To:	Liam Winter	**Date:**	20 February 2025
From:	James Botting	**Our Ref:**	3230635-776096487-5127
Copy:	Mandy McDavitt		
Subject:	Carrington Road Improvements Project - Check of Groundwater Permitted Activity Status		

1 Introduction

Auckland Transport (AT) intends to upgrade Carrington Road into a multi-modal urban road corridor which will comprise the widening of the existing Carrington Road Corridor and improvements or construction of various associated features such as bus lanes, cycle lanes and footpaths. The extent of Carrington Road is shown in Figure 1.

In conjunction, Watercare Services Limited (Watercare) has proposed the Point Chevalier Watermain No. 2 Project (the Watermain) along Carrington Road. The Watermain is a Ø750mm concrete-lined steel (CLS) pipeline approximately 1km in length between Seaview Terrace and Sutherland Road, and forms part of a wider scheme to improve supply, maintain levels of service, and provide resilience to both the Point Chevalier and Khyber water supply zones. The design and planning for the Watermain has been expedited to realise efficiencies with the CRIP, and to enable the projects to be constructed concurrently. The Watermain extent is shown in Figure 3.

Unless otherwise noted, the CRIP and Watermain projects are referred to collectively in this report as ‘the Project’. A full Project Description can be found in Section 3 of the Assessment of Effects on the Environment (AEE) report.

The Detailed Design and earthworks methodology for the road improvements has not been confirmed at the time of preparing this memo. Based on the Preliminary Design we understand that the only proposed works associated with the road improvements, which may potentially encounter groundwater, is piling associated with a new active mode bridge over the KiwiRail North Auckland Line (NAL) designation at the southern end of the alignment (Figure 2). Along the wider alignment, multiple existing services run parallel to Carrington Rd on both sides, typically located beneath the current footpaths (underground electricity lines, water mains, gas pipeline, telecommunications cables and less frequently stormwater pipelines) and due to the density of services it is presumed some services may require relocation as a result of the Project. For completeness, approach structures for the bridge and proposed retaining walls along the alignment have also been considered.

The Detailed Design and earthworks methodology for the Watermain has also not been confirmed at the time of preparing this memo; however, based on the Preliminary Design we understand that the only proposed works, associated with the watermain, which may potentially encounter groundwater is open trenching to allow installation of the new pipeline and excavation to install 4 No. below-ground chambers, most notably a cross connection isolation valve chamber at the northern termination within the Oakley Hospital historic heritage extent.

Confirmation is required as to whether the proposed works would encounter groundwater and thus would require resource consent as a restricted discretionary activity. This memo provides a high-level review of the proposed works against the Auckland Unitary Plan (Operative in Part) (AUP(OP))

permitted activity standards (PA standards) for the taking, using, damming and diversion of water (E7.6.1.6 and E7.6.1.10).

The proposed works we have considered are:

- **New active mode bridge over the KiwiRail North Auckland Line (NAL) designation and associated approach structures** – a new separate pedestrian bridge alongside the existing Mount Albert rail bridge on its northern side with associated approach structures.
- **Service relocations / diversions** – potential underground service relocations along the wider alignment.
- **Retaining walls** – several lengths of retaining wall along the alignment to enable widening of the road and stabilisation of sloped ground (if required).
- **Watermain No 2** – installation of a new 750mm diameter pipeline along the western side of Carrington Road requiring 2.5-3 m excavation to avoid utility conflicts.
- **Air, scour and cross connection/isolation valve chambers** – installation of air and scour valves as required to some 2.1-2.7 m depth respectively, and installation of a cross connection / isolation valve chamber at northern end of alignment to up to 3.2 m depth.

Figure 1: Carrington Road Improvement Project Extent (in red). (Base image source: Auckland Council GeoMaps)

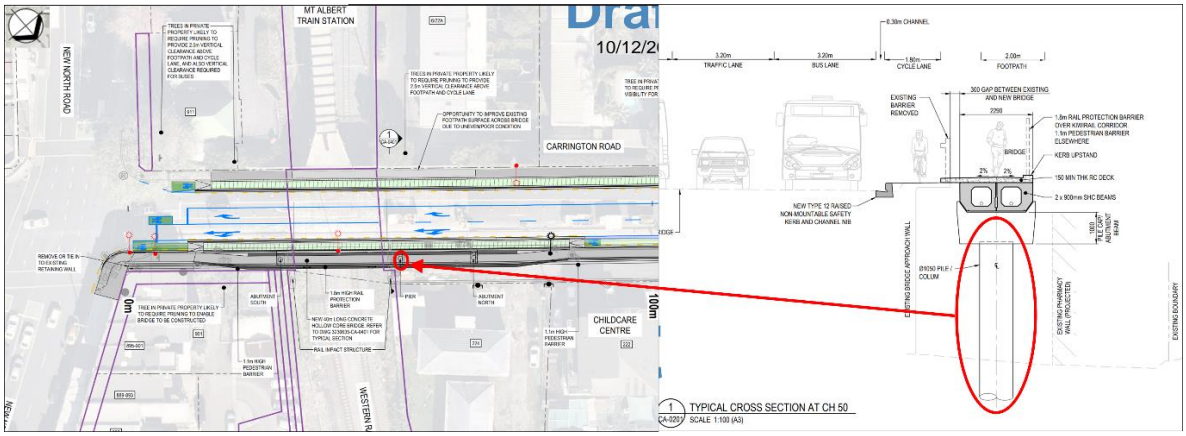

Figure 2: Excerpt of preliminary General Arrangement Plan CH 0 to CH100 (DWG 3230635-CA-0201 Rev A) and Typical Cross Section (DWG 3230635-CA-0401 Rev A) showing new active mode bridge over the KiwiRail NAL designation and indicative location of pier / column.

Figure 3: Sketch showing extent of Point Chevalier Watermain No.2

2 Design / Construction Assumptions

2.1 New active mode bridge over the KiwiRail NAL designation and approach structures

Based on Preliminary Design, the bridge foundation type is expected to comprise a deep piled foundation. Bridge pile(s) are anticipated to be less than 1.5 m in diameter. The approach structures may require a shallow undercut (~0.5 m), and piles are also anticipated to be less than 1.5 m in diameter hence both piling components are likely to fully meet the PA standards.

2.2 Service relocation / diversion

Some relocation / diversion of existing site services is anticipated to accommodate both the CRIP and Watermain projects. Full details of these works (method, depths, locations etc.) are not currently available however the PA standards for groundwater diversion and dewatering under the AUP(OP) specifically provide for short duration (< 10 day) trenching. For this reason, works associated with services are likely to fully meet the PA standards.

2.3 Retaining walls

Retaining walls may be required at several points along the alignment to facilitate widening of the corridor and stabilise sloped or cut ground. The retaining walls, if required, are not currently designed beyond concept however they are unlikely to permanently drain or impede groundwater and piles are anticipated to be less than 1.5 m in diameter hence are likely to fully meet the PA standards.

2.4 Watermain No. 2

Installation of a ~1 km long watermain along Carrington Road from Seaview Terrace to Sutherland Road via open trenching will be timed to align with the construction of the CRIP. Each section of open trench is expected to be progressively opened and closed within 10 days hence will fully meet the PA standards.

2.5 Scour and air valve chambers, and cross connection and isolation valve chamber

The Preliminary Design indicates an air valve chamber, and a scour valve chamber will be utilised in the northern and middle sections of the watermain. Installation of these chambers requires excavation to some 2.1 (air valve) to 2.7 m depth (scour valve), some 0.9 m below to 0.4 m above the inferred groundwater level in these areas respectively. If groundwater is encountered, it is anticipated that dewatering will not be required for greater than 30 days thus meeting E7.6.1.6.

The cross connection and isolation valve chamber at the northern end of the watermain alignment is expected to be installed in a DN3200 or DN4000 pre-cast concrete chamber (Figure 4). The expected foundation depth is approximately 3.2 m plus an additional 0.5 m to provide for a dry working floor. The groundwater level may be drawn down ~2.5 m below a natural groundwater level of 1.2 m at this location. As construction of the cross connection and isolation valve chamber may take longer than 30 days, it is unlikely that the PA standards can be met and consent for a Restricted Discretionary Activity will be required.

As noted in Section 2.4, works also encroach on the Oakley Hospital historic heritage overlay (Figure 4), however the valve chambers are approximately 18 m from the Main Building and there are no other pre-1905 features on the site not already affected by AT's CRIP project, which have been addressed in the overarching Assessment of Environmental Effects.

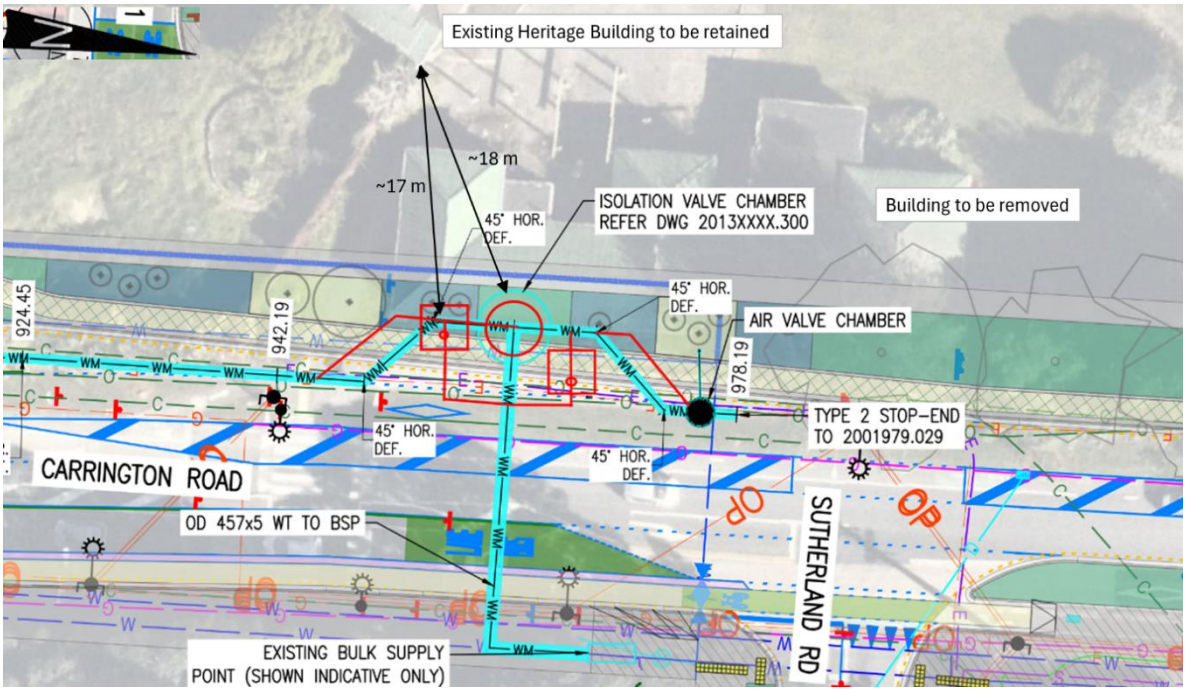

Figure 4: Excerpt of preliminary Carrington Road – Layout Plan and Pipe Longitudinal Section - Sheet 7 (DWG 2013XXX.208 Rev A) showing Isolation and cross connection valve chamber.

3 Site Groundwater Levels

Previous investigations have been carried out for various projects in the general vicinity of the project area. These were provided for the purpose of this project or obtained from the New Zealand Geotechnical Database (NZGD). The water levels were summarised in the Jacobs Preliminary Geotechnical Appraisal Report (Jacobs, 2023) (Appendix A). The depth to groundwater indicated by previous investigations within 100 m of the proposed alignment (Jacobs 2023) ranges between 1 m to 4 m below ground level (bgl) across the whole alignment, noting there is a groundwater level data gap at the southern end of the alignment.

Additionally, piezometers were installed in boreholes BH03, BH04 and BH05 along the Watermain No 2 alignment in December 2024. Manually recorded groundwater levels indicate the groundwater level is approximately 1.2 m below ground level in the northern part of the site and between 3.3 and 3.5 m below ground level in the southern part of the site. The water levels have been summarised from the Beca Geotechnical Interpretive Report in Appendix B.

4 Assessment of Permitted Activity Status

Table 1 provides a comparison of the proposed activities against the AUP(OP) criteria for groundwater diversion (E7.6.1.10). Piles up to 1.5 m in external diameter are exempt from standards E7.6.1.10 (2) to (6).

Potential excavations to relocate services are likely to be progressively undertaken and hence completed within 10 days and therefore would comply with E7.6.1.10 (1) and would be exempt from standards E7.6.1.10 (2) to (6). However, we have also tested against E7.6.1.10 (2) to (6) for completeness in the event that dewatered durations of up to 30 days are required.

Table 2 provides a comparison of those same activities against the criteria for a groundwater take associated with dewatering (E7.6.1.6). It is expected that excavation works for service relocation (if required) could be managed to allow each excavation to be open and closed within a period of 30 days or less.

Table 1: Assessment of activity against the AUP(OP) PA standards for diversion of groundwater (E7.6.1.10)

Standard E7.6.1.10			New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection / isolation valve (~3.7 m depth)
1	The following activities are exempt from the Standards E7.6.1.10 (2) – (6)							
	(a)	pipes cables or … that are drilled or thrust and less than 1.2 m in external diameter	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
	(b)	pipes … up to 1.5 m in external diameter where a closed faced or earth pressure balanced machine is used	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
	(c)	piles up to 1.5 m in external diameter are exempt from these standards	**MEETS**	**n/a**	**MEETS**	**n/a**	**n/a**	**n/a**
	(d)	diversions for no longer than 10 days	**n/a**	**MEETS**	**n/a**	**MEETS**	**DOES NOT MEET**	**DOES NOT MEET**

Standard E7.6.1.10			New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection / isolation valve (~3.7 m depth)
	(e)	diversions for network utilities and road network linear trenching activities ….	**n/a**	(excavations likely open for < 10 days but tested remaining standards for completeness)	**n/a**	(excavations likely open for < 10 days but tested remaining standards for completeness)	(excavation likely open for > 10 days)	(excavation likely open for > 10 days)
2	Any excavation that extends below natural groundwater level, must not exceed:							
	(a)	1 ha in total area	**EXEMPT**	**MEETS** (excavation =< 3.0 m bgl approx.)	**EXEMPT**	**MEETS** (excavation =< 3.0 m bgl approx.)	**MEETS** (excavation =< 3.0 m bgl approx.)	**MEETS** (excavation =< 3.7 m bgl approx.)
	(b)	6 m depth below the natural ground level						
3	The natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining site		**EXEMPT**	**MEETS** (excavation < 3 m bgl, therefore max drawdown ~2 m)	**EXEMPT**	**MEETS** (excavation < 3 m bgl, therefore max drawdown ~2 m)	**MEETS** (excavation < 3 m bgl, therefore max drawdown ~0.9 m)	**DOES NOT MEET** (excavation =< 3.7 m bgl, therefore max drawdown ~2.5 m within adjoining site)
4	Any structure, excluding sheet piling … that physically impedes the flow of groundwater through the site must not							

Standard E7.6.1.10			New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection / isolation valve (~3.7 m depth)
	(a)	impede the flow of groundwater over a length of > 20 m	**EXEMPT**	**MEETS** (flow will re-equilibrate around the pipes/services)	**EXEMPT**	**MEETS** (flow will re-equilibrate around the pipe)	**MEETS** (flow will re-equilibrate around the chamber)	**MEETS** (flow will re-equilibrate around the valves)
	(b)	extend more than 2 m below the natural groundwater level						
5	The distance to any existing building or structure … on an adjoining site from the edge of any:							
	(a)	trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation;	**EXEMPT**	**TBC**	**EXEMPT**	**MEETS**	**MEETS** (The excavation depths for the scour valve and air valve are 2.7m and 2.1m respectively. There are no buildings within those distances of the excavations).	**MEETS** (the excavation for the isolation valve is ~2.5 m bgl and the distance to the nearest building will be at least 17m as the nearest existing building on the site is to be demolished as part of the Carrington Residential
	(b)	tunnel or pipe with an external diameter of 0.2 - 1.5 m that extends below natural groundwater level must be 2 m or greater						

Standard E7.6.1.10			New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection / isolation valve (~3.7 m depth)
	(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.						Development to accommodate the works).
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	**EXEMPT**	**MEETS**	**EXEMPT**	**MEETS**	**MEETS**	**MEETS**
	(b)	10 m from a scheduled Historic Heritage Overlay		**DOES NOT MEET** (service relocations are unlikely to achieve 10m separation from the scheduled Historic Heritage overlay (ID 01618)).		**DOES NOT MEET** (the Watermain will not achieve 10 m separation from the scheduled Historic Heritage overlay (ID 01618))	**DOES NOT MEET** (the air valve chamber will not achieve 10m separation from the scheduled Historic Heritage overlay (ID 01618)).	**DOES NOT MEET** (the cross connection / isolation valve chamber will not achieve 10m separation from the scheduled Historic

Standard E7.6.1.10			New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection / isolation valve (~3.7 m depth)
								Heritage overlay (ID 01618)).
	(c)	10 m from a lawful groundwater take.		**MEETS**		**MEETS**	**MEETS**	**MEETS**

MEETS indicates the activity meets the standard, and, **n/a** indicates the standard is not relevant.

CHECKING REQUIRED indicates that further assessment / analysis would be required to confirm if the standard can be met

DOES NOT MEET indicates the activity does not meet the standard

Table 2: Assessment of activity against the AUP(OP) PA standards for take of groundwater (E7.6.1.6) (all conditions must be met)

	Standard E7.6.1.6	New pedestrian over-rail bridge (Max 1.5 m diameter pile(s))	Service Diversion / Relocations (unknown depth)	Retaining walls (Max 1.5 m diameter piles)	Watermain No 2 (2.5 m to 3 m depth)	Air valve and scour valve chambers (2.1-2.7 m depth)	Cross connection
1	The water take must not be geothermal water;	**MEETS** (no geothermal conditions)	**MEETS** (shallow excavations, no geothermal conditions)	**MEETS** (no geothermal conditions)	**MEETS** (no geothermal conditions)	**MEETS** (no geothermal conditions)	**MEETS** (no geothermal conditions)
2	The water take must not be for a period of more than 10 days where it occurs in peat soils, or 30 days in other types of soil or rock; and	**MEETS** (no peat soils, groundwater abstraction during piling will be < 30 days)	**MEETS** (no peat soils, groundwater abstraction from each excavation will be < 30 days)	**MEETS** (no peat soils, groundwater abstraction during piling will be < 30 days	**MEETS** (no peat soils, groundwater abstraction from each excavation will be < 30 days)	**MEETS** (no peat soils, groundwater abstraction from each excavation will be < 30 days)	**DOES NOT MEET** (some seepage of groundwater could occur into the excavation for a period exceeding 30 days)
3	The water take must only occur during construction	**MEETS** (dewatering will occur during construction only)					
	MEETS indicates the activity meets the standard, and, **n/a** indicates the standard is not relevant. **CHECKING REQUIRED** indicates that further assessment / analysis would be required to confirm if the standard can be met **DOES NOT MEET** indicates the activity does not meet the standard						

5 Summary

New pedestrian-over-rail bridge foundation piles

The piling works for bridge foundations and approach meet the Permitted Activity standard exemptions under E7.6.1.10(1) and is therefore expected to be a Permitted Activity. In any case, these activities are expected to fully meet the Permitted Activity Standards for groundwater take and diversion under E7.6.1.10(2)-(6).

Service diversions/relocations

Excavation and dewatering for potential service relocations / diversions meet the Permitted Activity standard exemptions under E7.6.1.10(1) if trenching activities are progressively opened, closed and stabilized where the part of the trench that is open, at any given time, is no longer than 10 days. Accordingly, the activities are expected to be a Permitted Activity. However, if the trench is open for more than 10 days, it is unlikely to meet E7.6.1.10 (6 b) due to its localised proximity to a scheduled historic heritage extent of place; and would still need to be tested against E7.6.1.10 (5) once depths are finalised.

Retaining walls

The retaining walls are currently in the concept design stage; however, the piles are expected to be less than 1.5 m in diameter and are unlikely to permanently drain or impede groundwater. Consequently, they are likely to fully meet the Permitted Activity standard exemptions under E7.6.1.10(1); and the standards under E7.6.10(2)-(6) and accordingly are expected to be a Permitted Activity.

Watermain No. 2 pipeline

The watermain will be progressively trenched and each section will be opened and closed within 10 days thus meeting Permitted Activity standard exemptions under E7.6.1.10 (1) and is therefore expected to be a Permitted Activity. However, if any part of the trench is open for more than 10 days, it may not meet standard E7.6.10(6b) due to its localised proximity to a scheduled historic heritage extent of place.

Air valve and scour valve chambers

The installation of the air valve chamber, and a scour valve chamber likely do not meet the Permitted Activity standard exemptions under E7.6.1.10 (1) due to the excavations being open for more than 10 days. Although the scour valve chamber likely meets the standards under E7.6.10(2)-(6) and accordingly is expected to be a Permitted Activity, the air valve chamber is unlikely to meet E7.6.1.10(6b) due to its proximity to a scheduled historic heritage extent of place.

Cross connection / isolation valve

The construction of the cross-connection and isolation valve chamber at the northern end of the alignment is expected to require dewatering for more than 30 days, making compliance with the Permitted Activity standard exemptions unlikely. In addition, the Permitted Activity standards E7.6.1.10 (1, 3, and 6) will not be fully met due to parts of the excavation being open for more than 10 days, the groundwater level being lowered by more than 2.0 m below the natural groundwater

level, and due to encroachment into the Oakley Hospital Historic Heritage extent of place (albeit while being located at least 17m from the primary feature (the former Oakley Hospital Main Building)).

Conclusion

As summarised above, the majority of the activities contemplated as part of the Project are anticipated to be Permitted Activities – either by meeting the E7.6.1.10(1) Permitted Activity standard exemptions; or by meeting the relevant Permitted Activity standards under E7.6.1.10(2)-(6).

The exception to this is the construction of the cross-connection and isolation valve chamber at the northern end of the alignment. Excavations for works in this localised part of the Project are likely to:

- Exceed 30 days in duration (noting that diversion and dewatering will only occur during construction);
- Will exceed permitted drawdown depths (2.5m drawdown > 2m permitted drawdown); and
- Will encroach/not achieve a 10m separation from the Oakley Hospital Historic Heritage extent of place (noting that the excavation will be located at least 17m from the nearest point of the primary feature (the former Oakley Hospital Main Building)).

It is therefore anticipated that resource consent for groundwater diversion and dewatering will be required under E7.4.1(20) and (28) for this localised part of the Project during construction. Based on the matters of discretion set out at E7.8.1(6), it is considered that the key matters of relevance to the Project are how excavation for the cross connection and isolation valve chamber will avoid, remedy, or mitigate adverse effects from ground settlement; and on the Oakley Hospital heritage building. To this end, it is recommended that the conditions of consent include a requirement for a Groundwater and Settlement Monitoring and Contingency Plan.

6 Applicability Statement

This report has been prepared by Beca Ltd (Beca) on the specific instructions of Auckland Transport (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

In preparing this report Beca has relied on the current understanding of proposed construction works, as well as the following:

- Preliminary Geotechnical Appraisal Report prepared by Jacobs New Zealand Limited for Auckland Transport, dated 3 March 2023
- New Zealand Geotechnical Database, available at <www.nzgd.org.nz/>, accessed 13 November 2024
- Auckland Council GeoMaps Underground Services layers, available at https://geomapspublic.aucklandcouncil.govt.nz/, accessed 13 November 2024

Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from

those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated here.

This memorandum has been verified by a Hydrogeological Professional on the basis of the agreed commission. No amendments should be made to the content of this document without subsequent re-verification by the geotechnical author and verifier.

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A

Appendix A – Preliminary Geotechnical Appraisal Report

Preliminary Geotechnical Appraisal Report

Document no: IA286400-CG-RPT-0001
Revision no: 0

Auckland Transport
781-22-658-PS

Carrington Road Improvements Detailed Business Case
3 March 2023

Preliminary Geotechnical Appraisal Report

Client name:	Auckland Transport		
Project name:	Carrington Road Improvements Detailed Business Case		
Client reference:	781-22-658-PS	**Project no:**	IA286400
Document no:	IA286400-CG-RPT-0001	**Project manager:**	Terri Bell
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Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to review and assess the site geological and geotechnical conditions in accordance with the scope of services set out in the contract between Jacobs and it's Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate, or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from Auckland Transport (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations, and conclusions expressed in this report.

Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures, and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations, and findings expressed in this report, to the extent permitted by law. This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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Executive Summary

An upgrade to the existing Carrington Road is proposed between the Northwestern Motorway and the North Auckland Railway to facilitate increased traffic volumes from development of the Unitec Campus. The study corridor is approximately 1.2 km in length. This report is intended to summarise the existing known geological and geotechnical conditions along the corridor to support the detailed business case for the upgrades.

The site is located atop a ridge and its geology is expected to mainly comprise of tuff from the Auckland volcanic field, with basalt lava flows in the valleys either side and Puketoka Formation near its northern extent, all underlain by East Coast Bays Formation. Geohazards on the site of relevance to the proposed works are typically expected to be of minor significance to the design, but include seismic ground accelerations, liquefaction, allophanic soils, the potential for rock outcrops, boulders and cobbles during excavations, slope instability (particularly relating to elevated groundwater conditions) and settlement (particularly in the Puketoka Formation).

A number of geotechnical investigations have been identified to date from the records contained in the New Zealand Geotechnical Database (New Zealand Geotechnical Society, 2023). These include Machine Boreholes, Cone Penetration Tests (CPTs) and Hand Augers. Whilst the majority of these are located at the northern extent of the study corridor, around the Northwestern motorway, they do also extend over the full extent of the corridor. No additional geotechnical specific investigations are proposed at this stage of the project to facilitate the development of the preferred technical option, although further targeted investigations are recommended prior to detailed design.

Contents

Appendices

1. Introduction

The Carrington Road Improvements Project (the 'Project') is focussed on confirming the integrated transport and infrastructure outcomes for Carrington Road. Improvements are required to achieve Auckland Transport's long-term strategic network objectives for the corridor while enabling growth in a manner that promotes healthy, sustainable, safe, and resilient multi modal connections.

The acceleration of the delivery of housing in the Wairaka Precinct (existing Unitech site on Carrington Road) brings forward the need to confirm the corridor upgrade requirements and to integrate delivery with the planned development.

Expected Project outcomes include:

- Improved safety through:
  - Upgraded Cycle Facilities
  - Safer Pedestrian Facilities at controlled intersections including appropriate crossing points.
  - Overall speed environment reduced with additional controlled intersections added to the corridor, reducing priority on Carrington Road for through trips.
  - Intersection upgrades addressing existing intersection safety issues.
  - Improved bus reliability through the provision of bus priority measures.
- Better travel choices through investment in bus, walking and cycling facilities and improved quality of service.
- High quality infrastructure that supports development within priority growth areas and provides activated frontage for the Wairaka development and supports intensification within walking distance of rapid transit stations.
- Support climate change through mode shift from private vehicles to low carbon transport modes. Infrastructure improvements that support the transformation to a low carbon transport network.

1.1 Project Summary

The geographic context of this project is the Carrington Road corridor, as shown in Figure 1. It is approximately 1.6 km long and includes the section of Carrington Road between New North Road/ Carrington Road intersection and Great North Road/ Carrington Road intersection. The project includes all intersections adjoining Carrington Road along the corridor.

The current understanding of the possible extent of works is as follows:

- The potential for widening of Carrington Road, which may involve the construction of earth retaining structures and minor earthworks cuts.
- The possibility of upgrades and widening to the existing bridge structures over the Northwestern Motorway (near the Great North Road/ Carrington Road intersection) and over the North Auckland Railway (near the New North Road/ Carrington Road intersection).
- The potential for the introduction of stormwater treatment basins at discrete locations over the length of the project corridor.

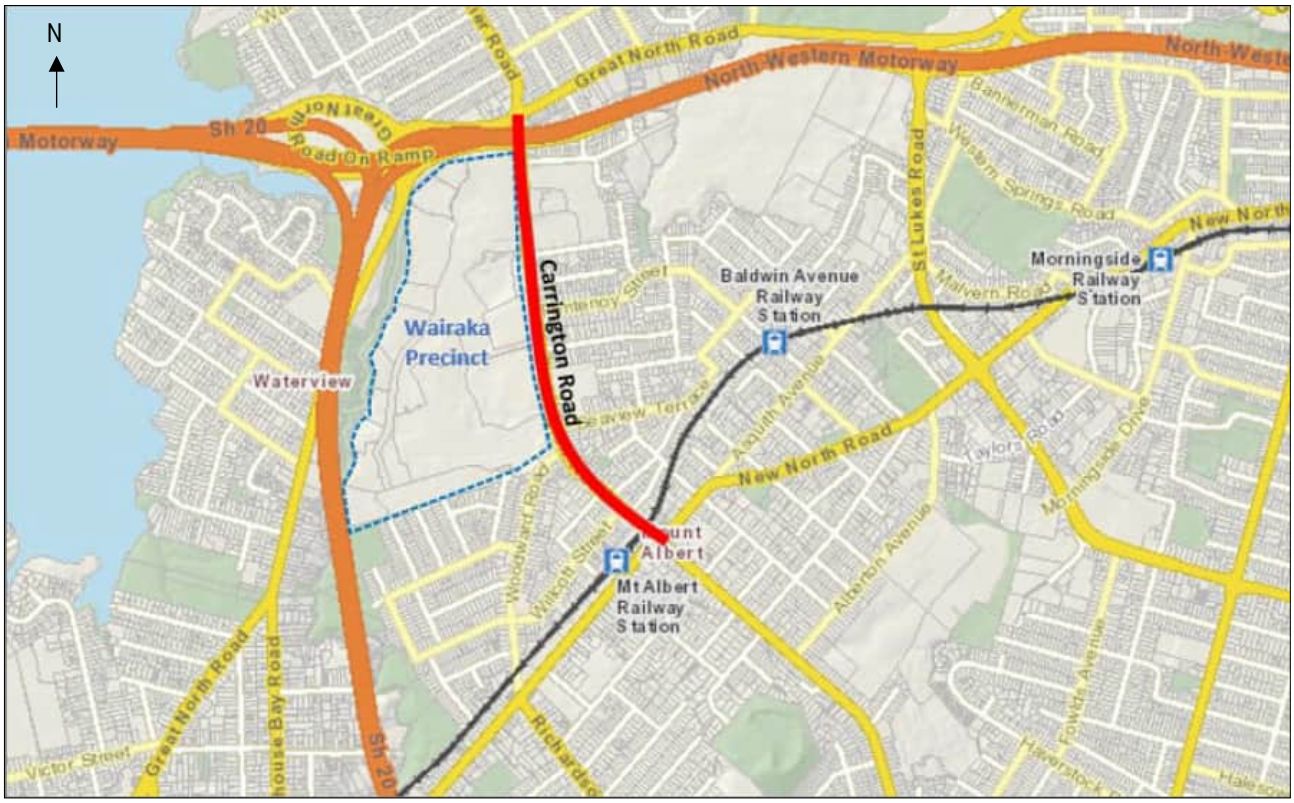

Figure 1. Extent of the project corridor

1.2 Purpose of this Report

A detailed business case for the project is currently being prepared, including the development of design options and their refinement to a preferred technical option. This report is intended to provide a high-level overview of the current state of knowledge regarding geological and geotechnical conditions along the project corridor. It includes a gap analysis of geotechnical information considered necessary to facilitate the development of that preferred technical option, with recommendations for additional site investigations as required to satisfy any gaps identified.

This overview has been prepared utilising information sources assessable from desktop sources and is intended to inform subsequent stages of the project, including field investigations, design, and construction. A previous assessment has been undertaken by Opus International Consultants in their Preliminary Geotechnical Appraisal and Investigation Report from 2016 (ref. GS16/003,1-C1451.00) for a significant subset of the current project corridor. As such, this report seeks to expand on this previous work, extending its assessment over the full extent of the current project corridor and incorporating any additional geotechnical information that may have arisen since the preparation of the previous work.

The information sources utilised in the preparation of this report include:

- Institute of Geological and Nuclear Sciences (GNS Science) maps and reports.
- New Zealand Geotechnical Database (NZGD).
- Auckland District Council GIS.
- Historical Aerial Photography.
- Opus Preliminary Geotechnical Appraisal and Investigation Report.
- Other publicly available technical papers and reports (see Section 6 for details).

For a review of existing information in relation to other non-geotechnical aspects of the project, please refer to Jacobs' Existing Site Information Review and Jacobs' Background and Gap Analysis Report.

2. Regional Geological Setting

2.1 Mapped Geology

This site includes multiple mapped geological units of varying ages and compositions. Details of these units are shown in Figure 2 and Table 1.

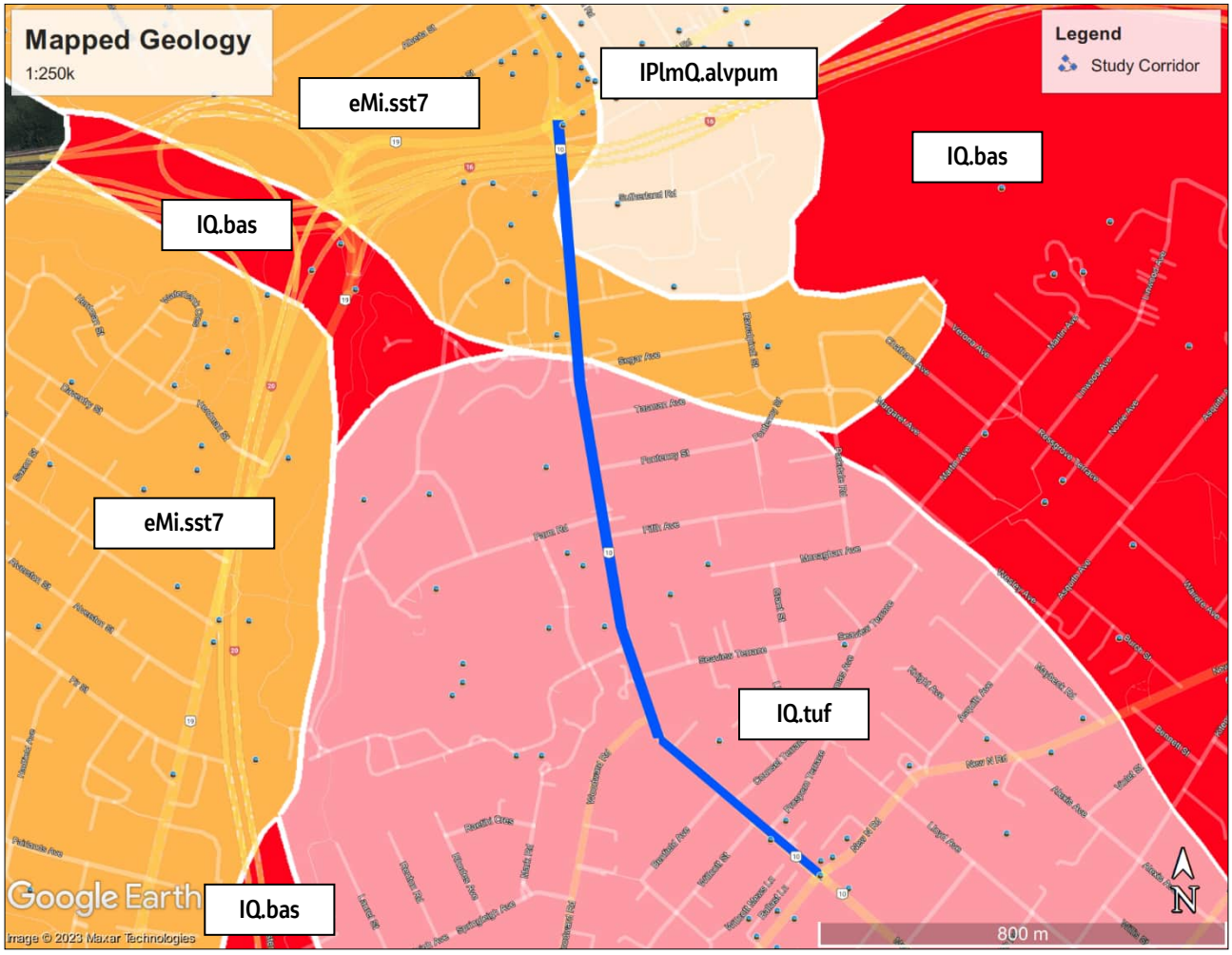

Figure 2. Mapped 1:250k Geology (GNS Science, 2023a)

Table 1. Geological Unit Properties (GNS Science, 2023a)

Unit Label	Unit Name	Age	Description	Geological Formation
IQ.tuf	Auckland Basalts tuff (Kerikeri Volcanic Group) of Auckland Volcanic Field	0.128 Mya – 0.0 Mya	Lithic tuff, comprising comminuted pre-volcanic materials with basaltic fragments, and unconsolidated ash and lapilli deposits.	Auckland Basalts
IQ.bas	Auckland Basalts lava (Kerikeri Volcanic Group) of Auckland Volcanic Field	0.14 Mya – 0.001 Mya	Grey to very dark grey, dense, fine grained olivine basalt or basanite lava flows.	
IPlmQ.alvpum	Late Pliocene to Middle Pleistocene pumiceous river deposits	3.6 Mya – 0.071 Mya	Pumiceous mud, sand and gravel with muddy peat and lignite: rhyolite pumice, including non-welded	Puketoka Formation

Unit Label	Unit Name	Age	Description	Geological Formation
			ignimbrite, tephra and alluvial pumice deposits; massive micaceous sand.	
eMi.sst7	East Coast Bays Formation of Warkworth Subgroup (Waitemata Group)	23.8 Mya – 16.4 Mya	Alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits.	East Coast Bays Formation (ECBF)

The site has been interpreted to consist of a ridge of East Coast Bays Formation that preceded the formation of the nearby Ō wairaka (Mt Albert) volcano (Opus International Consultants, 2016). The East Coast Bays Formation was formed by the accumulation of sedimentation in the Waitemata Basin from eroding landforms to the west; as this basin subsided, these sediments were consolidated to form the interbedded sandstone mudstone and volcaniclastic grits observed today. These deposits were subsequently uplifted and experienced faulting, folding and erosion (Beca, 2010c). These rocks have weathered to residual soils, and paleochannels, in the vicinity of the study corridor, partially infilled with Puketoka Formation (such as the lower lying area to the northwest of the project). During the deposition of the Puketoka Formation, there has been fluctuations in sea level, resulting in "both variations in the types of sediments deposited (sand, clay/silt and peat) and repeated cycles of deposition and erosion" (Beca, 2010c).

The basalt lava flows from the Ōwairaka eruption 40,000 to 50,000 years ago formed lava flows that were confined to the paleochannels (valleys) to the east and west of the East Coast Bays Formation ridge upon which the study corridor is located (Opus International Consultants, 2016). This has further infilled those paleochannels, overlaying any previous sediment that had accumulated, or, in the case of the lower lying area to the northwest of the project, damming it. Most of the study corridor was subsequently overlain with tuff deposits from the later stages of the Ōwairaka eruption (Beca, 2010c).

Ongoing weathering of all surface materials will have since continued. As a result of erosion and transportation of surface sediments, areas of undifferentiated alluvium are also possible. These alluvium sediments, in addition to those of the Puketoka Formation, can be collectively described as Tauranga Group Alluvium.

2.2 Topography

As noted previously, the site is largely set on the top of a ridgeline, climbing from 22m above sea level at the northern extent (intersection with Great North Road) to 52m between Woodward Road and Counsel Terrace before dropping back to 46m above sea level at the intersection with New North Road. A topographical map is presented in Appendix A.

Along its length, the site:

- At Great North Road is gently dipping to the west-southwest (slopes of ~1°).
- Undercut perpendicular by the Northwestern Motorway ~7m below, just south of Great North Road, with close to vertical retaining walls bounding the motorway.
- At Sutherland Road is gently dipping to the east-southeast (slopes of ~1°), increasing to ~5° slopes to the east just north of Segar Avenue.
- Between Segar Avenue and Fifth Avenue, along the eastern boundary, is dipping northeast at a slope of ~3°. Along the western boundary it is dipping west at a slope of ~8° between Segar Avenue and Tasman Avenue, reducing to a slope of ~2° to the northwest between Tasman Avenue and Fifth Avenue.
- Between Fifth Avenue and Woodward Road, along the eastern boundary, is sloping parallel to Carrington Road at ~4°. Along the western boundary it is dipping variably to the west and northwest with slope angles of 2° to 7°.
- Between Woodward Road and Counsel Terrace, has a local conical highpoint ~40m away on the eastern side. Hence, on the eastern side, the slope varies from a northwest dip of ~3° near Woodward Road, to a

southeast dip of ~3° near Counsel Terrace. On the western side it has a basin feature to the southwest with slopes dipping at up to ~16°.

- Between Counsel Terrace and the North Auckland Railway, has a local conical highpoint ~110m away on the western side. Hence, on the western side, the slope varies from a northeast dip of ~2° near Counsel Terrace, to an east dip of ~4° near the North Auckland Railway. On the eastern side, the slope dips east at ~4°.
- At the North Auckland Railway, undercut by ~5m, with near vertical slopes on the western side. On the eastern side, the slopes continue to dip east at ~4°. An arched curvature of the overpass bridge provides the necessary vertical clearance for Carrington Road passing over the railway.
- At New North Road is gently dipping to the northeast (slopes of ~1°).

2.3 Site History and Geomorphology

A review of the historical aerial photography retrieved from Retrolens (Local Government Geospatial Alliance, 2023) has been undertaken and a selection of these photographs have been included in Appendix B. These indicate that Carrington Road has existed largely in its current form since before 1940, with the most significant upgrade, being the construction of the Northwestern Motorway in the early 1980s (construction drawings for the overpass structure are dated 1980). There has also been gradual infilling of the land to the west of Carrington Road, initially largely open undeveloped paddocks in the 1940s, with a mixture of residential and industrial construction. The level crossing of Carrington Road over the North Auckland Railway appears to have been replaced with a bridge structure in the late 1950s (drawings are dated 1958).

This review did not identify any significant geomorphological changes in the site over the past 80 years. The primary geomorphic processes on the site, given the typically gentle contouring, are expected to include erosion by wind action or the overland flow of rainwater. The most significant feature considered likely to present heightened risk of instability, due to its steeper slopes, is the basin noted above at 161 to 183 Carrington Road (Figure 3).

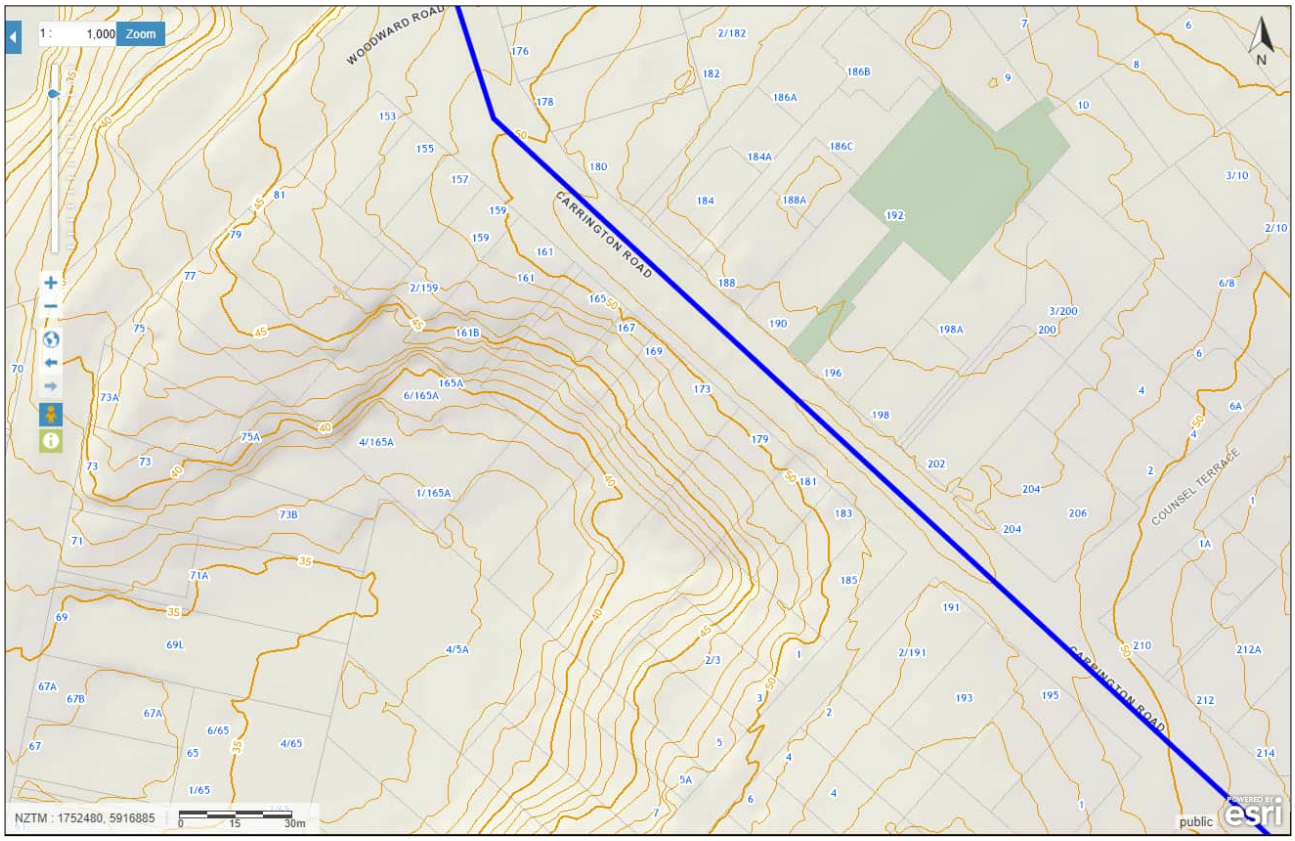

Figure 3. Steepened slopes at 161 to 183 Carrington Rd (Auckland Council, 2023b)

2.4 Groundwater and Hydrogeology

The site is underlain by the Waitemata Aquifer, and for areas south of Segar Avenue, also by the Mt Roskill-Mt Albert Volcanic aquifer (Auckland Council, 2023b). The groundwater conditions at depth are expected to be largely controlled by the rock mass characteristics (in particular, fractures/joints and interbedding) of both the Auckland Basalts and the East Coast Bays Formation. At the nearby Waterview Connection (SH20), a "perched" groundwater table was identified within the overlying Auckland Basalts and weathered East Coast Bays Formation, compared to the underlying unweathered East Coast Bays Formation, with a difference in groundwater levels of approximately 2 m (but up to 7 m) (Beca, 2010b). Groundwater springs are also noted to emerge from the Auckland Basalts in the Unitec campus (Beca, 2010b).

Across the corridor, there is expected to be a moderately thick (perhaps ~2m to ~10m) soil profile, including a combination of the tuff, in-situ weathered East Coast Bays Formation and Puketoka Formation. This profile is expected to include a range of particle sizes, from Sands and Gravels through to Silts and Clays. In the Puketoka Formation, there is also the possibility of organic deposits. It is considered likely that a piezometric surface will be present within these soils. This is corroborated by records noted on the New Zealand Geotechnical Database New Zealand Geotechnical Society, 2023), which record that the groundwater ranged between ~1 m to ~4 mBGL (refer Table 2 for details).

The Beca Groundwater assessment for the nearby Waterview Connection also presented a comparison of typical hydrogeological properties for the different formations across that site. Those recommendations are summarised below in Figure 4.

