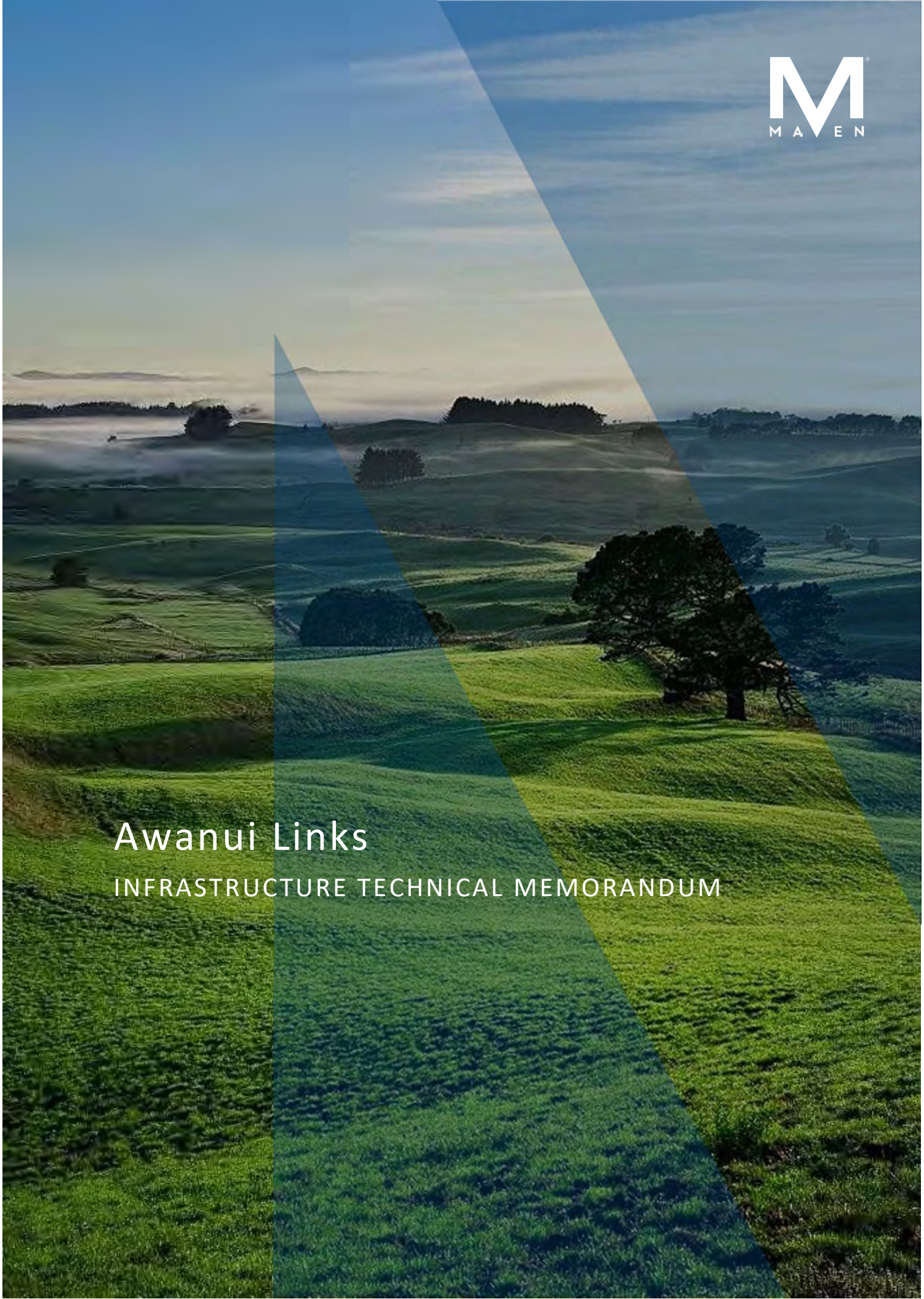

Awanui Links

INFRASTRUCTURE TECHNICAL MEMORANDUM

PROJECT INFORMATION

CLIENT	Barkers Associates
PROJECT	Awanui Links

DOCUMENT CONTROL

DATE OF ISSUE	23/03/2026
REVISION	A
AUTHOR	Bernard Devine Civil Engineer
REVIEWED BY	Dean Morris Regional Director
APPROVED BY	Dean Morris Regional Director

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1. Introduction

1.1. Background

Maven Waikato Ltd have been engaged by Swordfish Projects Limited to undertake infrastructure design in support of the Awanui Links referral application, in Puketaha, Hamilton.

1.2. Purpose of Report

The purpose of this report is to provide an initial assessment of the earthworks, transportation, and three waters infrastructure to service the proposed mixed use development. This report is to be read in conjunction with the associated engineering drawings and calculations

1.3. Site Description

The development area is a 108-hectare block of land located within the Waikato District, east of the Hamilton City boundary and the Waikato Expressway.

Most of the site is low lying flat farmland, with some rolling hill contours to the northern portion of the site. The site has Waikato Regional Council managed and maintained artificial drains pass through the site.

1.4. Legal Description

The development site is split across multiple parcels of land, and the legal descriptions for these parcels of land are listed in table 1 below:

Address	Lot Description	Area (m2)
28 Telephone Road, Puketaha	Lot 1 DP14821,	40,468 m2
	Lot 19 DP14821,	41,252 m2
	Lot 18 DP14821,	41,707 m2
	Lot 17 DP14821,	42,137 m2
	Lot 16 DP14821,	42,517 m2
	Lot 15 DP14821,	42,871 m2
	Lot 14 DP14821,	41,885 m2
	Lot 13 DP14821,	42,289 m2
	Lot 12 DP14821,	57,086 m2
	Lot 11 DP14821,	42,820 m2
	Lot 10 DP14821,	42,365 m2
	Lot 9 DP14821,	41,960 m2
	Lot 8 DP14821,	41,606 m2
	Lot 7 DP14821,	41,227 m2
	Lot 4 DP14821,	40,493 m2
	Lot 5 DP14821,	40,468 m2
	Lot 6 DP14821,	40,670 m2
	Lot 1 DP36551,	60,703 m2
	Lot 7 DP15049,	42,366 m2
	Lot 6 DP15049,	43,883 m2
	Lot 5 DP15049,	61,335 m2
	Lot 4 DP15049,	60,121 m2
	Lot 3 DP15049,	43,858 m2
	Lot 2 DP15049,	42,290 m2
	Lot 1 DP 15049	50,232 m2
	Total Area (Ha)	1,128,609m2 (112.6Ha)

Table 2: Lot Descriptions

1.5. Proposal Summary

The Awanui Links is a proposed mixed-use development approximately 6-7 kilometres east of the Hamilton urban boundary, located to the eastern side of the Waikato Expressway. The site is located within the Waikato District Council boundaries in a rural zone under the current district plan, refer to Figure 1 for the location of the site.

Figure 1: Site Location

1.6. Proposed Development

The Awanui Links development comprises circa 112 hectares of proposed mixed development, that includes an 18 hole international golf course and associated events and golf centre, a driving range and mini golf facilities, retirement village, rural lifestyle lots and a small provision of industrial lots.

Refer to figure 2 for the proposed master plan and table 1 below for a composition of the proposed lots.

Figure 2: Barkers and Associates High-level Masterplan

2. Earthworks & Geotechnical

A preliminary geotechnical desktop report for this development has been undertaken, refer Appendix E report by CMW, dated 20th March 2026. A summary of the anticipated geology is contained in table 3 below.

Simple Name	Holocene swamp deposits, Hinuera Formation
Description	Peat-based surficial layer overlies Alluvial soils (Sand, Silt, Gravel)
Subsidiary Rocks	Sand, Silt
Key Group	Organic Soils
Rock Group	N/A

Table 3: Geological Overview

Based on the CMW desktop assessment the peat depth is likely to range between 0.0-2.7m depth (average of 0.8m), with a stronger sand layer underlying that. Lower lying gulleys are likely to have deeper peat layers, and along ridges the peat will be to a shallower depth. The anticipated geology will require mitigation as outlined below and in the CMW desktop report. A further geotechnical investigation assessment will be required for the site to confirm the geology for this development site. This information will help inform the design strategy to manage the earthworks for this development site.

2.1. Low Lying Peatland

Future land suitable for development consists of low-lying peat. The peat is a characteristic deposit of the Waikato Basin and is described as consolidated peat and therefore is susceptible to significant ground settlement when it is saturated and subjected to loading.

It is recommended that a geotechnical assessment is undertaken to assess and create a map of any potential peat such as a "Peat Contour Plan" for underground mapping to show depths of indicative Peat soils using surrounding ground investigation results. It is anticipated that this will be undertaken at the substantive application stage if the referral is successful.

2.1.1. Development in Peatland

Where development has underlying peat present, the developers will need to create a strategy for either removing or strengthening the ground in order to make development viable.

- Likely to consist of the following
    - Identify if the underlying peat soils are to be removed or preloaded based on the depth the underlying peat layers.
    - Confirm that this does not change groundwater flows sufficiently to cause any adverse effects this will be determined by the geotechnical engineer.

2.1.2. Earthworks

Where the peat is present, drainage of the peat layers could lead to shrinkage and differential settlement. In areas where the peat is to remain groundwater recharge will be required to mitigate against peat shrinkage (see 5.5 Groundwater Recharge).

Peat and any existing over-lying fill material may require undercut and replacement with engineered fill where peat depths are up to 2m (above the water table).

Preload fill material may be suitable in areas where depths of peat are greater than 2m. Specific, underfill drainage, temporary pre-loading, and settlement monitoring, under the direction of a Geotechnical Engineer, will be required to limit post construction ground settlements.

All earthworks challenges for the site will be able to be managed through appropriate design and construction that will be developed in more detail at the substantive application stage.

2.1.3. Building Foundations

Where development in peat is proposed, pile foundations beyond base of peat or preload to induce ground settlements may be practical. Preload depths of approximately 2m with settlement hold periods of 3 to 6 months are expected based on historical works.

Lightweight buildings may require raft foundations that are designed to accommodate ground settlements. Where development in peat results in high foundation loads (i.e., heavy industrial buildings exceeding preloading weight), piled foundations beyond the base of the peat will likely be required. Foundations for larger structures resulting in high foundation loads typical to the zone, it would require specific design from a Geotechnical Engineer. Specific design (often requiring piling) is typically required in any case even if building foundations were in clay.

3. Roading

The preliminary roading layout is shown in the proposed masterplan (refer appendix A). All proposed roads will be non-arterial, low traffic roads designed in accordance with the current Regional Infrastructure Technical Specifications (RITS's) and other best practice requirements.

3.1. Roading Construction

For construction of any new roads, Waikato District Council will not accept new roads being built directly over existing peat soils. Where the peat is less than 2m the peat will likely be undercut and removed and approved engineered fill placed. For peat soils greater than 2m in depth, the peat will likely be preloaded to induce ground settlement and the settlement monitored. The expected settlement time is 3 to 6 months based on historical results for surrounding areas.

4. Three Waters Strategy

Refer to appendix B for the three waters drawings.

4.1. Water Sensitive Urban Design (WSUD)

WSUD is a land planning and engineering design approach which integrates the urban water cycle, including stormwater, groundwater and wastewater management and water supply, to minimise environmental degradation and improve aesthetic and recreational outcomes.

The overarching objectives of WSUD are:

- Protect or enhance the environmental, social, and economic values of downstream environments.
- Reduce the frequency, duration, and volume of stormwater runoff to mitigate the risks of nuisance flooding and moderate post-development flows to waterways.
- Reduce demand on potable water supply.
- Improve amenity in the urban environment.

4.2. Three Waters Strategy

The Three Waters strategy incorporates WSUD engineering design principles to create a low impact, sustainable development which minimises stormwater and wastewater discharge from site.

The Awanui Links Three Waters Strategy implements several key WSUD techniques, including:

- Restrict/ control the quantity of storm water and wastewater discharge.
- Reduce the frequency and severity of flooding at downstream properties
- Improve amenity in the rural environment by introducing planted waterways and green strips.

5. Stormwater

5.1. Existing Catchments

The site is situated in the southern end of the Lower Waikato catchment. The site discharges to the Waikato river through a series of farm drains and natural / modified streams and culverts.

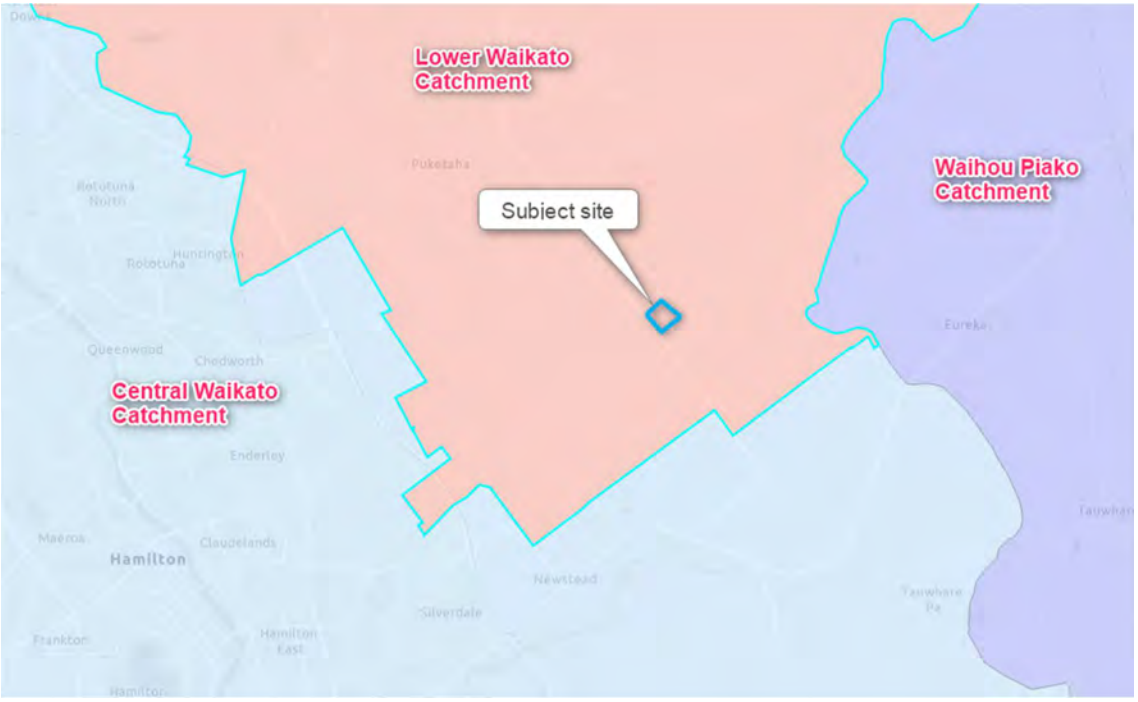

Figure 8 –Waikato Catchments

5.1.1. Lower Waikato Catchment

The Lower Waikato Catchment generally falls to the northwest and is drained by a series of drains that are maintained by Waikato Regional Council on behalf of the landowners. Waikato Regional Council categories the farm drains as artificial drains, and these discharge into the drain Asset ID 294 (road-side swale) that discharges via a culvert under State Highway 1b to the Kiroa Stream (part modified) WRC Asset ID 288.

The Kiroa Stream discharges into the Komakorau Stream where it intersects Taylor Road, prior to entering the Waikato River.

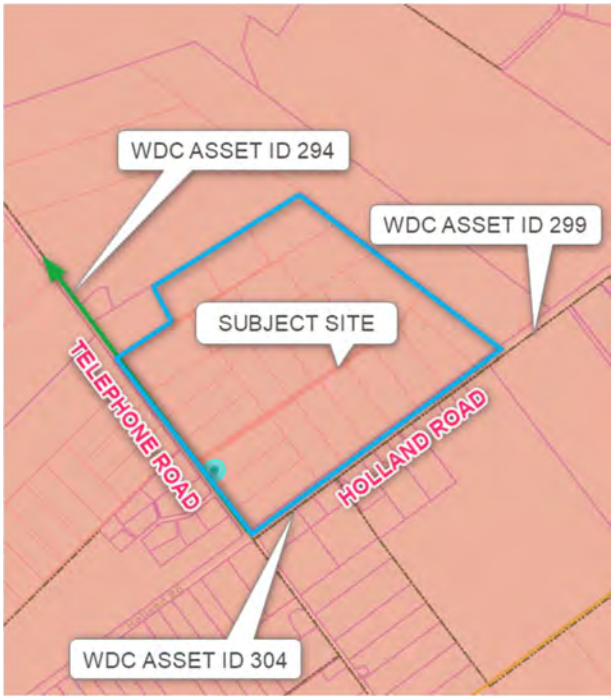

Figure 9 –Subject site Overview

Table 11: Summary of Central Waikato Catchment

The stormwater is currently managed by the existing farm drains and culverts to convey the surface runoff through the site. The site does not sit within an Integrated Catchment Plan (ICMP). A Stormwater Management Plan for the proposed development has not been undertaken at this time, however a high-level summary of the Stormwater Management Philosophy is provided below. Refer to Appendix B for the stormwater layout drawing. A Stormwater Management Plan (SMP) will be undertaken at substantive application stage.

5.2. Suggested Outcomes

Proposed objectives of the stormwater strategy are:

- Consideration of future public networks required in support of the study areas.
- Identify existing overland flowpaths.
- Identify existing flood hazards.
- Provide an option-based assessment for water quality treatment in support of the future development of the study areas.
- Consideration and requirement for extended detention in support of the future development of the study areas to avoid any downstream flooding, erosion, and scouring.
- Confirming the need for attenuation of peak flow during storm events up to the 100-year events. On-site retention (volume reduction) to ensure pre-development runoff rates and volumes are maintained within catchments and streams.
- Recommendations to guide future plan change application(s) to ensure positive environmental outcomes are achieved.

5.3. Reticulation

Existing stormwater infrastructure within the Awanui Links site is limited to farm/roadside drains and culverts. Development of the Awanui Links site will be supported by new public stormwater networks that will discharge into groundwater recharge pits and into the existing and proposed wetlands for primary and secondary water quality treatment. The future public networks would be developed by the developer. The stormwater infrastructure will need to comply with the conditions for resource consent and engineering approval conditions before being vested with HCC. Where possible, the stormwater network will be designed and constructed within the roads.

5.4. Stormwater Quality and Quantity

An assessment has been undertaken to establish the best practical design options for the stormwater quality and quantity design in support of the Awanui Links development. These options include at source stormwater quality control through the following controls:

- Inert roofing materials for all future buildings.
- Reduction of impervious areas using permeable paving (where possible).
- development supported by soakage pits where peat is present.
- Rural lots may drain directly to surrounding pervious areas via private spreader bars.
- Sub-catchment wide stormwater quality / volume management through detention basins and wetlands.
- Planting of riparian areas and protection of any existing bush features within the Awanui Links development.
- Use of the treatment devices (swales and/or amalgamated raingardens and artificial wetlands) to provide storage and attenuation for the required storm events from WQV, ED, 2-year, 10-year and 100-year ARI.
- Second option is to provide storage and attenuation within the existing (rehabilitated) drains in addition to wetlands.

A treatment train is proposed solution which would be in the form of the at source controls above and integrated forebay, and wetland for each catchment. This provides two-step treatment and means that disruptive maintenance in the road corridor is avoided.

Proposed preliminary wetland sizing is based on 4% of the attributing catchment areas. The wetland sizing will be further developed as part of the detailed design phase. The wetlands will discharge into the existing/enhanced streams. Refer to Appendix B for the concept stormwater plan, which provides preliminary catchments and wetland locations.

5.5. Groundwater Recharge

Soakage and recharge of stormwater into peat will be required to maintain hydrology to prevent dewatering of downstream wetland and streams and to mitigate ground shrinkage. For areas of deep peat, the preference would be to construct wetlands through these areas. Recharge pits should be designed at regular intervals throughout the development to encourage even distribution of groundwater recharge.

Detailed investigations by a suitable qualified Geotechnical Engineer, to determine the suitable recharge treatment measure to be implemented for each area. Recharge treatment measures will need to consider the future infrastructure and buildings in the decision-making process.

5.6. Rainwater Harvesting/Reuse

Reusing rainwater can significantly reduce the amount of water supply demand by each business by up to 50%. Decreasing demand on water supply has multiple benefits including meeting Water-Sensitive Urban Design (WSUD) criteria and decreasing each businesses water use.

Rainwater can be harvested and used for a range of different applications; for watering the gardens/green areas or washing the car, for use in the laundry and toilet. Rainwater is harvested directly off the roof and travels through down pipes to a water tank, which sits either above ground or below.

Rainwater harvesting requires a building consent and would be enforced by a condition of resource consent and consent notice on each title. The use of rainwater reuse and their effects on water supply demand will need to be investigated and confirmed with council. Rainwater reuse options will be further investigated as part of future resource consent applications.

Rainwater harvesting can significantly reduce the amount of water supply demand from each business. Rainwater harvesting will be incorporated into the proposed development.

5.7. Existing Stream Enhancement

The proposed wetlands are located adjacent and upstream of a few key existing conveyance channels/drains within the development. This will allow conveyance of flow from the development area into the existing environment. We have investigated the existing drain depths and levels based on available survey data and it appears most existing streams are very shallow. In their current state, this will restrict attenuation and flood storage ability for the adjacent catchment.

Based on the above, an option to address this would be enhancement of the existing drain, which would include realigning and introducing small wetland ponds, providing a large stormwater reserve area located within the existing low-lying areas adjacent to the existing drains to accommodate additional storage and attenuation for the Awanui Links development. Altering the drain provides the opportunity to rehabilitate the streams enhancing ecological habitat by providing a more natural meander, wetland areas and planting. This will require further inputs from an Ecologist during the substantive application stage. Proposed enhanced stream locations can be found on the stormwater plan in Appendix B.

5.8. Flooding

A Preliminary flood assessment has been carried out for the catchment in which the subject site sits.

The site generally discharges downstream via natural channels, culverts, and open rural drains and eventually outlets into the Waikato River.

A 2D HEC-RAS model using rain on grid methodology was developed to assess overland flow paths and existing conditions during pre-development and post-development scenarios.

