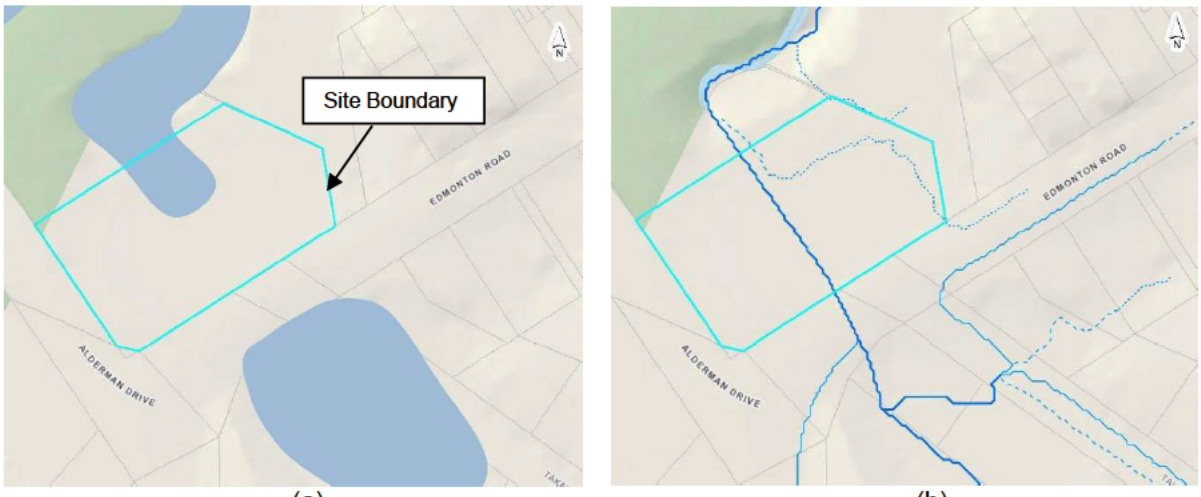
4.8 EXPANSIVE SOILS

Expansive soils are defined as soils that undergo large volume changes (shrink or swell) due to variations in soil moisture content. Such volume changes may cause damaging settlement and/or heave of foundations, slabs-on-grade, pavements, etc.

The near-surface soils found in the hand auger holes are generally characterised as having slight to moderate plasticity, but some highly plastic clayey soils were found at a depth of around 1 m. In the absence of site-specific laboratory testing to confirm otherwise, the shallow soils should be assumed to be 'Site Class H – Highly Expansive' as described in B1/AS1 or 'H1' as per AS 2870:2011.

4.9 FLOODING

The small portion of the northern part of the site is shown to be located within an Auckland Council-identified 'flood plain' area (AC Geomaps, 2025) – indicating that it is predicted to be covered by water as a result of a 1 in 100-year flood as shown in Figure 4-1. An overland flow path identified as draining an area of between 3 ha and 100 ha is also shown to run through the central portion of the site in a southerly direction. WP understands that site-specific flood modelling of the site is being undertaken by others and the AC flood information is shown for information only.



(a) (b)

Figure 4-1 – Flood Plain (a); Overland flow paths (b)

4.10 TSUNAMI

The site is not shown as located within 'Tsunami Evacuation Zone' (AC Hazard Viewer, 2025). A 'Yellow' Evacuation Zone, indicating an area that would need to be evacuated only in the event of a 'maximum-impact' tsunami, is located along the margins of Oratia Stream west of the site across Alderman Drive.

4.11 VOLCANIC ERUPTION

This site is not located within the Auckland Volcanic Field (AC Hazard Viewer, 2025).

4.12 COASTAL INUNDATION

The site is not located within an Auckland Council coastal inundation zone (AC Hazard Viewer, 2025).

4.13 ENVIRONMENTAL ISSUES

Environmental site assessment / engineering is beyond WP's scope of work, and we recommend that an environmental specialist be engaged to assess this aspect of the site.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our site investigations and geotechnical assessment, WP makes the following conclusions and preliminary recommendations for foundation support.

5.1 GEOTECHNICAL CONSTRAINTS

No significant geotechnical risks or constraints have been identified on the site. The proposed six-storey structure will require deep foundations (e.g., bored concrete piles) extending into slightly weathered rock of the ECBF as discussed below.

5.2 SITE SUBSOIL CLASS

Based on the consistency and depth of soils found in WP's site investigation, and the depth to bedrock, WP recommends a site subsoil class of 'Class C – deep soil' as defined by NZS 1170.5 (2004) be used for seismic design.

5.3 FOUNDATION SUPPORT

The site soils overlying rock have variable strength and stiffness both vertically and horizontally. A relatively stiff crust in the order of 2 to 3 m thick is present across the site, and this layer is anticipated to be suitable for shallow foundation support of relatively light structures up to 2-storeys. However, heavier structures will need to be supported on deep pile foundations that extend into slightly weathered ECBF rock.

The depth to the top of a suitable founding layer for end-bearing bored concrete or similar piles is anticipated to range from about 8 m in the western part of the site to about 13 m in the eastern part, and possibly somewhat shallower in the central part of the site.

It is anticipated that an ultimate geotechnical strength of 6 MPa will be available for end-bearing piles with the base founded a minimum of three pile diameters into intact, slightly weathered ECBF rock (defined as a rock mass with three consecutive SPT N-values of not less than 50 over 3 m depth interval).

The soils supporting shallow foundation beams should be assumed to be highly reactive / expansive (i.e., Site Class H – Highly Expansive in B1/AS1 or H1 in AS 2870:2011) for conceptual design. The reactivity class should be confirmed with appropriate laboratory testing for later stages of design.

5.4 EARTHWORK CONSIDERATIONS

WP understands that no major earthworks will be required for the proposed development of the site. Based on the information from the 2018 Soil & Rock Consultants shallow investigations, it should be assumed that up to about 0.4 m of topsoil and/or undocumented fill may need to be removed from portions of the site depending on the extent of the developed area. The potential for areas of deeper or more extensive undocumented fill to exist that would

require removal cannot be precluded; however, extensive fill removal is considered unlikely based on the site investigations to date.

Site earthworks are not anticipated to extend to the perched or permanent ground water tables (depth of about 2 to 2.5 m), hence dewatering of excavations is not anticipated.

5.5 FURTHER WORK

Further work will be required to confirm the foundation conditions and geotechnical design criteria presented in this report. This work is expected to include:

- Additional machine-drilled boreholes within the final building footprint to confirm the depth to, and strength of the target rock bearing layer.
- Additional shallow hand auger investigations will also be required to confirm the near-surface ground conditions and obtain samples for laboratory testing to confirm the soil reactivity/expansivity.

A suitably qualified and experienced geotechnical engineer should be engaged for the duration of the project to design, monitor and certify the geotechnical aspects of the project.

Subject to the additional site investigations and future detailed design taking into account the ground conditions, conclusions and recommendations contained in this report, and the geotechnical aspects of the design being undertaken by a suitably qualified and experienced Chartered Professional Engineer, it is considered that potential adverse geotechnical hazard effects will be less than minor.

6.0
APPLICABILITY AND LIMITATIONS

This report was prepared solely for the benefit of Ministry of Justice (the Client) and their project consultants with respect to the particular brief given to WP. The use by other parties of the information, opinions and recommendations contained in this report shall be at such parties' sole risk. This report is not intended to be used for design or building consent.

WP's services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. There is no other warranty, either expressed or implied.

The opinions and recommendations in this report are based on subsurface information collected from discrete investigation / test locations, and the subsurface conditions away from these locations are inferred. It must be appreciated that the actual soil conditions could vary from those described in this report.

During site preparation and construction of bulk earthworks, the site should be examined by a geotechnical professional with the appropriate skills and experience to determine whether the exposed subsoils are compatible with the inferred conditions on which the recommendations in this report are based. If the ground conditions found at the site are found to differ from those described in this report, WP should be contacted immediately so that we can review our recommendations and if revise them if necessary.

7.0
REFERENCES

Auckland Council (2025). GeoMaps, viewed 02 April, https://geomapspublic.auckland council.govt.nz/viewer /index.html

Auckland Council (2025). Hazard Viewer, viewed 02 April, https://aucklandcouncil.maps. arcgis.com/apps/MapSeries/index.html?appid=81aa3de13b114be9b529018ee3c649c8

Boyd, ME and Macklin, SR (2017). The Puketoka Formation, Auckland New Zealand. A review of geotechnical properties and hazards for tunnelling. 16th Australasian Tunnelling Conference 2017: Challenging Underground Space: Bigger, Better, More. Barton, ACT: Engineers Australia. [94]-[103].