Table 5.1 – Comparison of Hydrogeological Properties

Unit	SH16/SH20 K (m/s)	Vic Park Tunnel[1] K (m/s)	New Lynn Rail Box[2] K (m/s)	Britomart[3] K (m/s)	Three Kings Quarry[4] K (m/s)
Auckland Volcanic Field Basalt lava flows (Basalt)	K_h = 1.2 x 10^{-5} to 5.0 x 10^{-5} K_v = 5.0 x 10^{-5}	Not present	Not present	K_h = 7.0 x 10^{-5} K_v = 1.0 x 10^{-5}	K_h = 2.0 x 10^{-4} K_v = 2.0 x 10^{-4}
Tauranga Group Alluvium (TGA)	K_h = 1.0 x 10^{-7} to 2.3 x 10^{-7} K_v = 1.0 x 10^{-7} to 3.5 x 10^{-8}	K_h = 2.0 x 10^{-7} K_v = 2.0 x 10^{-8}	K_h = 3.0 x 10^{-7} K_v = 5.0 x 10^{-8}	K_h = 2.0 x 10^{-7} K_v = 7.0 x 10^{-9}	Not present
Weathered East Coast Bays Formation, Waitemata Group (WECBF)	K_h = 2.0 x 10^{-7} K_v = 2.0 x 10^{-8}				Not present
Weathered Parnell Grit, Waitemata Group (WPG)	K_h = 4.0 x 10^{-7} to 4.6 x 10^{-7} K_v = 1.5 x 10^{-7} to 4.0 x 10^{-8}				
East Coast Bays Formation, Waitemata Group rock (ECBF)	K_h = 3.5 x 10^{-7} to 5.7 x 10^{-7} K_v = 5.7 x 10^{-8}	K_h = 1 to 5 x 10^{-7} K_v = 1.0 x 10^{-8}	K_h = 1.0 x 10^{-7} K_v = 1.0 x 10^{-8}	K_h = 5.0 x 10^{-7} K_v = 5.0 x 10^{-8}	K_h = 1.5 x 10^{-8} K_v = 1.5 x 10^{-9}
Parnell Grit, Waitemata Group Rock (PG)	K_h = 3.0 x 10^{-5} to 2 x10^{-6} K_v = 1.0 x 10^{-6} to 9.0 x 10^{-6}	Not present	Not present	Not present	Not present

SH16/20: range indicates the difference in calibrated values for 2D and 3D models

[1] "Vic Park Tunnel Project – Hydrogeological and Engineering Assessments Report" Beca, 2006

[2] "New Lynn Rail Trench – Assessment of Groundwater Effects Addendum Report" Beca, 2008-07-23

[3] "Groundwater Effects Assessment of Queen Street Station" PDP, 2000

[4] "Groundwater Modelling of the Waitemata near Three Kings Quarry" PDP, 2003

Figure 4. Comparison of Hydrogeological Properties (Beca, 2010b)[1] [2]

[1] Tauranga Group Alluvium includes the Puketoka Formation, as well as more recent undifferentiated alluvium deposits (not mapped over the corridor of this project)

[2] Parnell Grit is the interbedded volcaniclastic grits referred to in the description of East Coast Bays Formation in Table 1. Whilst of the same geologic age as the alternating sandstone and mudstone that otherwise constitutes this formation, its properties can be significantly different and hence was considered as its own geological unit for the Waterview Connection project.

3. Existing Site-Specific Information

3.1 Site Investigations

3.1.1 Overview

A review of the New Zealand Geotechnical Database has been undertaken to identify any existing site investigations that may be of relevance to the project. This has identified multiple Machine Boreholes (BH), Cone Penetration Tests (CPTs) and Hand Augers (HA) along the proposed corridor, the details of which are included in Table 2. All are located within ~100 m laterally of Carrington Road, with a significant proportion of them at the northern extent of the study corridor. Further exiting investigations are also present outside of this ~200m wide study area.

A map of their locations is included in Appendix C and the associated logs are included in Appendix D.

Table 2. Existing Investigation Details (New Zealand Geotechnical Society, 2023)

Type	ID	Date	Coordinates[3]		Elevation[4] (m RL)	Termination Depth (mBGL)	Groundwater (mBGL)
			Easting (mE)	Northing (mN)			
BH	63495	30/11/75	1752369.576	5918013.506	28.1	22.7	-
BH	63496	30/11/75	1752374.249	5918050.379	28.2	15.9	-
BH	63497	30/11/75	1752372.888	5917979.375	28.1	29.0	-
BH	63527	01/11/76	1752329.203	5917994.608	27.6	11.9	1.6
BH	63528	01/11/76	1752372.180	5917993.114	28.2	37.2	4.1
BH	63529	01/11/76	1752415.158	5918040.427	28.6	19.8	1.5
BH	63530	01/11/76	1752418.192	5918015.166	28.9	24.0	2.2
BH	63531	01/11/76	1752417.831	5917995.471	28.1	20.1	2.0
BH	63532	01/11/76	1752445.898	5918042.159	28.4	12.8	1.0
BH	63534	01/11/76	1752389.081	5918041.609	28.5	22.2	-
BH	63535	01/11/76	1752392.136	5918017.549	28.1	22.5	-
BH	63536	01/11/76	1752393.676	5917993.017	28.1	30.4	-
BH	63557	15/01/78	1752411.234	5917985.091	28.0	32.8	-
BH	63558	15/01/78	1752403.750	5917985.929	28.2	38.7	-
BH	63559	15/01/78	1752412.106	5917994.476	28.1	32.2	-
BH	63560	15/01/78	1752484.862	5918029.136	27.8	13.1	-
BH	63565	15/01/78	1752483.766	5918056.561	27.8	8.4	-
BH	63566	15/01/78	1752491.021	5918005.120	27.3	6.1	-
BH	63567	15/01/78	1752478.604	5918064.057	27.9	11.5	-
BH	63568	15/01/78	1752492.019	5918005.101	11.6	12.8	-
BH	63569	15/01/78	1752484.045	5918044.754	27.0	13.4	1.5
BH	65692	03/04/03	1752375.846	5918049.708	28.6	20.1	-
BH	65696	02/12/08	1752539.042	5916946.143	46.5	40.0	-
BH	65697	02/12/08	1752473.438	5917250.983	31.5	36.1	-
BH	65702	02/12/08	1752409.351	5917796.800	25.4	15.1	-
BH	105510	06/06/13	1752444.311	5918053.879	28.6	19.5	-

[3] New Zealand Transverse Mercator Projection 2000

[4] New Zealand Vertical Datum 2016

Type	ID	Date	Coordinates[3]		Elevation[4]	Termination	Groundwater
BH	105512	29/01/13	1752417.574	5918050.402	28.6	19.5	-
BH	105513	22/01/13	1752381.713	5917982.032	28.2	30.0	-
BH	124183	29/02/12	1752804.235	5916577.832	-	15.1	-
BH	124184	29/02/12	1752823.256	5916644.079	-	18.1	-
BH	124185	29/02/12	1752840.681	5916621.569	-	18.1	-
BH	124186	29/02/12	1752777.698	5916589.407	-	15.1	-
BH	137791	22/06/15	1752369.569	5918102.734	28.1	18.2	-
BH	184208	15/06/22	1752486.760	5917696.190	20.0	9.3	1.3
CPT	105308	06/03/13	1752451.752	5917991.504	27.7	17.9	-
CPT	105310	01/03/13	1752380.621	5917982.593	28.2	20.0	-
CPT	105311	01/03/13	1752315.109	5917980.110	27.8	17.0	-
CPT	105317	28/02/13	1752491.228	5918057.747	26.8	16.0	-
CPT	105318	07/03/13	1752374.802	5918049.308	28.6	12.8	-
HA	63872	30/03/10	1752445.237	5917994.335	27.2	3.0	-
HA	63875	30/03/10	1752446.204	5918047.264	27.1	3.0	-
HA	63876	30/03/10	1752376.035	5918045.786	28.0	3.0	-
HA	148801	06/08/20	1752536.000	5917170.000	-	5.0	3.3
HA	148802	06/08/20	1752542.000	5917190.000	-	5.0	1.2
HA	148803	06/08/20	1752529.000	5917201.000	-	5.0	3.6
HA	155614(1)	11/11/19	1752619.300	5917102.100	40.3	0.9	-
HA	155614(2)	11/11/19	1752611.300	5917097.900	40.4	3.0	1.7
HA	155614(3)	11/11/19	1752603.400	5917108.000	39.8	3.0	-
HA	155614(4)	11/11/19	1752625.700	5917129.800	38.7	3.0	-
HA	158146(1)	10/03/21	1752688.770	5916799.660	-	5.0	-
HA	158146(2)	10/03/21	1752686.060	5916831.610	-	5.0	4.3
HA	158146(3)	10/03/21	1752709.740	5916814.270	-	5.0	-
HA	158146(4)	10/03/21	1752715.890	5916829.220	-	5.0	-
HA	158146(5)	10/03/21	1752699.690	5916845.430	-	5.0	-
HA	158146(6)	10/03/21	1752708.090	5916851.980	-	5.0	-
HA	158146(7)	10/03/21	1752725.150	5916867.320	-	5.0	-
HA	158146(8)	10/03/21	1752740.100	5916854.950	-	5.0	3.7
HA	184210	15/06/22	1752462.880	5917642.299	23.0	5.8	1.7

3.1.2 Ground Models

From the investigations noted above, several high-level ground models have been interpreted. These are presented in Table 3 to Table 6 and are intended to be indicative only. Further interpretation and should be undertaken when utilising this information for any design purposes. Validation of theses high-level models through additional site investigations is expected to be necessary for detailed design.

Table 3. High-level Ground Model at the Northwestern Motorway[5]

Top of unit (mBGL)	Thickness (m)	Unit Name	Unit Description
0.0	0.0 to 0.50	Fill	Asphalt, firm gravelly Silt and loose Gravel
0.0 to 0.50	4.8 to 8.8	Tauranga Group Alluvium	Soft to very stiff Silt and Clay, and Organics
5.3 to 8.8	5.0 to 15.1	Weathered East Coast Bays Formation	Very soft to hard Silt and Clay, and loose to dense Sand
13.2 to 23.9	>3.5	East Coast Bays Formation	Sandstone and Siltstone

Table 4. High-level Ground Model just north of Segar Avenue[6]

Top of unit (mBGL)	Thickness (m)	Unit Name	Unit Description
0.0	0.0 to 1.1	Fill	Stiff to very stiff Silt
0.0 to 1.1	1.9 to 2.9	Tauranga Group Alluvium	Stiff to very stiff Silt and Clay and loose to medium dense Sand
3.0 to 4.0	2.1 to 5.0	Weathered East Coast Bays Formation	Very stiff Silt and Clay and loose to very dense Sand
5.1 to 9.0	>4.2	East Coast Bays Formation	Sandstone and Siltstone

Table 5. High-level Ground Model just south of Fifth Avenue[7]

Top of unit (mBGL)	Thickness (m)	Unit Name	Unit Description
0.0	0.0 to 1.5	Fill	Stiff to very stiff Silt and Clay
0.7 to 1.5	3.3 to 5.3	Tauranga Group Alluvium	Stiff to very stiff Silt and Clay, loose Sand and Organics
6.8	>0.2 to 23.2	Weathered East Coast Bays Formation	Firm to very stiff Silt and loose to medium dense Sand
30.0	>6.1	East Coast Bays Formation	Sandstone and Siltstone

Table 6. High-level Ground Model at the North Auckland Railway[8]

Top of unit (mBGL)	Thickness (m)	Unit Name	Unit Description
0.0	0.2 to 1.4	Fill	Concrete, Silt and Gravel
0.2 to 1.3	1.3 to 2.9	Auckland Basalts	Basalt, firm to stiff Silt and Clay
1.1 to 4.2	2.4 to 3.7	Tauranga Group Alluvium	Firm to very stiff Silt and Clay
3.5 to 7.0	5.9 to 6.8	Weathered East Coast Bays Formation	Firm to hard Silt and Clay and loose to medium dense Sand
10.3 to 12.9	>3.1	East Coast Bays Formation	Sandstone and Mudstone

3.2 Bridge Drawings

A high-level review of drawings for both the Northwestern Motorway Overpass and the North Auckland Railway Bridges has been undertaken.

For the Northwestern Motorway bridge, its foundations are noted to include 9 no. 760 mm diameter bored piles raked at 1 in 3, with 9 no. 840 x 600 mm vertical precast concrete columns cast into 1500 mm diameter

[5] Based on BH_65692, BH_105512, BH_105510 and BH_105513. These represent the most recent and comprehensive records at this location; a more thorough interrogation against the information presented in other available records has not yet been undertaken.

[6] Based on BH_65702, BH_184208 and HA_184210

[7] Based on BH_65697, HA_148801, HA_148802 and HA_148803

[8] Based on BH_124183, BH_124184, BH_124185 and BH_124186

bored piles at each abutment. At the south abutment, the raked piles are noted to extend for a length of ~15 m below a top of pile level of ~RL 25.7 m and the vertical piles are noted to extend for a length of ~11 m below a top of pile level of ~RL 19.6 m. At the north abutment, the raked piles are noted to extend for a length of ~18 m below a top of pile level of ~RL 25.5 m and the vertical piles are noted to extend for a length of ~12 m below a top of pile level of ~RL 18.9 m. 5 no. 840 x 600 mm vertical precast concrete columns cast into 1500 mm diameter bored piles are present at the median pier. These piles are noted to extend for a length of ~11 m below a top of pile level of ~RL 19.6 m. No additional geological or geotechnical information has been identified from these records. A long section from the construction drawings is presented in Figure 5.

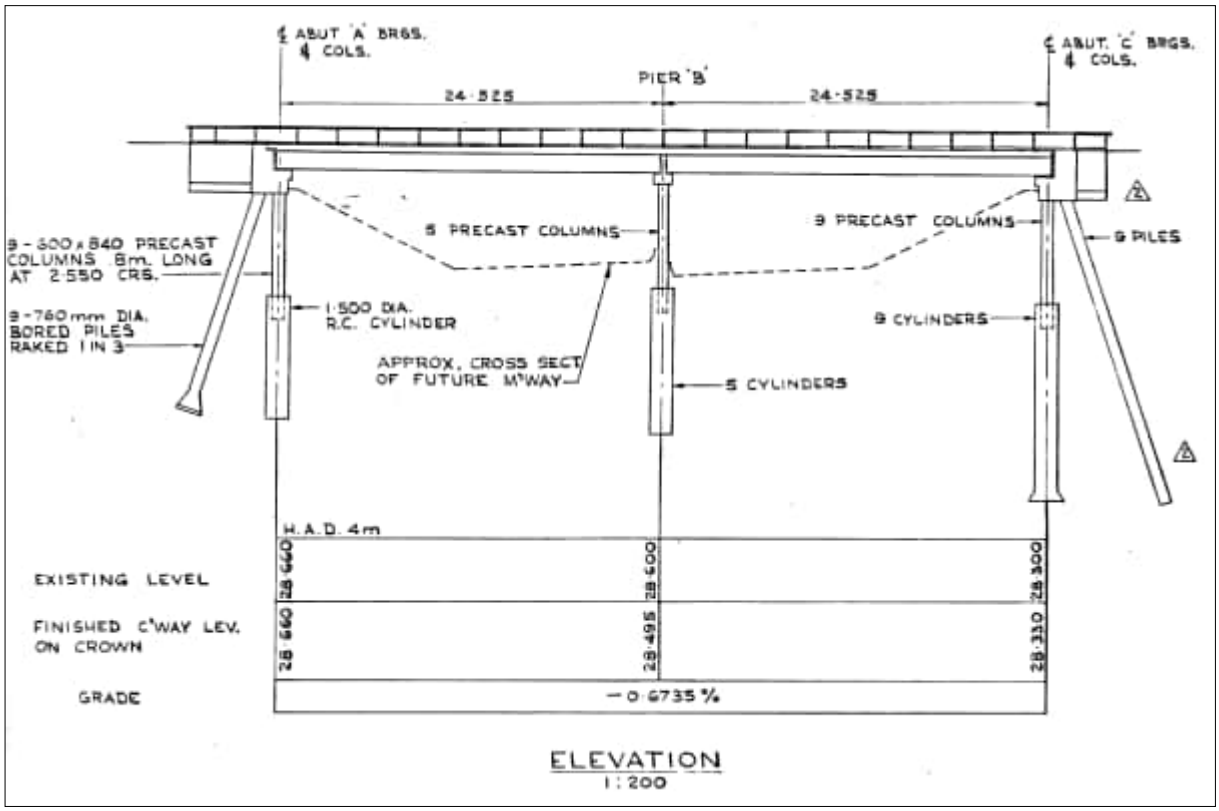

Figure 5. Northwestern Motorway bridge long section (Ministry of Works and Development, 1980)

For the North Auckland Railway bridge, its foundations are noted to include a cantilever retaining wall at each abutment and 8 no. 15" diameter piles at each pier. The length or elevations of the piles are not described. The approach embankment at the southern abutment is also noted to include cantilever retaining walls on each edge. No records for the northern approach abutment have been identified from these records, nor has any additional geological or geotechnical information. A long section from the drawings is presented in Figure 6.

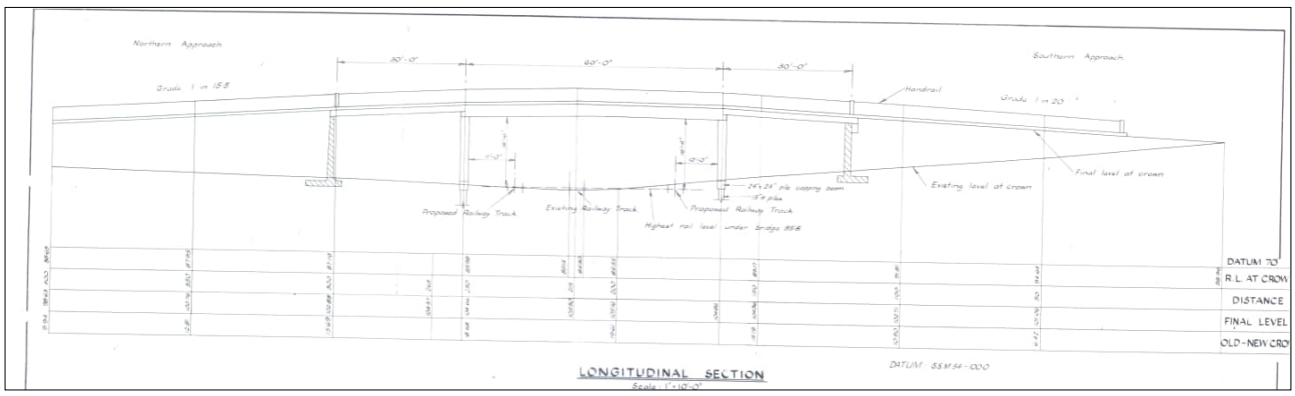

Figure 6. North Auckland Railway bridge long section (Harrison & Grierson & Partners, 1958)

3.3 Additional Reports

Additional reports from the nearby Waterview Connection have also been identified and reviewed, including:

- Geotechnical Interpretive Report (Beca, 2010c).
- Assessment of Groundwater Effects (Beca, 2010b).
- Assessment of Ground Settlement Effects (Beca, 2010a).

It is understood that they were prepared as part of the Resource Consent and Notice of Requirements application for that project. Whilst this is approximately 600 m to the west, the geological conditions encountered are likely to be similar due to the site's proximity. Table 7 below presents the recommended values for a variety of design parameters for each of the geological units identified on the Waterview Connection project. Therefore, these represent an approximation of what may also be expected on this project.

Table 7. Recommended/Average Geotechnical Design Parameters (Beca, 2010c)

Design Parameter		Unit Name			
		Tauranga Group Alluvium	Weathered East Coast Bays Formation	East Coast Bays Formation	Auckland Basalt lava
Unit Weight γ (kN/m^3)		19	18	21	-
Bulk Density ρ_{Bulk} (Mg/m^3)		1.87	1.80	2.09	2.77
Undrained Shear Strength S_U (kPa)		83	88	-	-
Effective Friction Angle φ' (°)		28	30	-	-
Effective Cohesion c' (kPa)		3 to 7	8	-	-
Unconfined Compressive Strength UCS (MPa)		-	-	2.22	-
Coefficient of Volume Compressibility m_v (m^2/MN)	20 kPa in-situ effective stress	0.3	0.3	-	-
	800 kPa in-situ effective stress	0.11	0.10	-	-
Normalised Compression Index $\frac{C_c}{1+e_0}$		0.13	0.15	-	-
Normalised Recompression Index $\frac{C_r}{1+e_0}$		0.025	0.015	-	-
Coefficient of Consolidation c_v (m^2/year)		12	35	-	-
Poison's Ratio v		-	-	0.25	0.15

Design Parameter		Unit Name			
Young's Modulus E (MPa)	Initial, low-strain modulus	-	-	100q [9]	10,000
	Unload/Reload modulus	-	-	200q [9]	-

3.4 Buried Utility Records

A review of the existing utility plans for the corridor has identified that the corridor is heavily constrained with buried water supply, wastewater, stormwater and electrical assets. An example of this is shown below in Table 7 for the section of the corridor immediately north of the North Auckland Railway.

Figure 7. Example map of buried utilities within the corridor (Auckland Council, 2023b)

Whilst details of the utilities are recorded, no additional information regarding the geotechnical and geological conditions encountered along their alignments has been identified.

[9] Where q is the confining axial stress

4. Geohazards

4.1 Seismicity

The study corridor is located within a region of low seismic hazard. The closest known active faultline to the site is the Wairoa North Fault, located ~30 km to the Southwest (GNS Science, 2023c). As such, the risk of fault rupture on the project corridor is negligible.

The seismic parameters for Geotechnical Design have been considered following the recommendations of the Geotechnical Earthquake Engineering Module 1 (Ministry of Business, Innovation & Employment & New Zealand Geotechnical Society, 2021). The Peak Ground Accelerations (PGAs) and Magnitude Weightings for typical earthquake return periods from this guidance are presented in Table 8. During subsequent stages of design, consideration should also be given to the implications of the 2022 National Seismic Hazard Model as this may result in recommendations that differ from those currently presented in this guidance.

Table 8. Recommended Geotechnical Seismic Design Parameters[10]

Annual Probability of Exceedance	PGA (g)	Magnitude Weighting
1/25	0.05	5.9
1/100	0.09	
1/500	0.15 (0.19)	5.9 (6.5)
1/1000	0.20 (0.19)	
1/2500	0.28 (0.19)	

Given the low seismic hazard on the site, the risk of liquefaction is also considered low to minor. Some potential is expected to exist where loose to medium dense sands and silty sands (such as those that may be found in the Tauranga Group Alluvium) are present below the groundwater table. A high-level review of this susceptibility utilising the available CPT data at the Northwestern Motorway has confirmed this low to minor risk for a PGA of 0.19g and a Magnitude Weighting of 6.5. This risk should therefore be considered on a case-by-case basis at any structures, with respect to the soil profiles present. This is expected to be particularly relevant for works undertaken on any high importance structures such as the overpasses over the Northwestern Motorway or the North Auckland Railway. Due to their expected heights, any retaining structures from carriageway widening are expected to be of lower importance, but the effects of liquefaction should be checked nonetheless where relevant.

4.2 Volcanic Activity and Volcanic Soils

Whilst the risk of eruption from the nearby Mount Albert is negligible, the site is located just beyond the assumed boundary of the Auckland Volcanic Field, an active field (Auckland Council, 2023a). The last eruption from this field occurred ~600 years ago at Rangitoto. As such, there is a low risk of the site being impacted by volcanic activity, within the design life of the project. Of those impacts, the most probable is ashfall, with the risk of more significant effects, like lava flows or fissuring, being significantly lower. It is not expected that account for these hazards will need to be made in design.

As noted by Opus in their study (Opus International Consultants, 2016), allophanic clays may be present on the site due to the volcanic derived nature of many of the soils present. "Allophanic soils are dominated by allophane, (and also imogolite or ferrihydrite) minerals. These stiff-jelly-like minerals coat the sand and silt grains and maintain a very porous, low-density structure with weak strength" (Landcare Research, 2023). Such clays are very susceptible to loss of strength and changes in plasticity when reworked and therefore care needs to be taken when undertaking earthworks involving such materials. Jacobs is not aware of any specific investigations to date confirming their presence on the site and therefore agrees with the Opus International Consultants (2016) recommendation for confirming the presence and extent of allophanic clays and evaluating the effects that they may have on the design with a targeted investigation prior to detailed design.

[10] Where multiple values are presented, the worst case conditions of the pair of PGA and Magnitude Weighting should be considered (i.e., the pair of values outside the brackets vs those inside the brackets)

Another consequence of volcanic derived soils on site is the potential for basalt rock outcrops being encountered during excavations and the potential for volcanic cobbles and boulders within the soil profile (where significant voids could also be present between such large particles). This should be investigated on site where possible, at relevant locations, prior to detailed design. Opus noted that allowance should be made for such features in construction estimates (Opus International Consultants, 2016) and Jacobs again would agree with that assessment. These allowances are recommended to include:

- Challenges in the comprehensive assessment of site conditions through geotechnical investigations prior to construction.
- Difficult excavation, including rock breaking.
- Greater than expected depths to rock or rock intrusions in the soil profile that are insufficiently thick or strong for use as a founding depth of structures.
- The need for over-excavation to achieve a consistent founding depth for the compaction of backfill, mitigating the potential for loss of material into voids.
- Difficulty in the compaction of backfill against an undulating rock surface.
- Potential for the re-use of site won aggregate.

4.3 Slope Stability

In general, the risk of slope instability on the site is expected to be low. This is due to the siting of the project corridor on top of a ridge and the typically gentle gradients of the slopes either side. A review of the New Zealand Landslide database has not identified any events in proximity to the site (GNS Science, 2023b). Whilst slope stability hazards will be introduced by widening of the Carrington Road carriageway in areas where that adjacent ground is lower than the new surface, it is expected that these can be effectively managed through standard engineering design. At this present time, the exact location of these areas in unknown as the design has not yet sufficiently progressed. This risk should be considered with additional geotechnical investigations at relevant locations prior to detailed design.

4.4 Settlement

All soil deposits are at risk of settlement when exposed to increased loadings than they have previously experienced. However, settlement is expected to be a minor consideration along the project alignment (i.e., a moderate likelihood of low settlements), due to the soil deposits present and the expected works constructed (i.e., only low height embankments associated with any carriageway widening are currently anticipated). The northern end of the study corridor is expected to be the most prone to settlement (where the Puketoka Formation is present), particularly in any areas of soft silt/clay or organic deposits. Such organic deposits have been observed in several of the existing site investigation records (e.g., ~0.8 m of stiff organic clay was encountered in BH_105510) and, whilst typically soils across the alignment have been logged as firm to very stiff, soft soils have also been observed in some areas (e.g., ~4.6 m of soft silty clay and clayey silt was observed in BH_105512). Where soils are fine-grained or organic in their nature, settlements are not expected to occur immediately, but rather be time dependent, continuing over a period of months to years unless otherwise mitigated.

In some instances, undercutting of settlement prone soils and backfilling with structural fill may be sufficient to mitigate the risk posed by such soils. Other alternatives that should be considered during design include the potential for foundations penetrating to greater depth in stiffer/denser units or designing for a degree of flexibility in the performance of structures founded at shallow depths and pavements built over embankments. Additional investigations, prior to detailed design, are recommended for any structures and embankments to further assess these risks and to confirm any proposed mitigation measures.

4.5 Climate Change

Anthropogenic induced climate change is well traversed by both domestic and international reports. This project is at a high enough elevation to be unaffected by sea level rise and therefore the primary effects of climate change on the site is the impact of increased rainfall. Whilst the variations in mean rainfall are expected to be minor for the site, there is predicted to be a significant increase in the number of heavy rainfall days (>25 mm of rain) and in the intensity of heavy rainfall events (Pearce, et al., 2018). This is expected to increase the likelihood of elevated groundwater levels which may induce slope instability, reduce bearing capacities and add additional loading to earth retaining structures. This should be mitigated in design throu

gh the adoption of appropriate, climate-adapted groundwater levels and pressures and the inclusion of retaining wall drainage that is sufficiently sized to account for increased flow rates from heavy rainfall events.

5. Conclusions and Recommendations

5.1 Geotechnical Risks

A brief summary of the expected geotechnical risks is provided in Table 9.

Table 9. Summary of Project Geotechnical Risks

Risk	Significance for Design	Description/Recommendation
Seismic Ground Shaking	Minor	Low seismic region of New Zealand A conventional seismic design approach is expected to be appropriate
Seismic Faulting	Negligible	Not expected to differ from the general risk posed to the greater Auckland region
Liquefaction and cyclic softening	Minor	Some soils may be susceptible at ~ULS shaking Should be considered on a location specific basis for design
Volcanic eruptions, lava flows, fissuring and ash deposits	Negligible	Not expected to differ from the general risk posed to the greater Auckland region
Allophanic Soils	Unknown	To be investigated further
Basalt Rock outcrops, volcanic cobbles and boulders within the soil profile etc.	Minor	Design implications should be limited but targeted investigations are recommended at relevant locations prior to detailed design Recommended that allowance be made in construction estimates
Slope Instability	Minor	Targeted investigations are recommended at relevant locations prior to detailed design Should be considered on a location specific basis for design
Settlement	Minor	Targeted investigations are recommended at relevant locations prior to detailed design Should be considered on a location specific basis for design
Climate Change	Minor	Should be considered on a location specific basis for design

5.2 Additional Investigations

As noted in Section 3.1, existing investigations have been undertaken throughout the study corridor utilising a variety of investigation techniques. Some information has also been gathered regarding groundwater conditions on the site as noted. It is expected that this geotechnical information will be sufficient to facilitate the development of a preferred technical option for the project. In making this judgment, consideration has also been given to the value of such additional data in light of the expected challenges undertaking investigations on the site. As identified in Section 3.4, the study corridor has a high density of buried utilities. Therefore, considerable effort and expense is expected in the positive identification of these services, prior to any intrusive investigations in their vicinity. Alternatives to avoid these utilities include the undertaking of investigations on adjacent private land, or within the carriageway area. These are expected to add logistical complexity through the acquirement of licence to occupy and pavement cutting and reestablishment respectively. Likewise, for any investigations undertaken within the road corridor (typically for anywhere between the property boundaries either side of the road), temporary traffic management would be required.

It is worth noting thought that additional investigations may be identified as necessary through the preferred technical option development process for the purpose of pavement design (such as pavement test pits) or stormwater design (such as further groundwater monitoring and in-situ permeability testing). The details of these, if warranted, is beyond the scope of this report.

Following selection of a preferred technical option, greater certainty will be achieved in the nature of the works to be undertaken; in particular, the location and extent of any proposed structures. It is therefore recommended that additional targeted investigations be undertaken prior to detailed design. Such investigations are expected to be able to focus on target depths for foundations and site-specific ground

models and the specific geotechnical problems to be overcome in the design of each element. The scope of these investigations should be confirmed prior to the commencement of detailed design.

6. References

Auckland Council. (2023a, February 13). *Auckland's Hazard Viewer*. Retrieved from https://aucklandcouncil.maps.arcgis.com/apps/MapSeries/index.html?appid=81aa3de13b114be9b529018ee3c649c8

Auckland Council. (2023b, February 13). *GeoMaps*. Retrieved from https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

Beca. (2010a). *Western Ring Route - Waterview Connection: Assessment of Ground Settlement Effects.* Auckland, NZ: NZ Transport Agency.

Beca. (2010b). *Western Ring Route - Waterview Connection: Assessment of Groundwater Effects.* Auckland, NZ: NZ Transport Agency.

Beca. (2010c). *Western Ring Route - Waterview Connection: Geotechnical Interpretive Report.* Auckland, NZ: NZ Transport Agency.

GNS Science. (2023a, February 13). *1:250k Geology*. Retrieved from New Zealand Geology Web Map: https://data.gns.cri.nz/geology/

GNS Science. (2023b, February 13). *Landslides Map*. Retrieved from Landslides Database: https://data.gns.cri.nz/landslides/wms.html

GNS Science. (2023c, February 13). *Surface Traces of Onshore Active Faults at a Scale of 1:250,000*. Retrieved from New Zealand Active Faults Database: https://data.gns.cri.nz/af/

Google Earth Pro. (2023, Feburary 13).

Harrison & Grierson & Partners. (1958). Proposed Overbridge at Carrington Road for the Mt. Albert Borough Council.

Landcare Research. (2023, March 2). *Allophanic Soils*. Retrieved from Soils Portal: https://soils.landcareresearch.co.nz/topics/soil-classification/nzsc/soil-orders/allophanic-soils/

Local Government Geospatial Alliance. (2023, February 13). *Webviewer*. Retrieved from Retrolens: https://retrolens.co.nz/

Ministry of Business, Innovation & Employment & New Zealand Geotechnical Society. (2021). *Earthquake Geotechnical Engineering Practice Module 1: Module 1 Overview of Earthquake Geotechnical Engineering Practice Guidelines.* Wellington, NZ: Ministry of Business, Innovation & Employment.

Ministry of Works and Development. (1980). Carrington Road Underpass Contract Drawings. *Auckland - Whenuapai Motorway - RD. 2A*.

New Zealand Geotechnical Society. (2023, Feburary 13). *Map Viewer*. Retrieved from New Zealand Geotechnical Database: https://www.nzgd.org.nz/ARCGISMapViewer/mapviewer.aspx

Opus International Consultants. (2016). *Carrington Road Corridor Improvement and UNITEC Hub PFR: Preliminary Geotechnical Appraisal and Investigation Report.*

Pearce, P., Bell, R., Bostock, H., Carey-Smith, T., Collins, D., Fedaeff, N., . . . Woolley, J. (2018). *Auckland Region climate change projections and impacts.* Auckland: National Institute of Water & Atmospheric Research.

Appendix A. Site Topography

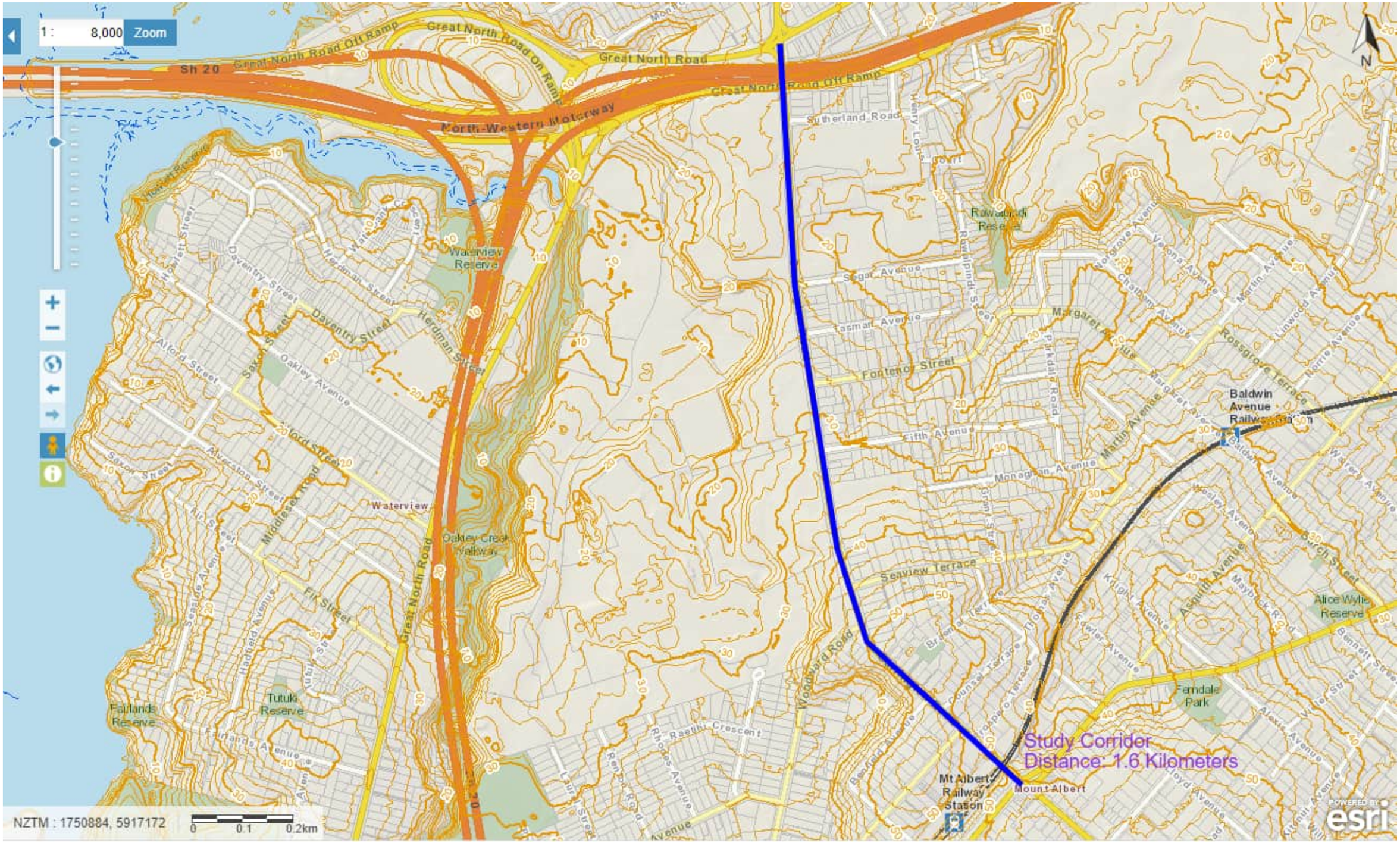

Figure A-1. Topography of the Project Corridor (Auckland Council, 2023b)

Appendix B. Historical Aerial Photography

Figure B-1. 1940 Aerial Photograph (Local Government Geospatial Alliance, 2023)

Figure B-2. 1958 Aerial Photograph (Local Government Geospatial Alliance, 2023)

Figure B-3. 1968 Aerial Photograph (Local Government Geospatial Alliance, 2023)

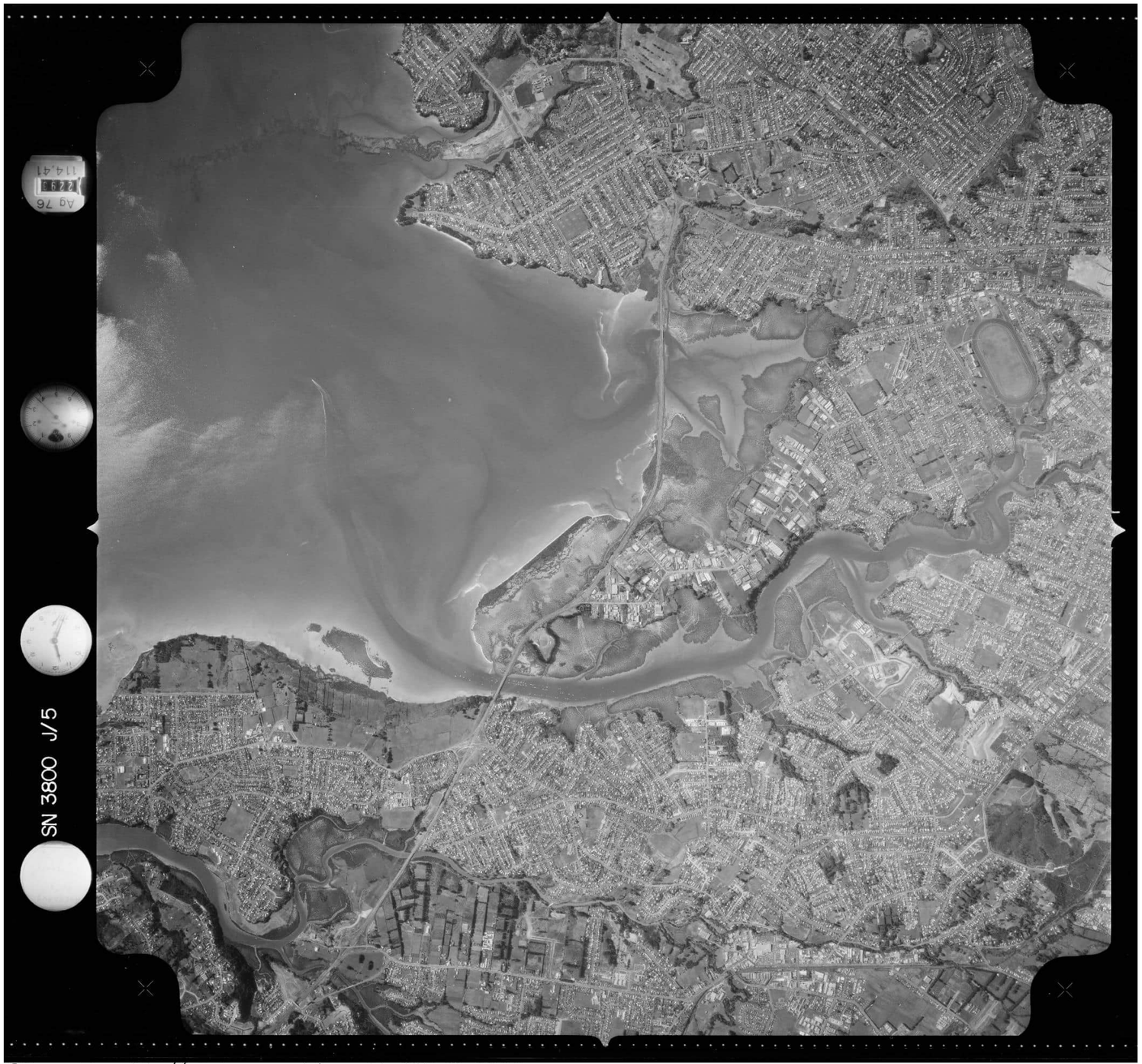

Figure B-4. 1975 Aerial Photograph (Local Government Geospatial Alliance, 2023)

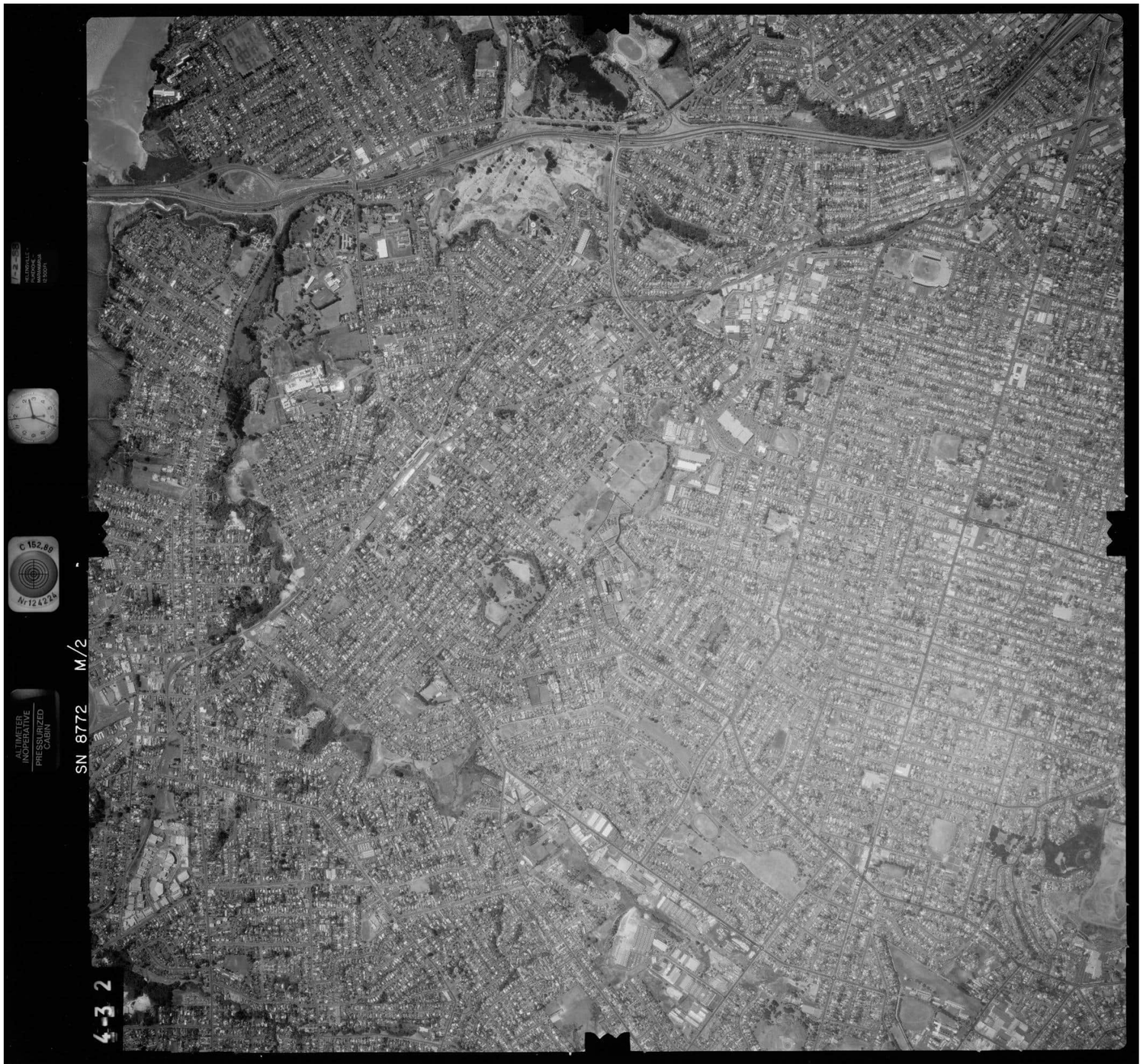

Figure B-5. 1988 Aerial Photograph (Local Government Geospatial Alliance, 2023)

Figure B-6. 2004 Aerial Photograph (Google Earth Pro, 2023)

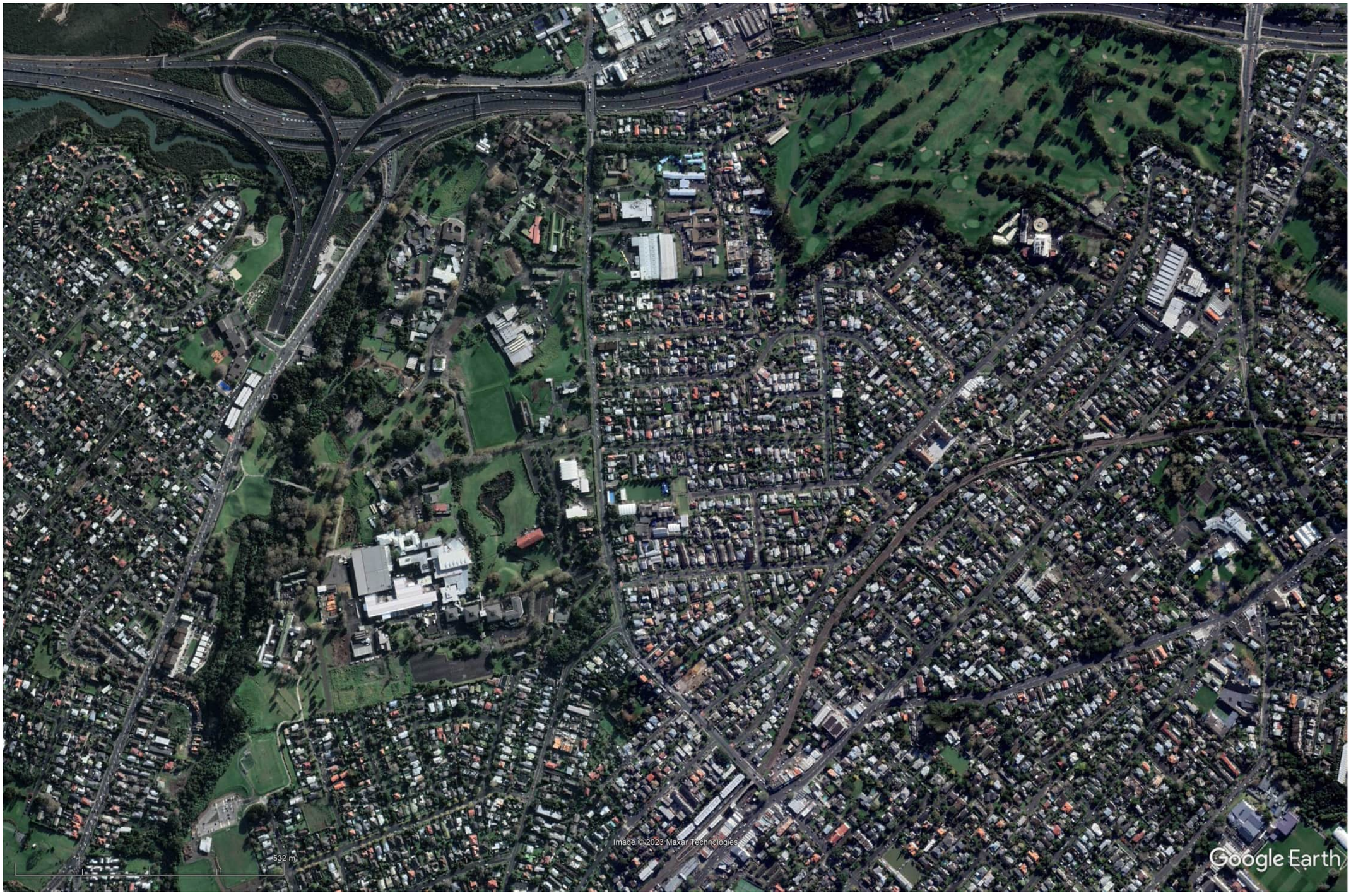

Figure B-7. 2022 Aerial Photograph (Google Earth Pro, 2023)

Appendix C. Existing Geotechnical Site Investigation Locations

Figure C-1. Existing Investigation Locations (Full Corridor)