The parameters used in the HEC RAS model are outlined below

- Rainfall Data Historical: 150mm
- Rainfall Data RCP 8.5 (2081-2100): 203mm
- CN: 74 assuming Soil Class D (Conservative)
- Mannings; Road & Impervious 0.025, farmland and Berm areas 0.05. Note, these will be further developed with more detailed areas with values likely adjusted during the calibration stage.
- Catchment is based on HEC HMS delineation. This was used for establishing the 2D flow area.

- LINZ and survey data and Design surfaces from 12D were used to form pre- and post development terrains.
- Results Min depth shown 100mm

Part of this preliminary, high-level assessment involves analysing the flow of incoming and outgoing flows through the site, as well as the downstream and upstream impacts that the development has on neighbouring areas. Four sections have been strategically placed in these locations to measure these impacts.

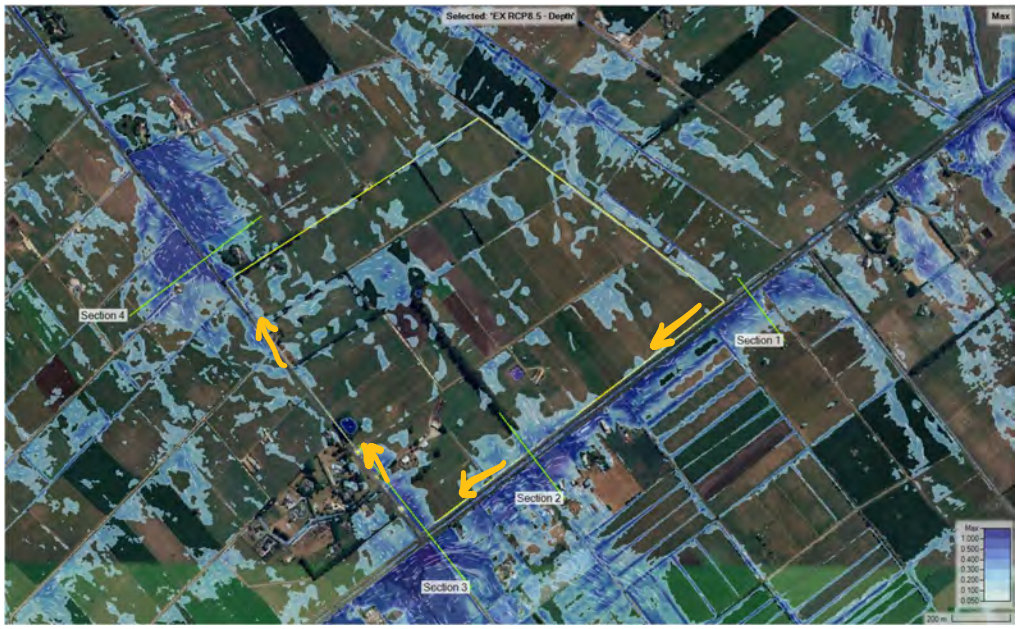

Figure 14 – Existing 1% ARI RCP8.5 flood map

Two preliminary pre-development models were created, one using historical data and the other using climate change-adjusted data (as shown above). Historical data determines the current flood extent, and the climate change-adjusted model will be used to compare with post-development results and assess impacts, as both use the adjusted hydrology data (see below preliminary POST development results).

Summary table below of the preliminary results from HEC RAS for each of the sections.

	Pre – Development RCP8.5	
Sections	WSL (m)	Flow Rate (m^3/s)
1	43.07	5.95
2	42.98	10.90
3	42.88	28.70
4	40.70	10.66

Table 12: Summary of HEC RAS Flows

Subject to the future development complying with the above, there will be no adverse downstream effects from the development of Awanui Links. Additional investigation and detailed design are required to refine the preferred solution as part of any future resource consent or plan change approval.

6. Wastewater

Maven have undertaken a desktop study to identify the most suitable option for wastewater disposal for Awanui Links. Reticulated, decentralised, and at source solutions have been considered. The site is in a rural location and there is no existing gravity reticulation within the site to service the proposed development. Connection to the existing Waikato District Council network is not feasible. The proposed development will likely be split into different land use areas, with each area having independent Wastewater treatment & disposal options. Refer to Appendix B for the concept wastewater layout option drawings.

6.1. Existing Public Infrastructure

The closest public wastewater is approximately 5km away on Harakeke Road. It is not considered feasible to connect to public wastewater over this distance.

6.2. Reticulation and decentralized treatment

The site topography is generally flat. The Awanui Links development would be predominantly serviced by gravity mains draining to multiple small scale decentralized wastewater treatment and disposal systems.

1. **Rural Residential Areas**

Rural Residential areas will utilise On-lot treatment & disposal for their wastewater such as On-lot Biocycle Systems & disposal field or similar systems.

2. **Industrial Areas**

Industrial areas will utilise On-lot treatment & disposal for their wastewater such as On-lot Biocycle Systems & disposal field or similar systems, this will limit the type of industrial activities suitable for the proposed development and consent notices would need to be applied to limit the type of industrial activity associated with those lots.

3. **Retirement Village (RV) Area**

The RV will require a combination of a central wastewater treatment system and On-lot treatment and disposal, with the final options dependant on RV layout, serviceability of individual villas via internal wastewater networks (both gravity and low-pressure systems) and specific requirements of the RV Care facility. A central wastewater treatment system & disposal system, such as an MBR/Aeration plants in combination with Biocycle systems (or similar systems) would accommodate the above approach.

4. **Golf/Events Centre Area**

The Golf/Events Centra area will require a combination of a central wastewater treatment system and On-lot treatment and disposal, with the final options dependant on final Villa & Event Centre layout. A central wastewater treatment system & disposal system, such as an MBR/Aeration plants in combination with Biocycle systems (or similar systems) would accommodate the above approach.

The Event Centre can also install a “greywater “system to collect suitable wastewater for storage and reuse within the golf course for irrigation purposes. This wastewater philosophy will need to be confirmed by HCC.

7. Water

Maven have undertaken a desktop study to identify the most suitable option for potable water for the development. Reticulated and decentralised solutions have been considered. Refer to Appendix B for the proposed water layout drawing.

7.1. Existing Public Infrastructure

The site is located rurally with only restricted flow water supply provided by Waikato district council. Therefore, it is not feasible to rely on the council provided network to provide the required water supply.

7.2. Reticulation and Capacity

Reticulation will be designed to provide the Awanui Links development with suitable means of potable and firefighting supply meeting RITS standard.

7.3. Alternative Supply Options

Due to the lack of sufficient council supply we have also considered groundwater as a potable water solution. The proposed water supply methods include decentralized water supply via rainwater harvesting and water bores depending on the particular land use;

1. Rural Residential Areas

Water supply for the Rural Residential areas will be via On-lot rainwater harvesting and reuse tanks, sized for both potable water supply and firefighting supply as per both the district plan and SNZ PAS 4509:2008-New Zealand Fire Service Firefighting Water Supplies Code of Practice

2. Industrial Areas

Water supply for the Industrial areas will be via On-lot rainwater harvesting and reuse tanks, sized for both potable water supply and firefighting supply as per each industries specific needs, the district plan and SNZ PAS 4509:2008-New Zealand Fire Service Firefighting Water Supplies Code of Practice

3. Retirement Village (RV) Area

The potable water supply options are still being explored which will likely include a combination of supply from multiple private bores and rainwater harvesting and reuse tanks. A centralised water treatment plant is also proposed as part of RV to ensure that any water sourced from the bore for use as potable water will be treated to the required drinking water standards.

4. Golf/Events Centre Area

The potable water supply options are still being explored which will likely include a combination of supply from multiple private bores and rainwater harvesting and reuse tanks. A centralised water treatment plant is also proposed as part of Event Centre area to ensure that any water sourced from the bore for use as potable water will be treated to the required drinking water standards.

Greywater collected from the Event Centre wastewater can also be collected and used for irrigation purposed for the golf course.

8. Services

8.1. Power

Wel Networks are the power service providers within this area. We assume that there is sufficient capacity within the network to accommodate the proposed development. This will need to be investigated further with WEL Networks if the development progresses.

8.2. Communications

The development site sits outside of the fibre provision areas shown on broadband availability maps NZ. The map shows that Wireless network and satellite connection is available for the entire site.

8.3. Gas

No gas is available for the subject site.

9. Conclusions

Stormwater drainage can be provided for the development through wetlands, ground water recharge and swale networks. Overland flow paths will be managed through the development, and it will reduce any potential flooding risks. An overarching stormwater strategy has been developed, and this sets out the high-level, best practice approach for stormwater management within the catchment.

Wastewater drainage can be provided for via a combination of small scale decentralized wastewater treatment plans and on lot disposal.

Water supply can be provided for the development through a combination of onsite rainwater harvesting, onsite bore supply and greywater reuse. New water bores will be established in strategic locations and onsite portable water treatment devices will treat the water before entering the water supply network.

Additional investigation work and detailed reporting for three waters and earthworks will be undertaken at the substantive application stage.

10. Limitations

The calculations and assessments included in this report are a 'desktop' analysis and are preliminary in nature based on information available at time of issue. To the best of our knowledge, it represents a reasonable interpretation of available information including the outcomes of the Kirikiriroa ICMP, which status is under development at the time of this issue.

Depending on the outcome of the high-level structure plan, further community; stakeholder engagement; and feasibility investigations, including engineering design and calculations, will be required to determine the suitability of the areas proposed for industrial and residential development.

This report is solely for our clients use for the purpose for which it is intended in accordance with the agreed scope of work. It may not be disclosed to any person other than the client and any use or reliance by any person contrary to the above, to which Maven has not given its prior written consent, is prohibited.

This report must be read in its entirety and no portion of it should be relied on without regard to the limitations and disclaimers set out.

Maven makes no assurances with respect to the accuracy of assumptions and exclusions listed within this report and some may vary significantly due to ongoing stakeholder engagement.

Appendix A – B & A Urban Master Plan

2.0 Master Plan

Scale: 1:6,000 @ A3

Legend

- Site Boundary
- Proposed Rural Residential Lots (70 lots)
- Proposed Light Industrial Lots (9 lots)
- Proposed Retirement Village (135 units)
- Proposed Retirement Village Care Facility
- Proposed Golf Course Visitor Accommodation
- Proposed Golf Course Facility Buildings
- Proposed Golf Course Driving Range and Mini Golf Building
- Proposed Commercial Amenities / Services
- Proposed Community Hub / Meeting Space
- Proposed Indicative Planting / Landscaping
- Proposed Stormwater Device
- Proposed Carpark (approx. 6300sqm)
- Rail Corridor Noise and Vibration Influence / Alert Area (Kiwi Rail) (100m)
- Existing Railway
- State Highway

1. Wellness Centre / Fine Dining (approx. 3500sqm)
2. Event Centre / Hotel (approx. 3500sqm)
3. Clubhouse / Club / Cafe (approx. 2550sqm)
4. Proshop (approx. 800sqm)
5. Vitual Golf / Sims (approx. 800sqm)
6. Cart Storage (approx. 1000sqm)
7. Putting Green
8. Storage Shed (approx. 1000 sqm)
9. Open Space / Wedding Venue
10. Visitor Accommodation - Large Luxury Villas (10 villas)
11. Visitor Accommodation - Small Luxury Villas (52 villas)
12. Retirement Village Care Facility (approx. 3000sqm)
13. Cafe (approx. 800sqm)
14. Convenience Store / Pharmacy / Medical Centre / Dentist / Wellness Gym / Physio (approx. 1100sqm)
15. General Recreation / Lawn Bowls / Tennis / Pickle Ball Courts (approx. 2500sqm)
16. Solar Farm (approx. 3000sqm)
17. Driving Range and Mini Golf

Figure 10 High-Level Masterplan

Appendix B – THREEWATERS OVERVIEW PLANS

LEGEND

- RURAL LOTS
- INDUSTRIAL LOTS
- GOLF COURSE & FACILITIES
- RETIREMENT VILLAGE
- WETLANDS / BASINS

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
Drawn	BD	02/2026
Checked	DM	02/2026

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Project
AWANUI LINKS
FAST-TRACK REFERRAL

Title
PROPOSED STORMWATER DRAINAGE PLAN

Project no.	
Scale	
Cad file	SK01.DWG
Drawing no.	C400-1
Rev	A

LEGEND

- RURAL LOTS
- INDUSTRIAL LOTS
- GOLF COURSE & FACILITIES
- RETIREMENT VILLAGE

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
Drawn	BD	02/2026
Checked	DM	02/2026

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Project
AWANUI LINKS
FAST-TRACK REFERRAL

Title
PROPOSED WASTEWATER DRAINAGE PLAN

Project no.	
Scale	
Cad file	SK01.DWG
Drawing no.	C500-1
Rev	A

DATE: 2/19/26 FILE PATH: F:\MAVEN HAMILTON\6. PROJECTS\2. PROMOWILL\WIRPOK\DWG\SK01.DWG

FIG. 6 Irrigation filter - long body.
IRRA25TFCL130 (disk)

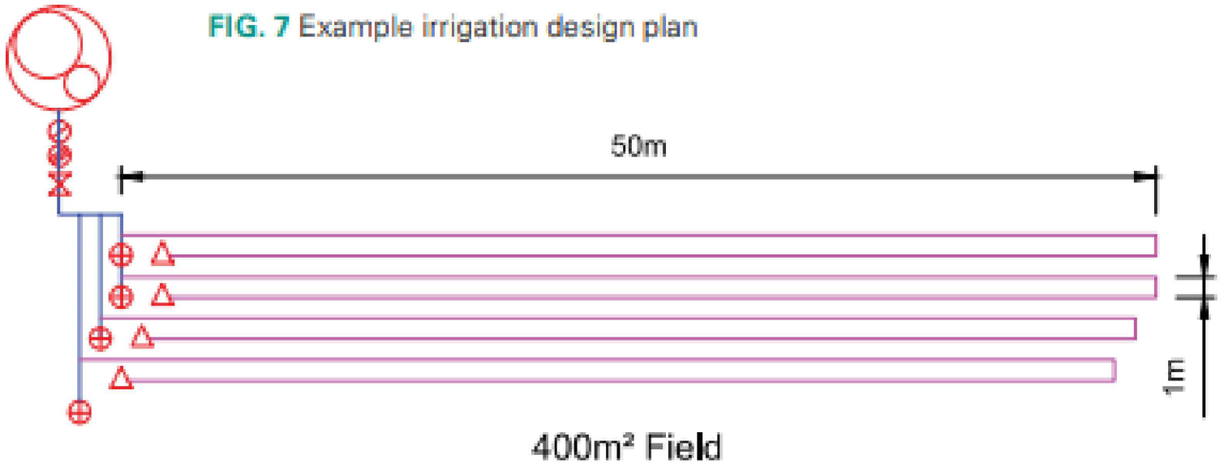

FIG. 7 Example irrigation design plan

FIG. 2 Hynds Lifestyle Ultimate

FIG. 3 Hynds Lifestyle Elite

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
Drawn	BD	02/2026
Checked	DM	02/2026

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Project
AWANUI LINKS
FAST-TRACK REFERRAL

Title
PROPOSED WASTEWATER DRAINAGE DETAIL

Project no.			
Scale			
Cad file	SK01.DWG		
Drawing no.	C500-2	Rev	A

DATE: 2/10/26 FILE PATH: F:\MAVEN HAMILTON_PROJECTS\2_PROMOVIILLO\WIP\DWG\SK01.DWG

AdvanTex ® Wastewater Treatment Systems

AX40
<6,000 L/day

AX100
<10,000 L/day

For non-typical residential or commercial systems, we do custom designs to factor hydraulic, organic and nutrient loadings.

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
Drawn	BD	02/2026
Checked	DM	02/2026

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FAST-TRACK REFERRAL

Title
PROPOSED WASTEWATER DRAINAGE DETAIL

Project no.			
Scale			
Cad file	SK01.DWG		
Drawing no.	C500-3	Rev	A

DATE 2/9/26 FILE PATH F:\MAVEN HAMILTON_PROJECTS_PROMOVILLO\PROMOVILLO\SK01.DWG

LEGEND

- RURAL LOTS
- INDUSTRIAL LOTS
- GOLF COURSE & FACILITIES
- RETIREMENT VILLAGE

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
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Project
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Title
PROPOSED WATER SUPPLY PLAN

Project no.	
Scale	
Cad file	SK01.DWG
Drawing no.	C600-1
Rev	A

DATE: 2/19/26 FILE PATH: F:\MAVEN HAMILTON\6. PROJECTS\2. PROMOVAWILLOWS\PROMOVAWGS\SK01.DWG

Rev	Description	By	Date
A	FAST TRACK REFERRAL	BD	02/2026

	By	Date
Survey	NA	-
Design	SM	02/2026
Drawn	BD	02/2026
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FAST-TRACK REFERRAL