Edbrooke, S.W. (complier) (2001). Geology of the Auckland area. Institute of Geological and Nuclear Sciences 1:250,000 geological map 3. 1 sheet + 74 p. Lower Hutt, Institute of Geological and Nuclear Sciences Limited.

New Zealand Active Faults Database (2025). GNS Science, viewed 02 April, http://data.gns.cri.nz/af/index.html

Soil & Rock Consultants (2023). Geotechnical Due-Diligence Investigation at 14 Edmonton Road, Henderson. Rev C. 13 February 2023.

APPENDIX A

PLATES

SOURCE: AUCKLAND COUNCIL GEOMAPS

APPROXIMATE LOCATION OF CPT (2024)

APPROXIMATE LOCATION OF MACHINE BOREHOLE (2024)

APPROXIMATE LOCATION OF HAND AUGER BOREHOLE (2018)

SITE BOUNDARY

WENTZ-PACIFIC GEOTECHNICAL ENGINEERS	Client: Ministry of Justice Waitakere District Courthouse Project No,: 1496-01-24	Drawn by: DD Reviewed by: RW Date: April 2025	**Site Investigation Plan** **Waitakere District Courthouse** **14 Edmonton Road, Henderson, Auckland**	PLATE A-2

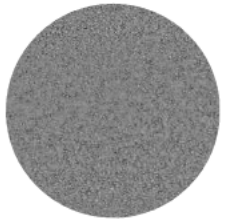
APPENDIX B

CONCEPT DESIGN SITE PLAN

Waitākere District Court - New Courthouse - Concept Design
Landscape Plan

COMMERCIAL IN CONFIDENCE

1. Indicative Permeable Areas



2. Indicative Impermeable Areas

Scale @ A3: 1:500

0 2 4 8 10 20 30 m

APPENDIX C

LOGS OF DEEP SITE INVESTIGATIONS

BOREHOLE LOG

Hole No.: MH01

Client:	Wentz-Pacific Ltd	**Contractor:**	Pro-Drill Ltd (Akl)	**Project ID:**	27042
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	03/09/2024
Site Location:	14 Edmonton Road, Henderson	**Driller:**	Clutch	**End Date:**	03/09/2024
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Water in/out flow	Backfill/ Installation/ Groundwater
-1		Material extracted by Hydro Excavation.	1							1	Hydrovac	0				Bentonite
					1/1//1/1/2/2 N = 6											1.0
-2	Puketoka Formation	Silty CLAY; brown and grey mottled light brown. Very stiff; moist; high plasticity; insensitive; with minor limonite.	2							2	SPT	100				
											Open Barrel	58				
		2.75m: becoming orange and grey mottled light brown; with trace limonite														
-3		Silty CLAY; orange/brown mottled grey. Very stiff; moist; medium plasticity; with some limonite staining.	3		138 / 81 kPa 1/1//1/1/1/1 N = 4					3	SPT	100			No groundwater observations during drilling	Gravel
-4		Clayey SILT, with minor sand; brown/grey. Firm; wet to saturated; low plasticity; sand, fine.	4		34 / 15 kPa 0/0//0/0/1/0 N = 1					4	Open Barrel	53				
-5		5.10m: becoming orange/brown	5							5	SPT	100				
		slightly Silty CLAY; light grey. Firm; wet to saturated; high plasticity.									Open Barrel	100				
		5.30m: becoming light brown/grey, with organic staining														
		5.40m: with 50mm bed andy SILT, with minor clay. Firm; wet to saturated; low plasticity.														
		5.50m: with trace medium sand sized organic inclusions														

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

PIEZO	DATE	LEVEL	REMARK
1	5/09/2024	2.40	

Hole Depth:	Inclination:
13.65	90.00
Logged By:	**Checked By:**
MK	JL
DRAFT	Sheet 1 of 3

BOREHOLE LOG

Hole No.: MH01

Client:	Wentz-Pacific Ltd	**Contractor:**	Pro-Drill Ltd (Akl)
Project:	Geotechnical Investigation	**Rig:**	SLG
Site Location:	14 Edmonton Road, Henderson	**Driller:**	Clutch
Test Location:	See plan	**Coordinates:**	
Located By:	Site plan/map	**Elevation:**	Not set

Project ID:	27042
Start Date:	03/09/2024
End Date:	03/09/2024
Grid:	NZTM
Datum:	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Water in/out flow	Backfill/ Installation/ Groundwater
	Puketoka	Sandy SILT, with minor clay; grey. Firm; wet; low plasticity.			SPT blows/75mm Shear vane peak/residual 31 / 15 kPa 0/0//1/1/3/4 N = 9						SPT	100				
		Clayey SILT, with trace sand; dark grey. Hard; moist; low plasticity; sand, fine.														
-7		Silty SAND, with trace clay; dark grey. Dense; moist; non-plastic.	7		UTP 5/5//6/9/10/15 N = 40					7	Open Barrel	92			No groundwater observations during drilling	Gravel
-8	Weathered East Coast Bays Formation		8			EW	RS			8	SPT	0				
		8.50m: with very thin bed of carbonaceous material									Triple tube	100				
-9			9		7/7//8/9/10/15 N = 42					9	SPT	0				
		Moderately weathered; dark grey; SILTSTONE; very weak.				VW	MW		9.60m: 4 Joints, Planar, 80°-90°, Rough to10m							
-10		Silty SAND; dark grey. Very dense; moist; non-plastic to weathered SANDSTONE; dark grey; Extremely weak.	10						9.95m: Parting, Planar, 70°-90°, Rough	10	Triple tube	100	63			
					9/11//13/15/20 for 10mm N = 50+	EW	CW		10.20m: 3 Joints, Planar, 80°90°, Rough to 10.5m							
											SPT	100	0			
-11		Moderately weathered; dark grey; SILTSTONE; very weak.	11						11.10m: 8 Joints, Planar, 80°90°, Rough to12.0m	11	Triple tube	100	58			
		11.20m: with thin bed very dense silty Sand to extremely weak SANDSTONE.				VW	MW									
		Slightly weathered; dark grey; Fine to medium grained SANDSTONE; weak.				W	SW									

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

PIEZO	DATE	LEVEL	REMARK
1	5/09/2024	2.40	

Hole Depth:	13.65
Inclination:	90.00
Logged By:	MK
Checked By:	JL
DRAFT	Sheet 2 of 3

BOREHOLE LOG

Hole No.: MH01

Client:	Wentz-Pacific Ltd	**Contractor:**	Pro-Drill Ltd (Akl)
Project:	Geotechnical Investigation	**Rig:**	SLG
Site Location:	14 Edmonton Road, Henderson	**Driller:**	Clutch
Test Location:	See plan	**Coordinates:**	
Located By:	Site plan/map	**Elevation:**	Not set

Project ID:	27042
Start Date:	03/09/2024
End Date:	03/09/2024
Grid:	NZTM
Datum:	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Water in/out flow	Backfill/ Installation/ Groundwater
-13	Weathered East Coast Bays Formation	[CONT] Slightly weathered; dark grey; Fine to medium grained SANDSTONE; weak.	13		12/20/31/19 for 20mm N = 50+	W	SW		12.35m: Joint, Planar, 70°, Rough 13.20m: 1 Joint, Planar to curved, 70°, Rough	13	SPT	0	0		No groundwater observations during drilling	Gravel
											Triple tube	60	60			
-14		EOH: 13.65m	14		7/43 N = 50+					14	SPT	0	0			
-15			15							15						
-16			16							16						
-17			17							17						

Remarks:

PIEZO	DATE	LEVEL	REMARK
1	5/09/2024	2.40	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	13.65
Inclination:	90.00
Logged By:	MK
Checked By:	JL
DRAFT	Sheet 3 of 3

0.00m - 5.50m

5.50m - 8.70m

8.70m - 13.65m

BOREHOLE LOG

Hole No.: MH02

Client:	Wentz-Pacific Ltd	**Contractor:**	Pro-Drill Ltd (Akl)
Project:	Geotechnical Investigation	**Rig:**	SLG
Site Location:	14 Edmonton Road, Henderson	**Driller:**	Clutch
Test Location:	See plan	**Coordinates:**	
Located By:	Site plan/map	**Elevation:**	Not set

