

100 Halsey Street

Geotechnical Assessment Report

1101937.1000-RPT-GEO-101

Prepared for: NZCRE 100 Halsey Limited

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Executive summary

Tonkin & Taylor Ltd (T+T) was engaged by NZCRE 100 Halsey Limited to conduct geotechnical investigations and assessment for the proposed development at 100 Halsey Street in Wynyard Quarter. The current stage of investigations was undertaken to support the Fast Track Approvals Act (2024) Substantive Application and provide inputs into the preliminary structural design.

Background

The proposed development includes 5-buildings for commercial and data centre use. The development features varying basement depths. Building B1 will have no basement, B2 and B3 will have single-level basements, and B4/B5 will have a two-level basement (requiring excavations down to RL -5.1 m).

Ground conditions at the site consist of historic reclamation (surficial layers and weak hydraulic fill) overlying loose/soft marine sediments, Pleistocene sediments (in the west), and East Coast Bays Formation (ECBF) rock. Rock depth typically varies from 8 m to 18 m, with a paleovalley in the western portion. Groundwater is shallow (approx. RL +0.4 m to +1.1 m) and tidally influenced.

Key geotechnical hazards & considerations

The upper soils are highly compressible. Basements will excavate through much of this material and consideration for groundwater drawdown related effects has been reported separately. The temporary basement walls and permanent basement structure must be sealed against groundwater. Design will need to consider shallow groundwater pressures and potential seismic hydrostatic uplift. The buildings should be supported on foundation piles taken to rock level.

Due to soft upper soils, basement retaining walls will require continuous support (e.g., top-down construction, propping, or anchoring) to limit deflections and external settlements. Preliminary basement retaining wall geotechnical design has been reported separately.

Under ULS seismic loading, hydraulic fill and marine sediments are susceptible to liquefaction. Estimated free-field settlements are between 20 mm and 60 mm (typically 30 mm), with potential lateral ground lurch averaging 70 mm. The site is not expected to liquefy under SLS conditions.

Piles must be designed to withstand negative skin friction (down-drag), kinematic loads from ground lurch, and reduced lateral support during ULS liquefaction.

Underlying marine and hydraulic sediments are identified as Potential Acid Sulphate Soils. Site specific testing is required. It is expected that exposure during earthworks will require specific environmental management and protection for below-ground concrete and steel elements.

Regulatory assessment

Groundwater (AUP E7): The excavations for Buildings B2–B5 exceed 6 m in depth and permanently divert groundwater. This triggers a Restricted Discretionary activity status.

Landslides (AUP E36): A site-specific assessment of PC120 Level A mapping confirmed that the risk of landsliding is Very Low, classifying the development as a Permitted activity under this rule.

1 Introduction

Tonkin & Taylor Ltd (T+T) was engaged by NZCRE 100 Halsey Limited to conduct geotechnical investigations and assessment for the proposed development at 100 Halsey Street in Wynyard Quarter, Auckland Central.

The current stage of investigations was undertaken to support the Fast Track Approvals Act (2024) Substantive Application and provide inputs into the preliminary structural design.

This work has been undertaken in accordance with our Variation Order dated 20 August 2026.

1.1 Site description

100 Halsey Street (the site) collectively refers to Section 2 SO 526051 and Lots 2 DP80054, but excludes the portion of the site occupied by the Travelodge building. The site, shown in Figure 1.1 is located in the Wynyard Quarter precinct, Auckland, and is bounded by Pakenham Street West to the north; Halsey Street to the east; Gaunt Street to the south and; Amey Daldy Park and 55 Gaunt to the west.

Amey Daldy Park includes a wastewater pump station, built circa 2020. The private land at 55 Gaunt St is currently an open sealed area used for carparking. Other properties surrounding the site and across the bounding road reserves are occupied by a mix of 4-8 storey mid-rise apartments, hotels, and offices.

The north-east portion of the site was developed circa 2019 and is occupied by a mid-rise commercial building. The remainder of the site to be developed is currently utilised as a bus depot and mechanics workshop, with the large majority of site utilised as a parking lot with the workshop located to the south-west, a refuelling station and bus wash located to the west and EV charging stations in the north.

Survey information[1] indicates the site is relatively flat ranging from RL+3.0 m to RL+3.8 m.



Figure 1.1: Site location. Project area shown in yellow. (Source: Auckland Council GIS).

[1] Harrison Grierson (11 November 2025); Site Survey, drawing no. A2516239-HG-XX-DR-XX-G, rev A.

1.2 Site history

The history of the site has been established through review of the following publicly available information:

- Auckland Council property file records;
- Auckland Council pollution records;
- Historical certificates of title; and
- Historical aerial imagery from GeoMaps[2] (Auckland Council GIS).

A summary of the site history as it pertains to geological/geotechnical conditions and potential remnant inground structures is provided below:

- **Reclamation:**
  - Ports of Auckland foreshore reclamations map[3] shows the site was reclaimed from the sea between 1905 and 1917 (reclamation stage "*Freemans Bay north of Victoria Park*"). The map legend indicates that the fill comprised sandstone from the cliffs adjoining Beaumont Street and dredgings from the harbour.
- **Records of historical buildings on the site with potential for remnant inground structures:**
  - 1924 (earliest property file record); building plans for the Auckland City Tramways Gaunt St Depot and plans for associated offices.
  - 1925 (property file record); factory plans for the Acetone Illuminating and Weldings Co Ltd, a forerunner of BOC Ltd. The plans show existing buildings along with plans for new buildings and additions. Plans include gas compressing station, cooling tower, oxygen separator pit and foundation.
  - 1940 (aerial photograph); shows the site approximately 70% covered by industrial buildings including a large L-shaped structure at the location of B1 and B2.
  - 1948 (property file record); a building consent plan for alterations to the Gaunt St building to make a trolley bus workshop. The building consent documents refer to in-ground servicing pits.
  - 1974 (property file record); application for building permit, to remove three existing tanks, install two new tanks and one additional pump.
  - 1987 (aerial photograph); changes to the site with demolition occurring. The three small structures on the eastern side adjacent to Halsey Street have been removed and the southern and eastern extents to L-shaped building have been demolished. There is evidence of some surface clearance in the northeast and south of the site.
  - The 1993, 2000, 2006, 2008, 2010, 2015 and 2017 aerial photographs show a rectangular building present fronting Gaunt Street with the northern two thirds of the site used for bus parking.
  - 2000 (property file); relating to a Tank Pull at 100 Halsey Street. The report indicates two tanks were removed. No information of the excavation depth and backfilled material was found in the property files.
  - The 2024 and 2025 aerial photographs show the previous rectangular building fronting Gaunt Street, significantly reduced in size with the eastern half (current location of Building B1) of the site used for bus and vehicle parking.

[2] Auckland Council, aerial imagery. Retrieved from: https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html.
[3] Ports of Auckland, 1972 drawing entitled "*Auckland Harbour Foreshore Reclamations to 1972*", Ref. 851/8.

1.3 Proposed development

The proposed development seeks to deliver a high-quality mixed-use commercial precinct of five buildings comprising premium office accommodation, retail and food and beverage uses, integrated amenities and end-of-trip facilities, together with the supporting infrastructure, building services and car parking required to service the development.

Building 2 is proposed as a purpose-built data centre. The building will accommodate the specialist plant, infrastructure and servicing requirements associated with the data centre use, while also incorporating centralised infrastructure to support the wider development The buildings will be in the order of 7 to 11 storeys above ground level. The masterplan comprises five buildings arranged around a central mid-block plaza, bounded by Gaunt Street, Halsey Street, Pakenham Street and Daldy Street / Amey Daldy Park. Refer Figure 1.2 below for the proposed development diagram.

- Building 1 - Commercial Office Building corner Halsey Street and Gaunt Street.
- Building 2 - Data Centre, sited centrally between B1 and existing Travelodge.
- Buildings 3A / 3B - Commercial Office buildings fronting Amey Daldy Park.
- Building 4 - Commercial Office on Gaunt Street.
- Building 5 - Commercial Office on Gaunt Street between Building 4 and VHHL site.



Figure 1.2: Proposed site development (source: Peddlethorpe 9/10/2026).

No basement levels are proposed for Building B1. Buildings B2 and B3 are proposed to have a single basement floor level. Buildings B4 and B5 are proposed to have a two level basement. Bulk excavation levels will be affected by the foundation design. Concept level information has been

provided by the project structural engineer[4] indicating the between 900 and 1300 mm thick foundation beams or a raft slab with 200 mm allowance for under slab layers is proposed. A summary is provided in Table 1.1.

The plaza area between the buildings is expected to be around the building threshold levels of RL+3.35 m.

Table 1.1: Summary of staging, proposed floor and excavation levels

Building	Development staging	Approximate plan area (m^2)	Lowest finished floor level (mRL)	Assumed bulk excavation level (mRL)
B1	Stage 1	1,200	+3.35	+2.1
B2	Stage 1	1,600	-0.56	-2.1
B3A / B3B	Stage 2	3,400	-0.85	-2.1
B4 / B5	Stage 3	2,800	-4.45	-5.7

Notes: 1. NZVD2016 datum.

2. Excludes local detailed excavation which may be required for piles, pile caps, lift pits, and subfloor building infrastructure.

2 Ground and groundwater conditions

2.1 Published geology

The published geology of the area[5] shows the site is underlain by historic reclamation material. Historical records[3] indicate this was placed between 1905 and 1917. Reclamation of this age at this location typically contains marine dredgings (sandy silt), clays and silty clays from excavation of headlands along the former city foreshore (namely Acheron Point ridge), demolition materials (mainly brick and iron castings), incinerator ash, gasworks wastes and basalt boulders. The latter were used to form seawalls for constructing the reclamation.

Beneath the reclamation fill typically lies unconsolidated marine sediments comprising of sand and silt below which are siltstone-sandstone (flysch) sequences of the East Coast Bays Formation (ECBF). The geomorphology and investigations of the wider Wynyard Quarter area indicates the presence of two paleochannels (former eroded streams gullies) beneath the reclaimed area. The banks of the eastern encroach on the western edge of the site. Lower Tauranga Group sediments have likely infilled these valleys during periods of elevated sea levels, and recent marine sediments overlie the Lower Tauranga Group.

The location of the site in the context of the regional geology is presented in Figure 2.1.

[4] Email: R. van Ballegooy (Holmes) to M. Kent (T+T), 8/9/2026, 3:31pm. *RE: 100 Halsey*.

[5] Geological map 3. 1 sheet + 74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Limited.

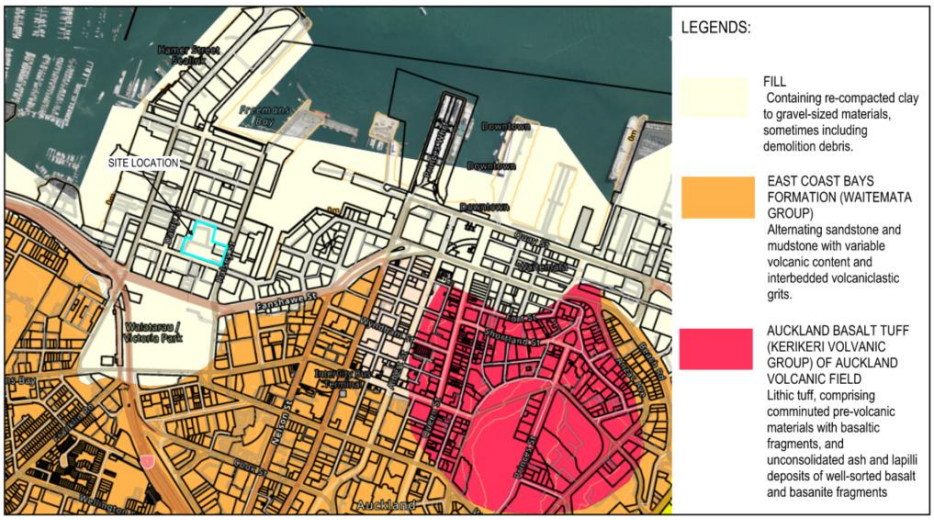


Figure 2.1: Published site geology.

2.2 Geotechnical investigations

A number of geotechnical site investigations have been undertaken on this site between 1982 and 2026. Locations are shown in Figure 2.2 below and Figure GEO 01, Appendix A. A summary of the investigation locations is given in Table 2.1. A full set of logs and test data are presented in Appendix B.

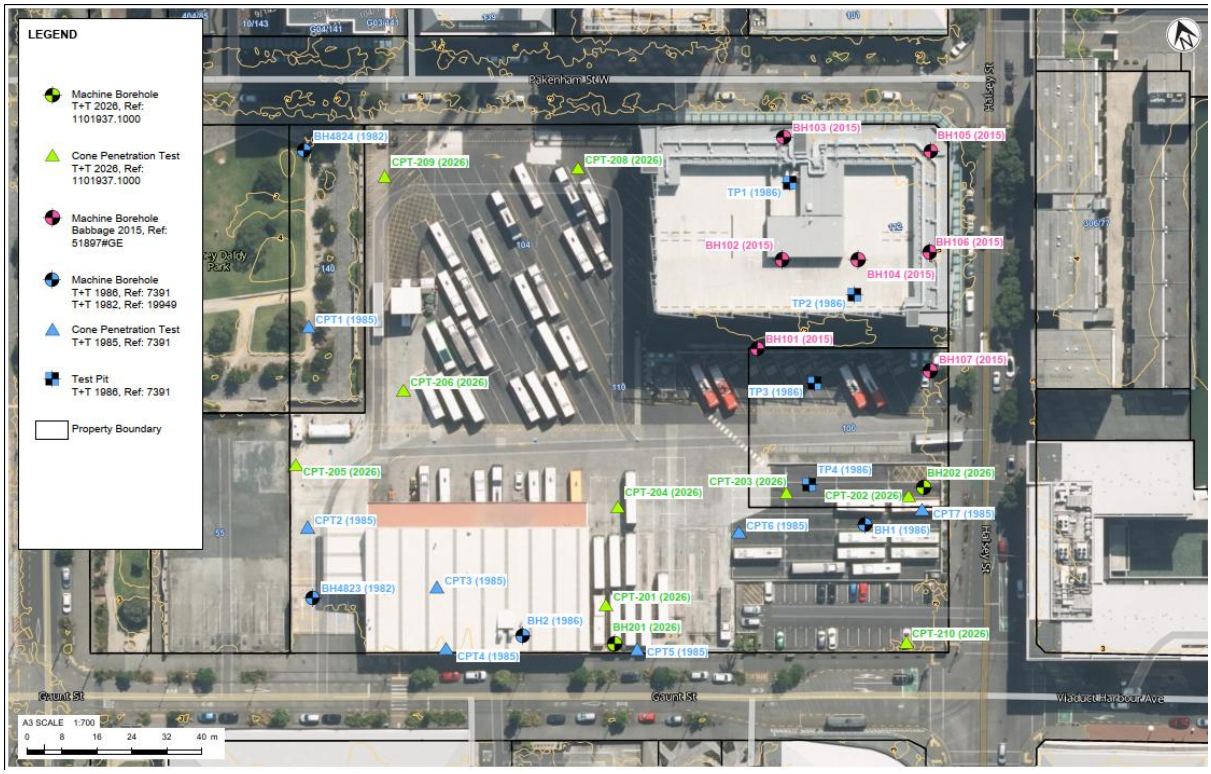


Figure 2.2: Geotechnical site investigations.

Table 2.1: Summary of geotechnical investigations at the site

Reference	Summary of information
T+T (April 1982) Ref: ARA 41032. Original records not available, logs re-reported and attached to T+T (June 2002), ref: 19949	Two machine boreholes (BH4823 and BH4824) to depths of 14.3 m and 16.5 m. BH4823 encountered soft silts/clays to 10 m depth and terminated in hard materials (SPT 'N' 40 to 60) described as soil at 14 m depth. BH4824 encountered soft silts/clays and loose sands over ECBF siltstone/sandstone from 15 m depth.
T+T (May 1985), Ref: 7391	Seven Cone Penetration Tests (CPT) pushed to effective refusal between 8.0 and 17.5 m depth. With exception of CPT2, each test is inferred to have met refusal on ECBF siltstone/sandstone. CPT2 (in close proximity to BH4823 described above) refused at about 12 m depth on the layer described for BH4823 above.
T+T (May 1986), Ref: 7391	Two machine boreholes (BH1 and BH2) to depths of 14.3 m and 16.35 m. Three test pits to depths of 1.6 to 2.2 m. These investigations encountered a layer of fill generally consisting of silts and clays with occasional lenses of organics soils. Interbedded siltstone and sandstone was encountered at 10.6 depth in BH1 and 15 m depth in BH2. Groundwater was at 2.2 m and 1.6 m depth about 2 days after drilling was completed. Laboratory testing carried out on samples from BH2, indicate m_v values in the hydraulic fill materials of between about 0.9 and 1.1 m^2/MN at the in-situ stress range of the samples.
Babbage (May 2017), Ref: 51897#GE BDOC0014796147	Seven machine boreholes (dated 2015) to depths between 9 and 12.6 m. ECBF rock (SPT'N'>50) was encountered between 8 and 9 m depth. Previous investigations measured groundwater nearby at 2.5 to 2.8 m depth.
T+T (May 2026), Ref: 1101803)	Contaminated Land Site Investigation. Five window sample / hand auger boreholes were carried out as part of the contaminated land site investigations in 2026 at the locations of Building B1 and B2. These extended to depths of 3.0 m bgl. Records indicate a 0.1 to 0.3 m thick layer of asphalt/concrete overlying a granular fill layer of varying thickness (1.25 to 3.0 m). Groundwater was encountered within two of these investigations at depths varying between 1.8 to 2.35 m bgl.
T+T (September 2026), Ref: 1101937.1000	Nine CPT to depths between 9.3 and 21.7 m. Including six dissipation (permeability) tests. Each CPT test is inferred to have met refusal on ECBF siltstone/sandstone. CPT-205 (in proximity to BH4823 (1982) and CPT2 (1985)) penetrated the hard layer between about 12-14 m depth and terminated at 18.3 m depth). CPT-209 encountered a significantly deeper depth of refusal (21.7 m) than expected based on the surrounding investigations. A localised very deep weathering profile or defect may be present in this area. Two machine boreholes to a depth of 16.6 m. Including standpipe piezometers. The borehole investigations encountered variable fill over soft hydraulic fill and marine deposits over ECBF rock from between 8.4 and 13.4 m bgl. Continuous groundwater monitoring and slug (permeability) testing was undertaken. Laboratory testing including consolidation and Atterberg classification testing was undertaken.

2.3 Geotechnical unit summary

Based on a review of historical geotechnical data, we interpret the ground conditions underlying the site to typically comprise the strata summarised in Table 2.2. This interpretation is subjective due to

the variability in log descriptions between investigations. A brief description of each unit is provided in the following sections.

Table 2.2: Summary of geological model

Geological Unit	Description	Depth to top of unit range and [typical value] (m bgl)	Layer thickness range and [typical value] (m)
Surficial fill	Variably comprising granular basecourse and assorted fill.	0	0.8 to 4.2 [2]
Hydraulic fill	Soft to firm, SILT/CLAYS (grey to brown) with variable sands, gravels.	0.8 to 4.2 [2]	2.1 to 4.7 [3]
Marine sediments (sand)	Loose, silty SAND (grey) with notable shell content.	4.1 to 6.6 [5]	0.5 to 3.6 [1]
Marine sediments (silt)	Soft to firm, SILT/CLAY (grey) with variable shell, sand and organic content.	5.0 to 9.1 [7]	1.5 to 3.85 [3]
Pleistocene sediments	Inferred western portion of site only. Firm to hard, sandy SILT/CLAY (green, grey).	9.75 to 12.75 [8]	2.4 to 3.1 [3]
CW-HW ECBF	Residually weathered soils to highly weathered extremely weak (soil strength) transitional materials.	7.4 to 13.4 [10]	0.6 to 1.7 [1]
MW-UW ECBF	Moderately to unweathered sandstone/siltstone 'rock' (SPT 'N' 50+).	8.1 to 18 [11]	Not proven

Notes: 1. Thicker Pleistocene sediments and/or CW-HW ECBF maybe present at the west of the site. Refer Section 2.3.6.

2.3.1 Surficial fill (various)

The site is overlain by asphalt and concrete pavement layers underlain by granular basecourse and assorted fill. The fill materials are highly variable gravel, sand and silt including organics and other relatively inert waste debris (e.g. brick, concrete, glass).

A large amount of services and historic site infrastructure is also understood present within the near surface layers. This includes stormwater, wastewater, power and historical maintenance pits/tunnels. This information is documented in Locatorworx drawing L250148-1025-01 (7 sheets), dated 4/8/2025.

2.3.2 Hydraulic fill

Materials comprising soft to firm clayey to sandy SILT with wood, organic and shell fragments. The hydraulic fill that has been placed will be of variable sources; some tipped from land and the rest derived from dredgings or pumped material from the harbour.

2.3.3 Marine (Holocene) sediments

The recent marine sediments are difficult to differentiate from the overlying hydraulic fill in many locations. Typically, the logs include notable shell fragments from about 4 to 6 m (about RL-1 to -3 m) depth which is likely the transition point to the historical shallow seabed in this area. The upper portion of these materials are generally sands which typically grade to fine grained soils. The upper sand portion of the strata is likely to be continuous and have a relatively stronger hydraulic connection with tidal levels. For this reason, the upper portion is identified separately for the purposes of design.

2.3.4 Pleistocene sediments

Pleistocene sediments of the (Tauranga Group) comprising sandy SILT/CLAY are inferred in several investigation locations on the western side of the site below the more recent marine deposits. The strength of these materials ranges from firm to hard. Also refer Section 2.3.6 for notable local variations.

2.3.5 East Coast Bays Formation (ECBF)

The ECBF typically includes a thin weathered ECBF layer transitioning to ECBF rock comprising weakly cemented siltstone and sandstone with a SPT 'N' value greater than 50 blows/300 mm. ECBF rock surface contours fall to the west of the site into a paleo valley. An inferred rock contour map of the site is shown in Figure 2.3 below, and Figure GEO 02, Appendix A. Also refer Section 2.3.6 for notable local variations.

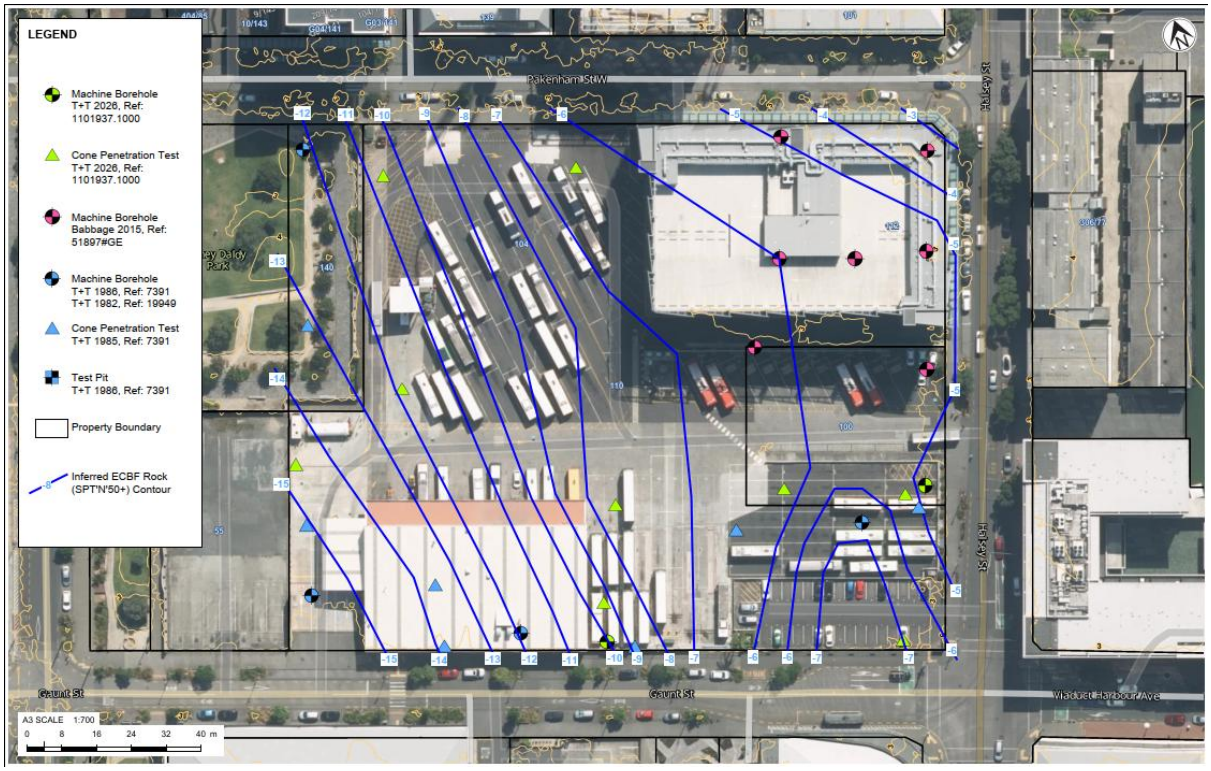


Figure 2.3: Inferred ECBF rock (SPT 'N' 50+) contours.

2.3.6 Local variations

Two notable local variations in the typical ground conditions were noted in the western portion of the site.

A hard (SPT N_f 40-60, q_c 10-30 MPa) clay layer was encountered in the western corner of the site in location BH4823 (1982), CPT2 (1985) and CPT-205 (2026) at around 12 to 14 m depth. This may be a hardpan layer within the Pleistocene deposits infilling the ECBF paleo valley or a significantly deeper ECBF weathering profile. Only CPT-205 (2026) penetrated this layer, under which the insitu strength reduces (q_c 2.5 MPa) before a sharp transition and refusal at 18.3 m depth (inferred ECBF rock).

Location CPT-209 (2026) penetrated to a depth of 21.7 m. The nearby investigation BH4824 (1982) and other boreholes outside of the site indicate the top of ECBF rock should be encountered at a shallower depth. The unexpected depth of penetration may be associated with a locally thicker ECBF weathering profile or penetration of a sub-vertical defect in the underlying rock strata.

2.4 Groundwater

Seasonal groundwater level fluctuations in the order of 1.5 m have been measured within the Western Reclamation[6]. Groundwater is typically expected in the range of 1.5 to 3.0 m below ground level (RL 1.5 to 0.0 m). Monitoring in nearby sites has reported shallower groundwater levels (up to 0.4 m depth) in responses to heavy rainfall events, this has been shown to dissipate relatively quickly and is likely to be controlled by relatively higher permeability services trenches around the site.

Limited groundwater monitoring was undertaken with piezometers installed within the two bore-holes carried out at the site. The water levels were recorded continuously over 26 days using electronic loggers. The retrieved data was corrected for barometric pressure recorded within an office building approximately 400 m from the site. As such minor differences from actual site levels may be recorded due to variation in atmospheric conditions between to two locations.

Groundwater head at BH202, positioned near the eastern boundary and closest to the marina, show a clear tidal influence typically varying about 100 to 200 mm. At location BH201, the tidal influence is relatively much lower.

Monitoring results are presented in Appendix C. Summary results are presented in Table 2.3.

Table 2.3: Summary of groundwater monitoring at the site

BH No	Response Zone	Monitoring Period	Highest Recorded Groundwater Level	Lowest Recorded Groundwater Level	Average Groundwater Level
BH201 (2026)	5.7 – 8.3	3/9/2026 to 21/9/2026	1.16 mRL	0.94 mRL	1.05 mRL
BH202 (2026)	2.7 – 5.3		0.76 mRL	0.31 mRL	0.47 mRL

Notes: 1. Level in terms of NZVD2016 datum.

2. BH201 values excludes readings prior to 2/9/2026 which are inferred to be related to initial dissipation of drilling/piezometer installation water levels.

3. Levels corrected using off-site barometer. Accuracy expected to +/-100 mm.

2.5 Testing

Testing results are summarised in the following sections. These include insitu tests and laboratory testing of samples from both the recent investigations and the historical investigation locations summarised above. The number of tests is summarised in Table 2.4.

A number of tables and charts are included in Appendix D which summarise the testing data.

CPT derived profiles in the following sections have been interpretated using CPeT-IT v.3.9.7.4. All data was filtered using the auto cross-correlation and auto transition layer detection functions.

[6] Woodward Clyde (NZ) Ltd (July 1996). Soil and Groundwater Contamination Review , Western Reclamation Area Auckland Viaduct. Ref AA245619/0001.

Table 2.4: Number of tests

Geological Unit	Standard Penetration Test (SPT)	Vane shear	Lab shear	Unconfined compressive strength	Water content	Bulk Density	Atterberg limits	1D consolidation
Surficial fill	4	10	2		5	1	1	
Hydraulic fill	13	14	3	1	9	3		3
Marine sediments (sand)	8	2						1
Marine sediments (silt)	3	1				1		
Pleistocene sediments	5	5			1			
CW-HW ECBF	3	2		10	13			
MW-UW ECBF	6	2						

2.6 Geotechnical design parameters

Geotechnical design parameters are presented in Table 2.5 and Table 2.6. They have been assessed based on the material descriptions, testing and experience with similar materials in the vicinity of the site.

Table 2.5: Geotechnical Design Parameters – Strength and Stiffness

Geological Unit	Bulk density (kN/m^3)	Effective cohesion. c' (kPa)	Friction Angle ϕ' (°)	Young's elastic modulus (MPa)	Poisson's ratio, v
Surficial fill	18	3	28	15	0.3
Hydraulic fill	15	1	25	7[1]	0.35
Marine sediments (sand)	18	0	26	10[1]	0.35
Marine sediments (silt)	17	1	25	10[1]	0.35
Pleistocene sediments	18	5	30	20	0.35
CW-HW ECBF	18	10	32	30	0.3
MW-UW ECBF	20	50	36	200	0.3

Notes: 1. Typical values. The normally consolidated hydraulic fill and marine sediments stiffness increases with depth. For modelling purposes, these materials may be combined with an elastic modulus profile of 0.7z+6 (MPa), where z is depth below ground level.

Table 2.6: Geotechnical Design Parameters – Compressibility and Permeability

Geological Unit	Coefficient of volume compressibility, m_v (m^2/MN)	Horizontal permeability, kh (m/s)	kv/kh ratio
Surficial fill (excluding pavement/basecourse layers)	0.1	Not assessed	
Hydraulic fill	0.8	2 x 10^{-7}	0.5

Geological Unit	Coefficient of volume compressibility, m_v (m^2/MN)	Horizontal permeability, kh (m/s)	kv/kh ratio
Marine sediments (sand)[1]	0.2	2×10^{-6}	1.0
Marine sediments (silt)	0.4	2×10^{-7}	0.1
Pleistocene sediments	0.05	2×10^{-7}	0.1
CW-HW ECBF	0.05	2×10^{-7}	0.1
MW-UW ECBF	Not assessed	5×10^{-7}	0.1

Very limited data is available on likely secondary compression parameters. A single laboratory test on a hydraulic fill sample indicates a strain based coefficient of secondary compression, $C_{\alpha\varepsilon}$ of 0.8%.

3 Geotechnical considerations

3.1 General

Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

3.2 Seismic parameters

3.2.1 Seismic site soil class

3.2.1.1 NZS1170, current design code

The available site investigation indicates that the site is underlain by fill/soils with ECBF rock encountered at maximum depth of 18 m. The low amplitude natural period, based on the shear wave profiles indicated by inferred CPT data is not expected to exceed 0.6s.

Based on the available information, it is assessed that the site conditions are consistent with subsoil Class C (shallow soil sites) in accordance with NZS 1170.5:2004[7].

3.2.1.2 Future design codes

In November 2025, TS1170.5:2025 was released as a Technical Specification that can be used as an alternative solution to demonstrate compliance with the Building Code.

At this time, TS1170.5:2025 is not referenced in the Building Code. NZS1170.5:2004 remains the referenced standard and the primary form of compliance with the Building Code. Adoption of TS1170.5:2025, while currently voluntary, ensures that the current understanding of earthquake risk is incorporated into the design of buildings.

To accommodate seismic design in accordance with TS1170.5:2025, further analysis of the existing CPT testing may be undertaken. This would be consistent with a Method 3 which would require a high uncertainly factor to be applied. It is likely that additional site-specific testing involving direct shear velocity measurements would be required to provide a reasonable range for design.

[7] Standards New Zealand (2004) NZS 1170.5:2004, Structural Design Actions – Earthquake Actions.

3.2.2 Ground shaking hazard

The design peak ground accelerations (PGAs) for geotechnical design have been determined in accordance with MBIE Module 1[8]. The Importance Level in accordance with NZS1170.0 is assumed to the IL2.

Design life and importance level to be verified by the structural engineer / architect, as appropriate. If different from that assumed or if this changes during the project life, then these values and the opinions in this report will need to be reviewed by the geotechnical engineer.

Table 3.1: Design Peak Ground Acceleration (PGA) Parameters

Importance Level	Serviceability Limit State (SLS)			Ultimate Limit State (ULS)		
	Return Period (years)	Peak Ground Acceleration	Magnitude	Return Period (years)	Peak Ground Acceleration	Magnitude
2	25	0.05	5.9	500	0.19	6.5

3.3 Liquefaction assessment

Seismic liquefaction occurs when excess pore pressures are generated in loose, saturated, generally cohesionless soil during earthquake shaking, causing the soil to undergo a partial to near complete loss in shear strength.

Such a loss of shear strength can result in settlement, bearing capacity yield or failure and/or horizontal movement of the soil mass towards an unsupported face. The occurrence of liquefaction is dependent on several factors, including the intensity and duration of ground shaking, soil density, particle size distribution and the elevation of groundwater.

The hydraulic fill and marine sediments encountered in the borehole logs are considered to have a moderate susceptibility to liquefaction under ULS level shaking. The liquefaction triggering for the site has been assessed based on the Boulanger & Idriss (2014) method using the design PGA outlined in 3.2.2. An inverse filter was applied to the raw CPT data to correct the data for thin sand layers within the soft deposits at the site. For this assessment a ground water level of 2 m below the surface (1.5 m RL) was adopted. Output of liquefaction susceptibility analysis completed using T+T in house software (TTGD Toolpack v4.3.3.42) are presented in Appendix E.

Output from the CPT analysis were compared with the CPT data and our understanding of the geology and portions of the potentially liquefiable materials are depth have been discounted due to penetration of hard/cemented materials which are considered non-liquefiable.

Results indicate that liquefaction is not expected to occur under at SLS seismic loads.

Under ULS seismic loads and existing effective stress conditions, liquefaction is indicated within isolated layers of hydraulic fill. The marine deposits, particularly the upper sandy layer, are indicated to be susceptible to liquefaction. Figure 3.1 gives a summary of the CPT liquefaction triggering potential at design ULS seismic loading current site conditions.

[8] Ministry of Business, Innovation and Employment. (2021) MBIE Module 1: Overview of the guidelines. MODULE 1: Overview of the guidelines - Earthquake geotechnical engineering practice (building.govt.nz).

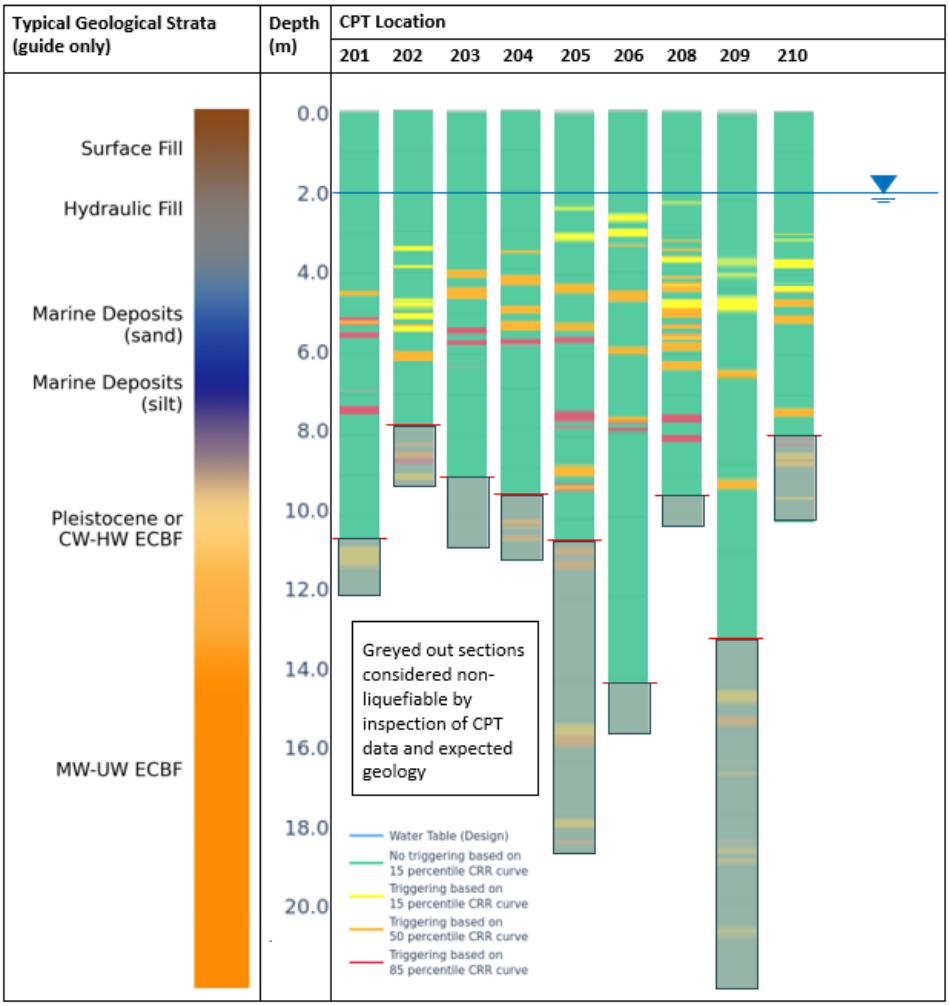


Figure 3.1: Summary of CPT liquefaction triggering potential at design ULS seismic loading (current site levels).

At the current site levels the onset of liquefaction below the site is indicated to occur between 0.1 and 0.15 g (i.e. 53 to 79% of ULS) as shown in Figure 3.2.

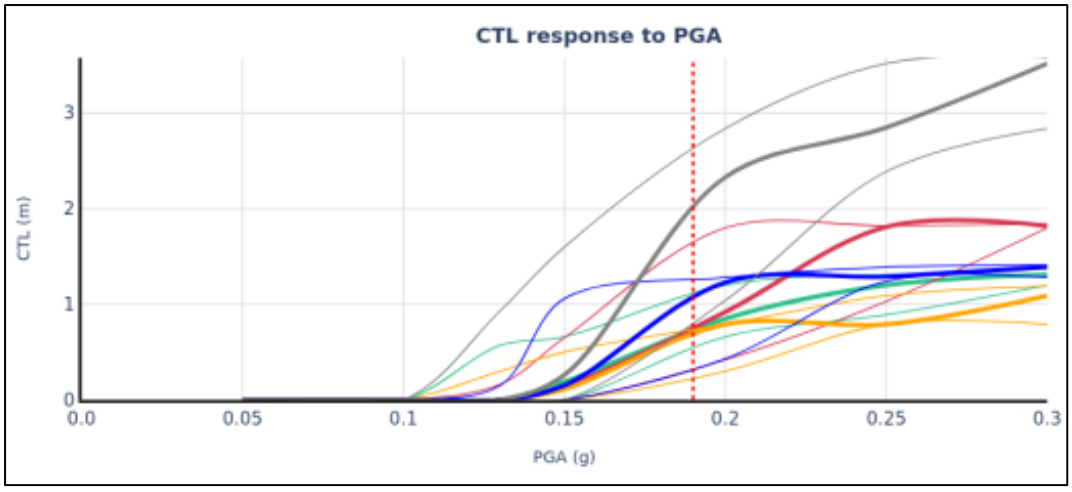


Figure 3.2: Onset of liquefaction.

A review has also been undertaken in terms of the consequence of reduced effective stress conditions below the proposed basement level. In general, due to the very loose nature of the

susceptible sand-like marine sediments, the extent of liquefaction below the basement are expected to be similar for a wide range of effective stress at ULS levels. The unloading effects of the basement excavation are not expected to significantly worsen the liquefaction potential below basement levels.

3.3.1 Liquefaction induced settlement

Under a ULS event, settlement[9] at existing ground level in the range of 20 to 60 mm (typical value 30 mm) is estimated. The level of the lowest soil layer assessed to be susceptible to liquefaction is presented in Table 3.2 alongside a comparison with the nearest building basement level.

Table 3.2: ULS liquefaction settlement

Location	Free field settlement, S_{V_1D} (mm)	Elevation of lowest liquefied layer (mRL)
CPT201	19	-4.1
CPT202	20	-2.6
CPT203	23	-2.7
CPT204	26	-2.6
CPT205	39	-6.0
CPT206	30	-4.5
CPT208	58	-4.5
CPT209	22	-4.9
CPT210	18	-4.5

Notes: 1. Values differ from those indicated in in liquefaction outputs Appendix D due to exclusion of layers at assessed to be not susceptible to liquefaction, refer Figure 3.1.

3.3.2 Lateral spread

Lateral spreading is the displacement of land towards a free face (e.g. the Lighter Quay area) and is the result of a crust of soil sliding over a continuous liquefied layer.

The proposed site is more than 100 m east from the nearest edge of the reclamation and is restrained on the eastern side of Halsey Street by the historical Julian's wall (about 20 m east) and more recent retained reclamation including: the marina apartments retaining walls and lock, associated with the Log Farm development circa 2006 (about 50 m east) and concrete post and panel walls and cement stabilisation of the marine sediments, associated with the development of Lighter Quay circa 1995-1997 (about 100 m east).

A previous study by T+T [10] indicates that the potential for lateral spread to affect the site under design earthquake conditions to be low.

[9] One-dimensional volumetric reconsolidation settlement (S_{V_1D}) in free field conditions (i.e. no consideration for structural loads or boundary constraints such as basement walls).

[10] T&T (2012) Western reclamation liquefaction and seawall stability assessment, prepared for Waterfront Auckland. T&T Ref 28897.

3.3.3 Surface rupture or ejection of soil

The risk of surface rupture or ejection of soil is low given the relatively thick layer of gravel fill crust overlying the thin lenses of liquefiable soils. The Liquefaction Severity Number (LSN), a method of characterising vulnerability to liquefaction related surface damage, is below 20 for all CPT indicating little or no expression of liquefaction at the current ground surface.

Notwithstanding the above, where liquefaction occurs below the proposed basement levels consideration is given to liquefied soil pressures at basement levels (refer Section 3.4).

3.3.4 Ground lurch

The potential lateral ground lurch displacements in a ULS liquefaction event have been assessed based on Tokimatsu & Asaka (1998)[11], specifically that cyclic strain may be expected to be in the order of 10 to 20% of the integration of γ_{max} (i.e. Lateral Displacement Index, LDI).

The estimated ULS liquefaction event ground lurch is shown in Figure 3.3. The range of estimates at the ground surface ranges from 25 to 160 mm. The average of the 9 recent CPT undertaken is 70 mm. This should be considered for preliminary design. It is noted that 2 to 4 m of unsaturated or otherwise non-liquefiable crust is assessed. This may act to suppress ground lurch movements. Further detailed assessment can be undertaken at detailed design.

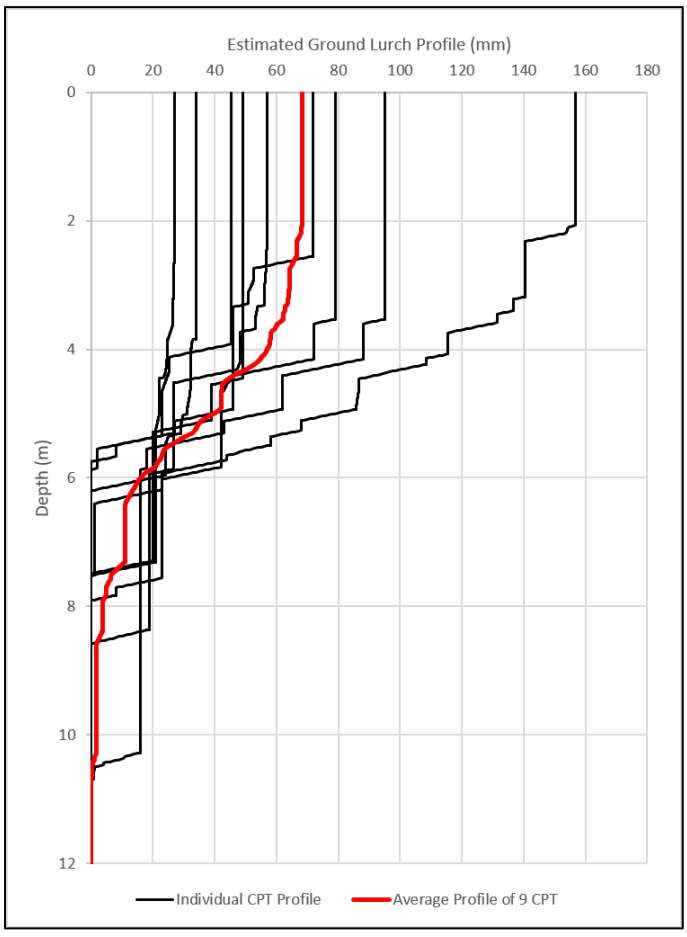


Figure 3.3: ULS liquefaction event ground lurch profile.

[11] K.Tokimatsu & Y.Asaka (1998) Effects of liquefaction-induced ground displacements on pile performance in the 1995 Hyogoken-Nambu earthquake, Special Issue of Soils and Foundations p163-177, Japanese Geotechnical Society.

3.4 Liquefaction mitigation design

3.4.1 Foundations

Pile foundations should be designed to accommodate the specific axial and lateral effects of the liquefied soil profile. For the ULS seismic case, the design must consider:

- Reduced lateral subgrade reaction (p-y stiffness) to residual liquefied strength values within the affected layers.
- Kinematic Loads: Lateral loads and induced bending moments resulting from ground lurch of the overlying non-liquefiable layers.
- Negative skin friction: Post-earthquake down drag effect applied to the basement walls and pile shafts due to above reconsolidation settlement within the and above the liquefied zones. Refer Section 3.6.5.

3.4.2 Basement slab

Potential liquefaction damage related to basement floor slab should be considered and may affect the integrity of the waterproofing membrane. While not considered necessary for compliance with ULS performance requirements (i.e. life safety, structural stability), consideration may be given to allowance for additional uplift pressure in the ULS seismic case. A factor of 1.6 times the static case hydrostatic pressure acting at the underside of the slab may be adopted for preliminary design.

3.4.3 Basement walls

Where liquefiable soils are indicated within the depth of the basement walls, the design should consider the envelope of two separate seismic load cases:

1 Peak dynamic earth pressures prior to liquefaction (e.g., using Mononobe-Okabe or Wood's method, ΔK_{ae}).

2 A post-triggering liquefied state where the soil acts as a heavy fluid with a lateral earth pressure coefficient of K = 1.0.

3.4.4 Buried services

We expect that the building is classified as Importance Level IL2 (NZS 1170) and therefore water supply (excluding fire suppression), stormwater and wastewater services are category P7 (NZS 4219). These services are required to retain structural and operational integrity without requiring repairs after a SLS1 earthquake (NZS 4219). There are no specific requirements for these services in the ULS earthquake event. The onset of seismic induced liquefaction within the underlying ground profile at the site is expected to occur at levels of shaking above the Serviceability Limit State (SLS1) and but below the Ultimate Limit State design (ULS) design earthquakes events, see Section 3.3 and Figure 3.2. Hence seismic liquefaction induced settlements at SLS1 are expected to be negligible. However, relative movement between the ground and building may be expected to increase sharply from the onset of soil liquefaction. While there are no specific requirements for these services in the ULS earthquake event, the use of flexible couplings at the building perimeter is recommended to limit the effects of differential displacement between the building and surrounding ground and provide additional resilience to the service connections under increased seismic events. Refer Table 3.2 and Figure 3.3 for estimates of vertical and lateral ground displacement. Basement walls will need to be designed such that wall deflections and subsequent induced settlements are managed to not adversely affect buried services.

3.5 Groundwater

A permanent 'tanked' basement design, fully sealed against groundwater, will be required. The basement design will need to accommodate groundwater pressures with an appropriate margin of safety, as required by NZS1170.0. Historic recorded high-water levels have been very shallow. A design pressure head equivalent to the existing ground level plus a factor of 1.2 is recommended.

Additional groundwater uplift pressures may occur as a result of a liquefaction event, refer Section 3.4.2.

3.6 Foundations

3.6.1 General

The ground conditions below the level of the proposed basement floors include weak, compressible and potentially liquefiable soils. It is recommended that any piles should be founded into ECBF rock with SPT N>50.

3.6.2 Bored Piles

Bored and cast in-situ piles embedded in ECBF rock are suitable, and likely to be the preferred option for support of the buildings. These are likely to be founded in order of 3 to 12 m below the top of rock (i.e between about 11 to 22 mBGL at buildings B1 and B2 and 13 to 30 mBGL at buildings B3 and B4/5)

For the design of bored piles embedded at least 3x pile diameters the ECBF rock (SPT 'N' > 50), a geotechnical ultimate end bearing capacity of 6 MPa and side friction of 500 kPa may be used for preliminary design.

In accordance with AS2159[12], the geotechnical ultimate capacity should be reduced by a geotechnical strength reduction factor of ϕ_g = 0.5 for ultimate limit state design and ϕ_g = 0.33 for working loads.

For piles through fill, when the fill is subject to surcharge and settlement the pile design loads should allow for negative skin friction.

The skin friction parameter may be used to assess the uplift resistance of piles. For permanent or sustained uplift load, the capacity should be reduced by an additional factor of 0.67 (on top of the strength reduction factor of ϕ_g = 0.5).

Open bored shafts within the hydraulic fill and marine sediments and shallow water table will be prone to collapse. The use of temporary or permanent steel casings should be used in construction to prevent collapse within the bored pile holes and tremmie pouring will be required. Alternatively, Continuous Flight Auger (CFA) piles could be considered.

3.6.3 Driven steel piles

Driven steel piles embedded in ECBF rock may be considered, although noise and vibration issues will need to be addressed. A higher number of relatively slender profiles such as steel UC sections, requiring lower driving energy may mitigate this somewhat. UCs would likely be installed in pile groups beneath the main building columns. Driven steel piles can be expected to achieve the required 'set' between about 2 to 5 m below the top of rock.

Preliminary geotechnical design capacities for various UC pile sizes are presented in Table 3.3 below. The UCs should be driven to refusal with an appropriately sized hammer. In accordance with

[12] AS2159 – 2009. *Australian Standard: Piling - Design and Installation*. SANZ

AS2159[13], a strength reduction factor of ϕ_g = 0.5 should be applied to the geotechnical ultimate capacity, although the strength reduction factor could be increased to ϕ_g = 0.7 if 10% of the piles undergo Pile Dynamic Analysis (PDA) testing. Furthermore, for piles placed through fill that is subject to surcharge and settlement, the pile design should allow for negative skin friction.

Table 3.3: Design parameters for driven UC piles into ECBF rock

Pile Section	Geotechnical Ultimate Capacity, kN	Maximum ULS load (Φg=0.5),kN
150UC30	720	360
200UC60	1,440	720
250UC89	2,140	1,070
310UC97	2,330	1,165
310UC137	3,390	1,645
310UC158	3,700	1,850

3.6.4 Screw piles

Screw piles could be considered to support the new buildings. These piles comprise a tubular steel section with a helix that can be extended into the upper layer of the ECBF weak rock. The relatively small shaft section has the advantage of attracting a relatively low negative friction following liquefaction events. However, the small shaft will engage only a limited lateral resistance, and a composite pile section such as an over-bored reinforced concrete or steel circular section may be required over the upper portion of the piles, subject to structural engineering design.

To gain full use of the helix size the pile needs to 'bite' into the hard soil and weak rock of the ECBF. There is a risk at this site that if the ECBF rock has limited residual soil and the change in strength from soil to rock maybe too abrupt which could result in the helix spinning during installation. Based on the boreholes from the surrounding area, a relatively sharp interface was identified, and an abrupt change is possible. If the helix does not cut into the rock the pile would need to rely on end bearing of the shaft only. A specialist screw pile contractor would be able to provide a more detailed assessment of this risk.

We recommend that a geotechnical ultimate bearing capacity of 4 MPa be adopted for preliminary design reduced by a geotechnical strength reduction factor of ϕ_g =0.5. Higher capacities maybe achievable following in-situ piles tests, the strength reduction factor could also be increased in accordance with AS2159.

3.6.5 Negative skin friction

Consideration for negative skin friction (down drag) on piles is required for the seismic liquefaction case. Section 3.3.1 includes an assessment of the of the total free field settlement and the lowest elevation of liquefaction expected at the ULS level event. This could be addressed in two ways:

1 Subject to structural engineering review of stability, accept total and differential building perimeter settlement to the free field settlement values in the ULS seismic case.

2 Design allowance for an average negative skin friction of 30 kPa for ground above the indicated levels in contact with basement walls and building piles. This will induce axial shortening and settlement of the piles which may be expected to be less than free field values. This should be confirmed by detailed soil-structure interaction assessment.

[13] AS2159 – 2009. *Australian Standard: Piling - Design and Installation*. SANZ.

Liquefaction is expected to occur at seismic shaking below ULS. Consideration may be required for intermediate load cases.

Additional consideration is also required due to the construction staging for the buildings. Excavation related groundwater drawdown and retaining wall defections may cause ground settlement beneath the adjacent completed buildings. An envelope of settlement has been presented in the groundwater effects report (ref: 1101937.1000-RPT-GEO-103), however, detailed review will be required to isolate the settlement effects by individual buildings.

3.6.6 Lateral soil resistance

The lateral soil resistance on building piles and basement walls will vary for each building due to the varying geological profile and basement levels. Soil response will also vary between the non-liquefied and liquefied cases. Detailed soil-structure interaction assessment will be required.

3.7 Settlement

The soils at the site are compressible and consolidation settlement may be expected to occur due to additional applied load and/or subsoil effective stress. Long-term secondary consolidation of the hydraulic fill and marine deposits will be ongoing natural occurrence.

The plans reviewed indicate that the plaza ground level will generally be reduced slightly from the existing ground levels. Mitigating potential primary consolidation effects due to fill placement. Considerations for pavements are included in Section 3.9.

Specific assessment will be required for lightly loaded ancillary structures or surface infrastructure (if proposed).

To limit construction phase settlement due to groundwater drawdown the basement excavation retaining walls should be effectively watertight during excavation.
The permanent basement structures should be sealed against groundwater (“tanked”). An assessment of groundwater drawdown and related settlement effects is reported separately (ref: 1101937.1000-RPT-GEO-103).

3.8 Retaining walls

Retaining walls will be required to support the basement excavations. As discussed in Sections 3.7, the walls will need to be sealed against groundwater. Options include secant bored piles, diaphragm walls or sheet piles with progressively welded clutches.

Due to the weak soils and depth to rock with respect to the proposed basements, it is expected that construction staging will need to allow for continuous support to the walls to limit deflection and settlement effects beyond the site boundary. Standard approaches include top-down construction, or the use of temporary props or anchors. Geotechnical retaining wall design is reported separately (ref: 1101937.1000-RPT-GEO-102).

3.9 Pavements

Historical investigations undertaken at the site, generally identified a granular fill layer overlying hydraulic fill consisting of soft to firm silts and clays. Laboratory testing and clegg hammer test carried out in the basecourse granular fill yielded California Bearing Ratio (CBR) values greater than 7%. CBR values estimated from in-situ testing in the surface fill and hydraulic fill materials below the basecourse layers ranged widely between 0.4 to 9%. Typical values for preliminary design are given in Table 3.4.

The thickness of the granular fill layer is variable across the site and the designer should consider the residual thickness of granular fill following excavation for the subbase course of any new pavement layers. The subgrade conditions will need to be verified by DCP testing during construction. Any localised soft areas encountered during construction could be locally undercut and replaced with compacted engineered hardfill.

Due to potential long-term ground settlement, consideration should be given to flexible and/or segmental pavements or suitable subgrade preparation to spread the effects of differential ground settlement.

Table 3.4: Preliminary subgrade CBR values

Material	Range of thickness encountered (mm)	CBR %
Existing pavement and basecourse	150 to 800	7
Surface fill (beneath basecourse)	750 to 4050	4
Hydraulic Fill	N/A	0.6

3.10 Soil aggressivity

The site is underlain by hydraulic reclamation fill and Holocene-age marine sediments. These subsurface soils contain naturally occurring iron sulphides and have been classified as Potential Acid Sulphate Soils (PASS) elsewhere in the Wynyard Quarter area. While these soils remain stable in anaerobic conditions below the permanent groundwater table, exposure to oxygen—through excavation, piling arisings, or temporary dewatering—can trigger oxidation and the generation of sulphuric acid. This may present an environmental risk (the mobilisation of heavy metals and acidic runoff), and a geotechnical/structural risk of accelerated degradation to in-ground concrete and steel elements.

Site specific testing has not been completed at this stage of assessment. Assessment will be required at the detailed design stage. For preliminary design and costing purposes allowance for the following mitigation measures should be considered.

3.10.1 Earthworks

- Subject to specific testing, a management plan for the handling of PASS and further construction phase testing (e.g. via the SPOCAS suite) may be required.
- Spoil may be required to be disposed to an appropriate licenced disposal site.
- Where spoil is stockpiled on site and exposed to the atmosphere (risking oxidation), neutralisation (blending spoil with agricultural lime) could be required prior to off-site disposal.

3.10.2 Structural elements

- For concrete cast against the ground, allowance for a chemical exposure XA# (value # to be determined by specific testing) classification in accordance with NZS 3101:2006. In practice this may include typically specified minimum concrete strengths (i.e. 30 MPa to 50 MPa) and minimum concrete cover (e.g. 75 mm for concrete cast directly against the soil) plus the inclusion of sulphate-resisting cementitious materials (e.g. fly ash or microsilica replacement) may be required to resist chemical attack.
- Uncoated in-ground steel elements (e.g., driven steel tubes, UC piles, sheet piling, or screw piles) may be subject to elevated corrosion rates in PASS and marine environments. In

practice, for driven steel elements, this would require an allowance for sacrificial steel thickness to account for higher corrosion rates.

4 Regulatory matters

4.1 AUP E7 - groundwater take and divert

An engineering assessment of the proposed development against the Auckland Unitary Plan (AUP) rules regarding the take, use, damming and diversion of groundwater. The AUP provides for the take, using damming and diversion of groundwater and drilling in association with excavation. The AUP includes several requirements that must be met for developments to be considered as a permitted activities with regard to groundwater, which are listed in Activity Table E7.4.1 and Permitted Activity Standards E7.6.1.10 and E7.6.1.6.

Table 4.1 provides an engineering assessment of the excavation activities associated with proposed buildings B2, B3A/B3B and B4/B5. Diversion of groundwater will not be required for Building B1.

The assessment of compliance with Permitted Activity Standard E7.6.1.10 is summarised in below and identifies a number of non-compliances and therefore further review of Permitted Activity Standard E7.6.1.6 is not required. On the basis of our assessment the project is considered to be a restricted discretionary activity for the dewatering and permanent diversion of groundwater in accordance with AUP, Table E7.4.1 (A20) and (A28).

Table 4.1: AUP E7 engineering assessment

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(1) All of the following activities are exempt from the Standards E7.6.1.10(2) – (6):		
(a) pipes cables or tunnels including associated structures which are drilled or thrust and are less than 1.2 m in external diameter;	There are not expected to be any pipes cables or tunnels ≥1.2 m.	Yes
(b) pipes including associated structures up to 1.5 m in external diameter where a closed face or earth pressure balanced machine is used;	N/A due to compliance with 1(a) above.	Yes
(c) piles up to 1.5 m in external diameter are exempt from these standards;	All piles are expected to be <1.5 m diameter.	Yes
(d) diversions for no longer than 10 days; or	Groundwater diversion will be longer than 10 days both during construction and in the permanent case.	No
(e) diversions for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days.	The groundwater diversion is for purposes other than network utilities and road network linear trenching activities.	Yes
(2) Any excavation that extends below natural groundwater level, must not exceed:		
(a) 1ha in total area: and	(a) The combine basement areas are not proposed to exceed 1ha.	Yes
(b) 6 m depth below the natural ground level	(b) The maximum excavation depths will be greater than 6 m below existing ground levels.	No
(3) The natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining site.	(3) Groundwater is not expected to be reduced by more than 2 m at the site boundary. Refer groundwater effects report (T+T ref: 1101937.1000-RPT-GEO-103).	Yes
4) Any structure, excluding sheet piling that remains in place for no more than 30 days, that physically impedes the flow of groundwater through the site must not:		
(a) impede the flow of groundwater over a length of more than 20 m; and	(a) The sealed basement structures will impede the flow of groundwater over a length of more than 20 m.	No
(b) extend more than 2 m below the natural groundwater level.	(b) The sealed basement structures will extend more than 2 m below pre-development levels for B2,B3,B4 + B5.	No
(5) The distance to any existing building or structure (excluding timber fences and small structures on the boundary) on an adjoining site from the edge of any:		

E7 Taking, using, damming and diversion of water and drilling - E7.6.1 PERMITTED ACTIVITY STANDARDS		
E7.6.1.10. Diversion of Groundwater Caused by any Excavation (including trench), or tunnel		
(A27) Permitted Activity Standards: Exemptions	**Geotechnical Interpretation of Compliance**	**Permitted activity compliance**
(a) trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation;	(a) Neighbouring structures are expected to be outside of the specified envelope.	Yes
(b) tunnel or pipe with an external diameter of 0.2 - 1.5 m that extends below natural groundwater level must be offset 2 m or greater; or	(b) Any site connections are likely to be greater than 2 m from neighbouring structures.	Yes
(c) a tunnel or pipe with an external diameter of up to 0.2 m that extends below natural groundwater level has no separation requirement.	(c) Not applicable.	Yes
(6) The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:		
(a) 50 m from the Wetland Management Areas Overlay;	Project Planner specialist to assess.	-
(b) 10 m from a scheduled Historic Heritage Overlay; or	Project Planner specialist to assess.	-
(c) 10 m from a lawful groundwater take.	Project Planner specialist to assess.	-

4.2 AUP E36 – landslide hazard risk

Plan Change 120 (PC120) to the AUP, Chapter E36 'Natural Hazards and Flooding' requires the completion of natural hazard risk assessments when a subdivision, use or development requiring resource consent is proposed to be undertaken on land which may be subject to natural hazards. Portions of PC120 became effective in November 2025.

A landslide hazard risk assessment has been prepared in accordance with Appendix 24 of the AUP PC120, which sets out Auckland Council's prescribed methodology for assessing landslide hazard risk for land use and land use changes. This provides a quantitative and semi-quantitative basis for evaluating landslide risk significance within mapped susceptibility areas.

4.2.1 Stage 1: desk study

A review of the Auckland Council (AC) Geomaps[14] and T+T's inhouse GIS database does not identify any mapped landslides in the vicinity of the site.

AC Level A Landslide Susceptibility Mapping GIS layers presents regional-scale mapping of terrain potentially susceptible to landsliding ('Level A Analysis'). The Level A Analysis is divided into Large-Scale Landslide Susceptibility and Shallow Landslide Susceptibility. These datasets are intended as regional screening tools and are not substitutes for site-specific geotechnical assessment (McLelland et al., 2025). The mapped layers are presented in Figure 4.1 and Figure 4.2. Review of the Level A Analysis layers indicate:

- The large landslide risk at the site is classified 'Very Low'. At the 150 m prescribed runout to the southeast of the site below the original coastline sea cliffs the risk is classified as 'Low'.

[14] Auckland Council GeoMaps: https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html.

- The shallow landslide risk at the site is typically classified as ‘Very Low’. There are grid points on the north and east boundaries of the site ranging from ‘Moderate’ to ‘Very High’ classification**.** Several other grid points within the 150 m prescribed runout zone, principally on the periphery of the Lighter Quay marina, also range from ‘Moderate’ to ‘Very High’.



Figure 4.1: Auckland Council Geomaps – Level A Analysis, Large Scale Landslide Susceptibility.

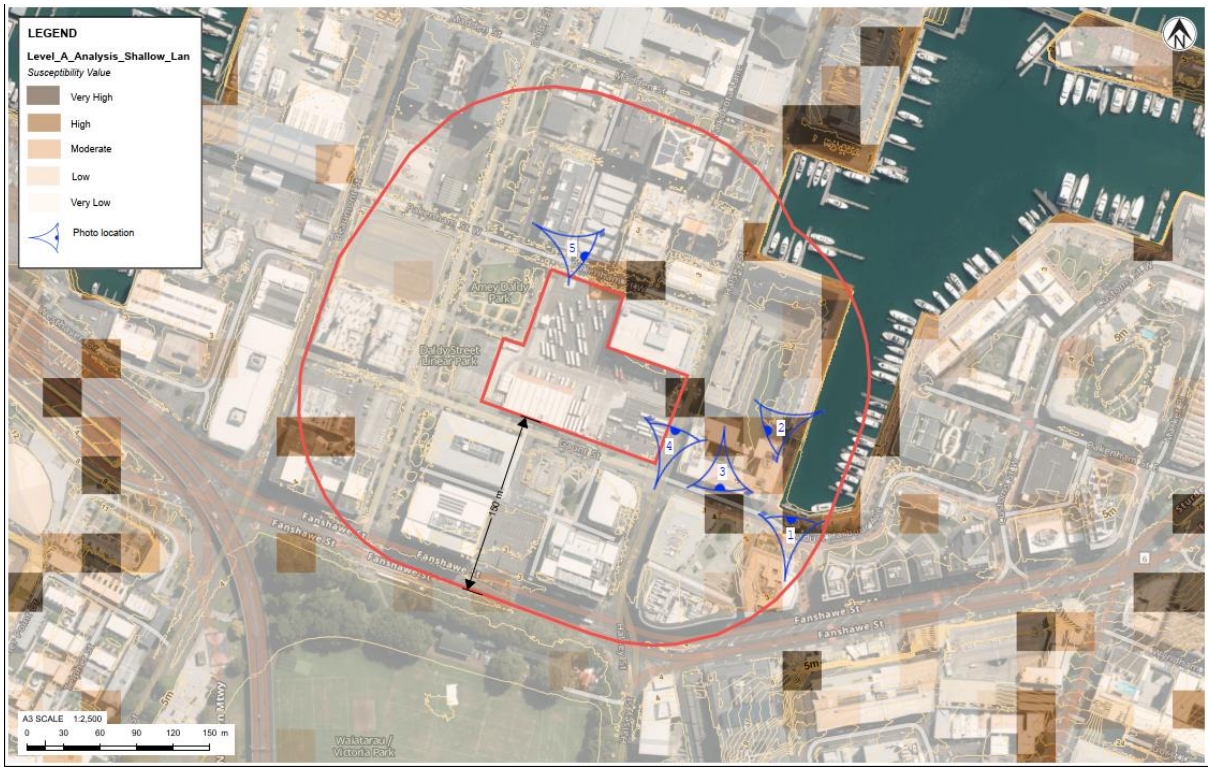


Figure 4.2: Auckland Council Geomaps – Level A Analysis, Shallow Landslide Susceptibility.

The locations where the AC Level A Analysis indicates 'Moderate' or above shallow landslide risk have been visually assessed on site. The locations of these areas are assessed have a very low risk of instability and the mapped grid classification are erroneous. All areas observed fall into one of the following categories:

- Located at the per periphery of the Lighter Quay marina and supported by engineered retaining structures – examples Photos 1 and 2.
- Located in an area with elevation change due to urban infrastructure – example Photo 3.
- Located on flat ground – example Photos 4 and 5.

Sample photos taken at the locations indicated in Figure 4.2 are presented below.



Photo 1 (24/9/2026)

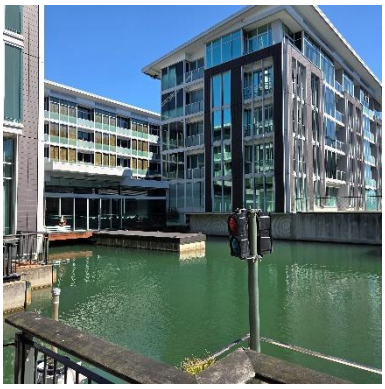


Photo 2 (24/9/2026)

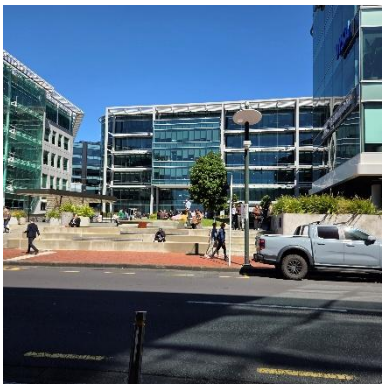


Photo 3 (24/9/2026)



Photo 4 (24/9/2026)



Photo 5 (24/9/2026)

4.2.2 Landslide risk conclusion and activity status

On the basis of the Stage 1 desktop study and verified on-site observations, it is assessed that the landslide risk at the site is very low. Accordingly, no further assessment is required.

It is assessed that the activity status is for the proposed development is Permitted in accordance AUP Table 36.4.1B.

4.3 Natural Hazard and Geohazards

In accordance with Section 106 of the Resource Management Act (RMA), Auckland Council Code of Practice 2023 (Auckland Council CoP) and National Policy Statement for Natural Hazard 2025 (NPS-NH), we have carried out a review of potential geohazards and natural hazards onsite.

Where the hazards are considered applicable to the site, geotechnical recommendations have been addressed in this report, to allow for mitigation of these hazards.

4.3.1 Potential geohazards

Table 4.2 summarizes the potential hazards for the site required to Auckland Council CoP and NPS-NH.

Table 4.2: Potential Natural Hazards deemed applicable to the site

Reference	Identified Hazards	Discussion	Report Section
Auckland Council CoP	Seismic Hazard	Seismic site class and peak ground acceleration (PGA) for geotechnical design have been derived based on site specific investigations.	3.2
	Problematic Soils (e.g. uncontrolled fill, compressible, collapsible, sensitive soils)	The subsoils are compressible and mitigation measures and further assessment requirements are identified.	3.7
	Acid Sulphate Soils	Site specific testing has not been undertaken. However, based on the geology and identification elsewhere in the area, the soils at the site are Potentially Acid Sulphate Soil (PASS). Mitigation measures have been identified.	3.10
Auckland Council CoP & NPS-NH	Landslide susceptibility (including Plan Change 120 Assessment)	The site is typically mapped as 'Very Low'. There are grid points on the north and east boundaries of the site ranging from 'Moderate' to 'Very High' classification**.** On-site visual assessment has confirmed that individual grid point map location are erroneous. The site is flat with no identified risk of landslide activity. Excavations for basements will be supported by walls to engineered design standards.	4.2
NPS-NH	Liquefaction	Site-specific liquefaction assessment undertaken and design mitigations proposed.	3.4
Hazards below are not applicable to the site or not within geotechnical scope			
Auckland Council CoP	Soil erosion (Stormwater and wastewater disposal control)	Stormwater and wastewater are expected to be connected reticulated services. Refer T+T ref: 1101937.1000-RPT-CIV-101 and 102.	
	Stream instability and erosion	No stream located within or adjacent to subject site.	
	Geothermal Issues	Site not located within a geothermal area.	
	Rockfall or falling debris	No exposed rockfaces are present at the site.	
	Contamination	A contamination assessment for the site has been reported separately by T+T (ref: 1101937.1000-RPT-CON-101).	

Reference	Identified Hazards	Discussion	Report Section
Auckland Council CoP & NPS-NH	Coastal Instability, Inundation and Erosion	The site is not expected to be subject to coastal instability or erosion. Inundation for the site has been reported separately by T+T (ref: 1101937.1000-RPT-NH-101).	
NPS-NH	Active faults	Site is located more than 20 km of the nearest major fault no increased seismic risk is identified.	
	Flooding	Flood risk for the site has been reported separately by T+T (ref: 1101937.1000-RPT-NH-101).	
	Tsunami	Tsunami risk for the site has been reported separately by T+T (ref: 1101937.1000-RPT-NH-101).	

4.3.2 Risk assessment

A risk assessment has been undertaken for potential hazards outlined in the Auckland Council CoP and NPS-NH. The risk matrix, likelihood and consequence tables adopted for the assessment are in accordance with NPS-NH Appendix 1. The assessment outcome is summarised in Table 4.3.

Consequence Level	Likelihood Level: Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

Figure 4.3: Risk matrix (National Policy Statement - Natural Hazard 2025).

Likelihood level	Annual exceedance probability (AEP)	Average recurrence interval (ARI) or 'return period'
Almost certain	10% or more	Up to and including 10 years
Very likely	10% to 5%	Over 10 and up to and including 20 years
Likely	5% to 2%	Over 20 and up to and including 50 years
Possible	2% to 1%	Over 50 and up to and including 100 years
Unlikely	1% to 0.2%	Over 100 and up to and including 500 years
Rare	0.2% to 0.02%	Over 500 and up to and including 5,000 years
Very rare	Less than 0.02%	More than 5,000 years

Figure 4.4: Likelihood table (National Policy Statement - Natural Hazard 2025).

Consequence level	Damage to property	Potential for injury or fatalities
Catastrophic	Severe damage to land and building(s), potential for collapse or total destruction of structures. Building(s) need to be demolished, rebuilt or relocated.	High threat to life safety, with probable fatalities and/or critical injuries.
Major	Major damage to land and building(s), including structural damage. Loss of use and substantial repair required.	Unsafe for people, with potential for many injuries, or critical injuries and/or fatalities.
Moderate	Some damage to land and non-structural damage to building(s). Limited loss of use, repairs required.	Unsafe for people, with potential for injuries, although expected to be minor.
Minor	Minor damage to land and building(s). No loss of use, minimal repairs required.	Isolated minor injuries possible.
Negligible	No loss of use, no building repairs required.	No injuries.

Figure 4.5: Consequence table (National Policy Statement - Natural Hazard 2025).

Table 4.3: Risk based assessment summary

Natural Hazard	Risk matrix assessment			Engineering Controls
	Likelihood	Consequence	Risk	
Seismic hazard SLS	Likely	Minor	Medium	Design to adopt seismic parameters in accordance with the Building Code.
Seismic hazard ULS	Unlikely	Major	Medium	
Problematic Soils	Almost certain	Minor	Medium	Specific assessments for groundwater effects, applied loads. Mitigation measures include sealed basements and piled foundations. Considerations for pavement and landscaping.
Acid Sulphate Soils	Very likely	Minor	Medium	Mitigations identified. Specific testing to be undertaken.
Landslides	Very rare	Moderate	Low	Mitigation not required.
Liquefaction	Unlikely	Major	Medium	Specific design of foundation systems to accommodate identified liquefaction effects.

5 Further work

Further geotechnical investigations will be required for later design stages. Key uncertainties at this stage include the depth and quality of rock in the western portions of the site where some investigation results to date have been ambiguous, refer Section 2.3.6.

Detailed geotechnical design will be required for basement excavation support and foundations including soil-structure interaction related to seismic cases which may induce liquefaction in the subsoils at the site.

During excavation and construction, the site should be examined by an engineer competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. We would be pleased to provide this service to you and believe your project would

benefit from the continuity. However, it is important that we be contacted if there is any variation in subsoil conditions from those described in the report.

6 Applicability

This report has been prepared for the exclusive use of our client NZCRE 100 Halsey Limited , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application under the Fast-Track Approvals Act 2024 and that the Expert Panel as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



.....

Matthew Kent
Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



.....

Andrew Hope
Project Director

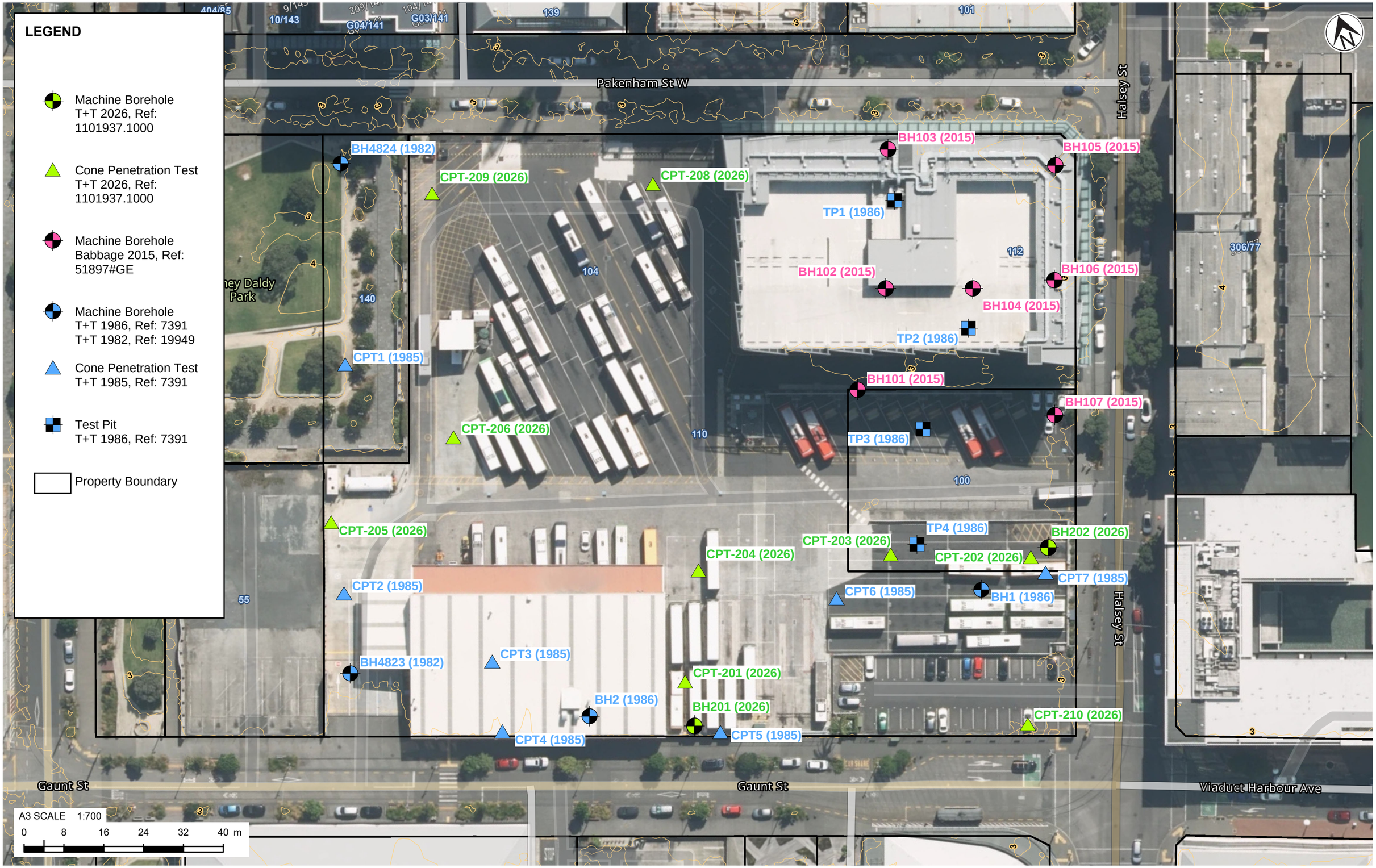
Technical review by Mark Child, Principal Geotechnical Engineer.