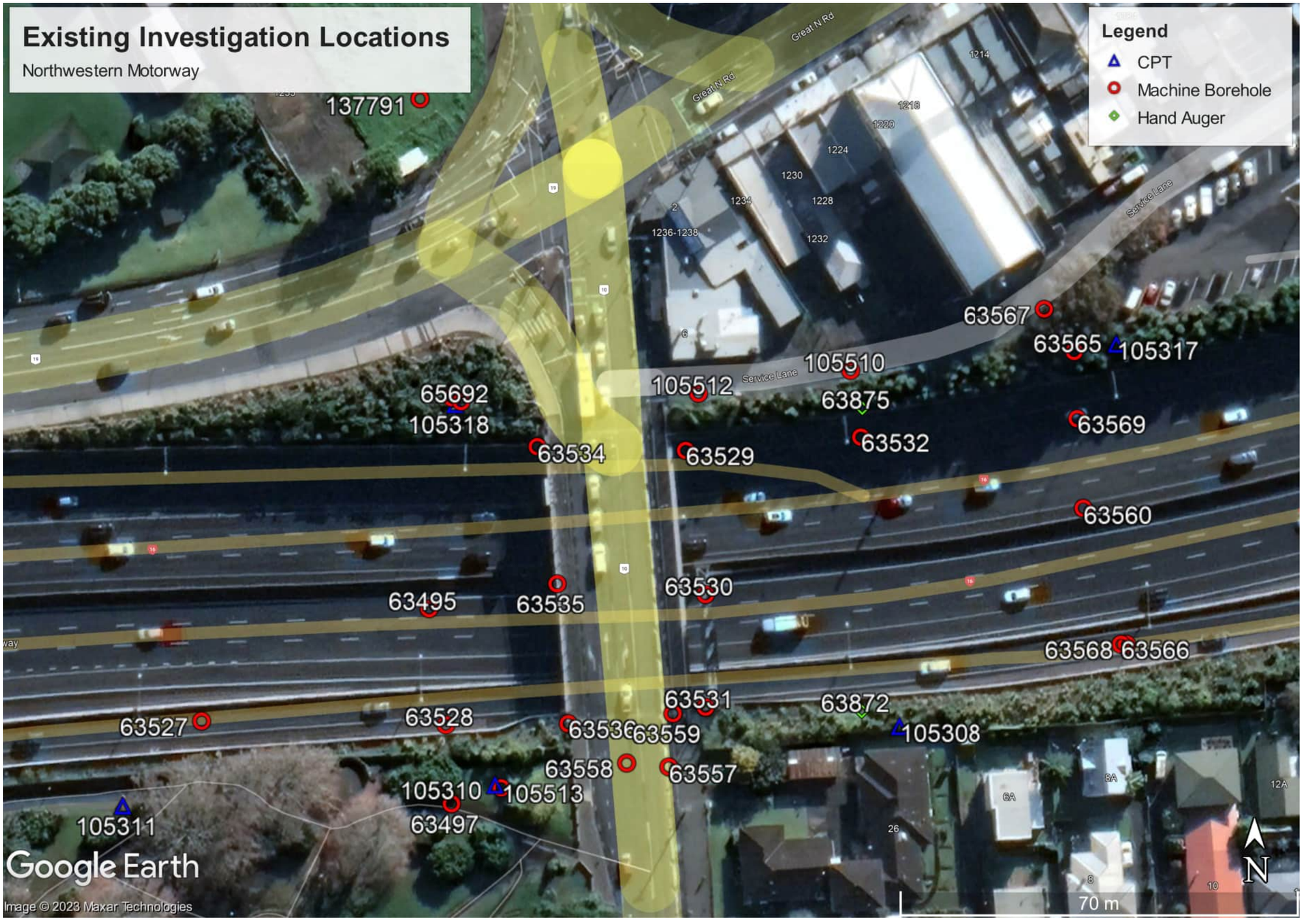

Figure C-2. Existing Investigation Locations (Northwestern Motorway)

Appendix D. Existing Geotechnical Site Investigation Records

OP09

RECORD OF BOREHOLE No. 1

SHEET 1

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

A.D.O. No _____ DATUM MSL SURFACE R.L. 28.1 m

TYPE OF SAMPLING Continuous Core and Sample Tubes

PLANT USED H.E. SUPERVISED P.F. Wood DATE 15.10.71

CO-ORDINATES 700723 295097 WATER LEVEL _____

% Core Recovery	R.L. / DEPTH m.	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa.	Bulk Density kg/m³
	0				
30		Road construction			
	1				
50		Stiff mottled light grey, red and light brown CLAY			
			37	270	1810
70	2				
	3				
			38	220	1780
60		Becoming silty			
	4	Firm/stiff light brown with light grey mottling SILTY CLAY			
70					
			42	160	1790
	5	Firm mottled light grey, pink and light brown CLAYEY SILT.	38	134	1810
100					
	6	Soft/firm mottled light grey, pink and light brown SILTY CLAY			
			48	70	1720

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RECORD OF BOREHOLE No. 1

SHEET 2

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

TYPE OF SAMPLING Continuous core and Sample tubes

% core Recovery RL	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS STRENGTH kPa	Bulk Density kg/m³	m
	6					6
100		Firm mottled light grey pink & light brown CLAYEY SILT	44	170	1760	
		Soft, grey SANDSTONE				
	7					7
25						
	8	Soft grey SILTSTONE	42	180	1780	8
70		Soft grey SANDSTONE Soft grey SILTSTONE Soft grey SANDSTONE				
		Soft grey SILTSTONE	40	200	1800	
	9	Soft grey SANDSTONE				9
30						
100	10		41	200	1780	10
		Alternating bands broken medium grey siltstone. mudstone and fine SANDSTONE.				
95						
	11					11
90	12					12
	13					13

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RECORD OF BOREHOLE No. 1

SHEET 3

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

TYPE OF SAMPLING Continuous Core

% core Recovery R.Q.D.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS STRENGTH kPa	Bulk Density kg/m³	m
90	3	Alternating bands grey SILTSTONE, MUDSTONE and SANDSTONE				
		Broken soft grey fine SANDSTONE				
70	14	Becoming coarser				
		SILTSTONE band 1cm				
	15					
		Alternating bands medium grey SILTSTONE and soft grey SANDSTONE				
80	16	very coarse SANDSTONE	33	280	1900	
		Medium grey SANDSTONE	32	770	1980	
0	17					
	18					
100						
	19	Alternating bands medium grey SILTSTONE and soft grey SANDSTONE				
		Soft grey SANDSTONE				
90						

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RECORD OF BOREHOLE No. 1

SHEET 4

SITE Whenuapai-Auckland Motorway Waterview-Western Springs Section

TYPE OF SAMPLING Continuous Core

% core Recovery	R.L. RWK.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH KPa	Bulk Density kg/m³
		20				
90			Alternating bands of medium grey siltstone and soft grey SANDSTONE	29	385	1990
			Soft grey SANDSTONE	42	168	1630
		21				
100						
		22				
			Hard grey-brown very coarse SANDSTONE			
			E.O.B. 22.71m			
		23				

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RECORD OF BOREHOLE No. 2

SHEET 1

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

A.D.O. No _____ DATUM MSL SURFACE R.L. 28.2 m

TYPE OF SAMPLING Continuous Core and Sample Tubes

PLANT USED H.E. SUPERVISED P.F. WOOD DATE 18.10.74

CO-ORDINATES 700760 295101 WATER LEVEL _____

% core Recovery	RL / DEPTH m.	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa.	Bulk Density kg/m³
15	0	Road construction and granular fill.			
100	1	Stiff mottled light grey and light brown SILTY CLAY			
75	2		35	300	1830
		Stiff light grey slightly SILTY CLAY	30	360	1900
100	3	Stiff mottled very light grey and red very SILTY CLAY			
		Stiff mottled light grey and light brown SILTY CLAY	38	210	1810
	4				
		Medium light grey silty fine SAND	44	95	1710
40	5	Washed, core lost			
		Becoming soft light grey fine SANDSTONE			
60	6		40	230	1780

m: 0, 1, 2, 3, 4, 5, 6

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OP09

RECORD OF BOREHOLE No. 2

SHEET 2

SITE Whenuapai-Auckland Motorway Waterview-Western Springs Section

TYPE OF SAMPLING Continuous core and Sample tubes

% core R.Q.D. Recovery	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density kg/m³
	6	Soft light grey fine SANDSTONE			
80					
	7		41	190	1810
100	8				
	9		39	310	1830
		Soft light grey and brown fine SANDSTONE			
	10				
95		Soft brown fine SANDSTONE			
		Alternating bands of grey SILTSTONE AND SANDSTONE			
	11		34	320	1860
		Soft grey SANDSTONE			
80			30	138	2130
	12	grey SILTSTONE			
		grey SANDSTONE R.C.E. 200 SILTSTONE			
100		B.C.M. grey SANDSTONE			
	13				

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 2

SHEET 3

SITE Whenuapai-Auckland Motorway. Waterview-Western Springs Section

TYPE OF SAMPLING Continuous Core

% core Recovery R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS STRENGTH kPa	Bulk Density kg/m3	m
100	13	Hard grey SANDSTONE				
			24	1710	2160	
50		- B.C.M.				
	14					
100	15					
		- B.C.M.	24	1360	2170	
	16	E.O.B. 15.85m				

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RECORD OF BOREHOLE No. 3

SHEET 1

SITE Whenuapai-Auckland Motorway Waterview-Western Springs Section

A.D.O. No _____ DATUM MSL SURFACE R.L. 28.1 m

TYPE OF SAMPLING Continuous Core and Sample Tube

PLANT USED H.E. SUPERVISED P.F. Wood DATE 9.10.74

CO-ORDINATES 700689 295101 WATER LEVEL _____

% Core Recovery R.Q.D.	DEPTH m.	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa.	Bulk Density kg/m³
	0				
30		Road construction and granular fill			
	1				
		Stiff mottled white and light orange brown CLAY	34	320	1820
70	2				
		Stiff white with pink and red mottling CLAY	38	310	1810
	3				
	4				
50			38	260	1970
	5				
	6				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 3

SHEET 2

SITE Whenuapai-Auckland Motorway. Waterview-Western Springs

TYPE OF SAMPLING Continuous core and sample tubes

% core Recovery	RL	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density kg/m³
		6	Firm mottled grey and red organic stained CLAY			
			Firm non-fibrous clayey PEAT	72	100	1480
70		7	Firm light grey organic stained CLAY			
		8	Firm light grey clayey SILT with fibrous B.C.M. flecks			
100		9	B.C.M. flecks disappearing	34	150	1860
			Firm light grey CLAY			
90		10	Stiff light grey clayey SILT. (Blue organic staining) blue organic staining	61	250	1640
		11				
100		12	Firm light grey clay with thin bands of organic staining			
			Firm light grey SANDY SILT	36	125	1840
		13				

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 3

SHEET 3

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs section

TYPE OF SAMPLING Continuous Core

% Core Recovery	R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS STRENGTH kPa	Bulk Density kg/m³	m
100		13	Firm light grey CLAY				
40		14	Firm light grey CLAYEY SILT and SANDY SILT. Mostly lost in drilling				
		15					
100		16	Soft-firm grey SILTY SAND				
			~~Stiff grey clay~~ (soft-med. grey mudstone)				
			soft grey SANDSTONE				
			~~Stiff grey CLAY~~ (soft-med. grey mudstone)				
		17					
		18					
80		19					
100		20					

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

OP09

RECORD OF BOREHOLE No. 3

SHEET 4

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

TYPE OF SAMPLING Continuous Core

% core Recovery	R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH KPa	Bulk Density kg/m³	m
		20	Soft grey SANDSTONE				
100				33	186	1830	
		21					
		22					
50							
		23	Soft grey SILTSTONE				
			Soft grey SILTSTONE				
		24					
70							
				28	-	-	
		25	Hard grey SILTSTONE				
			Hard grey SILTSTONE	26	5850	1950	
80		26					
90		27	Hard grey SILTSTONE with soft grey SANDSTONE bands washed away				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 3

SHEET 5

SITE Whenuapai-Auckland Motorway, Waterview-Western Springs Section

TYPE OF SAMPLING Continuous core

% core Recovery	R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density kg/m3
90		27	Cont.			
100			Hard grey SANDSTONE	24	1740	2020
		28	Hard grey SILTSTONE with thin SANDSTONE bands			
			Hard grey SANDSTONE	23	4140	2000
		29	E.O.B. 28.95m			

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 21

SHEET 1

SITE Auckland-Whenuapai Motorway R.D. 2 A
~~Waterview Interchange~~

A.D.O. No _____ DATUM MSL SURFACE R.L. 27.6 m

TYPE OF SAMPLING Continuous Core

PLANT USED Damco SUPERVISED J Northcott DATE 20/4/76

CO-ORDINATES 700703.4 295057.0 WATER LEVEL 1.6m

R.L. % Core	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density (kg/m³)	m
Reco	0	Firm dark brown SILTY TOPSOIL	15	160	1515	0
100		Firm light brown SILTY CLAY becoming so ft with depth	25	65	1850	
	1	Still light brown with occasional orange mottling slightly SILTY CLAY	26	190	1965	1
		Stiff/hard light grey with occasional light brown mottling slightly SILTY CLAY				
90	2	Hard light grey with occasional light brown dark brown and red mottling very slightly SILTY CLAY	30	380	1880	2
		Stiff light grey with red mottling CLAY				
	3		38	250	1810	3
		becoming silty from 3.7m				
100	4	silt increasing with depth	37	200	1815	4
	5					5
		1mm-2mm red bands at 2-5mm spacing	40	150	1800	
	6	becoming firm at 6m				6

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 21

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMP COMPRESS STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Reco	6					6
		Firm light grey CLAYEY SILT with occasional light brown 1cm - 2cm bands and some mottling Clay content decreasing with depth	38	90	1815	
	7		30	230	1895	7
100						
	8					8
	9	becoming firm light grey with occasional light brown mottling SILT	34	140	1875	9
	10					10
		Firm interbedded (1cm beds) light brown SILT & VERY SILTY CLAY				
	11	Firm/stiff brown CLAYEY SILT	33	170	1890	11
		Weakly cemented grey SILT with occasional B.C.M.				
	12	E.O.B.				12
	13					13

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SHEET 1

SITE AUCKLAND -WHENUAPAI MOTORWAY R.L. 2 A
WATERVIEW INTERCHANGE

A.D.O. No _____ DATUM M.S.L. SURFACE R.L. 28.2 m

TYPE OF SAMPLING CONTINUOUS CORE

PLANT USED DAMCO SUPERVISED J Northcott DATE 13/4/76

CO-ORDINATES 700702.7 295100.0 WATER LEVEL 4.1m

R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa.	Bulk Density (kg/m³)	m
% Core Recov	0	Turf and dark brown topsoil				0
		Hard brittle grey-brown mottled slightly SILTY CLAY with rootlets	24	620	1960	
	1	Hard light grey with occasional brown mottling CLAY becoming stiff with depth	41	370	1780	1
75		Hard light grey with occasional red mottling CLAY becoming stiff silty and occasional yellow mottled with depth				
	2					2
			28	350	1940	
50	3					3
	4	Stiff, brittle grey and red mottled slightly SILTY CLAY becoming paler and less red with depth	43	220	1775	4
80						
	5					5
90		Firm light grey SILTY CLAY with decayed vertical roots becoming more silty with depth				
	6					6

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

RL	DEPTH m	DESCRIPTION OF SOIL	W %	Comp COMPRESS. STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	6	As above				6
80	7	becoming firm light grey CLAYEY SILT No roots				7
	8	Dark grey patches from 8m				8
35	9	becoming soft light grey SILT with occasional firm light grey clay lenses				9
	10					10
70	11	becoming weakly cemented light grey SILT				11
60	12					12
50	13					13

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SHEET 5

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	M.C.%	Comp SHEAR STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	13	As above (Contact :20°)				
	14	Interbedded grey CEMENTED SILT and 1 - 2 mm light grey MUDSTONE PARTICLES in a light grey CLAY MATRIX (weathered gritstone) (each bed approx. 15cm bedding 30°) becoming limonite stained at 15.2m				
	15		40	270	1835	
80	16	Brown (limonite stained) CEMENTED SILT Considerable limonite at 16.3m				
	17	1mm light grey bands at 1 - 2 mm spacing from 16.9m				
		Limonite stained WEATHERED GRITSTONE				
		Stiff light grey CLAY at 30°				
100		Cemented limonite stained SILT	36	130	1965	
	18	Cemented light grey SILT	35	110	1845	
	19	Well cemented light grey with limonite staining SILT (Soft siltstone)	42	190	1900	
75		Soft limonite stained SILT with occasional bands of stiff light grey clay at 30°				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SHEET 4

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	M.C.%	Comp SHEAR STRENGTH KPa	Bulk Density (kg/m³)
% Core Recov	20	becoming weakly cemented with depth			
65		Well cemented grey			
	21	SILT (soft siltstone)			
		with traces of sand and BCM			
		sand and BCM decreasing with depth			
	22				
60		considerable B.C.M. from 22.6 - 22.7 m			
	23				
	24				
	25				
70					
	26				
	27	" " " 26.7 - 27.0 m			

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	M.C.%	Comp SHEAR STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	27	becoming slightly sandy from 27m				
60						
	28	B.C.M. From 28 m- 28.3m, bedding 30°				
		" at 28.8m " "				
	29	" from 29.6m - 29.7m	27	380	2070	
	30	becoming weakly cemented grey FINE SAND				
100			26	295	2190	
	31	Soft grey interbedded FINE SANDSTONE, SILTSTONE& GRITSTONE				
	32	Considerable BCM to 31.7m bedding 30°	22	420	2150	
	33	Medium grey FINE SANDSTONE with occasional B.C.B. bedding 30° becoming hard with depth	24	1070	2200	
	34		26	2900	2195	

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 22

SHEET 6

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

RL	DEPTH m	DESCRIPTION OF SOIL	MC%	Comp SHEAR STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	34	as above				
			20	2090	2155	
		Hard grey interbedded SANDSTONE & SILTSONE with B.C.M. bedding 30° Moderate fracturing				
	35					
		Hard grey fine SANDSTONE				
100		becoming coarser and harder with depth				
	36		28	4290	2155	
		Hard grey GRITSTONE with siltstone intrusions up to 2cm at 36.9 m	21	3300	2135	
	37	E.O.B.				
	38					

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 23

SHEET 1

SITE AUCKLAND - WHENUAPAI MOTORWAY R.D. 2 A
WATERVIEW INTERCHANGE

A.D.O. No _____ DATUM MSL SURFACE R.L. 28.6 m

TYPE OF SAMPLING CONTINUOUS CORE

PLANT USED DAECO SUPERVISED J Northcott DATE 31/3/76

CO-ORDINATES 700750.8 295142.1 WATER LEVEL 1.5m

R.L.	DEPTH m.	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa.	Bulk Density (kg/m³)
% Core Recov	0	Car park surfacing etc.			
80	1	Stiff light grey-brown mottled slightly SILTY CLAY becoming harder with depth	27	240	1910
	2	Stiff red, light grey and brown mottled slightly SILTY CLAY becoming hard, less red and more silty with depth	42	310	1790
50	3		30	340	1925
	4				
	5		47	160	-
80	6	Soft/firm light grey and brown with occasional red mottling CLAYEY SILT 15cm band of silty clay at 5.8 m			

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 23

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

% Core Recov	DEPTH m	DESCRIPTION OF SOIL	W %	Comp COMPRESS STRENGTH kPa	Bulk Density (kg/m³)
	6	As above, becoming soft, more silty and yellow with occasional red mottling with depth	40	-	1795
70	7				
		4 cm stiff red band at 7.6 m	43	180	1800
	8				
50		3 cm light purple band at 8.2 m			
	9				
20	10				
		becoming light yellow with 1mm bands of light grey at 2 - 5 mm spacing, weakly cemented SILT bedding 30°	38	200	1824
	11				
100		Light grey weakly cemented SILT & FINE SAND B.C.M. at 11.6m. bedding 30°			
	12				
		becoming more cemented with depth			
	13				

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

NZGD ID: BH_63529

OP09

RECORD OF BOREHOLE No. 23

SHEET 3

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

RL	DEPTH m	DESCRIPTION OF SOIL	M.C.%	Comp SHEAR STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	13	B. C. M. at 13.7 m				
	14	becoming light grey very soft fine SANDSTONE				
100	15	Medium light grey fine SANDSTONE B. C. M. at 15.8 m, bedding 45°	26	865	2045	
	16	Medium light grey fine SANDSTONE B. C. M. at 16.6 m – 16.8 m, bedding 60°				
	17	Hard light grey interbedded SANDSTONE & SILTSTONE (sandsone predominates)	26	845	2060	
		Occassional B. C. M. , bedding 30°	27	740	2095	
	18	White flecks at 18 3 m				
	19	Sandstone becoming coarse with depth Occassional red flecks from 19.2 m Considerable B. C. M. at 19.5m–19.7m bedding 30°	25	1555	2160	
	20	E. O. B.				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 24

SHEET 1

SITE WHENUAPAI - AUCKLAND MOTORWAY RD2A
WATERVIEW INTERCHANGE

A.D.O. No. _____ DATUM MSL SURFACE R.L. 28.9 m

TYPE OF SAMPLING CONTINUOUS CORE & OPEN BARREL

PLANT USED DAMCO SUPERVISED C J ROBINSON DATE 3.6.76

CO-ORDINATES 700725.6 295145.6 WATER LEVEL 2.2m

% core Recovery	R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	BULK DENSITY KG/M³
		0	TOPSOIL			
			Soft brown slightly plastic clayey SILT			
			Firm brown clayey SILT			
		1	Stiff grey and brown structured silty CLAY			
				45	390	1758
		2	Partially disturbed firm grey and pink plastic clay - becoming silty at 2.1m			
100		3	red and brown streaks between 3.4 and 4.4m			
		4				
			Very disturbed grey and slightly pink plastic sensitive CLAY	41	220	1776
		5	disturbed firm grey slightly pink plastic sensitive clay			
		6	Disturbed soft/firm plastic silts and CLAY			

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 24

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE & OPEN BARREL

% core Rec. / RL.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Density kg/m^{-3}
	6	Disturbed soft/firm plastic silts and clays	62	180	1543
80	7				
	8	Soft light grey and light yellow and pink banded friable clayey SILT			
85	9	- as above but yellow ochre in colour and containing bands of limonite	42	105	1760
	10	Contact between yellow and grey Soft grey Waitemata siltstone with occasional BCM layers (no determinable bedding)			
60	11				
	12	- slightly sandy layers starting to occur			
	13		33	175	1861

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 24

SHEET 3

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE & OPEN BARREL

% Core R.Q.D. Recovery	DEPTH m	DESCRIPTION OF SOIL	MC.%	COMPRESS SHEAR STRENGTH kPa	BULK DENSITY	m
	13					
		BCM showing sub horizontal bedding				
		Rock tightening up				
	14					
		--- becoming sandy				
	15					
100	16					
	17					
	18					
			33	113	1844	
	19					
		Soft grey horizontally bedded silty SANDSTONE				
	20					

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

NZGD ID: BH_63530

RECORD OF BOREHOLE No. 24

SHEET 4

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE & OPEN BARREL

% core Recovery	R.L.	DEPTH m	DESCRIPTION OF SOIL	M.C.%	COMPRESS SHEAR STRENGTH kPa	Density kg/m^{-3}	m
		20	Soft grey silty SANDSTONE				
				20.	988	2016	
		21	Medium/hard grey interbedded siltstone and mudstone				
100		22		23	1935	2042	
		23					
		24		20	1776	2103	
			EOB at 24.0m				

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

OP09

SHEET 1

RECORD OF BOREHOLE No. 25

SITE AUCKLAND - WHENUAPAI MOTORWAY R.D. 2A
WATERVIEW INTERCHANGE

A.D.O. No _____ DATUM MSL SURFACE R.L. 28.1 m

TYPE OF SAMPLING CONTINUOUS CORE

PLANT USED GELCO TRACTOR SUPERVISED I NORTHCOTT DATE 4/5/76

CO-ORDINATES 700705.9 295145.6 WATER LEVEL 2.0m

R.L.	DEPTH m.	DESCRIPTION OF SOIL	M.C. %	SHEAR STRENGTH kPa	Bulk Density (kg/m³)
% Core Recov	0	Turf and dark brown topsoil			
		Stiff brown SILTY CLAY with rootlets becoming hard with depth	26	510	1880
	1	Hard brown with orange mottling SILTY CLAY becoming more silty with depth			
		Stiff light grey with red mottling CLAY	44	270	1750
	2	Firm light grey and red mottled slightly SILTY CLAY becoming more silty with depth			
100	3	Stiff light grey slightly SILTY CLAY with occasional red and light brown mottling becoming more silty with depth			
	4		39	210	1825
	5	Firm/stiff light grey and red banded SILTY CLAY (bands 2-5mm) becoming more silty with depth			
	6	Firm/stiff light grey and light brown banded CLAYEY SILT (bands 2-5mm) becoming very silty with depth			

m: 0, 1, 2, 3, 4, 5, 6

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 25

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density (kg/m³)
% Core Recov	6	as above	41	170	1790
		Red pockets from 5.3m - 5.9m and 6.9m - 7.3m			
	7				
	8	becoming cemented light grey SILT with occasional light brown bands			
100	9	Weakly cemented light brown with occasional light grey bands SILT becoming darker with depth	9.2	120	1755
	10				
	11	Weakly cemented grey CLAYEY SILT			
		Cemented grey SILT			
	12	BCM at 11.4 m (bedding 30°) BCM at 11.9 m BCM at 12.2 m	40	170	1810
		BCM at 12.5 m BCM at 12.6 m BCM at 12.8 m			
	13	BCM at 13.0 m BCM at 13.1 m			

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 25

SHEET 3

SITE WAITAKERE VIEW INTERCHANGE

TYPE OF SAMPLING

RQD %	DEPTH m	DESCRIPTION OF SOIL	MC.%	Comp. SHEAR STRENGTH kPa	Bulk Density (kg/m³)	m
% Core Recov	13	as above, becoming more cemented with depth				
		Clay at 13,4 m	36	100	1850	
100		Clay at 13.9 m				
	14	BCM at 14m (bedding 30°)				
		Clay at 14.3 m				
		becoming soft grey				
		SILTSTONE				
	15	BCM at 15.1 m (bedding 30°)				
90		Soft grey interbedded fine SANDSTONE & SILTSTONE				
	16	sandstone becoming coarser with depth				
		sandstone predominates with depth				
	17	45° Zeolite infilled facture at 17.1 m	-	1050	2085	
100	18	BCM at 18.3m (bedding 30°)				
			27	490	2055	
	19					
		BCM at 19.7m (bedding 30°)				
	20	BCM at 20.1m " "	28	360	2030	

EOB 20.7m

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

OP09

SHEET 1

RECORD OF BOREHOLE No. 26

SITE AUCKLAND - WHENUAPAI MOTORWAY R. D. 2 A
WATERVIEW INTERCHANGE

A.D.O. No _____ DATUM M.S.L. SURFACE R.L. 28.4 m

TYPE OF SAMPLING CONTINUOUS CORE

PLANT USED LAMCO SUPERVISED J Northcott DATE 7/4/76

CO-ORDINATES 700753.1 295172.8 WATER LEVEL 1·0m

R.L.	DEPTH m.	DESCRIPTION OF SOIL	M.C. %	Comp. SHEAR STRENGTH kPa	Bulk Density (kg/m³)
% Core Recov	0	Car park surfacing etc			
100	1	Firm/stiff light grey-brown mottled slightly SILTY CLAY with rootlets, becoming more silty with depth	33	140	1880
			39	320	1810
50	2	Stiff red, light grey and occasional yellow mottled slightly SILTY CLAY			
	3		40	240	1695
80	4	Stiff light grey with occassional red. mottling structured slightly SILTY CLAY becoming redder with depth			
5.5	5				
		Firm orange slightly SILTY CLAY			
			41	160	1800
30	6				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 26

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

% core Rec. Recovery	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density kg/m³	m
	6	Firm orange slightly SILTY CLAY				6
30						
		Soft/firm dark grey-brown ORGANIC CLAY				
	7	as 3.4m-5.3m (SILTY CLAY)				7
		Firm/stiff light grey-brown ORGANIC CLAY with decomposed vegetation becoming stiff and dark with depth				
	8	Stiff brown ORGANIC SANDY CLAY with decomposed vegetation				8
100		Firm light grey CLAYEY FINE SAND with occasional decomposed vegetation				
	9	8cm light grey silty clay with occasional decomposed vegetation at 9.4m				9
		Weakly cemented light grey SILT AND FINE SAND less sand with depth				
	10	BCM at 10.1m bedding 45° " " 10.3m " " 4cm silty clay at 10.4m				10
90						
	11	BCM at 11.1m bedding 30°				11
		Light brown weakly cemented SILT with 1mm bands of dark brown and light grey at 3mm-5mm spacing (dark brown predominates)				
60	12					12
		Interbedded light grey and light brown cemented SILT				
	13	EOB				13

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

JOB NAME: CARRINGTON ROAD UNDERPASS
CARRINGTON HOSPITAL GROUNDS

BORE HOLE No.: 10 OP09

JOB No.: 1176 | D.I.P.S. No.: 1/83/2 | REPORT No.: 77/55

CO-ORDS: 700751·5N; 295116·0E | DATUM: M.S.L. | SURFACE R.L.: 28.5m

PLANT: GEMCO TRACTOR | DATE BORED: 1/11/77 | WATER DEPTH: m

LOGGED BY: C J ROBINSON | SAMPLING TECHNIQUE: CONTINUOUS CORE

SUPERVISED BY: " | JOB MANAGER:

DEPTH (m)	DESCRIPTION	w%		CORE REC.%
0	Soft dark brown topsoil			60%
				90%
1	Soft orange brown plastic slightly sandy clay – becoming firm with light grey mottling			
	Firm light brown and grey plastic silty clay – occasional decayed root fragments			
2				
	Firm orange, pink and cream mottled plastic clayey silt			70%
3	– becoming stiff with depth			60%
				80%
4	Soft disturbed cream grey plastic clayey silt			
	Soft disturbed pink and cream sensitive dilatant sandy silt.			70%
5				
				90%
6			Waitemata Group	
	Soft disturbed yellow brown plastic sensitive clayey silt, becoming sandier with depth		Erosion Surface	50%
7				

m: 0, 1, 2, 3, 4, 5, 6, 7

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

SIGNATORY:

SHEET 1 OF 3 SHEET(S)

JOB NAME: Carrington Road Underpass
Carrington Hospital Grounds

BOREHOLE No: OP09 101

JOB No: 1176 | D.I.P.S. No: 1/83/2

REPORT No: 77/55

DEPTH (m)	DESCRIPTION	ω %	qu kPa	CORE REC %
7	Soft disturbed yellow brown plastic sensitive dilatant sandy silt			50%
				60%
	- - - - becoming sandier with depth			
8				
	- - - - - grey horizon			100%
	Stiff brittle light brown silt - becoming sandier			
9				
				80%
10				
	Soft grey fine sandy siltstone with 30° bedding - becoming slightly stronger with depth			
11	- occasional B.C.M. layers and zones			30%
12		36	196	70%
13				45%
	- - - - -			
14	Very disturbed core			
	- - - - -			
15				

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:-

SHEET 2 OF 3 SHEETS

JOB NAME: CARRINGTON ROAD UNDERPASS
Carrington Hospital Grounds

BOREHOLE No: OP09

JOB No: 1176 | D.I.P.S. No: 1/83/2 | REPORT No: 77/55

DEPTH (m)	DESCRIPTION	w%	qu kPa	CORE REC %
15	Soft grey fine sandy siltstone with 30° bedding occasional B.C.M. layers and zones	31	300	
16	Medium grey interbedded sandstone andsiltstones - 30° bedding occasional B.C.M. layers and zones			
17	Hard grey sandstone with occasional siltstone layers - 30° bedding	24	997	
18				
19		25	2565	
20		23	1595	
	Core fractured below 20.4 m			
21				
22		23	2275	
	E.O.B. 22.2 m			
23				

m: 15, 1, 1, 1, 1, 2, 2, 2

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:-

SHEET 3 of 3 SHEETS

JOB NAME: Carrington Hospital Grounds

BORE HOLE No: OP09

JOB No: 1176 | D.I.P.S. No: 1/83/2 | REPORT No: 77/55

CO-ORDS: 700727·5N; 295119·5E | DATUM: M.S.L. | SURFACE R.L.: 28.1 m

PLANT: GEMCO TRACTOR | DATE BORED: 1/11/77 | WATER DEPTH: n

LOGGED BY: C J Robinson | SAMPLING TECHNIQUE: continuous core

SUPERVISED BY: " | JOB MANAGER: J Northcott

DEPTH (m)	DESCRIPTION	w%	CORE REC.%	m
0	Stiff dark brown topsoil		75%	
1	Firm orange brown plastic silty clay		60%	
2	Firm/stiff cream grey plastic silty clay becoming siltier			
3	Firm, cream grey, with occasional pink mottles, silt		50%	
4	Orange mottles becoming more pronounced and laminar		30%	
5			60%	
6	Grey horizon with B.C.M.			
7	Soft disturbed cream silt			

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

SIGNATORY:

SHEET 1 OF 3 SHEET(S)

Carrington Hospital Grounds

BOREHOLE No.: 102

OP09

JOB No.: 1176 | D.I.P.S. No.: 1/83/2 | REPORT No.: 77/55

DEPTH (m)	DESCRIPTION	ω %		CORE REC %
7	Soft disturbed cream and pink silt			20%
8			Waitemata Group	
	Soft disturbed yellow brown and cream clayey silt		Erosion surface	50%
9	- - becoming less disturbed			70%
10	disturbed grey fine silty sand			30%
11				
12				
13	Soft grey fine grained sandstone - moderately broken during drilling			90%
	- 30° bedding			
14	- occasional bands and zones of B.C.M.			
15				

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:-

SHEET 2 OF 3 SHEET

JOB NAME: CARRINGTON ROAD UNDERPASS — BOREHOLE No: OP09

JOB No: 1176 — D.I.P.S. No: 1/83/2 — REPORT No: 77/55

DEPTH (m)	DESCRIPTION	w %	qu kPa	CORE REC %
15	Soft grey fine grained sandstone - 30° bedding - occasional bands and zones of B.C.M.	25	588	75%
16				
17	fractured rock	27	438	70%
18	Medium grey fine grained sandstone - 30° bedding		1875	100
19	Hard grey interbedded sandstone with occasional siltstone layers - 30° bedding	21	1700	90%
20				
21		21	2675	
22		19	1800 +	
23	E.O.B. at 22.5 m			

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:-

SHEET 3 / 3 SHEETS

JOB NAME: CARRINGTON ROAD UNDERPASS
Carrington Hospital Grounds

BOREHOLE No.: OP09

JOB No.: 1176 | D.I.P.S. No.: 1/83/2 | REPORT No.: 77/55

CO-ORDS: 700703·0N; 295121·5E | DATUM: M.S.L. | SURFACE R.L.: 28.1 m

PLANT: GEMCO TRACTOR | DATE BORED: 1/11/77 | WATER DEPTH: m

LOGGED BY: C J Robinson | SAMPLING TECHNIQUE: CONTINUOUS CORE

SUPERVISED BY: " | JOB MANAGER: J Northcott

DEPTH (m)	DESCRIPTION	w%	CORE REC.%	m
0	Stiff dark brown topsoil		50%	0
1	Stiff orange and brown plastic clay		100%	1
2	Stiff light grey and pink plastic clay		75%	2
3	Stiff/hard cream and pink plastic clay – – – Becoming silty		100%	3
4	Stiff light orange and cream plastic clayey silt (contains a fine sand fraction) ---- colours becoming darker with depth, they are also sometimes mottled and sometimes laminar		90%	4
5			100%	5
6				6
7				7

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

SIGNATORY:

SHEET 1 OF 4 SHEET(S)

JOB NAME: Carrington Hospital Grounds

BOREHOLE No: OP09

JOB No: 1176 | D.I.P.S. No: 1/83/2

REPORT No: 77/5

DEPTH (m)	DESCRIPTION	ω %	CORE REC %
7	Stiff light orange and cream plastic clayey silt		100%
	Soft/firm light grey and orange sensitive silt		
8			
	Disturbed brown and grey brittle sensitive clayey silt - sub-horizontally laminated		
9			
10			
	Disturbed grey structured slightly cemented clayey silt - becoming a disturbed soft grey horizontally bedded siltstone with occasional layers of fine sand		
11			
12	Disturbed horizontally interbedded soft grey siltstone and fine sandstone - these may be weak enough to be considered as weakly cemented sands and silts		60%
			100%
13			
14			75%
	Weakly cemented fine light grey sandy silts		
15			

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:-

SHEET 1 OF 1 SHEET

JOB NAME: CARRINGTON ROAD UNDERPASS
Carrington Hospital Grounds

BOREHOLE No: BH 103 OP09

JOB Nº: 1176 | D.I.P.S. Nº: 1/83/2 | REPORT Nº: 77/55

DEPTH (m)	DESCRIPTION	w %	qu kPa	CORE REC %
15	Weakly cemented fine light grey sandy silts			
16			Waitemata Group	
	Weakly cemented fine grey silty sand		Erosion Surface	
17				
18				
19		31	238	
20				
	Weathered soft green and white gritstone – 30° bedding			
21				
	grey fine grey sandstone and siltstone – 30° bedding			
22		32	661	
23		28	944	

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:–

SHEET 3 of 4 SHEETS

JOB NAME: CARRINGTON ROAD UNDERPASS
Carrington Hospital Grounds

BOREHOLE No.: QP09

JOB No.: 1176 | D.I.P.S. No.: 1/83/2 | REPORT No.: 77/55

DEPTH (m)	DESCRIPTION	ω %	qu kPa	CORE REC.
23	Medium grey fine grained sandstone and siltstone – 30° bedding			
24				
		23	1340	
25				
26				
27				
		26	737	
	Medium grey coarse sandstone layer			
28				
29				
30				
	E.O.B. at 30.4 m			
31				

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

SIGNATORY:–

SHEET 4 of 4 SHEETS

BH1(1353)-78(0) OP09

JOB NAME: Waterview Interchange, Carrington Road
Underpass Contract, Foundation Investigation

BOREHOLE No.: 1

JOB No.: 1353 | FILE No.:- | REPORT No.: 78/68

CO-ORDS: 700695. 4N 295139.2E | DATUM: MSL | SURFACE R.L.: 28.0m

PLANT: Mayhew 100 | DATE BORED: 9 | 8 | 78 | WATER DEPTH: - m

LOGGED BY: J Northcott | SAMPLING TECHNIQUE: continuous core

SUPERVISED BY: J Northcott | JOB MANAGER: J Northcott

DEPTH (m)	DESCRIPTION	w%	ρs t/m³	qu kPa	Eu kPa	CORE REC.%	m
0							0
1							1
2	WASH BORED TO 15.8 M						2
3							3
4							4
5							15
5	Weakly cemented grey SAND	-	2.01	58	4.1×10^3	85	16
7							17

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

SIGNATORY:

SHEET 1 OF 3 SHEET(S)

JOB NAME: Carrington Road underpass

BOREHOLE No.: 1

JOB No.: 1353 | FILE No.: 1- | REPORT No.: 78/68

DEPTH (m)	DESCRIPTION	w%	ρs	qu	Eu	CORE REC %	m
17	as above becoming generally more cemented with depth					85 70	17
18	stiff grey CLAY						18
19	stiff grey CLAY sub horizontal BCM						19
20	sub-horizontal BCM	28.1	2.14	165	6.5×10^3		20
21						100	21
22	Very soft (weathered) interbedded GRITSTONE, SANDSTONE AND SILTSTONE bedding 25°, gritstone predominates (This material very easily disturbed by drilling)						22
23	Soft/medium grey SANDSTONE	26.7	2.15	580	1.1×10^2		23
24	becoming medium with depth Approx. 30° BCM						24
25							25

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY | SIGNATORY:- | SHEET 2 OF 3 SHEETS

JOB NAME: Carrington Road underpass | BOREHOLE No: 1

JOB No: 1353 | FILE No:- | REPORT No: 78/68

DEPTH (m)	DESCRIPTION	w%	ρ s	qu	Eu	CORE REC %
25	Approx. 30° BCM	-	2.13	305	7.6 x10⁴	
	as above					
26						
	Medium/hard interbedded SANDSTONE and SILTSTONE bedding approx 45° sandstone predominates	18.9	2.23	1530 (SST)	-	
28	bedding changing to approx 30°					
	soft grey SANDSTONE					
29	becoming medium grey SANDSTONE	23.9	2.39	380	8.7 x10⁴	100
	becoming soft/medium and coarser					
30	Approx 30° BCM					
	Approx 30° BCM					
31	Approx 30° BCM					
	Very soft					
	becoming softer					
	Very soft					
32	becoming soft	24.2	2.36	200	4.1 x10⁴	
	E.O.B.					
33						

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY | SIGNATORY:- | SHEET 3 of 3 SHEETS

BH2 (1353)-78(0) OP09

JOB NAME: Waterview interchange; Carrington Road nderpass Contract, foundation investigation

BOREHOLE No.: 2

JOB No.: 1353 | FILE No.: -

REPORT No.: 78/68

( )- ORDS: 700696.1N 295131.7E | DATUM: MSL | SURFACE R.L.: 28.2m

PLANT: Mayhew 100 | DATE BORED: 11/8/78 | WATER DEPTH: - m

LOGGED BY: J Northcott | SAMPLING TECHNIQUE: continuous core

SUPERVISED BY: J Northcott | JOB MANAGER: J Northcott

DEPTH (m)	DESCRIPTION	w%	ρs t/m³	qu kPa	Eu kPa	CORE REC.%	m
0							0
1							1
2	WASH BORED TO 15.2 M						2
3							3
4							4
15							15
16	Weakly cemented light grey SILT with occasional firm very clayey silt interbeds at approx 30°					85	16
17	Weakly cemented grey SILT					100	17

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY.

SIGNATORY:

SHEET 1 OF 4 SHEET(S)

JOB NAME: Carrington Road underpass

BOREHOLE No: 2

JOB No: 1353 | FILE No:- | REPORT No: 78/68

DEPTH (m)	DESCRIPTION	w%	ρs	qu	Eu	CORE REC %
17	as above	34.1	1.93	20	1.99 x10³	
	Very weathered GRITSTONE					
	Firm/stiff structured SILTY CLAY					
18	becoming coarser with depth					
19	10 cm BCM at approx 20° - 30°					
	Weakly cemented grey fine SAND becoming more cemented with depth	24.1	2.00	370	-	
20	Very soft (weathered) interbedded GRITSTONE, SANDSTONE and SILTSTONE bedding 25° gritstone predominates	67.5	1.72	-	-	
21	Partially weathered soft grey SILTSTONE					
	Medium grey SAND					
	Very soft interbedded grey SANDSTONE and SILTSTONE					
	weathered GRITSTONE bedding 25°					
22	Cemented grey SAND					
	Medium/hard interbedded grey SANDSTONE, SILTSTONE and GRITSTONE with occasional BCM at approx 30° sandstone predominates	25.7	2.02	1175 (SST)	1.9 x10⁵	
23	Weakly cemented grey SAND					
	Medium grey SILTSTONE approx 30° BCM					
	Soft grey SANDSTONE					
24	Medium/hard grey SANDSTONE with occasional BCM at approx 30°	24.6	-	2285	3.7 x10⁵	
	Medium/hard grey GRITSTONE					
	Soft grey SANDSTONE (badly disturbed core)					
25						

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY | SIGNATORY:- | SHEET 2 of 4 SHEETS

JOB NAME: Carrington Road underpass

BOREHOLE No: 2

JOB No: 1353 | FILE No:- | REPORT No: 78/68

DEPTH (m)	DESCRIPTION	w%	ρ_s	qu	Eu	CORE REC %
25						
	Cemented grey SAND					
	Medium/hard grey SILTSTONE					
26	Soft grey SANDSTONE with BCM becoming medium and fine with depth bedding 25°					
27	soft grey SANDSTONE	26.9	2.15	-	-	
	becoming medium with occasional BCM at approx 30°					
28						100
	becoming cemented grey SAND	25.2	2.15	63	-	
29	BCM at approx 30°					
30	becoming weakly cemented					
	becoming dense grey SAND					
31	becoming medium					
	weakly cemented grey SILT becoming fine SAND					
	becoming weakly cemented grey SAND					
32		26.2	2.20	64	2.2 x10³	
33						

MINISTRY OF WORKS AND DEVELOPMENT SOIL AND ENGINEERING LABORATORY | SIGNATORY:- | SHEET 3 of 4 SHEETS

JOB NAME: Carrington Road underpass | BOREHOLE No.: 2

JOB No.: 1353 | FILE No.:- | REPORT No.: 78/68

DEPTH (m)	DESCRIPTION	w%	ρ_s	qu	Eu	CORE REC %	m
33	BCM						33
	as above						
	becoming cemented with depth						
34	4 cm medium grey siltstone						34
	BCM at 30°						
35	1 cm soft grey siltstone with BCM at approx 30°					100	35
36	BCM at approx 30°						36
	Considerable BCM at approx 30°						
37							37
	Interbedded cemented grey SAND and soft grey SILTSTONE						
38	Sand becoming well cemented and siltstone becoming medium with depth						38
	bedding approx 30°, sand predominates						
	E.O.B.						
39							39

MINISTRY OF WORKS AND DEVELOPMENT SOILS AND ENGINEERING LABORATORY | SIGNATORY:- | SHEET 4 OF 4 SHEETS

BH3 (1353)-78(0) OP09

JOB NAME: Waterview Interchange, Carrington Road
Underpass contract, foundation investigation

BOREHOLE №: 3

JOB №: 1353 | FILE №:-

REPORT №: 78/68

CO-ORDS: 700704.8N 295139.9E | DATUM: MSL | SURFACE R.L.: 28.1 m

PLANT: DAMCO | DATE BORED: 12 | 9 | 78 | WATER DEPTH: — m

LOGGED BY: J.Northcott/G.Fowler | SAMPLING TECHNIQUE: Continuous core, SPT

SUPERVISED BY: J.Northcott | JOB MANAGER: J.Northcott

DEPTH (m)	DESCRIPTION	w%	ρ s t/m³	qu kPa	N blows	CORE REC.%	m
0							0
1	HAND BORED TO 15.2 M						1
2							2
3							3
4							4
5							5
	Medium grey interbedded SANDSTONE and SILTSTONE				43		
6	(sandstone predominates) occasional BCK bedding approx 20°	29.2	2.08	1198		100	6
	45° limonite stained fracture at 16.2 m	28.7	–	534			
		29.3	2.06	488	37		
7							7

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

CHECKED

SHEET 1 OF 3 SHEET(S)

JOB NAME: Carrington Road Underpass | BOREHOLE No: 3

JOB No: 1353 | FILE No:- | REPORT No: 78/68

DEPTH (m)	DESCRIPTION	w%	ρ s	qu	N	CORE REC %	m
17	becoming soft grey SANDSTONE with occasional medium grey siltstone interbeds bedding approx 30°	30.4	1.90	194			17
18	Weakly cemented grey SAND	30.1	2.01	60			18
					40		
19	strength increasing bedding approx 40°	-	1.95	267		100	19
	ECE from 19.7 m. increasing with depth						
20	bedding approx 45°	30.4	1.91	517	25		20
21	Core loss probably occurred here probably SAND						21
						45	
22	medium grey slightly clayey SAND						22
	Soft grey SANDSTONE	33.7	1.89	34			
		32.0	-	167			
					25	100	
23	Cemented grey SAND						23
						50	
24	becoming more cemented with depth	26.6	2.13	45			24
					51		
						100	
25						80	25

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY | CHECKED Mark | SHEET 2 OF 3 SHEETS

OP09

JOB NAME: Carrington Road Underpass

BOREHOLE No.: 3

JOB No.: 1353 | FILE No.:- | REPORT No.: 78/68

DEPTH (m)	DESCRIPTION	w%	ρs	qu	N	CORE REC %	m
25	as above						25
	8 cm BCM bedding approx 40°					80	
26							26
	Medium grey interbedded SANDSTONE GRITSTONE and SILTSTONE with occasional BCM bedding approx 30°				64	100	
27		21.0	1.69	1302			27
						80	
28	bedding becoming approx 40°	25.5	2.01	1630			28
					65+		
29	soft grey SANDSTONE	25.6	2.05	111			29
	hard grey GRITSTONE with occasional medium grey sandstone interbeds, bedding approx 30°	29.6	2.05	3731			
30							30
						100	
	Cemented grey SAND (very soft sandstone)						
31		24.4	2.09	9			31
	Medium grey SANDSTONE with BCM bedding approx 30°						
32	Cemented grey SAND						32
	E.O.B.						
33							33

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY | CHECKED Mask | SHEET 3 OF 3 SHEETS

OP09

JOB NAME: Auckland - Whenuapai Motorway RD.2A, Waterview Interchange

BOREHOLE No.: 111

JC No.: 1302 | D.I.P.S. No.:

REPORT No.: 1

CO-ORDS: 295212.0E 700740.8N | DATUM: MSL

SURFACE R.L.: 27.8 m

PLANT: DAMCO | DATE BORED: 30/5/78

WATER DEPTH: m

LOGGED BY: J Northcott | SAMPLING TECHNIQUE: continuous core

SUPERVISED BY: J Northcott | JOB MANAGER: G R W East

DEPTH (m)	DESCRIPTION	w%	qu (kPa)	bulk density (t/m^3)	CORE REC.%	m
0	Lost core, Car park surfacing and fill				0	0
1	Firm light grey and brown mottled slightly SILTY CLAY with rootlets becoming stiff	30.4	150	1.86		1
	Hard light grey with occasional red mottling structured very SILTY CLAY	34.1	400	1.86	100	
2	with occasional decomposed vegetation	33.6	420	1.88		2
	also light brown mottling from 2.7m	38.9	300	1.88		
3	becoming stiff				30	3
	becoming firm					
4		33.4	100	1.77	100	4
					90	
		42.2	80	1.74	100	
5	becoming soft				50	5
6	Soft light grey with red mottling coarse SILT	50.0	50	1.66	100	6
					60	
7						7

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

CHECKED

SHEET 1 OF 2 SHEET(S)

JOB NAME: Waterview Interchange

BOREHOLE No: OP09

JOB No: 1302

D.I.P.S. No:

REPORT No:

DEPTH (m)	DESCRIPTION	ω %	qu (kPa)	bulk density (t/m³)	CORE REC %
7	as above, becoming pink				60
8	as above becoming interbedded pink light grey and light brown				80
9		44.3	75	1.75	
10					100
11	Firm grey coarse SILT with [illegible] becoming cemented (soft siltstone)				85
12	cementing increasing with depth				
13					80
	E.o.b.				
14					
15					

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

CHECKED

SHEET 2 OF 2 SHEETS

OP09

JOB NAME: Auckland - Whenuapai Motorway R.D.2A. Waterview interchange - stability of cut batters		BORE HOLE Nº: SB6
JOB Nº: 1302	D.I.P.S. Nº:	REPORT Nº: 1
CO-ORDS: 295210.4E, 700768.2N	DATUM: MSL	SURFACE R.L.: 27.8 m
PLANT: Gemco H 22	DATE BORED: 6 | 6 | 78	WATER DEPTH: m
LOGGED BY: J.Northcott	SAMPLING TECHNIQUE: continuous core 4" brass tubes	
SUPERVISED BY: J Northcott	JOB MANAGER: G R W East	

DEPTH (m)	DESCRIPTION	w%	CORE REC.%	m
0	Lost core		0	0
	Firm brown with dark grey mottling SILTY CLAY			
1	becoming stiff light grey with occasional light brown and red mottling SILTY CLAY		55	1
2	SAMPLE TUBE			2
	as above becoming less silty. hard and with less red mottling		90	
3				3
	SAMPLE TUBE			
4	Firm light brown very SILTY CLAY with considerable 3 mm siltstone fragments			4
5			50	5
6	SAMPLE TUBE			6
	Soft light grey and brown banded slightly CLAYEY SILT		50	
7				7

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY. CHECKED SHEET 1 OF 1 SHEET(S)

OP09

JOB NAME: Auckland - Whenuapai Motorway ... Waterview interchange - stability of cut batters

BOREHOLE Nº:

JOB Nº: 1302 D.I.P.S. Nº:

REPORT Nº:

DEPTH (m)	DESCRIPTION	ω %		CORE REC
7	as above, becoming soft, pink SILT with occasional light grey pockets			50
8	SAMPLE TUBE			
	E.O.B.			
9				
10				
11				
12				
13				
14				
15				

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY

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SHEET 2 OF 2 SHEETS

OP09

JOB NAME: Auckland Metropolitan Motorway ...
Waterview interchange - stability of cut batters

BOREHOLE Nº: 237

JOB Nº: | D.I.P.S. Nº: | REPORT Nº: 1

CO-ORDS: 295219.6E 700 716.9 N | DATUM: MSL | SURFACE R.L.: 27.3 m

PLANT: Gemco H 22 | DATE BORED: 7 / 6 / 7 | WATER DEPTH: - m

LOGGED BY: J Northcott | SAMPLING TECHNIQUE: continuous core 4" Brass tubes

SUPERVISED BY: J Northcott | JOB MANAGER: G R W East

DEPTH (m)	DESCRIPTION	w%		CORE REC.%	m
0	Dark brown TOPSOIL				0
	Very soft brown SILTY CLAY				
1	Stiff light grey with occasional light brown banding SILTY CLAY becoming hard with depth			75	1
2	SAMPLE TUBE				2
3	Firm light grey with occasional red and light brown banding SILTY CLAY			80	3
	SAMPLE TUBE				
4	as above red banding increasing with depth Occasional very silty pockets			80	4
5					5
6	SAMPLE TUBE				6
	E.O.B.				
7					7

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

CHECKED

SHEET 1 OF 1 SHEETS

OP09

JOB NAME: Auckland - Whenuapai Motorway R.D.2a, Waterview Interchange			BOREHOLE No.: 115
JOB No.: 1303	D.I.P.S. No.:		REPORT No.: 1
CO-ORDS: 295205.1E 700775.6N	DATUM: MSL		SURFACE R.L.: 27.9 m
PLANT: Gemco H-22	DATE BORED: 1 1		WATER DEPTH:
LOGGED BY: G B Lawrence	SAMPLING TECHNIQUE: continuous core		
SUPERVISED BY: J Northcott	JOB MANAGER: G R W East		

DEPTH (m)	DESCRIPTION	w%	q_u (kPa)	ρ (t/m³)	CORE REC.%
0	Firm/stiff orange mottled light grey very SILTY CLAY				
		31.8	160	1.40	
1					
		23.1	100	1.50	
	less orange very slighty sandy				
2					
	Stiff light grey very SILTY CLAY with red and orange staining	42.0	130	1.33	
3					
	Firm with pink and red staining SILTY CLAY becoming soft				
4					
		45.3	60	1.27	
5					
	Orange and pink staining SILTY CLAY				
	16 cm SILT layer alternating clay				
6	Pink staining only predominately SILT	44.0	70	1.32	
	Orange staining				
	Orange grey CLAYEY SILT				
7					

MINISTRY OF WORKS AND DEVELOPMENT
AUCKLAND ENGINEERING LABORATORY.