Title
PROPOSED WATER SUPPLY DETAIL

Project no.			
Scale			
Cad file	SK01.DWG		
Drawing no.	C600-2	Rev	A

DATE 2/9/26 FILE PATH F:\MAVEN HAMILTON_PROJECTS_PROMON\AWILLOWS\PROMON\DWG\SK01.DWG

Appendix C – HEC-RAS Flood Model results

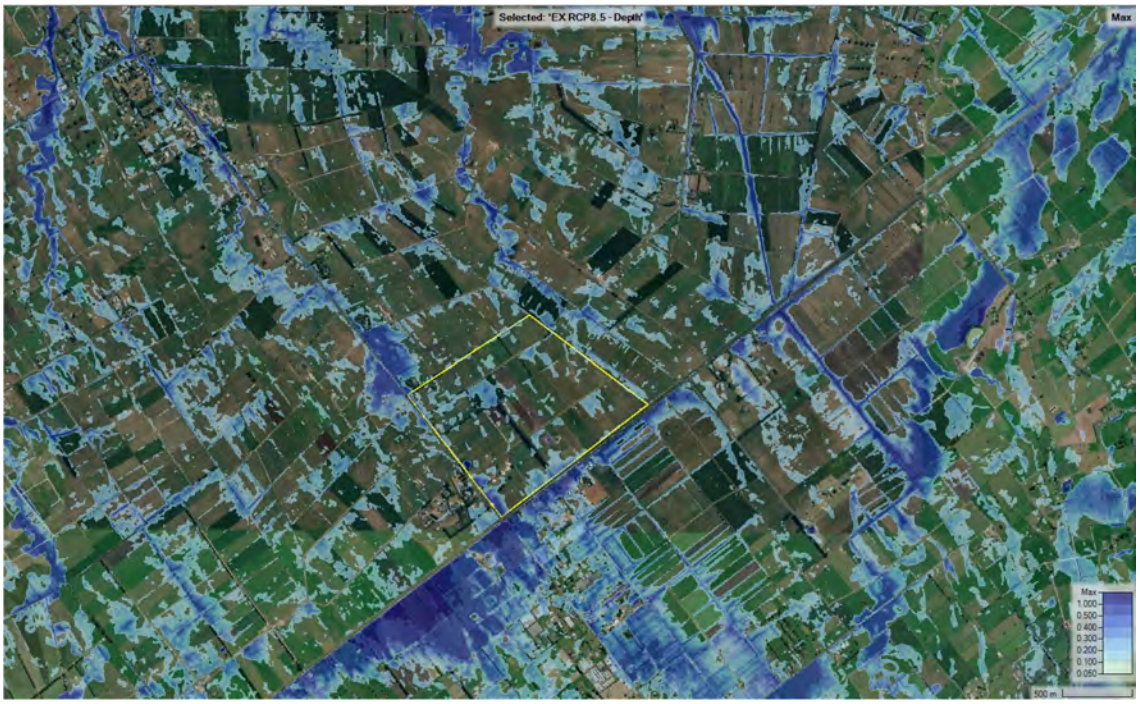

Figure 1.0 *100year Flood Overview*

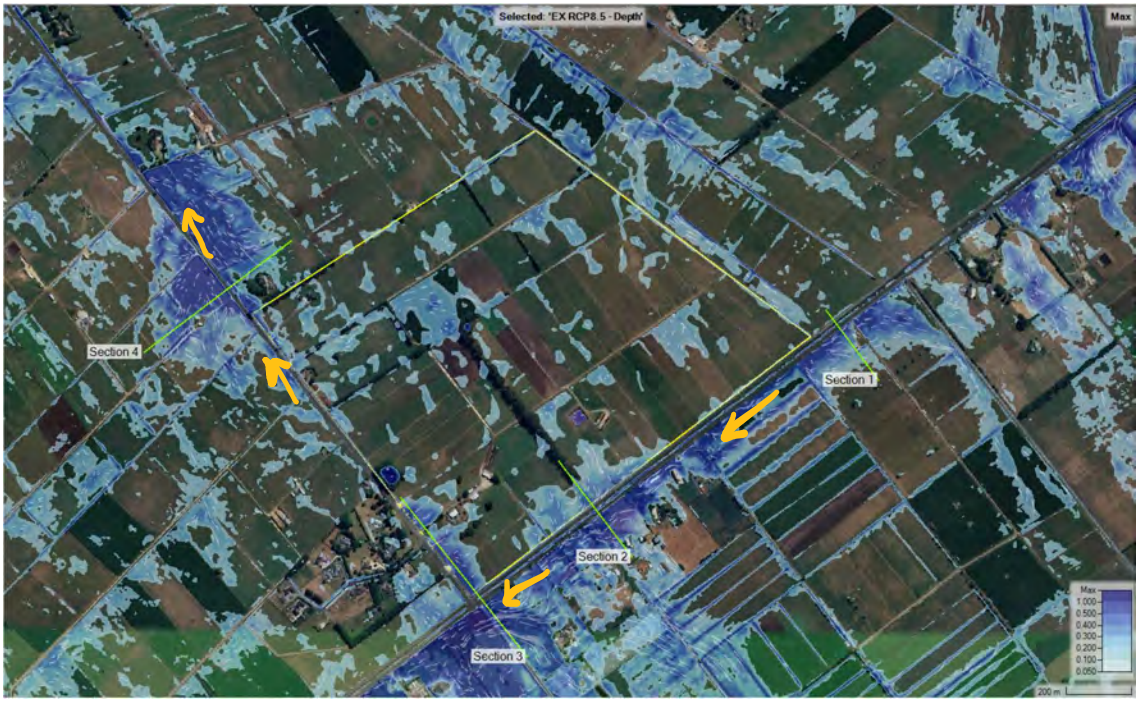

Figure 2.0 *100 year Event Result – Site*

Note Cross Sections were placed from left to Right direction of Flow

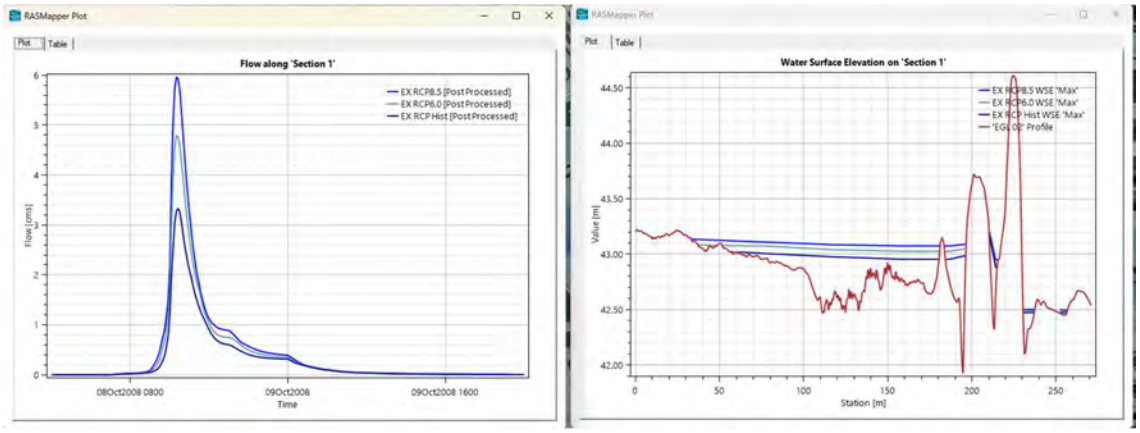

Figure 3.0 *Section 1 – Hydrograph and Water Surface Level*

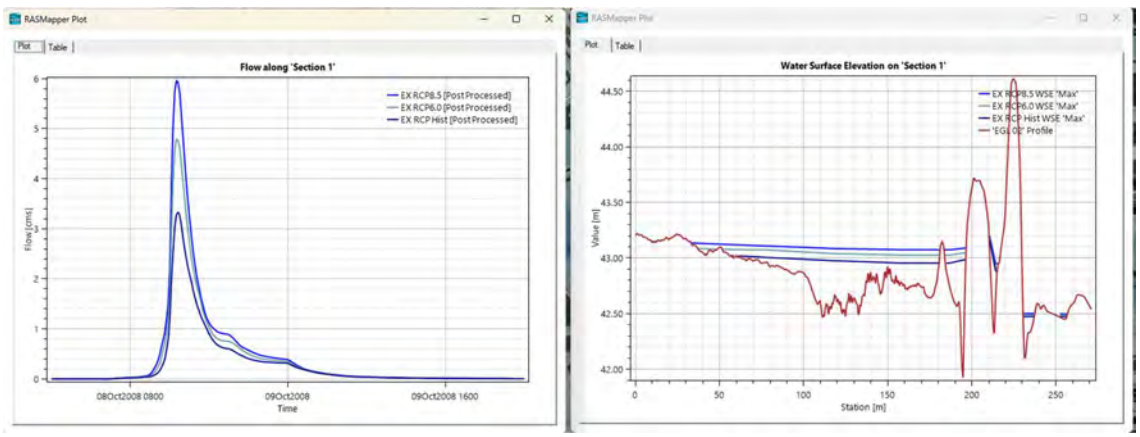

Figure 4.0 *Section 2 – Hydrograph and Water Surface Level*

	Flows (m^3/s)			Water Surface Level (m)		
Section	RCP HIST	RCP6.0	RCP8.5	RCP HIST	RCP6.0	RCP8.5
1	3.31	4.78	5.95	42.96	43.03	43.07
2	6.11	8.82	10.9	42.86	42.92	42.98
3	15.6	22.84	28.7	42.75	42.82	42.88
4	5.78	8.32	10.66	40.66	40.68	40.7

Table 1.0 *Flow Rate and Water Surface Level Table*

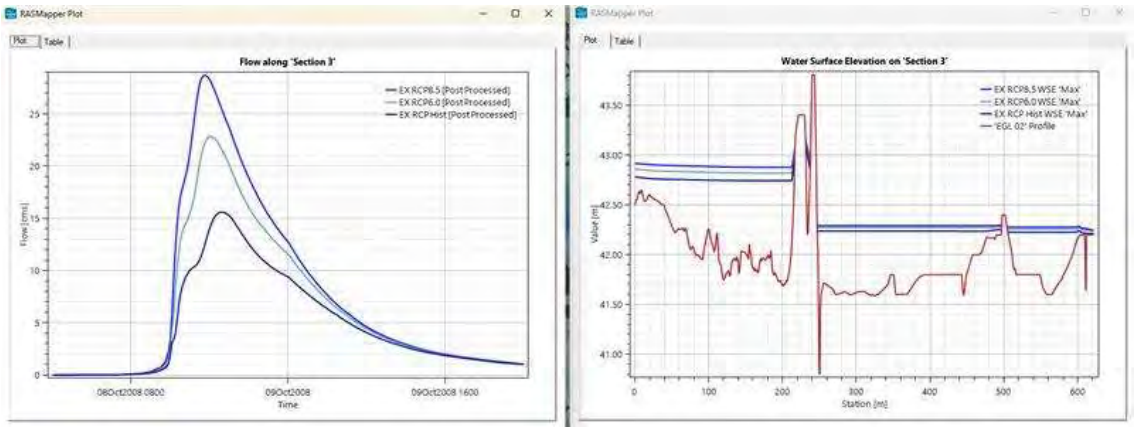

Figure 5.0 *Section 3 – Hydrograph and Water Surface Level*

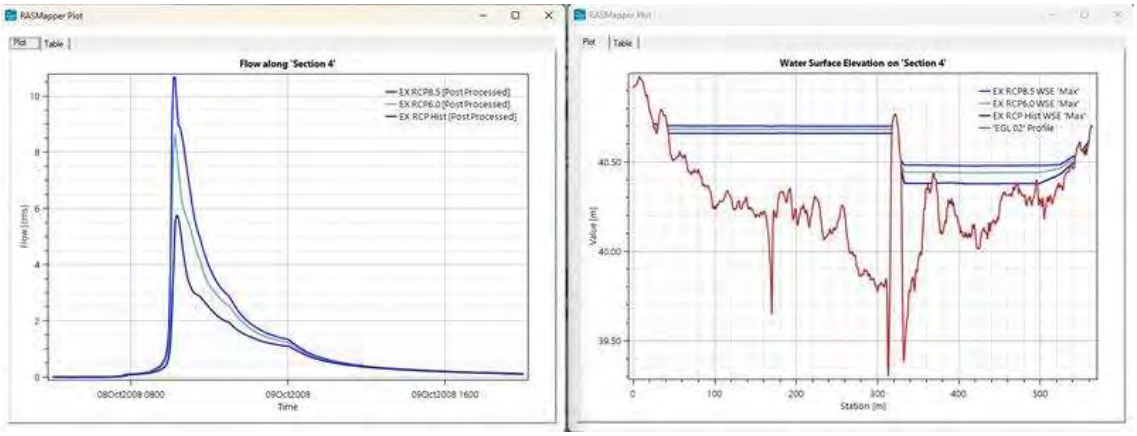

Figure 6.0 *Section 4 – Hydrograph and Water Surface Level*

	Flows (m^3/s)			Water Surface Level (m)		
Section	RCP HIST	RCP6.0	RCP8.5	RCP HIST	RCP6.0	RCP8.5
1	3.31	4.78	5.95	42.96	43.03	43.07
2	6.11	8.82	10.9	42.86	42.92	42.98
3	15.6	22.84	28.7	42.75	42.82	42.88
4	5.78	8.32	10.66	40.66	40.68	40.7

Table 1.0 *Flow Rate and Water Surface Level Table*

Appendix D – PRELIMINARY WATER AND WASTEWATER DEMAND

Maven Associates	Job Number	Sheet	Rev
	298001	1	A

		Author	Date	Checked
Job Title	Awanui Links			
Calc Title	WW Demand Calc	BD	19/02/2026	DJM

As per Waikato Local Authority RITS standards

Domestic Average Daily Flow (Water Consumption)=	200	*l/person/day*
Infiltration Allowance=	2,250	*l/Ha/day*
Surface Water Ingress=	16,500	*l/Ha/day*

No. of residential dwellings =	**275**	
Catchment area =	**11.00**	*Ha*
Total Population	825	
Wastewater Peaking factor as per Table 5-2=	3.1	

Using a population value person (max development scenario)

Average Daily Flow (ADF)=	189.75	*m^3/day*
Peak Daily Flow (PDF)=	6.21	*L/sec*
Peak Wet Weather Flow (PWWF)=	**8.31**	*L/sec*

Maven Waikato Ltd		Job Number	Sheet	Rev
		415001	1	A
Job Title	Awanui Links	Author	Date	Checked
Calc Title	Overall - Water Demand	BD	19/02/2026	DJM

Water Catchment

As per RITS Standard 6.2.3 — 3 people per dwelling

Demand — 260 l/person/day

Demand Rates

Average Demand = 260 litres/person/day

Peak Demand (5x) = 1300 litres/person/day

Population	Dwellings	People	Occupancy
Proposed Rural Dwellings	70	3	210
Proposed returement units	125	1.5	187.5
Golf course	40	3	120
Light industry (30/ha)	4Ha	30	120
Total			517.5

Demand	Persons	Rate l/p/day	Flow l/s
AD Water	517.5	260	1.56
PD Water	517.5	1300	7.79

Peak Demand	Persons	Rate l/p/day	Flow l/s
PD Water	517.5	1300	**7.79**

Appendix E – CMW PRELIMINARY GEOTECHNICAL DESKTOP REPORT

CMW Geosciences
Great People | Practical Solutions

20 March 2026

Awanui Links Development

28 Telephone Road, Puketaha

PRELIMINARY GEOTECHNICAL DESKTOP REPORT

Maven Waikato Ltd

Job No. HAM2025-0123AB | Version 1

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Version Control

Document version information	
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Review and Update History

Revision	Date	Comments
A	04 March 2026	Initial draft for internal review
0	11 March 2026	Report issue
1	19 March 2026	Updated masterplan

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APPENDIX D Preliminary Liquefaction Results

APPENDIX E Preliminary Load Induced Settlement Results

APPENDIX F Natural Hazards Risk Assessment

1.0 INTRODUCTION

1.1 Scope

CMW Geosciences (CMW) was engaged by Maven Waikato Ltd to carry out a geotechnical desktop of a site located at 28 Telephone Road, Puketaha, for the proposed Awanui Links development to support a fast-track referral application.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2025-0123AA, Rev 0 dated 3 November 2025.

This report has been prepared to summarise the expected ground conditions and provide preliminary recommendations for possible geohazards, foundations and site-specific geotechnical testing.

2.0 SITE DESCRIPTION

2.1 Site Location

The site is located at 28 Telephone Road, Puketaha, as shown in Figure 1. The site is approximately 96ha and is currently being used for agricultural purposes.

The site is bordered by Holland Rd and the East Coast Main Trunk (ECMT) railway to the south and Telephone Road (SH1B) to the west. Farmland borders the northern and eastern site boundaries.

Figure 1: Site Location Plan (Source: Google Earth Pro).

2.2 Landform

The landform is essentially near level with existing levels ranging from RL 42m to RL 43m across site. A depression is located close to Telephone Rd and ranged from RL 42m to RL40m. A hill is also identified near the southern boundary which ranges from RL 44m to RL 46m. These features have been shown in ***Appendix A.***

Two council open roadside drains run along Telephone and Holland Rd. These drains have very flat gradient with flow towards the north and ultimately feed into a gully system which feeds into the Kormakorau Stream, approximately 4km north of the proposed development. The drain locations are shown in ***Appendix A***.

2.3 Proposed Development

The proposed Awanui Links is a mixed-use development as shown in Figure 2. It includes rural residential lots, light industrial lots, a retirement village with a care centre, a solar farm and an 18-hole international golf course with visitor accommodation, an event centre and wellness centre.

Figure 2: Awanui Links Masterplan (Source: Maven)

3.0 CONCEPTUAL GROUND MODEL

3.1 Geology

Published geological maps[1] for the area depict the regional geology as Holocene swamp deposits comprising of soft organic peat and mud with lenses of sand and silt. This is illustrated in Figure 3 below.

The Holocene swamp deposits are forming a surficial layer that commonly overlies late-Pleistocene age Hinuera Formation alluvial sand, silt and gravel with occasional peat interbeds.

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

A small area of late-Pliocene to Pleistocene age Walton Subgroup non-welded ignimbrite with associated alluvium and volcanic ashes is exposed 1.5km northwest of the site. This older geology underlies the more recent Holocene swamp deposits and Hinuera Formation alluvium.

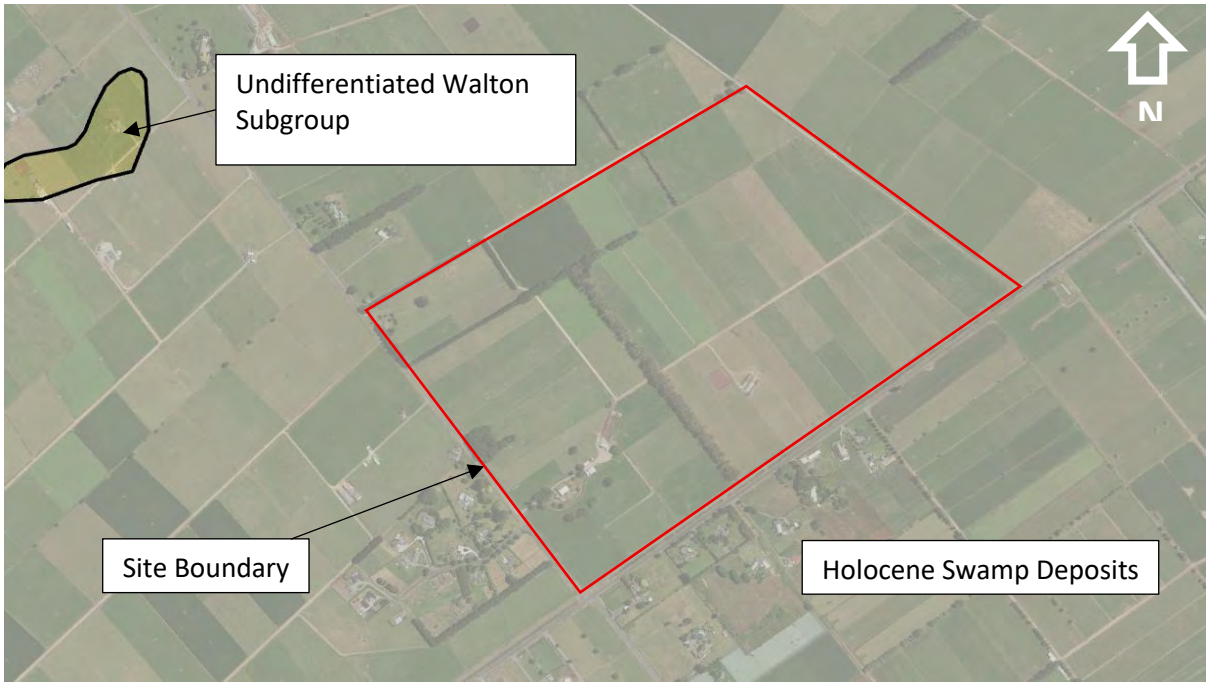


Figure 3: Regional Geology (Source: GNS Geology Map).[1]

3.2 Nearby Geotechnical Data

A review of nearby geotechnical logs from the New Zealand Geotechnical Database (NZGD) confirms the geology present in the published geological maps. Relevant plans and engineering logs are presented in ***Appendix A***.

Several bores are also located within or near the site. Three of these have a recorded lithology which has been included in ***Appendix A***.

Table 1: Summary of Strata encountered in Publicly Available Logs

Unit	Depth to Base of Unit (m)		Assessed Thickness (m)
	Min	Max	
Topsoil	0.1	0.2	0.2
PEAT (Swamp Deposits)	0.5	2.7	0.8
Interbedded Stiff SILT/loose to dense silty SAND and organic SILT and CLAY (Hinuera Formation) *	>20		-
Note: *Base of unit not encountered in limited available investigation logs.			

3.3 Groundwater

Nearby NZGD test results indicate groundwater between 0.4m and 2.5m below ground level (bgl). Observations on the 26 February 2026, showed that there was water within the open drains along Telephone Road and Holland Road approximately 1.5m below ground level. This water level may represent groundwater level.

4.0 DESKTOP FINDINGS

4.1 Historical Photos

Historical photographs dating back to 1952 have been reviewed and are attached in ***Appendix B***. The historical photographs show that the site has been used for agriculture prior to and since this time. In 1952, there are several structures present next to Telephone Road and more had been built in 1962. In 1991, the old buildings from 1952 have been removed and a tree had been planted. The depression next to Telephone Road also appears during this time. In an image from 2013, a pond is constructed in the southern part of site next to the silage pit.

4.2 Regional Hazards

A review of the Waikato Reginal Council Natural Hazard Portal[2] was undertaken. The hazard portal addresses potential flooding, coastal hazards, volcanic and seismic hazards. Hazard maps have presented in ***Appendix C***.

No river flooding risk had been identified. However, the site is part of the Waikato Central Drainage Scheme and there are Waikato Regional Council drains along Telephone and Holland Rd to remove water after a rainfall event. This demonstrates that the site is potentially prone to flooding after a heavy rainfall event. This will be addressed and resolved through the substantive application process.

The nearest active volcano is Ruapehu, which is approximately 170km away.

4.3 Fault Rupture

This site is not considered to be at risk of fault rupture on the basis that there are no mapped faults in the area. The GNS Active Fault Database[3] indicates the nearest active fault is the Kerepehi Fault with is approximately 50km to the east of the site and has a recurrence interval of 2,000 to 3,500 years.

4.4 Liquefaction and Lateral Spread

Liquefaction occurs in loose saturated cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-up, soil grains moving into suspension and temporary loss of strength causing vertical and lateral ground deformation. A liquefaction hazard map from the Waikato Regional Council is presented in ***Appendix C*** which classes the liquefaction risk at the site as “possible”.

The Peak Ground Acceleration (PGA) for both Ultimate Limit State (ULS) and Serviceability Limit State (SLS) was calculated based on a 50-year design life in accordance with the PGA from MBIE guidance module 1 and return period from NZS 1170.0 and importance level (IL) 2 structures. The PGA for the SLS and ULS earthquake scenarios is as follows:

Table 2: Design Peak Ground Acceleration (PGA) for Various Limit States

Limit State	AEP	PGA(g)	$Magnitude_{eff}$
SLS	1/25	0.06	5.9
ULS	1/500	0.25	5.9
Note: AEP = annual exceedance probability.			

[2] Waikato Regional Council. Waikato Regional Hazards Portal. https://experience.arcgis.com/experience/0eced30c44eb43a2b6fcb1ce8727c9db/
[3] GNS. New Zealand Active Fault Datasets. https://data.gns.cri.nz/af/index.html

The liquefaction susceptibility of the soils at this site was assessed using the existing CPT's at 545 Holland Road, approximately 300m from the site.

Liquefaction analyses were undertaken using the software package CLiq using the Boulanger and Idriss (2014) method. The cyclic stress ratio (CSR), being a function of the earthquake magnitude for the design return period event, was compared to the cyclic resistance ratio (CRR), being a function of the CPT cone resistance (q_c) and friction ratio (F_r). Results of this analysis has been presented in ***Appendix D*** and are summarised in the table below.

Table 3: Preliminary liquefaction analysis – 545 Holland Road.

CPT No.	SLS Settlements (mm)	ULS Settlements (mm)	Depth to liquefied layer (m bgl)
CPT_194534	<5	140	1.9
CPT_194537	<5	145	1.8
Note: ULS and SLS settlements are based on the full depth of the CPT trace with a weighing factor applied.			

The calculations indicate that in ULS cases, there is a potentially a high risk of liquefaction-induced settlement occurring at the site. Further investigations will need to take place to assess the site-specific liquefaction risk, however this can be managed through specifically designed foundations.

The fine-grained alluvium, while not liquefiable due to its high plasticity, may be susceptible to some strength loss, referred to as cyclic softening, during a ULS seismic event.

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where proposed cut and fill batters are proposed over or within liquefied soils. For example, lateral spread risk into stormwater retention swales or basins excavated below groundwater table will require slope stability analysis and lateral stretch assessment for adjacent buildings and infrastructure.

4.5 Slope Stability

Based on the general flat site topography, it is considered that the site is not generally considered to be at risk of slope instability. Slumping or subsidence has not been observed in the historical photographs.

The inclusion of fill with batters or cuts to form stormwater retention swales / basins will need an assessment of slope stability as part of the design process.

4.6 Load Induced Settlement

Given the site geology is predominantly swamp deposits over alluvial soils, there is a high risk of soft and compressible soils. In this instance, significant primary consolidation and long-term secondary creep settlements may occur as a response to the placement of fill and building loads.

Preliminary calculations were undertaken on the two CPT's located at 545 Holland Road and are presented in ***Appendix E***. The calculations assume loading for light weight single story structures, as appropriate for the proposed luxury villas, retirement village and rural-residential buildings. A summary of results is presented Table 4 below. No Fill load was assumed when conducting these calculations.

Table 4: Preliminary load induced settlement results – 545 Holland Road

CPT No.	Primary Settlement (mm)	Total Settlement (mm)
CPT_194534	50	85
CPT_134537	45	75

CPT No.	Primary Settlement (mm)	Total Settlement (mm)
Note: 1. Settlement calculations are based on an applied load of 10kPa, with a footing width of 20m and an embedment depth of 0.5m. 2. Total settlement includes primary settlement and secondary settlement over a 50 year design life.		

New Zealand Building Code, Clause C.2.1.2 of B1/VM2 provides the following differential settlement criteria for design of shallow foundations:

"Foundation design should limit the probable maximum differential settlement over a horizontal distance of 6m to no more than 25mm under serviceability limit state load combinations of AS/NZS 1170 Part 0, unless the structure is specifically designed to prevent damage under a greater settlement."