20-Oct-26
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Appendix A Figures

- **Figure GEO 01 – Ground investigation locations.**
- **Figure GEO 02 – Inferred ECBF rock SPT'n'50+ contours.**

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NOTES:

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LOCATION PLAN

PROJECT No.	1101937.1000		
DESIGNED	MMK	SEP.26	
DRAWN	-WEB-	SEP.26	
CHECKED			
	APPROVED	DATE	

CLIENT **NZ CRE 100 HALSEY LIMITED**

PROJECT **100 HALSEY ST**

TITLE GROUND INVESTIGATION LOCATIONS

SCALE (A3) 1:700 FIG No. GEO 01 REV 1

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LEGEND

- Machine Borehole T+T 2026, Ref: 1101937.1000
- Cone Penetration Test T+T 2026, Ref: 1101937.1000
- Machine Borehole Babbage 2015, Ref: 51897#GE
- Machine Borehole T+T 1986, Ref: 7391 T+T 1982, Ref: 19949
- Cone Penetration Test T+T 1985, Ref: 7391
- Test Pit T+T 1986, Ref: 7391
- Property Boundary
- -8 Inferred ECBF Rock (SPT'N'50+) Contour [mRL, NZVD2016]

Pakenham St W
Halsey St
Gaunt St
Gaunt St
Viaduct Harbour Ave
Halsey St
ey Daldy Park

A3 SCALE 1:700

0 8 16 24 32 40 m

NOTES:
1. Vertical datum NZVD2016
2. 2026 investigation ground levels based on plan location and comparison with Harrison Grierson (11 November 2025); Site Survey, drawing no. A2516239-HG-XX-DR-XX-G, rev A.
3. Pre-2026 investigation ground levels assumed based on current ground level or, where ground level is reported these have been adusted based on AUK49-0.3m

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LOCATION PLAN

PROJECT No.	1101937.1000		
DESIGNED	MMK	SEP.26	
DRAWN	-WEB-	SEP.26	
CHECKED			
	APPROVED	DATE	

CLIENT **NZ CRE 100 HALSEY LIMITED**

PROJECT **100 HALSEY ST**

TITLE INFERRED ECBF ROCK (SPT'N'50+) CONTOURS

SCALE (A3) 1:700 FIG No. GEO 02 REV 1

Appendix B Investigation logs and laboratory test reports

B1 **T+T 2026 machine borehole logs and CPT test reports.**

B2 **T+T 2026 laboratory test reports.**

B3 **Babbage 2015 machine borehole logs and laboratory test reports.**

B4 **T+T 1986 machine borehole, test pit logs and laboratory test reports.**

B5 **T+T 1985 CPT test reports.**

B6 **T+T 1982 machine borehole logs.**

B1 T+T 2026 machine borehole logs and CPT test reports

Investigation ID	Location (NZTM)		Ground surface elevation RL (NZVD2016)[1] (m)
	Easting (m)	Northing (m)	
BH201	1756560	5920934	3.4
BH202	1756639	5920944	3.5
CPT201	1756560	5920941	3.5
CPT202	1756636	5920941	3.6
CPT203	1756610	5920957	3.5
CPT204	1756569	5920961	3.4
CPT205	1756503	5920991	3.3
CPT206	1756533	5921003	3.3
CPT208	1756588	5921039	3.7
CPT209	1756546	5921051	3.5
CPT210	1756622	5920908	3.0

Notes: Ground surface elevations estimated from plan location and comparison with Harrison Grierson (11 November 2025); Site Survey, drawing no. A2516239-HG-XX-DR-XX-G, rev A.

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH201

SHEET: 1 OF 2

PROJECT: 100 Halsey Street Substantive FT
JOB No.: 1101937.1000
LOCATION: 100 Halsey street

CO-ORDINATES: (NZTM2000) 5920934.25 mN 1756560.46 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.4m
R.L. COLLAR: 3.4m
DATUM: NZVD2016
SURVEY: HG Survey

DRILLED BY: Pro Drill
LOGGED BY: GAAB
CHECKED: NIBU
START DATE: 02/09/2026
FINISH DATE: 03/09/2026
CONTRACTOR: Pro Drill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)
Fill	*0.00m:* Asphalt/Concrete.
Fill	*0.30m:* Fine to coarse GRAVEL, minor silt. Gravel, scoria. Basecourse.
Fill	*0.65m:* Fine to coarse GRAVEL, minor silt. Gravel, basalt and scoria mix.
Fill	*0.80m:* Gravelly SILT, minor clay; reddish dark brown and grey, low plasticity; gravel, fine to coarse, basalt and scoria mix.
Hydraulic Fill	*2.00m:* NO RECOVERY - Suspect soft and saturated cohesive material unable to be recovered. No recovery from push tube from 2.5 to 3 m bgl.
Hydraulic Fill	*3.00m:* SILT, minor clay and minor sand; grey. Soft, moist, low plasticity; sand, fine.
Marine Deposits	*5.40m:* Sandy SILT, some clay, trace shell fragments; grey. Soft, moist, low to medium plasticity; sand, fine.
Marine Deposits	*6.95m:* Silty fine SAND, some shell fragments; brownish grey. Loose, moist. *7.50 - 8.50m* Saturated.
Marine Deposits	*8.50m:* CORE LOSS - Suspect loose granular material dropped out of barrel.
Marine Deposits	*9.00m:* Clayey SILT, minor organics and shell fragments; grey, spotted black. Soft, wet, medium plasticity; organics, wood fragments (decomposed).

Depth (m)	RL (m)	Sampling Method	Core Recovery (%)	Testing	Description & Additional Observations
0	3	HYDRO EXCAVATION	0		*0.00 - 1.70m* Concrete cutting and hydrovac undertaken
1	2	HWT	0		
2	1	OB	0		*1.70 - 2.00m* Hole cased. Drilling commenced from 2.0 m bgl
		PT	0		*2.50 - 3.00m* Push tube - No recovery
3	0	SPT	100	0,0// 0,0/0/0 N=0	*3.00 - 3.45m* SPT recovered Recovered from open barrel next run *3.00 - 3.45m* .
4	-1	OB	100		
		PT	100	16/3 kPa In barrel 1 @4.50m	
5	-2	SPT	100	1,0// 0/1/0/0 N=1	
6	-3	OB	100		
		PT	0		*6.00 - 6.50m* Push tube - No recovery
7	-4	SPT	100	0,0// 0,0/0/0 N=0	
8	-5	OB	100		
		SPT	100	1,0// 0,0/0/0 N=0	
9	-6	OB	48		
		SPT	100	0,0// 0,0/0/0 N=0	
		OB	100		

Water Level / Fluid Loss (%): 25 50 75
Water level: 02/09/2026, 03/09/2026
Casing: 16.6m HQTT
Installation: Box 0.00-6.95m; Box 6.95-10.30m
Core Box No

COMMENTS: Hydrovac undertaken to 1.7 m bgl. Piezometer installed with screen depth between 6.5 and 7.5 m. Groundwater measured at the start of each day, and on 8/09/2026 prior to undertaking slug test

Hole Depth 16.61m

Scale 1:50

Rev.: A

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BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH201

SHEET: 2 OF 2

PROJECT: 100 Halsey Street Substantive FT
JOB No.: 1101937.1000
LOCATION: 100 Halsey street

CO-ORDINATES: (NZTM2000) 5920934.25 mN 1756560.46 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3m
R.L. COLLAR: 3m
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

DRILLED BY: Pro Drill
LOGGED BY: GAAB
CHECKED: NIBU
START DATE: 02/09/2026
FINISH DATE: 03/09/2026
CONTRACTOR: Pro Drill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Marine Deposits	[CONT] *9.00m:* Clayey SILT, minor organics and shell fragments; grey, spotted black. Soft, wet, medium plasticity; organics, wood fragments (decomposed).			OB 100			-7	10									
	10.65 - 10.90m Some sand; sand, fine.			SPT 100		0,0// 0/1/0/1 N=2	-8	11									
				OB 100													
				SPT 100		29/10 kPa In barrel 0,0// 0/1/1/1 N=3	-9	12									
East Coast Bays Formation				OB 100			-10	13					*13.00 - 13.50m* Short HQTT run undertaken				Box 10.30-13.61m
	12.85m: Highly weathered, grey, SILTSTONE. Extremely weak. Recovered as: SILT, some clay; grey. Very stiff, moist, low to medium plasticity.			HQTT 20													
	13.00m: CORE LOSS - Suspect material left in bottom of hole, washed out on subsequent run.			0		20/30// for 35mm N>=50 Solid Cone											
	13.40m: Moderately weathered, grey, SANDSTONE. Very weak, poorly cemented. Interbedded with: Moderately weathered, SILTSTONE. Very weak. Sub-horizontal, closely to moderately spaced defects.			HQTT 100			-11	14				89	*13.71m:* B, , 5 °, *13.85m:* J, 5°, PL, SM, 5 mm gravel infill *13.91m:* B, 5° *13.95m:* J, 5°, PL, SM, 5 mm gravel infill				
				0		21/29// for 35mm N>=50 Solid Cone	-12	15					*14.30-14.75m:* BZ, 5 - 20 mm gravel				
				HQTT 100								86	*15.41m:* J, 5°, PL, SM, 5 mm gravel infill *15.61m:* B, 5° *15.70m:* J, 5°, PL, SM *16.00m:* B, 5° *16.01m:* J, 5°, PL, SM *16.35m:* J, 5°, PL, SM				Box 13.61-16.61m
				0		20/30// for 30mm N>=50 Solid Cone	-13	16									
	16.61m: Target depth						-14	17									
							-15	18									
							-16	19									

Water Level / Fluid Loss (%): 25, 50, 75
Casing: 16.6m HQTT
Rock Weathering: UW, SW, MW, HW, CW, DW, RS
Rock Strength: VS+, S, MS, W, VW, EW
Fracture Spacing (mm): 2000, 600, 200, 60, 20

COMMENTS: Hydrovac undertaken to 1.7 m bgl. Piezometer installed with screen depth between 6.5 and 7.5 m. Groundwater measured at the start of each day, and on 8/09/2026 prior to undertaking slug test

Hole Depth 16.61m

Scale 1:50

Rev.: A

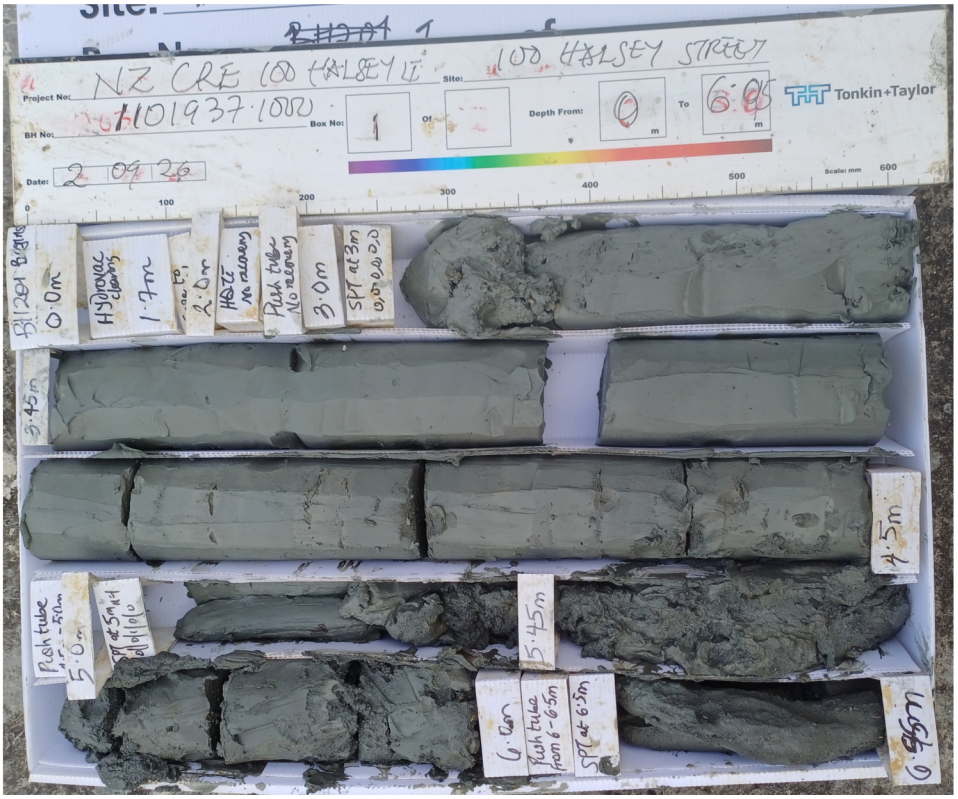
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CORE PHOTOS

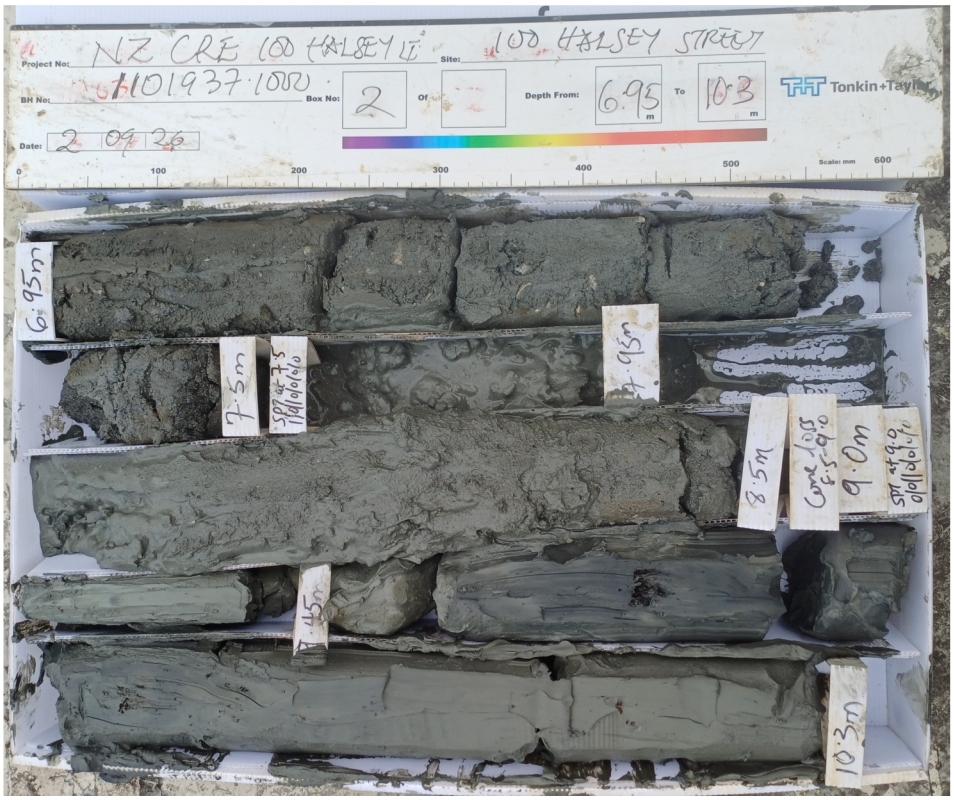
BOREHOLE No.: **BH201**

Hole Location: 100 Halsey street

PROJECT: 100 Halsey Street Substantive FT	LOCATION: Auckland	JOB No.: 1101937.1000
CO-ORDINATES: 5920934.25 mN (NZTM2000) 1756560.46 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: Fraste Sonic 2.0 METHOD: Rotary cored	HOLE STARTED: 02/09/2026 HOLE FINISHED: 03/09/2026 DRILLED BY: Pro Drill LOGGED BY: GAAB CHECKED: NIBU



0.00-6.95m



6.95-10.30m

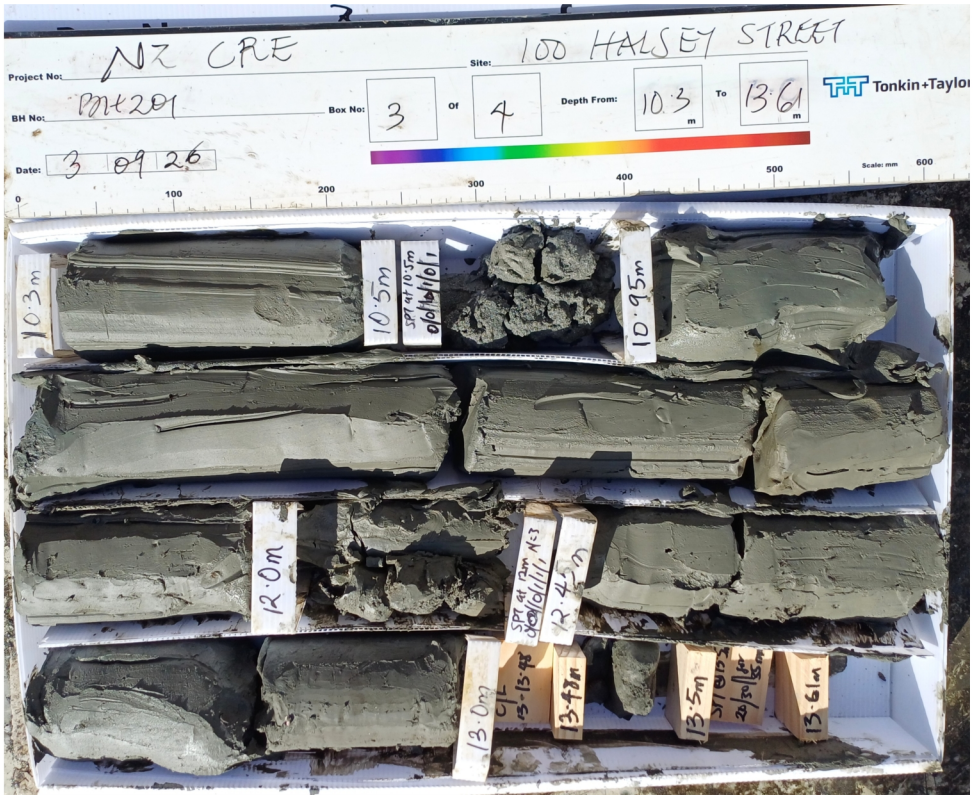
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CORE PHOTOS

BOREHOLE No.: **BH201**

Hole Location: 100 Halsey street

PROJECT: 100 Halsey Street Substantive FT	LOCATION: Auckland	JOB No.: 1101937.1000
CO-ORDINATES: 5920934.25 mN (NZTM2000) 1756560.46 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: Fraste Sonic 2.0 METHOD: Rotary cored	HOLE STARTED: 02/09/2026 HOLE FINISHED: 03/09/2026 DRILLED BY: Pro Drill LOGGED BY: GAAB CHECKED: NIBU



10.30-13.61m



13.61-16.61m

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BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH202

SHEET: 1 OF 1

PROJECT: 100 Halsey Street Substantive FT
JOB No.: 1101937.1000
LOCATION: 100 Halsey street

CO-ORDINATES: (NZTM2000) 5920943.57 mN 1756639.12 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.4m
R.L. COLLAR: 3.4m
DATUM: NZVD2016
SURVEY: HG Survey

DRILLED BY: Pro Drill
LOGGED BY: GAAB
CHECKED: NIBU
START DATE: 03/09/2026
FINISH DATE: 04/09/2026
CONTRACTOR: Pro Drill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)
Fill	*0.00m:* Asphalt/Concrete.
	0.10m: Fine to coarse GRAVEL, minor silt. Gravel, scoria. Basecourse.
	0.30m: Gravelly SILT, minor clay; reddish dark brown and grey, low plasticity; gravel, fine to coarse, siltstone, basalt and scoria mix.
	1.20m: NO RECOVERY - hole cased to 2 m bgl.
Hydraulic Fill	*2.00m:* Gravelly SILT, some clay; dark brownish grey streaked yellow. Soft, moist, low to medium plasticity; gravel, fine to coarse, basalt and scoria.
	2.65m: Clayey SILT, some shell fragments, minor organics, and minor gravel, trace sand; grey with black, streaked yellow. Soft medium plasticity, moist; gravel, fine, basalt; organics, wood fragments (decomposed).
Marine Deposits	*4.20m:* Fine SAND, some silt, minor shell fragments; dark greenish grey, medium dense, moist.
	5.30m: SILT, some clay, minor organics, trace sand; black mixed with greenish grey. Stiff, moist, low to medium plasticity; organics, wood fragments (decomposed).
	5.75m: SAND, some organics and shell fragments, minor silt; dark grey. Loose, moist; organics, wood fragments (fresh).
East Coast Bays Formation	*6.95m:* Clayey SILT, minor sand; brownish grey, streaked orange, spotted black. Stiff to very stiff, moist, medium plasticity.
	8.40m: Moderately weathered, grey, SANDSTONE. Very weak, poorly cemented. Interbedded with: Moderately weathered, grey, SILTSTONE. Very weak.
	8.95 - 9.00m Carbonaceous band along defect. *9.40 - 9.45m* Carbonaceous band along defect.
	10.10m: CORE LOSS - Suspect core bound.
	10.62m: Target depth

Depth (m)	RL (m)	Sampling Method	Core Recovery (%)	Testing	Rock Weathering	Rock Strength	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
0	3	HYDRO EXCAVATION	0								*0.00 - 1.20m* Concrete cutting and hydrovac undertaken				
1	2	HWT	0								*1.20 - 2.00m* Hole cased. Drilling commenced from 2.0 m bgl		10.6m HW		
2	1	OB	60								*2.00 - 2.50m* Short open barrel run undertaken	04/09/2026			
		OB	100	32/23 kPa In barrel							*2.50 - 3.00m* Short open barrel run undertaken				
3	0	SPT	100	0.0// 0/1/1/1 N=3								07/09/2026			Box 0.00-4.50m
		OB	100	39/16 kPa In barrel							*3.50 - 3.70m* Short open barrel run undertaken				
4	-1	OB	100								*3.70 - 4.50m* Short open barrel run undertaken				
		SPT	100	UTP In barrel 1/2// 1/2/3/4 N=10							*4.50 - 5.00m* No push tube recovery due to boulder size gravel fill obstruction *4.50m:* Gravel obstruction refusal, likely fill that fell into hole.				
5	-2	OB	100												
6	-3	PUSH TUBE	50	1 @6.00m Partial recovery							*6.00 - 6.50m* Partial push tube recovery: ~250 mm *6.00 - 6.50m* Partial recovery				
		SPT	100	1.0// 1.0/1/0 N=2											Box 4.50-7.50m
7	-4	OB	100								*7.00 - 7.50m* Short open barrel run undertaken				
		PUSH TUBE	100	106/32 kPa In barrel 2 @7.50m											
8	-5	SPT	100	2.0// 7/8/20/15 for 25mm N>=50											
		HQTT	100							91	*8.40 - 9.00m* Short HQTT run undertaken *8.50m:* J, 20°, ST, R, 5 mm gravel infill				
9	-6	HQTT	0	18/32// for 20mm N>=50 Solid Cone							*8.70m:* J, 5°, PL, R, 5 mm gravel infill *8.80m:* J, 38°, PL, R, 5 mm gravel infill *8.85m:* B, 5°, carbonaceous material *8.97m:* B, 5°, carbonaceous material *9.15m:* J, 5°, PL, R, 5 mm gravel infill *9.20m:* J, 5°, PL, R, 5 mm gravel infill *9.25-9.27m:* BZ, 5 - 25 mm gravel *9.30m:* J, 18°, UN, R, 5 mm gravel infill *9.40m:* J, 5°, PL, R, 5 mm gravel infill *9.67-9.72m:* BZ, 5 - 35 mm gravel *9.90m:* B, 5°, carbonaceous material *10.05m:* B, 5°, carbonaceous material				
10	-7	HQTT	71							67					Box 7.50-10.62m
		HQTT	0	23/27// for 40mm N>=50 Solid Cone											
11	-8														

COMMENTS: Hydrovac undertaken to 1.2 m bgl. Piezometer installed with screen depth between 3.5 and 4.5 m. Groundwater measured at the start of each day, and on 8/09/2026 prior to undertaking slug test

Hole Depth 10.62m

Scale 1:60

Rev.: A

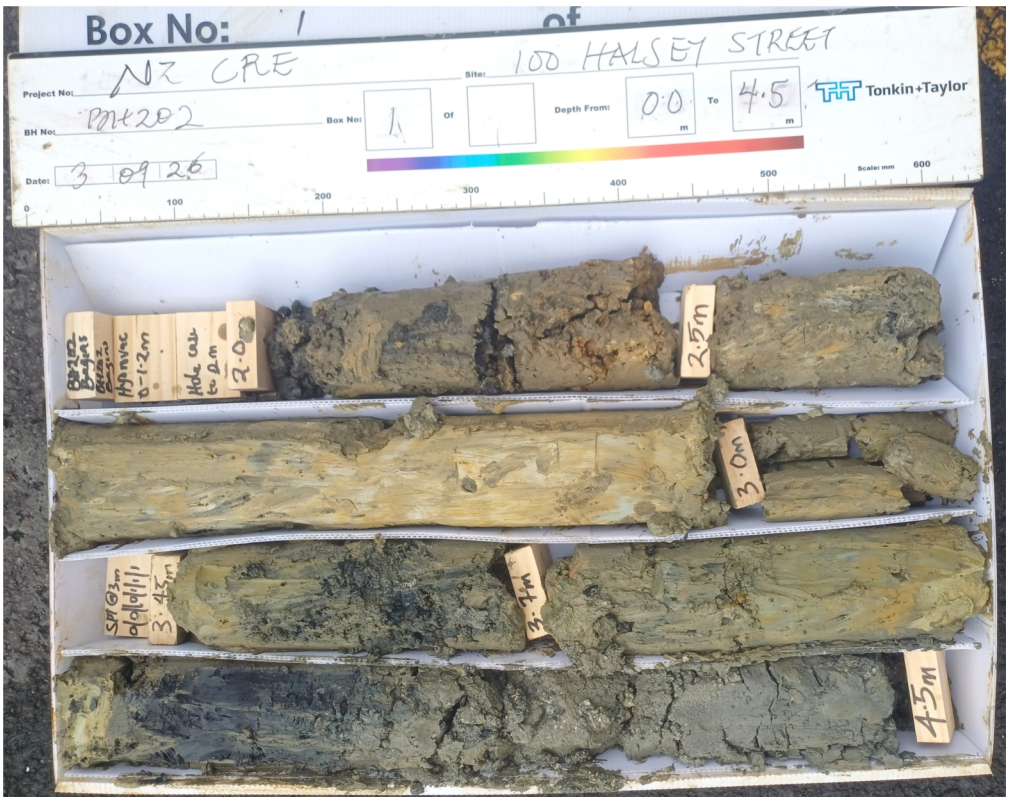
TTNZ_20260116 - GeneralLog - 24/09/2026 6:18:41 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

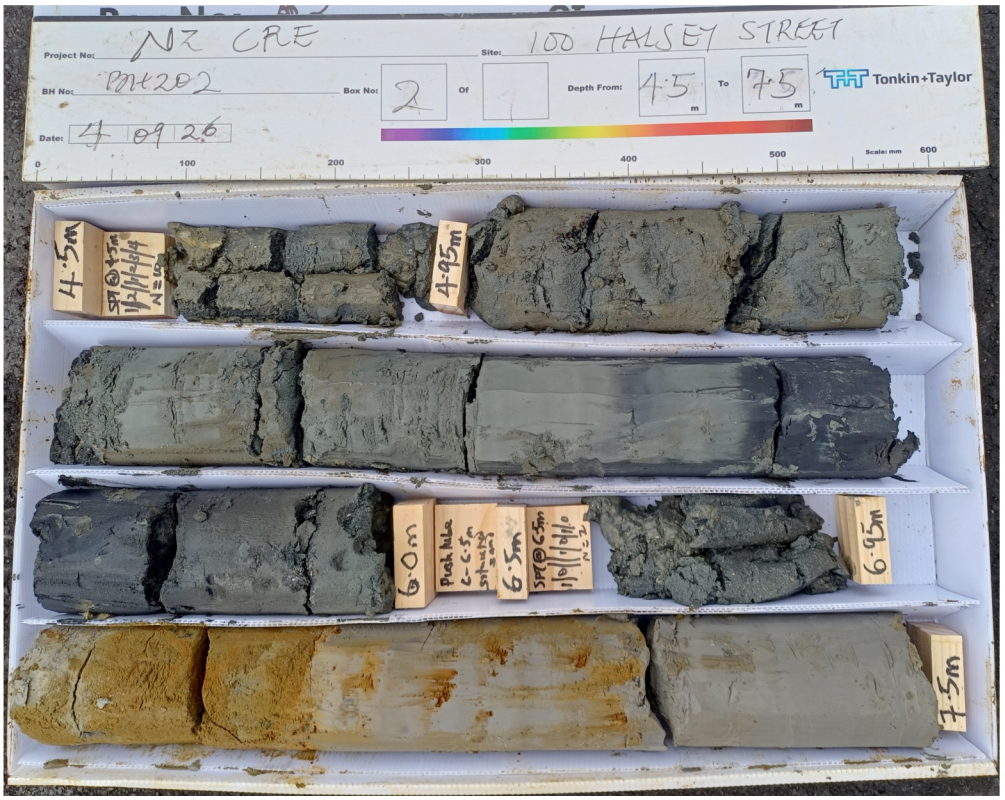
BOREHOLE No.: **BH202**

Hole Location: 100 Halsey street

PROJECT: 100 Halsey Street Substantive FT	LOCATION: Auckland	JOB No.: 1101937.1000
CO-ORDINATES: 5920943.57 mN (NZTM2000) 1756639.12 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: Fraste Sonic 2.0 METHOD: Rotary cored	HOLE STARTED: 03/09/2026 HOLE FINISHED: 04/09/2026 DRILLED BY: Pro Drill LOGGED BY: GAAB CHECKED: NIBU



0.00-4.50m



4.50-7.50m

TTNZ_20260116 - GeneralLog - 24/09/2026 6:18:41 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH202**

Hole Location: 100 Halsey street

PROJECT: 100 Halsey Street Substantive FT	LOCATION: Auckland	JOB No.: 1101937.1000
CO-ORDINATES: 5920943.57 mN (NZTM2000) 1756639.12 mE R.L.: 3m DATUM: NZVD2016	DRILL TYPE: Fraste Sonic 2.0 METHOD: Rotary cored	HOLE STARTED: 03/09/2026 HOLE FINISHED: 04/09/2026 DRILLED BY: Pro Drill LOGGED BY: GAAB CHECKED: NIBU



7.50-10.62m

TTNZ_20260116 - GeneralLog - 24/09/2026 6:18:41 pm - Produced with Core-GS by GeRoc

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 12.02
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 1/09/2026
Cone Ref: 71238

Test Name: CPT-201
Job Number: 260716

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 1.75 m

Dissipation 3 m

Dissipation 6.5 m

GROUND INVESTIGATION

Calculated CPT Log

Date: 1/09/2026

Project: 100 Halsey Street

1	Sensitive fine-grained	4	Silt mixtures: clayey silt & silty clay	7	Dense sand to gravelly sand	**Test Name:**	**CPT-201**
2	Clay - organic soil	5	Sand mixtures: silty sand to sandy silt	8	Stiff sand to clayey sand		
3	Clays: clay to silty clay	6	Sands: clean sands to silty sands	9	Stiff fine-grained	**Job Number:**	260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — S_u (kPa) 50 100 150 — 70 80 90 — 350 400 450

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.75 m

Water level 2.1 m
Estimated

Dissipation 3 m

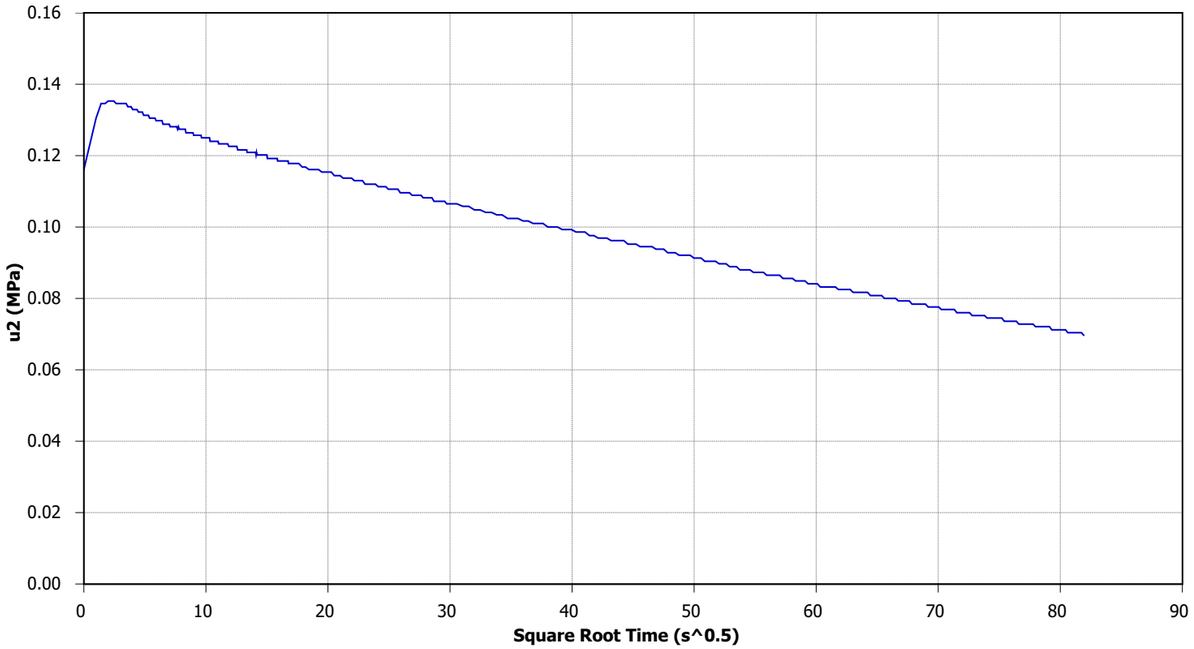
Dissipation 6.5 m

Depth has been corrected for inclination

CPT Dissipation Log

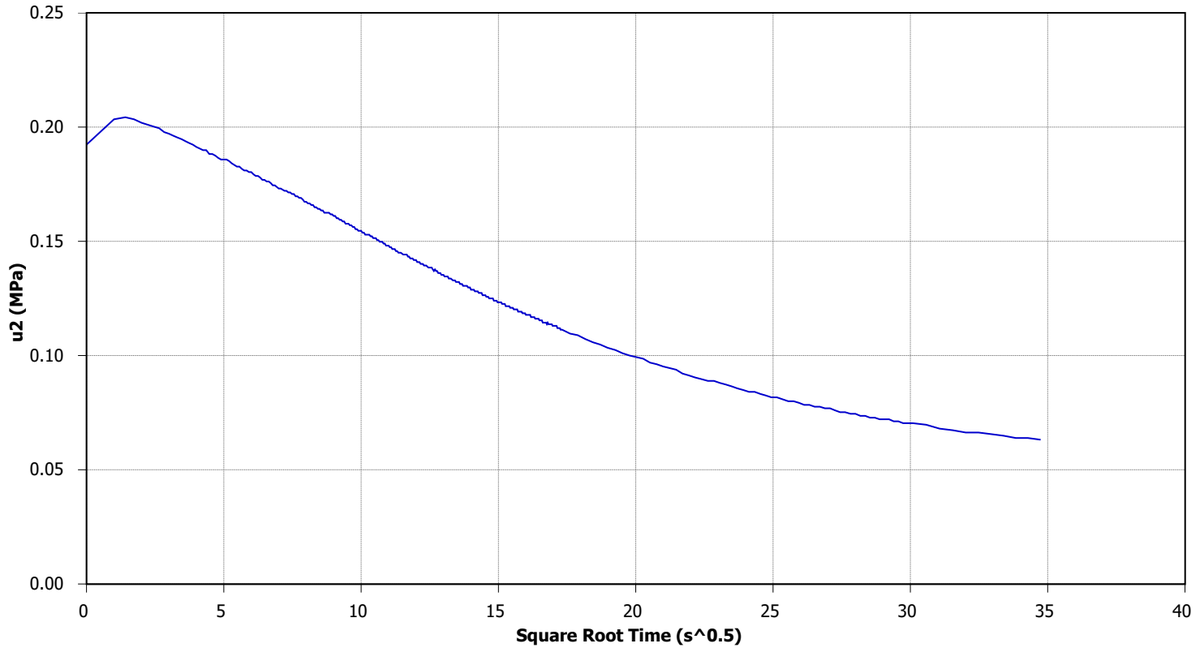
Test Name: CPT-201

Job Number: 260716



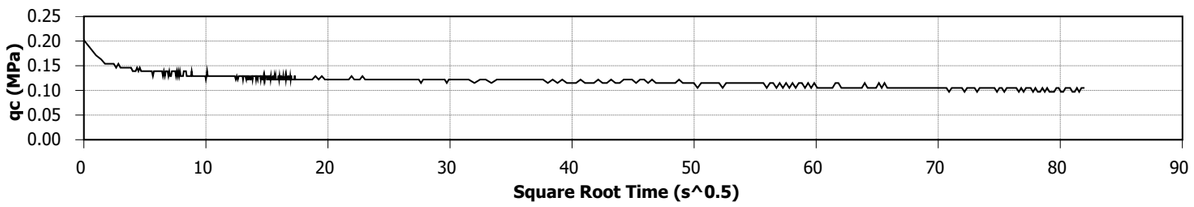
Depth (m): 3.00 **Test Date:** 1/09/2026 **Duration:** 111 minutes 50 seconds

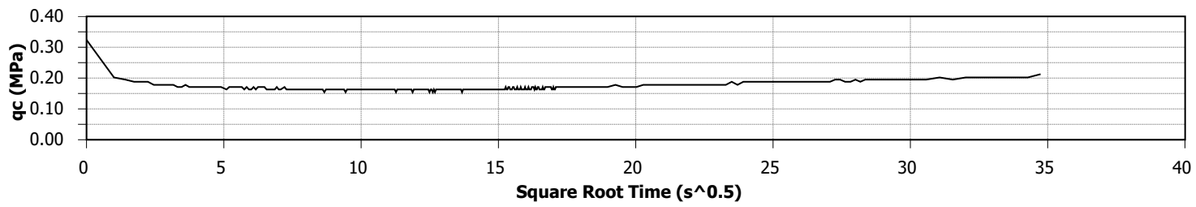
Remarks:

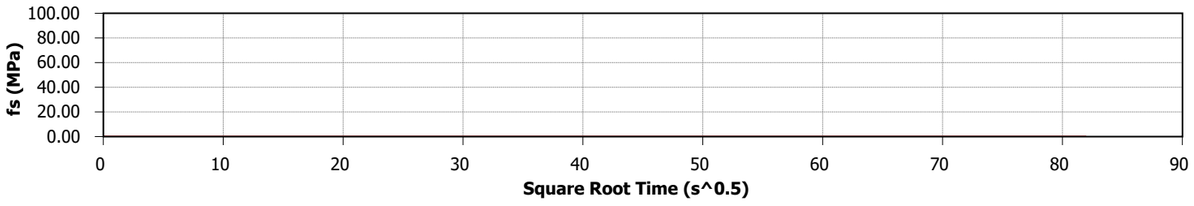


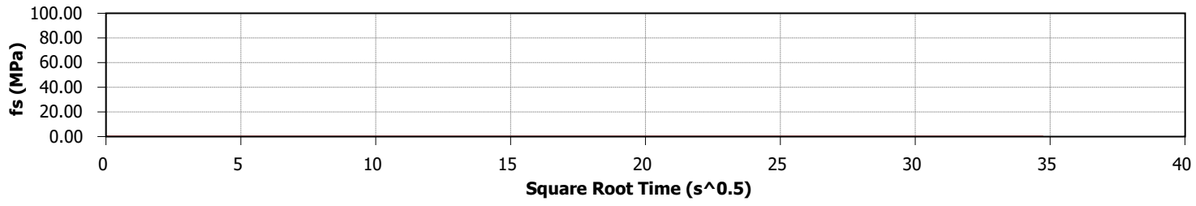
Depth (m): 6.50 **Test Date:** 1/09/2026 **Duration:** 20 minutes 5 seconds

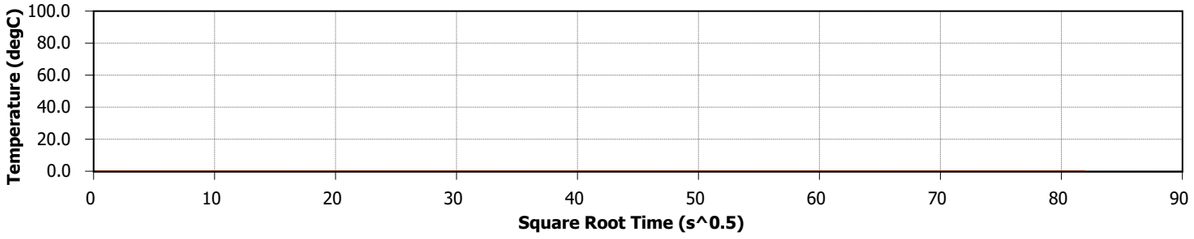
Remarks:

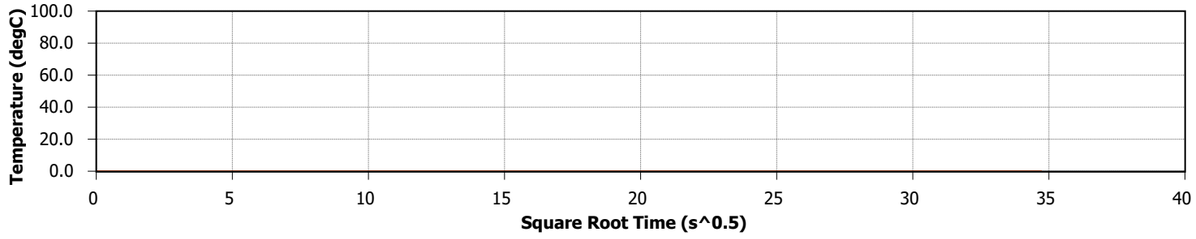












CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844468, 174.755931	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	1/09/2026 2:05:34 PM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.75
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	12.02
Ground water level:	2.1
Water level origin:	Estimated
Backfill:	Concrete
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-201

Job Number: 260716

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

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

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

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

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): $D_r = 100 \bullet \sqrt{\frac{Q_{tn}}{350}}$

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

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

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 $I_c < 2.2$

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

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

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

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,239.40	6,246.70	7.31	-	-
Sleeve friction	464.40	461.10	-3.26	-	-
Pore pressure	742.10	741.10	-0.96	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 9.28
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 2/09/2026
Cone Ref: 71238

Test Name: CPT-202
Job Number: 260716

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 1.1 m

Dissipation 3.01 m

Depth has been corrected for inclination

Calculated CPT Log

Date: 2/09/2026
Project: 100 Halsey Street

1	Sensitive fine-grained	4	Silt mixtures: clayey silt & silty clay	7	Dense sand to gravelly sand		
2	Clay - organic soil	5	Sand mixtures: silty sand to sandy silt	8	Stiff sand to clayey sand		
3	Clays: clay to silty clay	6	Sands: clean sands to silty sands	9	Stiff fine-grained		

Test Name: CPT-202
Job Number: 260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45
f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 50 100 150
S_u (kPa) 70 80 90 350 400 450
N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.1 m

Water level 1.8 m
Estimated

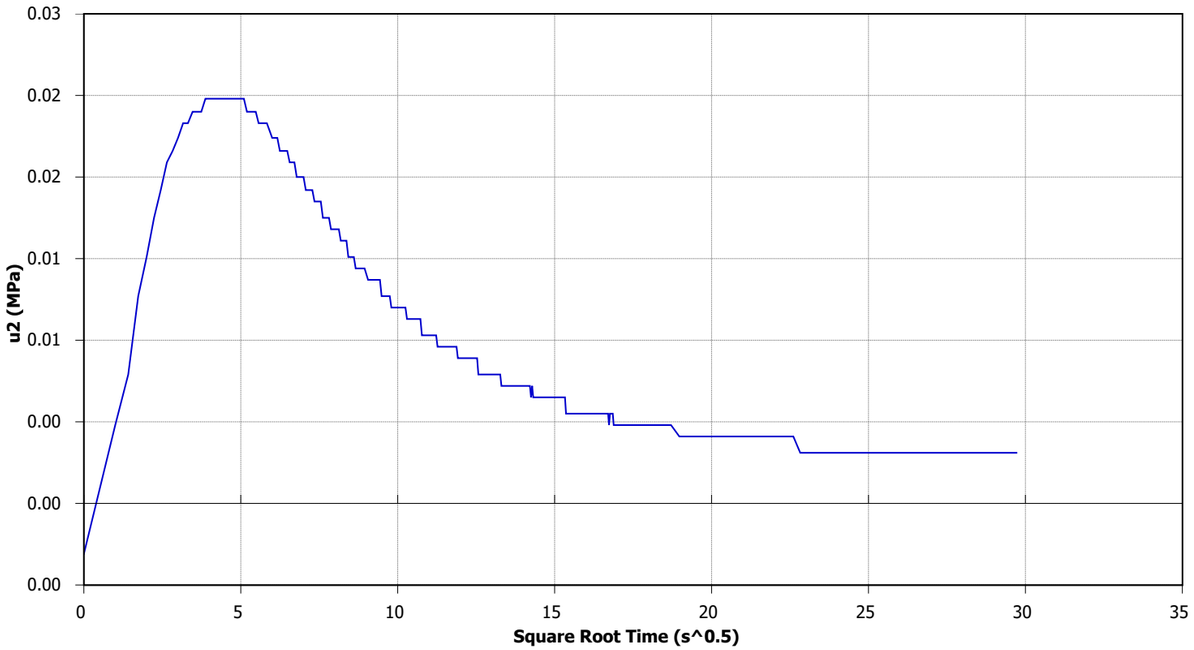
Dissipation 3.01 m

Depth has been corrected for inclination

CPT Dissipation Log

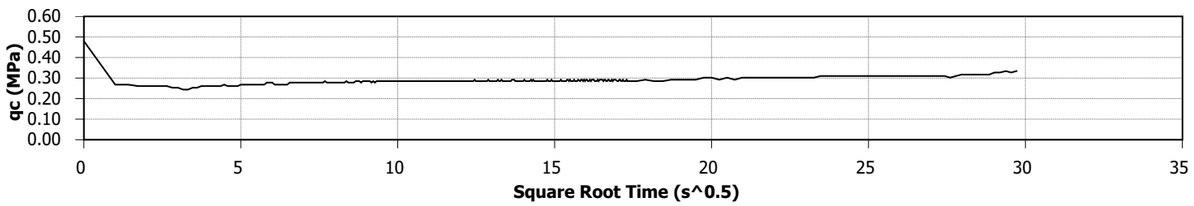
Test Name: CPT-202

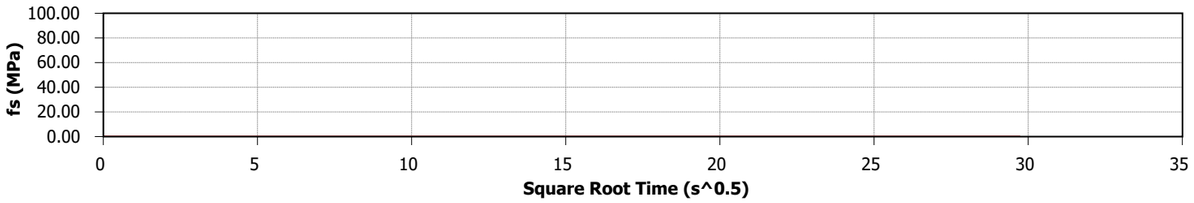
Job Number: 260716

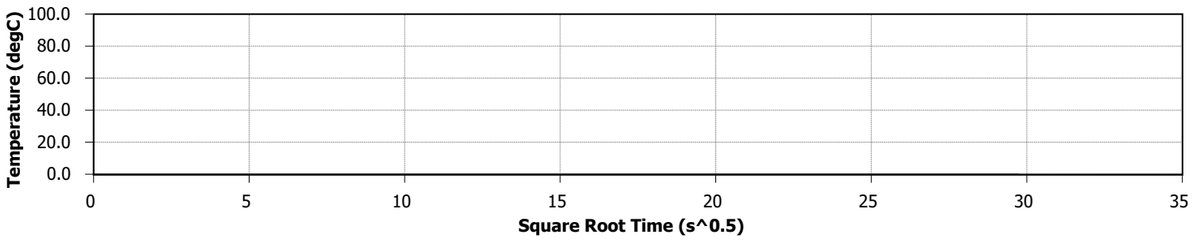


Depth (m): 3.01 **Test Date:** 2/09/2026 **Duration:** 14 minutes 43 seconds

Remarks:







CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844454, 174.756775	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	2/09/2026 10:35:00 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.10
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	9.28
Ground water level:	1.8
Water level origin:	Estimated
Backfill:	Gravel , Tar seal
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-202

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

Normalised soil behaviour type index:

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

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):

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

Relative density (D_r):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{\text{tn}})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,246.70	6,256.50	9.75	-	-
Sleeve friction	466.00	466.60	0.65	-	-
Pore pressure	742.80	742.80	0	-	-

GROUND INVESTIGATION

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 10.81
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 1/09/2026
Cone Ref: 70169

Test Name: CPT-203
Job Number: 260716

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 2 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 1/09/2026

Project: 100 Halsey Street

1 Sensitive fine-grained	4 Silt mixtures: clayey silt & silty clay	7 Dense sand to gravelly sand
2 Clay - organic soil	5 Sand mixtures: silty sand to sandy silt	8 Stiff sand to clayey sand
3 Clays: clay to silty clay	6 Sands: clean sands to silty sands	9 Stiff fine-grained

Test Name: CPT-203

Job Number: 260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — 50 100 150 S_u (kPa) 70 80 90 — 350 400 450

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 2 m

Water level 1.8 m
Estimated

Depth has been corrected for inclination

CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844321, 174.756483	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	1/09/2026 5:24:58 PM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	2.00
Start length (m):	0
Cone ID:	70169
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	10.81
Ground water level:	1.8
Water level origin:	Estimated
Backfill:	Gravel , Tar seal
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-203

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

Normalised soil behaviour type index:

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

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):

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

Relative density (D_r):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{\text{tn}})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	5,765.70	5,772.90	7.25	-	-
Sleeve friction	436.80	435.10	-1.63	-	-
Pore pressure	678.70	677.70	-0.97	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 11.30
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 1/09/2026
Cone Ref: 70169

Test Name: CPT-204
Job Number: 260716

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 1.5 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 1/09/2026

Project: 100 Halsey Street

1	Sensitive fine-grained	4	Silt mixtures: clayey silt & silty clay	7	Dense sand to gravelly sand	**Test Name:**	**CPT-204**
2	Clay - organic soil	5	Sand mixtures: silty sand to sandy silt	8	Stiff sand to clayey sand		
3	Clays: clay to silty clay	6	Sands: clean sands to silty sands	9	Stiff fine-grained	**Job Number:**	260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — S_u (kPa) 50 100 150 — 350 400 450 70 80 90

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.5 m

Water level 1.7 m
Estimated

Depth has been corrected for inclination

CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844288, 174.756029	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	1/09/2026 1:20:12 PM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.50
Start length (m):	0
Cone ID:	70169
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	11.3
Ground water level:	1.7
Water level origin:	Estimated
Backfill:	Concrete
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-204

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

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):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{tn})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	5,731.90	5,748.80	16.91	-	-
Sleeve friction	436.10	436.80	0.65	-	-
Pore pressure	677.70	677.70	0	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 18.34
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 2/09/2026
Cone Ref: 71238

Test Name: CPT-205
Job Number: 260716

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 - - - - -
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

u_2 (MPa)

Temp (°C) 15 30

Incl. (°) 0 10

Pre-drill from 0 m to 1.5 m

Dissipation 3 m

Dissipation 6.5 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 2/09/2026

Project: 100 Halsey Street

1 Sensitive fine-grained	4 Silt mixtures: clayey silt & silty clay	7 Dense sand to gravelly sand
2 Clay - organic soil	5 Sand mixtures: silty sand to sandy silt	8 Stiff sand to clayey sand
3 Clays: clay to silty clay	6 Sands: clean sands to silty sands	9 Stiff fine-grained

Test Name: CPT-205

Job Number: 260716

Depth has been corrected for inclination

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — 50 100 150 S_u (kPa) 70 80 90 — 350 400 450

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.5 m

Water level 1.7 m
Estimated

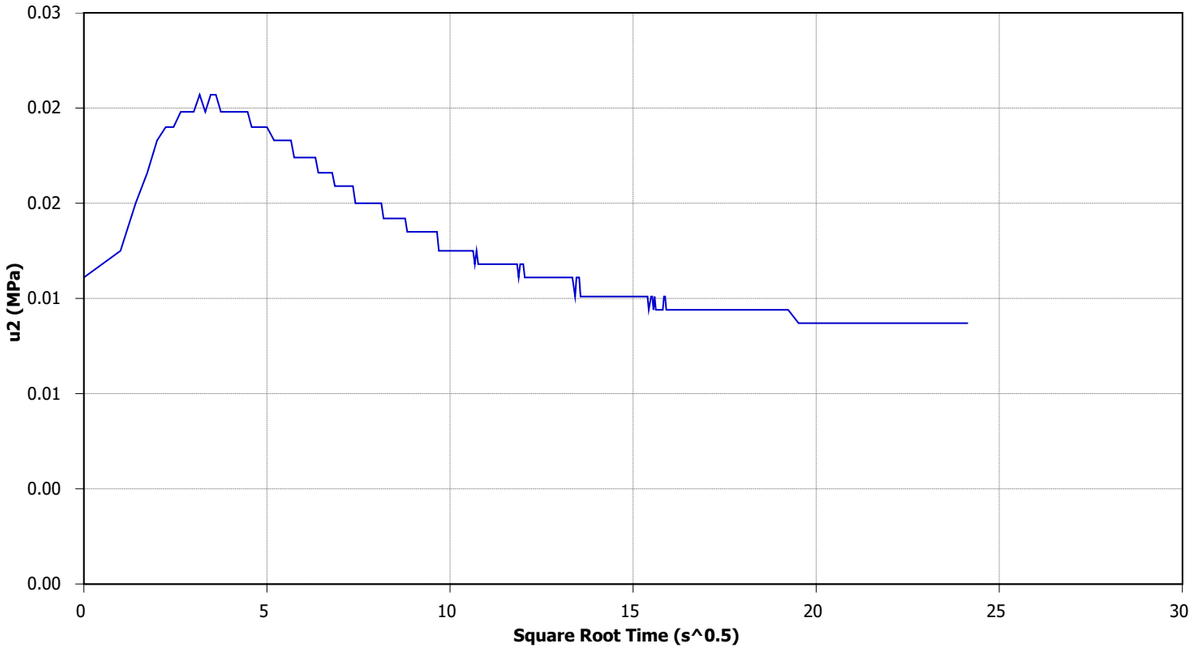
Dissipation 3 m

Dissipation 6.5 m

CPT Dissipation Log

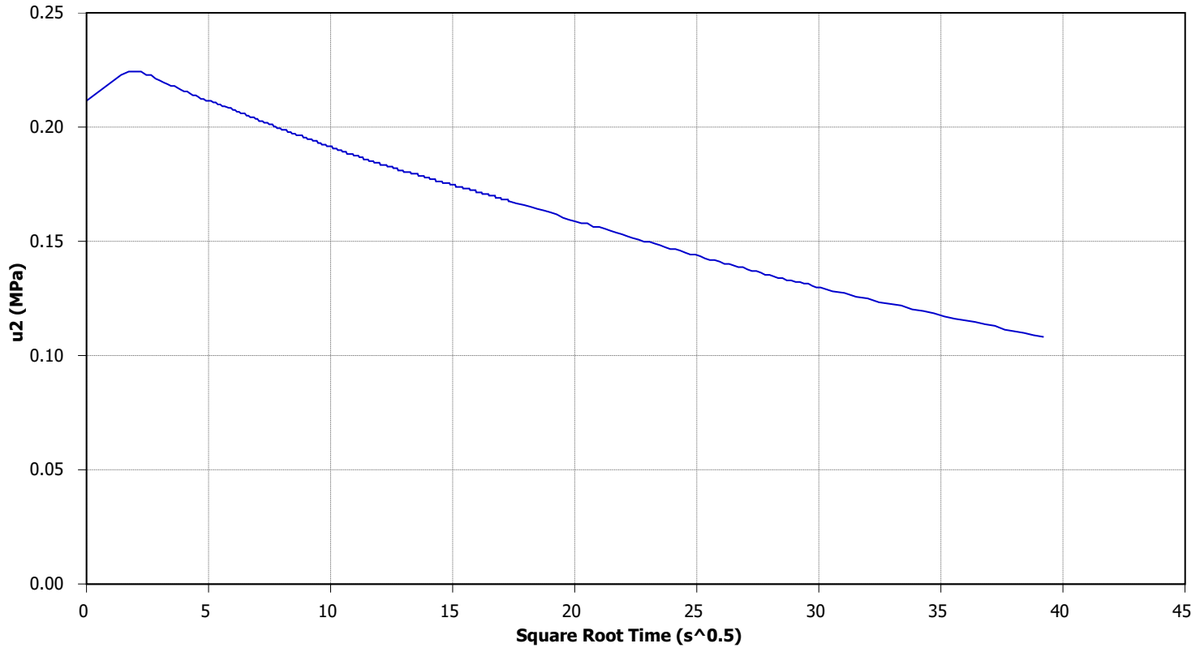
Test Name: CPT-205

Job Number: 260716



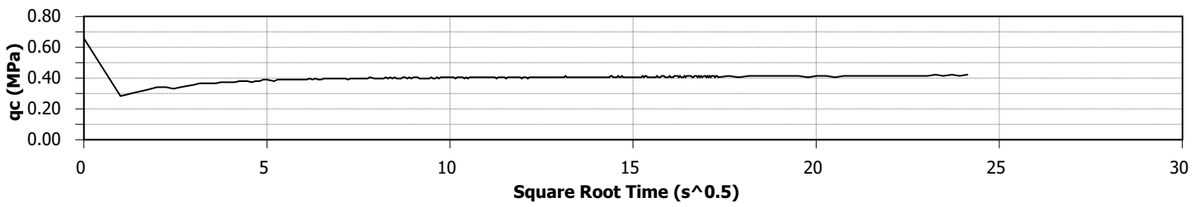
Depth (m): 3.00 **Test Date:** 2/09/2026 **Duration:** 9 minutes 42 seconds

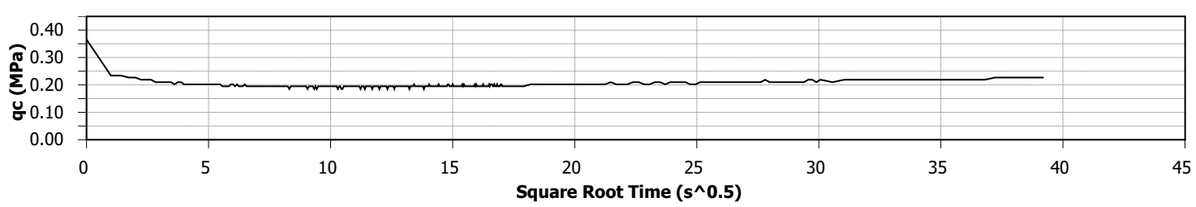
Remarks:

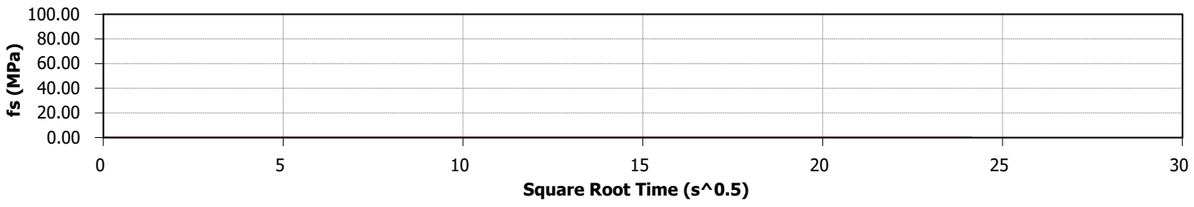


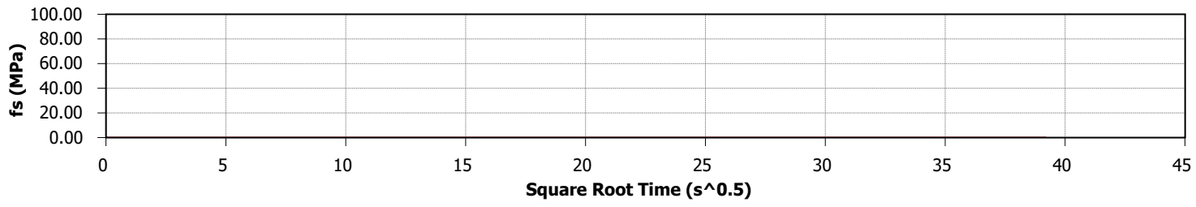
Depth (m): 6.50 **Test Date:** 2/09/2026 **Duration:** 25 minutes 35 seconds

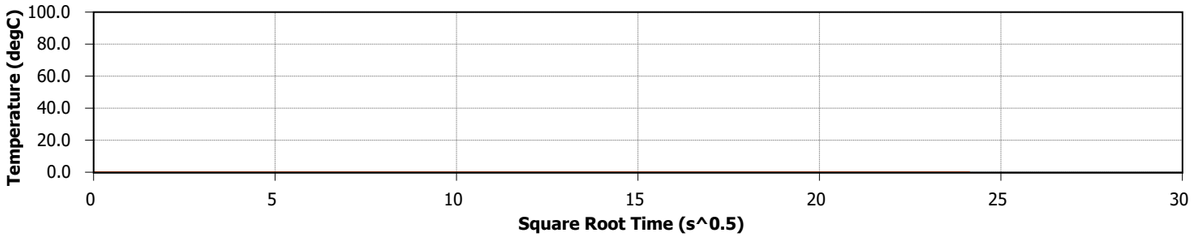
Remarks:

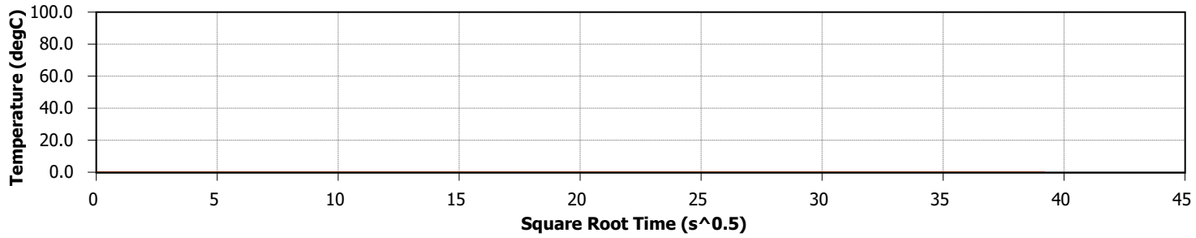












CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844031, 174.755273	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	2/09/2026 7:30:00 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.50
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	18.34
Ground water level:	1.7
Water level origin:	Estimated
Backfill:	Concrete
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-205

Job Number: 260716

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

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

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

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

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): $D_r = 100 \bullet \sqrt{\frac{Q_{tn}}{350}}$

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

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

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 $I_c < 2.2$

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

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

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

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,256.50	6,256.50	0	-	-
Sleeve friction	466.00	462.70	-3.26	-	-
Pore pressure	742.80	740.40	-2.4	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Intermittent interference on friction data. Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 15.40
Termination: High pore water pressure

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 2/09/2026
Cone Ref: 70169

Test Name: CPT-206
Job Number: 260716

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 - - - - -: 0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

u_2 (MPa)

Temp (°C): 15 30

Incl. (°): 0 10

Pre-drill from 0 m to 1.1 m

Dissipation 2.94 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 2/09/2026

Project: 100 Halsey Street

1	Sensitive fine-grained	4	Silt mixtures: clayey silt & silty clay	7	Dense sand to gravelly sand	**Test Name:**	**CPT-206**
2	Clay - organic soil	5	Sand mixtures: silty sand to sandy silt	8	Stiff sand to clayey sand		
3	Clays: clay to silty clay	6	Sands: clean sands to silty sands	9	Stiff fine-grained	**Job Number:**	260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — 50 100 150 S_u (kPa) 70 80 90 — 350 400 450

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.1 m

Water level 1.7 m
Estimated

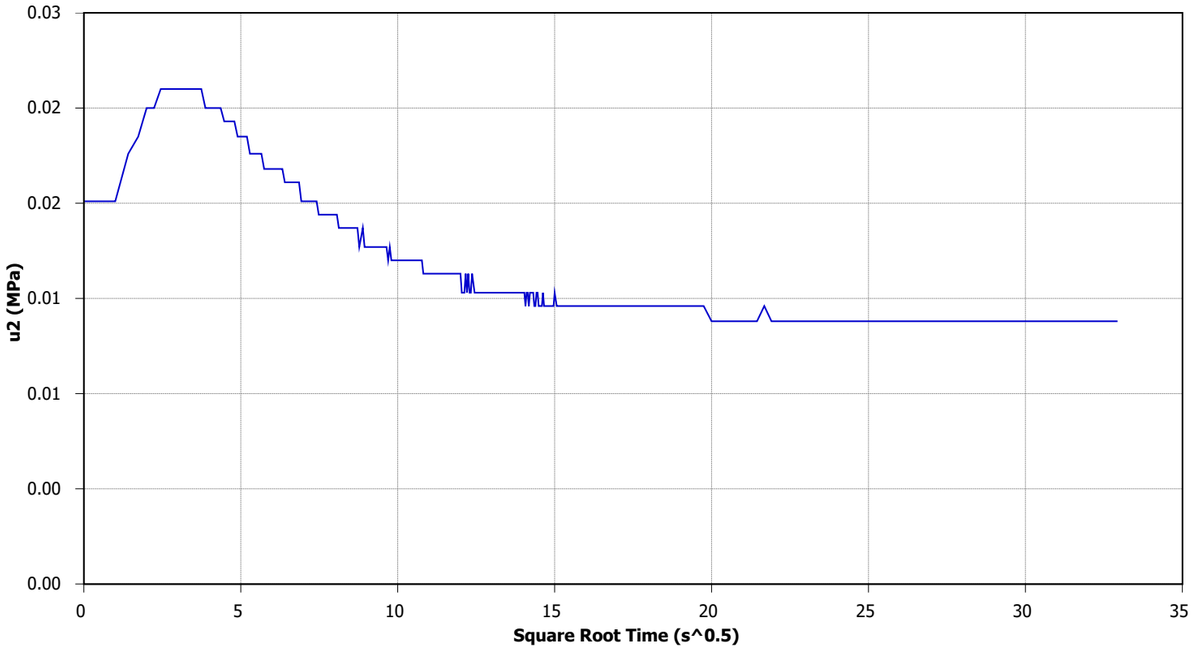
Dissipation 2.94 m

Depth has been corrected for inclination

CPT Dissipation Log

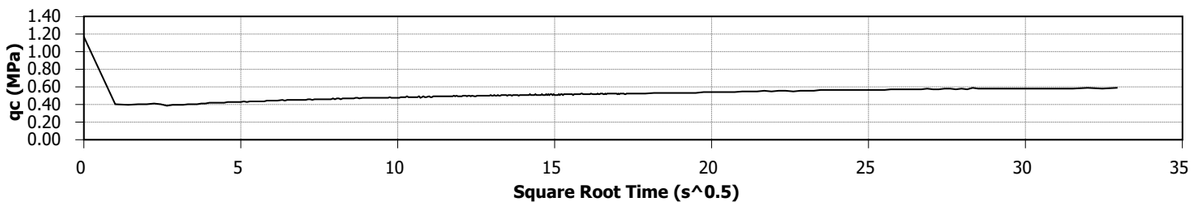
Test Name: CPT-206

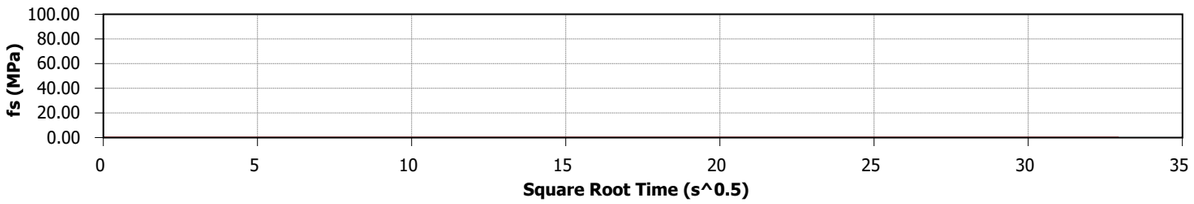
Job Number: 260716

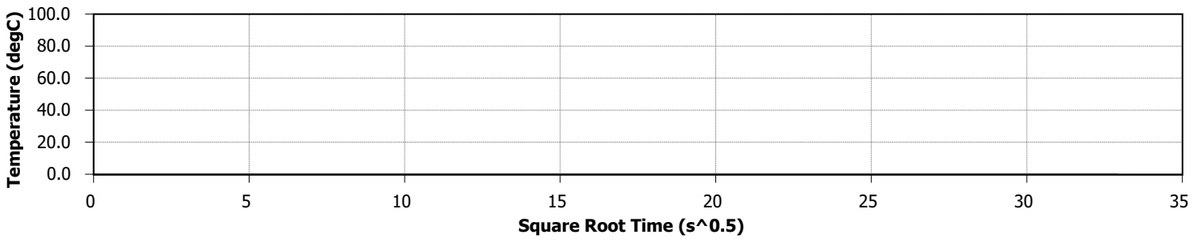


Depth (m): 2.94 **Test Date:** 2/09/2026 **Duration:** 18 minutes 3 seconds

Remarks:







CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.843915, 174.755612	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	2/09/2026 11:34:30 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.10
Start length (m):	0
Cone ID:	70169
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	High pore water pressure
Termination depth:	15.4
Ground water level:	1.7
Water level origin:	Estimated
Backfill:	Concrete
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-206

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

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):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{tn})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	5,828.50	5,821.30	-7.25	-	-
Sleeve friction	440.00	440.50	0.49	-	-
Pore pressure	679.40	678.70	-0.73	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 10.28
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 1/09/2026
Cone Ref: 70169

Test Name: CPT-208
Job Number: 260716

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 1.4 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 1/09/2026

Project: 100 Halsey Street

1	Sensitive fine-grained	4	Silt mixtures: clayey silt & silty clay	7	Dense sand to gravelly sand	**Test Name:**	**CPT-208**
2	Clay - organic soil	5	Sand mixtures: silty sand to sandy silt	8	Stiff sand to clayey sand		
3	Clays: clay to silty clay	6	Sands: clean sands to silty sands	9	Stiff fine-grained	**Job Number:**	260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45 — f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 — S_u (kPa) 50 100 150 — 70 80 90 — 350 400 450

N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.4 m

Water level 1.7 m
Estimated

Depth has been corrected for inclination

CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.843583, 174.756221	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	1/09/2026 10:19:07 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.40
Start length (m):	0
Cone ID:	70169
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	10.28
Ground water level:	1.7
Water level origin:	Estimated
Backfill:	Gravel , Tar seal
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-208

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

Normalised soil behaviour type index:

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

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):

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

Relative density (D_r):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{\text{tn}})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	5,683.60	5,724.60	41.06	-	-
Sleeve friction	437.30	432.40	-4.89	-	-
Pore pressure	677.70	677.00	-0.73	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 21.70
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 1/09/2026
Cone Ref: 71238

Test Name: CPT-209
Job Number: 260716

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

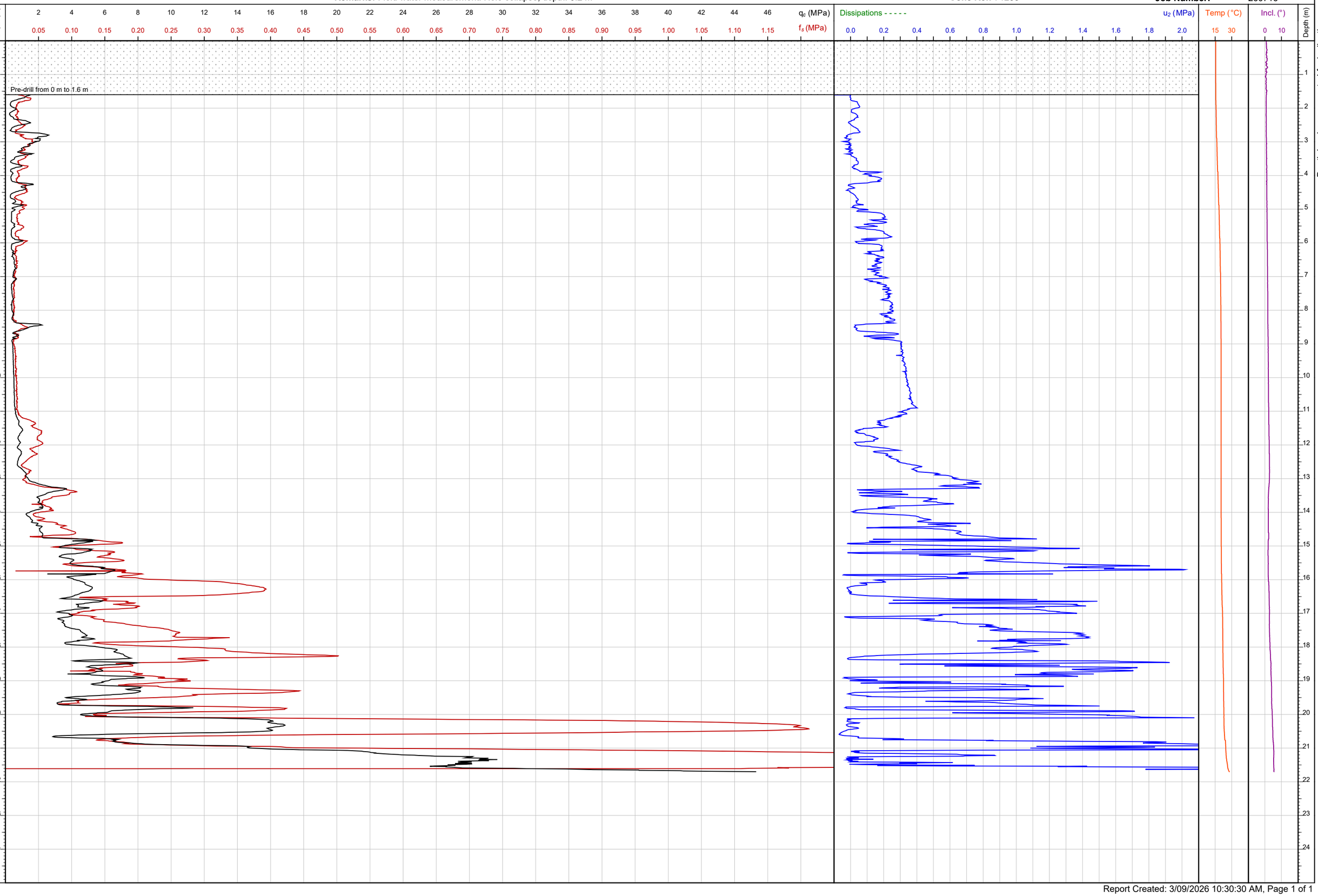
Dissipations - - - - -

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 1.6 m



GROUND INVESTIGATION

Calculated CPT Log

Date: 1/09/2026

Project: 100 Halsey Street

1 Sensitive fine-grained	4 Silt mixtures: clayey silt & silty clay	7 Dense sand to gravelly sand	
2 Clay - organic soil	5 Sand mixtures: silty sand to sandy silt	8 Stiff sand to clayey sand	
3 Clays: clay to silty clay	6 Sands: clean sands to silty sands	9 Stiff fine-grained	

Test Name: CPT-209

Job Number: 260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) / f_s (MPa)

u_0 - - - u_2 (MPa)

R_f(%)

SBT I_c

SBTn I_{cn}

Q_{tn}

B_q

γ (kg/m^3)

D_r(%) / S_u (kPa)

N_{kt} 15

Φ'

V_s (m/s)

G_0 (MPa)

M (MPa)

E (MPa)

N60

Pre-drill from 0 m to 1.6 m

Water level 1.75 m
Estimated

CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.843477, 174.755744	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	1/09/2026 8:53:02 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.60
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	21.7
Ground water level:	1.75
Water level origin:	Estimated
Backfill:	Concrete
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-209

Job Number: 260716

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

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

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

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

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):
$$D_r = 100 \bullet \sqrt{\frac{Q_{tn}}{350}}$$

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

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

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 $I_c < 2.2$
$$\alpha_M = 0.0188 \bullet 10^{(0.55 \bullet I_c + 1.68)}$$

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

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

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	6,215.00	6,239.40	24.37	-	-
Sleeve friction	440.60	454.60	14	-	-
Pore pressure	742.10	742.10	0	-	-

Measured CPT Log

Client: Geotechnics
Project: 100 Halsey Street
Remarks: Field water measurement: Hole collapse, depth: 0.2 m

Depth (m): 10.15
Termination: Danger of buckling rods

Standard: ISO 22476-1:2012 CETANZ TG6
Date: 2/09/2026
Cone Ref: 70169

Test Name: CPT-210
Job Number: 260716

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 1.1 m

Depth has been corrected for inclination

GROUND INVESTIGATION

Calculated CPT Log

Date: 2/09/2026

Project: 100 Halsey Street

1 Sensitive fine-grained
2 Clay - organic soil
3 Clays: clay to silty clay
4 Silt mixtures: clayey silt & silty clay
5 Sand mixtures: silty sand to sandy silt
6 Sands: clean sands to silty sands
7 Dense sand to gravelly sand
8 Stiff sand to clayey sand
9 Stiff fine-grained

Test Name: CPT-210

Job Number: 260716

Depth has been corrected for inclination

Depth (m)

q_t (MPa) 5 10 15 20 25 30 35 40 45
f_s (MPa) 0.25 0.50 0.75 1.00

u_0 - - - u_2 (MPa) 0.0 0.5 1.0 1.5 2.0

R_f(%) 2 4 6 8

SBT I_c 2 4 6 8

SBTn I_{cn} 2 4 6 8

Q_{tn} 100 200 300 400

B_q 0 0.4 0.8

γ (kg/m³) 16 18 20 22

D_r(%) 10 20 30 50 100 150 70 80 90
S_u (kPa) 350 400 450
N_{kt} 15

Φ' 30 35 40 45

V_s (m/s) 100 200 300 400

G_0 (MPa) 100 200 300 400

M (MPa) 100 200 300 400

E (MPa) 100 200 300 400

N60 10 20 30 40

Pre-drill from 0 m to 1.1 m

Water level 2.1 m
Estimated

Depth has been corrected for inclination

CPT Details

General Information

Project:	100 Halsey Street	**Location:**	100 Halsey Street, Auckland CBD, Auckland 1010, New Zealand
Contractor:	Ground Investigation		
WGS84 (deg):	-36.844760, 174.756633	**Rig details:**	22 Tonne MAN Truck
Elevation (m):	Unknown	**Location method:**	Handheld GPS
Date:	2/09/2026 9:25:07 AM	**Elevation datum:**	

Test Setup

Standard:	ISO 22476-1:2012
Test type:	
Pre-Drill (m):	1.10
Start length (m):	0
Cone ID:	70169
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 Porous - Plastic
Saturation method:	Silicone oil
Rig setup variation:	

Test Result

Termination reason:	Danger of buckling rods
Termination depth:	10.15
Ground water level:	2.1
Water level origin:	Estimated
Backfill:	Gravel , Tar seal
Observations and materials encountered:	
Deviations and interuptions:	Deviations: Interuptions:
Corrections applied:	
Test catagory:	
Operator name:	Alyssa Malamatenios
Manager name:	

CPT Formulas

Test Name: CPT-210

Job Number: 260716

Corrected cone resistance:

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

Friction ratio:

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

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:

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

Refined normalised cone resistance:

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

Normalised soil behaviour type index:

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

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):

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

Relative density (D_r):

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

Friction angle (Φ'):

$$\Phi' = 17.60 + 11 \bullet \log(Q_{\text{tn}})$$

Small strain shear modulus (G_0):

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

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 $I_c < 2.2$

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

Youngs modulus (E_s):

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

Estimated SPT N_{60}:

$$N_{60} = \frac{q_t \,/\, p_a}{8.5 \bullet \left(1 - \frac{I_c}{4.6}\right)}$$

Zero Readings

kPa	Initial zeros	Final zeros	Final difference	Clean zeros	Clean difference
Cone resistance	5,814.00	5,838.20	24.15	-	-
Sleeve friction	441.70	440.00	-1.63	-	-
Pore pressure	677.00	678.70	1.7	-	-

B2 T+T 2026 laboratory test reports

9 October 2026
Our Ref: 2025000.0082.02.0/Rep1
Customer Ref: 1101937.1000

Tonkin & Taylor Limited
PO BOX 5271
AUCKLAND 1141

Attention: Matthew Kent

Dear Matthew

100 Halsey Street

Laboratory Test Report

Customer's Instructions

The detailed testing instructions were provided by the customer.