CHECKED

SHEET 1 OF 2 SHEETS

OP09

JOB NAME: Waterview Interchange

BOREHOLE Nº:

JOB Nº: 1303

D.I.P.S. Nº:

REPORT Nº:

DEPTH (m)	DESCRIPTION	w %	q_u	ρ	CORE REC
7					
	Firm grey slightly CLAYEY SILT	49.2	125	1.28	
8					
9		41.2	70	1.31	
10	B.C.M.				
	SILTY CLAY [illegible] orange staining				
11	Small light grey lense				
	E.O.B. 11.5 m.				
12					
13					
14					
15					

MINISTRY OF WORKS AND DEVELOPMENT AUCKLAND ENGINEERING LABORATORY

CHECKED

SHEET 2 SH

RECORD OF BOREHOLE No. B28

SHEET 1

SITE AUCKLAND - WHENUAPAI MOTORWAY RD2A
WATERVIEW INTERCHANGE

ADO No _____ DATUM MSL SURFACE R.L. 27.3 m

TYPE OF SAMPLING CONTINUOUS CORE & 1½" Ø TUBES

PLANT USED GEFCO T SUPERVISED C J ROBINSON DATE 11.6 '6

CO-ORDINATES 700716.9 295219.6 WATER LEVEL 0.0m

% CORE RECOVERY	DEPTH m	DESCRIPTION OF SOIL	MC %	Comp. STRENGTH K Pa	Bulk Density kg/m⁻³
25	0	Turf and topsoil			
45	1	Soft, becoming firm light grey, brown, orange and red mottled silty CLAY	31	220	1874
90	2	Disturbed stiff light grey, pink and red clayey silt			
80			36	300	1830
	3	Stiff light grey, pink and red plastic SILT			
			34	210	1847
	4				
90			44	210	1758
	5	soft/firm organic stained silty clay -becoming light grey			
60		soft/firm black peaty CLAY	75	100	1500
	6				

m: 0, 1, 2, 3, 4, 5, 6

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

OP09

RECORD OF BOREHOLE No. B28

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE & 1½" ∅ TUBES

% CORE RECOVERY	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	BULK DENSITY kg/m⁻³
	6	soft/firm black peaty CLAY			
60			58	95	1636
	7	Soft medium grey plastic CLAY - becoming stiff with depth - contains decayed vegetation			
75	8		34	-	1842
	9				
	10				
100					
	11		43	105	1760
	12				
	13	E.O.B. at 12.8m			

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

OP09

RECORD OF BOREHOLE No. 29

SHEET 1

SITE AUCKLAND-WHENUAPAI MOTORWAY RD2A
WATERVIEW INTERCHANGE

A.D.O. No. _____ DATUM MSL SURFACE R.L. 27.6 m

TYPE OF SAMPLING CONTINUOUS CORE

PLANT USED DAMCO SUPERVISED J NORTHCOTT DATE 8.4.76

CO-ORDINATES 700756.4 295210.9 WATER LEVEL 1.5m

% Core Recovery	R.L. / Depth m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	Bulk Density kg/m³
	0	Car park surfacing etc			
		Firm/stiff dark grey-brown slightly SILTY CLAY with rootlets			
	1	Stiff light grey and brown mottled slightly SILTY CLAY	27	130	1945
			33	275	1880
100		Stiff light grey with occasional red mottling CLAY			
	2		46	175	1660
		Stiff light grey with occasional red mottling CLAY with occasional decomposed vegetation			
	3	Becoming slightly silty with depth			
	4		36	210	1850
		Soft light grey with occasional red and yellow mottling SILTY CLAY			
30	5				
65	6				

MINISTRY OF WORKS AUCKLAND ENGINEERING LABORATORY

RECORD OF BOREHOLE No. 29

SHEET 2

SITE WATERVIEW INTERCHANGE

TYPE OF SAMPLING CONTINUOUS CORE

R.L.	DEPTH m	DESCRIPTION OF SOIL	W %	COMPRESS. STRENGTH kPa	BULK DENSITY (Kg/m³)
	6				
		Soft/firm light grey with occasional red mottling CLAYEY SILT			
	7	Soft light brown and pink mottled SILT			
60	8	Weakly cemented light grey with occasional red mottling SILT			
		Soft grey SILTSTONE with occasional BCM bedding 30° becoming slightly harder with depth	42	170	1790
40	9				
	10				
30			33	175	1990
	11				
		Medium grey SILTSTONE with occasional BCM			
	12				
20					
	13	EOB 13.4m			

MINISTRY OF WORKS. AUCKLAND ENGINEERING LABORATORY

Beca Carter Hollings & Ferner Ltd

BOREHOLE No: **MB 58**

MACHINE BOREHOLE LOG

SHEET 1 of 3

PROJECT: State Highway 20- Avondale Extension — JOB NUMBER: 2108810/331

SITE LOCATION: Avondale/ Waterview — CLIENT: Transit NZ

BOREHOLE LOCATION: Cnr Carrington Rd/ Gt North Rd- Above bridge abutment wall

COORDINATES: N 6,479,756.93 m, E 2,662,806.11 m — R L: 28.59 m, DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Topsoil			0 %	Service Location							28	1					Service location- No recovery.	
Tauranga Group Alluvium		26/11/2003	100 %	SPT					2 4 6 N=10		27	2		MH	M	St	Stiff, light grey/ yellow banded SILT, some clay; moist, highly plastic.	
			100 %	OB			100/48	143/66			26	3		MH	M	St	Trace pink/ red colourings. Stiff, white/ red banded SILT, some clay; moist, highly plastic, sub-horizontal, laminated, pink/ red banding, extremely closely spaced. Trace orange-brown iron oxide staining.	
			100 %	SPT			90/46	127/63	2 4 5 N=9	Box 1	25	4		MH	M	St	Stiff, light grey/ yellow brown SILT-CLAY; moist, highly plastic. Trace orange-brown iron oxide staining.	Backfill/ Bentonite
			100 %	OB			24/6	34/9			24	5		MH	M	St	Stiff, yellow-brown/ white SILT, some clay; moist, highly plastic, some dark red colourings. Minor clay, slightly plastic. Trace clay.	
			100 %	SPT			60/22	83/32	3 4 6 N=10		23	6		ML	M	St	Stiff, light grey SILT, trace to minor clay, trace to minor fine sand; moist, moderately plastic. Trace black disseminated organics. Trace fine sand.	
			100 %	OB			64/20	88/29		Box 2	22	7					Sub-horizontal, laminated to very thin silt-clay interbeds. Trace disseminated organics. Trace black flecks. Gently inclined, light orange-red silt interbed, trace disseminated organics.	
			100 %	SPT			86/30	121/42	2 4 5 N=9									
			100 %	OB			100/26	143/37									Trace black flecks.	

DATE STARTED: 20/11/03 — DRILLED BY: Pro-Drill (Auck) Ltd

DATE FINISHED: 20/11/03 — DRILL TYPE: Gemco HP7

LOGGED BY: W Gunn — DRILL METHOD: OB/ Wireline TT

PILCON VANE No: DR3969 — DRILL FLUID: Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BCHF_MB P:\21\2108810\GINT\SH20EXTN.GPJ BCHFMB2.GDT 17/12/03

NZGD ID: BH_65692

Beca Carter Hollings & Ferner Ltd

BOREHOLE No: **MB 58**

MACHINE BOREHOLE LOG

SHEET 2 of 3

PROJECT: State Highway 20- Avondale Extension — JOB NUMBER: 2108810/331

SITE LOCATION: Avondale/ Waterview — CLIENT: Transit NZ

BOREHOLE LOCATION: Cnr Carrington Rd/ Gt North Rd- Above bridge abutment wall

COORDINATES: N 6,479,756.93 m — R L: 28.59 m

E 2,662,806.11 m — DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Tauranga Group Alluvium			100 %	SPT			74/24	103/34	4 6 8 N=14		21	8		ML	M	MD	Medium dense, light grey SILT, trace fine sand; moist, non plastic.	
																	Trace light pinkish red colourings.	
Waitemata Group: Moderately Weathered			100 %	OB			90/26	127/37		Box 3	20	9		ML	M	VS	Very stiff, light yellow grey SILT, minor clay; moist, highly plastic.	
																	Some orange-brown colourings.	
			100 %	SPT			140+	199+	6 8 10 N=18								Trace orange-brown iron oxide staining/ concretionary banding, sub-horizontal, very thin.	
																	Trace disseminated carbonised organics.	
			100 %	OB			90/22	127/32			19	10					Some moderately thin, sub-horizontal, silt, trace clay, interbeds, closely spaced, trace fine sand.	
																	Minor steeply inclined, orange-brown, very thinly laminated iron oxide staining.	
			100 %	SPT			140+	199+	8 10 10 N=20		18			ML	M	MD	Medium dense, orange-brown, SILT, trace fine sand, trace very thinly laminated, orange/ white silt banding.	Backfill/ Bentonite
			100 %	OB			UTP	UTP				11		ML	M	MD	Medium dense, orange-brown SILT, trace clay; moist, non plastic, trace sub-horizontal, very thin dark brown iron oxide concretionary banding.	
			100 %	SPT			UTP	UTP	10 17 17 N=34	Box 4	17			ML	M	MD	Medium dense, light grey SILT, trace clay; moist, non plastic, trace very thinly laminated to laminated carbonised organic banding.	
			100 %	OB								12					100mm section of black carbonised organics.	
											16					D	Dense.	
Waitemata Group: Siltstone/ Sandstone			100 %	TT								13			M	EW	Extremely weak, light grey, slightly weathered, fine SANDSTONE, some thin to moderately thin SILTSTONE interbeds; moist. Defects: sub-horizontal to gently inclined, extremely closely to closely spaced, planar, smooth drilling breaks along bedding planes.	
			0 %	SPT					50 for 145mm N=50+	Box 5	15							
			100 %	TT							14	14					Minor dark grey/ black disseminated carbonised organics.	
			100 %															

DATE STARTED: 20/11/03 — DRILLED BY: Pro-Drill (Auck) Ltd

DATE FINISHED: 20/11/03 — DRILL TYPE: Gemco HP7

LOGGED BY: W Gunn — DRILL METHOD: OB/ Wireline TT

PILCON VANE No: DR3969 — DRILL FLUID: Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BCHF_MB_P:\2121088101\GINT\SH20EXTN.GPJ BCHFMB2.GDT 17/12/03

NZGD ID: BH_65692

Beca Carter Hollings & Ferner Ltd

BOREHOLE No: **MB 58**

MACHINE BOREHOLE LOG

SHEET 3 of 3

PROJECT:	State Highway 20- Avondale Extension	JOB NUMBER:	2108810/331
SITE LOCATION:	Avondale/ Waterview	CLIENT:	Transit NZ

BOREHOLE LOCATION: Cnr Carrington Rd/ Gt North Rd- Above bridge abutment wall

COORDINATES: N 6,479,756.93 m E 2,662,806.11 m

R L: 28.59 m

DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group: Siltstone/ Sandstone			100 %	TT	100 %													
			0 %	SPT					50 for 145mm N=50+	Box 5	13	15						
			100 %	TT	100 %						12	16					Joint: 42°, planar, smooth, trace orange-brown/ green discolouration.	
			0 %	SPT					50 for 145mm N=50+			17					Defects: sub-horizontal to gently inclined, planar, smooth drilling breaks along bedding planes.	
			100 %	TT	100 %						11	18					Trace sub-horizontal to gently inclined disseminated carbonised organic banding.	Backfill/ Bentonite
			0 %	SPT					50 for 13mm N=50+	Box 6	10						Extremely closely spaced drilling breaks.	
			100 %	TT	100 %							19					Trace light yellow/ grey brown discolourations.	
			0 %	SPT					50 for 100mm N=50+		9						Joint: 61°, planar, smooth, no infill/ discolouration.	
											20							
											8						End of Borehole 20.1m.	
												21						
											7							
												22						

DATE STARTED:	20/11/03	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	20/11/03	DRILL TYPE:	Gemco HP7
LOGGED BY:	W Gunn	DRILL METHOD:	OB/ Wireline TT
PILCON VANE No:	DR3969	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY: CM

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BCHF_MB P:\2121088101\GINT\SH20EXTN.GPJ BCHFMB2.GDT 17/12/03

NZGD ID: BH_65692

BE07

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **MBR04**

SHEET 1 of 4

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand

BOREHOLE LOCATION: Grass verge, adjacent 145 Carrington Rd

COORDINATES: N 6,478,653.19 m E 2,662,966.92 m

R L: 46.52 m

DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
No Recovery			0 %	Vacuum							46	1					No recovery - vacuum excavated to avoid services.	Bentonite
Tauranga Group?				SPT					3 3 4 N=7		45		× × × ×	MH	M	St	Stiff, mottled light grey brown SILT, minor clay; moist, moderately plastic.	
			80 %	TT			81/50	114/72				2	× × × ×					
											44		× × ×	ML	M	St	Stiff, mottled light grey brown SILT, minor sand, trace clay; moist, slightly plastic.	
			100 %	SPT			31/21	23/30	1 2 2 N=4			3		SW	M	F	Firm, mottled light grey brown SAND, minor silt, trace clay; moist, moderately plastic.	
			90 %	TT			38/21	53/30			43							
			100 %	SPT					1 2 2 N=4			4						
			85 %	TT			40/21	57/30			42							Sand
												5						Gravel
Waitemata Group Parnell Grit			0 %	SPT			35/21	49/30	1 0 2 N=2		41	6		SW	M	VL	Very loose, mottled light grey brown SAND, minor silt; moist, non plastic. [CW Parnell Grit]	Screen + Gravel
			100 %	TT			31/20	42/28										
			75 %	SPT			21/15	29/20	1 3 6 N=10		40	7		SW	M	MD	Medium dense, light brown SAND, minor silt; moist, non plastic.	
			100 %	TT			38/14	52/19			39							
			100 %	SPT			62/38	87/52	3 6 7 N=13		38	8						
			50 %	TT							37	9						

DATE STARTED:	17/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	19/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811\3814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **MBR04**

SHEET 2 of 4

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand
BOREHOLE LOCATION:	Grass verge, adjacent 145 Carrington Rd		
COORDINATES:	N 6,478,653.19 m E 2,662,966.92 m	R L: DATUM:	46.52 m MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group Parnell Grit			50 %	TT					3		36			SW	M	MD	Medium dense, light brown SAND, minor silt; moist, non plastic.	
			100 %	SPT			40/15	55/20	4 6 N=10			11		SW	M	MD	Medium dense, light grey speckled white, fine to coarse SAND; moist, non plastic. Moderately thinly bedded medium to coarse and fine to coarse layers. [HW Parnell Grit]	
			100 %	TT			30/16	41/22			35							
			100 %	SPT			34/16	47/22	3 6 7 N=13		12							
			100 %	TT			38/18	52/25			34							
			80 %	SPT			UTP UTP		50 for 110 mm N=50+		13						Some fine white angular gravel-sized clasts [Grit].	
			90 %	TT	95 %						33						Very dense, minor fine white angular gravel-sized clasts [MW Parnell Grit].	
			0 %	SPT			UTP		50 for 145 mm N=50+		14						Trace fine gravel-sized clasts.	
			100 %	TT	100 %						32							
			0 %	SPT			UTP		50 for 110 mm N=50+		15						Some fine white angular gravel-sized clasts for 100 mm.	
			50 %	TT	30 %						31							
			0 %	SPT			UTP		50 for 110 mm N=50+		16							
			100 %	TT	77 %						30							
			0 %	SPT			UTP		50 for 130 mm N=50+		17							
				TT							29							
											18							
											28						Grey, minor silt, trace clay; moist, slightly plastic.	
											19						Black thinly laminated carbonaceous laminae.	
											27							Screen + Gravel

DATE STARTED:	17/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	19/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3813814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

BE07

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **MBR04**

SHEET 3 of 4

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand
BOREHOLE LOCATION:	Grass verge, adjacent 145 Carrington Rd		
COORDINATES:	N 6,478,653.19 m E 2,662,966.92 m	R L: DATUM:	46.52 m MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group Parnell Grit			100 %	TT	100 %						26			SW	M	VD	Very dense, light grey speckled white, massive fine to coarse SAND, trace fine gravel; moist, non plastic. [MW Parnell Grit]	Screen + Gravel
			0 %	SPT			UTP		50 for 100 mm N=50+			21						
			100 %	TT	83 %						25							
			0 %	SPT			UTP		50 for 150 mm N=50+		24	22		SW	W	VD	Very dense, light grey SAND, trace medium to fine gravel; wet, non plastic. [MW Waitemata Group Sandstone]	Gravel
Waitemata Group			100 %	TT	54 %						23							Sand
			0 %	SPT			UTP		8 10 12 N=22		23			SP	M	MD	Medium dense, grey SAND; moist, non plastic. [HW fine uncemented Sandstone]	
			90 %	TT							24							
			0 %	SPT			UTP		2 8 10 N=18		22	25						
			85 %	TT							21							
			0 %	SPT			UTP		6 10 15 N=25		26			ML	M	MD	Medium dense, light grey SILT, trace clay; moist, slightly plastic. [MW Siltstone]	
			100 %	TT	45 %						20	27		SP	M	MD	Medium dense, light grey SAND; moist, non plastic. [MW Sandstone]	
			0 %	SPT			UTP		10 12 13 N=25		19							
			100 %	TT	65 %						18	28						
											17	29						
									8									

Bentonite

DATE STARTED:	17/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	19/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811381\4238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

BE07

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MACHINE BOREHOLE LOG

BOREHOLE No: **MBR04**

SHEET 4 of 4

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand
BOREHOLE LOCATION:	Grass verge, adjacent 145 Carrington Rd		
COORDINATES:	N 6,478,653.19 m E 2,662,966.92 m	R L: DATUM:	46.52 m MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group			0 %	SPT			UTP		14 18 N=32		16	31		SP	M	MD	Medium dense, light grey SAND; moist, non plastic. [MW Sandstone]	
			90 %	TT	60 %													
			0 %	SPT			UTP		12 16 22 N=38		15	32			D	EW	Extremely weak, SW light grey, SILTSTONE; moist. [SW Waitemata Group]	Bentonite
			85 %	TT	85 %						14				M	EW	Extremely weak, SW light grey SANDSTONE; moist.	
			0 %	SPT			UTP		50 for 110 mm N=50+		13	33			M	EW	Extremely weak, SW light grey SILTSTONE, trace black fine grains; moist.	
			100 %	TT	72 %										M	VW	Very weak, SW light grey SANDSTONE; moist.	Sand
			0 %	SPT			UTP		50 for 50 mm N=50+		12	34						Gravel
			100 %	TT	83 %										M	VW	Very weak, SW light green SANDSTONE/SILTSTONE; wet.	Screen + Gravel
			0 %	SPT			UTP		50 for 70 mm N=50+		11	35						
			100 %	TT	91 %						10	36					Pinkish grey.	
			0 %	SPT			UTP		50 for 150 mm N=50+		9	37						
			100 %	TT	97 %							38					Brownish grey.	
			0 %	SPT					50 for 120 mm N=50+		8	39					End of Borehole 39.05m.	
											7							

DATE STARTED:	17/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	19/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811381\4238\130TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

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BOREHOLE No: **MBR05**

MACHINE BOREHOLE LOG

SHEET 1 of 4

PROJECT: WRR Waterview Connection — JOB NUMBER: 3814238/130

SITE LOCATION: Waterview - Owairaka — CLIENT: Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, Opposite 116 Carrington Rd

COORDINATES: N 6,478,958.41 m, E 2,662,902.25 m — R L: 31.53 m, DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	WATER LEVEL	CORE RECOVERY	METHOD	RQD	CASING	IN-SITU TESTS: SV (kPa)	τ (kPa)	SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
No Recovery			0 %	Vacuum							31	1					No recovery - vacuum excavated to avoid services.	Bentonite & concrete
Tauranga Group			100 %	SPT					3 5 6 N=11		30	2		MH	M	St	Stiff, white mottled light brown/grey SILT, minor clay; moist, moderately plastic.	
			20 %	TT							29							
			90 %	SPT					3 5 6 N=11			3		MH	M	St	Stiff, banded light brown and grey SILT, minor clay; moist, moderately plastic.	
			100 %	TT			31/25	43/35			28	4		SW	M	L	Loose, banded light brown and grey SAND, minor silt, trace clay; moist, slightly plastic.	
			75 %	SPT					1 2 3 N=5		27							
			90 %	TT			30/26	42/36			26	5		SM	M	L	Loose, thinly laminated orange-brown and brown-grey silty SAND, minor clay; moist, moderately plastic.	
			100 %	SPT			32/20	45/28	2 2 2 N=4			6						
Waitemata Group			100 %	TT			58/45	83/35			25	7		SM	W	L	Loose, grey SAND, interbedded with silt, trace clay; dry, slight plastic when wetted. [CW Waitemata Group]. Sharp, gently inclined contact with Tauranga Group above.	
			90 %	SPT			71/60	100/86	2 3 3 N=6		24							
			90 %	TT			32/24	45/34			23	8		ML	M	F	Firm, light grey sandy SILT, trace clay; moist, slightly plastic. [Residual Soil]	
			90 %	SPT			42/28	60/39	2 2 3 N=5		22	9						
			100 %	TT			60/35	86/49										Backfill Gravel

DATE STARTED: 19/9/07 — DRILLED BY: Pro-Drill (Auck) Ltd

DATE FINISHED: 21/9/07 — DRILL TYPE: QM-200

LOGGED BY: HW — DRILL METHOD: OB/SPT/TT

PILCON VANE No: DR4833 — DRILL FLUID: Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3813814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **MBR05**

SHEET 2 of 4

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, Opposite 116 Carrington Rd

COORDINATES: N 6,478,958.41 m E 2,662,902.25 m

R L: 31.53 m

DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: ROD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group			100 %	TT										ML	M	St	Stiff, light grey sandy SILT, trace clay; moist, slightly plastic.	
			100 %	SPT			60/39	86/55	2 4 6 N=10		21						Minor clay; moderately plastic.	
			95 %	TT			98/52	127/75				11						
			100 %	SPT			41/30	58/41	2 5 7 N=12		20	12		SM	M	MD	Medium dense, grey silty SAND; moist, non plastic, thin black carbonaceous laminae. [CW Waitemata Group]	
			85 %	TT			70/50	99/72			19							
			100 %	SPT			82/61	116/88	2 6 7 N=13		13							
			95 %	TT			52/30	75/42			18							
			100 %	SPT			54/16	78/22	4 4 7 N=11		14							
			100 %	TT			61/38	88/53			17	15						
			100 %	SPT			65/38	92/53	3 3 6 N=9		15							
			100 %	TT			51/35	73/49			16							
			100 %	SPT			74/55	105/79	3 4 6 N=10		14	16		ML	M	F	Firm, dark grey SILT, trace clay; moist, slightly plastic.	
			100 %	TT			98/52	137/75			13	17		ML	M	St	Stiff, grey sandy SILT, thin black carbonaceous laminae; moist, slightly plastic.	
			75 %	SPT			50/25	72/35	3 5 8 N=13		12	18						Backfill Gravel
												19						

DATE STARTED:	19/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	21/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3813814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

Beca

BOREHOLE No: **MBR05**

MACHINE BOREHOLE LOG

PROJECT: WRR Waterview Connection — JOB NUMBER: 3814238/130

SITE LOCATION: Waterview - Owairaka — CLIENT: Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, Opposite 116 Carrington Rd

COORDINATES: N 6,478,958.41 m, E 2,662,902.25 m — R L: 31.53 m — DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group			50 %	TT							11	21		ML	M	St	Stiff, grey sandy SILT, thin black carbonaceous laminae; moist, slightly plastic. [CW Waitemata Group]	Backfill Gravel
			100 %	SPT			51/31	73/43	4 5 8 N=13		10							
			100 %	TT			50/32	72/45				22						
			90 %	SPT			48/25	69/38	5 8 10 N=18		9							
			100 %	TT			51/36	72/50			8	23						
			90 %	SPT			50/28	72/39	4 7 11 N=18			24						
			100 %	TT			61/32	87/45			7	25						
			100 %	SPT			82/39	116/55	8 12 13 N=25		6	26						
			100 %	TT							5			ML	M	MD	Medium dense, grey SILT, trace sand; moist, non plastic. [MW Waitemata Group]	
			100 %	SPT			UTP		8 9 11 N=20			27		SP	M	MD	Medium dense light grey SAND; moist, non plastic.	
			100 %	TT			38/15	53/21			4			ML	M	MD	Medium dense, light grey SILT; moist, non plastic.	
			100 %	SPT			UTP		13 15 21 N=36		3	28						
			100 %	TTTT			UTP		15		2	29						

DATE STARTED: 19/9/07 — DRILLED BY: Pro-Drill (Auck) Ltd

DATE FINISHED: 21/9/07 — DRILL TYPE: QM-200

LOGGED BY: HW — DRILL METHOD: OB/SPT/TT

PILCON VANE No: DR4833 — DRILL FLUID: Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811\38142381\30\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

Beca

BOREHOLE No: **MBR05**

MACHINE BOREHOLE LOG

PROJECT: WRR Waterview Connection — JOB NUMBER: 3814238/130

SITE LOCATION: Waterview - Owairaka — CLIENT: Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, Opposite 116 Carrington Rd

COORDINATES: N 6,478,958.41 m, E 2,662,902.25 m — R L: 31.53 m — DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group			100 %	SPT			UTP		20 21 N=41		1	31			D	VW	Very weak, SW light grey SILTSTONE/SANDSTONE; dry, moderately thickly interbedded.	Backfill Gravel
			95 %	TT	85 %													
			100 %	SPT			UTP		15 18 24 N=42		0							Bentonite
			100 %	TT	55 %							32					Thinly interbedded.	Sand
			0 %	SPT			UTP		50 for 120 mm N=50+		-1	33			M		Moist, moderately thick sandstone beds.	Gravel
			100 %	TT	65 %						-2	34						Screen + Gravel
			0 %	SPT			UTP		50 for 80 mm N=50+		-3	35						
			100 %	TT	100 %						-4							
			0 %	SPT					50 for 145 mm N=50+			36						
											-5						End of Borehole 36.145m.	
												37						
											-6							
												38						
											-7							
												39						
											-8							

DATE STARTED: 19/9/07 — DRILLED BY: Pro-Drill (Auck) Ltd

DATE FINISHED: 21/9/07 — DRILL TYPE: QM-200

LOGGED BY: HW — DRILL METHOD: OB/SPT/TT

PILCON VANE No: DR4833 — DRILL FLUID: Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3813814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

BE07

Beca

BOREHOLE No: **MBR10**

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, opposite 50 Carrington Rd

COORDINATES: N 6,479,503.86 m E 2,662,839.00 m

R L: 25.44 m

DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
No Recovery			0 %	Vacuum							25	1					No recovery - vacuum excavated to avoid services.	Bentonite & concrete
Tauranga Group			100 %	TT							24			MH	M	St	Stiff, mottled light grey and brown SILT, minor clay; moist, moderately plastic. Thinly laminated, rootlets.	
			100 %	SPT			UTP		3 5 5 N=10			2		MH	M	St	Stiff, mottled light grey and orangey brown fine sandy SILT, trace clay; moist, moderately plastic when wetted.	
			40 %	TT							23							
			100 %	SPT					2 2 3 N=5			3		SW	M	L	Loose, light reddish brown SAND, minor silt and clay; moist, moderately plastic.	
			100 %	TT			98/54 54/28	137/75 137/38			22							
Waitemata Group			100 %	SPT					1 2 4 N=6		21	4		SM	M	L	Loose, light grey SAND, trace silt; moist, non plastic. [HW - CW Waitemata Group]	
			100 %	TT			69/39 42/21	96/53 58/29			20	5					Black fibrous organics.	
			90 %	SPT					5 8 5 N=13			6					Black fibrous organics.	
			100 %	TT			60/25 52/21	85/34 72/29			19	7						
			100 %	SPT					5 7 9 N=16		18							
			100 %	TT			61/26 120/40	85/36 168/55			17	8		SM	M	MD	Medium dense, thin to moderately thickly bedded, dark grey SAND and SILT; moist, non plastic. [HW Waitemata Group]	
			85 %	SPT			UTP		10 15 18 N=33		16	9			M	EW	Extremely weak, SW dark grey uncemented to poorly SANDSTONE; moist, moderately thinly bedded. [SW Waitemata Group]	
			100 %	TT														Backfill Gravel

DATE STARTED:	24/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	24/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811\3814238\130\TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

BE07

Beca

BOREHOLE No: **MBR10**

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT:	WRR Waterview Connection	JOB NUMBER:	3814238/130
SITE LOCATION:	Waterview - Owairaka	CLIENT:	Transit New Zealand

BOREHOLE LOCATION: Grass verge adjacent to Unitech, opposite 50 Carrington Rd

COORDINATES: N 6,479,503.86 m E 2,662,839.00 m

R L: 25.44 m

DATUM: MSL

GEOLOGICAL UNIT	DRILLING: FLUID LOSS	DRILLING: WATER LEVEL	DRILLING: CORE RECOVERY	DRILLING: METHOD	DRILLING: RQD	DRILLING: CASING	IN-SITU TESTS: SV (kPa)	IN-SITU TESTS: τ (kPa)	IN-SITU TESTS: SPT 'N'	SAMPLES	R L (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL / ROCK DESCRIPTION	INSTRUMENTATION
Waitemata Group			100 %	TT							15				M	EW	Extremely weak, SW dark grey uncemented to poorly SANDSTONE; moist, moderately thinly bedded. [SW Waitemata Group]	Bentonite
			100 %	SPT			UTP		50 for 100 mm N=50+									
			75 %	TT							14	11						Sand
			0 %	SPT			UTP		50 for 140 mm N=50+		12				W	VW	Very weak, SW grey poorly cemented moderately thick SANDSTONE interbedded with moderately thin SILTSTONE.	Gravel
			60 %	TT							13	13						
			0 %	SPT			UTP		50 for 110 mm N=50+		11						Two steeply inclined defects.	Screen + Gravel
			90 %	TT							14							
			0 %	SPT					50 for 70 mm N=50+		10	15					End of Borehole 15.07m.	
											16							
											9							
											17							
											8							
											18							
											7							
											19							
											6							

DATE STARTED:	24/9/07	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	24/9/07	DRILL TYPE:	QM-200
LOGGED BY:	HW	DRILL METHOD:	OB/SPT/TT
PILCON VANE No:	DR4833	DRILL FLUID:	Water

COMMENTS: Shear strengths (SV) measured in end of core barrel.

REVIEWED BY:

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_MB P:\3811381423813013TGE- REGIONAL BORES\GINT\WRR WATERVIEW CONNECTION.GPJ BCHFMB2.GDT 9/12/07

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1189

SHEET 1 OF 5

Hole Location: Service Lane near Carrington Road, RW601

CO-ORDINATES	800947.99 mN 395203.43 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	4/6/13
		DATUM:	M.S.L	HOLE FINISHED:	7/6/13
DIRECTION:	0.00°	R.L. GROUND:	28.58 m	DRILLED BY:	McMillan Drilling Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.58 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW EW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (0 10 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX	RL (m)
FILL	ASPHALT Fine to coarse GRAVEL, with minor sand and silt; dark grey. Loose, moist; gravel, sub-angular, basalt; sand, coarse 0.25m: grades reddish brown, scoriaceous, highly vesicular 0.45m: grades fine to coarse GRAVEL, with some cobbles and minor sand							0.5									28.5
	Silty CLAY; orange brown mottled grey. Stiff, moist, moderate plasticity					HA								6/6/13 am			28.0
	1.1m: grades grey mottled orange brown. Firm to stiff, high plasticity							1.0									27.5
	1.6m: grades grey mottled pinkish red. Soft (drilling induced), moderate plasticity					PQ3		1.5				**Note:** 1.6-3m could not recover core sample after three attempts. Push tubes used to recover and sample disturbed					CORE BOX 1	27.0
	1.75-1.8m: Core loss																
	1.8-2.05m: Core loss					PUSH TUBE		2.0									26.5
	Silty CLAY; orange brown. Firm (drilling induced), moist, moderate plasticity 2.15m: grades grey mottled pinkish red. Stiff													7/6/13 am			
A	Clayey SILT, with trace sand and rootlets; grey mottled pinkish red. Stiff, moist, low to moderate plasticity; sand, fine					PUSH TUBE		2.5									26.0
	2.85m: grades firm																
	3.3m: grades clayey SILT, with some sand. Stiff					PQ3		3.0									25.5
	Silty CLAY, with trace sand; grey mottled pinkish red, speckled white. Stiff, moist, moderate plasticity; sand, medium to coarse, pumiceous 3.7-3.8m: grades soft, sample disturbed, drilling induced																
	3.8-3.9m: Core loss							3.5									25.0
	Silty CLAY, with trace sand; grey mottled pinkish red, speckled white. Stiff, moist, moderate plasticity; sand, medium to coarse, pumiceous 3.95: grades very soft, sample disturbed, drilling induced 4.35m: grades stiff					PQ3		4.0								CORE BOX 2	24.5
	4.6m: grades silty CLAY; grey mottled pinkish red and orange brown							4.5									24.0
						PQ3		5									

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 21/6/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1189

SHEET 2 OF 5

Hole Location: Service Lane near Carrington Road, RW601

CO-ORDINATES	800947.99 mN 395203.43 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	4/6/13
		DATUM:	M.S.L	HOLE FINISHED:	7/6/13
DIRECTION:	0.00°	R.L. GROUND:	28.58 m	DRILLED BY:	McMillan Drilling Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.58 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
A	Silty CLAY; grey mottled pinkish red and orange brown. Stiff, moist, moderate plasticity 5.4m: grades dark grey mottled orange brown and pinkish red					PQ3		5.5								23.5
A	Organic CLAY, with minor silt, minor organics; black mottled orange brown. Stiff, moist, moderate to high plasticity 5.6-6.6m: core sample expanded 400mm 5.75m: grades black, firm to stiff, high plasticity 6.1m: grades firm 6.2m: grades soft 6.3m: grades firm					PQ3		6.0								23.0 CORE BOX 3 22.5
A	Silty CLAY, with trace sand; light brown mottled dark grey, speckled white. Stiff, moist, moderate to high plasticity; sand, fine, pumiceous 6.6-7.6m: core sample expanded 400mm					PQ3		6.5 7.0								22.0 21.5 CORE BOX 4 21.0
ER	Organic CLAY, with minor silt, minor organics; black. Firm, moist, moderate to high plasticity							7.5								
ER	Silty CLAY, with trace organics; light grey streaked black. Stiff, moist, moderate to high plasticity; organics, rootlets and carbonaceous fragments 7.6-9m: core sample expanded 200mm															20.5
ER	Clayey SILT, with minor sand and trace organics; grey mottled light grey, streaked black. Firm to stiff, moist, low plasticity; sand, fine to medium; organics, carbonaceous fragments 8.7m: grades sandy SILT, with minor clay, trace organics. Firm to soft					PQ3		8.0 8.5								20.0
EW	Moderately weathered, grey silty fine SANDSTONE. Extremely weak, moderately thickly bedded, with moderately thin interbeds of extremely weak, grey SILTSTONE; moderately inclined bedding; silty sand, medium dense, moist; silt, stiff to very stiff, moist, low plasticity 9-10.1m: core sample expanded 250mm 9.45m: grades grey streaked black, with carbonaceous laminations throughout 9.6m: sandstone grades loose to medium dense, moderately thinly bedded					PQ3		9.0 9.5 10								19.5 CORE BOX 5 19.0

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 21/6/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1189

SHEET 3 OF 5

Hole Location: Service Lane near Carrington Road, RW601

CO-ORDINATES	800947.99 mN 395203.43 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	4/6/13
		DATUM:	M.S.L	HOLE FINISHED:	7/6/13
DIRECTION:	0.00°	R.L. GROUND:	28.58 m	DRILLED BY:	McMillan Drilling Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.58 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%)	CORE BOX	RL (m)
EW	Moderately weathered, grey streaked black silty fine SANDSTONE. Extremely weak, moderately thinly bedded, with moderately thin interbeds of extremely weak, grey SILTSTONE and black carbonaceous laminations throughout; moderately inclined bedding; silty sand, loose to medium dense, moist; silt, stiff to very stiff, moist, low plasticity 10.1-10.5m: core sample expanded 200mm 10.5m: sandstone grades grey, loose, thickly bedded			2 2 3 N=5		PQ3 PQ3 SPT		10.5									18.5
	11.55m: siltstone grades sandy SILTSTONE, firm to stiff, moderately thickly bedded					PQ3		11.0 11.5				10.95-12m: core recovered in continuous stick		100		CORE BOX 6	18.0 17.5 17.0
	12m: sandstone and siltstone grade thinly bedded 12.15m: sandstone and siltstone grade moderately thickly bedded			2 3 4 N=7		SPT		12.0									16.5
	12.45m: siltstone grades grey mottled dark grey, stiff 12.7m: grades grey 12.85m: sandstone grades medium dense					PQ3		12.5 13.0				12.45-13.5m: core recovered in continuous stick		100			16.0 15.5
				3 6 10 N=16		SPT		13.5 14.0				13.95-15m: core recovered in continuous stick		100		CORE BOX 7	15.0 14.5
	14.35m: sandstone grades dense, thinly bedded; siltstone, very stiff, non-plastic, very thinly bedded 14.55m: sandstone grades medium dense, thickly bedded					PQ3		14.5 15									14.0

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 21/6/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1189

SHEET 4 OF 5

Hole Location: Service Lane near Carrington Road, RW601

CO-ORDINATES	800947.99 mN 395203.43 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	4/6/13
		DATUM:	M.S.L	HOLE FINISHED:	7/6/13
DIRECTION:	0.00°	R.L. GROUND:	28.58 m	DRILLED BY:	McMillan Drilling Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.58 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
EW	Moderately weathered, grey silty fine SANDSTONE. Extremely weak, thickly bedded, with very thin interbeds of extremely weak SILTSTONE and black carbonaceous laminations throughout; moderately inclined bedding; silty sand, dense, moist; silt, very stiff, moist, non-plastic			6 15 25 N=40		SPT (SC)		15.5				15.45-16.5m: core recovered in continuous stick				13.5 13.0 CORE BOX 8
	15.45m: sandstone grades very dense, thinly bedded; siltstone, very weak, thinly to very thinly bedded 15.65-15.7m: medium dense sandstone band					PQ3		16.0						100		12.5
	15.74-15.75m: medium dense sandstone band 15.75m: sandstone grades moderately thinly bedded 15.82m: sandstone grades very weak, thinly bedded 15.95m: grades steeply inclined bedding															
	Slightly weathered, bluish grey speckled and streaked black, silty fine to medium SANDSTONE, with high carbonaceous content. Extremely weak to very weak			25 50 for 100mm N>50		SPT (SC)		16.5								12.0
EU2	Unweathered, bluish grey silty fine SANDSTONE. Very weak, moderately thinly bedded, with moderately thin to very thin interbeds of very weak, bluish grey SILTSTONE and black carbonaceous laminations throughout; moderately inclined bedding					PQ3		17.0								11.5
	16.55m: sandstone grades moderately thickly bedded 16.75m: sandstone grades extremely weak to very weak 17.07m: sandstone grades thickly bedded							17.5						100		11.0
	17.85m: sandstone grades silty fine to medium SANDSTONE							18.0				18.2m: DD,0°				10.5
	18.42m: sandstone and siltstone grade very thinly to thinly bedded 18.42-18.64m: very closely spaced carbonaceous laminations 18.65m: sandstone grades silty fine SANDSTONE, moderately thickly bedded					PQ3		18.5				18.4-18.45m: B,20°,PL,SM,VN,CN		100		10.0
	18.94m: sandstone grades thinly bedded							19.0				19.05m: DD,0°				9.5
	19.11m: sandstone grades moderately thickly bedded											19.23m: DD,10°				CORE BOX 9
	19.35m: sandstone grades thinly bedded							19.5								9.0
	END OF BOREHOLE AT 19.5 m BELOW GROUND LEVEL (Target depth reached) **Slotted Screen Nested Piezometers installed 5.6-6.6m & 8.5-9.5m b.g.l**							20								

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 21/6/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1189

SHEET 5 OF 5

Hole Location: Service Lane near Carrington Road, RW601

CO-ORDINATES	800947.99 mN 395203.43 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	4/6/13
		DATUM:	M.S.L	HOLE FINISHED:	7/6/13
DIRECTION:	0.00°	R.L. GROUND:	28.58 m	DRILLED BY:	McMillan Drilling Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.58 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT | ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...); | ROCK WEATHERING (UW SW MW HW) | ROCK STRENGTH (R4 R3 R2 R1 R0) | SPT N VALUE SHEAR VANE (corrected) kPa | CORE LOSS / LIFT (%) (3 10 30 100) | METHOD, CORE & CASING | TEST SYMBOL | DEPTH (m) | GRAPHIC LOG | DEFECT LOG | FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1) | SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS; DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING; ANGLES ARE NORMAL TO CORE AXIS | DATE / DEPTH | RQD (%) | WATER | DRILL WATER LOSS (%) (25 50 75) | CORE BOX RL (m)

Key:
SC - Solid Cone Standard Penetration Test (SPT)
A - Tauranga Group Alluvium
ECBF - East Coast Bays Formation Sandstone and Siltstone
ER - Residual Soil (ECBF)
EW - Moderately to Highly Weathered ECBF
EU2 - Cemented ECBF

20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5

8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 21/6/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1191

SHEET 1 OF 5

Hole Location: RW601, Carrington Road

CO-ORDINATES	800944.02 mN 395176.76 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	29/1/13
		DATUM:	M.S.L	HOLE FINISHED:	31/1/13
DIRECTION:	0.00°	R.L. GROUND:	25.50 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	25.50 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	DESCRIPTION OF CORE	RL (m)
FILL	Gravelly SILT; brown mottled grey. Stiff, dry, non-plastic; gravel, fine to coarse, angular to sub-angular, slightly weathered, strong, basalt	25.5
A	Clayey SILT, with trace rootlets and sand; grey mottled orange brown. Stiff, moist, low plasticity; sand, fine	25.0
	Silty CLAY, with minor sand; light grey streaked red and orange brown. Very stiff, moist, moderate plasticity	24.5
	2-2.55m: Core loss	24.0
	Silty CLAY, with minor sand; light grey streaked red and orange brown. Very stiff, moist, moderate plasticity	23.5
	3m: grades red streaked and mottled grey	23.0
	3.3-3.45m: Core loss	22.5
	Silty CLAY, with minor sand; grey mottled orange brown and red. Firm, moist, moderate plasticity	22.0
	3.78m: grades orange brown streaked pink	
	3.95m: grades soft	21.5
	4.55m: grades greyish brown mottled red to pink. Soft to firm	21.0
		20.5

ROCK WEATHERING: UW SW MW HW | ROCK STRENGTH: R4 R3 R2 R1 R0 | SPT N VALUE / SHEAR VANE (corrected) kPa | CORE LOSS / LIFT (%): 3 10 30 100 | METHOD, CORE & CASING | TEST SYMBOL | DEPTH (m) | GRAPHIC LOG | DEFECT LOG | FRACTURE LOG spacing of natural fractures (cm): 50 10 5 1

SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS

DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING

ANGLES ARE NORMAL TO CORE AXIS

DATE / DEPTH | RQD (%) | WATER | DRILL WATER LOSS (%): 25 50 75 | CORE BOX

METHOD, CORE & CASING: HA; PQ3; PQ3

TEST SYMBOL: SV 161/69 kPa; SPT 1 3 2 N=5; SV 46/20 kPa; SPT 0 2 3 N=5

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5

CORE BOX: CORE BOX 1; CORE BOX 2

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1191

SHEET 2 OF 5

Hole Location: RW601, Carrington Road

CO-ORDINATES	800944.02 mN 395176.76 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	29/1/13
		DATUM:	M.S.L	HOLE FINISHED:	31/1/13
DIRECTION:	0.00°	R.L. GROUND:	25.50 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	25.50 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE

ROCK DEFECTS

GEOLOGICAL UNIT

ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);

ROCK WEATHERING (UW SW MW HW)

ROCK STRENGTH (R4 R3 R2 R1 R0)

SPT N VALUE SHEAR VANE (corrected) kPa

CORE LOSS / LIFT (%) (3 10 100)

METHOD, CORE & CASING

TEST SYMBOL

DEPTH (m)

GRAPHIC LOG

DEFECT LOG

FRACTURE LOG spacing of natural fractures (cm) (60 10 6 1)

SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS

DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING

ANGLES ARE NORMAL TO CORE AXIS

DATE / DEPTH

RQD (%)

WATER

DRILL WATER LOSS (%) (25 50 75)

CORE BOX RL (m)

A

4.95-5m: Core loss

Silty CLAY, with minor sand; greyish brown mottled red to pink. Soft to firm, moist, moderate plasticity

Clayey SILT, with trace sand; orange brown mottled grey. Soft, moist, low plasticity; sand, fine

5.4-5.9m: Core loss

ER

Clayey SILT, with trace sand; orange brown mottled grey. Soft, moist, low plasticity; sand, fine

SV 62/27 kPa

PQ3

5.5

6.0

SPT

0 3 3 N=6

6.2m: grades clayey SILT, with minor sand; orange brown mottled grey, streaked red. Soft to firm

6.45m: grades orange brown streaked red. Soft

6.6m: grades grey streaked red and orange brown. Soft to firm

6.75m: grades clayey SILT, with some sand; orange brown streaked grey

6.95m: grades soft

SV 36/14 kPa

PQ3

6.5

7.0

7.5m: grades sandy SILT, with some clay; grey mottled red and orange brown

7.65m: grades clayey SILT, with minor sand

SPT

0 2 3 N=5

7.5

8.0

Sandy CLAY, with minor silt; grey mottled red and orange brown. Soft to firm, moist, low plasticity

8.05m: grades silty CLAY, with minor sand

8.4m: grades sandy CLAY, with minor silt

8.55m: grades silty CLAY, with minor sand

PQ3

8.5

Silty fine to medium SAND, with minor clay; grey mottled orange brown. Loose, moist

8.68m: grades grey mottled red to pink

9.2m: grades grey mottled orange brown

SPT

1 3 3 N=6

9.0

9.5

9.45-9.9m: Core loss

PQ3

10

31/1/13 am

CORE BOX 3

20.5 20.0 19.5 19.0 18.5 18.0 17.5 17.0 16.5 16.0 15.5

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1191

SHEET 3 OF 5

Hole Location: RW601, Carrington Road

CO-ORDINATES	800944.02 mN 395176.76 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	29/1/13
		DATUM:	M.S.L	HOLE FINISHED:	31/1/13
DIRECTION:	0.00°	R.L. GROUND:	25.50 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	25.50 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
ER	Silty fine to medium SAND, with minor clay; grey mottled orange brown. Loose, moist					PQ3										BOX 15.5
	Sandy SILT, with minor clay; grey mottled orange brown. Firm, moist, low plasticity															
	Highly to moderately weathered, bluish grey silty fine SANDSTONE. Extremely weak; sandy silt, firm, moist															15.0
	Highly weathered, grey mottled orange brown silty fine SANDSTONE. Extremely weak; silty sand, loose, moist			2 4 4 N=8		SPT		10.5								
	10.95-11.05m: Core loss							11.0								14.5
EW	Highly weathered, grey mottled orange brown silty fine SANDSTONE. Extremely weak, moderate thinly to moderate thickly bedded, with very thin to thin interbeds of extremely weak, grey SILTSTONE; silt, firm to stiff, moist; silty sand, loose, moist 11.48m: very thin siltstone bed					PQ3		11.5								14.0
	11.6m: thin siltstone bed															
	Moderately weathered, bluish grey silty fine SANDSTONE. Extremely weak, thinly to thickly bedded, with moderately thick to moderately thin interbeds of extremely weak, bluish grey SILTSTONE; silt, very stiff, moist; silty sand, medium dense, moist			4 4 6 N=10		SPT		12.0								13.5 CORE BOX 5
	12.5m: moderately thin siltstone bed (120mm thick)							12.5								13.0
	12.85-12.95m: high carbonaceous content					PQ3						12.85-12.95m: B,30°				12.5
	13.05m: moderately thick siltstone bed (260mm thick)							13.0								
	13.5-13.95m: disturbed sample due to SPT			3 8 10 N=18		SPT (SC)		13.5				13.5-15m: core recovered in continuous stick				12.0
	14.25m: very thin siltstone bed							14.0								11.5
	14.3m: very thin siltstone bed											14.35-15m: B,30-40°				
EU2	Unweathered, bluish grey silty fine to medium SANDSTONE. Very weak, very thinly to thinly bedded, with very thin to thin interbeds of very weak, bluish grey SILTSTONE and black carbonaceous laminations; steeply inclining bedding 14.75m: grades moderately thinly to very thinly bedded sandstone					PQ3		14.5						100		11.0 CORE BOX 6
								15								10.5

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1191

SHEET 4 OF 5

Hole Location: RW601, Carrington Road

CO-ORDINATES	800944.02 mN 395176.76 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	29/1/13
		DATUM:	M.S.L	HOLE FINISHED:	31/1/13
DIRECTION:	0.00°	R.L. GROUND:	25.50 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	25.50 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%)	CORE BOX RL (m)
EU2	Unweathered, bluish grey silty fine to medium SANDSTONE. Very weak, moderately thinly to very thinly bedded, with very thin to thin interbeds of very weak, bluish grey SILTSTONE and black carbonaceous laminations; steeply inclined bedding 15.45-15.53m: high carbonaceous content			18 50 for 100mm N>50		SPT (SC)		15.5				15.25-16.5m: core recovered in continuous stick 15.25-15.75m: B,30-40°				10.5
	Unweathered, bluish grey silty fine to medium SANDSTONE. Very weak					PQ3		16.0						100		10.0
	16.23m: thin extremely weak band (30mm)															9.5
	Unweathered, bluish grey silty fine to medium SANDSTONE. Very weak, moderately thinly bedded, with moderately thin interbeds of very weak, bluish grey SILTSTONE; moderately inclined bedding 16.8m: grades thickly bedded SANDSTONE, thinly bedded SILTSTONE 16.94-16.98m: high carbonaceous content							16.5								9.0
	17.13m: grades silty fine to medium SANDSTONE, with trace coarse sand. Very weak to weak 17.27m: grades bluish grey speckled white, red and light green silty fine to coarse SANDSTONE 17.5m: grades silty fine to coarse SANDSTONE, with trace fine gravel; sub-angular to sub-rounded 17.6m: thin siltstone bed (40mm) 17.65m: grades silty fine SANDSTONE					PQ3		17.0				16.94-16.98m: B,30° (carbonaceous laminations) 17.12m: J,0°,UN,SM,N,CN 17.2m: J,0°,UN,SM,N,CN 17.3m: J,0°,UN,SM,N,CN		67			8.5
	18.1m: grades silty fine to medium SANDSTONE 18.15m: grades silty fine to medium SANDSTONE, with trace coarse sand 18.32-18.43m: high carbonaceous content 18.43m: thin siltstone bed (40mm)							17.5				17.6m: B,20° (siltstone)				8.0
	18.82m: grades silty fine to medium SANDSTONE					PQ3		18.0				18-18.3m: very closely spaced drilling induced defects 18.3-19.5m: closely spaced drilling induced defects 18.43m: B,50° (siltstone)					7.5
	19.1m: grades bluish grey speckled dark grey, light green and white silty fine to coarse SANDSTONE, with minor fine gravel; sub-rounded 19.2m: grades bluish grey silty fine to medium SANDSTONE, with trace coarse sand							18.5				18.85-19.03m: J,80°,UN,R,VN,CT		92		7.0
	END OF BOREHOLE AT 19.5 m BELOW GROUND LEVEL (Target depth reached)							19.0				19.2m: B,15° (carbonceous lamination)				6.5
								19.5								6.0
								20								5.5

CORE BOX 7 | CORE BOX 8

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1191

SHEET 5 OF 5

Hole Location: RW601, Carrington Road

CO-ORDINATES	800944.02 mN 395176.76 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	29/1/13
		DATUM:	M.S.L	HOLE FINISHED:	31/1/13
DIRECTION:	0.00°	R.L. GROUND:	25.50 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	25.50 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT | ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...); | ROCK WEATHERING (UW SW MW HW) | ROCK STRENGTH (R4 R3 R2 R1 R0) | SPT N VALUE SHEAR VANE (corrected) kPa | CORE LOSS / LIFT (%) (3 10 30 100) | METHOD, CORE & CASING | TEST SYMBOL | DEPTH (m) | GRAPHIC LOG | DEFECT LOG | FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1) | SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS
DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING
ANGLES ARE NORMAL TO CORE AXIS | DATE / DEPTH | RQD (%) | WATER | DRILL WATER LOSS (%) (25 50 75) | CORE BOX RL (m)

Note: Shear vane readings taken at end of core barrel

Key:
SC - Solid Cone Standard Penetration Test (SPT)
T/S - Topsoil
A - Tauranga Group Alluvium
ECBF - East Coast Bays Formation Sandstone and Siltstone
ER - Residual Soil (ECBF)
EW - Weathered ECBF
EU2 - Cemented ECBF

20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5

5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 1 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 6 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 60 75)	CORE BOX RL (m)
T/S	Organic SILT, with minor rootlets; dark brown. Firm, dry, non-plastic							0.5								28.0
A	SILT, with minor clay; orange brown. Firm, dry, non-plastic 1m: grades low plasticity					HA		1.0								27.5
	Clayey SILT; grey mottled orange brown. Firm, dry, low plasticity 1.3m: grades grey mottled orange brown and red. Moderate plasticity			1 1 5 N=6		SPT		1.5								27.0 CORE BOX
	1.95-2.4m: Core loss							2.0								26.5
	Silty CLAY; grey mottled orange brown and red. Stiff, moist, moderate plasticity 2.5m: grades very stiff					PQ3		2.5								26.0
	2.9m: grades grey mottled orange brown and red, speckled and streaked red			SV 146/48 kPa				3.0						24/1/13 3 am		25.5
	3.15-3.45m: Core loss			3 4 4 N=8		SPT										25.0
	3.45-4.2m: Core loss					PQ3		3.5								24.5
	Silty CLAY; grey mottled orange brown and red, speckled and streaked red. Stiff, moist, moderate plasticity							4.0								24.0
	Silty CLAY, with trace organics; dark grey mottled light grey and speckled black. Firm to stiff, moist, moderate plasticity; organics, carbonaceous flecks			SV 91/49 kPa				4.5								23.5
	4.76-4.95m: Core loss			1 2 4 N=6		SPT		5								

T:\T_DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 2 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE

ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
A	Silty CLAY, with trace organics; dark grey mottled light grey and speckled black. Firm, moist, moderate plasticity; organics, carbonaceous flecks 5.25m: grades CLAY, with minor silt and trace organics 5.45m: grades firm to soft 5.6m: grades grey speckled and streaked black 5.75m: grades silty CLAY, with trace organics. Stiff			SV 75/36 kPa 3 5 8 N=13		PQ3 SPT		5.5 6.0								BOX 2
	6.45-6.7m: Core loss					PQ3		6.5								22.5 22.0
	Silty CLAY, with trace sand; grey. Firm to stiff, moist, low plasticity; sand, fine 7.2m: grades silty CLAY, with trace organics; grey mottled light brownish grey. Firm, moist, moderate plasticity 7.38m: grades soft to firm					PQ3		7.0						31/1/13 am		21.5 21.0
	SILT, with some clay and minor sand; grey. Firm, moist, low plasticity; sand, fine			3 5 6 N=11		SPT		7.5								CORE BOX 3 20.5
	7.95-8.75m: Core loss					PQ3		8.0 8.5						26/4/13 am		20.0 19.5
ER	Clayey SILT, with trace sand; grey mottled light brown. Firm to stiff, moist, moderate plasticity; sand, fine			SV 66/33 kPa												
	Silty CLAY, with trace sand; grey. Very soft to soft, moist, moderate plasticity; sand, fine					PQ3		9.0 9.5								19.0
	Clayey SILT, with some sand; light bluish grey. Firm to stiff, moist, low plasticity; sand, fine							10								18.5

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 23/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 3 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW, SW, MW, HW)	ROCK STRENGTH (R4, R3, R2, R1, R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3, 10, 30, 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (60, 10, 5, 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25, 50, 75)	CORE BOX	CORE BOX RL (m)
ER	Clayey SILT, with some sand; light bluish grey. Firm to stiff, moist, low plasticity; sand, fine			SV 43/14 kPa		PQ3		10.5										18.0
	10.7m: grades sandy SILT. Firm			2 3 6 N=9		SPT										CORE BOX 4		17.5
	10.95-11.45m: Core loss							11.0										17.0
	Clayey SILT, with minor sand; light bluish grey. Soft, moist, low plasticity; sand, fine					PQ3		11.5										16.5
EW	Highly weathered, grey speckled bluish grey, silty fine to coarse SANDSTONE. Extremely weak, thinly bedded with thin interbeds of extremely weak, grey speckled bluish grey SILTSTONE; silt, firm to stiff, moist, low plasticity; silty sand, medium dense, moist			3 5 8 N=13		SPT		12.0										16.0
	12.45-12.7m: Core loss							12.5										15.5
	Moderately weathered, bluish grey silty fine SANDSTONE. Extremely weak; silty sand, medium dense, moist					PQ3		13.0										15.0
	Moderately weathered, bluish grey, SILTSTONE. Extremely weak; silt, firm to stiff, moist															CORE BOX 5		
	Moderately weathered, bluish grey, silty medium to coarse SANDSTONE, with fine gravel. Extremely weak; gravel, fine, sub-angular, highly weathered, siltstone; silty sand, dense, moist							13.5										14.5
	Moderately weathered, bluish grey streaked purple silty fine SANDSTONE. Extremely weak; silty sand, loose, moist			3 3 4 N=7		SPT												
	Highly weathered, orange brown streaked bluish grey silty fine SANDSTONE. Extremely weak, laminated sub-horizontal bedding; silty sand, medium dense, moist							14.0										14.0
	Moderately weathered, bluish grey speckled light green and yellow silty fine to coarse SANDSTONE, with minor lithics. Extremely weak to very weak; lithics, fine gravel sized, sub-rounded, volcaniclastic					PQ3		14.5										13.5
	Moderately to highly weathered, bluish grey streaked orange brown silty fine SANDSTONE. Extremely weak, very							15										

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 4 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
EW	thinly bedded, with very thin interbeds of extremely weak, bluish grey SILTSTONE; silt, very stiff; silty sand, dense; sub-horizontal bedding			3 6 15 N=21		SPT										CORE BOX 6
	Highly weathered, orange brown streaked bluish grey silty fine SANDSTONE. Extremely weak, sub-horizontal bedding; silty sand, medium dense, moist							15.5								13.0 12.5
	15.15m: grades moderately weathered, bluish grey, with carbonaceous laminations											15.75m: B,30°, siltstone				
	15.45-15.55m: Core loss															
	Moderately weathered, bluish grey silty fine SANDSTONE. Extremely weak, moderately thick to thickly bedded, with very thin to moderately thin interbeds of extremely weak, bluish grey SILTSTONE and black carbonaceous laminations; silty sand, medium dense, moist; silt, very stiff, moist; sub-horizontal bedding					PQ3		16.0								12.0
	15.75m: very thin SILTSTONE bed 15.79m: grades dense SANDSTONE 16.3m: grades grey, medium dense SANDSTONE			3 7 11 N=18		SPT		16.5								11.5
	16.95-17.05m: Core loss															
	Moderately weathered, grey silty fine SANDSTONE. Extremely weak, moderately thick to thickly bedded, with very thin to moderately thin interbeds of extremely weak, bluish grey SILTSTONE and black carbonaceous laminations; silty sand, medium dense, moist; silt, very stiff, moist; sub-horizontal bedding					PQ3		17.0				17.05-18m: core recovered as one continuous stick 17.1m: B,0°, siltstone				11.0
	17.1-17.2m: moderately thin SILTSTONE bed							17.5								10.5 CORE BOX 7
				4 8 7 N=15		SPT		18.0								10.0
	18.45-18.6m: Core loss							18.5								9.5
	Moderately weathered, grey silty fine SANDSTONE. Extremely weak, moderately thick to thickly bedded, with very thin to moderately thin interbeds of extremely weak, bluish grey SILTSTONE and black carbonaceous laminations; silty sand, medium dense, moist; silt, very stiff, moist; sub-horizontal bedding					PQ3		19.0				18.6-19.5m: core recovered as one continuous stick 18.65m: B,0°, siltstone				
	18.65m: very thin SILTSTONE bed 19-19.05m: high carbonaceous content															9.0
				4 9 14 N=23		SPT		19.5								8.5
	19.87m: very thin SILTSTONE bed, stiff							20				19.87m & 19.9m: B,0°, siltstone				

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 5 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%)	CORE BOX	RL (m)
EW	19.9m: very thin SILTSTONE bed, stiff 19.95-20.3m: Core loss					PQ3		20.5				20.3-21m: core recovered as one continuous stick 20.47m: B,15°, siltstone					8.0
	Moderately weathered, grey silty fine SANDSTONE. Extremely weak, moderately thick to thickly bedded, with very thin to moderately thin interbeds of extremely weak, bluish grey SILTSTONE and black carbonaceous laminations; silty sand, medium dense, moist; silt, very stiff, moist; sub-horizontal bedding 20.47m: thin SILTSTONE bed			6 11 18 N=29		SPT		21.0								CORE BOX 8	7.5
						PQ3		21.5				21.45-22.5m: core recovered as one continuous stick					7.0
	22.8-22.85m: high carbonaceous content			8 14 26 N=40		SPT		22.0									6.5
						PQ3		22.5				22.95-24m: core recovered as one continuous stick					6.0
						SPT		23.0								CORE BOX 9	5.5
						PQ3		23.5									5.0
EU1	Unweathered, bluish grey silty fine SANDSTONE. Extremely weak; very dense, moist			11 19 31 for 70mm N>50		SPT (SC)		24.0									4.5
						PQ3		24.5				24.37-25.5m: closely spaced drilling induced defects		88			4.0
	24.87m: grades very weak							25									3.5

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 6 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	DESCRIPTION OF CORE: ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3 10 90 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	ROCK DEFECTS: SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS; DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING; ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	CORE BOX RL (m)
EU1	25.07-25.17m: high carbonaceous content 25.17m: grades extremely weak, dense					PQ3		25.5						88		CORE BOX 10 3.0 2.5
	25.5-25.7m: Core loss															
	Unweathered, bluish grey silty fine SANDSTONE. Very weak, thinly to moderately thinly bedded, with very thin interbeds of very weak, bluish grey SILTSTONE; sub-horizontal bedding 25.82-25.88m: high carbonaceous content 25.83m: very thin SILTSTONE bed 25.92m: grades extremely weak SANDSTONE 26.11m: very thin SILTSTONE bed 26.15m: very thin SILTSTONE bed					PQ3		26.0 26.5				25.82m: B,5°, carbonaceous laminations 26.08m: DD,0° 26.23m: B, 40°, carbonaceous lamination		87		CORE BOX 11 2.0 1.5 1.0 0.5
						PQ3		27.0 27.5				27-28.5m: core recovered as one continuous stick		100		
EU2	Unweathered, bluish grey streaked black silty fine SANDSTONE, with some medium sand. Very weak, very thinly to thinly bedded, with very thin to thin interbeds of very weak, bluish grey SILTSTONE and black carbonaceous laminations; gently inclined bedding							28.0								CORE BOX 12 0.0 -0.5 -1.0 -1.5
	28.5-28.65m: Core loss							28.5								
	Unweathered, bluish grey streaked black silty fine SANDSTONE, with some medium sand. Very weak, very thinly to thinly bedded, with very thin to thin interbeds of very weak, bluish grey SILTSTONE and black carbonaceous laminations; gently inclined bedding 28.95-29.05m: moderately thin SILTSTONE bed							29.0				29.1m: DD,15°		90		
	Unweathered, bluish grey speckled white silty fine to medium SANDSTONE, with trace coarse sand. Very weak 29.05-29.11m: high carbonaceous content 29.35m: grades extremely weak					PQ3		29.5 30								

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

WELL-CONNECTED ALLIANCE

WATERVIEW CONNECTION

DRILL HOLE LOG

BOREHOLE No: BH1193

SHEET 7 OF 7

Hole Location: UNITEC, Mt Albert

CO-ORDINATES	800875 mN 395142.17 mE	DRILL TYPE:	Rotary Triple Tube	HOLE STARTED:	22/1/13
		DATUM:	M.S.L	HOLE FINISHED:	24/1/13
DIRECTION:	0.00°	R.L. GROUND:	28.19 m	DRILLED BY:	Boart Longyear Ltd
ANGLE FROM HORIZ.:	-90.00°	R.L. COLLAR:	28.00 m	LOGGED BY: PRMM	CHECKED: SSC

DESCRIPTION OF CORE | ROCK DEFECTS

GEOLOGICAL UNIT	ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);	ROCK WEATHERING (UW, SW, MW, HW)	ROCK STRENGTH (R4, R3, R2, R1, R0)	SPT N VALUE / SHEAR VANE (corrected) kPa	CORE LOSS / LIFT (%) (3, 10, 99, 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50, 10, 5, 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25, 50, 75)	CORE BOX RL (m)
	END OF BOREHOLE AT 30 m BELOW GROUND LEVEL (Target depth reached) **Slotted Screen Nested Piezometer installed 8.5-10.5m b.g.l** **Note:** Shear vane readings taken at end of core barrel **Key:** SC - Solid Cone Standard Penetration Test (SPT) T/S - Topsoil A - Tauranga Group Alluvium ECBF - East Coast Bays Formation Sandstone and Siltstone ER - Residual Soil (ECBF) EW - Weathered ECBF EU1 - Uncemented ECBF EU2 - Cemented ECBF							30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5								-2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

ROCKLG-WATERVIEW WATERVIEW_PAA.GPJ 22/5/13

LOG OF DRILLHOLE

OPUS

PROJECT: Mount Albert Rail Station Redevelopment
LOCATION: Ballast Lane (See Site Plan)
DEPTH OF BOREHOLE: 15.1m
JOB NUMBER: 1-C0623.00
ANGLE FROM VERTICAL: 90°
DIRECTION: N/A
CO-ORDINATES:
R.L.:
HOLE No.: BH4

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
F	Asphaltic concrete (Mix10/14).							
	Granular Basecourse.							
A.V.F. Basalt/Ash	SW grey BASALT. Strong, moderately vesicular.							
	Yellow brown silty clay. Firm to stiff, plastic (Inferred).	1				10	HQTT	
Recent Alluvium	Light grey CLAY; with some silt, trace decaying rootlets . Stiff, plastic, organic odour, trace orange streaks.	2		1//0/2/1/2 N=5		100	SPT	
	Becomes grey speckled orange silty CLAY. Very stiff, plastic.					100	HQTT	
	Introduction of trace fine sand. Becomes stiff to very stiff.	3				100	Push Tube	
	Grey clayey SILT; with some fine sand. Stiff, slightly brittle to plastic.	4		1//1/1/1/1 N=4		100	SPT	
	From 4.40m to 4.70m: Becomes mottled reddish orange and orange.					51	HQTT	
				1//0/1/1/1 N=3		100	SPT	
	Yellowish brown mottled grey/speckled orange fine sandy SILT; with some clay. Firm to stiff, brittle but plastic on rework.	5						
Waitemata Group	Orange brown mottled grey silty fine SAND. Loose, brittle.					100	HQTT	
	Becomes dark grey.	6				100	Push Tube	
	Grey SILT; with trace clay and trace fine sand. Very stiff to hard, brittle, trace Black carbonaceous material.			4//2/3/4/4 N=13		100	SPT	
	Greenish grey silt clast (~15mmØ).	7				100	HQTT	
	Grey silty fine SAND. Medium dense, brittle.							
	Grey SILT; with trace clay and trace fine sand. Very stiff to hard, brittle.			3//4/5/7/7 N=23		100	SPT	
	Grey silty fine SAND. Medium dense, brittle.	8				81	HQTT	
	20mm fine sandy silt lense.							
	Grey SILT; with trace fine sand. Hard, brittle.	9		7//6/7/10/13 N=36		100	SPT	
	Grey fine sandy SILT; with trace clay. Very stiff to hard, brittle but plastic once reworked.					86	HQTT	

REMARKS
Hole backfilled upon completion.
A.V.F.: Auckland Volcanic Field.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
13/12/11	Drillforce	B Steiner
FINISHED	DRILL	CORE BOXES
13/12/11	YDX1800A	4

NZGD ID: BH_124183

LOG OF DRILLHOLE

PROJECT Mount Albert Rail Station Redevelopment
HOLE No. BH4 Sheet 2 of 2
LOCATION Ballast Lane (See Site Plan)
DEPTH OF BOREHOLE 15.1m
CO-ORDINATES -
JOB NUMBER 1-C0623.00
ANGLE FROM VERTICAL 90°
DIRECTION N/A
R.L.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Waitemata Group	Grey silty fine SAND. Medium dense, brittle.					86	HQTT	
	Interbedded grey SILT; hard, brittle, abundant black carbonaceous material (~50%) with grey silty fine SAND; medium dense, brittle (~50%). Horizontally bedded.			11//10/10/17/13 for 40mm N=50+		100	SPT	
	Grey silty fine SAND. Medium dense, brittle.	11						
	Interbedded silty fine SAND; medium dense, brittle (~50%) and SILT; with trace sand; hard, brittle (~50%). 50mm-60mm thick lenses containing abundant black carbonaceous material.					90	HQTT	
	SW to MW Grey SANDSTONE. Extremely to very weak (Grey SAND. Hard, brittle, slightly cemented), black carbonaceous material.	12		50 for 115mm N=50+		SC	SPT	
						100	HQTT	
	Silty fine SAND; with trace 4mmØ greenish blue sandstone clasts. Medium dense, brittle.	13						
	SW grey SANDSTONE. Very weak, weakly cemented, trace black carbonaceous material.			50 for 150mm N=50+		SC	SPT	
		14		UCS: 1.44 MPa		73	HQTT	
	SW grey MUDSTONE. Very weak.			UCS: 1.40 MPa				
	SW grey SANDSTONE. Very weak, weakly cemented, trace black carbonaceous material.	15		UCS: 2.38 MPa 50 for 130mm N=50+		SC	SPT	
	End of borehole at 15.13m: Target depth reached.	16						
		17						
		18						
		19						

REMARKS
Hole backfilled upon completion.
A.V.F.: Auckland Volcanic Field.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
13/12/11	Drillforce	B Steiner
FINISHED	DRILL	CORE BOXES
13/12/11	YDX1800A	4

LOG OF DRILLHOLE

PROJECT: Mt Albert Station Redevelopment
HOLE No.: BH6
LOCATION: 22A Willcott Street (See Site Plan)
DEPTH OF BOREHOLE: 18.1m
CO-ORDINATES: -
JOB NUMBER: 1-C0623.11
ANGLE FROM VERTICAL: 90°
DIRECTION: N/A
R.L.: approx.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Fill	Pavers and binding sand.							P1 P2
	Grey SILT with fine to coarse angular gravels.							
	Clay brick; old railway fill?							
	Grey fine to coarse basalt and scoria GRAVEL; with some silt coating.	1				40	HQTT	2/5/12
Undifferentiated Alluvium	Grey mottled orange clayey SILT; with trace fine sand [Reworked Ash?]. Very stiff, plastic.							
	Yellowish brown mottled orange silty CLAY. Very stiff, plastic. Trace rootlets, trace limonite clasts, trace grey silt pockets.	2		1//1/2/2/3 N=8		100	SPT	
	Light grey mottled yellowish brown clayey SILT; with trace fine sand. Very stiff, plastic. Trace rootlets.					67	HQTT	
	Becomes streaked red at 2.8m.	3				100	Push Tube	
	Light grey mottled yellowish brown and streaked red SILT; with some clay and fine sand. Very stiff to hard, brittle but plastic when reworked.			2//2/2/2/3 N=9		100	SPT	
		4				45	HQTT	
Waitemata Group	Light grey mottled yellowish brown clayey SILT; with minor fine sand. Very stiff, plastic.			1//0/2/2/3 N=7		100	SPT	2/5/12
	Grey SILT; with some clay and fine sand. Very stiff, brittle but plastic when reworked. Trace black carbonaceous material.	5						
	Grey SILT; with minor clay. Stiff, brittle but plastic when reworked. Trace black carbonaceous material.					100	HQTT	
	Grey fine SAND; with minor silt. Loose, brittle. Trace black carbonaceous material.							
	Grey fine sandy SILT; with trace clay. Stiff, brittle but slightly plastic when reworked. Trace black carbonaceous material.	6		1//1/1/1/2 N=5		100	SPT	
	Grey silty fine SAND; loose, brittle; (10-50mm thick lenses) interbedded with fine sandy SILT; (10mm thick lenses). Horizontally bedded.					100	HQTT	
	Grey SILT; with trace clay. Very stiff, brittle but plastic when reworked. Trace black carbonaceous material.	7						
	Grey fine sandy SILT; with trace clay. Stiff, brittle but slightly plastic when reworked. Trace black carbonaceous material.			1//2/3/3/5 N=13		100	SPT	
	Grey SILT; with trace clay and fine sand. Very stiff to hard, brittle. Trace black carbonaceous material. Abundant black carbonaceous material at 8.3m.	8				100	HQTT	
	Grey SILT; with trace clay. Very stiff, brittle but plastic when reworked. Trace black carbonaceous material.							
	Grey silty fine SAND; loose, brittle; (10-50mm thick lenses) interbedded with fine sandy SILT; (10mm thick lenses). Horizontally bedded.	9		4//5/5/7/8 N=25		100	SPT	
	Grey SILT; with trace clay. Hard, brittle but slightly plastic when reworked. Trace black carbonaceous material. Abundant black carbonaceous material at 9.5m.							
	Grey fine sandy SILT. Hard, brittle but slightly plastic when reworked. Trace black carbonaceous material.					100	HQTT	

REMARKS
Two piezometers installed upon completion. Flush mounted toby box installed.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
14/2/12	Drillforce Ltd	B Steiner
FINISHED	DRILL	CORE BOXES
15/2/12	Herbie	5

LOG OF DRILLHOLE

PROJECT Mt Albert Station Redevelopment
HOLE No. BH6 Sheet 2 of 2
LOCATION 22A Willcott Street (See Site Plan)
DEPTH OF BOREHOLE 18.1m CO-ORDINATES -
JOB NUMBER 1-C0623.11 ANGLE FROM VERTICAL 90° DIRECTION N/A R.L. approx.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer P1 P2
Waitemata Group	At 9.9m and 9.95m: Pockets of non cemented, fine sand. Grey fine sandy SILT. Hard, brittle but slightly plastic when reworked. Trace black carbonaceous material.*(Continued)* Abundant black carbonaceous material at 10.05m.			21/19/26/5 for 5mm N=50+		100	HQTT	
						S.C	SPT	
	Grey SW muddy fine SANDSTONE; extremely weak (breaks down to a silty fine SAND; dense).	11				100	HQTT	
	Grey SW-MW MUDSTONE. Very weak.	12		50 for 150mm N=50+		S.C	SPT	
	Grey SW muddy fine SANDSTONE. Very weak.					100	HQTT	
	Becomes extremely weak to very weak at 13.2m.	13		30//32/18 for 50mm N=50+		S.C	SPT	
	Becomes very weak at 13.7m.	14				100	HQTT	
		15		50 for 130mm N=50+		S.C	SPT	
	Grey SW-MW MUDSTONE. Very weak. Grey SW fine SANDSTONE. Very weak. Grey SW MUDSTONE. Very weak. Grey SW fine SANDSTONE. Very weak. Abundant black carbonaceous material at 15.44m. Grey SW MUDSTONE. Very weak.	16				100	HQTT	
	Alternating beds of grey SW fine SANDSTONE; (70%) 20-250mm thick; very weak, trace black carbonaceous material and grey SW MUDSTONE; (30%) 20-100mm thick; very weak. Horizontally bedded. At 16.2m to 17.1m: Four fractures; sub-horizontally inclined dip; planar, smooth, some clay coating.			50 for 110mm N=50+		S.C	SPT	
		17			90	100	HQTT	
		18		50 for 130mm N=50+		S.C	SPT	
	End of borehole: 18.13m (Target Depth)	19						

REMARKS
Two piezometers installed upon completion. Flush mounted toby box installed.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
14/2/12	Drillforce Ltd	B Steiner
FINISHED	DRILL	CORE BOXES
15/2/12	Herbie	5

LOG OF DRILLHOLE

PROJECT: Mount Albert Rail Station Redevelopment
HOLE No.: BH8

LOCATION: Ballast Lane (See Site Plan)
DEPTH OF BOREHOLE: 18.1m
CO-ORDINATES:
JOB NUMBER: 1-C0623.00
ANGLE FROM VERTICAL: 90°
DIRECTION: N/A
R.L.:

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Fill	Asphaltic Concrete (50mm thick).							
	Granular basecourse.							
	Brown fine to medium angular, gravelly SILT.	1				53	HQTT	
A.V.F Tephra	Yellowish brown SILT; trace clay [ASH]. Stiff, brittle but slightly plastic when reworked. Trace limonite strain. Occasional sub-rounded, moderately vesicular basalt block (12mm Ø max) at 1.7m.			3/2/3/2/2 N=9		100	SPT	
	Brown SILT [ASH]; with moderately vesicular, sub-rounded to sub-angular basalt blocks (10mm-300mm Ø).	2				83	HQTT	
		3		18//5/6/8/6 N=25 (Solid Obstruction on seating drive?)		S.C	SPT	
	Light yellowish brown clayey SILT; with some fine sand and moderately vesicular, sub-rounded to sub-angular basalt blocks (10mm-300mm Ø). Stiff, plastic.	4				86	HQTT	
Undifferentiated Alluvium	Yellowish brown mottled grey clayey SILT; with some fine sand. Stiff to very stiff, plastic. Trace limonite staining. Occasional orange streaked from 4.6m.			0//1/1/2/2 N=6		100	SPT	
	Light grey mottled pink/orange silty CLAY; with trace fine sand. Stiff, plastic.	5				62	HQTT	
	Light grey mottled pink/orange clayey SILT; with minor fine sand. Stiff, plastic.	6				100	Push Tube	
	Light grey mottled yellowish brown clayey SILT; with trace fine sand. Stiff to very stiff, plastic.			2//2/2/3/2 N=9		100	SPT	
Waitemata Group	Grey silty CLAY. Very stiff, plastic.	7				18	HQTT	
				2//2/2/2/2 N=8		100	SPT	
	Grey fine sandy SILT; with minor clay. Very stiff, brittle but plastic when reworked.	8				86	HQTT	
	Grey silty CLAY. Very stiff, plastic.							
	Grey fine sandy SILT; with minor clay. Very stiff, brittle but plastic when reworked.	9		2//1/2/3/3 N=9		100	SPT	
						48	HQTT	

REMARKS
Hole backfilled upon completion.
A.V.F.: Auckland Volcanic Field.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
14/12/11	Drillforce	B Steiner
FINISHED	DRILL	CORE BOXES
15/12/11	YDX1800A	5

NZGD ID: BH_124185

LOG OF DRILLHOLE

PROJECT Mount Albert Rail Station Redevelopment
LOCATION Ballast Lane (See Site Plan)
HOLE No. BH8
DEPTH OF BOREHOLE 18.1m
CO-ORDINATES -
JOB NUMBER 1-C0623.00
ANGLE FROM VERTICAL 90°
DIRECTION N/A
R.L.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Waitemata Group	Grey fine sandy SILT; with minor clay. Very stiff, brittle but plastic when reworked. *(Continued)*					48	HQTT	
				6//2/3/4/7 N=17		100	SPT	
	Grey SILT; with trace clay. Hard, brittle but plastic when reworked. Trace black carbonaceous material.	11				100	HQTT	
	Grey silty fine SAND; with trace clay. Medium dense, brittle but slightly plastic when reworked. Trace black carbonaceous material.							
	Grey silty CLAY. Hard, plastic. Trace black carbonaceous material.							
	Grey SILT; with trace fine sand and trace clay. Hard, brittle.	12		6//5/7/9/11 N=32		100	SPT	
	Grey fine sandy SILT; with minor clay. Very stiff, brittle but plastic when reworked.							
	Interbedded grey fine SANDSTONE; very weak, 10mm-200mm thick lenses (~50%) and grey MUDSTONE; very weak, 50mm-200mm thick lenses (~50%). Sub-horizontally bedded.	13				100	HQTT	
	Grey SW fine to medium SANDSTONE. Very weak.			50 for 150mm N=50+		S.C	SPT	
		14		UCS: 1.42 MPa		100	HQTT	
	Interbedded grey fine SANDSTONE; very weak, 40mm-60mm thick lenses (~40%) and grey MUDSTONE; very weak, 50mm-100mm thick lenses (~60%). Sub-horizontally bedded.							
	Grey SW fine to medium SANDSTONE. Very weak.	15		50 for 110mm N=50+		S.C	SPT	
	Grey SW MUDSTONE. Extremely weak to very weak.					100	HQTT	
	Fracture; sub-horizontally inclined dip; planar, smooth at 15.46m. Grey SW fine to medium SANDSTONE. Very weak.	16						
	Interbedded grey fine SANDSTONE; very weak, 40mm thick lenses (~25%) and grey MUDSTONE; very weak, 20mm-70mm thick lenses (~75%). Sub-horizontally bedded.							
	Grey SW fine to medium SANDSTONE. Very weak.			50 for 110mm N=50+		S.C	SPT	
	Interbedded grey fine SANDSTONE; very weak, 30mm-200mm thick lenses (~80%) and grey MUDSTONE; very weak, 10mm-50mm thick lenses (~20%). Sub-horizontally bedded.	17		UCS: 1.80 MPa		100	HQTT	
				UCS: 3.48 MPa				
		18		50 for 100mm N=50+		S.C	SPT	
	End of borehole: 18.1m.	19						

REMARKS
Hole backfilled upon completion.
A.V.F.: Auckland Volcanic Field.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
14/12/11	Drillforce	B Steiner
FINISHED	DRILL	CORE BOXES
15/12/11	YDX1800A	5

LOG OF DRILLHOLE

PROJECT Mt Albert Station Redevelopment
LOCATION 22A Willcott Street (See Site Plan)
HOLE No. BH9 Sheet 1 of 2
DEPTH OF BOREHOLE 15.1m
CO-ORDINATES -
JOB NUMBER 1-C0623.11
ANGLE FROM VERTICAL 90°
DIRECTION N/A
R.L. approx.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Fill	Pavers and binding sand. Grey fine to coarse angular GRAVEL (Old Railway Fill?).	1				40	HQTT	
Undifferentiated Alluvium	Grey mottled yellowish brown streaked red clayey SILT; with trace fine sand [Reworked Ash?]. Very stiff, plastic.							
	Grey mottled yellowish brown clayey SILT; with some fine sand. Very stiff, brittle but plastic when reworked.	2		1//1/2/1/2 N=6		100	SPT	
	Grey mottled yellowish brown silt CLAY; with trace fine sand. Very stiff, plastic.					100	HQTT	
	Grey mottled yellowish brown clayey SILT; with some fine sand. Very stiff, brittle but plastic when reworked.							
	Light grey mottled yellowish brown streaked red silty CLAY. Stiff, plastic.	3		1//0/1/1/1 N=3		100	SPT	
	Light grey mottled yellowish brown fine sandy SILT; with some clay. Stiff, brittle but plastic when reworked.							
	Light grey streaked yellowish brown silty CLAY; with some horizontally bedded lenses of fine sandy SILT; some clay (10-20mm thick).	4				29	HQTT	
Waitemata Group	Grey clayey SILT; with minor fine sand. Firm to stiff, plastic.			1//1/0/1/1 N=3		100	SPT	
		5				24	HQTT	
		6		0//0/2/1/1 N=4		100	SPT	
	Becomes very stiff to hard at 7.2m.	7				86	HQTT	
	Grey SILT; with trace clay and fine sand. Hard, brittle but slightly plastic when reworked. Trace black carbonaceous material.			3//3/4/4/5 N=16		100	SPT	
	Alternating layers of clayey SILT; (50%) 100mm-300mm thick; hard brittle but plastic when reworked and fine sandy SILT; (50%) 50mm-200mm thick; very stiff, brittle.	8				100	HQTT	
		9		6//5/7/6/8 N=26		S.C	SPT	
	Grey silty fine SAND; loose, brittle; (10-50mm thick lenses) interbedded with fine sandy SILT; (10mm thick lenses). Horizontally bedded.					100	HQTT	

REMARKS
Hole backfilled upon completion.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
16/2/12	Drillforce Ltd	B Steiner
FINISHED	DRILL	CORE BOXES
16/2/12	Herbie	4

NZGD ID: BH_124186

LOG OF DRILLHOLE

PROJECT Mt Albert Station Redevelopment
LOCATION 22A Willcott Street (See Site Plan)
HOLE No. BH9 Sheet 2 of 2
DEPTH OF BOREHOLE 15.1m
CO-ORDINATES -
JOB NUMBER 1-C0623.11 ANGLE FROM VERTICAL 90° DIRECTION N/A R.L. approx.

Geology	Soil/Rock Description	Depth (m)	Graphic Log	Test Results	RQD (%)	Recovery (%)	Drilling Method	Piezometer
Waitemata Group	Grey silty fine SAND; loose, brittle; (10-50mm thick lenses) interbedded with fine sandy SILT; (10mm thick lenses). Horizontally bedded. *(Continued)*					100	HQTT	
	Grey SW-MW MUDSTONE. Extremely weak to very weak. Trace black carbonaceous material.			19//20/28/2 for 5mm N=50+		S.C	SPT	
	Grey SW muddy fine SANDSTONE. Extremely weak. Becomes very weak at 10.6m.							
	At 10.9m: Fracture; sub-horizontally inclined dip; planar, smooth, clay coating.	11			100	100	HQTT	
	Grey SW MUDSTONE. Very weak.							
	Grey SW fine SANDSTONE. Very weak. Trace black carbonaceous material.	12		34//35/15 for 40mm N=50+		S.C	SPT	
	Abundant carbonaceous material at 12.3m.							
	Grey SW MUDSTONE. Very weak.							
	Grey SW fine SANDSTONE. Very weak. Trace black carbonaceous material. Abundant carbonaceous material at 13.05m.	13			100	100	HQTT	
	Grey SW MUDSTONE. Very weak.			50 for 145mm N=50+		S.C	SPT	
	Grey SW fine SANDSTONE. Very weak. At 13.9m: Fracture; gently inclined dip; planar, smooth, clay coating.	14			70	100	HQTT	
	Crumbled grey fine SANDSTONE zone. Extremely weak to very weak.	15		50 for 140mm N=50+		S.C	SPT	
	End of borehole: 15.14m (Target Depth)	16						
		17						
		18						
		19						

REMARKS
Hole backfilled upon completion.
S.C: Solid Cone SPT

STARTED	DRILLER	LOGGED
16/2/12	Drillforce Ltd	B Steiner
FINISHED	DRILL	CORE BOXES
16/2/12	Herbie	4

NZGD ID: BH_124186

ENGEO Expect Excellence

LOG OF BORING BH01

Geotechnical Investigation
1243 Great North Road
Point Chevalier
13134.000.000_03

Client : Housing New Zealand
Date : 22/06/2016
Hole Depth : 18.15 m
Drilling Method : Mud Rotary
Drilling Contractor : Prodrill Ltd

Core Diameter : 83 mm
Hammer Efficiency : 56 %
Logged By/Reviewed By : KJL / MM
Latitude :
Longitude :

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
0.0	FILL		ML	SILT with minor clay; dark brown. Low plasticity [FILL]. Trace gravel encountered at 0.25 m depth.				NA					
0.5			ML	Sandy SILT; light orange brown. Low plasticity. Sand, fine to coarse, well graded, subrounded to subangular [FILL].				F			39/9		
	EAST COAST BAYS FORMATION SOILS		CH	CLAY with trace silt; light orange brown. High plasticity.				S			18/3		
1.0													
1.5				Push tube sample taken from 1.5 m to 2.0 m depth.							98/53		
2.0								St	1//1/2/2/2 N=7				
2.5							M						
			ML	SILT with minor clay; light grey with orange and red mottles. Low plasticity.				F					
3.0			ML	SILT with some sand; light grey with orange streaks. Low plasticity. Sand, fine to coarse, well graded, subrounded to subangular.					2//1/1/1/1 N=4		30/14		
3.5													
4.0								F					
4.5				Some clay encountered at 4.8 m depth.					2//0/1/2/1 N=4				
5.0			SM	Silty fine to coarse SAND; light yellowish brown. Well graded, subrounded to subangular.				L					

NA = NOT ASSESSED

GEOSCIENCE MACHINE BORING 13134_BH01 AND BH02 LOGS.GPJ NZ DATA TEMPLATE 2.GDT 5/8/16

ENGEO Expect Excellence

LOG OF BORING BH01

Geotechnical Investigation
1243 Great North Road
Point Chevalier
13134.000.000_03

Client : Housing New Zealand
Date : 22/06/2016
Hole Depth : 18.15 m
Drilling Method : Mud Rotary
Drilling Contractor : Prodrill Ltd

Core Diameter : 83 mm
Hammer Efficiency : 56 %
Logged By/Reviewed By : KJL / MM
Latitude :
Longitude :

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
5.5	EAST COAST BAYS FORMATION SOILS		SM	Silty fine to coarse SAND; light yellowish brown. Well graded, subrounded to subangular.			M						
6.0				Becomes wet with white flecks at 5.65 m depth.					1//1/1/1/2 N=5				
6.5													
7.0											75/15		
7.5								L			120/15		
8.0							W		1//1/1/1/2 N=5				
8.5											27/2		
9.0											44/5		
9.5				Trace gravel encountered from 9.45 m depth. Gravel comprises of lithorelicts.					4//3/5/6/8 N=22				
10.0			SST	Highly weathered, massive, grey SANDSTONE; extremely weak. Recovered as fine to coarse SAND with minor silt. Well graded, subrounded to subangular.				D					

NA = NOT ASSESSED

GEOSCIENCE MACHINE BORING 13134_BH01 AND BH02 LOGS.GPJ NZ DATA TEMPLATE 2.GDT 5/8/16

ENGEO Expect Excellence

LOG OF BORING BH01

Geotechnical Investigation
1243 Great North Road
Point Chevalier
13134.000.000_03

Client : Housing New Zealand
Date : 22/06/2016
Hole Depth : 18.15 m
Drilling Method : Mud Rotary
Drilling Contractor : Prodrill Ltd

Core Diameter : 83 mm
Hammer Efficiency : 56 %
Logged By/Reviewed By : KJL / MM
Latitude :
Longitude :

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%) 25 50 75	Notes
10.5	TRANSITION TO BEDROCK		SST	Highly weathered, massive, grey SANDSTONE; extremely weak. Recovered as fine to coarse SAND with minor silt. Well graded, subrounded to subangular.			W	D	8//7/8/11/6 N=32				
11.0													
11.5													
12.0									17//11/11/12/13 N=47				
12.5													
13.0													
13.5	EAST COAST BAYS FORMATION BEDROCK							VD	23//10/16/11/17 N=50				
14.0													
14.5													
15.0									10/40 for 75 mm N=50				
15.5													

NA = NOT ASSESSED

GEOSCIENCE MACHINE BORING 13134_BH01 AND BH02 LOGS.GPJ NZ DATA TEMPLATE 2.GDT 5/8/16

ENGEO Expect Excellence

LOG OF BORING BH01

Geotechnical Investigation
1243 Great North Road
Point Chevalier
13134.000.000_03

Client : Housing New Zealand
Date : 22/06/2016
Hole Depth : 18.15 m
Drilling Method : Mud Rotary
Drilling Contractor : Prodrill Ltd

Core Diameter : 83 mm
Hammer Efficiency : 56 %
Logged By/Reviewed By : KJL / MM
Latitude :
Longitude :

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%) 25 50 75	Notes
16.0	EAST COAST BAYS FORMATION BEDROCK		SST	Highly weathered, massive, grey SANDSTONE; extremely weak. Recovered as fine to coarse SAND with minor silt. Well graded, subrounded to subangular.			W	VD					
16.5			SST	Moderately weathered, massive, grey SANDSTONE; very weak.					11/39 for 75 mm N=50				
17.0								VD					
17.5													
18.0									13/37 for 75 mm N=50				

End of Hole Depth: 18.15 m
Termination: Target depth

NA = NOT ASSESSED

GEOSCIENCE MACHINE BORING 13134_BH01 AND BH02 LOGS.GPJ NZ DATA TEMPLATE 2.GDT 5/8/16

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH01

SHEET: 1 OF 2

PROJECT: 56 Carrington

JOB No.: 1020622.0000

LOCATION: 56 Carrington Road, Pt Chevalier - centre of site

CO-ORDINATES: (NZTM2000) 5917696 mN 1752487 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 20m

R.L. COLLAR: 20m

DATUM: AUCKHT1946

SURVEY: Handheld GPS

DRILLED BY: Harley

LOGGED BY: COCU

CHECKED: RLXB

START DATE: 15/06/2022

FINISH DATE: 15/06/2022

CONTRACTOR: DCN Drilling Ltd

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
TSoil	*0.00m:* Organic SILT, some clay, minor sand; dark brown. Very stiff, dry, medium to high plasticity. Organics, roots greater than 2mm diameter.					● 115/19 kPa Insitu											
Fill	*0.40m:* Clayey SILT, minor sand, trace rootlets; light greyish orange. Very stiff, dry, high plasticity. Rootlets up to 5 mm.			HA	100	● 114/31 kPa Insitu ● 158/61 kPa Insitu	19	0.5 1.0									
Takanini Formation	*1.10m:* CLAY, some silt, trace rootlets; light grey mottled orange. Stiff to very stiff, moist, high plasticity. , Rootlets up to 4 mm.					● 126/35 kPa Insitu 84/30 kPa Insitu											
	2.00 - 2.20m: Light grey speckled dark brown.			SPT	56	1/1// 1/1/2/2 **N=6**	18	1.5 2.0									
	2.20m: Brownish grey with thin laminations of dark brown (organic) stained clay.																
	2.60m: Silty fine SAND, some clay; light grey mottled orange. Medium dense, moist, well graded.			HQ3	100			2.5									
	2.95 - 2.97m: Organic CLAY; dark brown. Stiff, moist, high plasticity.					145/27 kPa Insitu											
East Coast Bays Formation	*3.00m:* Completely weathered, grey, SILTSTONE. Extremely weak. Soil description: CLAY, some silt, trace sand; grey. Very stiff, moist, high plasticity.			SPT	100	1/1// 2/3/4/5 **N=14**	17	3.0									
	3.45m: CORE LOSS - Suspect washed out.							3.5									
	3.60m: Completely weathered, grey, SILTSTONE. Extremely weak. Soil description: CLAY, some silt, trace sand; grey. Very stiff, moist, high plasticity.																
	3.70m: Completely weathered, grey, SANDSTONE. Extremely weak, well cemented, fine grained. Soil description: Fine SAND, some silt, trace clay; grey. Medium dense, moist, well graded.			HQ3	86		16	4.0				23					
	4.00m: Highly weathered, grey, SANDSTONE. Extremely weak, moderately cemented. Soil description: Fine to medium SAND, some silt; grey. Dense to very dense, moist.																
	4.30m: Moderately weathered, grey, SILTSTONE. Extremely weak. Soil description: Clayey SILT, trace sand; grey. Hard, moist, high plasticity.			SPT	100	UTP In barrel 5/6// 9/12/15/14 for 55mm **N>=50**		4.5									
	4.80m - 4.83m: Carbonaceous laminations dipping at 5.																
												37					

Box 0.00-1.50m

Box 1.50-4.95m

16/06/2022

COMMENTS: Target depth reached. Piezometer screen 2.5 m to 5.5 m bgl. Flush toby in lawn ~ 3m from edge of upper carpark.