There is no site specific testing to enable an assessment of differential settlement, however these can typically be achieved through foundation and (if required) ground improvement design.

Settlement across site is expected to be variable. Further testing is required to establish site specific settlement results.

4.7 Earthworks, Civil Works and Road Subgrades

Due to the relatively flat landform, bulk earthworks involving cuts and fills are likely to be minor.

Excavations to form stormwater attenuation swales and ponds, service trenches and form road subgrades will encounter soft organic soils near the ground surface. The underlying silts / clays can be sensitive and may lose strength when they are disturbed or allowed to get wet.

Geotechnical site investigation and future reporting will provide advice on how to manage and treat soft soils. This may include removal and replacement or ground improvement methods, such as preloading.

Groundwater may be encountered at shallow depth. Future reporting will assess the need for groundwater mitigation measures, which may include the installation of underfill subsoil drains or granular drainage blanket layers as mitigation measures.

Temporary support of services trenches and excavations for buried infrastructure such as pump stations by benching along with use of trench shields and with temporary construction dewatering is anticipated.

Low CBR values for road subgrades should be expected with mitigation in the form of Subgrade Improvement Layers (SIL's).

If temporary or long-term groundwater levels are affected by any site development, then an assessment of groundwater drawdown effects such as settlement of surrounding properties may be required. If this is a significant risk then monitoring plans are typically required.

4.8 Acid sulphate soils

Acid sulphates can be found in waterlogged soils and can cause damage to water ways and infrastructure when exposed to oxygen through excavation or drainage. The Waikato Regional Council has assessed that there is a high probability of acid sulphate soils in this area, as shown on ***Appendix C***. From recent experience in the Waikato region organic/peat soils present a potential higher risk of having acid sulphate conditions. Inorganic soils are typically low risk.

Testing and sampling will be required during the geotechnical investigation to assess the level of risk for the site. If mitigation is required, this can typically be done through the addition of Ag-Lime.

4.9 Seismic Site Subsoil Category

Based on those ground conditions and specific geophysical data gathered by the University of Waikato and Auckland University, the typical site period for the site is expected to be about 3 seconds where the seismic site subsoil category is assessed as being Class D (deep soil site) in accordance with NZS1170.5.

4.10 Foundation

4.10.1 Bearing Capacity

Further investigations will advise on anticipated foundation design parameters and any restrictions that require further engineering investigation and/or design on individual lots to address any remaining natural hazards as described in Section 71(3) of the Building Act, i.e. erosion, falling debris, subsidence, slippage, and inundation. The certification for residential lots is based on compliance with the “good ground” definition of NZS 3604 at finished ground levels.

There may be areas where localised variations in shear strength within the natural cut ground occur. Further confirmation of available bearing pressures will be addressed at the time of the geotechnical investigation.

4.10.2 Preliminary Foundation Options

Depending on the assessed magnitude of liquefaction-induced and static (load induced) settlement, engineered foundation solutions may be required. This may include foundation options such as TC2 or TC3 type raft foundations. Deep pile foundations/ deep ground improvement may also be required for larger loads expected in commercial / light industrial buildings.

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

Ground improvement options that could be considered include:

- Undercut and rework of soft ground (to address static settlement only);
- Temporary surcharge fills (to address static settlement only);
- Deep soil mixing and/or vibro-stone columns (to mitigate both liquefaction and static settlement).

Confirmation of the most suitable approach will require detailed geotechnical investigation and design and will vary for different building typologies and locations.

5.0 FURTHER WORK

Based on the assessment presented in this report, there are no unusual features or geotechnical constraints observed for this site that would prevent a mixed use development as indicated on the Maven masterplan from proceeding.

We have identified the following additional scope of work that is considered necessary to further assess the risk profile for the scheme and to support a substantive consent application. This additional scope of work is typical for mixed use development of this scale, and includes the following:

- Geotechnical investigation to inform ground model development, detailed geohazard assessment, selection of geotechnical design parameters, and design and construction recommendations.

- Geotechnical analysis and reporting, suitable to support future project stages including resource consent application, detailed design, and building consent applications (as required).
- Design of ground improvement (if necessary) to mitigate load or liquefaction induced settlement, or lateral spread.
- Geotechnical completion reporting following subdivision earthworks.

6.0 CLOSURE

This report has been prepared for use by Maven Waikato Ltd in relation to the Awanui Links, 28 Telephone Road, Puketaha project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Maven Waikato Ltd seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

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

Preparation of your report

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

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

Your geotechnical report is based on your project's requirements

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

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

Interpretation of geotechnical data

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

Subsurface conditions can change

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

Interpretation and use by other design professionals

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

Your report's recommendations require confirmation during construction

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

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

Environmental matters are not covered

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

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

APPENDIX A

NZGD Logs and WRC Bores

LEGEND:

- SITE BOUNDARY
- HAXX — NZGD HAND AUGER (HA) LOCATION
- NZGD TEST PIT (TP) LOCATION
- NZGD CPT LOCATION
- WRC BORE LOCATION

NOTES:

1. SITE BOUNDARY SHOWN INDICATIVELY.
2. BASE PLAN COURTESY OF GOOGLE EARTH.
3. TEST LOCATIONS SHOWN INDICATIVELY ONLY.

CMW Geosciences
Great People | Practical Solutions

CLIENT: MAVEN WAIKATO LTD	DRAWN: PM	PROJECT: HAM2025-0123	
PROJECT: AWANUI LINKS	CHECKED: KL	DRAWING: 01	
	REVISION: 0	SCALE: NTS	
TITLE: EXISITING SITE INVESTIGATION PLAN	DATE: 2/07/2025	SHEET: A3	

LEGEND:

- SITE BOUNDARY
- ROADSIDE DRAINS
- DEPRESSION
- HILL

NOTES:

1. SITE BOUNDARY SHOWN INDICATIVELY.
2. BASE PLAN COURTESY OF GOOGLE EARTH.

100 0 100 200 300 400 m

CMW Geosciences
Great People | Practical Solutions

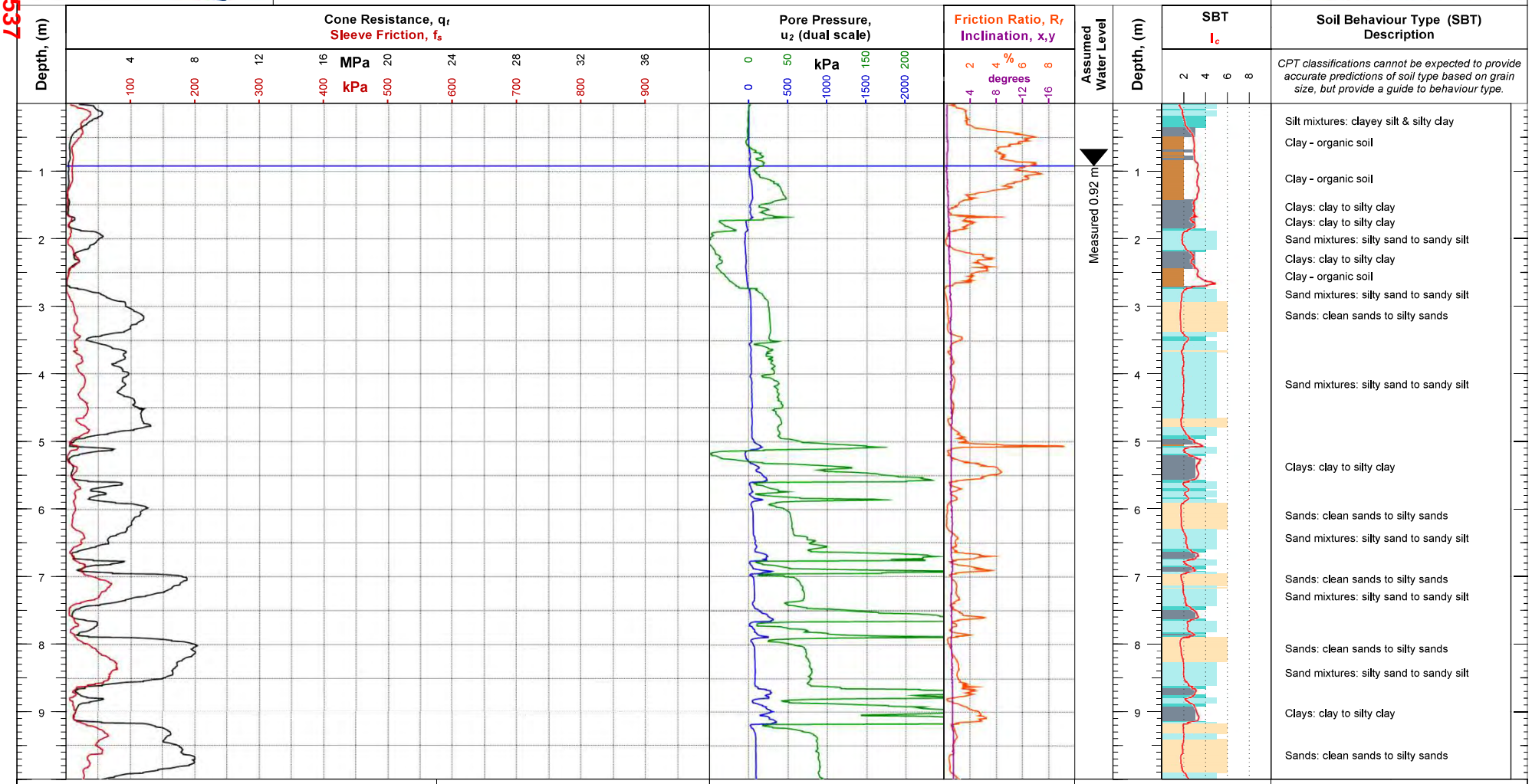
CLIENT: **Maven Waikato Ltd**	DRAWN: PM	PROJECT: HAM2025-0123
PROJECT: **Awanui Links**	CHECKED: KL	DRAWING: 02
	REVISION: 0	SCALE: 1:10,000
TITLE: **Site Features**	DATE: 01/01/2025	SHEET: A3L

NZGD ID: 194537

Geoconsult GEOTECHNICAL CONSULTANTS

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Geoconsult	**Operator:** Carlos Prieto	**NZTM2000 N,E (m):** 5820192.03, 1809172.98	**Elevation (m):** Unknown	**Client Job Ref:**
Project: 454 Holland Road	**Cone Ref:** MKJ167	**WGS84, (deg):** -37.741681, 175.373977	**Date of Test:** 18/01/2019	**CPT Number:** CPT-02
Location: Eureka, Hamilton	**Cone Type:** 10 cm² Compression	**Location Method:** Handheld GPS	**Depth (m):** 19.90	
Engineer: Mark McDonald	**Area Ratio:** 0.8	**Surveyor:** N/A	**Pre-Drill (m):** N/A	
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Filter Type:** u2	**Termination Reason:** Limit of reaction force		**G.I. Job Ref:** 19-026

Remarks:

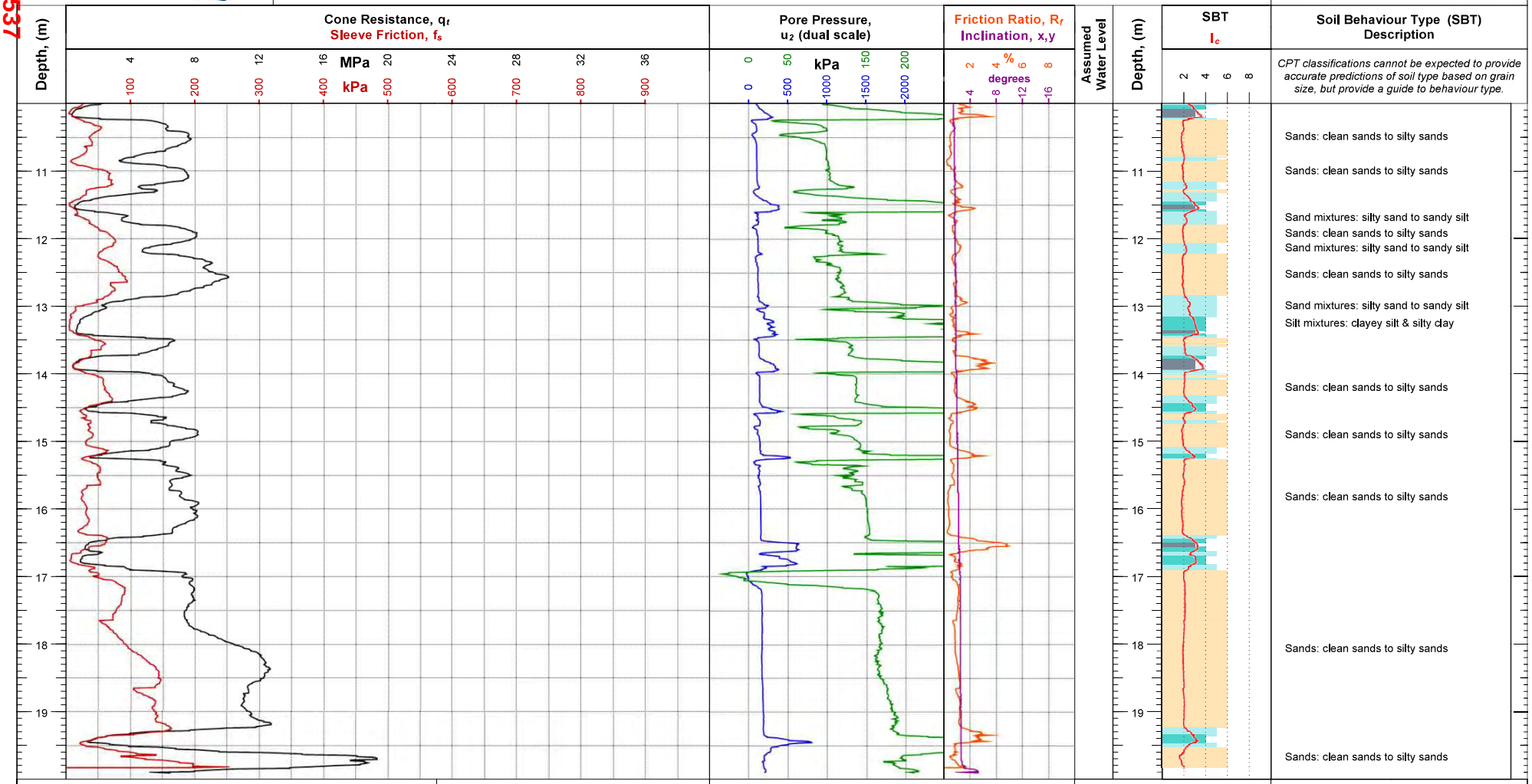
NZGD ID: 194537

NZGD ID: 194537

Geoconsult GEOTECHNICAL CONSULTANTS

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Geoconsult	**Operator:** Carlos Prieto	**NZTM2000 N,E (m):** 5820192.03, 1809172.98	**Elevation (m):** Unknown	**Client Job Ref:**
Project: 454 Holland Road	**Cone Ref:** MKJ167	**WGS84, (deg):** -37.741681, 175.373977	**Date of Test:** 18/01/2019	**CPT Number:** CPT-02
Location: Eureka, Hamilton	**Cone Type:** 10 cm² Compression	**Location Method:** Handheld GPS	**Depth (m):** 19.90	
Engineer: Mark McDonald	**Area Ratio:** 0.8	**Surveyor:** N/A	**Pre-Drill (m):** N/A	
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Filter Type:** u2	**Termination Reason:** Limit of reaction force		**G.I. Job Ref:** 19-026

Remarks:

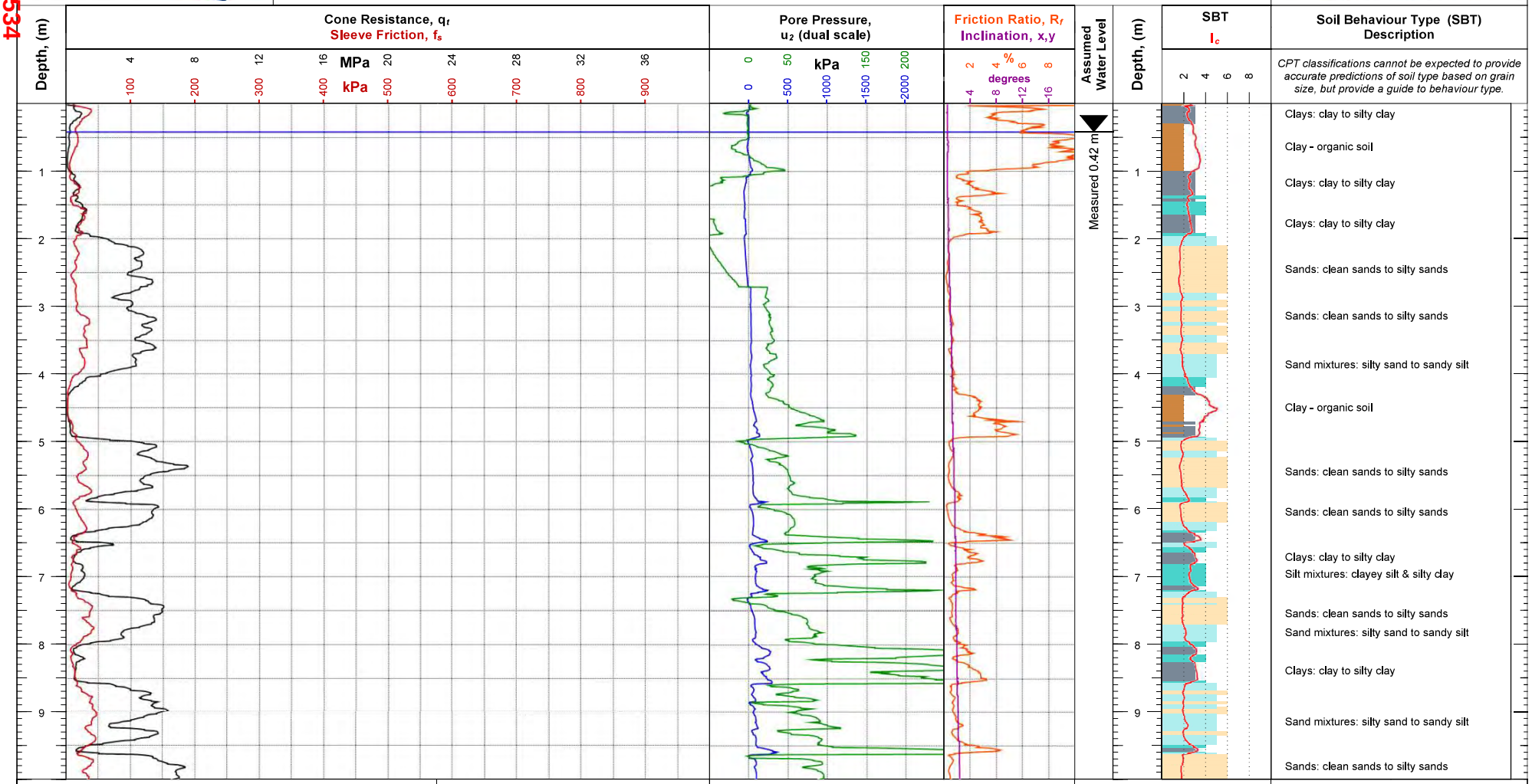
NZGD ID: 194537

NZGD ID: 194534

Geoconsult GEOTECHNICAL CONSULTANTS

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Geoconsult	**Operator:** Carlos Prieto	**NZTM2000 N,E (m):** 5820225.48, 1809185.2	**Elevation (m):** Unknown	**Client Job Ref:**
Project: 454 Holland Road	**Cone Ref:** MKJ167	**WGS84, (deg):** -37.741377, 175.374106	**Date of Test:** 18/01/2019	**CPT Number:** CPT-01
Location: Eureka, Hamilton	**Cone Type:** 10 cm² Compression	**Location Method:** Handheld GPS	**Depth (m):** 19.84	
Engineer: Mark McDonald	**Area Ratio:** 0.8	**Surveyor:** N/A	**Pre-Drill (m):** N/A	
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Filter Type:** u2	**Termination Reason:** Limit of reaction force		**G.I. Job Ref:** 19-026

Remarks:

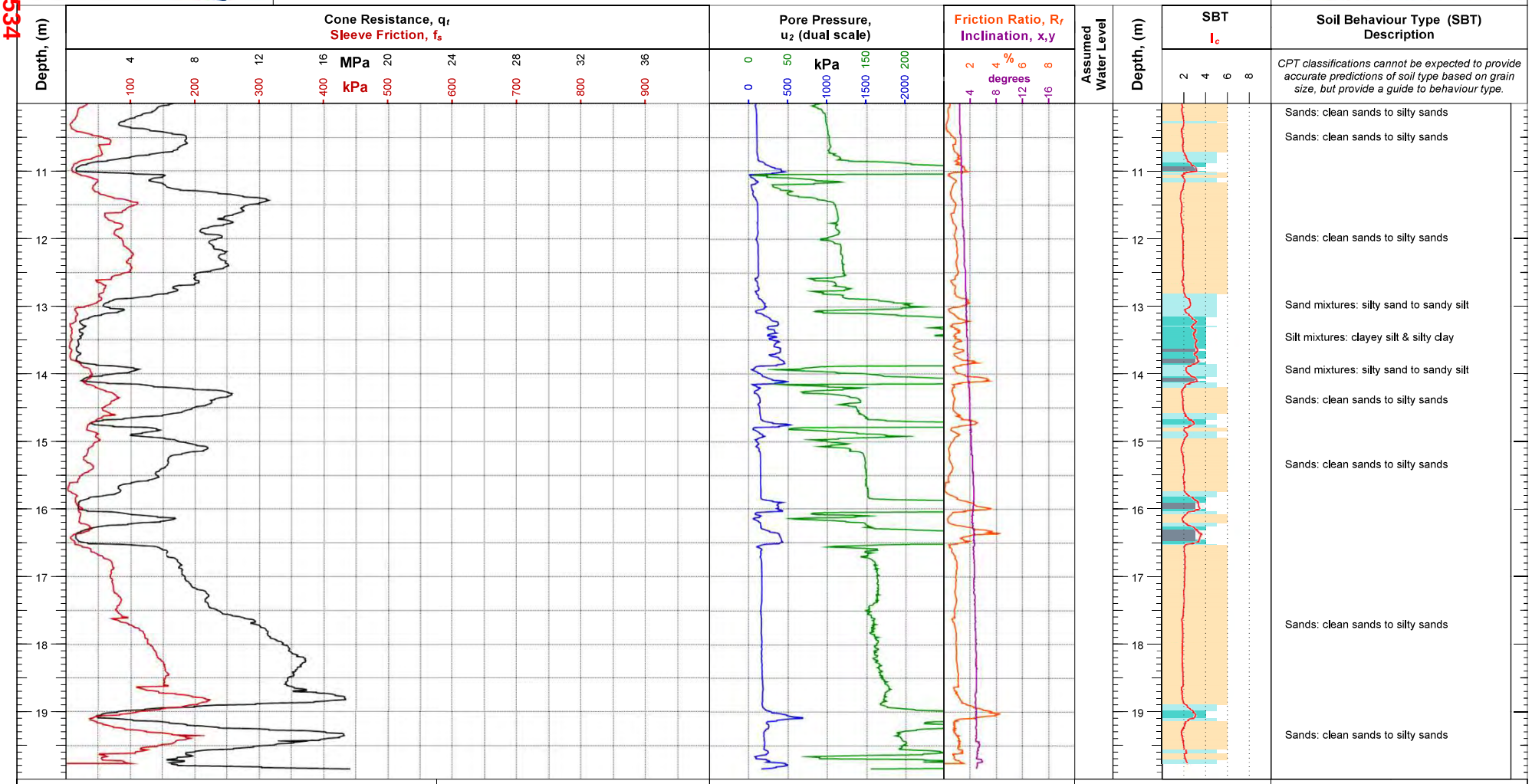
NZGD ID: 194534

NZGD ID: 194534

Geoconsult GEOTECHNICAL CONSULTANTS

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Geoconsult	**Operator:** Carlos Prieto	**NZTM2000 N,E (m):** 5820225.48, 1809185.2	**Elevation (m):** Unknown	**Client Job Ref:**
Project: 454 Holland Road	**Cone Ref:** MKJ167	**WGS84, (deg):** -37.741377, 175.374106	**Date of Test:** 18/01/2019	**CPT Number:** CPT-01
Location: Eureka, Hamilton	**Cone Type:** 10 cm² Compression	**Location Method:** Handheld GPS	**Depth (m):** 19.84	
Engineer: Mark McDonald	**Area Ratio:** 0.8	**Surveyor:** N/A	**Pre-Drill (m):** N/A	
Contractor: Ground Investigation Ltd. www.g-i.co.nz	**Filter Type:** u2	**Termination Reason:** Limit of reaction force		**G.I. Job Ref:** 19-026

Remarks:

NZGD ID: 194534

NZGD ID: 193754

TITUS CONSULTING ENGINEERS

Log:

HA1

Address: 200 Holland Road
Date: 29/04/2022
Testers: PetaM

Project №: 13592

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: (5, 10, 15)	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
	100	Undefined		Topsoil				
	200, 300, 400, 500, 600, 700, 800	Holocene Swamp Deposits		Dark brown and black, organics, Wood pieces present				
	900, 1000, 1100, 1200, 1300, 1400			SILT, light brownish grey, low plasticity, moist to wet, stiff		151	32	4.8
						127	40	3.2
	1500, 1600, 1700, 1800			Sandy SILT, dark brownish grey, low plasticity, moist to wet, very stiff		162	48	3.4
	1900, 2000, 2100, 2200, 2300, 2400, 2500			SILT with some sand, dark greyish blue and brown, low plasticity, wet, stiff		103	44	2.3
▼	2600, 2700			SILT with some sand, dark greyish blue and brown, low plasticity, saturated, stiff		127	48	2.7
	2800			*Borehole terminated due to non-retrieval @2700mm*				

NZGD ID: 193754

NZGD ID: 193755

TITUS CONSULTING ENGINEERS

Log:

HA2

Address: 200 Holland Road
Date: 29/04/2022
Testers: PetaM

Project №: 13592

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: (5, 10, 15)	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
Not Found	100, 200	Undefined		Topsoil				
	300, 400, 500, 600, 700, 800	Holocene Swamp Deposits		Dark brown and black, moist, organics, Wood pieces present				
	900, 1000			SILT, light brownish grey, low plasticity, moist, stiff		143	32	4.5
	1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800			Sandy SILT, dark greyish brown, low plasticity, moist to wet, stiff		119	44	2.7
	1900, 2000			Sandy SILT, dark grey, low plasticity, wet, stiff		87	16	5.5
	2100			*End of Borehole @2000mm*		127	48	2.7

NZGD ID: 193755

NZGD ID: 193756

TITUS CONSULTING ENGINEERS

Log:

HA3

Address: 200 Holland Road
Date: 29/04/2022
Testers: PetaM

Project №: 13592

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: (5, 10, 15)	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
	100, 200	Undefined		Topsoil				
	300, 400, 500, 600, 700, 800	Holocene Swamp Deposits		Dark brown and black, moist, organics				
	900, 1000			SILT, light brownish grey, low plasticity, moist, very stiff		187	41	4.5
	1100, 1200, 1300, 1400, 1500			SILT, brownish grey mottled yellow, low plasticity, moist, very stiff		222	40	5.6
	1600, 1700			SILT, brownish grey, low plasticity, moist to wet, stiff		127	48	2.7
	1800, 1900, 2000, 2100, 2200, 2300			SILT with some sand, dark greyish blue and brown, low plasticity, wet, stiff to very stiff		159	49	3.2
	2400, 2500			SILT with some sand, dark greyish brown and blue, low plasticity, saturated, stiff		95	36	2.6
	2600			*Borehole terminated due to non-retrieval @2500mm*		125	48	2.6

NZGD ID: 193756

NZGD ID: 193758

TITUS CONSULTING ENGINEERS

Log:

HA4

Address: 200 Holland Road
Date: 29/04/2022
Testers: PetaM

Project №: 13592

Water Table:	Depth (mm):	Geology:	Graphic Log:	Material Description:	Blows /100mm: (5, 10, 15)	Shear Strength (kPa): Undrained:	Remoulded:	Sensitivity:
Not Found	100, 200	Undefined		Topsoil				
	300, 400, 500, 600, 700, 800, 900	Holocene Swamp Deposits		Dark brown and black, moist, organics				
	1000, 1100			SILT, light brownish grey, low plasticity, moist to wet, stiff		111	55	2
	1200, 1300, 1400, 1500			Sandy SILT, light brownish grey, low plasticity, moist to wet, stiff		127	40	3.2
	1600, 1700, 1800, 1900, 2000			SILT with some sand, dark greyish blue and brown, low plasticity, moist to wet, stiff to very stiff		222	48	4.7
	2100			*End of Borehole @2000mm*		95	55	1.7

NZGD ID: 193758

Soil Description

Log Identification: HA03

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S	
		PEAT (peat is amorphous); dark blackish brown. Moist to wet.	PEAT	
	0.5			0.5
		SILT with trace fine sand; brown. Stiff, moist to wet, slightly plastic.	SWAMP DEPOSITS	
		Sandy **SILT** with trace medium to coarse sand; brown. Stiff*, wet, slightly plastic.		
	1.0			1.0
		Silty medium to coarse **SAND**; brown. Loose to dense, wet.		
		- colour becoming light brownish grey.		
		- becoming wet to saturated.		
	1.5			1.5
		- becoming saturated.		
	2.0			2.0
	2.5			2.5
	3.0	End of hand auger at 2.8m - No sample retained.		3.0
		* consistency based on diagnostic features		
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5			5.5

Field Test Data

Vane Shear Strength (NZGS) kPa Peak / Residual: 84/24

Scala Penetrometer (blows per 100mm drop)

Plot of Scala results (Very loose: 0–1; Loose: 2–3; Medium Dense: 4–6; Dense: 7–10)

Blow count
3
2
1
1
0.5
0.5
0.5
0.5
2
2
3
2
3
3
4
4
4
2
2
4
5
4
6
8
7
9
7
7
6

Groundwater Level: Groundwater encountered at 1.8m bgl.

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: 2206
Logged By: L.H.

Soil Description

Log Identification: HA04

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S	
		PEAT (peat is amorphous); dark blackish brown. Moist to wet.	PEAT	
	0.5			0.5
		SILT with trace fine sand; brown. Stiff, moist to wet, slightly plastic. Note: Rootlets (dia < 10mm) oberved at 0.6m.	SWAMP DEPOSITS	
	1.0	Sandy **SILT**; light brownish grey. Stiff*, wet, slightly plastic.		1.0
		Silty medium to coarse **SAND**; light brownish grey. Loose to medium dense, wet to saturated.		
	1.5			1.5
		- becoming saturated.		
	2.0			2.0
	2.5			2.5
		End of hand auger at 2.7m - No sample retained.		
	3.0			3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5			5.5

Field Test Data

Vane Shear Strength (NZGS) kPa Peak / Residual: 72/34

Scala Penetrometer (blows per 100mm drop)

Plot of Scala results (Very loose: 0 1; Loose: 2 3; Medium Dense: 4 5 6; Dense: 7 8 9 10)

Blow count	Very loose	Loose	Medium Dense	Dense
1	1			
2	2	2		
0.5	1			
0.5	1			
1	1			
1	1			
1	1			
1	1			
1	1			
2	2	2		
3	3	3	3	
3	3	3	3	
3	3	3	3	
3	3	3	3	
2	2	2		
3	3	3	3	
3	3	3	3	
2	2	2		
2	2	2		
2	2	2		
3	3	3	3	
4	4	4	4	4
3	3	3	3	
3	3	3	3	
2	2	2		
3	3	3	3	
4	4	4	4	4
5	5	5	5	5 5
7	7	7	7	7 7 7 7

Groundwater Level: Groundwater encountered at 1.8m bgl.

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: 2206
Logged By: L.H.

Soil Description

Log Identification: HA05

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)	Vane Shear Strength (NZGS) kPa Peak / Residual	Field Test Data: Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose 0 1, Loose 2 3, Medium Dense 4 5 6, Dense 7 8 9 10)	Groundwater Level
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S					Groundwater not encountered during testing
		PEAT (peat is amorphous); dark blackish brown. Moist to wet.	PEAT					
	0.5	**SILT**; brown. Moist to wet, slightly plastic.	SWAMP DEPOSITS	0.5				
		- with trace fine sand						
	1.0	Sandy **SILT**; light greyish brown. Wet, slightly plastic.		1.0				
		End of hand auger at 1.0m - Target depth.						
	1.5			1.5				
	2.0			2.0				
	2.5			2.5				
	3.0			3.0				
	3.5			3.5				
	4.0			4.0				
	4.5			4.5				
	5.0			5.0				
	5.5			5.5				

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: N/A
Logged By: L.H.

Soil Description

Log Identification: HA06

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)	Vane Shear Strength (NZGS) kPa Peak / Residual	Field Test Data: Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose 0 1, Loose 2 3, Medium Dense 4 5 6, Dense 7 8 9 10)	Groundwater Level
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S					Groundwater not encountered during testing
		PEAT (peat is amorphous); dark blackish brown. Moist to wet.	PEAT					
	0.5			0.5				
		SILT; brown. Moist to wet, slightly plastic.	SWAMP DEPOSITS					
		- with trace fine sand. Colour becoming light greyish brown.						
	1.0	Sandy **SILT**; light greyish brown. Wet, slightly plastic.		1.0				
		End of hand auger at 1.0m - Target depth.						
	1.5			1.5				
	2.0			2.0				
	2.5			2.5				
	3.0			3.0				
	3.5			3.5				
	4.0			4.0				
	4.5			4.5				
	5.0			5.0				
	5.5			5.5				

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: N/A
Logged By: L.H.

Soil Description

Log Identification: HA01

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S	
		PEAT (peat is amorphous); dark blackish brown. Moist to wet.	PEAT	
	0.5			0.5
		SILT with trace fine to medium sand; brown. Stiff, moist to wet, slightly plastic.	SWAMP DEPOSITS	
	1.0			1.0
		- with trace of clay. Sand increasing to minor. Colour becoming light brownish grey. Becoming wet.		
		Sandy **SILT**; light brownish grey. Stiff, wet to saturated, slightly plastic.		
	1.5			1.5
		SILT with trace fine to medium sand; light brownish grey. Stiff*, wet to saturated, slightly plastic.		
	2.0			2.0
	2.5			2.5
		End of hand auger at 2.4m - No sample retained. * consistency based on diagnostic features		
	3.0			3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5			5.5

Field Test Data

Vane Shear Strength (NZGS) kPa Peak / Residual	Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose 0 1; Loose 2 3; Medium Dense 4 5 6; Dense 7 8 9 10)
	2	2 2
	2	2 2
	1	1
	2	2 2
	2	2 2
	1	1
	1	1
	1	1
	1	1
	2	2 2
91/43	2	2 2
	5	5 5 5 5 5
	5	5 5 5 5 5
	5	5 5 5 5 5
76/30	4	4 4 4 4
	3	3 3 3
	2	2 2
	1	1
	1	1
	2	2 2
	2	2 2
	2	2 2
	4	4 4 4 4
	5	5 5 5 5 5
	4	4 4 4 4
	4	4 4 4 4
	3	3 3 3
	3	3 3 3
	3	3 3 3

Groundwater Level: Groundwater encountered at 1.6m bgl.

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP
Consulting Engineers and Planners
bcdgroup.nz
HAMILTON | 240 Ulsterm St, Hamilton | 07 839 9107
NEW PLYMOUTH | Level 3/53 Brougham St, New Plymouth | 06 757 5051

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: 2206
Logged By: L.H.

Soil Description

Log Identification: HA02

Investigation method	Depth (meters)	Field Description	Geological Unit	Depth (meters)
HAND AUGER		**TOPSOIL**; dark brown. Moist.	T/S	
		PEAT; dark blacking brown. Moist to wet.	PEAT	
	0.5			0.5
		SILT with trace fine sand; brown. Stiff, moist to wet, slightly plastic.	SWAMP DEPOSITS	
	1.0			1.0
		- sand increasing to some. Colour becoming light brownish grey.		
		Silty medium to coarse **SAND**; light brownish grey. Loose to medium dense, moist to wet.		
		- becoming wet to saturated.		
	1.5			1.5
	2.0	**SILT**, minor medium sand; greyish brown. Stiff, wet to saturated.		2.0
		Silty medium to coarse **SAND**; greyish brown. Loose to medium dense, saturated.		
	2.5			2.5
	3.0	End of hand auger at 2.8m - No sample retained.		3.0
	3.5			3.5
	4.0			4.0
	4.5			4.5
	5.0			5.0
	5.5			5.5

Field Test Data

Vane Shear Strength (NZGS) kPa Peak / Residual	Blow count	Scala Penetrometer (blows per 100mm drop) – Plot of Scala results (Very loose 0 1; Loose 2 3; Medium Dense 4 5; Dense 6 7 8 9 10)
	2	2 2
	4	4 4 4 4
	1	1
	1	1
	1.5	2 2
	1.5	2 2
	1	1
	2	2 2
	2	2 2
	2	2 2
69/17	4	4 4 4 4
	3	3 3 3
	4	4 4 4 4
	3	3 3 3
	2	2 2
	3	3 3 3
	3	3 3 3
	2	2 2
	3	3 3 3
57/43	3	3 3 3
	3	3 3 3
	5	5 5 5 5 5
	4	4 4 4 4
	4	4 4 4 4
	5	5 5 5 5 5
	6	6 6 6 6 6 6
	4	4 4 4 4
	6	6 6 6 6 6 6
	5	5 5 5 5 5

Groundwater Level: Groundwater encountered at 2.0m bgl.

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 369A Marshmeadow Road
Site location: Newstead
Date of investigation: 10-01-2019

Job Number: 18-1143
Shear Vane ID: 2206
Logged By: L.H.

Log Key Sheet

WATER

Water level on date shown

METHOD *(shows drilling method)*

OB	open barrel
Wash	wash boring
TT	triple tube
UT	thin walled undisturbed tube
SPT	standard penetration test – open nose sampler
Nc	standard penetration test – solid nose sampler
MA	machine auger
PS	piston sample
PCT	percussion – top drive
PCB	percussion – bottom drive
Conc	concentrics
Sonic	sonic
HA	hand auger
VE	vacuum excavation

SAMPLES

Dx	Disturbed sample, number x
Bx	Bulk sample, number x
Ux(d)	Undisturbed sample, number x, tube diameter d in mm
Wx	Water sample, number x

MOISTURE

Dry, looks and feels dry
Moist, no free water on hand when remoulding
Wet, free water on hand when remoulding
Saturated, soil below water table

SOIL AND ROCK DESCRIPTIONS

Soil and Rock Descriptions are generally as described in the NZ Geotechnical Society "Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", dated December 2005.
Vane Shear Strength measurements in accordance with the NZ Geotechnical Society "Guideline for hand held shear vane test" dated August 2001.

IN SITU TESTS

SV	= 40/10	In situ shear strength and remoulded shear strength respectively, as measured by Geotechnics/ Pilcon Shear Vane
τ	= 50/12	Vane shear strength and remoulded vane shear strength respectively, corrected to BS1377
UTP	=	Unable To Penetrate with Shear Vane
N	= 15	SPT uncorrected blow count for 300mm penetration
N_c	= 50+	SPT uncorrected blow count for 300 mm penetration using solid nose sampler

★	**Laboratory Test(s) carried out:**
AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

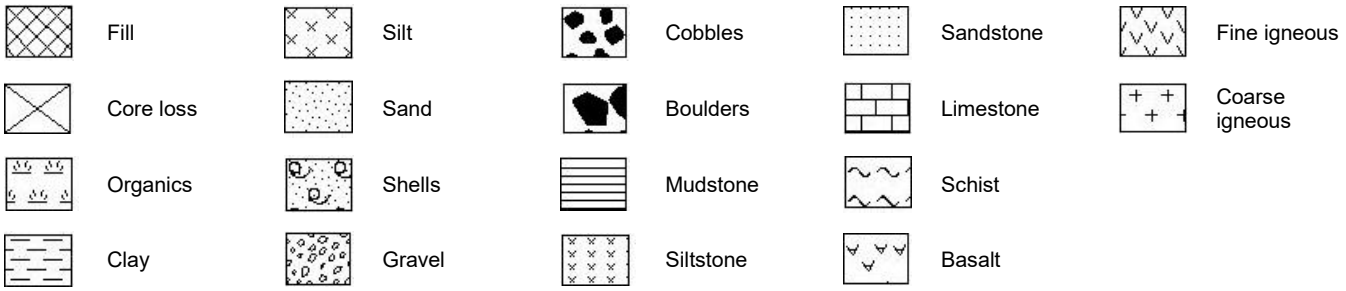
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils	Undrained Shear Strength (kPa)
Very soft	<12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	>200

Non-cohesive Soils	SPT – Uncorrected
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	>50

GRAPHIC LOG (1 or a combination of the following)



ORGANIC SOILS

Von Post Degree of Humification

H1	Completely unconverted and mud-free peat, when pressed gives clear water and plant structure is visible.
H2	Practically unconverted and mud-free peat, when pressed gives almost clear water and plant structure is visible.
H3	Very slightly decomposed or very slightly muddy peat, when pressed gives marked muddy water, no peat substance passes through the fingers and plant structure is less visible.
H4	Slightly decomposed or slightly muddy peat, when pressed gives marked muddy water and plant structure is less visible.
H5	Moderately decomposed or very muddy peat with growth structure evident but slightly obliterated.
H6	Moderately decomposed or very muddy peat with indistinct growth structure.
H7	Fairly well decomposed or very muddy peat but the growth structure can just be seen.
H8	Well decomposed or very muddy peat with very indistinct growth structure.
H9	Practically decomposed or mud-like peat in which almost no growth structure is evident.
H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

NZGD ID: 154362

NZ TRANSPORT AGENCY | Safe Roads

TEST PIT LOG

TEST PIT No: TP05

SHEET 1 of 1

PROJECT:	SRA Level Crossing Programme	JOB NUMBER:	3413241
SITE LOCATION:	SH1B Telephone Road, Eureka	CLIENT:	Safe Roads Alliance

CIRCUIT: NZTM 2000
COORDINATES: N 5,819,878 m
E 1,808,639 m

TEST PIT LOCATION: 20m from road edge and 1m from rail track
R L: 44 m
DATUM: Auckland 1946 (MSL)
COORDINATE ORIGIN: MAP
ACCURACY: ±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
0.5			Loosely packed, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, trace organics; greyish brown; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke. Organics: rootlets.	Ballast					43.5
			Loosely packed, medium to coarse gravelly medium to coarse SAND; dark grey; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke.	Sub-ballast					
1.0			Loosely packed, fine to coarse SAND, minor fine gravel, trace coarse gravel; brownish yellow; moist, non plastic.	Holocene Alluvium	3				43.0
			END OF LOG @ 1 m		1				
					0				
					0				
					0				
1.5					0				42.5
					1				
					0				
					0				
					0				
2.0					1				42.0
					2				
					1				
					1				
					2				
2.5									41.5
3.0									41.0
3.5									40.5

DATE EXCAVATED:	21/6/18	CONTRACTOR:	Abernethy
LOGGED BY:	LZ	EQUIPMENT:	1.7t Excavator
SHEAR VANE No:		METHOD:	E

COMMENTS:
- Test Pit terminated at target depth.
- Coordinates estimated from WRC LocalMaps (accuracy +/- 5m).
- RL estimated from survey plan 3413241-SUR-0001 (accuracy +/- 1m).
- Water table not encountered.
- Test Pit backfilled and compacted in 300mm layers with excavator.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Rev A

BECA LIB 1.07.4.GLB Log BECA TEST PIT SH1B TELEPHONE ROAD, EUREKA - LEVEL CROSSING.GPJ TELEPHONE RD - TP LOGS.GDW 29/08/2018 14:32 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

NZGD ID: 154362

Log Key Sheet

WATER

Water level on date shown

METHOD *(shows drilling method)*

OB	open barrel
Wash	wash boring
TT	triple tube
UT	thin walled undisturbed tube
SPT	standard penetration test – open nose sampler
Nc	standard penetration test – solid nose sampler
MA	machine auger
PS	piston sample
PCT	percussion – top drive
PCB	percussion – bottom drive
Conc	concentrics
Sonic	sonic
HA	hand auger
VE	vacuum excavation

SAMPLES

Dx	Disturbed sample, number x
Bx	Bulk sample, number x
Ux(d)	Undisturbed sample, number x, tube diameter d in mm
Wx	Water sample, number x

MOISTURE

Dry, looks and feels dry
Moist, no free water on hand when remoulding
Wet, free water on hand when remoulding
Saturated, soil below water table

SOIL AND ROCK DESCRIPTIONS

Soil and Rock Descriptions are generally as described in the NZ Geotechnical Society "Field Description of Soil and Rock – Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes", dated December 2005.
Vane Shear Strength measurements in accordance with the NZ Geotechnical Society "Guideline for hand held shear vane test" dated August 2001.