Sampling Procedure

Samples have been tested as received.

Sample Location Plan

Not applicable.

Samples

We received three push tube samples labelled with the location ID and sample depth.

Date(s) of Sample Receipt

10 September 2026

Test Method(s)

NZS 4402: 1986 Test 2.1 - Water Content

NZS 4402: 1986 Test 7.1 - Determination of the One-dimensional Consolidation Properties

Material Description

Descriptions are provided in the attached presentation pages.

Test Results

Test results are attached.

Test Remarks

Test remarks are detailed on the presentation page.

General Remarks

Samples not destroyed during testing, will be retained for one month from the date of this report before being discarded.

Descriptions are enclosed for your information but are not covered under the IANZ endorsement of this report.

This report has been prepared for the benefit of Tonkin & Taylor Limited, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report approved by:



.....
Helen Wang
Triaxial Laboratory Manager
Key Technical Person

Authorised for Geotechnics by:



.....
Steven Anderson
Project Director

ACCREDITED IANZ TESTING LABORATORY

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

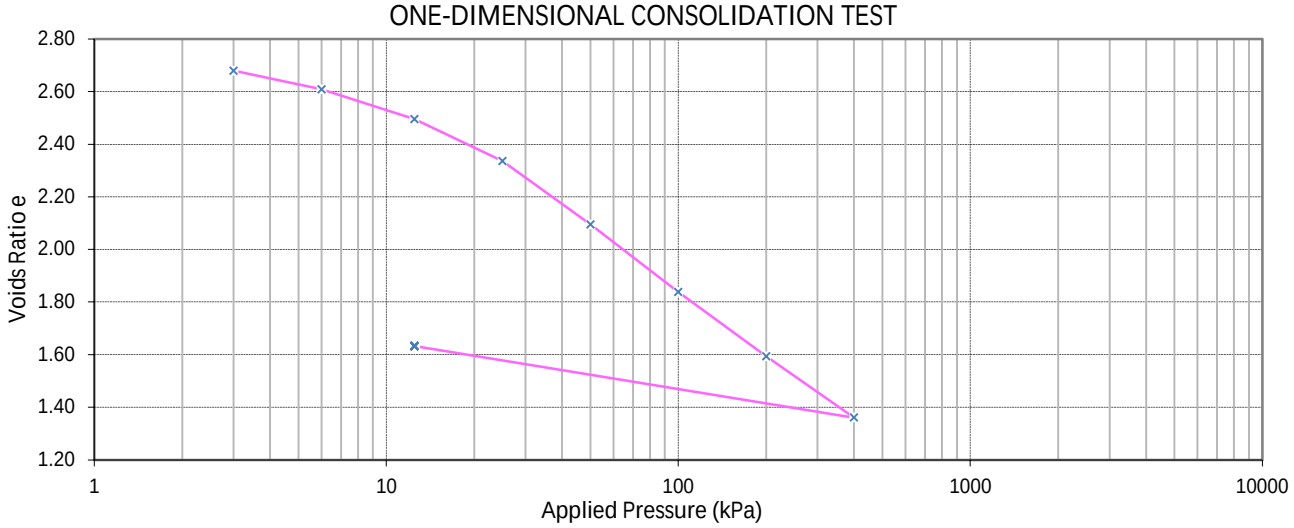
9-Oct-26
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Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Testing Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST



Sample Parameters

Initial Sample Height:	19.96	mm	Initial Water Content:	101	%
Initial Sample Diameter:	50.05	mm	Initial Saturation Degree:	95	%
Initial Bulk Density:	1.38	t/m³	Solid Density (assumed):	2.55	t/m³
Initial Dry Density:	0.68	t/m³	Temperature During Testing:	19.5 to 20.5	°C

One-Dimensional Consolidation Results

Test Status	Applied Pressure (kPa)	Void Ratio e	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m^2/yr)		Coefficient of Volume Compressibility Mv (m²/MN)
				Logarithm Time	Square-root Time	
As received	0	2.729				
Loading & Unloading	3	2.679	0 to 3	0.60	0.52	4.4
	6	2.609	3 to 6	0.94	0.71	6.4
	12.5	2.496	6 to 12.5	0.25	0.48	4.8
	25	2.336	12.5 to 25	0.28	0.33	3.7
	50	2.095	25 to 50	0.32	0.28	2.9
	100	1.839	50 to 100	0.33	0.32	1.7
	200	1.593	100 to 200	0.37	0.37	0.87
	400	1.360	200 to 400	0.40	0.42	0.45
	12.5	1.633	400 to 12.5	NA	NA	NA

Sample History: Undisturbed core trimmed at natural water content.

Soil Description: Clayey SILT, with a trace of sand and organics; grey, speckled black. Very soft, moist.

Test Remarks: Test results have been corrected for equipment deformation. The coefficients of consolidation Cv for each load stage have been derived by using a logarithm time method and a square-root time method. The calculations of void ratio are affected by the solid density value, which was assumed to be 2.55 t/m³ for the test. The Void Ratio e and the Coefficient of Volume Compressibility Mv derived for the first load stage may not be representative as the initial contact between the specimen and testing device may not be perfect, though a 1 kPa seating pressure was applied to the specimen before test commenced.

Tested by: PIHE Date: 7/10/2026 Approved by KTP: Date: 9/10/2026

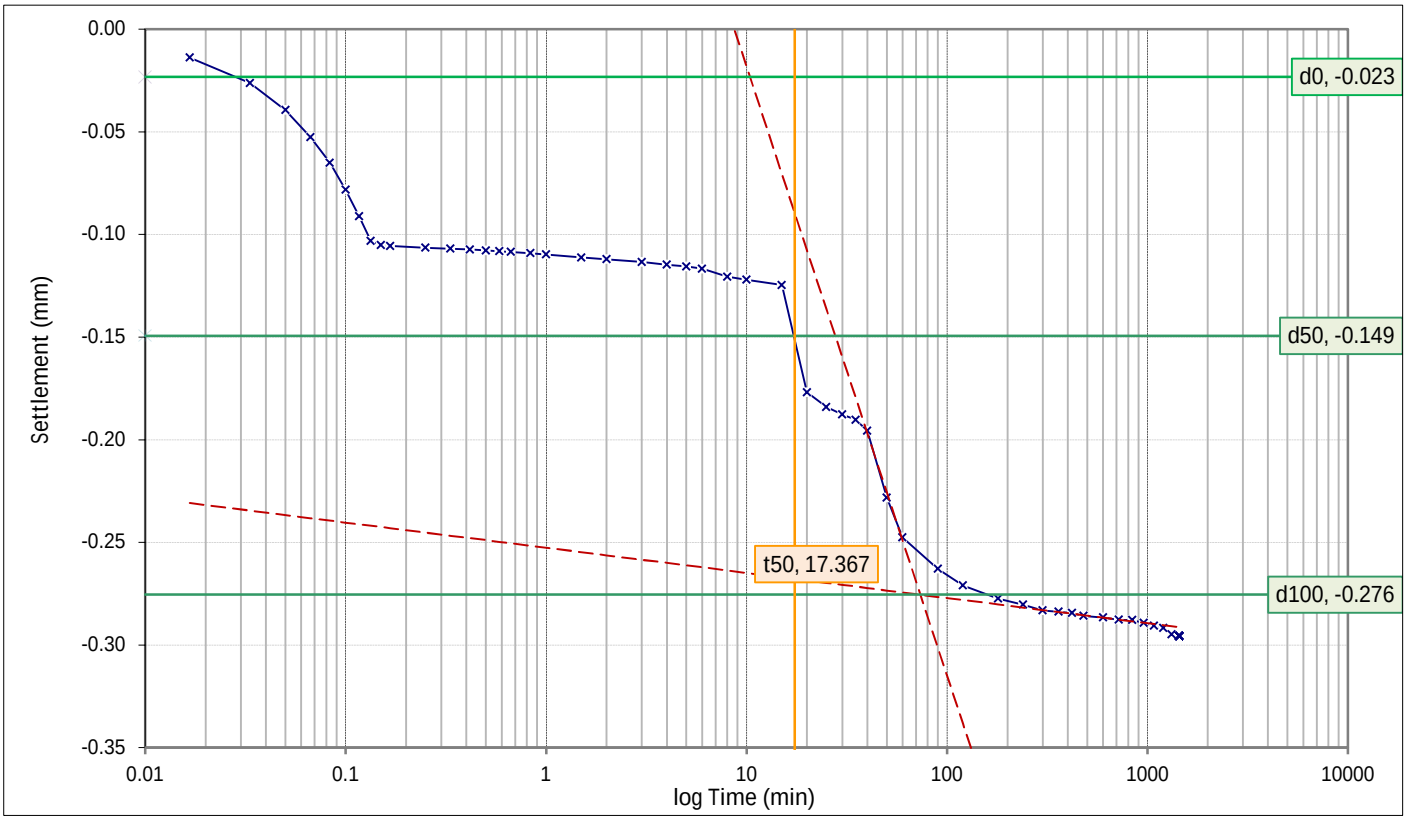
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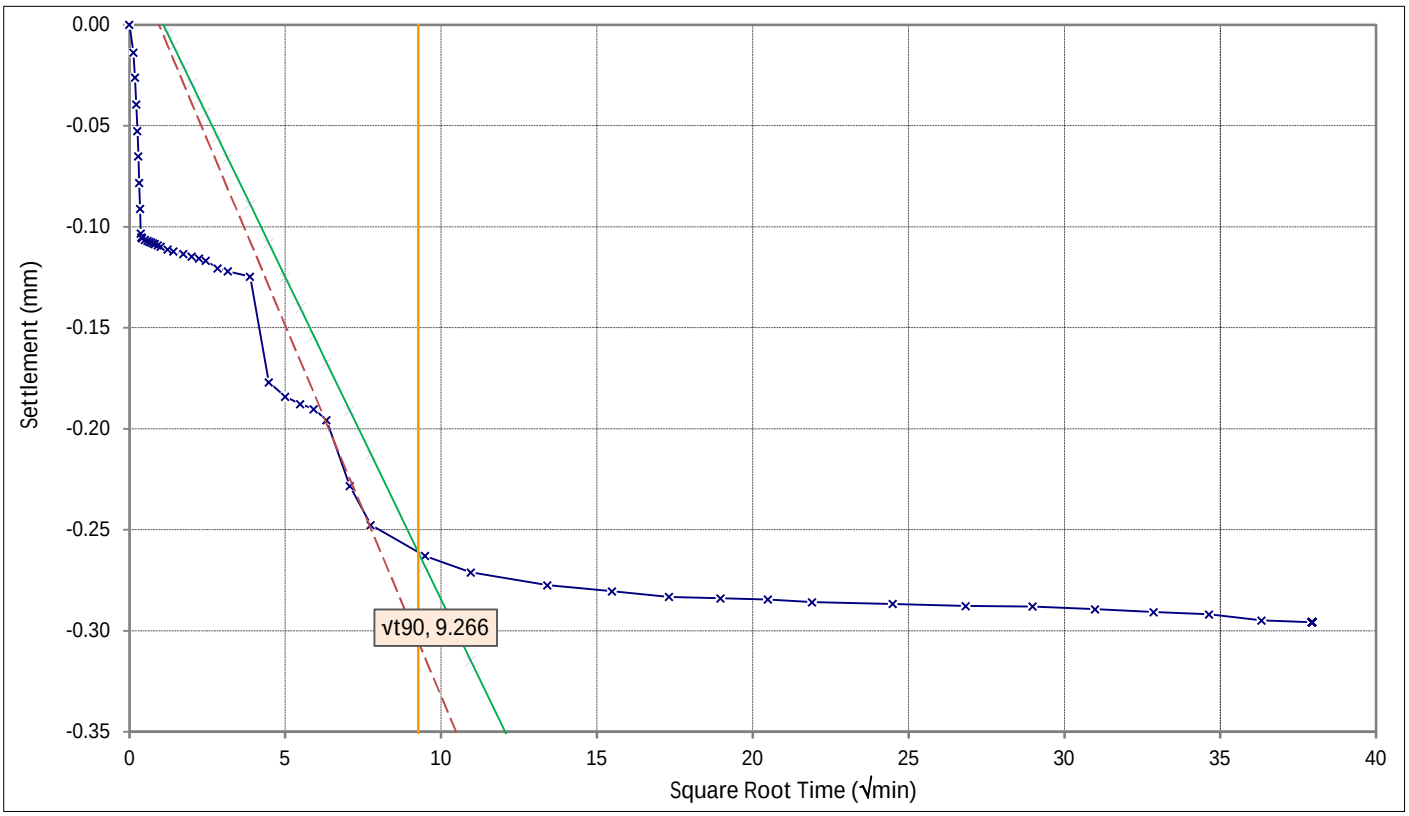
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 3 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

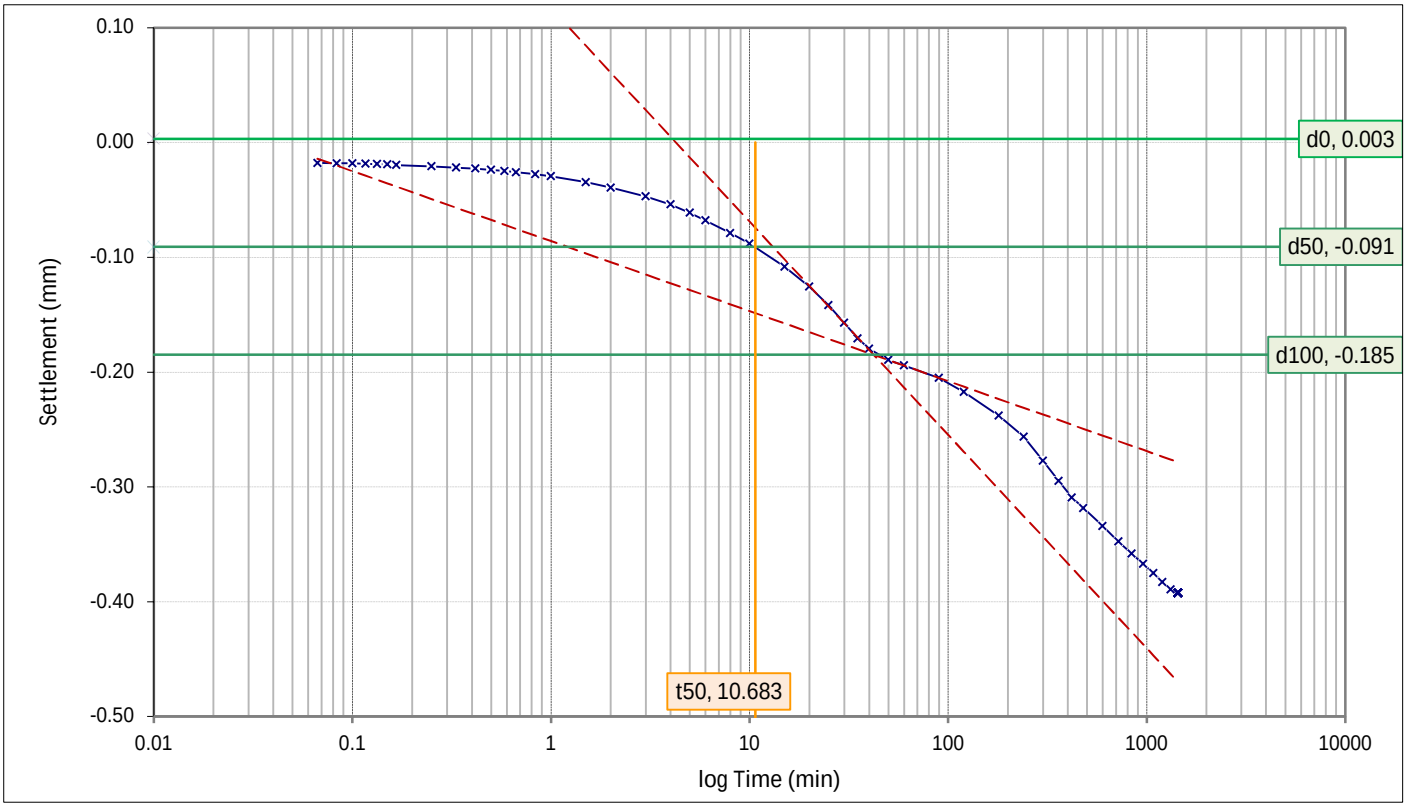
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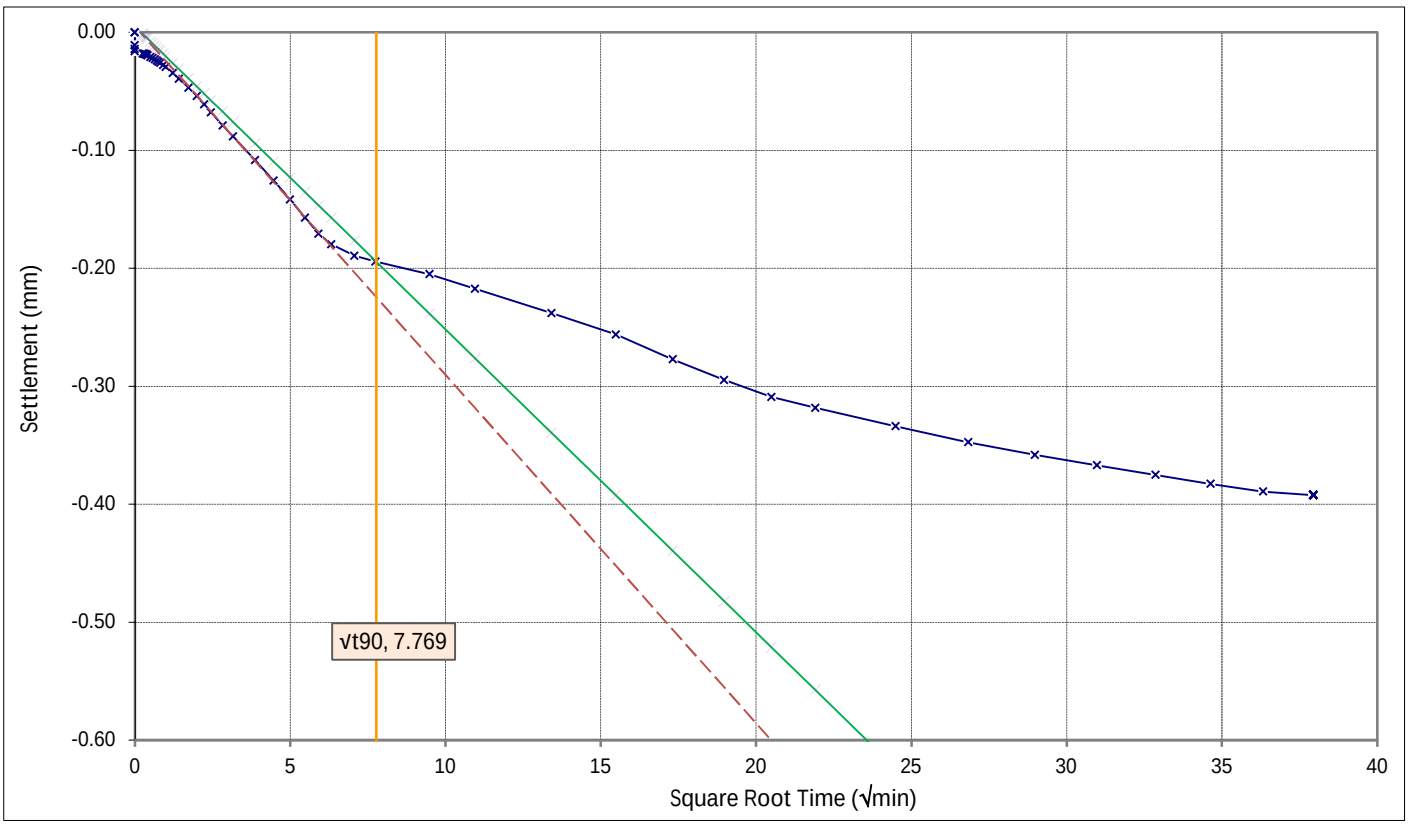
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 6 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

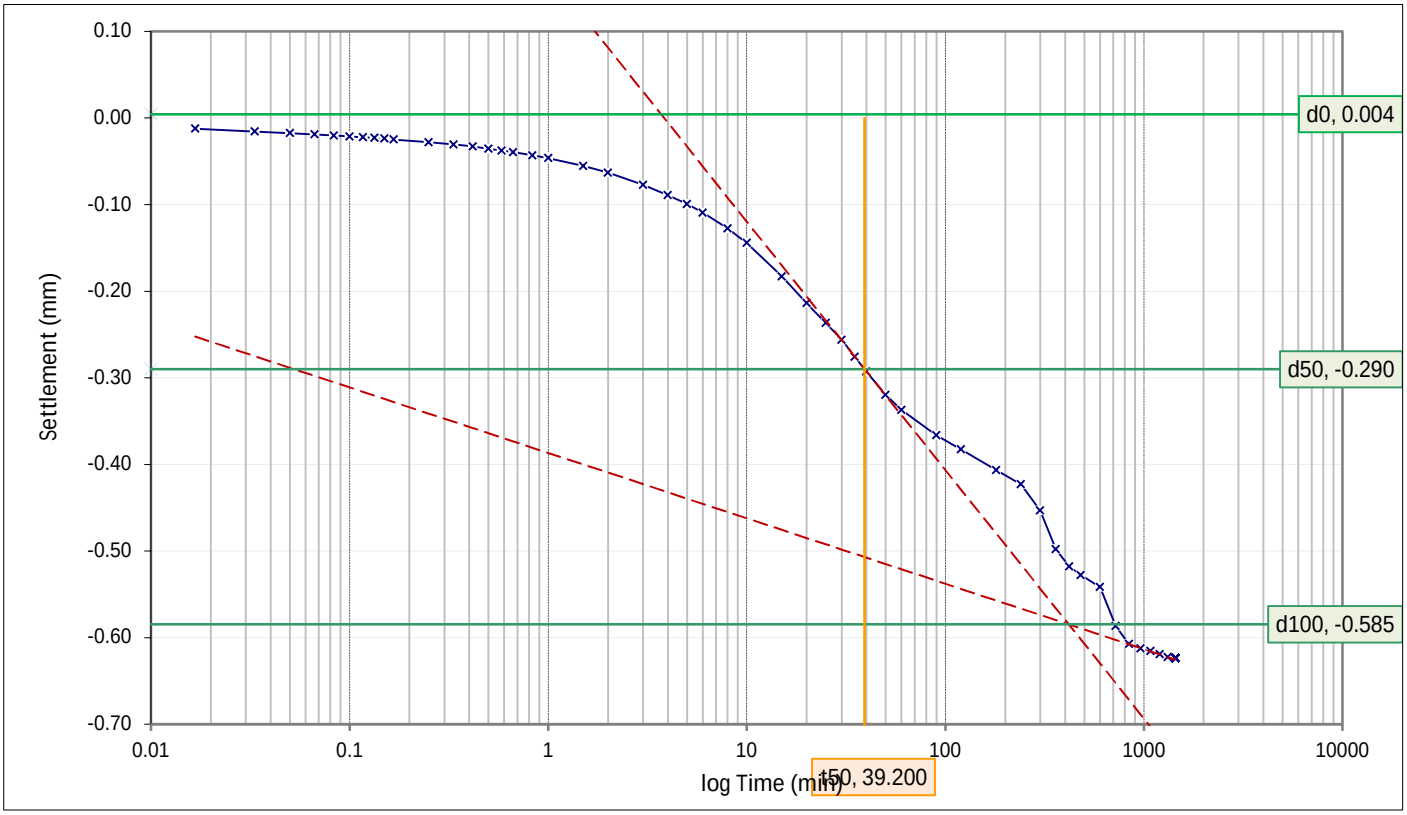
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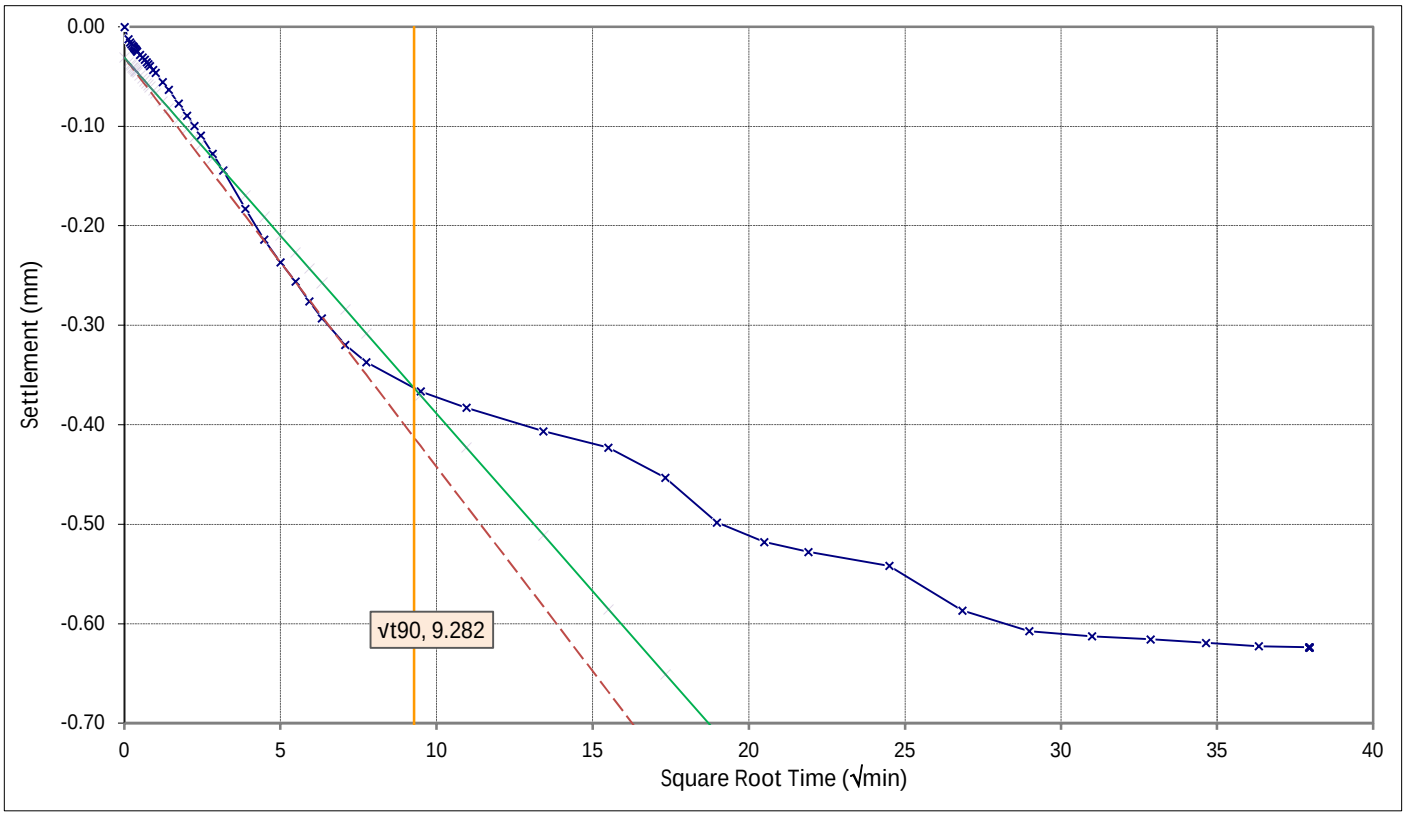
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 12.5 (kPa)





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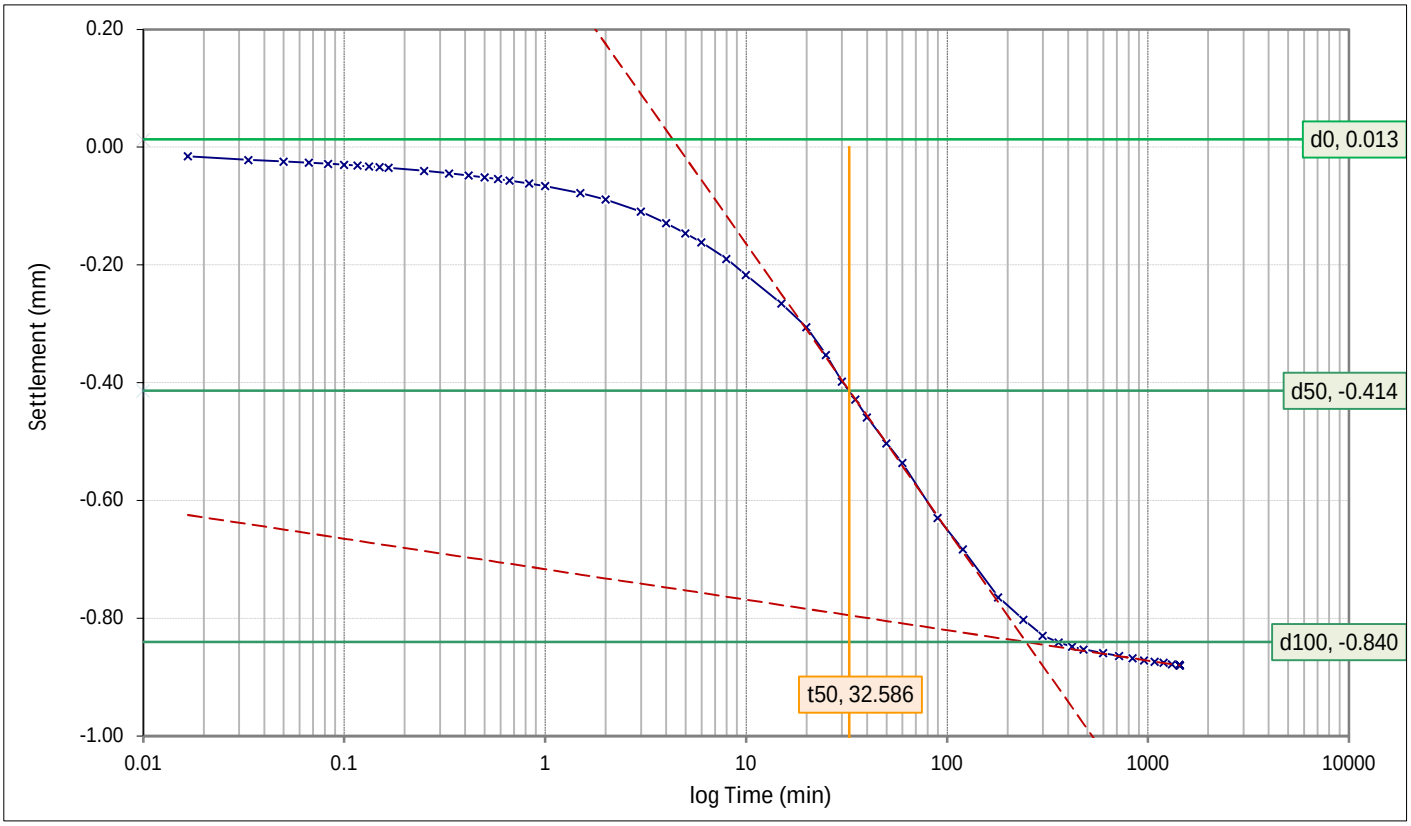
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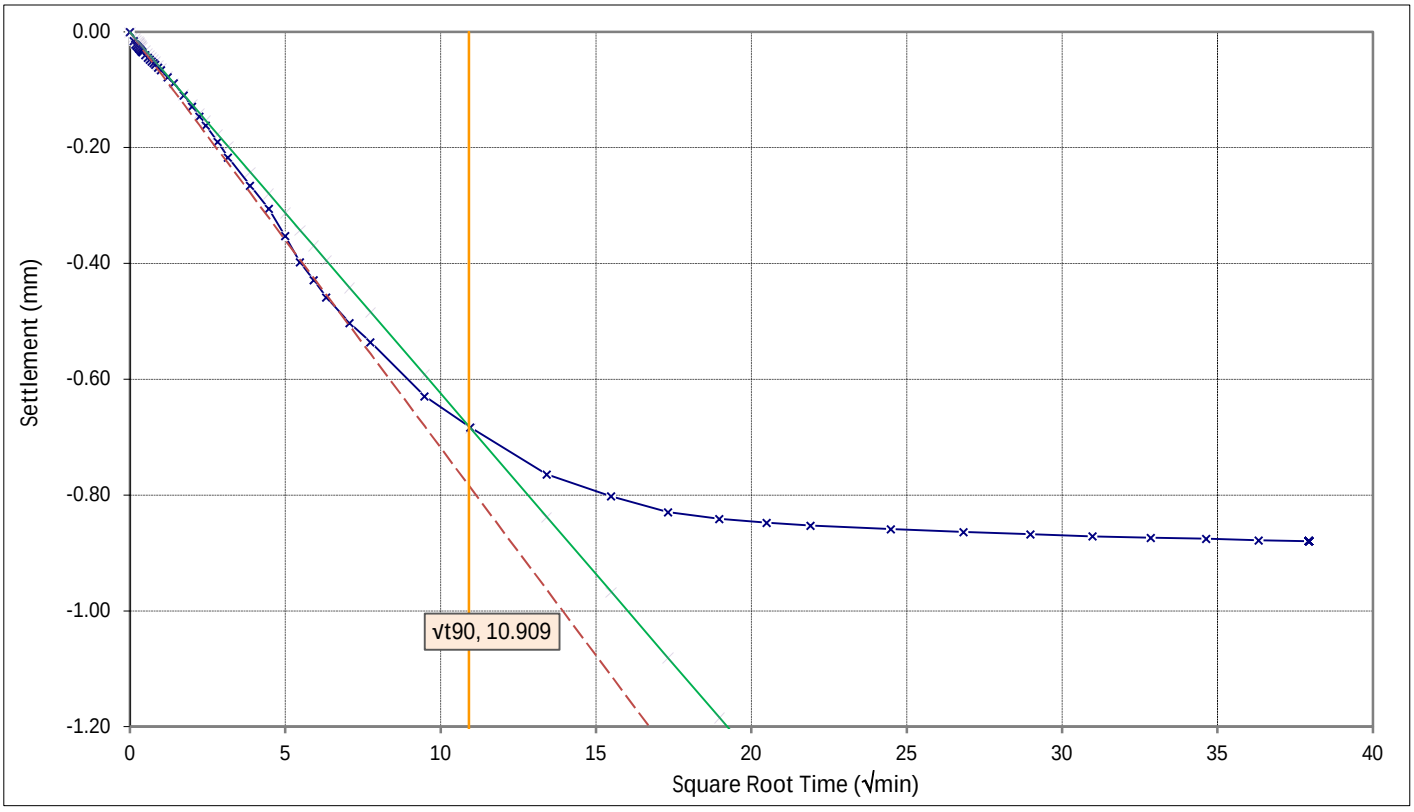
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 25 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

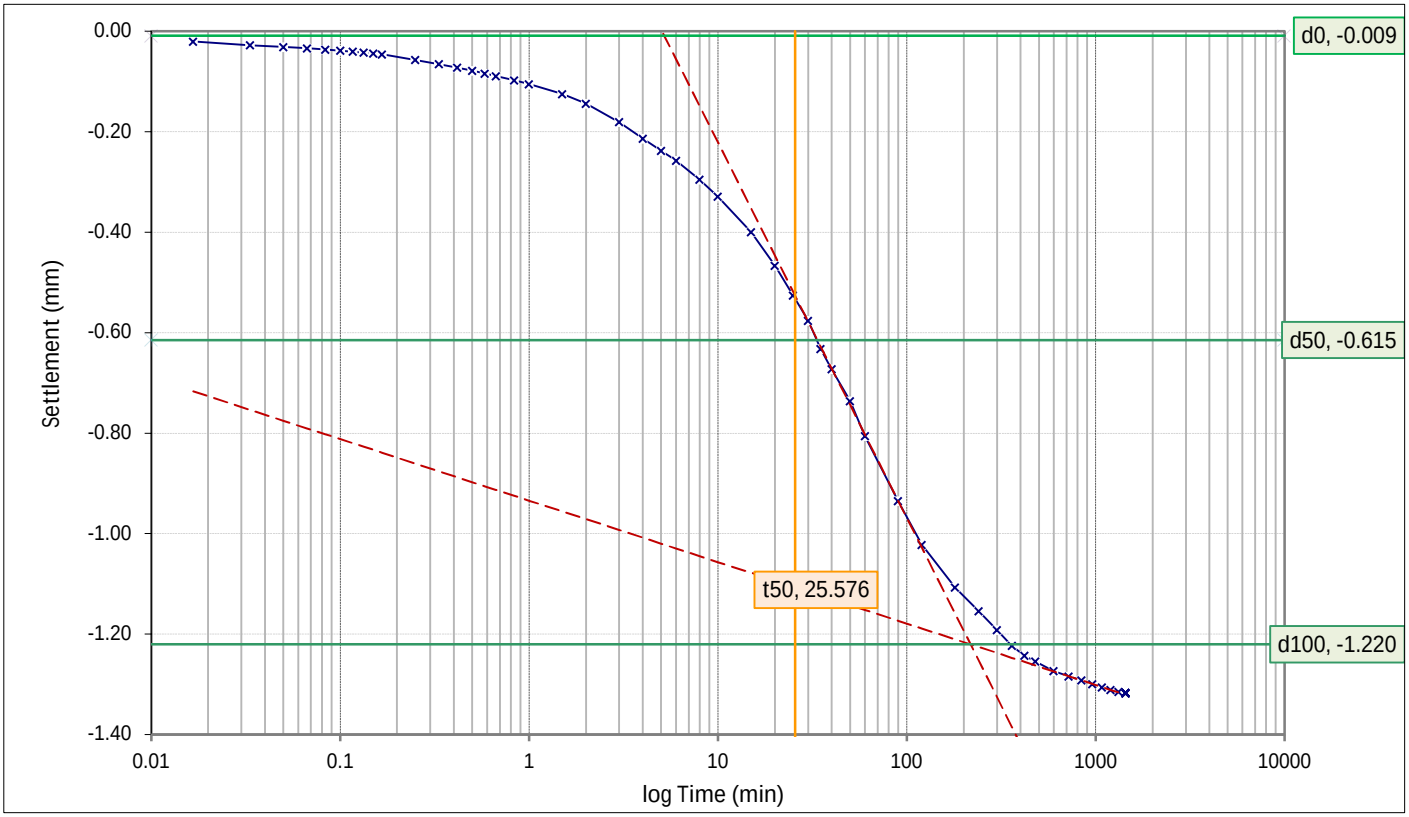
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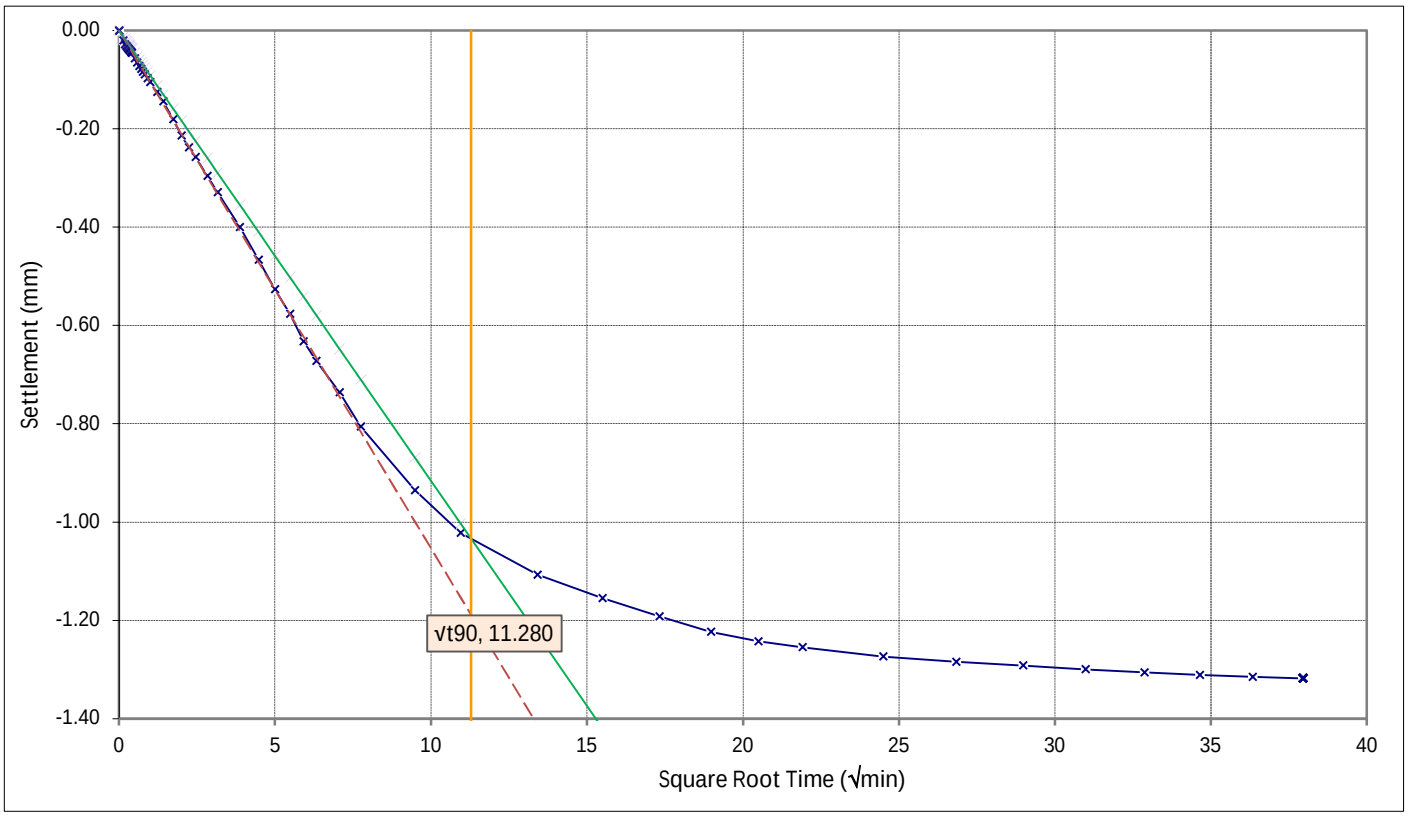
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 50 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

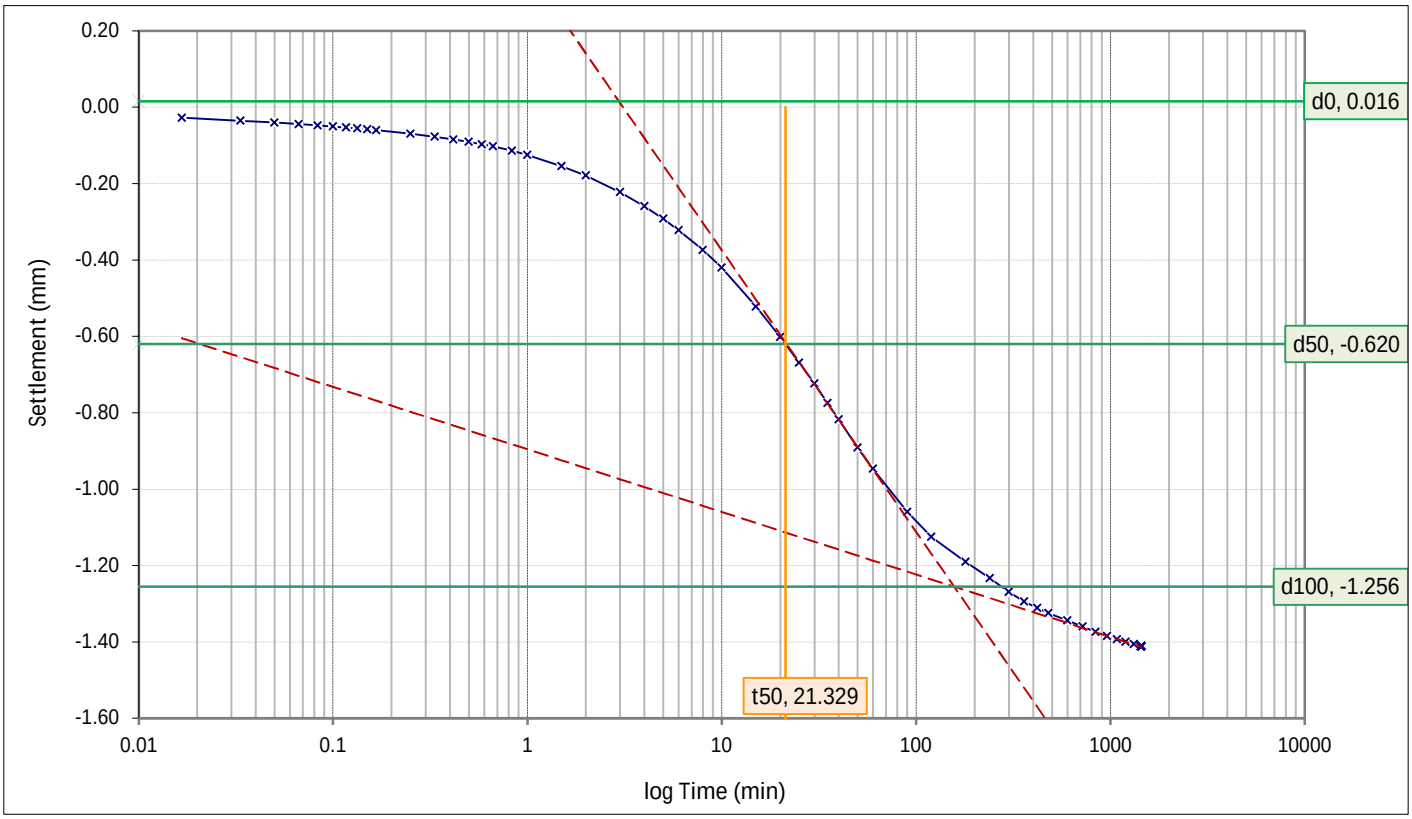
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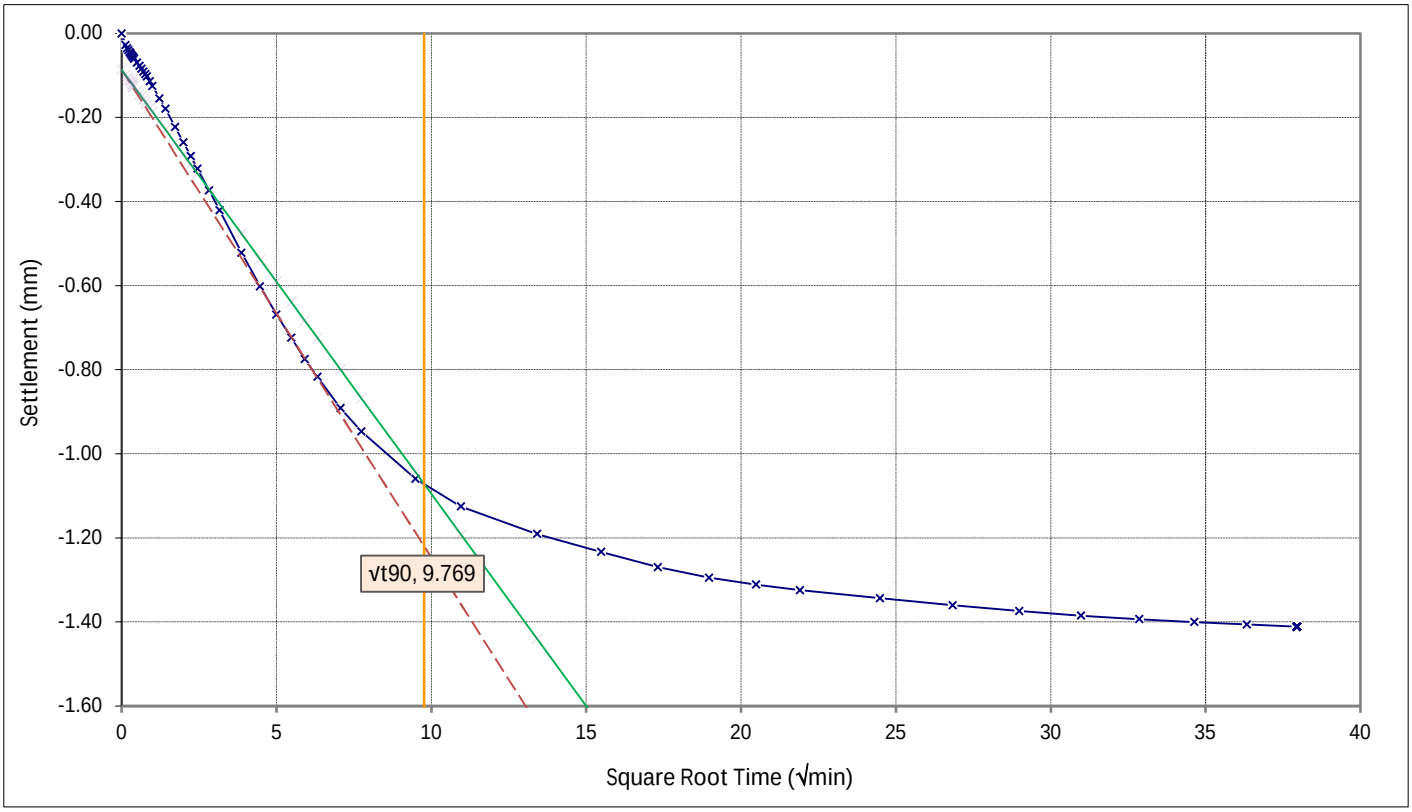
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 100 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

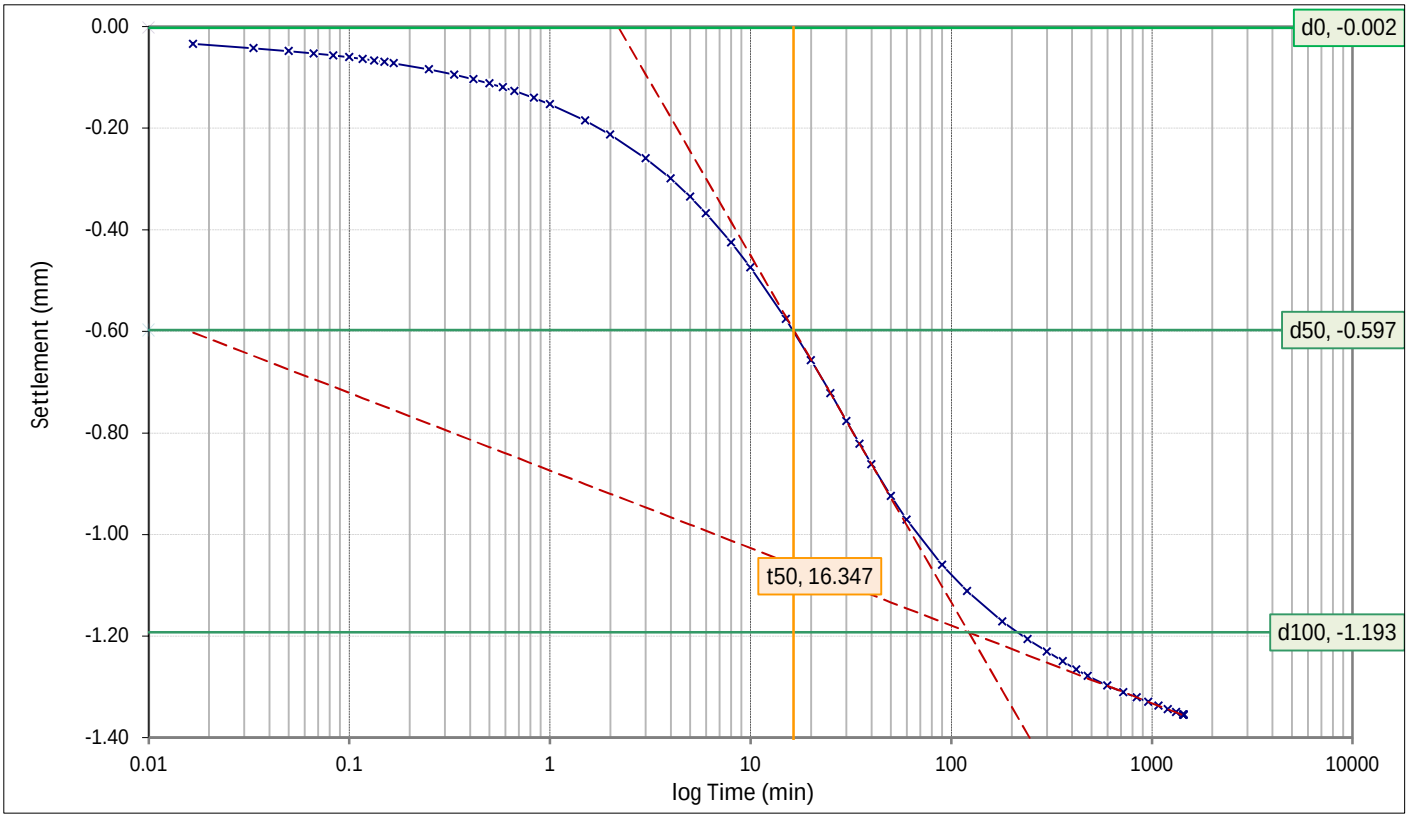
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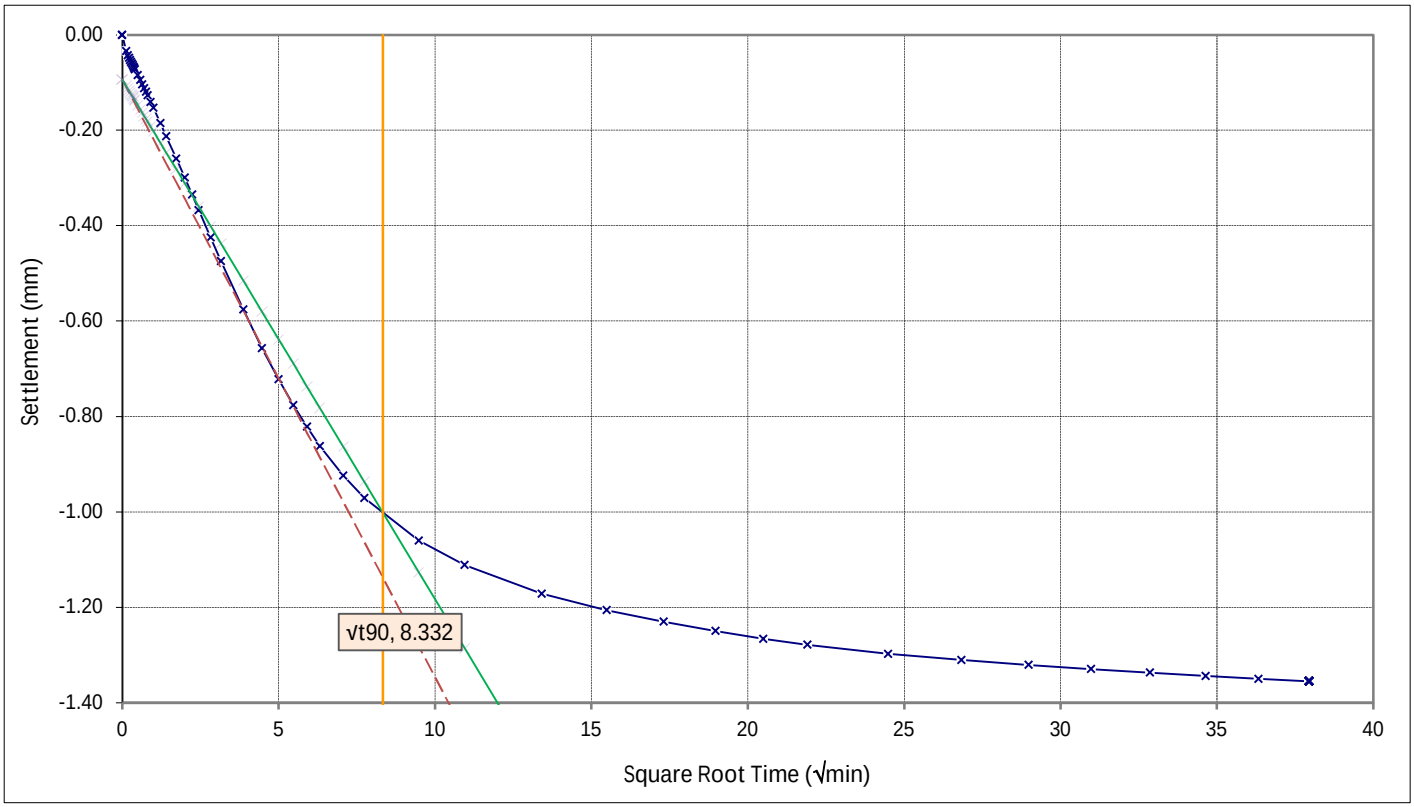
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 200 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

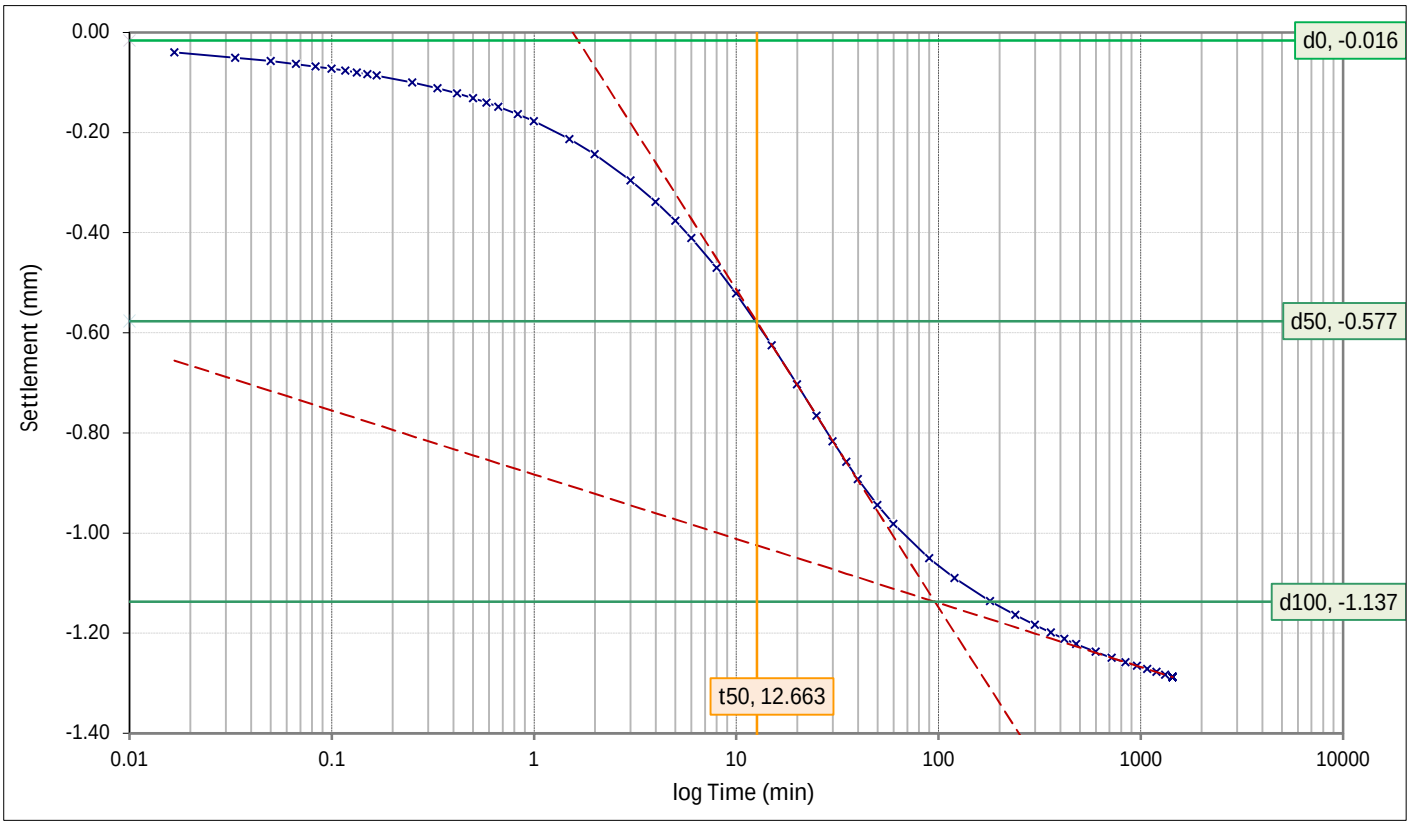
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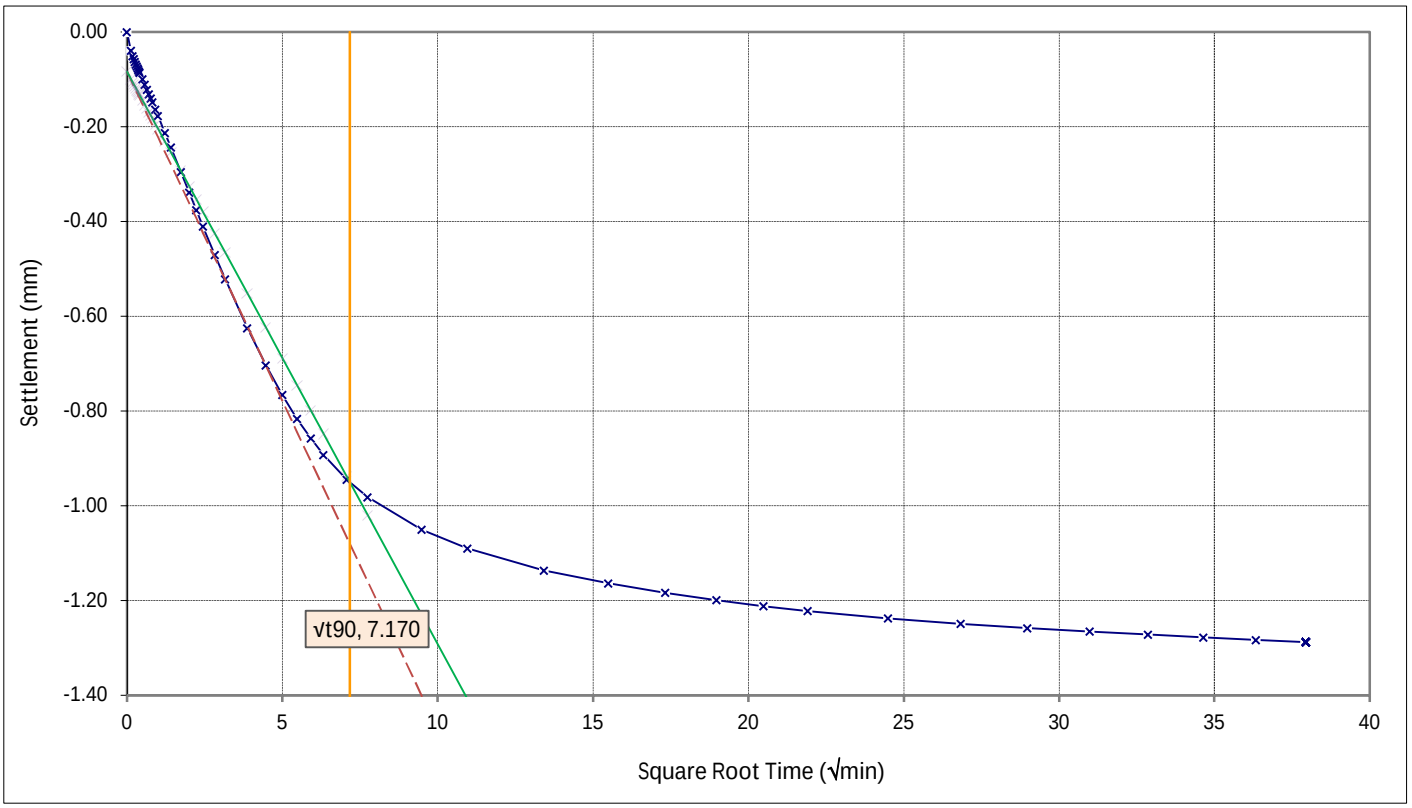
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 400 (kPa)





Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

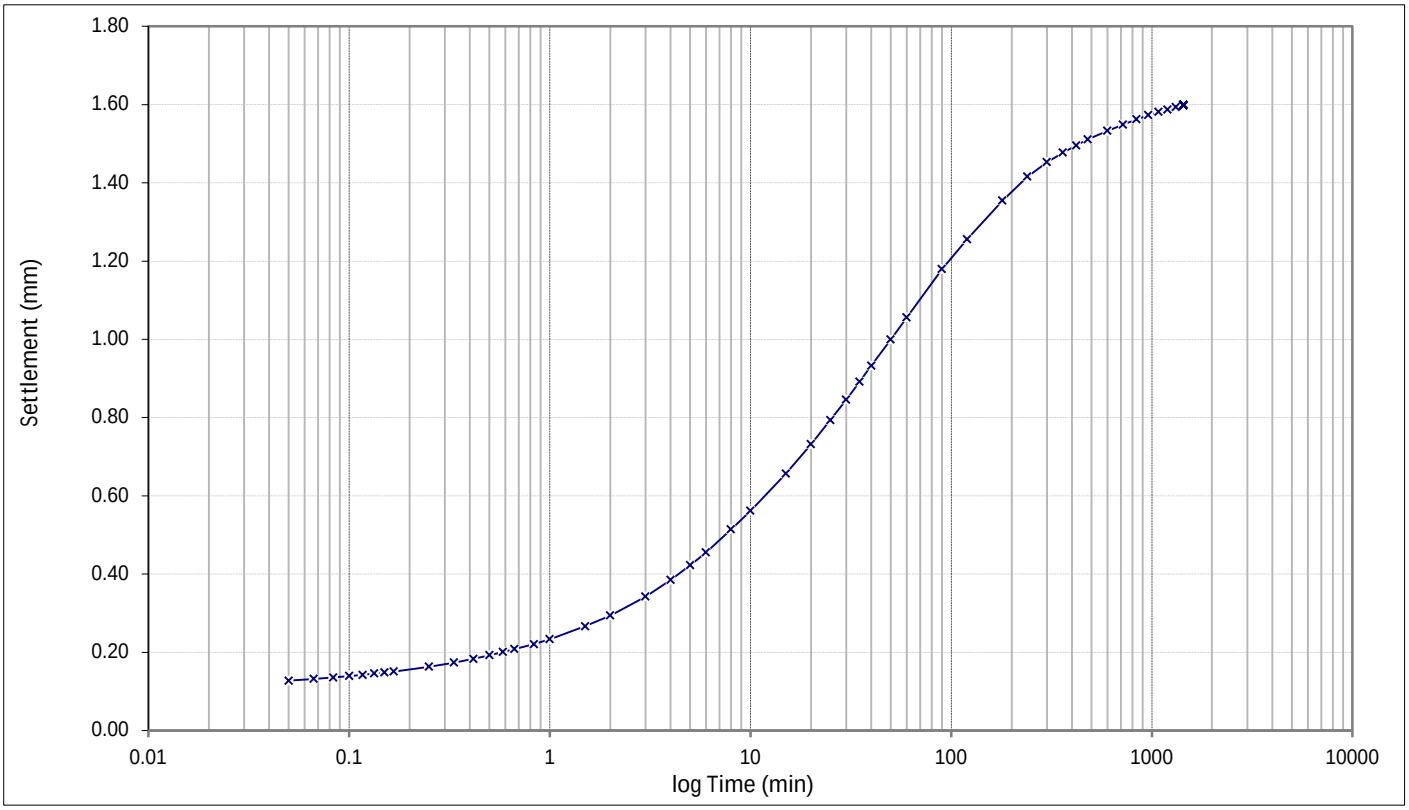
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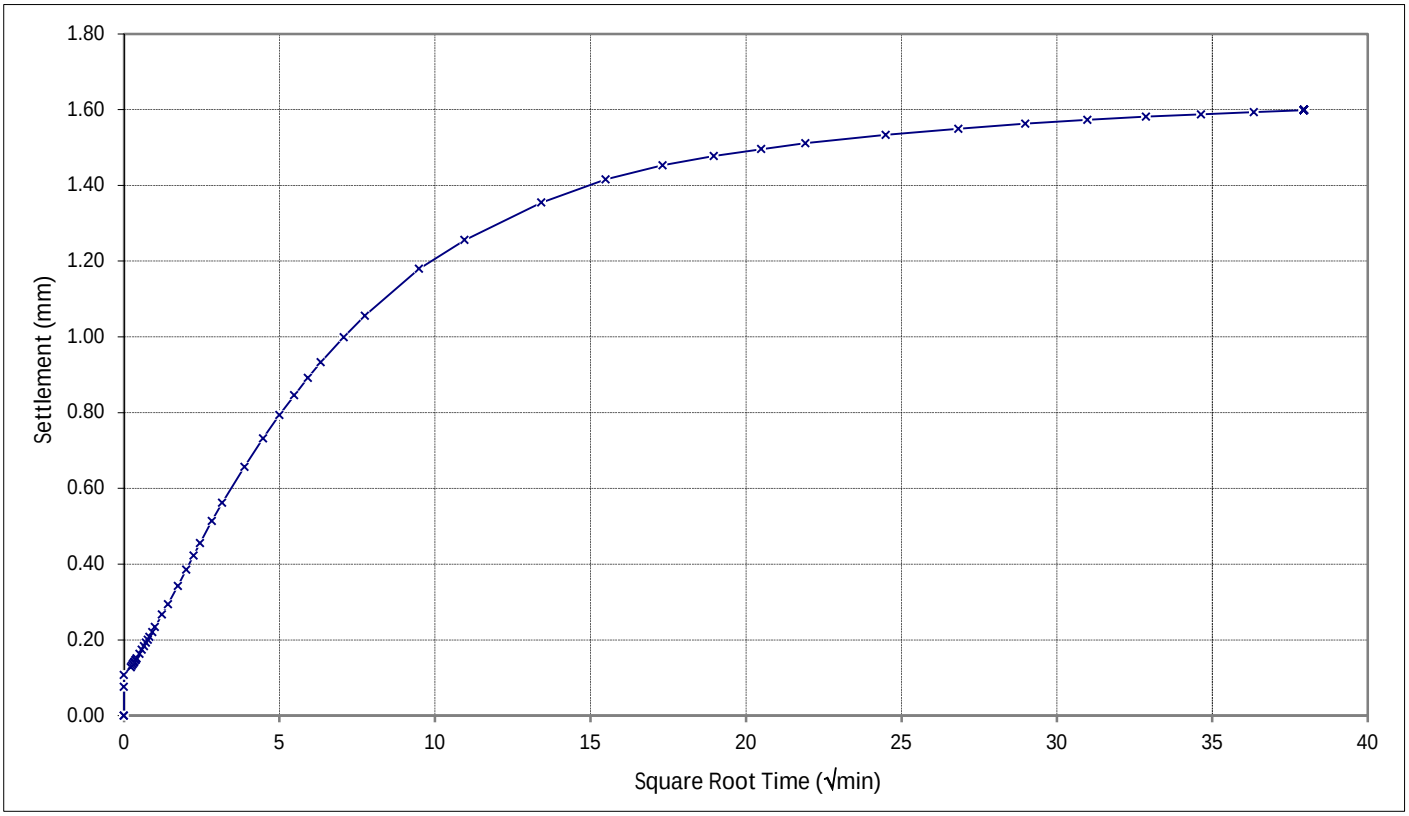
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH201
Sample Ref.: -- Geotechnics ID: -- Depth: 4.64 - 4.66 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 12.5 (kPa)





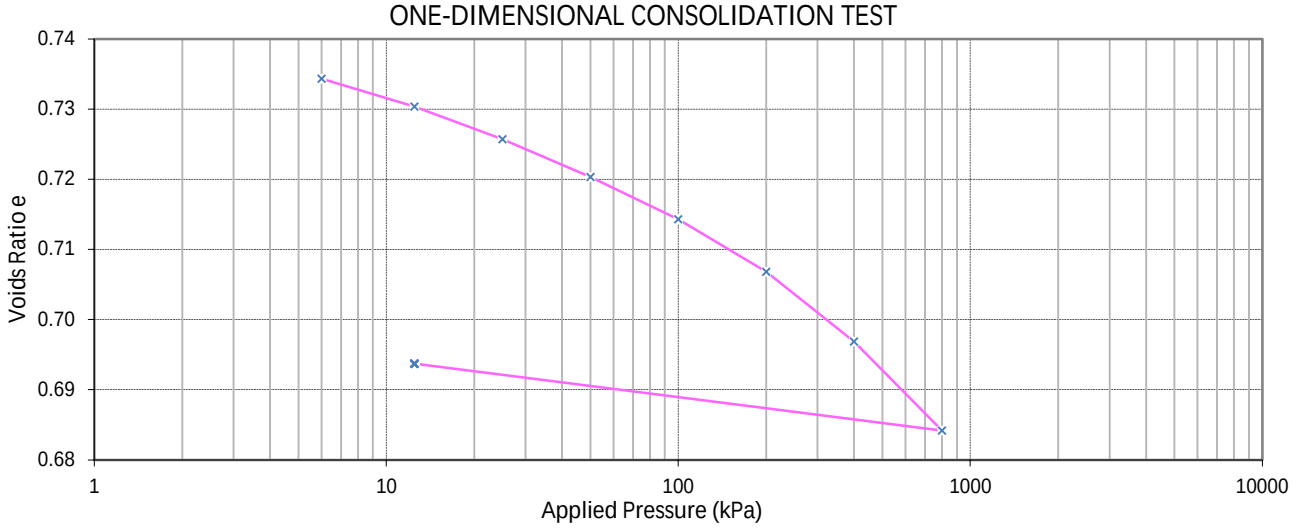
Tested by: PIHE Date: 7/10/2026 Approved by KTP: YHW Date: 9/10/2026

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Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Testing Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST



Sample Parameters

Initial Sample Height:	19.96	mm	Initial Water Content:	27.5	%
Initial Sample Diameter:	49.99	mm	Initial Saturation Degree:	98	%
Initial Bulk Density:	1.94	t/m³	Solid Density (assumed):	2.65	t/m³
Initial Dry Density:	1.52	t/m³	Temperature During Testing:	19.0 to 20.0	°C

One-Dimensional Consolidation Results

Test Status	Applied Pressure (kPa)	Void Ratio e	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m^2/yr)		Coefficient of Volume Compressibility Mv (m²/MN)
				Logarithm Time	Square-root Time	
As received	0	0.743				
Loading & Unloading	6	0.734	0 to 6	NA	39	0.82
	12.5	0.730	6 to 12.5	NA	213	0.35
	25	0.726	12.5 to 25	NA	205	0.22
	50	0.720	25 to 50	NA	196	0.12
	100	0.714	50 to 100	NA	166	0.070
	200	0.707	100 to 200	NA	164	0.044
	400	0.697	200 to 400	NA	145	0.029
	800	0.684	400 to 800	NA	142	0.019
	12.5	0.694	800 to 12.5	NA	NA	NA

Sample History: Undisturbed core trimmed at natural water content.

Soil Description: SAND with some silt and a traces of shells; dark grey. Loosely packed, wet.

Test Remarks: Test results have been corrected for equipment deformation. The coefficient of consolidation Cv for each load stage has been derived by using a square-root time method. The calculations of void ratio are affected by the solid density value, which was assumed to be 2.65 t/m³ for the test. The Void Ratio e and the Coefficient of Volume Compressibility Mv derived for the first load stage may not be representative as the initial contact between the specimen and testing device may not be perfect, though a 1 kPa seating pressure was applied to the specimen before test commenced.