Hole Depth 9.29m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 25/08/2022 5:53:16 PM - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: BH01

SHEET: 2 OF 2

Tonkin+Taylor

PROJECT: 56 Carrington

JOB No.: 1020622.0000

LOCATION: 56 Carrington Road, Pt Chevalier - centre of site

CO-ORDINATES: 5917696 mN 1752487 mE (NZTM2000)

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 20m

R.L. COLLAR: 20m

DATUM: AUCKHT1946

SURVEY: Handheld GPS

DRILLED BY: Harley

LOGGED BY: COCU

CHECKED: RLXB

START DATE: 15/06/2022

FINISH DATE: 15/06/2022

CONTRACTOR: DCN Drilling Ltd

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
East Coast Bays Formation	*4.95m:* CORE LOSS - Suspect washed out.																
	5.10m: Slightly weathered, grey, SANDSTONE. Very weak, well cemented, fine to medium grained.			HQ3				5.5					*5.80m:* J, 10°, UN, SM, MW, No infill				
				SPT	100	10/25// 25 for 50 mm N>=50	14	6.0									
	6.20m: CORE LOSS - Suspect washed out.							6.5									
	6.65m: Slightly weathered, grey, SANDSTONE. Very weak, well cemented, fine to medium grained.			HQ3	65		13	7.0				40					
	7.05m: Slightly weathered, grey, SILTSTONE. Very weak.																
	7.25m: Slightly weathered, grey, SANDSTONE. Very weak, well cemented, fine to medium grained. *7.25 - 7.30m:* Carbonaceous laminations dipping at 25 degrees.							7.5					*7.25m:* BF, 25°, VN, No infill				
				SPT	100	7/8// 14/15/21 for 70mm N>=50											
	7.87m: CORE LOSS - Suspect washed out.						12	8.0									
	8.25m: Slightly weathered, grey, SANDSTONE. Very weak, well cemented, fine grained.			HQ3	66							35					
	8.30m: Slightly weathered, grey, SILTSTONE. Very weak.							8.5									
	8.50m: Slightly weathered, grey, SANDSTONE. Very weak, well cemented, fine grained. *8.50 - 8.65m:* Carbonaceous laminations dipping at 10 degrees.																
	8.90m: Slightly weathered, grey, SILTSTONE. Very weak.						11	9.0									Box 8.90-9.29m
				SPT	100	7/11// 26/24 for 60mm N>=50											
	9.29m: END OF BOREHOLE. Target depth.							9.5									

COMMENTS: Target depth reached. Piezometer screen 2.5 m to 5.5 m bgl. Flush toby in lawn ~ 3m from edge of upper carpark.

Hole Depth 9.29m

Scale 1:25

Rev.: A

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: 56 Carrington Road, Pt Chevalier - centre of site

PROJECT: 56 Carrington	LOCATION:	JOB No.: 1020622.0000
CO-ORDINATES: 5917696 mN (NZTM2000) 1752487 mE R.L.: 20m DATUM: AUCKHT1946	DRILL TYPE: Trailer rig METHOD: Rotary cored	HOLE STARTED: 15/06/2022 HOLE FINISHED: 15/06/2022 DRILLED BY: DCN Drilling Ltd LOGGED BY: COCU CHECKED: RLXB

0.00-1.50m

1.50-4.95m

NZGD ID: BH_184208

Tonkin+Taylor

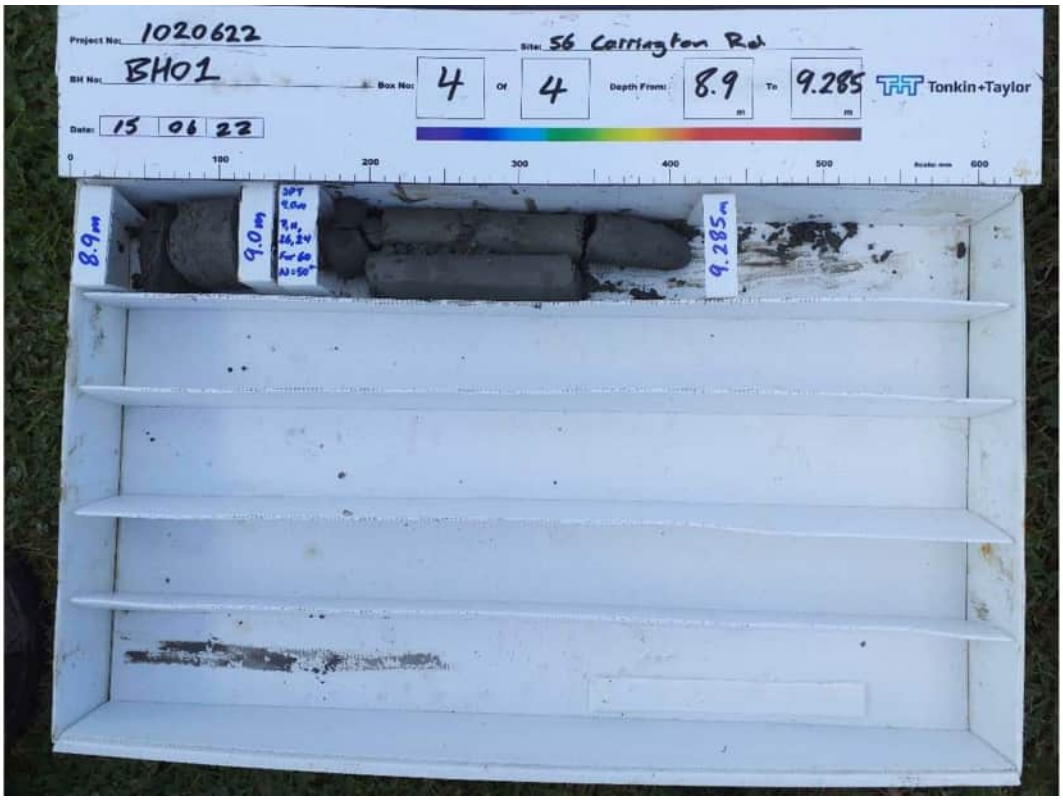
CORE PHOTOS

BOREHOLE No.: **BH01**

Hole Location: 56 Carrington Road, Pt Chevalier - centre of site

PROJECT: 56 Carrington	LOCATION:	JOB No.: 1020622.0000
CO-ORDINATES: 5917696 mN (NZTM2000) 1752487 mE R.L.: 20m DATUM: AUCKHT1946	DRILL TYPE: Trailer rig METHOD: Rotary cored	HOLE STARTED: 15/06/2022 HOLE FINISHED: 15/06/2022 DRILLED BY: DCN Drilling Ltd LOGGED BY: COCU CHECKED: RLXB

4.95-8.90m



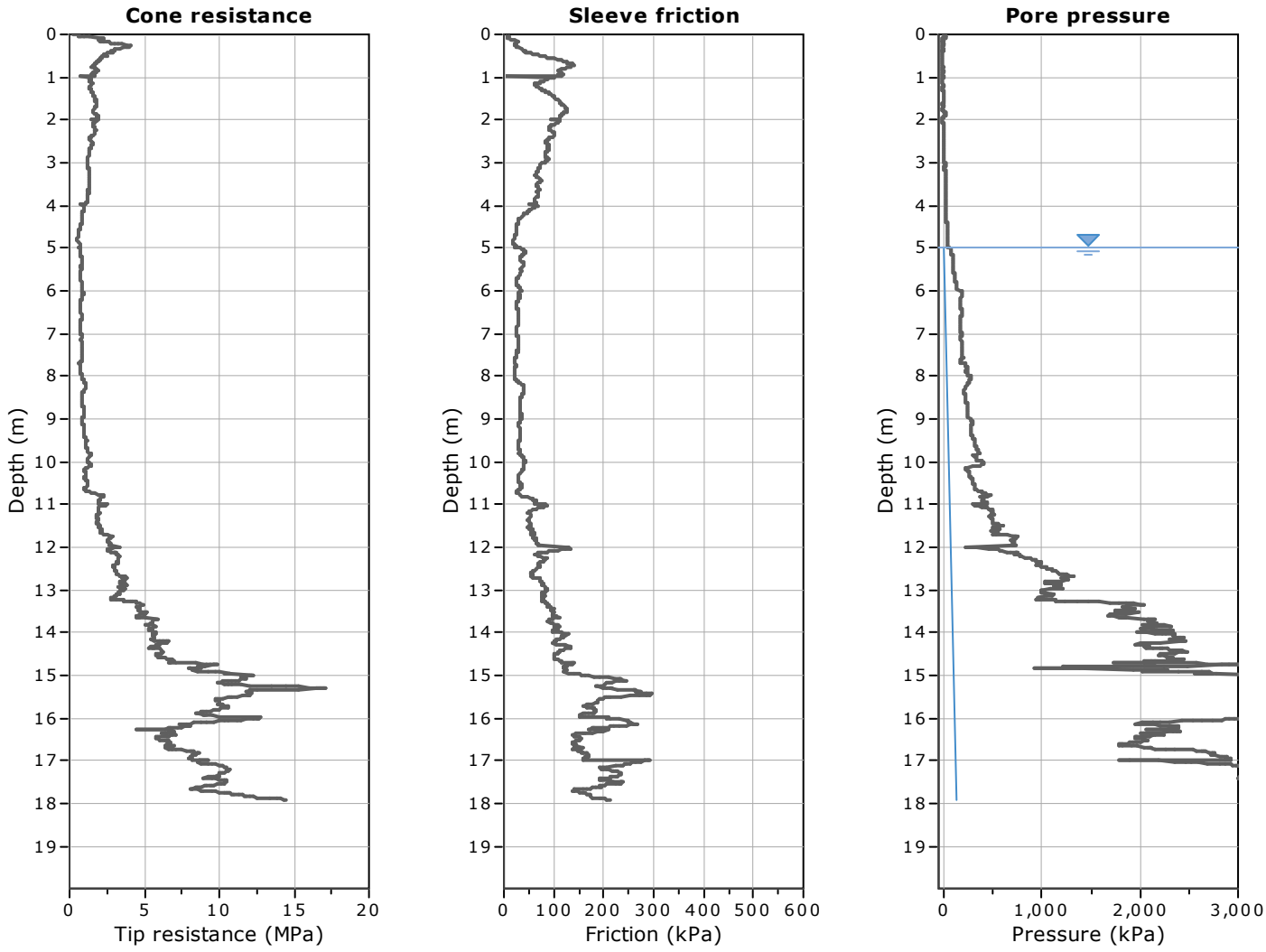
8.90-9.29m

NZGD ID: BH_184208

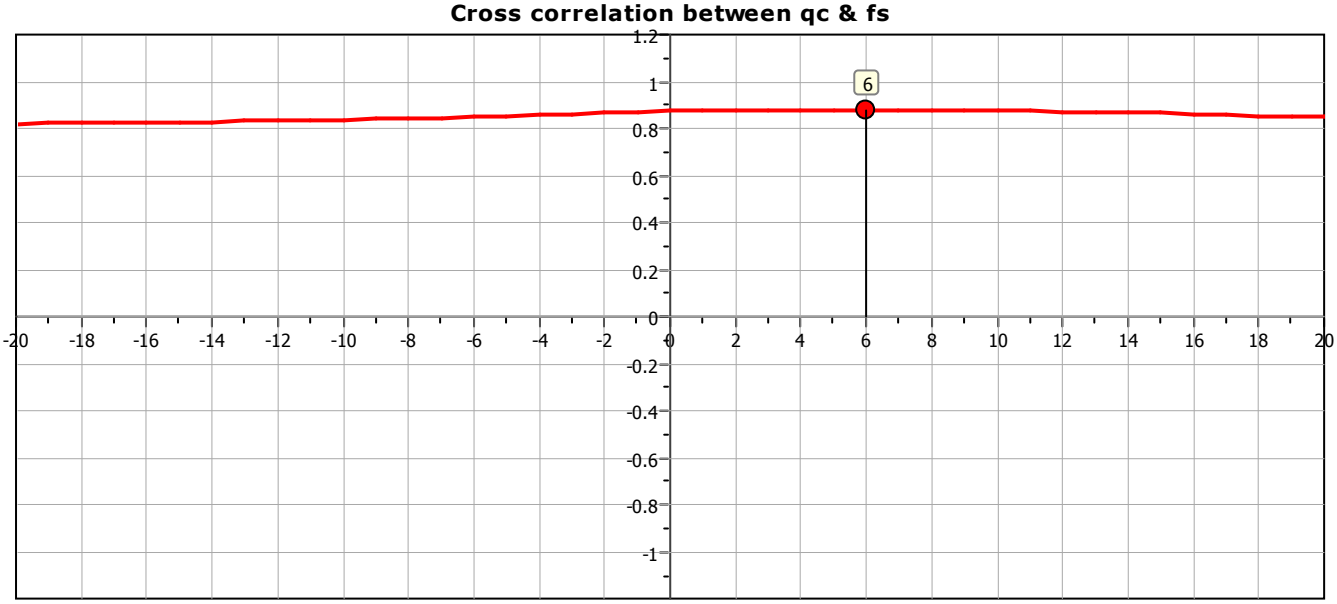
Ground Investigation Ltd
PO Box 21-956, Henderson, Auckland 0650
Ph: (09) 950 1919, (021) 191 6000
http://www.g-i.co.nz

CPT: CPT1056
Total depth: 17.91 m, Date: 7/03/2013
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Waterview Project**
Location: **Waterview**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

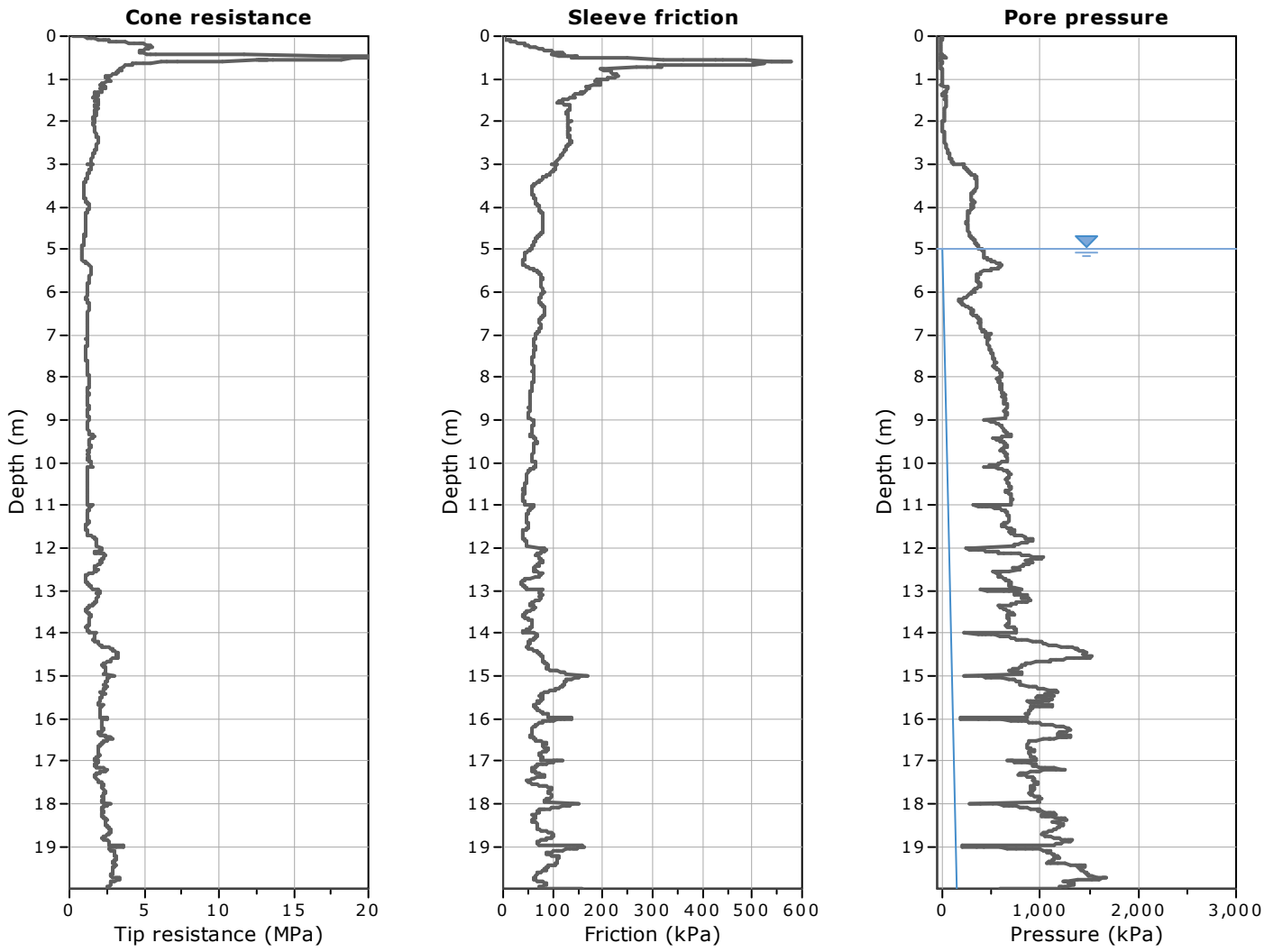


NZGD ID: CPT_105308

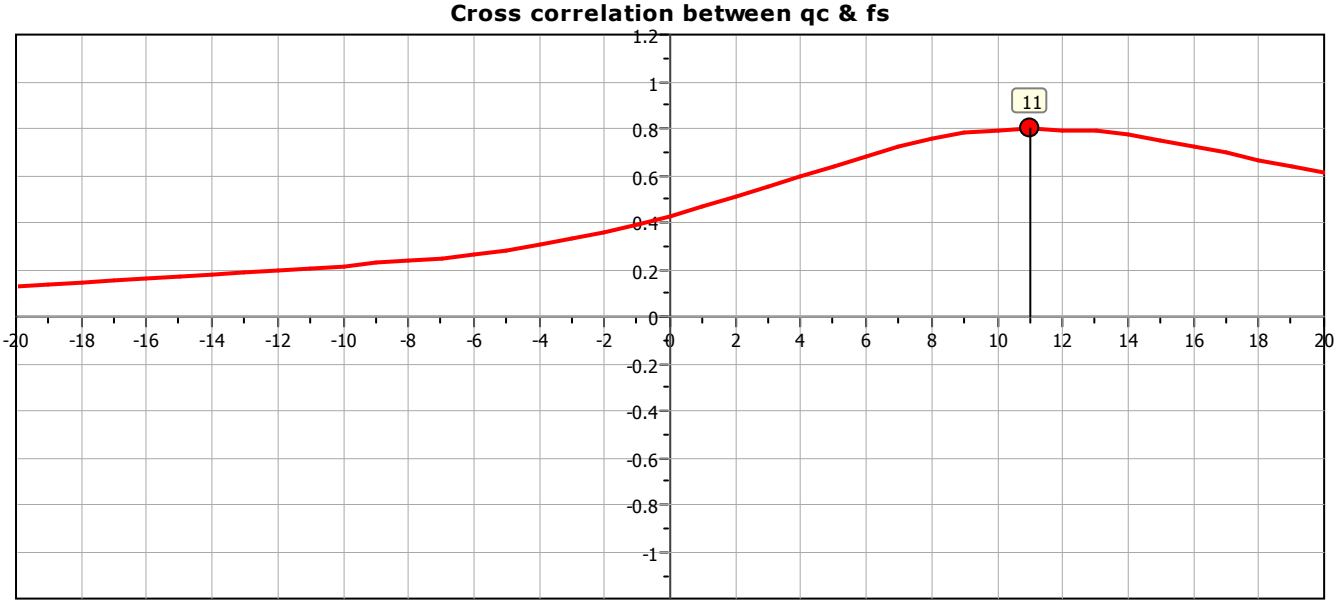
Ground Investigation Ltd
PO Box 21-956, Henderson, Auckland 0650
Ph: (09) 950 1919, (021) 191 6000
http://www.g-i.co.nz

CPT: CPT1058
Total depth: 19.99 m, Date: 2/03/2013
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: 10cm2, 50MPa, Piezocone
Cone Operator: TW/TP

Project: **Waterview Project**
Location: **Waterview**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

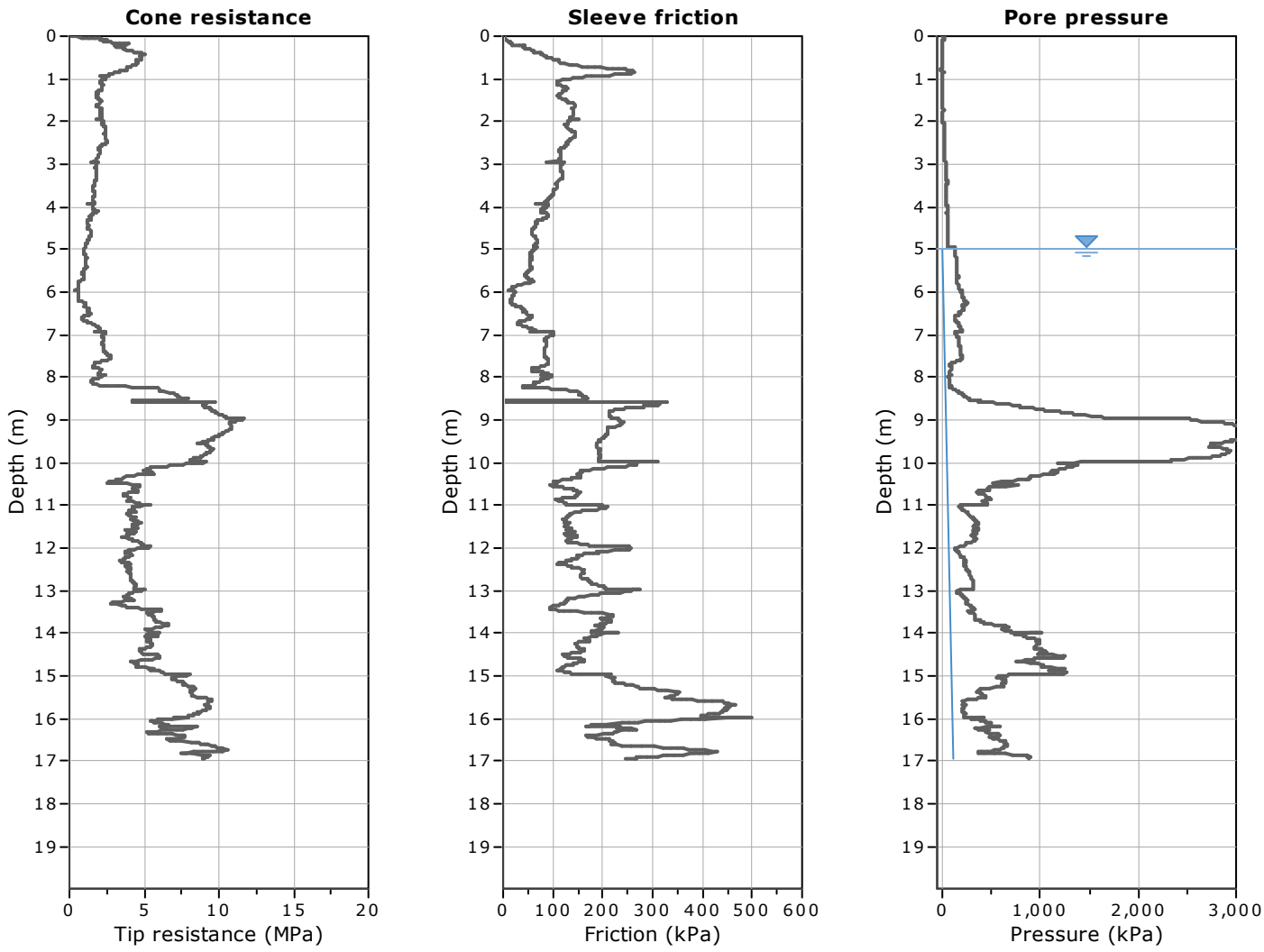


NZGD ID: CPT_105310

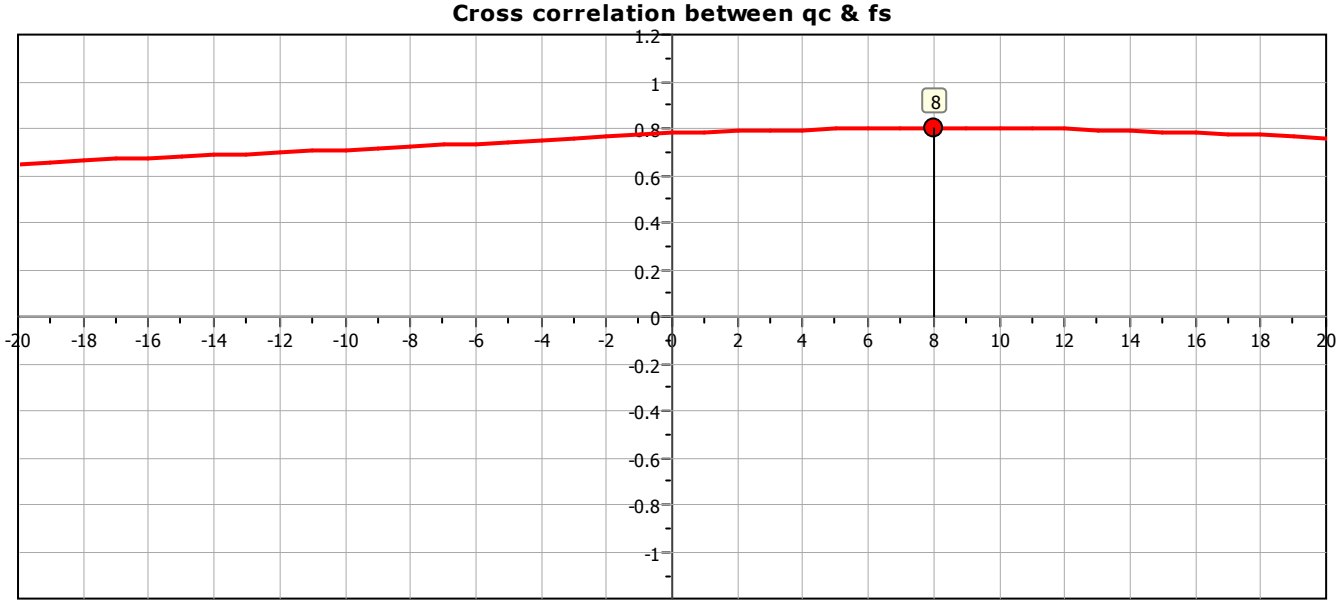
Ground Investigation Ltd
PO Box 21-956, Henderson, Auckland 0650
Ph: (09) 950 1919, (021) 191 6000
http://www.g-i.co.nz

CPT: CPT1059
Total depth: 16.95 m, Date: 2/03/2013
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: 10cm2, 50MPa, Piezocone
Cone Operator: TW/TP

Project: **Waterview Project**
Location: **Waterview**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

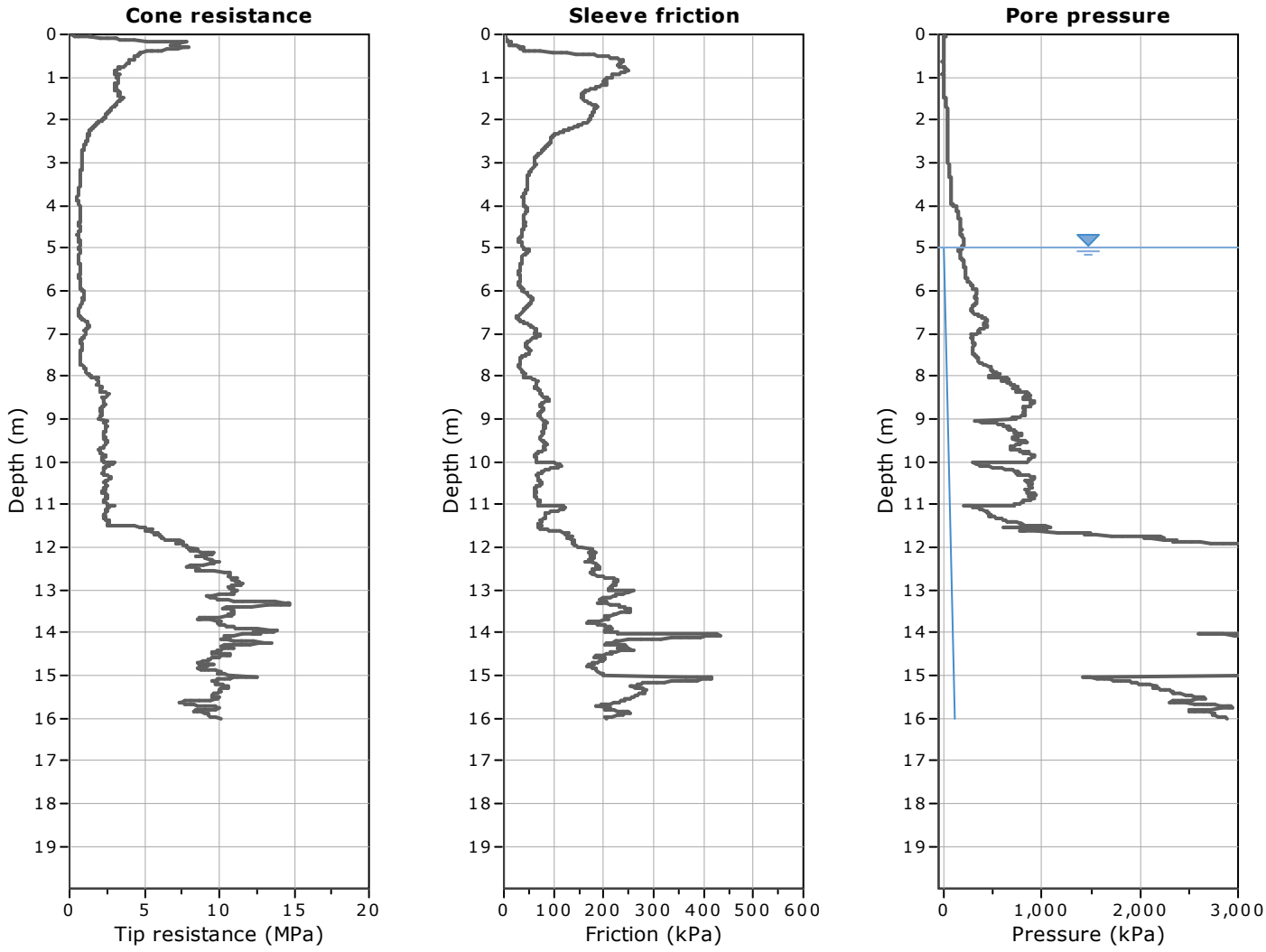


NZGD ID: CPT_105311

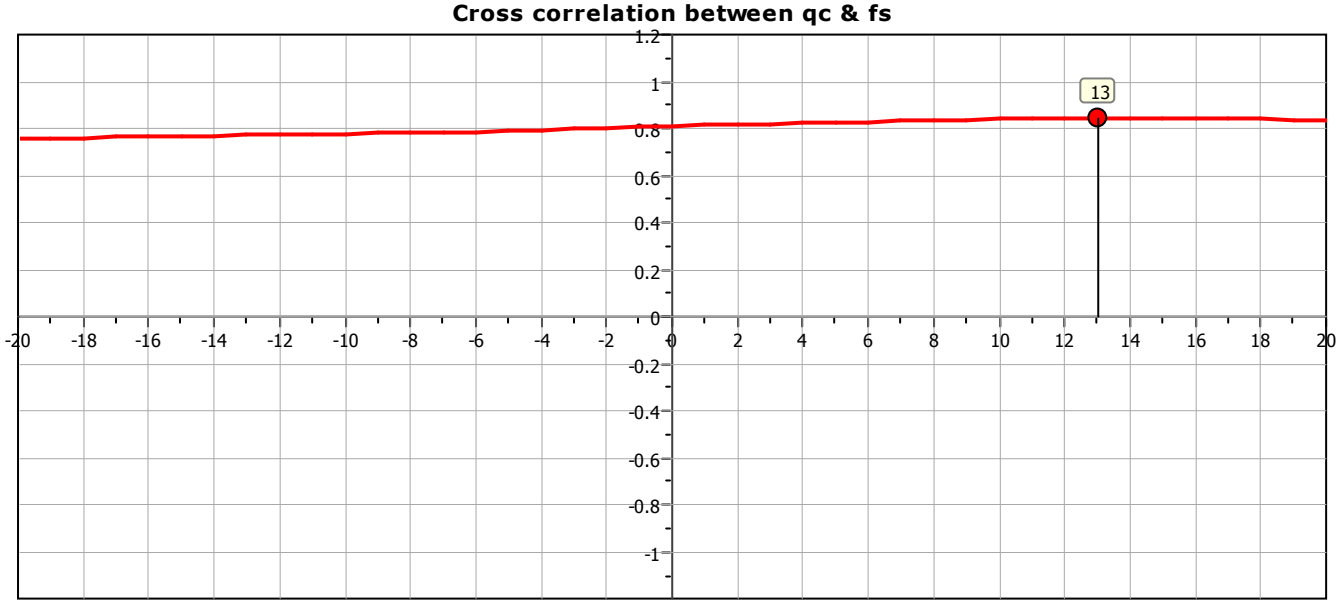
Ground Investigation Ltd
PO Box 21-956, Henderson, Auckland 0650
Ph: (09) 950 1919, (021) 191 6000
http://www.g-i.co.nz

CPT: CPT1065
Total depth: 16.00 m, Date: 1/03/2013
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Waterview Project**
Location: **Waterview**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

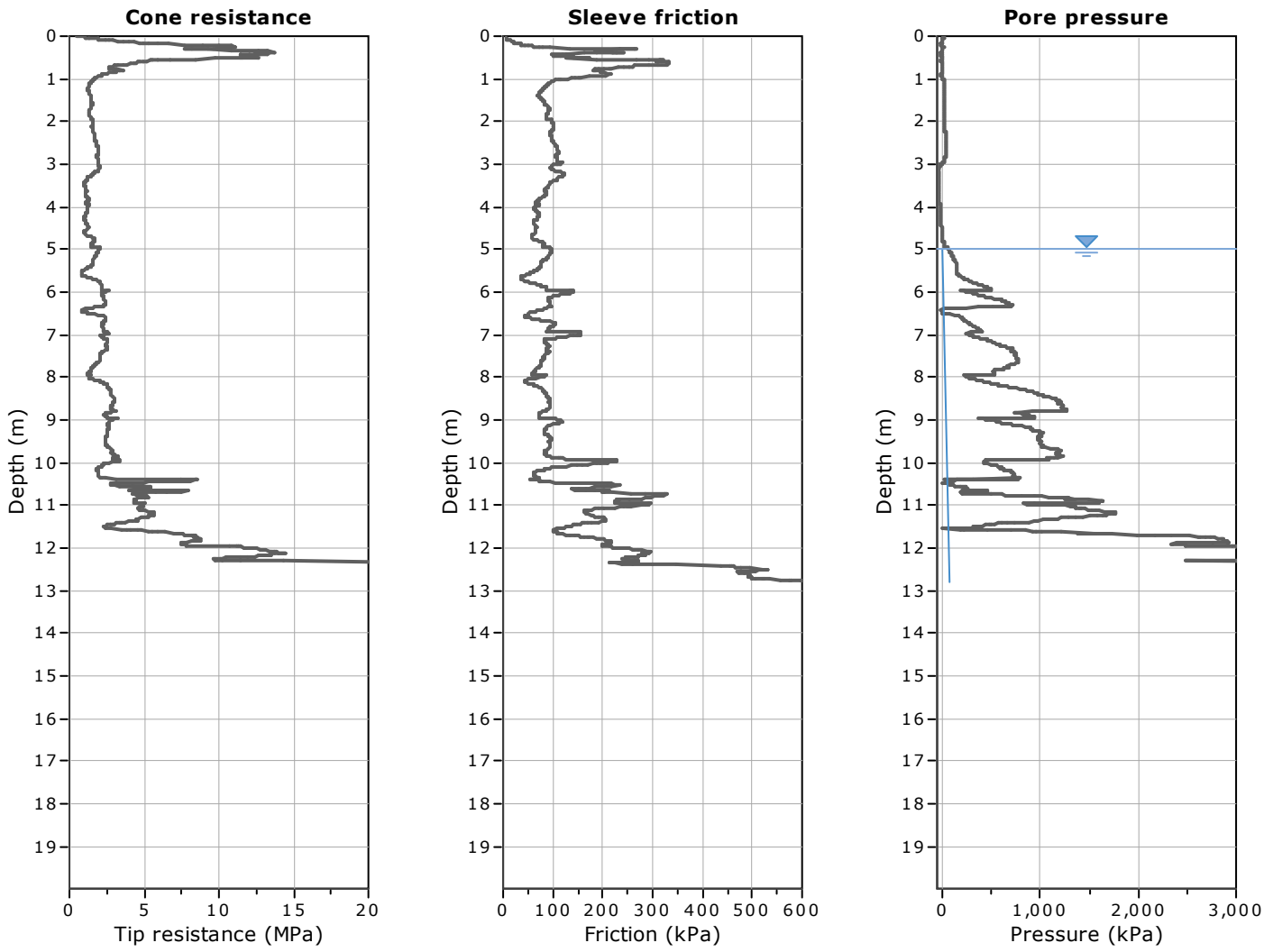


NZGD ID: CPT_105317

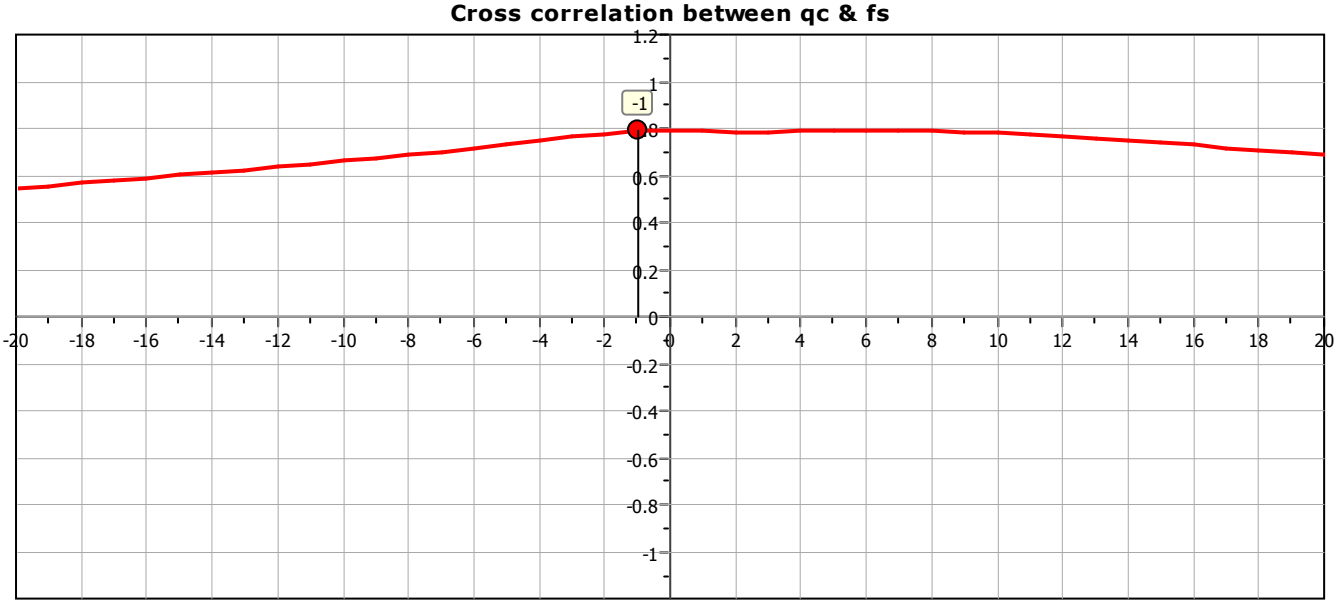
Ground Investigation Ltd
PO Box 21-956, Henderson, Auckland 0650
Ph: (09) 950 1919, (021) 191 6000
http://www.g-i.co.nz

CPT: CPT1067
Total depth: 12.79 m, Date: 8/03/2013
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project: **Waterview Project**
Location: **Waterview**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



NZGD ID: CPT_105318

aurecon
139 Carlton Gore Road
PO Box 9762
Newmarket
Auckland, New Zealand
Tel: +64 9 520 6019
www.aurecongroup.com

Client: **New Zealand Transport Agency**
Project: **SH16 - Sectors 5 and 6 Waterview Connection**
Location: **Westbound, east of Carrington Rd on top of embankment.**
Project Reference: **B289-033-06**

WS720

DRILLING INFORMATION

Drilling Method: Hand Held Window Sampler
Diameter Core: 85mm - 38mm
Flush: N/A
Contractor: Geotechnics

CO-ORDINATES []

Easting: 1752445.237
Northing: 5917994.335
Ground Level: 27.20m
[]

Date Started: 3/03/2010
Date Completed: 3/03/2010

Inclination: -90°
Orientation: N/A

Drilling Method	R.L. (m)	Depth (m)	Sample Type	Water Level (m)	Graphic Log	Geological Name	Layer Code	Description of Materials	Weathering/USCS	TCR (%)	SCR (%)	RQD (%)	Fracture Index	Standard Penetration Tests [SPT] Peak/ Residual 'Su' or Blows	Standard Penetration Tests [SPT] 'N' Value	Additional Information (Defect Description)	Installation Details
WS	27.0						T	**0m:** TOPSOIL								0m: TOPSOIL	
							ATl	**0.2m:** Clayey SILT, yellowish brown. Hard, dry, moderately plastic when wet [TAURANGA GROUP].	MI							0.2m: TAURANGA GROUP	
	26.5		ES			Tauranga Group		**0.5m:** Clayey SILT with bands of trace fine sand, light grey mottled brownish yellow. Very stiff, dry to moist, slightly plastic.	ML								
WS	26.0	1						**1.2m:** ...becomes light grey mottled brownish red and brownish yellow.									
	25.5							**1.7m:** Grades to silty CLAY, light grey. Stiff to very stiff, moist, highly plastic.									
WS		2					ATc	**2.2m:** ...grades to light grey mottled brownish red.	CH								
	25.0																
	24.5		ES														
		3						WS720 terminated at 3m depth - .								3m: Target depth.	

Remarks:
1. Hole cleared for underground services.
2. Hole backfilled with recovered material.
3. No groundwater encountered.
4. No obvious evidence of contamination noted in field.

Logged: DAC
Input: DAC
Checked: AJB
Verified: NRH

Last Generated: 4/11/2010 12:21:22 PM

aurecon
139 Carlton Gore Road
PO Box 9762
Newmarket
Auckland, New Zealand
Tel: +64 9 520 6019
www.aurecongroup.com

Client: **New Zealand Transport Agency**
Project: **SH16 - Sectors 5 and 6 Waterview Connection**
Location: **Eastbound, top of embankment in carpark east of Carrington Rd.**
Project Reference: **B289-033-06**

WS725

DRILLING INFORMATION

Drilling Method: Hand Held Window Sampler
Diameter Core: 85mm - 38mm
Flush: N/A
Contractor: Geotechnics

CO-ORDINATES []

Easting: 1752446.204
Northing: 5918047.265
Ground Level: 27.08m
[]

Date Started: 4/03/2010
Date Completed: 4/03/2010

Inclination: -90°
Orientation: N/A

Drilling Method	R.L. (m)	Depth (m)	Sample Type	Water Level (m)	Graphic Log	Geological Name	Layer Code	Description of Materials	Weathering/USCS	TCR (%)	SCR (%)	RQD (%)	Fracture Index	Standard Penetration Tests [SPT] Peak/ Residual 'Su' or Blows	Standard Penetration Tests [SPT] 'N' Value	Additional Information (Defect Description)	Installation Details
WS	27.0						T	**0m:** Silty CLAY with trace rootlets, brown. Very stiff, dry, moderately plastic when wet [TOPSOIL].	CL							0m: TOPSOIL	
								0.1m: SIlty CLAY, light grey with thinly laminated orange brown banding. Moist to dry, very stiff. Occasional white speckles (RW pumice?). Occasional tree roots [TAURANGA GROUP].								0.1m: TAURANGA GROUP Desication cracks(?) have polished faces.	
	26.5		ES					**0.7m:** ...light grey mottled brownish red. White speckles present.									
WS	26.0	1				Tauranga Group	ATc	**1.15m:** ...white speckles up to fine gravel size.	CH								
			ES														
	25.5							**1.5m:** ...occasional thin bands with up to minor fine gravel size white speckles (RW pumice?).									
		2															
WS	25.0							**2.2m:** ...banding becomes light pink.									
	24.5							**2.6m:** ...becomes reddish brown banded light grey.									
		3						WS725 terminated at 3m depth - .								3m: Target depth.	

Remarks:
1. Hole cleared for underground services.
2. Hole backfilled with recovered material.
3. No groundwater encountered.
4. No obvious evidence of contamination noted in field.

Logged: DAC
Input: DAC
Checked: AJB
Verified: NRH

Last Generated: 4/11/2010 12:21:23 PM

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139 Carlton Gore Road
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Newmarket
Auckland, New Zealand
Tel: +64 9 520 6019
www.aurecongroup.com

Client: **New Zealand Transport Agency**
Project: **SH16 - Sectors 5 and 6 Waterview Connection**
Location: **Eastbound, west of Carrington Rd.**
Project Reference: **B289-033-06**

WS727

DRILLING INFORMATION

Drilling Method: Hand Held Window Sampler
Diameter Core: 85mm - 38mm
Flush: N/A
Contractor: Geotechnics

CO-ORDINATES []

Easting: 1752376.035
Northing: 5918045.786
Ground Level: 28.00m
[]

Date Started: 4/03/2010
Date Completed: 4/03/2010

Inclination: -90°
Orientation: N/A

Drilling Method	R.L. (m)	Depth (m)	Sample Type	Water Level (m)	Graphic Log	Geological Name	Layer Code	Description of Materials	Weathering/USCS	TCR (%)	SCR (%)	RQD (%)	Fracture Index	Standard Penetration Tests [SPT] Peak/ Residual 'Su' or Blows	Standard Penetration Tests [SPT] 'N' Value	Additional Information (Defect Description)	Installation Details
WS	27.5		ES			Fill	F	**0m:** Silty GRAVEL with some fine to coarse sand, brown. Medium dense to dense, moderately tightly packed, dry. Gravel is fine to coarse scoria and basalt, sub angular to angular [FILL]. **0.59m:** ...50mm of tightly packed scoria gravel.								0m: FILL	
WS	27.0	1				Tauranga Group	ATc	**0.7m:** Silty CLAY, trace organic fragments, yellowish grey mottled orange brown. Very stiff, moist to dry, highly plastic when wet [TAURANGA GROUP]. **1.4m:** ...becomes light grey mottled orange brown. Trace white speckles (RW pumice?).	CH							0.7m: TAURANGA GROUP	
WS	26.5		ES														
WS	26.0	2					ATl	**2.2m:** Clayey SILT, trace fine sand, light grey with trace orange brown mottling. Firm, moist, moderately to highly plastic.	MI								
WS	25.5																
	25.0	3						WS727 terminated at 3m depth - .								3m: Target depth.	