IN SITU TESTS

SV	= 40/10	In situ shear strength and remoulded shear strength respectively, as measured by Geotechnics/ Pilcon Shear Vane
τ	= 50/12	Vane shear strength and remoulded vane shear strength respectively, corrected to BS1377
UTP	=	Unable To Penetrate with Shear Vane
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AL	Atterberg limits
UU	Unconsolidated undrained triaxial
PSD	Particle size
CU	Consolidated undrained triaxial
CONS	Consolidation
COMP	Compaction
UCS	Unconfined compression

WEATHERING

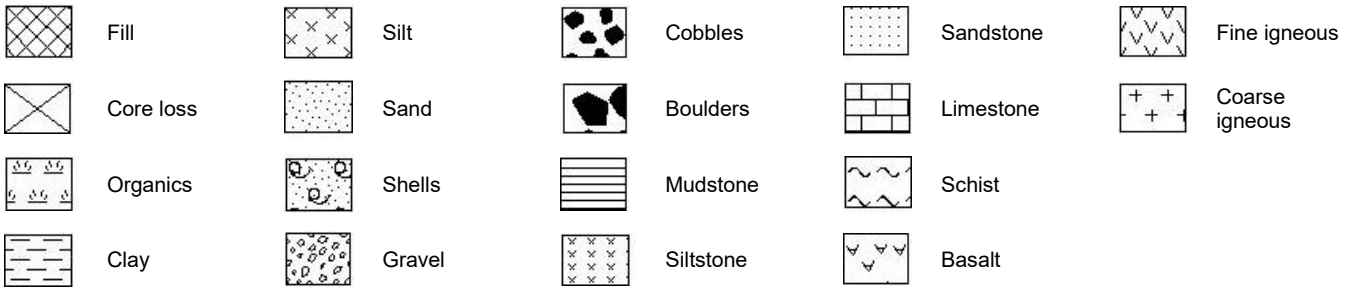
CW	Completely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
UW	Unweathered

CONSISTENCY

Cohesive Soils	Undrained Shear Strength (kPa)
Very soft	<12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	>200

Non-cohesive Soils	SPT – Uncorrected
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	>50

GRAPHIC LOG (1 or a combination of the following)



ORGANIC SOILS

Von Post Degree of Humification

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NZGD ID: 154363

NZ TRANSPORT AGENCY | Safe Roads

TEST PIT LOG

TEST PIT No: TP06

SHEET 1 of 1

PROJECT:	SRA Level Crossing Programme	JOB NUMBER:	3413241
SITE LOCATION:	SH1B Telephone Road, Eureka	CLIENT:	Safe Roads Alliance

CIRCUIT: NZTM 2000
COORDINATES: N 5,819,883 m
E 1,808,648 m

TEST PIT LOCATION: 30m from road edge and 1m from rail track
R L: 44 m
DATUM: Auckland 1946 (MSL)
COORDINATE ORIGIN: MAP
ACCURACY: ±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
			Loosely packed, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, trace organics; greyish brown; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke. Organics: rootlets.	Ballast					
0.5									43.5
			Loosely packed, medium to coarse gravelly medium to coarse SAND; dark grey; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke.	Sub-ballast					
			Loosely packed, fine to coarse SAND, minor fine gravel, trace coarse gravel; brownish yellow; moist, non plastic.	Holocene Alluvium					
1.0			END OF LOG @ 1 m		2				43.0
					1				
					0				
					0				
					1				
1.5					0				42.5
					0				
					0				
					1				
					0				
2.0					2				42.0
					2				
					2				
					1				
					3				
2.5									41.5
3.0									41.0
3.5									40.5

DATE EXCAVATED:	21/6/18	CONTRACTOR:	Abernethy
LOGGED BY:	LZ	EQUIPMENT:	1.7t Excavator
SHEAR VANE No:		METHOD:	E

COMMENTS:
- Test Pit terminated at target depth.
- Coordinates estimated from WRC LocalMaps (accuracy +/- 5m).
- RL estimated from survey plan 3413241-SUR-0001 (accuracy +/- 1m).
- Water table not encountered.
- Test Pit backfilled and compacted in 300mm layers with excavator.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Rev A

BECA LIB 1.07.4.GLB Log BECA TEST PIT SH1B TELEPHONE ROAD, EUREKA - LEVEL CROSSING.GPJ TELEPHONE RD - TP LOGS.GDW 29/08/2018 14:32 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: Beca 1.07.4 2016-01-15 Prj: Beca 1.07 2014-12-16

NZGD ID: 154363

Log Key Sheet

WATER

Water level on date shown

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VE	vacuum excavation

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Soft	12 to 25
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Hard	>200

Non-cohesive Soils	SPT – Uncorrected
Very loose	0 to 4
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Medium dense	10 to 30
Dense	30 to 50
Very dense	>50

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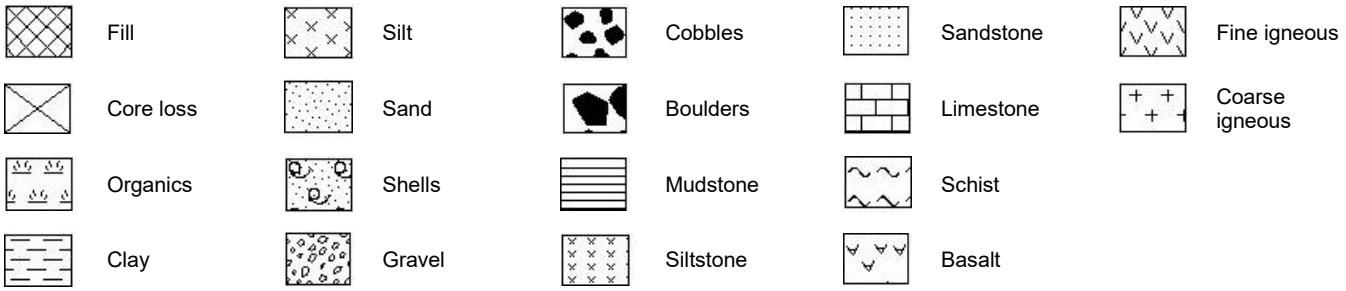

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H9	Practically decomposed or mud-like peat in which almost no growth structure is evident.
H10	Completely decomposed or mud peat where no growth structure can be seen, entire substance passes through the fingers when pressed.

NZGD ID: 154361

NZ TRANSPORT AGENCY | Safe Roads

TEST PIT LOG

TEST PIT No: TP04

SHEET 1 of 1

PROJECT:	SRA Level Crossing Programme	JOB NUMBER:	3413241
SITE LOCATION:	SH1B Telephone Road, Eureka	CLIENT:	Safe Roads Alliance

CIRCUIT: NZTM 2000
COORDINATES: N 5,819,871 m
E 1,808,631 m

TEST PIT LOCATION: 10m from road edge and 1m from rail track
R L: 44 m
DATUM: Auckland 1946 (MSL)
COORDINATE ORIGIN: MAP
ACCURACY: ±5m

DEPTH (m)	SAMPLES	GRAPHIC LOG	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT	Scala (Blows/100mm)	SV	τ (kPa)	WATER LEVEL	R L (m)
			Loosely packed, fine to coarse sandy fine to coarse GRAVEL, minor cobbles, trace organics; greyish brown; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke. Organics: rootlets.	Ballast					
			Loosely packed, medium to coarse gravelly medium to coarse SAND; brownish black; moist, non plastic. Gravel: angular to subangular, slightly weathered, greywacke.	Sub-ballast					
0.5			Loosely packed, fine to coarse SAND, minor fine gravel, trace coarse gravel; brownish yellow; moist, non plastic.	Holocene Alluvium					43.5
			'Firm', organic SILT; black; moist, non plastic. Organics: rootlets.						
1.0			END OF LOG @ 1 m		1				43.0
					0				
					0				
					1				
					1				
1.5					2				42.5
					2				
					3				
					4				
					2				
2.0					8				42.0
					3				
					4				
					5				
2.5									41.5
3.0									41.0
3.5									40.5

DATE EXCAVATED:	21/6/18	CONTRACTOR:	Abernethy
LOGGED BY:	LZ	EQUIPMENT:	1.7t Excavator
SHEAR VANE No:		METHOD:	E

COMMENTS:
- Test Pit terminated at target depth.
- Coordinates estimated from WRC LocalMaps (accuracy +/- 5m).
- RL estimated from survey plan 3413241-SUR-0001 (accuracy +/- 1m).
- Water table not encountered.
- Test Pit backfilled and compacted in 300mm layers with excavator.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Rev A

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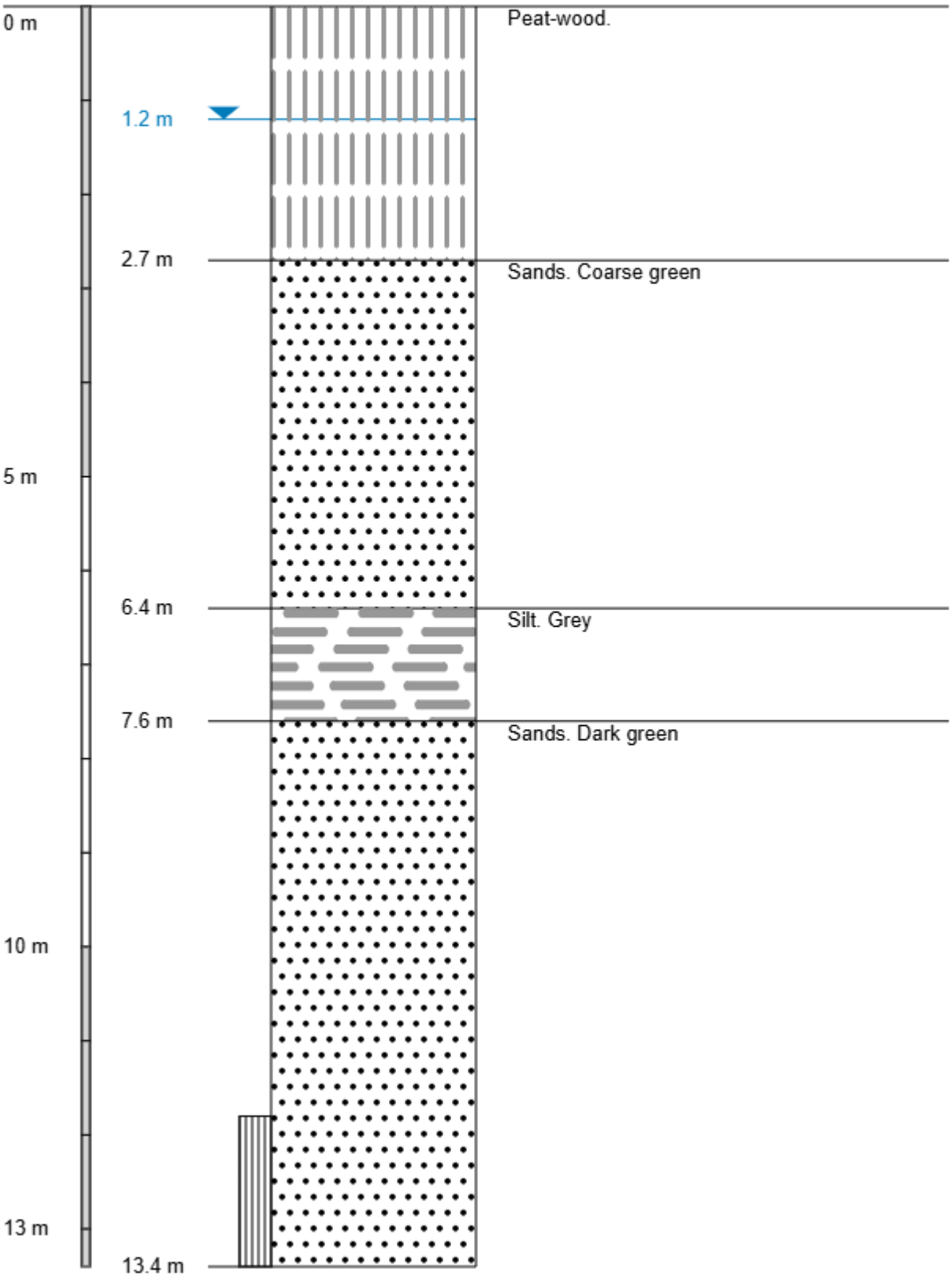
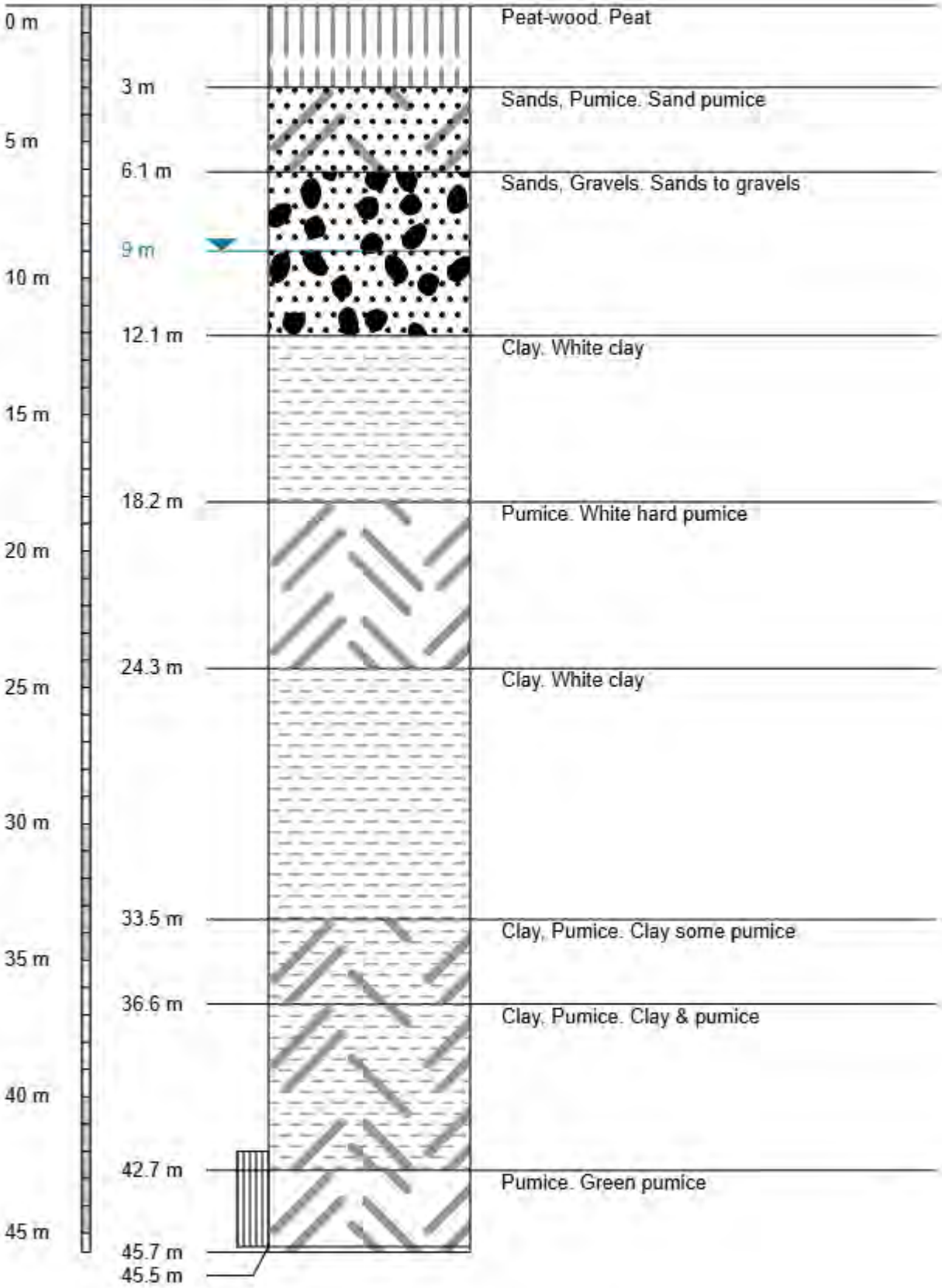
NZGD ID: 154361

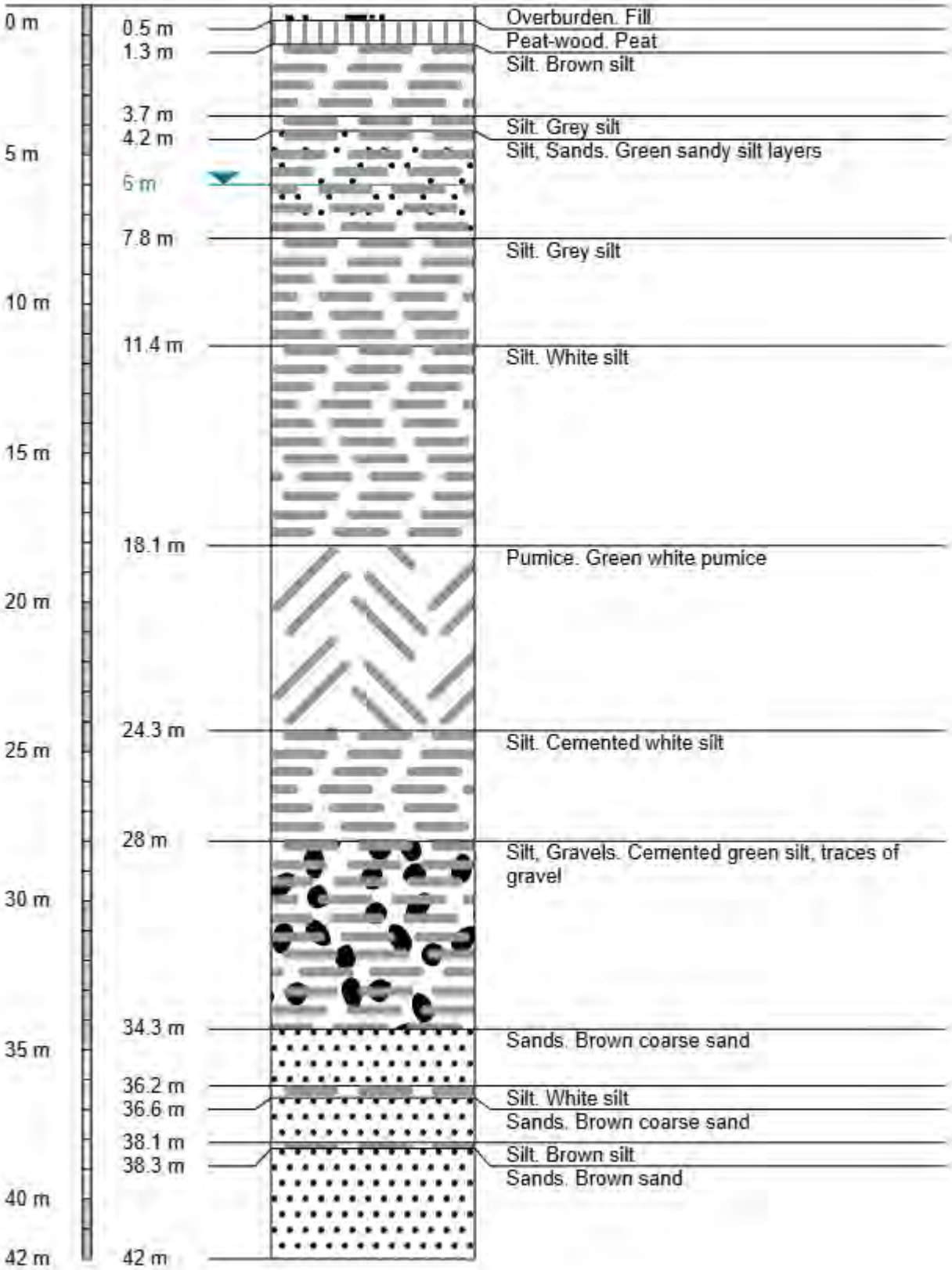
Council well number : 69_933
Well name : Bore 69 - Station 933
Drilling company : Benton & Son Limited
Drilling date : 12/05/1992
Drilling method : -
Locality : -
Total depth drilled : 13.4m
NZTM : 1808851 : 5819785



Council well number : 72_2804
Well name : Bore 72 - Station 2804
Drilling company : Geo Hutchinson (1984) Limited
Drilling date : 20/11/2005
Drilling method : -
Locality : -
Total depth drilled : 45.5m
NZTM : 1810050 : 5820987