Tested by: PIHE Date: 23/09/2026 Approved by KTP: Date: 30/09/2026

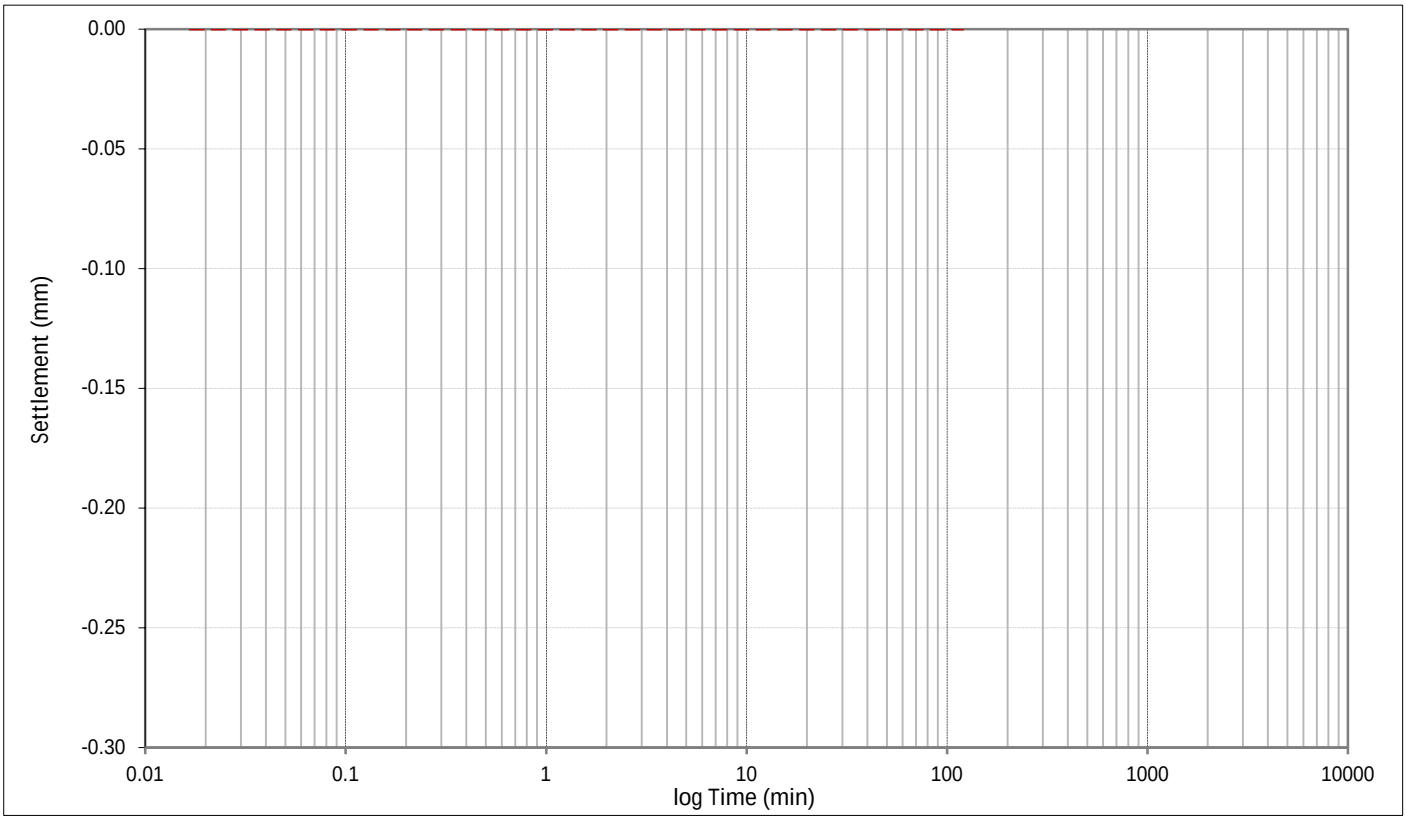
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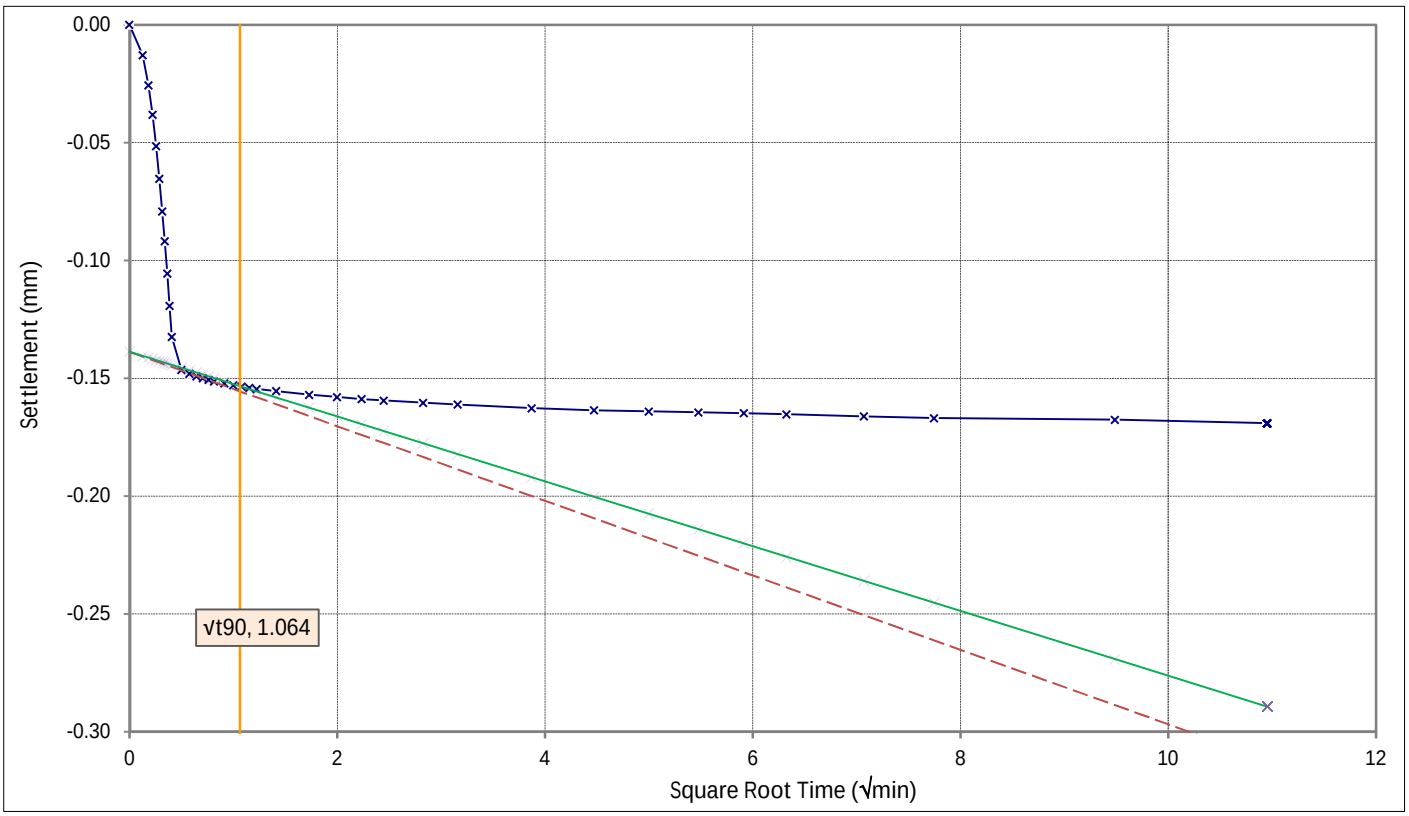
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 6 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

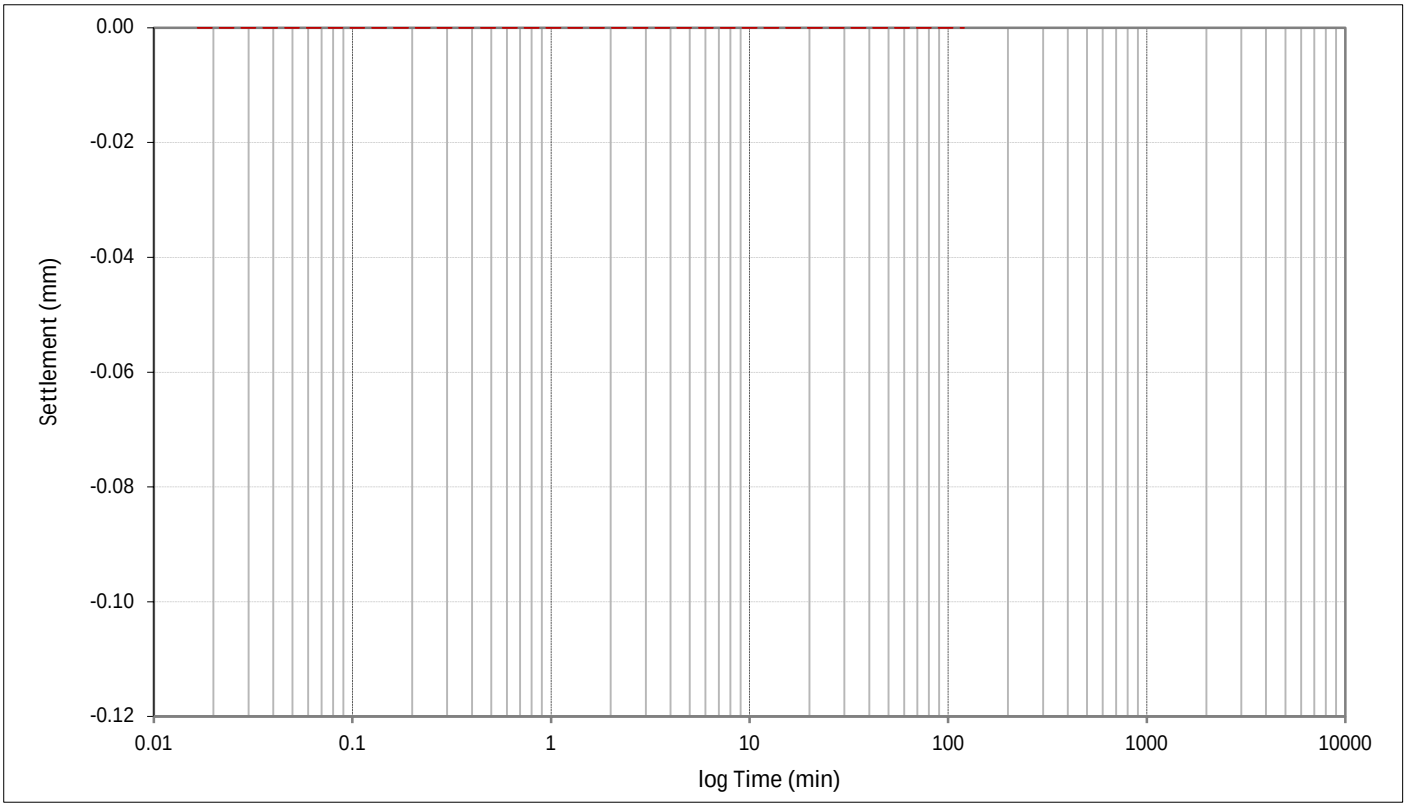
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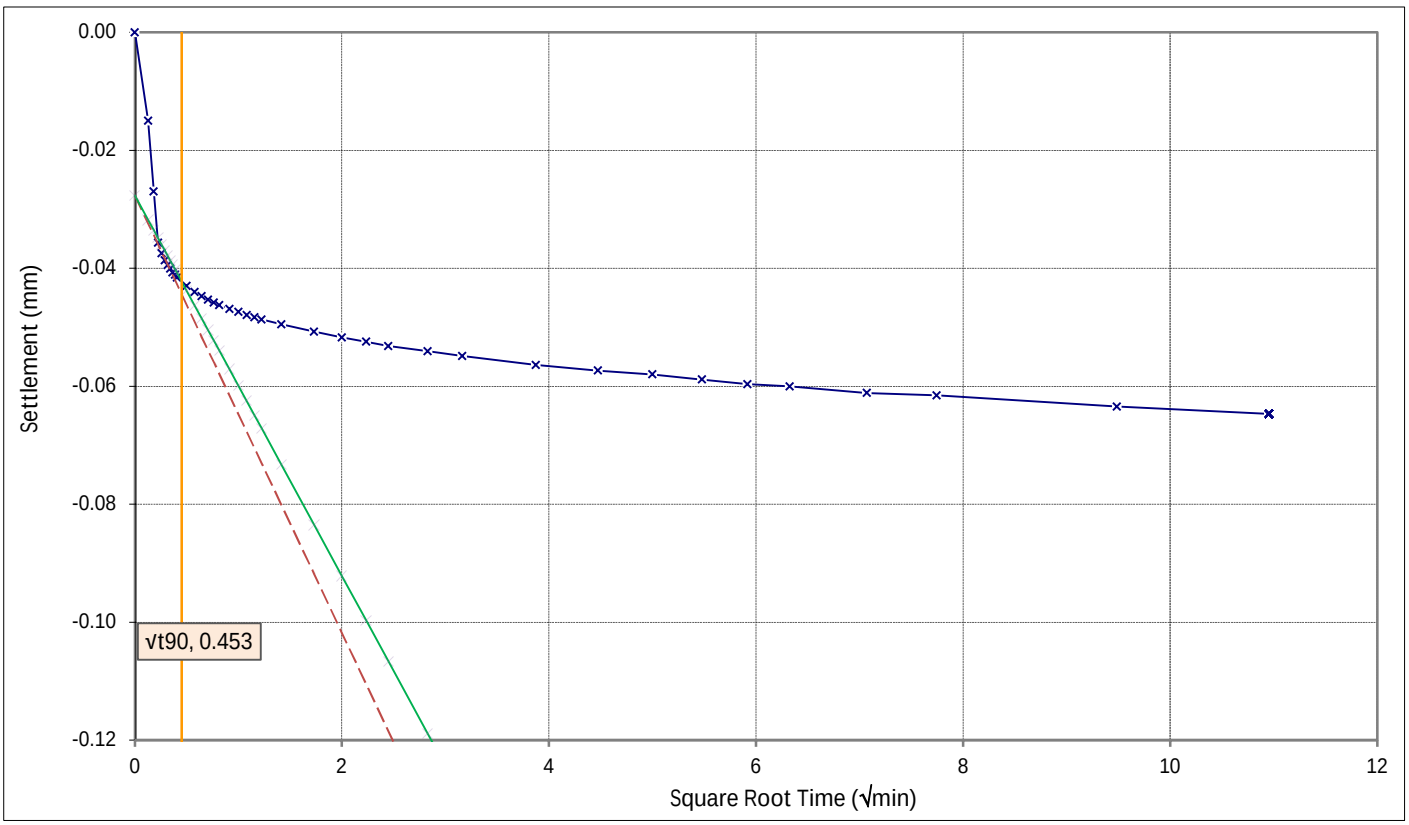
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Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 12.5 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

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1 Hill Street
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New Zealand
p. +64 9 356 3510

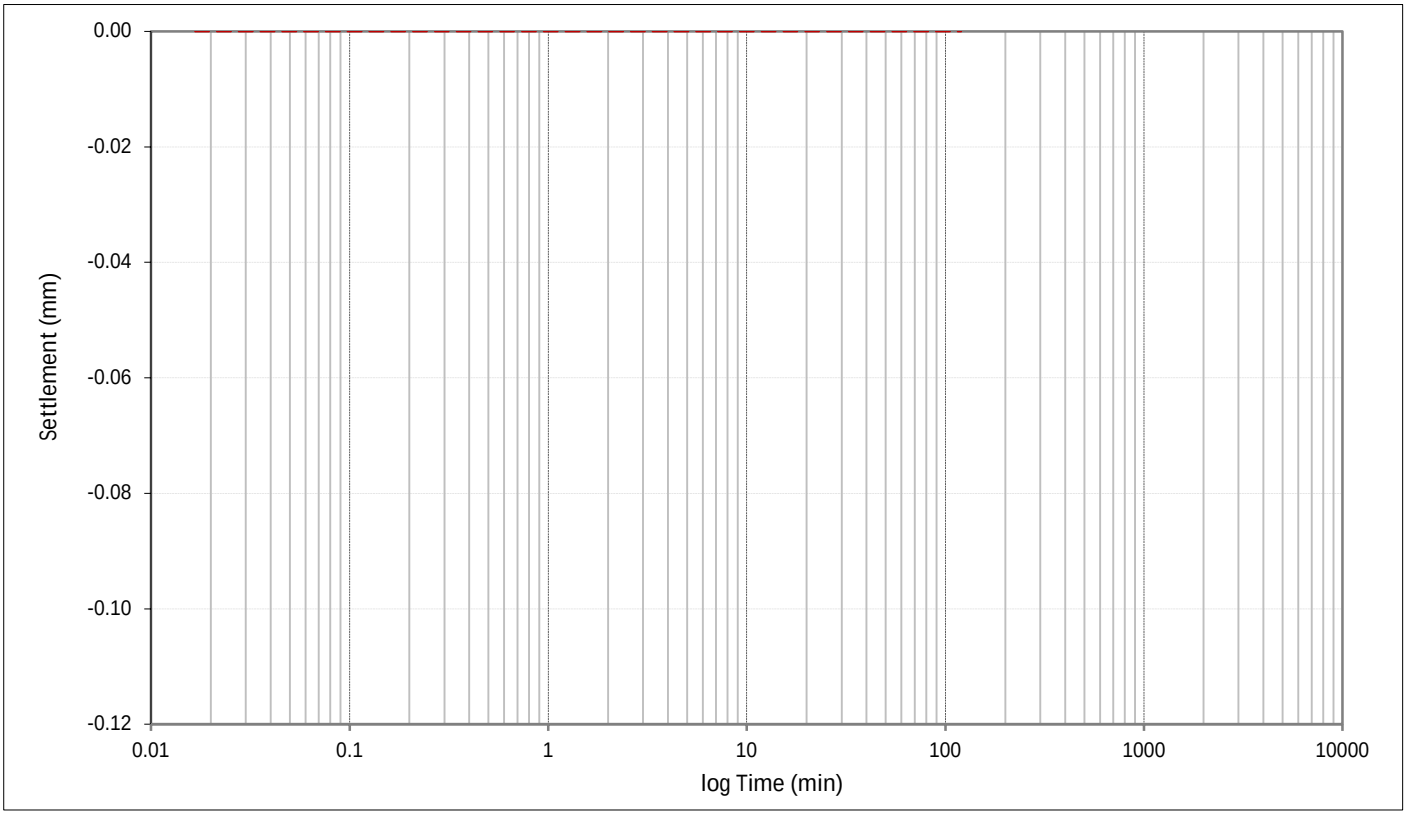
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

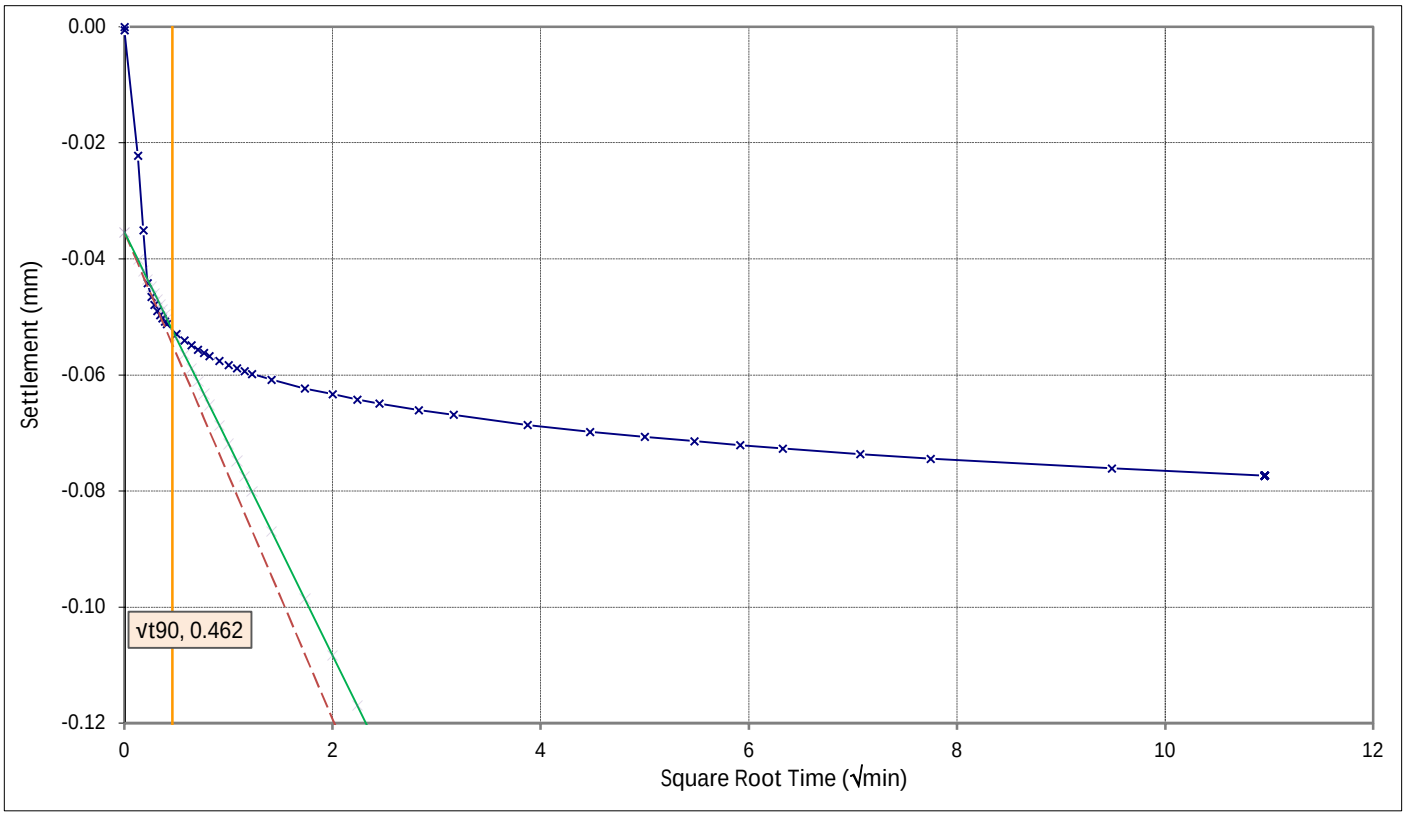
Site/Location: 100 Halsey Street
Location ID: BH202
Sample Ref.: --
Geotechnics ID: --
Depth: 6.08 - 6.10 (m)

Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 25 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

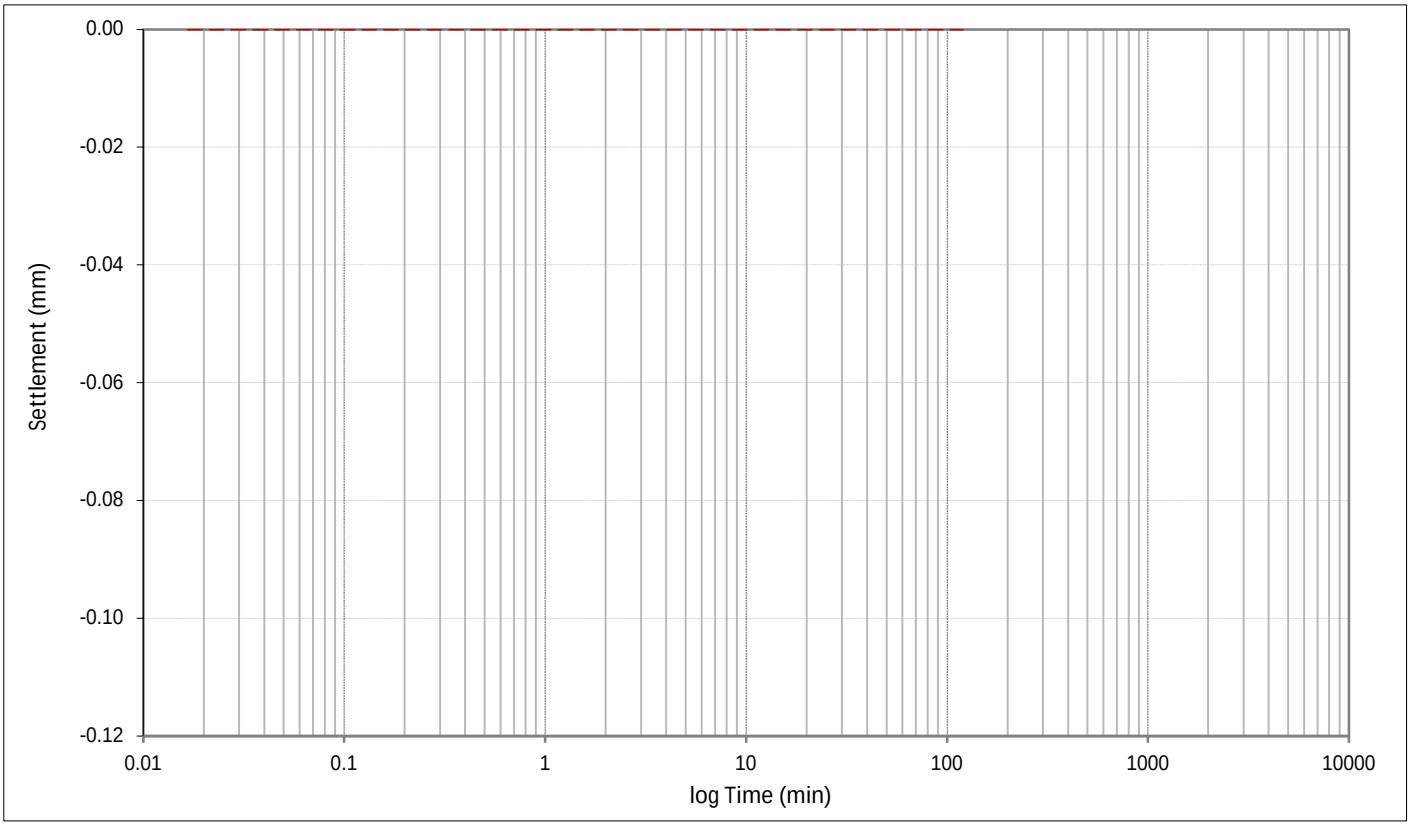
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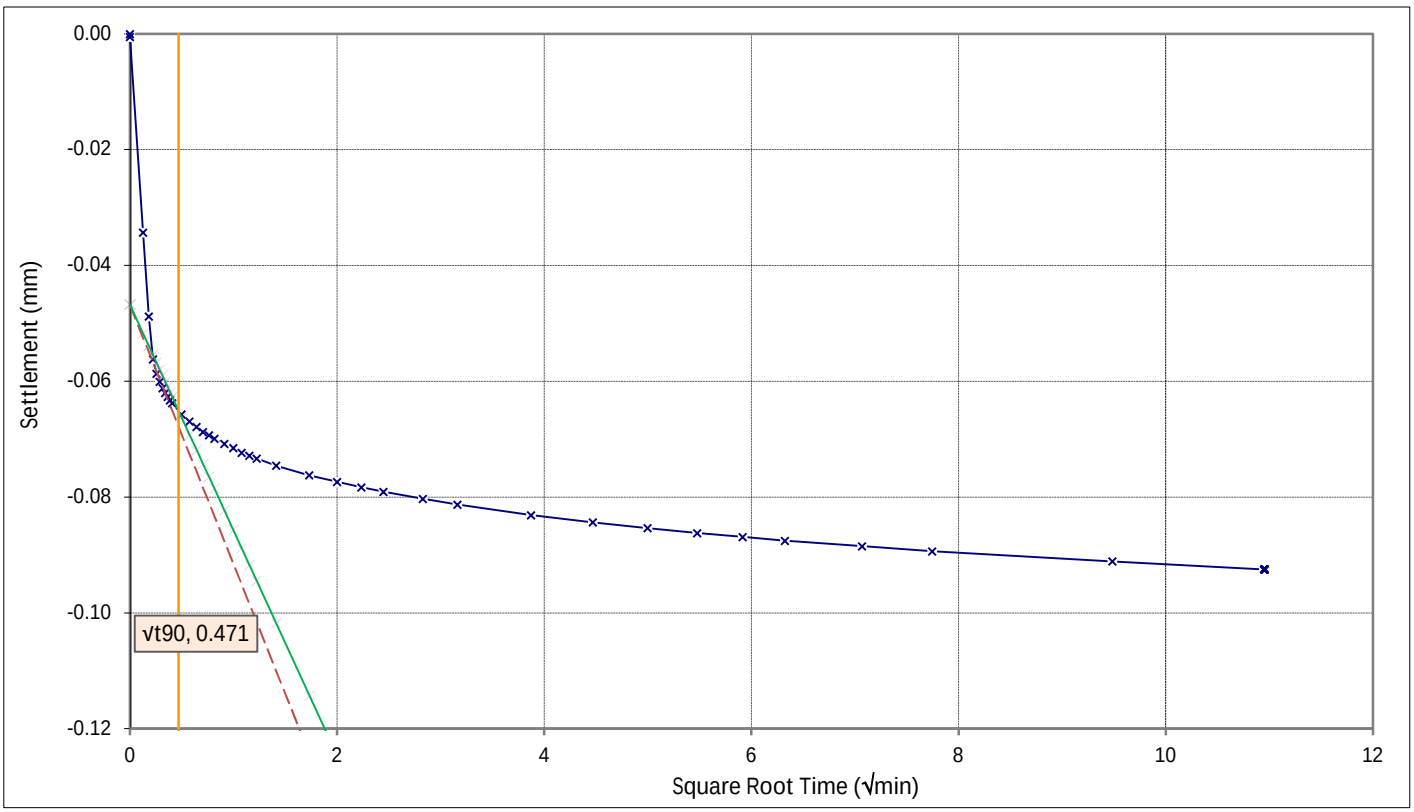
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 50 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

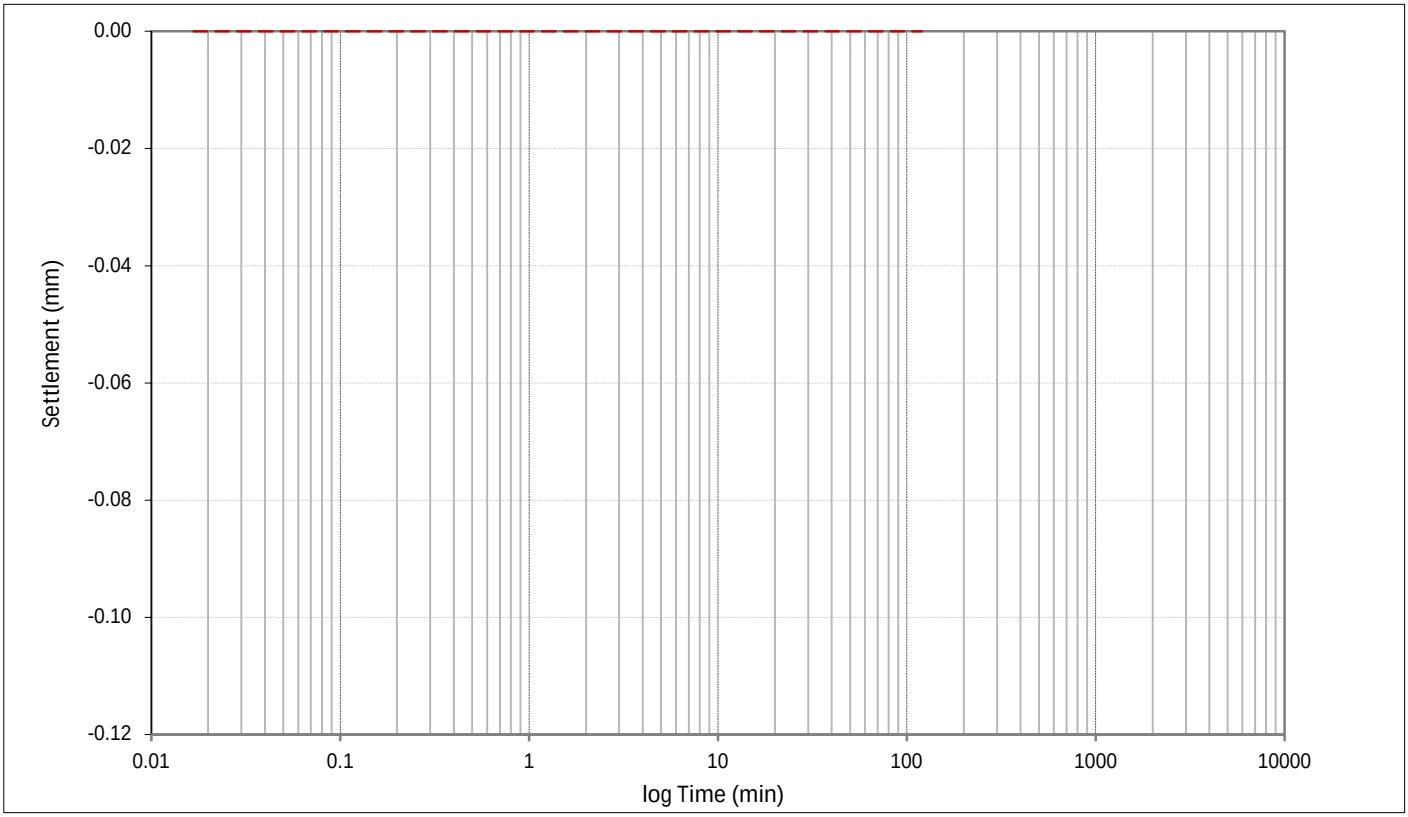
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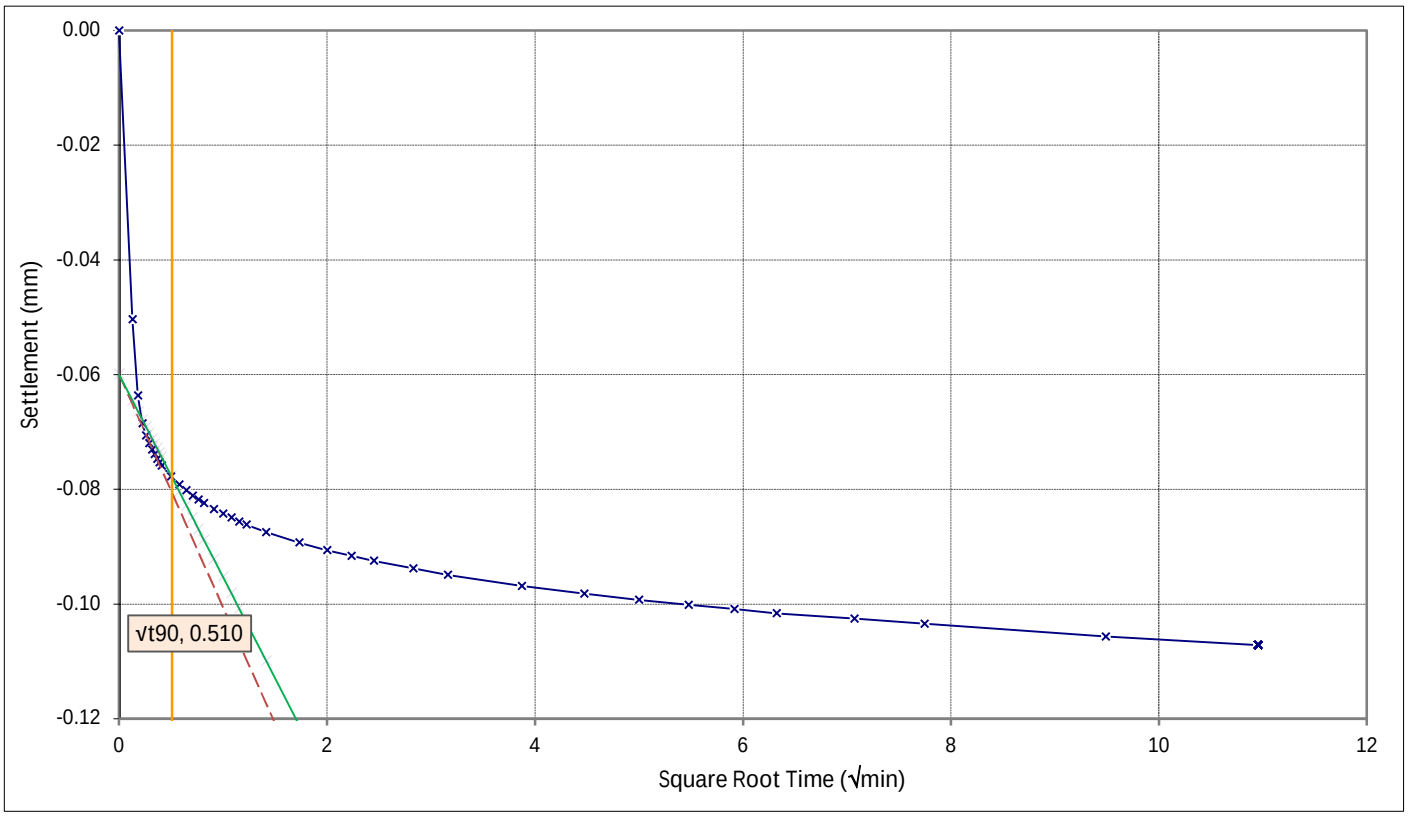
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 100 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

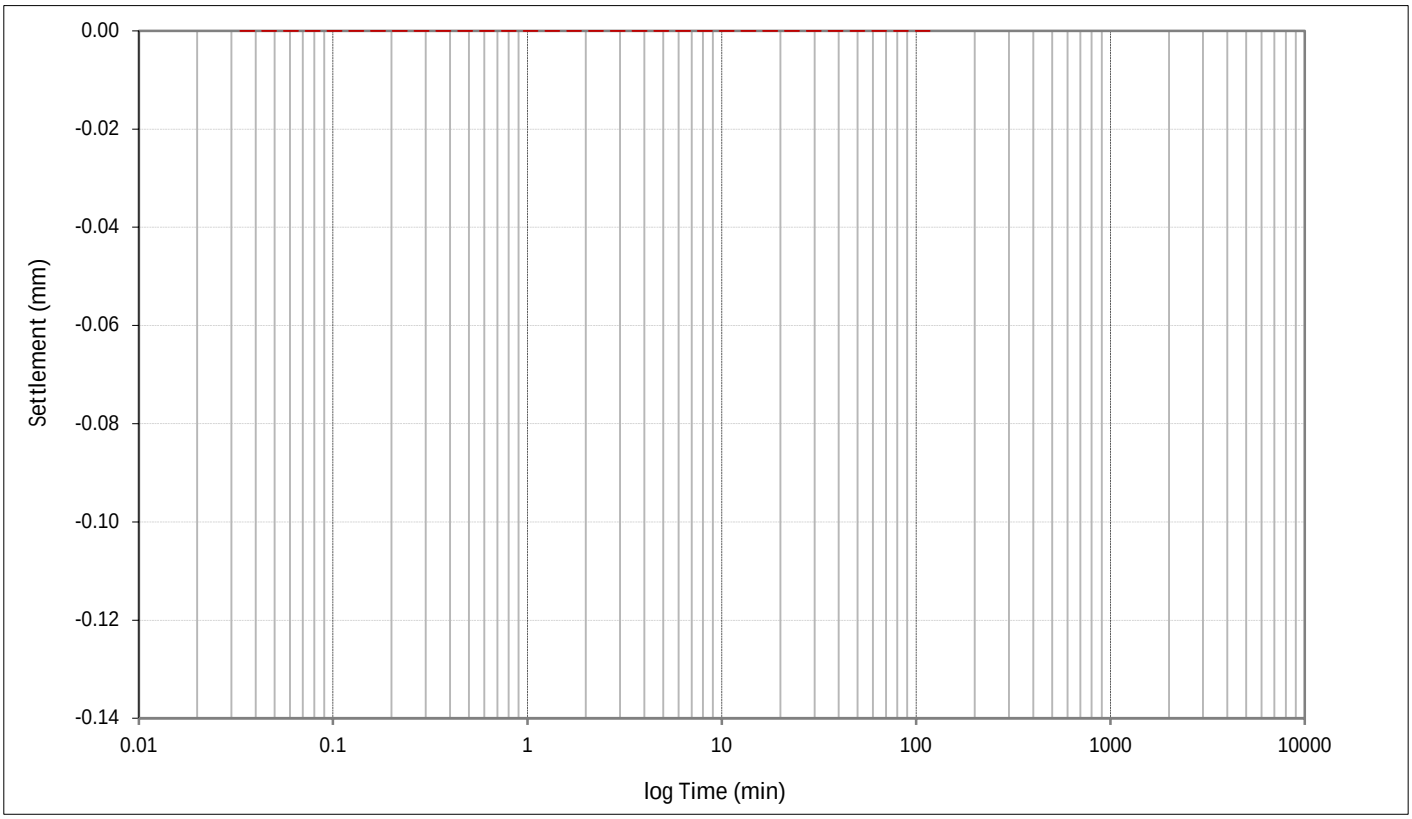
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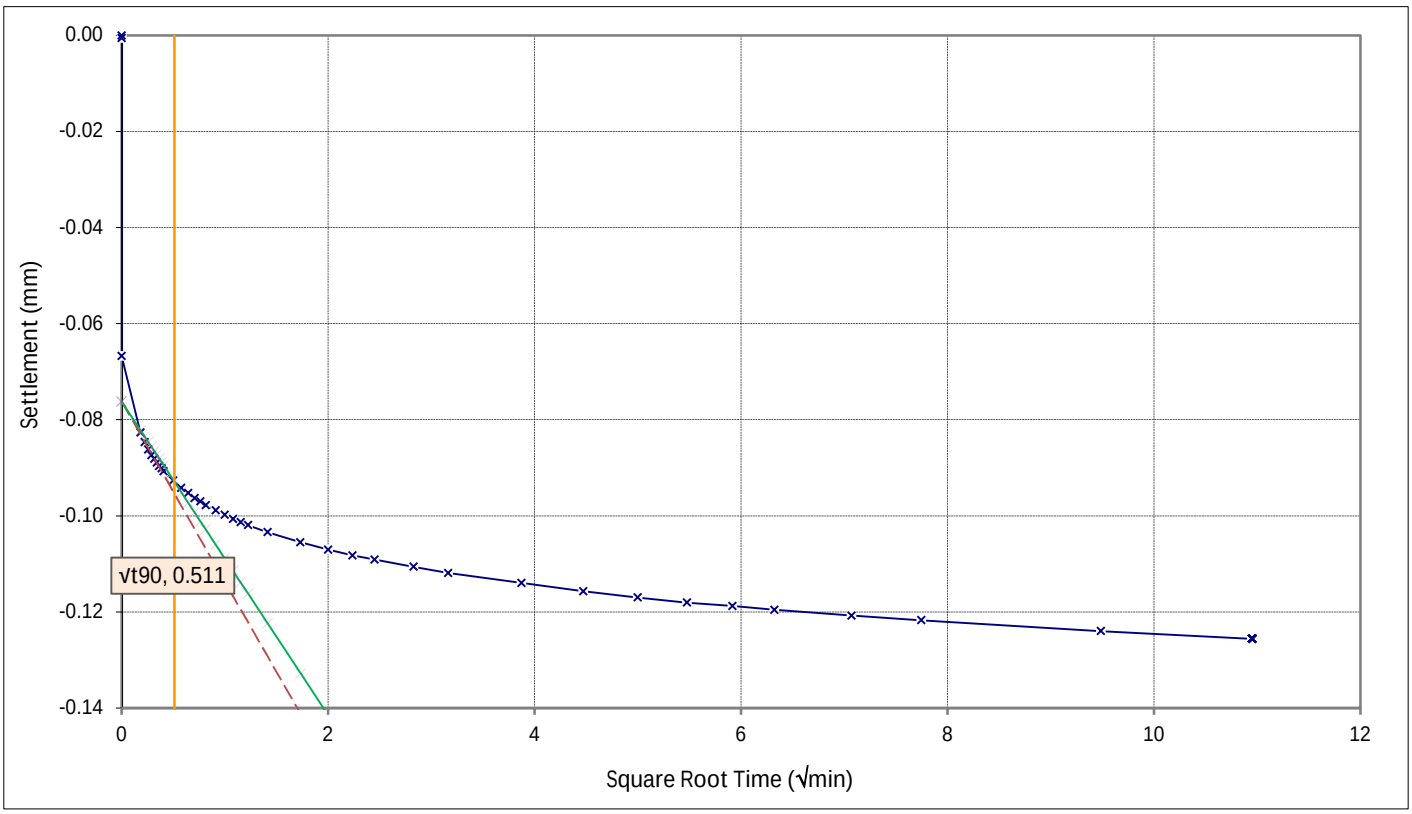
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 200 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

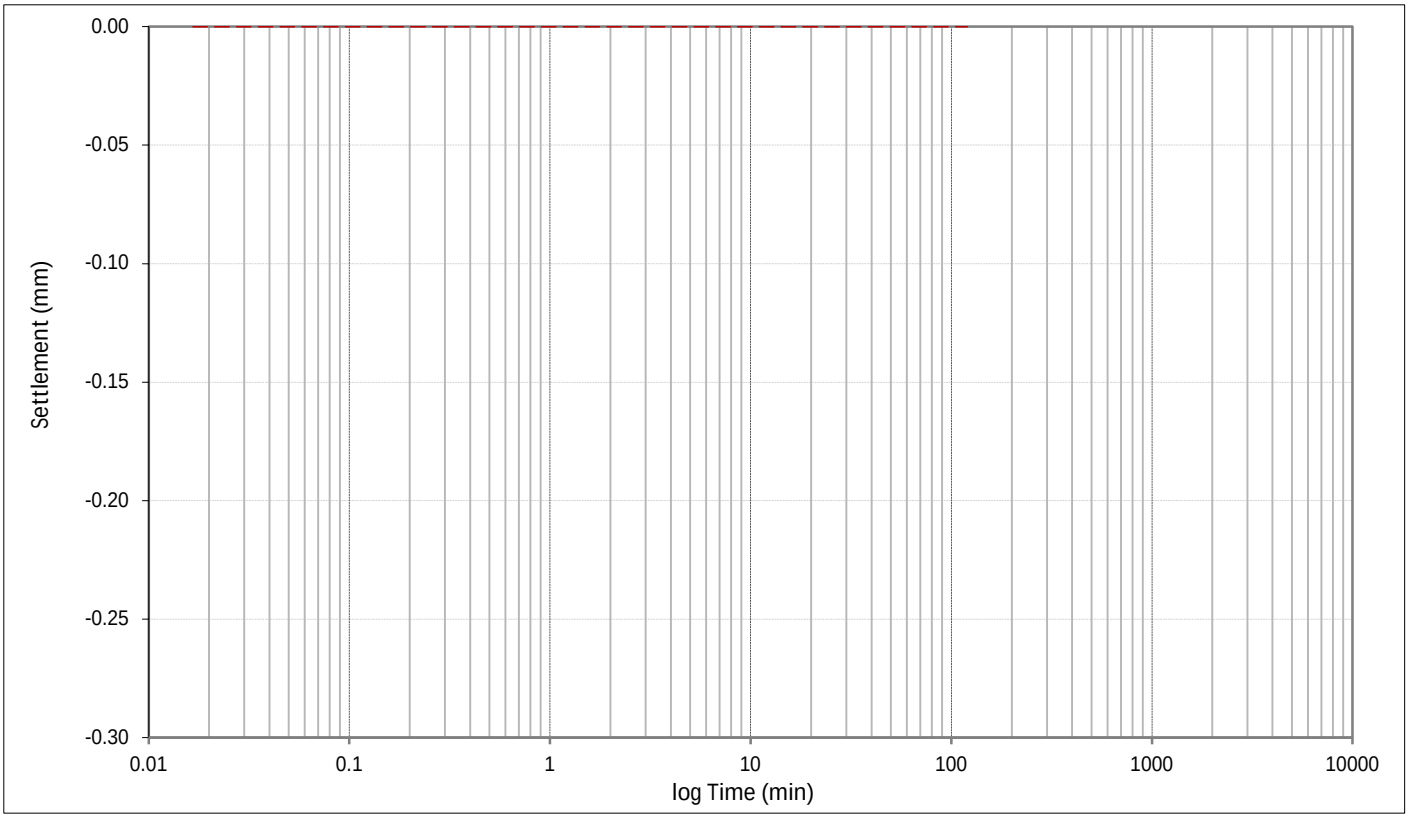
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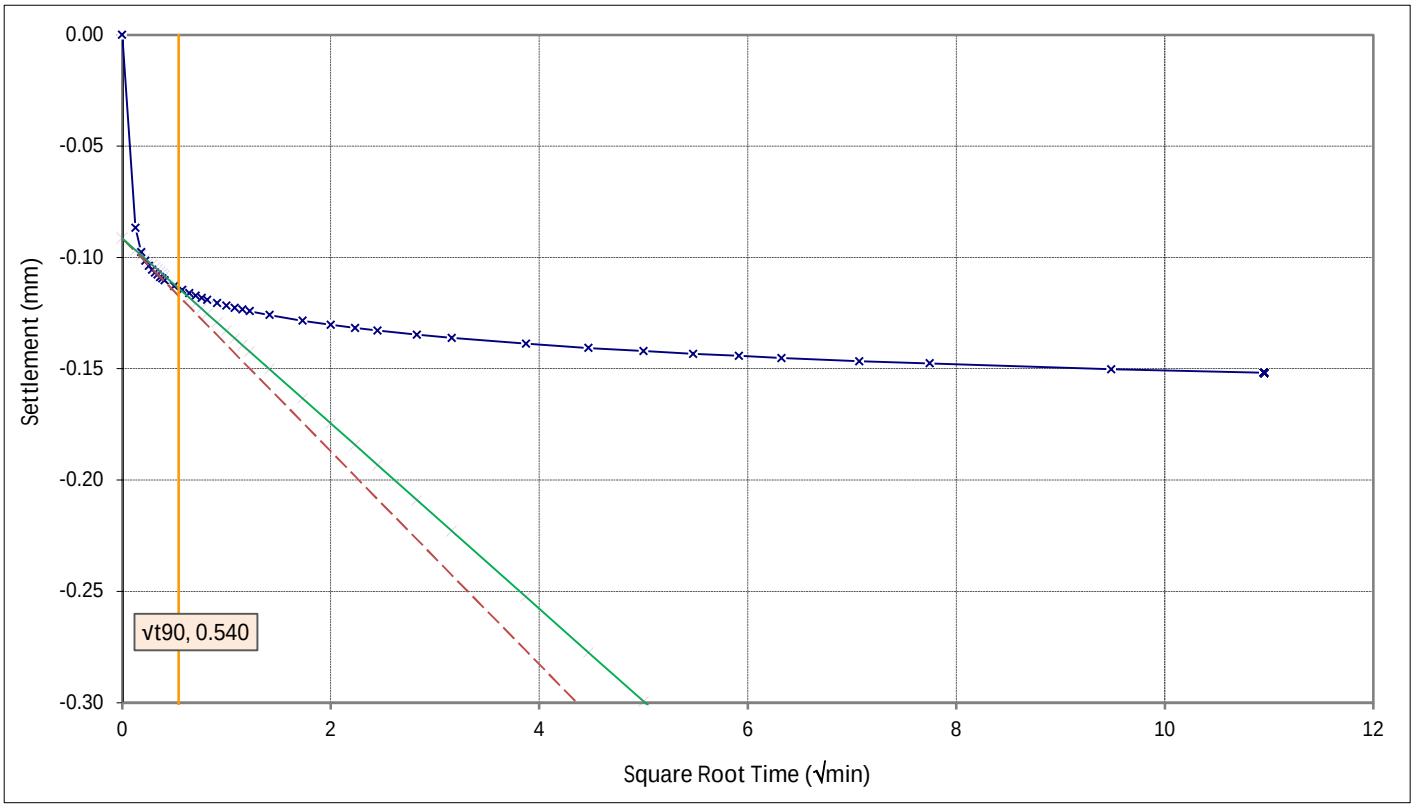
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 400 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

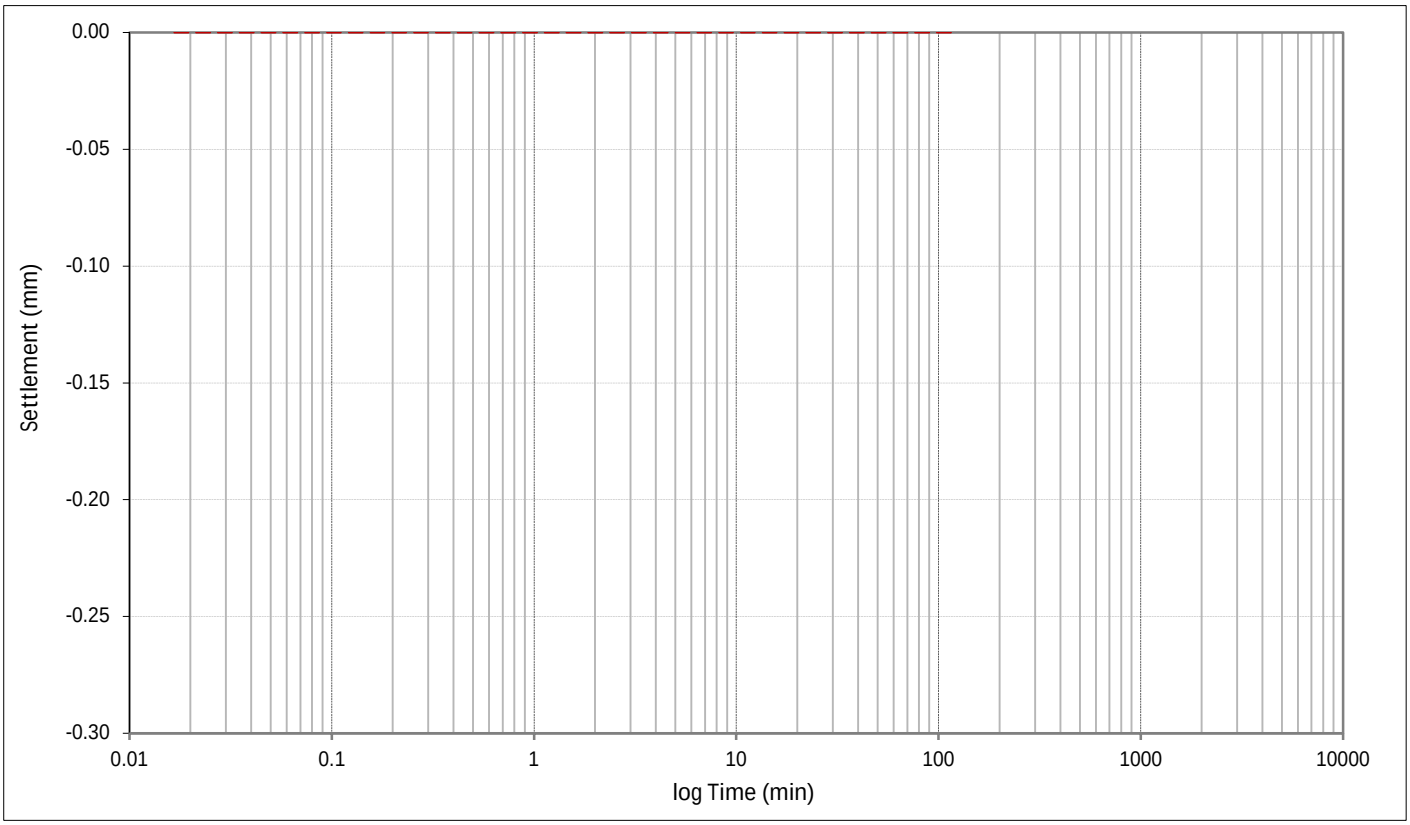
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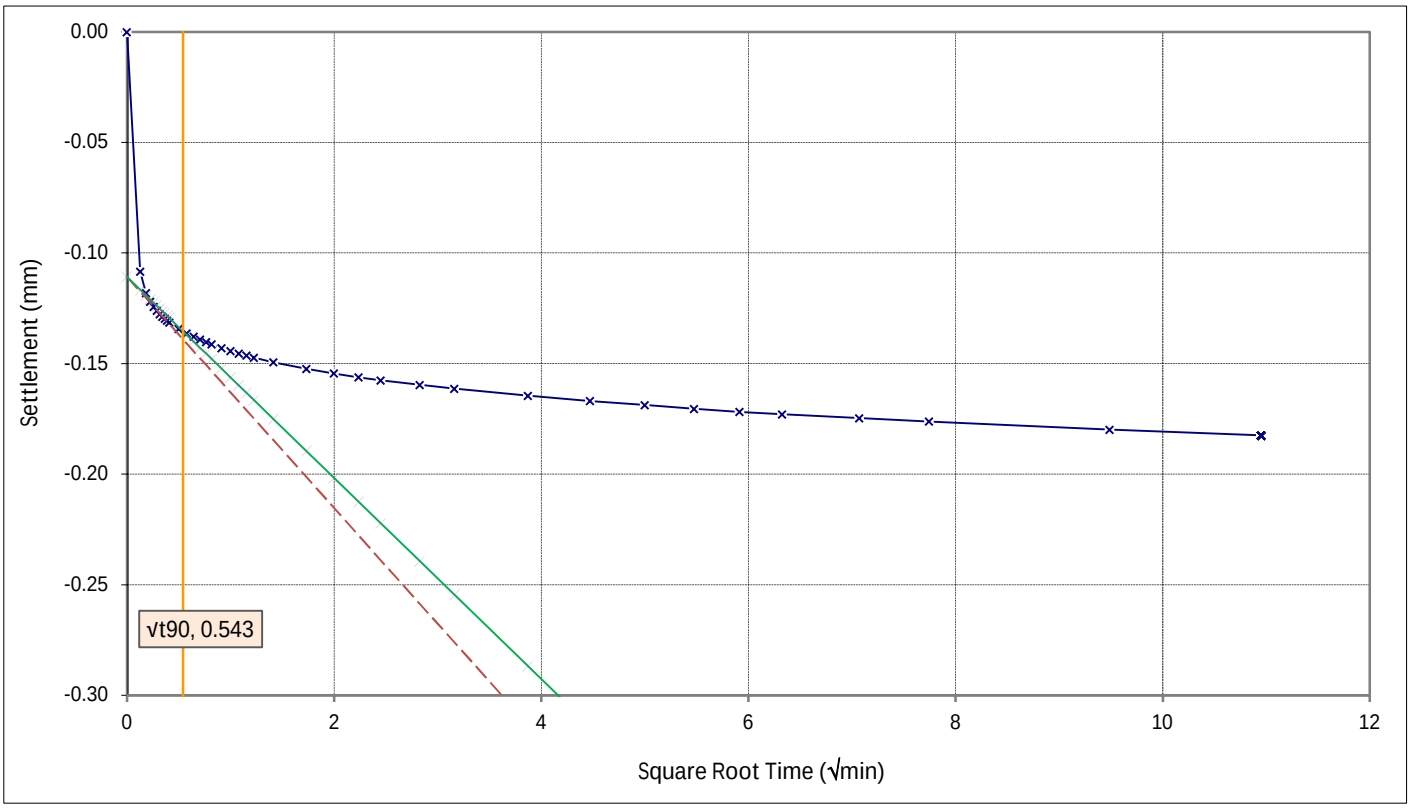
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 800 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

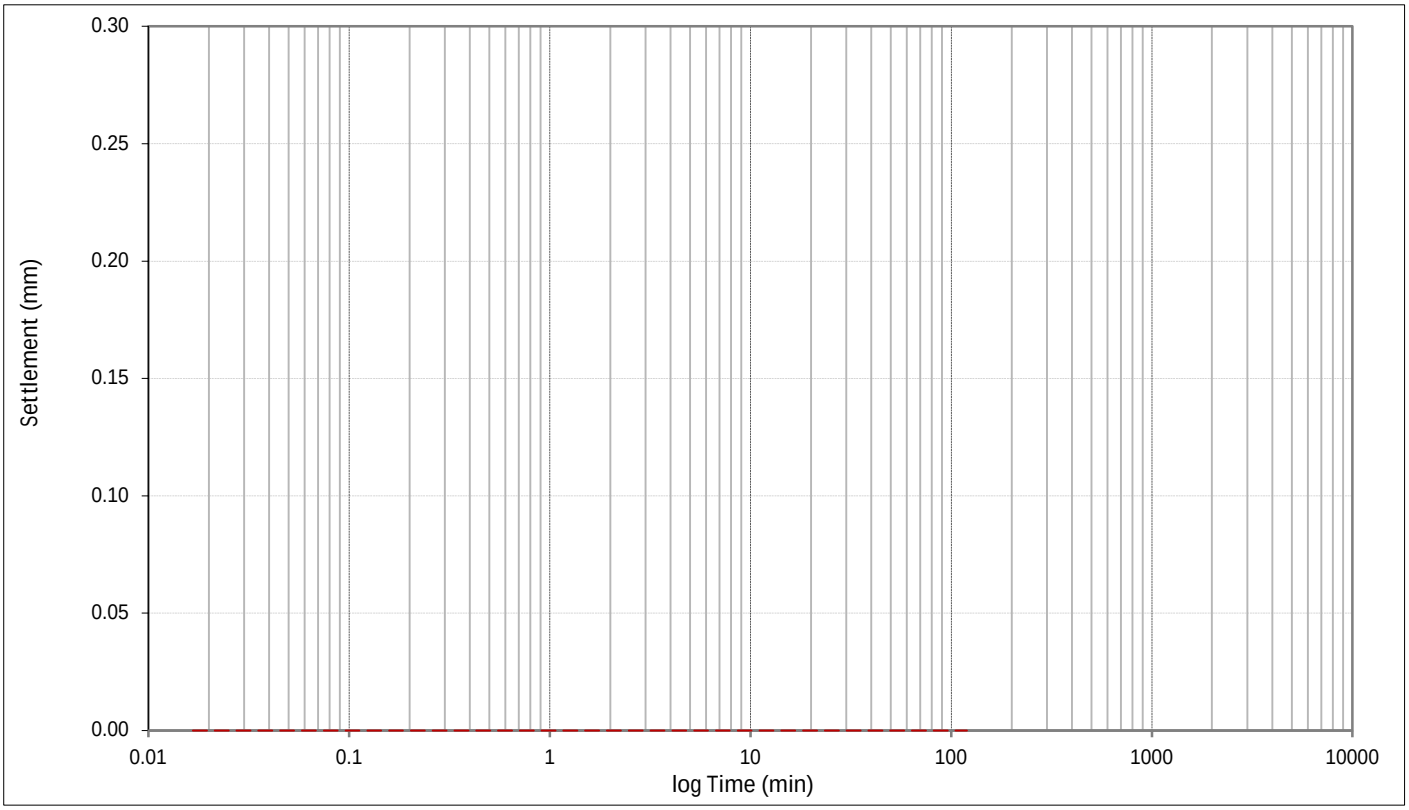
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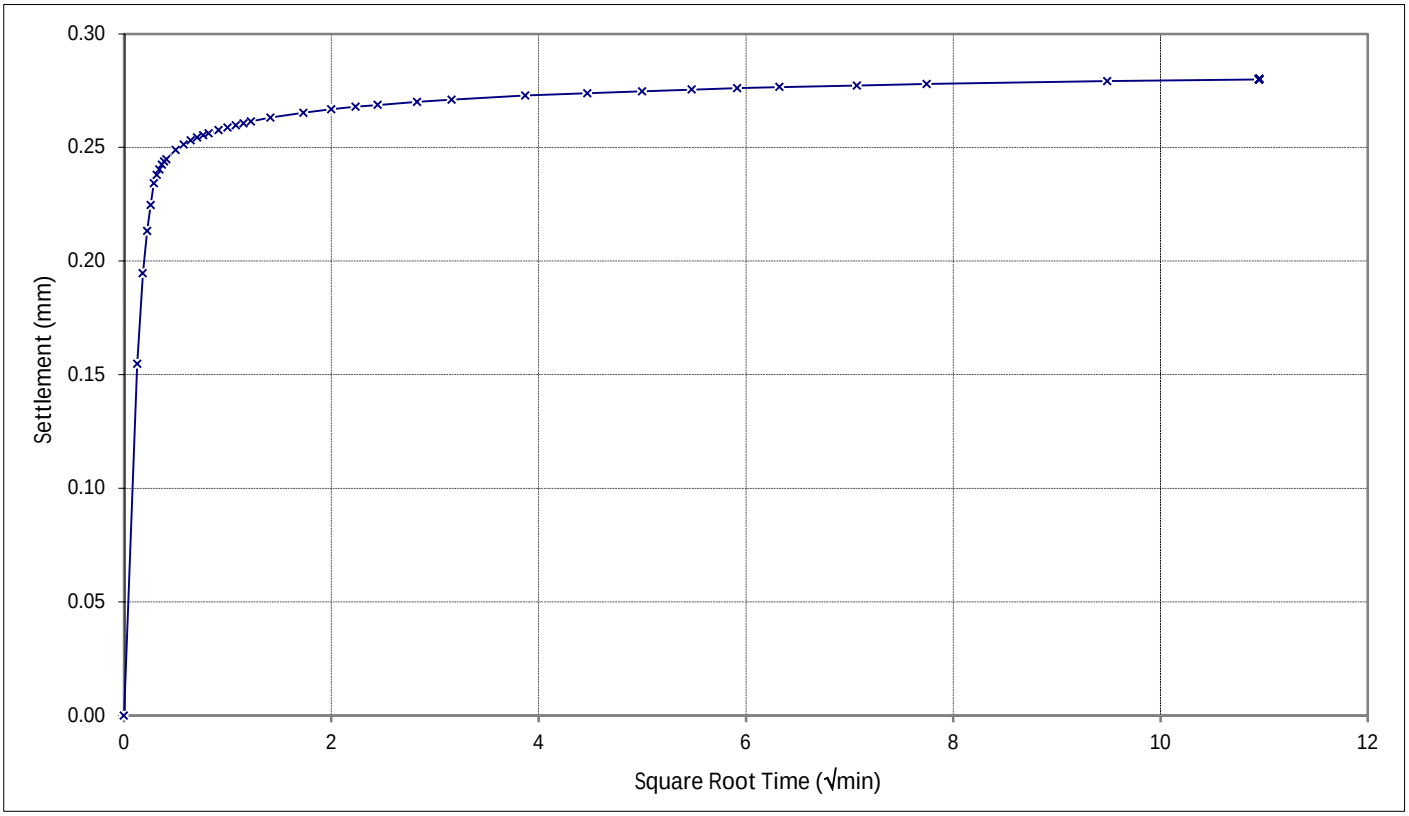
Geotechnics Project ID: 2025000.0082.02.0
Customer Project ID: 1101937.1000
Test Schedule Reference: --

Site/Location: 100 Halsey Street Location ID: BH202
Sample Ref.: -- Geotechnics ID: -- Depth: 6.08 - 6.10 (m)
Test method used: NZS 4402:1986 Test 7.1 Determination of the One-dimensional Consolidation Properties
NZS 4402:1986 Test 2.1 Determination of Water Content

ONE-DIMENSIONAL CONSOLIDATION TEST

Applied Pressure = 12.5 (kPa)





Tested by: PIHE Date: 23/09/2026 Approved by KTP: YHW Date: 30/09/2026

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auckland@geotechnics.co.nz

Report Number	2025000.0082.3.0/Rep 7	02-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Water content - NZS 4402:1986 Test 2.1

Customer Sample Details

Location	**ID**	BH201				
	Description	N/A				
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A
Sample	**Geotechnics ID**	A3662		**Date Sampled**	21-09-2026	
	Reference	BH20-1		**Depth From**	3.0 m	**to** 3.5 m
	Sampling Method	BH.				
	Description	Silty SAND				
Customer Instructions	N/A					

Test Results

Natural Water Content	55.0 %
Date Tested	25-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- Laboratory Description: Silty CLAY; dark grey. Firm, moist, high plasticity.

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
- This report has been prepared for the benefit of Halsey Street, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.
- Please reproduce this report in full when transmitting to others or including in internal reports.
- Samples not destroyed during testing will be retained for one month from the date of this report before being discarded. If we can be of any further assistance, feel free to get in touch.
- Sample descriptions are enclosed for your information but are not covered under the IANZ endorsement of this report.

Approved by KTP	Authorised by Project Director
Eliza Morton	Corey Papu-Gread

ACCREDITED IANZ TESTING LABORATORY

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Report Number	2025000.0082.3.0/Rep 8	02-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Liquid (4 point) and plastic limits, plasticity index - NZS 4402:1986 Test 2.2, 2.3, 2.4

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3662		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	3.0 m	**to**	3.5 m
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Liquid Limit	95
Plastic Limit	33
Plasticity Index	62
Date Tested	26-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- The sample used for testing: Fraction Passing a 425 µm sieve. Mechanically pushed through the sieve. Estimated retained: 0 %.
- Liquid limit device: Mechanical
- Plastic limit device: Manual
- Liquid limit grooving tool: Original (Metal)
- Laboratory Description: Silty CLAY; dark grey. Firm, moist, high plasticity.
- Sample description follows the NZGS Guidelines for field description of soil and rock.

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
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Eliza Morton	Corey Papu-Gread

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Report Number	2025000.0082.3.0/Rep 1	01-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Water content - NZS 4402:1986 Test 2.1

Customer Sample Details

Location	**ID**	BH201				
	Description	N/A				
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A
Sample	**Geotechnics ID**	A3663		**Date Sampled**	21-09-2026	
	Reference	BH20-1		**Depth From**	9.0 m	**to** 9.5 m
	Sampling Method	BH.				
	Description	Silty SAND				
Customer Instructions	N/A					

Test Results

Natural Water Content	74.6 %
Date Tested	26-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- Laboratory Description: Clayey SILT; dark grey. Firm, moist, high plasticity.

General Remarks

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Eliza Morton	Corey Papu-Gread

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Report Number	2025000.0082.3.0/Rep 2	01-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Liquid (4 point) and plastic limits, plasticity index - NZS 4402:1986 Test 2.2, 2.3, 2.4

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3663		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	9.0 m	**to**	9.5 m
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Liquid Limit	76
Plastic Limit	26
Plasticity Index	50
Date Tested	26-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- The sample used for testing: Fraction Passing a 425 µm sieve. Mechanically pushed through the sieve. Estimated retained: 0 %.
- Liquid limit device: Mechanical
- Plastic limit device: Manual
- Liquid limit grooving tool: Original (Metal)
- Laboratory Description: Clayey SILT; dark grey. Firm, moist, high plasticity.
- Sample description follows the NZGS Guidelines for field description of soil and rock.

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
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Eliza Morton	Corey Papu-Gread

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Report Number	2025000.0082.3.0/Rep 5	02-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Water content - NZS 4402:1986 Test 2.1

Customer Sample Details

Location	**ID**	BH202					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3664		**Date Sampled**	21-09-2026		
	Reference	BH20-2		**Depth From**	3.0 m	**to**	3.5 m
	Sampling Method	BH.					
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Natural Water Content	44.6 %
Date Tested	25-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- Laboratory Description: Clayey SILT; grey. Firm, moist, high plasticity.

General Remarks

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Eliza Morton	Corey Papu-Gread

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Report Number	**2025000.0082.3.0/Rep 6**	**02-10-2026**
Test Schedule Reference	**NZG512_113**	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Liquid (4 point) and plastic limits, plasticity index - NZS 4402:1986 Test 2.2, 2.3, 2.4

Customer Sample Details

Location	**ID**	BH202					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3664		**Date Sampled**	21-09-2026		
	Reference	BH20-2		**Depth From**	3.0 m	**to**	3.5 m
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Liquid Limit	59
Plastic Limit	25
Plasticity Index	34
Date Tested	25-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- The sample used for testing: Fraction Passing a 425 µm sieve. Mechanically pushed through the sieve. Estimated retained: 0 %.
- Liquid limit device: Mechanical
- Plastic limit device: Manual
- Liquid limit grooving tool: Original (Metal)
- Laboratory Description: Clayey SILT; grey. Firm, moist, high plasticity.
- Sample description follows the NZGS Guidelines for field description of soil and rock.

General Remarks

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Eliza Morton	Corey Papu-Gread

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Report Number	2025000.0082.3.0/Rep 3	02-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Water content - NZS 4402:1986 Test 2.1

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3665		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	6.0 m	**to**	6.5 m
	Sampling Method	BH.					
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Natural Water Content	39.2 %
Date Tested	26-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- Laboratory Description: Clayey SILT; dark grey. Firm, moist, high plasticity.

General Remarks

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Eliza Morton	Corey Papu-Gread

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Report Number	2025000.0082.3.0/Rep 4	02-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Liquid (4 point) and plastic limits, plasticity index - NZS 4402:1986 Test 2.2, 2.3, 2.4

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3665		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	6.0 m	**to**	6.5 m
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Liquid Limit	49
Plastic Limit	20
Plasticity Index	29
Date Tested	26-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- The sample used for testing: Fraction Passing a 425 µm sieve. Mechanically pushed through the sieve. Estimated retained: 0 %.
- Liquid limit device: Mechanical
- Plastic limit device: Manual
- Liquid limit grooving tool: Original (Metal)
- Laboratory Description: Clayey SILT; dark grey. Firm, moist, high plasticity.
- Sample description follows the NZGS Guidelines for field description of soil and rock.

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
- This report has been prepared for the benefit of Halsey Street, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.
- Please reproduce this report in full when transmitting to others or including in internal reports.
- Samples not destroyed during testing will be retained for one month from the date of this report before being discarded. If we can be of any further assistance, feel free to get in touch.
- Sample descriptions are enclosed for your information but are not covered under the IANZ endorsement of this report.

GEOTECHNICS

Approved by KTP	Authorised by Project Director
	
Eliza Morton	Corey Papu-Gread

ACCREDITED IANZ TESTING LABORATORY

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

www.geotechnics.co.nz

GEOTECHNICS

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1 Hill Street
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Report Number	2025000.0082.3.0/Rep 9	07-10-2026
Test Schedule Reference	NZG512_113	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Water content - NZS 4402:1986 Test 2.1

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3666		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	4.5 m	**to**	5.0 m
	Sampling Method	BH.					
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Natural Water Content	102 %
Date Tested	25-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- Laboratory Description: clayey SILT, with trace of sand; dark grey. Very soft, moist, high plasticity

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
- This report has been prepared for the benefit of Halsey Street, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.
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Approved by KTP	Authorised by Project Director
Eliza Morton	Steven Anderson

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Report Number	**2025000.0082.3.0/Rep 10**	**07-10-2026**
Test Schedule Reference	**NZG512_113**	

Customer Details

Customer	Halsey Street
Address	100 Halsey St
Project Name	G-GI TT - 100 Halsey Street GI
Project ID	TBC

Laboratory Test Report

Liquid (4 point) and plastic limits, plasticity index - NZS 4402:1986 Test 2.2, 2.3, 2.4

Customer Sample Details

Location	**ID**	BH201					
	Description	N/A					
	Data	E°: N/A	N°: N/A	Level: N/A	Chainage: N/A	Offset: N/A	
Sample	**Geotechnics ID**	A3666		**Date Sampled**	21-09-2026		
	Reference	BH20-1		**Depth From**	4.5 m	**to**	5.0 m
	Description	Silty SAND					
Customer Instructions	N/A						

Test Results

Liquid Limit	88
Plastic Limit	31
Plasticity Index	57
Date Tested	30-09-2026

Test Remarks

- Condition of the sample as received: Natural.
- The sample used for testing: Fraction Passing a 425 µm sieve. Mechanically pushed through the sieve. Estimated retained: 0 %.
- Liquid limit device: Mechanical
- Plastic limit device: Manual
- Liquid limit grooving tool: Original (Metal)
- Laboratory Description: clayey SILT, with trace of sand; dark grey. Very soft, moist, high plasticity
- Sample description follows the NZGS Guidelines for field description of soil and rock.

General Remarks

- Samples have been tested as received and according to your instructions. Results apply only to the sample(s) tested.
- This report has been prepared for the benefit of Halsey Street, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.
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GEOTECHNICS

Approved by KTP	Authorised by Project Director
	
Eliza Morton	Steven Anderson

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B3 Babbage 2015 machine borehole logs and laboratory test reports

EXPLANATION OF TERMS AND SYMBOLS

These pages present an explanation of the terms and symbols used on the log sheets entitled "Summary of Soil Profile and Testing". The materials, boundaries and conditions have been interpreted at the test hole locations only and could differ elsewhere on the site.

1. DEPTH / ELEVATION

This column refers to the depth below the ground surface existing at the time of drilling. The corresponding elevations are shown with respect to the datum noted where survey information is available.

2. SOIL AND ROCK SYMBOL

This column contains the standard soil and rock symbols used by Babbage for the materials encountered in the boreholes as shown below:

 Fill	 Clay	 Boulders
 Asphalt	 Silt	 Sandstone
 Concrete	 Sand	 Siltstone
 Topsoil	 Gravel	 Volcanic Rock
 Peat or Organic Soil	 Cobbles	 Uncertain Material

3. SOIL AND ROCK DESCRIPTION

The terms used to describe the soils and rocks are generally in accordance with the NZ Geotechnical Society's "***Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes***" December 2005.

*The **soils** are generally described in the following order:*

Major soil type, minor soil type/s, consistency (for cohesive soils) or density (for cohesionless soils), plasticity, structure and/or particle shapes, colour, moisture condition, minor inclusions, other significant aspects (e.g. geological description).

*Where rock is encountered, the **rock material** and the **rock mass** are described in the following order:*

Major rock type, texture and fabric, strength, weathering, colour, discontinuity type, discontinuity spacing, discontinuity orientation, discontinuity opening, discontinuity roughness, geological description (if this can be determined).

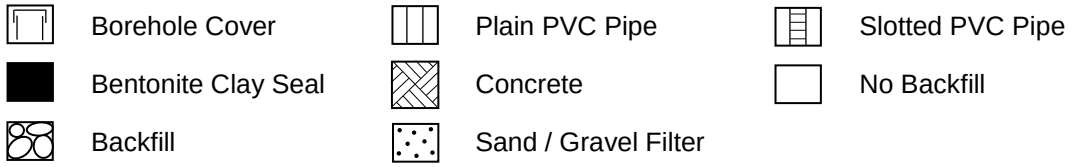
Where no field or laboratory tests are carried out, the soils and rock descriptions are based on handling and visual assessment of the recovered samples. **Any design based on such descriptions should allow for the generic nature of the descriptions.**

4. GEOLOGIC UNIT

This column divides the soil and/or rock encountered in the borehole into units that have been formally described and published by geologists (determined from geological maps), or informal units describing what general categories the materials belong to eg. fill, weathered rock, alluvium, etc.

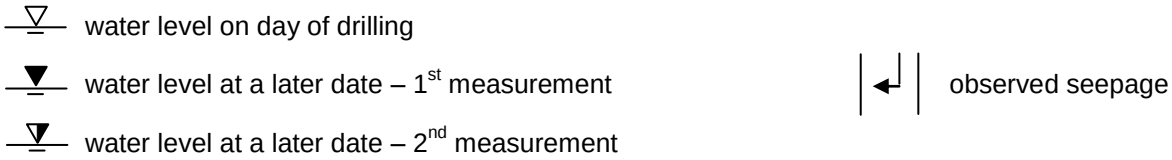
5. PIEZOMETER

This column graphically displays what happens to the hole on completion of drilling – ie. whether the hole is backfilled, left open with a plug, or if a piezometer/standpipe is installed.



6. GROUNDWATER

The groundwater level, or the depth at which free water was observed in the borehole, or any seepage observed in the borehole, are denoted by the symbols given below.