Remarks:
1. Hole cleared for underground services.
2. Hole backfilled with recovered material.
3. No groundwater encountered.
4. No obvious evidence of contamination noted in field.

Logged:	DAC
Input:	DAC
Checked:	AJB
Verified:	NRH

Last Generated: 4/11/2010 12:21:24 PM

HAND AUGER LOG

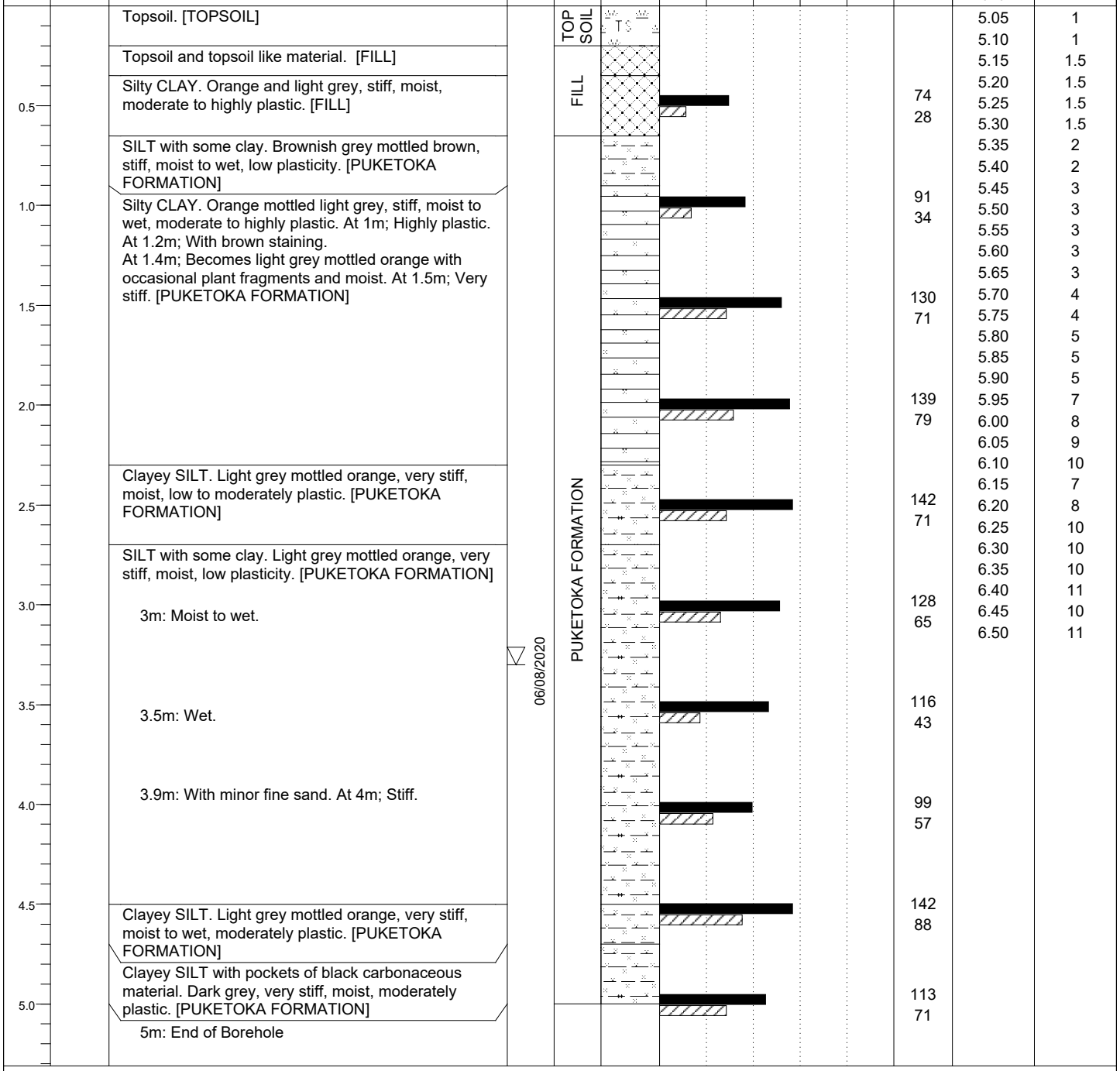
Job No.:	**200576**
Hole No.:	**AH1**
Date:	6/08/2020
Logged By:	SR
Sheet:	1 of 1

Client: KGA Geotechnical Group Ltd

Project: Gladstone Primary School, Mt Albert

Location: See Site Plan

Coordinates: , **Ground Level:** -



Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

Water

▼ Standing Water Level

▽ Water Level At Time Of Drilling

Shear Vane

Corrected as per NZGS Guidelines
Vane No.:GEO1596 is 1.42
UTP = Unable To Penetrate
+ = Peak Exceeded
- = No Result

Other Comments

Flat, School Field. Hole data is for a set location only.

SOIL DYNE LTD
AUCKLAND

M: 027 368 8832

E:
soil.dyne@yahoo.com

Soil Dyne Ltd

Printed: 7/08/2020 4:26:59 pm

NZGD ID: HA_148801

HAND AUGER LOG

Job No.:	**200576**
Hole No.:	**AH2**
Date:	6/08/2020
Logged By:	SR
Sheet:	1 of 1

Client: KGA Geotechnical Group Ltd

Project: Gladstone Primary School, Mt Albert

Location: See Site Plan

Coordinates: , **Ground Level:** -

Depth (m)	RL	Subsurface Conditions	Groundwater	Geological Unit	Graphic Log	Vane Shear Strength (kPa) (refer notes for details) 50 100 150 200	Values	Scala Penetrometer (blows / 50mm) Depth (m)	Blows
0.0		Topsoil. [TOPSOIL]		TOPSOIL				5.05	1
								5.10	2
								5.15	1
								5.20	2
0.5		Topsoil with clayey silt. Brown mottled orange, very stiff, moist, low to moderately plastic. [FILL]		FILL			113	5.25	2
		Silty CLAY with pockets of black carbonaceous material. Orange mottled light grey, black and brown, very stiff, moist, moderate to highly plastic. [FILL]					28	5.30	2
								5.35	2
								5.40	3
1.0		Clayey SILT. Orange mottled brownish grey, very stiff, moist to wet, moderate to highly plastic. At 1m; Becomes stiff with pockets of Topsoil and black carbonaceous material. [FILL]	06/08/2020				85	5.45	3
							31	5.50	3
								5.55	3
								5.60	4
1.5		SILT with some clay and some fine sand. Brown (organic color), stiff, wet to saturated, low plasticity. At 1.4m; Becomes saturated and pushing down. [FILL]					85	5.65	4
							28	5.70	4
								5.75	4
								5.80	5
								5.85	4
2.0		Silty CLAY. Light grey mottled orange, stiff, wet, moderate to highly plastic. At 1.8m; Becomes light grey, moist and highly plastic. [PUKETOKA FORMATION]		PUKETOKA FORMATION			130	5.90	6
							77	5.95	6
		CLAY with some Silt. Light grey mottled orange, very stiff, moist, highly plastic. With occasional plant fragments. [PUKETOKA FORMATION]						6.00	6
								6.05	7
								6.10	7
2.5		Silty CLAY. Light grey and orange, very stiff, moist, highly plastic. [PUKETOKA FORMATION]					139	6.15	8
							71	6.20	7
								6.25	8
								6.30	9
3.0		Clayey SILT. Light grey mottled orange, very stiff, moist to wet, moderately plastic. Between 3.1-3.2m; With some clay. [PUKETOKA FORMATION]					128	6.35	10
							68	6.40	10
								6.45	10
								6.50	10
3.5		SILT with some clay. Light grey, very stiff, wet, low plasticity. At 3.6m; With minor to some clay. [PUKETOKA FORMATION]						6.55	11
							113	6.60	12
							57		
		3.9m: With minor fine sand.							
4.0							128		
		4.2m: With some clay and brownish grey mottled light grey.					71		
4.5		Clayey SILT. Brown and brownish grey, very stiff, moist to wet, moderately plastic. [PUKETOKA FORMATION]					133		
							71		
		Clayey SILT. Dark grey, very stiff, moist, moderately plastic. [WAITEMATA GROUP SOILS]		WAITEMATA GROUP SOILS					
5.0							128		
		SILT with some clay. Dark grey, very stiff, moist to wet, low plasticity. [WAITEMATA GROUP SOILS]					71		
		5m: End of Borehole							
5.5									

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

Water

▼ Standing Water Level

▽ Water Level At Time Of Drilling

Shear Vane

Corrected as per NZGS Guidelines
Vane No.:GEO1596 is 1.42
UTP = Unable To Penetrate
+ = Peak Exceeded
- = No Result

Other Comments

Flat, School Field. Hole data is for a set location only.

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HAND AUGER LOG

Job No.:	**200576**
Hole No.:	**AH3**
Date:	6/08/2020
Logged By:	SR
Sheet:	1 of 1

Client: KGA Geotechnical Group Ltd

Project: Gladstone Primary School, Mt Albert

Location: See Site Plan

Coordinates: , **Ground Level:** -

Depth (m)	Subsurface Conditions	Groundwater	Geological Unit	Vane Shear Strength (kPa) (refer notes for details)	Values	Scala Penetrometer (blows / 50mm) Depth (m)	Blows
0.0	Topsoil. [TOPSOIL]		TOPSOIL	50 100 150 200		5.05	1
						5.10	1
						5.15	2
	Clayey SILT with Topsoil. Orange mottled brown, very stiff, moist, moderately plastic. [FILL]					5.20	2
0.5	Silty CLAY with Topsoil pockets. Orange mottled brown, very stiff, moist, moderate to highly plastic. [FILL]		FILL		116	5.25	2
					34	5.30	3
						5.35	3
						5.40	4
1.0					133	5.45	3
					28	5.50	4
	Topsoil with Silt and minor clay. Brown mottled brownish grey, very stiff, moist to wet, very low plasticity. [FILL]					5.55	4
						5.60	4
						5.65	4
1.5	SILT with minor clay. Orange mottled brownish grey, very stiff, moist to wet, low plasticity. At 1.5m; With some clay, stiff and wet. [PUKETOKA FORMATION]		PUKETOKA FORMATION		99	5.70	5
					31	5.75	6
	Clayey SILT. Orange mottled light grey, stiff, wet, moderately plastic. [PUKETOKA FORMATION]					5.80	6
						5.85	5
						5.90	6
2.0	Silty CLAY. Orange and light grey, stiff, moist to wet, highly plastic. At 2m; Very stiff. [PUKETOKA FORMATION]				128	5.95	10
					48	6.00	10
						6.05	11
						6.10	11
	CLAY with some Silt. Light grey and orange, very stiff, moist, highly plastic. With occasional plant fragments. [PUKETOKA FORMATION]					6.15	12
2.5					156	6.20	13
					85		
3.0	3m: Becomes brown (Organic color)				139		
					88		
	Silty CLAY. Brown with black staining (Organic color) , very stiff, moist to wet, highly plastic. [PUKETOKA FORMATION]						
3.5		▽ 06/08/2020			57		
	Organic Silty CLAY with some black plant fragments. Dark brown, stiff, wet, moderate to highly plastic. [PUKETOKA FORMATION]				28		
4.0	Wood fragments. [PUKETOKA FORMATION]				102		
					31		
	Clayey SILT. Grey, very stiff, wet, moderately plastic. With pockets of plant fragments. [PUKETOKA FORMATION]						
4.5	4.6m: With Clasts (25-30%<2mm:d).				116		
					28		
	Fine, loose Sandy SILT with Clasts (<2mm) and minor to trace of clay. Grey, wet, very low plasticity. [PUKETOKA FORMATION]						
5.0	5m: End of Borehole				156		
					28		

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

Water

▼ Standing Water Level

▽ Water Level At Time Of Drilling

Shear Vane

Corrected as per NZGS Guidelines
Vane No.:GEO1596 is 1.42
UTP = Unable To Penetrate
+ = Peak Exceeded
- = No Result

Other Comments

Flat, School Field. Hole data is for a set location only.

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NZGD ID: HA_148803

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BOREHOLE LOG

Borehole No **HA1**

Sheet 1 of 1

Project:	Additions to School Hall			Project No:	GL1404	Drilled:	FDR
Location:	Gladstone Primary School, Mount Albert			Date Drilled:	11-11-2019	Logged:	FDR
Client:	Gladstone Primary School			Hole Type:	HA	Checked:	JM
Coords:	1752619.30 - 5917102.10	Level:	40.30 m AOD	Hole Diameter:	50mm	Scale	1:25

Depth (m)	Legend	Soil Description	Depth (m)	Groundwater	RL (m AOD)	Vane Shear Strength (kPA) Peak	Remould	Soil Sensitivity	Scala Penetrometer (blows per 50mm) 0 5 10 15 20	Depth (m)
		ASPHALT. [Non-engineered Fill]	0.03		40.27					
		HARDFILL, fine to medium scoria gravel, wet. [Non-engineered Fill] *At 0.3m becoming coarse gravel. Some silt.*								
		CLAY, orange brown. Stiff, wet to saturated, high plasticity. [East Coast Bays Formation]	0.80		39.50					
		End of borehole at 0.85 m	0.85		39.45					
1										1
2										2
3										3
4										4

Remarks: Coordinates and levels are derived from Auckland Council GIS and are considered approximate only.
No groundwater encountered.
End of borehole due to hole collapsing.

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BOREHOLE LOG

Borehole No **HA2**

Sheet 1 of 1

Project:	Additions to School Hall		Project No:	GL1404	Drilled: FDR
Location:	Gladstone Primary School, Mount Albert		Date Drilled:	11-11-2019	Logged: FDR
Client:	Gladstone Primary School		Hole Type:	HA	Checked: JM
Coords:	1752611.30 - 5917097.90	Level: 40.40 m AOD	Hole Diameter:	50mm	Scale 1:25

Depth (m)	Soil Description	Depth (m)	RL (m AOD)	Vane Shear Strength (kPA) Peak	Remould	Soil Sensitivity	Scala Penetrometer (blows per 50mm) 0 5 10 15 20	Depth (m)
	TOPSOIL/FILL, some gravel. [Non-engineered Fill]							
	Silty CLAY, grey brown. Stiff, saturated, high plasticity. [Alluvium]	0.40	40.00	77	3	26		
	CLAY, light grey brown and greyish orange brown. Very stiff, wet to saturated, high plasticity. [East Coast Bays Formation]	0.80	39.60					
1	*At 1m becoming orange brown.*			121	46	3		1
	At 1.5m trace rootlets.			103	48	2		
	At 1.7m becoming light greyish orange brown.							
2				161	92	2		2
	Silty CLAY, light whitish grey streaked orange brown. Very stiff, wet, high plasticity. [East Coast Bays Formation]	2.20	38.20					
				220+				
	Clayey SILT, trace to minor fine to medium sand, light whitish grey streaked orange brown. Very stiff, wet, low plasticity. [East Coast Bays Formation]	2.60	37.80					
3	End of borehole at 3.00 m	3.00	37.40	220+				3
4								4

Groundwater ▼

Remarks: Coordinates and levels are derived from Auckland Council GIS and are considered approximate only.
Groundwater measured at 1.7m on completion of borehole
End of borehole at target depth.

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BOREHOLE LOG

Borehole No **HA3**

Sheet 1 of 1

Project:	Additions to School Hall			Project No:	GL1404
Location:	Gladstone Primary School, Mount Albert			Date Drilled:	11-11-2019
Client:	Gladstone Primary School			Hole Type:	HA
Coords:	1752603.40 - 5917108.00	Level:	39.80 m AOD	Hole Diameter:	50mm

Depth (m)	Legend	Soil Description	Depth (m)	Groundwater	RL (m AOD)	Vane Shear Strength (kPA) Peak	Remould	Soil Sensitivity	Scala Penetrometer (blows per 50mm) 0 5 10 15 20	Depth (m)
		ASPHALT.	0.04		39.76					
		GRAVEL, fine to medium, some silt, dark brown and red brown. Loose, wet. [Non-engineered Fill]	0.15		39.65					
		Clayey SILT, some intermixed clay, dark grey brownmixed grey and orange brown. Firm, wet, low plasticity. [Non-engineered Fill]	0.50		39.30	37	21	2		
		CLAY, grey and grey brown. Firm, wet, high plasticity. [Alluvium]	0.70		39.10					
		Silty CLAY, orange brown. Very stiff, moist, high plasticity. [East Coast Bays Formation]								
1						135	58	2		1
		At 1.2m becoming orange brown streaked light grey.								
						135	64	2		
		At 1.6m becoming light grey streaked orange brown.								
2						150	99	2		2
		Clayey SILT, trace fine sand, light grey streaked orange brown. Very stiff, moist, low plasticity. [East Coast Bays Formation]	2.50		37.30	181	104	2		
3		End of borehole at 3.00 m	3.00		36.80	150	61	2		3
4										4

Remarks: Coordinates and levels are derived from Auckland Council GIS and are considered approximate only.
No groundwater encountered.
End of borehole at target depth.

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BOREHOLE LOG

Borehole No **HA4**

Sheet 1 of 1

Project:	Additions to School Hall			Project No:	GL1404
Location:	Gladstone Primary School, Mount Albert			Date Drilled:	11-11-2019
Client:	Gladstone Primary School			Hole Type:	HA
Coords:	1752625.70 - 5917129.80	Level:	38.70 m AOD	Hole Diameter:	50mm

Drilled:	JC
Logged:	FDR
Checked:	JM
Scale	1:25

Depth (m)	Legend	Soil Description	Depth (m)	Groundwater	RL (m AOD)	Vane Shear Strength (kPA) Peak	Remould	Soil Sensitivity	Scala Penetrometer (blows per 50mm) 0 5 10 15 20	Depth (m)
		SILT, some fine to medium gravel, brown, dry to moist, friable. [Non-engineered Fill]								
		Silty CLAY, trace roots/rootlets, orange brown streaked orange brown and light grey brown. Very stiff, moist to wet, high plasticity. [East Coast Bays Formation]	0.25		38.45	145	34	4		
		At 0.6m becoming orange brown mixed light grey.								
1						147	73	2		1
		At 1.1m becoming light grey streaked orangne brown.								
						135	58	2		
		At 1.7m roots/rootlets absent.								
2						135	73	2		2
		At 2.5m trace rootlets.				116	52	2		
		Clayey SILT, light grey streaked orange brown. Stiff to Very stiff, wet, low plasticity. [East Coast Bays Formation]	2.60		36.10					
3		End of borehole at 3.00 m	3.00		35.70	73	23	3		3
4										4

Remarks: Coordinates and levels are derived from Auckland Council GIS and are considered approximate only.
No groundwater encountered.
End of borehole at target depth.

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NZGD ID: HA_155614

LandTech CONSULTING

Client:	Williams Corporation	Augerhole No.	HA01
Project:	Proposed Risedintial Subdivision	Sheet No.	1 of 8
Address:	200 Carrington Road, Mount Albert		

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	CB
Drilled By:	CB	Coordinates:	E1752688.77 N5916799.66	Shear Vane No:	2486
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.483
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	17-Feb-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL			SILT, minor fine to coarse sand, trace organics, dark brown, very stiff dry, non-plastic.
AUCKLAND VOLCANIC FIELD	0.5		SILT, minor clay, trace fine sand, brownish orange with grey mottles, hard, moist, slightly plastic.
	1.0		Clayey SILT, trace fines sand, light grey with orange streaks, light grey and dark grey specks, very stiff, moist, moderately to highly plastic.
	1.5		minor fine to medium sand, reddish orange streaks
	2.0		SILT, some clay, minor fine to medium sand, light grey with orange and reddish orange steaks, very stiff, moist, moderately plastic.
			pinkish red streaks
	2.5		trace fine to medium sand
EAST COAT BAYS FORMATION	3.0		Clayey SILT, light grey with pinkish red and orange streaks, very stiff, moist, moderately to highly plastic.
	3.5		pinkish red with light grey mottles
	4.0		
	4.5		
	5.0		End of Hand Auger Hole 5.0m [TARGET DEPTH]

Groundwater Level (m)

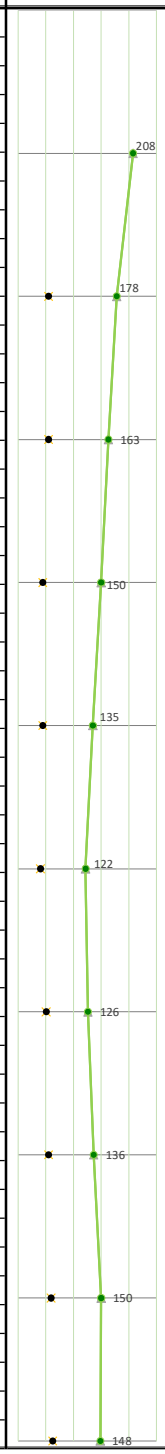
In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0 50 100 150 200 250



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		0
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

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Website: www.landtech.nz

NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client:	Williams Corporation	Augerhole No.	HA02
Project:	Proposed Risedintial Subdivision	Sheet No.	2 of 8
Address:	200 Carrington Road, Mount Albert		

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	NS
Drilled By:	NS	Coordinates:	E1752686.06 N5916831.61	Shear Vane No:	2995
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.399
Date Finished:	10-Mar-21	Groundwater Level (m):	4.3m	Calibration Date:	12-Oct-20

Stratigraphy	Depth (m)	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL	0.0	SILT, minor fine to medium sand, some clay, trace roots, dark brown, very stiff, moist, slightly plastic.
AUCKLAND VOLCANIC FIELD	0.5	Clayey SILT, mottled dark brown and brown, very stiff, moist, moderately plastic.
		orange streaks
	1.0	white speckles
		SILT, minor clay, mottled light grey and orange brown, very stiff, moist, slightly plastic.
	1.5	pink mottles, trace clay, minor fine sand, non-plastic.
	2.0	
	2.5	orange brown speckled white
	3.0	
EAST COAT BAYS FORMATION	3.5	SILT, minor to some clay, brown mottles with light grey streaks, very stiff, wet, slightly plastic.
	4.0	pink
	4.5	brown
		Silty CLAY, light grey with pink and orange streaks, very stiff, wet, highly plastic
	5.0	dark brown and light grey intermixed

Groundwater Level 4.3m

In-situ Field Testing

Shear Strength (kPa) — Peak: / Remoulded: — 0 50 100 150 200 250

Depth (m)	Peak	Remoulded
0.5	173	
1.0	143	
1.5	196	
2.0	196	
2.5	196	
3.0	162	
3.5	98	
4.0	102	
4.5	95	
5.0	196	

Dynamic Cone (Scala) Penetrometer — Depth (m) / Blow Count / Scala Blow Count / 100mm (0)

-0.1 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1.0 -1.1 -1.2 -1.3 -1.4 -1.5 -1.6 -1.7 -1.8 -1.9 -2.0 -2.1 -2.2 -2.3 -2.4 -2.5 -2.6 -2.7 -2.8 -2.9 -3.0 -3.1 -3.2 -3.3 -3.4 -3.5 -3.6 -3.7 -3.8 -3.9 -4.0 -4.1 -4.2 -4.3 -4.4 -4.5 -4.6 -4.7 -4.8 -4.9 -5.0

End of Hand Auger Hole 5.0m
[TARGET DEPTH]

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

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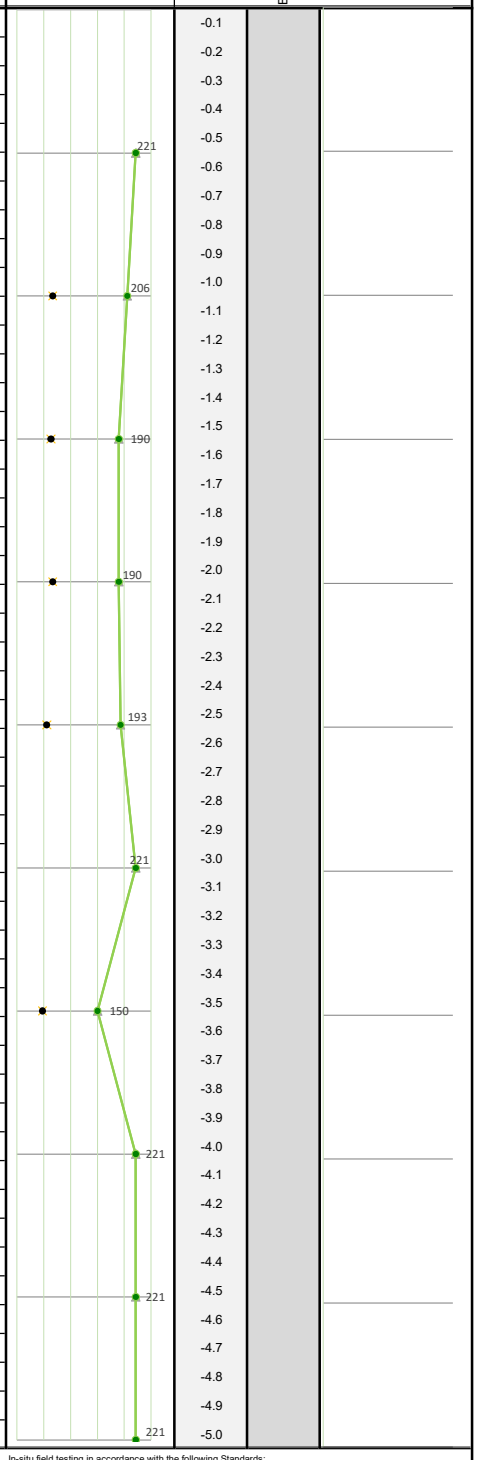
Website: www.landtech.nz

NZGD ID: HA-DCP_158146

Client:	Williams Corporation	Augerhole No.	HA03
Project:	Proposed Risedintial Subdivision		
Address:	200 Carrington Road, Mount Albert	Sheet No.	3 of 8

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	AA
Drilled By:	AA	Coordinates:	E1752709.74 N5916814.27	Shear Vane No:	2715
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.582
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	21-Aug-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL			SILT, orgaic, minor rootlets, brown. minor fine to medium gravel (brick), trace fine to medium sand
AUCKLAND VOLCANIC FIELD	0.5		Silty CLAY, trace rootlets, orange brown with grey brown mottles, very stiff to hard, moist, highly plastic.
	1.0		SILT, trace clay, light grey with orange brown streaks, very stiff, moist, slightly plastic.
EAST COAT BAYS FORMATION	1.5		light grey streaked orange brown, clay absent
	2.0		red brown with light grey and pinkish red streaks
	2.5		red brown mottled pink
	3.0		
	3.5		
	4.0		light greyish pink
	4.5		light grey, wet
	5.0		End of Hand Auger Hole 5.0m [TARGET DEPTH]



In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

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Website: www.landtech.nz

NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client: Williams Corporation
Project: Proposed Risedintial Subdivision
Address: 200 Carrington Road, Mount Albert

Augerhole No. HA04
Sheet No. 4 of 8

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	CB
Drilled By:	CB	Coordinates:	E1752715.89 N5916829.22	Shear Vane No:	2486
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.483
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	17-Feb-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL			SILT, minor fine to medium sand, trace clay, trace organics, dark brown, stiff, moist, slightly plastic.
AUCKLAND VOLCANIC FIELD	0.5		Clayey SILT, orangish brown with grey mottles, very stiff, moist, moderately to highly plastic.
			light grey with orange streaks and light grey and dark grey specks
	1.0		minor fine to medium sand
EAST COAT BAYS FORMATION	1.5		Clayey SILT, orangish brown with grey mottles and pinkish red streaks, very stiff, moist, moderately to highly plastic.
	2.0		Silty CLAY, pinkish red with light grey mottles and orange streaks, very stiff, moist, highly plastic.
	2.5		dark orange mottles
	3.0		
	3.5		
	4.0		
	4.5		minor fine sand
	5.0		End of Hand Auger Hole 5.0m [TARGET DEPTH]

Groundwater Level (m)

In-situ Field Testing

Shear Strength (kPa) — Peak: / Remoulded: — 0 50 100 150 200 250

Depth (m)	Peak	Remoulded
0.5	169	
1.0	181	
1.5	175	
2.0	123	
2.5	113	
3.0	113	
3.5	119	
4.0	89	
4.5	113	
5.0	110	

Dynamic Cone (Scala) Penetrometer — Depth (m) / Blow Count / Scala Blow Count / 100mm (0)

-0.1 -0.2 -0.3 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1.0 -1.1 -1.2 -1.3 -1.4 -1.5 -1.6 -1.7 -1.8 -1.9 -2.0 -2.1 -2.2 -2.3 -2.4 -2.5 -2.6 -2.7 -2.8 -2.9 -3.0 -3.1 -3.2 -3.3 -3.4 -3.5 -3.6 -3.7 -3.8 -3.9 -4.0 -4.1 -4.2 -4.3 -4.4 -4.5 -4.6 -4.7 -4.8 -4.9 -5.0

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd. (Christchurch): 11B Carlyle Street, Sydenham
LandTech Consulting Ltd. (Auckland): 17 Nils Andersen Road, Whenuapai
Phone: (03) 390 1371
Phone: (09) 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

NZGD ID: HA-DCP_158146

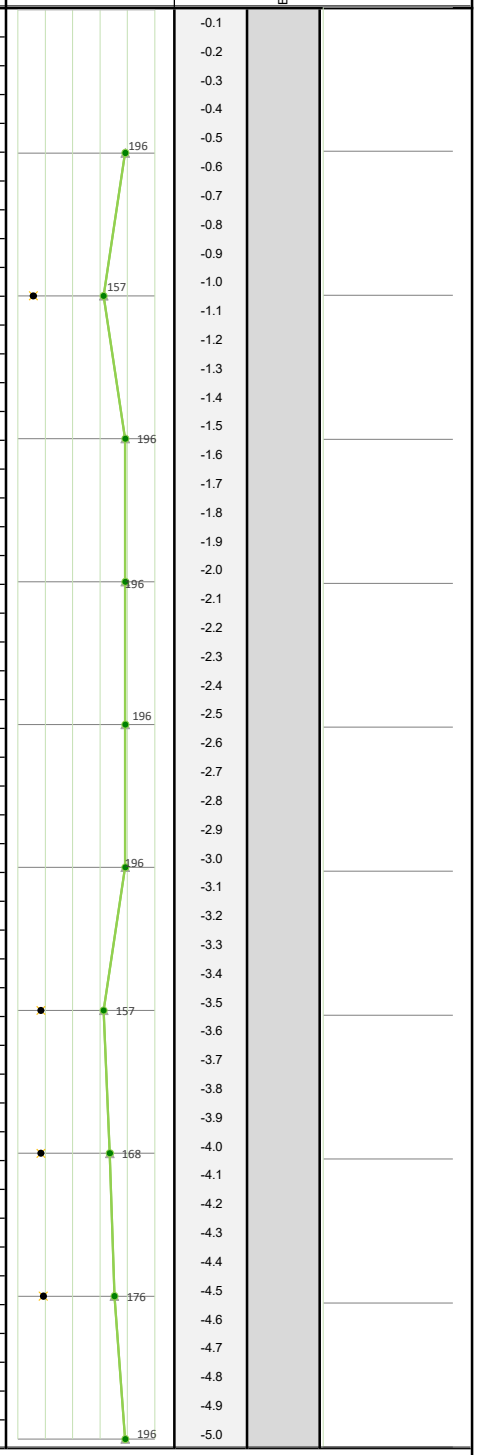
LandTech CONSULTING

Client: Williams Corporation
Project: Proposed Risedintial Subdivision
Address: 200 Carrington Road, Mount Albert

Augerhole No. HA05
Sheet No. 5 of 8

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	NS
Drilled By:	NS	Coordinates:	E1752699.69 N5916845.43	Shear Vane No:	2995
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.399
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	12-Oct-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)
TS/FILL	0.5		SILT, some fine to coarse sand, dark brown, moist non-plastic.	
AUCKLAND VOLCANIC FIELD	1.0		SILT, minor clay, yellowish brown, very stiff, moist, slightly plastic.	
	1.5		Silty CLAY, brown with orange and light grey streaks, very stiff, moist, highly plastic.	
	2.0		Clayey SILT, light grey mottled orange brown, very stiff, moist, moderately plastic.	
	2.5		SILT, minor clay, moist, light grey orange, very stiff, moist, slightly plastic. mottled light grey	
	3.0		purple mottles, trace clay	
	3.5		brownish orange with white specks	
	4.0			
	4.5		wet	
	5.0		End of Hand Auger Hole 5.0m [TARGET DEPTH]	



In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

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Phone: (03) 390 1371
Phone: (09) 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client: Williams Corporation
Project: Proposed Risedintial Subdivision
Address: 200 Carrington Road, Mount Albert

Augerhole No. HA06
Sheet No. 6 of 8

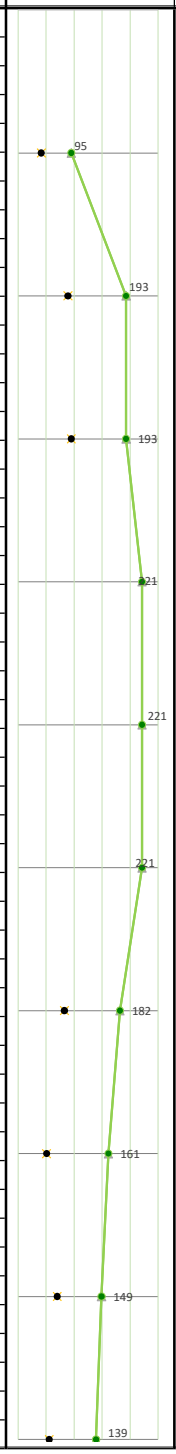
Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	AA
Drilled By:	AA	Coordinates:	E1752708.09 N5916851.98	Shear Vane No:	2715
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.582
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	21-Aug-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL	0.5		SILT, organic brown, moist, stiff.
AUCKLAND VOLCANIC FIELD	1.0		Silty CLAY, orange brown with grey brown mottles, stiff to very stiff, moist, highly plastic.
	1.5		light grey with orange brown streaks speckled brown
	2.0		
	2.5		SILT, trace fine sand, trace clay, light red brown streaked light grey, very stiff to hard, moist, slightly plastic.
	3.0		light greyish pink, clay absent
	3.5		red brown with light grey and pink mottles, sand absent
EAST COAT BAYS FORMATION	4.0		SILT, trace fine sand, trace clay, dark orange brown with light grey mottles, very stiff to hard, moist, slightly plastic.
	4.5		light grey with orange brown and red brown streaks
	5.0		

Groundwater Level (m)

In-situ Field Testing

Shear Strength (kPa) — Peak: / Remoulded: — 0 50 100 150 200 250



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		0
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

End of Hand Auger Hole 5.0m
[TARGET DEPTH]

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

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Phone: (03) 390 1371
Phone: (09) 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

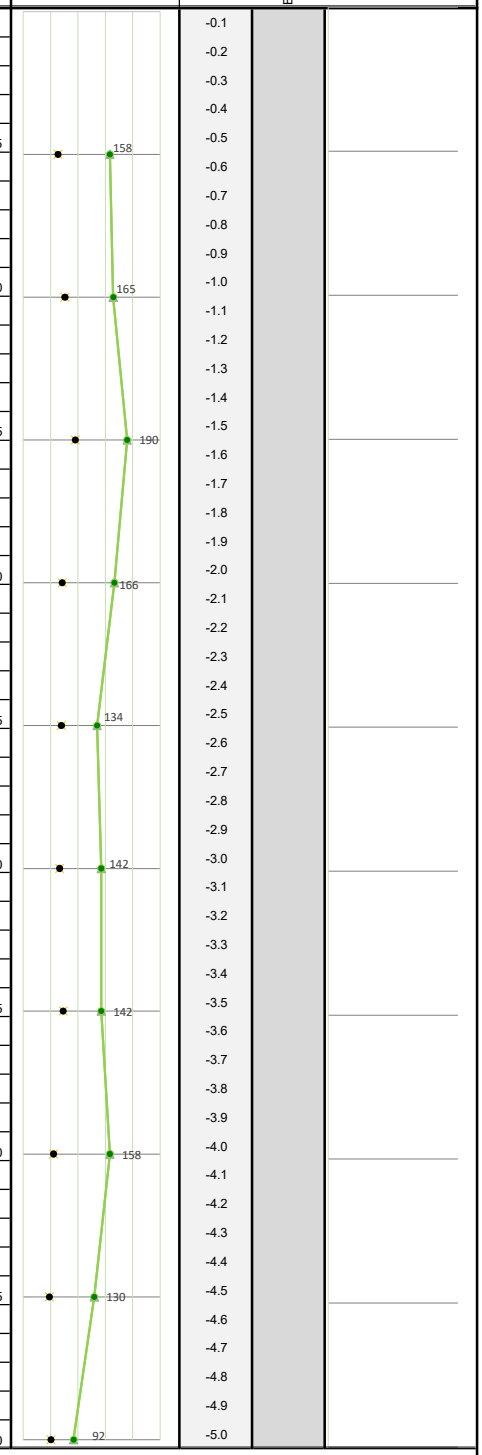
NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client:	Williams Corporation	Augerhole No.	HA07
Project:	Proposed Risedintial Subdivision	Sheet No.	7 of 8
Address:	200 Carrington Road, Mount Albert		

Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	AA
Drilled By:	AA	Coordinates:	E1752725.15 N5916867.32	Shear Vane No:	2715
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.582
Date Finished:	10-Mar-21	Groundwater Level (m):	Ground Water Not Encountered	Calibration Date:	21-Aug-20

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL	0.5		SILT, organic, minor clay, brown speckled light grey, moist,
EAST COAT BAYS FORMATION	1.0		Silty CLAY, orange brown streaked orange grey, very stiff, moist, highly plastic.
	1.5		orange brown streaked light grey
	2.0		SILT, orange brown streaked light grey, very stiff, moist, slightly plastic.
	2.5		red brown streaked light grey
	3.0		orange brown streaked light grey
	3.5		
	4.0		
	4.5		light pinkish red with light grey streaks, wet
	5.0		minor fine sand
			dark orange brown, trace fine to medium limonite gravel
			End of Hand Auger Hole 5.0m [TARGET DEPTH]



In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd. (Christchurch): 11B Carlyle Street, Sydenham
LandTech Consulting Ltd. (Auckland): 17 Nils Andersen Road, Whenuapai
Phone: (03) 390 1371
Phone: (09) 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client: Williams Corporation
Project: Proposed Risedintial Subdivision
Address: 200 Carrington Road, Mount Albert

Augerhole No. HA08
Sheet No. 8 of 8

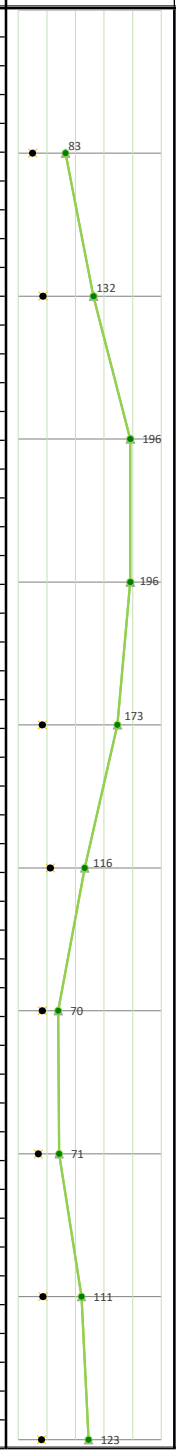
Drill Type:	50mmØ Hand Auger	Project No:	LTA21084	Logged By:	NS
Drilled By:	NS	Coordinates:	E1752740.1 N5916854.95	Shear Vane No:	2995
Date Started:	10-Mar-21	Ground Conditions:	Near Level Grass	Calibration Factor:	1.399
Date Finished:	10-Mar-21	Groundwater Level (m):	3.7m	Calibration Date:	12-Oct-20

Stratigraphy	Depth (m)	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS/FILL	0.5	SILT, minor clay, minor fine sand, dark brown, moist, slightly plastic.
AUCKLAND VOLCANIC FIELD	1.0	Silty CLAY, brown, very stiff, moist, highly plastic.
		light grey and orange streaks
	1.5	SILT, some clay, brown, light grey and orange streaks, very stiff, moist, slightly plastic.
		Clayey SILT, brown, light grey and orange streaks, very stiff, moist, medorately to highly plastic.
		dark brown
	2.0	SILT, trace sub-angular fine gravel, minor clay, dark brown and brown intermix, very stiff, moist, slightly plastic.
		gravel absent
	2.5	
EAST COAT BAYS FORMATION	3.0	Clayey SILT, brown with light grey streaks, very stiff, wet, moderately plastic.
	3.5	
	4.0	SILT, minor clay, brown, very stiff, saturated, slightly plastic.
		clay absent
	4.5	
	5.0	End of Hand Auger Hole 5.0m [TARGET DEPTH]

Groundwater Level 3.7m

In-situ Field Testing

Shear Strength (kPa) — Peak: / Remoulded: — 0 50 100 150 200 250



Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1		0
-0.2		
-0.3		
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:
Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech Consulting Ltd. (Christchurch): 11B Carlyle Street, Sydenham
LandTech Consulting Ltd. (Auckland): 17 Nils Andersen Road, Whenuapai
Phone: (03) 390 1371
Phone: (09) 930 9334
Email: info@landtech.nz
Website: www.landtech.nz

NZGD ID: HA-DCP_158146

LandTech CONSULTING

Client: Williams Corporation Ltd
Project: Proposed Residential Subdivision
Address: 200 Carrington Road, Mount Albert, Auckland

Scala Penetrometer Testing

Date tested: 10/03/2021

Tested By: AA+CB

Test ID	HA01	HA02	HA03	HA04	HA05	HA06	HA07	HA08		
Test from (m)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0		
Depth (m)	Blows/100mm penetration									
5.0	6	5	6	3	7	3	2	3		
5.1	6	6	9	4	7	4	4	4		
5.2	6	8	8	4	8	6	5	4		
5.3	8	9	9	7	10	6	5	8		
5.4	4	10	10	8	10	8	7	7		
5.5	11	12	12	8	13	9	6	8		
5.6	14	11	13	9	15	9	7	10		
5.7	13	11	13	10	21	13	8	8		
5.8	14	15	17	11	20	8	11	12		
5.9	17	19	20	13		11	10	15		
6.0	20	20	20	16		14	15	18		
6.1	20	20		16		15	15	20		
6.2				14		17	14	20		
6.3				16		15	14			
6.4				16		16	12			
6.5				18		17	15			
6.6				20		18	14			
6.7				20		20	15			
6.8						20	17			
6.9							14			
7.0							20			
7.1							20			
7.2										
Test depth (m)	6.1	6.1	6.0	6.7	5.8	6.8	7.1	6.2		

In-situ field testing in accordance with Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Tonkin+Taylor

HAND AUGER LOG

HOLE Id: **HA02**

Hole Location: 56 Carrington Road, Pt Chevalier - southwestern corner of site.

SHEET: 1 OF 1

PROJECT: 56 Carrington | LOCATION: | JOB No.: 1020622.0000

CO-ORDINATES: (NZTM2000) 5917642.30 mN 1752462.88 mE

R.L.: 23.00m

DATUM: NZVD2016

DRILL TYPE: Hand Auger

DRILL METHOD: HA+DCP

HOLE STARTED: 15/06/2022

HOLE FINISHED: 15/06/2022

DRILLED BY: Tonkin + Taylor Ltd

LOGGED BY: COCU CHECKED: RLXB

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Description and Additional Observations
Topsoil	*0.00m:* Organic SILT, some clay and some sand; brown. Very stiff, dry, well graded, low plasticity. Sand, fine.
Fill	*0.20m:* CLAY, some silt, trace sand; light brown streaked orange. Very stiff, dry, high plasticity.
East Coast Bays Formation	*1.00m:* Silty CLAY, trace sand; grey mottled orange. Very stiff, dry, high plasticity.
	1.80m: SILT, some clay, minor sand, trace rootlets; grey mottled orange. Stiff to very stiff, moist, high plasticity. , Rootlets 2-3 mm.
	2.00m: Clayey SILT, minor sand; light brownish orange. Stiff, moist, high plasticity.
	2.40m: Sandy SILT, minor clay; light brownish grey. Stiff to very stiff, moist, medium plasticity. Sand, fine.
	3.50m: Silty fine SAND, minor clay; light brownish grey. Loosely packed, moist.
	3.90m: Fine to medium SAND, some silt, minor clay; greyish orange. Loosely packed, moist.
	5.8m: END OF BOREHOLE. Target depth.

WATER: 15/06/2022

CORE RECOVERY (%): Box 1, 0.0-4.0m

METHOD

SCALA PENETROMETER (Blows/50mm)

TESTS: 105/12 kPa; 149/52 kPa; 130/66 kPa; 117/31 kPa; 134/69 kPa; 106/47 kPa; 78/41 kPa; 106/30 kPa; 89/25 kPa; 86/31 kPa; 58/28 kPa; 124/30 kPa; 118/34 kPa

SAMPLES

RL (m): 22, 21, 20, 19, 18

DEPTH (m): 1, 2, 3, 4, 5

GRAPHIC LOG: TS

MOISTURE CONDITION / WEATHERING: D; D / RS; M / RS

STRENGTH/DENSITY CLASSIFICATION

SHEAR STRENGTH (kPa): 10, 25, 50, 100, 200

COMMENTS: Hand auger reached target depth of 4.0m bgl. Scala penetrometer test undertaken from the base of the borehole to refusal at 5.8 m bgl. Environmental samples collected prior to photo of spoil.

Hole Depth 5.8m

Scale 1:30

Rev.: A

NZGD ID: HA-DCP_184210

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **HA02**

Hole Location: 56 Carrington Road, Pt Chevalier - southwestern corner of site.

PROJECT: 56 Carrington	LOCATION:	JOB No.: 1020622.0000
CO-ORDINATES: (NZTM2000) 5917642.30 mN 1752462.88 mE R.L.: 23.00m DATUM: NZVD2016	DRILL TYPE: Hand Auger DRILL METHOD: HA+DCP	HOLE STARTED: 15/06/2022 HOLE FINISHED: 15/06/2022 DRILLED BY: Tonkin + Taylor Ltd LOGGED BY: COCU CHECKED: RLXB

0.00-4.00m

NZGD ID: HA-DCP_184210

B

Appendix B – Geotechnical Interpretive Report

Point Chevalier Watermain No.2

Geotechnical Interpretive Report

Prepared for Watercare Services Limited
Prepared by Beca Limited

12 February 2025

Contents

Appendices

Revision History

Revision Nº	Prepared By	Description	Date
0	Sophie Hindley/ Hugh MacMurray	Draft report issued to Watercare	12.02.2025

Document Acceptance

Action	Name	Signed	Date
Prepared by	Sophie Hindley/ Hugh MacMurray		12.02.2025
Reviewed by	Ross Paterson		12.02.2025
Approved by	David Heiler		12.02.2025
on behalf of	Beca Limited		

1 Introduction

Watercare Services Limited (Watercare) is proposing to upgrade their existing water infrastructure at Carrington Road, Mount Albert. To realise efficiencies from a design coordination and construction perspective, a stretch of watermain has been taken out of the wider project to deliver in parallel with the AT Carrington Road Improvements Project (CRIP).

Watercare has engaged Beca Limited (Beca) to confirm the basis of design and deliver the preliminary design of this stretch of watermain along Carrington Road between Seaview Terrace and Sutherland Road BSP, referred to as the Point Chevalier Watermain No.2.

The geotechnical scope of work to be undertaken by Beca is outlined in Task Order Agreement No. 22-023-EDS.A issued under Design Delivery Partner Contract for Engineering Consultancy between Watercare and Beca.

The purpose of this report is to provide geotechnical analysis and recommendations to support the preliminary design of the Point Chevalier Watermain No.2. This geotechnical interpretive report summarises the ground conditions at the site, assesses the key geotechnical risks, and provides geotechnical recommendations for design.

2 Proposed Development

The proposed development is located at Carrington Road, Mount Albert and involves upgrading a stretch of watermain as part of a larger development. The key geotechnical components of the proposed works are to provide:

- Geological profile along the pipeline alignment.
- Expected groundwater levels and soil permeability.
- Design soil parameters.
- In-situ soil modulus and bearing capacity at subgrade level along the pipeline alignment.
- Bearing capacity at the base of the proposed valve chamber.
- Earth pressure parameters around the proposed valve chamber.
- High level commentary on trenching stability / identification of locations with instability.
- Commentary on pipe floatation risk.
- Commentary on seismic behaviour of the pipeline corridor (to 5m depth).