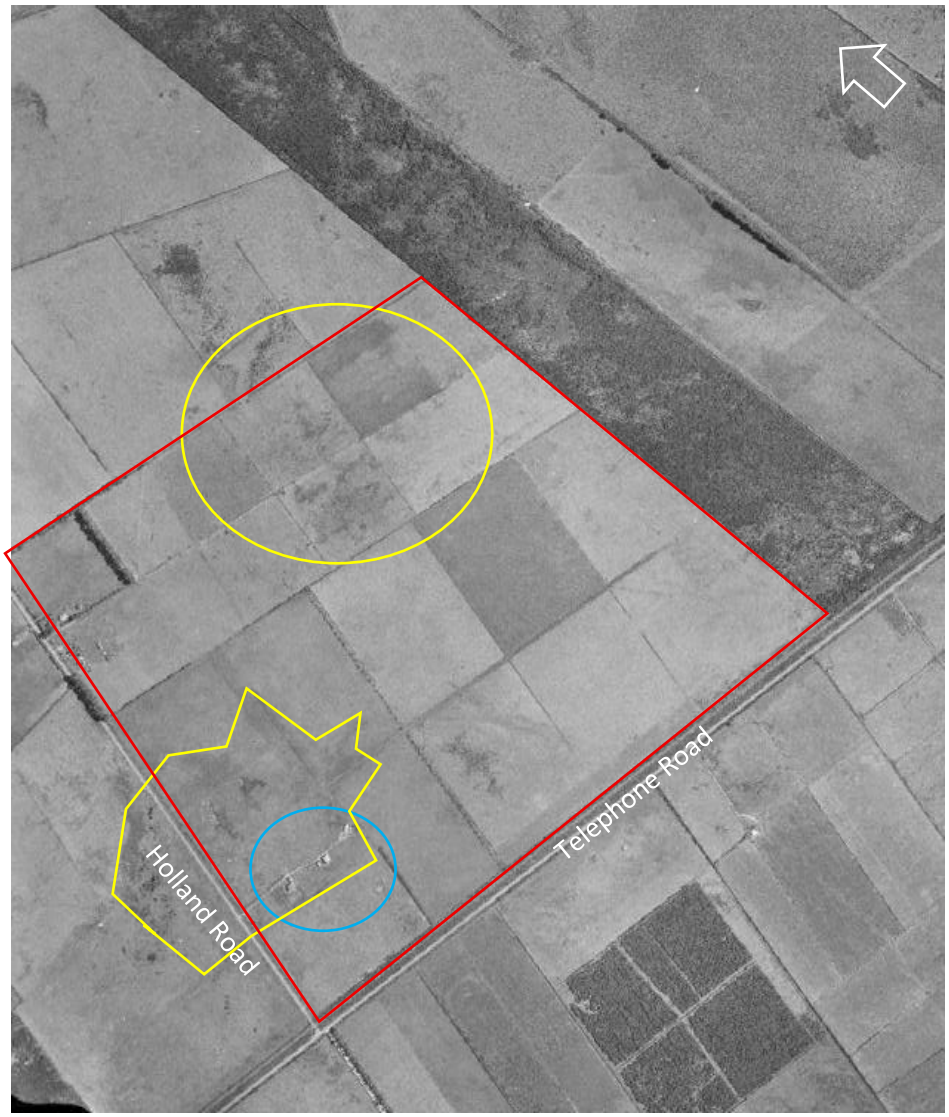


Council well number : 72_4357
Well name : Bore 72 - Station 4357
Drilling company : Benton & Son Limited
Drilling date : 05/06/2008
Drilling method : -
Locality : -
Total depth drilled : 42m
NZTM : 1808663 : 5820242



APPENDIX B

Histocial Photographs

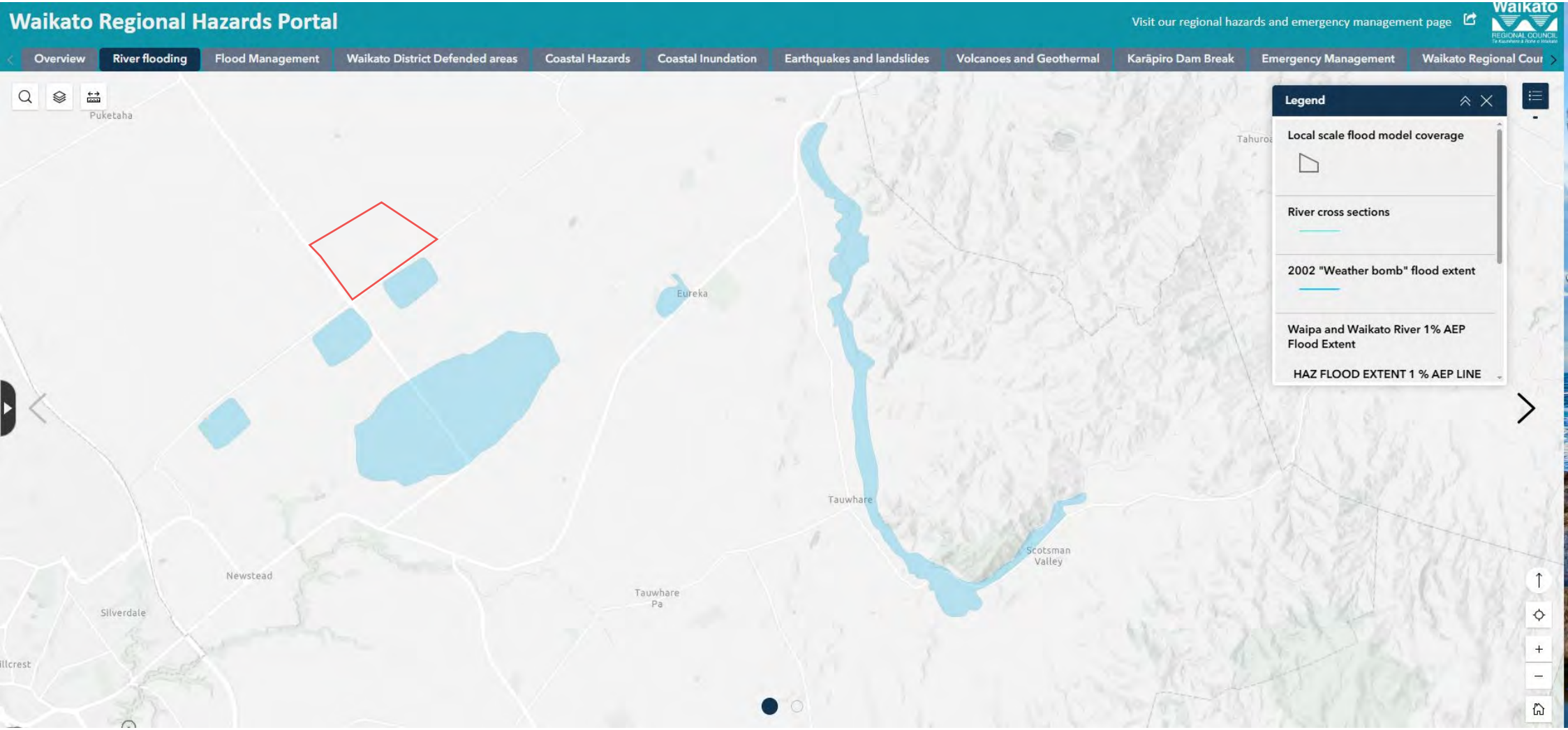
Date and source	Key Features
1962 Retrolens	 • building structures (circled in blue) • Potentially swamy areas (outlined in yellow)

Date and source	Key Features
1991 Retrolens	 • Depression next to Telephone road appears (circled in blue) • Additional paddocks have been created. Farm drains could run between them.

Date and source	Key Features
2013 Google Earth	 • Effluent pond being constructed next to silage pad (circled in blue).

APPENDIX C

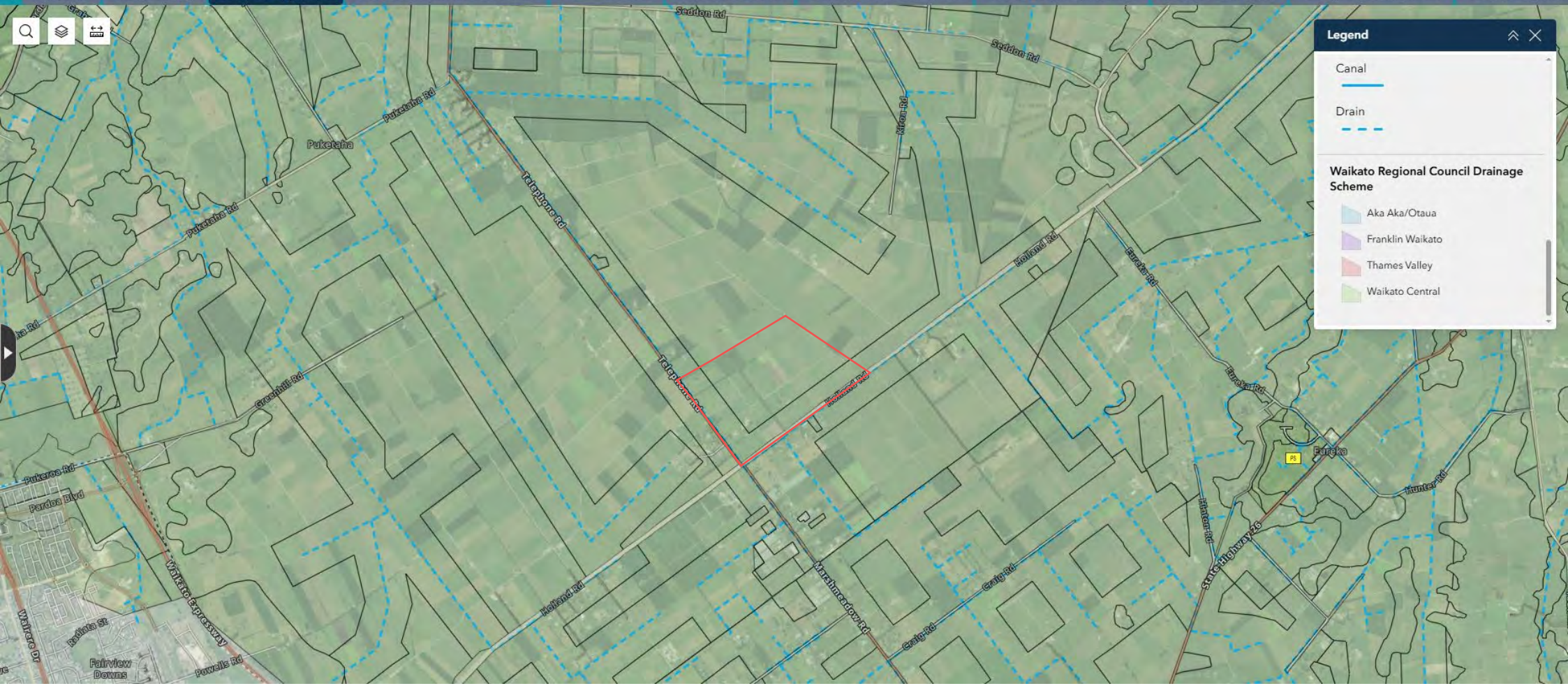
Waikato Regional Council Hazrads Portal


Waikato Regional Hazards Portal
Visit our regional hazards and emergency management page
Waikato
REGIONAL COUNCIL
Overview
River flooding
Flood Management
Waikato District Defended areas
Coastal Hazards
Coastal Inundation
Earthquakes and landslides
Volcanoes and Geothermal
Karāpiro Dam Break
Emergency Management
Waikato Regional Cour
Puketaha
Eureka
Tauwhare
Scotsman Valley
Newstead
Tauwhare Pa
Silverdale
Legend
Local scale flood model coverage
River cross sections
2002 "Weather bomb" flood extent
Waipa and Waikato River 1% AEP Flood Extent
HAZ FLOOD EXTENT 1 % AEP LINE

Waikato Regional Hazards Portal

Visit our regional hazards and emergency management page

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



Waikato Regional Hazards Portal

Visit our regional hazards and emergency management page

Waikato Regional Council

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

Flood protection and land drainage assets

Legend

Acid Sulfate Soil Probability

Acid Sulfate Soil Probability

- Negligible Probability
- Low Probability
- Moderate Probability
- High Probability

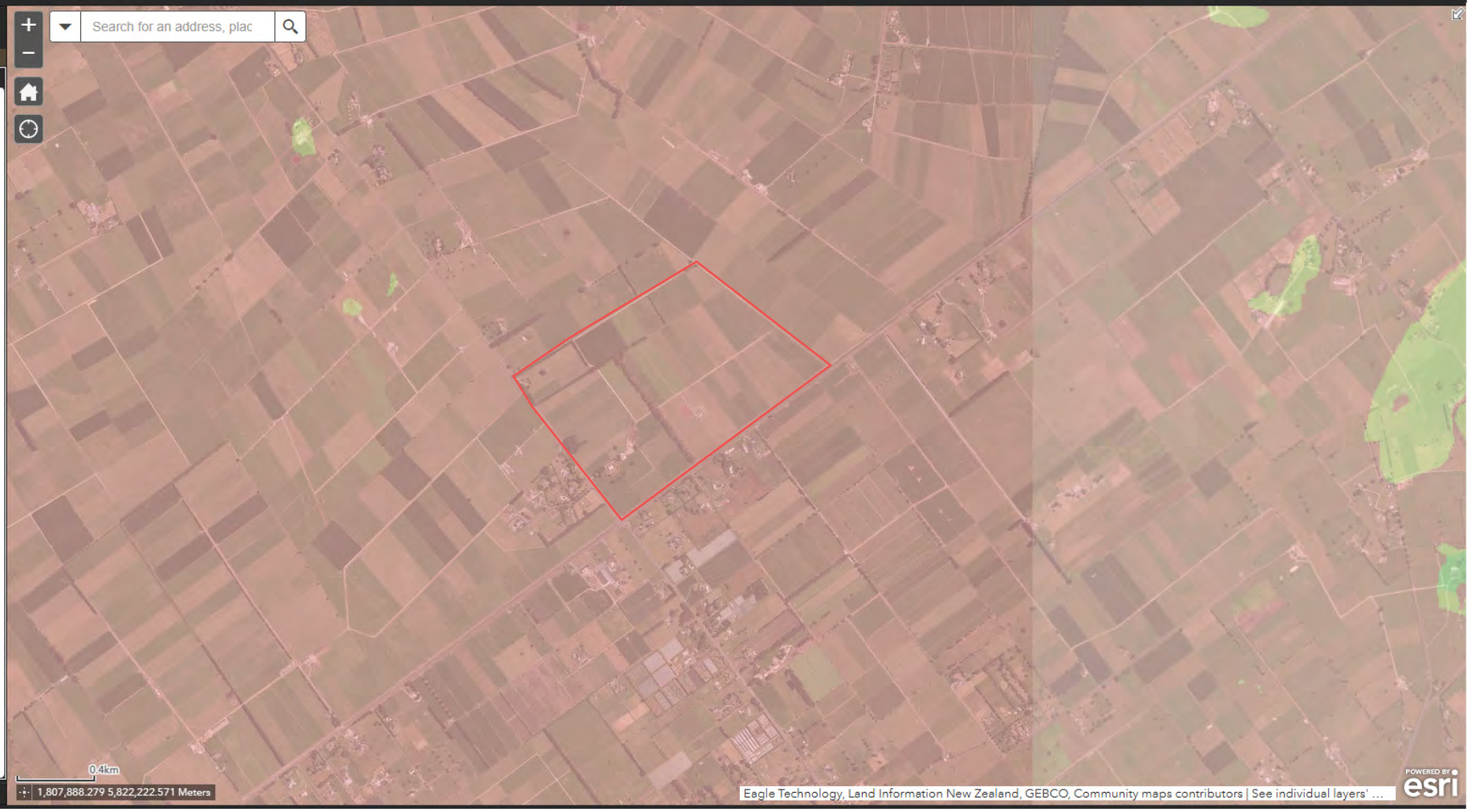
Base Layers

Biosec Clam Risk Areas

Clam Red Risk

Clam Orange Risk

Clam Yellow Risk



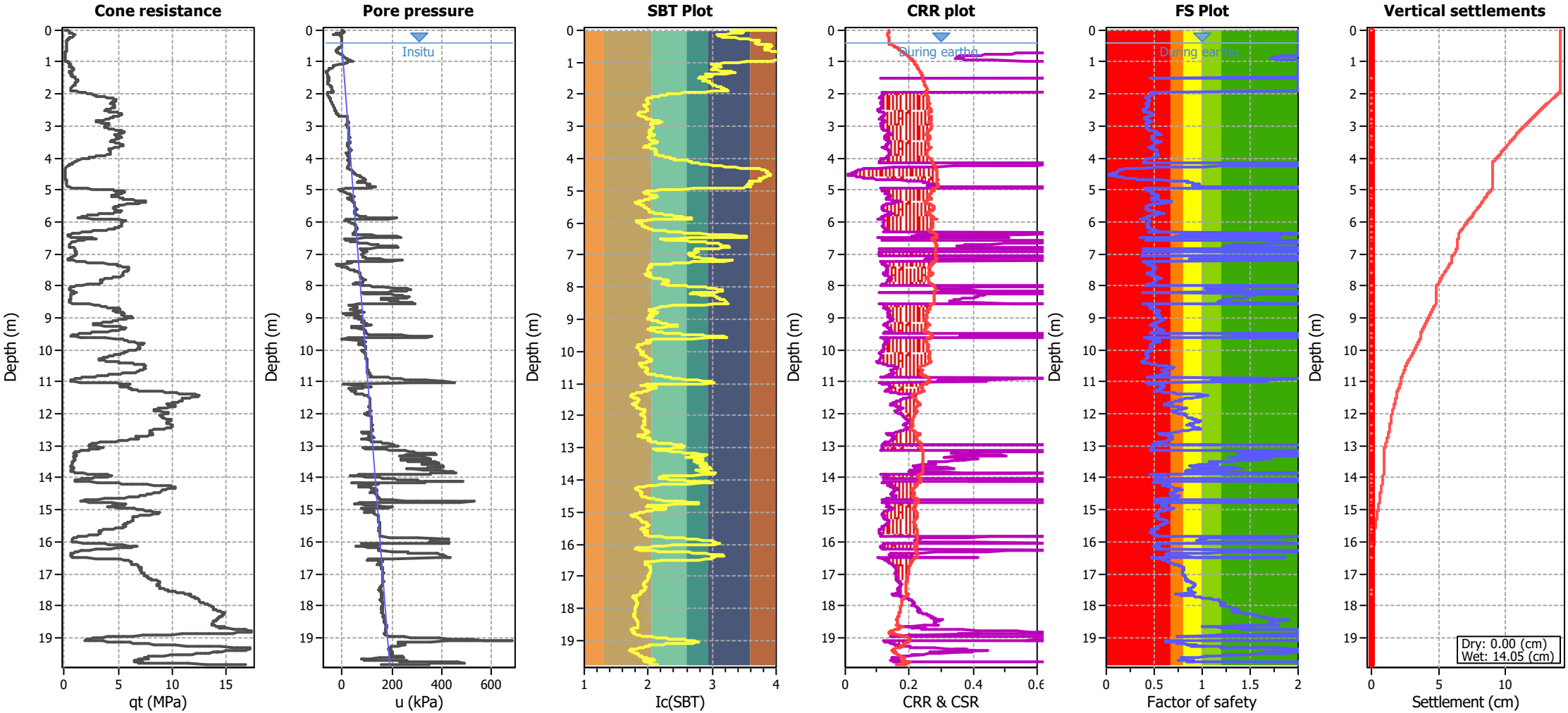
APPENDIX D

Preliminary Liquefaction Results

CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

Project:
Location:

CPT: CPT_194534
Total depth: 19.84 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.42 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.42 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

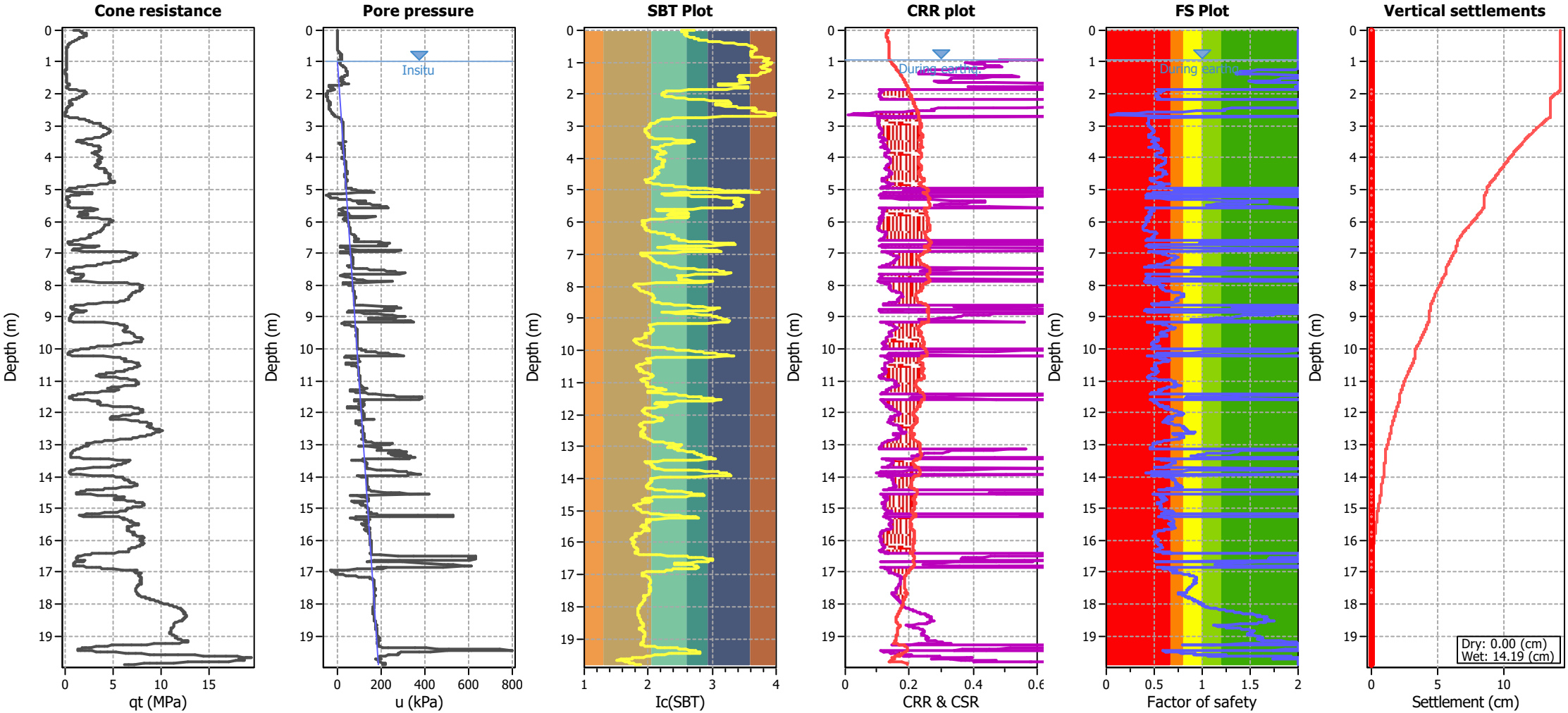
CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