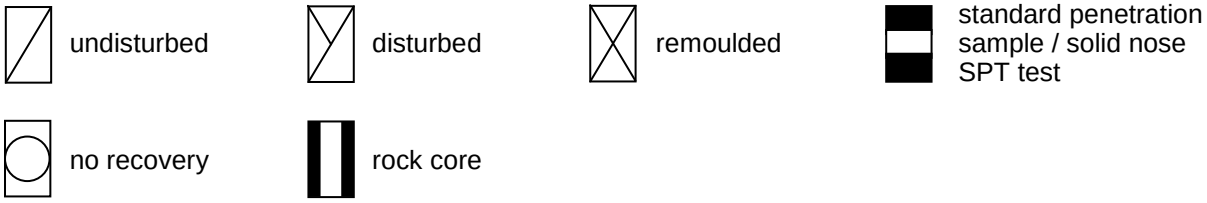
The level is the water level in an open hole unless otherwise indicated.

N in the column indicates the water level could not be recorded due to drilling water/mud, rain or hole caving.
NR in this column indicates that no record of the groundwater level was taken.
D in this column indicates that the hole was dry.
F in this column indicates when free water in the hole was first noticed.

7. SOIL SAMPLES

Condition

This column indicates the depth, length and condition of each sample taken. The following symbols are used to represent the condition of the samples.



Type *(and sample number)*

The type of sample and its sequential number is indicated in this column as follows:

A	auger sample	**P**	piston tube sample
B	block or bulk sample	**S**	standard penetration test (SPT) sample
D	disturbed sample (eg. open barrel core)	**T**	thin-walled tube sample
J	jar sample	**W**	wash or air return sample
GW	ground water sample	**O**	other (see text)

Disturbed soils samples are transported and stored in plastic bags. Machine borehole disturbed samples are transported and stored in core boxes. Tube samples are sealed with plastic bags in the field and with wax on return to the laboratory.

Method

This refers to the particular drilling/sampling technique:

HA	hand auger	**TU**	push-tube
HD	hand dug	**SSA**	solid stem machine auger
HSA	hollow stem machine auger	**SPT**	standard penetration test
EX	hydraulic excavator	**SP**	scala penetrometer
OB	open barrel	**TT**	triple tube
PP	pneumatic percussion	**WD**	wash drill
VAC	vacuumed	**SD**	sonic vibration drilling

Recovery

This column gives the sample recovery as a percentage of the sampled length for open barrel and triple tube core runs, and also split spoon SPT tests. If nothing is shown, the sample recovery was not measured.

8. TEST RESULTS

Penetration Resistance

The Penetration Resistance is the number of blows required to drive either a 50mm (outside diameter) open end "spilt spoon" or "Raymond" sampler the final 300mm of a 450mm penetration using a 64kg weight falling 760mm. The number of blows required to drive the sampler the final 300mm is referred to as the **"N" value**. The test is referred to as the **Standard Penetration Test or SPT**. The number of blows for each 150mm penetration of the test, or part-penetration when driving is terminated due to hard ground, are given in the "Other Tests" column, e.g. 15, 36, 46 for 55mm would indicate 15 blows for the first 150mm, 36 blows for the second 150mm and 46 blows for a further 55mm penetration and a N value of greater than 50 would be reported.

In some cases a solid steel 60º cone is used for this test (a **solid nose Standard Penetration Test**). For these cases the penetration resistance is reported as an **"S" value** is reported in this column.

Water Content and Atterberg Limits

The moisture or water content, plastic limit and liquid limit of the recovered soil sample, as determined in the laboratory in accordance with the test procedures set out in NZS4402, is plotted against depth. The abbreviations and graphic symbols are defined as follows:

●	w	natural moisture content
×	w_P	plastic limit
+	w_L	liquid limit

Other Tests

The following abbreviations are used to indicate the type of test undertaken:

COM	Compaction Test	pp	Pocket penetrometer strength	
*CON	Consolidation test	*Q	Consolidated undrained triaxial test	
G	Specific gravity or solid density of particles	qu	Unconfined compressive strength	
k	Permeability coefficient	*SB	Shear box test	
LS	Linear shrinkage	SP	Scala penetrometer	
OC	Organic content	*ST	Swelling test	
*PSD	Particle size distribution	SV	Vane shear strength:	(U) – undisturbed (R) – remoulded

*These tests are usually summarised separately.

9. REMARKS

Any additional observations or relevant information such as weather conditions, piezometer design, daily drilling progress, survey co-ordinates of the borehole, problems encountered during drilling, etc.

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH101	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 3
DATE FINISHED: 16/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist

DATUM: Google Earth
EASTING: 399317.081 mE
NORTHING: 803954.562 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		ASPHALT, 50mm thick.										
		FILL, gravel, coarse, 'medium dense', dark grey, well graded, [BASECOURSE].		not measured			OB	75				3
1.00		Core lost from 0.8 to 2.4m then hole wash drilled to 3.0m.										2
2.00					○		OB	0				1
3.00		FILL, clay, silty, soft, moderately plastic, grey, very moist.				S1	SPT	89	2		0/0/2/N = 2	0
		FILL, silt, fine sandy, non-plastic to slightly plastic, grey, very moist.										
		FILL, sand, fine, silty, 'very loose', grey, very moist. Wet Sieve test carried out on sample from 3.60m: 2% gravel / 78% sand / 20% silt and clay fractions.					OB	76				
4.00		Grades to dark grey. Trace wood fragments and petrified wood.										-1
		Loose.					SPT	0	5		0/3/2/N = 5	
5.00							OB	76				-2

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH101	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 3
DATE FINISHED: 16/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist

DATUM: Google Earth
EASTING: 399317.081 mE
NORTHING: 803954.562 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** (U = peak / R = remoulded); SPT / Scala Penetrometer	ELEVATION (m)
		Trace shells.	FILL									
6.00		75mm band of ORGANIC SILT.				S2	SPT	67	0		0/0/0/N = 0	-3
		CLAY, silty, soft, moderately to highly plastic, mottled grey, orange and dark grey, very moist.	TAURANGA GROUP ALLUVIUM				OB	100				
7.00						S3	SPT	89	10		1/3/7/N = 10	-4
8.00		SAND, fine, silty, 'loose to medium dense', brown moist.	WAITEMATA GROUP									-5
		SANDSTONE, fine, very weak, grey.					OB	100				
9.00		Banded SILTSTONE,very weak, moderately weathered, grey, and SANDSTONE, very weak, moderately weathered, grey, well cemented.					SPT	0			S > 50 50 blows for 140mm penetration	-6
							TT	74				
10.00												-7
							SPT	0			S > 50 50 blows for 140mm penetration	
11.00												

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH101	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 3 of 3
DATE FINISHED: 16/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist

DATUM: Google Earth
EASTING: 399317.081 mE
NORTHING: 803954.562 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
			WAITEMATA GROUP				TT	100				-8
12.00		TARGET DEPTH REACHED. End of Borehole at 12 m										-9
13.00												-10
14.00												-11
15.00												-12
16.00												-13

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH102	
DATE STARTED: 15/12/2015	METHOD: OB/SPT/TT/WD	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 3
DATE FINISHED: 15/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: M. Al-Haidar

DATUM: Google Earth
EASTING: 399326.063 mE
NORTHING: 803974.283 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		FILL, wash drilled.	FILL	not measured			WD	0				3
		FILL, gravel, fine to coarse, angular, dark grey with pockets of greyish brown slightly plastic silt.					OB	88				
		FILL, concrete, sub-rounded to sub-angular gravel, reddish brown.										
1.00		Core lost.					OB	0				2
							SPT	0	1		2/0/1/N = 1	
2.00		Fill, silt, sub-angular to angular fine gravelly, some fine sand, slightly plastic, grey, very moist to saturated.										1
		FILL, silt, slightly plastic, grey, saturated.					OB	86				
		FILL, silt, fine to coarse sub-angular to angular gravelly, slightly plastic, grey, saturated.										
3.00		SPT sample lost.					SPT	0	0		0/0/0/N = 0	0
		FILL, silt, slightly plastic, grey with some pockets of SAND, trace shell fragments.										
		FILL, sand, fine to coarse, some silt, grey, some wood fragments.										
4.00		FILL, silt, slightly plastic, grey, with pockets of SAND, fine to coarse, silty, with minor shell fragments.					OB	86				-1
		FILL, sand, fine to coarse, some silt, minor shell fragments.										
		FILL, silt, fine sandy, slightly plastic, grey, saturated.										
		FILL, sand, fine to coarse, minor silt, some shell fragments.										
5.00		FILL, sand, fine to medium, silty, minor shell fragments.					OB	67				-2
		FILL, silt, non-plastic, grey.										

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH102	
DATE STARTED: 15/12/2015	METHOD: OB/SPT/TT/WD	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 3
DATE FINISHED: 15/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: M. Al-Haidar

DATUM: Google Earth
EASTING: 399326.063 mE
NORTHING: 803974.283 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) / IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		FILL, sand, fine to medium, minor silt, dark grey, trace shell fragments.	FILL									
		FILL, organic silt, non-plastic, black, strong organic odour.										
		FILL, sand, fine to coarse, some shell fragments, dark grey.										
6.00		Black, organic odour.										
		Dark grey, minor shell fragements.				S1	SPT	56	2		2/1/1/N = 2	-3
		FILL, sand, fine to coarse, silty, dark grey, minor shell fragments.										
		SILT, clayey, moderately plastic, light brown with light grey streaks.	TAURANGA GROUP ALLUVIUM				OB	86				
7.00		SILT, slightly plastic, light grey.										-4
		SAND, fine to medium, silty, light brown.				S2	SPT	78	12		2/3/9/N = 12	
8.00		SILT, slightly plastic, grey.										-5
		SAND, fine to medium, minor silt, grey.										
		SILTSTONE, very weak, moderately weathered, weakly cemented, carbonaceous inclusions, occasional very thin bands of SANDSTONE.	WAITEMATA GROUP				OB	90				
9.00		Moderately cemented. Solid nose SPT.					SPT	0			S > 50 50 blows for 135mm penetration	-6
							TT	88				
10.00												-7
11.00												

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2		JOB No.	51897#GE
		HOLE No.	BH102
DATE STARTED: 15/12/2015	METHOD: OB/SPT/TT/WD	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 3 of 3
DATE FINISHED: 15/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: M. Al-Haidar

DATUM: Google Earth
EASTING: 399326.063 mE
NORTHING: 803974.283 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		SANDSTONE, fine to medium, very weak, moderately weathered, moderately cemented, grey.	WAITEMATA GROUP				TT	80				-8
		Solid nose SPT.					SPT	0			S > 50 50 blows for 70mm penetration	
		TARGET DEPTH REACHED.										
12.00		End of Borehole at 11.57 m										-9
13.00												-10
14.00												-11
15.00												-12
16.00												-13

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH103	
DATE STARTED: 15/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 2
DATE FINISHED: 16/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: M. Al-Haidar / R. Sandquist

DATUM: Google Earth
EASTING: 399337.923 mE
NORTHING: 803998.918 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		ASPHALT.										3
		FILL, gravel, fine to coarse, sub-angular to angular, fine to coarse sandy, dark grey, trace glass fragments.										
		FILL, concrete, sub-angular to angular gravel, reddish brown.					OB	60				
		FILL, gravel, fine to medium, fine to coarse sandy, sub-angular to angular, dark grey to black.										
1.00		Core lost.										2
				16/12/2015			OB	0				
2.00			FILL									1
3.00							SPT	0	4		2/3/1/N = 4	0
		FILL, sand, fine to coarse, silty, 'loose', greenish grey, some shell fragments, saturated.					OB	81				
4.00												-1
		FILL, sand, fine to medium, some silt, greenish grey, minor shell fragments, saturated. Wet sieve test carried out at 4.40m: 11% gravel / 73% sand / 16% silt or clay fractions.				S1	SPT	22	4		2/3/1/N = 4	
5.00		Some shell fragments.					OB	100				-2

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH103	
DATE STARTED: 15/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 2
DATE FINISHED: 16/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: M. Al-Haidar / R. Sandquist

DATUM: Google Earth
EASTING: 399337.923 mE
NORTHING: 803998.918 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	OTHER TESTS	ELEVATION (m)
	FILL, sand, fine to medium, silty, 'loose', bluish grey.									
	FILL, clay, silty, soft to firm, highly plastic, grey, moist.									
	Grades to FILL, sand, fine to medium, silty, 'loose' grey, moist.	FILL				SPT	0	3	0/1/2/N = 3	-3
6.00	FILL, clay, silty, firm, highly plastic, mottled brown and grey, moist.									
	CLAY, silty, fine sandy, stiff, moderately plastic, grey, moist.									
7.00	SAND, fine, silty, 'medium dense', grey, moist.					OB	100			-4
	SANDSTONE, fine to medium, very weak, moderately weathered, weakly cemented, grey. Solid nose SPT.					SPT	0		S > 50 18 / 32 blows for 50mm penetration	
8.00		WAITEMATA GROUP				TT	31			-5
	Well cemented.									
9.00	Solid nose SPT.					SPT	0		S > 50 25 / 25 blows for 45mm penetration	-6
						TT	100			
10.00	20mm thick band of fine gravel. Broken by drilling.									-7
	Solid nose SPT.					SPT	0		S > 50 31 / 19 blows for 15mm penetration	
	TARGET DEPTH REACHED. End of Borehole at 10.665 m									
11.00										

MOISTURE CONTENTS = ●
LIMITS: PLASTIC = × LIQUID = +
20 40 60
IN SITU VANE (kPa) = ✳
50 100 150

OTHER TESTS
Corrected Shear Vane Result **
U = peak / R = remoulded
SPT / Scala Penetrometer

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH104	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist / J. Husband

DATUM: Google Earth
EASTING: 399341.132 mE
NORTHING: 803966.841 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		ASPHALT.										3
		FILL, gravel, fine to coarse, sub-angular, dark grey, well graded, fines washed out ?, [BASECOURSE].		not measured			OB	100				
		No recovery.					OB	0				2
1.00							SPT	0	0		1/0/0/N = 0	
2.00							OB	14				1
3.00		FILL, clay, soft, moderately to highly plastic, dark grey to black.	FILL									
		SPT sample lost.					SPT	0	2		1/1/1/N = 2	0
		FILL, sand, fine to coarse, silty, 'loose', grey, some shell fragments.										
		Trace wood inclusions.					OB	100				-1
4.00		Thin band of shells.										
		SPT sample lost.					SPT	0	2		1/1/1/N = 2	
5.00							OB	100				-2

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH104	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist / J. Husband

DATUM: Google Earth
EASTING: 399341.132 mE
NORTHING: 803966.841 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) / IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		FILL, clay, silty, soft, moderately to highly plastic, grey, very moist.	FILL									
6.00										✳	15kPa (U) 9kPa (R)	
		FILL, sand, fine, silty, 'loose', grey, trace shell fragments, very moist.				S1	SPT	100	3		1/1/2/N = 3	-3
		CLAY, firm, highly plastic, mottled light grey and brown.	TAURANGA GROUP ALLUVIUM				OB	67				
7.00												-4
		SILT, fine sandy, clayey, firm, moderately plastic, light grey.								✳	41kPa (U) 15kPa (R)	
						S2	SPT	100	18		1/6/12/N = 18	
		CLAY, stiff, highly plastic, light grey, with brown streaks.	WAITEMATA GROUP									
8.00		SANDSTONE, fine, very weak, highly weathered, grey.										-5
		SILTSTONE, very weak, highly weathered, grey with occasional very thin bands of SANDSTONE, fine, very weak, highly weathered, grey.					OB	71				
9.00		Solid nose SPT.					SPT	0			S > 50 26 / 31 / 19 blows for 30mm penetration	-6
		SANDSTONE, fine, weak, moderately weathered, dark grey.										
		SILTSTONE, weak, moderately weathered, dark grey.										
		SANDSTONE, fine, weak, moderately weathered, dark grey.					TT	100				
10.00		SILTSTONE, weak, moderately weathered, dark grey. Carbonaceous inclusions.										-7
		SANDSTONE, fine, weak, moderately weathered, dark grey, numerous horizontal fractures, drilling induced ? Solid nose SPT.					SPT	0			S > 50 50 blows for 90mm penetration	
11.00												

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH104	
DATE STARTED: 16/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 3 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: R. Sandquist / J. Husband

SOIL/ROCK DESCRIPTION*

DATUM: Google Earth
EASTING: 399341.132 mE
NORTHING: 803966.841 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

SAMPLES RECOVERED & TEST RESULTS

MOISTURE CONTENTS = ●
LIMITS: PLASTIC = × LIQUID = +
20 40 60
IN SITU VANE (kPa) = ✳
50 100 150

OTHER TESTS
Corrected Shear Vane Result **
U = peak / R = remoulded
SPT / Scala Penetrometer

DEPTH (m)	SOIL SYMBOL	DESCRIPTION	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	OTHER TESTS	ELEVATION (m)
							TT	95			-8
		SILTSTONE, weak, moderately weathered, dark grey.									
		SANDSTONE, fine to medium, weak, moderately weathered, dark grey.									
		SILTSTONE, weak, moderately weathered, dark grey.									
		SANDSTONE, fine to medium, weak, moderately weathered, dark grey.	WAITEMATA GROUP								
12.00		Solid nose SPT.					SPT	0		S > 50 50 blows for 80mm penetration	-9
		TARGET DEPTH REACHED.									
		End of Borehole at 12.08 m									-10
13.00											
											-11
14.00											
											-12
15.00											
											-13
16.00											

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH105	
DATE STARTED: 18/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 2
DATE FINISHED: 18/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399368.425 mE
NORTHING: 803988.379 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	OTHER TESTS	ELEVATION (m)
	ASPHALT, 30mm thick.	FILL	not measured			OB	60			3
	FILL, gravel, fine to coarse, angular to sub-rounded, silty, dark grey and dark red.									
	CONCRETE, 150mm thick, red rock and greywacke aggregate.									
	FILL, gravel, fine to coarse, angular to sub-rounded, silty, dark grey and dark red.					OB	40			
	FILL, gravel, medium to coarse, angular to sub-angular, dark grey and dark red.									
1.00	CONCRETE, 150m thick.									2
	FILL, gravel, fine to coarse, silty, sandy, dark brown.					OB	60			
	FILL, clay, firm, highly plastic, greenish grey.									
	SPT sample not recovered.				S1	SPT	22	25	4/9/16/N = 25	
	150mm of wood and gravel material in the end of the SPT. SPT encountered obstruction.									
2.00	Core lost.					OB	36			1
	FILL, wood, dark brown to black.									
	FILL, clay, silty, stiff, highly plastic, bluish grey, with occasional very thin bands of sand.					OB	90			
	FILL, sand, fine, 'loose', dark grey. Wood inclusion.									
3.00	SAND, fine, loose, dark grey.	TAURANGA GROUP ALLUVIUM			S2	SPT	44	3	1/1/2/N = 3	0
	Core lost.					OB	0			
4.00					S3	SPT	100	5	2/2/3/N = 5	-1
5.00	Core lost.									-2
	SAND, fine, silty, 'loose', numerous shell					OB	50			

MOISTURE CONTENTS = ●
LIMITS: PLASTIC = × LIQUID = +
20 40 60
IN SITU VANE (kPa) = ✳
50 100 150
OTHER TESTS: Corrected Shear Vane Result **; U = peak / R = remoulded; SPT / Scala Penetrometer

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH105	
DATE STARTED: 18/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 2
DATE FINISHED: 18/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399368.425 mE
NORTHING: 803988.379 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		inclusions, dark grey.										
		SILTSTONE, weak, moderately weathered, dark grey.										
6.00		SANDSTONE, fine, weak, moderately weathered, dark grey. Grey.				S4	SPT	100			N > 50 19 / 44 / 6 blows for 5mm penetration	-3
		Thinly banded SILTSTONE, weak, moderately weathered, dark grey and SANDSTONE, fine, weak, moderately weathered, dark grey.					TT	75				
7.00		Carbonaceous inclusions.	WAITEMATA GROUP									-4
		Solid nose SPT.					SPT	0			S > 50 50 blows for 100mm penetration	
8.00							TT	90				-5
		Thin band of carbonaceous inclusions.										
9.00		TARGET DEPTH REACHED. End of Borehole at 9 m										-6
10.00												-7
11.00												

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

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SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH106	
DATE STARTED: 17/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 2
DATE FINISHED: 18/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399359.162 mE
NORTHING: 803958.553 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		ASPHALT, 30mm thick.										
		FILL, gravel, fine to coarse, dark grey and red.		not measured			OB	100				3
		Thin bands of silt.					OB	100				
1.00		FILL, silt, very stiff, non-plastic, black, numerous coarse gravel and brick inclusions.					OB	80				2
		Core lost.										
2.00		FILL, silt, clayey, firm, bluish grey, fine to coarse gravel inclusions.	FILL				OB	60				1
		FILL, clay, silty, stiff, moderately plastic, grey with bands of dark grey.					OB	100				
3.00		Gravel or brick obstruction in end of barrel.					SPT	0	2		unable to penetrate with vane 0/1/1/N = 2	0
		Grey with yellow streaks.										
4.00		Gravel obstruction.					OB	100				-1
		SAND, fine, very loose, dark grey, numerous, shell inclusions.	TAURANGA GROUP ALLUVIUM			S1	SPT	100	3		1/2/1/N = 3	
5.00		SAND, fine, 'loose', dark grey.					OB	100				-2

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2		JOB No.	51897#GE
		HOLE No.	BH106
DATE STARTED: 17/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 2
DATE FINISHED: 18/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399359.162 mE
NORTHING: 803958.553 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20 / 40 / 60) IN SITU VANE (kPa) = ✳ (50 / 100 / 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		CLAY, silty, stiff, highly plastic, grey.	TAURANGA GROUP ALLUVIUM									
6.00		SAND, fine, 'loose', dark grey, numerous shell inclusions.										-3
		Casing installed to 6m depth then hole was wash drilled. SPT sample at 6m was lost.					SPT	0	3		1/2/1/N = 3	
		SILT, fine sandy, stiff, slightly plastic, dark grey.										
		SAND, fine to medium, 'loose', dark grey.										
		SILT, fine sandy, stiff, slightly plastic, dark grey, organic inclusions.										
7.00		CLAY, silty, fine sandy, firm to stiff, moderately to highly plastic, grey with yellow streaks, occasional organic inclusions.					OB	100				-4
		Wood inclusion.								✳	34kPa (U) 15kPa (R)	
		SAND, fine, some silt, very loose to loose, greenish dark grey.				S2	SPT	100	4		1/2/2/N = 4	
8.00		SILTSTONE, very weak, moderately weathered, dark grey, with very thin bands of SANDSTONE.	WAITEMATA GROUP									-5
		SANDSTONE, fine, very weak, highly weathered, dark grey.					OB	100				
		SILTSTONE, very weak, moderately weathered, dark grey.										
9.00		SANDSTONE, fine, very weak, moderately weathered, dark grey.										-6
		SILTSTONE, very weak, moderately weathered, dark grey.					SPT	0			S > 50 21 / 26 / 24 for 140mm penetration	
		SANDSTONE, fine, very weak, moderately weathered, dark grey, horizontal fractures, drilling induced? UCS test carried out on sample from 9.45m to 9.57m UCS = 2.5MPa										
10.00		SILTSTONE, very weak, moderately weathered, dark grey, occasional very thin bands of SANDSTONE, horizontal fractures.					TT	100				-7
		SANDSTONE, fine, weak, moderately weathered, dark grey.					SPT	0			S > 50 50 for 85mm penetration	
		Solid nose SPT.										
		End of Borehole at 10.585 m										
11.00												

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH107	
DATE STARTED: 17/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 1 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399346.809 mE
NORTHING: 803934.398 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) / IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS (Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer)	ELEVATION (m)
		ASPHALT, 40mm thick.										
		FILL, gravel, medium to coarse, angular to sub-rounded, dark grey and red.					OB	100				3
		Fine to medium.		not measured								
		FILL, clay, silty, very stiff, moderately plastic, greenish grey with orange streaks.					OB	100				
1.00		FILL, gravel, fine to medium, sandy, black and orange, glass fragments, boiler ash?										
		FILL, sand, medium to coarse, fine to medium gravelly, 'loose', black.					OB	100		✳	35kPa (U) 14kPa (R)	2
						S1	SPT	100	2		1/1/1/N = 2	
2.00		FILL, clay, stiff, highly plastic, light greenish grey, numerous gravel and ceramic inclusions.	FILL				OB	48				1
		FILL, clay, fine sandy, silty, stiff, highly plastic, mottled dark grey and greenish grey.										
3.00		FILL, silt, clayey, firm, moderately plastic, mottled light grey and yellow.					SPT	0	9		1/4/5/N = 9	0
							OB	54				
4.00		FILL, silt, clayey, stiff, moderately plastic, grey with yellow streaks. Black band.										-1
		SAND, fine to medium, loose, grey, numerous shell inclusions.	TAURANGA GROUP ALLUVIUM									
		Occasional silty bands.				S2	SPT	100	4		1/2/2/N = 4	
5.00		CLAY, stiff, highly plastic, light grey with dark grey and black bands.					OB	76				-2

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH107	
DATE STARTED: 17/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 2 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399346.809 mE
NORTHING: 803934.398 mN
SURFACE ELEVATION: 3.17 m
For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) / IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		Grades to SILT, fine to medium sandy, firm, moderately plastic, dark grey, numerous shell inclusions.	TAURANGA GROUP ALLUVIUM							✳	44kPa (U) 9kPa (R)	
6.00		SPT sample lost.					SPT	0	4		2/2/2/N = 4	-3
		CLAY, fine sandy, stiff, moderately plastic, dark brownish grey.										
		SAND, fine to medium, 'loose', dark grey, organic inclusions.										
		CLAY, fine sandy, stiff, moderately plastic, dark brownish grey.										
7.00		CLAY, silty, very stiff, highly plastic, mottled light grey and grey with occasional yellow streaks, occasional sandy bands.					OB	100				-4
		Grades to CLAY, silty, hard, dark grey.										
		SAND, fine, medium dense, dark grey.				S3	SPT	100	22		2/6/16/N = 22	
		SILTSTONE, very weak, moderately weathered, dark grey.										
8.00		Thinly banded SILTSTONE, very weak, moderately weathered, dark grey and SANDSTONE, fine, very weak, moderately weathered.	WAITEMATA GROUP				TT	68				-5
9.00		Solid nose SPT.					SPT	0			S > 50 50 blows for 120mm penetration	-6
		SANDSTONE, fine to coarse, very weak, moderately weathered, dark grey. UCS test carried out on sample from 9.50 - 9.62m. UCS = 2.7MPa. Fine to medium. Fine. Medium to coarse. Very thin band of SILTSTONE, weak, moderately weathered, light grey.					TT	68				-7
10.00		Solid nose SPT.					SPT	0			S > 50 50 blow for 135mm penetration	
11.00		SILTSTONE, very weak to weak, moderately weathered, grey.										

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

SUMMARY OF SOIL PROFILE & TESTING

Babbage®

JOB No.	51897#GE		
PROJECT: 100 HALSEY STREET: GEOTECH REPORT B1 - B2	HOLE No.	BH107	
DATE STARTED: 17/12/2015	METHOD: OB/SPT/TT	RIG: Cortech Drilling Equip. YDX - 3L	SHEET 3 of 3
DATE FINISHED: 17/12/2015	DRILLED BY: DCN Drilling Ltd.	FLUID: Water	LOGGED BY: J. Husband

DATUM: Google Earth
EASTING: 399346.809 mE
NORTHING: 803934.398 mN
SURFACE ELEVATION: 3.17 m

For an explanation of the terms & symbols used see attached sheets.

DEPTH (m)	SOIL SYMBOL	SOIL/ROCK DESCRIPTION*	GEOLOGIC UNIT	GROUND WATER	CONDITION	TYPE	METHOD	RECOVERY (%)	PENETRATION RESISTANCE	MOISTURE CONTENTS = ● LIMITS: PLASTIC = × LIQUID = + (20, 40, 60) IN SITU VANE (kPa) = ✳ (50, 100, 150)	OTHER TESTS: Corrected Shear Vane Result ** U = peak / R = remoulded; SPT / Scala Penetrometer	ELEVATION (m)
		Fine to medium. UCS test carried out on sample from 11.10 to 11.21m. UCS = 2MPa.										
		SANDSTONE, fine, very weak, moderately weathered, dark grey. UCS test carried out on sample from 11.10 to 11.21m. UCS = 2MPa.	WAITEMATA GROUP				TT	81				
		SILTSTONE, very weak to weak, moderately weathered, grey.										
		SANDSTONE, fine to medium, very weak to weak, moderately weathered, dark grey.										
12.00		Solid nose SPT.					SPT	0			S > 50 50 blows for 83mm penetration	-8 / -9
		TARGET DEPTH REACHED. End of Borehole at 12.083 m										
13.00												-10
14.00												-11
15.00												-12
16.00												-13

Remarks:

*Soil descriptions based on NZ Geotechnical Society Guidelines 2005. **Shear vane test based on NZ Geotechnical Society Guidelines 2001.

19/1/16

BABBAGE LOG NEW LOGO L:\GINT\PROJECTS\51000 - 52000\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2\51897#GE 100 HALSEY STREET - GEOTECH REPORT B1-B2.GPJ

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	16 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	22 January 2016
	Title:	**Borehole 101 – Core box photos**		



Depth: 0 to 6.0m



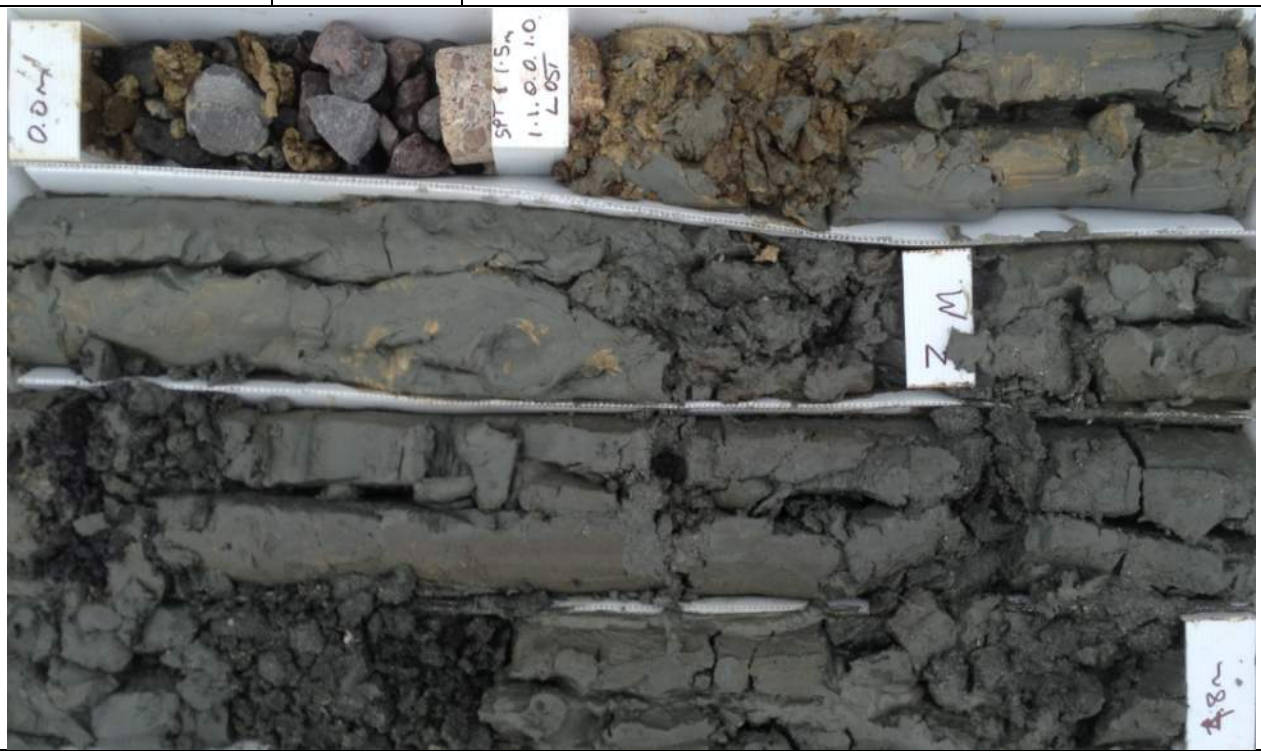
Depth: 6.0 t 9.0m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	16 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	22 January 2016
	Title:	**Borehole 101 – Core box photos**		



Depth: 9.0 to 12.0m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	15 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 102 – Core box photos**		



Depth: 0 to 4.8m



Depth: 4.8 t 8.4m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	15 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 102 – Core box photos**		



Depth: 8.4 to 11.5m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	15 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 103 – Core box photos**		



Depth: 0 to 5.6m



Depth: 5.6 t 9.0m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	15 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 103 – Core box photos**		



Depth: 9.0 to 10.5m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	16 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 104 – Core box photos**		



Depth: 0 to 6.0m



Depth: 6.0 t 10.5m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	16 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 104 – Core box photos**		

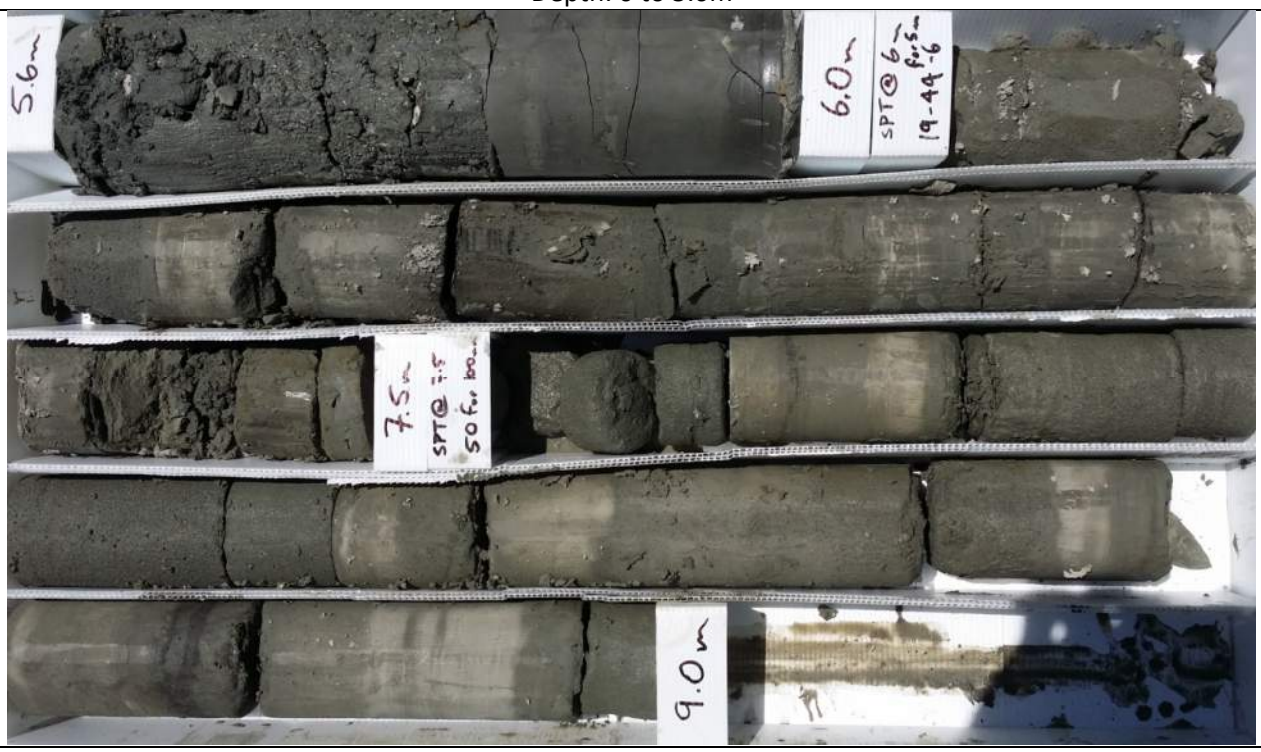


Depth: 10.5 to 12.08m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	18 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 105 – Core box photos**		



Depth: 0 to 5.6m

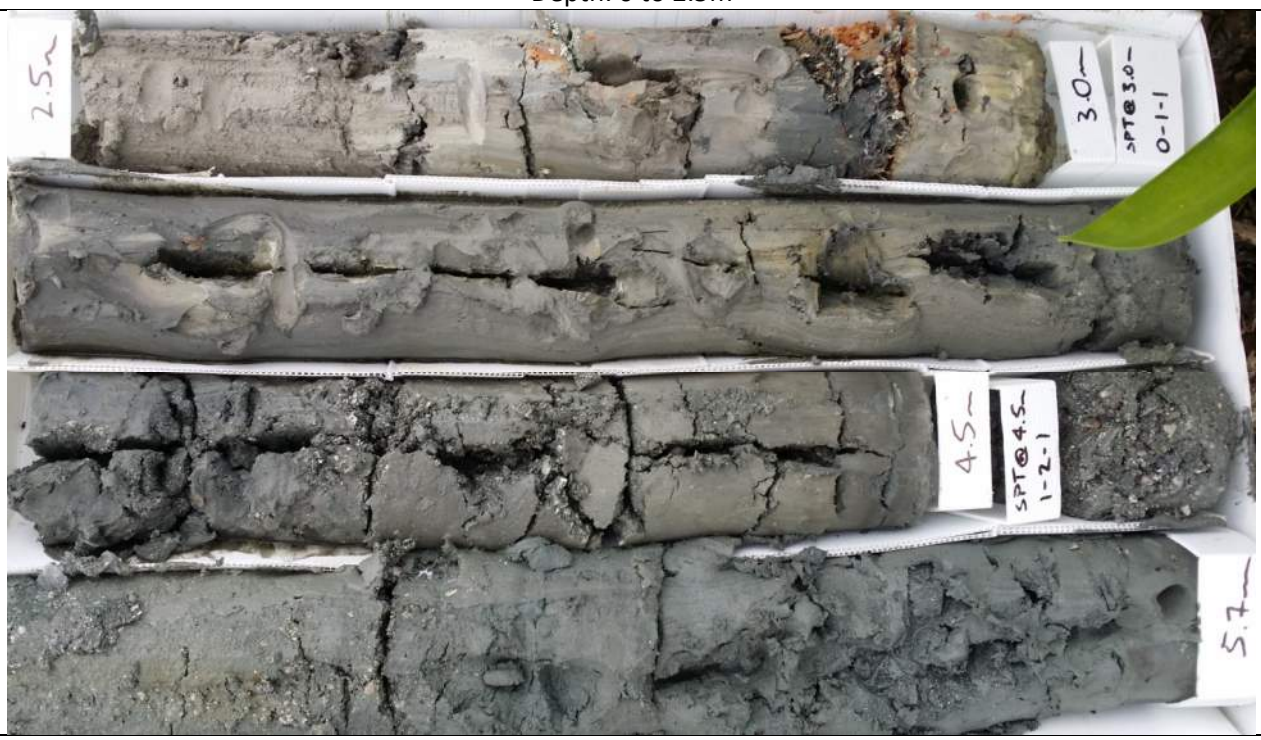


Depth: 5.6 t 9.0m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	17 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 106 – Core box photos**		



Depth: 0 to 2.5m



Depth: 2.5 t 5.7m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	17 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 106 – Core box photos**		



Depth: 6.0 to 9.6m

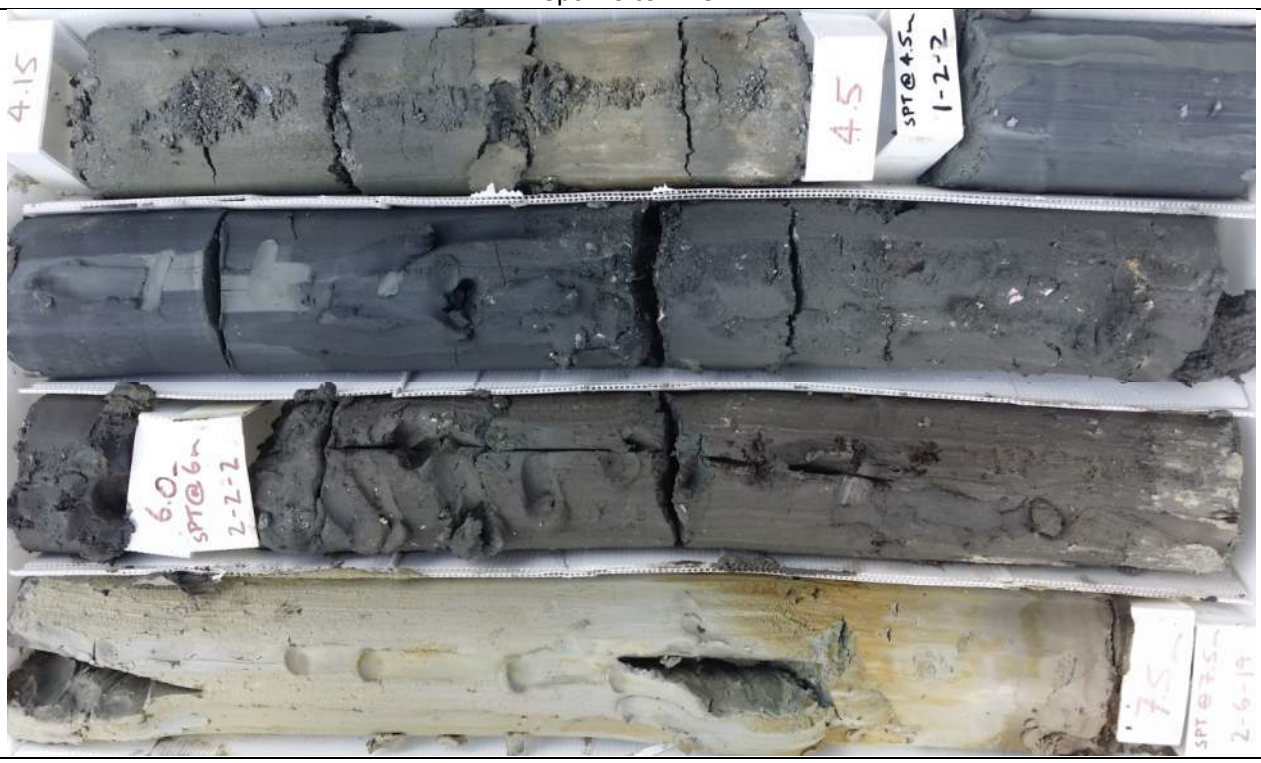


Depth: 9.6 to 10.585m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	17 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 107 – Core box photos**		



Depth: 0 to 4.15m



Depth: 4.15 to 7.5m

Babbage partners in excellence	Project Name:	**100 HALSEY STREET: GEOTECH REPORT B1 – B2**	Date:	17 December 2015
Client: **Infratil Infrastructure Property Limited**	Project Number:	**51897#GE**	Compiled	13 January 2016
	Title:	**Borehole 107 – Core box photos**		



Depth: 7.5 to 11.83m



Depth: 11.83 to 12.085m

Appendix C – Laboratory Test Results

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
P O Box 2027
New Zealand
Telephone 64-9-367 4954
E-mail wec@babbage.co.nz

Babbage Consultants Limited
PO Box 2027
Shortland Street
Auckland 1140

Attention: **ROB SANDQUIST**

Job Number: 51897#L
BGL Registration Number: 2265
Checked by: WEC

23rd December 2015

UNCONFINED COMPRESSIVE STRENGTH (UCS) TESTING

Dear Sir,

Re: NZ BUS 100 HALSEY ST DEPOT REDEVELOPMENT

Report Number: 51897#L/UCS

The following report presents the results of Uniaxial Unconfined Compressive Strength Testing of rock core samples delivered to this laboratory during December 2015. These samples were tested in accordance with the following standards:

Water Content:	NZS4402:1986:Test 2.1
Unconfined Compressive Strength Test:	NZS4402:1986:Test 6.3.1

The table below summarises the test results, with the following pages presenting sample measurements and test data.

Borehole Number	Sample Number	Depth (m)	FAILURE CONDITIONS			
			Unconfined Compressive Strength (kPa)	Strain at Failure		Failure Mode
				mm	%	
BH106	CORE	9.40	2,500	1.2	1.0	brittle
BH107	CORE	9.50	2,700	0.91	0.77	brittle
BH107	CORE	11.10	2,000	1.4	1.4	brittle

Please note that the test results relate only to the samples under test.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the undersigned at your convenience.

Yours faithfully,



Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory

IANZ
ACCREDITED LABORATORY
ACCREDITATION Nº: 126

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 3 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: BH106 **Sample Number:** CORE **Depth:** 9.40m

Time (minutes)	Compression Gauge (mm)	Specimen Compression (mm)	Strain	Load Gauge (mm)	Axial Force (N)	Corrected Area (mm^2)	Axial Stress (kPa)
0.00	14.909	0.000	0.000	8.619	0.0	2827.4	0
0.35	15.030	0.121	0.001	8.635	346.7	2830.3	122
0.68	15.132	0.224	0.002	8.663	932.9	2832.7	329
1.03	15.227	0.318	0.003	8.695	1633.1	2835.0	576
1.37	15.318	0.410	0.003	8.731	2409.2	2837.2	849
1.72	15.409	0.500	0.004	8.770	3242.3	2839.3	1142
2.07	15.499	0.590	0.005	8.809	4064.1	2841.5	1430
2.40	15.601	0.693	0.006	8.842	4766.9	2843.9	1676
2.75	15.710	0.802	0.007	8.869	5360.2	2846.5	1883
3.08	15.817	0.909	0.008	8.897	5963.5	2849.1	2093
3.43	15.926	1.018	0.009	8.923	6518.2	2851.7	2286
3.62	15.987	1.078	0.009	8.937	6801.4	2853.2	2384
3.78	16.042	1.133	0.009	8.948	7047.3	2854.5	2469
3.97	**16.100**	**1.191**	**0.010**	**8.957**	**7239.5**	**2855.9**	**2535**
4.18	16.199	1.290	0.011	8.953	7156.6	2858.3	2504
4.27	16.241	1.333	0.011	8.950	7090.3	2859.3	2480
4.37	17.307	2.398	0.020	8.620	21.7	2885.3	8

Unconfined Compressive Strength: 2,500 kPa

Babbage Geotechnical Laboratory

PROJECT: **NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT**

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: **BH106** **Sample Number:** **CORE** **Depth:** **9.40m**

Test Performed on: Whole soil /~~ Fraction passing 19mm test sieve~~

Sample History: Undisturbed~~ / remoulded / recompacted / unknown~~

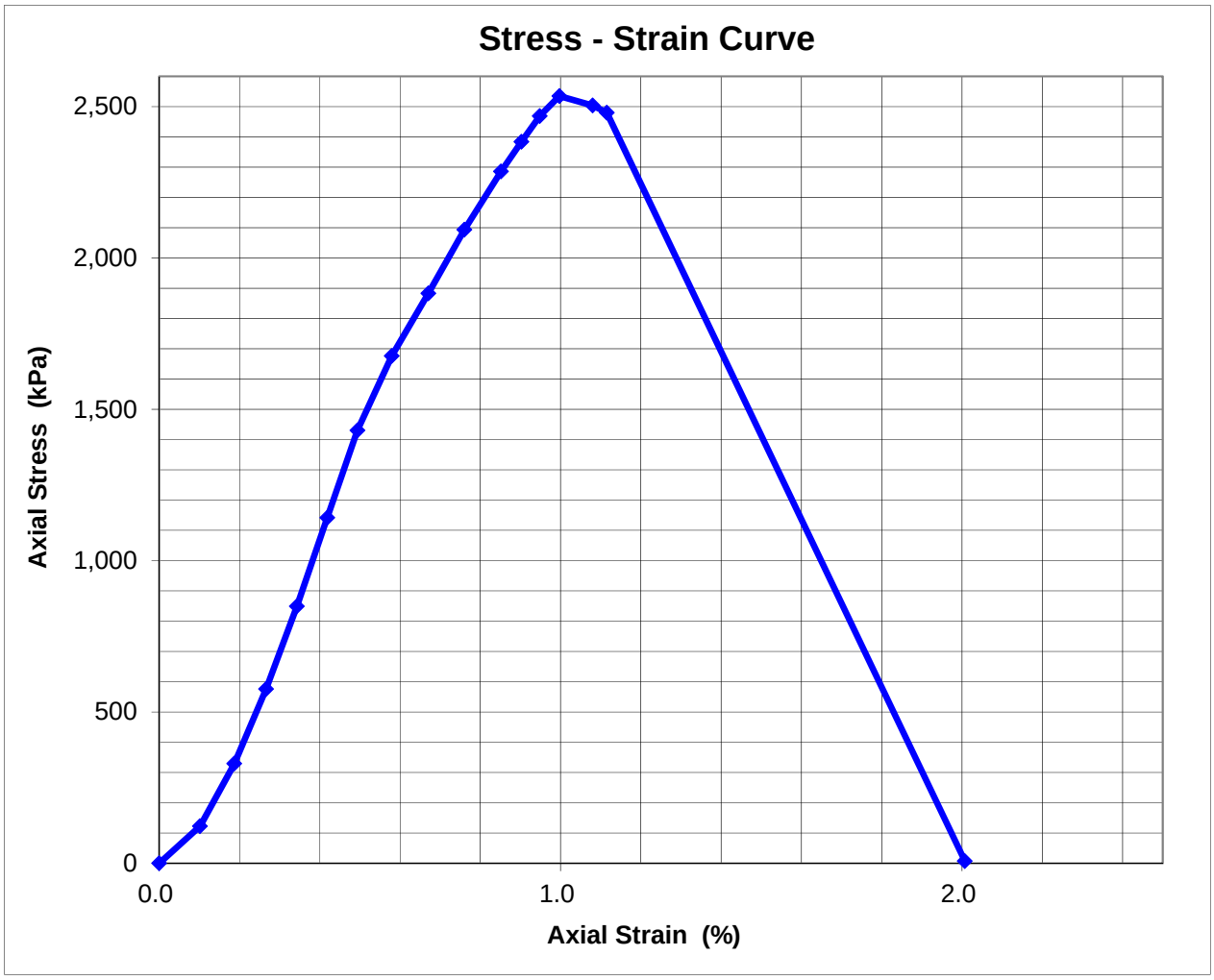
Sample Method & Type: from core sample ~~/ from tube sample / larger tube / block sample / pressed into tube compacted with standard/heavy compactive effort~~

Initial Diameter:	60.00	mm
Initial Length:	119.50	mm
Initial Mass:	697.11	g
Initial Bulk Density:	2.06	t/m^3
Initial Dry Density:	1.70	t/m^3
Water Content After Test:	22.4	%

Failure Conditions:

Strain at failure:	1.0	%
Compression at failure:	1.2	mm
Rate of Compression:	0.30	mm / minute

Mode of Failure: **brittle**



BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 5 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1			
	Tested By:	JF	22/12/2015
	Compiled By:	JF	22/12/2015
	Checked By:	WEC	23/12/2015

Bore Number: BH106 **Sample Number:** CORE **Depth:** 9.40m

Sample Description (*not part of BGL IANZ Accreditation*):

Top half of sample is SILTSTONE, bottom half is well cemented fine to coarse SANDSTONE. Very weak, slightly weathered, dark grey.

SAMPLE BEFORE TEST





SAMPLE AFTER TEST

BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 6 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: BH107 **Sample Number:** CORE **Depth:** 9.50m

Time (minutes)	Compression Gauge (mm)	Specimen Compression (mm)	Strain	Load Gauge (mm)	Axial Force (N)	Corrected Area (mm^2)	Axial Stress (kPa)
0.00	16.591	0.000	0.000	8.615	0.0	2642.1	0
0.33	16.661	0.070	0.001	8.623	157.0	2643.6	59
0.67	16.726	0.135	0.001	8.636	431.9	2645.1	163
1.02	16.787	0.196	0.002	8.651	757.2	2646.5	286
1.35	16.840	0.249	0.002	8.668	1118.1	2647.7	422
1.68	16.891	0.299	0.003	8.687	1534.2	2648.8	579
2.03	16.945	0.353	0.003	8.706	1946.4	2650.0	734
2.37	16.993	0.402	0.003	8.727	2400.3	2651.1	905
2.70	17.041	0.450	0.004	8.751	2908.6	2652.2	1097
3.05	17.085	0.494	0.004	8.775	3419.7	2653.2	1289
3.38	17.131	0.540	0.005	8.800	3948.1	2654.2	1487
3.73	17.177	0.586	0.005	8.824	4467.5	2655.3	1683
4.07	17.223	0.632	0.005	8.849	5011.2	2656.3	1887
4.40	17.268	0.677	0.006	8.874	5540.6	2657.3	2085
4.75	17.320	0.729	0.006	8.896	6018.5	2658.5	2264
5.08	17.373	0.781	0.007	8.919	6505.2	2659.7	2446
5.42	17.433	0.842	0.007	8.940	6947.7	2661.1	2611
5.77	**17.504**	**0.913**	**0.008**	**8.955**	**7282.6**	**2662.7**	**2735**
6.10	17.718	1.126	0.010	8.916	6432.7	2667.5	2411
6.43	19.757	3.166	0.027	8.625	204.9	2714.9	75

Unconfined Compressive Strength: 2,700 kPa

BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 7 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: BH107 **Sample Number:** CORE **Depth:** 9.50m

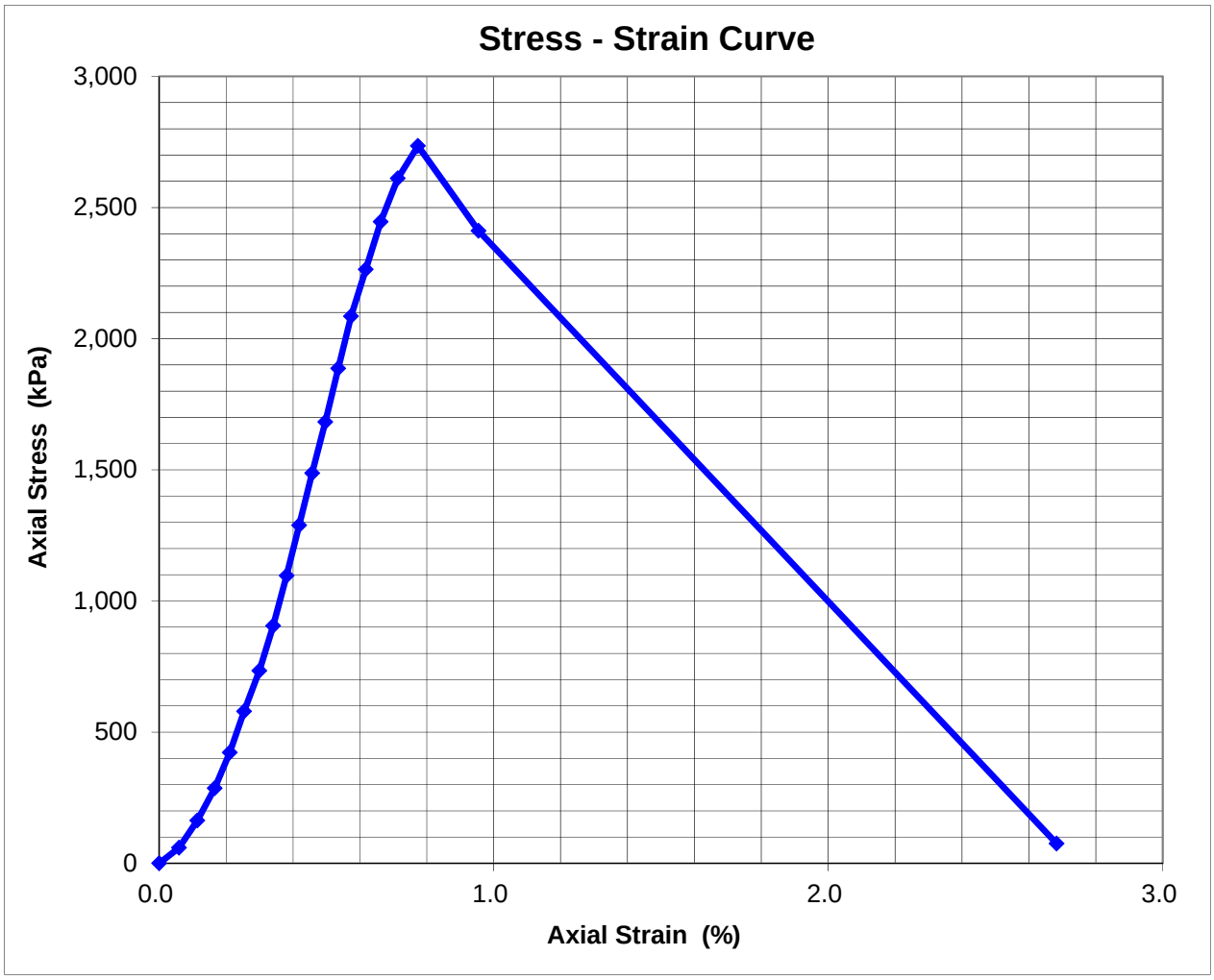
Test Performed on: Whole soil /~~ Fraction passing 19mm test sieve~~
Sample History: Undisturbed~~ / remoulded / recompacted / unknown~~
Sample Method & Type: from core sample ~~/ from tube sample / larger tube / block sample / pressed into tube compacted with standard/heavy compactive effort~~

Initial Diameter:	58.00	mm
Initial Length:	118.00	mm
Initial Mass:	667.31	g
Initial Bulk Density:	2.14	t/m^3
Initial Dry Density:	1.75	t/m^3
Water Content After Test:	20.6	%

Failure Conditions:

Strain at failure:	0.77	%
Compression at failure:	0.91	mm
Rate of Compression:	0.16	mm / minute

Mode of Failure: brittle



BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 8 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1			
	Tested By:	JF	22/12/2015
	Compiled By:	JF	22/12/2015
	Checked By:	WEC	23/12/2015

Bore Number: BH107 **Sample Number:** CORE **Depth:** 9.50m

Sample Description (*not part of BGL IANZ Accreditation*):

SANDSTONE, fine to coarse, very weak, slightly weathered, dark grey, well cemented.

SAMPLE BEFORE TEST





SAMPLE AFTER TEST

BGL Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 9 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: BH107 **Sample Number:** CORE **Depth:** 11.10m

Time (minutes)	Compression Gauge (mm)	Specimen Compression (mm)	Strain	Load Gauge (mm)	Axial Force (N)	Corrected Area (mm^2)	Axial Stress (kPa)
0.00	30.219	0.000	0.000	8.626	0.0	2827.4	0
0.35	30.284	0.066	0.001	8.641	314.6	2829.2	111
0.68	30.350	0.131	0.001	8.657	657.1	2831.0	232
1.03	30.414	0.196	0.002	8.673	1014.3	2832.7	358
1.37	30.479	0.260	0.002	8.690	1365.9	2834.5	482
1.70	30.545	0.326	0.003	8.708	1751.7	2836.2	618
2.05	30.608	0.390	0.004	8.727	2157.4	2838.0	760
2.38	30.674	0.455	0.004	8.744	2532.5	2839.7	892
2.72	30.740	0.521	0.005	8.763	2924.1	2841.5	1029
3.07	30.808	0.589	0.006	8.781	3312.3	2843.4	1165
3.40	30.876	0.657	0.006	8.797	3665.3	2845.2	1288
3.73	30.948	0.729	0.007	8.813	3995.6	2847.2	1403
4.08	31.021	0.802	0.008	8.826	4272.6	2849.2	1500
4.42	31.100	0.881	0.008	8.836	4505.5	2851.4	1580
4.75	31.170	0.951	0.009	8.848	4746.4	2853.3	1663
5.10	31.248	1.030	0.010	8.858	4963.3	2855.4	1738
5.43	31.324	1.105	0.011	8.868	5173.8	2857.5	1811
5.78	31.401	1.182	0.011	8.877	5372.0	2859.6	1879
6.12	31.477	1.258	0.012	8.885	5554.8	2861.7	1941
6.45	31.557	1.339	0.013	8.893	5707.9	2863.9	1993
6.80	**31.639**	**1.421**	**0.014**	**8.896**	**5780.3**	**2866.2**	**2017**
7.13	31.762	1.543	0.015	8.874	5302.1	2869.6	1848
7.47	31.967	1.748	0.017	8.655	627.8	2875.3	218

Unconfined Compressive Strength: 2,000 kPa

Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 10 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: BH107 **Sample Number:** CORE **Depth:** 11.10m

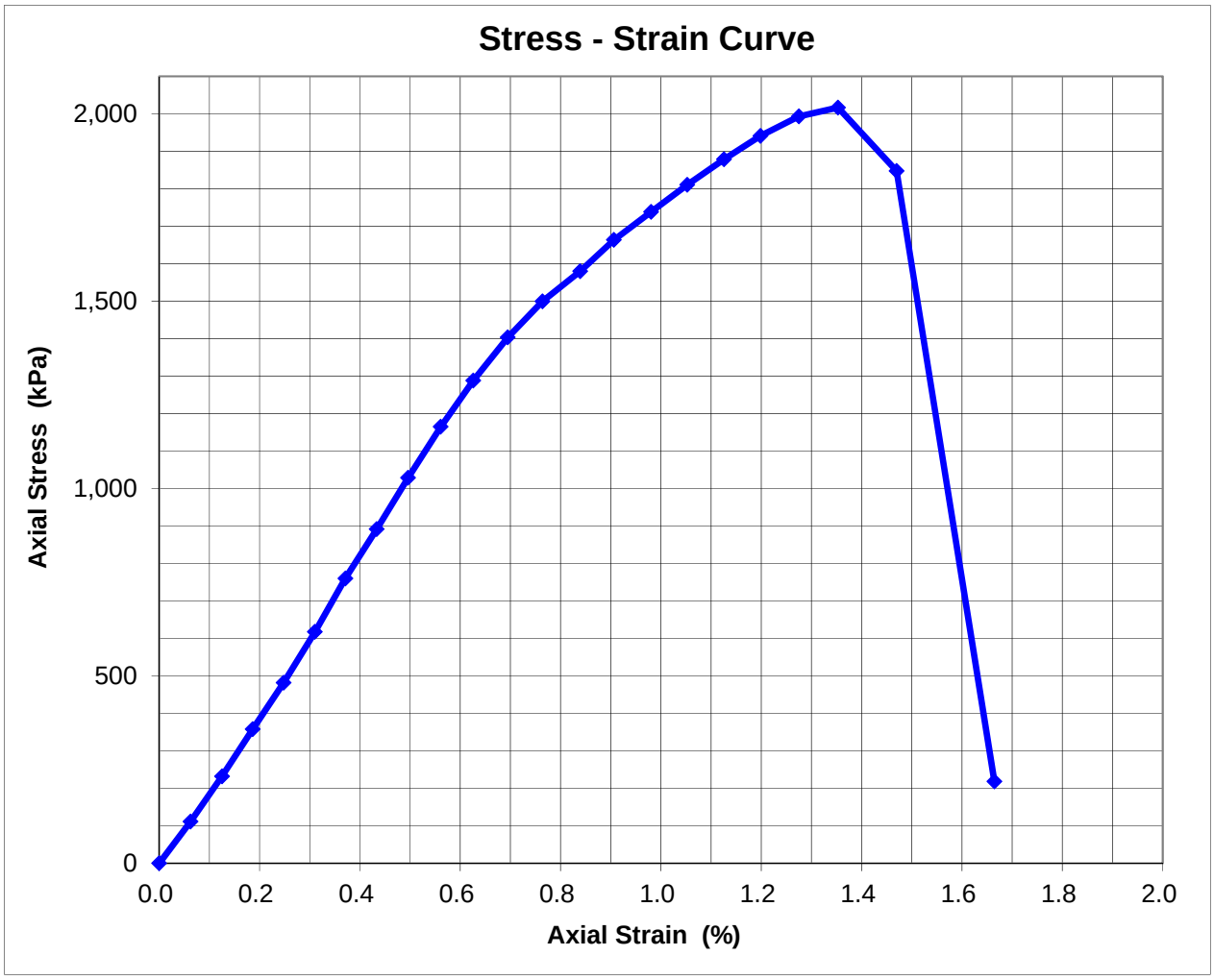
Test Performed on: Whole soil /~~ Fraction passing 19mm test sieve~~
Sample History: Undisturbed~~ / remoulded / recompacted / unknown~~
Sample Method & Type: from core sample ~~/ from tube sample / larger tube / block sample / pressed into tube compacted with standard/heavy compactive effort~~

Initial Diameter:	60.00	mm
Initial Length:	105.00	mm
Initial Mass:	625.12	g
Initial Bulk Density:	2.11	t/m^3
Initial Dry Density:	1.70	t/m^3
Water Content After Test:	23.7	%

Failure Conditions:

Strain at failure:	1.4	%
Compression at failure:	1.4	mm
Rate of Compression:	0.21	mm / minute

Mode of Failure: brittle



Babbage Geotechnical Laboratory	Job No:	Reg. No:	Report No:	Page 11 of 11
	51897#L	2265	51897#L/UCS	Version 1, Issued Jan-15
	PROJECT:	NZ BUS 100 HALSEY ST DEPOT REDEVLOPMENT		

Unconfined Compressive Strength of Cohesive Soils

Test Methods: NZS4402: 1986: Test 2.1 / Test 6.3.1

Tested By:	JF	22/12/2015
Compiled By:	JF	22/12/2015
Checked By:	WEC	23/12/2015

Bore Number: **BH107** **Sample Number:** **CORE** **Depth:** **11.10m**

Sample Description (*not part of BGL IANZ Accreditation*):

SILTSTONE, very weak, slightly weathered, dark grey.

SAMPLE BEFORE TEST





SAMPLE AFTER TEST

Babbage Geotechnical Laboratory
Level 4
68 Beach Road
Auckland 1010
P O Box 2027
New Zealand
Telephone 64-9-367 4954
E-mail wec@babbage.co.nz

Please reply to: W.E. Campton

Babbage Consultants Limited
PO Box 2027
Shortland Street
Auckland 1140

Attention: **ROB SANDQUIST**

Job Number: 51897#L
BGL Registration Number: 2265
Checked by: WEC

11th January 2016

WET SIEVE PARTICLE-SIZE DISTRIBUTION TESTING

Dear Sir,

Re: NZ BUS 100 HALSEY ST DEPOT REDEVELOPMENT

Report Number: 51897#L/PSD

The following report presents the results of wet sieve particle-size distribution testing of soil samples delivered to this laboratory during December 2015. Test results are summarised below, with the following pages showing graphs and detailed results. Test standards used were:

Water Content: NZS4402:1986:Test 2.1
Grading (Wet Sieve): NZS4402:1986:Test 2.8.1

Borehole Number	Sample Number	Depth (m)	Fraction of Sample (% of Dry Mass)		
			GRAVEL (2 – 60mm)	SAND (0.06 – 2mm)	SILT & CLAY FRACTIONS (< 0.06mm)
BH101	**D1**	**3.60**	**2**	**78**	**20**
BH103	**BAG**	**4.40**	**11**	**73**	**16**

Please note that the results table immediately above with the various particle-size fractions is included for your information only, and is not included in the IANZ endorsement for this report.

Please note that the test results relate only to the samples under test. Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report, please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory

ACCREDITED LABORATORY
ACCREDITATION Nº: 126

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.

BGL Babbage Geotechnical Laboratory	Job Number:	51897#L	Sheet 1 of 1	Page 2 of 3
	Reg. Number:	2265	Version No:	2
	Report No:	51897#L/PSD	Issue Date:	August 2012
	Project:	NZ BUS 100 HALSEY ST DEPOT REDEVELOPMENT		

PARTICLE SIZE DISTRIBUTION BY WET SIEVE

Test Methods: NZS4402: 1986: Test 2.1, Test 2.8.1

Tested By:	JH	Jan 2016
Compiled By:	JH	7-Jan-16
Checked By:	JF	11-Jan-16

BH: **BH101** ***Sample No:*** **D1**

Depth: **3.60m** ***Moisture Content:*** **41.0 %** (material < 37.5mm)

Sieve Size (mm)	Percentage Passing
26.50	100
19.00	99
13.20	99
9.50	99
6.70	99
4.75	99
2.00	98
1.18	98
0.600	97
0.425	96
0.300	95
0.212	92
0.150	81
0.090	43
0.063	20

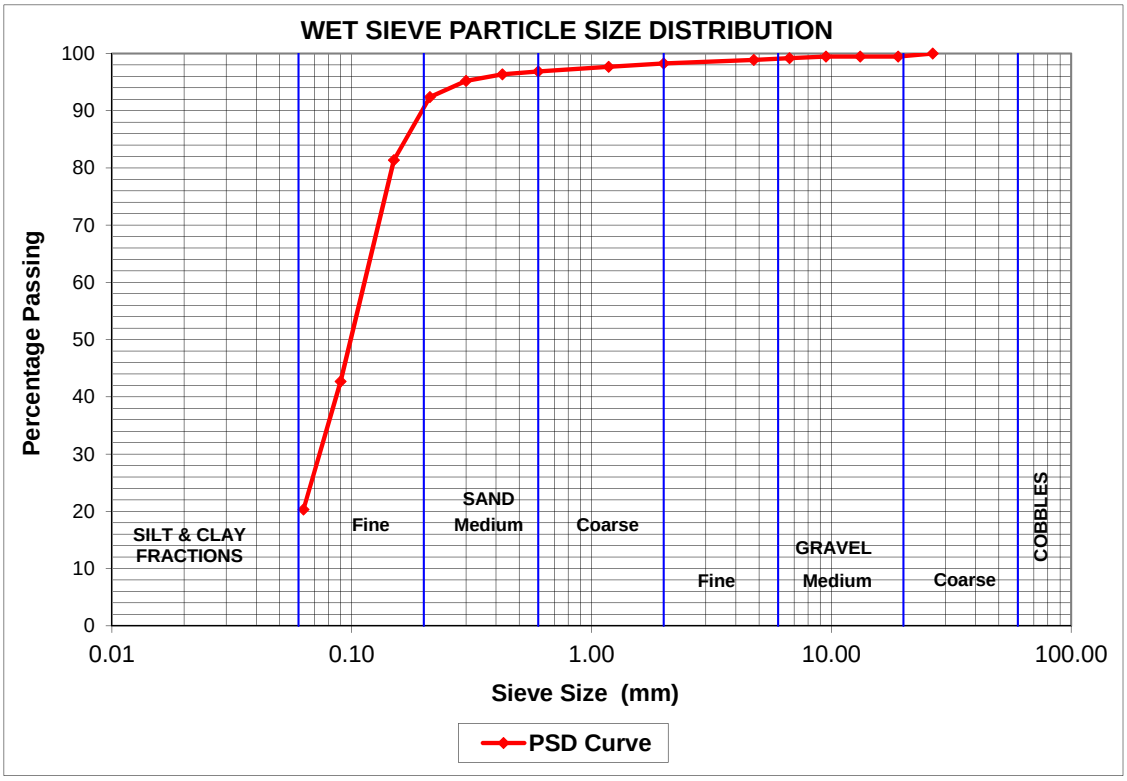
TEST METHOD:

Sample weighed wet, then oven-dried and re-weighed. Sample then washed over a 63µm sieve. Sample then oven dried, weighed & sieved over a stack of test sieves. The percentage passing the 63µm was obtained by difference.

SIEVE ANALYSIS (% of dry mass)

				TOTAL	
COBBLES:		*200 - 60mm*		0	%
GRAVEL:	(Coarse)	*60 - 20mm*	0		
	(Medium)	*20 - 6mm*	1	2	%
	(Fine)	*6 - 2mm*	1		
SAND:	(Coarse)	*2.0 - 0.6mm*	1		
	(Medium)	*0.6 - 0.2mm*	7	78	%
	(Fine)	*0.2 - 0.06mm*	70		
SILT & CLAY FRACTIONS:		*< 0.06mm*		20	%
				100%	

Please note that the various particle-size fractions shown above is included for your information only, and is not included in the IANZ endorsement for this report.



BGL Babbage Geotechnical Laboratory	Job Number:	51897#L	Sheet 1 of 1	Page 3 of 3
	Reg. Number:	2265	Version No:	2
	Report No:	51897#L/PSD	Issue Date:	August 2012
	Project:	NZ BUS 100 HALSEY ST DEPOT REDEVELOPMENT		

PARTICLE SIZE DISTRIBUTION BY WET SIEVE

Test Methods: NZS4402: 1986: Test 2.1, Test 2.8.1

Tested By:	JH	Jan 2016
Compiled By:	JH	7-Jan-16
Checked By:	JF	11-Jan-16

BH: **BH103** ***Sample No:*** **BAG**

Depth: **4.40m** ***Moisture Content:*** **32.0 %** (material < 37.5mm)

Sieve Size (mm)	Percentage Passing
26.50	100
19.00	99
13.20	98
9.50	96
6.70	94
4.75	93
2.00	89
1.18	87
0.600	85
0.425	84
0.300	80
0.212	71
0.150	46
0.090	26
0.063	16

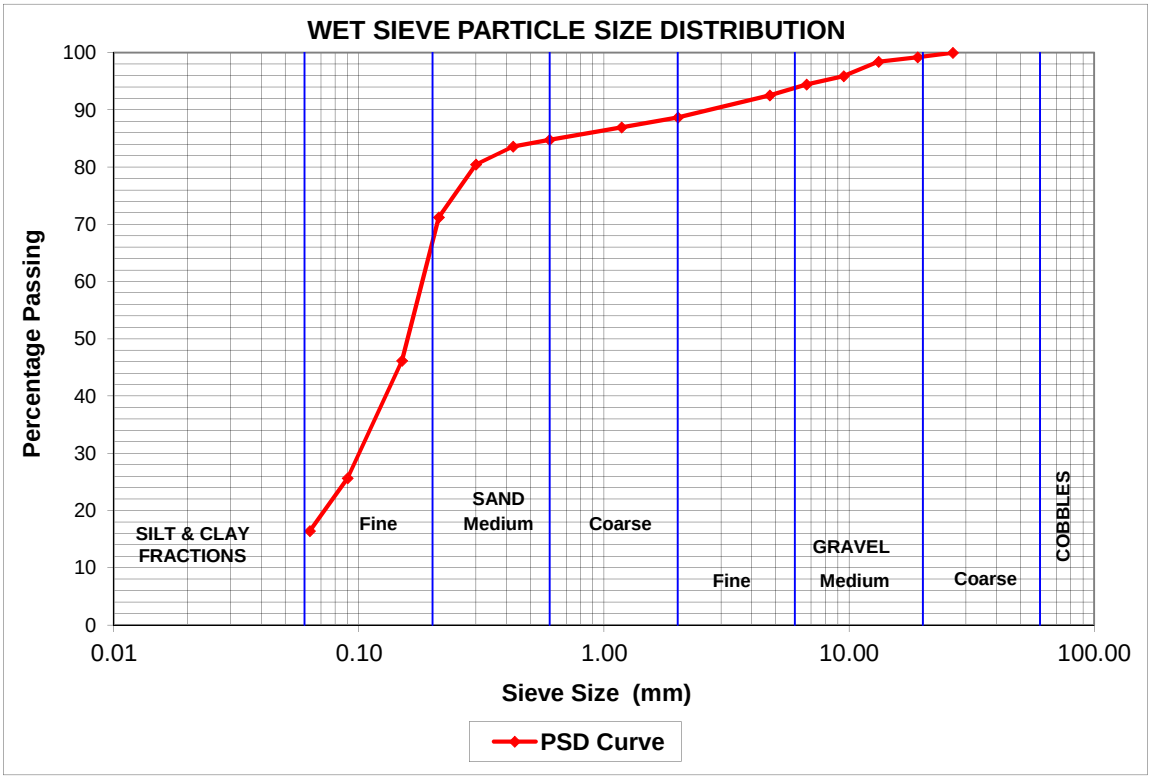
TEST METHOD:

Sample weighed wet, then oven-dried and re-weighed. Sample then washed over a 63µm sieve. Sample then oven dried, weighed & sieved over a stack of test sieves. The percentage passing the 63µm was obtained by difference.

SIEVE ANALYSIS (% of dry mass)

				TOTAL	
COBBLES:		*200 - 60mm*		0	%
GRAVEL:	(Coarse)	*60 - 20mm*	1		
	(Medium)	*20 - 6mm*	5	11	%
	(Fine)	*6 - 2mm*	5		
SAND:	(Coarse)	*2.0 - 0.6mm*	4		
	(Medium)	*0.6 - 0.2mm*	18	73	%
	(Fine)	*0.2 - 0.06mm*	51		
SILT & CLAY FRACTIONS:		*< 0.06mm*		16	%
				100%	

Please note that the various particle-size fractions shown above is included for your information only, and is not included in the IANZ endorsement for this report.



B4 T+T 1986 machine borehole, test pit logs and laboratory test reports

BOREHOLE LOGS AND TEST RESULTS
APPENDIX OF TERMS

SOIL DESCRIPTIONS

General: The descriptive system used is based mainly on grain size and comments on geological origin are supplementary

Soil Types and Symbols:

Symbol	Description
	limestone
	volcanic rock
	sandstone
	siltstone or mudstone
	cemented
	gravel (size > 2mm)
	sand (size 0.06 to 2.0 mm)
	silt (size 0.002 to 0.06 mm)
	clay (size < 0.002 mm)
	peat
	fill

These symbols are similar to those of the Unified Classification System (U.S.A.). They are adapted in some instances to denote soils not completely described in the adjacent table.

example



sandy clay

silty sand

Soil Strengths (cohesive)

Term	Undrained Shear Strength (kPa)
very soft	0 – 12
soft	12 – 25
medium	25 – 50
firm	50 – 100
stiff	100 – 200
hard	200 – 400
stone strength	>400

SOIL COLOURS

Colours, for purposes of description, have been simplified to light, standard and dark shades of red, pink, yellow, orange, brown, grey, green, blue and purple together with plain white and black.

ABBREVIATIONS

●	undrained triaxial test result	W_L	liquid limit
○	ditto – sample remoulded	PSD	particle size determination
■	laboratory vane test result	CONS	consolidation test
□	ditto – sample, remoulded	COMP	compaction test
N	blows per foot, standard penetration test (SPT)	Q	compressive strength
		Cu ϕu	undrained triaxial test (set)
B	blows per 3 feet for 3" open barrel driven as for S.P.T. test	C' ϕ'	effective stress triaxial test
		ɣ mm	max./min. density test
⏚	recorded water level	k	permeability coefficient
W	natural moisture content	S.L.	shrinkage limit
W_p	plastic limit	O.C.	organic content
St	sensitivity	ρ	bulk density

SAMPLE TYPES

●	open barrel	▮	large diameter thin walled tube (10 cm. or greater)
◉	double or triple barrel	▯	small diameter thin walled tube
▮	standard penetration test	○	disturbed sample
△	block		

SITE: CARPARK, A.R.A. BUS DEPOT, FREEMANS BAY.