Project ID:	27042
Start Date:	03/09/2024
End Date:	03/09/2024
Grid:	NZTM
Datum:	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Water in/out flow	Backfill/ Installation/ Groundwater
-1		Materials extracted by Hydro Excavation.	1							1	Hydrovac	0				
		1.50m: with sandy fine to medium gravel														
		Silty CLAY; orange and grey streaked light brown. Stiff; moist; high plasticity.			1/1//1/1/1/2 N = 4						SPT	100				
-2	Puketoka Formation		2							2	Open Barrel	95				
		Silty CLAY; orange and grey mottled light brown. Stiff; moist; high plasticity; moderately sensitive.														
-3		Sandy SILT, with trace clay; light brown mottled light grey/blue. Very loose; saturated; non-plastic; with trace fine gravel sized, rounded pumice and clay clasts.	3		89 / 37 kPa 0/0//1/0/0/0 N = 1					3	SPT	100				
		Silty CLAY, with minor sand; orange mottled grey. Stiff; moist to wet; medium plasticity; sand, fine.														
-4		Silty fine to coarse SAND, with trace clay; dark grey. Loose; saturated; non-plastic; with trace fine gravel sized, rounded pumice and clay clasts .	4							4	Open Barrel	100				
		4.65m: with 20mm bed of limonite			46 / 15 kPa 3/4//7/8/10/12 N = 37											
		Silty medium SAND; dark grey. Dense; moist; non-plastic; with coarse white sand sized clasts.									SPT	100				
-5	Weathered East Coast Bays Formation		5			EW	RS			5	Triple tube	62				
		5.80m: becoming silty fine sand, with occasional carbonaceous laminae														

Remarks: Note: some gravel falling downhole over first run

PIEZO	DATE	LEVEL	REMARK

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	10.65
Logged By:	MK
DRAFT	

Inclination:	90.00
Checked By:	JL
Sheet 1 of 2	

BOREHOLE LOG

Hole No.: MH02

Client:	Wentz-Pacific Ltd	**Contractor:** Pro-Drill Ltd (Akl)	**Project ID:** 27042
Project:	Geotechnical Investigation	**Rig:** SLG	**Start Date:** 03/09/2024
Site Location:	14 Edmonton Road, Henderson	**Driller:** Clutch	**End Date:** 03/09/2024
Test Location:	See plan	**Coordinates:**	**Grid:** NZTM
Located By:	Site plan/map	**Elevation:** Not set	**Datum:** Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Water in/out flow	Backfill/ Installation/ Groundwater
-7	Weathered East Coast Bays Formation	[CONT] Silty medium SAND; dark grey. Dense; moist; non-plastic; with coarse white sand sized clasts.	7		1/2/6/7/12/15 N = 40	EW	RS		6.45m: 3 Joints, Planar, 80°-90°, Rough to 6.80m	7	SPT	0			No groundwater observations during drilling	
		medium SAND. Dark grey. Dense. moist, non-plastic to Completely weathered; dark grey; medium SANDSTONE; extremely weak.							7.00m: Parting, Stepped, 30°, Rough		Triple tube	99	90			
-8		Slightly weathered; dark grey; SANDSTONE; very weak.	8		3/7//17/20/13 for 30mm N = 50+	EW	CW		8.10m: 4 Joints, Planar, 80°-90°, Rough to 8.50m	8	SPT	0	0			
		8.20m: coarsing downwards to coarse SANDSTONE									Triple tube	100	99			
		8.50m: becoming fine SANDSTONE, with occasional carbonaceous laminae														
-9			9		9/29//38/12 for 25mm N = 50+					9	SPT	0	0			
		9.30m: with 75mm bed medium SANDSTONE				VW	SW		9.30m: 8 Joints, Planar, 90°, Smooth to 10m, generally along medium SANDSTONE beds to 10.0m							
		9.40m: with 30mm bed medium SANDSTONE														
		9.50m: with 75mm bed medium SANDSTONE														
-10		9.90m: with 50mm bed medium SANDSTONE	10							10	Triple tube	94	75			
		10.10m: with 30mm bed of medium SANDSTONE														
		10.30m: with 30mm bed of medium SANDSTONE														
		10.40m: with 30mm bed of medium SANDSTONE														
		EOH: 10.65m			9/41 for 70mm N = 50+						SPT	0	0			
-11			11							11						

Remarks: Note: some gravel falling downhole over first run

PIEZO	DATE	LEVEL	REMARK

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	Inclination:
10.65	90.00
Logged By:	**Checked By:**
MK	JL
DRAFT	Sheet 2 of 2

0.00m - 4.95m

4.95m - 9.25m

9.25m - 10.65m

GROUND INVESTIGATION

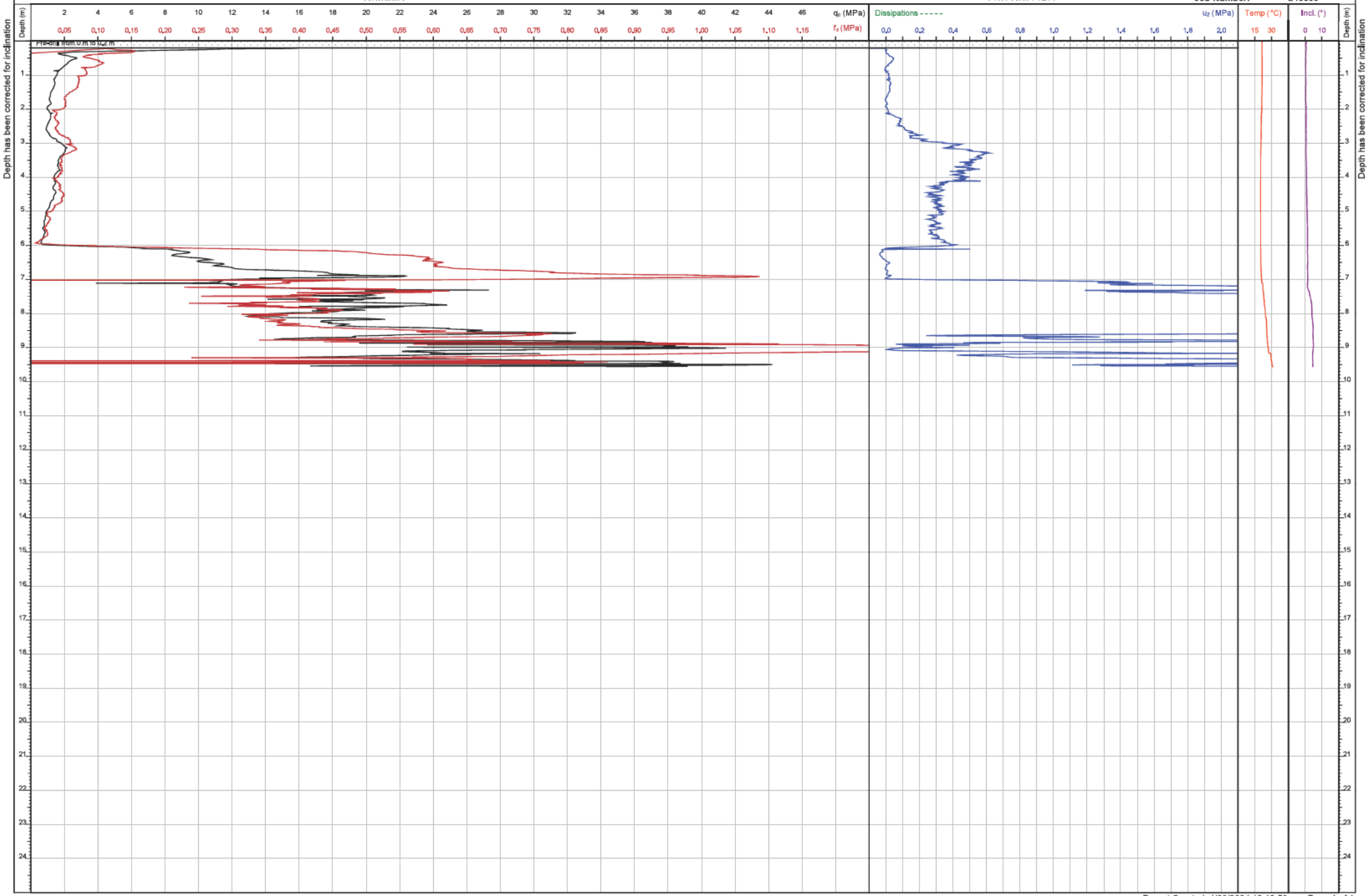
Measured CPT Log

Client: Wentz-Pacific Ltd
Project: 14 Edmonton Road, Henderson, Auckland
Remarks:

Depth (m): 9,56
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 3/09/2024
Cone Ref: 71238

Test Name: CPT-01
Job Number: 240633



GROUND INVESTIGATION

CPT Details

General Information

Project:	14 Edmonton Road, Henderson, Auckland	**Location:**	14 Edmonton Road, Henderson, Auckland
Contractor:	Ground Investigation	**Rig details:**	22 Tonne MAN Truck
WGS84 (deg):	-36.877693, 174.63486499999996	**Location method:**	Handheld GPS
Elevation (m):	Unknown	**Elevation datum:**	
Date:		**Start time:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	0.20
Start length (m):	0
Cone ID:	71238
Cone type:	15cm2 Subtraction
Cone class:	
Manufacturer:	
Calibration date:	
Cone area ratio:	0.75
Sleeve area ratio:	0
Sleeve offset:	0.09
Filter type:	U2 Stainlesss steel
Saturation method:	Vacuum pump
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	9.56
Ground water level:	0.9
Water level origin:	Estimated
Backfill:	
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	
Manager name:	

CPT Formulas

Test Name: CPT-01

Job Number: 240633

Corrected cone resistance: $q_t = q_c + u_2 \cdot (1 - a)$

Friction ratio: $R_f = \frac{f_s}{q_c} \cdot 100$

Non-normalised soil behaviour type (SBT): Calculated using q_{net} and R_f for the Robertson's 2010 non-normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Soil behaviour type index, (used for non-normalised SBT) : $I_c = \left((3.47 - \log(q_t))^2 + (\log(R_f) + 1.22)^2 \right)^{0.5}$

Friction ratio: $F_r = \frac{f_s}{q_t - \sigma_{v0}} \cdot 100$

Refined normalised cone resistance: $Q_{tn} = \frac{(q_t - \sigma_{v0}) / \sigma_{atm}}{\left(\sigma'_{v0} / \sigma_{atm}\right)^n}$ where $n = 0.381 \cdot I_c + 0.05 \cdot \left(\sigma'_{v0} / \sigma_{atm}\right) - 0.05 \leq 1.0$

Normalised soil behaviour type index: $I_c = \left((3.47 - \log(Q_{tn}))^2 + (\log(F_r) + 1.22)^2 \right)^{0.5}$

Normalised pore pressure: $B_q = \frac{\Delta u}{q_t - \sigma_{v0}}$

Normalised soil behaviour type (SBTn): Calculated using Q_{tn} and F_r for the Robertson's 2010 normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Undrained shear strength (s_u): $s_u = \frac{q_t - \sigma_{v0}}{N_{kt}}$

Relative density (D_r): $D_r = 100 \cdot \sqrt{\frac{Q_{tn}}{350}}$

Friction angle (Φ'): $\Phi' = 17.60 + 11 \cdot \log(Q_{tn})$

Small strain shear modulus (G_0): $G_0 = (qt - \sigma_{v0}) \cdot \left(0.0188 \cdot 10^{(0.55 \cdot I_c + 1.68)}\right)$

Estimated shear wave velocity (V_s): $V_s = \sqrt{\frac{G_0}{\rho}}$ where $\rho = \frac{\gamma}{\gamma_w}$

Constrained modulus (M): $M = \alpha_M (q_t - \sigma_{v0})$

when $I_c > 2.2$

$\alpha_M = Q_t$ when $Q_t < 14$

$\alpha_M = 14$ when $Q_t > 14$

when $I_c < 2.2$

$\alpha_M = 0.0188 \cdot 10^{(0.55 \cdot I_c + 1.68)}$

Youngs modulus (E_s): $E_s = (qt - \sigma_{v0}) \cdot \left(0.015 \cdot 10^{(0.55 \cdot I_c + 1.68)}\right)$

Estimated SPT N_{60}: $N_{60} = \frac{q_t / p_a}{8.5 \cdot \left(1 - \frac{I_c}{4.6}\right)}$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,838.80	6,838.80	0	-	-
Sleeve friction	464.10	457.50	-6.52	-	-
Pore pressure	737.70	737.70	0	-	-

GROUND INVESTIGATION

Measured CPT Log

Client: Wentz-Pacific Ltd
Project: 14 Edmonton Road, Henderson, Auckland
Remarks:

Depth (m): 6,69
Termination: High friction resistance

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 3/09/2024
Cone Ref: 71137

Test Name: CPT-02
Job Number: 240633

Depth has been corrected for inclination

Depth (m)

q_c (MPa) 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46

f_s (MPa) 0,05 0,10 0,15 0,20 0,25 0,30 0,35 0,40 0,45 0,50 0,55 0,60 0,65 0,70 0,75 0,80 0,85 0,90 0,95 1,00 1,05 1,10 1,15

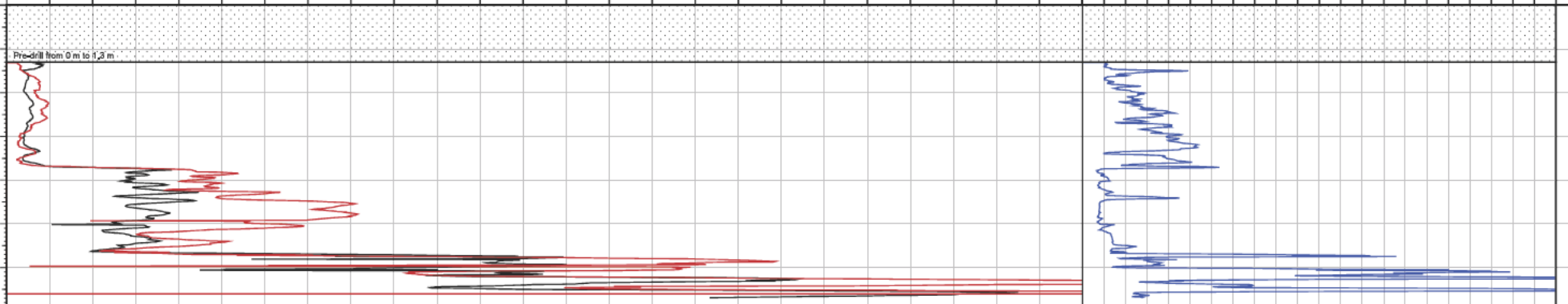
Dissipations - - - - -

u_2 (MPa) 0,0 0,2 0,4 0,6 0,8 1,0 1,2 1,4 1,6 1,8 2,0

Temp (°C) 15 30

Incl. (°) 0 10

Pre-drill from 0 m to 1,3 m



Depth has been corrected for inclination

GROUND INVESTIGATION

CPT Details

General Information

Project:	14 Edmonton Road, Henderson, Auckland	**Location:**	14 Edmonton Road, Henderson, Auckland
Contractor:	Ground Investigation	**Rig details:**	22 Tonne MAN Truck
WGS84 (deg):	-36.877704, 174.63525199999998	**Location method:**	Handheld GPS
Elevation (m):	Unknown	**Elevation datum:**	
Date:		**Start time:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.30
Start length (m):	0
Cone ID:	71137
Cone type:	15cm2 Subtraction
Cone class:	
Manufacturer:	
Calibration date:	
Cone area ratio:	0.75
Sleeve area ratio:	0
Sleeve offset:	0.09
Filter type:	U2 Stainless steel
Saturation method:	Vacuum pump
Rig setup variation:	

Test Result

Termination reason:	High friction resistance
Termination depth:	6.69
Ground water level:	1.1
Water level origin:	Measured
Backfill:	
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	[redacted]
Operator name	
Manager name:	

CPT Formulas

Test Name: CPT-02

Job Number: 240633

Corrected cone resistance: $q_t = q_c + u_2 \cdot (1 - a)$

Friction ratio: $R_f = \frac{f_s}{q_c} \cdot 100$

Non-normalised soil behaviour type (SBT): Calculated using q_{net} and R_f for the Robertson's 2010 non-normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Soil behaviour type index, (used for non-normalised SBT) : $I_c = \left(\left(3.47 - \log\left(q_t\right)\right)^2 + \left(\log\left(R_f\right) + 1.22\right)^2\right)^{0.5}$

Friction ratio: $F_r = \frac{f_s}{q_t - \sigma_{v0}} \cdot 100$

Refined normalised cone resistance: $Q_{tn} = \frac{\left(q_t - \sigma_{v0}\right) / \sigma_{atm}}{\left(\sigma'_{v0} / \sigma_{atm}\right)^n}$ where $n = 0.381 \cdot I_c + 0.05 \cdot \left(\sigma'_{v0} / \sigma_{atm}\right) - 0.05 \leq 1.0$