Project:

Location:

CPT: CPT_194537

Total depth: 19.90 m

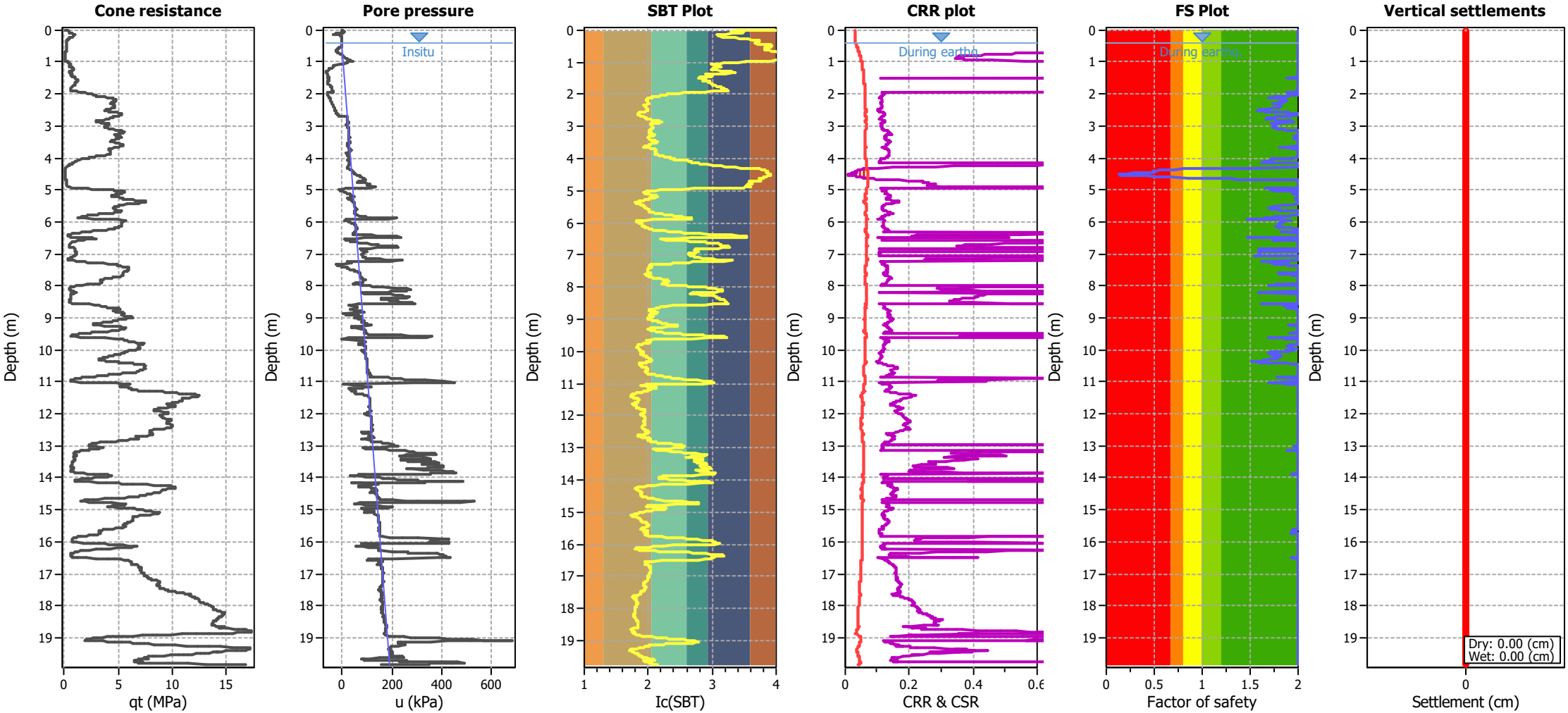


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.92 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.25	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

Project:
Location:

CPT: CPT_194534
Total depth: 19.84 m

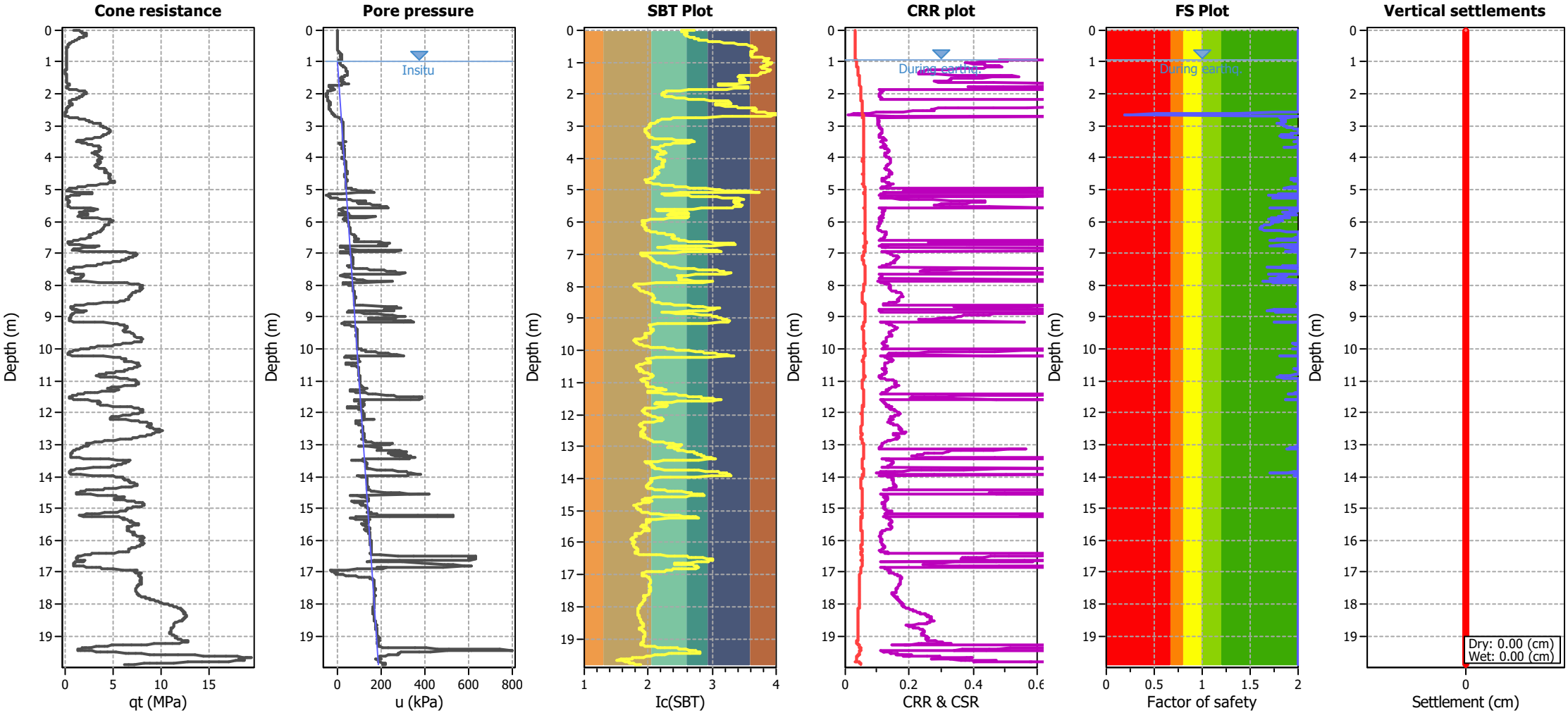


Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.42 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.42 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.06	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

Project:
Location:

CPT: CPT_194537
Total depth: 19.90 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.92 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.06	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

APPENDIX E

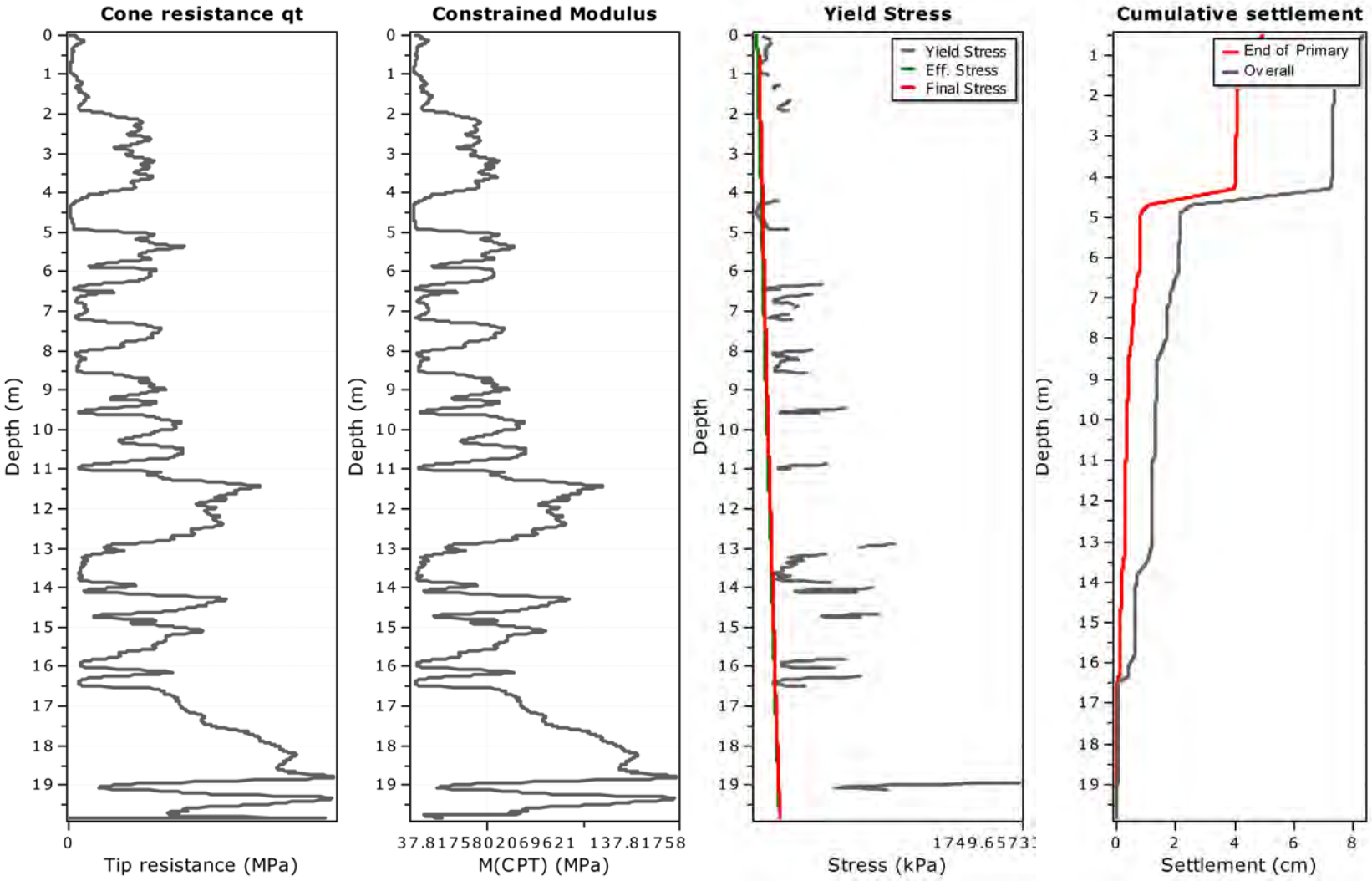
Preliminary Load Induced Settlement Results

CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

CPT: CPT_194534
Total depth: 19.84 m, Date: 3/03/2026
Surface Elevation: 0.00 m, Est. GWL: 0.42 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 20.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 10 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

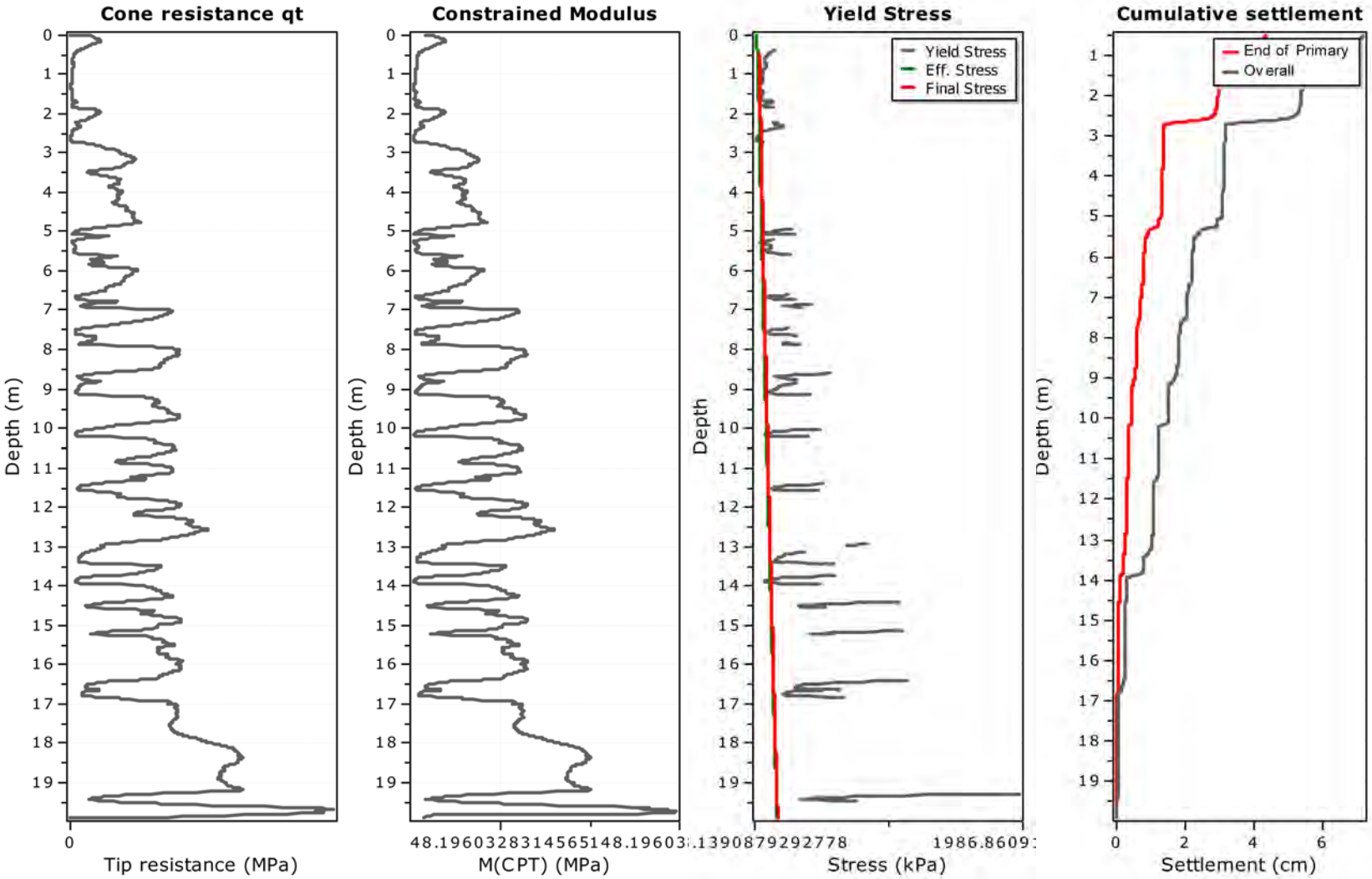
where t_p is the duration of primary consolidation

CMW Geosciences
Level 1, Block C, 401 Grey Street
Hamilton 3216
www.cmwgeosciences.com

CPT: CPT_194537
Total depth: 19.90 m, Date: 3/03/2026
Surface Elevation: 0.00 m, Est. GWL: 1.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 20.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 10 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

where t_p is the duration of primary consolidation

CMW Geosciences
Great People | Practical Solutions

APPENDIX F

Natural Hazards Risk Assessment

NATURAL HAZARDS RISK ASSESSMENT FOR LANDUSE CHANGE

PROPOSED DEVELOPEMENT, AWANUI LINKS, 28 TELEPHONE ROAD

1 CONTEXT

This appendix to CMW report reference HAM2025-0123AB Rev 0 sets out the criteria for and presents the results of an assessment of the geotechnical-related natural hazards associated with this proposed development.

Section 106 of the Resource Management Act (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land, other land, or structures (consequence).

Section 2 of the RMA defines natural hazards as any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

The National Policy Statement for Natural Hazards 2025 (NPS-NH) provides direction under the Resource Management Act 1991 for assessing the risk associated with natural hazards for subdivision, use and development.

2 BASIS OF ASSESSMENT

2.1 Risk Classification

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk matrix is used to assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1 which is derived from Appendix 1 of the NPS-NH.

Table B1: Risk Matrix

ARI (Years) AEP	Almost certain Up to 10 10% or more	Very Likely 10-20 10% to 5%	Likely 20 – 50 5% to 2%	Possible 50 – 100 2% to 1%	Unlikely 100 – 500 1% to 0.2%	Rare 500 – 5000 0.2% to 0.02%	Very rare >5000 <0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

2.2 Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification, which is derived from Appendix 1 of the NPS-NH.

Table B2: Likelihood Classification (extract from NPS-NH)

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

2.3 Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification, which is derived from Appendix 1 of the NPS-NH.

Table B3: Consequence Table (extract from NPS-NH)

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

2.4 Proportionate Management of Natural Hazard Risk

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Decision-makers must consider the scale and detail of information necessary to assess the risk by having regard to the anticipated level of risk.

Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

When managing natural hazard risk associated with subdivision, use and development, decision-makers must apply mitigation measures, including location and design, for the purposes of ensuring that:

(a) very high natural hazard risk is avoided;

(b) high or medium natural hazard risk is avoided or mitigated proportionate to the

level of risk; and

(c) any creation of, or increase in, significant natural hazard risk on other sites is avoided or mitigated proportionate to the level of natural hazard risk.

3 RISK ASSESSMENT

The natural hazards relevant to this proposed subdivision development and adjacent, potentially affected land have been assessed with respect to the criteria outlined above.

Assessment is based on proposed post development ground conditions with and without any geotechnical controls. The latent risk was first assessed with the site in its proposed developed state to consider the risks to the development and surrounding land, including assessment of land modifications from the pre-existing natural state, without any implemented geotechnical controls. The specific geotechnical mitigation measures and engineering design solutions outlined in the table below and CMW report, where relevant, were then considered to determine the natural hazard residual risk remaining after the proposed controls have been implemented.

Results of this assessment are presented in Table C1 below.

Table C1: Natural Hazard Risk Assessment Results

NPHS Hazard	Description	Proposed Site Latent Risk of Damage to Land / Structures			Comments and Geotechnical Control	Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Earthquake	Fault Rupture	Rare	Major	Low	Approximately 50km from the Kerepehi Fault. Recurrence interval of 2,000 to 3,500 years, no control required.	Rare	Major	Low
	Liquefaction Subsidence	Possible	Major	Medium	Shallow foundations. TC2/TC3 foundation may be required.	Rare	Moderate	Low
	Lateral Spread	Possible	Major	Low	Shallow Groundwater table. Drains along the road present as a free face, may require a setback.	Rare	Moderate	Low
Volcanic Activity	Ash & Pyroclastic Falls	Very Rare	Moderate	Low	No geotechnical controls warranted	Very Rare	Moderate	Low
	Lava flows & Lahars	Very Rare	Moderate	Low	No geotechnical controls warranted	Very Rare	Moderate	Low
Geothermal Activity	Formation of geysers, hot springs,	Very Rare	Moderate	Low	Low risk due to distance from closest known geothermal area	Very Rare	Minor	Low

Table C1: Natural Hazard Risk Assessment Results								
NPHS Hazard	Description	Proposed Site Latent Risk of Damage to Land / Structures			Comments and Geotechnical Control	Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
	fumaroles, mud pools							
Erosion	Cut and Fill Batters	Almost Certain	Minor	Medium	Slope batters to be designed by geotechnical engineer	Possible	Minor	Medium
Landslip	Global Slope Instability	Possible	Moderate	Medium	Landform near level. Cut batters to be assessed by engineer	Unlikely	Minor	Medium
	Soil Creep	Rare	Negligible	Low	No geotechnical control warranted	Rare	Negligible	Low
	Bearing Capacity Failure	Possible	Major	High	Bearing Capacity to be assessed by a Geotechnical Engineer, and foundations designed to suit	Unlikely	Major	Low
	Cut & Fill Batter Instability	Possible	Major	High	Slope batters are to be designed by a geotechnical engineer	Unlikely	Moderate	Low
Subsidence	Soft soils leading to foundation subsidence	Likely	Major	High	Undercut and remove any surficial soft soils, existing fill and replace with engineered fill. Preloading of building platforms. Geotechnical engineer to observe building preparation works during construction.	Unlikely	Major	Medium
	Sinkholes	Rare	Moderate	Low	Site Investigation and geomorphic mapping will determine the risk	Very Rare	Moderate	Low
Sedimentation	Debris Inundation	Possible	Major	High	The site is near level in many areas.	Very Rare	Major	Medium

Table C1: Natural Hazard Risk Assessment Results								
NPHS Hazard	Description	Proposed Site Latent Risk of Damage to Land / Structures			Comments and Geotechnical Control	Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration/ Worsening of Hazard with Geotechnical Controls Implemented		
		Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Coastal Erosion **& Coastal** Inundation	Erosion and Inundation	Very Rare	Negligible	Low	Site is >15km away from coast	Very Rare	Negligible	Low
Tsunami	Tsunami	Very Rare	Negligible	Low	Site is >15km away from coast.	Very Rare	Negligible	Low
Flooding from Rainfall	Inundation	Possible	Moderate	Medium	No flooding shown on council hazard maps. Stormwater disposal design for concentrated flows from roads and roof areas.	Possible	Minor	Low

Notes:

- Assessments include the impact of the proposed subdivision works on adjacent properties.
- The following reference(s) contain information on the hazards contained in this assessment and the non-geotechnical hazards that have not been included:
    - **Waikato** https://waikatoregion.maps.arcgis.com/apps/MapSeries/index.html?appid=f2b48398f93146e8a5cf0aa3fddce92c

CMW Geosciences

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401 Grey Street
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