BOREHOLE No. 1

JOB No: 7391 DATE DRILLED: 21/04/86 RL GROUND: 3.31

SHEET 1 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE / S.P.T. 'N' Value (Blows/300mm)
PAVEMENT ASPHALT			
FILL: SILT (organic), sl.clayey, firm, mottled dk.grey, brown, green and black		1.0	
-some miscellaneous rubbish (@0.8m)			
-some cinders and wood. -bec. medium to firm.		2.0	
-bec. medium, abundant glass pieces. CORE LOST		3.0	
-some pockets of CLAY, medium, yellow.		4.0	
SAND, very loose, grey-brown.		5.0	
SILT, clayey, soft-medium, greyish green with SAND layers. -bec. organic, dk.grey, some pockets of shells, loose.		6.0 7.0	
CLAY, silty, soft-medium, greyish green. CORE LOST -becoming sl.sandy, grey with yellow mottles. -becoming sandy, dk.yellow.		8.0 9.0	
SILT, clayey, hard, with weakly cemented SAND layers, dk.grey.		10.0	
Interbedded SILTSTONE and SANDSTONE, moderately cemented, dk.grey. -some weakly to moderately cemented layers.		11.0 12.0 13.0	

G.W.L. (23/4/86)

UNDRAINED SHEAR STRENGTH K Pa
× Field Shear Vane (End of Open Barrel)
⊙ Lab. Shear Vane
50 100 150 200

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)
W_P W W_L
20 40 60 80

0 50 100 75

NOTES:

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: CARPARK, GAUNT STREET BUS DEPOT.

BOREHOLE No. 1

JOB No: 7391 DATE DRILLED: 21/04/86 RL GROUND: 3.31

SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	S.P.T. 'N' Value (Blows/300mm)	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L
Interbedded SILTSTONE and SANDSTONE, moderately cemented, dk. grey.		14.0	● ● ■	>100		
End of Borehole @ 14.30m		15.0				
		16.0				

DRILL METHOD: MACHINE-ROTARY

NOTES:

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: GAUNT STREET, A.R.A. BUS DEPOT, FREEMANS BAY.

BOREHOLE No. 2

JOB No: 7391 DATE DRILLED: 22/04/86 RL GROUND: 2.97

SHEET 1 OF 2

DESCRIPTION OF SOIL	DEPTH (m)
PAVEMENT: ASPHALT	
FILL:GRAVELS (Scoriaceous)	
Concrete	1.0
SILT (organic) soft-medium, black, some brick and glass	
CLAY, sl.silty, soft-medium, grey, occ. sand lenses	2.0
	3.0
- minor organic traces	4.0
	5.0
CLAY, sandy, medium to firm, dk.grey some shells	6.0
CLAY, silty, medium, dk.grey, some organic inclusions.	
SAND, silty, medium, dk.grey, some shell pieces.	7.0
CLAY, silty, medium, dk.grey, some shell and wood pieces.	8.0
-occasional shell and wood pieces	9.0
-becoming sandy.	10.0
SILT, clayey, firm, lt.grey with stiff sandy layers.	11.0
-becoming stiff, abundant - gravels, some wood and peat	12.0
SILT, sl.clayey, sandy, hard, green with grey mottles.	13.0
	>50

SOIL SYMBOL | SAMPLE TYPE | S.P.T. 'N' Value (Blows/300mm) | G.W.L. (28/4/86)

UNDRAINED SHEAR STRENGTH K Pa
× Field Vane (End of Open Barrel)
⊙ Lab. Shear Vane
50 100 150 200

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)
W_P W W_L
20 40 60 80

NOTES:

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: GAUNT STREET, A.R.A. BUS DEPOT, FREEMANS BAY

BOREHOLE No. 2

JOB No: 7391 DATE DRILLED: 22/04/86 RL GROUND:

SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT 'N' Valve (Blows/300mm)	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L
SILT, sl.clayey, sl.sandy, hard, green with grey mottles				CORE LOST		
SAND, very dense, dk.grey with some interbedded hard SILT layers.		14.0				
		15.0		> 50		
Interbedded SILTSTONE and SANDSTONE moderately to well cemented, dk.grey.		16.0		> 100		
End of Borehole @ 16.35m						

NOTES:

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: CARPARK, ARA BUS DEPOT, FREEMANS BAY

PIT No. 1

JOB No: 7391 DATE DRILLED: 30/4/86 RL GROUND:

SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE
Pit 1: R.L.3.29 m			
Concrete			
FILL: GRAVELS (fine), silty, medium dense, lt brownish black with orange pockets, abundant pieces of shell, glass and concrete			O
CLAY, sl silty, very soft, bluish grey		1.0	O
End of Pit @ 1.3 m			

UNDRAINED SHEAR STRENGTH K Pa

× Field Shear Vane

20 40 60 80

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)

W_P W W_L

20 40 60 80

GWL (30/4/86)

NOTES:

EXCAVATION METHOD: Hydraulic Excavator

TONKIN & TAYLOR LTD CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: CARPARK, ARA BUS DEPOT, FREEMANS BAY

PIT No. 2

JOB No: 7391 DATE DRILLED: 30/4/86 RL GROUND:

SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE
Pit 2: R.L.3.39 m			
Asphalt		0.0	
ILL: GRAVELS, well graded, medium dense, grey (Basecourse)			
CLAY, lt brown			
GRAVELS (fine), silty, dense, lt brownish black with orange mottles, abundant miscellaneous rubbish, ie ~~glass, concrete~~		1.0	
CLAY, sl silty- very soft, bluish grey			
- some wood and metal pieces		2.0	
End of Pit @ 2.2 ,			

UNDRAINED SHEAR STRENGTH K Po
X Field Shear Vane
20 40 60 80

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)
W_P W W_L
20 40 60 80

GWL (30/4/86)

NOTES:

EXCAVATION METHOD: Hydraulic Excavator

TONKIN & TAYLOR LTD CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: CARPARK, A.R.A. BUS DEPOT, FREEMANS BAY

PIT No. 3

JOB No: 7391 DATE DRILLED: 30/04/86 RL GROUND:

SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE
Pit 3: R.L.3.16 m			
GRAVELS (Scoriaceous) medium-dense.			
FILL: CLAY, silty, medium, abundant miscellaneous pieces (concrete brick and glass).			
- some organics			
- becomes gravelly, orange staining		1.0	
SILT, sandy, firm, bluish-grey			
-becomes clayey, medium, occ. wood pieces, (@ 1.1m)			
CLAY, sl.silty, soft			
- organic layer		2.0	
End of Pit @ 2.2m			

UNDRAINED SHEAR STRENGTH K Pa

× Field Shear Vane

20 40 60 80

○ (Bulk)

GWL (30/4/86)

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)

W_P W W_L

NOTES:

EXCAVATION METHOD: Hydraulic Excavator

TONKIN & TAYLOR LTD CONSULTING CIVIL AND FOUNDATION ENGINEERS



PIT 2

GRAVELS, medium dense, well graded, grey

GRAVELS, (fine), silty, dense, abundent shell and glass pieces, dk. grey

SILT, sandy, firm, bluish-grey, becomes clayey, soft with depth

PIT 3

CLAY, silty, gravelly, medium, brownish-grey

SILT, sandy, firm, bluish-grey



SITE: CARPARK: ARA BUS DEPOT, FREEMANS BAY

PIT No. 4

JOB No: 7391 DATE DRILLED: 30/4/86 RL GROUND: 100.13 m SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE
Pit 4: R.L.3.21 m			
Asphalt seal		0.0	
FILL, GRAVELS, dense, dk grey (Basecourse) (≯ 50 mm)			○ (Bulk)
Old Pavement			
SILT, gravelly, firm, black, some glass pieces			
SILT, sandy, firm, bluish-grey			
CLAY, sl silty, soft, bluish-grey		1.0	○ (Bulk)
GRAVELS, silty, loose to medium dense black, some wood.			○
End of Borehole @ 1.6 m		2.0	

UNDRAINED SHEAR STRENGTH K Pa
× Field Shear Vane
20 40 60 80

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)
W_P W W_L
20 40 60 80

NOTES:

EXCAVATION METHOD: Hydraulic Excavator



PIT 4

GRAVELS, well graded, dense, grey

SILT, gravelly, firm, black

CLAY, sl. silty, soft, bluish-grey

TABLE 1 : SUMMARY OF LABORATORY TEST RESULTS

BOREHOLE No.	BOREHOLE Depth	Description	Natural Water (%)	Bulk Density (t/cu.m)	Undrained Shear Strength (kPa)	Other Tests
1	1.0	CLAY, sandy, medium, brown, some wood, bitumen and gravels	36.1		37	
	4.5	SAND, silty, loose, dk.grey, with brick and glass	34.5		22	
	2.0	CLAY, silty, medium grey, some glass pieces	32.9	1.84	34	
2	2.0	CLAY, sandy, soft, dk. grey	93.8	1.44	18	Consol
	4.0	SILT, sandy, soft, grey, orange matter, some SAND layers	83.5	1.52	13	Consol
3	2.5	SAND, silty, loose, grey	57.2	1.54	35	
	7.0	CLAY, silty, soft, lt. grey with orange matter	47.7	1.69	24	
Pit No.	Depth					P.S.D.
2	0.4	GRAVELS (fine-coarse), sandy, black	11.1			C.B.R. = 70% @ W.C. = 7.8%
3	0.5	CLAY, silty, brownish grey	57.9			L.L. = 111 P.I. = 41
4	0.3	GRAVELS, (fine-coarse), sandy, black	6.2			P.S.D. C.B.R. = 60% @ W.C. =8.8%

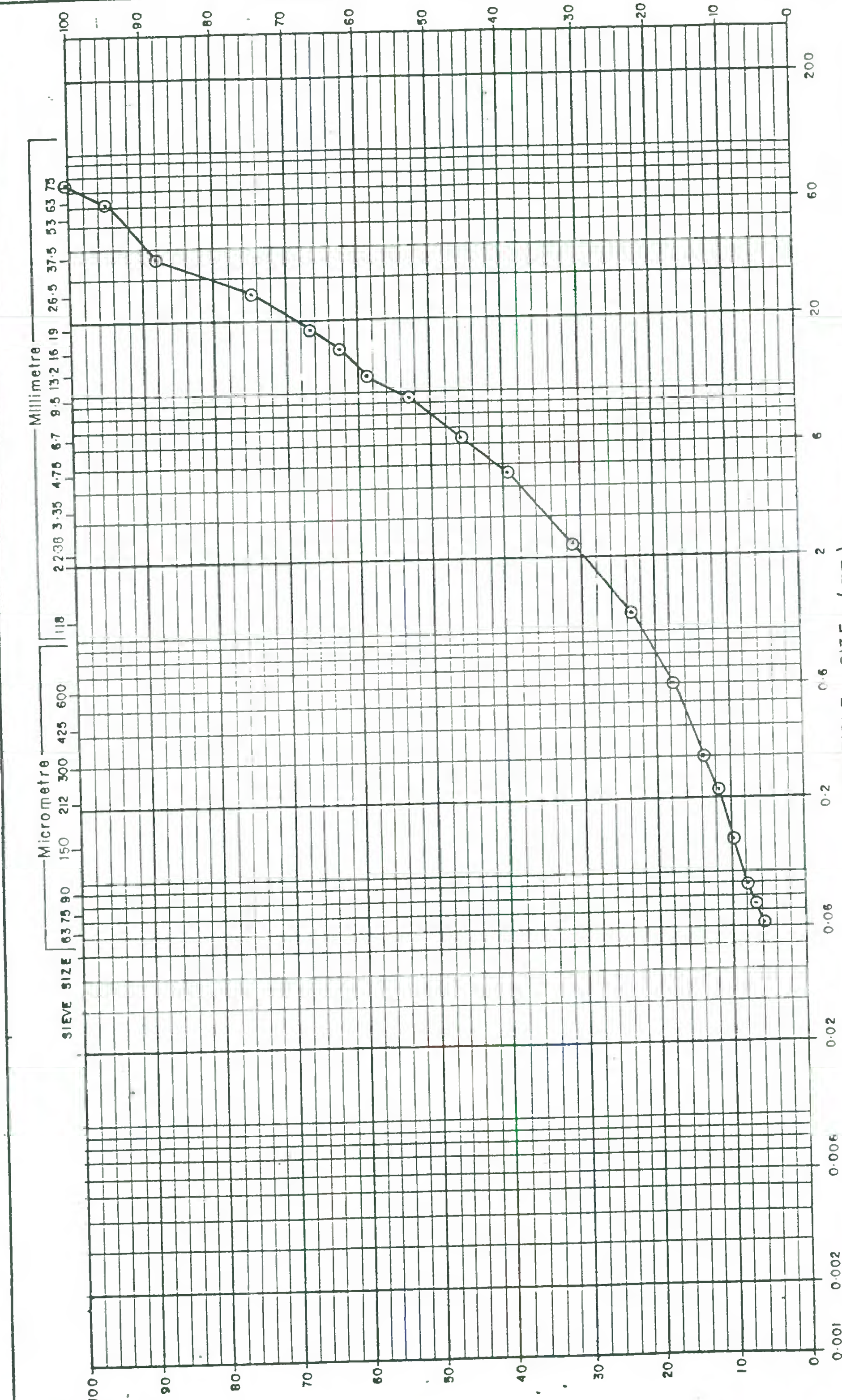
TABLE 2 : SUMMARY OF CONCRETE CORE TEST RESULTS

Location	CORE DIMENSIONS		Density (kg/cu.m)	Description	Original slab (1920's)	Overlay slab (1950's)	Compressive strength (MPa)
	Length (mm)	Diameter (mm)					
CC1	175	96	2,600	Aggregate size > 220 mm. Homogeneous sample, few voids 1 x 15 mm Ø reinf. bars		x	44.5
CC2	142	95	2,670	Aggregate size > 20 mm. Homogeneous sample, some minor voids 1 x 19 mm Ø reinf. bar		x	52.5
	157	96	2,640	Aggregate size > 20 mm. Homogeneous sample with 2 x 10 mm Ø reinf. bar.		x	57.0
CC3	147	96	2,600	Aggregate size > 20 mm Homogeneous matrix, with part of 1 x 15 mm Ø reinf. bar		x	51.0
	103	96	2,200	Aggregate size > 25 mm. Lean matrix, numerous small voids. 2 x 15 mm Ø reinf. bars.	x		18.0
Pit 1	90	96	2,190	Aggregate size > 30 mm. Excess voids, agg. well distributed	x		18.0
	105	96	2,210	Aggregate size > 30 mm. Homogeneous matrix.	x		19.0

FORM No. S7

PARTICLE SIZE DISTRIBUTION

S7



TESTED BY:	SA
DATE:	26.5.86
CHECKED BY:	SL
DATE:	26.5.86

REMARKS - Sample washed thru 63 μm and mass passing calculated by difference

Pit	2
SAMPLE No.	1
DEPTH (m)	0.4
PLOTTING SYMBOL	⊙
SOLID DENSITY (t/m³)	
Assumed / measured	

JOB No: 7391

SITE: ARA BUS DEPOT Gaunt Street

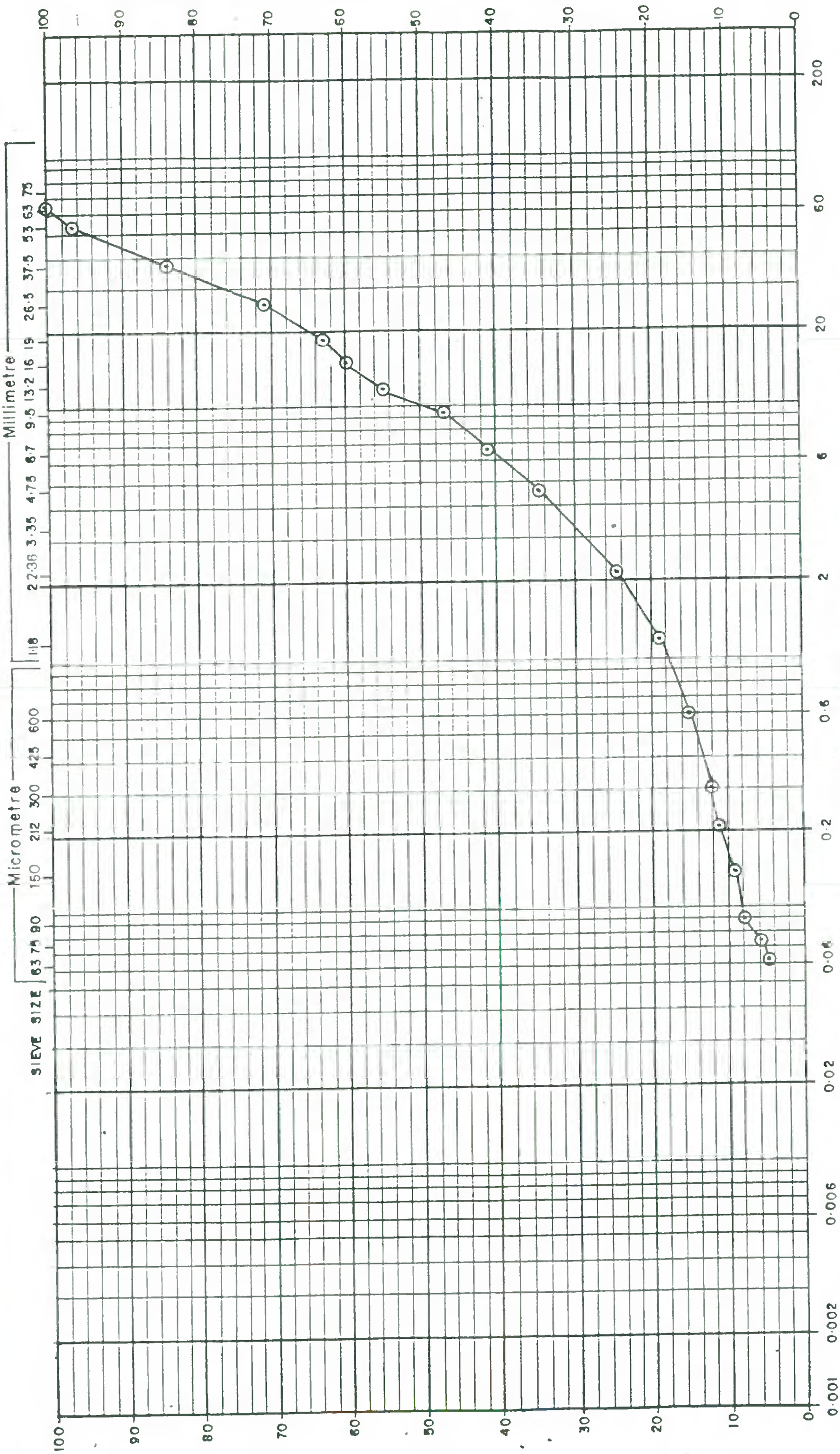
NZS 4402. Part 6. 1988 Test 6.6. NZS 3111. 1980. Method 6..

GEOTECHNICS LTD.	JOB No. 7391	PLATE No. 1

FORM No. S7

PARTICLE SIZE DISTRIBUTION

S7



	MEDIUM	COARSE	FINE	MEDIUM	COARSE	V. COARSE
	SILT	SAND	GRAVEL			
CLAY	FINE					

B.H. No.	Pit 4
SAMPLE No.	1
DEPTH (m)	0.3
PLOTTING SYMBOL	○
SOLID DENSITY (t/m³)	Assumed / measured

TESTED BY:	SA
DATE:	26.5.86
CHECKED BY:	SL
DATE:	26/5/86

JOB No:	7391
SITE:	ARA BUS DEPOT Gaunt Street

REMARKS Sample washed over 63 μm and mass passing calculated by difference.

NZS 3111 1980 Method 6..

GEOTECHNICS LTD.

JOB No. 7391

PLATE No. 2

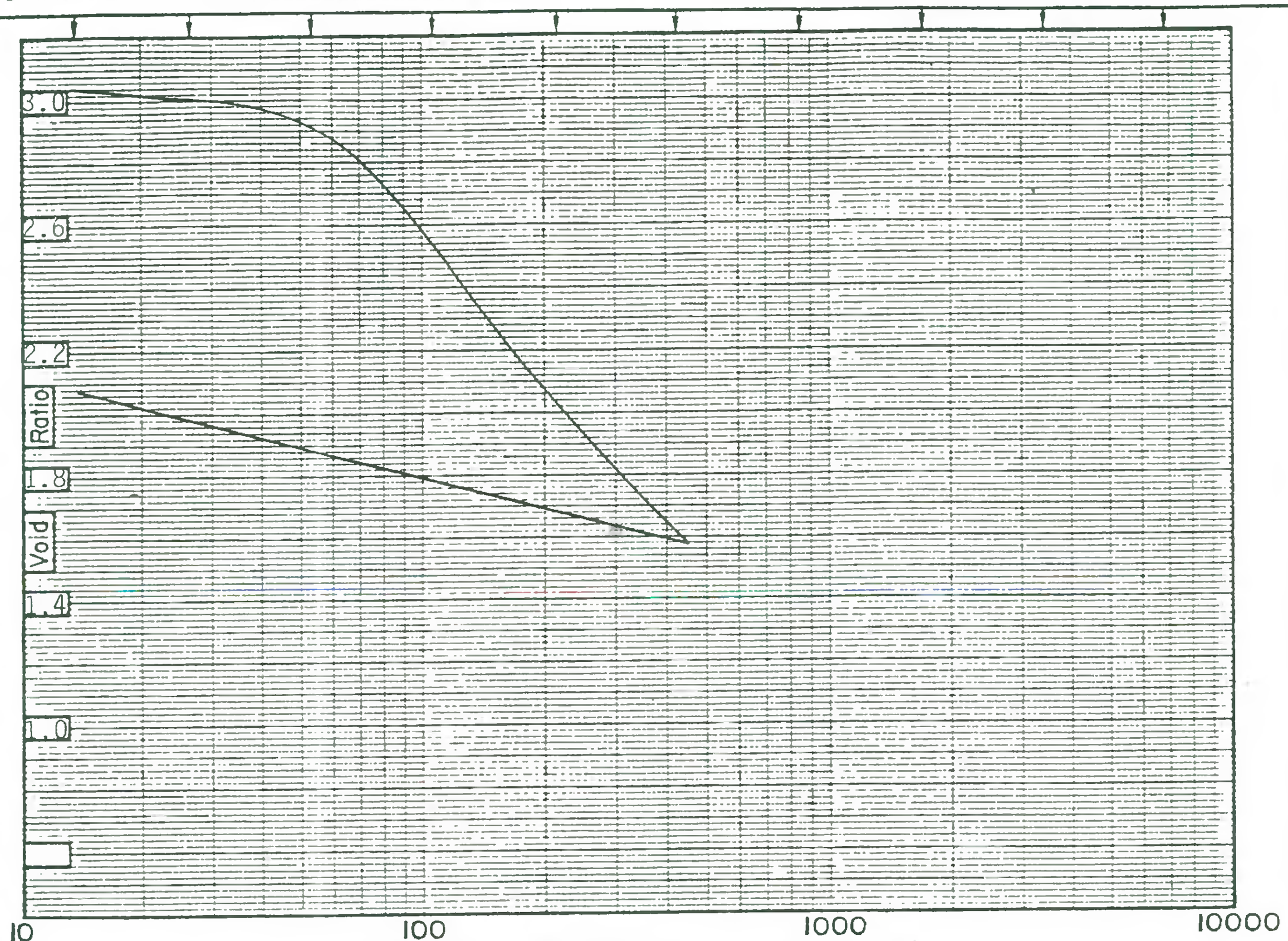
geotechnics limited

Form No S.3.2

Operator RW **Date** 26.5.86 **Site** ARA BUS DEPOT Gaunt Street **Job No** 7391

Test Method Used: *NZS 4402 Part 2P 1981, TEST 21*

BOREHOLE / PIT Nº 2 SAMPLE Nº 1 DEPTH 2 m



INITIAL PROPERTIES	PRESSURE kPa	VOID RATIO e	COEFFICIENT OF - CONSOLIDATION C_v (m^2 / yr)	COMPRESSIBILITY M_v (m^2 /MN)
ρ_{di} = 0.66 t / m^3	As Received	3.058	-	0.55
	6.7	3.043	11	0.44
w_i = 117 %	13.4	3.031	11	0.74
	26.8	2.991	10	0.89
S_i = 100 %	53.6	2.896	1	1.96
	107	2.488	1	1.34
TEMPERATURE DURING TEST	215	1.982	1	0.63
	429	1.580		
MAX = 25 °C	Rebounded 13.4	2.076		
MIN = 21 °C				

SAMPLE HISTORY : Undisturbed Core, Natural Water Content

REMARKS : -

CONSOLIDATION TEST(38.1/76.2mm Ø Ring) Plate No. 3

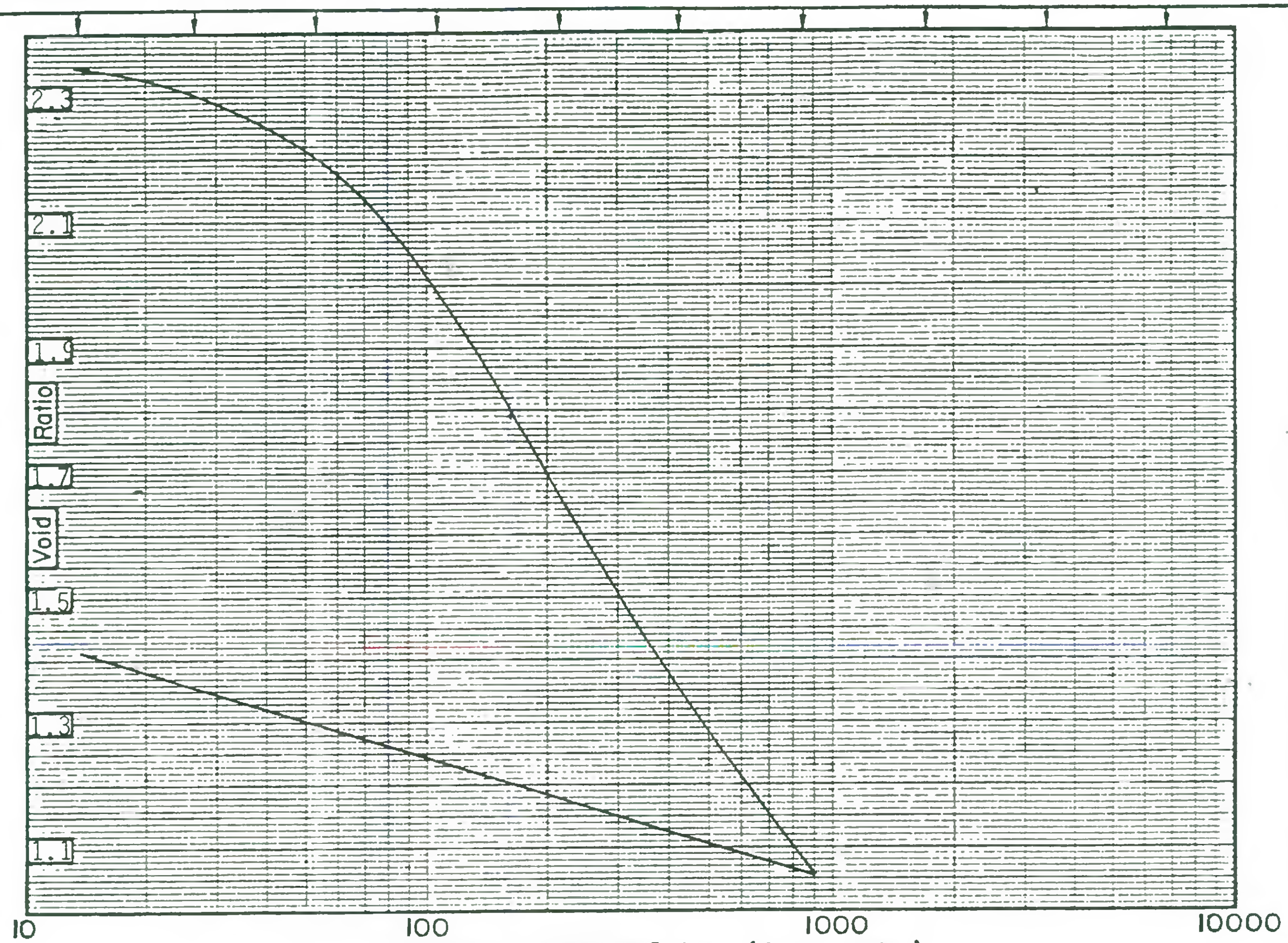
geotechnics limited

Form No S.32

Operator RW **Date** 15.5.86 **Site** ARA BUS DEPOT Gaunt Street **Job No** 7391

Test Method Used: *NZS 4402 Part 2P 1981, TEST 21*

BOREHOLE / PIT Nº 2 SAMPLE Nº 4 DEPTH 4 m



INITIAL PROPERTIES	PRESSURE kPa	VOID RATIO e	COEFFICIENT OF - CONSOLIDATION C_v (m^2 / yr)	COMPRESSIBILITY M_v (m^2 /MN)
ρdi = 0.78 t / m^3	As Received	2.366	-	0.53
wi = 94 %	6.7	2.354	9	0.80
	13.4	2.336	10	1.05
Si = 100 %	26.8	2.289	4	1.09
	53.6	2.193	2	1.33
TEMPERATURE DURING TEST	107	1.968	1	1.06
	215	1.631	1	0.56
	429	1.318	1	0.26
MAX = 23 °C	858	1.055		
MIN = 19 °C	Rebounded 13.4	1.410		

SAMPLE HISTORY : Undisturbed Core, Natural Water Content

REMARKS :

CONSOLIDATION TEST(38.1/76.2mm Ø Ring) Plate No. 4

B5 T+T 1985 CPT test reports

MINISTRY OF WORKS
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STATIC CONE PENETROMETER GRAPH SHEET

JOB NO: 78500

PROJECT: BRA BUS DEPOT

DRAWING NO.

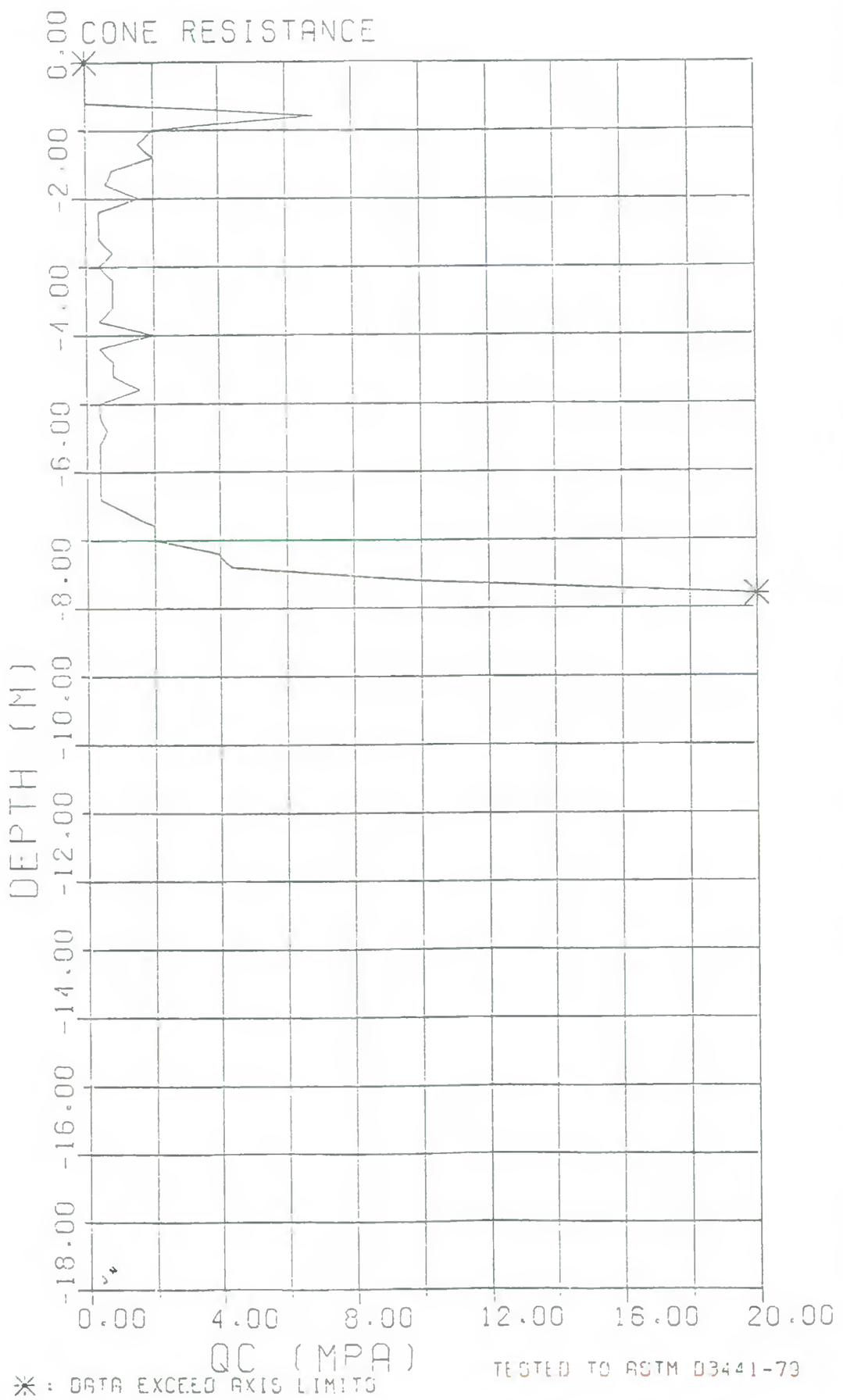
LOCATION: CUBNT ST.

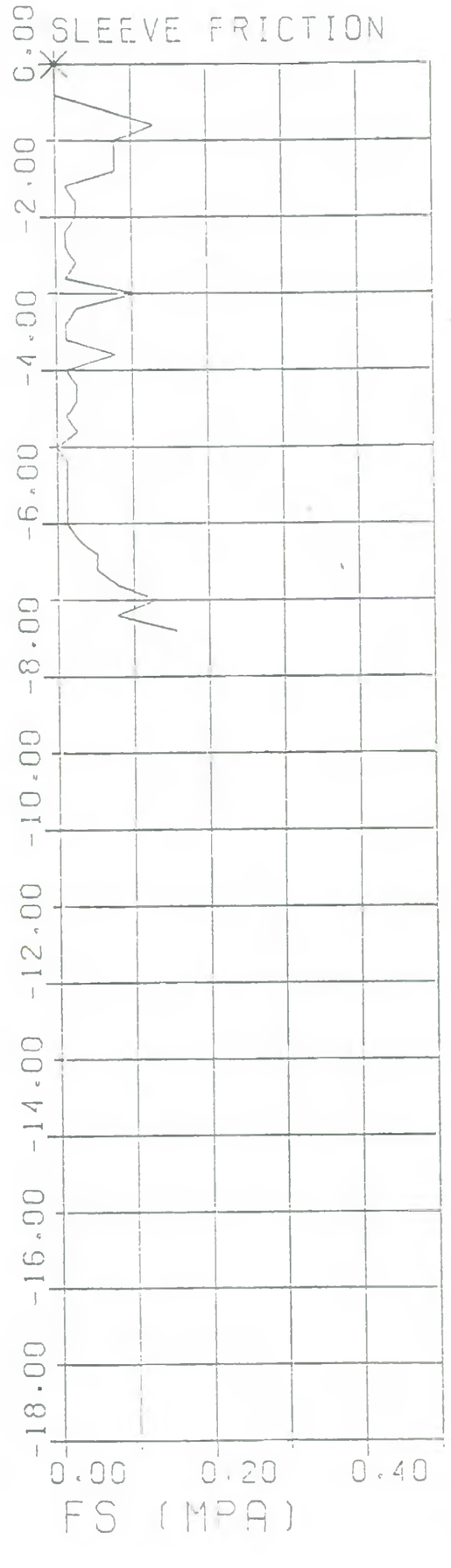
CPT 7

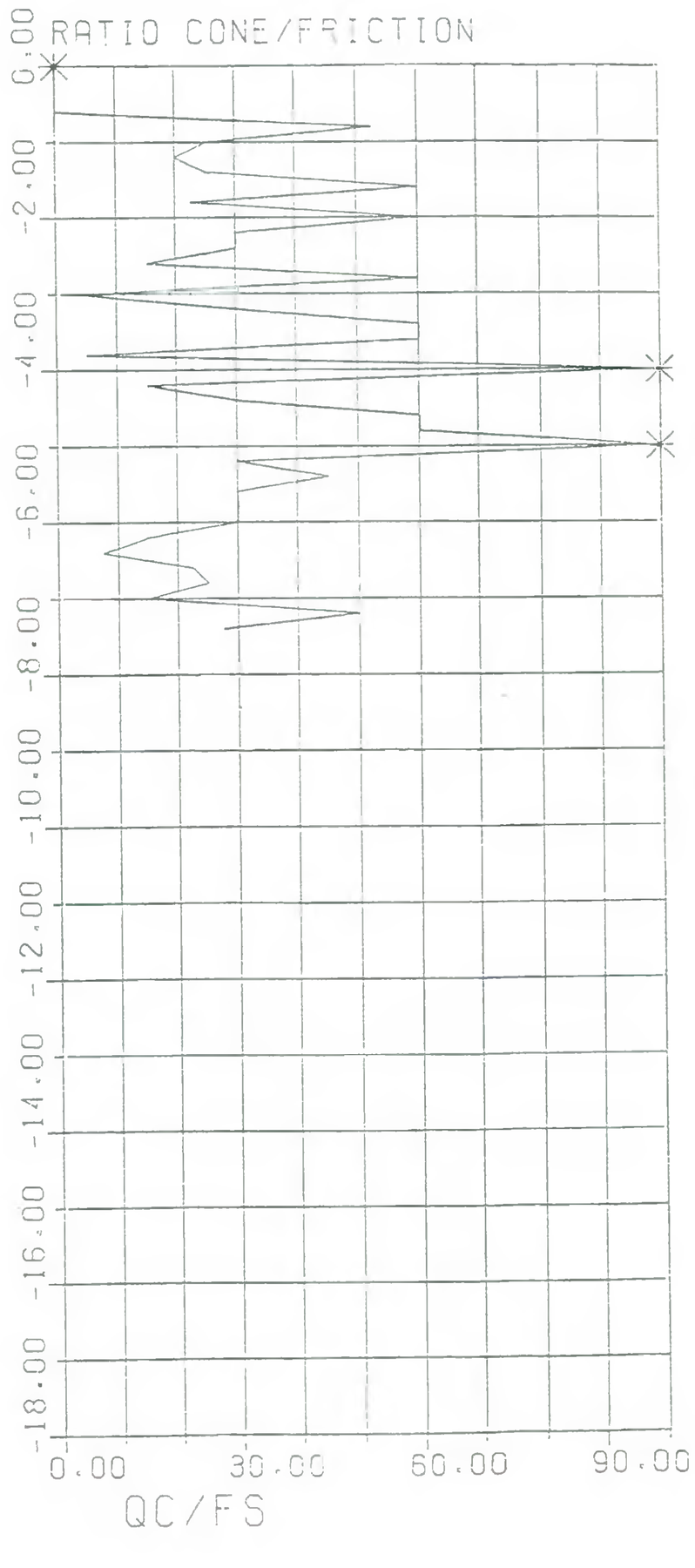
R.L. AT SURFACE:

WATER LEVEL:

DATE OF TEST: 7 MAY 1985







TESTED TO ASTM D3441-79

* : DATA EXCEED AXIS LIMITS

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY: . . . . . DATE: . . . . . .

MINISTRY OF WORKS
AND DEVELOPMENT

AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER GRAPH SHEET

JOB NO.: 79500

PROJECT: ARA BUS DEPOT

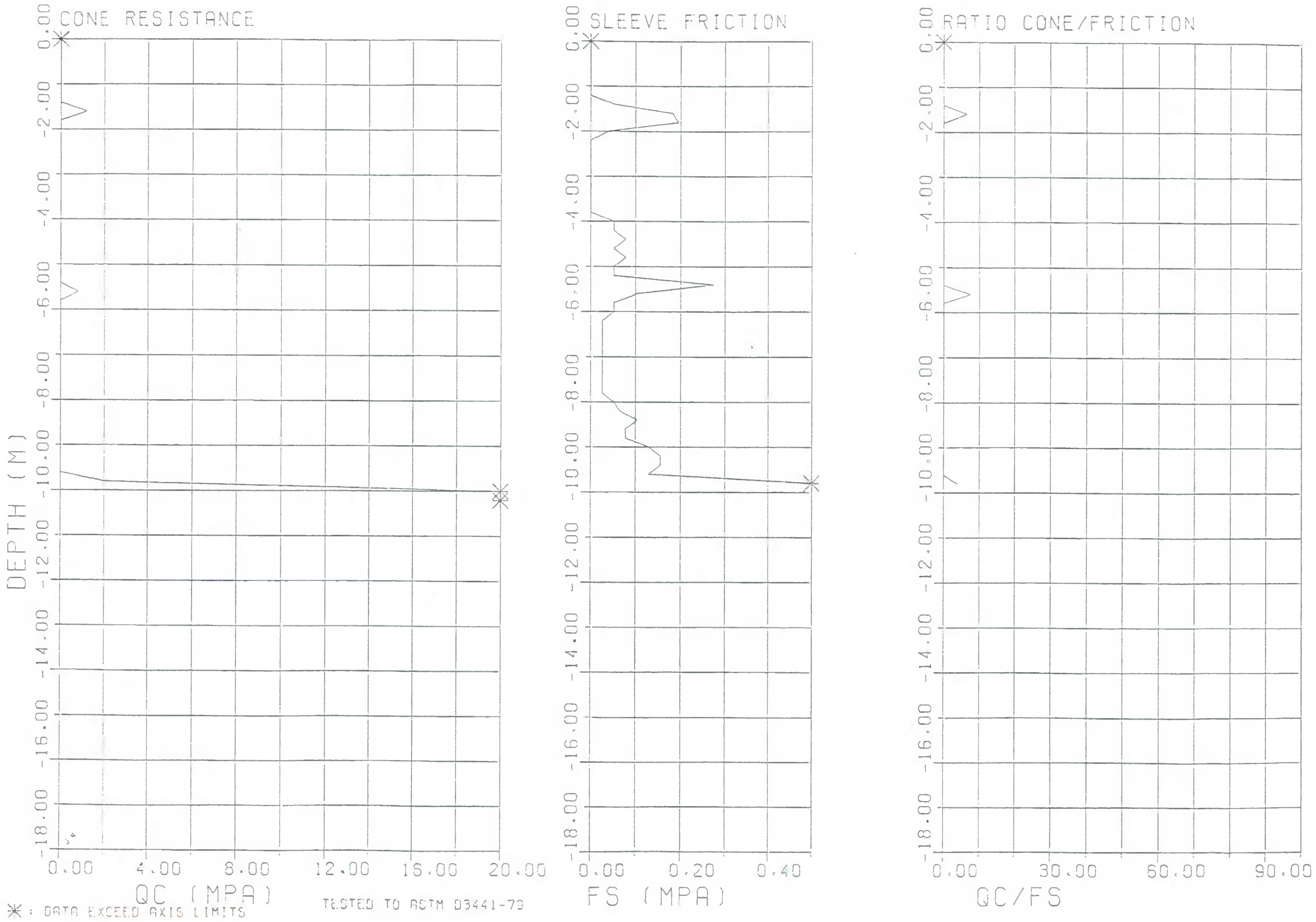
DRAWING NO.

LOCATION: CURNT ST.

CPT 6

R.L. OF SURFACE: WATER LEVEL:

DATE OF TEST: 2 MAY 1986



✳: DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY: . . . DATE: . . .

MINISTRY OF WORKS
AND DEVELOPMENT
AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER GRAPH SHEET

JOB NO: 79500

PROJECT: BRA BUS DEPOT

DRAWING NO:

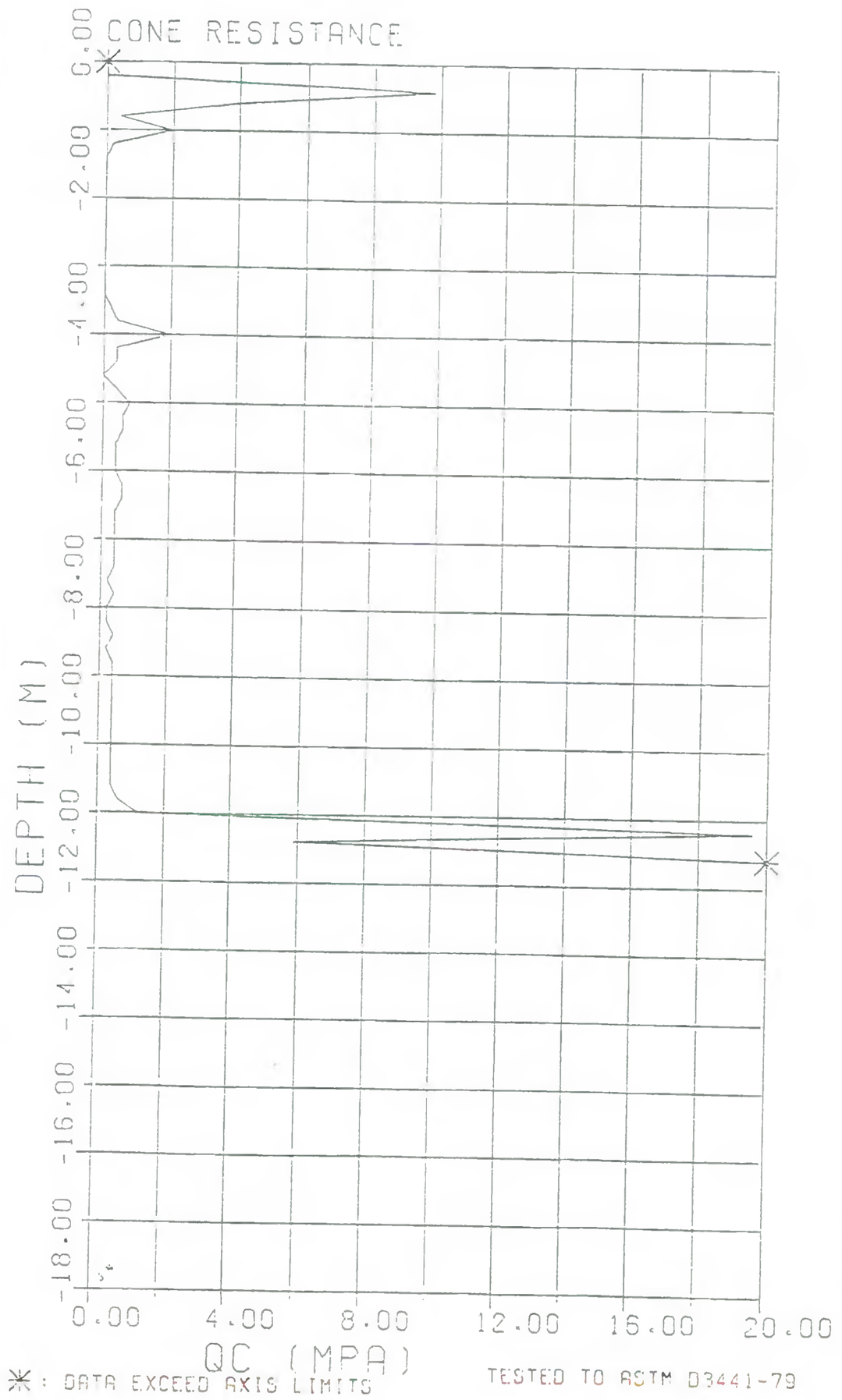
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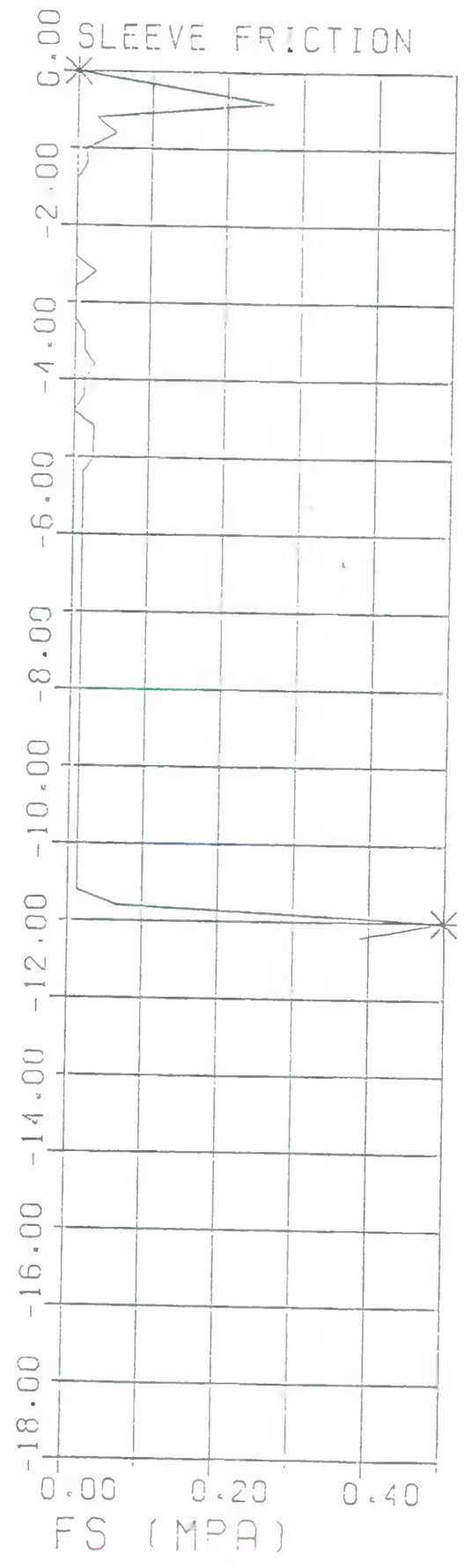
CPT 5

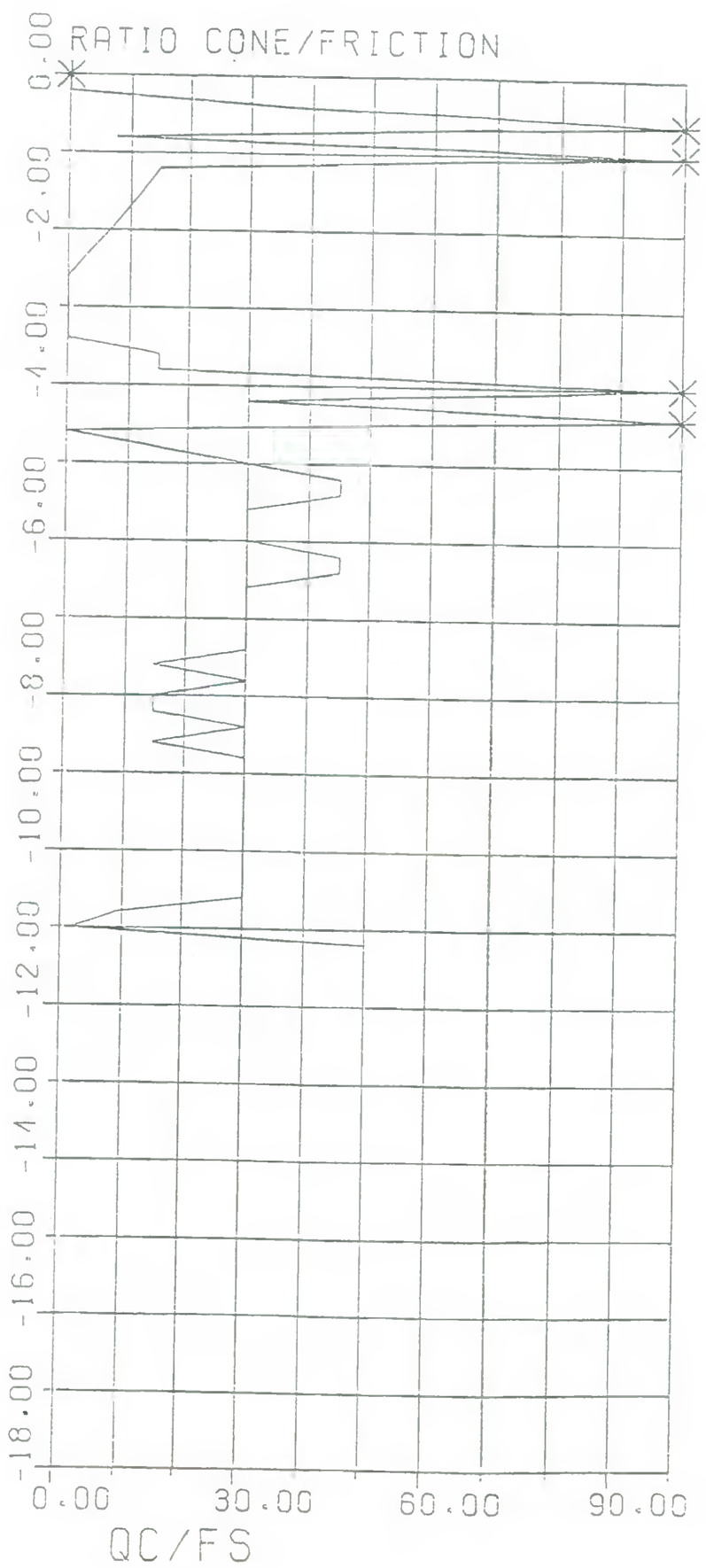
R.L. AT SURFACE:

WATER LEVEL:

DATE OF TEST: 2 MAY 1995







✳ : DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY: . . . DATE: . . .

MINISTRY OF WORKS
AND DEVELOPMENT
AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER GRAPH SHEET

JOB NO. 78500

PROJECT: BRA BUS DEPOT

DRAWING NO.:

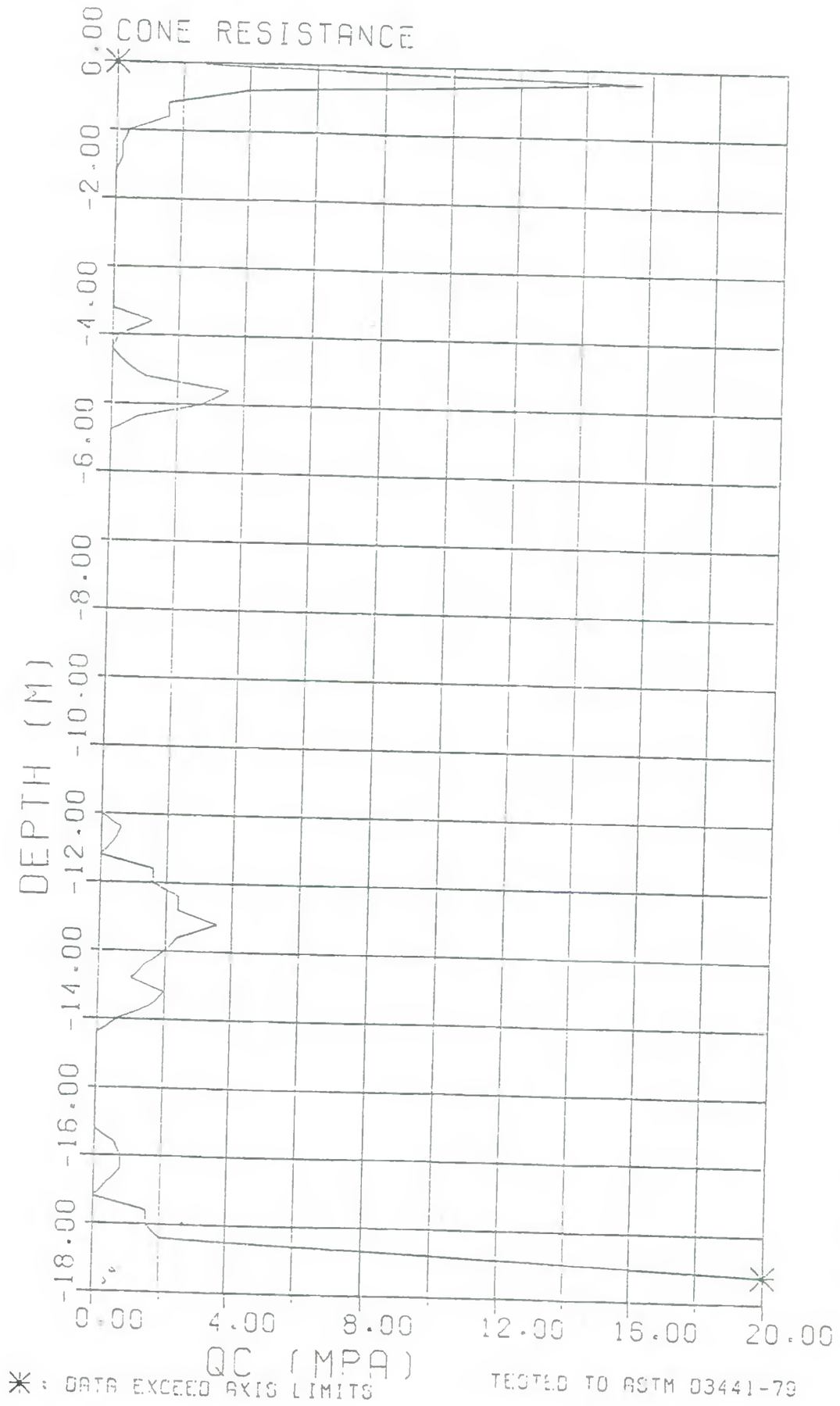
LOCATION: CURRY ST.

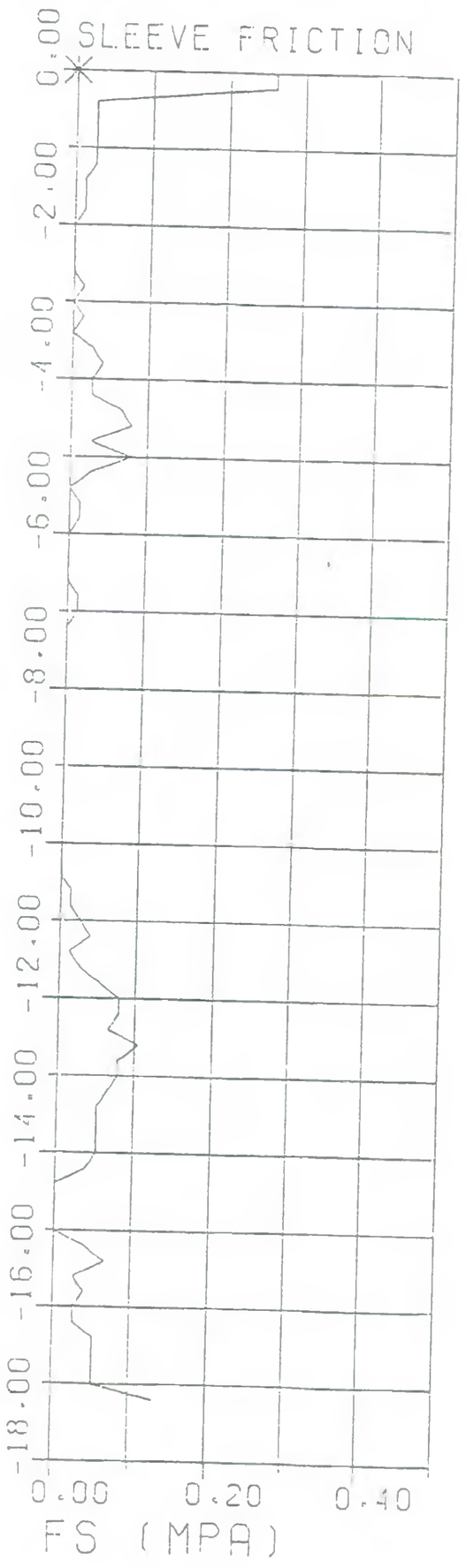
CPT 4

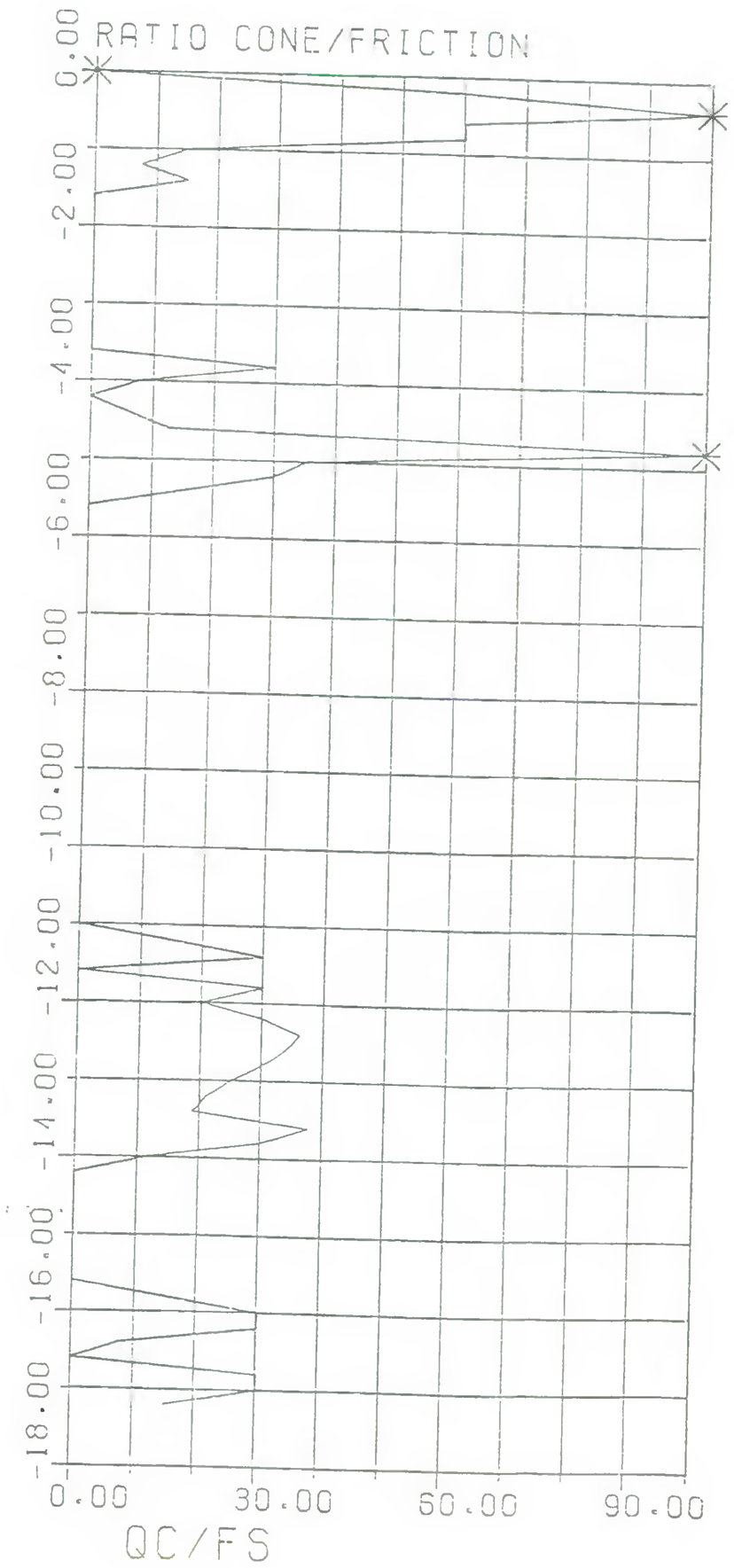
R.L. AT SURFACE:

WATER LEVEL:

DATE OF TEST: 2 MAY 1995







* : DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY:..... DATE:.....

MINISTRY OF WORKS
AND DEVELOPMENT
AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER
GRAPH SHEET

PROJECT: ARA BUS DEPOT

LOCATION: GRANT ST.

R.L. AT SURFACE:

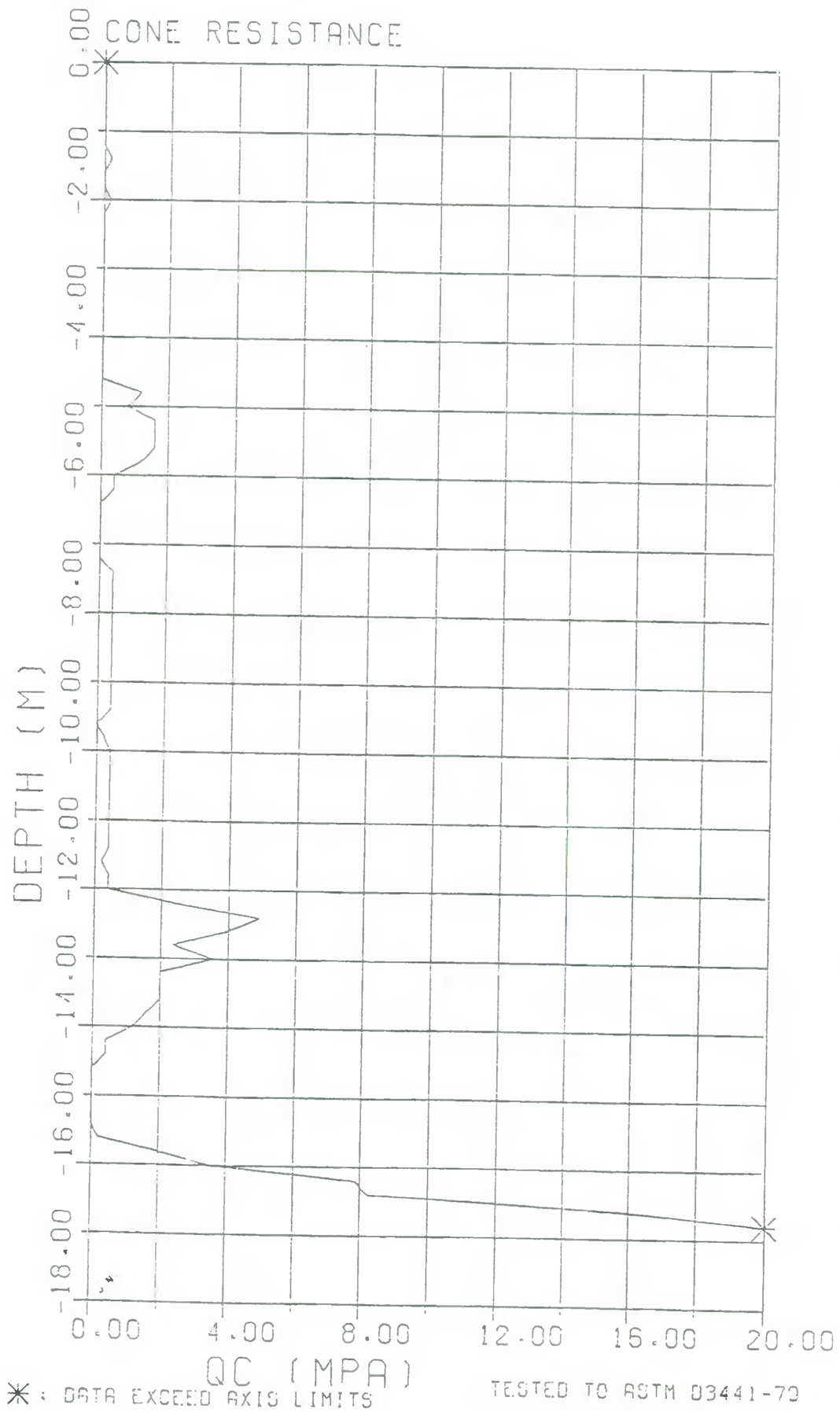
WATER LEVEL:

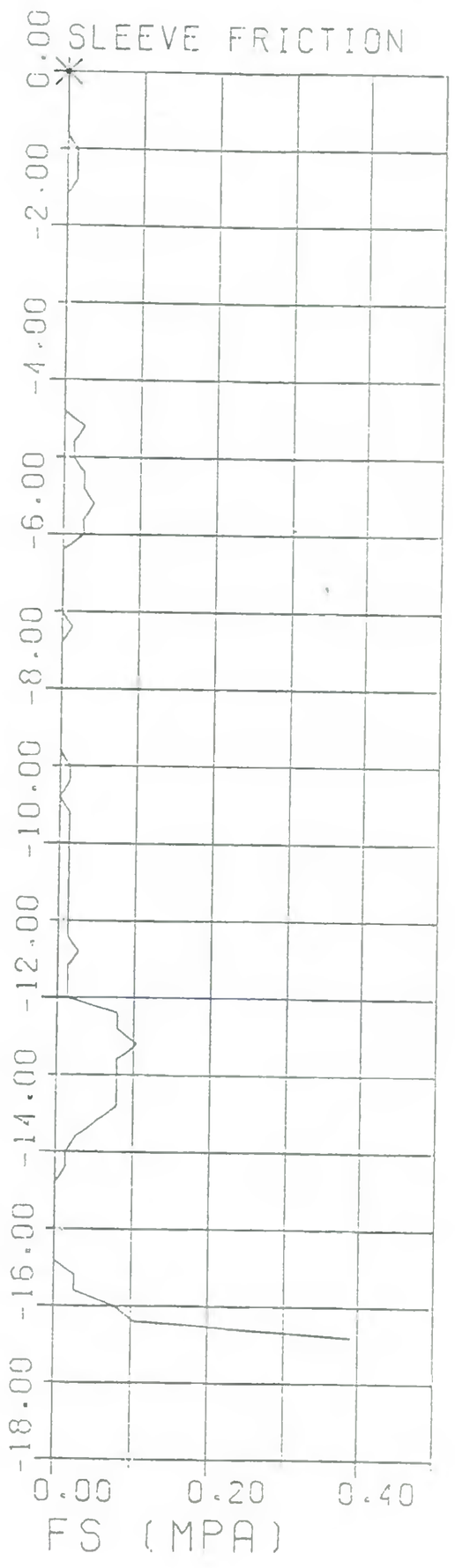
JOB NO.: 78590

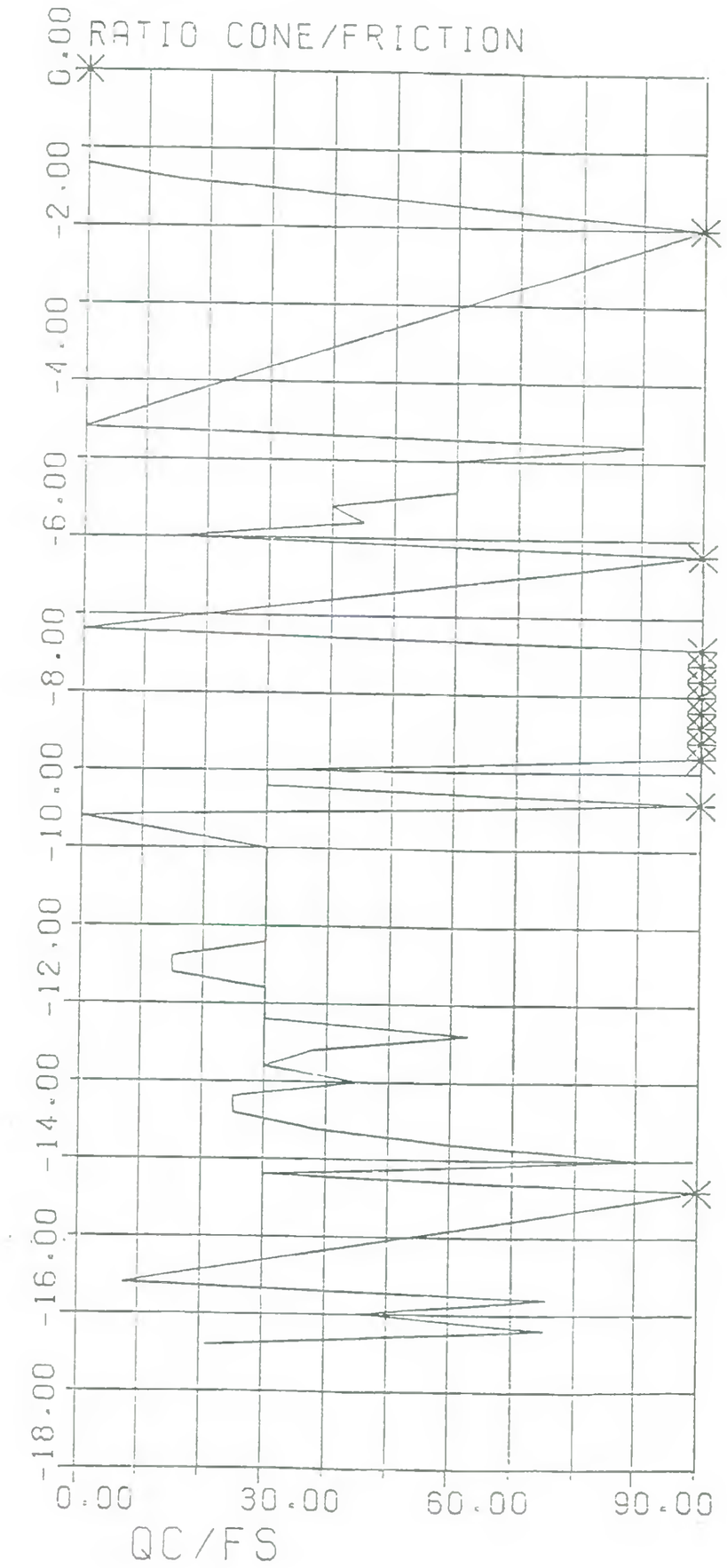
DRAWING NO.:

CPT 3

DATE OF TEST: 7 MAY 1985







✳ : DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
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AND DEVELOPMENT
AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER GRAPH SHEET

JOB NO: 78500

PROJECT: ARA BUS DEPOT

DRAWING NO.:

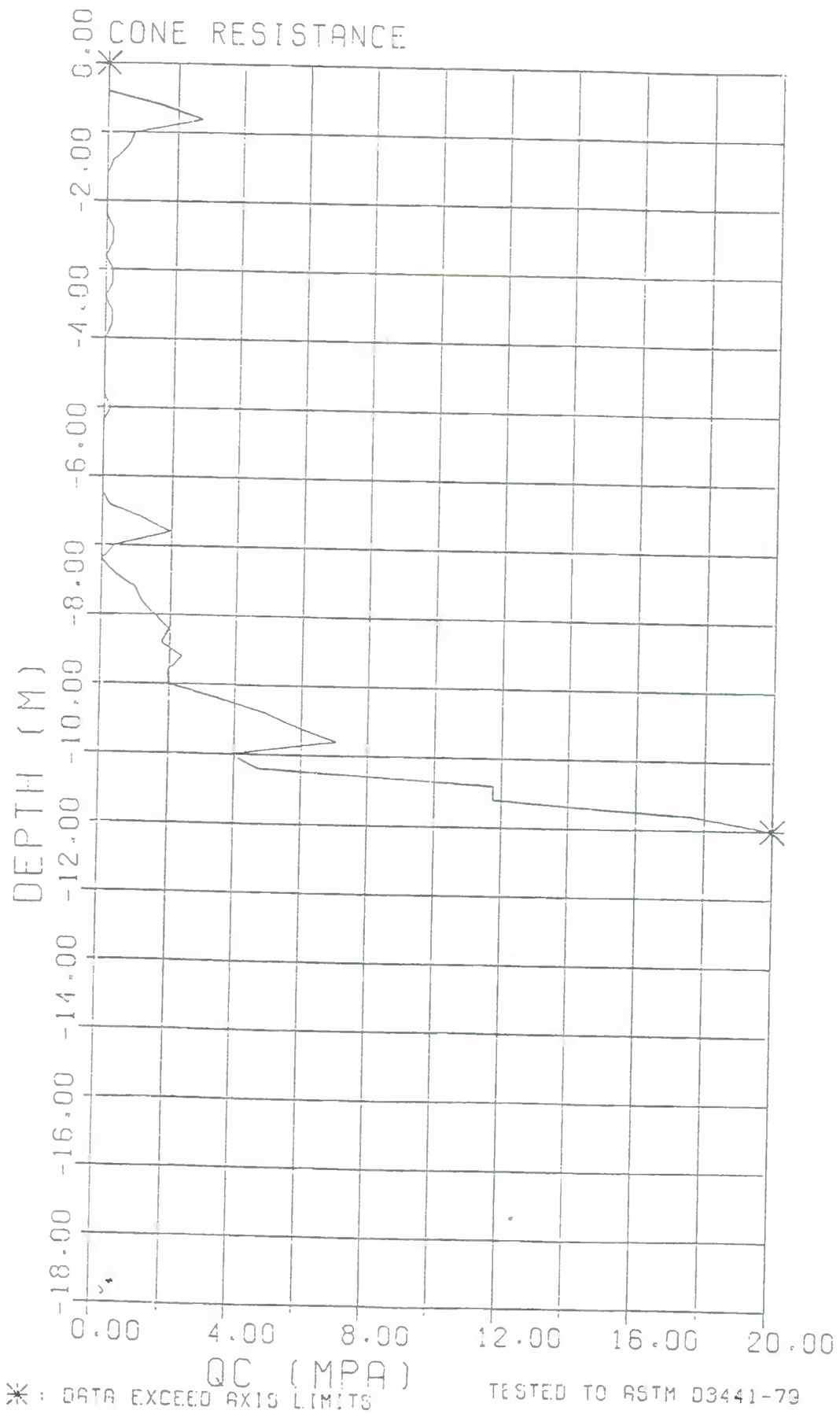
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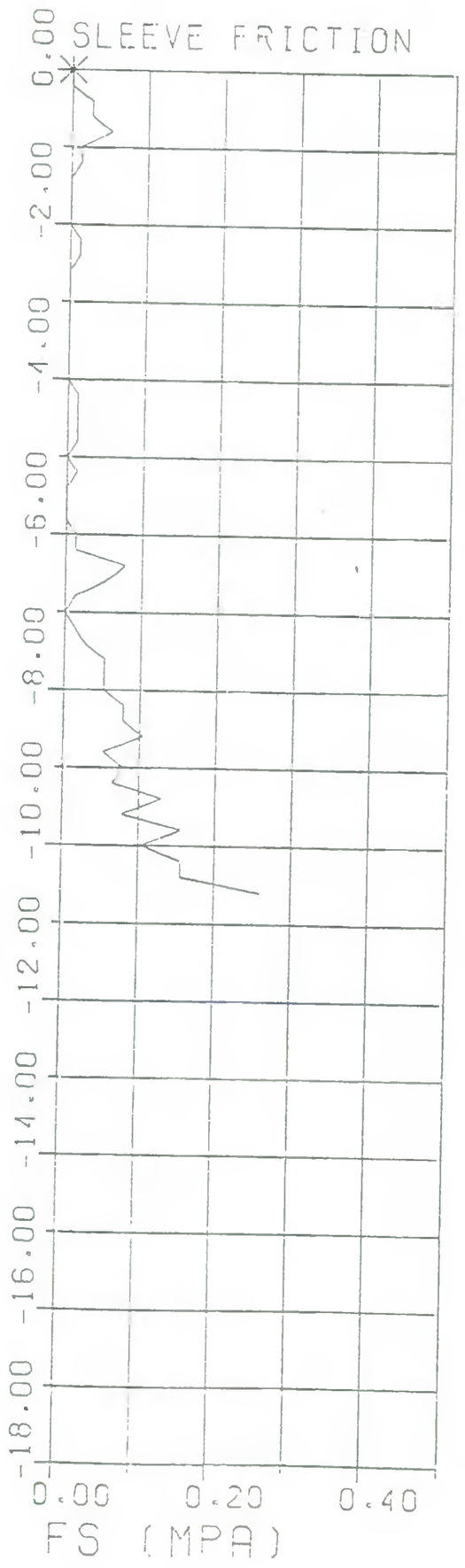
CPT 2

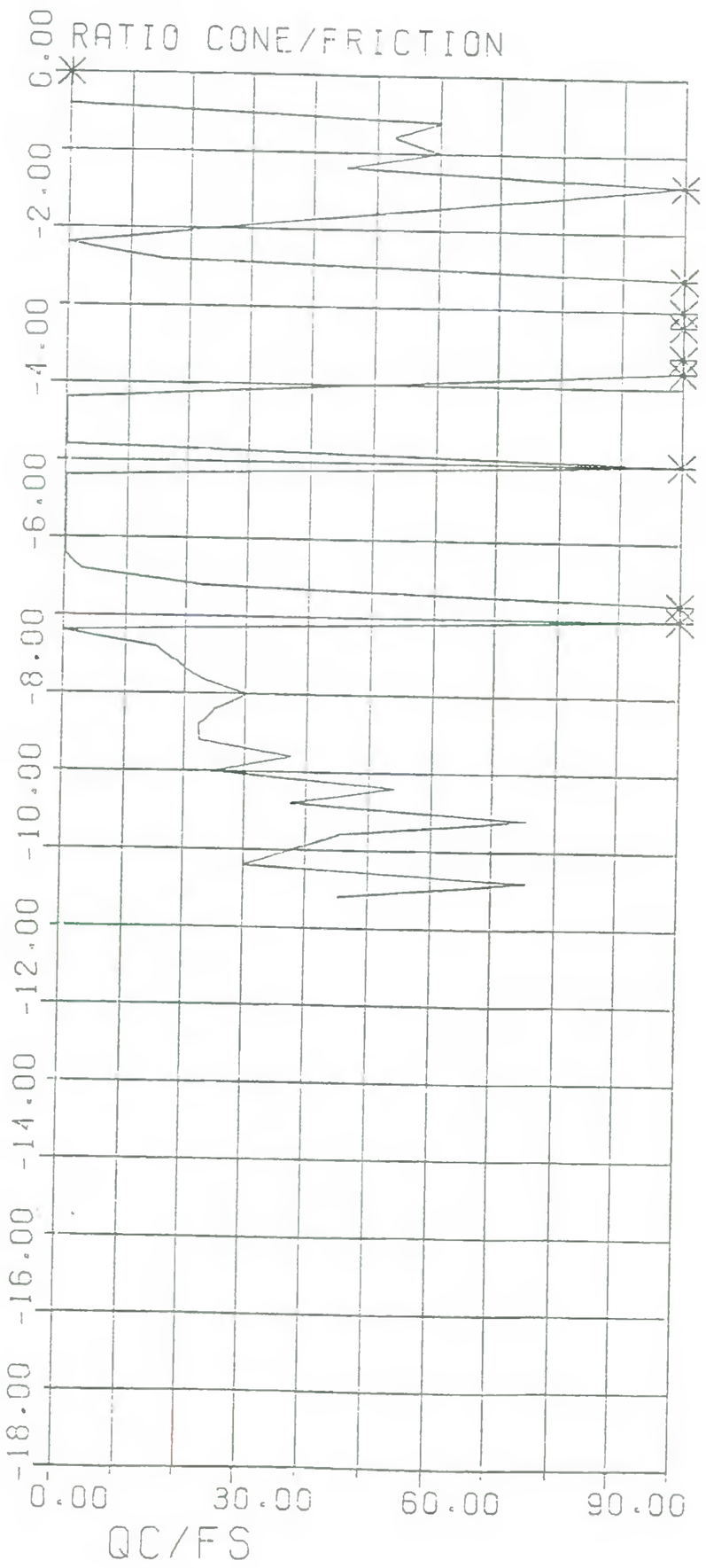
R.L. AT SURFACE:

WATER LEVEL:

DATE OF TEST: 6 MAY 1985







* : DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY: . . . . . DATE: . . . . . .