Normalised soil behaviour type index: $I_c = \left(\left(3.47 - \log\left(Q_{tn}\right)\right)^2 + \left(\log\left(F_r\right) + 1.22\right)^2\right)^{0.5}$

Normalised pore pressure: $B_q = \frac{\Delta u}{q_t - \sigma_{v0}}$

Normalised soil behaviour type (SBTn): Calculated using Q_{tn} and F_r for the Robertson's 2010 normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Undrained shear strength (s_u): $s_u = \frac{q_t - \sigma_{v0}}{N_{kt}}$

Relative density (D_r): $D_r = 100 \cdot \sqrt{\frac{Q_{tn}}{350}}$

Friction angle (Φ'): $\Phi' = 17.60 + 11 \cdot \log\left(Q_{tn}\right)$

Small strain shear modulus (G_0): $G_0 = \left(qt - \sigma_{v0}\right) \cdot \left(0.0188 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}\right)$

Estimated shear wave velocity (V_s): $V_s = \sqrt{\frac{G_0}{\rho}}$ where $\rho = \frac{\gamma}{\gamma_w}$

Constrained modulus (M):

$M = \alpha_M\left(q_t - \sigma_{v0}\right)$

when $I_c > 2.2$

$\alpha_M = Q_t$ when $Q_t < 14$

$\alpha_M = 14$ when $Q_t > 14$

when $I_c < 2.2$

$\alpha_M = 0.0188 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}$

Youngs modulus (E_s): $E_s = \left(qt - \sigma_{v0}\right) \cdot \left(0.015 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}\right)$

Estimated SPT N_{60}: $N_{60} = \frac{q_t / p_a}{8.5 \cdot \left(1 - \frac{I_c}{4.6}\right)}$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,308.10	6,332.50	24.36	-	-
Sleeve friction	449.10	447.00	-2.11	-	-
Pore pressure	705.10	705.10	0	-	-

GROUND INVESTIGATION

Measured CPT Log

Client: Wentz-Pacific Ltd
Project: 14 Edmonton Road, Henderson, Auckland
Remarks:

Depth (m): 11.83
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 3/09/2024
Cone Ref: 71137

Test Name: CPT-03
Job Number: 240633

Depth has been corrected for inclination

Depth (m)

q_c (MPa)

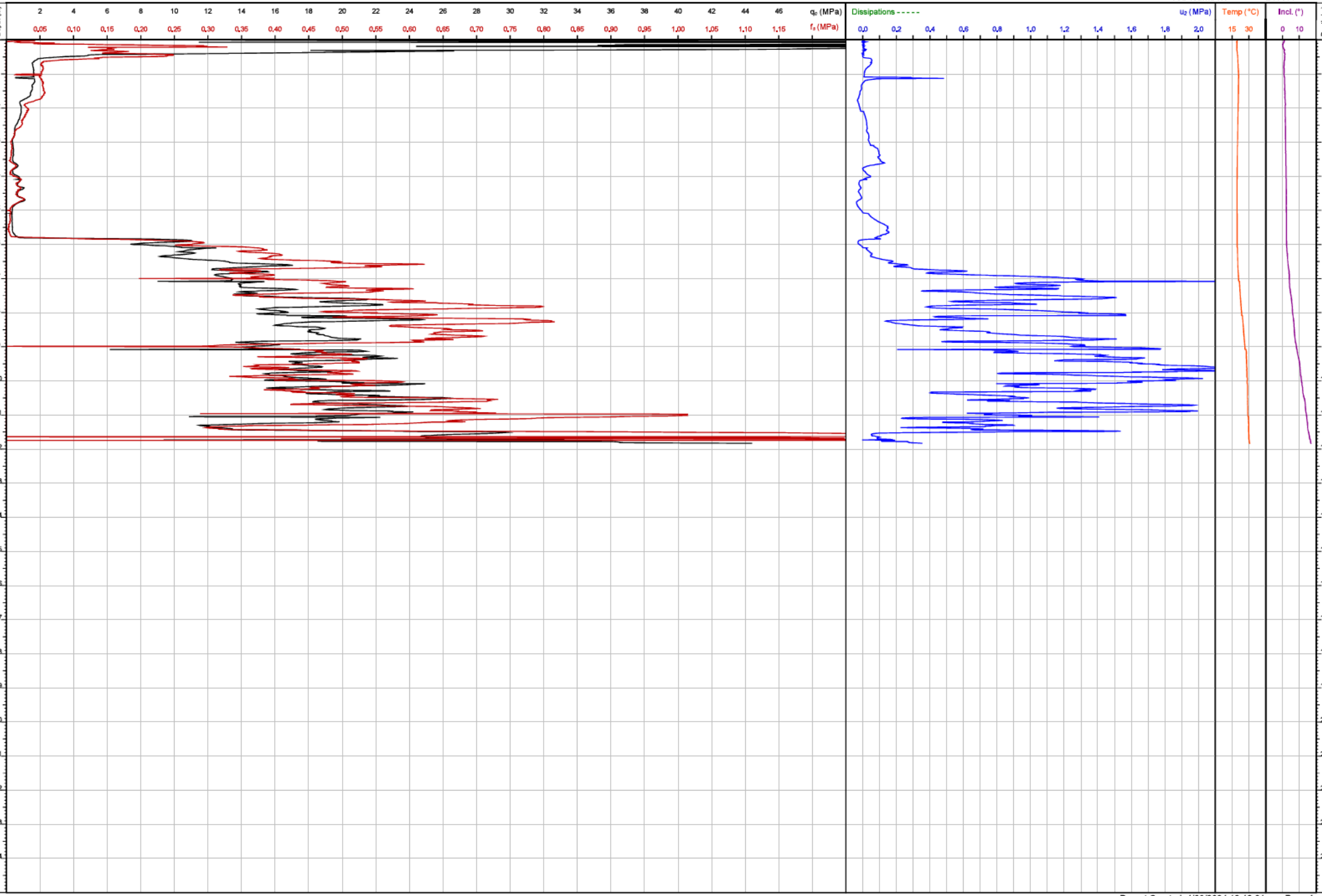
f_s (MPa)

Dissipations - - - - -

u_2 (MPa)

Temp (°C)

Incl. (°)



GROUND INVESTIGATION

CPT Details

General Information

Project:	14 Edmonton Road, Henderson, Auckland	**Location:**	14 Edmonton Road, Henderson, Auckland
Contractor:	Ground Investigation	**Rig details:**	22 Tonne MAN Truck
WGS84 (deg):	-36.877441, 174.635551	**Location method:**	Handheld GPS
Elevation (m):	Unknown	**Elevation datum:**	
Date:		**Start time:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	0.00
Start length (m):	0
Cone ID:	71137
Cone type:	15cm2 Subtraction
Cone class:	
Manufacturer:	
Calibration date:	
Cone area ratio:	0.75
Sleeve area ratio:	0
Sleeve offset:	0.09
Filter type:	U2 Stainless steel
Saturation method:	Vacuum pump
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	11.83
Ground water level:	1
Water level origin:	Estimated
Backfill:	
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	[redacted]
Operator name:	
Manager name:	

CPT Formulas

Test Name: CPT-03

Job Number: 240633

Corrected cone resistance:
$$q_t = q_c + u_2 \cdot (1 - a)$$

Friction ratio:
$$R_f = \frac{f_s}{q_c} \cdot 100$$

Non-normalised soil behaviour type (SBT):
Calculated using q_{net} and R_f for the Robertson's 2010 non-normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Soil behaviour type index, (used for non-normalised SBT) :
$$I_c = \left((3.47 - \log(q_t))^2 + (\log(R_f) + 1.22)^2 \right)^{0.5}$$

Friction ratio:
$$F_r = \frac{f_s}{q_t - \sigma_{v0}} \cdot 100$$

Refined normalised cone resistance:
$$Q_{tn} = \frac{(q_t - \sigma_{v0}) / \sigma_{atm}}{\left(\sigma'_{v0} / \sigma_{atm}\right)^n} \quad \text{where} \quad n = 0.381 \cdot I_c + 0.05 \cdot \left(\sigma'_{v0} / \sigma_{atm}\right) - 0.05 \leq 1.0$$

Normalised soil behaviour type index:
$$I_c = \left((3.47 - \log(Q_{tn}))^2 + (\log(F_r) + 1.22)^2 \right)^{0.5}$$