3 Site Description

The site address is 28 to 158 Carrington Road, Mount Albert, Auckland. The site is bounded by residential houses to the East and Unitec Mt Albert Campus to the west. The approximate site boundary is shown on Figure 1.

The proposed pipeline alignment is on the west side of Carrington Road which generally follows a broad ridgeline, gently sloping down to the north, with elevation ranging from about 38 m to 24 m above mean sea level (NZVD2016).

Carrington Road carriageway, pavement, vegetation, overhead and buried services are all present on the site.

A review of historical aerial imagery indicates that Carrington Road has been in existence since at least 1940. From the historic aerial imagery, the area west of the site appears to have been used for agricultural purposes, while the area east of the site was occupied by residential houses.

Oakley Creek flows approximately south to north, 270m West of the site. There are overland flow paths mapped along Carrington Road and site drainage is generally toward the Northern end of the site.

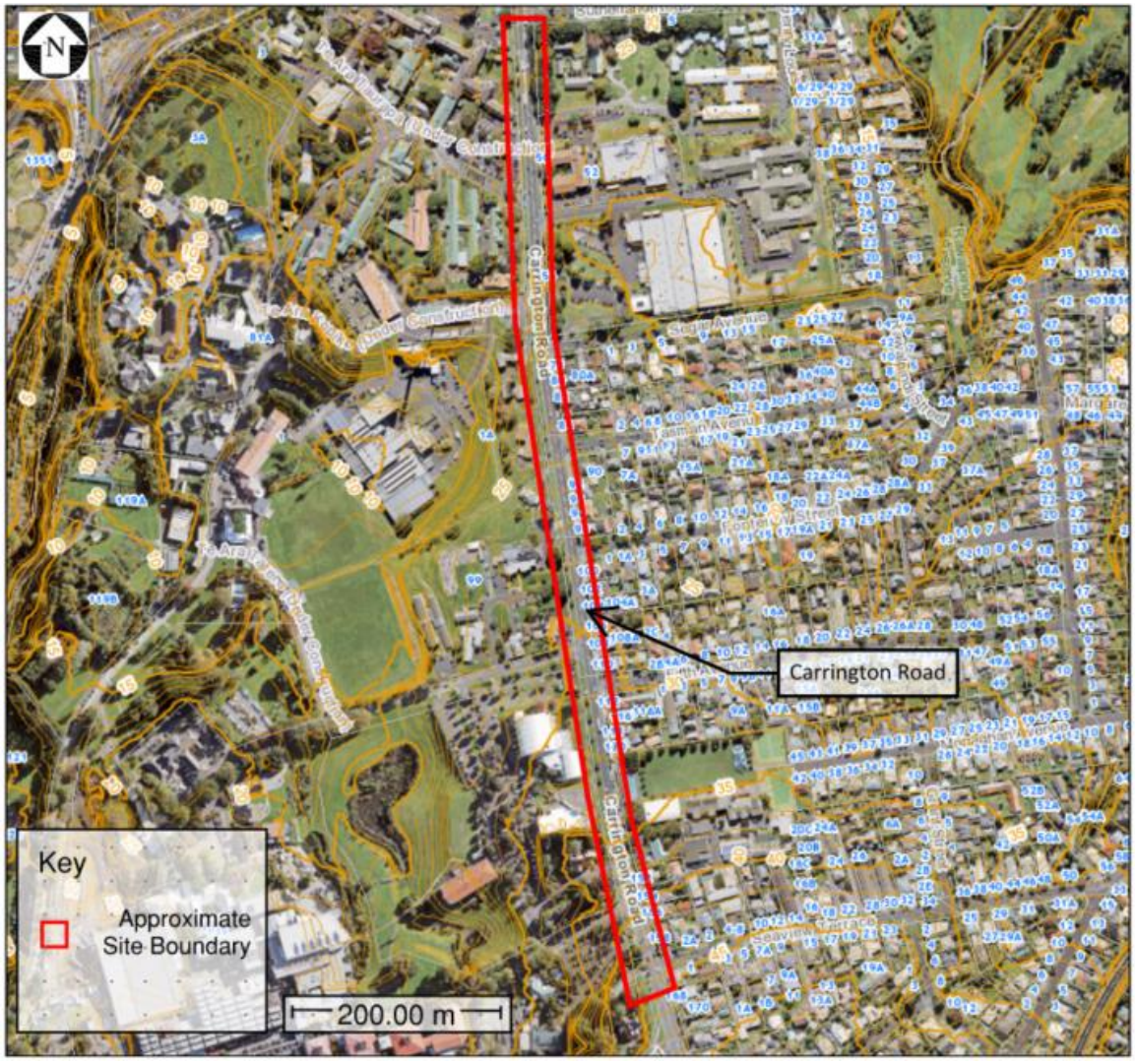


Figure 1: Site Plan

4 Geology

The published geological map 1:250,000 Geology of the Auckland Area (GNS Science, 2023) indicates the southern end of the site to be underlain by Auckland basalts tuff of the Auckland Volcanic Field, and the northern end of the site to be underlain by Takaanini Formation of the Tauranga Group and East Coast Bays Formation of the Waitemata Group. Auckland basalts tuff has an estimated age of between 0 to 0.14 million years (Ma), and can be described as lithic tuff, comprising comminuted pre-volcanic materials with basaltic fragments, and unconsolidated ash and lapilli deposits of well-sorted basalt and basanite fragments. Takaanini Formation has an estimated age of between 0 and 3.7 million years (Ma) and can be described as Late Pliocene to Middle Pleistocene pumiceous river deposits. East Coast Bays Formation has an estimated age of between 16 and 23 million years (Ma) and can be described as alternating sandstone and mudstone

with variable volcanic content and interbedded volcaniclastic grits. It is typically weathered to a residual soil to 5-15m depth. The geological units are shown on the Geological Plan in Figure 2.

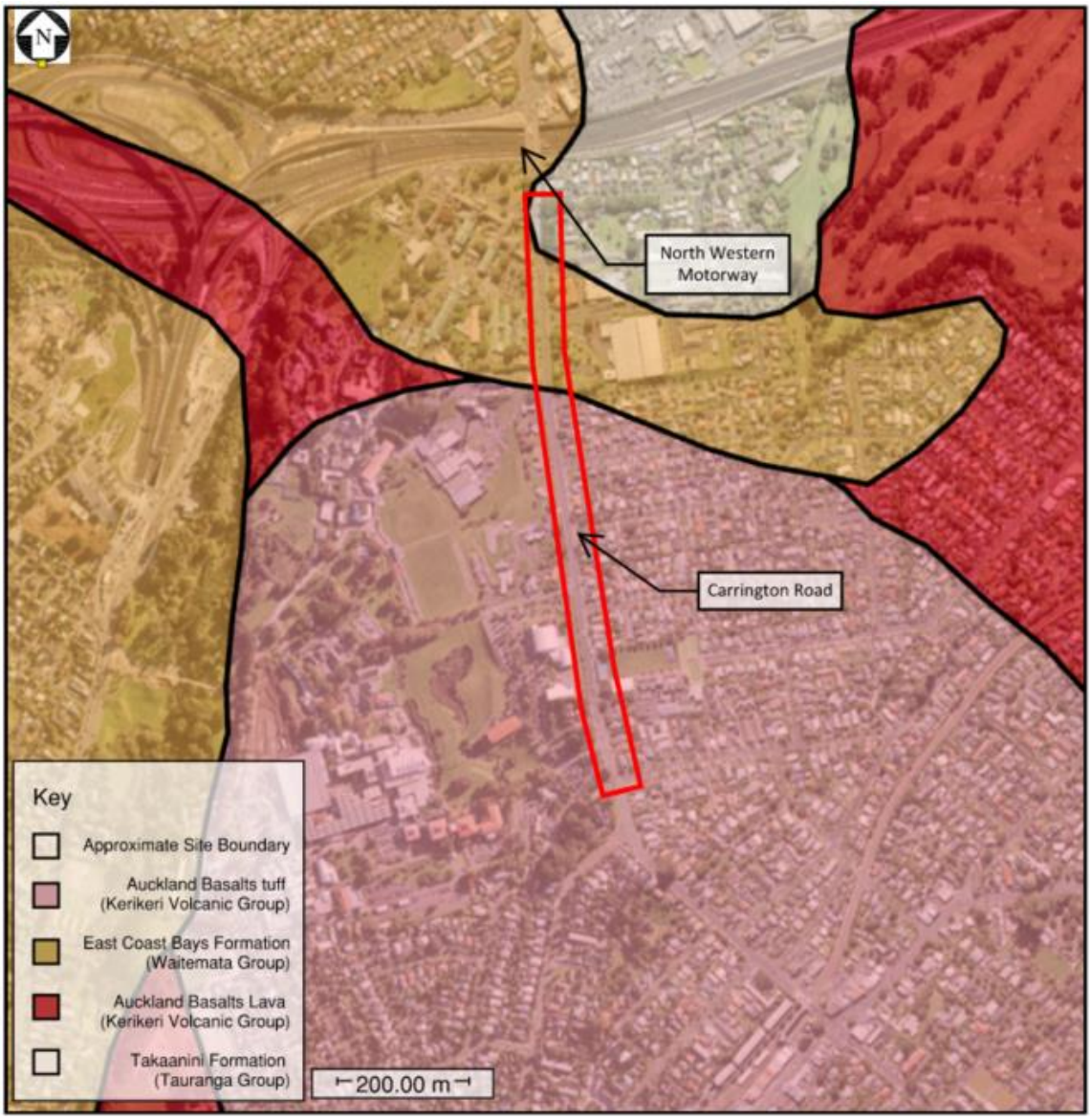


Figure 2: Geological map

5 Geotechnical Investigations

5.1 Geotechnical Investigations

A geotechnical investigation was carried out that commenced on the 21st of November 2024 and was completed on the 28th of November 2024.The investigation locations at Carrington Road are shown on the Geotechnical Investigation Plan in Appendix A. The purpose of the investigation was to understand the subsurface conditions and to inform the design of the proposed watermain upgrades. The results of this investigation are presented in the Beca Geotechnical Factual Report dated 15th January 2025.

The geotechnical investigation comprised:

- 3 Machine boreholes (BH03 to BH05) to between 5.1 and 5.2m bgl
- 4 Hand augers (HA01 to HA04) to 5.0m bgl
- Scala (dynamic cone) penetrometer testing
- Shear vane measurements
- 3 Standpipe installations
- Groundwater monitoring

5.2 Previous Geotechnical Investigations

Previous geotechnical investigations were carried out near to the project alignment and are available on the New Zealand Geotechnical Database (NZGD).

These investigations comprised:

- 3 machine boreholes carried out in 2007, referred to as MBR04, MBR05 and MBR10
- 1 machine borehole carried out in 2022, referred to as TNT-BH01.

These previous investigations were used to help develop the ground model. The locations of these ground investigations are shown in the site plan in Appendix A.

6 Ground Model

6.1 Ground Conditions

The site extends approximately 1km along Carrington Road and the ground model is based on 11 ground investigations (7 carried out specifically for the project and 4 historic investigations available from the NZGD). Ground conditions may vary from what was found during site investigations and what is shown by available investigations on the NZGD.

The ground conditions encountered during the geotechnical site investigation are partially consistent with the mapped geology. Auckland Volcanic Field Tuff was not encountered in the southern ground investigations, with Tauranga Group soils overlying East Coast Bays Formation encountered instead. East Coast Bays Formation soils were encountered in the northern ground investigations which is generally consistent with the mapped geology.

The ground profile is variable along the site and generally comprises of completely weathered East Coast Bays Formation and Tauranga Group soils. The site appears to have been modified in the past with layers of fill reaching thicknesses up to 1.2m adjacent to road infrastructure.

Completely weathered East Coast Bays Formation comprised of firm to very stiff clayey Silt was encountered in all 3 boreholes and in 1 hand auger at a depth of 0.4 to 4.2m below ground level with a typical thickness of 3.6 to 4.3m. Tauranga Group deposits comprised of stiff to very stiff clayey Silt were also encountered at the northern end and centrally along the alignment with organic deposits being encountered in hand augers HA02 and HA03 at 3.6 to 4.4m depth.

The ground profile summary is presented in Table 6-1 and a long section along the Watermain corridor showing the ground profile is presented in Appendix B.

Table 6-1 – Ground Profile

Unit No	Geological Unit	Description	Depth to Top of Layer (m bgl)	Thickness (m)	Peak Undrained Shear Strength[1], (kPa)	SPT N (blows/ 300 mm)	Scala[2] (blows/50 mm)
-	Fill	Very stiff clayey SILT, minor organics	0	0.4 – 1.2	159 – 170 (143)	-	-
TGA 1	Tauranga Group	Stiff to Very stiff clayey SILT/ Loose to medium dense SAND	1.1 – 2.0	1.5 – 7.8	42 - 178 (80)	4 - 13 (7)	-
TGA 2	Tauranga Group Organics	Very stiff organic SILT	0.7	0.6 – 4.7	120 – 199 (171)	6.0	0 – 8 (3)
ECBF 1	East Coast Bays Formation	Firm clayey SILT	2.2 - 8.8	2.0 - 5.2	31 – 43 (37)	2 – 16 (7)	-
ECBF 2	East Coast Bays Formation	Stiff to very stiff clayey SILT/ Loose to dense SAND	0.4 – 12	1 - 22.5	53 – 182 (100)	8 - 33 (15)	2 – 11 (5)

Note: [1] Corrected peak undrained shear strength values are presented. Vane readings have been undertaken using a Pilcon Shear Vane and corrected to BS 1377. Average results are presented in brackets.

6.2 Groundwater Conditions

Groundwater was encountered and measured during site investigations in the hand augers following completion of drilling. Groundwater has also been measured in the piezometers at BH03, BH04 and BH05 on 6 December 2024 and 18 December 2024.

Groundwater data from the recent Beca investigations is summarised in Table 6-2.

In previous investigations we note that groundwater level was recorded in TNT-BH01 at 1.3m bgl on 15 June 2022 and groundwater was not recorded in MBR-04, MBR-05 or MBR-10.

Note that the groundwater measurements in the recent Beca investigations have been limited to summer months and monitoring over a longer period, e.g. 12 months would provide information on seasonal fluctuation of groundwater levels. Further groundwater monitoring will be carried out at the piezometers with information provided to Watercare.

The data collected indicates the groundwater is generally 1.2 m to 4.1 m below ground across the site. There is a general trend of groundwater getting shallower towards the north as elevation drops.

We note that groundwater level may rise to higher levels than those recorded following high intensity rainfall events or wet periods, conversely the groundwater levels may be lower than those recorded in drier periods.

Table 6-2 – Groundwater Measurements

Borehole/ Piezometer ID	Type of measurement	Screened Depth (m bgl) and Unit	Date of Measurement or Period of Monitoring	Depth to Groundwater (m bgl)	Level of Groundwater (m RL)
BH03	Piezometer	2 – 5 East Coast Bays Formation	18.12.24	3.5	38.0
			6.12.24	4.1	37.4
BH04	Piezometer	2 – 5 East Coast Bays Formation	18.12.24	3.3	25.9
			6.12.24	3.8	25.5
BH05	Piezometer	2 – 5 Tauranga Group	18.12.24	1.2	25.3
			6.12.24	1.3	25.2
HA01	Hand Auger	n/a	19.11.2024	4.0	30.0
HA02	Hand Auger	n/a	20.11.2024	Dry	n/a
HA03	Hand Auger	n/a	28.11.2024	3.6	20.4
HA04	Hand Auger	n/a	25.11.2024	2.6	21.9

7 Geotechnical Design Parameters

7.1 Soil Parameters

Soil parameters for the in-situ materials have been derived based on correlations to in-situ tests. The parameters adopted for geotechnical analyses are summarised in Table 7-1. Due to the potential variability in strength and uncertainty of the uncontrolled fill material origin, specific soil parameters have not been assigned. Likewise, soil parameters have not been assigned to the organic layer.

Table 7-1 – Soil Parameters

Unit No	Geological Unit	Description	Unit Weight, γ (kNm^{-3})	Friction Angle, Φ' (°)	Cohesion, c' (kPa)	Undrained Shear Strength, S_u (kPa)
-	Fill	Very stiff clayey SILT, minor organics	-	-	-	-

Unit No	Geological Unit	Description	Unit Weight, γ (kNm^{-3})	Friction Angle, Φ' (°)	Cohesion, c' (kPa)	Undrained Shear Strength, S_u (kPa)
TGA 1	Tauranga Group	Stiff to very stiff clayey SILT	17	29	3	75
ECBF 1	East Coast Bays Formation	Firm clayey SILT	16	27	2	35
ECBF 2	East Coast Bays Formation	Stiff to Very stiff clayey SILT	17	29	3	120
TGA 2	Tauranga Group	Organic SILT	-	-	-	-

7.2 Design Groundwater Levels

Design long term static groundwater levels and a high design groundwater level are provided along the watermain alignment and shown in Table 7-2 below. Design groundwater levels are based on piezometer readings are are lower at the north part of the site. Note that further groundwater information will be provided as further measurements are made.

Table 7-2 – Groundwater levels along watermain alignment

Chainage (m)	Long term static groundwater level (mbgl)
0-150	3.5
150-450	3.3
450-978.19 (End of watermain chainage)	1.2

It should be noted that groundwater levels could be expected to be 1m or more higher than this during winter or heavy rainfall conditions.

7.3 Soil Permeability

Permeability is the intrinsic property of a material that describe its ability to transmit fluids (expressed in units of length squared e.g. m^2). Hydraulic conductivity refers to the impact of both the fluid and the material on how easily a specific fluid (typically water) can flow through the material and takes into account both the fluid's properties and the material's permeability. Hydraulic conductivity (expressed in units of length over time e.g. m/s) is more commonly used as it can be directly measured in the field and offers a more complete and context-specific understanding of fluid movement through porous materials under real-world conditions.

Hydraulic conductivity values are estimated based on laboratory testing carried out on Tauranga Group and East Coast Bays formation soils at nearby sites. An expected range for typical hydraulic conductivity values is provided in Table 7-3 below. Testing could be carried out if site specific hydraulic conductivity values are required.

Table 7-3 Hydraulic Conductivity

Unit No	Geological Unit	Description	Hydraulic conductivity k (m/s)
ECBF 1	East Coast Bays Formation	Firm clayey SILT	K_H = 1.0 to 3.0 x 10^{-7} K_V = 1.0 to 3.0 x 10^{-8}
ECBF 2	East Coast Bays Formation	Stiff to Very stiff clayey SILT	K_H = 1.0 to 3.0 x 10^{-7}

Unit No	Geological Unit	Description	Hydraulic conductivity k (m/s)
			K_V = 1.0 to 3.0 x 10^{-8}
TGA 1	Tauranga Group	Firm to stiff clayey SILT	K_H = 1.0 to 2.3 x 10^{-7} K_V = 1.0 to 3.5 x 10^{-8}

K_H = horizontal conductivity

K_V = vertical conductivity

8 Design Basis

8.1 Design Life and Importance Level

The design life of the proposed Watermain and Valve Chamber are given in Table 8-1 below and are as per the Beca Design Basis Report, Rev 2.0, dated 19.12.2024.

Table 8-1 Design Life and Importance Level

Structure	Design Life	Importance Level
Watermain	100 years	IL4
Valve Chamber	50 years	IL4

8.2 Seismic Design Criteria

8.2.1 Site Subsoil Class

The site subsoil class was assessed in accordance with NZS 1170.5:2004 and is dependent on the depth of soils or rock at the site.

The site subsoil class for the proposed site has been assessed as Class C, based on existing information indicating the site is underlain by soils that are unlikely to exceed the maximum depth limits in Table 3.2 of NZS 1170.5:2004.

8.2.2 Seismic Loading

Seismic loading, as per NZS1170.0, requires a site specific seismic hazard analysis (SSSHA) for a IL4 and 100 year design life structure and this falls outside the scope of NZS1170.0 to derive peak ground acceleration values.

If this is required then this would need to be carried out by a seismic specialist experienced in SSSHA work and could be carried out by Beca.

The seismic design accelerations for the proposed valve chamber (IL4 and 50 year design life) have been determined in accordance with NZS1170.0 and are presented in Table 8-2.

Table 8-2: Valve Chamber Seismic Design Loadings

Design Event	Annual Probability of Exceedance	Peak Ground Acceleration a_{max} (g)	Earthquake Magnitude (M)
ULS	1/2500	0.31	7.5
SLS1	1/25	0.04	7.5

Design Event	Annual Probability of Exceedance	Peak Ground Acceleration a_{max} (g)	Earthquake Magnitude (M)
SLS2	1/500	0.17	7.5

8.3 Foundation Design Criteria

Geotechnical ultimate bearing capacities have been derived in accordance with B1/VM4 (MBIE, 2023) for the Watermain and Valve Chamber.

9 Liquefaction Commentary

9.1 Liquefaction and Cyclic Softening Overview

Liquefaction describes the short-term loss of strength of a loosely packed cohesionless (sandy) soil during an earthquake or other dynamic loading. Liquefaction occurs when the soil particles are disturbed and densify during dynamic loading, temporarily raising pore water pressures and reducing the effective stress between particles to near zero. This causes the affected soil to behave essentially like a liquid until the excess pore pressures are dissipated.

Liquefaction can have several significant effects where it occurs, including large lateral displacements (lateral spreading), post liquefaction settlements (due to the densification and loss of material to the surface) and potentially large and uneven settlement of shallow founded structures.

Cyclic softening is a liquefaction related phenomenon that occurs where cohesive soils are sheared during strong earthquake shaking. Cyclic softening can cause a significant strength loss in sensitive soils and may result in several consequences including slope instability, foundation settlement or tilting.

Existing information and Beca geotechnical investigations indicate the soil profile along the Watermain corridor to 5m depth mainly consists of firm to very stiff cohesive silt and clay material, indicating a low susceptibility to liquefaction.

At the Northern end of the site, previous investigations (e.g. TNT-BH01 and MBR10) identified layers of loose sand within the upper 5m of the soil profile. However, further review of these investigations indicate that the soils exhibit strengths greater than those typically associated with liquefaction potential, with sample photos indicating cohesive material properties.

Based on soil descriptions, strength testing, and geological review, liquefaction and cyclic softening are considered unlikely within the upper 5m of the watermain alignment. Should Watercare wish to assess the risk of liquefaction potential further, additional ground investigations could be carried out at discrete locations. The ground investigation could comprise CPT's and/or laboratory testing of sandy soil samples from additional hand auger / borehole investigations.

10 Slope Instability

The pipe alignment is adjacent to Carrington Road and there are no known issues with global instability that affect this area with no slips identified on the Landslide Database.

We are not aware of any existing retaining walls that are supporting the proposed alignment.

11 Design Elements

11.1 Watermain and Valve Chamber Bearing Capacity

We have been requested to provide geotechnical ultimate bearing capacities for the soil at Watermain and valve chamber founding level. It is understood that the Watermain will be founded in a trench at approximately 2.0 to 3.0m below ground level along the corridor. Based on this a bearing capacity failure at the base is unlikely given the load from the ground being removed.

We have carried out an assessment of bearing capacity below the base using the following formula from New Zealand Building Code B1/VM4.

$$q_u = c'\lambda_{cs}\lambda_{cd}\lambda_{ci}\lambda_{cg}N_c + q'\lambda_{qs}\lambda_{qd}\lambda_{qi}\lambda_{qg}N_q + {}^1/_2\gamma'B'\lambda_{\gamma s}\lambda_{\gamma d}\lambda_{\gamma i}\lambda_{\gamma g}N_\gamma$$

The watermain is to have a founding depth of between 2.0 and 3.0m bgl with a width of 1.2m. The expected soil at the Watermain founding depth is generally firm to very stiff clayey silt.

It is understood that four chambers will be constructed on in-situ material along the watermain alignment:

- A line valve and two cross valve chambers at the Northern end of the site (approximately CH960) will be founded at a depth of approximately 3.0m
- A scour valve chamber at CH654 will be founded at approximately 2.5m depth

The valve chambers are circular with plan dimension diameters of approximately 4.0m (line valve), 2.5m (cross valves) and 2.4m (scour valve). Based on BH05 the line valve and cross valve chambers are expected to founded on stiff clayey silts of soil unit TGA 1. Based on HA03 the scour valve chamber is expected to founded on very stiff silty Clay of soil unit TGA 1.

A preliminary ultimate bearing capacity has been assessed for locations where the watermain and valve chambers are founded on firm, in-situ soils, free of organics at an assumed minimum founding depth of 2.0m bgl. This is shown in Table 2 and has taken into account the potential for variation in the Tauranga Group alluvium and the expected firm strengths.

Ground investigation identified an area where Organic Silt was present at a depth of approximately 3.6m bgl (CH550 to CH600). If organic or soft/loose soil is encountered along the founding level of the watermain alignment, over-excavation and replacement with compacted hardfill may be required.

It is recommended that both the watermain and the pad foundation of the valve chambers are constructed on a layer of free draining, well compacted clean hardfill, a minimum of 200mm thick.

Table 2: Estimating Bearing Capacity Values

Ultimate Bearing Capacity	Structures
200kPa	Watermain, line valve chamber, cross valve chambers, scour valve chamber

Code derived load factors and an ultimate bearing capacity strength reduction factor of 0.5 should be applied for limit state design.

11.1.1 Subgrade Testing and Inspections

To achieve the above geotechnical ultimate bearing capacities, the foundation subgrade is to be inspected and the foundation test results are to be reviewed by the Engineer during construction of the Watermain and

Valve Chambers. The minimum required ultimate bearing capacity and test result requirements are to be included on the drawings.

11.2 Earth Pressure

The lateral earth pressures applied in structural design for non-seismic load cases should be calculated from the earth pressure coefficients provided in Table 10-1.

Table 10-1: Earth Pressure Coefficients

Structural Element	Soil Identification	Unit Weight, γ (kNm^{-3})	Friction Angle, Φ' (°)	Earth Pressure Coefficients		
				K_A	K_0	K_P
Retaining wall for valve chamber	Structural Fill (GAP65)	19	35	0.237	0.426	5.879
	Tauranga Group Formation (TGA 1)	17	29	0.307	0.515	4.041

11.3 Settlement and Floatation

The watermain is understood to be pressurised and will be full with water. The typical load of the full watermain is understood to be approximately 650kg/m length of pipe. This is comprised of approximately 220kg/m length of 762 x 8mm thickness CSL pipe, with the full cross section of water.

Following construction, the difference between soil load removed and full watermain pipe + hardfill load added at the Watermain founding level is estimated to be an increase of up to approximately 10kPa . Settlement is expected to be minor due to this change in loading and the underlying stiff to very stiff soils.

Given the design levels of the Watermain with and assuming a minimum 1.2m cover and a high groundwater level (up to 0.2 mbgl), the overburden is expected to be sufficient to prevent floatation of the Watermain. It is understood that GAP25 will be used as backfill material above the pipe, this will need to be compacted to provide sufficient overburden above the Watermain.

The valve chamber is expected to be founded approximately 2m below existing groundwater levels. The valve chamber foundation design will be developed during detailed design stage to minimise settlement and uplift from floatation during normal and design high groundwater levels.

11.4 Soil Modulus

The soil modulus value has been requested for the structural design of the pipe, and is provided for the expected base of the Watermain at 2.0 to 3.0m bgl. The soil modulus has been derived from shear vane and scala penetrometer tests carried out in ground investigations along the Watermain corridor, and correlation based on previous experience with Tauranga Group and East Coast Bays Formation soils.

Table 10-2 Soil Modulus

Project location (Distance)	Soil Modulus E (MPa)
0 to 978 (whole Watermain location)	3

11.5 Construction Considerations

The following should be considered before beginning construction:

- Groundwater levels along the Watermain and at the Valve Chamber locations during excavation. Dewatering is expected to be required and the Contractor should make their own assessment of any likely groundwater induced settlement given their construction methods (such as dewatering) and the actual materials encountered. They are responsible for dewatering design, permissions/consents, and ensuring settlements remain within the Auckland Council consent conditions specified limits.
- Temporary works for benching/shoring of the pipeline and valve chamber excavations. Specific assessment along the alignment will need to be carried out by the Contractor to evaluate the temporary works (shoring, benching) that is required. Reference should be made to the Geotechnical Factual Report carried out for this project and any available information on the NZGD.
- Protection of nearby structures during excavation. This includes but is not limited to overhead and underground services, residential housing and adjoining roads.
- Ground conditions can vary across short distances and this variation should be anticipated during construction. The Contractor shall consider this variability for the works.

12 Risks and Opportunities

This section presents the key geotechnical risks and opportunities that have been identified at this stage of the Project based on the work done to date and information gathered. It is not an exhaustive list of risks and opportunities. Further risks and opportunities may become apparent as the Project is developed further and additional information becomes available. It is recommended that the geotechnical risks and opportunities continue to be reviewed and updated regularly as the Project progresses.

Assessment of any potential existing slopes/ walls affected by temporary trench excavation is excluded from this GIR. Temporary support designed by others will be required such that excavations do not impact existing structures.

- There is limited geotechnical investigations and no laboratory tests were carried out for the site. The site extends approximately 1km along Carrington Road with 11 ground investigations (7 carried out specifically for the project and 4 historic investigations available from the NZGD). There is a risk that ground conditions vary from what was found during site investigations.
- Organic soils (chainage 500 to 600m), soft soils (chainage 0 to 400m) and loose sandy soils (chainage 750 to 850m) have been identified. These are likely to exist at other locations along the alignment. If these soils are exposed at foundation level for the watermain or valve chamber then remedial measures, such as undercut and replacement with hardfill, may be required.
- Groundwater levels may be higher or lower than anticipated. Based on the ground investigations there is likely a requirement for dewatering along approximately half the alignment.
- There are risks around consenting or interactions with third parties for excavation for the watermain and valve chamber (councils/ service providers/ peer reviewers/ archaeological personnel).
- The proposed works are near multiple existing services, there is a risk of service strike during works. Existing underground and overhead services are to be identified and located prior to any excavations.
- The proposed works are near buildings and roads. There is a risk of vibrations/settlement of the infrastructure or potential undermining of infrastructure, resulting in a potential need for increased temporary works.

- There is a risk of trench collapse during excavation. Temporary works design will need to consider the expected soil types and the most appropriate method of safe excavation.

13 Safety in Design

Key geotechnical Safety in Design considerations are presented below. These have been identified at preliminary design stage of the Project based on the work done to date. Further Safety in Design considerations are likely to become apparent as the project is developed.

- WorkSafe Good Practice Guidelines should be referred to for safety during excavation trenching for the Watermain and the Valve Chamber
- Site accessibility for excavation and construction equipment, on the western edge of the 'live' Carrington Road corridor.

14 Sustainability

Sustainability in engineering considers the short and long-term environmental, economic, social and cultural impacts of a development. When evaluating sustainability, we should consider these factors throughout the design, construction, and operational stages of the development.

This section presents the key geotechnical opportunities identified for this project to improve sustainable outcomes and enable a circular design approach. Further opportunities may become apparent as the project progresses and additional information becomes available. It is recommended that these opportunities continue to be reviewed and updated regularly as the project progresses.

The key geotechnical opportunities are summarised below:

Table 14-1 – Key Geotechnical Sustainability Opportunities

Opportunity	Description	Potential Outcome	Potential Impact
Optimizing foundation design	Undertake Additional Geotechnical Investigation to increase understanding of ground conditions.	Design optimisation by understanding founding conditions, groundwater levels and potential dewatering requirements.	Low
Groundwater monitoring equipment	Telemetric monitoring equipment could be considered for groundwater monitoring over manual readings.	Reduce carbon emission associated to travel and provides increased efficiency and density of data.	Low

15 Applicability

This report has been prepared by Beca Limited (Beca) on the specific instructions of Watercare Services Limited (Client). It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk. Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter

materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document. In preparing this report Beca has relied on key information including the following:

- New Zealand Geotechnical Database, accessed 29 January 2025

Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client, including the information listed above, and has not sought independently to verify the information provided. This report should be read in full, having regard to all stated assumptions, limitations and disclaimers. No part of this report shall be taken out of context and, to the maximum extent permitted by law, no responsibility is accepted by Beca for the use of any part of this report in any context, or for any purpose, other than that stated herein.

16 References

Brightman, C and R Roberts. (2021). *Auckland Liquefaction Assessment Technical Report*

MBIE. (2014). *Acceptable Solutions and Verification Methods for New Zealand Building Code Clause B1 Structure*, Ministry of Business, Innovation and Employment.

MBIE/ NZGS. (2021). *Earthquake Geotechnical Engineering Practice – Module 1: Overview of Guidelines*, Wellington, Ministry of Business Innovation and Employment and the New Zealand Geotechnical Society.

NZS 1170.0: 2002: *Structural design actions – Part 0: General principles*.

NZS 1170.5: 2004: *Structural design actions – Part 5: Earthquake actions – New Zealand*.

NZ Geotechnical Society Inc. (2005). *Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*.

NZ Transport Agency. (2013). *Bridge Manual 3rd Edition, Amendment 3*, (SP/M/022).

A

Appendix A – Geotechnical Site Investigation Plan

FOR INFORMATION
NOT FOR CONSTRUCTION

PDF ONLY
NO DWG FILE

Beca	Client: WATERCARE	Project: POINT CHEVALIER WATERMAIN NO.2	Title: SITE INVESTIGATION PLAN	Discipline: GEOTECHNICAL Drawing No. / Rev.

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PDF ONLY
NO DWG FILE

Beca	Client: WATERCARE	Project: POINT CHEVALIER WATERMAIN NO.2	Title: SITE INVESTIGATION PLAN SHEET 1	Discipline: GEOTECHNICAL
				Drawing No. / Rev.

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PDF ONLY
NO DWG FILE

Beca	Client: WATERCARE	Project: POINT CHEVALIER WATERMAIN NO.2	Title: SITE INVESTIGATION PLAN SHEET 2	Discipline: GEOTECHNICAL
				Drawing No: / Rev:

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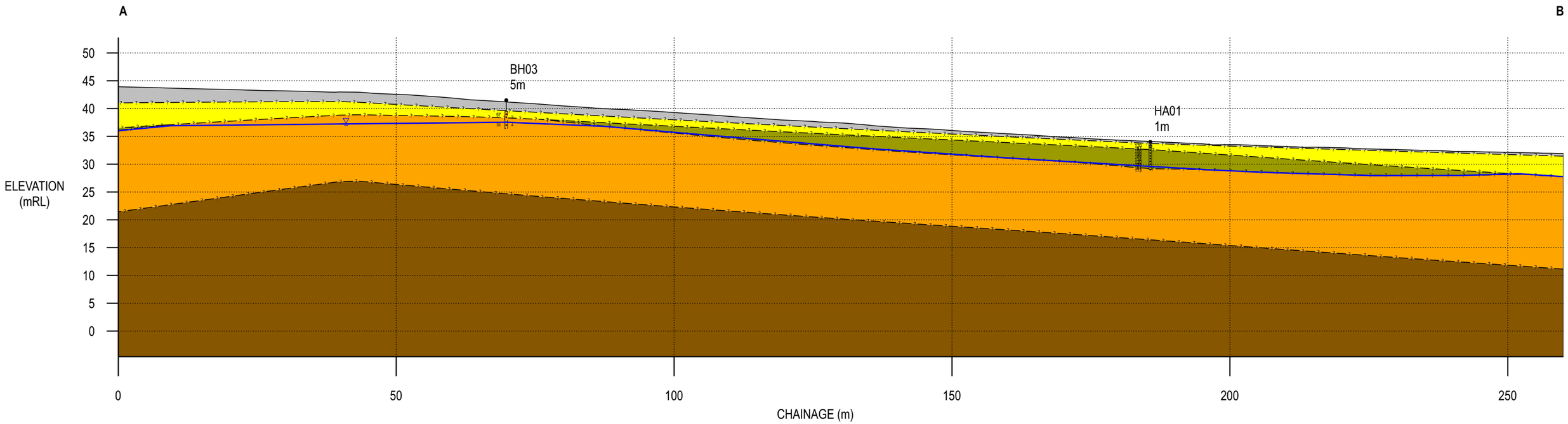
Beca	Client: WATERCARE	Project: POINT CHEVALIER WATERMAIN NO.2	Title: SITE INVESTIGATION PLAN SHEET 3	Discipline: GEOTECHNICAL Drawing No. / Rev.

B

Appendix B – Ground Model

Carrington Rd Alignment Ch 0 - 260



Legend

- Fill
- Tauranga Group - Stiff to firm clayey SILT
- Tauranga Group - Very stiff clayey SILT
- Assumed Groundwater Table
- East Coast Bays Formation - Residual Soils/Completely Weathered Rock
- East Coast Bays Formation - Highly Weathered/Unweathered Rock
- Groundwater Measurement

IN-SITU TESTING

Shear Strength (kPa)

SPT N value

NOTES:
1. THIS SECTION HAS BEEN PRODUCED USING INTERPRETED EXPLORATORY HOLE INFORMATION INCLUDING THOSE UNDERTAKEN BY OTHERS. FURTHER INVESTIGATION AND MAPPING IN THIS AREA MAY RESULT IN CHANGES TO INTERPRETATION.
2. EXPLORATORY HOLE LOCATION DATA WITHIN 25m HAS BEEN TRANSPOSED ONTO THE SECTIONS AND OFFSETS ARE SHOWN.
3. EXPLORATORY HOLE LOCATION DETERMINED BY: AUCKLAND COUNCIL GEOMAPS.
4. ALL BOUNDARIES ARE APPROXIMATE. ACTUAL GROUND CONDITIONS WILL VARY.
5. ELEVATION DATUM: NZVD2016
6. TOPOGRAPHICAL DATA SOURCED FROM: LINZ DATA SERVICE

Scale: 1:700

0m 80m

FOR INFORMATION
NOT FOR CONSTRUCTION

PDF ONLY
NO DWG FILE

No.	Revision	By	Chk	Appd	Date
A	Issue to Client	CS	RP	RP	3.02.2025

Original Scale (A1) Double Shown
Reduced Scale (A3) As Shown

Design	C. STUART	3.02.2025
Drawn	C. STUART	3.02.2025
Dsg Verifier	R. PATERSON	3.02.2025
Drg Check	R. PATERSON	3.02.2025

* Refer to Revision 1 for Original Signature

Beca

Client: WATERCARE

Project: CARRINGTON ROAD CORRIDOR

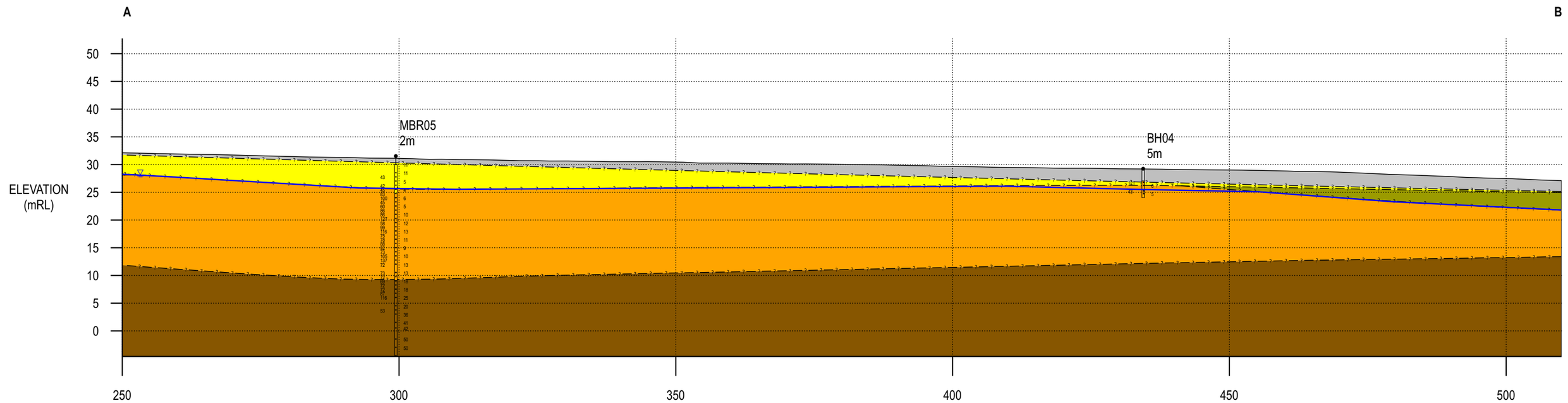
Title: GEOLOGICAL LONG SECTION SHEET 1

Discipline: GEOTECHNICAL

Drawing No.: 3250660-GE-005

Rev.: A

Carrington Rd Alignment Ch 250 - 510



Legend

- Fill
- Tauranga Group - Stiff to firm clayey SILT
- Tauranga Group - Very stiff clayey SILT
- Assumed Groundwater Table
- East Coast Bays Formation - Residual Soils/Completely Weathered Rock
- East Coast Bays Formation - Highly Weathered/Unweathered Rock
- Groundwater Measurement

IN-SITU TESTING

Shear Strength (kPa)

SPT N value

NOTES:
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5. ELEVATION DATUM: NZVD2016
6. TOPOGRAPHICAL DATA SOURCED FROM: LINZ DATA SERVICE

Scale: 1:700

0m 80m

FOR INFORMATION
NOT FOR CONSTRUCTION

PDF ONLY
NO DWG FILE

No.	Revision	By	Chk	Appd	Date
A	Issue to Client	CS	RP	RP	3.02.2025

Original Scale (A1) Double Shown	Design	C. STUART	3.02.2025
	Drawn	C. STUART	3.02.2025
Reduced Scale (A3) As Shown	Dsg Verifier	R. PATERSON	3.02.2025
	Drg Check	R. PATERSON	3.02.2025
* Refer to Revision 1 for Original Signature			

Client: WATERCARE

Project: CARRINGTON ROAD CORRIDOR

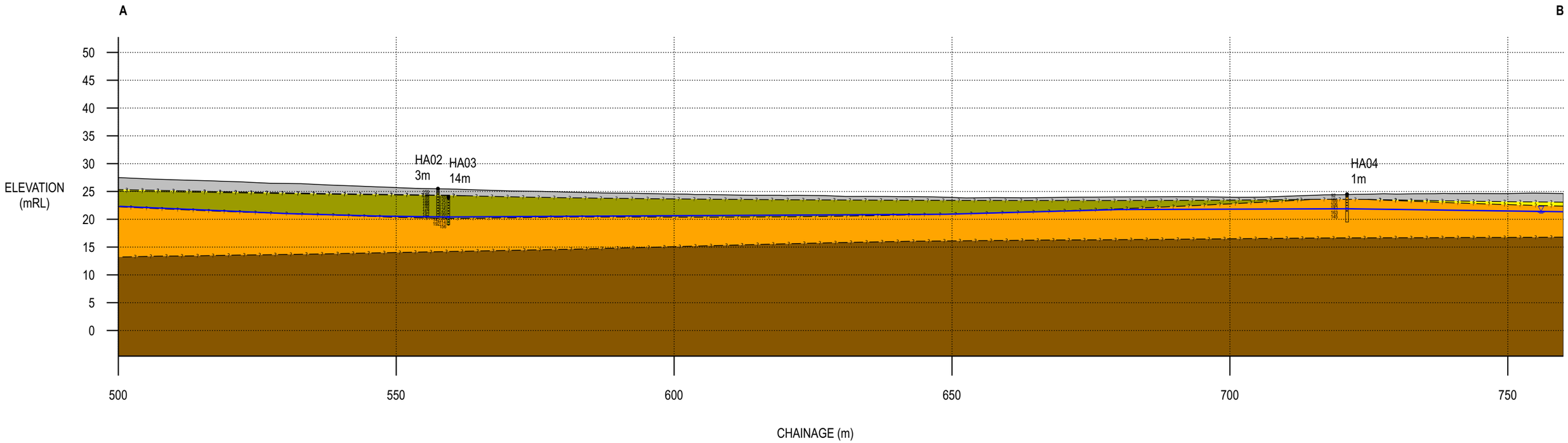
Title: GEOLOGICAL LONG SECTION SHEET 1

Discipline: GEOTECHNICAL

Drawing No.: 3250660-GE-005

Rev.: A

Carrington Rd Alignment Ch 500 - 760



Legend

- Fill
- Tauranga Group - Stiff to firm clayey SILT
- Tauranga Group - Very stiff clayey SILT
- Assumed Groundwater Table
- East Coast Bays Formation - Residual Soils/Completely Weathered Rock
- East Coast Bays Formation - Highly Weathered/Unweathered Rock
- Groundwater Measurement

IN-SITU TESTING

Shear Strength (kPa)

SPT N value

NOTES:
1. THIS SECTION HAS BEEN PRODUCED USING INTERPRETED EXPLORATORY HOLE INFORMATION INCLUDING THOSE UNDERTAKEN BY OTHERS. FURTHER INVESTIGATION AND MAPPING IN THIS AREA MAY RESULT IN CHANGES TO INTERPRETATION.
2. EXPLORATORY HOLE LOCATION DATA WITHIN 25m HAS BEEN TRANSPOSED ONTO THE SECTIONS AND OFFSETS ARE SHOWN.
3. EXPLORATORY HOLE LOCATION DETERMINED BY: AUCKLAND COUNCIL GEOMAPS.
4. ALL BOUNDARIES ARE APPROXIMATE. ACTUAL GROUND CONDITIONS WILL VARY.
5. ELEVATION DATUM: NZVD2016
6. TOPOGRAPHICAL DATA SOURCED FROM: LINZ DATA SERVICE

Scale: 1:700

0m 80m

FOR INFORMATION
NOT FOR CONSTRUCTION

PDF ONLY
NO DWG FILE

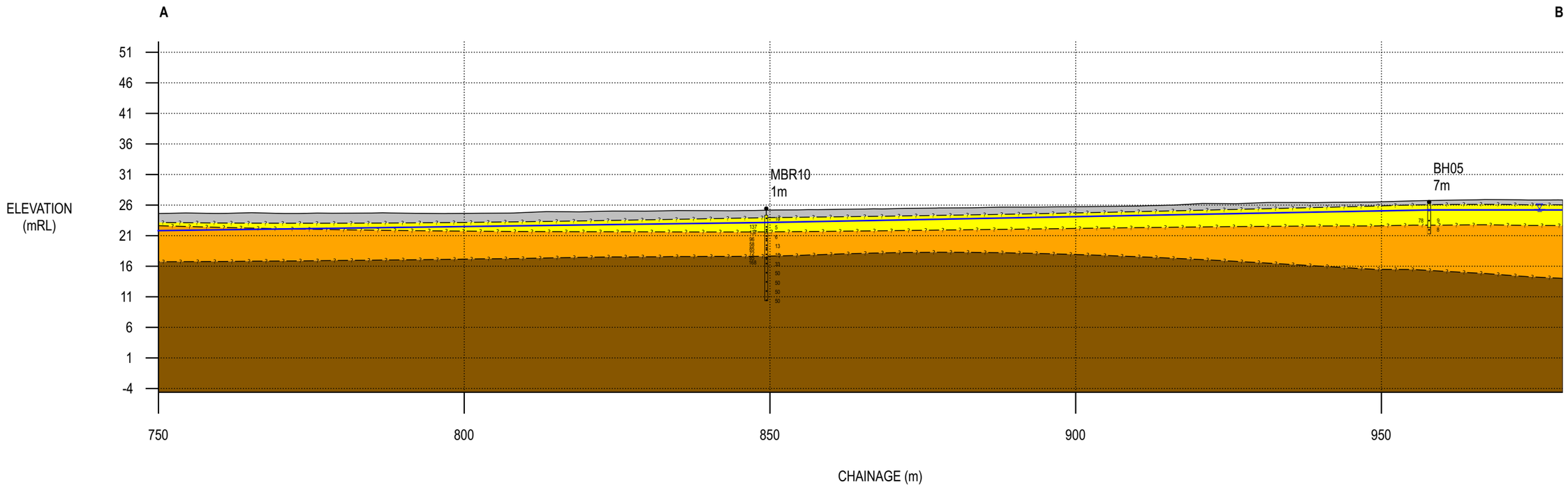
No.	Revision	By	Chk	Appd	Date
A	Issue to Client	CS	RP	RP	3.02.2025

Original Scale (A1) Double Shown	Design	C. STUART	3.02.2025
	Drawn	C. STUART	3.02.2025
Reduced Scale (A3) As Shown	Dsg Verifier	R. PATERSON	3.02.2025
	Drg Check	R. PATERSON	3.02.2025
* Refer to Revision 1 for Original Signature			

Beca

Client:	WATERCARE
Project:	CARRINGTON ROAD CORRIDOR
Title:	GEOLOGICAL LONG SECTION SHEET 1
Discipline	GEOTECHNICAL
Drawing No.	3250660-GE-005
Rev.	A

Carrington Rd Alignment Ch 750 - 1000



Legend

- Fill
- Tauranga Group - Stiff to firm clayey SILT
- Tauranga Group - Very stiff clayey SILT
- Assumed Groundwater Table
- East Coast Bays Formation - Residual Soils/Completely Weathered Rock
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0m — 80m

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