MINISTRY OF WORKS
AND DEVELOPMENT

AUCKLAND DISTRICT LABORATORY

STATIC CONE PENETROMETER GRAPH SHEET

JOB NO.: 78530

PROJECT: ARA BUS DEPOT

DRAWING NO.:

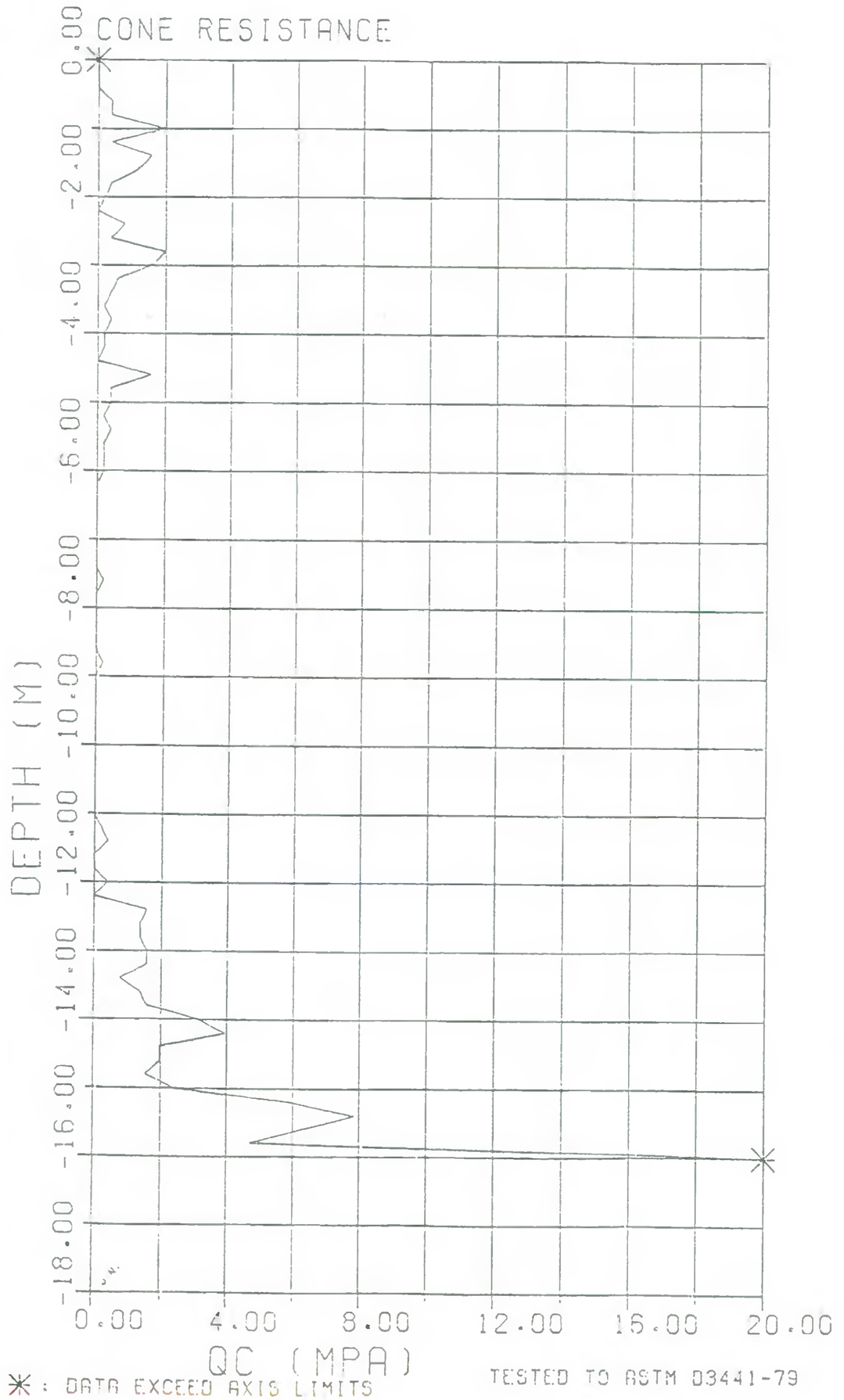
LOCATION: CURNT ST.

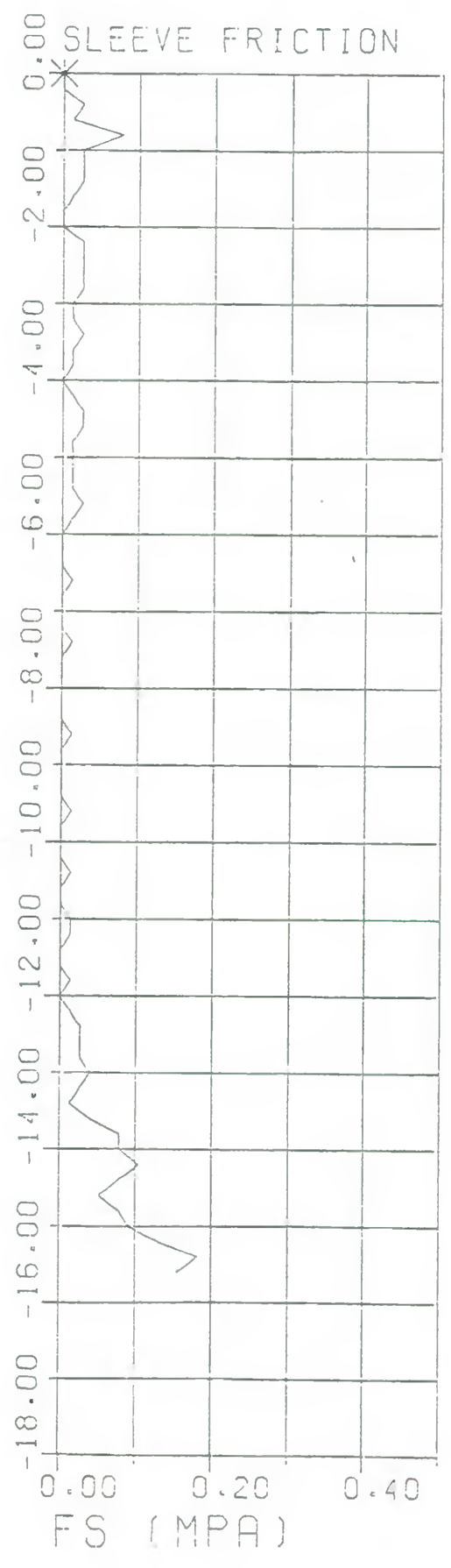
CPT 1

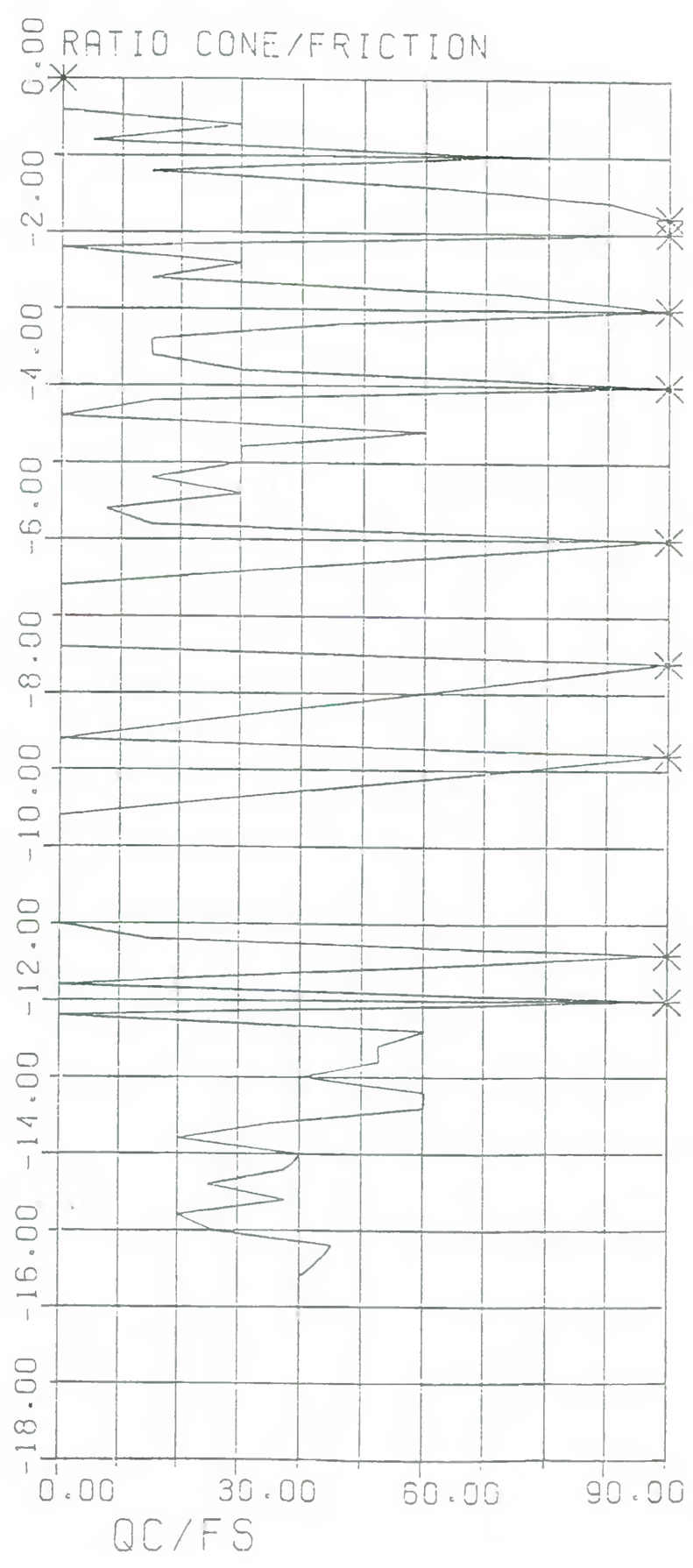
R.L. AT SURFACE:

WATER LEVEL:

DATE OF TEST: 6 MAY 1985







✳ : DATA EXCEED AXIS LIMITS

TESTED TO ASTM D3441-79

CALCULATED & PLOTTED BY
ICES STATS COMPUTER PROGRAM

CERTIFIED BY: . . . . . DATE: . . . . . .

B6 T+T 1982 machine borehole logs

SITE: A.R.A. BUS DEPOT, FREEMANS BAY.

BOREHOLE No. 4823

JOB No: ARA 41032 DATE DRILLED: 5/7/82 RL GROUND: -

SHEET 1 OF

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT 'N' Value (Blows/300mm)
Pavement, Asphalt/Basecourse				
SAND, silty, firm, grey, lt.brown mottles, some shells		1.0		
SILT, sandy, firm, grey, lt.brown mottles.		2.0		0
CLAY, silty, minor sand fraction, soft bluish green-grey.		3.0		0
SILT, clayey, sl.sandy, soft, greyish green		4.0		
-becoming less sandy				
-becoming sl.sandy		5.0		
		6.0		
		7.0		
CORE LOST		8.0		
		9.0		
? ? ?		10.0		
CLAY, medium, lt.brown, with grey mottles, minor silt and sand traces.				
-becoming sl.sandy, medium-firm greyish green		11.0		60
-becoming stiff-hard		12.0		
		13.0		

UNDRAINED SHEAR STRENGTH K Pa
⊗ Unconfined Compression Test
50 100 150 200

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)
W_P W W_L
20 40 60 80 100

107 → 104 → (126) → (251) → (254)

NOTES: Logged & Tested by A.R.A.

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

BOREHOLE No 4823

SITE: A.R.A. BUS DEPOT, FREEMANS BAY

JOB No: ARA 41032 DATE DRILLED: 5/7/82 RL GROUND: -

SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	S.P.T. 'N' VALUE (Blows/300 mm)	UNDRAINED SHEAR STRENGTH K Pa ⊗ Unconfined Compression Test 50 100 150 200	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L 20 40
CLAY, sandy, stiff, lt. green-grey		14.0	●	41	(163) → ⊗	
End of Borehole @ 14.5m						

NOTES: Logged & Tested by the A.R.A.

DRILL METHOD: MACHINE-ROTARY

BOREHOLE No. 4824

SITE: A.R.A. BUS DEPOT, FREEMANS BAY

SHEET 1 OF 2

JOB No: ARA 41032 DATE DRILLED: 9/7/82 RL GROUND: -

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	*UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L 20 40 60 80
Asphalt					
Basecourse					
CLAY, silty, firm, brownish, grey		1.0			
SAND, loose, greyish green		2.0			
		3.0			
		4.0	●		
SAND, silty, sl.clayey, loose, grey with some CLAY and SILT layers, soft.		5.0	●		
		6.0			
		7.0			
		?			
CORE LOST		8.0			
		9.0			
		?			
		10.0			
		11.0			
SILT, clayey, minor sand and shell fraction, soft, grey.		12.0	●		
-becoming sandy, soft, greyish green		13.0	●		

NOTES: Logged & Tested by the A.R.A.

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: A.R.A. BUS DEPOT, FREEMANS BAY

BOREHOLE No. 4824

JOB No: ARA 41032 DATE DRILLED: 9/7/82 RL GROUND: -

SHEET 2 OF 2

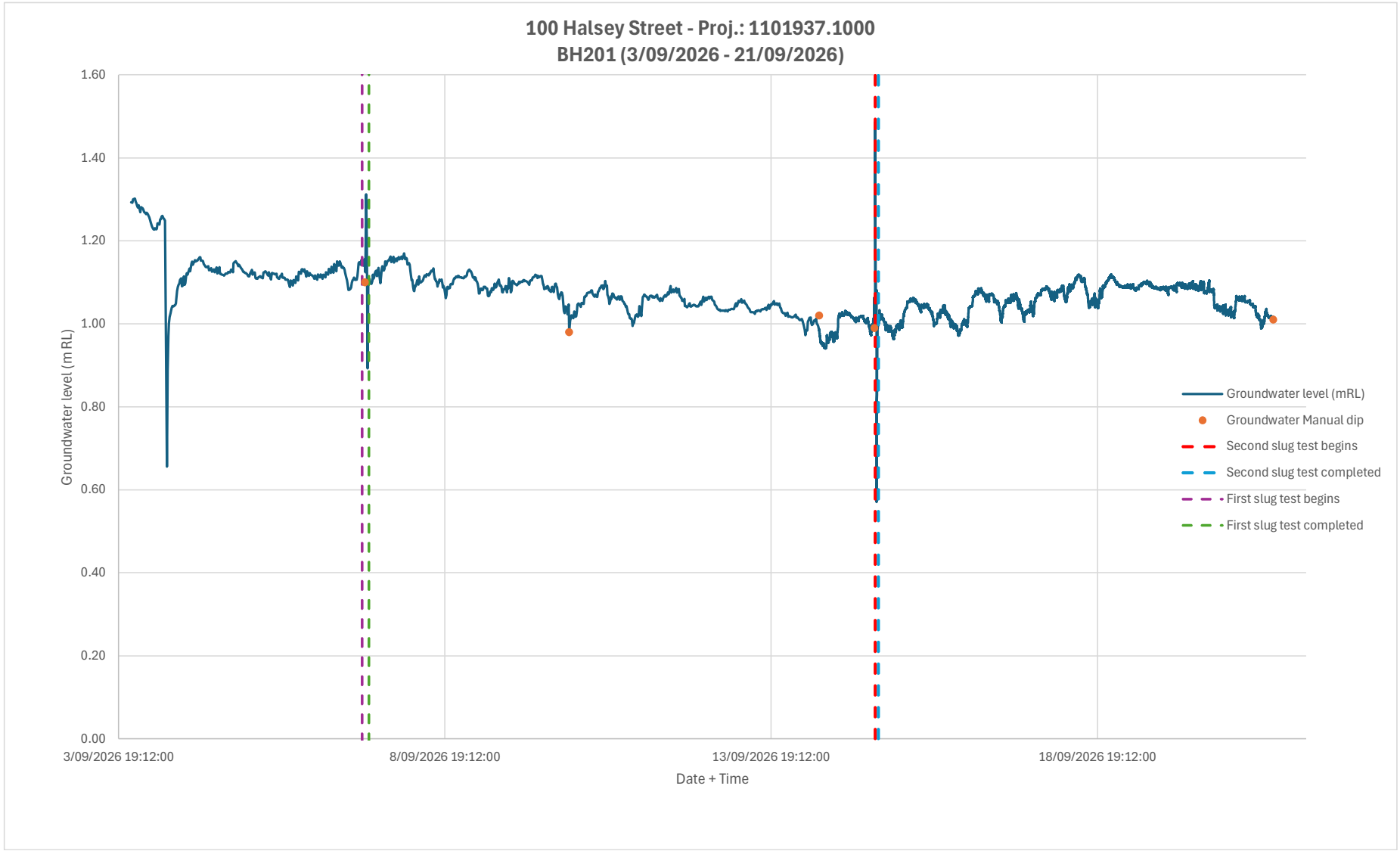
DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT "N" Value (Blows/300mm)	UNDRAINED SHEAR STRENGTH K Pa ⊗ Unconfined compressive strength 500 1000 1500 2000	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L 20 40 60 80
SILT, sandy, soft, greyish, green		14.0				
Interbedded SANDSTONE and SILTSTONE moderately cemented, dk.grey.		15.0		>100		
End of Borehole @ 16.5m		16.0				

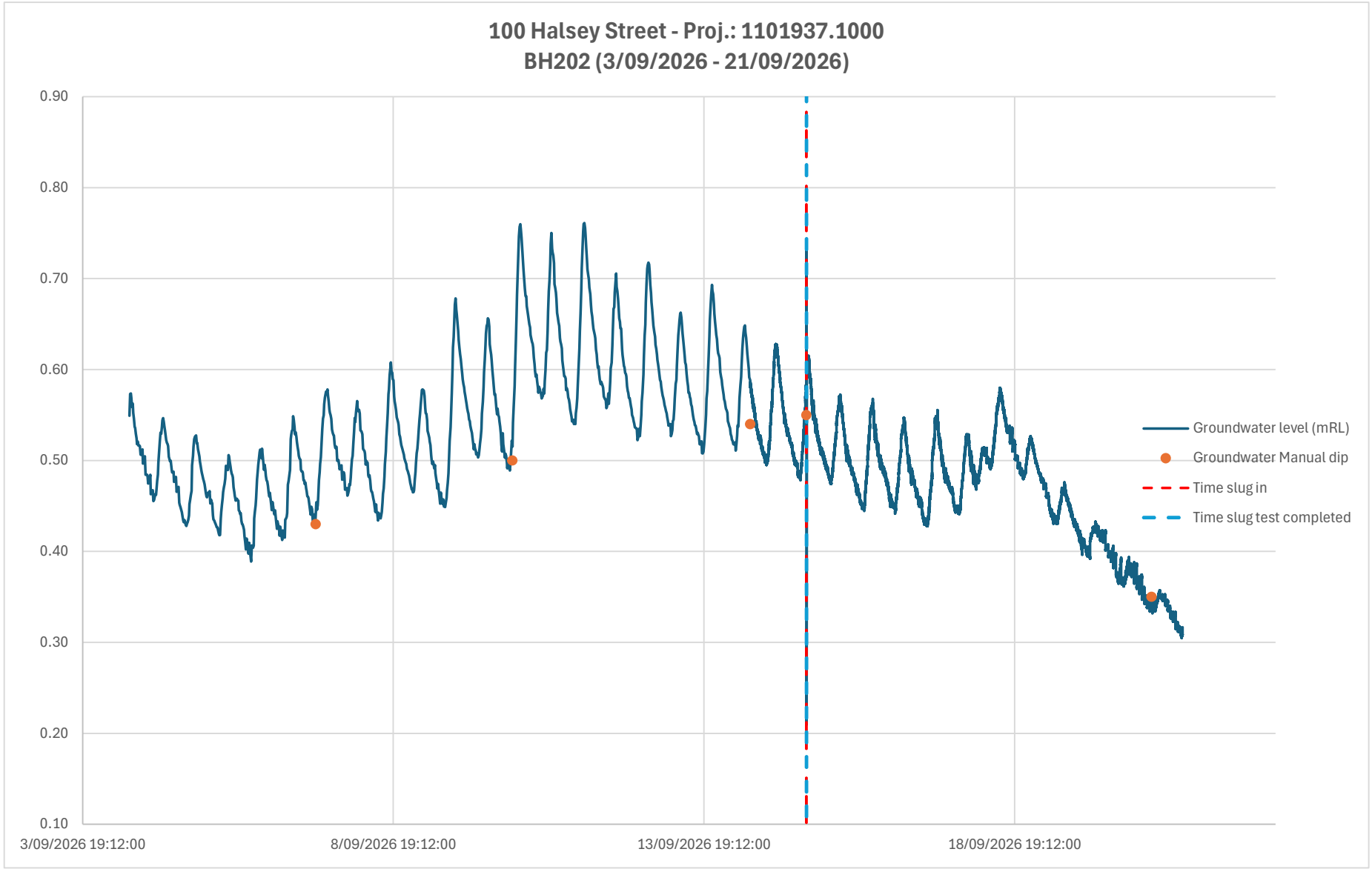
NOTES: Logged & Tested by the A.R.A.

DRILL METHOD: MACHINE-ROTARY

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

Appendix C Groundwater monitoring


100 Halsey Street - Proj.: 1101937.1000
BH201 (3/09/2026 - 21/09/2026)
Groundwater level (m RL)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
3/09/2026 19:12:00
8/09/2026 19:12:00
13/09/2026 19:12:00
18/09/2026 19:12:00
Date + Time
Groundwater level (mRL)
Groundwater Manual dip
Second slug test begins
Second slug test completed
First slug test begins
First slug test completed


100 Halsey Street - Proj.: 1101937.1000
BH202 (3/09/2026 - 21/09/2026)
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
3/09/2026 19:12:00
8/09/2026 19:12:00
13/09/2026 19:12:00
18/09/2026 19:12:00
Groundwater level (mRL)
Groundwater Manual dip
Time slug in
Time slug test completed

Appendix D Summary of testing results

D1 Classification tests

The results of natural water content, Atterburg limits and density testing are summarised in Figure Appendix D.1, Appendix D Table 1 and Appendix D Table 2.

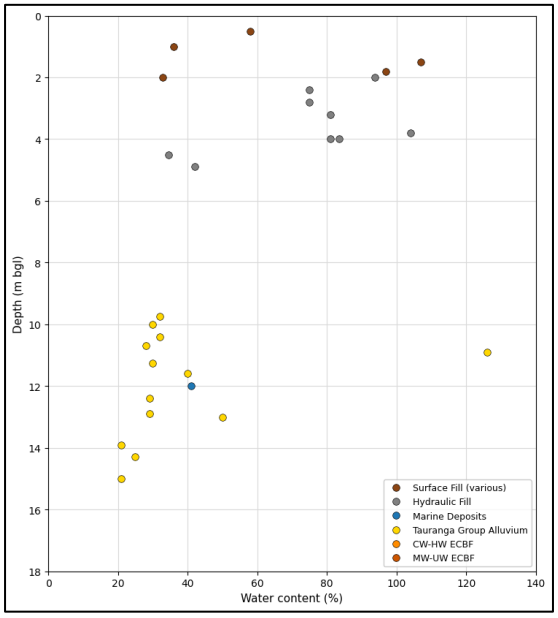


Figure Appendix D.1: Summary of natural water content tests.

Appendix D Table 1: Atterberg limit test results

BH No.	Sample depth (m)	Geological Unit	Liquid Limit (PL)	Plastic Limit (PL)	Plasticity Index (PI)
BH201 (2026)	3.0 to 3.5	Hydraulic fill	95	33	62
	4.5 to 5.0	Hydraulic fill	88	33	62
	6.0 to 6.5	Marine sediment	49	20	29
	9.0 to 9.5	Marine sediment	76	26	50
BH202 (2026)	3.0 to 3.5	Hydraulic fill	59	25	34
TP3 (1983)	0.95	Surface fill	111		41

Appendix D Table 2: Bulk density results

BH No.	Sample depth (m)	Geological Unit	Bulk density (t/m^3)
BH1 (1986)	2	Surface fill	1.84
BH2 (1986)	2	Hydraulic fill	1.44
BH2 (1986)	4	Hydraulic fill	1.53
BH107 (2015)	9.4	MW-UW ECBF	2.06
BH107 (2015)	9.5	MW-UW ECBF	2.14
BH107 (2015)	11.1	MW-UW ECBF	2.11

D2 Undrained strength and stiffness

The results of SPT testing and CPT derived SPT $N_{1(60)}$ are presented in Figure Appendix D.2. The SPT results are in terms of field values and have not been corrected for depth and hammer efficiency.

The results of vane shear, lab shear and CPT derived undrained shear strength are presented in Figure Appendix D.3. Vane shear tests are, typically undertaken in the end of the retrieved core sample prior to extraction. The CPT derived values are calculated using an assumed N_{kt} value of 14.

The results of laboratory unconfined compression strength tests on soil samples are presented in Figure Appendix D.4.

The results of CPT derived shear wave velocity and small strain shear modulus are presented in Figure Appendix D.5.

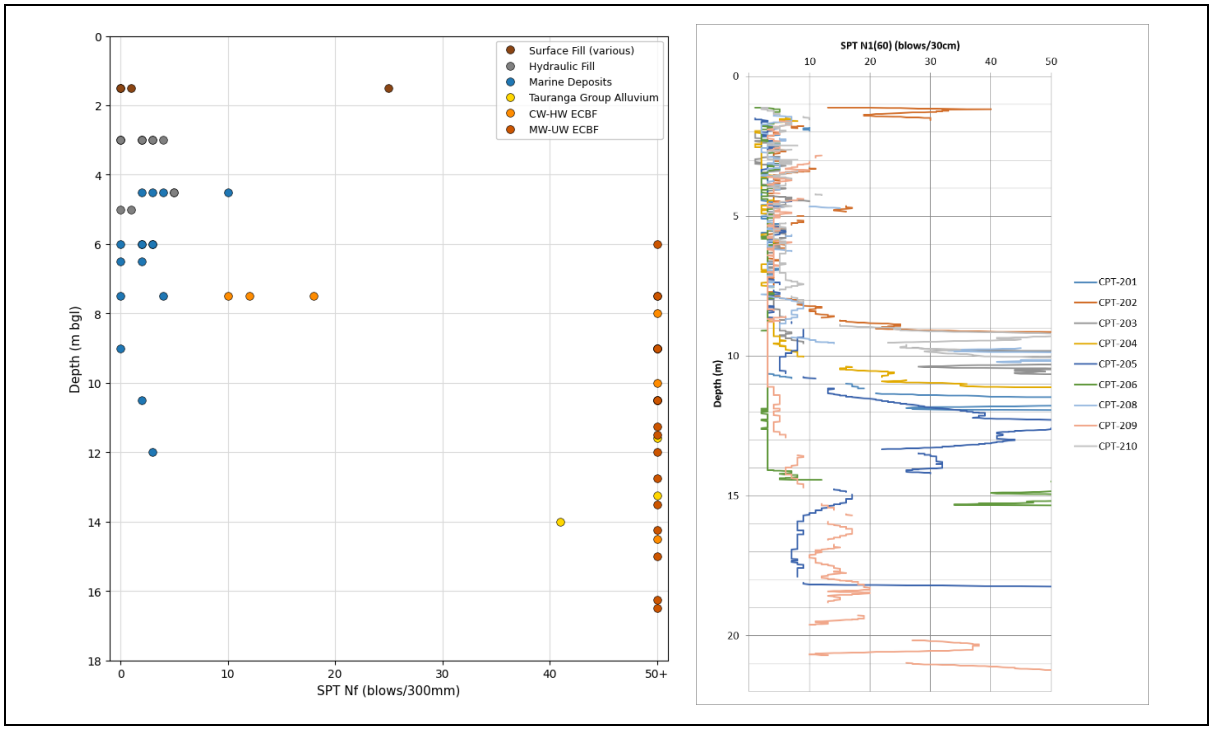


Figure Appendix D.2: Summary borehole SPT N_f tests and CPT derived SPT $N_{1(60)}$.

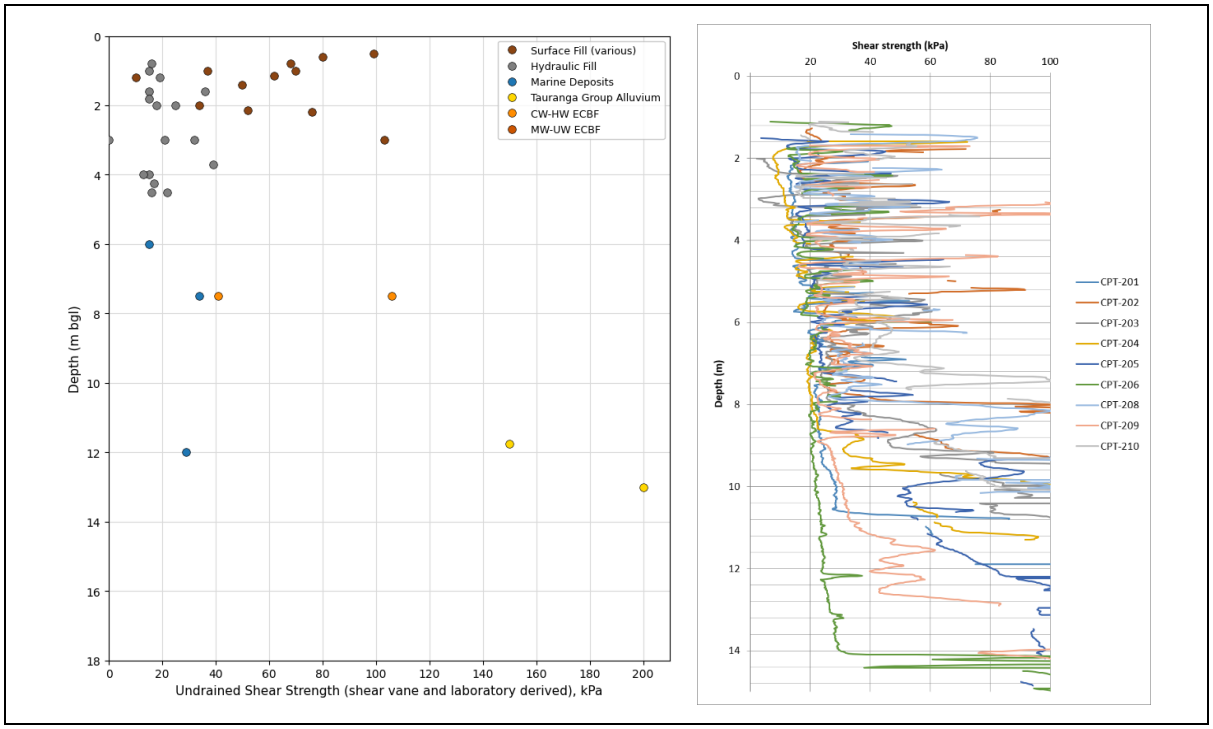


Figure Appendix D.3: Summary vane and lab undrained shear tests and CPT derived undrained shear strength.

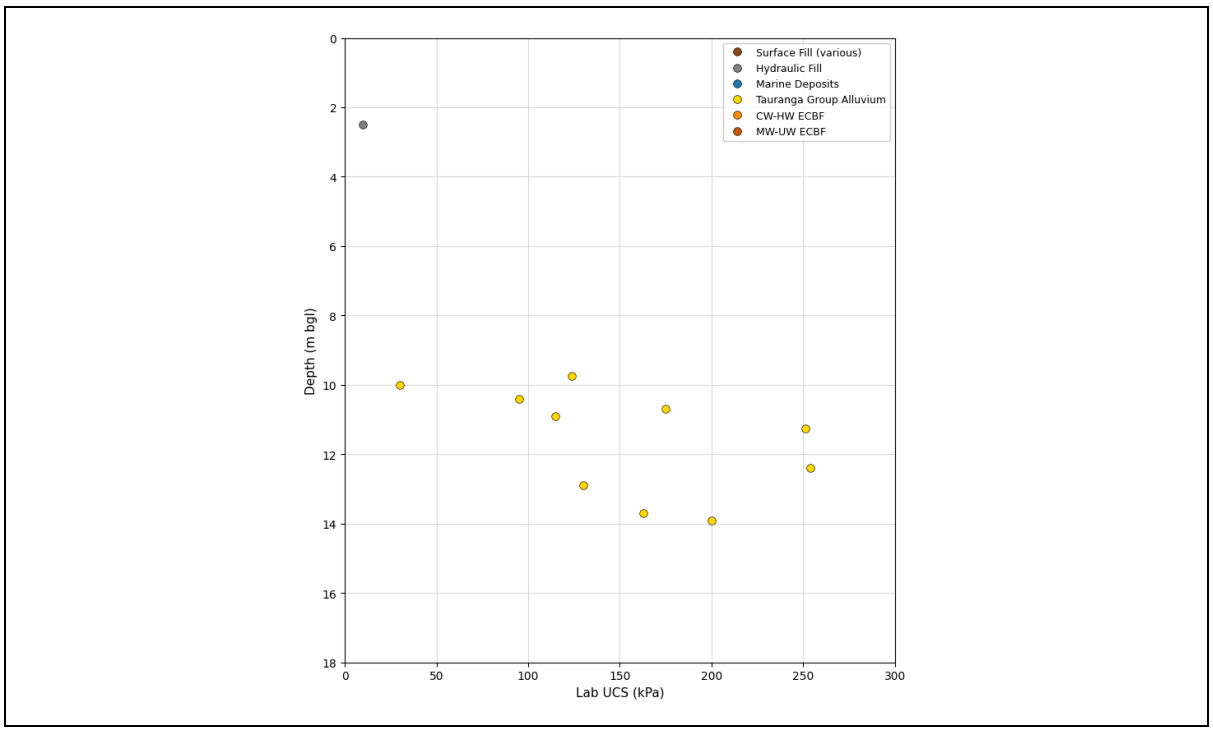


Figure Appendix D.4: Summary laboratory unconfined compression tests on soil samples.

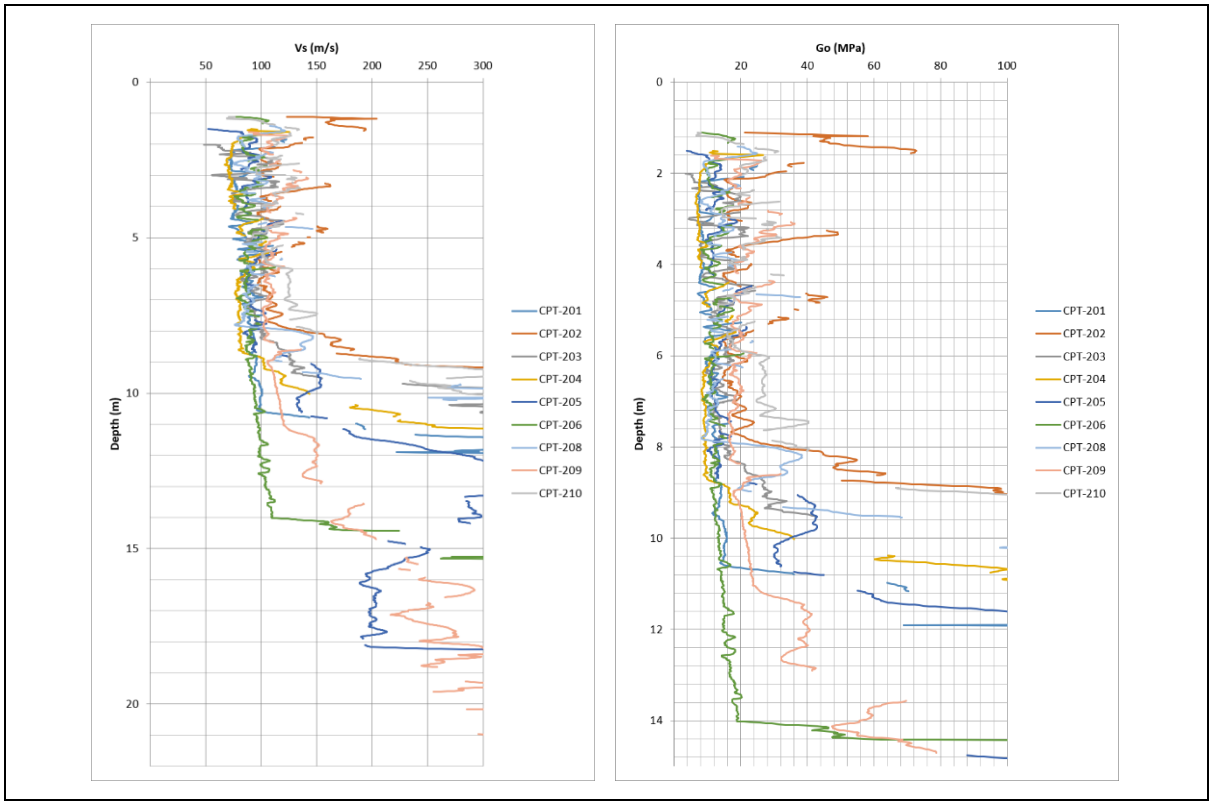


Figure Appendix D.5: Summary of CPT derived shear wave velocity and small strain shear modulus.

D3 Compressibility

The results of CPT derived shear wave velocity and small strain shear modulus are presented in Figure Appendix D.6.

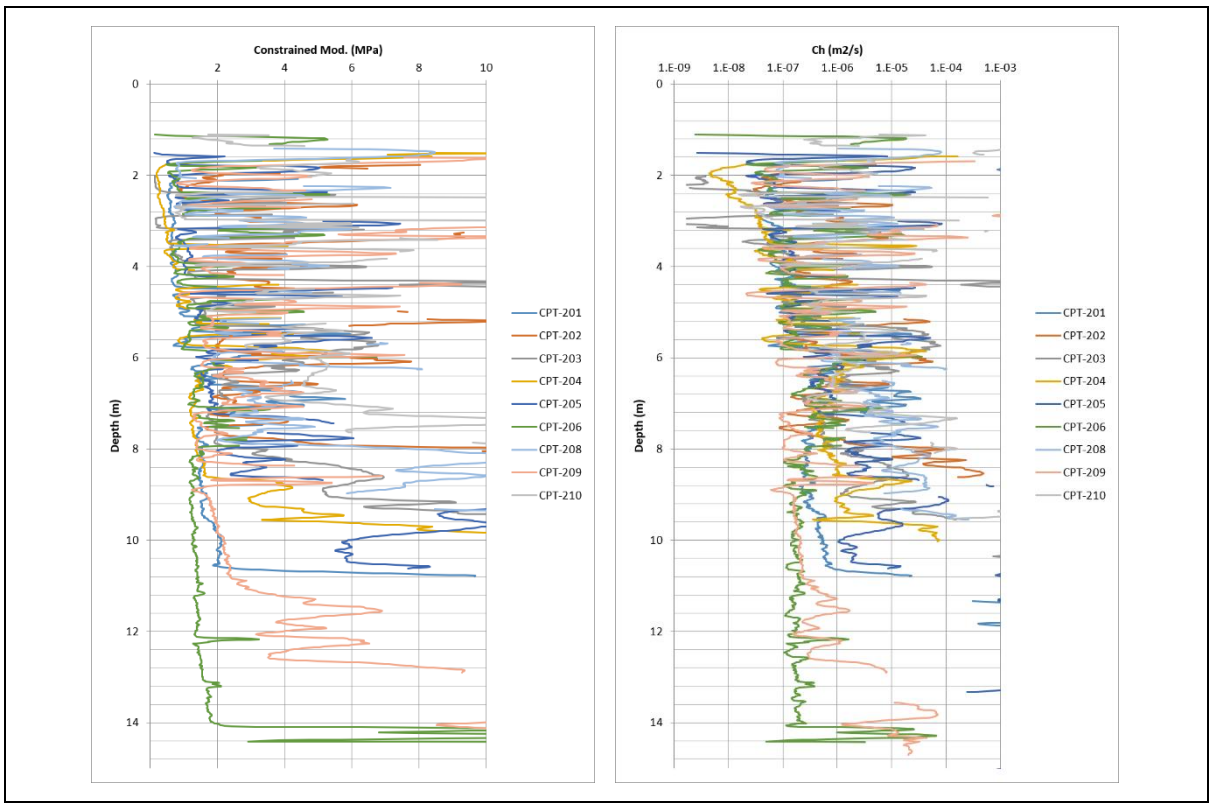


Figure Appendix D.6: Summary of CPT derived constrained modulus and horizontal coefficient of consolidation.

Appendix D Table 3: Laboratory one dimensional consolidation test results

BH No	Sample depth (m)	Geological Unit (description)	Pressure Increment (kPa)	Coefficient of Consolidation (sq root time) c_v (m^2/yr)	Coefficient of Volume Compressibility m_v (m^2/MN)
BH201 (2026)	4.5 to 5.0 m	Marine sediment (clay/silt)	0 - 3	0.52	4.4
			3 - 6	0.71	6.4
			6 – 12.5	0.48	4.8
			12.5 - 25	0.33	3.7
			25 - 50	0.28	2.9
			50 - 100	0.32	1.7
			100 - 200	0.37	0.87
			200 - 400	0.42	0.45
			400 – 12.5		0.27 (unload)
BH202 (2026)	6.0 to 6.5	Marine sediment (sand)	0 – 6	39	0.82
			6 – 12.5	213	0.35
			12.5 – 25	205	0.22

BH No	Sample depth (m)	Geological Unit (description)	Pressure Increment (kPa)	Coefficient of Consolidation (sq root time) c_v (m^2/yr)	Coefficient of Volume Compressibility m_v (m^2/MN)
			25 – 50	196	0.12
			50 – 100	166	0.07
			100 – 200	164	0.044
			200 – 400	145	0.029
			400 – 800	142	0.019
			800 – 12.5		0.0075 (unload)
BH2 (1986)	2.0 m	Surface Fill (Organic clayey SILT)	6.7 – 13.4	11	0.44
			13.4 – 26.8	11	0.74
			26.8 – 53.6	10	0.89
			53.6 – 107	1	1.96
			107 – 215	1	1.34
			215 – 429	1	0.63
			429 – 13.4		0.39 (unload)
BH2 (1986)	4.0 m	Surface Fill (Organic clayey SILT)	6.7 – 13.4	9	0.80
			13.4 – 26.8	10	1.05
			26.8 – 53.6	4	1.09
			53.6 – 107	2	1.33
			107 – 215	1	1.06
			215 – 429	1	0.56
			429 – 858	1	0.26
			858 – 13.4		0.17 (unload)

D4 Permeability

6 no. CPT dissipation tests were undertaken to provide information on permeability of the hydraulic fill and marine deposits. Testing periods were undertaken to at least 50% pore pressure dissipation (t_{50}). CPT soil behaviour type index, I_c was generally 3.0 to 3.5 at the dissipation test depths indicating clay-like soil behaviour.

Interpretation of the CPT data has been undertaken at each location to determine the rigidity index, I_r. A 'softening factor', s_f of 0.26 has been applied to the small strain shar modulus of the clay type materials for the determination of the stiffness parameters in the expected strain range.

$$I_r = \frac{s_f . G_0}{s_u}$$

Rising and falling head 'slug' tests were performed in the borehole standpipe piezometers. Using the Horslev (1951) and Bower & Rice (1976) methods.

The analysis outputs of the permeability testing are presented in below. Summary results are presented in Appendix D Table 4.

Appendix D Table 4: Insitu permeability testing interpretated results

Location	Response zone (m bgl)	Inferred geology	Test type	Permeability, k_h (m/s)
CPT-201	3.0	Hydraulic Fill	CPT dissipation	1×10^{-8}
CPT-201	6.5	Marine Deposits	CPT dissipation	4×10^{-8}
CPT-202	3.0	Hydraulic Fill	CPT dissipation	1×10^{-7}
CPT-205	3.0	Hydraulic Fill	CPT dissipation	5×10^{-7}
CPT-205	6.5	Marine Deposits	CPT dissipation	2×10^{-8}
CPT-206	2.9	Hydraulic Fill	CPT dissipation	3×10^{-7}
BH201	5.7 – 8.3	Marine Deposits	Slug falling head Slug rising head	1×10^{-7} 6×10^{-7}
BH202	2.7 – 5.3	Hydraulic Fill / Marine Deposits	Slug falling head Slug rising head	3×10^{-5} 3×10^{-5}

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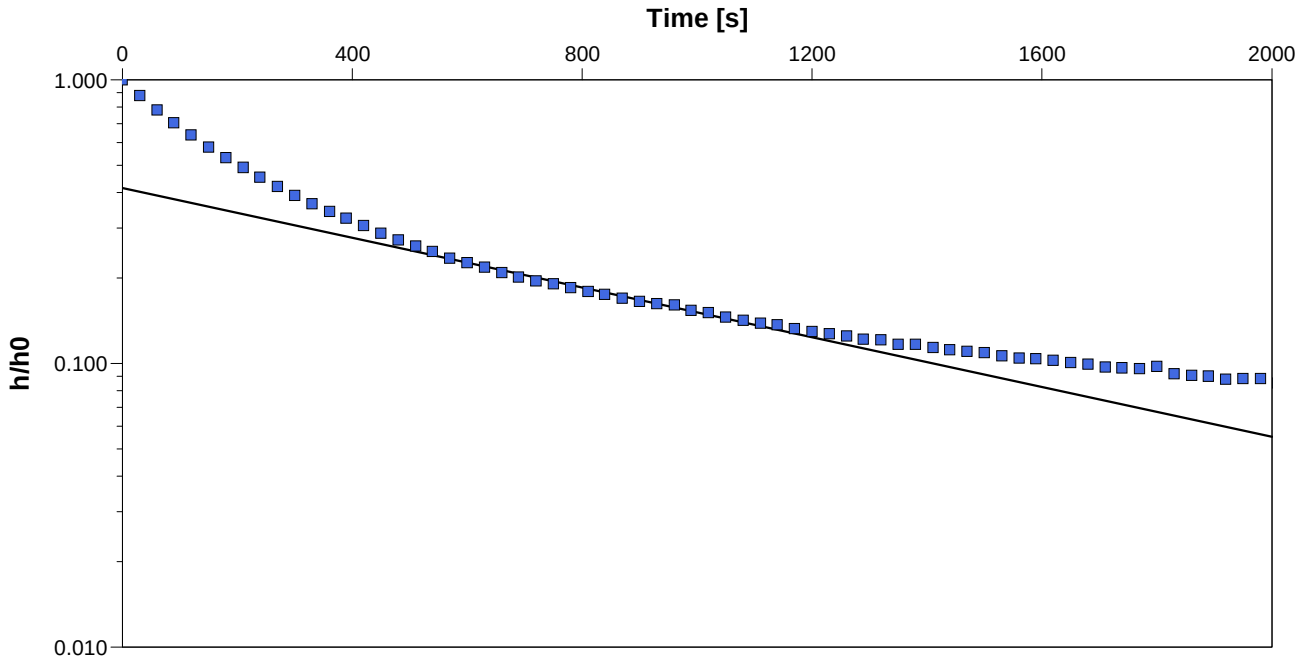
Slug Test Analysis Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Falling head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Analysis Performed by: GAAB	Hvorslev	Analysis Date: 15/09/2026
Aquifer Thickness: 5.09 m		

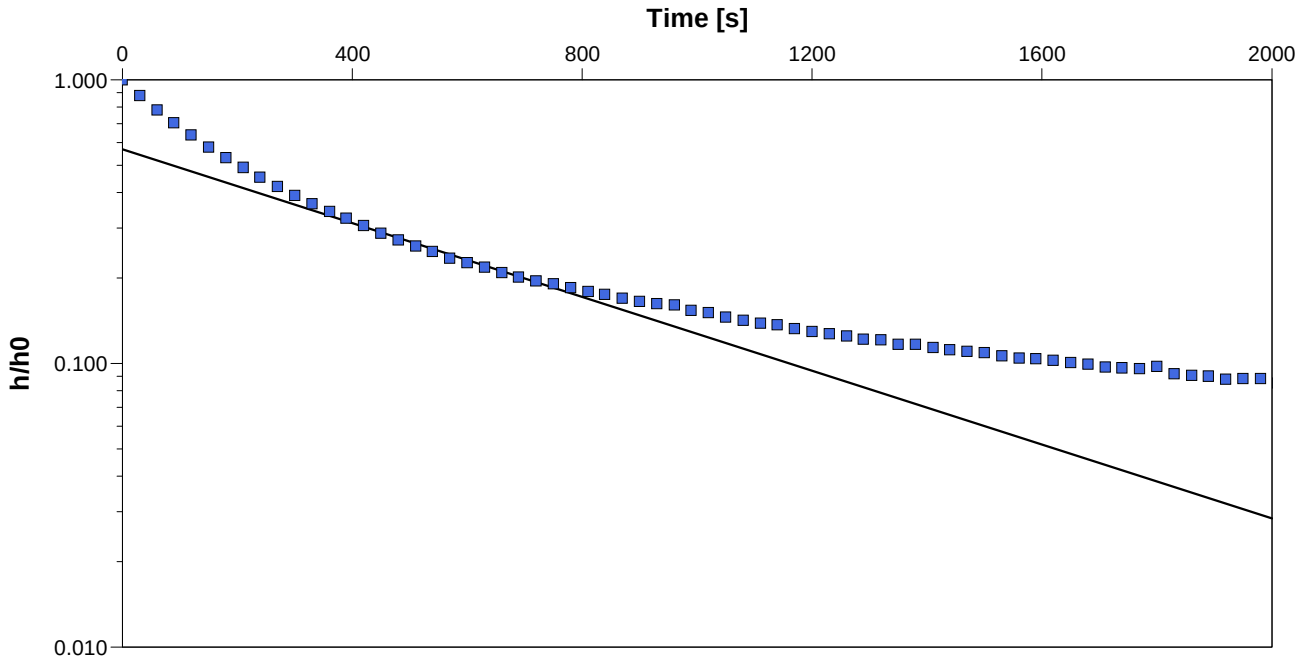


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH201	1.17×10^{-6}	

Tonkin+Taylor	**Slug Test Analysis Report**
	Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION
	Number: 1101937.1000
	Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Falling head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Analysis Performed by: GAAB	Bouwer & Rice	Analysis Date: 15/09/2026
Aquifer Thickness: 5.09 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH201	1.32×10^{-6}	

Tonkin+Taylor

Slug Test - Analyses Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

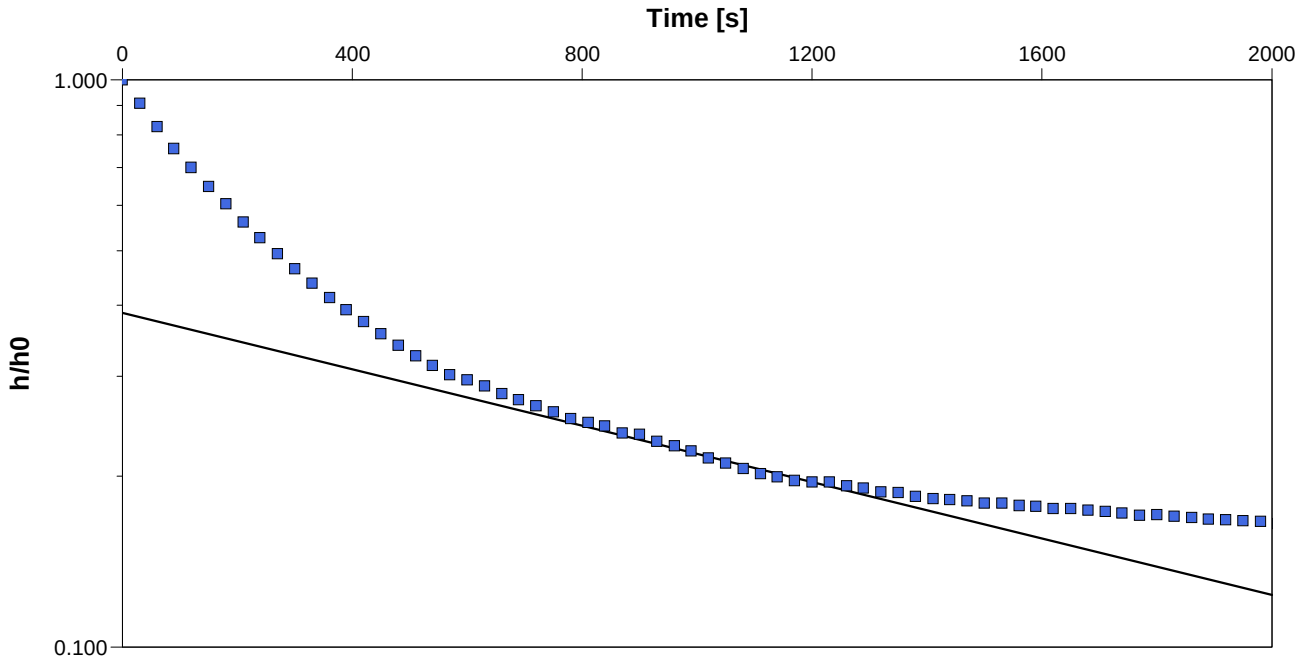
Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Falling head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Aquifer Thickness: 5.09 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	Hvorslev	GAAB	15/09/2026	Hvorslev	BH201		1.17×10^{-6}	
2	Bouwer & Rice	GAAB	15/09/2026	Bouwer & Rice	BH201		1.32×10^{-6}	

Tonkin+Taylor	**Slug Test Analysis Report**
	Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION
	Number: 1101937.1000
	Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Rising head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Analysis Performed by: GAAB	Hvorslev	Analysis Date: 15/09/2026
Aquifer Thickness: 5.09 m		

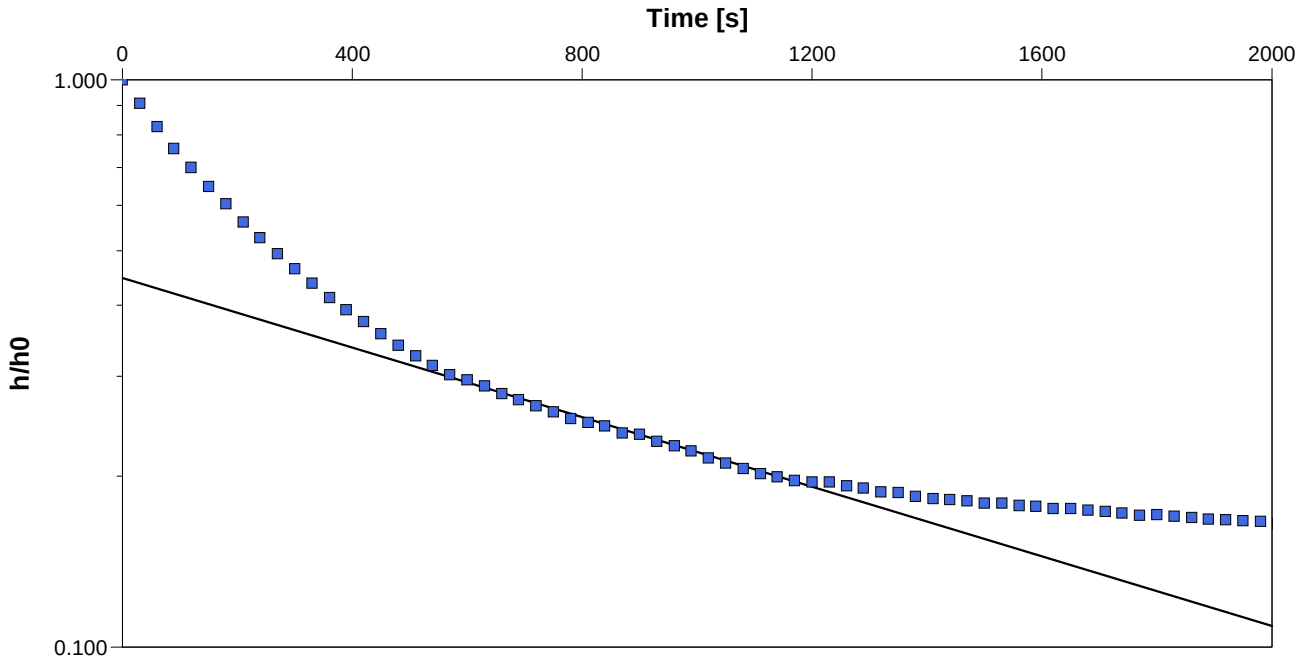


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH201	6.65×10^{-7}	

Tonkin+Taylor	**Slug Test Analysis Report**
	Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION
	Number: 1101937.1000
	Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Rising head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Analysis Performed by: GAAB	Bouwer & Rice	Analysis Date: 15/09/2026
Aquifer Thickness: 5.09 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH201	6.22×10^{-7}	

Tonkin+Taylor

Slug Test - Analyses Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH201 - Rising head test	Test Well: BH201
Test Conducted by: GAAB		Test Date: 15/09/2026
Aquifer Thickness: 5.09 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	Hvorslev	GAAB	15/09/2026	Hvorslev	BH201		6.65×10^{-7}	
2	Bouwer & Rice	GAAB	15/09/2026	Bouwer & Rice	BH201		6.22×10^{-7}	

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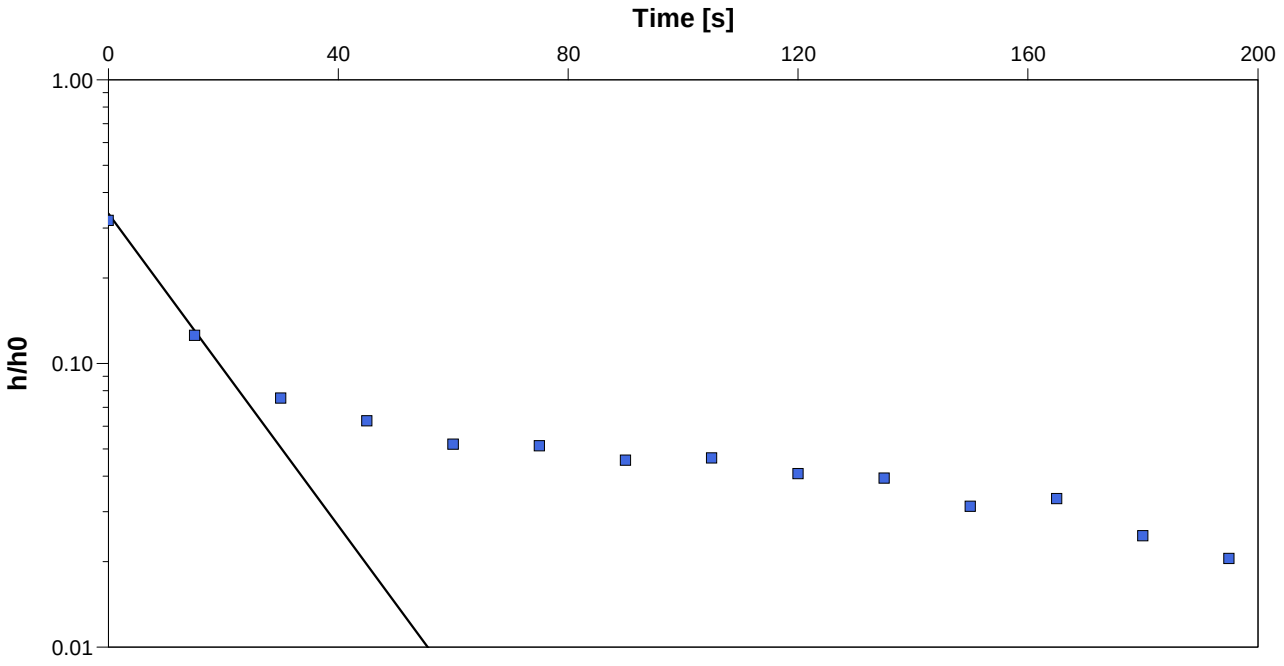
Slug Test Analysis Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Falling head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 21/09/2026
Analysis Performed by: GAAB	Hvorslev	Analysis Date: 17/09/2026
Aquifer Thickness: 2.45 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH202	3.36×10^{-5}	

Tonkin+Taylor

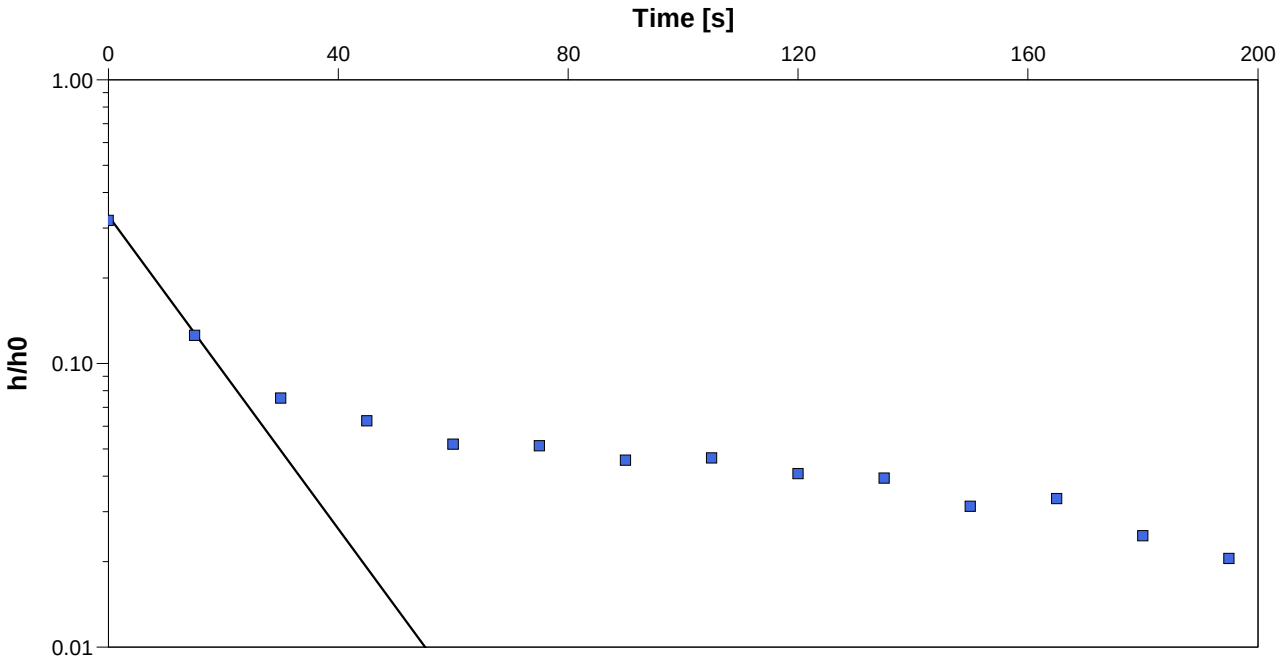
Slug Test Analysis Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Falling head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 21/09/2026
Analysis Performed by: GAAB	Bouwer & Rice	Analysis Date: 17/09/2026
Aquifer Thickness: 2.45 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH202	2.56×10^{-5}	

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Slug Test - Analyses Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Falling head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 21/09/2026
Aquifer Thickness: 2.45 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	Hvorslev	GAAB	17/09/2026	Hvorslev	BH202		3.36×10^{-5}	
2	Bouwer & Rice	GAAB	17/09/2026	Bouwer & Rice	BH202		2.56×10^{-5}	

Tonkin+Taylor

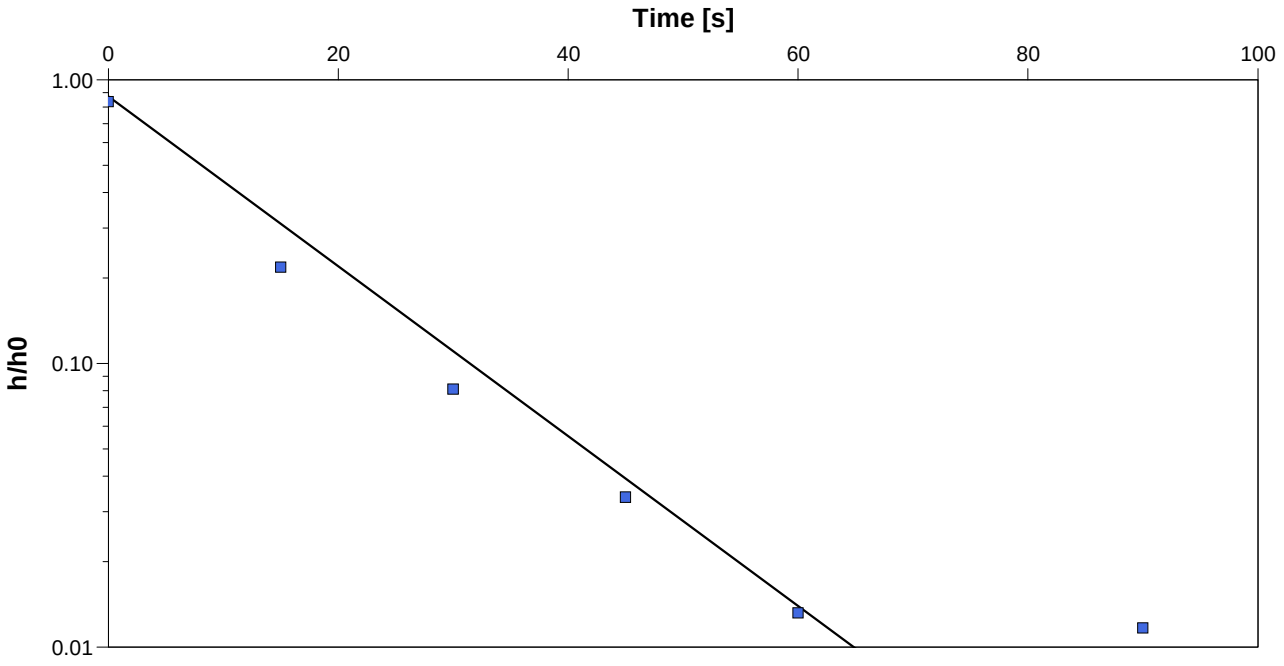
Slug Test Analysis Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Rising head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 17/09/2026
Analysis Performed by: GAAB	Hvorslev	Analysis Date: 17/09/2026
Aquifer Thickness: 2.45 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH202	3.66×10^{-5}	

Tonkin+Taylor

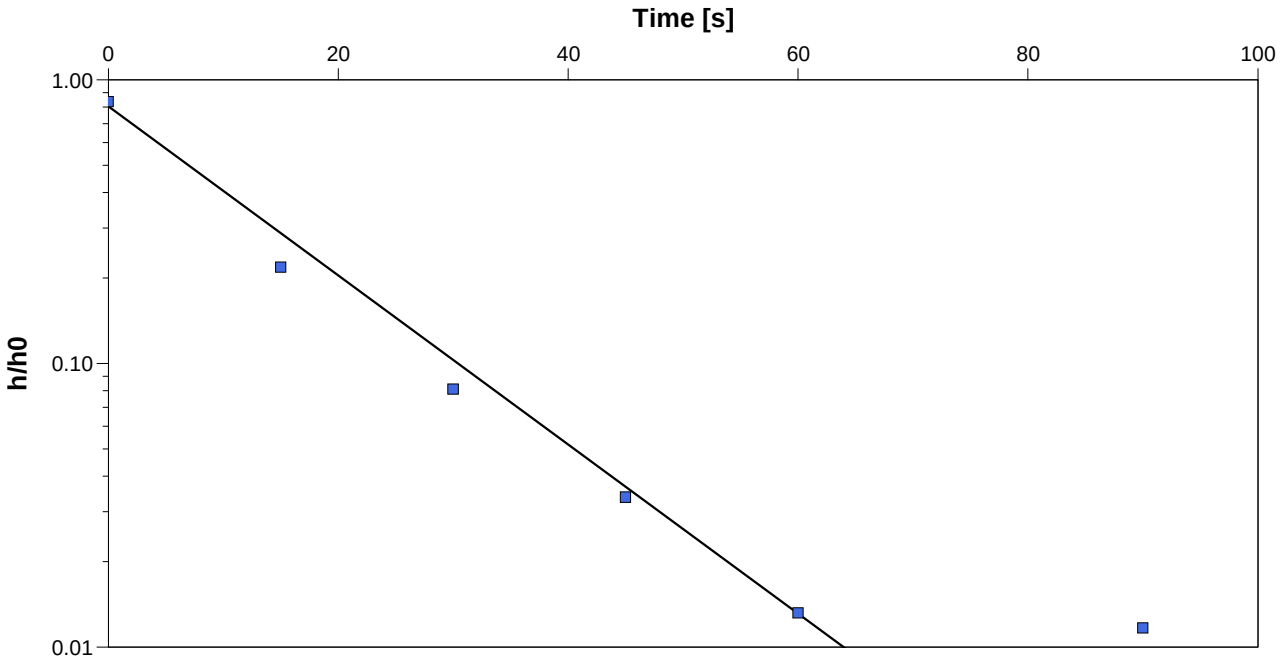
Slug Test Analysis Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Rising head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 17/09/2026
Analysis Performed by: GAAB	Bouwer & Rice	Analysis Date: 17/09/2026
Aquifer Thickness: 2.45 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH202	2.77×10^{-5}	

Tonkin+Taylor

Slug Test - Analyses Report

Project: 100 HALSEY STREET - SUBSTANTIVE APPLICATION

Number: 1101937.1000

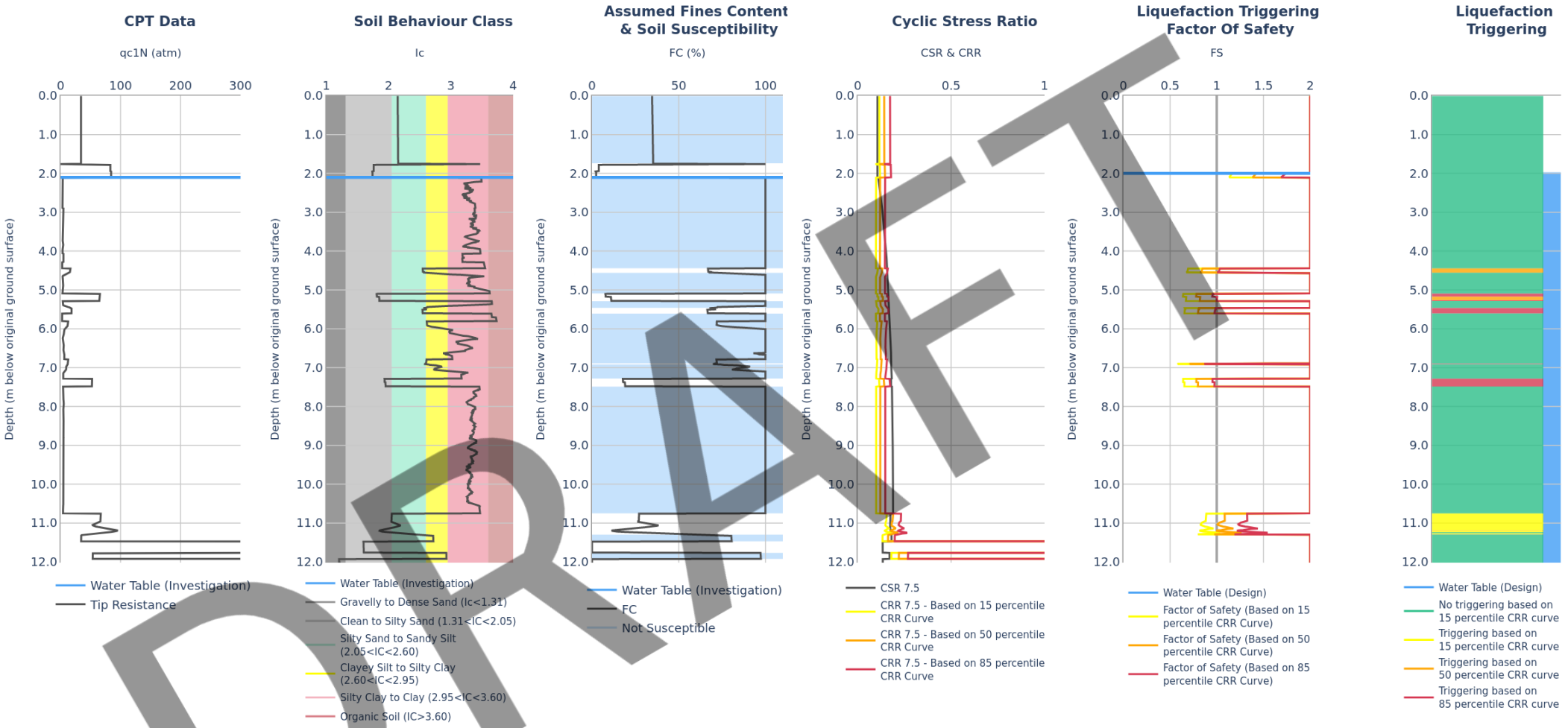
Client: NZ CRE 100 HALSEY LIMITED

Location: 100 Halsey Street	Slug Test: BH202 - Rising head test	Test Well: BH202
Test Conducted by: GAAB		Test Date: 17/09/2026
Aquifer Thickness: 2.45 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	Hvorslev	GAAB	17/09/2026	Hvorslev	BH202		3.66×10^{-5}	
2	Bouwer & Rice	GAAB	17/09/2026	Bouwer & Rice	BH202		2.77×10^{-5}	

Appendix E Liquefaction analysis outputs

CPT DATA AND LIQUEFACTION TRIGGERING ASSESSMENT



DRAFT

Input

Note: Inverse filter Qc/Fs data (15 cm²).