Normalised pore pressure:
$$B_q = \frac{\Delta u}{q_t - \sigma_{v0}}$$

Normalised soil behaviour type (SBTn):
Calculated using Q_{tn} and F_r for the Robertson's 2010 normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Undrained shear strength (s_u):
$$s_u = \frac{q_t - \sigma_{v0}}{N_{kt}}$$

Relative density (D_r):
$$D_r = 100 \cdot \sqrt{\frac{Q_{tn}}{350}}$$

Friction angle (Φ'):
$$\Phi' = 17.60 + 11 \cdot \log(Q_{tn})$$

Small strain shear modulus (G_0):
$$G_0 = (qt - \sigma_{v0}) \cdot \left(0.0188 \cdot 10^{(0.55 \cdot I_c + 1.68)}\right)$$

Estimated shear wave velocity (V_s):
$$V_s = \sqrt{\frac{G_0}{\rho}} \quad \text{where} \quad \rho = \frac{\gamma}{\gamma_w}$$

Constrained modulus (M):
$$M = \alpha_M (q_t - \sigma_{v0})$$

when $I_c > 2.2$

$\alpha_M = Q_t$ when $Q_t < 14$

$\alpha_M = 14$ when $Q_t > 14$

when $I_c < 2.2$

$$\alpha_M = 0.0188 \cdot 10^{(0.55 \cdot I_c + 1.68)}$$

Youngs modulus (E_s):
$$E_s = (qt - \sigma_{v0}) \cdot \left(0.015 \cdot 10^{(0.55 \cdot I_c + 1.68)}\right)$$

Estimated SPT N_{60}:
$$N_{60} = \frac{q_t / p_a}{8.5 \cdot \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,349.60	6,356.90	7.31	-	-
Sleeve friction	451.90	444.20	-7.62	-	-
Pore pressure	705.10	705.80	0.73	-	-

GROUND INVESTIGATION

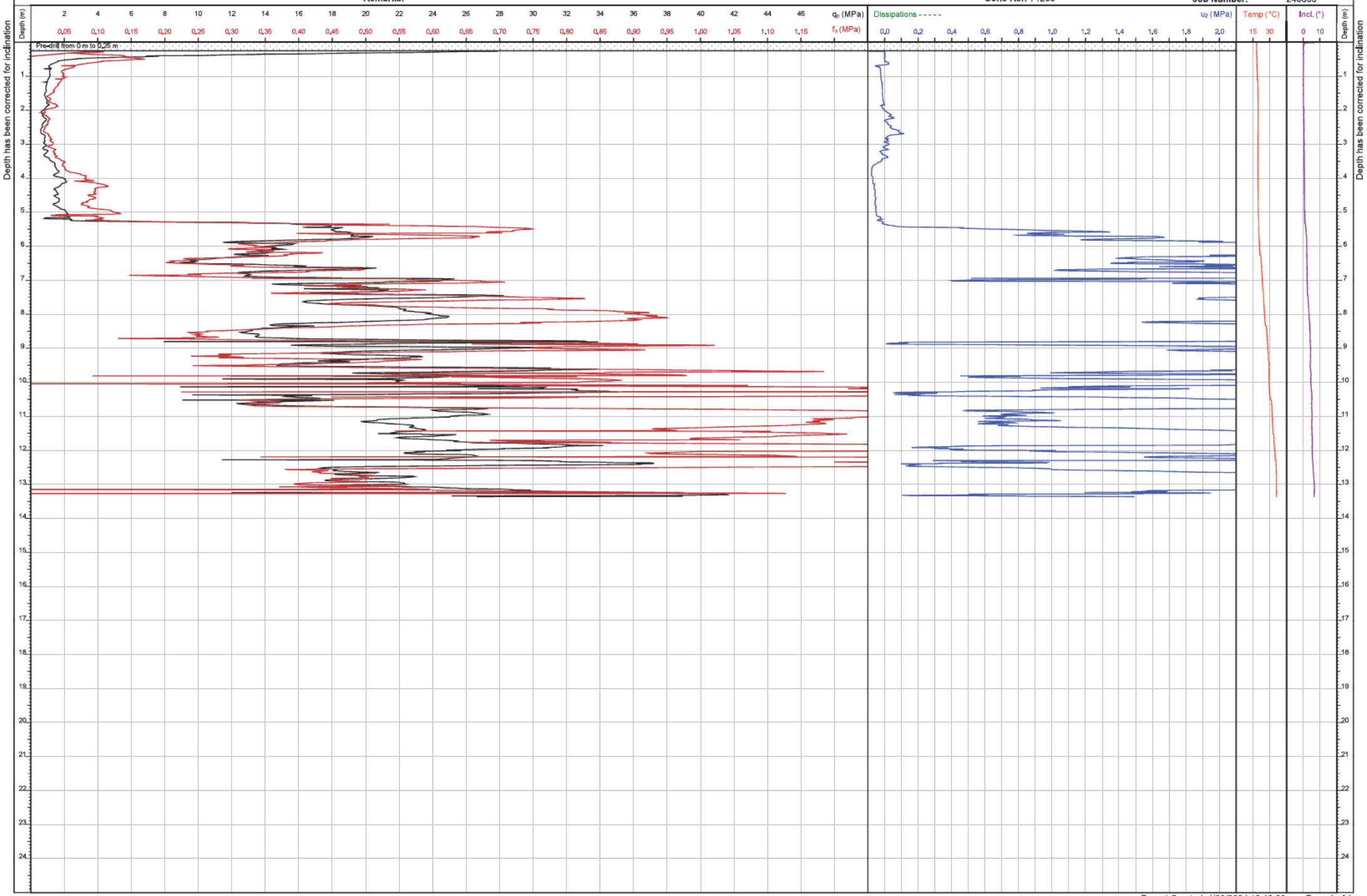
Measured CPT Log

Client: Wentz-Pacific Ltd
Project: 14 Edmonton Road, Henderson, Auckland
Remarks:

Depth (m): 13.36
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 3/09/2024
Cone Ref: 71238

Test Name: CPT-04
Job Number: 240633



GROUND INVESTIGATION

CPT Details

General Information

Project:	14 Edmonton Road, Henderson, Auckland	**Location:**	14 Edmonton Road, Henderson, Auckland
Contractor:	Ground Investigation	**Rig details:**	22 Tonne MAN Truck
WGS84 (deg):	-36.87760999999999, 174.635692	**Location method:**	Handheld GPS
Elevation (m):	Unknown	**Elevation datum:**	
Date:		**Start time:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	0.25
Start length (m):	0
Cone ID:	71238
Cone type:	15cm2 Subtraction
Cone class:	
Manufacturer:	
Calibration date:	
Cone area ratio:	0.75
Sleeve area ratio:	0
Sleeve offset:	0.09
Filter type:	U2 Stainless steel
Saturation method:	Vacuum pump
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	13.36
Ground water level:	1.8
Water level origin:	Estimated
Backfill:	
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	[redacted]
Manager name:	

CPT Formulas

Test Name: CPT-04

Job Number: 240633

Corrected cone resistance:

$$q_t = q_c + u_2 \cdot (1 - a)$$

Friction ratio:

$$R_f = \frac{f_s}{q_c} \cdot 100$$

Non-normalised soil behaviour type (SBT): Calculated using q_{net} and R_f for the Robertson's 2010 non-normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Soil behaviour type index, (used for non-normalised SBT) :

$$I_c = \left(\left(3.47 - \log\left(q_t\right)\right)^2 + \left(\log\left(R_f\right) + 1.22\right)^2\right)^{0.5}$$

Friction ratio:

$$F_r = \frac{f_s}{q_t - \sigma_{v0}} \cdot 100$$

Refined normalised cone resistance:

$$Q_{tn} = \frac{\left(q_t - \sigma_{v0}\right) / \sigma_{atm}}{\left(\sigma'_{v0} / \sigma_{atm}\right)^n} \quad \text{where} \quad n = 0.381 \cdot I_c + 0.05 \cdot \left(\sigma'_{v0} / \sigma_{atm}\right) - 0.05 \leq 1.0$$

Normalised soil behaviour type index:

$$I_c = \left(\left(3.47 - \log\left(Q_{tn}\right)\right)^2 + \left(\log\left(F_r\right) + 1.22\right)^2\right)^{0.5}$$