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT201	CPT_TT288829	01/09/2026	1.75	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

Output

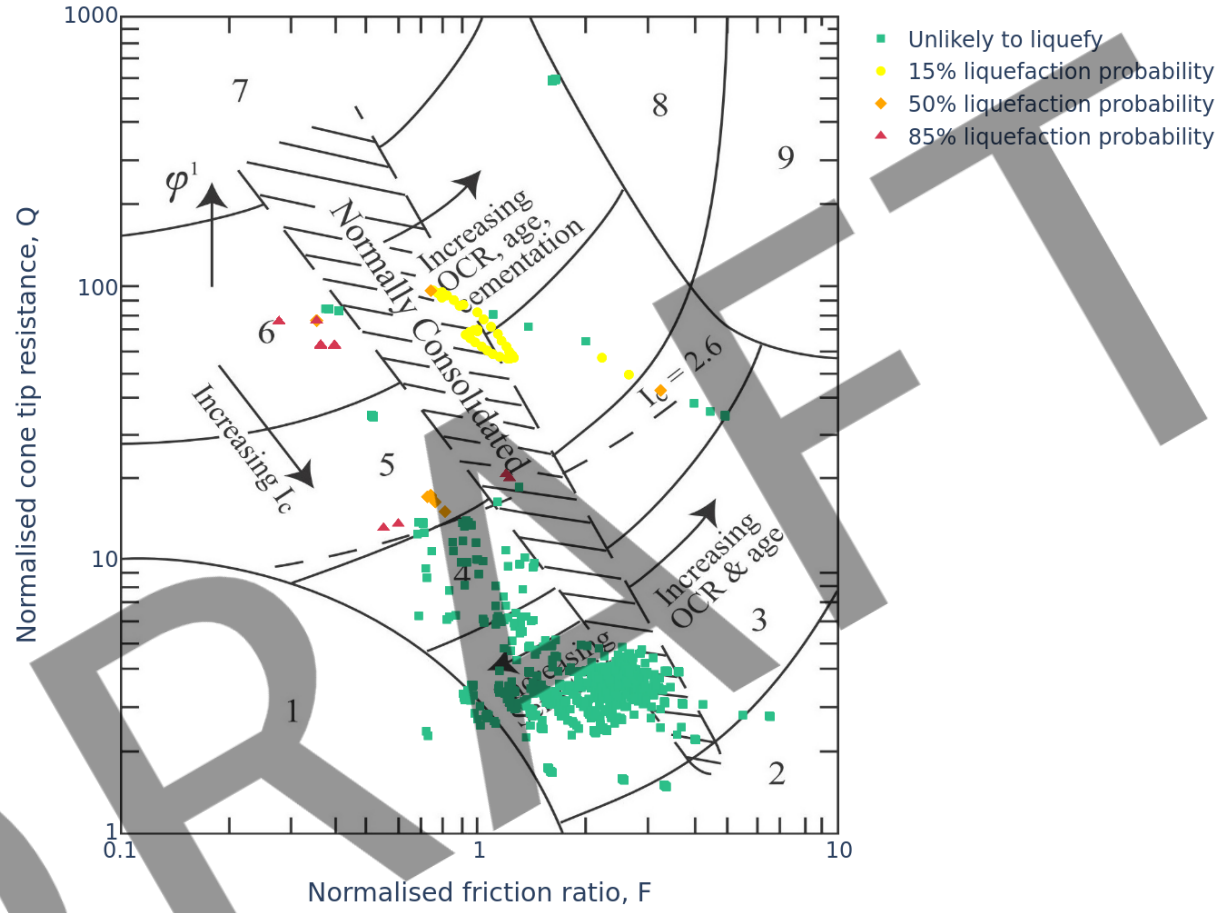
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
15%	27	1.2	1	4	4.5	0
50%	23	0.7	0	3	4.5	0
85%	11	0.5	0	1	5.3	0

Reviewed by

CPT inversion	
Groundwater	
Stress	
Susceptibility	
Triggering	
Consequence	

Tonkin+Taylor	*CLIENT*	*NZ CRE 100 Halsey Limited*	*LOCATION*	*Auckland CBD*	*DATE: 23/09/2026*
	PROJECT	*100 Halsey Street*			*ANALYSED: MMK*
	TITLE	*Liquefaction Assessment*	*JOB NUMBER*	*1101937.1*	
	COMMENT	*ULS seismic case*			*Page 1/20*

SOIL BEHAVIOUR TYPE CLASSIFICATION ASSESSMENT



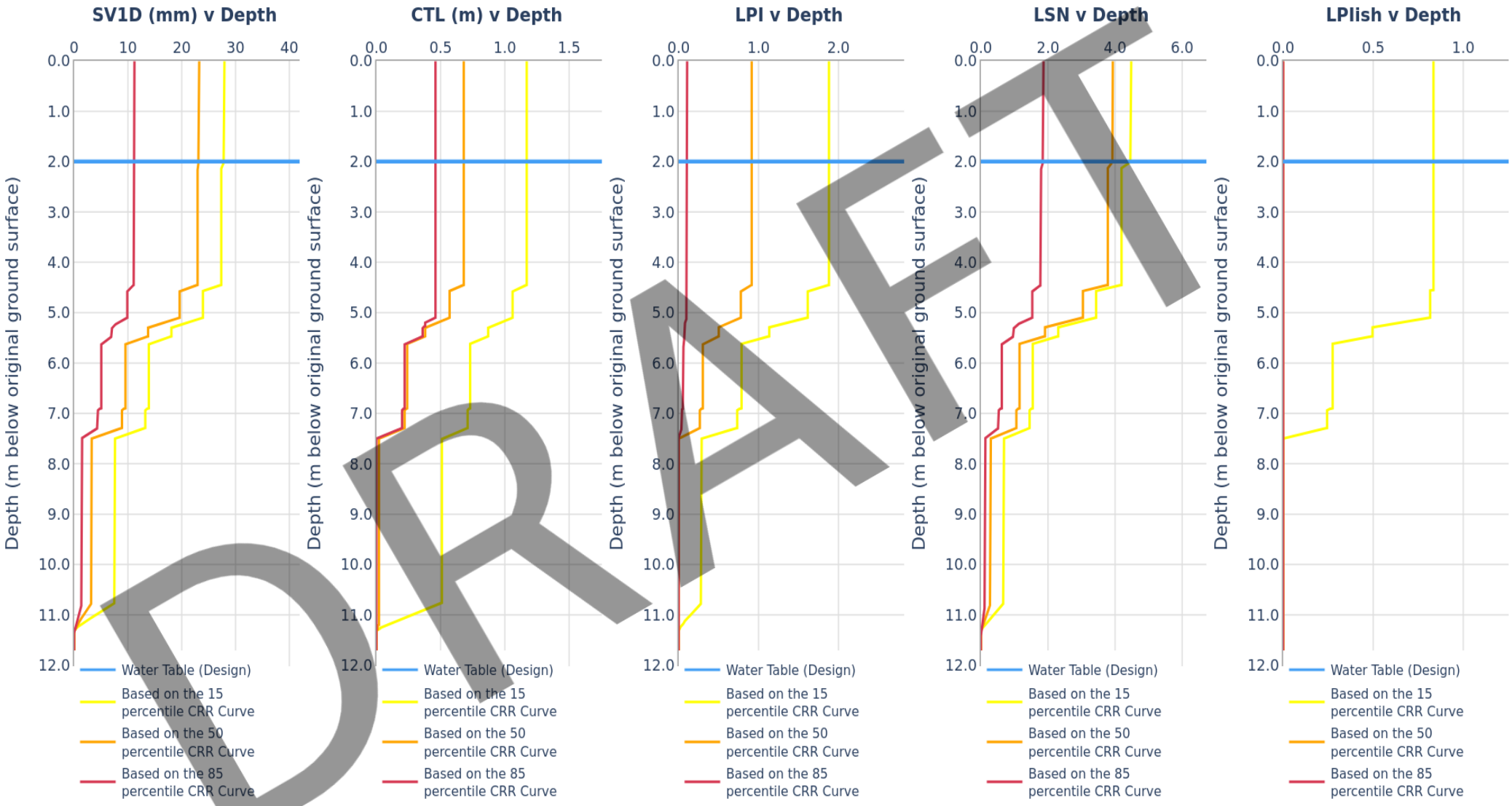
DRAFT

1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT

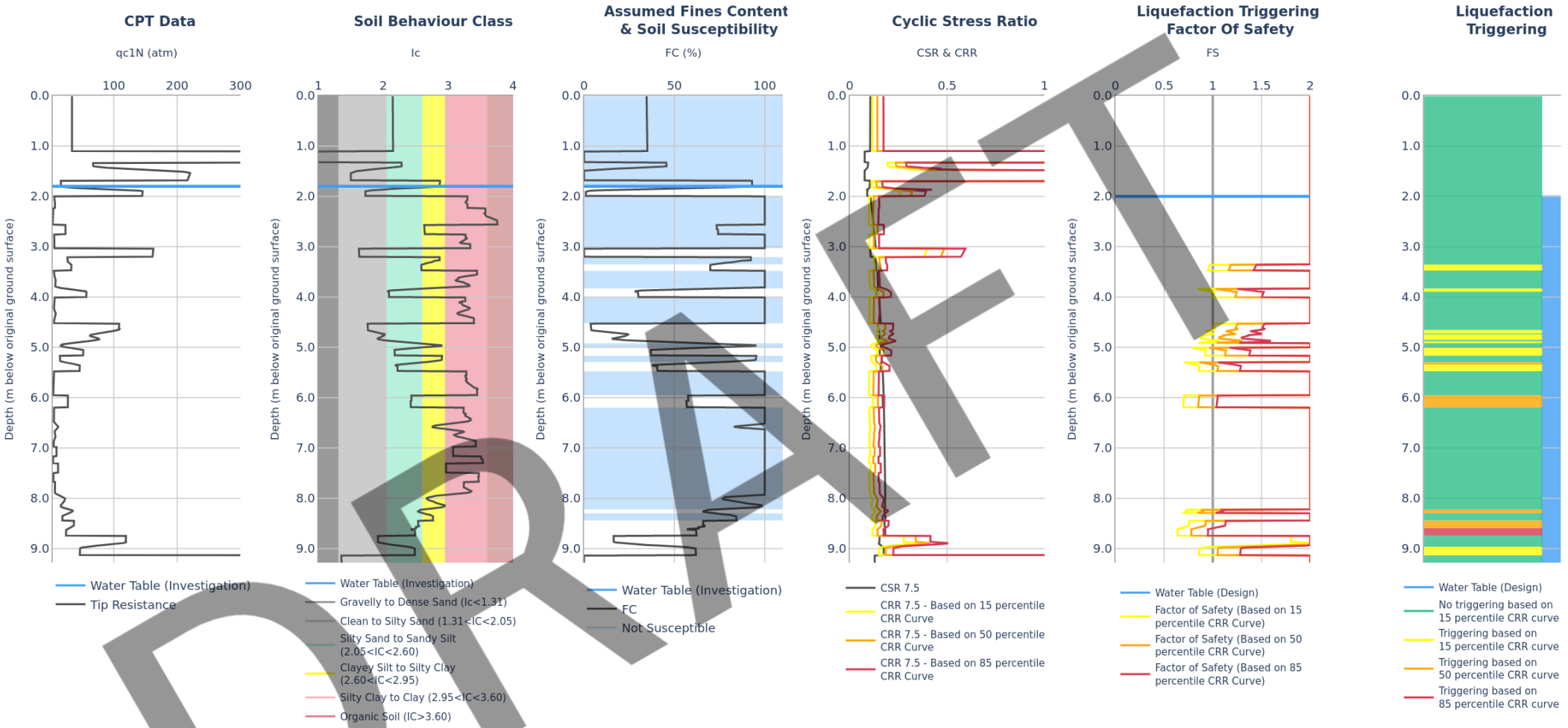


DRAFT

Input

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT201	CPT_TT288829	01/09/2026	1.75	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

CPT DATA AND LIQUEFACTION TRIGGERING ASSESSMENT



DRAFT

Input

Note: Inverse filter Qc/Fs data (15 cm²).

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT202	CPT_TT288833	02/09/2026	1.1	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

Output

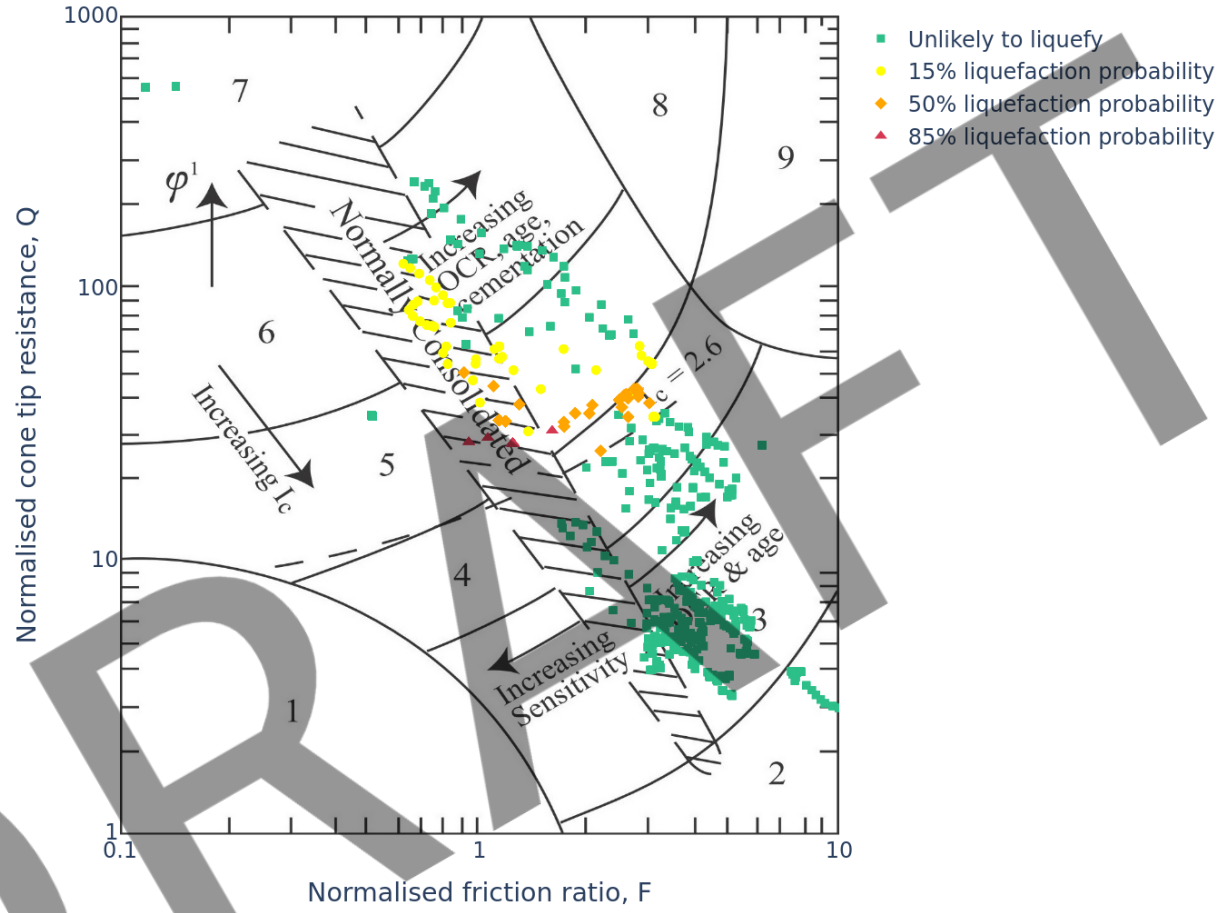
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
15%	32	1.5	1	5	3.4	0
50%	20	0.7	0	3	6.0	0
85%	8	0.2	0	1	8.7	0

Reviewed by

CPT inversion	
Groundwater	
Stress	
Susceptibility	
Triggering	
Consequence	

Tonkin+Taylor	*CLIENT*	*NZ CRE 100 Halsey Limited*	*LOCATION*	*Auckland CBD*	*DATE: 23/09/2026*
	PROJECT	*100 Halsey Street*			*ANALYSED: MMK*
	TITLE	*Liquefaction Assessment*	*JOB NUMBER*	*1101937.1*	
	COMMENT	*ULS seismic case*			*Page 4/20*

SOIL BEHAVIOUR TYPE CLASSIFICATION ASSESSMENT



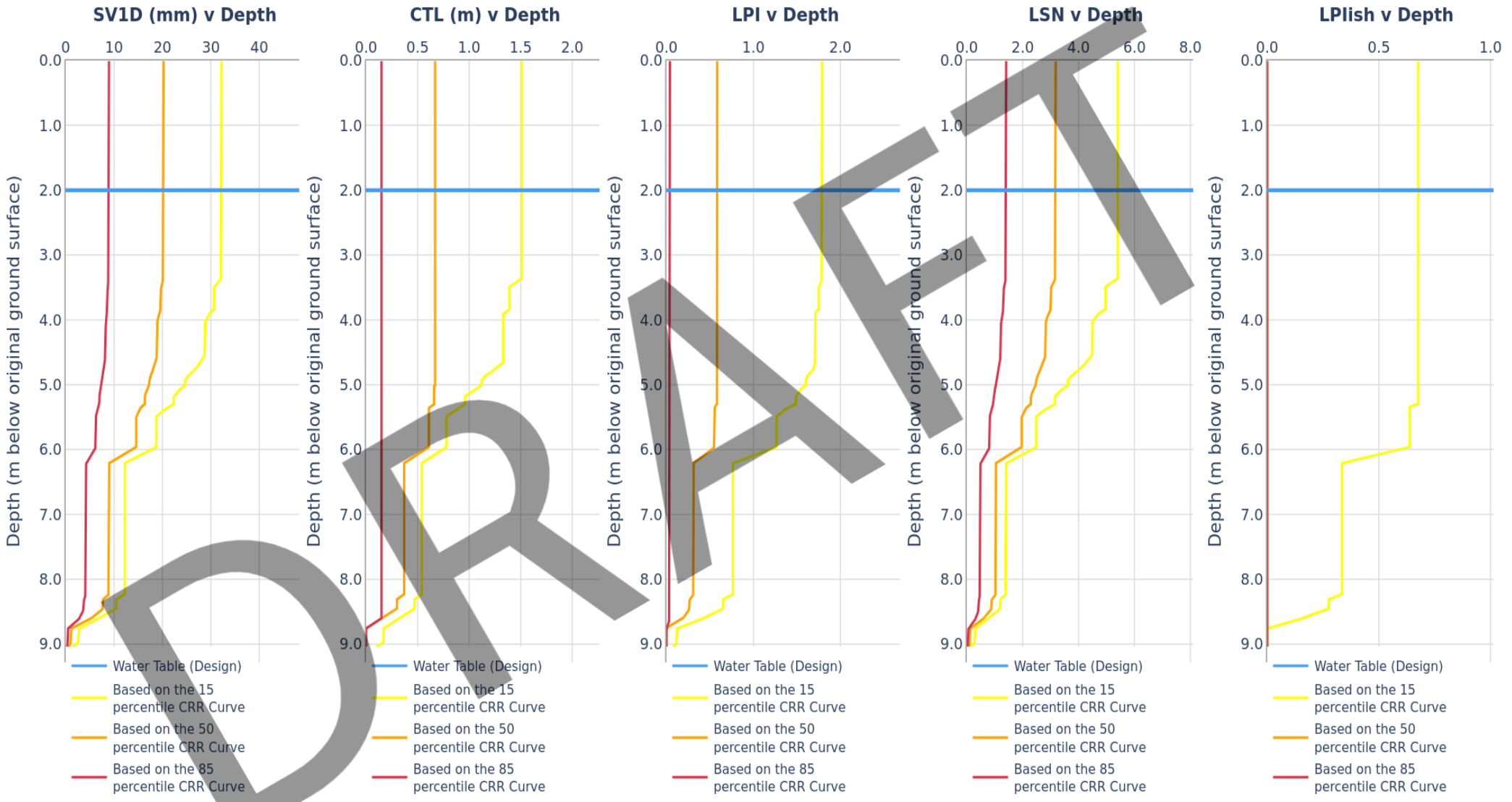
DRAFT

1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT

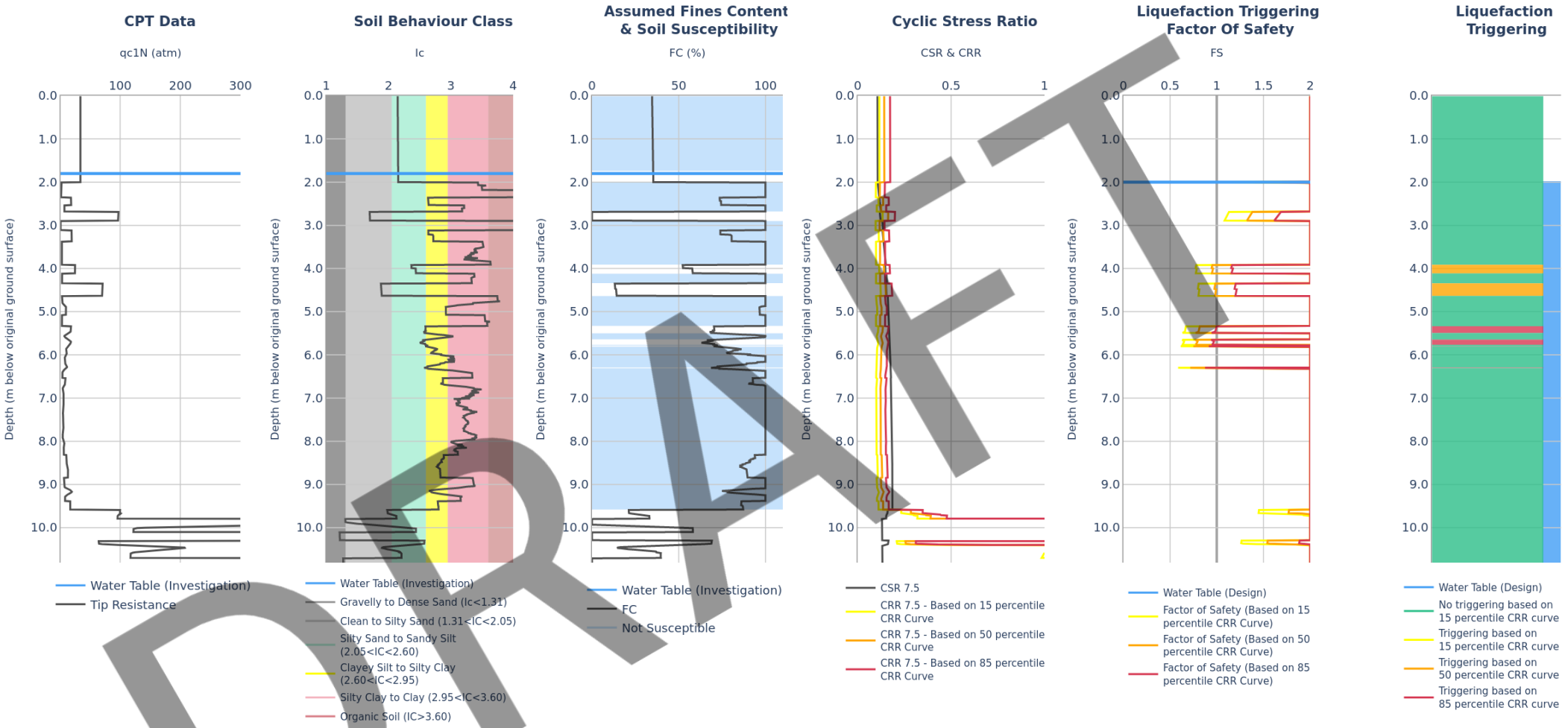


DRAFT

Input

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT202	CPT_TT288833	02/09/2026	1.1	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

CPT DATA AND LIQUEFACTION TRIGGERING ASSESSMENT



DRAFT

Input

Note: Inverse filter Qc/Fs data (15 cm²).

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT203	CPT_TT288838	01/09/2026	2.0	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

Output

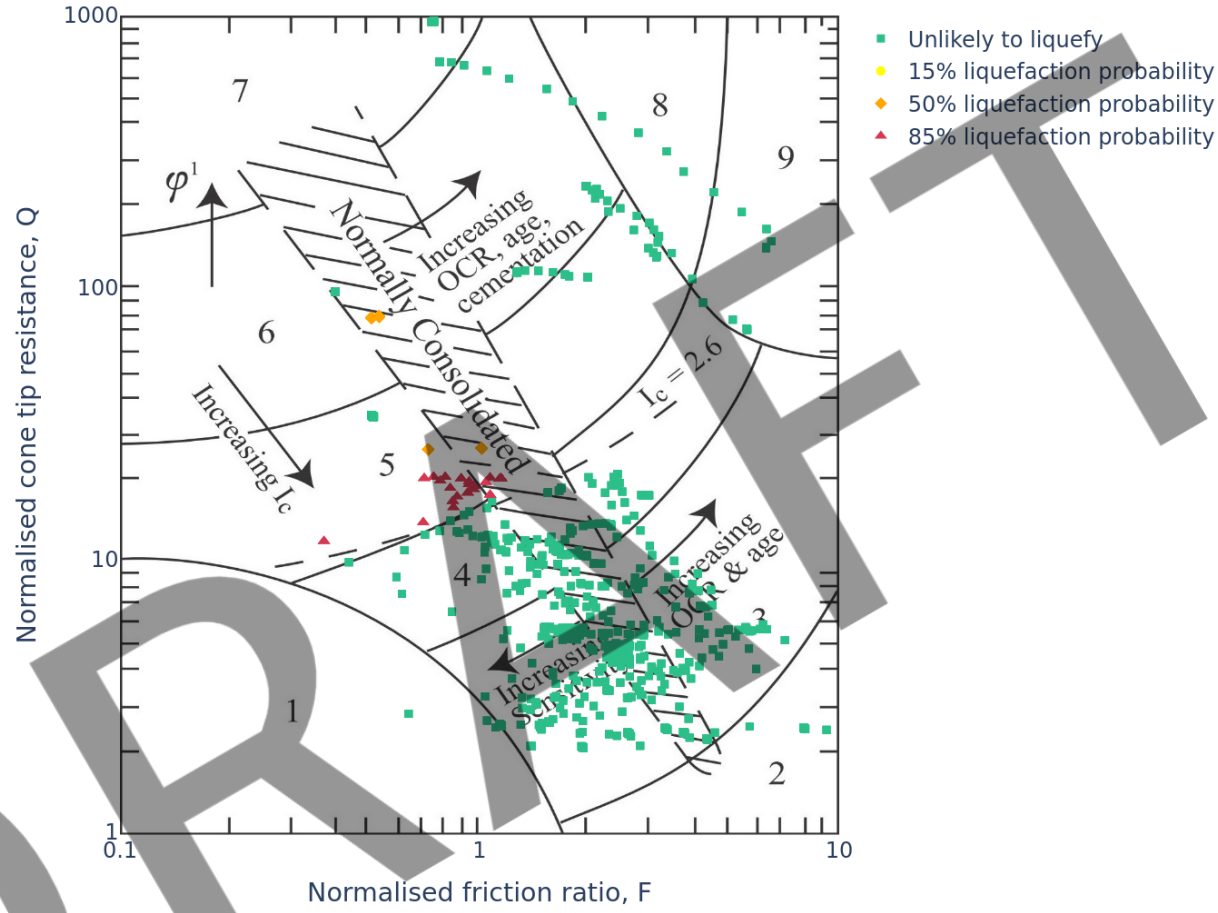
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
15%	23	0.8	1	5	4.0	0
50%	16	0.8	0	3	4.0	0
85%	7	0.3	0	1	5.4	0

Reviewed by

CPT inversion	
Groundwater	
Stress	
Susceptibility	
Triggering	
Consequence	

Tonkin+Taylor	*CLIENT*	*NZ CRE 100 Halsey Limited*	*LOCATION*	*Auckland CBD*	*DATE: 23/09/2026*
	PROJECT	*100 Halsey Street*			*ANALYSED: MMK*
	TITLE	*Liquefaction Assessment*	*JOB NUMBER*	*1101937.1*	
	COMMENT	*ULS seismic case*			*Page 7/20*

SOIL BEHAVIOUR TYPE CLASSIFICATION ASSESSMENT



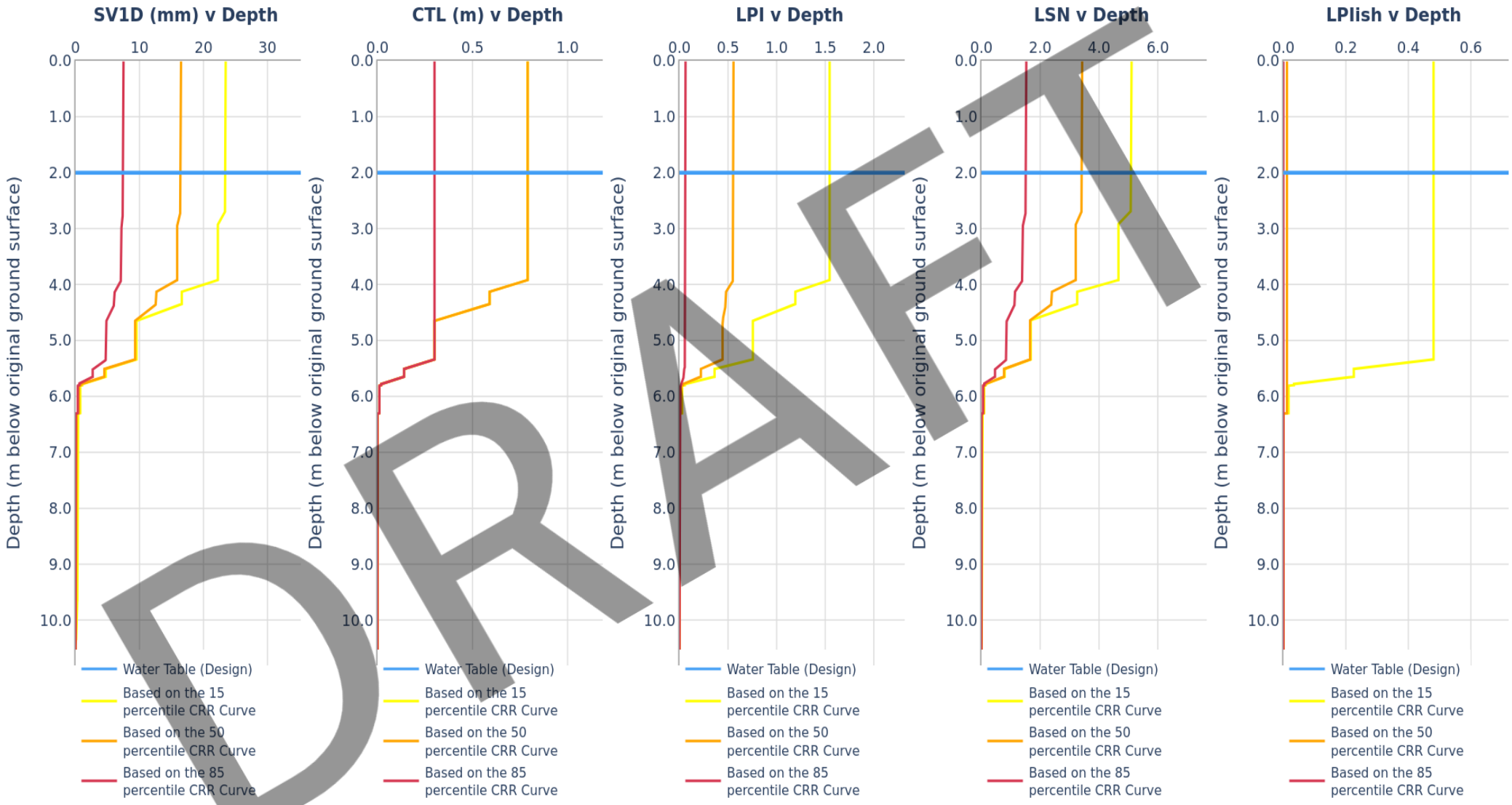
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

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LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT

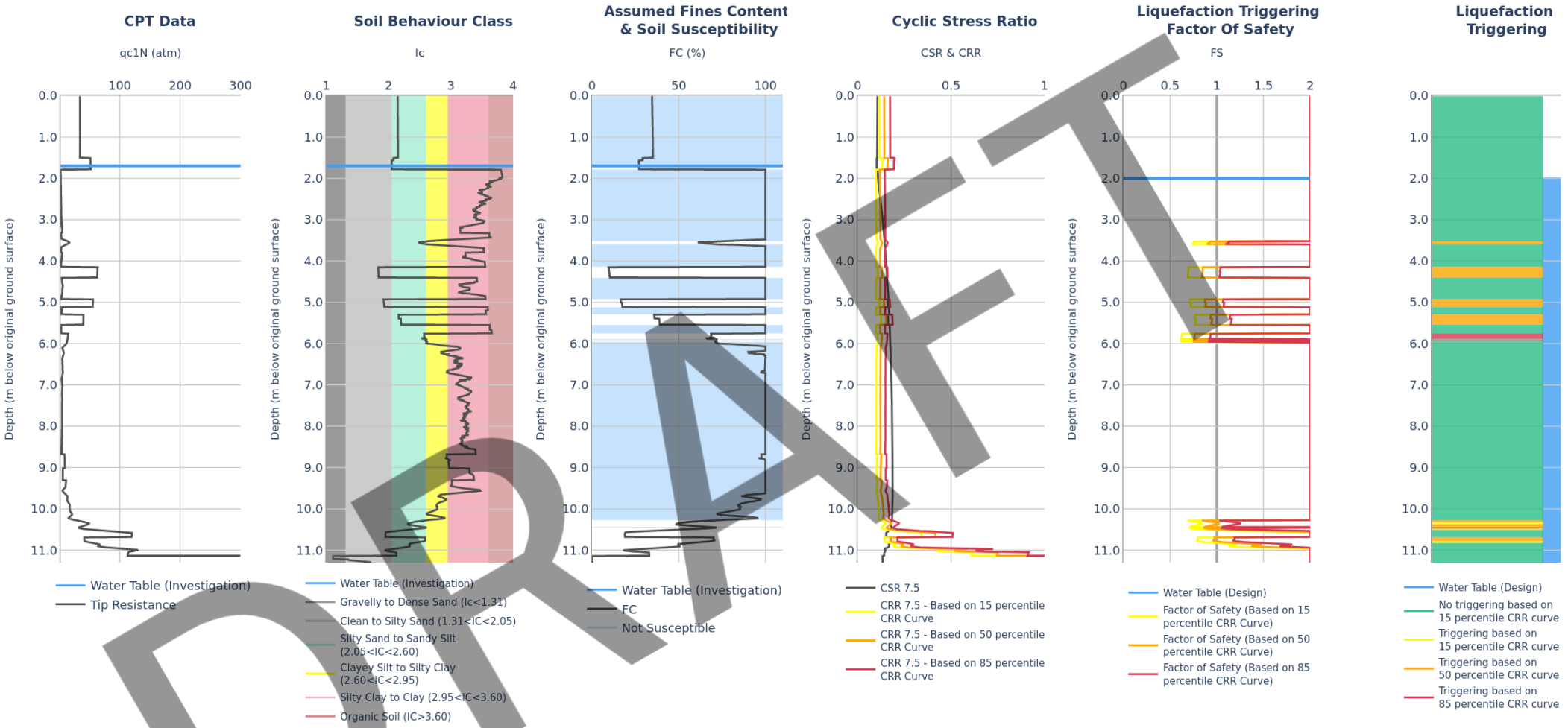


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Input

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT203	CPT_TT288838	01/09/2026	2.0	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

CPT DATA AND LIQUEFACTION TRIGGERING ASSESSMENT



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Input

Note: Inverse filter Qc/Fs data (15 cm²).

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT204	CPT_TT288839	01/09/2026	1.5	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

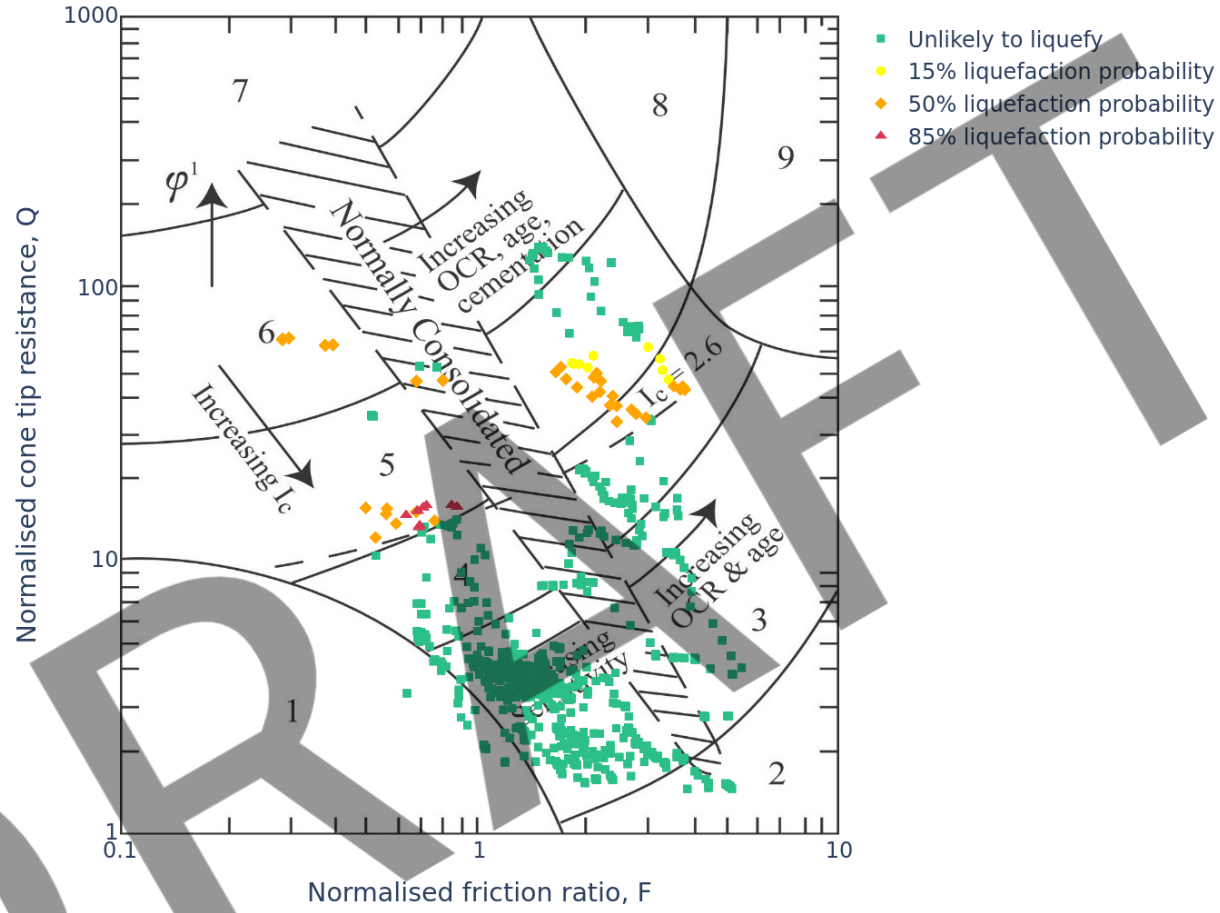
Output

PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
15%	34	1.3	2	6	4.2	1
50%	26	1.2	0	5	4.2	0
85%	11	0.1	0	2	5.8	0

Reviewed by

CPT inversion	
Groundwater	
Stress	
Susceptibility	
Triggering	
Consequence	

SOIL BEHAVIOUR TYPE CLASSIFICATION ASSESSMENT



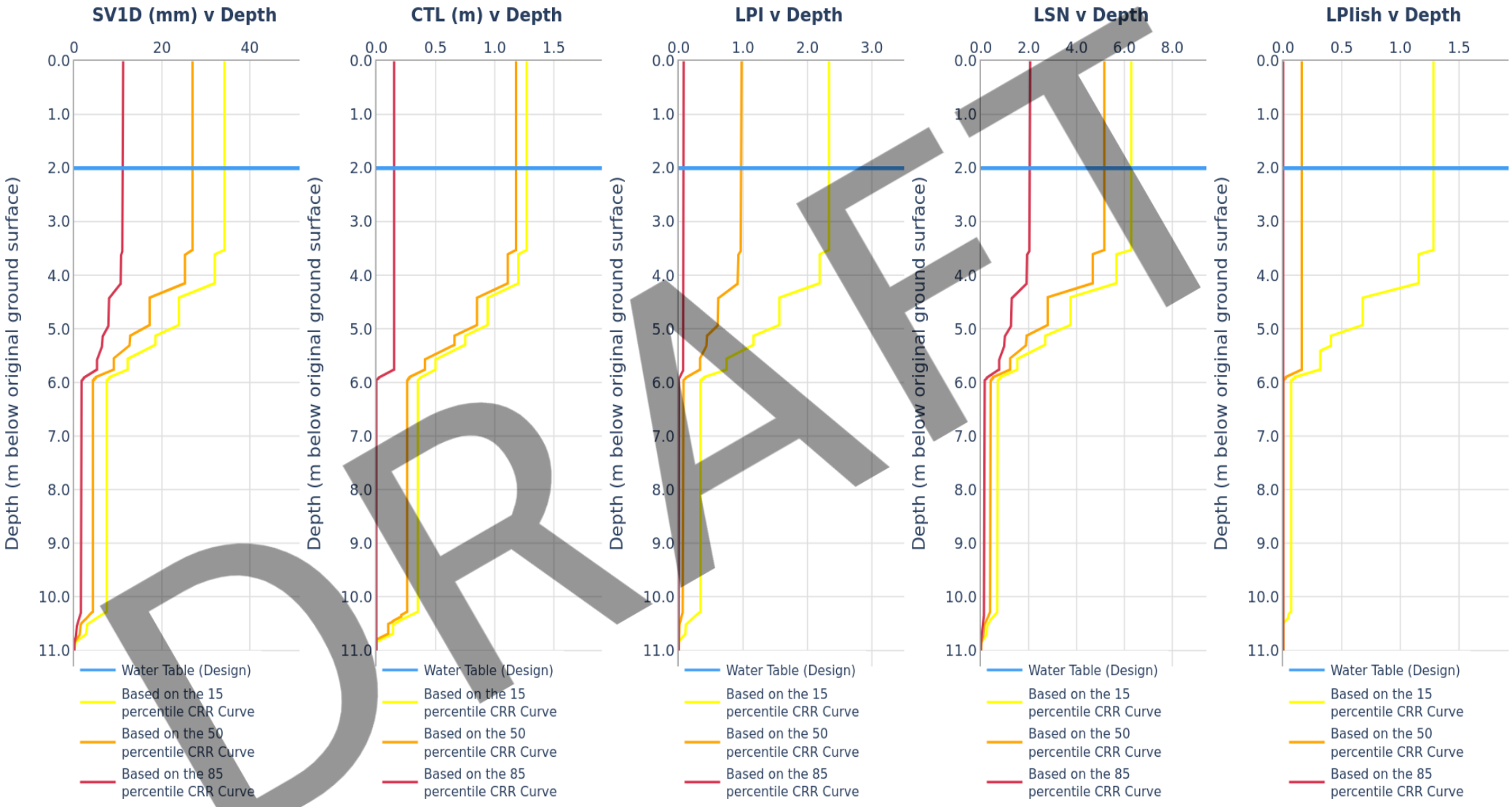
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1. Sensitive, fine grained
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5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT

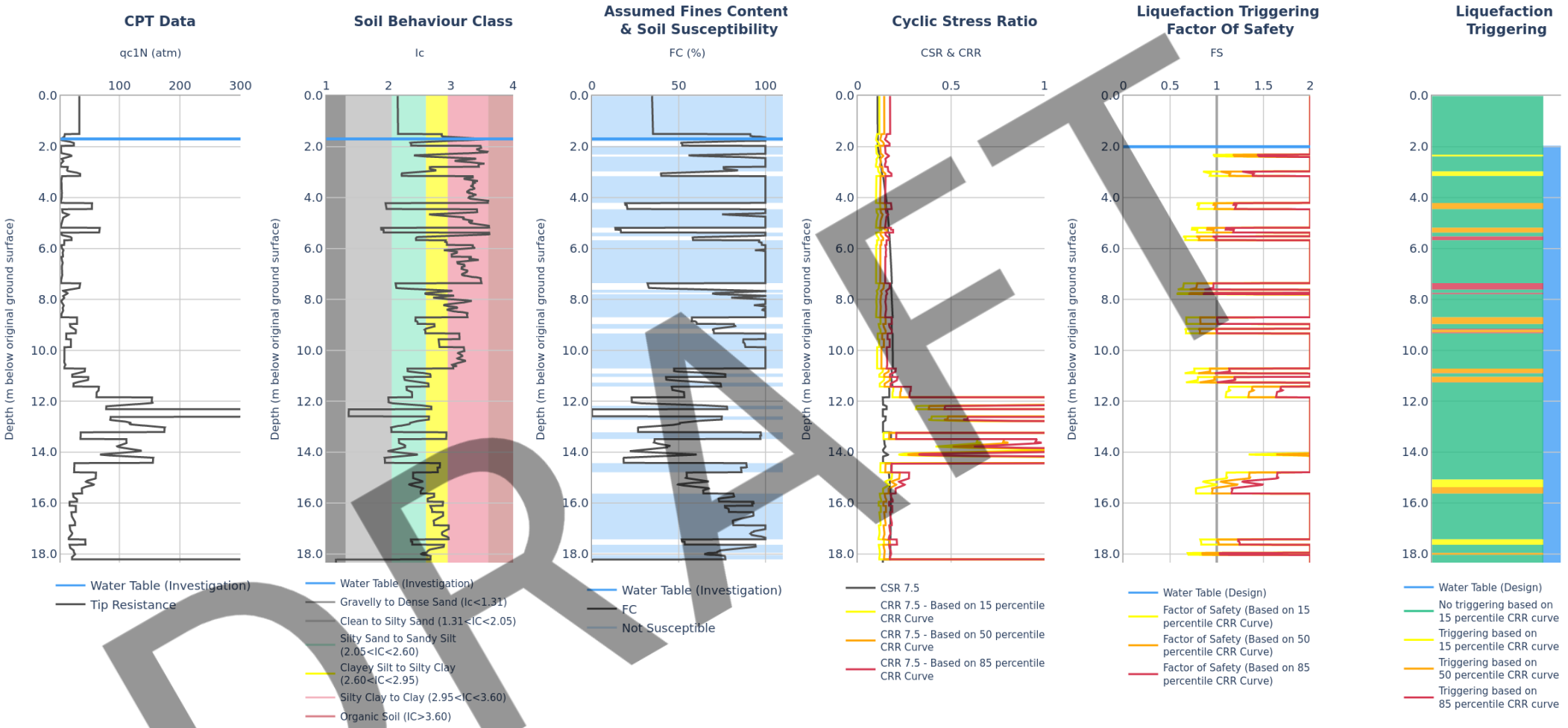


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Input

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT204	CPT_TT288839	01/09/2026	1.5	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

CPT DATA AND LIQUEFACTION TRIGGERING ASSESSMENT



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Input

Note: Inverse filter Qc/Fs data (15 cm²).

Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT205	CPT_TT288840	02/09/2026	1.5	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

Output

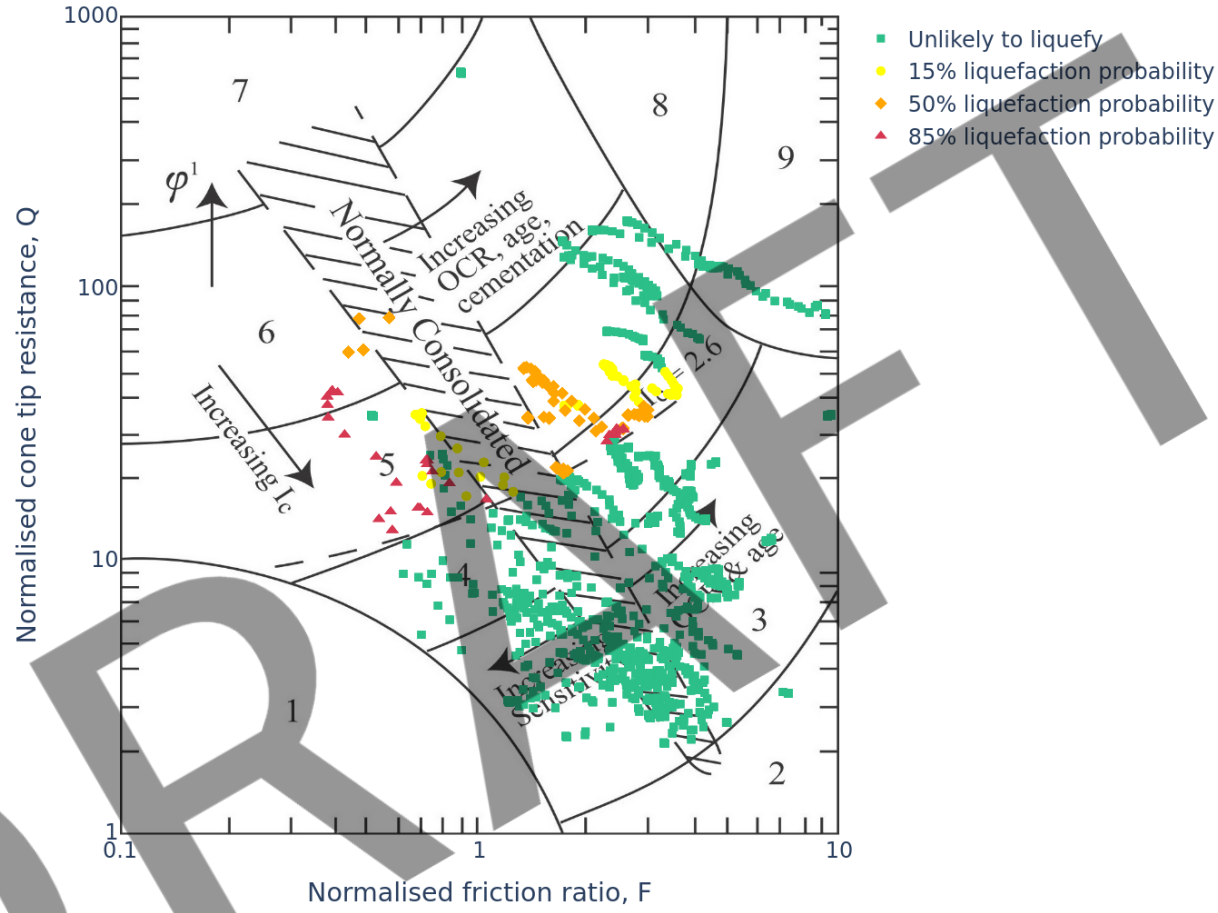
PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
15%	67	2.8	3	9	3.0	1
50%	46	2.1	1	6	4.3	0
85%	21	0.6	0	2	5.6	0

Reviewed by

CPT inversion	
Groundwater	
Stress	
Susceptibility	
Triggering	
Consequence	

Tonkin+Taylor	*CLIENT*	*NZ CRE 100 Halsey Limited*	*LOCATION*	*Auckland CBD*	*DATE: 23/09/2026*
	PROJECT	*100 Halsey Street*			*ANALYSED: MMK*
	TITLE	*Liquefaction Assessment*	*JOB NUMBER*	*1101937.1*	
	COMMENT	*ULS seismic case*			*Page 13/20*

SOIL BEHAVIOUR TYPE CLASSIFICATION ASSESSMENT



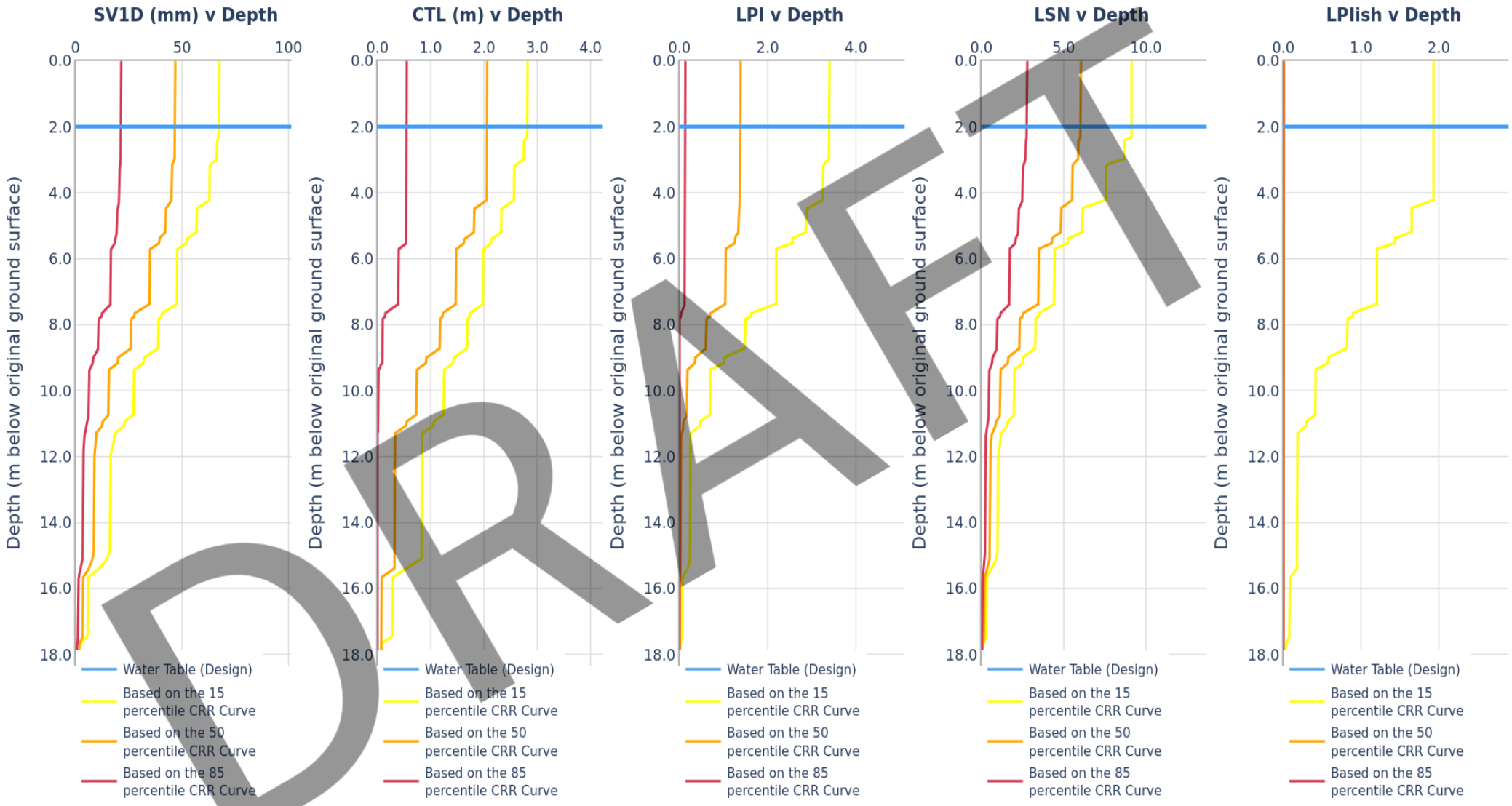
1. Sensitive, fine grained
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6. Sands - clean sand to silty sand
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8. Very stiff sand to clayey sand
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)

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LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT

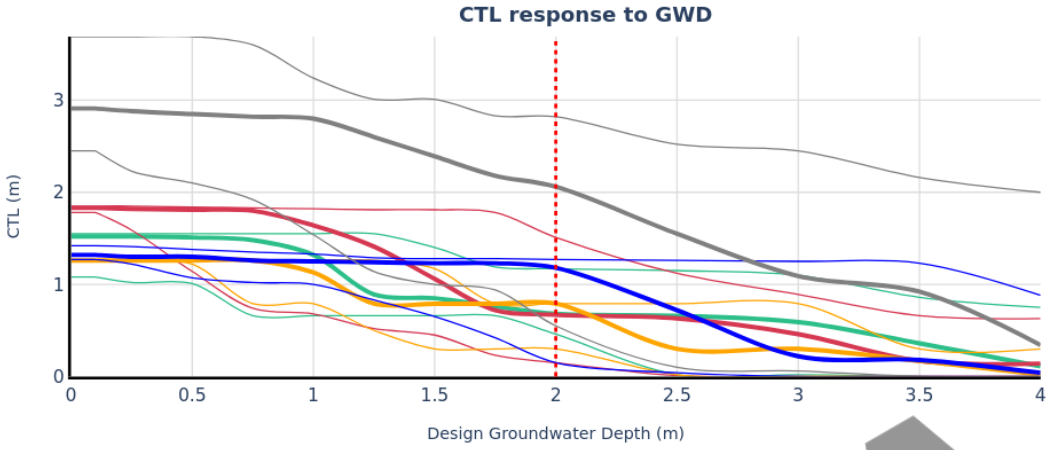


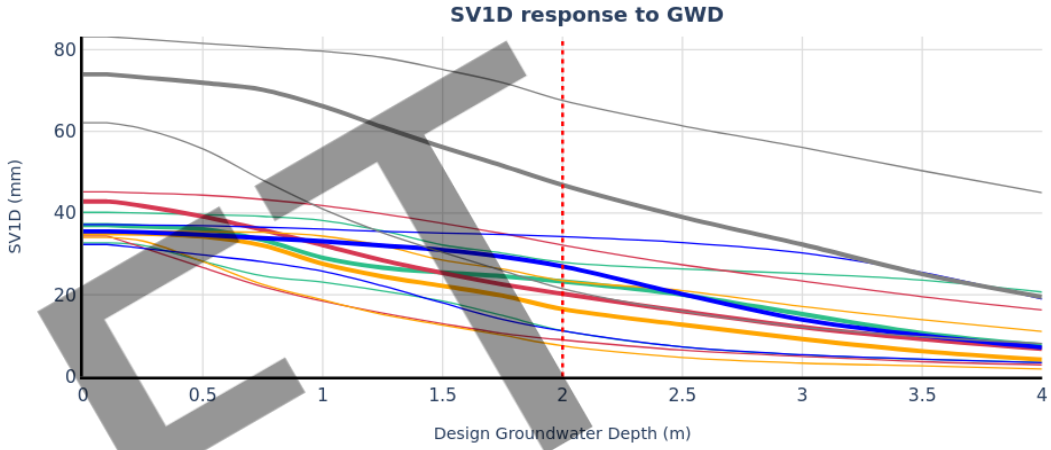
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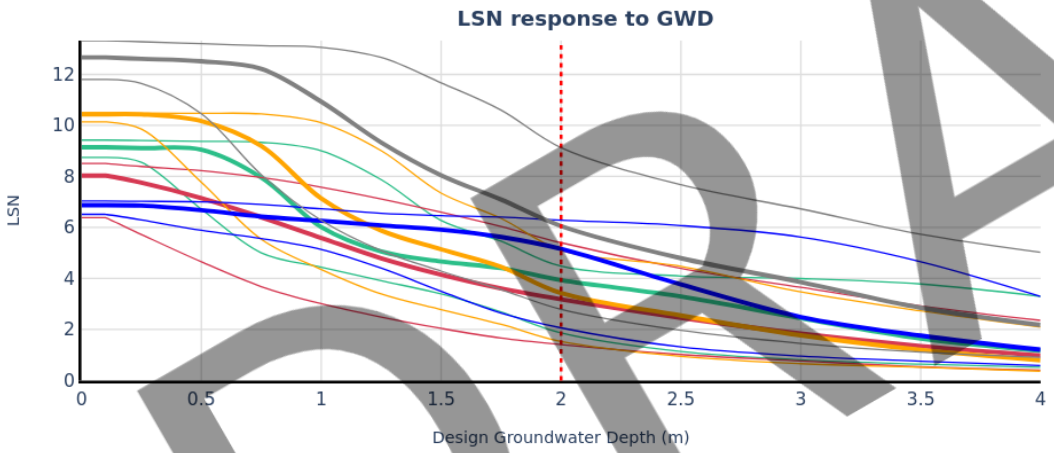
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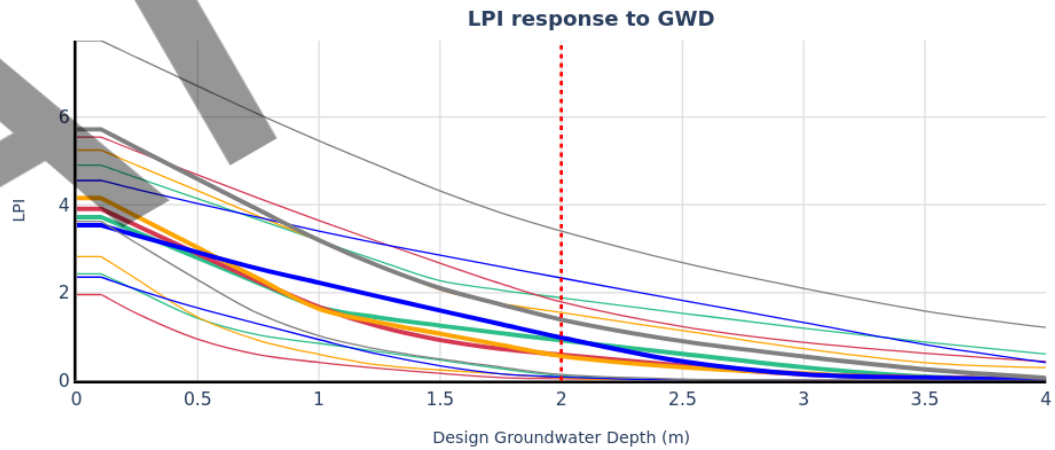
Run Description	NZGD ID	Investigation Date	Pre-drill depth (m)	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT205	CPT_TT288840	02/09/2026	1.5	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

GROUNDWATER DEPTH SENSITIVITY ASSESSMENT OF LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT









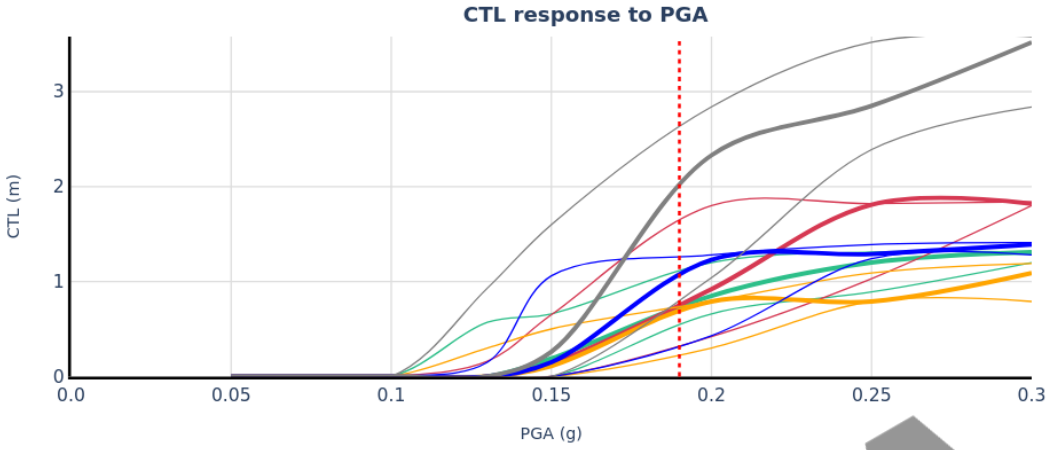
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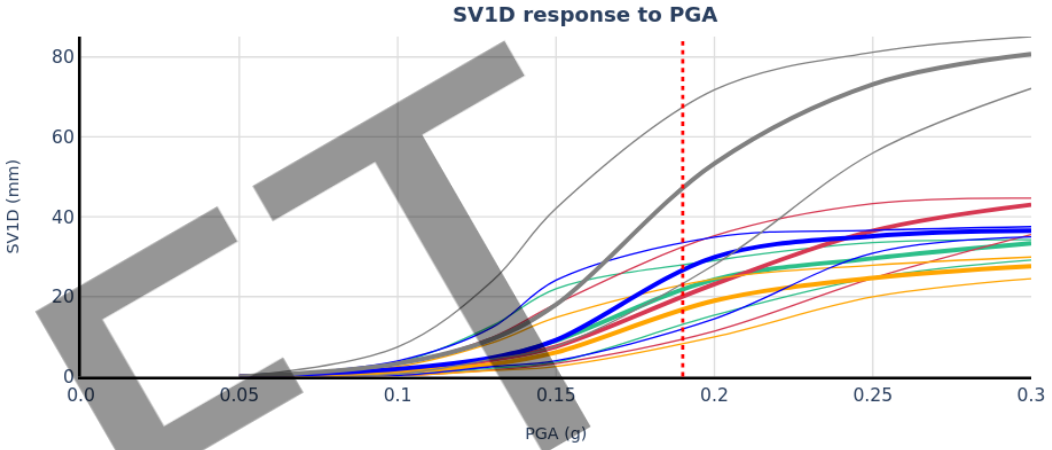
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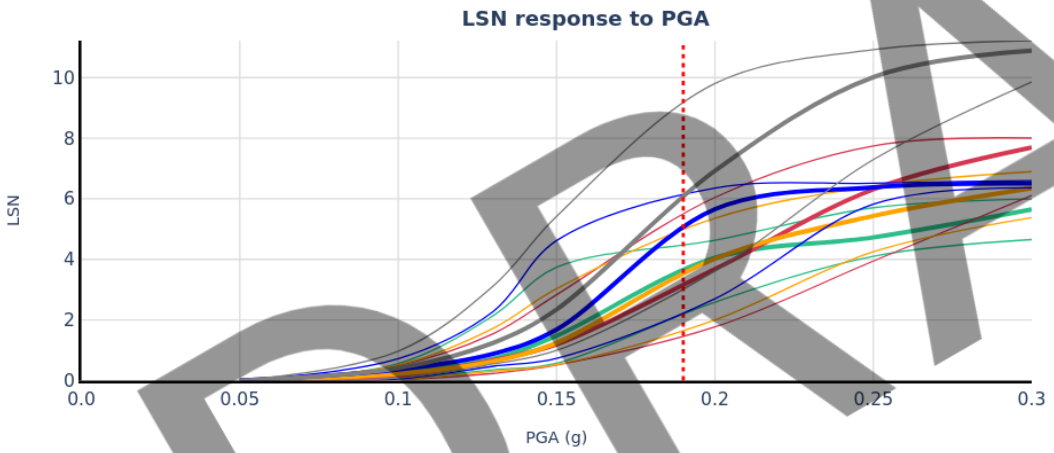
Run Description	NZGD ID	Investigation Date	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT201	CPT_TT288829	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT202	CPT_TT288833	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT203	CPT_TT288838	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT204	CPT_TT288839	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT205	CPT_TT288840	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

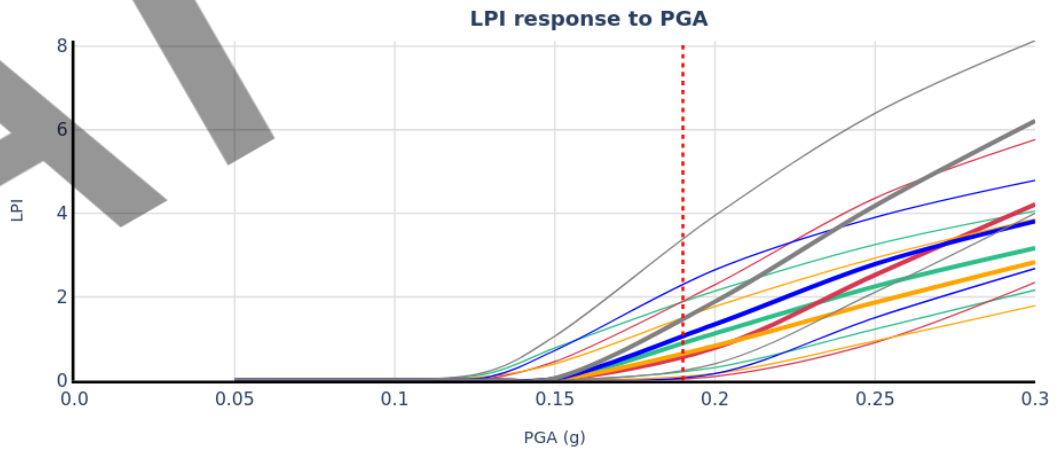
Thicker lines based on 50 percentile CRR curve and the thinner lines beneath and above the thicker lines are based on 85 and 15 percentile CRR curve, respectively.

PGA SENSITIVITY ASSESSMENT OF LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT









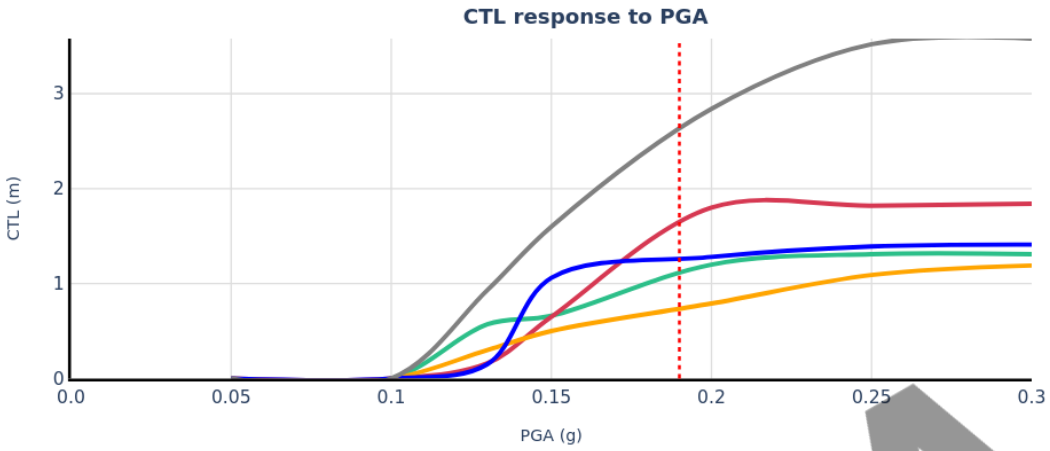
DRAFT

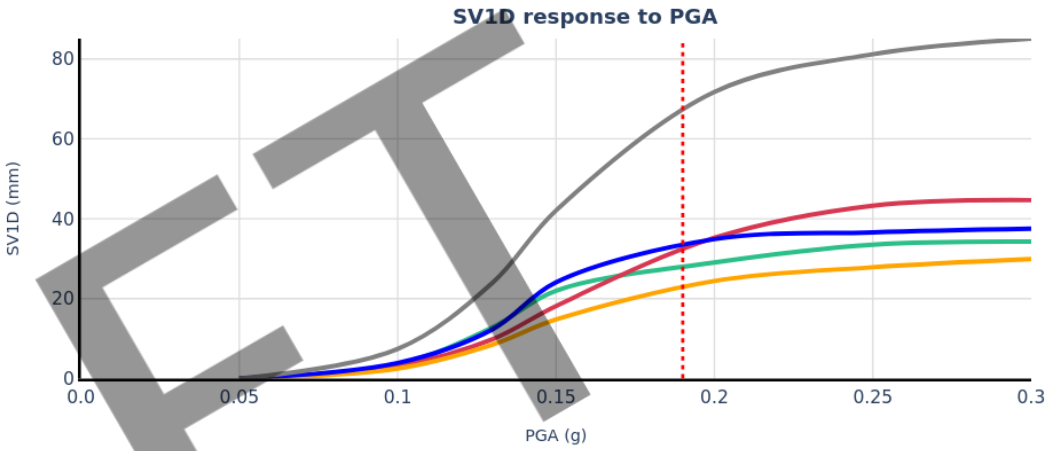
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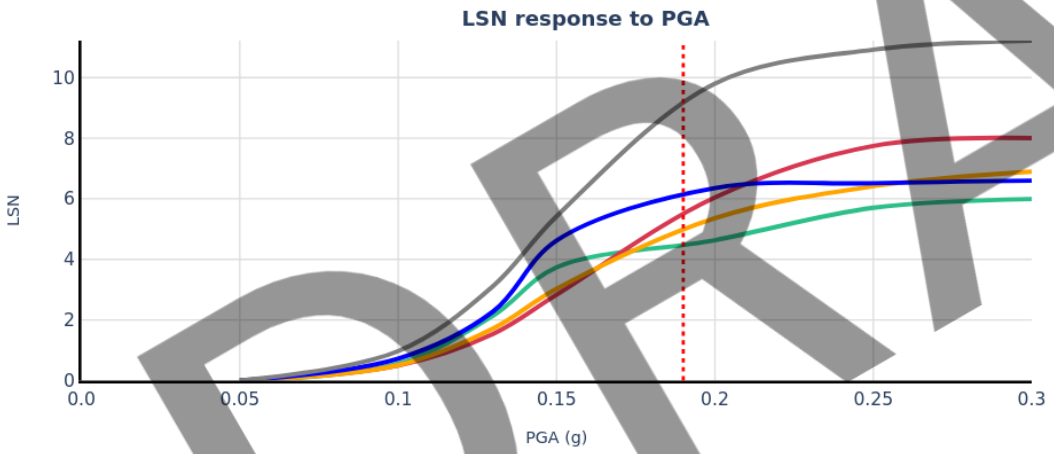
Run Description	NZGD ID	Investigation Date	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT201	CPT_TT288829	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT202	CPT_TT288833	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT203	CPT_TT288838	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT204	CPT_TT288839	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT205	CPT_TT288840	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

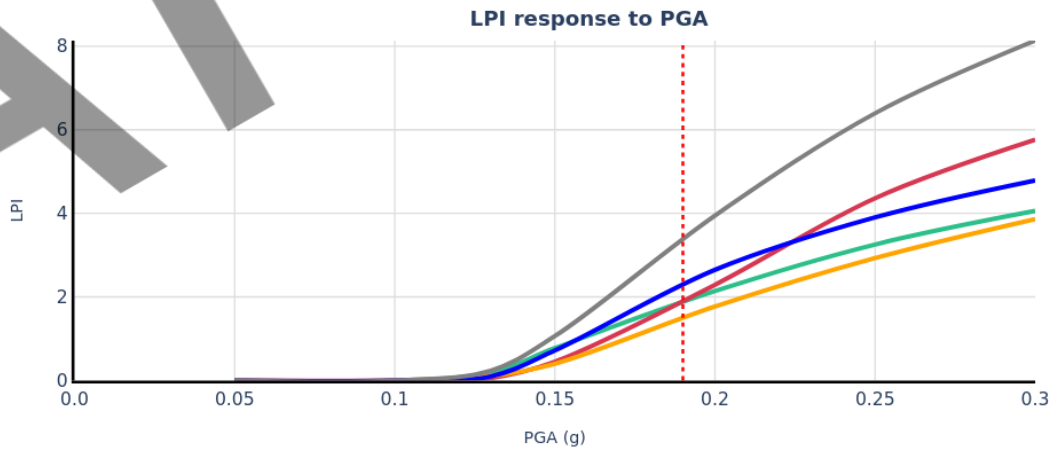
Thicker lines based on 50 percentile CRR curve and the thinner lines beneath and above the thicker lines are based on 85 and 15 percentile CRR curve, respectively.

PGA SENSITIVITY ASSESSMENT OF LIQUEFACTION CONSEQUENCE AND GROUND DAMAGE INDICATORS ASSESSMENT BASED ON 15 PERCENTILE CRR CURVE









DRAFT

Input

Run Description	NZGD ID	Investigation Date	EQ Magnitude	EQ PGA (g)	Trigger Method	Settlement Method	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT201	CPT_TT288829	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT202	CPT_TT288833	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT203	CPT_TT288838	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT204	CPT_TT288839	01/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A
CPT205	CPT_TT288840	02/09/2026	6.5	0.19	BI-2014	ZRB-2002	None	N/A	N/A

SUMMARY OF INPUT PARAMETERS FOR LIQUEFACTION ASSESSMENT

Table 1 Summary of inputs for liquefaction analysis

NZGD ID	TTGD 288829	TTGD 288833	TTGD 288838
CPT Name	CPT-201	CPT-202	CPT-203
Run Description	CPT201	CPT202	CPT203
EQ PGA (g)	0.19	0.19	0.19
EQ Magnitude	6.5	6.5	6.5
Depth to groundwater at time of Investigation (m)	2.1	1.8	1.8
Depth to groundwater for design (m)	2	2	2
Pre-drill depth (m)	1.75	1.1	2.0
Assumed predrill tip resistance and skin friction (MPa)	qc= 2 & Fs= 0.01	qc= 2 & Fs= 0.01	N/A
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	12.02	9.28	10.81
Minimum depth of analysis (m)	0	0	0
Maximum depth of analysis (m)	20	20	20
Inverse filtering applied?	Yes (15 cm²)	Yes (15 cm²)	Yes (15 cm²)
Cut/Fill Height	N/A	N/A	N/A
Surcharge load (kPa)	N/A	N/A	N/A
Fill unit weight (kN/m³)	N/A	N/A	N/A

Table 2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
TTGD 288829	CPT201	0.0	1.75	0.0
TTGD 288829	CPT201	1.75	19.98	2.6
TTGD 288833	CPT202	0.0	1.75	0.0
TTGD 288833	CPT202	1.75	19.98	2.6
TTGD 288838	CPT203	0.0	1.75	0.0
TTGD 288838	CPT203	1.75	19.98	2.6

Table 3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
TTGD 288829	CPT201	1.75	19.98	0.0 CFC
TTGD 288833	CPT202	1.75	19.98	0.0 CFC
TTGD 288838	CPT203	1.75	19.98	0.0 CFC

Table 4 Summary of soil density inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Unit Weight (kN/m³)
TTGD 288829	CPT201	0.0	1.75	16.0
TTGD 288829	CPT201	1.75	19.98	16.0
TTGD 288833	CPT202	0.0	1.75	16.0
TTGD 288833	CPT202	1.75	19.98	16.0
TTGD 288838	CPT203	0.0	1.75	16.0
TTGD 288838	CPT203	1.75	19.98	16.0

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SUMMARY OF INPUT PARAMETERS FOR LIQUEFACTION ASSESSMENT

Table 1 Summary of inputs for liquefaction analysis

NZGD ID	TTGD 288839	TTGD 288840
CPT Name	CPT-204	CPT-205
Run Description	CPT204	CPT205
EQ PGA (g)	0.19	0.19
EQ Magnitude	6.5	6.5
Depth to groundwater at time of Investigation (m)	1.7	1.7
Depth to groundwater for design (m)	2	2
Pre-drill depth (m)	1.5	1.5
Assumed predrill tip resistance and skin friction (MPa)	qc= 2 & Fs= 0.01	qc= 2 & Fs= 0.01
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002
Total depth of CPT (m)	11.3	18.34
Minimum depth of analysis (m)	0	0
Maximum depth of analysis (m)	20	20
Inverse filtering applied?	Yes (15 cm^2)	Yes (15 cm^2)
Cut/Fill Height	N/A	N/A
Surcharge load (kPa)	N/A	N/A
Fill unit weight (kN/m^3)	N/A	N/A

Table 2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
TTGD 288839	CPT204	0.0	1.75	0.0
TTGD 288839	CPT204	1.75	19.98	2.6
TTGD 288840	CPT205	0.0	1.75	0.0
TTGD 288840	CPT205	1.75	19.98	2.6

Table 3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
TTGD 288839	CPT204	1.75	19.98	0.0 CFC
TTGD 288840	CPT205	1.75	19.98	0.0 CFC

Table 4 Summary of soil density inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Unit Weight (kN/m^3)
TTGD 288839	CPT204	0.0	1.75	16.0
TTGD 288839	CPT204	1.75	19.98	16.0
TTGD 288840	CPT205	0.0	1.75	16.0
TTGD 288840	CPT205	1.75	19.98	16.0

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Together we create + sustain a better world