Normalised pore pressure:

$$B_q = \frac{\Delta u}{q_t - \sigma_{v0}}$$

Normalised soil behaviour type (SBTn): Calculated using Q_{tn} and F_r for the Robertson's 2010 normalised CPT soil behaviour chart using zone equations defined by P.W. Mayne in "Evaluating effective stress parameters and undrained shear strength of soft-firm clays from CPT and DMT" 2016

Undrained shear strength (s_u):

$$s_u = \frac{q_t - \sigma_{v0}}{N_{kt}}$$

Relative density (D_r):

$$D_r = 100 \cdot \sqrt{\frac{Q_{tn}}{350}}$$

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \cdot \log\left(Q_{tn}\right)$$

Small strain shear modulus (G_0):

$$G_0 = \left(qt - \sigma_{v0}\right) \cdot \left(0.0188 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}\right)$$

Estimated shear wave velocity (V_s):

$$V_s = \sqrt{\frac{G_0}{\rho}} \quad \text{where} \quad \rho = \frac{\gamma}{\gamma_w}$$

Constrained modulus (M):

$$M = \alpha_M\left(q_t - \sigma_{v0}\right)$$

when $I_c > 2.2$

$\alpha_M = Q_t$ when $Q_t < 14$

$\alpha_M = 14$ when $Q_t > 14$

when $I_c < 2.2$

$$\alpha_M = 0.0188 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}$$

Youngs modulus (E_s):

$$E_s = \left(qt - \sigma_{v0}\right) \cdot \left(0.015 \cdot 10^{\left(0.55 \cdot I_c + 1.68\right)}\right)$$

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t / p_a}{8.5 \cdot \left(1 - \frac{F_r}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,870.60	6,821.70	-48.9	-	-
Sleeve friction	468.30	461.30	-7.01	-	-
Pore pressure	737.70	737.70	0	-	-

APPENDIX D

LOGS OF SHALLOW SITE INVESTIGATIONS

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Ministry of Justice

PROJECT: 14 Edmonton Road, Henderson, Auckland

Auger Hole No: AH09

Sheet 1 of 1

Drill Type:	50 mm Hand Auger	Project No:	18511	Logged By:	DG
Drilled By:	DG	Coordinates:		Shear Vane No - Calibration Date:	DR1768 - 21/12/2017
Date Started:	21/8/18	Ground Elevation:		Surface Conditions:	Level, grass
Date Finished:	21/8/18	Water Level:	0.8m 21/08/2018		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
TS	0.0		SILT, some clay, trace fine sand, brown, firm, wet, slightly plastic (TOPSOIL)	
ALLUVIAL DEPOSITS	0.5		SILT, some clay to clayey, minor fine sand, orange brown, very stiff, wet, slightly to moderately plastic (ALLUVIAL DEPOSITS) clayey, orange, moderately plastic	
			some clay, some fine sand, orange, wet, red with orange streaks	
	1.0		some fine sand, saturated	
			clayey, moderately plastic	
			some clay, dark orange, orange, yellow streaks, slightly plastic	
	1.5			
	2.0		Silty CLAY, yellow, stiff, saturated, highly plastic	
	2.5		orange and light grey	
			firm	
	3.0		SILT, some clay, some fine to medium sand, light bluish grey, firm, saturated, slightly plastic	
	3.5		Clayey SILT, trace fine sand, light grey, firm, saturated, moderately plastic	
			SILT, some clay, some fine to medium sand, light blue, firm, saturated	
	4.0			
	4.5		Fine to medium sandy SILT, minor clay, grey, stiff, saturated, non to slightly plastic	
	5.0			
			END OF BORE. 5.00 METRES. (TARGET DEPTH)	

21/08/2018

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH
REMOULDED SHEAR
v
r
50 100 150 (kPa)

DEPTH (m)		
0.5	36 r	162 V
1.0	36 r	148 V
1.5	36 r	144 V
2.0	36 r	126 V
2.5	58 r	108 V
3.0	27 r	54 V
3.5	23 r	40 V
4.0	27 r	63 V
4.5	32 r	68 V
5.0	36 r	94 V

LABORATORY TESTS

HAND AUGER LOG WITH SCALA LOGS_18511 AH01-13 AUG 18.GPJ S+R_2013.GDT 13/2/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Ministry of Justice

PROJECT: 14 Edmonton Road, Henderson, Auckland

Auger Hole No: AH10

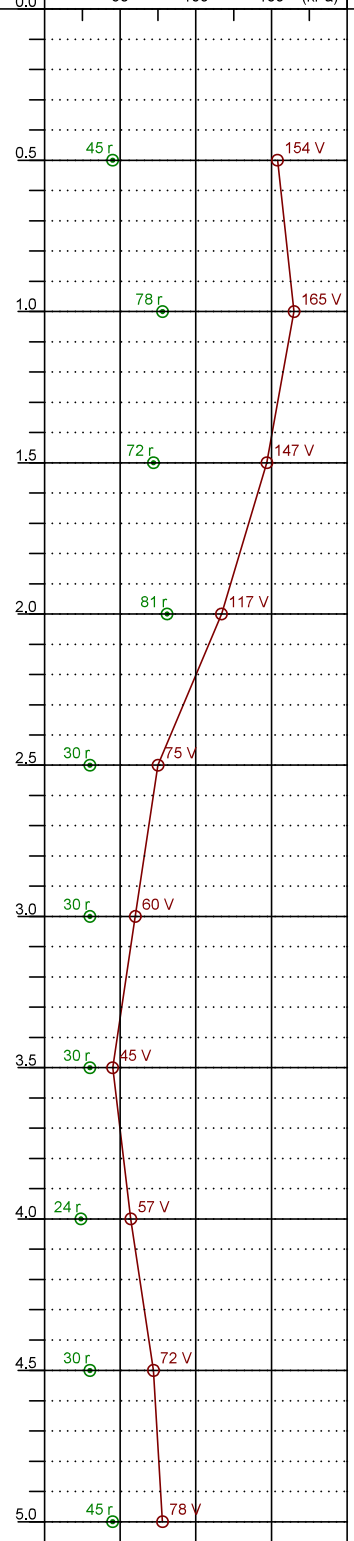
Sheet 1 of 1

Drill Type:	50 mm Hand Auger	Project No:	18511	Logged By:	NC
Drilled By:	NC	Coordinates:		Shear Vane No - Calibration Date:	GEO122 - 1/12/2017
Date Started:	21/8/18	Ground Elevation:		Surface Conditions:	Near Level Asphalt
Date Finished:	21/8/18	Water Level:	2.6m 21/08/2018		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
FILL	0.0		ASPHALT for 30mm fine to coarse angular GRAVEL, grey, dense, wet to saturated	
ALLUVIAL DEPOSITS	0.5		SILT, some clay, minor fine to medium sand, blue grey and yellowish brown, stiff, moist, slightly plastic (ALLUVIAL DEPOSITS)	
	1.0		dark orange, blue grey with black speckles (non organic)	
	1.5			
	2.0		clayey SILT, trace to minor fine to medium sand, dark orange, grey, stiff, moist, moderately plastic 10 to 20mm bands of fine sand, dark orange	
	2.5		SILT, minor clay, some fine to medium sand, blue grey, firm to stiff, saturated, slightly plastic	21/08/2018
	3.0			
	3.5		silty CLAY, trace fine to medium sand, blue grey, firm to stiff, saturated, highly plastic	
	4.0			
	4.5			
	5.0		END OF BORE. 5.00 METRES. (TARGET DEPTH)	

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH
REMOULDED SHEAR
v
r
50 100 150 (kPa)



LABORATORY TESTS

HAND AUGER LOG WITH SCALA LOGS_18511 AH01-13 AUG 18.GPJ S+R_2013.GDT 13/2/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Ministry of Justice

PROJECT: 14 Edmonton Road, Henderson, Auckland

Auger Hole No: AH11

Sheet 1 of 1

Drill Type:	50 mm Hand Auger	Project No:	18511	Logged By:	DG
Drilled By:	DG	Coordinates:		Shear Vane No - Calibration Date:	DR1768 - 21/12/2017
Date Started:	21/8/18	Ground Elevation:		Surface Conditions:	Slightly Sloping Grass
Date Finished:	21/8/18	Water Level:	Ground Water Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows) / SHEAR STRENGTH REMOULDED SHEAR v r 50 100 150 (kPa)	LABORATORY TESTS
FILL	0.0		SILT, trace clay, brown, firm, wet, non plastic (TOPSOIL/FILL)		0.0		
			silty fine to coarse angular GRAVEL, some fine to coarse sand, brown, dark grey, loose, moist, silt is TOPSOIL wet, some cobbles of basalt to 120mm Ø				
	0.5		SILT, some clay, some fine to medium sand intermixed with TOPSOIL (SILT, minor clay), brown, orange, stiff, moist, slightly plastic		0.5	70 r, 130 V	
ALLUVIAL DEPOSITS			clayey SILT, minor fine to medium sand, orange brown, orange yellow brown, very stiff, moist, moderately plastic (ALLUVIAL DEPOSITS)				
	1.0		some light blue mottles orange brown, yellow brown		1.0	54 r, 148 V	
			some clay to clayey, stiff, slightly to moderately plastic				
	1.5		a 8mm Ø root		1.5	63 r, 112 V	
			very stiff				
	2.0				2.0	54 r, 144 V	
			SILT, some fine to medium sand to sandy, minor clay, orange brown, dark orange, stiff to very stiff, moist, non to slightly plastic				
	2.5		SILT, some clay, some fine to medium sand, orange brown, stiff to very stiff, moist, slightly platic		2.5	50 r, 122 V	
			clayey SILT, minor fine to medium sand, orange brown, stiff to very stiff, moist, moderately plastic				
			silty CLAY, dark orange, orange, light grey, very stiff, moist, highly plastic				
	3.0				3.0	76 r, 173 V	
			END OF BORE. 3.00 METRES. (TARGET DEPTH)				
	3.5				3.5		
	4.0				4.0		
	4.5				4.5		
	5.0				5.0		

HAND AUGER LOG WITH SCALA LOGS_18511 AH01-13 AUG 18.GPJ S+R_2013.GDT 13/2/23

Soil&Rock Consultants
Your responsive & cost-effective engineers

CLIENT: Ministry of Justice

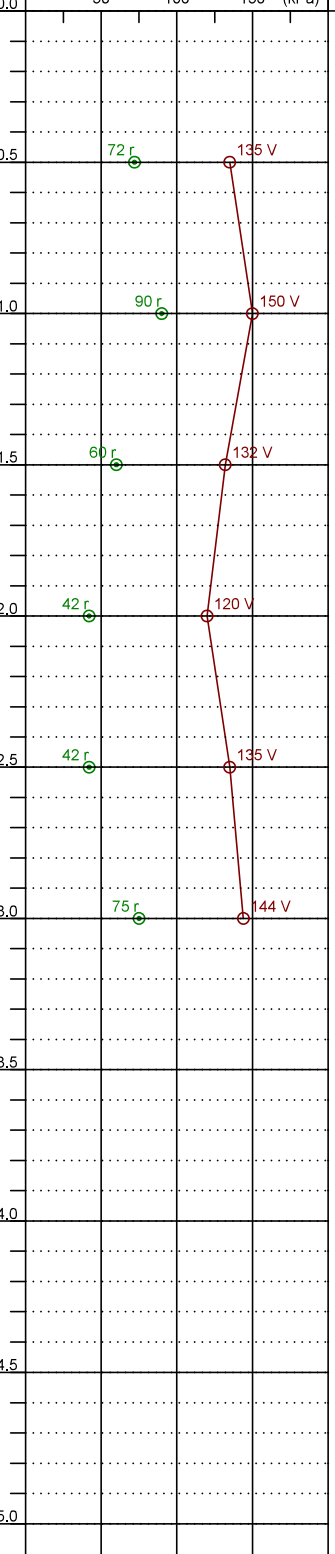
PROJECT: 14 Edmonton Road, Henderson, Auckland

Auger Hole No: AH12

Sheet 1 of 1

Drill Type:	50 mm Hand Auger	Project No:	18511	Logged By:	NC
Drilled By:	NC	Coordinates:		Shear Vane No - Calibration Date:	GEO122 - 1/12/2017
Date Started:	21/8/18	Ground Elevation:		Surface Conditions:	Near Level Asphalt
Date Finished:	21/8/18	Water Level:	Ground Water Not Encountered		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)
FILL	0.0		ASPHALT for 30mm fine to coarse angular GRAVEL, grey, dense, wet (FILL)	
ALLUVIAL DEPOSITS	0.5		SILT, some clay, minor fine to medium sand, orange, brown orange with dark brown streaks, very stiff, moist, slightly plastic (ALLUVIAL DEPOSITS)	
	1.0		trace coarse sand	
	1.5		no coarse sand	
	2.0		stiff clayey SILT, minor fine to medium sand, yellowish brown, light greyish brown, very stiff, moist, moderately plastic	
	2.5		SILT, minor to some clay, minor fine to medium sand, dark orange, grey, very stiff, moist, slightly plastic	
	3.0		END OF BORE. 3.00 METRES. (TARGET DEPTH)	
	3.5			
	4.0			
	4.5			
	5.0			



LABORATORY TESTS

HAND AUGER LOG WITH SCALA LOGS_18511 AH01-13 AUG 18.GPJ S+R_2013.GDT 13/2/23

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CLIENT: Ministry of Justice

PROJECT: 14 Edmonton Road, Henderson, Auckland

Auger Hole No: AH13

Sheet 1 of 1

Drill Type:	50 mm Hand Auger	Project No:	18511	Logged By:	NC
Drilled By:	NC	Coordinates:		Shear Vane No - Calibration Date:	GEO122 - 1/12/2017
Date Started:	21/8/18	Ground Elevation:		Surface Conditions:	Near Level Asphalt
Date Finished:	21/8/18	Water Level:	2.0m 21/08/2018		

STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
FILL	0.0		ASPHALT for 20mm fine to coarse angular GRAVEL, grey, dense, wet to saturated
ALLUVIAL DEPOSITS	0.5		SILT, some clay, trace to minor fine to medium sand, blue grey with dark yellowish brown mottles, very stiff, moist, slightly plastic (ALLUVIAL DEPOSITS)
	1.0		some clay to clayey ,blue grey, slightly to moderately plastic
	1.5		silty CLAY, blue grey, stiff, moist, highly plastic
	2.0		minor fine to medium sand, saturated
	2.5		SILT, minor to some clay, minor fine to medium sand, blue grey, stiff, saturated, slightly plastic
	3.0		30% recovery
	3.5		
	4.0		
	4.5		END OF BORE. 4.50 METRES. (HOLE COLLAPSE)
	5.0		

WATER LEVEL (m): 21/08/2018

SCALA PENETROMETER TEST
NZS:4402:1986 test 6.5.2
(Blows per 100mm Increment)
10 20 30 (Blows)

SHEAR STRENGTH
REMOULDED SHEAR
O v
⊙ r

50 90 r 100 150 147 (kPa)

DEPTH (m)	r	v
0.0	90	147
1.0	81	150
1.5	45	90
2.0	27	60
2.5	27	45
3.0	42	75
3.5	39	78
4.0	45	75
4.5	39	87

LABORATORY TESTS

HAND AUGER LOG WITH SCALA LOGS_18511 AH01-13 AUG 18.GPJ S+R_2013.GDT 13/2/23

Soil&Rock Consultants
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SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NAME: 14 Edmonton Road, Henderson JOB NO: 18511 TESTED BY: DEG/JL/NC DATE: 21/08/2018

Depth of Penetration [mm]	AH09	AH10	AH11	AH12	AH13							
DEPTH START[m]	5.00	5.00	3.00	3.00	4.50							
50 mm	SUNK	SUNK	1	0.5	1							
100			2	0.5	2							
150			2	11	1							
200		1	2	1	2							
250		1	2	1	1							
300	1	1	3	1	2							
350	1	1	4	1	2							
400	2	2	5	1	2							
450	2	2	5	1	2							
500	1	2	5	1	4							
550	2	2	7	1	4							
600	2	2	6	1	5							
650	2	3	6	1	6							
700	2	1	10	2	5							
750	2	2	10	2	4							
800	2	3	10	2	4							
850	2	2	10	2	6							
900	2	2	10	2	6							
950	2	3		2	4							
1000	2	3		3	10							
1050	3	2		5	8							
1100	3	4		4	10							
1150	3	4		3	8							
1200	4	4		3	10							
1250	3	4		4	10							
1300	3	4		5	10							
1350	4	8		7	12							
1400	5	20+		8	12							
1450	4			8								
1500	4			10								
1550	6			10								
1600	7			10								
1650	10			10								
1700	11			10								
1750	14											
1800	20+											
1850												
1900												
1950												
2000												
DEPTH END [m]	6.80	6.40	3.90	4.70	5.90							

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer