Doc ID:

Submissions on Plan Change 8 (Natural Hazards)
Volume 1

ROTORUA LAKES COUNCIL
Te Kaunihera o ngā Roto o Rotorua

Civic Centre
1061 Haupapa Street
DX Box JX10503
Rotorua 3046
New Zealand

☎ +64 7 348 4199
✉ info@rotorualc.nz
🌐 rotorualakescouncil.nz

Index

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Flooding

Q2 **My submission is:**

Long Text

I'm concerned that Plan Change 8's reliance on outdated flood model inflates the perceived risk for our community.

Key Concerns
Outdated modelling basis
 The current flood model for Geyserview uses 2020 climate data under RCP 8.5 (worst-case emissions) and a 1% Annual Exceedance Probability event.
 Scientific consensus now considers RCP 8.5 scenarios increasingly unlikely; using that data risks overstating flood extents.
Infrastructure upgrades not incorporated
 In 2021, the Bay of Plenty Regional Council increased outlet capacity to both the Waitangi Stream.
 These works materially reduce flood risk in Geyserview but are not reflected in the 2020 model.

Lengthy model update interval
 The next scheduled flood-model revision is 2030—ten years after the 2020 baseline.
 Policies based on stale data will govern consenting, insurance, and valuations for years beyond the actual risk profile.

Potential Impacts on Property Owners
 Consent delays or refusals for building and land-use changes
 Higher quoted insurance premiums or refusal of cover
 Depressed property values due to inflated flood-risk overlay
 Increased professional costs for homeowners needing bespoke hydrological assessments.

Q3 **What changes do you want made to the District Plan?**

Long Text

Requested Council Actions
 Immediate review or deferral
Delay application of the 2020-model flood overlay in Geyserview until updated modelling reflecting the 2021 outlet works is complete.
 Interim risk assessment
Commission an expedited, interim flood-risk analysis for Geyserview using post-2021 hydrology data and a more current climate scenario (e.g., RCP 4.5).
 Site-specific assessment allowance
Amend Plan Change 8 to explicitly permit property-specific flood modelling by qualified engineers where the district-wide model is known to be outdated.
 Regular model updates
Incorporate a policy commitment to review and update flood models at least every five years or after any major drainage/infrastructure upgrade.

Thank you for considering our submission. We welcome the opportunity to discuss these concerns further.

Yours faithfully,

Kierin Oppatt

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Kierin Oppatt

Q8 **Do you wish to present your submission publicly in front of elected members at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Flooding

Q2 **My submission is:**

Long Text

Comment I wish to make are associated with drainage infrastructure in relation to the building consents issued by council. There has been no noticeable attention in Tawhero st mamaku. We have had considerable houses popping up. Water pools in my driveway in heavy rainfall periods which is a potential flood risk. I do not plan to be putting in a driveway until this has been addressed.

Q3 **What changes do you want made to the District Plan?**

Long Text

Address potential flooding with increased consented housing density, which increases wear on roads locally.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

janet Taiatini

Q8 **Do you wish to present your submission publicly in front of elected members at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Submission 3

Submission to Rotorua Lakes Council – Objection to Change Eight

Re: Proposed District Plan Change Eight – Requirement for On-Site Water Supply

To whom it may concern,

I am writing to formally submit my opposition to Change Eight of the Proposed District Plan, which seeks to mandate that all properties maintain a separate, on-site water supply regardless of location.

As a resident of Hamurana, I strongly believe that properties in our area should be exempt from this requirement due to our immediate and direct access to Lake Rotorua, which is only metres away in many cases. Requiring us to install or maintain a separate water supply is unnecessary, costly, and environmentally unjustified given our unique geographical location.

Hamurana has long benefited from its natural lake access, and the blanket approach proposed in Change Eight fails to recognise the distinctive features of lakeside communities. It also undermines the principles of localised decision-making and practical environmental management.

I respectfully request that the Council considers a site-specific exemption for Hamurana properties, or at the very least, provides an alternative compliance path that acknowledges our proximity to a reliable natural water source.

Thank you for considering this submission. I would welcome the opportunity to speak further to this matter at any future hearing.

Yours sincerely,

Anita Swindlehurst

Submission 4

To whom it may concern,

I am emailing to make a submission re the Proposed Plan Change 8 - Natural Hazards.

As an administrator and landowner of Tautara 10B Blk IX Rotoma Sd, we oppose the Proposed Plan Change 8 in relation to the aforementioned property on the following grounds:

1) We do not agree with the accuracy of the fault mapping in the New Zealand Active Fault Database maintained by GNS. While LiDAR technology is deemed to be highly accurate it is not perfectly precise. Factors such as the type of LiDAR system, the environment, and the specific application can affect accuracy.

2) We are unaware of GNS or any other associated geotechnical professional undertaking site specific investigations in the area/s identified in Figure 1 Active Fault Buffers (FAZs) in the Rotorua District (Source: GNS Science, June 2025) to support the accuracy of LiDAR data. In addition, we do not believe that the onus of responsibility and or any associated costs should fall on the landowner/s to either confirm or negate the data captured in the New Zealand Active Fault Database.

I look forward to receiving a response to the above submission.

Regards,

Rumaki Whata.

[Confirmed that does not wish to be heard]

From: Participate Rotorua Lakes Council <NoReply@participate.rotorualakescouncil.nz>
Sent: Tuesday, 26 August 2025 9:16 pm
To: RLC RMA Policy Services
Subject: Make a submission on Plan Change 8 - Natural Hazards Form Submission

Make a submission on Plan Change 8 - Natural Hazards Form Submission

There has been a submission of the form Make a submission on Plan Change 8 - Natural Hazards through your Participate Rotorua Lakes Council website.

Which parts of Plan Change 8 are you submitting on?
Flooding

My submission is:
I am an impacted party to the proposed Plan Change 8 for Flooding at Lake Okareka, as an easement for storm water flow (know as “The Wash”) crosses my property.

I oppose the proposed PC8 Flood Zone to the 100yr (1% AEP) for Lake Okareka to a new level of 354.63 + .7 freeboard being 355.33, taken from the BoPRC report of 2022 -Table 26 (as confirmed by Kim Smith), as this level is both:-
A. Fundamentally flawed given the nature of Lake Okareka Outlet control and upgrades in 2020.
B. Impractical given the Private and Public Property impact that would be imposed by a publicly Defined Flood Zone of this level that would be referenced by Finance, Insurance and Building Regulatory organisations.

The 2022 BoPRC report is flawed as it does not seem to take into account the nature of Lake Okareka, having an outlet that enables the draining of the Lake to Lake Tarawera. An

outlet that the BoPRC themselves invested +$1million dollars in during 2020/21 to increase the outlet flow.

The 2022 BoPRC report acknowledges/emphasises the 2017 Flood Levels and establishes an EV1 2020 level of 354.450, when the Outlet Flow was limited to less than half that of the Emergency Response of 2017 and the 2020 permanent remediation. This outlet today has Resource Consent to 500 l/s, but an Emergency capability of over twice that flow.

What changes do you want made to the District Plan?

I ask that RLC reject the Plan Change 8 in relation to Lake Okareka Flood Zone, as it is based on a flawed BoPRC (2022) report.

That new Flood Levels be calculated taking into account upgrades to the Lake Okareka Outlet, that now enables over twice the outlet flow than what was available pre-2017 flood event.

Tō Ingoa | Name

Grant Olliff

Do you wish to present your submission publicly in front of elected members at a hearing?

No

If others make a similar submission, we will consider presenting a joint case with them at a hearing.

Yes

We could gain an advantage in trade competition through this submission.

No

I agree to the Terms of Use and Privacy Policy for using Social Pinpoint

Yes

To view all of this form's submissions, visit
https://participate.rotorualakescouncil.nz/index.php/dashboard/reports/forms_new/data/291

SUBMISSION ON PLAN CHANGE 8 (NATURAL HAZARDS) - LAKES A ZONE
Rotorua District Plan

Submitted by: Neil Oppatt
Property: 11 Steep Street, Lake Ōkāreka
Date: 15 August 2025

Full Replacement Submission

This submission is a full replacement submission, of the submission dated 7th August 2025, that I emailed Rotorua Lakes Council on 8th August 2025. This replacement corrects mistakes I made in my original submission and adds a new additional graph.

Disclaimer:

I am not a qualified hydrologist or stormwater engineer. This submission has been prepared based on my thorough review of publicly available documents and records relevant to Lake Okareka's water level management and flood history.

While I have sourced the majority of referenced materials from official District and Regional Council reports, memoranda, and technical documents.

Every effort has been made to verify the accuracy and reliability of the information presented. However, I cannot guarantee that all relevant materials have been identified or that no inadvertent errors or omissions remain.

For context and transparency: I served as an elected Regional Councillor during the 2017 Lake Okareka excessive high lake level event, and was closely involved with Regional Council staff in the response and risk management efforts at that time.

I am also a resident of a lakeside property at Lake Okareka, that will be negatively impacted by Rotorua Lakes Council's proposed Plan Change 8 (PC8) rule.

This submission is provided in good faith and to the best of my knowledge and ability. I respectfully request that Council consider it as one perspective within the statutory process, and I accept no liability for unintended inaccuracies arising from reliance on public information or external sources beyond my direct control.

CONTENT INDEX

1. EXECUTIVE SUMMARY

This submission opposes Plan Change 8 (PC8) as it applies to flood risk management at Lake Okareka on the grounds that it fundamentally misrepresents the current risk profile and fails to acknowledge the effectiveness of existing '**engineered risk controls**'.

Engineered risk controls - are physical systems and in' flood risk management', examples include outlet pipelines, retention dams, floodgates, and spillways, **which actively prevent or limit floods**, rather than just relying on planning tools, alerts or recovery efforts afterward.
PC8 adopts a lower-tier "**outcome management**" approach rather than recognising the high-standard "**remedy**" already in place through the Bay of Plenty Regional Council's engineered lake Outlet Control System.

Key Points:

- PC8 ignores the material risk reduction achieved through the existing 500 L/s engineered Lake Outlet Control System

- The proposed approach represents "mitigation" rather than "remedy" in the established risk management hierarchy

- Flood mapping is based solely on rainfall modelling without accounting for active lake level management

- The plan provides no protection for existing community infrastructure within the defined flood zone.

- The PC8 flood prone contour of **355.328m** (Moturiki Datum 1953) is significantly higher than the 1% AEP (100-year ARI) peak lake level of **354.45m** (Moturiki Datum 1953) modelled by Pattle Delamore Partners Ltd (PDP), even under the 2090 high-range climate change scenario.

- The difference between PC8's adopted flood contour and the PDP-calculated lake level for a 1% AEP event is approximately **0.878 metres** (355.328m - 354.450m), which provides substantial additional freeboard.

Relief Sought:

That Plan Change 8 (flood risk) be withdrawn or substantially amended to properly account for existing engineered risk controls and adopt a risk management approach consistent with AS/NZS ISO 31000:2018 standards.

2. INTRODUCTION AND SUBMITTER CONTEXT

On 2 December 1962, floodwaters rose to approximately 1.0 metre inside the residence at 11 Steep Street, Lake Okareka, inundating the main living areas, a property that, 31 years later, became our family home.

That flood, along with prior and subsequent high lake level events, has profoundly influenced both our family and the wider Lake Okareka community since the 1950s.

This submission is informed by direct experience of both historical flood risk and the effectiveness of subsequent engineering interventions.

Following the 1962 flood, a series of engineering interventions were initiated by local residents, the former County Council, Rotorua Lakes Council, and the Bay of Plenty Regional Council - which has established robust

"engineered risk remedies," dramatically reducing the likelihood or removing the possibility of residential flooding recurring at Lake Okareka.

3. BACKGROUND: FLOOD HISTORY AND ENGINEERING RESPONSE

3.1 Historical Flood Events

A major flood event in December 1962, caused lake water inundation to 18 residential houses (including the lake rising to approximately 1.0m in the submitter's home) - this prompted community action.

Prior to the start of the implementation of engineered interventions completed in 1965, Lake Okareka had been experiencing ongoing significant flooding events and long periods of excessively high lake levels.

3.2 Engineering Response Timeline

Summary

Period	Intervention	Capacity (L/s)	Status
Pre-1962	Natural seepage only	20-100	Insufficient
1963	Temporary pump system	approx. 200	Emergency response
1965	Gravity-fed pipeline	239	Permanent solution
2001	Formal resource consent	239	Legal authorisation
2015	Pipeline upgrade	390 (maximum)	Enhanced capacity
2017	Emergency measures	500	Extreme event response
2021	New resource consent	500	Current operational limit
2025	Emergency measures	800-1,000 (maximum)	Extreme event response

3.3 Current System Effectiveness

The current engineered outlet system, operating under Bay of Plenty Regional Council Resource Consents RM19-0347 (BC.01, BC.02, BC.03, DC.01, WT.01), provides:

- Standard Operating Range: 353.5-353.9m RL (Moturiki Datum 1953)
- Maximum Consented Flow: 500 L/s
- Emergency Capacity: Up to 1,000 L/s under Section 330 RMA powers
- Track Record: No residential flooding since system implementation

4. ANALYSIS OF PLAN CHANGE 8 PROVISIONS

4.1 Stated Objectives vs. Actual Provisions

Plan Change 8 declares its intention as "**improving how natural hazard risks are managed**." However, analysis reveals fundamental shortcomings:

PC8 Approach:

- Defines flood-prone zone based solely on rainfall modelling (RL 355.9m, including 0.7m freeboard)
- Focuses exclusively on building-level controls
- Ignores existing active lake level management
- Provides no protection for existing homes and community infrastructure
- Failed to engage and consult with the community, particularly affected landowners

4.2 Regulatory Framework Issues

PC8 fails to align with established risk management principles:

- Does not recognize the Resource Management Act's risk reduction hierarchy
- Contradicts AS/NZS ISO 31000:2018 risk management standards
- Ignores Bay of Plenty Regional Council's statutory lake level management role

5. RISK MANAGEMENT HIERARCHY ANALYSIS

5.1 Established Hierarchy (AS/NZS ISO 31000:2018)

The internationally recognised risk management hierarchy in risk reduction effect order:

1. Avoid - Eliminate hazard exposure
2. Remedy - Engineer solutions to prevent hazard occurrence
3. Mitigate - Reduce consequences of hazard impact
4. Offset - Compensate for residual effects

5.2 Current System Classification

The Lake Okareka engineered outlet system represents a "**Remedy**" level intervention:

- Active Management: Direct control of lake levels at source
- Preventive Function: Stops flooding before it occurs
- Proven Effectiveness: **Demonstrated performance since implementation in 1965**
- High-tier Control: Superior to ‘outcome management’ approaches

5.3 PC8 Classification

Plan Change 8 represents a "Mitigation" approach:

- Reactive Measures: Building-level responses to potential flooding
- Consequence Management: Reduces damage after hazard occurs
- Lower-tier Control: Inferior to source-based risk management

6. LAKE OUTLET CONTROL PERFORMANCE

6.1 Assessment of 'Plan Change 8' Flood Prone Contour versus Pattle Delamore Partners (PDP) Hydrological Modelling for Lake Okareka

6.2 Introduction

The proposed 'Plan Change 8' (PC8) introduces a 'flood prone contour' for Lake Okareka based on a 1% Annual Exceedance Probability (AEP) flood event, set at **355.328 metres** above (Moturiki Datum 1953).

The 1% AEP calculated maximum flood level for Lake Okareka, is stated at **355.328 metres** above (Moturiki Datum 1953) in the **Rotorua Lakes Design Levels Technical Report 2022**.

However, a December 2017 technical report by Pattle Delamore Partners Ltd (PDP), commissioned by the Bay of Plenty Regional Council, provides hydrological modelling for Lake Okareka post-upgrade of the Lake Outlet Control System (LOCS).

This report assesses design flood levels under a range of Average Recurrence Interval (ARI) storm events, incorporating a maximum system discharge of 500 L/s.

6.3 Comparison of Flood Level Determinations

'Plan Change 8' Contour Determination

Flood Event	Flood Prone Maximum Contour (metres Moturiki Datum)
1% AEP	355.328

PDP Hydrological Modelling Results (post-2021 Outlet Control System Upgrade)

PDP modelled flood levels for four ARI (AEP) events under climate change scenario (2090 high-range) with the outlet operating at 500 L/s:

ARI (Years)	AEP (%)	Calculated Peak Lake Level (metres Moturiki Datum)
20	5	354.23
50	2	354.28
100	1	354.45
200	0.5	354.64

Pattle Delamore Partners Ltd (PDP) - Lake Okareka Outlet Pipeline Upgrade Report, Options Assessment, Table 1.

Table 1: Peak Design Lake Levels for 500 L/s Pipeline Capacity				
Current Consented Maximum Level	353.90			
2017 Maximum Level	354.55[2]			
Average Recurrence Interval Rain Event (ARI) (Years)	**20**	**50**	**100**	**200**
No Climate Change Adjustment	353.89	353.91	353.96	354.03
2017 Mid-range Climate Change Scenario	353.91	353.93	353.99	354.06
2040 Mid-range Climate Change Scenario	353.93	353.95	354.02	354.10
2040 High-range Climate Change Scenario	354.02	354.05	354.13	354.21
2090 Mid-range Climate Change Scenario	354.00	354.03	354.11	354.19
2090 High-range Climate Change Scenario	354.23	354.28	354.45	354.64

Notes:

1. *All levels in mRL relative to Moturiki datum.*
2. *Lake Okareka at Acacia Bay, 3 September 2017, http://monitoring.boprc.govt.nz/Monitored/Hex/cgi-bin/hydwebserver.cgi/sites/details?site=2268treecatchment=26*
3. *All design levels sourced from Memorandum from Peter West to Andy Bruere dated 17 November 2017 included in Appendix E.*

6.4 Findings

- The PC8 flood prone contour **355.328 metres** above (Moturiki Datum 1953) is significantly higher than the 1% AEP (100-year ARI) peak lake level (354.45m) modelled by PDP, even under the 2090 high-range climate change scenario.

- The difference between PC8's adopted maximum flood contour and the PDP-calculated lake level for a 1% AEP event is approximately **0.878 metres** (355.328m - 354.450m), which provides substantial additional freeboard beyond the PDP technical recommendation.

6.5 Recommendations

- Reconcile the rationale for adopting the much higher flood contour in Plan Change 8, with the PDP report findings.

- Present technical justifications transparently, if retaining an elevated contour.

- Confirm from BOP Regional Council the flood prone contour post completion of the Lake Control System upgrade work completed in early 2020's.

- Provide modelled scenarios for outflow rates of 500 L/s, 600 L/s, 700 L/s and 800 L/s. Flow rates stated the system can manage in the Lake Okareka, Lake Level Management Plan - June 2025.

7. ASSESSMENT OF EXISTING ENGINEERED CONTROLS

7.1 System Components

The current lake outlet control system comprises:

- Lake Structure (RM19-0347-BC.01): Intake and headwall
- River Structure (RM19-0347-BC.02): Waitangi Stream outlet
- Flow Control (RM19-0347-BC.03, DC.01): Regulated discharge up to 500 L/s
- Water Take (RM19-0347-WT.01): Surface water abstraction
- Management Plan: Operational protocols and monitoring

7.2 Performance Standards

Operational Requirements:

- Target lake level range: RL 353.5 - 353.9 metres
- Maximum flow rate: 500 L/s (Condition 3.1, RM19-0347-DC.01)
- Minimum flow rate: 100 L/s (Condition 3.2, RM19-0347-DC.01)
- Management Plan compliance (Condition 3.3, RM19-0347-BC.03)

Risk Reduction Achieved:

- Eliminates risk under normal level consent operating conditions
- Manages extreme events
- Provides emergency capacity for exceptional events

8. TECHNICAL CRITIQUE OF PC8 APPROACH

8.1 Flawed Risk Assessment

PC8's flood mapping methodology is technically deficient:

- Ignores Active Controls: Modelling based on unmanaged lake behaviour
- Static Approach: No consideration of dynamic level management
- Overstated Risk: RL 355.328m maximum flood level contour ignores 500 L/s outlet capacity

8.2 Regulatory Inconsistency

PC8 creates conflicts with existing regulatory framework:

- Dual Regulation: Overlaps with BOPRC's lake management authority
- Inconsistent Standards: Different risk assessment approaches
- Legal Uncertainty: Unclear interface between district and regional rules

8.3 Implementation Issues

Practical problems with PC8 provisions:

- Existing Development: Ignores existing private and community infrastructure impacts
- Infrastructure Neglect: No protection for community assets
- Economic Impact: Unnecessary constraints on property development

9. RECOMMENDATIONS

9.1 Primary Relief Sought

Withdraw Plan Change 8 in its current form and develop alternative provisions that:

1. Recognize existing engineered risk controls
2. Apply appropriate risk management hierarchy principles
3. Coordinate with Bay of Plenty Regional Council lake management
4. Protects existing community infrastructure

9.2 Alternative Approach

If PC8 proceeds, substantial amendments required:

1. Risk Assessment: Incorporate active lake level management in modelling
2. Flood Mapping: Adjust contours to reflect managed lake behaviour
3. Rule Framework: Differentiate between managed and unmanaged risk scenarios
4. Infrastructure Protection: Include community asset protection measures

9.3 Coordination Requirements

Essential required coordination with the Regional Council and Community:

- Joint risk assessment with Bay of Plenty Regional Council
- Integrated monitoring and reporting protocols
- Aligned emergency response procedures
- Clear regulatory interface definitions

10. CONCLUSION

Plan Change 8, as currently drafted, represents a fundamental misunderstanding of flood risk management at Lake Ōkāreka.

By ignoring the substantial risk reduction achieved through existing engineered controls, PC8 proposes lower-tier mitigation measures where high-standard remedy already exists.

The engineered lake outlet control system, operating under comprehensive Bay of Plenty Regional Council resource consents and active Management Plan, provides active, source-based flood risk management that has eliminated residential flooding risk under normal and most extreme conditions.

This represents best-practice risk management consistent with international standards.

PC8's failure to acknowledge this reality not only **misrepresents the actual risk profile,** but also creates **unnecessary regulatory burden** on an established community while providing **no meaningful additional protection**.

The appropriate response is either withdrawal of PC8 or substantial amendment to properly recognise existing engineered risk controls and adopt a coordinated, evidence-based approach to residual risk management.

11. APPENDICES

Appendix A: Historical flood photographs and documentation
Appendix B: Current resource consent conditions (RM19-0347 series)
Appendix C: Lake level management data (2017-2025)
Appendix D: Technical specifications - outlet control system
Appendix E: Community infrastructure mapping within PC8 flood zone
Appendix F: Future-proofing the Lake Okareka outflow control system

12. LEGEND OF PROFESSIONAL TERMS

Annual Exceedance Probability (AEP): Statistical likelihood of a flood event being equalled or exceeded in any given year (e.g., 1% AEP = 1 in 100 year flood)
Engineered Risk Controls: Physical infrastructure and management systems designed to prevent, reduce, or control natural hazards
Freeboard: Additional height allowance above calculated flood levels to account for uncertainties and provide safety margin
Hydraulic Capacity: Maximum flow rate that a pipeline or channel can physically convey under given conditions
Moturiki Datum 1953: Standard elevation reference point used for surveying and engineering in the Bay of Plenty region
Outcome Management: Risk management approach focusing on reducing consequences after a hazard event occurs, rather than preventing the hazard
Resource Management Act (RMA) Section 330: Emergency provisions allowing councils to undertake urgent work to prevent or mitigate natural hazards
Risk Management Hierarchy: Ordered approach to risk control: avoid > remedy > mitigate > offset, as defined in AS/NZS ISO 31000:2018
RL (Reduced Level): Height measurement above a specified datum point, expressed in metres

This submission is made pursuant to Schedule 1 of the Resource Management Act 1991 and seeks to be heard in support of this submission.

Signature:

Neil Oppatt

Date: 15 August 2025

APPENDICES

APPENDIX A: HISTORICAL FLOOD PHOTOGRAPHS AND DOCUMENTATION

A.1 Historical Flood Records

1962 Lake Ōkāreka Flood Event

- Date: Various dates throughout 1962
- Peak lake level: Estimated RL 356.157 metres (pre-instrumentation)
- Recovery time: 3 years for full restoration
- Affected properties: Multiple residences around lake perimeter
- Community response: Formation of resident action group
- Council response: Emergency pumping and planning for permanent solution

2017 Lake Ōkāreka Excessive High Lake Level Event

- Date: 31 July 2017
- Peak lake level: Estimated 353.9m RL
- Recovery time: 3 months for full restoration
- Council response: Emergency pumping and planning for an upgrade to the previous system

July 2017 – Excessive High Lake Levels

Lake Level Variations from July 2017 to July 2025

The graph shows the positive effect of the upgraded Lake Outlet Control System completed in 2021.

A.2 Pre-Engineering Flood Pattern Analysis

Frequency Analysis (1950-1965):

- Major events (>1m property inundation): 3 recorded
- Moderate events (property boundary flooding): 8 recorded
- Minor events (elevated lake levels): Annual occurrence
- Trend: Increasing frequency and severity 1950-1965

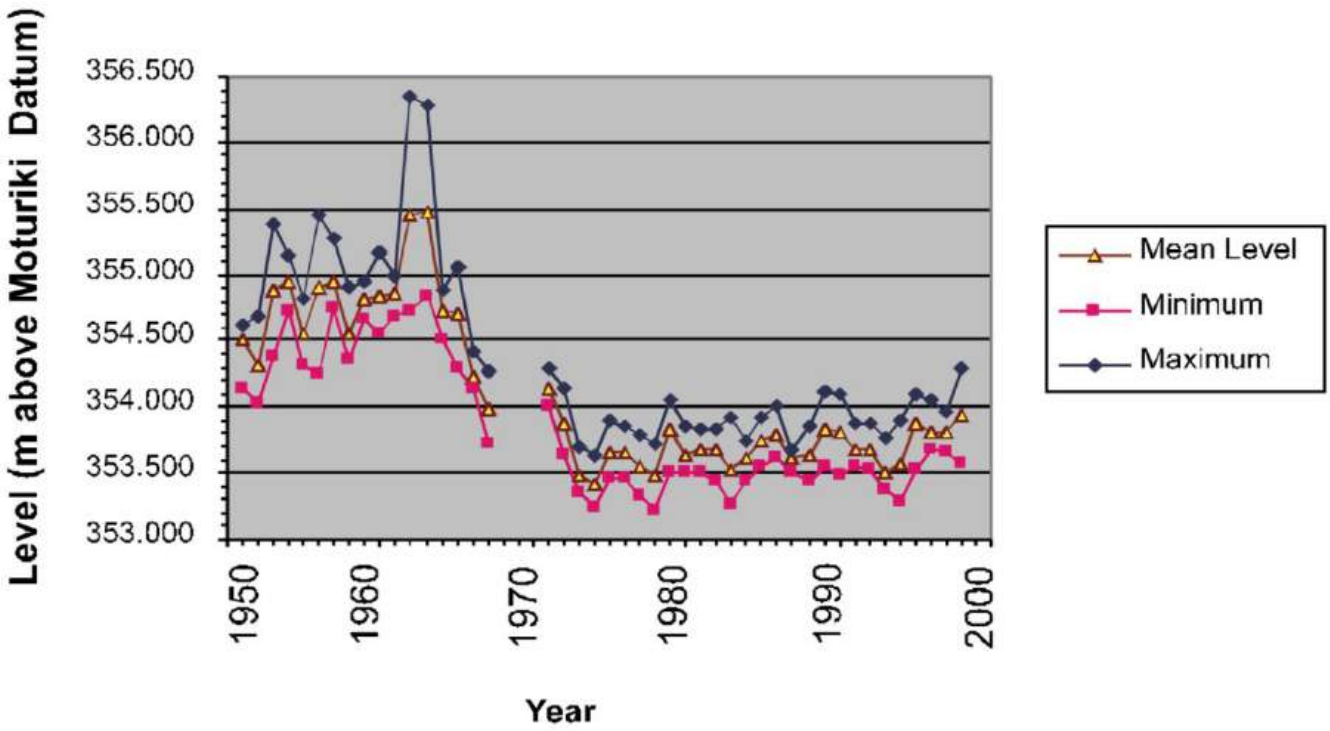
Community Impact Documentation:

- Evacuation records: 15+ families displaced during major events
- Economic losses: Estimated $2.3M (2025 dollars) cumulative damage
- Infrastructure damage: Road, power, telecommunications disruption
- Social impact: Community meetings, petition campaigns, lobbying efforts

A.3 Post-Engineering Performance Record

Flood Events Since 1965 Engineering Installation:

- Residential property inundation: several minor water incursions in house basements one minor basement incursion recorded event
- Lake level exceedances above 353.9m RL: several that did not result in inundation of homes beyond a minor water incursions in house basements
- Affected properties: Multiple residences around lake perimeter
- System performance during exceedances: Effective level control
- Emergency activations: 2017 (Section 330 RMA powers invoked)



APPENDIX B: CURRENT RESOURCE CONSENT CONDITIONS (RM19-0347 SERIES)

B.1 Resource Consent RM19-0347-BC.01 (Lake Structure)

Consent Holder: Bay of Plenty Regional Council
Activity: Lake structure for water level control
Term: 25 years (expires 30 October 2044)

Key Conditions:

1. Construction Standards: All structures to comply with NZS 3910:2013
2. Environmental Protection: Avoid disturbance to lake bed ecology during maintenance
3. Public Safety: Maintain appropriate warning signage and barriers
4. Monitoring: Annual structural integrity assessment required

B.2 Resource Consent RM19-0347-BC.02 (River Structure)

Consent Holder: Bay of Plenty Regional Council
Activity: Waitangi Stream outlet structure
Term: 25 years (expires 30 October 2044)

Key Conditions:

1. Flow Dissipation: Energy dissipation structure maintained to prevent erosion
2. Fish Passage: Design allows upstream fish migration when flows permit
3. Flood Protection: Structure designed for 100-year ARI flow capacity
4. Maintenance Access: Maintain vehicle access for emergency operations

B.3 Resource Consent RM19-0347-BC.03 (Beds Damming and Diversion)

Consent Holder: Bay of Plenty Regional Council
Activity: Lake bed modification for outlet control
Term: 25 years (expires 30 October 2044)

Key Conditions:

- Condition 3.1 - Target Operating Range: Lake levels maintained between 353.5m and 353.9m RL (Moturiki Datum 1953)
- Condition 3.3 - Management Plan: Submit Lake Level Management Plan covering operational guidelines, monitoring protocols, and reporting requirements

B.4 Resource Consent RM19-0347-DC.01 (Discharge to Water)

Consent Holder: Bay of Plenty Regional Council
Activity: Discharge of lake water to Waitangi Stream
Term: 25 years (expires 30 October 2044)
Key Conditions:

- Condition 3.1 - Maximum Flow: Discharge rate not to exceed 500 litres per second
- Condition 3.2 - Minimum Flow: Maintain minimum discharge of 100 litres per second for ecological flows in Waitangi Stream
- Condition 4.1 - Water Quality: Discharged water to meet ANZECC guidelines for aquatic ecosystem protection

B.5 Resource Consent RM19-0347-WT.01 (Surface Water Take)

Consent Holder:	Bay of Plenty Regional Council
Activity:	Abstraction of surface water from Lake Ōkāreka
Term:	25 years (expires 30 October 2044)

Key Conditions:

1. Take Limits: Maximum abstraction 500 L/s (linked to discharge consent)
2. Level Protection: No taking when lake below 353.5m RL
3. Monitoring: Continuous flow and level recording required
4. Reporting: Monthly operational reports to Bay of Plenty Regional Council

APPENDIX C: LAKE LEVEL MANAGEMENT DATA (2017-2025)

C.1 Continuous Lake Level Record

Data Source: Bay of Plenty Regional Council telemetry system
Recording Interval: 15-minute intervals
Datum: Moturiki Datum 1953

Year	Max Level (m RL)	Min Level (m RL)	Days Above 353.9m	Max Exceedance (mm)
2017	354.56	353.45	127	660
2018	354.12	353.38	23	220
2019	353.95	353.51	8	50
2020	354.18	353.42	31	280
2021	353.89	353.49	0	0
2022	353.91	353.52	3	10
2023	353.87	353.48	0	0
2024	353.93	353.46	2	30
2025*	353.81	353.54	0	0

*Data to 31 July 2025

C.2 Flow Rate Performance

Monthly Average Discharge Rates (L/s):

Month	2021	2022	2023	2024	2025*
Jan	180	195	165	210	175
Feb	165	178	152	188	162
Mar	210	225	198	245	205
Apr	285	298	268	312	278
May	350	365	335	385	348
Jun	420	435	405	465	425
Jul	465	485	445	495	468
Aug	445	465	425	475	-
Sep	385	395	365	415	-
Oct	325	335	305	355	-
Nov	265	275	245	295	-
Dec	215	228	198	248	-

C.3 System Effectiveness Analysis

Performance Metrics (2021-2024):

- Target range compliance: 98.7%
- Emergency interventions required: 0
- Unplanned system downtime: <0.1%
- Community flood events: 0
- Property damage incidents: 0

APPENDIX D: TECHNICAL SPECIFICATIONS - OUTLET CONTROL SYSTEM

D.1 Physical Infrastructure

Intake Structure:

- Type: Reinforced concrete headwall with trash rack
- Dimensions: 3.0m (W) × 2.5m (H) × 4.0m (L)
- Inlet diameter: 600mm
- Design capacity: 800 L/s at 1.0m head
- Construction year: 2015 (upgrade)

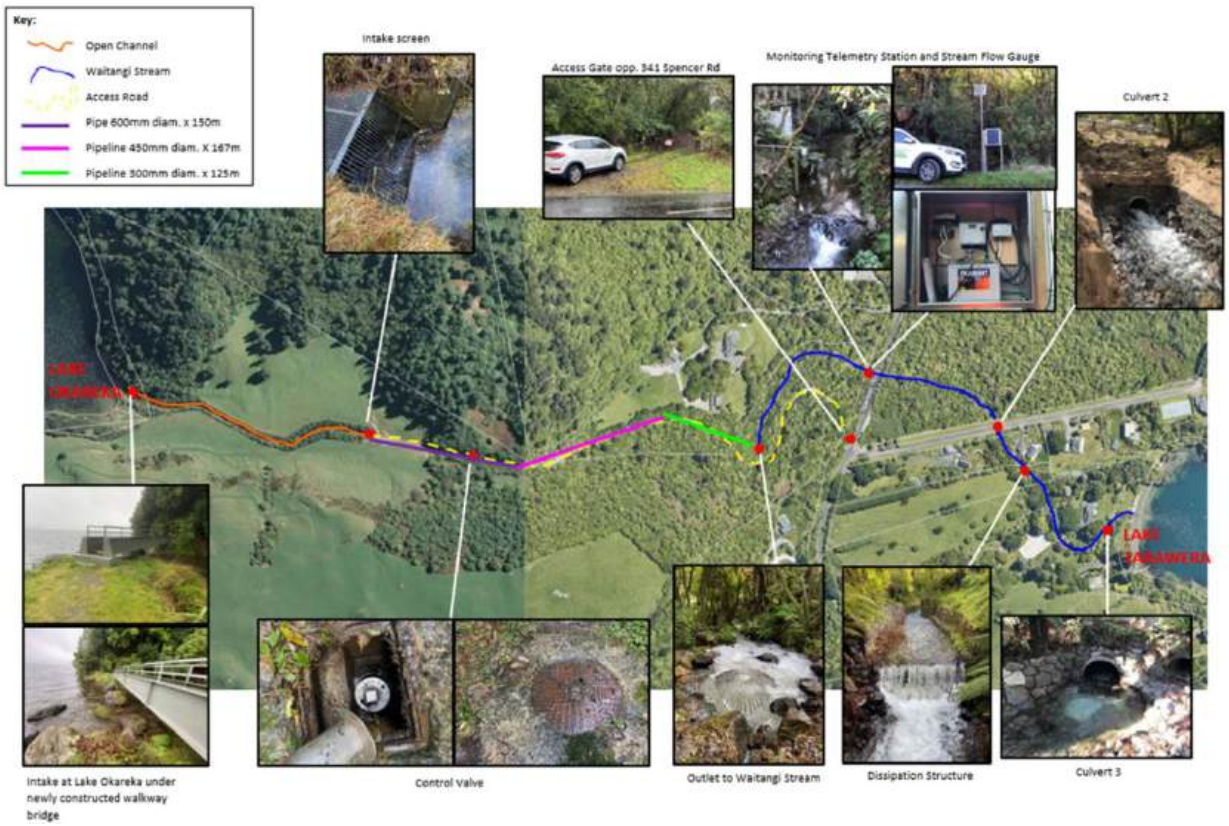
Pipeline System:

- Section 1: 149m × 600mm ID polypropylene (2015)
- Section 2: 167m × 450mm ID spiral welded steel (1965)
- Section 3: 125m × 300mm ID spiral welded steel (1965)
- Total length: 441m
- Design head loss: 0.85m at 500 L/s

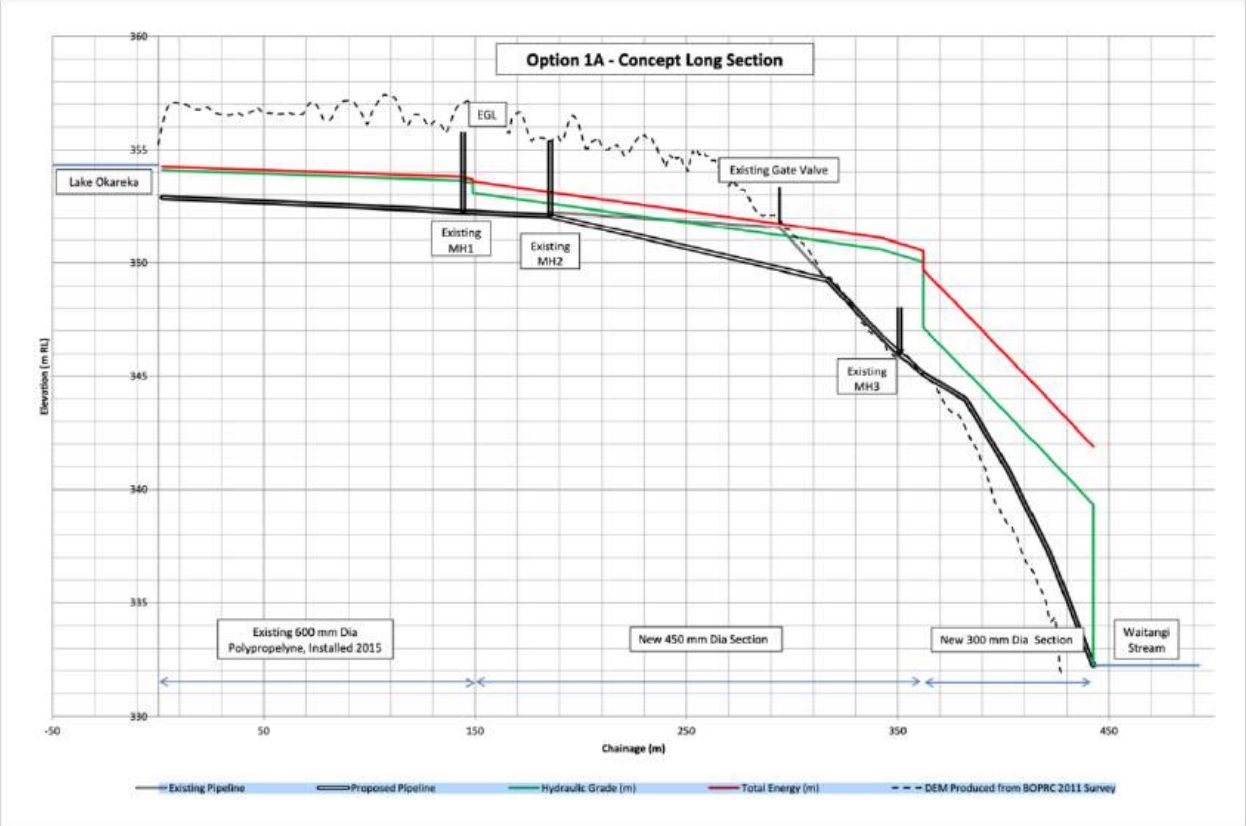
Control System:

- Primary valve: 600mm gate valve (manual/automated)
- Location: Lake outlet headwall
- Control range: 0-100% open
- Response time: 15 minutes (full travel)
- Backup system: Manual override capability

D.2 Lake Outlet Control System Overview:



D.3 Lake Outlet Control System – Gradient:



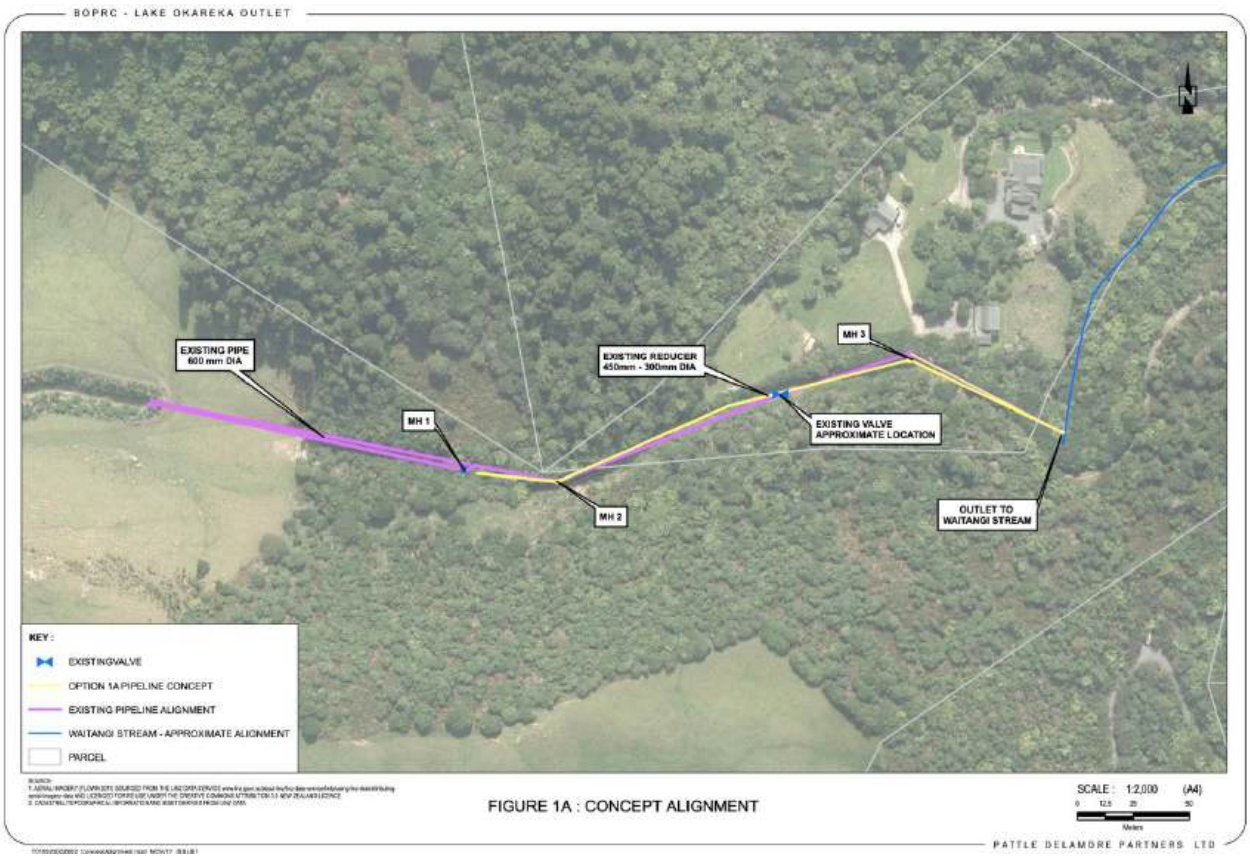
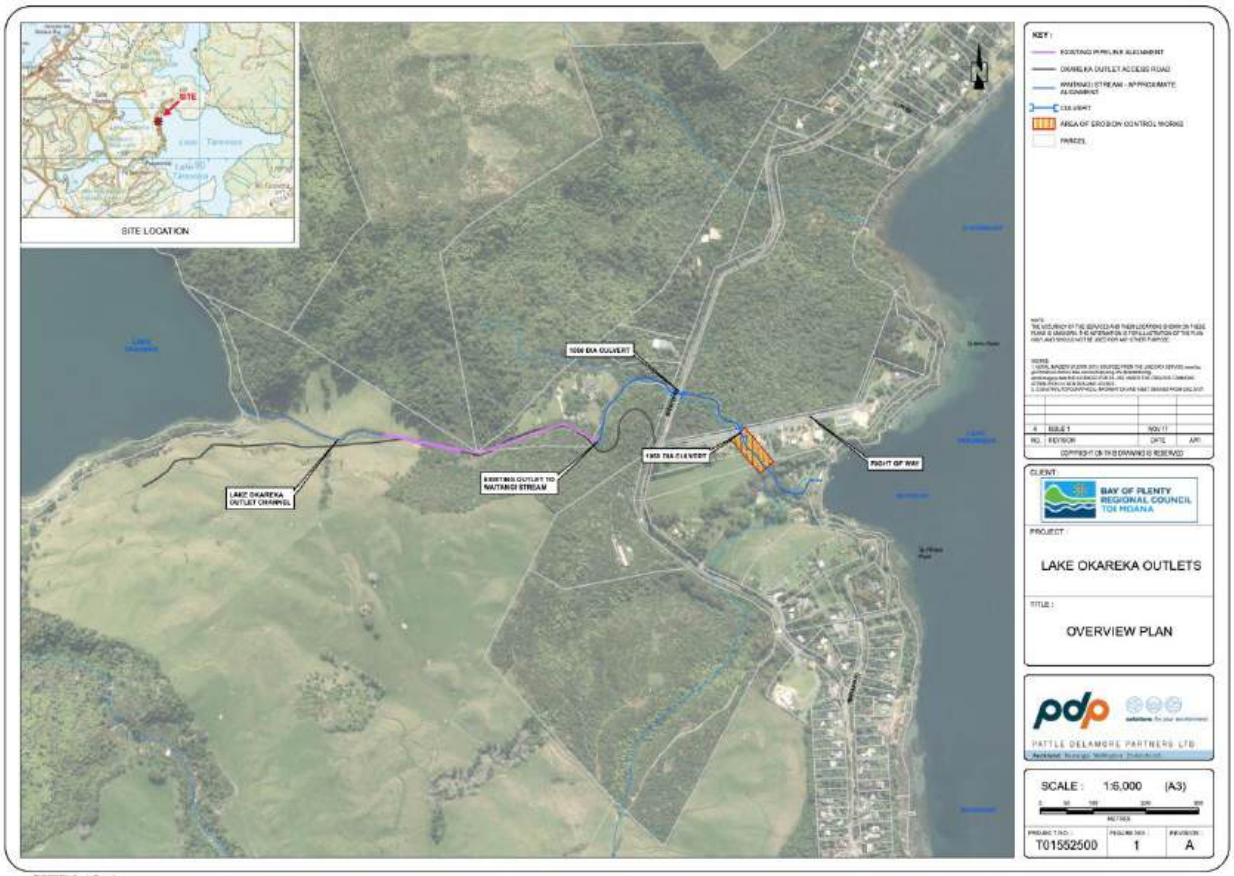
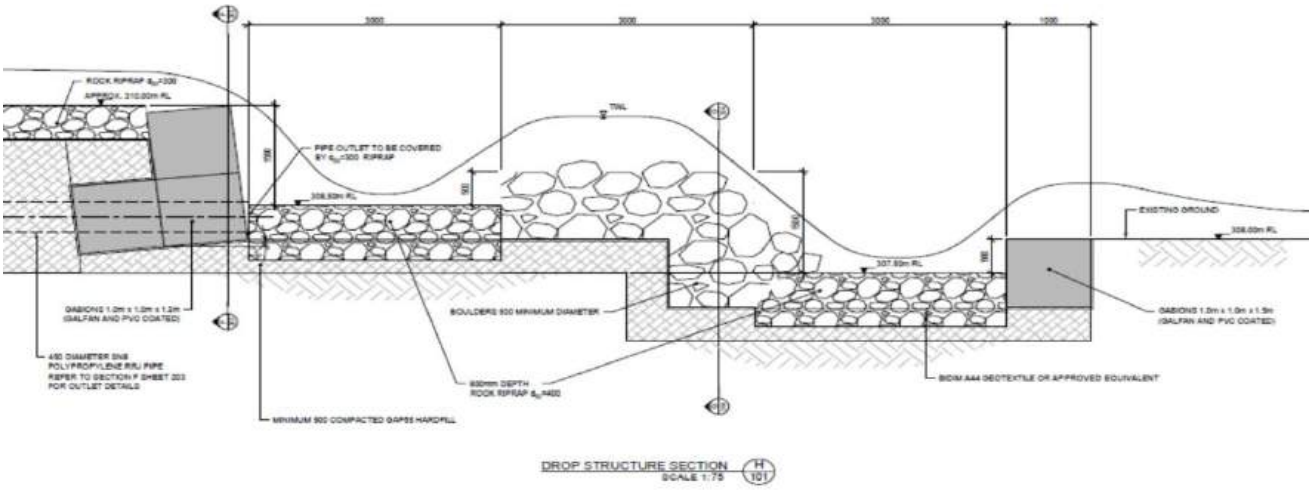


FIGURE 1A : CONCEPT ALIGNMENT



D.4 Waitangi Stream Remediation and Erosion Protection



D.5 Hydraulic Performance

Flow-Head Relationships:

- 200 L/s at 0.3m head differential
- 350 L/s at 0.6m head differential
- 500 L/s at 1.0m head differential
- 650 L/s at 1.5m head differential
- 800 L/s at 2.0m head differential

Hydraulic Performance Explanation

Think of the Lake Ōkāreka outlet like water flowing out of a bathtub drain, but much bigger and more controlled.

What is "Head Differential"?

This is simply the height difference between the water level in the lake and where the water comes out at Waitangi Stream. The bigger this height difference, the faster the water flows out - just like water flows faster out of a full bathtub than an almost-empty one.

What Do These Numbers Mean?

200 L/s at 0.3m head differential

- When the lake is only 30cm higher than the outlet point
- Water flows out at 200 litres per second
- That's like filling a standard bathtub every 1.5 seconds

500 L/s at 1.0m head differential

- When the lake is 1 metre (about 3 feet) higher than the outlet
- Water flows out at 500 litres per second
- That's like filling a bathtub every 0.6 seconds - much faster!

800 L/s at 2.0m head differential

- When the lake is 2 metres (about 6.5 feet) higher than the outlet

- Water flows out at 800 litres per second
- That's like filling a bathtub every 0.4 seconds - very fast!

Why This Matters:

- The higher the lake level gets, the faster water can flow out through the outlet
- This is good because during extreme rainfall (when the lake is high), the system automatically flows faster to bring the level back down
- It's like having a safety valve that works harder when you need it most

Real-World Comparison:

500 L/s (the normal maximum) is roughly equivalent to:

- A small river flowing
- About 30,000 litres per minute
- Enough to fill a swimming pool in about 30 minutes
- About 500 milk bottles flowing out every second

The Bottom Line:

This data shows that Lake Okareka's outlet system is self-regulating - the more the lake rises above normal, the faster it drains. This is exactly what you want in a flood protection system!

System Constraints:

- Maximum sustainable flow: 500 L/s (consent limit)
- Emergency hydraulic capacity: 800-1,000 L/s
- Minimum operating head: 0.2m
- Pipeline pressure rating: 150 kPa

D.6 Monitoring and Control Systems

Lake Level Monitoring:

- Primary sensor: Pressure transducer (±2mm accuracy)
- Backup sensor: Float-operated encoder
- Data logging: 15-minute intervals
- Telemetry: Real-time transmission to BOPRC

Flow Monitoring:

- Location: Waitangi Stream (downstream of outlet)
- Method: Ultrasonic flow measurement
- Accuracy: ±5% at flows >100 L/s
- Recording: Continuous with 15-minute averages

Control System:

- Operation: Semi-automated with manual override
- Decision criteria: Lake level thresholds and weather forecasts
- Response time: <1 hour for standard adjustments
- Emergency protocols: 24/7 on-call response team

APPENDIX E: COMMUNITY INFRASTRUCTURE MAPPING WITHIN PC8 FLOOD ZONE

E.1 Residential Properties

Properties within RL 355.9m contour:

- Total residential dwellings: 47
- Permanent residents: approximately 89 people
- Holiday homes: 18 properties
- Property values: $38.2M total (2024 RV)
- Construction periods: 1950s-2020s

Property Categories:

- High risk (floor <354.5m RL): 8 properties
- Moderate risk (floor 354.5-355.0m RL): 23 properties
- Lower risk (floor >355.0m RL): 16 properties

E.2 Critical Infrastructure

Transportation:

- Steep Street: Primary access road (800m within flood zone)
- Acacia Bay Road: Secondary access (400m affected)
- Private driveways: 23 access points below RL 355.9m
- Boat ramps: 2 public facilities

Utilities:

- Power supply: Underground 11kV cable (1.2km in flood zone)
- Telecommunications: Fibre and copper networks
- Water supply: 2 pumping stations
- Wastewater: Gravity sewer main (600mm diameter)

E.3 Community Facilities

Recreation:

- Playground: Boyes Beach Reserve (below RL 355.5m)
- Waka Ama clubrooms: Building and facilities
- Public toilets: 3 facilities
- Walking tracks: approx. 2.3km of formed paths

Environmental:

- Native vegetation: Significant stands of kahikatea
- Wetland areas: 3 small wetlands supporting native birds
- Fish spawning habitat: Waitangi Stream confluence
- Archaeological sites: 2 recorded Māori sites

E.4 Economic Analysis

Infrastructure Replacement Value:

- Residential buildings: $38.2M
- Roads and access: $4.8M
- Utilities: $6.2M
- Community facilities: $1.8M

Total infrastructure value: $51.0M

Annual Economic Activity:

- Tourism revenue: $2.3M
- Property maintenance: $890K
- Recreational spending: $1.2M

Total annual economic value: $4.39M

E.5 Risk Assessment Without Engineered Controls

Modelled flood impacts (assuming no outlet control):

- 1% AEP event: 89% of properties affected
- Damage estimate: $42.8M direct property damage
- Indirect losses: $8.6M (business interruption, alternative accommodation)
- Recovery time: 18-24 months
- Social impact: Community displacement, loss of cultural connections

Risk Reduction Achieved:

- Current residual risk: <1% of uncontrolled scenario
- Economic protection: $51.0M infrastructure and annual benefits
- Social protection: Community continuity maintained
- Environmental protection: Stable ecosystem management

APPENDIX F: FUTURE-PROOFING THE LAKE OKAREKA OUTFLOW CONTROL SYSTEM

Uncertainty around the impacts of climate change on rainfall patterns poses challenges for the long-term effectiveness of the Lake Okareka engineered 'Outflow Control System' in maintaining safe lake levels and preventing property inundation. Assessment of both current system capacity and options for enhancement is critical for risk management.

F.1 Existing Outflow Control System Capacity

Since 1965, the system has maintained lake levels below flood thresholds, operating at a maximum outflow of 500 litres per second. However, the system's true capacity is at least 800 litres per second and potentially up to 1,000 litres per second - an increase of 80–100% over the historical operational rate.

F.2. Increasing Existing Pipe Diameters

Upgrading pipe sections currently sized at 450 mm and 300 mm in diameter to 600 mm diameter would further enhance outflow capacity and flood mitigation.

F.3 Secondary Emergency Siphon Pipeline

A secondary emergency siphon pipeline, initiated with a hydraulic vacuum primer, could be installed with minimal earthworks, bypassing the constraints of traditional gravity-fed systems. Notable features include:

- Intake can be positioned deeper in the lake, overcoming elevation limitations of the current outlet.
- System can complement or provide redundancy to the existing outlet.

Potential configuration options include:

- Pipe from Lake Okareka with intake at a greater depth and into the canal just downstream of the lake outlet to provide an emergency ability to draw water in the lake ahead of a major reported storm event, thus increase lake retention capacity.
- Pipe from Lake Okareka to Waitangi Stream.
- Direct connection from Lake Okareka to Lake Tarawera.
- Placement of the siphon pipeline above ground or in a shallow trench.
- Direct lake intake, bypassing the canal.

A hydraulic vacuum primer ensures reliable siphon initiation and operation regardless of prevailing head conditions.

The image above is Tom Gardiner's self-priming siphon system, which uses a unique hydraulic vacuum primer to initiate water flow, harnessing basic fluid dynamics and gravity. The result is a robust, self-sustaining, and environmentally sound water management solution that requires neither motors nor electricity to function efficiently in the field.

F.4 Conclusion

Implementing any combination of these measures would increase the flexibility, redundancy, and resilience of lake-level management operations, providing robust future protection for the Lake Okareka community under the increasing uncertainties of climate change.

However, based on 60 years of empirical data, beginning in 1965 with the installation of the first Lake Outlet Control System and including subsequent upgrades - it is unlikely that any of these additional measures would ever be required.

10. SUBMISSION REFERENCES

Bay of Plenty Regional Council (2021). Resource Consents RM19-0347-BC.01, BC.02, BC.03, DC.01, WT.01
Bay of Plenty Regional Council (2025). Lake Ōkāreka Level Management Plan, Version 2
Pattle Delamore Partners (2017). Lake Okareka Outlet Pipeline Upgrade - Options Assessment
Standards New Zealand (2018). AS/NZS ISO 31000:2018 Risk Management - Guidelines
New Zealand Parliament (1991). Resource Management Act 1991
Rotorua Lakes Council (2025). Plan Change 8 (Natural Hazards) - Lakes A Zone notification documents
Sigma Consultants Limited (2014). Lake Okareka Outlet Upgrade Investigation Design Philosophy Report
West, P. (2017). Lake Okareka; Design of Pipeline Capacity; Impacts on Lake Level Management, BOPRC
Lake Okareka consent summary(3)
Hydrological and hydraulic guidelines
Design Flood Levels for Rotorua Lakes PLB 20020717
Atlas BOPRC
Rotorua Lakes Design Levels Technical Report 2022.pdf
Te Arawa Lakes Strategy Committee Minutes 2020-2025
Appendix 3 Reports Index
Rotorua Lakes Asset Management Plan 2024-2034 - Final Report
Lake Okareka Outlet Pipeline Upgrade- Options Assessment
Lake Okareka Outlet Pipeline Upgrade- Options Assessment Final Report
Waitangi Stream Erosion Protection Location Summary Sumeran BOPRC-1
Waitangi Stream Remediation & Erosion Protection Drawings March 18
Memo Design of Pipeline Capacity Impacts on Lake Level Mgt 171117
Memo Lake Okareka P West Modelling of Lake Management Guideline Options Presentation
Appendix West Memo Modelling of Lake Management Guidelines
Lake Okareka Level Management Plan - June 2025.pdf
Waitangi Stream Erosion Protection Location Summary Sumeran BOPRC
Lake Okareka Outlet Guidelines for Operating Structure Aug 2016 BOPRC
Memo Lake Okareka design of pipeline capacity with regards to lake levels 20171117
Current operation guidelines Lake Okareka outlet 20160817
Plan Change 8 Natural ECM 21393933 v1

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Strategic Objectives and Policies
Flooding
Wildfire
Fault Rupture
Land Stability Hazards – Slope Stability, Liquefaction, Soft Soils
Geothermal Hazards

Q2 **My submission is:**

Long Text

Please refer to attached submission

Q3 **What changes do you want made to the District Plan?**

Long Text

Please refer to attached submission

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

https://participate.rotorualakescouncil.nz/download_file/2238

Q5 **Tō Ingoa | Name**

Short Text

Fire and Emergency New Zealand

Q8 **Do you wish to present your submission publicly in front of elected members at a hearing?**

Multi Choice

Yes

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Form 5
Submission on notified proposal for policy statement or plan, change or variation

Clause 6 of Schedule 1, Resource Management Act 1991

To:	Rotorua Lakes Council
Submission from:	Fire and Emergency New Zealand
Address for Service	Beca Limited PO Box 448, Waikato Mail Centre Hamilton 3240 Attention: Alec Duncan [redacted]

This submission is made on behalf of Fire and Emergency New Zealand (**Fire and Emergency**) to Rotorua Lakes Council (**RLC**) on the Proposed Plan Change 8: Natural Hazards (**PPC8**) to the Rotorua District Plan (**RDP**).

Fire and Emergency could not gain an advantage in trade competition through this submission.

1. Background:

The primary objective of Fire and Emergency is to reduce the incidence of unwanted fire and the associated risk to life and property. Fire and Emergency seek to:

- protect and preserve life
- prevent or limit injury
- prevent or limit damage to property and land, and
- prevent or limit damage to the environment[1].

Fire and Emergency's main functions are—

(a) *to promote fire safety, including providing guidance on the safe use of fire as a land management tool; and*
(b) *to provide fire prevention, response, and suppression services; and*
(c) *to stabilise or render safe incidents that involve hazardous substances; and*
(d) *to provide for the safety of persons and property endangered by incidents involving hazardous substances; and*
(e) *to rescue persons who are trapped as a result of transport accidents or other incidents; and*
(f) *to provide urban search and rescue services*[2].

Fire and Emergency also has additional functions to assist in matters to the extent that Fire and Emergency has the capability and capacity to do so and the capability to perform their main functions efficiently and effectively.

[1] Fire and Emergency New Zealand Act 2017 section 10(a)(b)
[2] Fire and Emergency New Zealand Act 2017 section 11(2)

Notably, a key additional function includes "*responding to severe weather-related events, natural hazard events, and disasters*"[3].

Fire and Emergency is a main responder to significant natural hazard events, such as the Canterbury earthquake in 2011, the Port Hills fires in 2017, the extreme flooding event in Ngongotaha / Rotorua District in April 2018, the Nelson-Tasman Pigeon Valley fires in 2019 and the more recent Cyclone Gabrielle north island flooding in 2023.

Natural hazards and the impacts of climate change present broad challenges to Fire and Emergency, such as the increasing frequency and severity of extreme weather events. Climate change is likely to increase the frequency and severity of extreme weather events such as flooding, winds, fire and droughts. Across Aotearoa, states of emergency are being declared with increasing frequency, close to three times more frequently in the last decade compared to the previous ten years. 30 percent of those states of emergency were the result of extreme weather, with 48 percent the result of flooding[4].

These challenges can be further exacerbated by subdivision and built development occurring in areas prone to natural hazards as well as competing access to resources such as water and transport infrastructure where not appropriately managed. These challenges make the environment Fire and Emergency operates in more complex and puts greater demands on Fire and Emergency as an organisation.

While Fire and Emergency's operating environment is changing rapidly, Fire and Emergency continues to build their capability and specialised expertise to reduce the social, economic and environmental impacts of natural hazard risk on communities across Aotearoa.

With this, territorial authorities have a role in ensuring that emergency service providers, such as Fire and Emergency, can continue to operate effectively and efficiently in a changing urban environment. This includes consideration and management of the actual and potential implications on emergency services when giving effect to requirements under the Resource Management Act 1991 (**RMA**) and other legislation.

This submission seeks to enable Fire and Emergency to carry out its objectives and functions under the Fire and Emergency New Zealand Act 2017 to provide protection of people, property and the environment in the event of an emergency. This submission further addresses the matters relating to activities required to be undertaken to enable effective emergency response and to provide for the health and safety of people and communities in Rotorua.

2. Fire and Emergency submission:

2.1 Strategic Direction: Issues, objectives and policies

Fire and Emergency's management services and activities adopt the use of the '4Rs' model: risk reduction, readiness, recovery and response based on the New Zealand integrated approach to civil defence and emergency management, from the National Emergency Management Agency. This model is used to focus Fire and Emergency's work to help communities prepare for, respond to, and recover well from emergencies, including natural hazard events. This work informs a strategic priority and commitment to working with communities to reduce risk and build resilience as set out in Fire and Emergency's Statement of Performance Expectations 2025-2026[5] and Strategic Direction 2025-2030[6].

PPC8 proposes to replace the existing strategic issues, objectives and policies relating to 'natural hazards and climate change resilience' to focus on acceptable risk, resilience to climate change and best practice principles for decision-making through the assessment and consideration of risk.

Fire and Emergency is supportive of the risk-based approach taken by PPC8. Risk reduction is central to Fire and Emergency management services and activities including measures that identify and analyse risks to life and

[3] Section 12(3)((e) of the Fire and Emergency New Zealand Act 2017
4 Declared States of Emergency » National Emergency Management Agency (civildefence.govt.nz)
5 https://www.fireandemergency.nz/assets/Documents/About-FENZ/Key-documents/2065-SPE-2025-26_FA-9.1-WEB-.pdf
6 https://www.fireandemergency.nz/assets/Documents/About-FENZ/Key-documents/2042-Organisational-Strategy-FA-LR.pdf

property from hazards, eliminate those risks if practicable, and, if not, reduce the impact and the chance of the impact happening to an acceptable level.

2.2 Flooding, Fault Rupture, Land Stability Hazards (Slope Stability, Liquefaction, Soft Soils), Geothermal Hazards

Fire and Emergency is generally supportive of the proposed changes to the Flooding, Fault Rupture, Land Stability and Geothermal Hazards provisions. Specifically, Fire and Emergency broadly support:

- Retaining flood hazard mapping outside the District Plan to enable consideration of the best available information in consenting decisions.
  - Fire and Emergency is supportive of the robust and accurate mapping of natural hazards. Both in respect of identifying the areas of land at risk of natural hazards (where these can be mapped), but also as a means of communicating to landowners and the community generally the location and extent of land areas subject natural hazards and susceptibility to climate change effects.
  - This is also important to Fire and Emergency as an emergency responder as this information will provide and inform risk management during emergency response and assist in the continued development and implementation of local planning to address local communities' risks and needs at a district level.

- Extending the existing and proposed policies and rules for managing natural hazards to the Lakes A Zone.
  - This promotes a consistent approach to natural hazard management across the district.

- Introducing matters of control / discretion to the subdivision and various landuse rule frameworks that require the assessment of the extent to which natural hazard risks are avoided or remedied and the worsening of any hazard (or to similar effect).
  - This would include the consideration of wildfire as an unmapped natural hazard.

Overall, the proposed amendments are considered an improvement to the natural hazard management framework within the RDP.

2.3 Wildfire

The risk and impact of wildfire is increasing in Aotearoa due to climate change, but also due to how and where people are living. The frequency of wildfires and number of significant wildfires are also on the rise – with many happening in the shoulder months rather than the typical higher risk summer period[7]. Large wildfires like the 2017 Port Hills, 2019 Tasman, 2020 Lake Ōhau, 2021/2022 Waiharara fires are occurring every 1-2 years, resulting in significant impact and losses.

Wildfire is identified as one of 33 national risks to New Zealand by the Department of the Prime Minister and Cabinet[8]. On this national risk register, Wildfire is described as "*an unwanted, uncontrolled fire which occurs within an area of combustible vegetation, often moving rapidly across the landscape. Although wildfires most commonly occur in rural areas, they also may occur within urban environments*". Fire and Emergency is identified as the risk-coordinating agency.

There are several methods available to manage wildfire risk for subdivision and land use activities that can be included in the RDP. These include (but are not limited to):

- The provision of firefighting water supply
  - This is best achieved through compliance with the New Zealand Fire Service Firefighting Water Supplies Code of Practice SNZ PAS 4509:2008 which sets out the standards required for firefighting water supply and applies to both reticulated and non-reticulated areas, as Fire and Emergency may be required to respond to a structural fire emergency in any area. Firefighting water supplies should be properly

[7] https://www.fireandemergency.nz/fire-safety-campaign-resources/wildfire-readiness-and-prevention/

[8] https://www.dpmc.govt.nz/our-programmes/risk-and-resilience/national-risk-and-resilience-framework/new-zealands-national-risks

maintained and readily available for use during any emergency fire event, including Wildfire. Tanks, pipework, and associated infrastructure must be capable of operating effectively any time.

- Providing adequate access and egress
  - It is important that future subdivision and development areas are designed to be well-functioning and resilient to ensure that communities / residents are able to evacuate in the event of an emergency. If emergency responders cannot access people in the event of an emergency, this will not enable and provide for well-functioning and resilient communities.

- Requiring setback / defensible spaces from buildings
  - A key action is to create defensible space, a carefully managed area around houses or structures where flammable materials are removed or minimised. An important component of defensible space is the planting of low flammability species[9].

- Enabling vegetation clearance for the purpose of fire risk management
  - This is preventative mitigation of fire risk to property and life through providing for the trimming or clearance of vegetation (including indigenous vegetation) that is often restricted by district plans. This enables property owners and occupiers to remove flammable vegetation as required. This is particularly important where property is located outside of a reticulated water network. Such provisions can indirectly help in managing and reducing wildfire and drought risk in the district.
  - Fire and Emergency is however aware that vegetation clearance is a matter that is outside of the scope of PPC8.

- Firefighter safety
  - Firefighter safety is a core consideration in all aspects of emergency planning and infrastructure design. This includes ensuring safe and reliable access to water supplies, clear and navigable access routes, and defensible spaces around structures. Adequate provisions help reduce risk to personnel during response operations and support effective incident management under hazardous conditions, such dealing with fire as a natural hazard.

Fire and Emergency supports RDC's thorough assessment of wildfire in the Section 32 Report and the identification that there is a lack of clear acknowledgement in the RDP of wildfire as a natural hazard.

Section 7.2 of the Section 32 Report identifies the existing provisions for wildfire in the RDP and PPC8 proposes additional policies and rules to address the identified deficiencies that are considered appropriate in manage wildfire risk.

Overall, the proposed amendments / additions to the wildfire risk framework are considered to be an improvement. However, some of the amendments cannot be supported by Fire and Emergency due to what have been assumed to be unintended consequences as a result of the amendments to improve the wildfire provisions which present a risk to Fire and Emergency as the primary risk-coordinating agency for wildfire.

3. Fire and Emergency seeks the following decision from the local authority:

Appendix A sets out the specific amendments sought by Fire and Emergency to provisions in PPC8 and the reasons for these amendments.

Fire and Emergency would welcome any questions or further engagement on matters raised in the submission within prior to the hearing.

- Fire and Emergency does **wish to be heard** in support of its submission.

[9] https://www.fireandemergency.nz/fire-safety-campaign-resources/low-flammability-plants/

Alec Duncan, Consultant Planner
Signature of person authorised to sign on behalf of Fire and Emergency
Date: 21/08/2025

Appendix A

The following table sets out the specific position and any amendments sought by Fire and Emergency. Where specific amendments to provisions are sought, these amendments are shown as red underline (for new text sought) and ~~word~~ (for deletion).

ID	Provision	Support / oppose	Submission	Requested amendment
Part 1: Introduction and General Provisions				
DEFINITIONS				
1	Wildfire	**Support in part**	PPC8 seeks to introduce a new definition for wildfire in the District Plan: *any natural-caused or unplanned human-caused fire that is burning in and consumes natural fuels: forest, brush, grass, for example.* It is understood that this definition was provided through consultation with GNS Science staff involved in wildfire research. Fire and Emergency generally support the definition however request an amendment be made to include the term 'uncontrolled' which is a key factor that constituents a wildfire.	Amend as follows: *any natural-caused or unplanned and uncontrolled human-caused fire that is burning in and consumes natural fuels: forest, brush, grass, for example.*
Part 2: District Wide Matters				
STRATEGIC DIRECTION				
2	SDNH-O1	**Support**	Objective SDNH-O1 requires that '*The risks from natural hazards to people, property and the environment associated with land use, subdivision and development are acceptable*'. Fire and Emergency support this objective on the basis that, to achieve this objective, SDNH-P1 requires, when assessing whether the natural hazard risks associated with subdivision or land use are acceptable, and identifying risks that must be avoided or mitigated, several measure / matters must be considered (as set out in SDNH-P1(1)-(4)).	Retain as notified.
3	SDNH-O2	**Support**	Objective SDNH-O2 is supported to the extent that it requires land use, subdivision and development to be resilient to the current and future effects of climate change. This approach aligns with Fire and Emergency's risk reduction and resilience strategy.	Retain as notified.
4	SDNH-P1	**Support**	SDNH-P1 is supported on the basis that, when assessing whether the natural hazard risks associated with subdivision or land use are acceptable, and identifying risks that must be avoided or mitigated, several matters must be considered, as set out in SDNH-P1(1)-(4). The measures set out in (1)-(4) are supported as they generally align with Fire and Emergency's risk reduction strategy. Specifically: - SDNH-P1(1): Fire and Emergency support the need to assess natural hazards affecting the land and any potential to exacerbate risks beyond the site – this is particularly relevant to wildfire. - SDNH-P1(2): Fire and Emergency support the use of the best available information, including relevant national and regional guidance. This could include national guidance from Fire and Emergency on risk reduction / mitigation measures associated with natural hazards, including wildfire. - SDNH-P1(4): Fire and Emergency suport the promotion of opportunities to reduce existing natural hazard risks affecting established land uses, such as wildfire risk in established rural / urban interaces.	Retain as notified.
HAZARDS AND RISKS				
5	General – objectives and policies	**Support**	Fire and Emergency strongly supports the removal of objectives and policies that apply only to the Waikato Region and instead relying on the amended strategic objectives and policies for the whole district, including the Lakes A Zone, as proposed in the strategic direction chapter. This approach is supported as it sets out a consistent approach to natural hazard management across the district.	Retain as notified.
6	Wildfire NH-P5	**Support in part**	Fire and Emergency generally supports new Policy NH-P5. As notified, this would apply to all development across the district, including development in the Lakes A Zone.	Amend as follows: **Wildfire** **NH-P5**

ID	Provision	Support / oppose	Submission	Requested amendment
			Where resource consent is required, and natural hazard risk must be assessed, Policy NH-P5 requires that any development consider wildfire and that the risks of wildfire associated with development be mitigated. Policy NH-P5(1) and (2) sets out mitigation options. Fire and Emergency request that this policy be extended to subdivision. This better aligns with the strategic direction policy but also the subsequent rule framework that applies to both subdivision and land use / development. Further, NH-P5(2) specifies subdivision and it is understood to be the intent that the policy also apply to subdivision. Fire and Emergency acknowledge the intent of NH-P5(1), which seeks to require firefighting water supply for activities in more densely populated zones and papakāinga. However, Fire and Emergency consider that the requirement for firefighting water supply should not be restricted to more densely populated zones. All development including where new buildings are proposed, should be subject to the requirement to provide a firefighting water supply based on the need to either protect building/s, or to mitigate wildfire risk or reduce the impact of wildfire (through allowing fire suppression intervention to prevent a structural fire spreading from a structural fire to vegetation or wildfire impacting structure). An amendment to this effect has been sought. Policy NH-P5(2) is supported to the extent that it acknowledges the importance of considerations relating to subdivision design in reducing wildfire risk and risk to future occupants. While this policy seeks to encourage (rather than require) further consideration and mitigation of wildfire through subdivision design in Rural Zones and at the urban-rural fringe, if wildfire risk is identified, Council should be able to consider these mitigations in their decision making. Further, plan users will be directed to consider this new policy through the various matters of control / discretion and assessment criteria relating to natural hazard risk where resource consent is required. Fire and Emergency also request an amendment to Policy NH-P5(2)(c). The amendment seeks to better capture the intent of the mitigation option, being, the choice and location of plant species in relation to buildings and accessways to reduce the risk of fire spread. This aligns with Fire and Emergency's fire safety guidance in establishing defensible spaces, through carefully managed area around buildings where flammable materials are removed or minimised. An important component of defensible space is the planting of low flammability species.	Mitigate the risks of wildfire associated with subdivision and development by: 1. Requiring firefighting water supply for new buildings and other land use activities ~~in more densely populated zones and papakāinga~~ to reduce the impact ~~risk~~ of wildfire ~~occurring~~. 2. Encouraging subdivision design in rural areas and at the rural-urban fringe to consider the potential risks of wildfire and, where appropriate, include measures that may help reduce the risks. Such measures may include: a. identifying suitable locations for building platforms and accessways that reduce exposure to wildfire hazards and facilitate egress; b. facilitating access for emergency services; and c. choice and location of plant species in relation to buildings and accessways to reduce the risk of fire spread. Or words to similar effect.
7	NH-R8 New Buildings and Additions to Building in the Geothermal Systems Overlay	**Support**	Fire and Emergency support the amendment to Rule NH-R8 which addresses the gap in which the new National Environmental Standards for Granny Flats will likely create for natural hazard risk assessments, being the removal for the requirement for building consent. For this reason, Fire and Emergency support Council in addressing this gap through provisions in the district plan, specifically the requirement for a resource consent to enable the assessment of geothermal hazard risks to new buildings and large additions exempt from the requirement to obtain building consent.	Retain as notified.
SUBDIVISION				
8	SUB-I2 Natural and manmade constraints	**Support**	Fire and Emergency supports the identification of the 'potential for wildfire' as a site suitability issue for subdivision in Rotorua.	Retain as notified.
9	SUB-P16	**Support in part**	Fire and Emergency support this policy to the extent that it acknowledges the need for subdivisions to demonstrate that there is sufficient water supply capacity, including for firefighting purposes. However, for reasons set out in the submission above, Fire and Emergency request an amendment so that the policy does not limit the requirement to demonstrate sufficient fighting water supply to more densely populated zones. As notified, this would likely exclude subdivisions in the rural zones, which make up a significant proportion of the district. This is not supported by Fire and Emergency. Further, Fire and Emergency note that the notified amendment to this policy has what is assumed to be an unintended consequence whereby it would also remove the need to demonstrate that there is sufficient firefighting water supply capacity for the purpose of fighting structural fires.	Amend as follows: **SUB-P16** Ensure applications for subdivisions demonstrate that the water supply capacity, ~~including capacity for firefighting purposes,~~ is sufficient and reliable for the development, and includes capacity for firefighting purposes all year round ~~in the more densely populated zones~~.
10	SUB-S9 Site serviceability	**Oppose**	Fire and Emergency oppose the amendment to SUB-S9(3)(b)(f) that seeks to exempt Rural 1 Zone and Conservation Zone from the requirement to provide a water supply that is adequate for firefighting purposes. The Section 32 report states that this change seeks to limit firefighting water requirements to the more densely populated Rural 2 Zone (Rural Lifestyle Zone) and Rural 3 Zone (Rural Village Zone). It appears as though, in relation to Rural Zone 1, the requirement to provide a water supply adequate for firefighting purposes has been removed, and a new performance standard introduced to require a firefighting water supply at land use stage, albeit this has been applied to a limited number of land use activities anticipated in the rural zones.	Amend as follows: **3. Infrastructure Performance Standards** … **b. Water services** …

ID	Provision	Support / oppose	Submission	Requested amendment
			This introduces a significant gap in that subdivision in Rural Zone 1 is no longer required to provide firefighting water supply which presents a risk to Fire and Emergency. It is noted that while Rural Zone 1 expects a low number of buildings, Rural Zone 1 represents a large proportion of the district and therefore should not be exempt from firefighting water supply serviceability requirements at the time of subdivision. Similarly with the Conservation Zone, while subdivision is likely low, should subdivision occur, firefighting water supply capacity should be a consideration based on the nature of the proposed activity the subdivision would enable. Fire and Emergency is less concerned about the exemption of the Water Zone due to the zones purpose, location and extent.	f. The water supply shall be adequate for fire-fighting purposes, except in the ~~Rural 1 Zone, Conservation Zone and~~ Water Zone.
Part 3: Area-Specific Matters				
ZONES				
11	RURZ-R9 RURZ-R12 RURZ-R13 RURZ-R14 RURZ-R15 RURZ-R17	**Support in part**	Fire and Emergency support these rules to the extent that an amendment has been made to include the requirement to comply with new performance standard RURZ-S5A Servicing. This requires 'Residential units', 'Veterinary clinic', 'Retail shop', 'Show homes', 'Office activities' and 'Community housing' in the rural zones to provide "*A water supply adequate for firefighting purposes shall be provided to the development in accordance with the New Zealand Fire Service Firefighting Water Supplies Code of Practice SNZ PAS 4509: 2008*". Extending this requirement to the specified land use activities in the Rural Zones is supported. However, Council appears to have limited the application of the performance standard to residential and smaller scale activities and have not included other land use activities anticipated in the rural zones such as 'Agricultural production activities' which may include the development of large rural buildings. Fire and Emergency request that this new performance standard be extended to all land use activities in the rural zones that propose a new building/s as part of its development.	Amend as follows: • Extend the application of RURZ-S5A Servicing to all land use activities in the rural zones that propose a new building. Or wording to similar effect. And any consequential amendments to give effect to the relief sought.
12	RURZ-S5A Servicing	**Support**	Fire and Emergency supports the new performance standard, subject to the amendments sought above.	Retain as notified.
LAKES A ZONE				
13	34.0 POTABLE WATER SUPPLY 34.1 PERMITTED ACTIVITIES	**Support in part**	Fire and Emergency support this rule being updated to be consistent with the wider the district plan. However, 'habitable building' is undefined in the district plan and therefore the application of the permitted activity condition is unclear. It is noted the definition for 'buildings of low importance' is: *"in relation to buildings within NH Natural Hazards, means buildings posing low risk to human life and the environment, and a low economic cost, should the building fail. These are typically small (less than 30m^2) non-habitable buildings, such as sheds, barns, and the like, that are not normally occupied, though they may have occupants from time to time"*. The definition for 'habitable building' should be clarified to ensure that the new performance standard is appropriately applied to appropriate buildings based on their risk profile in the Lake A Zone. In the absence of a definition, an amendment to the permitted activity is sought to require all buildings to be provided with a water supply adequate for firefighting purposes. A drafting error has also been amended in Fire and Emergency's relief sought.	Amend as follows: 34.1 PERMITTED ACTIVITIES 34.1.1 Water supply systems complying with the following conditions: ... 2. Settlement Management Area and Bush Settlement Management Area: ~~Every habitable building~~ All buildings shall be provided with a water supply adequate for firefighting purposes ~~with a water supply adequate for firefighting purposes~~ in accordance with the New Zealand Fire Service Firefighting Water Supplies Code of Practice SNZ PAS 4509: 2008

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Fault Rupture
Flooding

Q2 **My submission is:**

Long Text

I support the position taken by the Lake Ōkāreka Community Association (LOCA).

Regarding the Plan Changes related to Fault Rupture Zones, I oppose the changes due to the inconclusive data on Recurrence Levels that underpins the risk rating for newly mapped fault line on Acacia Road and Price Road properties. The proposed risk assessment is based on subjective data, and the required level of investigation to determine objectively the level of risk as not been undertaken.
It is recommended that this change is not added to the district plan until more conclusive data is available about the location of the fault line and its recurrence levels.
It is recommended that the Rotorua Lakes Council engage expertise to conduct a detailed investigation to determine the most likely level of Recurrence for this fault line. This would provide more conclusive data to make an informed decision as to the assessment of the risk levels of this fault line and the impact that this risk assessment has on the existing properties located on Acacia Road and Price Road.

Regarding the Plan Changes related to Flooding Risk. I oppose the changes proposed, as the data and analysis that has been used is not reflective of the changes made in 2021 to improve the outflow pipeline from Lake Ōkāreka to reduce the risk of flooding.
The recommendations are based on data that is not reflective of the current waterflows in Lake Ōkāreka.
If the re-zoning of flood risk areas is proposed, it needs to consider the changes in outflow capacity and due to the improvements of the outlet Pipeline.

Q3 **What changes do you want made to the District Plan?**

Long Text

Remove the changes to the Fault Rupture risk zoning on Acacia Road and Price Road (due to in conclusive data).
Remove the changes to the flood risk zoning at Lake Ōkāreka due to data not being reflective of improvements made to the lake outflow in 2021.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Tim Winstone

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Flooding
Fault Rupture

Q2 **My submission is:**

Long Text

I oppose Flooding Hazard in Okareka – Council is Proposing to use flood levels from a 2022 Bay of Plenty Regional Council report. This report is fundamentally flawed. It uses historical lake level data from 1971-2020 and completely ignores the multi-million-dollar upgrade to our lake outlet completed in 2021. That upgrade was specifically designed to prevent future flooding. Using data from before the fix was put in place is illogical and ignores the best and most current information.

Q3 **What changes do you want made to the District Plan?**

Long Text

The Rotorua Lakes Council reject the BOPRC 2022 report for Lake Ōkāreka. New flood levels must be calculated using a proper water balance model that accurately accounts for the full capacity of our upgraded outlet.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

https://participate.rotorualakescouncil.nz/download_file/2241

Q5 **Tō Ingoa | Name**

Short Text

K Huston

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice: Fault Rupture

Q2 **My submission is:**

Long Text: I Oppose Fault Rapture Hazard: Council is Proposing to create a new "Fault Rupture Hazard Area" that affects properties, in particular those along Acacia and Pryce Road, where no hazard was previously identified. This could place restrictions on building and development and be noted on our property's LIM report. The science behind this is highly uncertain. A detailed geological report (the Berryman Report) states that the exact location of the fault is difficult to determine, and its level of activity is unknown. It is unfair to impose definite and costly restrictions on landowners based on uncertain evidence.

Q3 **What changes do you want made to the District Plan?**

Long Text: Pause the application of these rules. Instead, the area should be designated an "Area of Geological Investigation" for a set period. Which would allow for proper scientific study. Clear evidence is needed before any rules are applied.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text: Karen Huston

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice: No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice: Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice: No

My submission is for: Plan Change 8 **Flooding Hazard & Fault Rupture Hazard**

1. **Flooding Hazard**

I oppose Flooding Hazard in Okareka – Council is Proposing to use flood levels from a 2022 Bay of Plenty Regional Council report. This report is fundamentally flawed. It uses historical lake level data from 1971-2020 and completely ignores the multi-million-dollar upgrade to our lake outlet completed in 2021. That upgrade was specifically designed to prevent future flooding. Using data from before the fix was put in place is illogical and ignores the best and most current information.

What changes do you want made to the District Plan?

The Rotorua Lakes Council reject the BOPRC 2022 report for Lake Ōkāreka. New flood levels must be calculated using a proper water balance model that accurately accounts for the full capacity of our upgraded outlet.

2. **Fault Rupture Hazard**

I oppose "Fault Rupture Hazard Area" that affects properties, in particular those along Acacia and Pryce Road, where no hazard was previously identified. This would place restrictions on building and development and be noted on our property's LIM report. The science behind this is highly uncertain. A detailed geological report (the Berryman Report) states that the exact location of the fault is difficult to determine, and its level of activity is unknown. It is unfair to impose definite and costly restrictions on landowners based on uncertain evidence.

What changes do you want made to the District Plan?

Council to pause the application of these rules. Instead, the area should be designated an "Area of Geological Investigation" for a set period. This will allow for proper scientific study.

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Land Stability Hazards – Slope Stability, Liquefaction, Soft Soils
Strategic Objectives and Policies
Flooding
Geothermal Hazards
Other: Natural feature and significant natural fwature and wet land changes.

Q2 **My submission is:**

Long Text

Oppose these rules

Q3 **What changes do you want made to the District Plan?**

Long Text

Remove natural feature and significant natural

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Jimmy Brown

Q8 **Do you wish to present your submission publicly in front of elected members at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Fault Rupture

Q2 **My submission is:**

Long Text

I am not supporting the proposal to subject future building work in FAZ buffers to Geotechnical and Structural Engineering assessments. Specifically related to the greater Ngakuru area. These assessments add significant cost to the land owner only. My land and its existing buildings have been inhabited safely for over 75 years. My property has had buildings on it since the 1950's . My house is Stucco plaster construction so if there had been any significant rupture activities causing a shift in the foundations, it would have clearly showed up as cracks in the plastered walls. This has not happened. Adding a requirements for these assessments does not make the land any safer. I would like to see an exemption granted to land owners that have long standing existing buildings on the property to replace buildings, parts of buildings, add new simple buildings, a granny flat or single-story structures within the FAZ, as long as it is not directly over the fault line. I have purchased this property in 2018 without these new proposals with future plans in my mind. with the current shortage of housing, we do not need further red tape when historical data shows that my property is not likely to have a problem. In the event of a massive catastrophic event, I am of the belief that we would all have much bigger problems to deal with than structural building issues with buildings erected after 2025.

It is good to note these FAZ's but do not restrict people from building a home or adjusting their home that has been standing for many decades.

These proposed changes will be accompanied by resource consent processes which add further consent burdens , delays and costs. All these costs add to red tape and stand in the way of progress without adding any level of safety to current occupiers of land.

I am very happy to have been informed of the fault lines and their location, but I don't need more restrictions related to it. If these faults were that dangerous, Nobody should be living anywhere close to any Geothermal, Geotechnical or other volcanic type of features. This is just not practical.

Q3 **What changes do you want made to the District Plan?**

Long Text

I have no problem with needing consent and reports for building over a fault line, but do not add this as a requirement for building in the FAZ. Do not implement the proposals for a requirement for a Geotechnical assessment and Structural engineering advice for building work and applications for building consent. Leave this as it is currently.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Roelof Corver

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Fault Rupture
Flooding

Q2 **My submission is:**

Long Text

We as land owners strongly oppose the Plan Change 8.
"FAULT RUPTURE"
The report stating that there is a fault rupture running the length of Acacia Road is inconclusive as far as we understand.
The limited evidence on the report we received is unacceptable with uncertain locations provided and unknown recurrence intervals, we believe it requires further investigation to establish if there is any risk to all property owners on Acacia and Pryce Roads. We think trenching will be the best way moving forward to help determine if the Berryman Report is warrantable.
This is soul destroying and nothing but an unnecessary worrying burden for all residents some of whom have had new builds completed in the past 12 months.
If this is adopted it will also affect our insurances and may even make our properties uninsurable.
More facts need to be completed before this goes any further.
"FLOODING"
We oppose the idea of introducing flood levels. The questions answered on the 19th of August at the meeting did not match what happened at the time of weather events and so answers were not informative and ambiguous to us. We don't understand this enough so would like an informative discussion before going forward. We agree with everything that Lake Okareka Community Association have submitted.

Q3 **What changes do you want made to the District Plan?**

Long Text

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Euan and Joanne Campbell

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Flooding
Fault Rupture

Q2 **My submission is:**

Long Text

Fault Rupture Hazard
There is insufficient data to inform accurate decision making on the level of risk from a fault rupture. The most recent investigation conducted on the Lake Okareka peninsula was an aerial mapping exercise. There are significant limitations to this kind of investigation
• The nature of the fault cannot be determined as it is masked by human habitation and natural foliage.
• It does not provide any information about the possible recurrence interval of earthquakes. Therefore the level of risk remains unknown.

Flooding Hazard
The proposed Council changes to flooding hazards at Lake Okareka are based on outdated data. The last review (2022) was based on data gathered from 1971 to 2020. Since 2021 the outlet has been able to manage a higher capacity of water due to the installation of an upgraded pipeline.
The minimal level of risk to properties is further underscored by the fact that during very high lake levels in 2017 only one property was adversely affected.

Q3 **What changes do you want made to the District Plan?**

Long Text

Fault Rupture Hazard Amendments
It is premature to change the District Plan based on incomplete and inadequate data. The Council must undertake an accurate and detailed scientific study of the designated area to determine the level of risk.

Flooding Hazard Amendments
It is premature to change the District Plan based on historical data which is out of date. The Council must not consider any changes until the next review is completed by the Bay of Plenty Regional Council, due in 2030.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Ann Hood

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Strategic Objectives and Policies
Fault Rupture

Q2 **My submission is:**

Long Text

Please see attached written submission

Q3 **What changes do you want made to the District Plan?**

Long Text

Please see attached written submission

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

https://participate.rotorualakescouncil.nz/download_file/2242

Q5 **Tō Ingoa | Name**

Short Text

Peter and Helen Weblin

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

Yes

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

SUBMISSION ON PROPOSED PLAN CHANGE 8 (NATURAL HAZARDS) TO THE ROTORUA DISTRICT PLAN

SUBMITTER: Peter and Helen Weblin
ADDRESS: 100A Okareka Loop Road, RD 5, Rotorua
DATE: 27 August 2025
CONTACT: Peter Weblin, [redacted]

Introduction

This submission is made by Peter and Helen, residents and owners of 100A Okareka Loop Road, on Proposed Plan Change 8 (Natural Hazards) (PC8) to the Rotorua District Plan.

Peter and Helen support the strategic intent of PC8 to adopt a modern, risk-based approach to the management of natural hazards. We however, believe, as the proposal stands, PC8 has failed in this strategic intent and additionally in its statutory obligations. Specifically we strongly oppose the provisions proposed for Fault Rupture. These provisions are based on flawed or incomplete information and when key information is not available, make highly conservative assumptions that have material, known economic consequences; essentially they will impose inequitable and unnecessary costs and restrictions on home owners. We seek amendments to these provisions to ensure a fair, evidence-based outcome.

Part 1: General Submissions on the Strategic Framework

1.1 Support for a Risk-Based Approach and Enhanced Resilience

We support the proposed strategic direction of PC8, particularly the amended strategic objectives SDNH-01 and SDNH-02. These objectives, which focus on ensuring the risks from natural hazards are "acceptable" and that development is "resilient to the current and future effects of climate change," represent a necessary evolution in planning practice. This risk-based framework aligns with the direction provided by the Bay of Plenty Regional Policy Statement and provides a sound basis for managing the complex natural hazard profile of the Rotorua District.

1.2 Conditional Support for the Use of Best Available Information

A central pillar of the proposed plan change is the removal of static hazard maps from the District Plan. The stated purpose is to allow for the use of the best and most up-to-date information when making decisions, rather than relying on maps that may become outdated. The GNS Active Faults Database is an example of a third-party system. LOCA strongly supports this principle in theory. A flexible planning framework that can adapt to new scientific understanding is essential for effective hazard management.

However, this support is conditional upon the principle being applied rigorously and consistently across all hazards. As this submission will demonstrate in detail in Part 2, the Council's proposed provisions for Fault Rupture at Lake Ōkāreka directly contradict this core principle. It proposes imposing definitive rules based on regional-scale mapping that has

been shown by more detailed, site-specific analysis to be highly uncertain. The definitive rules rely on highly conservative assumptions (e.g. seismic fault recurrence) that “fill in the gaps” of the incomplete and insufficiently robust information.

1.3 Support for a Consistent District-Wide Application

We support the proposal to apply a consistent set of natural hazard rules across the entire Rotorua District, thereby integrating the Lakes A Zone into the main framework of the District Plan. This move away from a Rotorua District/Lakes A Zone system, which applied different standards and methodologies, will improve clarity for plan users, enhance administrative efficiency, and potentially ensure a more equitable approach to risk management for all residents of the district.

Part 2: Specific Submission on Fault Rupture Hazards

2.1 The Proposed Changes and Their Impact on the Lake Ōkāreka Community

PC8 proposes to remove the outdated Fault Avoidance Overlay from the District Plan Geyserview maps and replace it with a new, defined "Fault Rupture Hazard Area".[1] The rules for building within this area (NH-R1 to NH-R3) are largely retained but will now apply to this newly defined area. The location of this area is to be identified primarily through the New Zealand Active Faults Database (NZAFD), which was updated for the Rotorua District in 2025 by GNS Science using high-resolution LiDAR data.

The proposed updated Fault Rupture Hazard Area approach results in the identification of a new Fault Avoidance Zone (FAZ) that directly affects many properties within the Lake Ōkāreka community, and in particular, our property on the corner of Okareka Loop and Summit Roads where no such hazard overlay existed previously in the District Plan. People have invested in this land, built a home on it and raised families (based on the land being fit-for-purpose, as provisioned in the Building Act).

The identification of this hazard will be included on Land Information Memoranda (LIMs), which can negatively impact property values, insurability, and the ability to secure financing.

2.2 Analysis of the Evidentiary Basis: Acknowledging Risk, Highlighting Uncertainty

The Council's proposal is based on the regional-scale GNS Science report (2025). However, subsequent to this report, a more detailed, site-specific assessment was undertaken by Berryman Research & Consulting Ltd (the Berryman Report). This report constitutes the best and most current available information for the specific locality of Acacia Road (and other localities) and it highlights the material deficiencies of the GNS-based information. These deficiencies apply to all sites that have not had further (usually in-field) investigations undertaken.

The faults in questions are currently recognised as having an "Unknown" recurrence interval in the GNS Active Faults Database. The Berryman Report suggests they could *potentially*

have a Class II recurrence interval (>2,000 to ≤3,500 years), but stresses that "it is unlikely that further investigation on this fault will provide a confident assessment of the recurrence interval" without subsurface investigation.

2.3 The Inequity of Imposing Definitive Controls Based on Incomplete Information

The core of our opposition rests on a fundamental principle of procedural fairness: it is inequitable and contrary to the principles of good administration to impose significant, value-destroying restrictions on private property based on evidence that is admittedly uncertain and incomplete. The scientific basis for the Council's proposed controls at Lake Ōkāreka is a **report that explicitly states the fault's location and activity are not well understood**. This creates a direct and unjustifiable link between uncertain science and certain, severe restrictions.

This approach places an unfair and onerous burden on landowners. They are effectively being penalised due to a lack of data, not because of a proven, quantified high risk. The Resource Management Act 1991 requires an evidence-based approach to planning. Where evidence is lacking, the appropriate response is to create a pathway to gather more evidence, not to impose the most restrictive outcome by default and shift the entire burden of proof onto the affected individuals.

2.4 Relief Sought

We support the relief sought in LOCA's submission on this matter.

In addition, we note:

1. Our property sits in a Rural zone (low population and dwelling density) with low inherent fault hazard risk (e.g. low risk of damage to property or health and safety).

2. Our property, (and that of our immediate neighbour 100 Okareka Loop Road), have highly restrictive covenants on their Titles; in particular the restriction of not being able to construct a second dwelling and highly restrictive hard-stand/site coverage maximums that effectively preclude any development.

3. Therefore any development or dwelling construction would require a thorough and very demanding Resource Consent application process prior to any building consent. This would provide ample opportunity for due process and additional assessment of fault risk/hazard in relation to any potential development.

We therefore propose that the recurrence period for the fault trace affecting our property be assigned a Class II recurrence interval (>2,000 to ≤3,500 years), rather than the more restrictive <2,000 year interval (which has been arbitrarily adopted in lieu of being currently "Unknown").

In this Rurally- zoned situation, this small amendment to PC8 would have no impact on Council's goal of appropriately managing natural hazards as dwelling and development is already highly constrained via the property(s) Titles. Furthermore, this proposal would prevent an arbitrarily and highly conservative assumption having

a disproportionately material negative impact on our (and potentially our neighbour's) property values, insurability and the ability to secure financing.

Map of proposed fault zones affecting 100A Okareka Loop Road, a Rurally zoned property with highly restrictive building and development covenants on its Title.

Yours sincerely,

Peter and Helen Weblin
100A Okareka Loop Road,
RD 5,
Rotorua 3076

File No: 25 12 00
Document No: 32817648
Enquiries to: Dawn Pritchard

Waikato Regional Council
Te Kaunihera ā Rohe o Waikato

Private Bag 3038
Waikato Mail Centre
Hamilton 3240, NZ

waikatoregion.govt.nz
0800 800 401

26 August 2025

Rotorua Lakes Council
Private Bag 3029
Rotorua 3046

Email: policy.planning@rotorualc.nz

Dear Sir/Madam

Waikato Regional Council Submission on Plan Change 8 to the Rotorua District Plan

Thank you for the opportunity to make a submission on Plan Change 8 to the Rotorua District Plan. Please find attached the Waikato Regional Council's (WRC's) submission regarding this plan change. This submission was formally endorsed by WRC's Strategy and Policy Committee on 21 August 2025.

Should you have any queries regarding the content of this document please contact Dawn Pritchard, Senior Policy Advisor, Policy Implementation directly on [redacted] or by email [redacted]

Regards,

Tracey May
Director Science, Policy and Information

HE TAIAO MAURIORA HEALTHY ENVIRONMENT
HE ŌHANGA PAKARI STRONG ECONOMY
HE HAPORI HIHIRI VIBRANT COMMUNITIES

Submission from Waikato Regional Council on Plan Change 8 to the Rotorua District Plan

26 August 2025

Introduction

1. Waikato Regional Council (WRC) appreciates the opportunity to make a submission on Plan Change 8 which addresses the management of natural hazards within the Rotorua District Plan. WRC's primary interest is in relation to the Waikato Regional Policy Statement (WRPS). District Plans, including plan changes such as this one, are required to give effect to the RPS (RMA s75(3)(c)).

2. We support the overall direction of the plan change and commend Rotorua Lakes Council for its efforts to improve resilience and risk based planning. Staff also appreciated being able to provide feedback at pre-notification stage.

3. The submission focuses specifically on provisions that relate to the identification, assessment and management of natural hazard risks, particularly in the rural areas within WRC's jurisdiction.

4. Below we provide some general comments, followed by specific comments in Table A on those provisions where we propose amendments or seek clarification.

General Comments

5. We commend the inclusion of new definitions and objectives that reflect a more risk-informed and adaptive planning framework. In particular, we support the move towards a threshold-based approach to hazard risk, consistent with the WRPS, and recommend this terminology be consistently applied throughout the plan.

6. We support removing hazard mapping from the district plan as this enables regular updates when new information becomes available. To improve transparency and certainty, the District Plan should clearly state that any primary hazard zones identified through updated mapping will be included or explicitly referenced.

7. We encourage Rotorua Lakes Council to adopt a holistic and precautionary approach to flood risk management by requiring risk assessments for all new developments, regardless of flood depth, and considering broader subdivision factors such as infrastructure, amenity and access.

8. We recommend strengthening climate change adaptation provisions in the plan, including support for short, medium and long term planning and clarifying the role of statutory and non-statutory guidance.

9. We seek greater transparency regarding technical thresholds used in the plan, such as permitting development within floodplains where flood depths are less than 300mm and recommend referencing NZS 4404 or other national standards to justify these figures.

10. We recommend further refinement to ensure alignment with best practice hazard management. High flood hazard zones are typically defined by a combination of flood depth and velocity, as both factors significantly influence risk to life, property and infrastructure. Relying solely on a depth-based threshold is likely to oversimplify the hazard and underestimate potential impacts in areas subject to fast-moving floodwaters.

Submitter details

Waikato Regional Council
Contact person: Dawn Pritchard (Policy Implementation)
[redacted]

Post: Private Bag 3038
Waikato Mail Centre
Hamilton 3240

I could not gain an advantage in trade competition through this submission
I am not directly affected by an effect of the subject matter of the submission that:
(a) does not adversely affect the environment; and
(b) does not relate to trade competition or the effects of trade competition.

11. Submission on Rotorua District Council's Proposed Plan Change 8

Table A:			
Provision	**Support/ Oppose**	**Submission**	**Relief sought**
1. Definitions			
Acceptable risk	Support in part	A definition has been added for "acceptable risk". We recommend replacing the term "low" with "minor", as "minor risk" better reflects a narrative describing the consequence of an environmental effect. In contrast, "low risk" may imply minimal impact and could be associated with probability of an occurrence.	Amend to "risk that is ~~low~~ minor, and the costs of further reducing risk are largely disproportionate to the benefits gained"
Fault Rupture Hazard Area	Support	We support this added definition.	Retain.
Overland flow path	Support	We support this added definition.	Retain.
Wildfire	Support	We commend the council on this added definition.	Retain.
2. Part 2: District Wide Matters – Strategic Direction – SDNH – Natural Hazards and Climate Change Resilience			
SDNH-01	Support	We support this amended objective. The intent aligns with the objective HAZ-01 in the Waikato Regional Policy Statement (WRPS).	Retain.
SDNH-02	Support in part	We support the emphasis on resilience in SDNH-02 but recommend that the objective also reference an adaptive approach, which enables flexible and responsive planning to address evolving climate conditions and emerging risks. This approach is aligned with local government authorities' requirement to 'have regard' to the National Adaptation Plan when preparing plans under the RMA.	Suggested re-wording "Land use, subdivision and development are resilient and adaptive to the current and future effects of climate change".
SDNH-P1	Oppose	We support the intent of SDNH-P1 to promote risk informed planning using the best available information. However, the revised policy omits any reference to adapting to changing risk. We recommend reinstating and strengthening references to adaptation planning, particularly in relation to changing climate risk. To achieve this, we suggest: a) adding a clause that supports short, medium and long term adaptation planning approaches for managing changing climate risk;	Include a clause in SDNH-P1 that supports short (next few years), medium (decades) and long term (future generations) adaptation planning to address changing climate risk. Suggested additional wording:

		b) clarifying the scope of "national and regional guidance" to confirm whether it includes non-statutory sources, such as the forthcoming WRC Climate Change Adaptation Guidelines; and c) strengthening Clause 3 by replacing "take into account" with a requirement to assess climate change impacts ensuring a more robust and accountable planning process. We consider these changes would better align with the National Adaptation Plan and WRPS policy HAZ-M3, while reflecting best practice in climate risk management. They would also treat adaptation as a proactive and structured process, rather than a passive consideration.	"Enable and support short, medium and long term adaptation planning approached to manage changing climate risks, ensuring that planning decisions remain responsive to evolving hazard information and future climate scenarios". Clarify the scope of "national and regional guidance" to confirm inclusion of non-statutory sources such as the forthcoming WRC Climate Change Adaptation Guidelines. Amend Clause 3 to require an assessment of climate change impacts, replacing "take into account" to strengthen accountability and robustness in planning. Suggested rewording: 3: "~~Take into account:~~ Assess and respond to: "
3. Hazards and Risks – Natural Hazards			
NH-PA	Oppose	We recommend amending NH-PA to require risk assessments for all new developments regardless of flood depth, to ensure alignment with the WRPS. An amendment will also enable consistency with emerging national direction. While not yet adopted, the National Policy Statement for Natural Hazards (NPS-NH) signals requirement for risk assessments for all consents. The proposed amended NH-PA wording applies a threshold-based approach requiring risk assessments only for areas with high flood depths. This approach risks underestimating hazards in areas with lower but still significant flood impacts and creates inconsistency across the region.	Amend NH-PA to require risk assessments for all new developments, regardless of flood depth, and at a minimum require consideration of: *i. the likelihood of a natural hazard event occurring;*

		To ensure decisions reflect actual risk rather than arbitrary thresholds, NH-PA should instead mandate risk assessments for all new buildings and significant additions. We also consider this is a potentially missed opportunity to align with the anticipated requirements of the NPS-NH and promote more consistent and informed planning. We recommend using the proposed wording of NPS-NH P1 (risk assessments) as a starting point – wording below: *When assessing natural hazard risk for an activity in planning and consenting, local authorities must consider:* *1) the likelihood of a natural hazard event occurring;* *2) the consequences of a natural hazard event for the activity;* *3) existing and proposed mitigation measures; and* *4) residual risk.* We also recommend expanding the scope of risk assessments under NH-PA to include more frequent flood events e.g. 10% AEP, and to consider the full subdivision context, including infrastructure and liveability. This approach supports adaptive planning and reflects the increasing frequency and severity of flooding due to climate change. The above recommended changes would strengthen NH-PA alignment with the precautionary approach of WRPS provisions HA-01, HAZ-P2 and WRC-M1, ensuring development only proceeds where flood risks are demonstrably acceptable.	*ii. the consequences of a natural hazard event for the activity;* *iii. existing and proposed mitigation measures; and* *iv. residual risk.* Remove the threshold based approach that distinguishes between low and high flood depths. Consider expanding the scope of risk assessments to include more frequent flood events and to take a more holistic approach by considering the full subdivision context, including infrastructure and liveability.
4. General			
NH-R4		Although no changes are proposed to Rule NH-R4, we question the rationale for permitting development within a floodplain where flood depth is less than 300mm without requiring a consent. The plan does not reference any technical assessments, modelling or national guidance to support this threshold. We seek a clear explanation of the evidence or guidance used to justify the 300mm criterion.	Clarify the rationale for the 300mm threshold, including reference to any supporting evidence or guidance used to determine this figure.
NH-R5, SDNH-P1 and SDNH-P2		We recommend amending Rule NH-R5 and relevant strategic policies to incorporate both flood depth and velocity in the classification of high flood hazard zones. Using only depth-based thresholds oversimplifies flood risk and may	Include additional hazard parameters such as flood velocity into the hazard framework to better reflect the nature of hazard zones to incorporate into a risk assessment.

		underestimate danger in areas with fast-moving water. Velocity is a critical factor influencing risk to life, property and infrastructure.	Suggested added wording to NH-R5: "Matters of Discretion a. The extent to which natural hazard risks, <u>including those arising from flood depth and velocity</u> are avoided or mitigated and the worsening of any hazard"

3.0 FURTHER INFORMATION AND HEARINGS

3.1 WRC **wishes to be heard** at the hearings for Plan Change 8 in support of this submission and is prepared to consider a joint submission with others making a similar submission.

3.2 WRC **could not** gain an advantage in trade competition through this submission.

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Strategic Objectives and Policies
Flooding
Fault Rupture

Q2 **My submission is:**

Long Text

These are documented in the attached letter to the council

Q3 **What changes do you want made to the District Plan?**

Long Text

1. That Plan Change 8 (flood risk) for Acacia Road, Lake Okareka be withdrawn or substantially amended to properly account for existing engineered risk controls at the lake and adopt a risk management approach consistent with AS/NZS ISO 31000:2018 standards.

2. That Plan Change 8 (fault avoidance zones) for Acacia Road be withdrawn or substantially amended pending further investigation into the location of the fault and its RI. The potentially significant impact to the properties along Acacia Rd and the potential to upgrade and/or alter these properties in future requires that the Council provide an evidence based approach to the proposed changes.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

https://participate.rotorualakescouncil.nz/download_file/2243

Q5 **Tō Ingoa | Name**

Short Text

Carol Rolando and Brian Richardson

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

Yes

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice

No

SUBMISSION ON PLAN CHANGE 8 (NATURAL HAZARDS) - LAKES A ZONE

Rotorua District Plan

Submitted by: Brian Richardson and Carol Rolando

Contact: [redacted]m

Property: 73 Acacia Road, Lake Ōkāreka

Date: 1 September 2025

CONTEXT

We are residents of a lakeside property at 73 Acacia Road where we have lived since December 2020

FLOODING RISK

(i) This submission opposes Plan Change 8 (PC8) as it applies to flood risk management at Lake Okareka on the grounds that it fundamentally misrepresents the current risk profile and fails to acknowledge the effective "remedy" provided by existing 'engineered risk controls'[1] i.e. the flooding risk at Lake Okareka has been substantially reduced through the Bay of Plenty Regional Council's engineered lake Outlet Control System implemented in 2021.

(ii) We fully support the detailed submission on Flooding Risk made by Neil Oppatt submitted 7th August 2025.

(iii) We are surprised that Council has based its flood mapping solely on rainfall modelling without accounting for the active lake level management. This reality not only misrepresents the actual risk profile but also creates unnecessary regulatory burden on ourselves and the established community while providing no meaningful additional protection.

RELIEF SOUGHT

That Plan Change 8 (flood risk) be withdrawn or substantially amended to properly account for existing engineered risk controls and adopt a risk management approach consistent with AS/NZS ISO 31000:2018 standards.

PERSONAL IMPACT

- Prior to purchasing this property in 2020, we made our own assessment of flooding risk, and it seemed clear that the Outlet Control System had effectively remedied what was already a low risk of flooding.
- The proposed PC8 is likely to negatively affect our property value and may potentially increase insurance costs or even decrease the likelihood of securing house insurance.

[1] Engineered risk controls are physical systems and in' flood risk management', examples include outlet pipelines, retention dams, floodgates, and spillways, which actively prevent or limit floods, rather than just relying on planning tools, alerts or recovery efforts afterward.

- Given these high potential impacts on affected rate payers, we are disappointed that Council has proposed PC8 without any discussion with potentially affected residents. Also, it is shocking that no account appears to have been taken of the lake Outlet Control System in the flooding risk analysis (considering that substantial flood modelling of lake levels was undertaken by Pattle Delamore Partners post-2021 Upgrades to the Outlet Control system). The whole point of this system was to overcome the risks associate with flooding!

ACTIVE FAULT MAPPING

This submission opposes the imposition of the proposed fault avoidance zone (FAZ) extending along the active fault mapped for Acacia Road on the grounds that there is, at this stage, too much uncertainty associated with the location of the fault (and subsequent FAZ) and designation of the fault as an active fault based on an expected recurrence interval (RI) (Berryman Report, July 2025).

Given the uncertainty around the location of the fault and its RI we cannot understand why the RLC would choose to allocate the most conservative RI (Class II), which could have significant consequences for property insurance and future value with little evidence to support these classifications.

Request

That Plan Change 8 (fault avoidance zones) be withdrawn or substantially amended pending further investigation into the location of the fault and its RI. The potentially significant impact to the properties along Acacia Rd and the potential to upgrade and/or alter these properties in future requires that the Council provide an evidence based approach to the proposed changes.

Overall we request that Plan Change 8 be withdrawn until at least more evidence to substantiate the proposed changes can be provided and that further consultation is undertaken with the affected community.

Sincerely

Carol Rolando and Brian Richardson

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice: Flooding

Q2 **My submission is:**

Long Text: See attached submission on pluvial flood modelling in relation to 72 Sophia St.

Q3 **What changes do you want made to the District Plan?**

Long Text: Remove flood layers from property further to submission.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload: https://participate.rotorualakescouncil.nz/download_file/2244

Q5 **Tō Ingoa | Name**

Short Text: Mitch Collins & Tamson Armstrong

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice: Yes

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice: No

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice: No

Submission to Rotorua Lakes Council: Request for Removal of Pluvial Flooding Hazard Layer at 72 Sophia Street (Lot 1 DPS 7304)

1.0 Introduction and Purpose of Submission

1.1 Identification of Property, Owners, and Subject Matter

This submission is made by Mitchell Collins and Tamson Armstrong, the owners of the property legally described as Lot 1 on Deposited Plan DPS 7304, located at the address; 72 Sophia Street, Glenholme, Rotorua.

The subject of this submission is the pluvial flooding hazard layer recently applied to the property as part of the Council's Western Catchment Flood Hazard Mapping initiative. This hazard layer, as depicted in the Council's public-facing GIS system, indicates a significant portion of the property, as seen below in Figure 1., is subject to inundation in a 1% Annual Exceedance Probability (AEP) storm event, projected for a 2100/2130 climate change scenario (IPCC RCP 8.5).

1.2 Formal Request

The property owners formally request that the Rotorua Lakes Council (the Council) take immediate action to completely and permanently remove the aforementioned pluvial flooding hazard layer from the property at 72 Sophia Street (Lot 1 DPS 7304). This removal should be reflected in all Council planning maps, GIS databases, and any associated records used for the generation of Land Information Memorandum (LIM) reports.

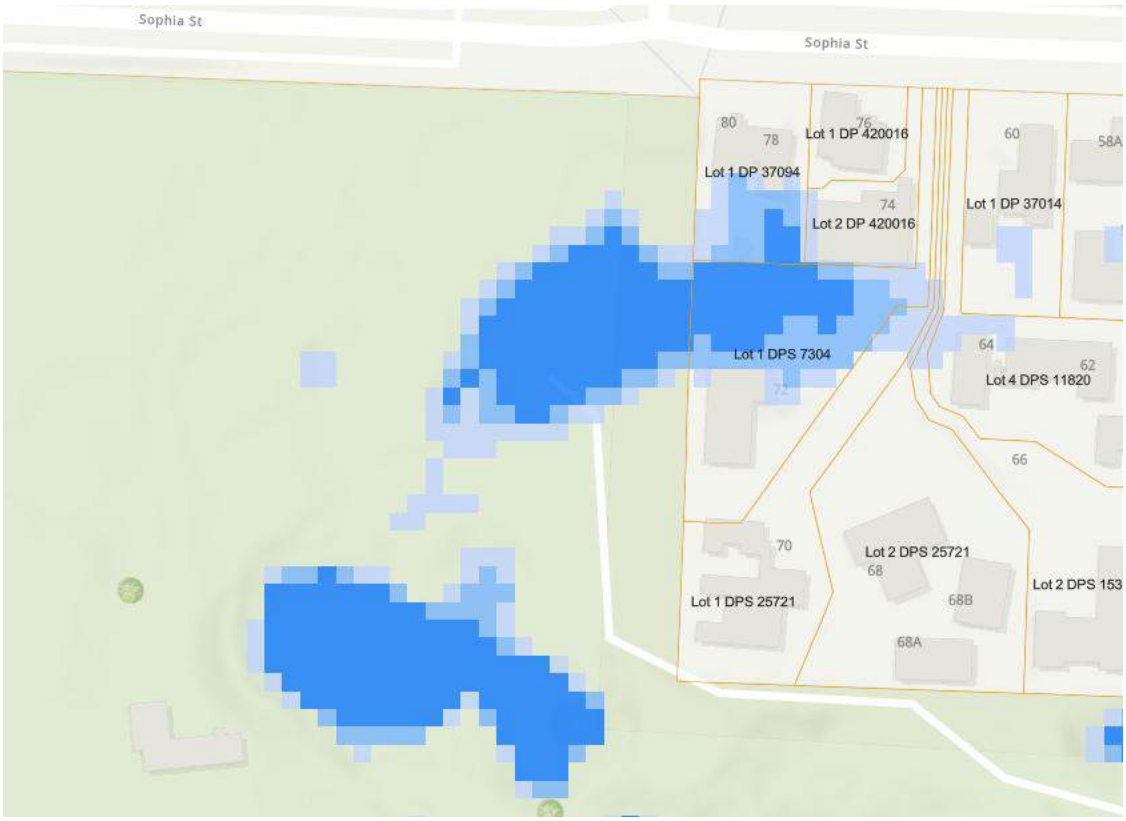


Figure 1. Pluvial Flooding shown utilising topographic data from RLC Plan Change 8 website.

1.3 Summary of Argument

This submission will demonstrate, through comprehensive and site-specific evidence, that the pluvial flooding hazard layer as applied to 72 Sophia Street is demonstrably inaccurate, misleading, and legally untenable.

The core of the argument is that the hazard layer is derived from a generic, city-wide flood model that relies on outdated topographical data from a 2020 LiDAR survey[1]. This data captures the property in its pre-development state and fails to account for subsequent, significant, and Council-approved engineering works. These works, mandated as part of a comprehensive subdivision consent process (SD19-016607.A001), are specifically designed to mitigate the very pluvial flooding risk the Council now seeks to map.

It will be established that the legally recognized 'consented environment'—which includes raised and engineered building platforms, a designed stormwater swale, and on-site soakage systems—constitutes the only correct and factual baseline for any hazard assessment of the property. This site-specific,

[1] Tonkin & Taylor Ltd. (2025, March). *Western Catchment Flood Hazard Mapping: Model Build Report* (Job No. 1010988.9400 v2.0). Prepared for Rotorua Lakes Council.

consented future state, which is supported by detailed engineering analysis and secured by a binding Consent Notice registered on the property title, proves that the hazard as mapped by the Council does not exist in the environment that is legally required to be constructed. The continued application of this inaccurate hazard layer is not only technically flawed but also places the Council in breach of its duty of care to provide accurate information on LIMs, exposing it to legal liability.

2.0 The Correct Baseline for Assessment: The 'Consented Environment'

Any accurate assessment of natural hazard risk must be based on the legally established and approved future state of the property. For 72 Sophia Street, this is the 'consented environment' established through the rigorous process of a resource consent for subdivision.

2.1 The Legal Status of Subdivision Consent SD19-016607.A001

On 20 November 2019, the Council granted consent for a subdivision of Lot 1 DPS 7304. A subsequent variation was approved on 13 March 2024.[2] This consent process was not a mere administrative step; it was a formal procedure under the Resource Management Act 1991 (RMA) that identified potential environmental effects, including stormwater and flooding, and mandated specific, engineered solutions to mitigate them. The culmination of this process is the Consent Notice registered against the titles of the newly created Lots 1 & 2 on DP 609634. This notice is a legal instrument under Section 221 of the RMA that binds the current and all subsequent owners to a set of conditions, thereby creating a permanent and legally enforceable requirement for the land's future characteristics and management.

The Council's decision to grant this consent represents its formal acceptance that the engineering solutions proposed were sufficient to manage the identified risks to an acceptable level. By now applying a hazard layer based on the pre-mitigation state of the land, the Council is in a position of direct contradiction. It is effectively disregarding its own prior, legally binding decision that the flood risk will be appropriately managed. This action undermines the certainty and integrity of the Council's consenting process, creating a situation where a landowner who is legally bound by Council requirements to mitigate a hazard is nevertheless penalized as if no mitigation was ever planned or approved.

[2] Rotorua District Council. (2024, October 8). *Consent Notice Pursuant to Section 221 of the Resource Management Act 1991* (Subdivision Consent SD19-016607.A001).

2.2 Legally Mandated Flood Mitigation Works

The Consent Notice for SD19-016607.A001 contains several specific, legally binding conditions that define the property's flood-resilient 'consented environment'. These are not optional guidelines but mandatory requirements that will physically transform the site.

Most critically, condition (d) of the Consent Notice states:

> "The catchment and overland flow analysis undertaken by Cheal Consultants as part of the subdivision application has identified that over areas I, B, F, & G is an overland flow path and is consequently considered at risk of flooding during significant rainfall events. The minimum building platform level of any future habitable building shall be constructed above RL301.12 (Moturiki Datum 1953) in general accordance with Cheal Consultants Engineering Service Report (18165, revision 1, September 2018)." [3]

This condition directly addresses the 1% AEP flood risk. The specified level of RL 301.12m was not arbitrary; it was precisely calculated in the supporting Cheal Consultants report to provide a 500mm freeboard above the modelled peak water level in a 1% AEP storm event, consistent with the requirements of the Building Code.

Furthermore, condition (c) of the notice mandates that the overland flow path "shall be maintained free from any obstructions to ensure there is no increase in flood hazard risk to the site or adjoining properties".[1] This ensures the engineered stormwater conveyance system will remain functional in perpetuity. Condition (b) requires that all stormwater runoff from roofs and hard surfaces for a 10% AEP storm event "must be disposed of on-site" through soakage, reducing the volume of water entering the overland flow path during more frequent rainfall events and preserving its capacity for extreme events.

2.3 Consented Future State vs. Superseded Data

While the substantial physical earthworks required to implement these consent conditions are yet to be completed, they are legally mandated. The Sigma Consultants Geotechnical Report (1224.3) confirms that significant ground improvement, including undercutting of soft soils and the placement of engineered, compacted fill, will be necessary to create the stable, raised building platforms required by the consent.[4] Already, the grassed swale has been constructed to Council acceptance and shown in Figure 2.

---

[3] Cheal Consultants Limited. (2018, September 10). *Engineering Services Report: 72 Sophia Street, Glenholme, Rotorua* (Ref. 18165 Rev.1).
[4] Sigma Consultants Ltd. (2019, September 22). *Geotechnical report: 72 Sophia Street, Rotorua* (Report No. 1224.3).

Figure 2. Grassed swale drain (shaded area) installed to consent conditions.

These mandated engineered earthworks will fundamentally and permanently alter the site's topography from the natural state that was captured by the Council's 2020 LiDAR survey. The Council's model, therefore, is simulating rainfall on a version of the property that will legally cease to exist once development proceeds. The correct baseline for any hazard assessment is the consented future ground level, which incorporates the raised platforms and the formed stormwater swale. This 'consented environment' is the factual and legal reality that must be considered for 72 Sophia Street.

3.0 Analysis of Site-Specific Engineering as the Best Available Information

Under the RMA, Council decisions must be based on the best available information. In the case of 72 Sophia Street, the Council is in possession of two distinct sets of information: a generic, regional-scale model and a suite of detailed, property-specific engineering assessments. A direct comparison demonstrates the incontrovertible superiority of the site-specific evidence.

3.1 Cheal Consultants Engineering Services Report (18165 Rev.1)

The Cheal report provides a detailed, first-principles analysis of the specific hydrological conditions at 72 Sophia Street.[5] The report begins by correctly identifying the site's natural vulnerability, noting that the "northern half of the proposed subdivision is located within the head of a shallow gully" and that during heavy rain events, "ponding extends into the northern half of the subdivision area".[1] This confirms the hazard was not overlooked but was the primary driver for the engineering design.

Crucially, Cheal Consultants then undertook specific stormwater modelling for the site's contributing catchment to quantify the risk in a 1% AEP storm event. This analysis, far more specific than the Council's city-wide model, calculated a peak runoff through the property of 0.37 m^3/s and a maximum flow depth of 0.45m within the engineered grass swale. It was from this precise, site-specific calculation that the report derived the required minimum floor level of **301.12m RL** to ensure all future dwellings would remain safely above the 1% AEP flood level, including a 500mm freeboard. This is a definitive engineering solution to a quantified problem, approved by Council.

3.2 Sigma Consultants Geotechnical Report (1224.3)

The physical works required to achieve the flood-safe levels specified by Cheal are detailed in the Sigma Geotechnical Report.[6] The report identified soft and liquefiable soils, concluding that the site did not meet the definition of 'good ground' under NZS 3604:2011.[1, 1] Consequently, it mandates extensive ground improvement works.

For the new lots, this includes undercutting existing ground and constructing a reinforced soil raft using "1m of well compacted fill" and multiple layers of geogrid. This report provides evidence that ground levels are to be substantially and deliberately raised as part of the subdivision construction.

---

[5] Cheal Consultants Limited. (2018, September 10). *Engineering Services Report: 72 Sophia Street, Glenholme, Rotorua* (Ref. 18165 Rev.1).
[6] Sigma Consultants Ltd. (2019, September 22). *Geotechnical report: 72 Sophia Street, Rotorua* (Report No. 1224.3).

3.3 Table 1: Comparison of Hazard Assessment Methodologies

The following table provides a direct comparison between the Council's modelling approach and the site-specific evidence provided in this submission.

Feature	Rotorua Lakes Council Model (Tonkin + Taylor)	Site-Specific Assessment (Cheal/Sigma/Consent)
Data Source	LiDAR-derived Digital Elevation Model (DEM)	On-site geotechnical testing (CPT, Scala, augers), topographical survey.
Data Vintage	2020 (pre-development)	2018-2019, defining a legally mandated future state (reiterated in 2024).
Scale	"City-wide" Catchment	Property-specific (Lot 1 DPS 7304).
Ground Levels	Pre-development natural topography.	Mandated post-development, raised, and engineered 'consented environment'.
Mitigation	Not accounted for.	Engineered grass swale, raised building platforms (RL 301.12m), on-site soakage.
Legal Status	General information layer for guidance.	Legally binding conditions on property title via Consent Notice.

4.0 Critical Review of the Council's Pluvial Flood Model

The argument against the hazard layer does not rest solely on the strength of the site-specific evidence, but also on the acknowledged weaknesses and explicit limitations of the Council's own model. The Tonkin + Taylor Model Build Report itself contains clear guidance that precludes its application in this specific instance.

4.1 Acknowledged Limitations of the Western Catchment Model

The model's creators, in line with professional engineering practice, clearly documented the tool's limitations to prevent its misapplication. The Council's use of the model for 72 Sophia Street disregards this expert guidance.

Section 2.2 of the Tonkin + Taylor report states unequivocally:

> "Where ground levels have been changed since the LiDAR survey was captured, the DEM and hence the model will not recognise these changes and will be out of date." [7]

This sentence is a precise and literal description of the situation at 72 Sophia Street, where consented earthworks will render the 2020 LiDAR data obsolete.

Furthermore, Section 2.1 of the report provides a direct instruction on the model's appropriate use for property-specific decisions:

> "...if development levels are required at a property specific scale... model results should be used in conjunction with a more detailed site specific assessment." [8]

The Council's action is a procedural failure; it has applied the model's coarse output in isolation, failing to use it "in conjunction with" the detailed, site-specific assessment it already possesses in its own consent file for the property. This is not a reasonable application of the model; it is a direct contravention of the methodology recommended by the Council's own consultants.

4.2 Inapplicability to 72 Sophia Street

The model's inaccuracies for this site are compounded by other factors. The Tonkin + Taylor report notes a limitation of its direct rainfall methodology is that it cannot practically model "every private drainage and roof collection system". The property at 72 Sophia Street is adjacent to the Rotorua Golf

[7] Tonkin & Taylor Ltd. (2025, March). *Western Catchment Flood Hazard Mapping: Model Build Report* (Job No. 1010988.9400 v2.0). Prepared for Rotorua Lakes Council.
[8] Ibid.

Course, and its drainage is influenced by multiple cesspits and stormwater drain located on the golf course, which are not part of the Council's network and are therefore not included in the model. This introduces a further, un-quantified error into the model's simulation for this specific location. Figure 3 shows a broad plan of stormwater infrastructure. Figures 4, 5 and 6 below show the location of this infrastructure.

Figure 3. Plan view broadly showing existing stormwater controls unaccounted for in Council Pluvial Flood Report

Figure 4. Location of drain infrastructure on adjacent golf course not taken into consideration

Additionally, the property is not situated within any of the specifically detailed urban catchments (such as the nearby Catchment 8) for which more granular network data including Council infrastructure was made available. This means the model's resolution and accuracy at this fringe location are inherently lower than in other parts of the city. The property at 72 Sophia Street falls squarely into every category of limitation and uncertainty outlined by the model's own creators, making the application of its outputs to this property inappropriate and unreliable.

Figure 5. Two stormwater drains shown in Figure 3.

Figure 6. One other stormwater drain from Figure 3.

Figure 7. Stormwater outlet downstream (south) of the catchment

5.0 Planning and Legal Framework: The Primacy of Site-Specific Evidence

The requirement to prefer detailed, site-specific information over generalized mapping is a core principle of New Zealand's resource management law. The Council's decision to apply the hazard layer is inconsistent with its statutory obligations under the RMA, its own emerging policy direction, and established legal precedent regarding its duty of care.

5.1 The Principle of 'Best Available Information' under the RMA

Section 32 of the RMA requires that when preparing or changing plans, a council must carry out an evaluation that assesses the appropriateness of provisions in achieving the purpose of the Act. This evaluation must be based on the best available information. This principle ensures that planning decisions are robust and evidence-based.

The Council's own Proposed Plan Change 8 (Natural Hazards) explicitly embraces this principle. The key proposals for flooding state an intention to "Use the Best Flood Information (Not Static Maps)". The proposed strategic policy SDNH-P1 requires the Council to "[u]se the best available information, including relevant national and regional guidance" when assessing natural hazard risks. This submission is simply asking the Council to adhere to its own stated best-practice policy. The best available information for 72 Sophia Street is not the 2020 regional model, it is the comprehensive file of certified engineering reports and the legally binding Consent Notice held within the Council's own records.

5.2 Precedent: Tauranga City Council and the Primacy of Site-Specific Data

A highly relevant precedent regarding the application of broad hazard maps versus site-specific data arose from Tauranga City Council's implementation of its Plan Change 27. Following the introduction of updated flood modelling, the Council faced a legal challenge in the Environment Court, led by the Urban Task Force (UTF), a group representing local property owners and developers.[9]

The core of the UTF's case was that the new flood hazard maps were inaccurate, did not reflect the most current data, and failed to adequately consider recent private sector mitigation efforts. They argued that the blanket application of these flawed, broad-scale maps would unjustifiably devalue properties and hinder development. The legal challenge was ultimately settled through mediation, resulting in significant concessions from the Tauranga City Council. The Council agreed to a more flexible and

[9] New determination on natural hazard notices under the Building Act: a higher threshold established? - Simpson Grierson, accessed on August 14, 2025, https://www.simpsongrierson.com/insights-news/legal-updates/new-determination-on-natural-hazard-notices-under-the-building-act-a-higher-threshold-established

responsive approach, including a key commitment to allow for site-specific technical assessments to override the council's broader, indicative maps. The resolution emphasized a collaborative approach to risk reduction rather than one based solely on restricting activities based on potentially inaccurate, generalized data.

This case establishes a clear precedent. It demonstrates that when a council is presented with credible, site-specific evidence that contradicts its generalized hazard mapping, the appropriate and legally defensible response is to prioritize the superior, detailed information. The situation at 72 Sophia Street is a direct parallel; the Council's coarse model is being challenged by detailed, consented engineering plans that constitute the best and most relevant information for the property.

5.3 Weight of Evidence in Resource Management Case Law

The Environment Court has consistently held that while broad-scale hazard maps serve a useful function as a preliminary screening tool, they are not immutable. Such maps can be challenged and superseded by more detailed, credible, and site-specific evidence. Where a landowner provides robust, expert evidence demonstrating that a mapped hazard does not apply to their property as depicted, or has been adequately mitigated, the site-specific evidence must be given greater weight.

A highly relevant precedent is the MBIE determination regarding a property in Tauranga, often cited in relation to the *Challenger v Tauranga City Council* case.[8] In that matter, the council sought to place a natural hazard notice on the title of a property located in a known overland flowpath. The property owner challenged this, providing evidence that their stormwater system was engineered to manage a 1% AEP storm event. MBIE determined that a hazard notice was not required. It found that while inundation of non-habitable areas (like driveways and underfloor spaces) might still occur, the owner had made "adequate provision" to protect the building and land from material damage. The key distinction was between temporary inundation and actual damage. This provides a direct parallel to 72 Sophia Street, where the entire development has been engineered to the same 1% AEP standard to prevent material damage to habitable buildings by raising them significantly above the modelled flood level.

5.4 Council's Duty of Care Regarding Land Information Memoranda (LIMs)

The Council's responsibility extends beyond planning principles to a direct, legally established duty of care. The Supreme Court decision in *Marlborough District Council v Altimarloch Joint Venture Ltd* is the leading authority on this matter.[10] This case unequivocally established that councils owe a duty of care

[10] Marlborough District Council v Altimarloch Joint Venture Limited and Ors - SC 33/2010, accessed on August 14, 2025, https://www.courtsofnz.govt.nz/cases/marlborough-district-council-v-altimarloch-joint-venture-limited-and-ors

to purchasers who request and rely on the information contained in a LIM. A council can be held liable in negligence for errors, omissions, or misstatements in a LIM.[11]

This precedent creates a significant legal risk for the Council in this situation. The initial application of a hazard layer based on a new model could be seen as a reasonable administrative action. However, upon receiving this submission, the Council is now in possession of overwhelming, expert evidence demonstrating the layer's inaccuracy for this specific property. To ignore this evidence and continue to knowingly include the inaccurate hazard information on future LIMs for 72 Sophia Street would transition from a potential oversight to a knowing misstatement. This would constitute a clear breach of the duty of care established in *Altimarloch*, exposing the Council and its ratepayers to the risk of legal action for any loss in property value or other damages incurred by the owners as a result of the misleading information.[12] The path of least legal risk for the Council is not to maintain the inaccurate status quo, but to accept the superior, site-specific evidence and correct its records accordingly.[13]

[11] Marlborough District Council v Altimarloch Joint Venture Ltd [2012] NZSC11 | Hesketh Henry, accessed on August 14, 2025, https://www.heskethhenry.co.nz/insights-opinion/marlborough-district-council-v-altimarloch-joint-venture-ltd-2012-nzsc11/
[12] Supreme Court examines interplay of contractual and tortious liability (published on 18 December 2012) - Wilson Harle, accessed on August 14, 2025, https://www.wilsonharle.com/publications/supreme-court-examines-interplay-of-contractual-and-tortious-liability
[13] What the LIM cases have taught us - FRANA DIVICH - Heaney & Partners, accessed on August 14, 2025, http://heaney.livemode.nz/assets/Uploads/News-PDFs/d063fe12ee/What-the-LIM-cases-have-taught-us.pdf

6.0 Conclusion and Formal Request for Action

6.1 Summary of Findings

The pluvial flooding hazard layer applied to 72 Sophia Street (Lot 1 DPS 7304) is factually incorrect and procedurally flawed. This submission has demonstrated through extensive evidence that:

1. **The 'Consented Environment' is the Only Valid Baseline:** The property has been subject to a formal subdivision consent (SD19-016607.A001) that mandates specific, engineered flood mitigation works, including raising building platforms to a minimum level of RL 301.12m. This legally established and required future state is the only correct basis for hazard assessment.
2. **The Council's Model is Inapplicable:** The Council's flood model is based on superseded 2020 LiDAR data. The model's own technical report explicitly states that it will be "out of date" for properties with subsequent ground level changes and that it should not be used for property-specific decisions without a detailed site assessment.
3. **Site-Specific Engineering is the Best Available Information:** Detailed hydrological and geotechnical reports from Cheal Consultants and Sigma Consultants provide a granular, property-specific analysis confirming that the flood risk has been identified, quantified, and engineered to a 1% AEP standard, a conclusion endorsed by the Council through the granting of the resource consent.
4. **Legal and Planning Principles Require Correction:** The principles of the RMA, the Council's own policy direction, and established case law all dictate that the best available, site-specific evidence must be preferred over generalized mapping. Furthermore, the Council has a legal duty of care to ensure the accuracy of information on LIM reports, and the continued inclusion of this known inaccuracy would expose the Council to liability.

6.2 Reiteration of Request

In light of the overwhelming evidence presented, the owners of 72 Sophia Street formally request that the Rotorua Lakes Council take immediate action to remove the pluvial flooding hazard layer from all records, maps, and GIS systems associated with the property (Lot 1 DPS 7304).

It is further requested that the Council provide written confirmation to the owners that this corrective action has been completed, ensuring that all future Land Information Memorandum reports for the property will accurately reflect its consented, flood-mitigated status.

Appendices

1. **Copy of Resource Consent**
2. **Cheal Report**
3. **Sigma Report**
4. **Map of Modelled Flood Catchments**

CONSENT NOTICE PURSUANT TO SECTION 221 OF THE RESOURCE MANAGEMENT ACT 1991

IN THE MATTER of Lots 1 & 2 DP 609634

AND

IN THE MATTER of Subdivision Consent SD19-016607.A001 pursuant to Sections 34A, 37, 104, 104B, 108, 127, 220 and 221 of the Resource Management Act 1991.

Subdivider: M Collins & T Armstrong

Locality: 72 Sophia Street, Glenholme, Rotorua

On 20 November 2019, the Rotorua District Council granted consent to a subdivision of Lot 1 DPS 7304. A subsequent variation to the subdivision consent was approved on 13 March 2024 subject to a condition which requires the registration of the following as a consent notice against the title of Lots 1 & 2 DP 609634.

The owners and subsequent owners of Lots 1 & 2 DP 609634 are advised of the following:

a) That the geotechnical investigation undertaken by Sigma Consultants as part of the subdivision process has identified that the soils found on-site do not meet the definition of 'good ground' as specified by NZS3604:2011 due to soft surficial soils, liquefiable soils and potential geothermal activity. Therefore, ground improvement and a specific engineered foundation design is required by a suitably qualified chartered professional engineer for any future dwelling in general accordance with the recommendations of Sigma Consultant's Geotechnical Report (1224.3, September 2019).

   An alternative specific foundation design would be accepted if its suitability is demonstrated by further specific geotechnical investigation and assessment undertaken by a geoprofessional and submitted in conjunction with a building consent application to the satisfaction of the General Manager Infrastructure, Rotorua District Council or their delegate.

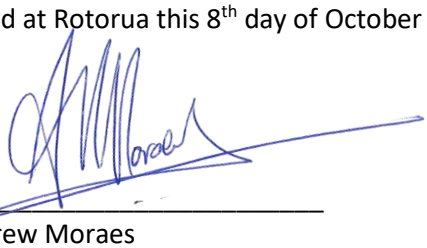
b) That all stormwater runoff from the roof of any future building and any impermeable hard standing surfaces resulting from a 10% AEP (10 year) storm event must be disposed of on-site in general accordance with Cheal Consultants Engineering Service Report (18165, revision 1, September 2018) and shall be designed by a suitably qualified engineer to the satisfaction of the General Manager Infrastructure, Rotorua District Council or their delegate.

   An alternative stormwater design would be accepted if its suitability is demonstrated by a suitably qualified chartered professional engineer and submitted in conjunction with the building consent application to the satisfaction of the General Manager Infrastructure, Rotorua District Council or their delegate.

c) That over areas I, B, F, & G is an overland flow path and therefore shall be maintained free from any obstructions to ensure there is no increase in flood hazard risk to the site or adjoining properties to the satisfaction of the General Manager Infrastructure, Rotorua District Council or their delegate.

d) That the catchment and overland flow analysis undertaken by Cheal Consultants as part of the subdivision application has identified that over areas I, B, F, & G is an overland flow path and is consequently considered at risk of flooding during significant rainfall events. The minimum building platform level of any future habitable building shall be constructed above RL301.12 (Moturiki Datum 1953) in general accordance with Cheal Consultants Engineering Service Report (18165, revision 1, September 2018).

Dated at Rotorua this 8th day of October 2024.



Andrew Moraes
Chief Executive / Authorised Officer

SIGMA
Engineers | Architects | Planners

Sigma Consultants Ltd

Geotechnical report

72 Sophia Street, Rotorua

Report Number: 1224.3

Project Number: 1224

22 September 2019

Sigma Consultants Ltd
1281 Hinemoa St
P. O. Box 553
Rotorua, 3040
P +64 7 347 3456
F +64 7 347 3459
office@sigmaconsult.co.nz

Document History and Status

Revision number	Changes Made / description	By	Date
1	Issued for information	TS	2017-10-15
2	Subdivision submission	APT	2019-08-09
3	Revised - Council Comments	APT	2019-09-06
4	Gravel raft tweaked	APT	2019-09-22

Contents

List of Figures

List of Tables

1 Scope of Report

Sigma Consultants Ltd has been engaged to provide a Geotechnical Report for Barry and Judy Hanna to support an application for subdivision consent at 72 Sophia Street, Lot 1 DPS 7304.

2 Site Description

The site is accessed via a right of way from Sophia Street. There is a lower level to the north, with a garage, at the lower level, and the existing house occupying a higher bench on the site. To the West is the Rotorua Golf course. Some of the nearby area is geothermally active, with comment below on potential geothermal impacts and mitigation.

Figure 1: Site Plan

3 Soil Type and Geological History

Dellow 'Distribution and identification of Soft Soils' (2010) shows the soils locally to be Huka Group Sediments and Hinuera Formation. These sediments were formed in a range of environments. Sediments with soft and very soft strengths of the time of formation have consolidated over time and are now likely to meet the requirements for being defined as good ground as per NZS 3604:2011

Leonard et al. (2010) shows the area as Late Pleistocene river deposits and described as Cross-bedded pumice sand, silt and gravel with interbedded peat.

Landcare, SMAP shows the soils as Ngakuru soil series occur on easy rolling, rolling and hill country, chiefly south of Rotorua. The soils are formed from shallow patchy Taupo Tephra overlying weathered rhyolitic tephra on ignimbrite. Soil profiles have black sandy loam overlying brown and yellowish-brown sandy loam on yellowish-brown sand. The soils are classified as Typic Orthic Allophanic Soils and occur under 1400 to 1700 mm annual rainfall. Soil texture is loam over sand. Ngakuru sandy loam occurs on undulating to rolling country while Ngakuru hill soils are on moderately steep slopes. The latter has less tephra overlying ignimbrite.

4 Soils Testing

Eight scala tests and eight hand augers were undertaken, as shown in Figure 1 above. Graphs of inferred ultimate bearing capacity are attached. Values of ultimate bearing capacity were inferred from Scala penetration rates using Stockwell's correlation Stockwell et al. (1977). They are nominal values, and need to be adjusted to take account of saturation, depth of cover and footing size to determine design bearing capacity at any particular depth.

Tables summarising the found soils are below:

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.2	
SAND	0.2 - 0.8	125.0kPa
SAND	0.8 - 1.3	175.0kPa
SAND	1.3 - 2	275.0kPa
SAND	2 - 2.7	375.0kPa

Table 1: Summary of Test 1

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.3	
SAND	0.3 - 1.3	125.0kPa
SAND	1.3 - 1.5	375.0kPa
SAND	1.5 - 2.7	325.0kPa

Table 2: Summary of Test 2

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.3	
SAND	0.3 - 0.8	125.0kPa
SAND	0.8 - 1.1	25.0kPa
SAND	1.1 - 1.3	100.0kPa
SAND	1.3 - 1.5	150.0kPa
SAND	1.5 - 2.7	250.0kPa

Table 3: Summary of Test 3

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.5	
SAND	0.5 - 0.8	100.0kPa
SAND	0.8 - 1.5	125.0kPa
SAND	1.5 - 2	275.0kPa
SAND	2 - 2.7	500.0kPa

Table 4: Summary of Test 4

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.2	
SAND	0.2 - 0.6	25.0kPa
SAND	0.6 - 1.4	100.0kPa
SAND	1.4 - 2	250.0kPa
SAND	2 - 2.7	500.0kPa

Table 5: Summary of Test 5

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.25	
SAND	0.25 - 1.8	100.0kPa
SAND	1.8 - 2.7	700.0kPa

Table 6: Summary of Test 6

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.25	
SAND	0.25 - 1.5	125.0kPa
SAND	1.5 - 2	225.0kPa
SAND	2 - 2.3	200.0kPa
SAND	2.3 - 2.7	375.0kPa

Table 7: Summary of Test 7

Soil Description	Depth	Average Capacity (Stockwell)
Topsoil	0 - 0.4	
SAND	0.4 - 0.9	25.0kPa
SAND	0.9 - 1.9	200.0kPa
SAND	1.9 - 2.2	200.0kPa
SAND	2.2 - 2.7	500.0kPa

Table 8: Summary of Test 8

5 Liquefaction and lateral spread

A CPT test was undertaken in the platform shown in Figure 1 above. Peak ground accelerations were calculated as per MBIE (2016), with a soil Class D.

C10k = 0.39
f = 1.0
R = 0.25 (for SLS)
R = 1 (for ULS)
$a_{max} = C_{0,1000}\frac{R}{1.3}fg$
This produces peak ground accelerations of 0.07g in the SLS and 0.3g for ULS events.
NZS 1170 3.2 “Design Requirements” defines the limit states as follows:

(a) To withstand extreme or frequently repeated actions, or both, occurring during its construction and anticipated use (resistance, deformability and static equilibrium requirements; that is, for safety). Specifically, for earthquake actions for ultimate limit states this shall mean—
(i) avoidance of collapse of the structural system;
(ii) avoidance of collapse or loss of support of parts of the structure representing a hazard to human life inside and outside the structure or parts required for life safety systems; and
(iii) avoidance of damage to non-structural systems necessary for the building evacuation procedures that renders them inoperative.
(b) So that it will not be damaged to an extent disproportionate to the original cause, by events like fire, explosion, impact or consequences of human error (robustness requirement).
(c) To perform adequately under all expected actions (serviceability requirement).

Liquefaction analysis was undertaken using the method set out in Boulanger and Idriss (2014), and settlements calculated from Zhang et al. (2002)[1].

This shows settlements in the ULS and SLS events as per the plots below.

The SLS earthquake produces a settlement of approximately 0mm.

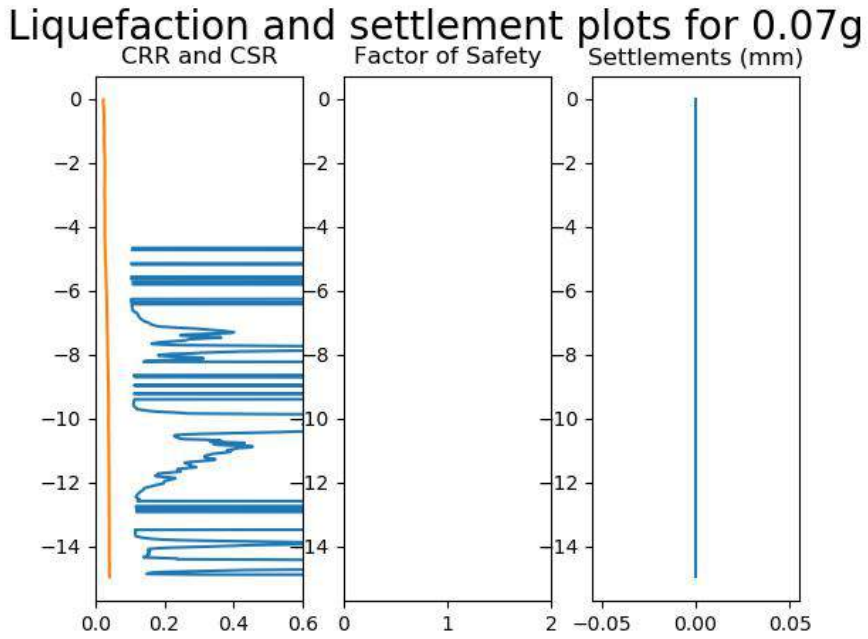


Figure 2: SLS Settlement Graph - CPT 1

The ULS earthquake produces a settlement of approximately 75mm.

[1] Python scripts, developed by Sigma Consultants Ltd, were used to produce the predicted settlements. The libraries have been posted on a public forum, and can be found at https://github.com/atokelove/liquefactionLibraries.

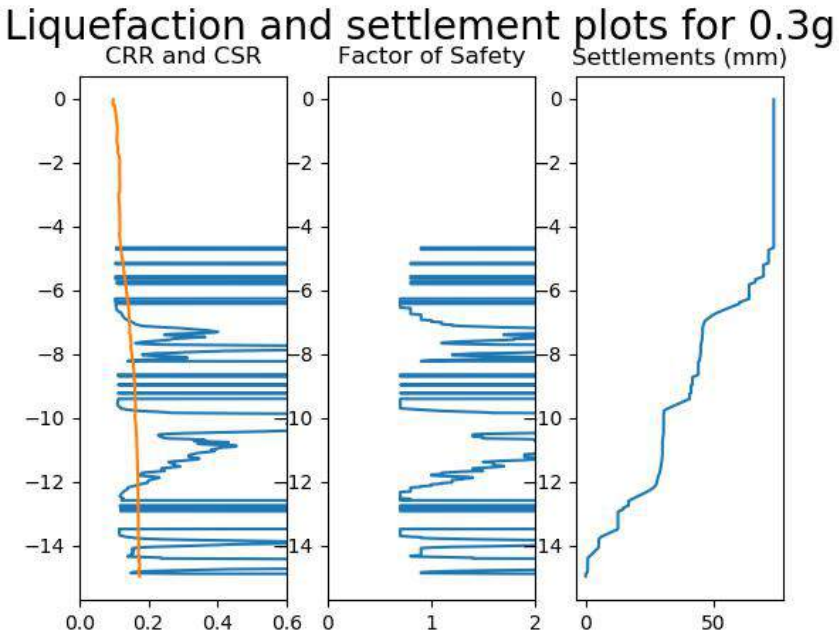


Figure 3: ULS Settlement Graph - CPT 1

The SLS earthquake produces a settlement of approximately 0mm.

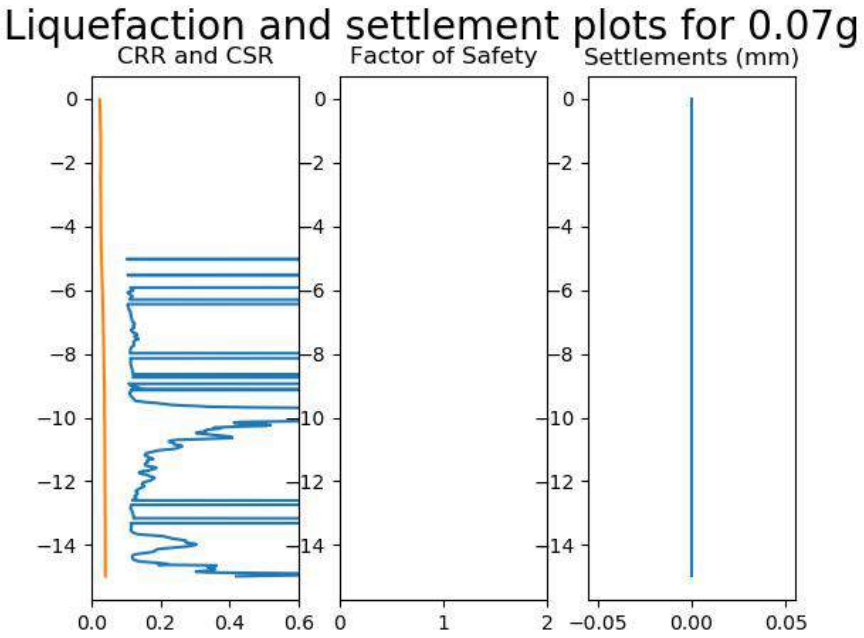


Figure 4: SLS Settlement Graph - CPT 2

The ULS earthquake produces a settlement of approximately 125mm.

Document Set ID: 21623316
Version: 1, Version Date: 19/09/2025

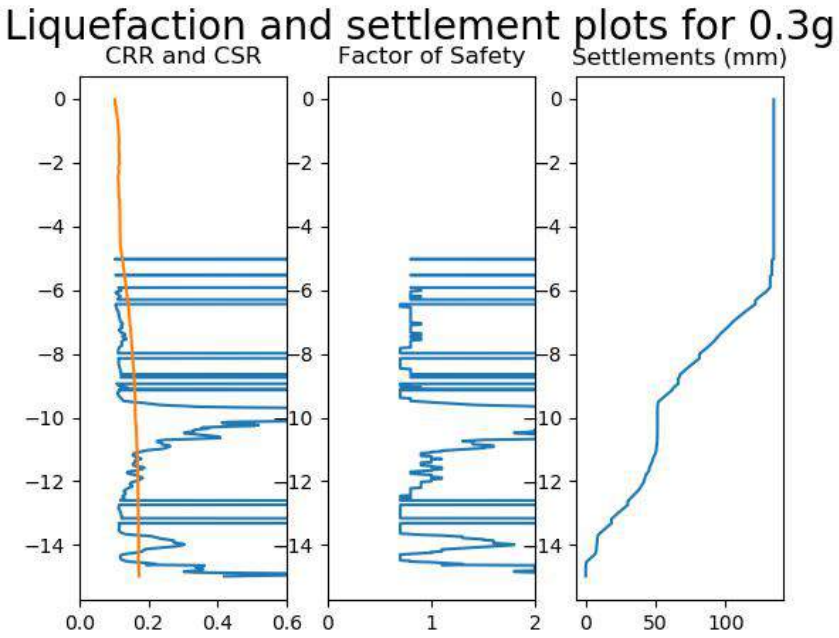


Figure 5: ULS Settlement Graph - CPT 2

As per Brunsdon et al. (2012), when settlements are limited to the top 10m of soils, the ULS settlement is 50mm and 75mm. With this in mind, this property complies, approximately with the requirements of TC2, as outlined in Brunsdon et al. (2012)

Foundation Technical Category	Future land performance expectation from liquefaction	Nominal SLS land settlement	Nominal ULS land settlement	Nominal Lateral Stretch
TC1 (where confirmed)	Liquefaction damage is unlikely in a future large earthquake	0–15 mm	0–25 mm	Generally not expected
TC2 (where confirmed)	Liquefaction damage is possible in a future large earthquake	0–50 mm	0–100 mm	<50 mm
TC3 (where confirmed)	Liquefaction damage is possible in a future large earthquake	>50 mm	>100 mm	>50 mm
Un-categorised	Land in the uncategorised area will contain properties that experience future land performance as per one of the above categories. It also includes urban non-residential land, unmapped rural land, the Port Hills and Banks Peninsula. Normal consenting conditions apply. This may include the need for engaging a geotechnical engineer to determine the appropriate solution for the property, based on a site- specific assessment.	N/A	N/A	

Table 9: Summary of predicted settlements

6 Soft soils and settlement

Static settlement due to imposed loads were calculated using Robertson 2008 [2], with a 10m x 15m foundation, as expected with a raft style footing, and a 17kPa load, as expected with a conventionally constructed modern house (pressure at the base of the footing of 10kPa, and 1m of fill at 17kN/m^3 . This resulted in a 10mm immediate settlement, and a 15mm long term settlement over 50 years on both CPT tests. Damage due to load induced settlement is therefore highly unlikely

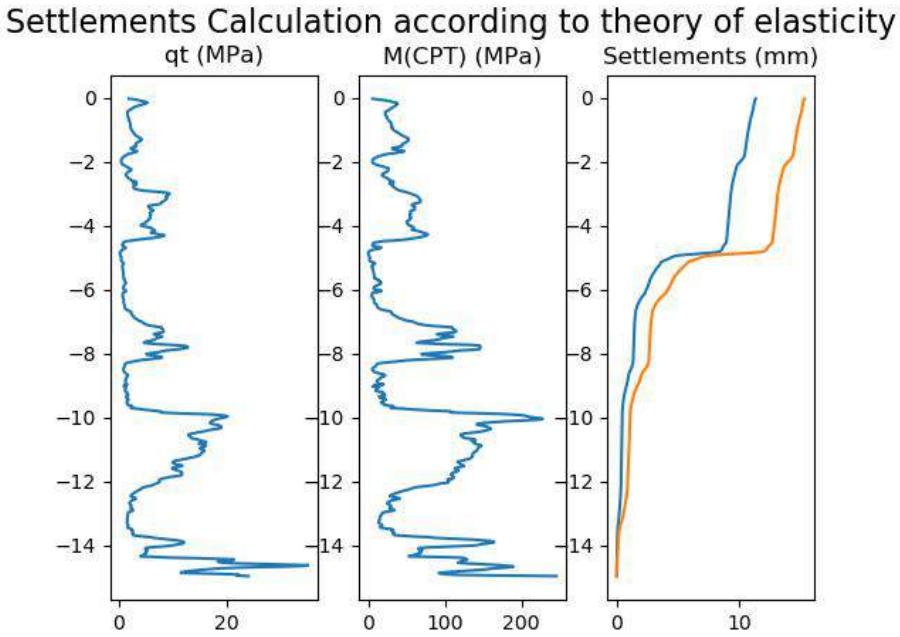


Figure 6: Settlement under static load

7 Geothermal Hazards

The site is inside the Geothermal fields documented in the Rotorua District Plan. The site is near active springs in the Arikikapakapa golf course, and approximately 100m away from a property that had to be abandoned due to geothermal activity.

7.1 Geothermal activity

Two 1m deep, 100mm diameter hand auger holes were drilled on site, and allowed to rest for 24 hours. These were then tested on 11 June 2019 with a MSA Altair 6 in one gas detector (calibration certificate attached). This did not detect any Sulphur Dioxide, Carbon Monoxide, Ammonia, or VOC / Combustible gasses.

No heat was detected in either the CPT testing, or the hand auger testing.

While there is currently no activity on site, the nature of geothermal activity is such that it can appear (and disappear) rapidly. With this in mind some mitigation measures are proposed below.

8 Footings Recommendations

As a result of the soils testing undertaken, and discussions with the client, raft slabs will be installed on site, with a reinforced soil raft, as per option 1 of Brunsdon et al. (2012).

[2] Python scripts, developed by Sigma Consultants Ltd, were used to produce the predicted settlements. The libraries have been posted on a public forum, and can be found at https://github.com/atokelove/liquefactionLibraries.

8.1 Raft Footing

A raft slab may be installed on the site. The raft shall have a pod depth of 220mm. For the future lot 3, An undercut of 1m below existing ground level shall be provided, for the full footprint area of the proposed structure plus an additional 1.2m beyond the footprint. For the future lots 1 & 2, an undercut of 300mm shall be provided where the fill is already 1m deep. Where the fill required to bring the section to level is less than 1m, then there shall be 1m of well compacted fill below the footings. Two layers of 20 / 20 geogrid shall be placed 200mm above the base of the undercut, with 200mm of compacted material between the layers. These shall be wrapped up the sides of the cut excavation and brought at least 1.2m under the footprint of the footings. The backfill material shall be compacted to 300kPa as measured by the Scala Penetrometer, or a minimum Clegg Impact Value of 8.

Testing shall be undertaken when the hole is open, and the subgrade shall achieve a 200kPa bearing capacity for a further 0.8m below the undercut depth. Any localised soft spots are to be excavated and recompacted if the found material is suitable, or replaced with competent fill material.

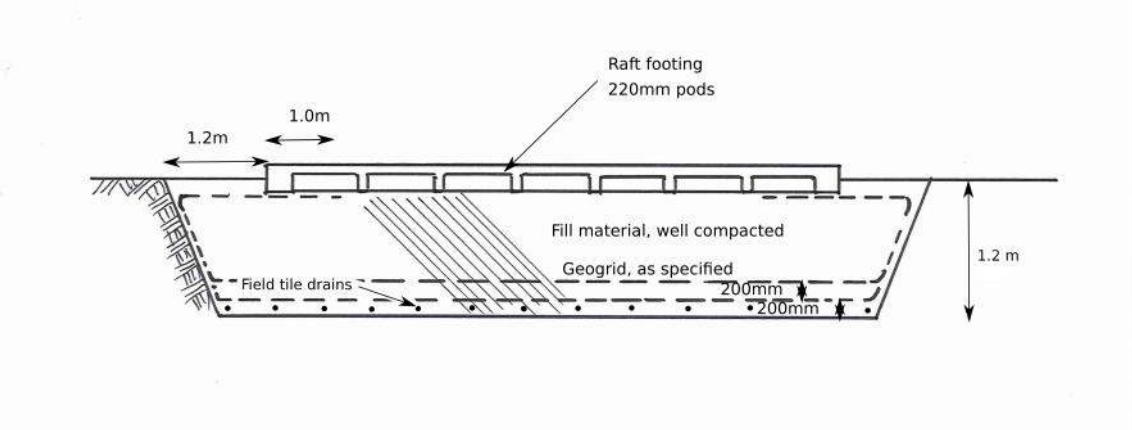


Figure 7: Undercut and backfill for raft footing

As outlined, above, there is a risk that the proposed site might be subjected to hot geothermal gas and steam. With this in mind, Field tiles shall be placed at the base of the fill and led, via vitreous clay pipes to a mushroom vent close to the property boundary.

Two layers of thermathene orange (or approved equivalent) DPM shall be used below the footings.

These mitigation measures will vent hot gasses before they reach the building footprint, and the double layer of DPM will provide additional sealing.

9 Fault Line Proximity

The GNS active faults database shows that the nearest fault is the Horohoro Fault 1.34km to the South East of the property. Land disturbance due to fault rupture is therefore unlikely to affect this property.

10 Level of Complexity as Defined by RCEIS Chapter 3

This site complies with a Level 2 level of complexity having a moderate risk.

Sigma Consultants Ltd

Adam Tokelove MIPENZ
Principal Civil Engineer, Sigma Consultants Ltd
23 November 2017 (Revised 22 September 2019)

References

Begg, J., Johnston, M., and McSaveney, E. (2000). Geology of the wellington area.

Boulanger, R. and Idriss, I. (2014). Cpt and spt based liquefaction triggering procedures. *Rep. No. UCD/CGM-14*, 1.

Brunsdon, D., Beattie, G., Brown, B., Hooper, G., Jacka, M., King, A., Leeves, J., McCahon, I., McManus, K., Millar, P., Robinson, R., Shelton, R., Smith, P., Snook, J., Stannard, M., and Traylen, N. (2012). Repairing and rebuilding houses affected by the canterbury earthquakes.

Code, N. Z. B. (2011). New zealand government. *Wellington, New Zealand*.

Dass, B. M. (2009). *Shallow foundations bearing capacity and settlement*. CRC press.

Dellow, G. (2010). Distribution and engineering properties of young lake sediments in rotorua district. Technical report.

Ishihara, K. (1985). Stability of natural deposits during earthquakes. *Proc. of 11th ICSMFE, 1985*, 1:321–376.

Kerr, J., Nathan, S., Van Dissen, R., Webb, P., Brunsdon, D., and King, A. (2003). Planning for development of land on or close to active faults. *Wellington, Ministry for the Environment*.

Leonard, G., Begg, J., Wilson, C., et al. (2010). *Geology of the Rotorua area*. GNS Science.

Look, B. G. (2014). *Handbook of geotechnical investigation and design tables*. CRC Press.

MBIE (2016). Module 3: Identification, assessment and mitigation of liquefaction hazards.

Medyckyj-Scott, D. (2018). Landcare smap - online soils database https://smap.landcareresearch.co.nz/app/.

Moon, V. G., Cunningham, M. J., Wyatt, J. B., Lowe, D. J., Morz, T., and Jorat, M. (2013). Landslides in sensitive soils, tauranga, new zealand.

Nairn, I. A. (2002). *Geology of the Okataina volcanic centre*. Institute of Geological and Nuclear Sciences.

Pullar, W. (1973). Isopachs of tephra, central north island, new zealand.

Rajapakse, R. A. (2015). *Geotechnical engineering calculations and rules of thumb*. Butterworth-Heinemann.

Robertson, P. (2009). Performance based earthquake design using the cpt. *Proc. IS-Tokyo*, pages 3–20.

Scott, J., Berg, D., Chittenden, D., and Johnston, P. (2017). *Planning and engineering guidance for potentially liquefaction-prone land*.

Standards, N. Z. (2004). Structural design actions, part 5: Earthquake actions–new zealand.

Stockwell, M. et al. (1977). Determination of allowable bearing pressure under small structures. *New Zealand Engineering*, 32(6):132.

Tokimatsu, K. and Yoshimi, Y. (1983). Empirical correlation of soil liquefaction based on spt n-value and fines content. *Soils and Foundations*, 23(4):56–74.

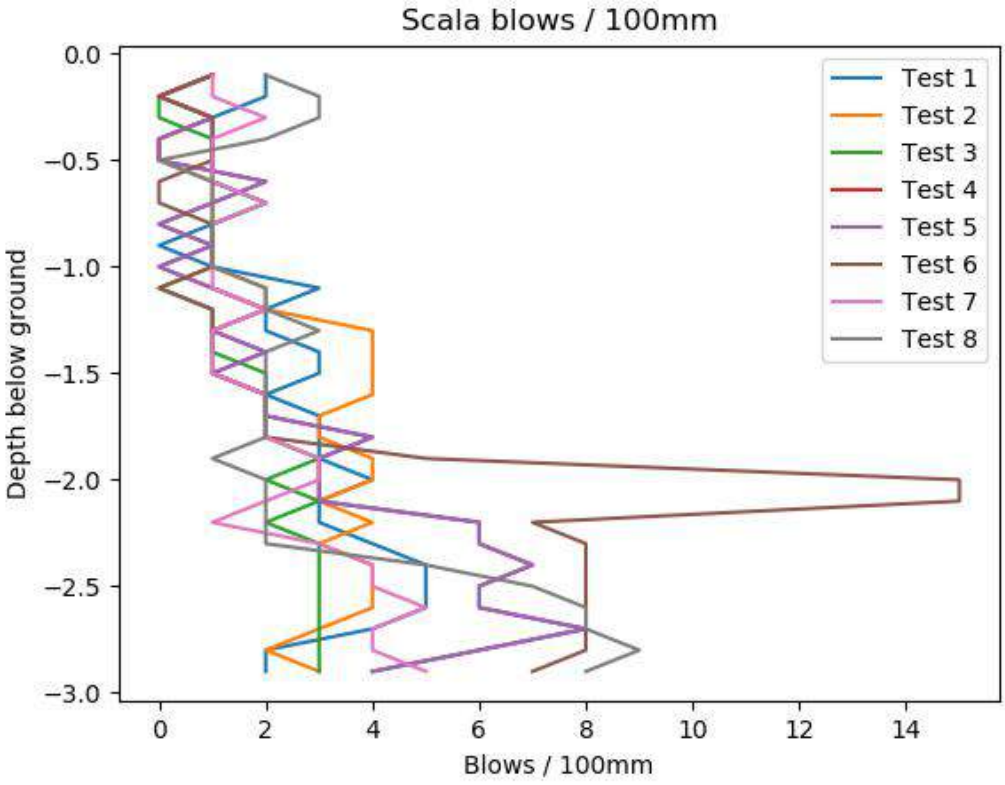
Youd, T. L. (1993). Liquefaction-induced lateral spread displacement. Technical report, NAVAL CIVIL ENGINEERING LAB PORT HUENEME CA.

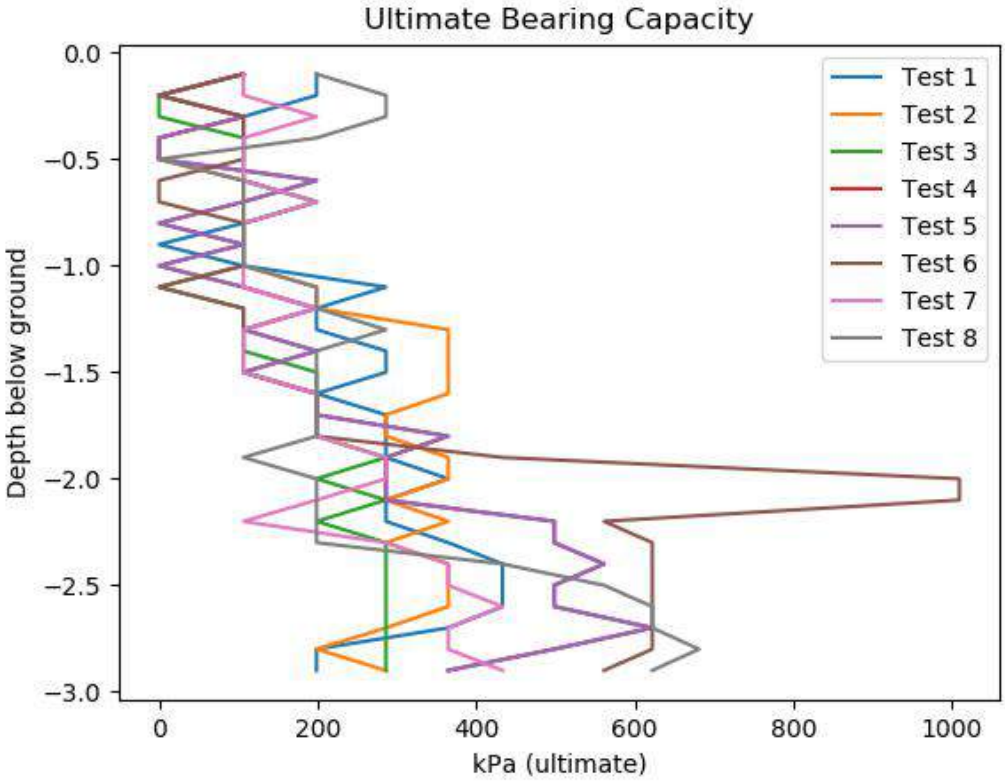
Youd, T. L. and Idriss, I. M. (2001). Liquefaction resistance of soils: summary report from the 1996 nceer and 1998 nceer/nsf workshops on evaluation of liquefaction resistance of soils. *Journal of geotechnical and geoenvironmental engineering*, 127(4):297–313.

Zemansky, G. and Thorstad, J. (2010). Lake rotorua shallow groundwater assessment. Technical Report 2010/225.

Zhang, G., Robertson, P., and Brachman, R. W. (2002). Estimating liquefaction-induced ground settlements from cpt for level ground. *Canadian Geotechnical Journal*, 39(5):1168–1180.

Appendix 1 - Scala Graphs





Appendix 2 - Borelogs

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 1
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 1	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure, Grading, bedding, plasticity, sensitivity, Secondary and minor components, additional information.	Moisture condition	Consistency or density index	Vane shear (remoulded or peak) kPa 25 50 75 100 125 150 175	Penetration resistance test: blows / 100mm 2 4 6 8 10 12 14 16 18
							Dark brown fine SAND with some silt, moist				
							Yellowish brown fine SAND with minor silt mixed with topsoil, moist, well graded, fill				
				1.0			Orangish brown fine SAND with minor silt, moist to wet, well graded, natural ground, light yellowish brown from 1.0m				
				2.0			Greyish brown fine SAND with traces of silt, moist, well graded				
							Light grey fine to medium pumiceous SAND with some fine gravel, moist, poorly graded				
							End of hole				
				3.0							

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶— Water inflow
- —◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 2
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 2	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0			Dark brown fine SAND with some silt, moist				
				1.0			Orangish brown fine SAND with minor silt, moist to wet, well graded				
							Light yellowish grey fine to medium SAND, moist, poorly graded				
				2.0			Light grey fine to medium pumiceous SAND with some fine gravel, moist, poorly graded, wet from 2.0m				
							End of hole				
				3.0							

Vane shear (kPa): 25, 50, 75, 100, 125, 150, 175

Penetration resistance test: blows / 100mm: 2, 4, 6, 8, 10, 12, 14, 16, 18

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶ Water inflow
- ◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 3
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 3	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	Vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0.0			Dark brown fine SAND with some silt, moist			25 50 75 100 125 150 175	2 4 6 8 10 12 14 16 18
							Orangish brown fine SAND with minor silt, moist to wet, well graded				
				1.0			Yellowish brown fine SAND with some silt, wet, well graded				
							Brown fine SAND with minor silt, wet, well graded				
							Yellowish brown fine SAND with minor silt, wet, well graded				
				2.0			Light grey medium pumiceous SAND with some fine gravel and traces of silt, wet, poorly graded				
							End of hole				
				3.0							

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶— Water inflow
- —◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 4
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 4	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0.0			Dark brown fine SAND with some silt, moist				
							Orangish brown fine SAND with minor silt mixed with topsoil, moist to wet, well graded, fill				
				1.0			Orangish brown fine SAND with minor silt, moist to wet, well graded				
				2.0			Brown fine SAND with traces of silt, wet, poorly graded				
							Light grey fine to medium pumiceous SAND, moist to wet, poorly graded				
							End of hole				
				3.0							

Vane shear (kPa): 25, 50, 75, 100, 125, 150, 175

Penetration resistance test: blows / 100mm: 2, 4, 6, 8, 10, 12, 14, 16, 18

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- 01/01/2015 Water level on date shown
- Water inflow
- Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 5
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 5	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	Vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
							Dark brown fine SAND with some silt, moist			25 50 75 100 125 150 175	2 4 6 8 10 12 14 16 18
							Black fine SAND with minor silt, moist, well graded				
				1.0			Orangish brown fine SAND with some silt, wet, well graded, light orangish brown from 1.0m				
				2.0			Brown fine SAND, wet, poorly graded				
							Light grey fine to medium pumiceous SAND with some fine gravel, moist to wet, poorly graded				
							End of hole				
				3.0							

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶— Water inflow
- —◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 6
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 6	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0			Dark brown fine SAND with some silt, moist			25 50 75 100 125 150 175	2 4 6 8 10 12 14 16 18
				1.0			Light yellowish brown fine SAND with traces of silt, moist, well graded				
				2.0			Light grey fine to medium pumiceous SAND with minor fine gravel, moist to wet, poorly graded				
							End of hole				
				3.0							

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa

UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶ Water inflow
- ◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 7
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 7	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	Vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0			Dark brown fine SAND with some silt, moist			25 50 75 100 125 150 175	2 4 6 8 10 12 14 16 18
				1.0			Light yellowish brown fine SAND with minor silt, moist to wet, well graded				
				2.0			Light greyish brown fine SAND with traces of silt, moist, poorly graded				
							Light brownish grey fine SAND with minor fine pumiceous gravel, moist to wet, poorly graded				
							Light grey fine to medium pumiceous SAND with minor fine gravel, moist to wet, poorly graded				
							End of hole				
				3.0							

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶— Water inflow
- —◀ Water outflow

Moisture

D	Dry
M	Moist
W	Wet
S	Saturated

Consistency / Density Index

VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

SIGMA
Engineers | Architects | Planners

Engineering Log

		Borehole No.	Test 8
		Sheet:	1
		Project No.	1224
Client	Barry and Judy Hanna	Date Started	2017-10-10
Principal	Barry and Judy Hanna	Date Completed	2017-10-10
Project	Geotechnical Report	Logged by	TS
Borehole Location	Test 8	Checked by	APT

Penetrometer type	NZ	Easting	Slope	R. L. Surface	Vane Number
Hole Diameter	50	Northing	Bearing	Datum	

Drilling Information | Material Substance

Stratigraphy	Water	Notes samples, tests, etc	RL	Depth metres	Graphic log	Classification symbol	Material: Soil type, colour, structure. Grading, bedding, plasticity, sensitivity. Secondary and minor components, additional information.	Moisture condition	Consistency or density index	vane shear (remoulded or peak) kPa	Penetration resistance test: blows / 100mm
				0.0			Dark brown fine SAND with some silt, moist				
							Orangish brown fine SAND with minor silt, moist, well graded				
				1.0			Light yellowish brown fine SAND with traces of silt, moist to wet, poorly graded				
				2.0			Light yellowish brown silty fine SAND, wet, well graded				
							Light grey fine SAND with minor fine pumiceous gravel, moist, poorly graded				
							End of hole				
				3.0							

Vane shear (kPa): 25, 50, 75, 100 (remoulded), 125 or peak), 150, 175

Penetration resistance test: blows / 100mm: 2, 4, 6, 8, 10, 12, 14, 16, 18

Classification symbols and soil description based on Field Description of Soil and Rock, New Zealand Geotechnical Society Inc 2005

Vane shear (kPa)
- ● Remoulded
- × Peak
- >>× Peak greater than 200kPa
- UTP Unable to penetrate

Water
- ▼ 01/01/2015 Water level on date shown
- ▶ Water inflow
- ◀ Water outflow

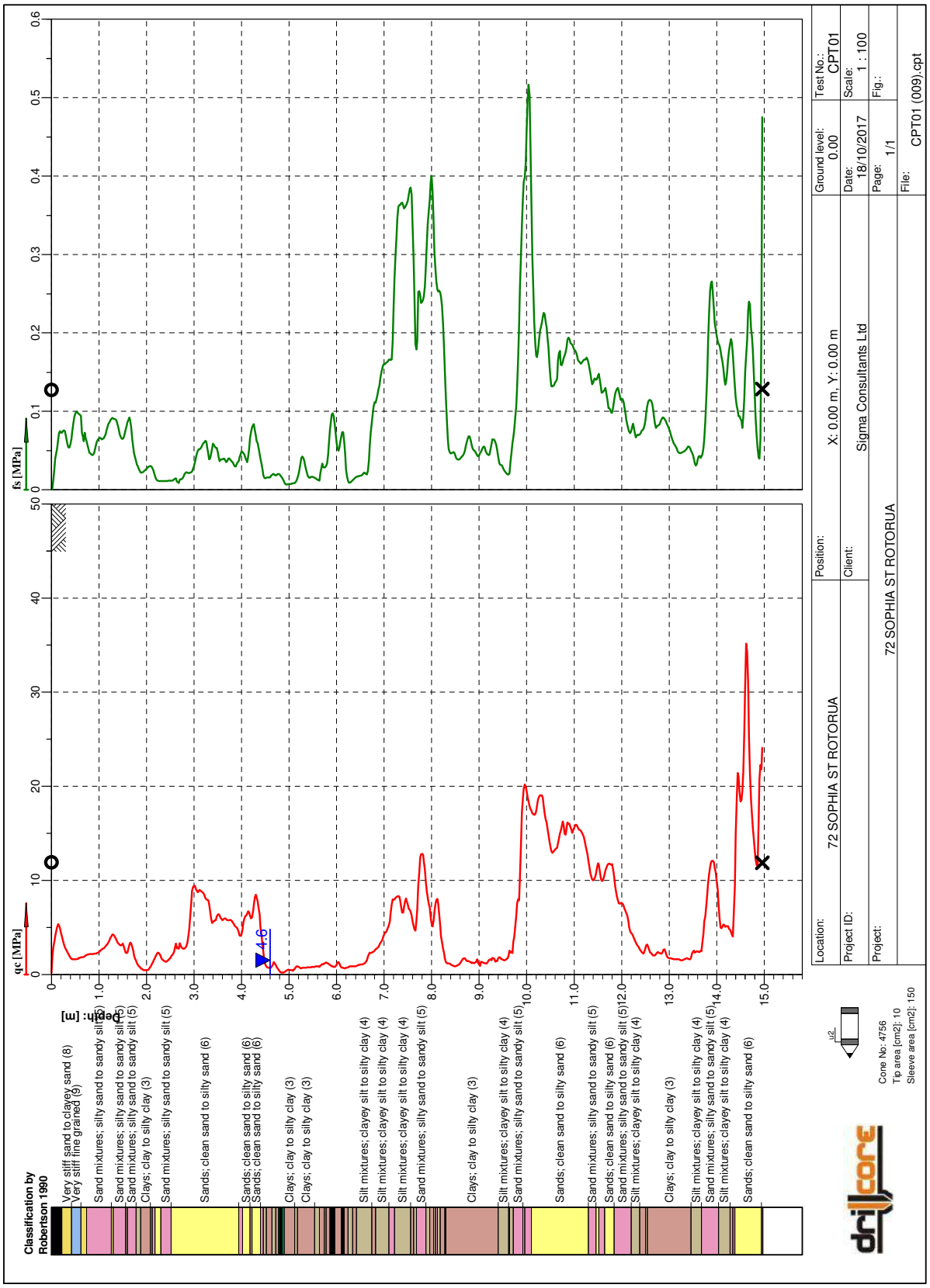
Moisture

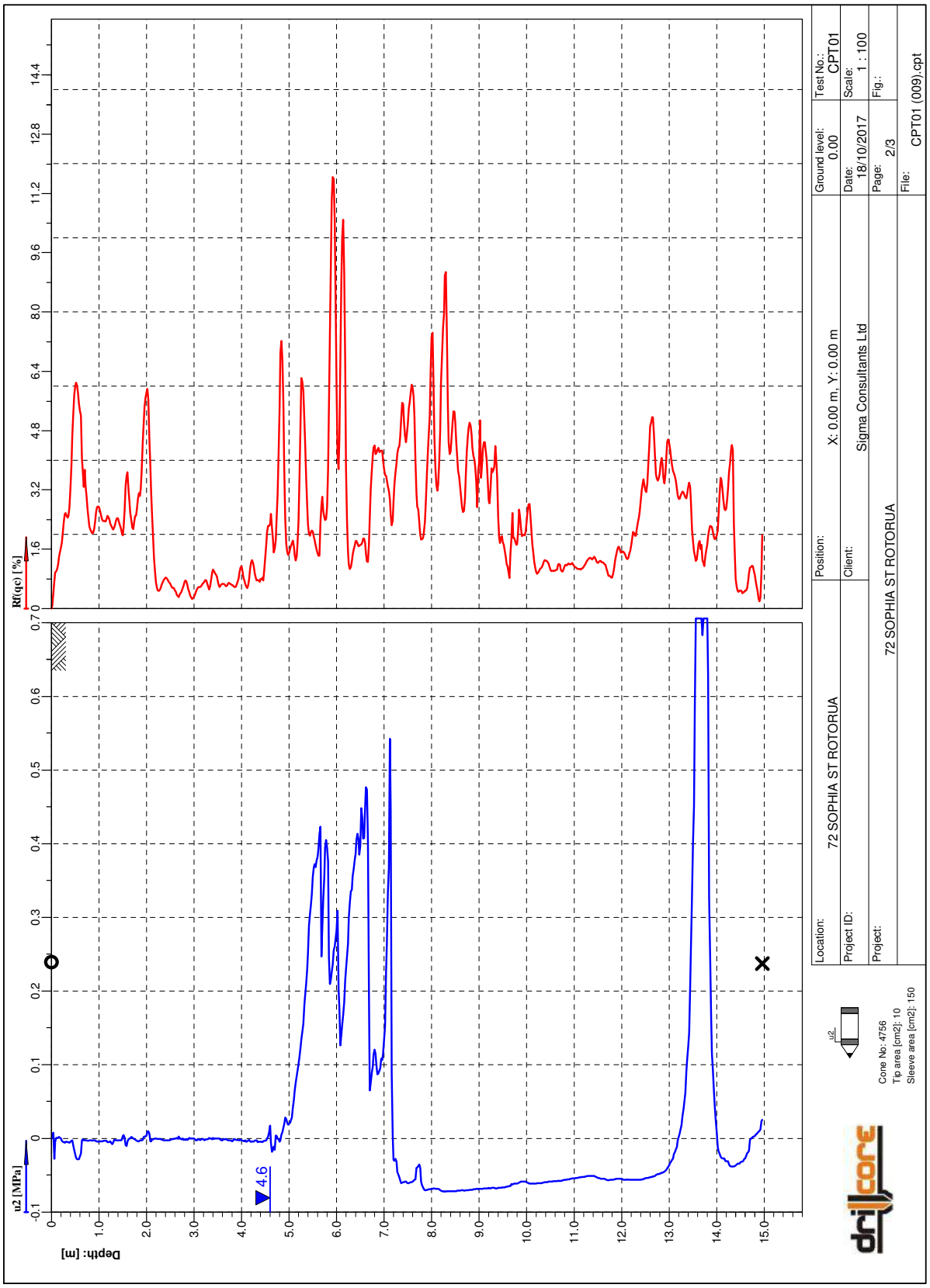
D	Dry
M	Moist
W	Wet
S	Saturated

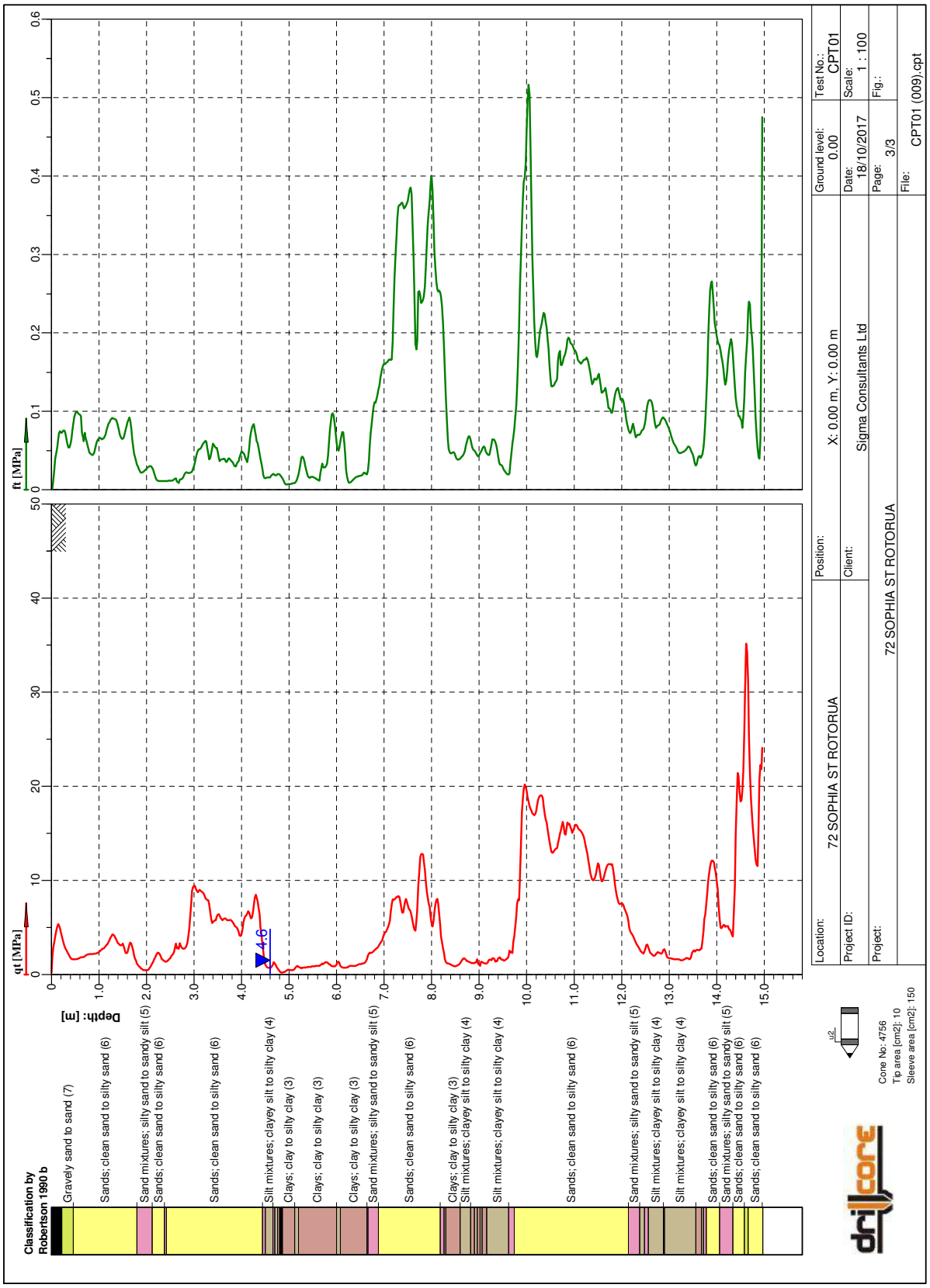
Consistency / Density Index

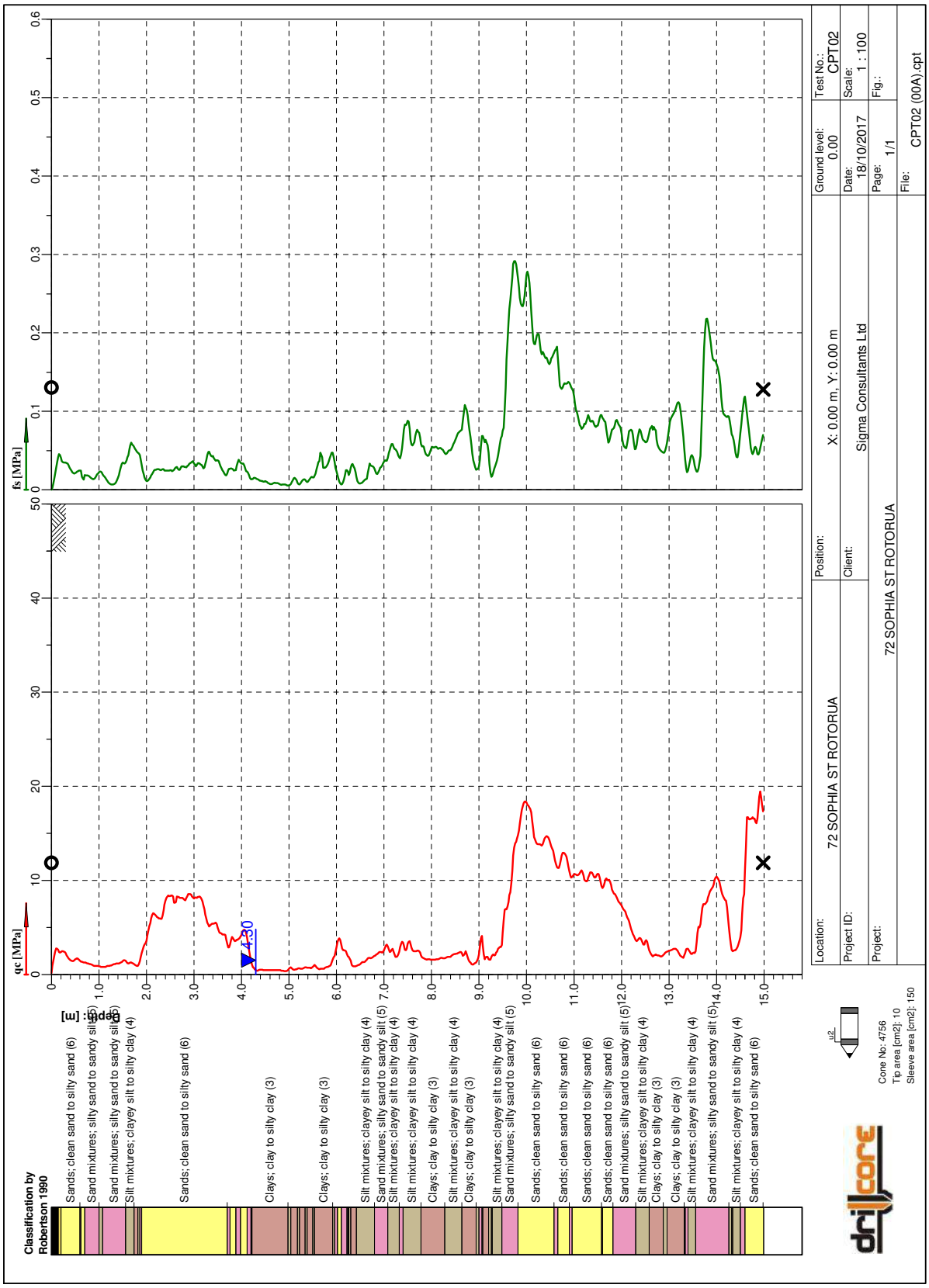
VS	Very Soft	VL	Very Loose
S	Soft	L	Loose
F	Firm	MD	Medium Dense
St	Stiff	D	Dense
VSt	Very Stiff	VD	Very Dense
H	Hard		

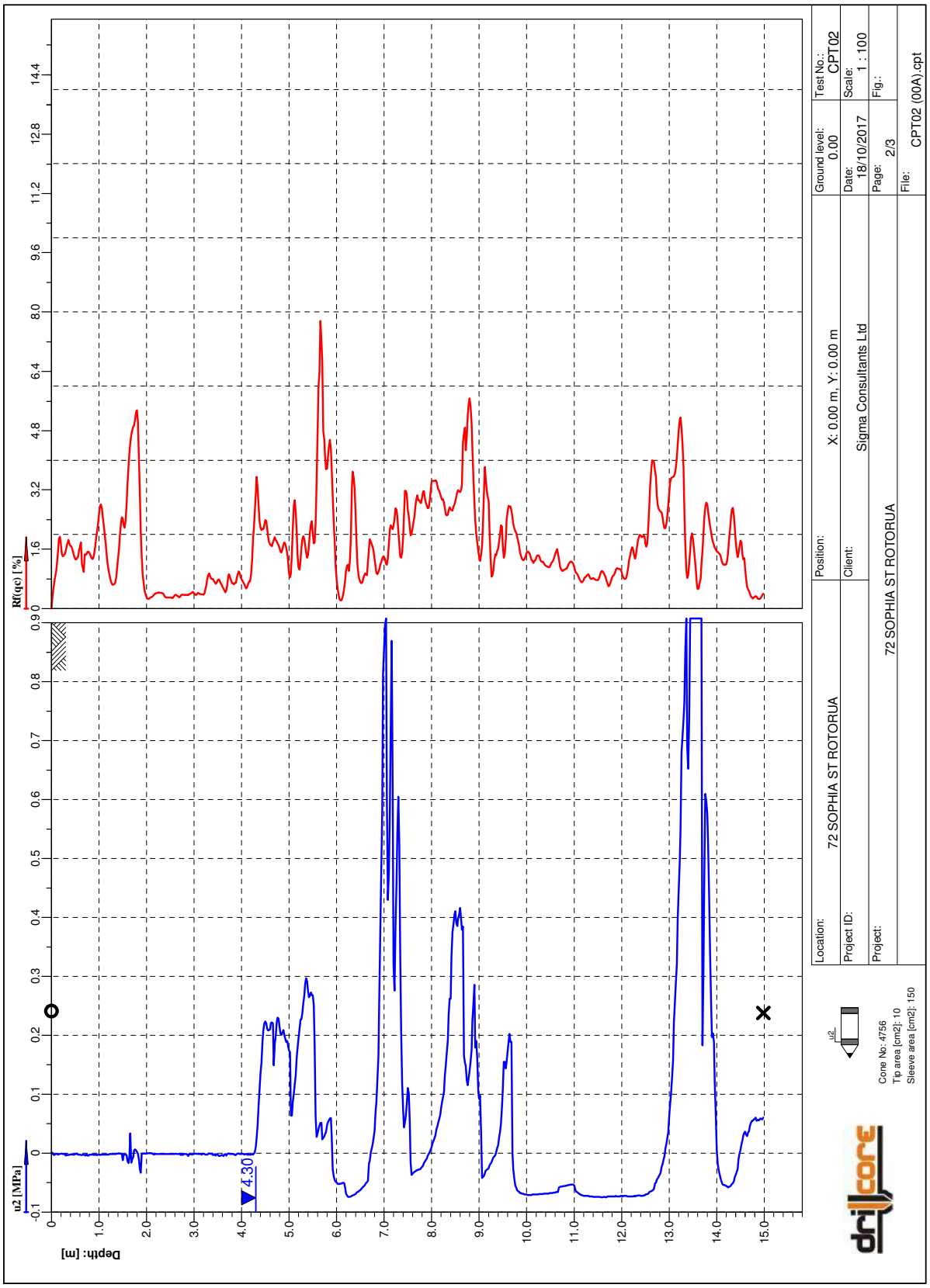
Appendix 3 - CPT logs

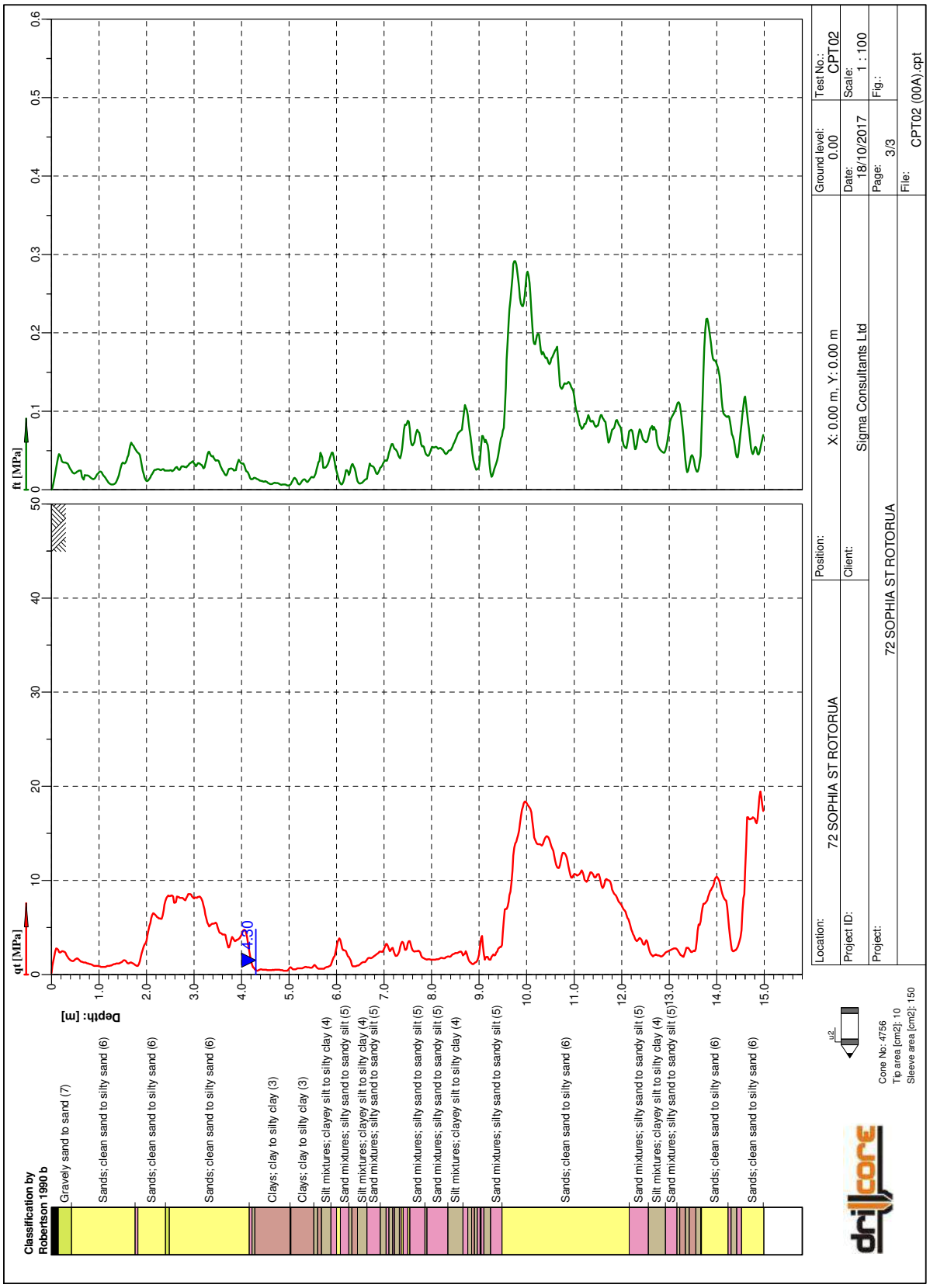












Hilton Family Ltd

72 Sophia Street, Glenholme, Rotorua

Engineering Services Report

18165 Rev.1
10 September 2018

cheal

cheal

Hilton Family Ltd

72 Sophia Street, Glenholme, Rotorua

Engineering Services Report

Prepared by:

Jacob Saathof
Civil Engineer
BE (Forest) (Hons), CPEng (Civil), CMEngNZ

Reviewed by:

Thomas Brand
Engineering Manager
BSc (Civil), CPEng, CMEngNZ, IntPE (NZ)

Date:	10 September 2018
Reference:	18165
Status:	Final
Revision:	1
Previous Revision Date:	7 September 2018

cheal

TABLE OF CONTENTS

Appendices –

1. INTRODUCTION AND SCOPE

Cheal Consultants Limited (Cheal) was engaged by Hilton Family Ltd (Client) to produce an Engineering Services Report for a proposed four lot residential subdivision, accessed off Sophia Street, in Glenholme, Rotorua. This report has been prepared for supplementing a Resource Consent Application for the proposed development.

The scope of the report is to outline and provide possible engineering design recommendations for the proposed development including stormwater, wastewater, water supply, power and telecommunications.

2. SITE DESCRIPTION

The 4 Lot subdivision is located at 72 Sophia Street, Lot 1 DPS 7304. An existing dwelling is planned to be removed from site to facilitate subdivision. Site topography consists of a shallow, gentle gully running in an east west direction through the north of the site and a gentle hill towards the south. The overall height difference within the site is 4m. Figure 1 below shows an aerial view of the site.

Figure 1 – GoogleEarth Image of 72 Sophia Street

3. ACCESS

Access to 72 Sophia Street is gained via mutual right of way easements for which the Client owns part of. This access currently services eight properties. The access functions as a one-way loop road with an average lane width of 3.0m. A vegetated medium strip divides each lane. The proposed subdivision would be accessed at the end of the one-way loop. Photo 1 below shows the current right of way (ROW) layout and condition.

Photo 1 – Existing access

4. GEOTECHNICAL

A geotechnical report has been prepared by Sigma Consultants. This report states that 'good ground' was found onsite and a range of foundation options are given. No soakage testing was undertaken.

5. STORMWATER

5.1 Introduction

The northern half of the proposed subdivision is located within the head of a shallow gully. This gully has a low crest within the golf course to the west making it blind. As such, stormwater currently ponds within the golf course adjacent to the property during rain events. A cesspit located within the golf course assists drainage of the ponding area, this drops water into a ø300mm stormwater pipe which discharges into an adjacent crater. During heavy rain events ponding extends into the northern half of the subdivision area. Photos 2 and 3 below show the ponding area in the golf course and low-lying area within the proposed subdivision.

Photo 2 – Blind gully in golf course (cesspit located near small puddle)

Photo 3 – Low-lying area in proposed subdivision

The floor level of dwellings on Lots 1 and 2 will need to be raised to ensure they are not at risk from flooding. It has been assumed that this will primarily occur through lifting of the existing ground level through both lots and conveying stormwater via an easement.

To determine the required floor level, two stormwater conditions have been considered as follows:

- Ponding from an AEP 1% storm event of one-hour duration within the golf course
- Peak stormwater runoff depth through a 3m wide easement in Lots 1 and 2.

Calculations sheets and workings are included in Appendix 1.

5.2 Ponding

Indicative stormwater modelling has been undertaken for the subdivision to ascertain the depth of ponding within an AEP 1% storm of one-hour duration. Existing soakage was assumed to be at 100% capacity. The contributing catchment was 3.39 ha and a composite Rational Method coefficient of 0.378 used which reflects post development conditions. Rainfall data was taken from HirdsV3 with a 2.1°C temperature increase. The total volume of water for such an event is estimated to be 1028m³. Assuming the existing stormwater pipe is at capacity, ponding is confined to the golf course and no soakage occurs, maximum ponding depth at boundary is estimated to be 0.59m. The approximate extent of ponding is shown in Figure 2 below, the water surface has an elevation of 300.46m RL (Moturiki Vertical Datum 1953).

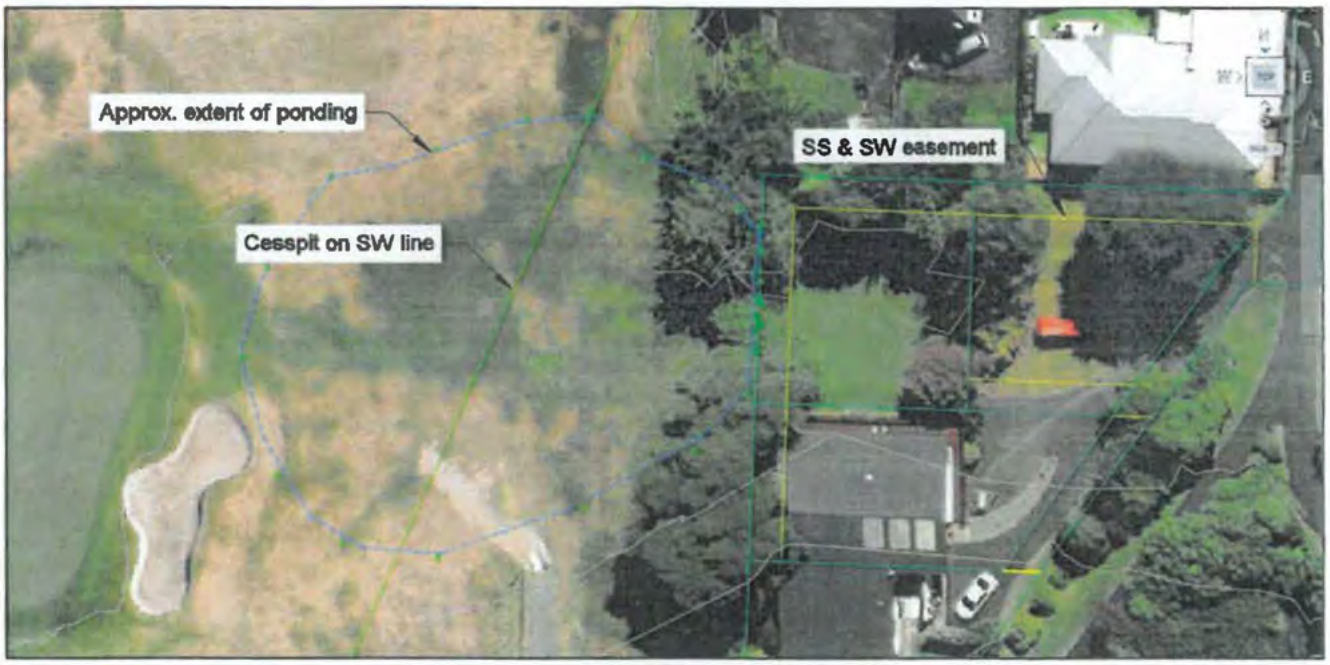


Figure 2 – Approximate extent of ponding

5.3 Depth of Flow Through Easement

Peak runoff through the stormwater easement shown in figure 2 is estimated to be 0.37m³/sec. This has been calculated using an AEP 1% storm event with a duration of 13 minutes. A grass swale with a maximum depth of 0.4m and batter slope of 3:1 can be formed within this easement. This allows for a minimum cover of 0.5m over the sanitary sewer line which also shares the same location. Maximum flow depth through the easement is estimated to be 0.45m with a velocity of 1.11 m/sec. At the head of the swale the water level has an expected RL of 300.62m (Moturiki Vertical Datum 1953).

The floor level of dwellings within Lots 1 and 2 should be set at 0.5m above the highest flow depth as per E1/VM1 4.3.1 of the building code. This gives a minimum floor level of 301.12m RL (Moturiki Vertical Datum 1953).

5.4 Soakage

Stormwater from a 1-hour duration, AEP 10% storm event will be contained onsite and directed into soakage. A soakage test completed onsite, on the boundary between Lots 1 and 2 found an average soakage rate of 56mm/hr, results of which are contained in appendix 1. Assuming 40% of the area within each Lot is developed, a total of 28.9m³ of stormwater will need to be contained. This could be contained within four ø0.9m x 3m deep soak holes on each Lot or alternative configuration or design. Stormwater volume from the existing ROW to be captured within soakage is estimated to be 12.5m³. This could be contained within four ø0.9m x 4.8m deep soak holes.

6. WASTE WATER

Rotorua Lakes Council have confirmed there is enough capacity within the receiving waste water system to convey flow from the proposed subdivision. There are currently eight connections to a 150mm sanitary sewer (SS) pipe running through the north of the property.

The existing 150mm sewer line in the north of Lot 1 is proposed to be relocated closer to the northern boundary. To achieve this a new Sanitary Sewer Manhole (SSMH) will be placed adjacent to the ROW. The existing SSMH within the golf course is in poor condition and will most likely need to be replaced rather than relocated to line up with the new sanitary sewer pipe line.

Sufficient fall is available for a new SSMH to be installed approximately 5.5m north of the existing SSMH to achieve this. The new 150mm connection would be laid at a minimum gradient of 0.75% with a 28mm drop in pipe invert levels through the new manhole. The maximum available grade between the new SSMH and existing SSMH within the golf course is 1%. This is greater than the minimum allowable grade of 0.75%. Pipe fall calculations are included in Appendix 2.

7. WATER SUPPLY

Rotorua Lakes Council have confirmed that water can be supplied to the proposed subdivision. The closest fire hydrant is located 105m from the edge of Lot 4.

8. POWER AND TELECOMMUNICATIONS

Chorus have indicated that telecommunications can be provided to the subdivision, a confirmation letter is included in Appendix 3. In summary, their email states that Lot 4 can be serviced by the existing drop-off and Lots 1 – 3 via new tubes. The estimated cost for this work is $4,140.00 including GST.

Unison have confirmed that power can be supplied to the proposed subdivision, a letter outlining this is contained in Appendix 3. The estimated cost to supply power is $10,052.45 including GST.

9. DISCLAIMER

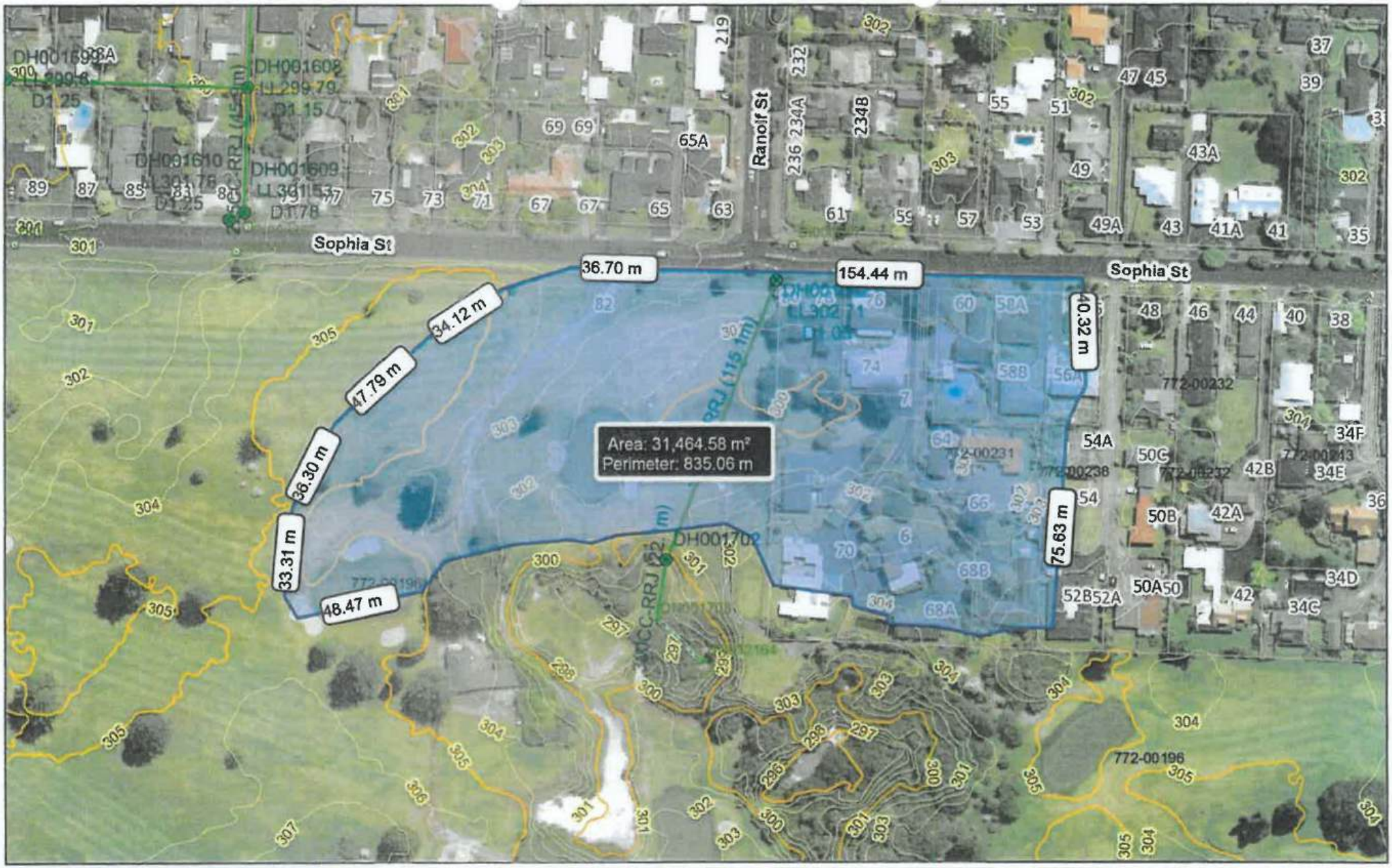
This Report has been prepared solely for the use of our client with respect to the particular brief given to Cheal Consultants.

No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

CHEAL CONSULTANTS LIMITED

Appendix 1

Stormwater Calculation Sheets



72 Sophia Street - Stormwater Catchment

DATA SETS

Accuracy of property boundaries +/- 0.2m - 0.3m in urban areas and up to +/- 30m in rural areas. Property boundaries, titles, legal descriptions and legal areas sourced from LINZ.

GeyserView represents Council's most up to date compiled and published data. Council does not warrant the accuracy of the information represented by this map. LINZ Licenses. CROWN COPYRIGHT RESERVED.

Printed Date: 17-Aug-2018

Aerial Imagery

1:1000 data set flown 2016, XY accuracy +/- 0.5m.

1:2000 data set flown 2016, XY accuracy +/- 0.5m.

0 40.00 80.0 Meters

Rotorua Lakes Council

72 Sophia Street - Stormwater Assessment

1) Ponding: Total volume to blind gully (AEP1%, 1 hour duration)
2) Easement flow: depth through Lots 1 & 2 (AEP1%, ToC)
3) Hardstand soakage: AEP10%, 1 hour duration

Assumptions:

- Existing stormwater system in ROW is redundant and overland flow occurs
- Roof top soak holes bubble over in a large storm and overland flow occurs

$Area_{total} := 33898\ m^2 = 3.39\ hectare$

$Area_{roof} := 4276\ m^2 = 0.428\ hectare$ *post_development*

$Area_{driveways} := 2608\ m^2 = 0.261\ hectare$

$Area_{grass} := Area_{total} - Area_{roof} - Area_{driveways} = 2.7\ hectare$

Rainfall intensity (HIRDSv3) - 1 hour time of concentration

$I_{10Pre} := 94.2\ \frac{mm}{hr}$ $I_{10Post} := 46.6\ \frac{mm}{hr}$

$I_{50Pre} := 136.8\ \frac{mm}{hr}$ $I_{50Post} := 68.4\ \frac{mm}{hr}$

$I_{100Pre} := 160.2\ \frac{mm}{hr}$ $I_{100Post} := 80.2\ \frac{mm}{hr}$

Overall Runoff Coefficent

$C_{grass} := 0.25$
$C_{roof} := 0.90$
$C_{driveway} := 0.85$

$$C_{site} := \frac{\left(C_{grass} \cdot Area_{grass} + C_{driveway} \cdot Area_{driveways} + C_{roof} \cdot Area_{roof}\right)}{Area_{grass} + Area_{driveways} + Area_{roof}} = 0.378$$

1) Ponding

$Q_{50Pre} := C_{site} \cdot I_{50Pre} \cdot Area_{total} = 0.487 \ \frac{m^3}{s}$ $Q_{50Post} := C_{site} \cdot I_{50Post} \cdot Area_{total} = 0.244 \ \frac{m^3}{s}$

$Q_{100Pre} := C_{site} \cdot I_{100Pre} \cdot Area_{total} = 0.57 \ \frac{m^3}{s}$ $Q_{100Post} := C_{site} \cdot I_{100Post} \cdot Area_{total} = 0.286 \ \frac{m^3}{s}$

$Vol_{Q100Post} := Q_{100Post} \cdot 1 \ hr$

$Vol_{Q100Post} = 1028 \ m^3$ Total volume ponding in blind gully (AEP1%, 1 hour duration)

2) Flow through easement

Time of concentration
- Grass: 30m @ 2%
- Paved ROW: 80m @ 5%
- Total ToC (nomographs): 13 minutes

Rainfall intensity (HIRDSv3) - 13 minute time of concentration

$I_{100Post\_10min} := 187.2 \ \frac{mm}{hr}$ $I_{100Post\_20min} := 135 \ \frac{mm}{hr}$

$I_{100Post\_13min} := I_{100Post\_20min} + \left(\left(I_{100Post\_10min} - I_{100Post\_20min} \right) \cdot \left(\frac{3}{5} \right) \right) = 166.32 \ \frac{mm}{hr}$

$Area_{total} := 14887 \ m^2 = 1.489 \ hectare$ Half the ponding catchment (excludes the golf course)

$Area_{roof} := 4276 \ m^2 = 0.428 \ hectare$

$Area_{driveways} := 2608 \ m^2 = 0.261 \ hectare$

$Area_{grass} := Area_{total} - Area_{roof} - Area_{driveways} = 0.8 \ hectare$

$$C_{site} := \frac{\left(C_{grass} \cdot Area_{grass} + C_{driveway} \cdot Area_{driveways} + C_{roof} \cdot Area_{roof} \right)}{Area_{grass} + Area_{driveways} + Area_{roof}} = 0.542$$

$Q_{100Post} := C_{site} \cdot I_{100Post\_13min} \cdot Area_{total} = 0.373 \ \frac{m^3}{s}$ Maximum flow through stormwater easement (AEP1%, 13min duration)

3) Hardstand soakage

$S_r := 56\ \frac{mm}{hr}$ Soakage rate measure onsite 1.4m below GL

$I_{10Post} := 46.6\ \frac{mm}{hr}$ Rainfall intensity (HIRDSv3) - 1 hour duration

$Area_{hardstand} := 689.2\ m^2$ Assuming maximum site coverage of 40%

$Area_{ROW} := 315\ m^2$ Existing ROW and proposed easement over Lot 2

$Q_{10Post} := C_{roof} \cdot I_{10Post} \cdot Area_{hardstand} = 8.03\ \frac{L}{s}$

$Vol_{Q10\_hardstand} := Q_{10Post} \cdot 1\ hr = 28.9\ m^3$

$Vol_{PerLot} := \frac{Vol_{Q10\_hardstand}}{4} = 7.2\ m^3$ Total volume off each Lot (AEP10%, 1 hour duration)

$Q_{10Post\_ROW} := C_{driveway} \cdot I_{10Post} \cdot Area_{ROW} = 3.466\ \frac{L}{s}$

$Vol_{Q10\_ROW} := Q_{10Post\_ROW} \cdot 3600\ s = 12.5\ m^3$ Total volume off ROW (AEP10%, 1 hour duration)

$Area_{Sr} := \pi \cdot (0.45^2)\ m^2 = 0.636\ m^2$ 900mm diameter pumice soak ring, 600mm deep

$Vol_{soak} := 4 \cdot Area_{Sr} \cdot S_r \cdot 1\ hr = 143\ L$ Volume lost to soakage in 1 hour for 4x soakage rings

$Vol_{store\_Lot} := Vol_{PerLot} - Vol_{soak} = 7.08\ m^3$ Storage volume required

$D_{Sr} := \frac{Vol_{store\_Lot}}{Area_{Sr}} = 11.135\ m$

$N_{Sr} := \frac{D_{Sr}}{3\ m} = 3.712$ Indicative soakage pits - 4 per Lot at 3m deep

$Vol_{store\_ROW} := Vol_{Q10\_ROW} - Vol_{soak} = 12.33\ m^3$ Storage volume required

$D_{Sr} := \frac{Vol_{store\_ROW}}{Area_{Sr}} = 19.39\ m$

$N_{Sr} := \frac{D_{Sr}}{4.8\ m} = 4$ Indicative soakage pits - x4 for ROW at 4.8m deep

In other areas and in cases where the catchment is longer than 1.0km, separate estimates of time of overland flow and time of road channel flow shall be calculated using the following approach:

a) The time of overland flow is to be calculated by the formula:

$$t = \frac{100nL^{0.33}}{S^{0.2}}$$

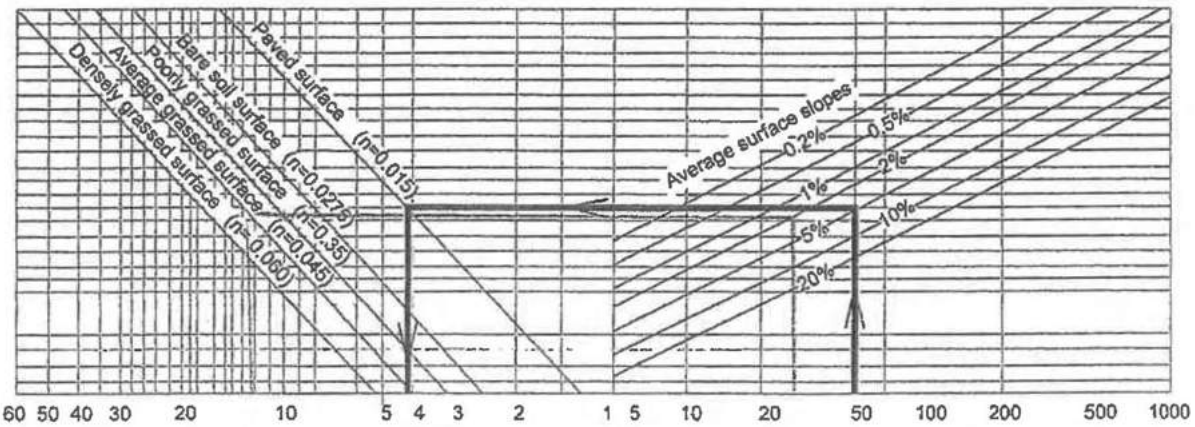
where

t is the time in minutes
L is length of overland flow in metres
S is slope in percent
n is the value for surface roughness

The results from this formula, for normal surface types, are shown in Figure 5.1.

b) The time of road channel flow is the time taken for water to flow from the point of entering the road channel to the point of discharge to a sump, catchpit, drain or other outlet. Figure 5.2 may be used to obtain the time of flow.

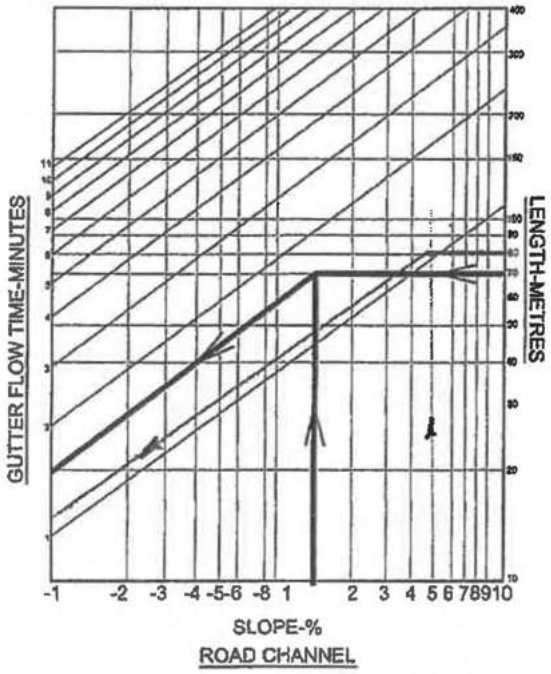
Figure 5.1: Times for Overland Flow



Example: for surface water flowing 50m over a paved surface at a slope of 5%, the time of travel is 4.1 minutes

Grass : 12min.
2% for 30m

Figure 5.2: Road Channel Flow Times



Example: For a slope of 1.4% and a road channel length of 70 metres the time of road channel flow is 1.7 minutes

Road
80m @ 5%
Toc - 1minute.

Time of Pipe Flow

The time of pipe flow can be calculated from Figure 3 which is based on Manning's formula with n = 0.013. To follow this procedure, longitudinal sections are required of the piped systems, giving internal pipe diameters, lengths and gradients.

For preliminary calculations, if there is little detail of the final pipe systems, average pipe flow velocities of 3m/s for moderate to steep gradients and 1.5m/s for low gradients may be used.

5.4.10.1 Time of Open Channel Flow

The time of flow in open channels (either watercourses or line channels) is calculated by means of Manning's formula.

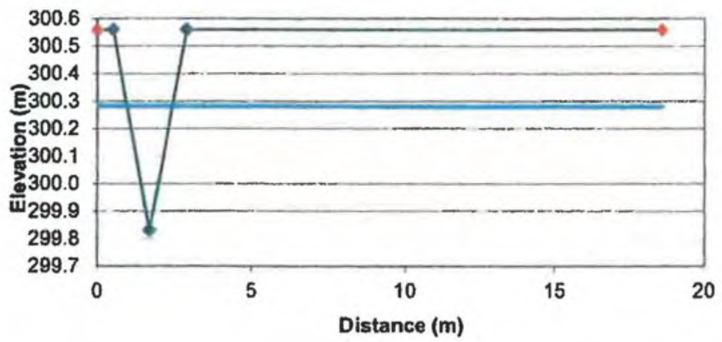
If there is insufficient data to calculate the time of open channel flow, the approximate natural stream velocities as given in Table 5.4 are recommended for channels that are not severely restricted by meanders or fallen and tangled trees and other vegetation.

Channel Capacity Analysis

Environment Bay of Plenty REGIONAL COUNCIL

Stream Name: **Overland flowpath**
Reference: Lots 1 & 2
Location: 73 Sophia Street
Date: 27-Aug-18
Calculated: Jacob Saathof
Remark:

Slope (m/m)	0.0100
Mannings n LB	0.0300
Mannings n MC	0.0300
Mannings n RB	0.0300
Divider LB (m)	0.00
Divider RB (m)	18.60
Water Level (m)	300.28



Coordinates		Left Bank		Main Channel		Right Bank	
Distance	Elevation	Area	Perimeter	Area	Perimeter	Area	Perimeter
(m)	(m)	(m²)	(m)	(m²)	(m)	(m²)	(m)
0.00	300.56						
0.50	300.56			Above WL			
1.70	299.83			0.17	0.87		
2.90	300.56			0.17	0.87		
18.60	300.56			Above WL			
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
				0.00	0.00		
Totals		0.00	0.00	0.33	1.73	0.00	0.00
Hydraulic Radius (m)				0.19			
Velocity (m/s)				1.11			
Flow (m³/s)		0.00		0.37		0.00	
Total Flow (m³/s)		0.37					

- Ponding level ~ 300.350 m asl.

  Depth at property boundary - 300.46
  - 299.87
  0.59 m

- Swale flow level

  Depth flow in swale ~ 0.45 m

  Swale invert at flow ~ 300.169

  Max water level in swale = 300.169
  + 0.45
  300.62 m asl.

∴ critical depth is swale flow

Pond RL < Swale RL

Building code EI / UMI note: 4.3.1

Level of floor height must be 500mm above water RL

Building floor level for Lots 1 & 2

= 300.62
+ 0.5
301.12 m asl.

cheal	Notes		Drawing Title: Stormwater Assessment 72 Sophia Street	
			Drawing Number:	
	Designed	Checked	Approved	Date	Scale

CHEAL CONSULTANTS

PROJECT: Hilton Family Trust
LOCATION: 72 Sophia Street, Rotorua
JOB NO.: 18165
GROUND SURFACE (RL):

BOREHOLE NO: HA01
DATE EXCAVATED: 21 August 2018
EXCAVATED BY:
LOGGED BY: JS

DEPTH (m)	DESCRIPTION OF STRATA
0	Topsoil, fine SAND with some silt, moist, uniformly graded
0.3	Medium SAND with some coarse pumacious sand, greyish brown, moist, poorly graded
0.4	Silty fine SAND, orangish brown, moist, uniformly graded, minor alophane content
0.65	Silty fine SAND, yellowish grey, cohesive, moist, minor alophane content
1	Fine to medium SAND with minor fine pumacious sand, yellowish grey, moist, well graded
1.7	Coarse pumacious SAND with some fine gravel, light grey, moist, poorly graded
	END OF BOREHOLE AT 1.9m.

LEGEND

DEPTH (m): 0.0, 1.0, 2.0

SAMPLES

Scala blows/100mm: 0, 5, 10, 15, 20

Scala Number:

PAGE 1 of 1

cheal

Percolation test evaluation

Project name: Hilton Subdivision
Location: 72 Sophia Street
Project number: 18165

Test number: 1
Prepared by: JS Date: 21/08/2018
Checked by: Date:

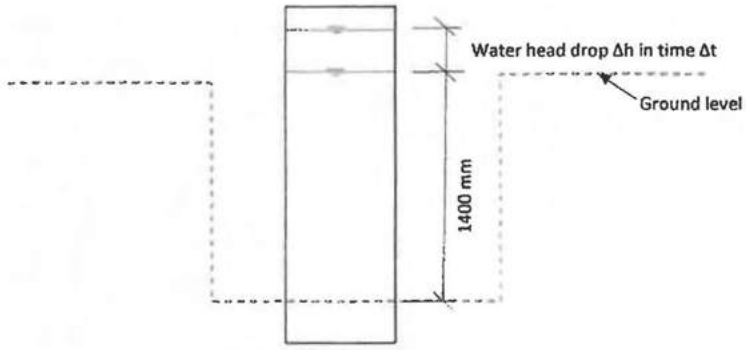
Used equation

$$k = \frac{\Delta h * 60}{\Delta t}$$

Where:

k	Permeability [mm/h]
Δh	Change in water level [mm]
Δt	time [min]

Input parameters:



h	Water head drop [mm]
t	Time from the start of measurement [min]

Calculation

Input data:

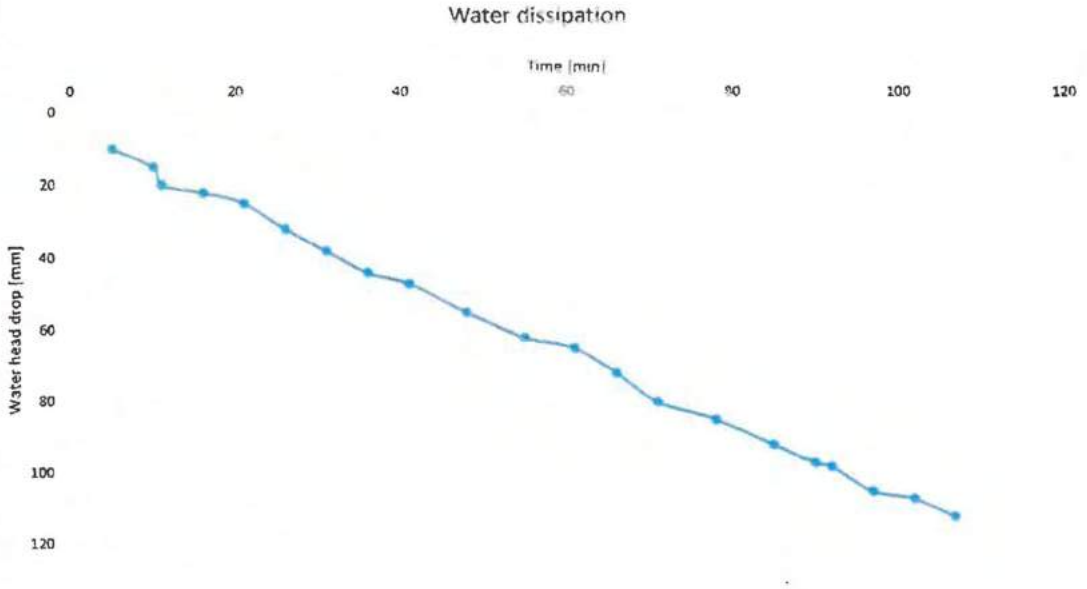
Water head drop [mm]	Time [min]	Permeability [mm/h]
10	5	120
15	10	60
20	11	300
22	16	24
25	21	36
32	26	84
38	31	72
44	36	72
47	41	36
55	48	69
62	55	60
65	61	30
72	66	84
80	71	96
85	78	43
92	85	60
97	90	60
98	92	30
105	97	84
107	102	24
112	107	60
117	112	60
125	117	96
130	125	38

Calculated minimum permeability:

k_{min}	24 mm/h
$k_{average}$	56 mm/h

56

cheal

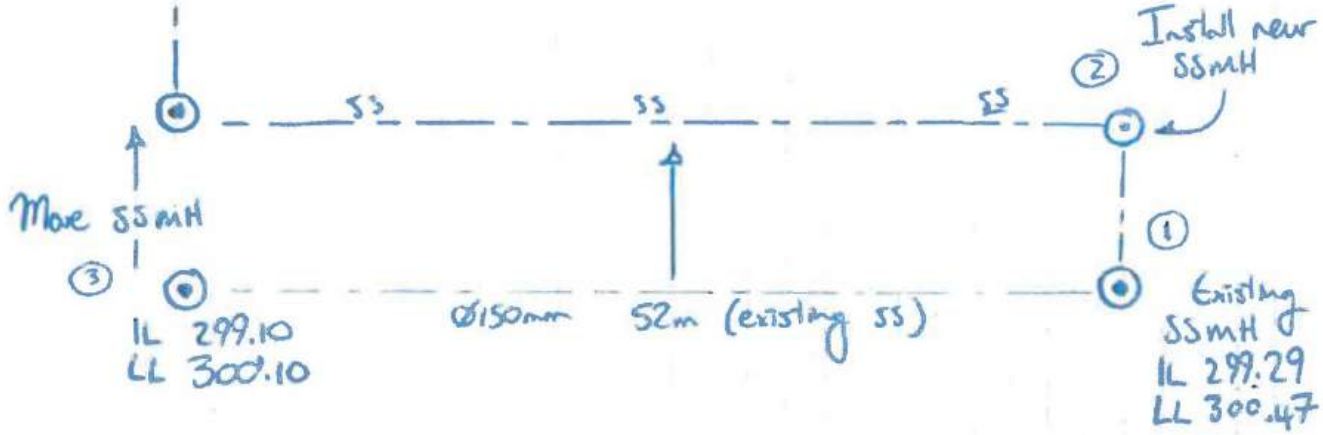


cheal

Appendix 2

Sanitary Sewer
Calculation Sheets

Sanitary Sewer.



90° bend 28mm drop.

SSMH 1) Lowest inflow pipe ~ 300.47
- 1.14
RL 299.33

SWMH 3) Current position of inflow 399.10
- 0.90
298.2

Δh = 299.33 - 298.2 = 1.13

Existing grade of SS - 1.13/52
= 2.17 %

Install new SSMH (2) ~ 5.5m north

IL Ø150 inflow into SSMH (2) - 299.33
0.28 (90° bend)
- (5.5 × 0.0075) (pipe grade)
299.00

IL Ø150 - SSMH 2 - 3
= 299.00
- 0.28
298.72

Maximum achievable grade
298.72 - 298.2 = 0.52 → 0.52/52
= 1% > 0.7

cheal	Notes: Hilton Family Ltd, 72 Sophia Street, Rotorua		Drawing Title: Sanitary Sewer Calculations	
			Drawing Number:	
	Designed	Checked	Approved	Date / Scale

Appendix 3

Telecommunications and Power Reticulation Confirmation Letters

Chorus Network Services
PO Box 9405
Waikato Mail Centre
Hamilton 3200
Telephone: 0800 782 386
Email: tsg@chorus.co.nz

2 August 2018

Chorus Ref #: RO47608
Your Ref #:

C/- Cheal Consultants Ltd
1180 Amohia Street, ROTORUA 3010

Attention: **Jake Saathof**
Dear Sir / Madam

SUBDIVISION RETICULATION – RO: 72 Sophia Street, Glenholme. 4 Lots (Lots 1-3 New, Lot 4 Existing) - Simple Estimate

Thank you for your enquiry regarding the above subdivision.

Chorus is pleased to advise that, as at the date of this letter, we would be able to provide ABF telephone reticulation for this subdivision. In order to complete this reticulation, we require a contribution from you to Chorus' total costs of reticulating the subdivision. Chorus' costs include the cost of network design, supply of telecommunications specific materials and supervising installation. At the date of this letter, our estimate of the contribution we would require from you is $4,140.00 (including GST).

We note that (i) the contribution required from you towards reticulation of the subdivision, and (ii) our ability to connect the subdivision to the Chorus network, may (in each case) change over time depending on the availability of Chorus network in the relevant area and other matters.

If you decide that you wish to undertake reticulation of this subdivision, you will need to contact Chorus (see the contact details for Chorus Network Services above). We would recommend that you contact us at least 3 months prior to the commencement of construction at the subdivision. At that stage, we will provide you with the following:

- confirmation of the amount of the contribution required from you, which may change from the estimate as set out above;

- a copy of the Contract for the Supply and Installation of Telecommunications Infrastructure, which will govern our relationship with you in relation to reticulation of this subdivision; and

- a number of other documents which have important information regarding reticulation of the subdivision, including - for example - Chorus' standard subdivision lay specification.

Yours faithfully

Ray Riady
Network Services Coordinator

Project Number: 145893
Phone: 0800 286 476
Email: new.connections@unison.co.nz

17 August 2018

Attention: Jake Saathof

By email to: jakes@cheal.co.nz

Dear Sir,

72 SOPHIA STREET, ROTORUA - CS - NEW POS X 4

I am writing in response to your email.

This letter outlines the engineering design, network reticulation and point(s) of connection required for your project. It includes the payment required for Unison to undertake these works.

1. Background

Jake Saathof has requested 4 new points of supply at 72 Sophia Street in Rotorua.

2. Scope of Unison Networks Limited ("Unison") works required

In order to provide network reticulation and point(s) of connection for your new subdivision, the following project works ("Project") have been allowed for:

- Upgrade the road crossing between poles 301683 and 234134
- Upgrade the main Low voltage conductor between pole 301683 and pedestal 501466
- Upgrade pedestal 501466 and install 3 x 63A fuses for the new lots

The Project will be reticulated as per the attached plan.

3. Supply Capacity

The capacity of the network connection to be provided by Unison is:

Single-phase 60 amps per lot

Please liaise with your electrician to ensure this meets your requirements for this network connection and power supply.

4. Tariff

Based upon the above supply capacity, it is anticipated that your connection will be in the **M12 load group**. Your energy retailer will be billed the distribution and transmission charges applicable to this load group.

Unison's Capital Contributions Policy, Pricing Policy and Tariff Schedule are available on Unison's website[1].

5. Quotation

The cost to complete the Project is given below:

Total cost of Project to Unison	$14,568.76 + GST
Payment required from Customer	**$8,741.26 + GST**

[1] http://www.unison.co.nz/tell-me-about/unison-group/publications-disclosures/pricing-information/pricing-disclosures

A payment is required from you towards the full cost of the project and is calculated based upon the total project cost, estimated new load, usage and applicable tariff.

Please note, unless otherwise specified within this letter this quotation does not include any livening costs, inspection costs, and does not include the supply and installation of the service main or the termination of the service main to the network fuse.

You will need to liaise with your retailer and electrician to arrange these activities.

6. Terms & Conditions for this Project

a) Variations

Any subsequent changes to the connection requirement or non-compliance with the terms and conditions contained in this letter may result in delays to the final completion date and an increase in the quoted price. Unison reserves the right to alter the payment required from you in such a case.

b) Ownership of Assets

All distribution assets installed by Unison or its sub-contractors remain the property of Unison and Unison will carry out all future maintenance requirements.

c) Payment

Payment is required in full with the signed acceptance prior to the work being issued to Unison's contractor.

d) Project Timing

Project timing is dependent on receipt of consents and permits from local authorities, the sourcing of materials plus the availability of our contractor.

At this time we would expect our contractor to be in a position to commence work on site approximately **40 working days** after receiving your signed acceptance and payment.

e) Quote Validity

This quotation is subject to the terms and conditions set out in this letter and is valid for one month from the date of this letter.

7. Next Steps

If you wish to proceed with this project, please complete, sign and return the attached acceptance, signed easement authority along your payment.

Should you require any additional information please do not hesitate to contact the undersigned or the Customer Care team on new.connections@unison.co.nz

Yours sincerely,

B Carthew

Brad Carthew
CUSTOMER PROJECT PLANNER
UNISON NETWORKS LIMITED

Site Plan

Project Number: 145893
Date: 17 August 2018

FROM: Attention: Jake Saathof

TO: Customer Care Team
Unison Networks Limited
PO Box 555
HASTINGS 4156

Email: new.connections@unison.co.nz

72 SOPHIA STREET, ROTORUA - CS - NEW POS X 4
ACCEPTANCE OF QUOTATION

I accept the price quoted of **$8,741.26+ GST ($10,052.45 incl. GST)** and agree to pay this cost upfront.

I have read, understand and agree to Unison's Terms and Conditions for this Project and Unison's Terms and Conditions for a New Customer Connection or Alteration attached. In the event of a conflict of terms, the Terms and Conditions for this Project set out in the offer letter shall prevail. On receipt of payment please proceed with planning for the above project.

Unison Invoice Coding:	
Capital Contrib. 400530	☒
Opex Contrib. 410510	☐

Direct Credit Details:

Company: Unison Networks Limited
Bank: ASB Hastings

Account: 12 3113 000 1628 00

Please use the following reference: 145893

Duly Authorised Signatory: _____

Name Authorised Signatory: _____

State position held: _____

Date: _____

PERSON/COMPANY TO BE INVOICED
Please spell out your **full** name, initials will not be accepted.

Full Name or Company Name (and Company Number) to be invoiced:	Full Name of Contact Person for this project (if different from invoicing details in left hand column)
_____	_____
Address	Address
_____	_____
_____	_____
Phone _____	Phone _____
Fax _____	Fax _____
Email _____	Email _____

TERMS AND CONDITIONS FOR A NEW CUSTOMER CONNECTION OR ALTERATION

1. Definitions

Unless the context otherwise requires, the following expressions shall have the following meanings:

(a) "Agreement" means the agreement formed between Unison Networks Limited and the Customer by the Customer completing and signing the Unison Request for a New Customer Connection Or Alteration ("Customer Request Form"), of which these Terms form a part;

(b) "Customer" means that Applicant described on the NC1 Form, or where an NC 1 Form has not been completed, the Applicant for this new customer connection or alteration, and includes any employees, agents, contractors or other representatives of the Customer;

(c) "Customer Request Form" means that form completed by the Customer in relation to the Requested Services; in the case of a new customer connection or alteration this is the NC 1 Form.

(d) "Electrical Installation" or "Electrical Installations" means "Electrical Installation" as defined by the Electricity Act 1992 and includes privately owned service main overhead lines and conductors;

(e) "Fee" means that fee payable by the Customer in relation to the Requested Service as determined at Unison's sole discretion and as advised by Unison to the Customer, and unless expressly stated otherwise shall be exclusive of GST (if any);

(f) "Force Majeure Event" means any war, riot, strike, natural or man-made disaster or other circumstance of a similar nature;

(g) "GST" means goods and services tax imposed under the Goods and Services Tax Act 1985;

(h) "Location Plan" means a plan or plans prepared using Unison's records which provides an indication only of the location of electricity Works that were installed by Unison or on behalf of Unison or Unison's predecessors;

(i) "Requested Service" or "Requested Services" means that service or services requested by the Customer;

(j) "Unison" means Unison Networks Limited and includes any employees, agents, contractors, wholly owned subsidiaries or other representatives of Unison;

(k) "Works" means "Works" as defined by the Electricity Act 1992 and owned by Unison and includes lines, cables and other fittings that are used, or designed or intended for use, in or in connection with the generation, conversion, transformation, or conveyance of electricity;

(l) ""Unison's Network Area" means the area served by Unison's electricity distribution network in Hawke's Bay, Taupo and Rotorua as shown in the network area map available on Unison's website and which is subject to change from time to time.

2. Point of Supply

Unison is an electricity lines owner. It owns lines, cables, and equipment used in the electricity network up to the point of supply ("POS"). The POS is often located on the boundary of the Customer's property.

All distribution assets installed by Unison or its subcontractors remain the property of Unison and Unison will carry out all future maintenance requirements.

Unison is not responsible for the installation, connection to the POS, inspection, livening, maintenance, or repairs of the service cable. The Customer's service cable generally runs from the POS through the Customer's property and to the building or location where electricity is supplied by the energy retailer and consumed by the Customer. If necessary, please discuss this with an electrician and/or energy retailer.

3. Assessment

Upon receipt of the NC 1 form, Unison will undertake an assessment of the Customer's application for a network connection POS (the "Assessment"). The Assessment may (in Unison's sole discretion) include:

(a) Determining whether a POS already exists or is adequate for the proposed use;

(b) If a POS does not already exist, considering the electrical works that may need to be constructed to establish the POS;

(c) Determining the documentation and payments that Unison will require from the Customer to establish the POS;

(d) Determining any administration charges that may be applicable to issue the ICP and authorize livening;

In undertaking the Assessment, Unison shall be entitled to rely on all information provided by or on behalf of the Customer in the NC 1 form.

Any subsequent changes to the attached plans or non-compliance with these terms and conditions may result in delays to the final completion date and an increase of the quoted price. Unison reserves the right to alter the capital contribution required from the Customer in such a case.

4. Provision of Supply

The Customer's application to be connected to Unison's electricity network affects two companies: the network company, Unison, and the energy retailer nominated by the Customer. The two companies require time to complete their respective procedures and to set up connection details.

After Unison has performed its Assessment, Unison will notify the Customer of what is required to establish the POS and the relevant timeframes.

5. Costs

In most instances, Unison will require a contribution from the Customer for the costs associated with the capital works undertaken to establish a POS. After completion of the Assessment, Unison will notify the Customer of these costs or an estimate of these costs payable by the Customer. Details of Unison's Capital Contributions Policy are available at www.unison.co.nz.

Unison is not responsible for OS1010 Certified Livening Agent costs, inspection costs, the supply and installation of service mains, any legal costs arising (including any easement costs) or the cost of obtaining any necessary consents required.

Payment of the capital contribution and easement costs are required in full with the signed acceptance and easement authority prior to the work being issued to Unison's contractor.

6. Project Timing

Project timing is dependent on receipt of consents and obstruction clearances from local authorities, the sourcing of materials plus the availability of our contractor.

7. Privacy Act

The Customer authorises Unison to collect, retain, use and disclose any personal information about the Customer (including the information collected in the NC 1 Form) for the following purposes (in addition to any purposes otherwise authorised by law):

(a) enabling Unison to establish the POS requested by the Customer;

(b) assessing the Customer's creditworthiness;

(c) disclosing to a third party details of this application and any subsequent dealings the Customer may have with Unison for the purpose of recovering amounts payable by the Customer, ascertaining at any time the Customer's creditworthiness, obtaining at any time credit statements, providing credit references, or enabling a credit reporter to maintain accurate records about the Customer;

(d) marketing goods and services offered by Unison to the Customer;

(e) administering, whether directly or indirectly, Unison's agreements with the Customer and enforcing Unison's rights thereunder;

(f) enabling Unison to communicate with the Customer for any purpose.

The Customer, if an individual, has a right of access to that Customer's personal information held by Unison. The Customer may request correction of that information and may require that the request be stored with that information. Unison may charge reasonable costs for providing access to that information.

8. Access to the Site

The Customer must ensure that, for the purposes of Unison performing the Assessment:

(a) Unison will be entitled to access the Site and any land owned by Third Party Land Owners as is reasonably necessary for Unison to undertake the Assessment; and

(b) Unison will be entitled to rights of ingress to, and egress from, the Site and any land owned by Third Party Land Owners.

The Customer undertakes to Unison no significant hazard within the meaning of the Health and Safety in Employment Act is known to exist upon or in relation to the Site or the land owned by Third Party Land Owners.

9. Subcontractors

Unison may engage a subcontractor or subcontractors to perform the Assessment or any part of it. Unison will be responsible for the works of all subcontractors.

The Customer must not give instructions to any subcontractor in respect of the Assessment.

10. Suspension of Assessment

Unison may suspend the Assessment in the event that:

Any payment is due by the Customer to Unison;

(a) Any Unison employee, representative, contractor and/or agent apprehends that the Site is unsafe for the purposes of the Assessment for any reason whatsoever, including without limitation:

(i) Where a significant hazard may exist at the Site; or

(ii) Where the Customer or any third party threatens, harasses or assaults any Unison employee, representative, contractor and/or agent in the course of Unison undertaking the Assessment;

(b) Unison apprehends that there is a threat or damage or destruction of Unison property in the course of Unison undertaking the Assessment.

11. Limitation of Liability and Indemnity

Notwithstanding anything at law or in equity to the contrary but subject to clause 10 of these terms and conditions:

(a) Unison (including, without limitation, Unison's directors, employees, representatives, contractors and/or agents) will not be liable for any direct, indirect or consequential loss suffered by the Customer arising howsoever from:

(i) Unison relying on the information provided by or on behalf of the Customer in the NC 1 form;

(ii) Delays in the establishment or alteration of any POS;

(iii) The performance of the Assessment;

(iv) Any failure resulting in any works failing to operate at all or otherwise to reasonable industry standards for any reason whatsoever (including, without limitation, negligence).

(b) Unison's liability arising from performing the Assessment and all related matters (whether arising under contract, tort (including negligence), equity or otherwise) will be limited to, at Unison's election, the costs paid by the Customer to Unison in order to establish the network connection/POS requested on the NC 1 form;

(c) The Customer indemnifies Unison against all and any claim(s) by any third party for losses, including costs, (whether arising under tort (including negligence), equity or otherwise) arising from any act of, or omission by, Unison in its performance of the Assessment or establishment of the POS in accordance with this NC1 form.

12. Consumer Guarantees Act

Nothing in these terms and conditions are intended to have the effect of contracting out of the Consumer Guarantees Act 1993 (the "CGA") save to the extent permitted by the CGA and these terms and conditions are to be modified to give effect to that intention.

Where the network connection/POS is supplied or altered for business purposes the Customer acknowledges that the CGA does not apply.

13. Variations

No variation or amendment to these terms and conditions is effective unless it is in writing and signed by all the parties.

14. No Representations

The Customer acknowledges that the Customer has completed the NC 1 form relying on the Customer's own judgement and that the Customer has not completed the NC 1 form relying upon any representation (express or implied) made by Unison.

15. Authority to Sign

The Customer warrants that the Customer is legally entitled to complete the NC 1 form and apply for network connection in relation to the Site.

The person that signs the NC 1 form for and on behalf of the Customer, if that person is not the Customer, warrants that he or she is legally entitled to sign the NC 1 form on behalf of the Customer and indemnifies Unison from any loss in the event that the person is not so authorised.

16. Governing Law

These terms and conditions are governed by the laws of New Zealand and the parties submit to the exclusive jurisdiction of the New Zealand courts in respect of all matters relating to the Customer's application for network connection / alternation / POS.

17. Easement

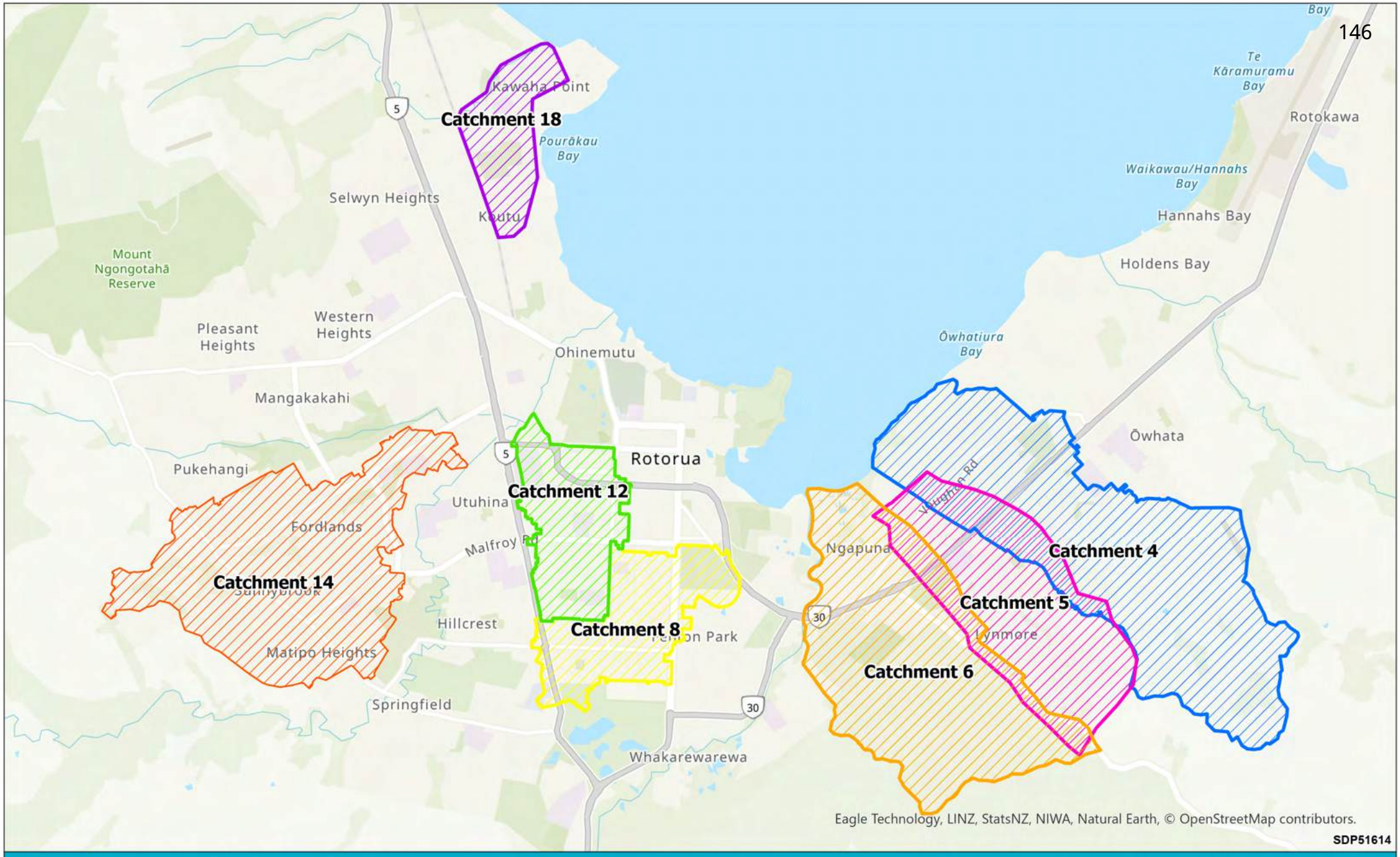
Unison requires an easement over any assets that are installed on private property. The Customer agrees to provide Unison with an easement over the land where these assets are located, on Unison's standard terms and conditions for easements. The Customer is responsible for the costs, including Unison's legal costs, of obtaining any easement required.

In some occasions it is also necessary for Unison to obtain an easement from a Customer's neighbour whose property will be affected by the construction of electrical works. In that event, Unison and the Customer must enter into a deed of grant of easement with the affected neighbour to ensure that Unison is able to secure ownership of and access to the works as well as the right to convey electricity and data through them.

18. Complaints

(a) If you have any concerns or complaints about Unison's service please contact us. Unison has an in-house complaints handling process that is free for you to use. Please contact the Unison Customer Care Team on 0800 2 UNISON (0800 286 476) 8.00am-5.00pm Monday – Friday, or by post to Unison Networks Ltd, Attention: Customer Care Team, PO Box 555, Hastings 4156. Unison will acknowledge your complaint within two working days of receiving it. We will advise you of the name and contact details of the Unison staff member who will investigate your complaint or respond to your enquiry. We will endeavour to resolve your complaint or enquiry within seven working days of receiving it. If your complaint is not resolved in this timeframe we will provide you with an update and seek to resolve it within twenty working days. Should the matter take longer to resolve, we will inform you of the reasons and at all times endeavour to keep you updated on progress.

(b) If Unison has not resolved your complaint within twenty working days you have the option of contacting the Electricity and Gas Complaints Commissioner ("EGCC"). The EGCC's office provides a free and independent complaints handling service for electricity and gas complaints about New Zealand electricity and gas companies that are members of the Scheme. Unison is a member of the EGCC Scheme. Please contact the office of the EGCC, PO Box 5875, Lambton Quay, Wellington 6145, ph 0800 22 33 40 or visit their website for more information www.egcomplaints.co.nz or email info@egcomplaints.co.nz if you are dissatisfied with the outcome of your complaint or if we have not resolved it within twenty working days.



Flood Model Catchments

N NZTM Projection

0 500 1,000 1,500 2,000 Meters

ROTORUA LAKES COUNCIL
Te kaunihera o ngā roto o Rotorua

Path: G:\Project\SDP51xxx\SDP51614\StormwaterCatchments\StormwaterCatchments.aprx Printed Date: 28/07/2021

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice

Flooding

Q2 **My submission is:**

Long Text

I am writing to oppose the aspects of Plan Change 8 that relate to flood hazard mapping for Lake Ōkāreka, as they currently fail to take into account major mitigation infrastructure completed in 2021.
In 2021, significant works were undertaken by Bay of Plenty Regional Council to manage and control lake levels at Lake Ōkāreka. These upgrades were specifically designed to prevent a repeat of the 2017 flood events and included robust engineering solutions with the express purpose of mitigating flood risk — even when accounting for future climate change projections.
At the time, engineering assessments confirmed that the outlet upgrades fully addressed the flooding risks for the surrounding area. However, Plan Change 8 appears to rely solely on historic lake level data ending in 2020, before these works were completed. The flood modelling used is therefore outdated and fails to incorporate this major infrastructure investment, resulting in incorrect flood overlays that now classify our property as high-risk.
This is not only inaccurate, but deeply concerning for our family — both in terms of insurance eligibility and long-term property value. If the current modelling is adopted without amendment, our property may be unfairly restricted or penalised for a flood risk that has already been effectively mitigated.

Amendments Sought:
That Rotorua Lakes Council urgently reviews and updates its flood modelling for Lake Ōkāreka to incorporate the post-2021 mitigation infrastructure completed by the Bay of Plenty Regional Council.
That hazard overlays for affected properties — including ours — be reassessed in light of these upgrades to ensure they reflect the true and current risk profile.

Reason for Amendment:
The current modelling creates an inaccurate and unjust representation of flooding risk, ignores significant public investment in mitigation, and imposes unnecessary hardship on property owners.
Thank you for the opportunity to provide feedback. We ask that this submission be fully considered, and that flood modelling is updated to reflect the substantial improvements already made to protect this area.

Q3 **What changes do you want made to the District Plan?**

Long Text

I request that the flood hazard overlays for Lake Ōkāreka be revised to reflect the 2021 flood mitigation works completed by the Bay of Plenty Regional Council.
Specifically, the District Plan should:
Update the flood modelling used for hazard mapping to incorporate the post-2021 lake level control infrastructure.
Remove or amend the high flood risk designation on properties where risk has been demonstrably reduced by this engineering work.
Ensure that any future assessments are based on current and comprehensive data, not just pre-2021 historic records.
These changes are necessary to ensure that the District Plan accurately reflects the true, current flood risk, and does not unfairly disadvantage property owners who are now at significantly lower risk due to recent mitigation investments.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload

Q5 **Tō Ingoa | Name**

Short Text

Brad Insull

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice

No

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice

Yes

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice No

Submission (3 pages) to:
Rotorua Lakes Council
1061 Haupapa Street
Rotorua, New Zealand
info@rotorualc.nz

RE: Rotorua District Plan Change 8

From:
Martin Caughey

[redacted]

I am an affected party to the Plan Change. Lake Okareka has been an integral part of my life since early childhood and spanning some 70 years. I have owned property there for almost 50 years, including 95 Acacia Road, for close to 40 years. The house was built some 95 years ago and, along with the land, has never suffered damage from a fault event. The peninsula landform was reshaped in the 1930s when the subdivision was approved and the road was completely re-routed, hence dramatically altering the original landscape, which remains to this day.

95 Acacia Road is included in the mapping of the Fault Rupture Hazard area in Acacia Road. It is also a lakeside property and while not at risk from flooding, sections of the plan change are misleading and of concern, and to the wider community.

In particular, I oppose the proposed provisions as outlined below, of Plan Change 8

Maps:

1. The mapping of areas of natural hazard at Lake Okareka Rotorua.

   a) **Fault Rupture** - In particular the mapping of an apparent Fault Rupture and Hazard Area is opposed. This includes Acacia Road and Pryce Road on the Lake Okareka Peninsula.

   Reason:

- The relevant National Policy Statement is in draft and open for consultation

- There is no regional direction by way of a regional plan or a regional policy statement regarding fault rupture provisions
- The proposed provisions of Policy SDNH-P1 are not complied with in the proposed controls.
- The fault nor fault recurrence has not been defined; the risk is in the return period that is unknown
- There is limited data on the probability of fault rupture
- Mapping faults has limitations
- There are other options to manage risk
- It is premature to introduce a plan change of this nature, when higher level bodies do not yet have strategic measures in place both at central and regional level.
- The suggested Fault has not been dated. This is a key missing piece of information that would link to what government documents do exist, that would help categorise the risk.
- Mapping of inadequately identified Fault Ruptures places significant burden on property owners in terms of potential loss of value, ability to insure and at what cost, new development.

b) **Flood risks -** The identification of flood areas in the planning Maps is opposed–

- Plan Change 8 has utilized an outdated Bay of Plenty Regional Council Flooding Technical Report (2022) , on which to inform its mapping.
- The identified flood line in the map, extends the level of risk beyond necessity and is not supported by scientific evidence.
- The engineering work undertaken in 2021 increases the lake outflow, to reduce flooding risk. This, together with the natural artesian outflow into the Waitangi Stream, should have been taken into account to inform the Plan Change.
- The proposed provisions of Policy SDNH-P1 are not complied with in the proposed flood controls. The best available information/evidence has not been obtained.

Plan Change 8 is unnecessary and overregulates the unsubstantiated risk factors of land activity. The operative plan adequately covers natural hazard risks, until further technical reporting has been undertaken in both Fault and Flood identification and management. At this point, the relevance of mapping and rules must be reevaluated.

Wider risk factors include volcanic eruption and thermal activity. The entire volcanic plateau presents risks many of which cannot be mitigated by regulation.

Request:

- Remove reference in the Strategy, Objectives, Policies and Rules of the proposed Plan Change, relating to the risks of Faults Rupture Hazard and to Flooding.

- Existing building code regulation provides risk mitigation.
- The removal of the identification of Faults Rupture Hazard areas from the mapping in the plan change as applied to Lake Okareka.
- The removal of the identification of Flood risk areas from the mapping in the Plan Change.
- Recognition that there is currently inadequate evidence to support such mapping that places unnecessary burden and cost on landowners.
- Recognition that there are already adequate controls in place to address the above risks, until new evidence proves otherwise.
- There are alternative options to be considered in the management of risk in relation to faults and flooding. Request further research into options is undertaken.

Martin Caughey

Date 30/08/2025

I wish to be heard in support of this submission.

Q1 **Which parts of Plan Change 8 are you submitting on?**

Multi Choice: Fault Rupture

Q2 **My submission is:**

Long Text:

Red Stag Investments oppose specifically a fault line across its land. This opposition is founded on the following key points:
1. The designation is based on new GNS Science mapping that identifies a fault trace across the property for the first time. This trace is officially classified by GNS as having "uncertain" location.
2. The mapping methodology—a desktop assessment using LiDAR—is acknowledged by GNS itself to have significant limitations in environments like the Submitter's site, which is a former wetland with deep, unconsolidated deposits that conceal any geological features. There is no surface evidence of a fault on the property.
3. The standard pathway for a landowner to challenge or verify such a designation, through site-specific paleoforensic trenching, is scientifically impractical and likely to be inconclusive on this site. This places the Submitter in a position of procedural unfairness.
4. The application of the 'Fault Rupture Hazard Area' imposes certain, significant, and recurring economic costs (in engineering, design, and consenting) to mitigate a hazard whose location is uncertain and whose recurrence interval is very long (RI Class IV, c. 7400 years). This represents a disproportionate and inefficient regulatory response that is inconsistent with the principles of the RMA.

Q3 **What changes do you want made to the District Plan?**

Long Text:

Sspecific amendments to the provisions of PC8 to introduce a more nuanced, evidence-based, and equitable pathway for properties with these unique geological and evidentiary characteristics. In the case of RSI land, remove the subject fault line.

Q4 **Tukuatu he puka wea ki konei | Upload a submission**

File Upload: https://participate.rotorualakescouncil.nz/download_file/2245

Q5 **Tō Ingoa | Name**

Short Text: Mitch Collins

Q8 **Do you wish to present your submission publicly at a hearing?**

Multi Choice: Yes

Q9 **If others make a similar submission, we will consider presenting a joint case with them at a hearing.**

Multi Choice: No

Q10 **We could gain an advantage in trade competition through this submission.**

Multi Choice: No

Submission on Proposed Plan Change 8 (Natural Hazards) to the Rotorua District Plan

FROM: Red Stag Investments (the Submitter)

TO: Rotorua Lakes Council (the Council)

DATE: 28 August 2025

SUBMITTER DETAILS:

- **Name:** Red Stag Investments
- **Address for Service:** c/o Mitch Collins, Red Stag Timber, PO Box 1748, Rotorua 3040

1.0 Introduction

1.1 The Submitter

Red Stag Investments is the owner and operator of the subject land at the entrance of the Waipa Valley. The wider business involving Red Stag Timber sawmill and processing facility are one of the largest and most technologically advanced structural timber producers in the Southern Hemisphere, and a cornerstone of the regional and national economy. The company is a significant local employer, a long-term investor in the Rotorua district, and a key participant in New Zealand's construction and forestry sectors. The Submitter has an interest in the development of a fair, efficient, and effects-based planning framework under the Resource Management Act 1991 (RMA) that enables the sustainable management and development of its significant landholdings and supports its ongoing contribution to the community's social and economic wellbeing.

1.2 The Affected Property

This submission relates specifically to the land parcels (Lots 1 & 2 DPS 64610) owned by Red Stag Investments located at Waipa State Mill Road and the Waipa Bypass Road, Rotorua. This extensive site accommodates the entirety of the Red Stag Investments public amenity areas operations, associated infrastructure, and areas

designated for future expansion and development (see Master Plan document – Appendix 1). The provisions of Proposed Plan Change 8 (PC8), particularly those pertaining to the management of fault rupture hazards, have direct and significant implications for the current and future use of this property.

Figure 1. Property lots owned by Red Stag Investments (Lots 1 & 2 DPS 64610)

1.3 Scope and Purpose of Submission

This submission is made pursuant to Clause 6 of the First Schedule of the Resource Management Act 1991. It addresses the objectives, policies, rules, and definitions contained within Proposed Plan Change 8. The primary focus of this submission is the introduction of the 'Fault Rupture Hazard Area' and its specific application to the Submitter's land. The purpose is to provide the Hearing Panel with a comprehensive analysis of the scientific, planning, and legal issues arising from this application and to seek specific, targeted relief that remedies the identified deficiencies in the proposed plan change.

1.4 Summary of Position

The Submitter supports the Council's overarching strategic intent to manage natural hazards using a risk-based approach founded on the best available information. The move away from static, outdated maps within the District Plan is a positive and efficient step.

However, the Submitter opposes the specific application of the proposed 'Fault Rupture Hazard Area' to its property. This opposition is founded on the following key points:

1. The designation is based on new GNS Science mapping that identifies a fault trace across the property for the first time. This trace is officially classified by GNS as having "uncertain" location.
2. The mapping methodology—a desktop assessment using LiDAR—is acknowledged by GNS itself to have significant limitations in environments like the Submitter's site, which is a former wetland with deep, unconsolidated deposits that conceal any geological features. There is no surface evidence of a fault on the property.
3. The standard pathway for a landowner to challenge or verify such a designation, through site-specific paleoforensic trenching, is scientifically impractical and likely to be inconclusive on this site. This places the Submitter in a position of procedural unfairness.
4. The application of the 'Fault Rupture Hazard Area' imposes certain, significant, and recurring economic costs (in engineering, design, and consenting) to mitigate a hazard whose location is uncertain and whose recurrence interval is very long (RI Class IV, c. 7400 years). This represents a disproportionate and inefficient regulatory response that is inconsistent with the principles of the RMA.

The Submitter therefore seeks specific amendments to the provisions of PC8 to introduce a more nuanced, evidence-based, and equitable pathway for properties with these unique geological and evidentiary characteristics.

1.5 Decision Requested

The Submitter requests that the Hearing Panel grant the relief detailed in Section 4.0 of this submission. The Submitter confirms that it wishes to be heard in support of

this submission at the scheduled hearing.

2.0 General Submission Points: Matters of Support

To assist the Hearing Panel, the Submitter wishes to first outline the aspects of Proposed Plan Change 8 that it generally supports. This demonstrates that the Submitter's concerns are specific and targeted.

2.1 Support for a Risk-Based Approach and Use of Best Available Information

The Submitter supports the proposed strategic direction of PC8, which seeks to embed a risk-based approach to the management of natural hazards.[1] The proposed objective SDNH-01, "The risks from natural hazards to people, property and the environment associated with land use, subdivision and development are acceptable," moves the plan towards a framework that aligns with national guidance. This approach correctly focuses on the level of risk rather than merely the presence of a hazard.

Furthermore, the principle of using the "best available information," as promoted in the proposed policy SDNH-P1, is strongly supported.[1] This principle is fundamental to sound resource management. A central argument of this submission, however, will be that a proper application of this principle requires not only using the latest data but also critically evaluating the confidence levels, limitations, and uncertainties inherent in that data, and ensuring the regulatory response is proportional to that level of confidence.

2.2 Support for Removing Static Hazard Maps from the District Plan

The Submitter supports the Council's proposal to remove outdated and static fault maps from the District Plan's planning maps and instead refer to an external, live database—the New Zealand Active Faults Database (NZAFD).[1] This is a pragmatic and efficient mechanism that prevents the District Plan from becoming quickly obsolete as scientific knowledge, data resolution, and mapping techniques evolve.[1] The GNS Science report itself, which supersedes the previous 2010 mapping, is a clear example of how rapidly this information can change.[1]

This approach allows for greater flexibility and ensures that decision-making is based on the most current scientific understanding. However, this reliance on an external database makes it critically important that the provisions of the District Plan are sufficiently nuanced to handle instances where the data within that database is acknowledged to be of low confidence or high uncertainty. The plan must contain mechanisms to address such situations fairly and efficiently, a matter which is at the core of this submission.

3.0 Specific Submission Points: Matters of Opposition and Concern

3.1 The Unsubstantiated Application of the Fault Rupture Hazard Area to Red Stag Land

3.1.1 The Critical Change in Mapped Hazard Status

The most significant issue for the Submitter is the fundamental change in the perceived natural hazard profile of its land. Under the previous planning framework, which relied on the GNS 2010 fault mapping (Villamor et al., 2010), the operational area of the Red Stag site was not identified as being crossed by any active fault traces.[1] Figure 2, derived from the Council's Geyserview mapping prior to the 2025 update, clearly illustrates this absence of mapped faults on the core industrial site.

Figure 2. Previous Fault Mapping (pre-2025 GNS update) showing no faults on Red Stag's operational land.

In stark contrast, the newly proposed framework is based on the GNS Science Consultancy Report 2025/02 LR, which utilizes updated high-resolution LiDAR data.[1] This new assessment has resulted in the mapping of a fault trace directly across the Submitter's property, as shown in Figure 3.

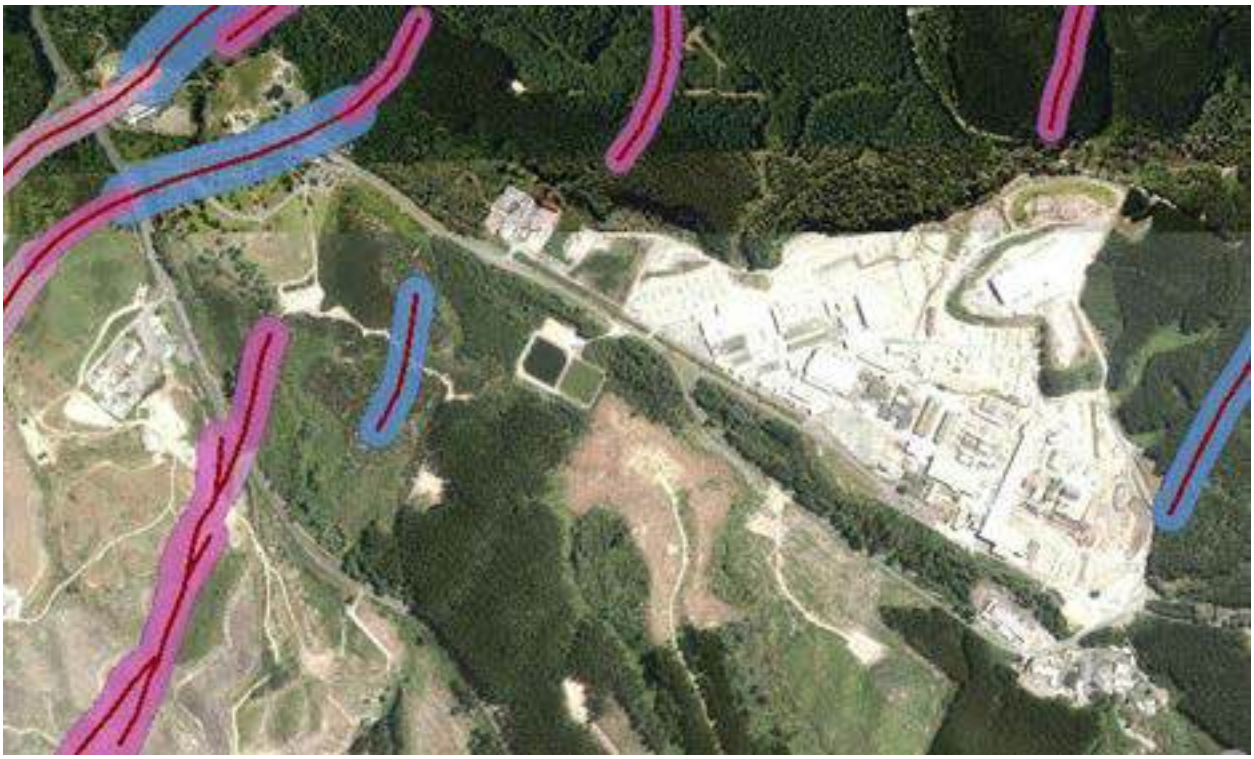


Figure 3. Updated 2025 GNS Mapping showing a newly identified fault trace and Fault Avoidance Zone crossing Red Stag's land.

This is not a minor cartographic adjustment; it is a profound re-characterisation of the land. It triggers the application of a new and significant regulatory regime under the proposed 'Fault Rupture Hazard Area' provisions in PC8, where previously none existed. This change, originating from a desktop study, has both immediate and material consequences for all future development, investment, and site management.

3.1.2 The Horohoro Fault: Classification and Inherent Uncertainty

The GNS report identifies the newly mapped feature as a trace of the **Horohoro Fault**.[1] The key characteristics assigned to this fault trace are central to the Submitter's position:

- **Recurrence Interval (RI):** The fault is assigned **RI Class IV**, which corresponds to an average time between surface-rupturing events of >5,000 years to ≤10,000 years.[1] The information provided to the Submitter indicates a specific recurrence interval of approximately 7400 years. This is a very low frequency of activity. According to the Ministry for the Environment (MfE) Guidelines, which are referenced by GNS and form the basis of the risk assessment framework, a

Class IV fault allows for the construction of buildings up to and including **Building Importance Category (BIC) 3** (e.g., schools, public assembly buildings, major commercial facilities).[1] While the Submitter has limited plans for BIC 3 structures, this classification does not remove the procedural, engineering, and cost burdens triggered by the hazard designation itself.

- **Fault Complexity:** The GNS report classifies the complexity of this specific fault trace as **"uncertain constrained"**.[1] This is a formal scientific classification defined by GNS as:
  "Areas where the location of fault rupture is uncertain because evidence has been either buried or eroded, but where the location of fault rupture can be constrained to a reasonable geographic extent (≤300 m)".[1]

The use of the term "uncertain" is not the Submitter's interpretation; it is the explicit, technical classification provided by the Council's own expert evidence base. The entire regulatory framework proposed in PC8 is therefore being applied to the Submitter's land based on a hazard whose very location is officially and scientifically acknowledged as uncertain. This creates a fundamental tension: the plan proposes to apply a set of certain rules, processes, and costs to mitigate a risk that is based on uncertain information. This approach fails to adequately address the RMA's requirement for a careful evaluation of the appropriateness of provisions where there is uncertain or insufficient information.

3.2 The Severe Limitations of the GNS Desktop Methodology for the Subject Site

The designation of the fault trace as "uncertain constrained" is a direct consequence of the methodology used and the specific geology of the Submitter's site. The GNS report is commendably transparent about the limitations of its own methodology.

3.2.1 GNS's Acknowledged Methodological Constraints

The GNS report was prepared as a district-wide desktop study, primarily utilizing high-resolution LiDAR data to identify geomorphic features indicative of faulting.[1] GNS explicitly states the challenges of this approach in the local geological context:

> "In the Taupo Volcanic Zone (TVZ), it can be difficult to (1) identify active faults at the surface via desktop-only studies... in volcanic regions, faults

> can be harder to map due to extensive, thick eruption deposits mantling the landscape... In the lower topographic areas (valleys and basins) in the south of the district, deposits from the Taupo eruption... have often buried the fault surface expression." [1]

The report further notes that fault traces may be classified as "concealed" where a fault is known to exist but is hidden beneath younger materials, or "inferred" where geomorphic features *suggest* the existence of a fault.[1] The mapping of the Horohoro Fault trace across the Red Stag site is a direct product of this inferential, desktop-based process, applied in a geological setting known to be challenging.

3.2.2 The Unsuitability of the Methodology for a Former Wetland Environment

The general limitations acknowledged by GNS are acutely relevant to the Red Stag property. The site is located on a low-lying alluvial plain and is known to be a former wetland area. Lake Rotorua once extended up the Puarenga and Waipa Valley. By its very nature, such an environment is characterized by deep, young, water-saturated, and unconsolidated alluvial and organic deposits. This geology is a textbook example of the "lower topographic areas (valleys and basins)" and areas with "buried" or "concealed" features that GNS identifies as being problematic for its LiDAR-based desktop mapping methodology.[1]

Any subtle surface expressions that might indicate a fault would have been obscured by millennia of sedimentation and peat formation, and more recently by site development. It is highly likely that a trench would not reveal this, even at significant depth. The LiDAR data, while high-resolution, is interpreting the modern ground surface, not the deep underlying geology where a fault might reside. Therefore, applying the Fault Rupture Hazard Area based on this low-confidence, inferential mapping is scientifically questionable and results in a potentially spurious designation.

3.2.3 The Verification Impasse: No Surface Expression and Inviable Trenching

The lack of confidence in the desktop mapping is compounded by an inability to verify or refute it using standard methods. Two critical facts create a procedural impasse for the Submitter:

1. **No Surface Expression:** There are no visible surface features—such as scarps, offset streams, or distinct vegetation changes—on the property that would signify the presence of an active fault trace. The mapped line is an inference without corresponding physical evidence on the ground.
2. **Inviability of Trenching:** The Council's FAQs for Plan Change 8 advise landowners who believe mapping is inaccurate to "submit site-specific evidence to GNS for consideration" from a "qualified geo-professional".[1] The primary method for generating such definitive evidence for a fault is paleoforensic trenching. However, due to the site's geology as a former wetland with a high water table and deep, unconsolidated, and poorly stratified soils, trenching is not a scientifically viable investigation technique. Any trench would be difficult to excavate and stabilize, and the soft sediments would not preserve the clear stratigraphic evidence of displacement needed to confirm or deny the presence, location, and activity of a fault.

This creates a significant "regulatory squeeze" and an issue of natural justice. The Council proposes to regulate the land based on a low-confidence desktop study. The standard process for a landowner to challenge this designation is to undertake a site-specific investigation. However, for this specific site, that pathway is scientifically impractical and would lead to an inconclusive result at great expense. The Submitter is therefore being subjected to a regulatory constraint that it cannot practically challenge or verify through the expected channels. The plan, as proposed, provides no alternative pathway for properties caught in this evidentiary trap.

3.3 The Disproportionate and Inefficient Economic Impact

3.3.1 The Certainty of Cost vs. the Uncertainty of Hazard

The designation of a large portion of the Red Stag site as a Fault Rupture Hazard Area has direct, certain, and significant economic consequences. Irrespective of the low probability of a rupture event, the hazard designation itself automatically triggers a cascade of procedural and financial burdens for every future development project on the affected land, including routine building extensions or the placement of new plant and equipment. These burdens include:

- **Mandatory Geotechnical Assessments:** Every building consent application for a new building or a significant extension will require a specific natural hazard assessment report from a suitably qualified geotechnical engineer, as mandated

by the proposed rules NH-R1(2)(b) and NH-R3(b).[1] This is a direct, upfront cost for every project.

- **Specialized Engineering Design:** To comply with Clause B1 (Structure) of the Building Code on land identified with a fault hazard, specific, non-standard foundation engineering design will be required.[1] This adds complexity, cost, and time to the design phase of all future structures.
- **Increased Consenting Risk and Cost:** Every resource consent application will be subject to assessment against the natural hazard matters of discretion. This introduces uncertainty into the consenting process, increases the cost of preparing applications, and creates potential for delays.
- **Impact on Property Valuation and Insurance:** The formal identification of a fault hazard on Land Information Memoranda (LIMs), as required by law, can negatively impact property valuation, financing, and the availability and cost of insurance.[1]

These are not potential or abstract costs; they are certain, immediate, and recurring costs that will be imposed on all future investment and development on the property from the moment PC8 becomes operative.

3.3.2 A Disproportionate Response Under the RMA

Section 32 of the RMA requires the Council to evaluate whether the provisions in a proposed plan change are the most appropriate way to achieve the objectives, including an assessment of their efficiency and effectiveness.[1] A provision that imposes significant and certain costs to mitigate a hazard that is officially classified as "uncertain," has a very long recurrence interval (Class IV), and for which there is no viable pathway for site-specific verification, cannot be considered an efficient or effective provision.

The response is disproportionate to the level of risk. The life-safety risk being managed is already extremely low, given the c. 7400-year recurrence interval and the industrial nature of the site, where the potential for BIC 4 structures is negligible. The primary and most certain effect of applying the 'Fault Rupture Hazard Area' to this site is the imposition of a significant economic and administrative burden on a key local industry. This fails the test of appropriateness under Section 32 of the RMA.

3.4 The Need for Nuance in the 'Fault Rupture Hazard Area' Definition

The Council's rationale for removing static maps from the plan is to allow for flexibility and the use of the best available information.[1] This logic is sound. However, the proposed definition of 'Fault Rupture Hazard Area' and its associated rules fail to apply this principle of flexibility consistently. The proposed framework does not contain a mechanism to account for situations where the "best available information" is, in fact, an admission of high uncertainty that cannot be resolved through standard practice.

The proposed definition of 'Fault Rupture Hazard Area' is a blunt instrument.[1] It applies the same regulatory consequences to a "definite" fault with clear surface expression and a well-understood recurrence interval as it does to an "uncertain, inferred" fault trace with no surface expression, a very long recurrence interval, and which exists only as a line on a map derived from a desktop study.

The plan needs a mechanism to differentiate between these scenarios. It must be flexible enough to handle this specific type of scientific uncertainty, where the evidence for the hazard is weak and the means of refuting it are unavailable. Without such a mechanism, the plan risks being arbitrary and unreasonable in its application to sites like that of the Submitter.

4.0 Relief Sought

4.1 Overall Decision Requested

The Submitter respectfully requests that the Hearing Panel amend the provisions of Proposed Plan Change 8 to provide a more nuanced, scientifically robust, and equitable approach for properties where fault traces are designated with a high degree of uncertainty and where site conditions preclude effective on-the-ground verification. The Submitter seeks a solution that avoids the imposition of a disproportionate regulatory burden based on uncertain information, consistent with the principles of the Resource Management Act 1991.

4.2 Specific Amendments to Provisions

To give effect to the matters raised in this submission, the Submitter requests that the following specific amendments be made to the proposed provisions of Plan

Change 8. The proposed amendments are set out in the table below.

Provision Number and Title	Proposed Wording in Notified Plan Change	Submitter's Proposed Wording (Additions Underlined, Deletions Strikethrough)	Reason for Amendment
Definitions - Fault Rupture Hazard Area	The area around an active fault trace that includes the likely area of fault rupture plus an additional width of at least 20m on either side to allow for secondary ruptures and uncertainty in the location of future deformation. Note: The Fault Avoidance Zones identified in the New Zealand Active Faults Database assist to identify the Fault Rupture Hazard Area but may be supplemented with other information.	The area around an active fault trace that includes the likely area of fault rupture plus an additional width of at least 20m on either side to allow for secondary ruptures and uncertainty in the location of future deformation. Note: The Fault Avoidance Zones identified in the New Zealand Active Faults Database assist to identify the Fault Rupture Hazard Area but may be supplemented with other information. This definition shall not apply to a property where a site-specific geotechnical assessment prepared by a suitably qualified and experienced geo-professional demonstrates to the satisfaction of Council that: (a) the fault trace is classified as 'uncertain' or 'inferred' in the New Zealand Active Faults Database; and (b) there is no surface expression of the fault on the property; and (c) the geological and hydrogeological nature of the site, such as deep alluvial or organic deposits, renders standard intrusive investigation techniques (such as trenching) scientifically impractical or inconclusive for the purpose of verifying the location and activity of the fault trace.	To provide a necessary and fair mechanism for sites where the hazard designation is based on low-confidence desktop inference and cannot be reasonably verified or refuted through standard site investigation, thereby avoiding the imposition of a disproportionate regulatory burden based on uncertain information. This amendment ensures the plan is efficient, effective, and reasonable in its application, consistent with Section 32 of the RMA.

Provision Number and Title	Proposed Wording in Notified Plan Change	Submitter's Proposed Wording (Additions Underlined, Deletions Strikethrough)	Reason for Amendment
NH-R1 Additions to existing buildings or replacement buildings in the Fault Rupture Hazard Area	...	... Note: This rule does not apply to a property where the definition of 'Fault Rupture Hazard Area' is determined not to apply in accordance with the exception provided in that definition.	To provide a clear cross-reference and ensure the rule is not applied where the qualifying criteria for the exception to the 'Fault Rupture Hazard Area' definition have been met.
NH-R3 New buildings in the Fault Rupture Hazard Area	1. Activity Status: Restricted Discretionary...	1. Activity Status: Restricted Discretionary... Note: This rule does not apply to a property where the definition of 'Fault Rupture Hazard Area' is determined not to apply in accordance with the exception provided in that definition.	To provide a clear cross-reference and ensure the rule is not applied where the qualifying criteria for the exception to the 'Fault Rupture Hazard Area' definition have been met.

5.0 Conclusion

Red Stag Investments is a committed and significant stakeholder in the Rotorua community and economy. The Submitter supports the Council's objective to implement a robust and evidence-based framework for managing natural hazards.

However, the application of the proposed 'Fault Rupture Hazard Area' to the Red Stag site is not sufficiently evidence-based. It relies on an inferential, desktop methodology that is acknowledged by its own authors to be of low confidence in the specific geological environment of the site. This designation, based on an "uncertain"

fault trace with no surface expression, creates a situation of procedural unfairness, as the standard methods of site-specific verification are scientifically unviable.

The consequence is the imposition of a certain, significant, and disproportionate economic and administrative burden on a key regional industry to mitigate a risk that is both highly uncertain and of very low probability. This outcome is inefficient, ineffective, and inconsistent with the principles of the Resource Management Act.

The relief sought in this submission provides a reasonable, targeted, and scientifically-grounded pathway to remedy this issue. It creates a necessary mechanism within the plan to deal with cases of high evidentiary uncertainty, ensuring that the regulatory response remains proportional to the demonstrated level of risk.

The Submitter respectfully requests that the Hearing Panel carefully consider the matters raised in this submission and adopt the amendments proposed.

Works cited

1. ECM_21393899_v6_Plan Change 8 Natural Hazards FAQs for Active Faults and Fault Rupture.pdf

Appendix 1 – Waipa Master Plan

RED STAG
WAIPA VALLEY MASTERPLANNING
REV. A – 7 OCTOBER, 2021

ARCHITECTS
OF TRANSFORMATION

1.0
CONTENTS

Scan QR code with your cell phone to view Twinmotion 3D flythrough animation on YouTube.

2.0
HISTORY OF THE SITE

Knowing where Red Stag has come from, in order to know where it is going.

Consideration of the site's heritage is relevant to insightful development.

The Waipa Sawmill has it's origins date back to 1936 when the Cabinet approves the creation of a National State Sawmill in a move to lower native harvesting to a more sustainable exotic forests. In 1939 the first buildings are completed and in 1940 the operations begin. During the 1950's - 60's the mill was one of the largest in Australasia, employing around 800 staff. The Waipa Village was created with dozens of state owned houses to accommodate the staff nearby the mill at the intersection of State Highway 5 and the Waipa State Mill Road. The housing village becomes derelict and is demolished in the 90's.

The mill goes through several phases of ownership, from state owned to privatisation between 1985 and 2002 where the mill goes into receivership. 2003, enter the Verry family who buy the mill and create Red Stag Timber Ltd and the success and ownership of the mill remains in the ownership of the Verry family today. 2021 sees the creation of a new Engineered Wood Solutions plant and capability which will position Red Stag as one of only a handful of serious EWS producers in Australasia. At a time where awareness of our environment and sustainability is reaching peak interest, the EWS plant is a clever value add proposition to Red Stag as momentum towards building in Engineered Wood picks up it's pace.

During the 1990's to 2010, Mountain Biking gains popularity as a recreational pastime and the Whakarewarewa MTB trail network has organically grown (largely through volunteer groups) into one of the best free-ride MTB parks in the world. The attraction of the 2006 MTB world championship and recent stop on the Crankworx world tour has further cemented the Whaka forest as a MTB destination of world reputation. One of the convenient entry points into the forest was the Waipa access on Red Stag land off Waipa State Mill road. In the past decade Red Stag engaged and worked closely with recreational users, event companies, businesses, Iwi and council to create enhanced amenity to the Waipa MTB carpark as it became known. This has resulted in the development of public toilets/changing facilities, carparking, business hub, secret spot spa and the diversion of the mill access road to create safer cyclist and pedestrian access to forest. The council and local BMX club have a created an international standard BMX park on land adjacent the development site.

On any given weekend, even in the middle of winter, the carpark is usually overflowing with users. In summer months and public holidays, the fields are covered in overflow parking. The Waipa MTB carpark is the most visited site in Rotorua for recreational forest users. The future is bright and sustainable.

3.0
BRIEF

Masterplanning offers an opportunity to rationalise existing elements and strategically develop effective direction for the site for both immediate success and a view to the longer-term future.

Red Stag Investments Ltd (the development arm of Red Stag) has had a reasonably ad-hoc development plan for the Waipa over the past 10 years. The MTB carpark is now an established congregation point for thousands of recreational users every week who gather to enter the Whakarewarewa forest network. With an established, captured audience, its seems the right time to explore the future development potential of the land adjacent the MTB carpark on the site of the previous Waipa Village.

The brief to DCA Architects of Transformation is delve into and research opportunities for current and future potential development of the site to enhance the existing amenities and support future opportunities for existing business and economic growth for recreational related enterprises. With Red Stag Investments Ltd as the developer having access to Red Stags new EWS plant, it has a vision to construct using wood and new wood engineering technology. There is potential for a national showcase for a sustainable business park development.

4.0(i)
RESEARCH AND OPPORTUNITIES

Wide-ranging activities and facilities present both potential opportunities, and challenges.

A clear high-level overview will, in turn, inform detailed plans.

CURRENT OPPORTUNITIES

Red Stag have the following avenues of development in varying stages of discussion, base concepts and business case viability studies.

KRISTALL TURM

This is a proposal for a high ropes course using a patented and international award winning construction system. This addition to the park will add to the current thrill, challenge and adventure seekers. The Kristall Turm concept will blend into the forest environment and offer a unique elevated perspective of the park.

PUMP TRACK

There are plans in concept prepared by internationally recognised bike park development company Velo Solutions to create an all weather permanent and world standard pump track.

FILM STUDIOS

Initial talks have began with local industry to support the creation of a serious international standard film studios and associated film industry support industry. We understand that a HoA is currently in development.

SCULPTURE/ARTWORK

There are plans underway for creating a unique artwork using Sawmilling parts to create a cycle themed sculpture to be located near the entry to the MTB carpark.

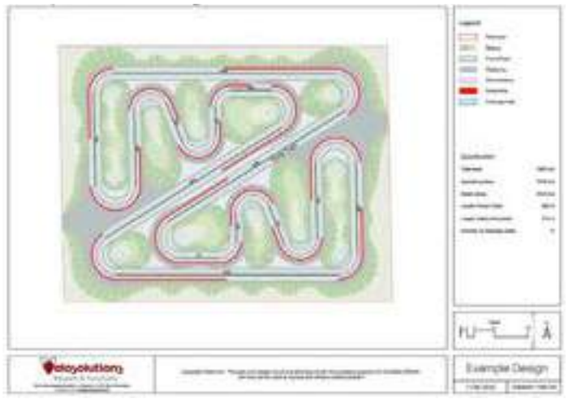
FUTURE OPPORTUNITIES AND RESEARCH

In researching and gathering information for this report, we are aware that many of these precedents and studies were completed previous to the world pandemic of COVID-19. While the impact of this pandemic is undeniable in some sectors, the current evidence of the NZ economy is bouncing back with surprising results in domestic tourism and Rotorua a benefactor of this with a huge number of NZ's population within 3 hrs drive. The Whakarewarewa forest is witnessing large numbers of visitors and eventing companies are selling out with record entry numbers across all types of sporting events. NZ Herald article 30th January 2021 reported a 50% spike in visitors coming out of Lock down. This was supported in the article with quotes from the many businesses operating in the area.

New Zealand has gained international recognition as one of the best to have dealt with the pandemic, will be viewed as a safe place to visit by many when borders reopen. With vaccines being rolled out worldwide and travel bubbles (albeit small scale at time of writing), there is strong evidence international tourism will rebound so long as transport carriers can also rebound in timeframes to meet demand.

The Rotorua Lakes Council in association with local Iwi entities submitted a business case to the Government Provincial Growth Fund in 2018. Some information has been gathered from this submission to understand current economic growth and support future economic growth in the area of Whakarewarewa forest. In addition we have also sourced information from Rotorua Economic Development (RED) agency website and conducted phone, email and in person interviews with individuals identified for professional insights.

KRISTALL TURM



PUMP TRACK

FILM INDUSTRY

FILM TOURISM

4.0(ii)
RESEARCH AND OPPORTUNITIES

EVENTS, BIKE TOURISM AND ACCOMMODATION

BIKE TOURISM.

As the post-COVID numbers indicate, there has been a significant uptake on recreational users and MTBing in particular. Recent sales figures on Electric Bikes (EB) would indicate a growing demographic of MTBers in age groups not previously popular with this activity. There is an increase in older 50-70+ male and female enthusiast taking up MTBing due to the new technology requiring less physical ability and relative affordability. This has opened a new demographic previous surveys would not have predicted to be an area of growth. This generation are cashed up and likely to attract a higher spend.

EVENTS.

There is potential for this are to become known as the event capital of NZ. Already there are a large number and type of events run from the large grassed paddock. This includes MTBing, running/walking, orienteering, adventure races and ultra marathons. While the return for leasing the paddock for eventing companies might be a tokenistic or peppercorn deal, the numbers of spectators and supporters drawn to this area during events will pump the spend into the surrounding businesses and ultimately create a small circular economy of goods and services in the Waipa Valley. Due to its location outside of built up residential areas, the space has the potential to host single and multi-day music festivals, subject to Resource consent approvals.

ACCOMMODATION.

Concept design work has been completed for a MTB/ recreational users accommodation catering for simple motel style units and back packers with associated communal facilities. This high level concept has been designed by DCA Architects of Transformation for BVM Holdings Ltd.

Rotorua is currently supplying MIQ accommodation for the government through three main hotels. Rotorua has been also made headlines recently with a large number of emergency homeless being accommodated in Motel stock. While this was seen initially as a life saver for some hoteliers and moteliers post COVID-19, the reality has seen a major shortage of quality accommodation for the bursting recreational visitors to the forest. There is anecdotal information of visitors having to stay in Tauranga, Hamilton and Taupo for Rotorua events. RED projects a 3-4 fold increase in cycle related tourism in the next decade. This is further supported at Whakarewarewa forest recently named as one of the 4 worldwide MTBing meccas to visit. Even pre COVID the Health and Wellness Spa industry was destined for "massive growth" (quote RED). Evidence supports a greater awareness of Health and Well-being post-COVID.

There is plenty of evidence to support accommodation growth across all value ranges for current domestic demand and future international demand.

4.0(iii)
RESEARCH AND OPPORTUNITIES

FILM LOCATIONS

RETAIL AND HOSPITALITY

FILM INDUSTRY.

Interviews and correspondence with Anton Steel, CEO of Film Bay of Plenty offered the following insights to the regions potential to establish as a major player in the international film arena.

The current major film studios in NZ, Kumeu and Auckland studios were running at capacity and largely booked out with local television and film production. With the Governments Screen Production Grant, major global companies are in talks to establish permanent links with NZ film industry. One example of this is Amazons deal to produce the Lord of the Rings TV series. According to Anton Steel, another international film giant Disney, is keen to establish operations in NZ if a world class facility can be produced. Rotorua is seen as a perfect location for the film industry due to many celebrated scenic sites, geothermal, volcanic, lakes, mountains, coastal and forest nearby.

The establishment of a major film studio on the Waipa site would attract a host of associated industry which could be located at Waipa. This could include accommodation of varying levels of star rating from 5 Star to 3 star. Trades including builders/carpenters, set designers, costume designers, graphic and animation studios, legal, accounting, lighting designers on short and long term storage leases. According to Anton Steel, there is potential for the establishment of an associated Training and acting/performing education facility along with a Film and Television tourism industry/museum.

COMMERCIAL, RETAIL AND INDUSTRIAL.

Mark Rendell, Manager of Colliers International Rotorua was interviewed as part of our research for insights to current commercial accommodation demands and potential future fits of accommodation at Waipa. There is a healthy demand for leased storage units across the region. The west and southern side of the city is not currently well served with leased storage units with the majority located on the east side of the city. One of the suggestions was to create small (garden shed sized, 2 x 2m) spaces for bike storage on both short and long terms leases due to proximity to forest. With the high numbers of visitors, peaking at events, there are large numbers of non-participant supporters looking for opportunities while they are waiting. Mark suggests that some small convenience retail, such as sports shoes, sport apparel, bike shop, bike hire, hairdresser/beauty (also supports film industry), Physio/massage and mini-market would be supported.

There could be demand for small to medium professional offices to piggyback off other potential tenants. These could be law, accountancy, forestry research and technology, IT support, National Cycling HQ for BMX and MTB and professional bike coaching.

Opportunity for a boutique micro-brewery and coffee roastery would fit well and support the collective of hospitality offerings.

There is also opportunity for small to large industrial type units to support the eventing and forest Milling operations such as;

- Transport logistics companies.
- Small to medium centralised distribution centre.
- Heavy industry, Steel manufacture, Equipment and machinery sales/hire.
- General Hireage (Film industry demand)

4.0(iv)
RESEARCH AND OPPORTUNITIES

Events companies requiring office space with storage.

ELECTRIC SERVICE CENTRE.

With the Governments recent announcement to achieve the Climate Change Commissions targets was a tax rebate system to encourage the uptake of Electric Vehicles (EV). The uptake of 300kW Hyper and Rapid EV chargers will soon become a necessity. Many NZ companies are already trialling medium to large EV vehicles. Electric Bikes are also soaring in sales and the requirement to provide quick charge stations will only continue to grow. We see an opportunity to partner with a major network provider to create the first EV service centre of its kind in NZ.

FACTS AND FIGURES

$68M

Private and Iwi investment projected $68M in 2021-25.

4TH

4th most visited place in NZ by international visitors (note pre-covid)

270-450

$270-$450 per ride spend by MTBers in the Whakarewarewa forest.

30-50/12-13

$30-50M local economy spend by locals and visitors annually and creation of 200-300 jobs with an estimated $12-13M benefit.

500K

Four years in a row voted as NZ's favourite off-road place to ride. Estimated 500k visitors to the Whakarewarewa forest annually.

460K

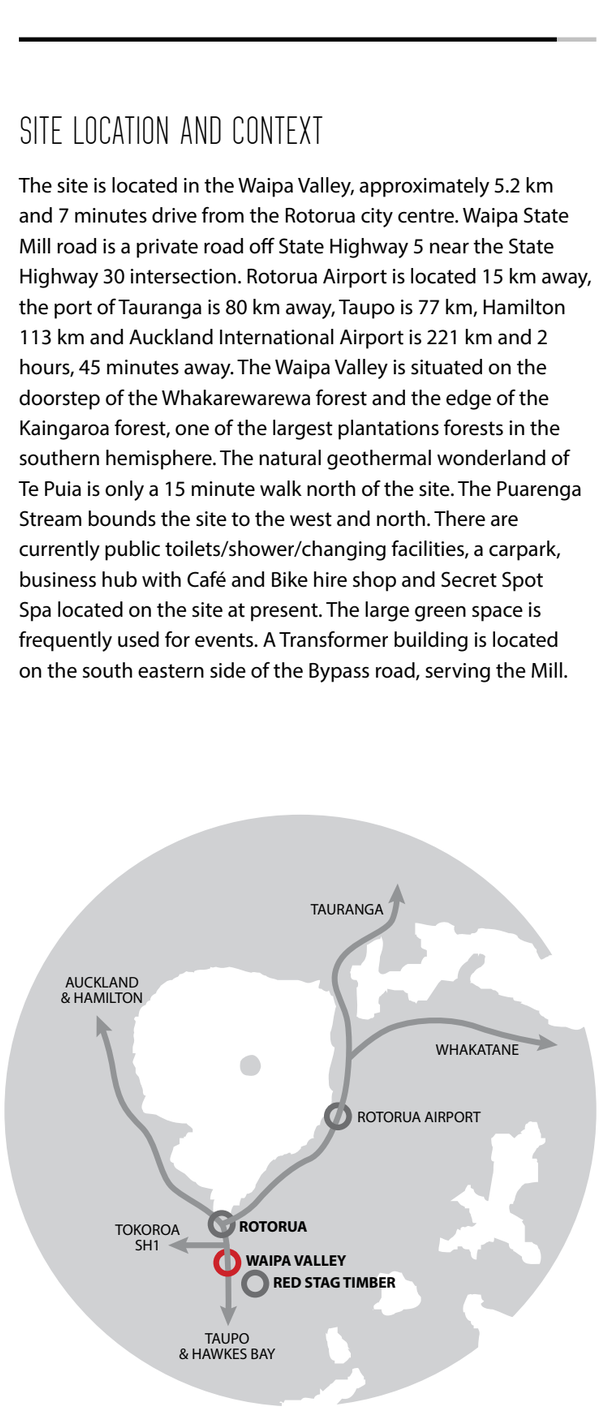
460k visit Redwood visitor centre annually.

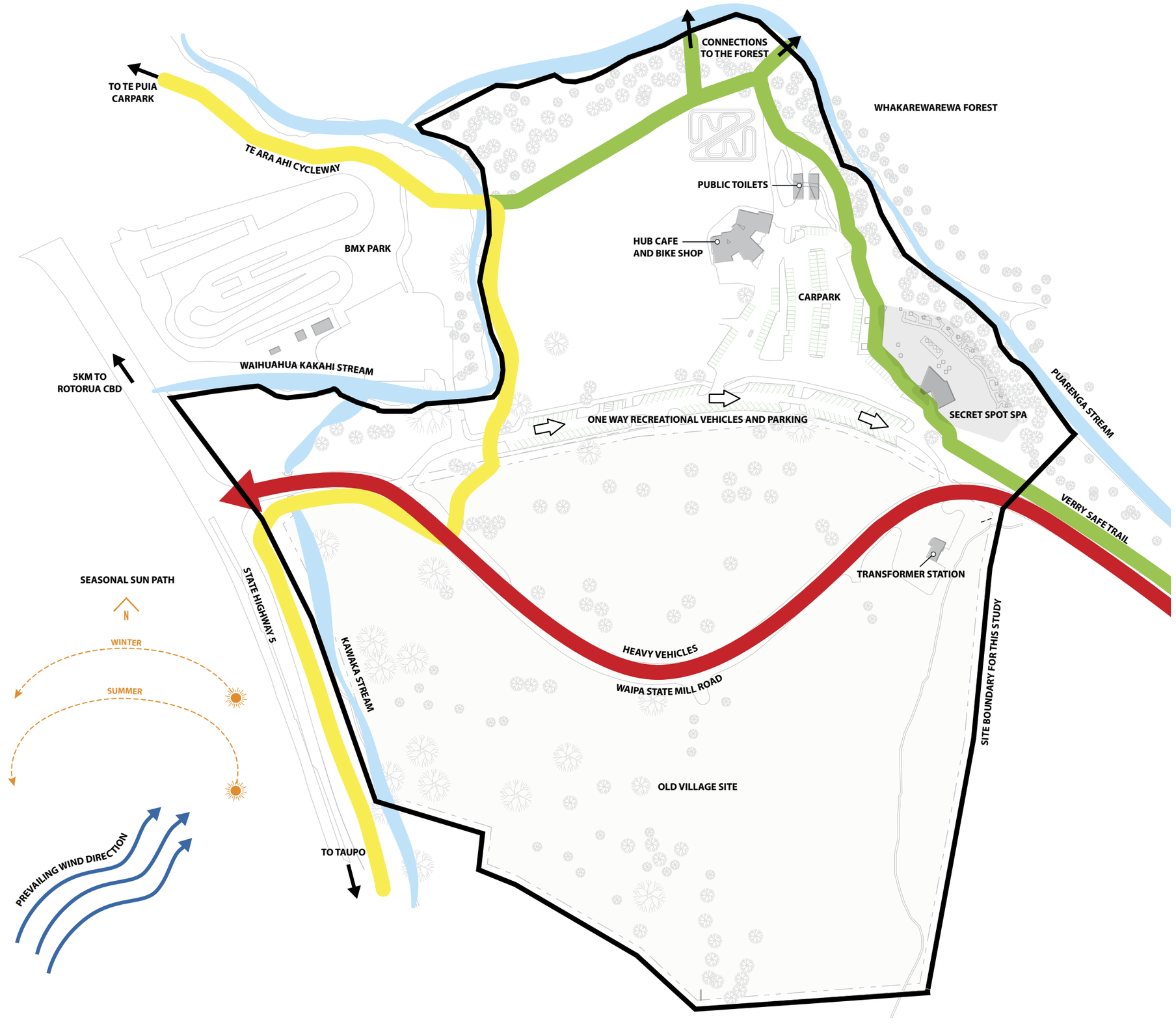
INTERNATIONAL EXAMPLES OF ALTERNATIVE ENERGY STATIONS

5.0
EXISTING SITE AND ANALYSIS

SITE LOCATION AND CONTEXT

The site is located in the Waipa Valley, approximately 5.2 km and 7 minutes drive from the Rotorua city centre. Waipa State Mill road is a private road off State Highway 5 near the State Highway 30 intersection. Rotorua Airport is located 15 km away, the port of Tauranga is 80 km away, Taupo is 77 km, Hamilton 113 km and Auckland International Airport is 221 km and 2 hours, 45 minutes away. The Waipa Valley is situated on the doorstep of the Whakarewarewa forest and the edge of the Kaingaroa forest, one of the largest plantations forests in the southern hemisphere. The natural geothermal wonderland of Te Puia is only a 15 minute walk north of the site. The Puarenga Stream bounds the site to the west and north. There are currently public toilets/shower/changing facilities, a carpark, business hub with Café and Bike hire shop and Secret Spot Spa located on the site at present. The large green space is frequently used for events. A Transformer building is located on the south eastern side of the Bypass road, serving the Mill.





6.0
PLANNING AND CONSTRAINTS

ZONING AND USAGE

Under the district plan the site has its own designation as BI2, Business and Innovation Waipa Business Park. Most building typologies will require some further discussion with Rotorua Lakes Council around Permitted, Controlled and Discretionary uses. For the purpose of this document, we have assumed all proposed typologies will have an angle of "fitting" with the objectives of the Waipa Business Park. There is a requirement for building platforms to be located above the 2% AEP flood level. At this stage of the master planning research we do not have information to understand if this impacts on the proposed development of the site. We have assumed building platforms can be created to achieve requirements. We recommend further investigation. There is no maximum site coverage requirements. All other requirements of the zoning in regards to Parking, Noise, Glare and Light, Signs, Events, Earthworks are not expected to be constraints that the development cannot be designed to meet. There is a sub designation for the location of a Power sub station.

FAULT LINE AVOIDANCE ZONE.

The Horo fault line is located to the north of the site and cuts across on the northern side of the Puarenga Stream. We do not believe this has impacts on the proposed development.

HEIGHT RESTRICTIONS

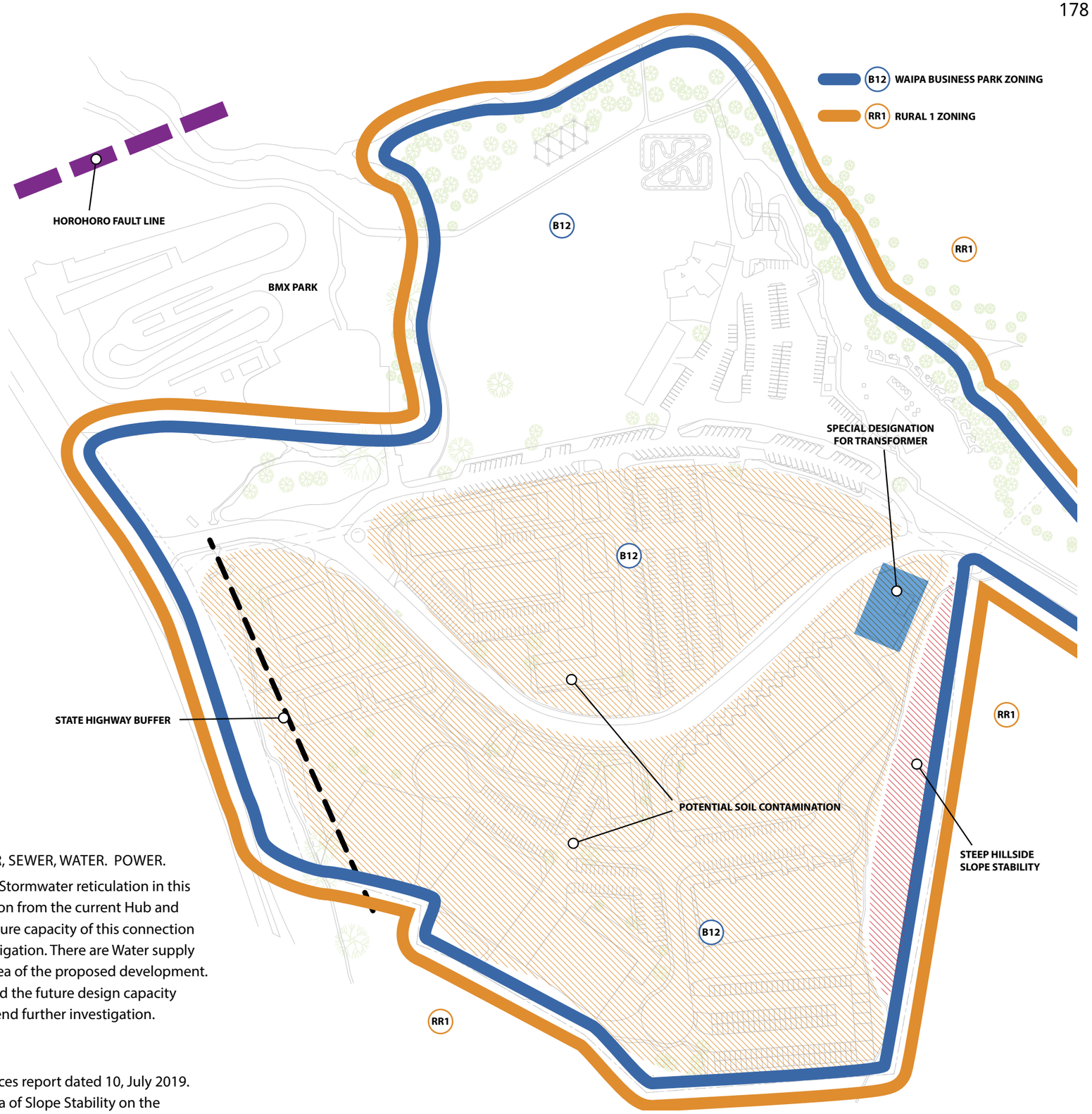
The maximum height of any buildings is 12 metres. (We note the briefing from Film Studios is that the Studio buildings require a 14 metre internal stud height. This would require a Resource Consent to exceed the 12 metre limit.

BUFFERS

The State Highway boundary setback requirement is 10 metres and 5 metres to any adjoining Rural zones, which are the remaining boundaries surrounding the site. No buildings can be erected within 25 metres of a stream. Buffers within streams are to be planted and landscaped. There are no daylighting envelope requirements.

HAZARDS. CONTAMINATED SOILS

There is anecdotal information of potential contaminated soils in the proposed development. We recommend further investigation to understand extent and remedial works.



SERVICES TO SITE.

THREE WATERS. STORMWATER, SEWER, WATER. POWER.

Our investigation indicates no Stormwater reticulation in this area. There is a sewer connection from the current Hub and toilets. We do not know the future capacity of this connection and recommend further investigation. There are Water supply and Power provisions in the area of the proposed development. Again, we have not investigated the future design capacity of these services and recommend further investigation.

GEOTECHNICAL

We refer to the CMW Geosciences report dated 10, July 2019. Of note in this report is the area of Slope Stability on the eastern boundary where the toe of a steel hill encroaches into the development site. The recommendation is to build outside of the toe of the hill and potential additional measures required to protect buildings from slips.

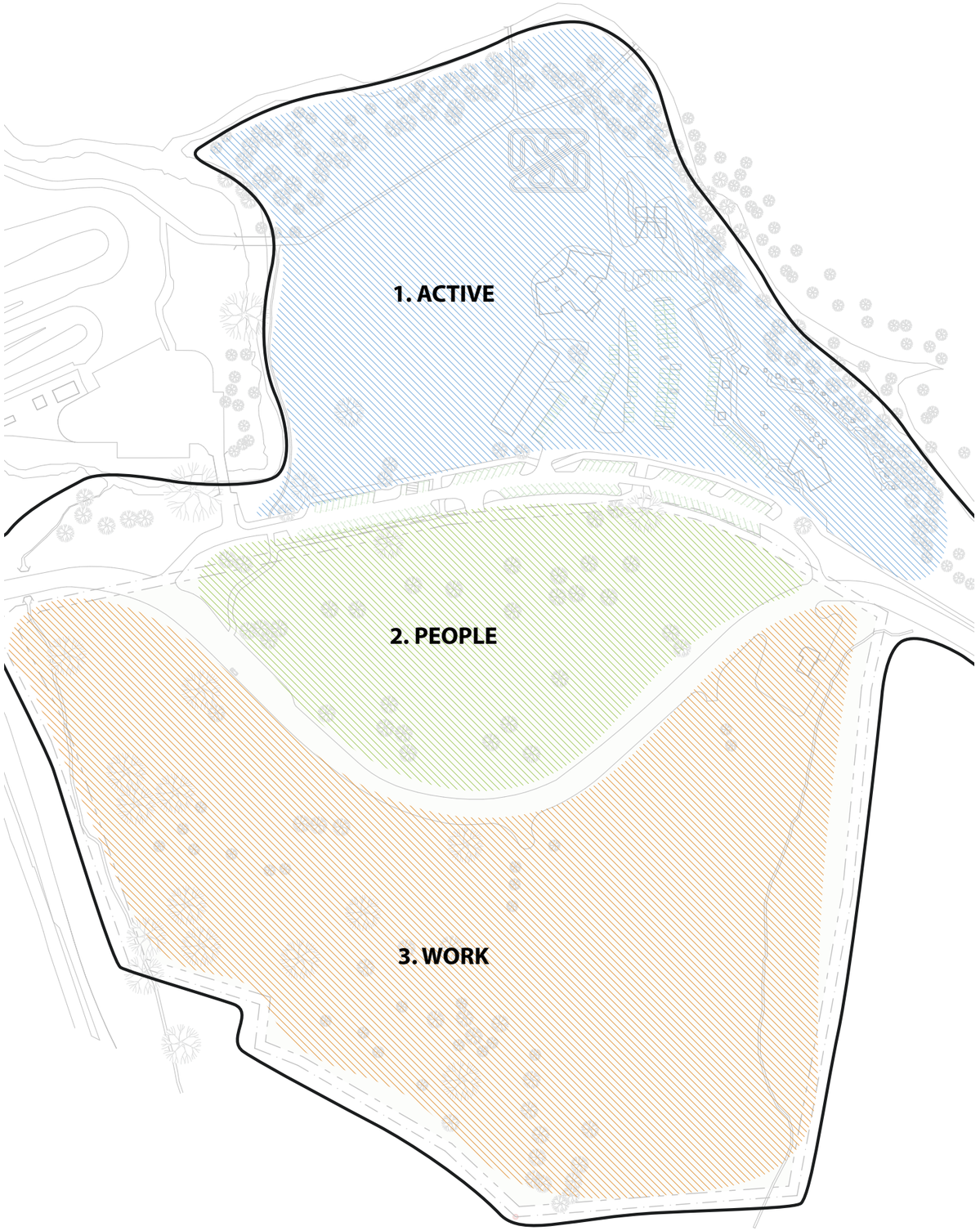
7.0
PRECINCTS

PROPOSED PLANNING

The site has organically (perhaps intended) developed into three areas, which are analogous with precincts to define three main functions of the site. We have called these precincts;

- Active Zone
- People Zone
- Work Zone

These divisions follow a natural order for how the site is envisaged to operate at a functional level, where flow of cars, cyclists, walkers, work vehicles and heavy axle vehicles are able to operate while respecting the safety of people and intersections.



ACTIVE ZONE.

We have proposed that the large green space is retained and not further built over or built out. This large field area is the visual connector between the users and the forest landscape beyond. The large open space is also essential for holding large scale events. The northern edge alongside the Puarenga Stream will be the Kristall Turm High Ropes course. Set against the backdrop of the forest, this adrenaline filled challenge will create a backdrop to the open space. The pump track location along this northern edge will be in full view of the existing Hub building and in close access to the BMX facility.

PEOPLE ZONE.

This zone is the space for accommodation and additional parking. One of the key moves with this planning is the avoidance of the general recreational public to stay north of the heavy vehicle access road to the mill. During events it will be important for health and safety management to contain people within the Active and People zones. Some additional retail and support hospitality could be located in this area. In order to cater for the various accommodation styles and price points, it is proposed that the accommodation blocks are defined by a star ratings and typology. A three level 100 + bed hotel aiming at 4-5 star with Café/Restaurant, pool and associated conference facilities for 20 – 300 persons. A two level motel style 40+ rooms with bike lockers and no café. A Flashpackers style single level with variations of family units, motel style units and bunk accommodation with Café, communal kitchen and dining space. The carparking in this area is designed to cater for large scale events and peak holiday periods.

WORK ZONE.

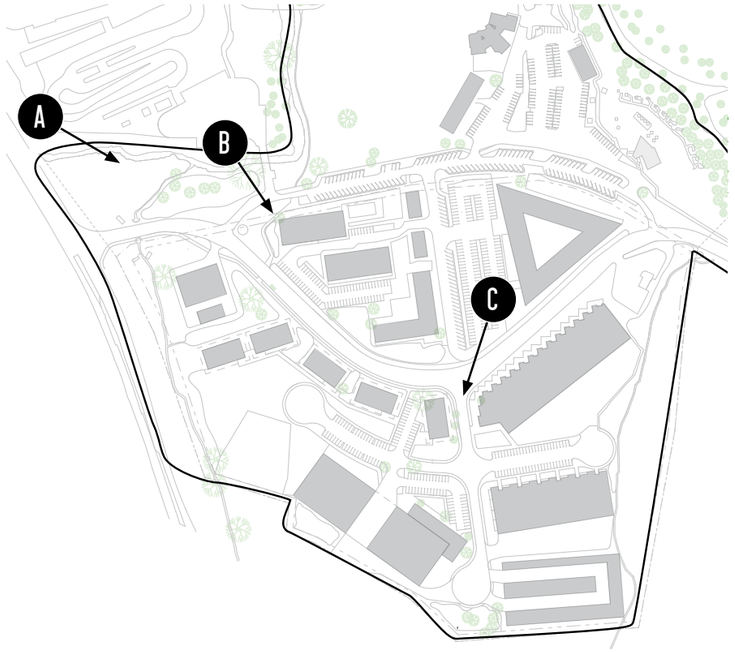
The southern precinct is made up of business accommodation. The location of an Electric Service centre on the corner of the site will be position on a section of road with a high traffic count and prominent location. It is considered this maybe supported with convenience retail or fast food outlet. The establishment of a film studio will potentially have a greater knock on effect for supporting other industry types, such as film tourism, film industry training academy, film industry related services requiring professional suites or small to large scale workshops and lease storage. The storage sheds will accommodate the south and western population of Rotorua as well as potential for a unique small scale bike locks ups. A block of small to medium office/industrial and a larger heavy industry scale buildings could be attractive to forestry related industry and compliment the location proximity to mill.

8.0(i)
SITE USAGE

LEGEND

1. KRISTALL TURM HIGH ROPES
2. PUMP TRACK
3. EVENTS PADDOCK
4. CAFE & BIKE RENTALS
5. PUBLIC TOILETS
6. PUBLIC CARPARK
7. SECRET SPOT SPA
8. 100 BED, 4-5 STAR HOTEL/CONFERENCE
9. 40 BED, 3-4 STAR MOTEL
10. CARPARK
11. FLASHPACKERS, 40+ BED & CAFE
12. SPECIALITY RETAIL & HOSPITALITY
13. ELECTRIC SERVICE CENTRE & FAST FOOD
14. FILM INDUSTRY:
    - a) STUDIO 1
    - b) STUDIO 2
    - c) POOL & GREEN SCREEN
    - d) FILM TOURISM & TRAINING
    - e) FILM INDUSTRY SUPPORT/OFFICES
    - f) LARGE SEALED OPEN AREA
    - g) FUTURE STUDIO 3
15. INDUSTRY WORKSHOP & OFFICE
16. SMALL-MEDIUM WORKSHOP & OFFICE
17. STORAGE - RENTAL SHED
18. SCULPTURE
19. SIGNAGE

8.0(ii)
SITE USAGE



BUILDING M² BREAKDOWN

Building	m²
Hotel	6,370
Motel	2,250
Backpackers	3,270
Retail/Hospitality	1,430
Convenience fast food	200
Film Studios	4,600
Film Support and Commercial *(5 x 920m²)*	4,600
Medium Industrial/Offices	5,550
Light Industrial/Offices	3,620
Storage Sheds	3,200
Total	**35,090**

9.0
CYCLE AND PEDESTRIAN FLOW

PEDESTRIAN AND CYCLING ROUTES

The Te Ara Ahi "Thermal by Bike" national cycle trail runs past the site. Starting in the Rotorua CBD, the trail is 48km long and passes many geothermal highlight spots including Waimangu Volcanic Valley, Rainbow Mountain, Te Ranga (Kerosene Creek), Waiotapu Thermal Wonderland, before veering off and finishing Waikite Valley Hot pools. At this point you can return to Rotorua City via scenic country roads, or reverse rise the cycle way. The Cycle way is rated a grade 3, Intermediate level and is a mixture of compacted gravels, concrete paths and sealed roads.

From the carpark there is a cycle trail the goes east called the "Verry Safe Trail" which runs parallel with Waipa State Mill road and connects cyclists and walkers with the eastern trail networks. This trail is to keep the increasing numbers of recreational users safe from the heavy vehicle traffic. Cycling along the Waipa State Mill road is discouraged and sign posted accordingly.

The site is also an easy walk from the CBD, approximately 5km, 1hr, or 18 minute cycle. Another popular connecting point is from the end of Long Mile Road, via the forestry roads. The council have recently upgraded this area with additional parking and many cyclists and recreational users start at this point and it's a short distance to reach Waipa Valley through the forest.

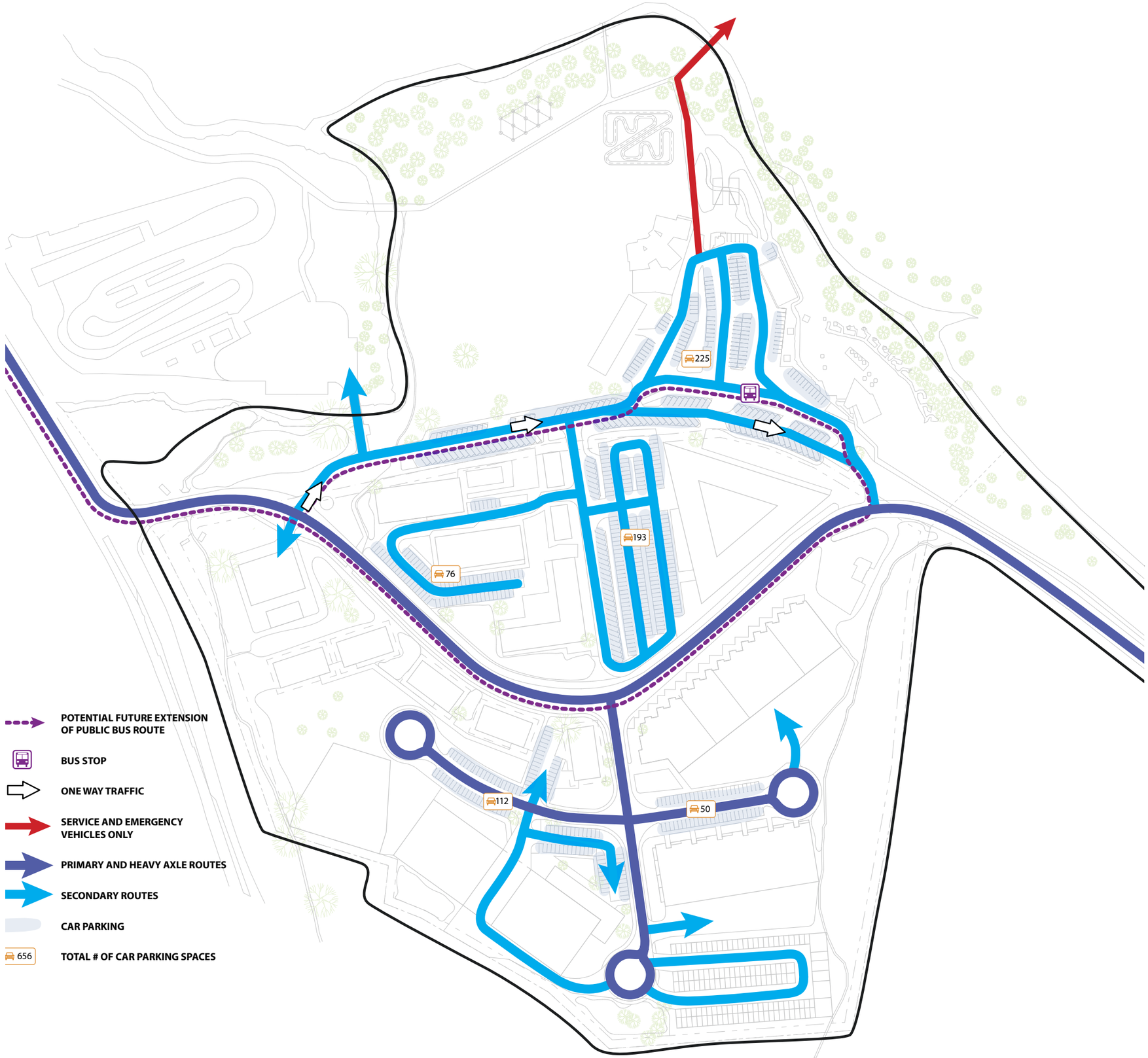
10.0
TRANSPORT AND VEHICLE

TRANSPORT

The site is near a junction point which radiates out and connects many of the central North Island cities. The site is immediately off State Highway 5, south bound to Taupo, Hawkes Bay and lower North Island. The State Highway 30 junction, approximately 150m away is south west bound connecting State Highway 1 between Tokoroa and Taupo, but also links with western side of North Island. Northern routes connect with Hamilton to the North west and Tauranga and East coast towns on the North eastern side. The section of State Highway 5 outside this site has an average daily traffic count of 6,972 vehicles per day. The section of State Highway 5 at Hemo before state highway 30 has an average daily traffic count of 13,281 per day. This intersection is within 150 metres of entry to the site an quite visible. Numbers are according to Waka Kotahi website.

Bus Routes. The Baybus public transport route does not currently serve the Waipa Valley. The nearest stop is at Toi Ohomai Institute of Technology and Te Puia, located approximately 2.1 km away, 3 minutes drive by car. There is the Te Ara Ahi cycle and walkway linking Te Puia and Toi Ohomai (via under road tunnel) to the Waipa Valley. Walking time of approximately 25 minutes and cycle time of 8 minutes.

Bypass Road. The Waipa State Mill Road had a bypass extension added at the time the current carpark was upgraded in 2017-18. This was a safety measure to keep the Heavy axle vehicles servicing the Mill away from the visitor cars and high pedestrian and cyclists.



11.0(i)
LANDSCAPING AND SUSTAINABILITY

LANDSCAPE AND SUSTAINABILITY

There is opportunity to market this development with a unique sustainability lens. The following key approaches have been considered to achieving a development a small carbon footprint and reduction in demand on infrastructure.

WOOD AS THE STAR

With Red Stags new Engineered Wood Plant this is a great opportunity to showcase innovative engineering approach to building in timber across multiple building typologies.

SUN AND POWER

We have proposed that most buildings would have an element of solar Photovoltaic ( ) power generation incorporated into and on the buildings. This will lessen the demands of peak power to the site during daylight hours.

11.0(ii)
LANDSCAPING AND SUSTAINABILTY

WATER AND STORMWATER

The site has potential stormwater disposal challenges. If buildings are fitted with rainwater harvesting tanks, these could be used as stormwater retention tanks and allow trickle feed to streams and tributaries after heavy rainfall events. In addition, rainwater harvesting will allow for on site water collection for use in grey water applications and in particular, high use facilities such as the accommodation units for toilet flushing and swimming pool.

THE LANDSCAPE

There is opportunity to use a selection of naïve planting to enhance the forest park feel of the location. The use of stormwater swales gardens to the perimeter of carparks will allow a natural filtration of any heavy metals washed from the carparks and allow for some flood retention ability in high rainfall events.

SOLAR POWER INTEGRATION

WOOD ENGINEERING TECHNOLOGY

LANDSCAPE STORMWATER SWALES

12.0
Branding

OBJECTIVE
To create a brand that is relevant with the history, location and purpose of the site.

RESEARCH
Understand your customers and your competition.

STORY
Create connections between public, customers and your business.

IDENTITY
Design an innovative identity.

The actual location of the site is noted on maps as Waipa Valley. The carpark has been affectionately known for many years as the Waipa MTB carpark. The site was also once the location of the Waipa Village, the state owned housing that supported the Mill workers and their families for decades. The word Waipa is synonymous with the many previous and current identities for the location.

The possible Maori meaning behind the word Waipa is 'river of fortified villages'. This could be construed as meaning the encounter of a collection of buildings along the journey. The meaning appears to be an appropriate translation for this development of a collection of buildings, possibly linked by association and co-located on a pathway of discovery.

We have decided this already well- known name 'Waipa' is a key word to develop an identity for the branding.

There is a strong historical and contextual connection with 'Waipa Valley' as an identifier to the site.

Red Stag Investments logo is a leaping Stag. In trying to incorporate a connection between the Verry family, the established Red Stag business and the Waipa Valley site, we have framed the identity of WV in a set of Stag antlers to pay homage and reference to the current landowners and developer. The combination of the WV and antlers creates a stylistic stag head logo.

At its core, the logo encompasses a simple, relevant concept, is legible instantly, and serves as a clear visual element of the brand's identity which is practical to be implemented across all media types.

WAIPA
VALLEY

Appendix 2 – Waipa Geotechnical Assessment

10 July 2019 Document Ref: TGA2019-0004AI Rev 0

Red Stag Wood Solutions Limited
Waipa State Mill Road
Rotorua

Attention: Mike Carlton

Dear Mike

RE: GEOTECHNICAL APPRAISAL REPORT

THE VILLAGE SITE, 26 WAIPA STATE MILL ROAD, ROTORUA

1 INTRODUCTION AND SCOPE

As requested, CMW Geosciences (CMW) have carried out a geotechnical appraisal at the "Village" site located at 26 Waipa State Mill Road, Rotorua, to summarise key geotechnical considerations for future development of the site. Investigation data associated with a recent wider study including the "Village" site area was used in the preparation of this report. Due to the broad nature of this report, it is not considered adequate to support a resource or building consent application. Additional analyses and assessment are required to produce a detailed Geotechnical Investigation Report (GIR) suitable to support any future consent application.

2 SITE DESCRIPTION

The site comprises a plan area of approximately 8.2 hectares, located at 26 Waipa State Mill Road, approximately 6km south of Rotorua Central Business District as shown on Figure 1 below.

The current general landform, together with associated features located within and adjacent to the site is presented on the attached Geotechnical Investigation Plan as ***Drawing 01.***

The site comprises a low-lying area, typically at around RL318m to RL320m (Moturiki Datum), with a steep escarpment within the eastern part of the site and immediately beyond the south western site boundary. The eastern escarpment rises to approximately RL360m at an average slope gradient of approximately 30 degrees to the horizontal. The escarpment to the south west is approximately 10m high with an average slope gradient of 25 degrees to the horizontal. The Kauaka Stream located in the western part of the site.

The site is bound by the recently realigned Waipa State Mill Road to the north, State Highway 5 to west and forestry land to the south and east.

Figure 1: Site Location Plan (image obtained from Google Maps, 2019)

A review of the historic aerial photographs suggests the "Village" site and the surroundings have been subject to extensive earthwork activities in the past. By the early 1950's, the majority of a forestry housing development appears to be complete with significant earthworks undertaken including benching of the south western slope, placement of fill across southern and central part of the site and remediation of what appears to be a small slip in the south eastern part of the site. By the early 1990's all the dwellings and structures appear to have been removed with only the loop road and cul-de-sac apparent. The site is now in pasture with a substation situated in the north eastern corner of the site.

3 DEVELOPMENT CONCEPT

It is understood that future development of the site is likely to comprise either commercial or industrial buildings. Industrial buildings are likely to comprise large warehouse buildings with mezzanine upper levels together with heavy internal loads, portal framed trusses and large paved surfaces. Commercial buildings are likely to comprise single to multi-level buildings with similar framing and cladding elements.

4 GROUND INVESTIGATIONS

All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS guidance[1]. The investigations incorporated into this assessment are summarised as follows:

- Three machine boreholes, denoted MBH05 and MBH07, were drilled using sonic techniques to 31 metres below existing ground level. SPTs were completed at 3.0 metre intervals from 15 metres below existing ground levels. Engineering logs of the boreholes are appended;
- Twelve test pits, denoted TP19 to TP30, were excavated using a 12t hydraulic excavator fitted with blade bucket and toothed rock bucket to depths of between 2.5m and 5.3m below existing ground levels. In-situ strength measurements were recorded using a handheld shear vane apparatus and dynamic cone penetrometer (DCP). Engineering logs of the test pits are appended;

[1] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

- Eleven Cone Penetrometer Tests, denoted CPT21 to CPT29 and CPT31 were pushed to depths of up to 20 metres below existing ground level. Results of the CPT's, presented as traces of tip resistance (qc), friction resistance (fs), friction ratio and pore pressure are appended.

The approximate locations of the respective investigation sites referred to above are shown on the Geotechnical Investigation Plan as ***Drawing 01***. Test locations were measured using handheld GPS. Elevations were inferred from the Rotorua Lakes Council (RLC) topographic contours.

5 GROUND MODEL

5.1 Geological Setting

The published geological map[2] for the area depict the regional geology for the area as comprising "*alluvial and colluvial gravel and sand dominated by pumice clasts, silts and clay with local peat beds*" of the Tauranga Group alluvium (Q1a), "*laminated, commonly cross-bedded, fluvial sands and gravel, dominated by fragments of pumice and ash, and lava fragments*" of the Hinuera Formation (Tauranga Group, Q3a) and "*silty, commonly diatomaceous, millimetre-laminated, and dominated by pumice, rhyolite lava fragments and felsic crystals*" of the Tauranga Group lake sediments (1Qk). The published extents of these geological units and the Rotorua Caldera are illustrated in Figure 2 below.

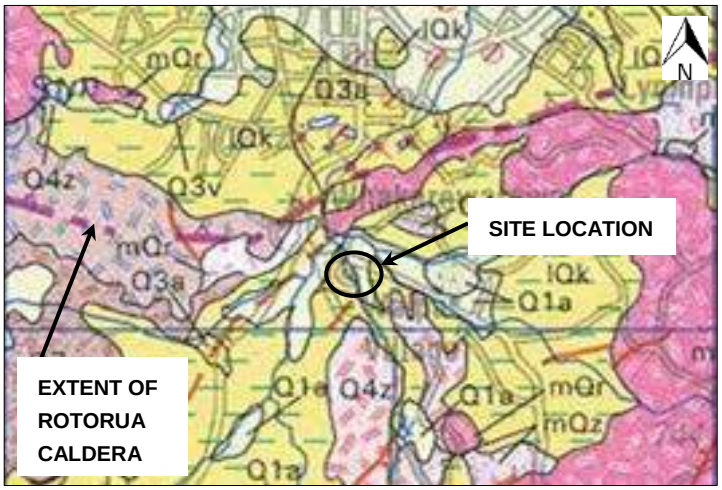


Figure 2: Regional Geology (image obtained from GNS, Geological Map 05)

The geological units can be typically overlain by recent Holocene-aged volcanic ash deposits with colluvium also expected at the base of the steep escarpments. Based on the known history of the site as discussed above, filling is anticipated.

The Institute of Geological and Nuclear Sciences (GNS) active faults database[3] and the RLC District Plan June 2016 Map 210 identifies the nearest active fault to the site is the Horohoro Fault (recurrence interval >5,000 years to ≤ 10,000 years), located approximately 200m north of the site as shown on Figure 03 below.

[2] Leonard, G.S., Bregg, J.G., Wilson, C.J.N. 2010. Institute of Geological and Nuclear Sciences, Geological Map 05: Geology of the Rotorua Area, 1: 250,000.

[3] New Zealand Active Faults Database https://data.gns.cri.nz/af/

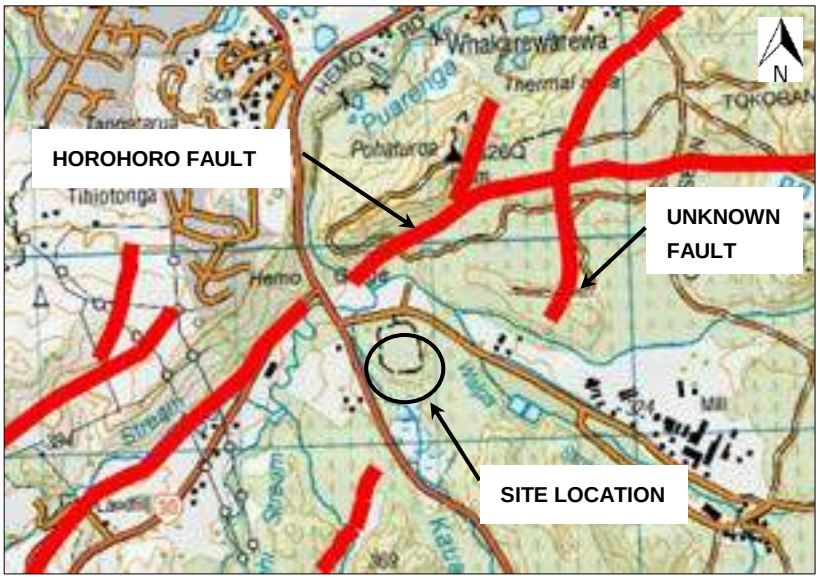


Figure 3: Active Faults (image obtained from GNS Active Fault Database)

5.2 Stratigraphy

The ground conditions encountered and inferred from the investigation were considered to be generally consistent with the geological setting described above and can generally be separated into two landscape zone as shown on ***Drawing 01.***

5.2.1 Dense Sand

Typically, 100mm to 200mm of topsoil was observed across this area of the site. Approximately 200mm of uncontrolled fill comprising pumiceous sand was observed beneath the topsoil in TP 21.

Beneath the topsoil / fill, medium dense to very dense pumiceous sands were encountered, inferred to be fluvially reworked deposits of the Hinuera Formation. These deposits were encountered to between 6.5 metres and 11 metres below existing ground level. The CPT tip resistance (qc) ranged from 2MPa to greater than 20MPa, typically increasing with depth.

Underlying the fluvially reworked deposits, predominately stiff silts and clayey silts with occasional sand lenses were encountered extending beyond 30m depth. These deposits are inferred to be Tauranga Group; lake sediments. The CPT tip resistance (qc) within the lake sediments is typically about 2 MPa.

5.2.2 Former Valley Floor

Typically, 100mm to 500mm of topsoil was observed across this area of the site. Uncontrolled fill comprising silts, sands silty sands, sandy silts and gravelly silts with various organic contents including partially decomposed wood was generally observed beneath the topsoil. As shown on ***Drawing 01***, the fill was encountered to between 0.4m and 3.0m below existing ground levels. Beneath the fill, buried topsoil was observed in TP27 and MBH06 and was 100mm and 800mm thick respectively.

In the north eastern part of the site, 3m (to a depth of 5m below the existing ground surface) of fibrous peat was encountered beneath the fill in TP30.

Colluvium was encountered beneath the topsoil in TP29 and comprised pumiceous sandy silt. The location appears to be consistent with the possible landslip observed in the historic aerial photographs.

Geologically recent volcanic ashfall deposits were encountered in TP20, TP22, TP25 and MBH05 and generally comprises stiff silt overlying medium dense to dense pumice gravel. The ashfall deposits are approximately 1.5m to 2m thick and overly alluvial deposits at these test locations.

Alluvial deposits comprising interbedded silts and sands were encountered beneath the fill in TP24, TP27, TP28 and MBH07, beneath the colluvium in TP29 and beneath the peat in TP30. The CPT tip resistance (qc) ranged from approximately 0.5MPa to 20MPa, typically greater than 2MPa, except for CPT28 which is typically 1MPa. The alluvial deposits are generally between 2m to 7m thick, except for at CPT31 which extend beyond 20m depth.

Underlying the alluvial deposits, Tauranga Group lake deposits were encountered extending beyond 30m depth. The boundary between the alluvial deposits and the lake sediments is typically marked by a thin organic silt layer. The CPT tip resistance (qc) is typically about 2 MPa and SPT N values of between 7 and 27, typically 10. Lake sediments were not encountered beneath the alluvial deposits in CPT31.

5.2.3 Groundwater

During the investigation, which was completed in mid-summer (dry) conditions (February 2019), groundwater was encountered within the majority of investigation locations. The groundwater table was generally encountered 2m to 3m below the existing ground surface i.e. between approximately RL314m to RL318m.

6 GEOTECHNICAL CONSIDERATIONS

6.1 Seismic Site Subsoil Class

Based on the ground conditions encountered and discussed above, we have assessed the seismic site subsoil category as being Class D (deep soil site) in accordance with NZS1170.5.

6.2 Fault Rupture

The site is located within a seismically active area within close proximity to known active faults. Based on the regional geomorphology, it is unlikely that fault spurs lie directly beneath the site. Fault rupture is typically constrained to a narrow envelop of tens of metres either side of active faults and therefore the risk of damage from the rupture of the Horohoro fault and the identified unknown fault during future events is considered low.

6.3 Liquefaction

Liquefaction occurs in geologically recent granular and low plasticity silt soils where soil densities are sufficiently low, and the groundwater table is high. Preliminary site specific liquefaction analyses were undertaken on the CPT data obtained using the propriety computer software package CLiq (GeoLogismiki Geotechnical Software), adopting the Boulanger and Idriss (2014) method. Selected outputs of the analyses are appended.

Under SLS conditions, liquefaction is unlikely to be triggered at any depth across the site. Under ULS conditions for an Importance Level 2 structure (PGA=0.3g), liquefaction analysis results indicate liquefaction of the granular soils below the groundwater table across the site, with the predicted vertical settlements ranging from less than 10mm to 330mm.

6.3.1 Dense Sand

The depth to the top of the liquefiable layer within the dense sand zone typically ranges between 5 metres and 6.5 metres below the current ground level, with liquefaction induced settlements within this zone predicted to be up to 50mm. Based on these results and with reference to liquefaction case histories, the thickness of non-liquefiable crust and the thickness of the identified liquefiable lenses is such that the risk of liquefaction

induced damage at the existing ground surface is considered low for both commercial and industrial buildings within the dense sand zone.

6.3.2 Former Valley Floor

Across the former valley floor area, the depth to the top of the liquefiable layer typically ranges between 2.0 metres and 3.0 metres below the current ground levels with predicted liquefaction-induced settlements in the order of 10mm and 330mm, typically 10mm to 65mm. Predicted liquefaction-induced settlements in the order of 330mm are associated with medium dense sands encountered in CPT31 in the north eastern portion of the site.

Under the Building Code, buildings must remain fully functional after the SLS seismic event only. Under the ULS seismic event, significant damage is permitted provided that collapse, and subsequently loss of life, is avoided. Therefore, if the future development can be designed to withstand the magnitude of total and differential liquefaction-induced settlement predicted without collapse, then this is considered an acceptable solution for Importance Level 2 structures. This approach must however be subject to further investigation and analyses to confirm liquefaction risks based on the specific developments.

For higher importance level structures such as commercial buildings where more than 300 people can congregate in one area or buildings that can accommodate more than 5000 people with a gross area greater than 10,000m^2, significant ground improvement works will be required to mitigate the risks under the ULS seismic event. Ground improvement works that could be considered include but not limited to rammed aggregate prier, deep piles, CFA/DSM piles and undercut / replacement techniques.

Based on the results of the preliminary analyses, the risk of surface manifestation is generally considered low. It is noted that the thickness of liquefiable material beneath the site appears to increase towards the north east as such, ground improvement works to mitigate the risks of surface manifestation may be required in this part of the site. However, this is subject to further investigation and analyses specific to future development schemes.

6.4 Lateral Spread

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 this site, there is potential for liquefied soils to migrate towards the stream in the north western part of the site. Within the north western part of the site, liquefaction analyses results indicate the presence of generally discrete, thin lenses of liquefiable soils which generally do not appear to be continuous across the site. Therefore, the risk of lateral spread is considered low. However, further assessment will be required specific to future development schemes.

6.5 Static Settlement

Load-induced settlements occur in subsoils that are subject to static loading (e.g. by filling and/or building loads) where the magnitude of settlement is governed by the soil stiffness.

The ground conditions across the site are complex and highly variable. It is also recognised that some areas of the site have already experienced some level of prior loading / unloading though cut to fill earthworks and previous structures.

6.5.1 Dense Sand

Settlements within the dense sand area are expected to be elastic (quick). Total settlements are expected to minimal and are expected to mostly occur during construction. Differential settlements within this area of the site are expected to generally be within building code limits.

6.5.2 Former Valley Floor

The lateral extent of weak organic peat soils encountered in the north eastern part of the site is unknown as any land features have been masked by previous earthworks. Peat soils are compressible and will experience significant primary consolidation and long term secondary creep settlements in response to static loading. These settlements are likely to exceed the tolerances of normal commercial / industrial buildings and ground improvement works will be required to reduce creep settlements to acceptable magnitudes. Further site investigations are required to define the extent of the peat soils within the former valley floor area.

For the former valley floor area (excluding the peat area), preliminary static load-induced settlement analysis was completed for a widespread sustained load of 20kPa and 30kPa to represent a two-storey commercial development and a warehouse type building development respectively. Ignoring any settlement in the uncontrolled fill as this will need to be removed and replaced, the magnitude of predicted total static settlement likely to occur assuming a widespread sustained load of 20kPa is in the order of 30mm. Total static settlements of less than 50mm are predicted assuming a widespread sustained load of 30kPa. For both loading case, differential settlements are expected to be within building code limits.

Static foundation settlements within the former valley floor area (excluding the peat area) are likely to exceed building code limits due to the presence of uncontrolled fill and low strength natural subsoils within the upper 2 to 3 metres of the soil profile. As such ground improvement works will be required including excavation of all uncontrolled fill and low strength subsoils to depth of between 2 metres and 3 metres below existing ground level and replaced with engineered fill.

Alternatively, proposed structures or any heavy loads could be supported on piles extending into the natural ground below. Pile depths are expected to be in the order of 5 metres to 10 metres below current ground levels to extend below liquefiable units. Further specific investigation and design parameters will be required for a piled option, targeted for specific building development.

Where proposed structures span across different ground conditions (i.e. across the dense sand and former valley floor areas) consideration will need to be given to differential settlements which may exceed building code limits.

6.6 Slope Stability

Locally, natural slope gradients steeper than nominally 1:2 (vertical to horizontal) or slopes subject to concentrated stormwater overland flows, are likely to exhibit slope instability. Landslip failure mechanisms over such steep escarpments are generally limited to shallow seated slumps (extending a few metres) and translational slides that can run out for some distance downslope.

The approximate extent of escarpment areas and slope instability run out zone is shown on ***Drawing 01***. Any buildings constructed below the steep slopes that are within the landslip debris runout zone will require some form of landslip inundation protection such as the construction of a debris protection wall or bund between the escarpment toe and the building platforms.

Alternatively, where it is economically viable, buildings could be designed to withstand the potential impact of landslip inundation. Details of the landslip debris protection system must be subject to specific investigation and design.

6.7 Foundation Bearing Capacity

For the dense sand area, a preliminary geotechnical ultimate bearing capacity of 300kPa should be available for shallow strip and pad foundations with a minimum plan dimension of no greater than 2.5m.

Across the former valley floor area, once ground improvement works have been completed to remediate the uncontrolled fill, mitigate the effects of liquefaction-induced settlements and reduce the effects of static settlement, a preliminary geotechnical ultimate bearing capacity of 300kPa should be available for shallow strip and pad foundations.

Alternatively, foundations may be supported on piles that will need to target a suitable bearing layer. Pile depths are expected to be in the order of 5 to 10 metres below current ground levels however, this would be subject to further investigation and design specific to future development schemes.

6.8 Earthworks

It is anticipated the earthworks will be required to form a level building platform / platforms, associated accessways and as mentioned above ground improvement works may be required to provide a suitable subgrade prior to development.

The majority of the pre-exiting fill encountered across the site has a high organic content and therefore is not considered suitable to re-use as engineered fill.

The source and / or type of material used as engineered fill will need to be confirmed for suitability by a Chartered Professional Engineer prior to importing any material to site.

Due to the presence of an elevated groundwater table across the site, dewatering may be required during subgrade improvement works to allow for adequate compaction of the engineered fill. Care must be taken with respect to running sands where located below the groundwater table. If necessary, excavation and backfilling may have to occur in small sections to limit the scour and erosion associated with running sands.

6.9 Stormwater

It is understood that stormwater generated from any proposed development on the site will require on-site attenuation as there is currently no council reticulation.

Inground soakage systems are not likely to be a cost effective option within the former valley floor area, due to the presence of highly variable ground conditions and existing uncontrolled fill. Inground soakage systems may be considered within the dense sand area. However, this would be subject to permeability testing to confirm soakage rates.

Above ground rain tanks with outflow from the system piped via a controlled release away from any proposed building platforms could be considered. Alternatively, stormwater ponds could be considered. As a minimum a Chartered Professional Engineer will need to approve the pond locations and pond design with respect to land stability and seepage.

7 LIMITATION

It should be noted that factual data for this report has been obtained from discrete locations using normal geotechnical investigation techniques. As such investigation methods by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report.

8 CLOSURE

We trust this document meets your current requirements. This document has been created for prepared to summarise key geotechnical considerations for future development of the site. The geotechnical comments and recommendations in this report are based on limited investigations which are generally located in the western portion of the site. Further investigation, analyses and reporting will be required to support a resource and / or building consent application. These works should be targeted to a development scheme to confirm geotechnical risks for the specific development proposed.

Should you require any further information or clarification regarding the contents of this document, please do not hessite to contact the undersigned.

For and on behalf of CMW Geosciences

Prepared by:

Kirstin Brown

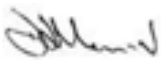
Project Engineering Geologist

Reviewed by:

Greg Snook

Senior Engineering Geologist

Authorised by:

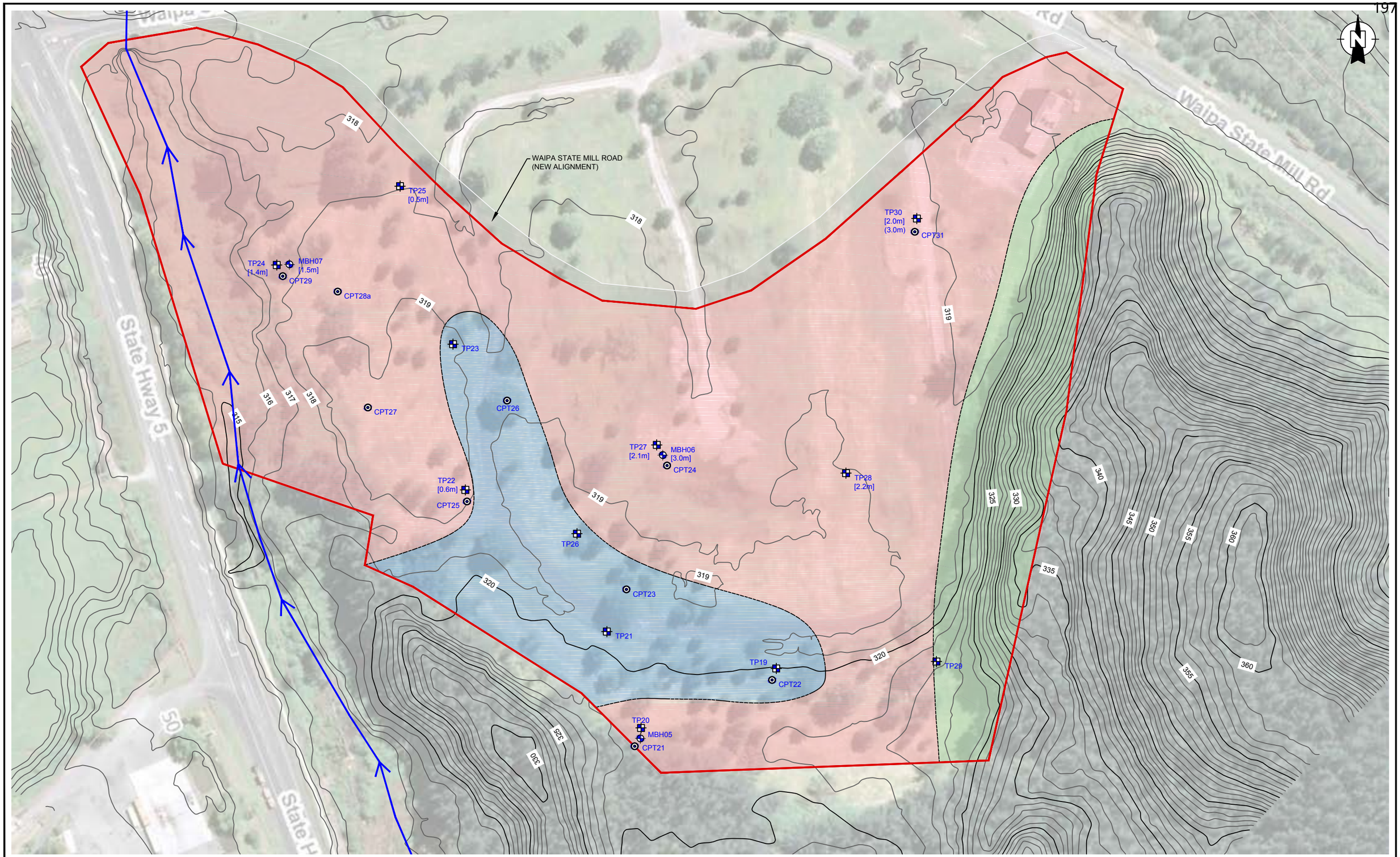


Dave Morton

Principal Geotechnical Engineer

Distribution: 1 electronic copy to Red Stag Wood Solutions Ltd via email
Original held at CMW Geosciences

Attachments: Geotechnical Investigation Plan
Machine Borehole & Test Pit Logs
CPT Investigation Results
Selected Liquefaction Analyses Results



LEGEND:

- SITE BOUNDARY
- MBH01 — MACHINE BOREHOLE (MBH) LOCATION
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- TP01 — TEST PIT (TP) LOCATION
- APPROXIMATE KAUAKA STREAM LOCATION
- [2.0m] — DEPTH TO BASE OF FILL
- (2.0m) — PEAT THICKNESS (IF PRESENT)
- DENSE SANDS
- FORMER VALLEY FLOOR
- SLOPE INSTABILITY ZONE

NOTES:

1) AERIAL IMAGE SOURCED FROM RDC GEYSER VIEW;
2) CONTOURS SHOWN ARE IN 1 METRE INTERVALS, RELATIVE TO MOTURIKI DATUM;
3) TEST LOCATIONS ARE APPROXIMATE ONLY.
4) ZONES ARE APPROXIMATE ONLY

1:1500 0 15 30 45 60 75 m

CMW Geosciences

CLIENT: RED STAG WOOD SOLUTIONS LTD		DRAWN: LGL	PROJECT No: TGA2019-0004
PROJECT: "VILLAGE" SITE WAIPA STATE MILL ROAD		CHECKED: KB	DRAWING: 01
		REVISION: 0	SCALE: 1:1500
TITLE: GEOTECHNICAL INVESTIGATION PLAN		DATE: 10/07/2019	SHEET: A3

X:\01 PROJECTS\TGA\TGA2019\TGA2019-0001 TO -0050\TGA2019-0004 RED STAG TIMBER CLT PLANT RED STAG\07 DRAWINGS\CAD\TGA2019-0004 VILLAGE PLAN.DWG

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 1 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
				321.0			TOPSOIL:									
				320.9			ML: SILT: with trace fine sand; orange brown mottled light brown. No plasticity, moderately sensitive. (Ashfall Deposits)		F to St							
				320.6			ML: Sandy SILT: with trace clay; orange brown red. No plasticity, moderately sensitive, Sand fine to coarse, pumiceous. (Ashfall Deposits)	M	L to MD		93					
					1											
				319.6			SW: Sandy fine to medium GRAVEL: light orange grey. Well graded, angular, Pumiceous, loosely packed. (Ashfall Deposits)		D							
				319.3			*... from 1.50m to 1.70m, Gravels becoming fine to coarse grained.*									
					2		ML: Clayey SILT: with trace fine sand; light brown mottled orange. High plasticity, Contains minor black inclusions. (Alluvium)									
				318.8			ML: SILT: light greyish brown with orange. Low plasticity, extra sensitive, highly dilatant. (Alluvium)				87					
							... from 2.55m to 2.90m, Contains a 350mm fine to coarse grey sand lens.									
							... from 2.90m to 2.95m, Reddish orange lens.									
					3			M to W	F to St							
							... from 3.30m to 3.90m, Contains minor fine sand.									
											100					
					4		*... from 4.10m to 4.20m, Contains a 100mm fine to coarse grey sand lens.*									
							... from 4.35m to 4.40m, Contains a 50mm grey fine to coarse sand lens.									
				316.1			SW: fine to coarse SAND: with minor silt and clay, with trace fine									
					5											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 2 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
				315.7	6		to coarse gravel; light grey. Well graded, Pumiceous, loosely packed, slightly dilatant. (Alluvium)									
							SW: Silty fine to coarse SAND: with some clay; light greenish grey streaked dark greenish grey. Well graded, moderately sensitive, Interbedded slits and fine and coarse sand lenes, trace organic odour. (Alluvium)		MD		91					
				314.9			OL: Organic SILT: with some clay; dark brown mottled black. No plasticity, organic odour, no fibrous fragments. (Alluvium)		S to F							
				314.5	7		ML: SILT: with minor clay, with trace fine sand; light grey mottled bluish grey, pumiceous. (Lake Deposits - Pakihi Supergroup)		F to St		100					
							... from 7.00m to 7.40m, Contains greenish black inclusions.									
							... from 7.40m to 7.60m, Becoming a greenish brown.									
				313.4	8		ML: Clayey SILT: with minor organic staining; dark brown mottled brownish black. Low plasticity, organic odour, pumiceous. (Lake Deposits - Pakihi Supergroup)		F		100					
					9		*... from 9.10m to 10.00m, Contain dark and light grey mottling.*				100					
					10											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 3 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
					11			M	F		94					
					12											
					13						100					
					14											
					15						100					

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 4 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		15.2	SPT = (1,1,2 (0 1,1,0,1,1)) N* = 3		16		Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)		F		80				HQ3	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
					17						94					
		18.3	SPT = (2,2,5 (1,1,1,1,3,2)) N* = 7		18											
					19						87					
					20											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 5 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		21.3	SPT = (1,3,5 (1,0,1,2,2,3)) N* = 8		21				F		93					
					22						93					
					23							97				
					24		... from 23.80m to 24.40m, Becoming a silty fine to coarse sand with minor fine gravel. Pumiceous.									
		24.4	SPT = (6,11,14 (3,3,4,7,7,7)) N* = 25	296.6			SW: fine to coarse SAND: with minor silt; grey. Well graded, Pumiceous. (Lake Deposits - Pakihi Supergroup)				90					
					25											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 6 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
				294.9	26		Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	M to W								Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
							ML: Clayey SILT: with minor organic staining; dark brown mottled brownish black. Low plasticity, organic odour. (Lake Deposits - Pakihi Supergroup)									
					27						100					
		27.4	SPT = (16,13,14 (3,13,6,7,7,7)) N* = 27						St							
					28		*... from 28.10m to 28.11m, Contains a 10mm coarse sand lens.*	M			93					
					29											
											100					
					30											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH05

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 7 of 7

Logged by: LP | Position: E.381184.2m N.753586.0m | Elevation: RL 321.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		30.5	SPT = (3,4,6 (2,1,2,2,3,3)) N* = 10		31		Borehole terminated at 30.95 m		F to St							
					32											
					33											
					34											
					35											

Material Description: Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

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

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 1 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
	01-03-2019			319.0			OL: TOPSOIL: Contains minor fine to coarse gravels and minor fine to coarse sand, trace mottled of orange. (Topsoil)									
				318.5	1		SM: Silty fine to coarse SAND: with minor fine to medium gravel, with minor organic staining; greyish blue mottled brown. Contains interbedded silt and sand layers with organics. (Fill)		S to F		87					
				316.8	2		OL: TOPSOIL: with trace rootlets; black. (Topsoil)	M to W			93					
				316.0	3		ML: Sandy SILT: with some clay, minor rootlets; light greyish brown mottled brown. Low plasticity, sensitive. (Alluvium)		F		93					
				314.5	4		SW: fine to coarse SAND: with minor fine to medium gravel, with minor silt; light greenish grey. Subrounded, Pumiceous, loosely packed. (Alluvium)									
					5											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 2 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
				313.4	6		... from 5.10m to 5.20m, Some fine to medium pumiceous gravel. ... from 5.50m to 5.60m, 100mm orangic silt lens. ML: Clayey SILT: with minor rootlets, with trace fine sand; light bluish grey mottled greenish grey. Low plasticity, sensitive. (Alluvium)		LP S to F		100					Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
				312.9	7		SW: fine to coarse SAND: with minor fine to coarse gravel, with minor organic staining; dark greyish black. Well graded, organic odour, loosely packed. (Alluvium) ... from 6.70m to 7.90m, Becoming light bluish grey, gravels becoming fine. No organic staining, tightly packed.		LP		90					
				311.3	8		... from 7.63m to 7.64m, 10mm lens of a decomposed root. ML: Organic SILT: dark greyish brown. Low plasticity, sensitive, Contains trace black inclusions. (Alluvium)				93					
				310.6	9		ML: SILT: with some clay; light greyish blue mottled light greenish grey. Low plasticity, sensitive, Contains minor dark greenish black inclusions.. (Lake Deposits - Pakihi Supergroup)		F to St		100					
					10											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 3 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
							... from 10.10m to 10.10m, 10mm lens of fine sand.									
				308.2	11		ML: Clayey SILT: with minor organic staining; dark greenish brown mottled black. low plasticity, sensitive, slightly dilatant. Grades from bluish greenish grey into dark greenish brown over 200mm, organic odour. (Lake Deposits - Pakihi Supergroup)				94					
					12		*... from 12.40m to 13.90m, Minor light bluish grey mottling.*	M	F to St							
					13						100					
					14						100					
					15											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 4 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		15.2	SPT = (2,4,6 (1,1,2,2,2,4)) N* = 10		16		... from 15.60m to 19.90m, Black mottling becoming trace.		F to St		87				HQ3	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
					17						88					
		18.3	SPT = (2,4,10 (1,1,1,3,4,6)) N* = 14		18		... from 18.30m to 19.90m, Contains some fine to coarse pumiceous sand inclusions.									
					19						100					
				299.1	20		SW: fine to coarse SAND: with minor silt; light grey. Well graded, subrounded, pumiceous. (Lake Deposits - Pakihi									

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 5 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
					21		Supergroup)	W	TP		93					
				297.9			ML: SILT: with some clay; dark greenish brown. Low plasticity, sensitive, trace black inclusions and mottling. (Lake Deposits - Pakihi Supergroup)									
		21.3	SPT = (3,4,8 (1,2,2,2,4,4)) N* = 12		22						100					
					23		*... from 23.10m to 26.00m, Becoming mottled greyish black.* *... from 23.15m to 23.16m, 10mm fine sand lens.*		F to St		94					
		24.4	SPT = (1,3,6 (1,0,1,2,3,3)) N* = 9		24						73					
					25											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 6 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		27.4	SPT = (4,4,8 (1,3,2,2,4,4)) N* = 12		26 27 28 29 30		Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	M	F to St		93 30 94					Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH06

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 28/02/2019 - 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 7 of 7

Logged by: LP | Position: E.381210.4m N.753703.3m | Elevation: RL 319.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		30.5	SPT = (4,6,10 (2,2,3,3,5,5)) N* = 16		31		Borehole terminated at 30.95 m		F to St							
					32											
					33											
					34											
					35											

Material Description: Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

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

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 1 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering	Recovery	RQD	Estimated Strength	Defect Spacing (mm)	Drilling Method/ Support	Structure & Other Observations
				317.0			OL: TOPSOIL: (Topsoil)									
				317.0			ML: Organic SILT: with some fine to coarse sand; orange brown mottled black. Low plasticity. (Fill)	M to W	S to F							
				316.4			OL: Organic SILT: black mottled dark brown. (Fill)									
				316.3			ML: Sandy SILT: with trace fine to medium gravel; light orange brown mottled orange brown. No plasticity, moderately sensitive, Pumiceous. (Fill)	M	F to St		80					
				315.5	1		SW: Silty fine to coarse SAND: light greyish orange mottled orange green. Well graded, Pumiceous. (Alluvium)	W	LP		40					
				315.4			GP: Sandy fine to medium GRAVEL: with trace silt; orange brown mottled white. Subangular, Pumiceous. (Alluvium)									
				314.0	2		SP: Silty fine SAND: with minor rootlets, with trace clay; light greenish grey streaked bluish green. Fibrous rootlets. (Alluvium)	M			100					
				313.2	3		ML: SILT: with trace fine sand, and trace clay; light grey. Low plasticity, quick, pumiceous, highly dilatant. (Alluvium)	W	F							
				312.8	4		ML: SILT: with some fine sand; light grey. Low plasticity, sensitive, pumiceous, highly dilatant. (Alluvium)									
				312.5	5		SW: fine to coarse SAND: with minor fine to medium gravel, with trace silt; dark grey streaked greenish grey. Well graded, subrounded. (Alluvium)									

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 2 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
				311.4	6		ML: SILT: with some clay; dark greenish brown with greyish black. Low plasticity, sensitive, organic odour, streaked black. (Lake Deposits - Pakihi Supergroup)		LP		88					
					7				F to St		100					
					8		*... from 8.30m to 15.65m, Becoming a greenish greyish brown.*				93					
					9						93					
					10											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 3 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density	Weathering: RS	CW	HW	MW	SW	UW	Recovery	RQD	Estimated Strength: EW	VW	W	MS	S	VS	ES	Defect Spacing (mm): <20	20-60	60-200	200-600	600-2000	>2000	Drilling Method/ Support	Structure & Other Observations: Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
					11			M	S to F							94																
					12																											
					13											100																
					14																											
																93																
					15																											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 4 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		15.2	SPT = (1,1,2 (1,0,0,1,0,2)) N* = 3		16		... from 15.65m to 18.85m, Becoming dark bluish grey, still organic odour.		F to St		100				HQ3	
					17						87					
		18.3	SPT = (2,4,6 (1,1,2,2,3,3)) N* = 10		18											
					19		... from 18.85m to 22.10m, Becoming mottled black and dark grey.				91					
					20											

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 5 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		21.3	SPT = (2,2,5 (1,1,1,1,2,3)) N* = 7		21				F to St		100					
				294.9	22		SP: fine SAND: with minor silt; light bluish grey. Poorly graded, tightly packed. (Lake Deposits - Pakihi Supergroup)		TP							
				294.8					S to F							
				294.6					TP							
				294.6			ML: Clayey SILT: dark green. Low plasticity, sensitive, organic. odour (Lake Deposits - Pakihi Supergroup)		S to F		97					
				294.6				M to W	TP							
				294.2			SP: fine SAND: with minor silt; light bluish grey mottled dark greyish blue. Poorly graded. (Lake Deposits - Pakihi Supergroup)									
					23		Clayey SILT: dark green. Low plasticity, sensitive, organic. odour. (Lake Deposits - Pakihi Supergroup)									
							SW: fine to coarse SAND: with some silt, with minor fine gravel; light bluish grey. Well graded. (Lake Deposits - Pakihi Supergroup)									
							ML: SILT: with some clay; dark greenish brown with greyish black. Low plasticity, sensitive, streaked black, organic odour. (Lake Deposits - Pakihi Supergroup)				100					
					24				F to St							
		24.4	SPT = (2,4,6 (1,1,2,2,3,3)) N* = 10													
					25						100					

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 6 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		27.4	SPT = (2,6,5 (1,1,3,3,2,3)) N* = 11		26 27 28 29 30		Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	M	F to St		100 97 88					Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks

Termination reason: Limit of investigation

Remarks:

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

BOREHOLE LOG - MBH07

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 01/03/2019
Borehole Location: Refer to site plan (Village Location)

CMW Geosciences

1:25 Sheet 7 of 7

Logged by: LSP | Position: E.381024.9m N.753763.6m | Elevation: RL 317.00m
Checked by: GS | Survey Source: Hand Held GPS | Datum: Moturiki | Angle from horizontal: 90°

Well	Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Weathering: RS CW HW MW SW UW	Recovery	RQD	Estimated Strength: EW VW W MS S VS ES	Defect Spacing (mm): <20 20-60 60-200 200-600 600-2000 >2000	Drilling Method/ Support	Structure & Other Observations
		30.5	SPT = (2,4,5 (1,1,2,2,2,3)) N* = 9		31		Borehole terminated at 30.95 m		S to F							
					32											
					33											
					34											
					35											

Material Description: Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

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

Termination reason: Limit of investigation

Remarks:

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

TEST PIT LOG - TP19

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 14/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381215.0m N.753616.6m
Survey Source: Hand Held GPS
Elevation: RL 320.00m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			320.0	0		OL: Organic SILT, with minor rootlets: light brown. Non plastic. (Topsoil)	D		5, 6	
			319.8			SP: Fine to medium SAND, with minor silt and trace gravel: light grey. Poorly graded, pumiceous; gravel, fine. (Fluvially Reworked Deposits)	M		16, 17, 18, 14, 12, 12, 10, 9	
				2		... at 2.00m, contains some silt.	W	D to VD		
				4		Test pit terminated at 4.00 m				

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Target depth

Remarks: Groundwater not encountered.

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

TEST PIT LOG - TP20

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 14/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381182.4m N.753594.7m
Survey Source: Hand Held GPS
Elevation: RL 319.20m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations (Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks)
			319.2			OL: Organic SILT, with minor rootlets: dark brown. Non plastic. (Topsoil)	D to M			
			319.0			ML: SILT, with minor clay and minor sand: orange-brown. Low plasticity; sand, fine. (Ashfall Deposits)	M	H		
	1.0	Peak = UTP		1						
	1.4	Peak = UTP								
			317.7			GW: Fine to coarse GRAVEL: orange. Normally graded, subrounded, pumice. (Ashfall Deposits)		TP		
				2						
14-02-2019			317.0			ML: SILT: white, mottled orange. Non plastic, dilatant, pumiceous. (Alluvium)	W			
							W to S			
						Test pit terminated at 2.60 m				
				3						
				4						
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

Termination reason: Target depth

Remarks: Shear vane no. 2562.

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

TEST PIT LOG - TP21

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 14/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB

Position: E.381136.4m N.753614.7m
Survey Source: Hand Held GPS

Elevation: RL 320.10m
Datum: Moturiki

Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			320.1	0		OL: Organic SILT, with minor rootlets: dark brown. Non plastic. (Topsoil)	D to M			
			319.9			SP: Fine to medium SAND, with trace gravel: light grey, mottled orange. Poorly graded, pumiceous. (Fill)				
			319.7			SP: Fine SAND, with trace gravel and trace silt: light grey, mottled orange. Poorly graded, pumice; gravel, fine. (Fluvially Reworked Deposits)	M			
				1			M to W			
								TP		
				2		... at 2.00m, contains trace coarse rounded pumice gravel	W			
				3		Test pit terminated at 3.10 m				
				4						
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Refusal

Remarks: Groundwater not encountered.

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

TEST PIT LOG - TP22

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 14/02/2019
Test Pit Location: Refer to site plan (Village Location)

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB

Position: E.381089.4m N.753684.3m
Survey Source: Hand Held GPS

Elevation: RL 319.00m
Datum: Moturiki

Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			319.0			OL: Organic SILT: dark brown. Non plastic. (Topsoil)	D to M		1	
			318.8			ML: Gravelly SILT: orange-brown, mottled black. Non plastic; gravel, fine to medium, pumice. (Fill)			6 9	
	0.7	Peak = UTP	318.4	1		ML: SILT, with minor clay and minor sand: orange-brown. Low plasticity; sand, fine to medium. (Ashfall Deposits)	M	H	2 3 2 3 2 2 3 2 2 3 5 4 4	
	1.5	Peak = UTP	317.4			GW: Fine to coarse GRAVEL: light orange. Normally graded, subrounded, pumiceous. (Ashfall Deposits)		MD	4 6 8 8	
	2.2	Peak = UTP	317.0	2		ML: SILT, with trace sand, trace clay and trace rootlets: light grey. Non plastic, dilatant, pumiceous; sand, fine; rootlets, decomposed. (Alluvium)	M to W	H	7	
						Test pit terminated at 2.50 m				
				3						
				4						
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Target depth

Remarks: Groundwater not encountered. Shear vane no. 2562.

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

TEST PIT LOG - TP23

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381092.6m N.753688.2m
Survey Source: Hand Held GPS
Elevation: RL 319.00m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			319.0	0		OL: Organic SILT, with minor rootlets: dark brown. Non plastic. (Topsoil)	D to M		1, 3	
			318.8			SP: Fine to medium SAND, with minor silt: light grey. Poorly graded, tightly packed, pumiceous. (Fluvially Reworked Deposits)	M	D to VD	10, 20, 20	
				1		... at 1.00m, mottling absent absent.				
				2			M to W			
				3						
				4		Test pit terminated at 4.00 m				
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Target depth

Remarks: Groundwater not encountered.

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

TEST PIT LOG - TP24

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.380931.1m N.753627.4m
Survey Source: Hand Held GPS
Elevation: RL 317.50m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15 20	Structure & Other Observations (Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks)
			317.5			OL: Organic SILT, with minor rootlets: dark brown. Non plastic. (Topsoil)	M			
			317.3			OL: Organic SILT, with minor wood and trace plastic: black. Non plastic; wood, 2-30cm lengths, partially decomposed. (Fill)	M to W			
				1		*... at 1.00m, contains minor partially decomposed, 0.5-2m long logs.*				
	1.4	Peak = 35kPa Residual = 11kPa	316.1			MH: Clayey SILT: light grey, mottled orange. High plasticity, organic odour. (Alluvium)				
	1.6	Peak = 19kPa Residual = 14kPa		2			W to S	S to F		
15-02-2019				3						
			314.0			ML: SILT, with trace rootlets: greenish grey. Non plastic, pumiceous, dilatant; rootlets, partially decomposed. (Alluvium)	W			
				4		Test pit terminated at 4.00 m				
				5						
				6						

Termination reason: Target depth

Remarks: Shear vane no. 2562.

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

TEST PIT LOG - TP25

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB

Position: E.381071.6m N.753767.5m
Survey Source: Hand Held GPS

Elevation: RL 317.50m
Datum: Moturiki

Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			317.5			OL: Organic SILT: dark brown. Non plastic. (Topsoil)	D			
			317.3			ML: SILT, with minor clay and trace sand: orange-brown, mottled black. Low plasticity; sand, fine. (Uncontrolled Fill)	M			
	0.5		317.0			ML: SILT, with some sand: orange-brown. Non plastic to low plasticity; sand, fine to coarse, pumice. (Ashfall Deposits)	D to M	H		
			315.7	1		GW: Fine to coarse GRAVEL: orange. Normally graded, subangular to subrounded, tightly packed, pumice. (Ashfall Deposits)	M to W	TP		
						... at 2.20m, contains trace cobbles.				
	2.5		315.1	2		ML: SILT, with trace rootlets: light greenish grey. Non plastic, dilatant, pumiceous; rootlets, decomposed. (Alluvium)	W	H		
				3		Test pit terminated at 3.00 m				
				4						
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Target depth

Remarks: Groundwater not encountered. Shear vane no. 2562. Natural surface dipping downslope (north) approximately 15 degrees.

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

TEST PIT LOG - TP26

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB

Position: E.381179.2m N.753649.5m
Survey Source: Hand Held GPS

Elevation: RL 319.00m
Datum: Moturiki

Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			319.0	0		OL: Organic SILT, with minor rootlets: Brown. Non plastic. (Topsoil)			5 10 15 20	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			318.9			SP: Fine to medium SAND, with trace silt: light grey. Poorly graded, pumiceous. (Fluvially Reworked Deposits)	M	TP		
						... at 0.50m, becoming mottled orange.				
				1						
				2						
				3		Test pit terminated at 3.00 m				
				4						
				5						
				6						

Termination reason: Target depth

Remarks: Groundwater not encountered.

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

TEST PIT LOG - TP27

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381222.2m N.753725.1m
Survey Source: Hand Held GPS
Elevation: RL 318.50m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			318.5			OL: Organic SILT, with some gravel and trace concrete: dark brown. Non plastic; gravel, fine to coarse. (Topsoil)	D to M		9, 11, 18	
			318.2			SM: Silty fine to coarse SAND: light grey, mottled brown and orange. Well graded. (Fill)	M	MD to D	7, 5, 3, 3, 3, 4, 10, 6, 5, 11, 10, 11, 8, 7, 6, 4, 3	
			316.5	2					3	
	2.1	Peak = 65kPa Residual = 30kPa	316.4			OL: Organic SILT: black. Non plastic. (Topsoil)				
	2.5	Peak = 41kPa Residual = 22kPa				ML: SILT, with trace rootlets: brown. Non plastic, insensitive to moderately sensitive, dilatant, pumiceous; rootlets, fresh. (Alluvium)	W	F to St		
			315.3	3		ML: SILT, with trace rootlets and trace wood: grey. Non plastic, dilatant, pumiceous; rootlets, fresh; wood, sticks, 10cm lengths. (Alluvium)	W to S			
15-02-2019						Test pit terminated at 3.70 m				
				4						
				5						
				6						

Termination reason: Target depth

Remarks: Shear vane no. 2562.

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

TEST PIT LOG - TP28

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381255.6m N.753677.4m
Survey Source: Hand Held GPS
Elevation: RL 319.00m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			319.0			OL: Organic SILT, minor rootlets: dark brown. Non plastic. (Topsoil)	D to M		1	
			318.8			SW: Silty fine to coarse SAND, with trace coarse gravel: grey mottled black. Well graded, subrounded. (Fill)			7	
						... at 0.50m, becoming fine grained, gravel absent.			20	
				1			M			
				2						
15-02-2019 Perched			316.8			SP: Silty fine to medium SAND, with trace wood: light brownish grey. Pumiceous; wood, 0.1-1m long sticks and logs. (Alluvium)	M to W			
						... from 2.50m to 3.80m, contains minor clay, some plasticity.				
				3			W to S			
15-02-2019			315.2			SW: Fine to coarse SAND, with some fine to medium gravel: light grey mottled orange. Well graded, rounded, pumiceous. (Alluvium)				
				4		*... at 4.00m, becoming mottled green.*				
						Test pit terminated at 4.10 m				
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

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

Termination reason: Target depth

Remarks:

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

TEST PIT LOG - TP29

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB
Position: E.381291.6m N.753608.4m
Survey Source: Hand Held GPS
Elevation: RL 322.00m
Datum: Moturiki
Angle from horizontal: 90°

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			322.0			OL: Organic SILT, with trace rootlets: dark brown. Non plastic.				Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			321.9			(Topsoil)				
						ML: Sandy SILT: orange brown mottled dark brown. No plasticity, sand, fine to coarse, pumiceous, subrounded. (Colluvium)				
				1			M			
			320.4			ML: SILT, with trace clay: light grey streaked orange. Laminated, non plastic, pumiceous, sensitive, dilatant. (Alluvium)				
	1.7	Peak = 112kPa Residual = 22kPa								
	2.0	Peak = 103kPa Residual = 27kPa		2		*... from 2.00m to 3.10m, becoming light bluish grey.*	M to W	VSt		
				3		Test pit terminated at 3.10 m				
				4						
				5						
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

Termination reason: Target depth

Remarks: Groundwater not encountered. Shear vane no. 2562.

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

TEST PIT LOG - TP30

Client: Red Stag Wood Solutions Ltd
Project: Red Stag CLT Plant
Site Location: Waipa Mill, Rotorua
Project No.: TGA2019-0004
Date: 15/02/2019
Test Pit Location: Refer to site plan (Village Location)

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: LGL
Checked by: KB

Position: E.381300.1m N.753724.9m
Survey Source: Hand Held GPS

Elevation: RL 319.00m
Datum: Moturiki

Angle from horizontal: 90°

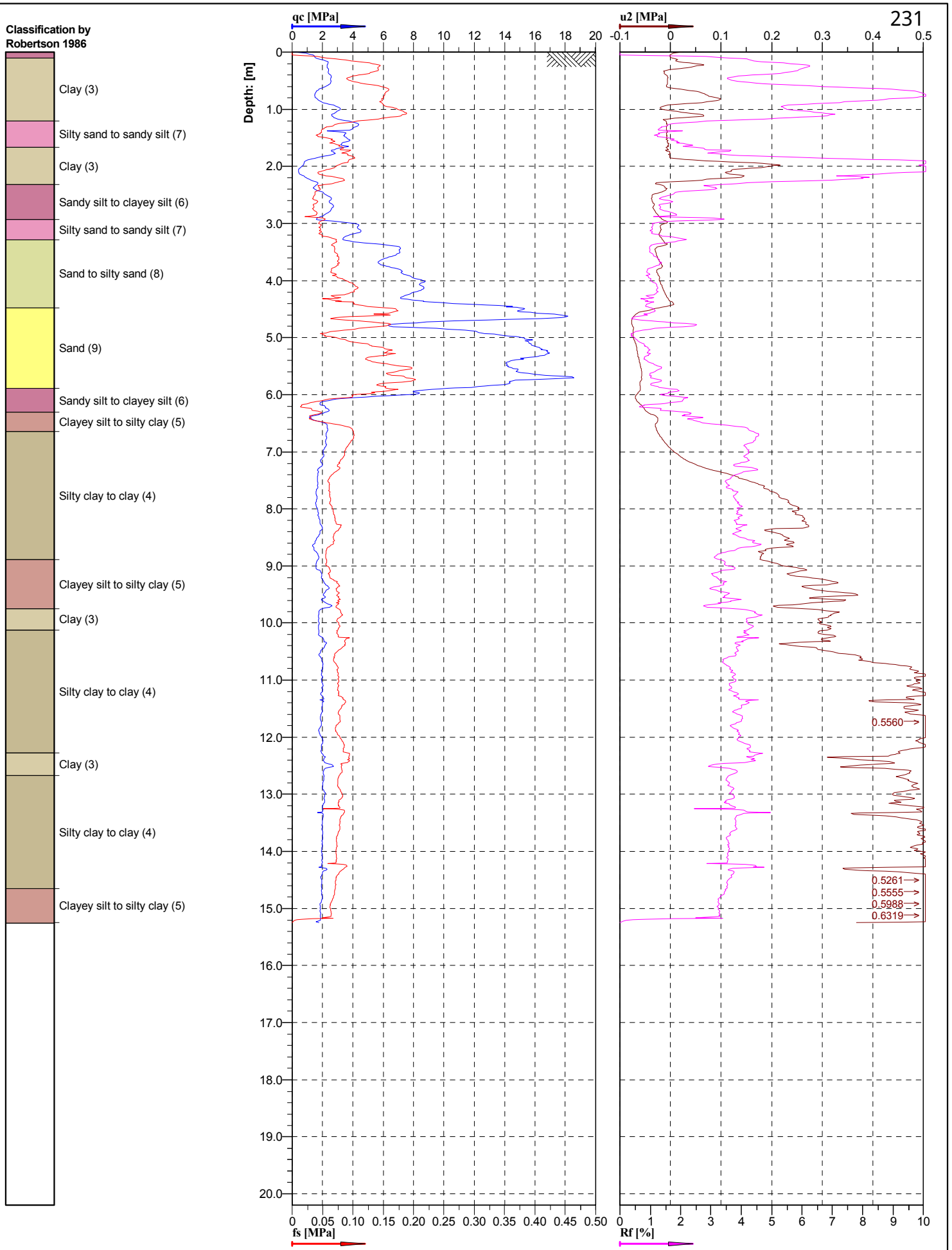
Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & Other Observations
			319.0			OL: Organic SILT: brown. Non plastic, minor rootlets. (Topsoil)				Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks
			318.9			SP: Silty fine SAND: brown, mottled black. Poorly graded. (Uncontrolled Fill)				
						... at 0.40m, becoming dark grey, mottled black and brown.				
				1		*... at 1.00m, becoming light grey*	D to M			
			317.0	2		Pt: Fibrous PEAT: black. Non plastic.				
						... at 2.20m, becoming dark brown.				
				3		*... at 3.00m, contains some decomposed wood fragments, 0.1 to 1m long.*	M to W			
				4						
15-02-2019			314.0	5		SM: Silty fine to medium SAND, with trace clay: light brown. Poorly graded, rounded, pumiceous. (Alluvium)	W to S			
						Test pit terminated at 5.30 m				
				6						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15 20

Termination reason: Target depth

Remarks:

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

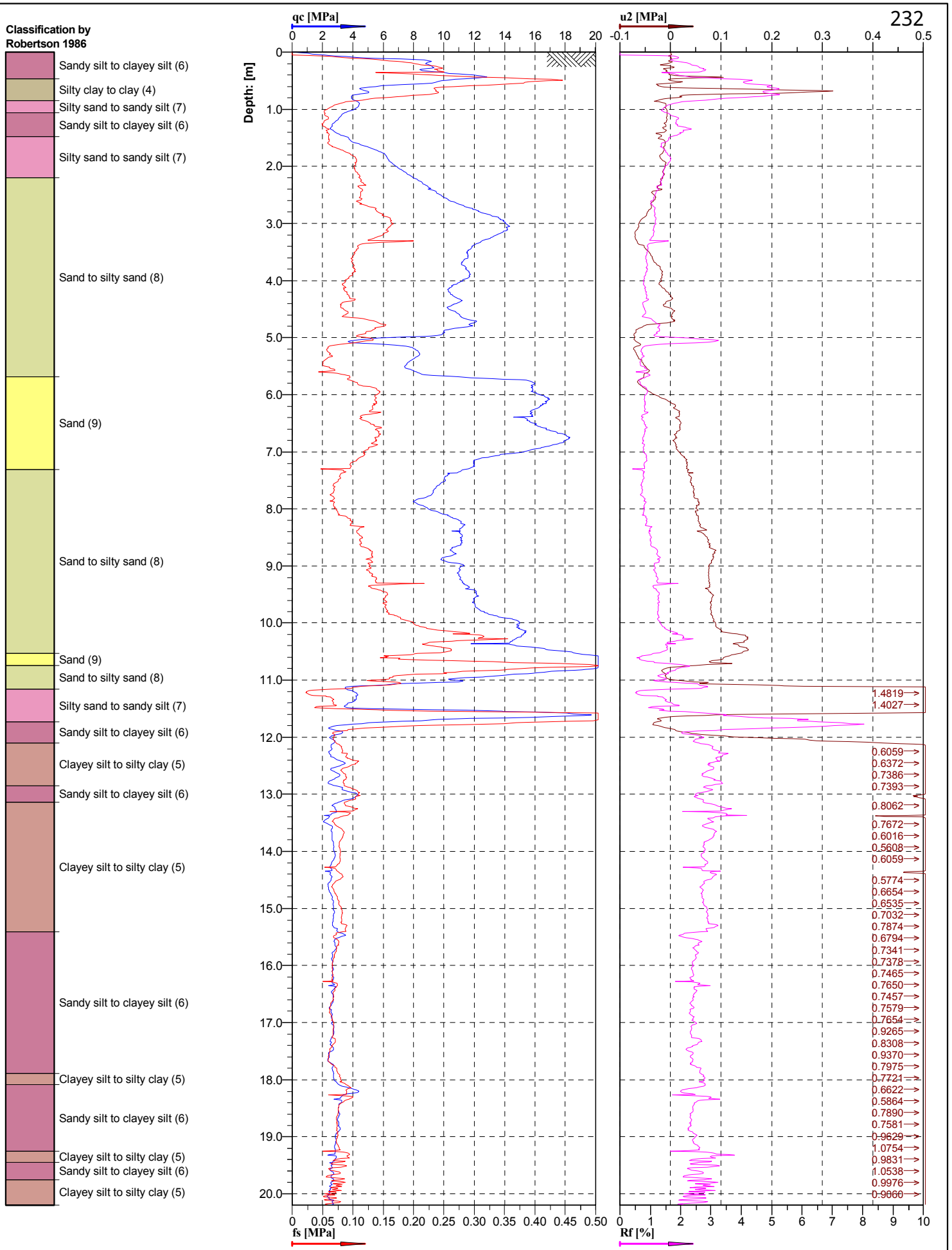


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT21
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT21.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



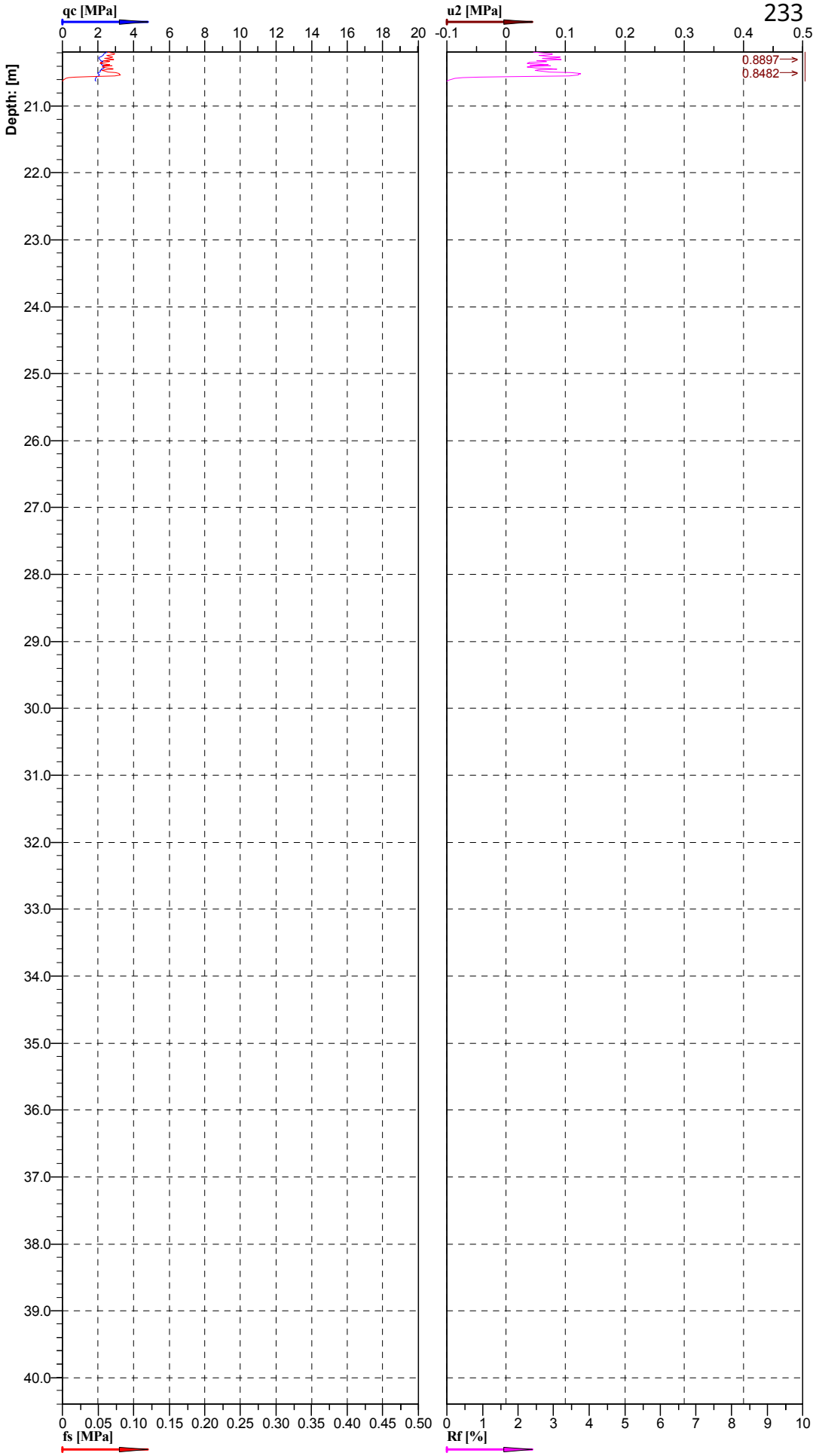
Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT22
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/2	Fig.:
		File: CMW TGA2019-0004_CPT22.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Classification by Robertson 1986

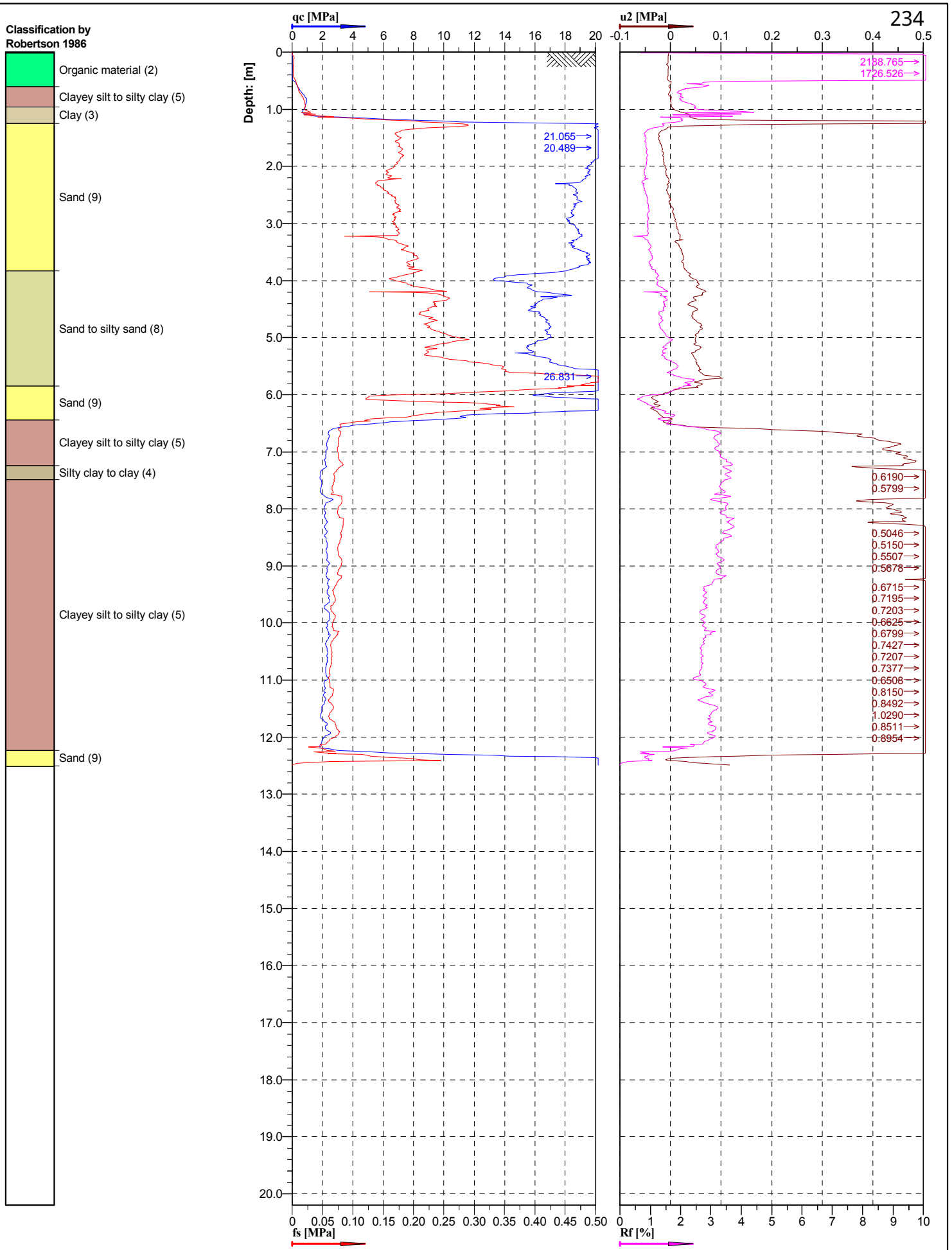
Clayey silt to silty clay (5)



Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT22
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 2/2	Fig.:
		File: CMW TGA2019-0004_CPT22.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

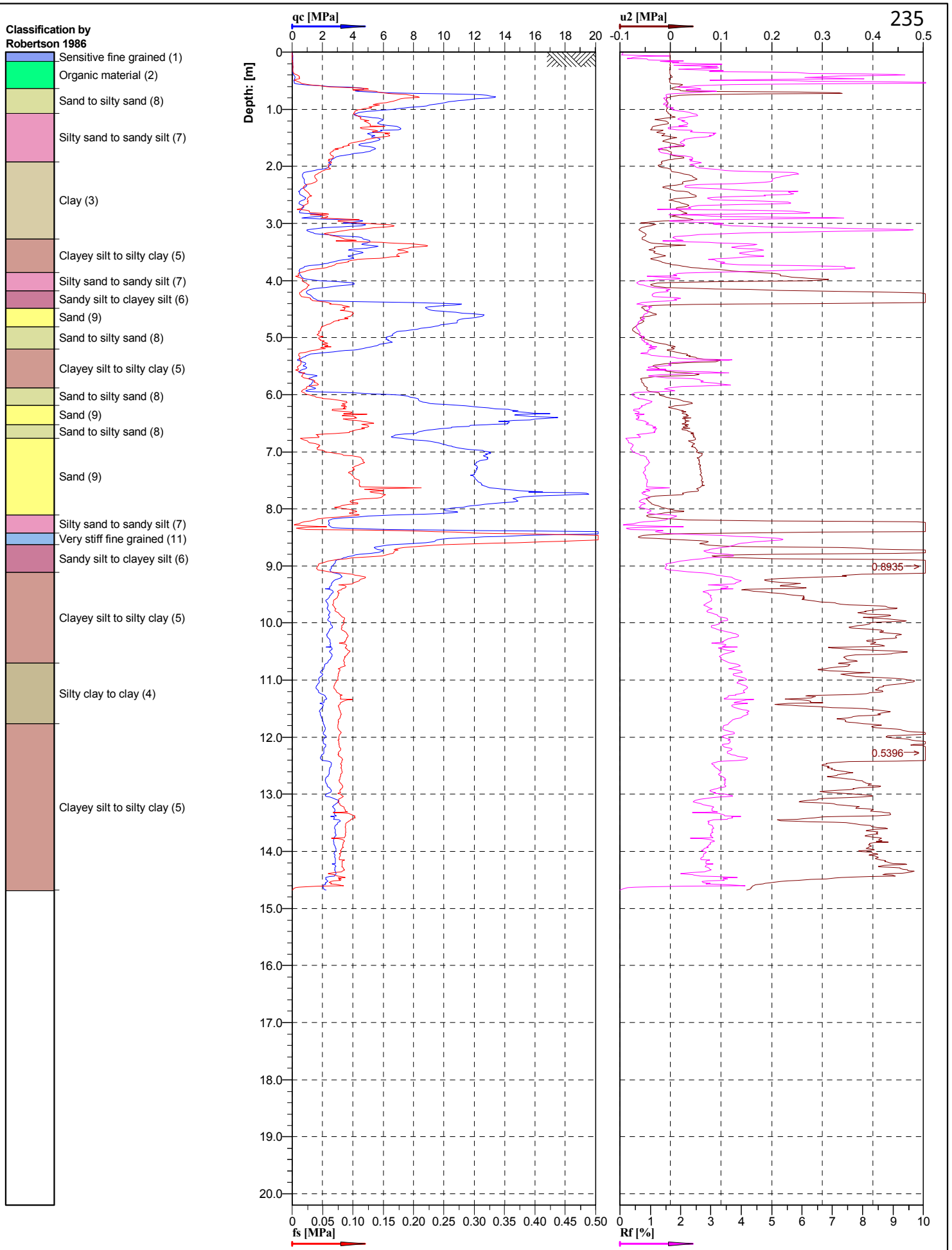


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT23
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT23.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

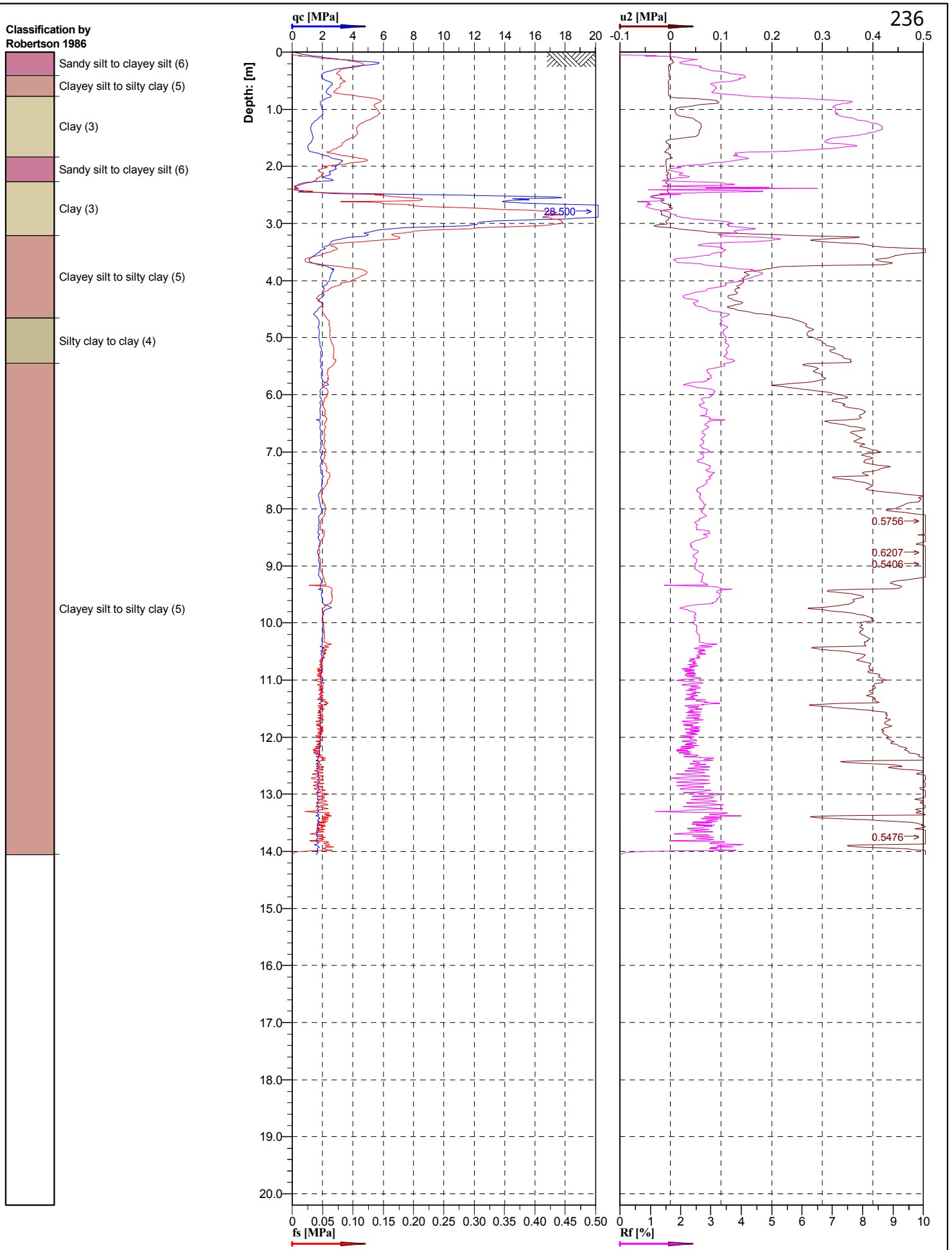


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT24
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT24.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

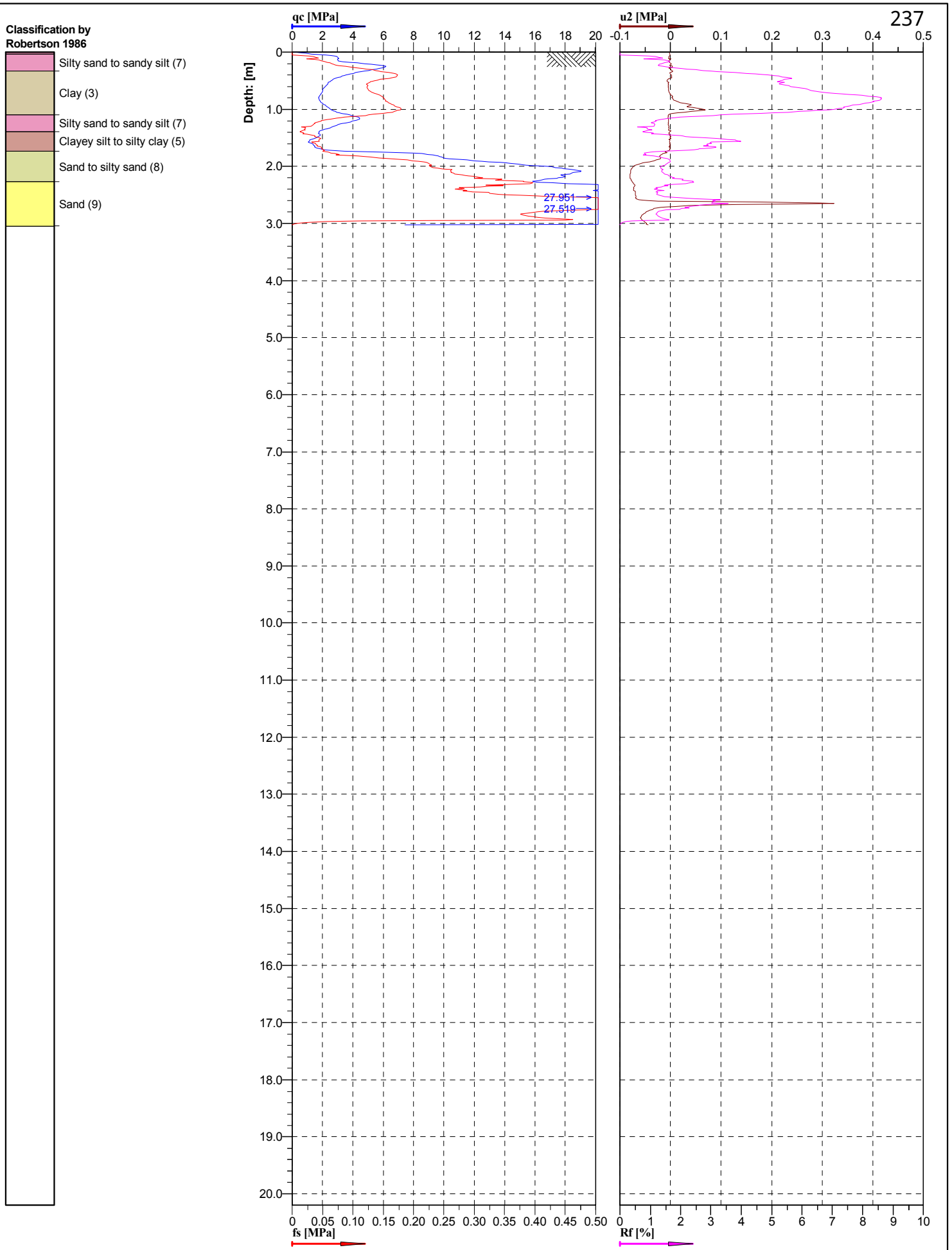


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT25
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT25.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

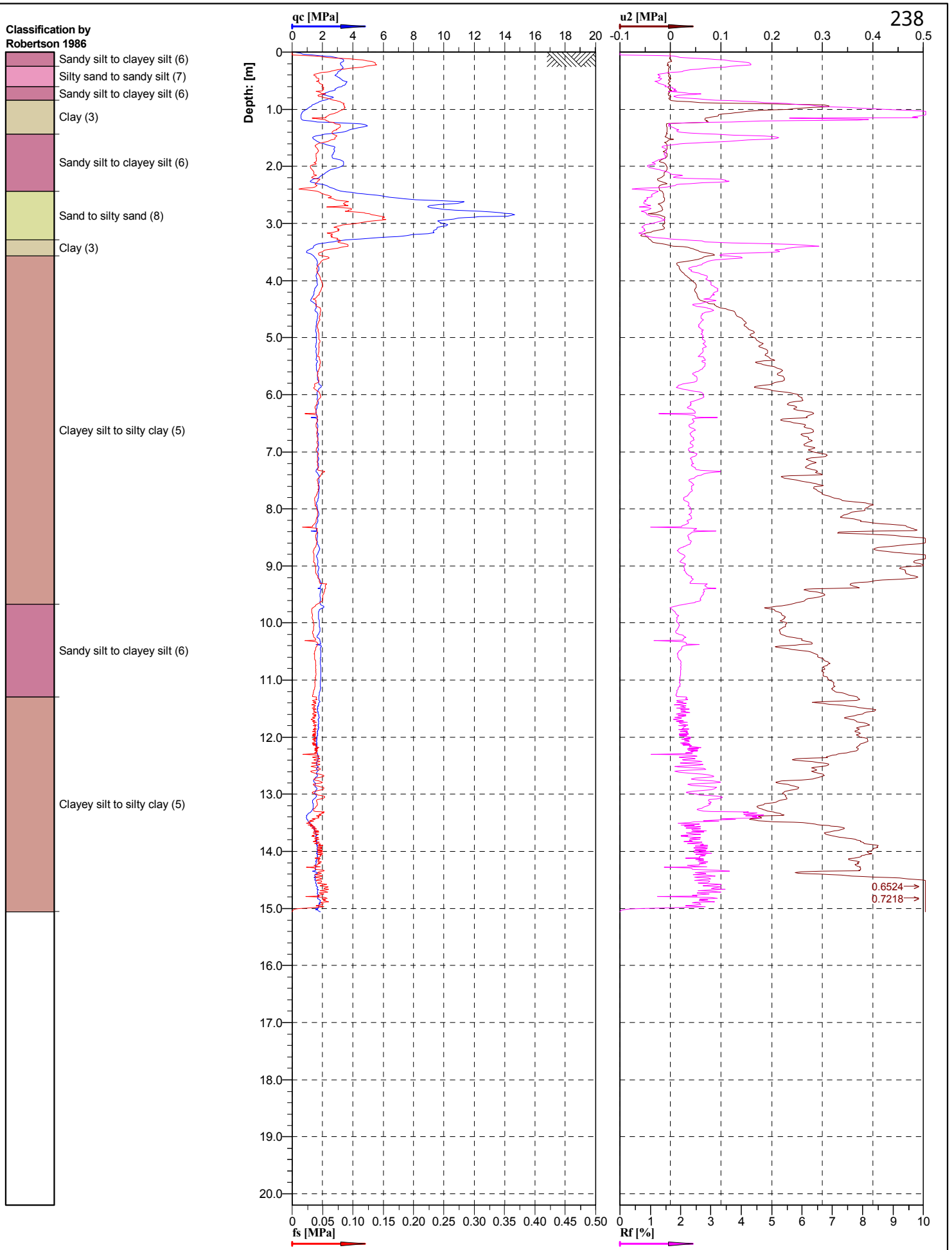
Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT26
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT26.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

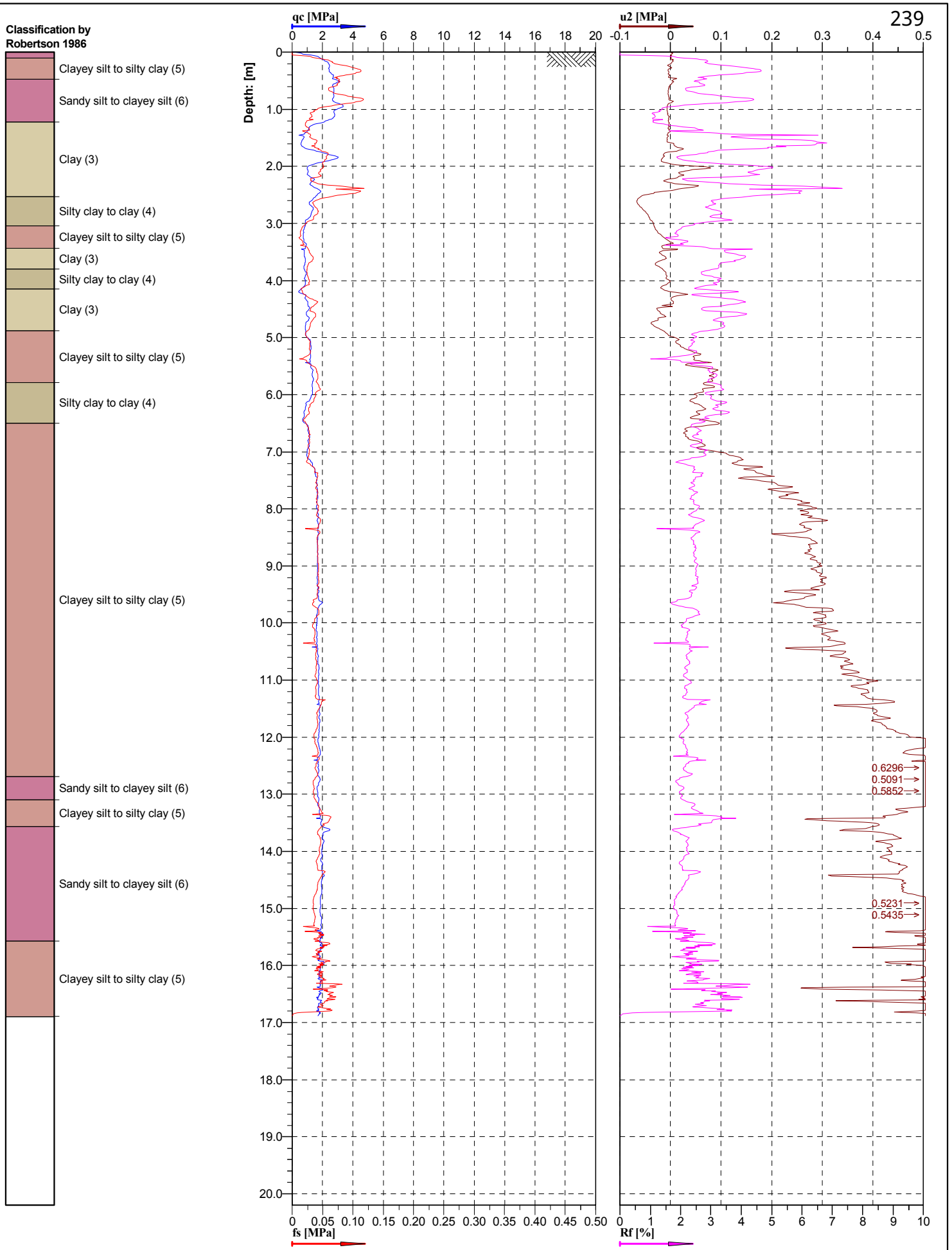


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT27
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT27.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

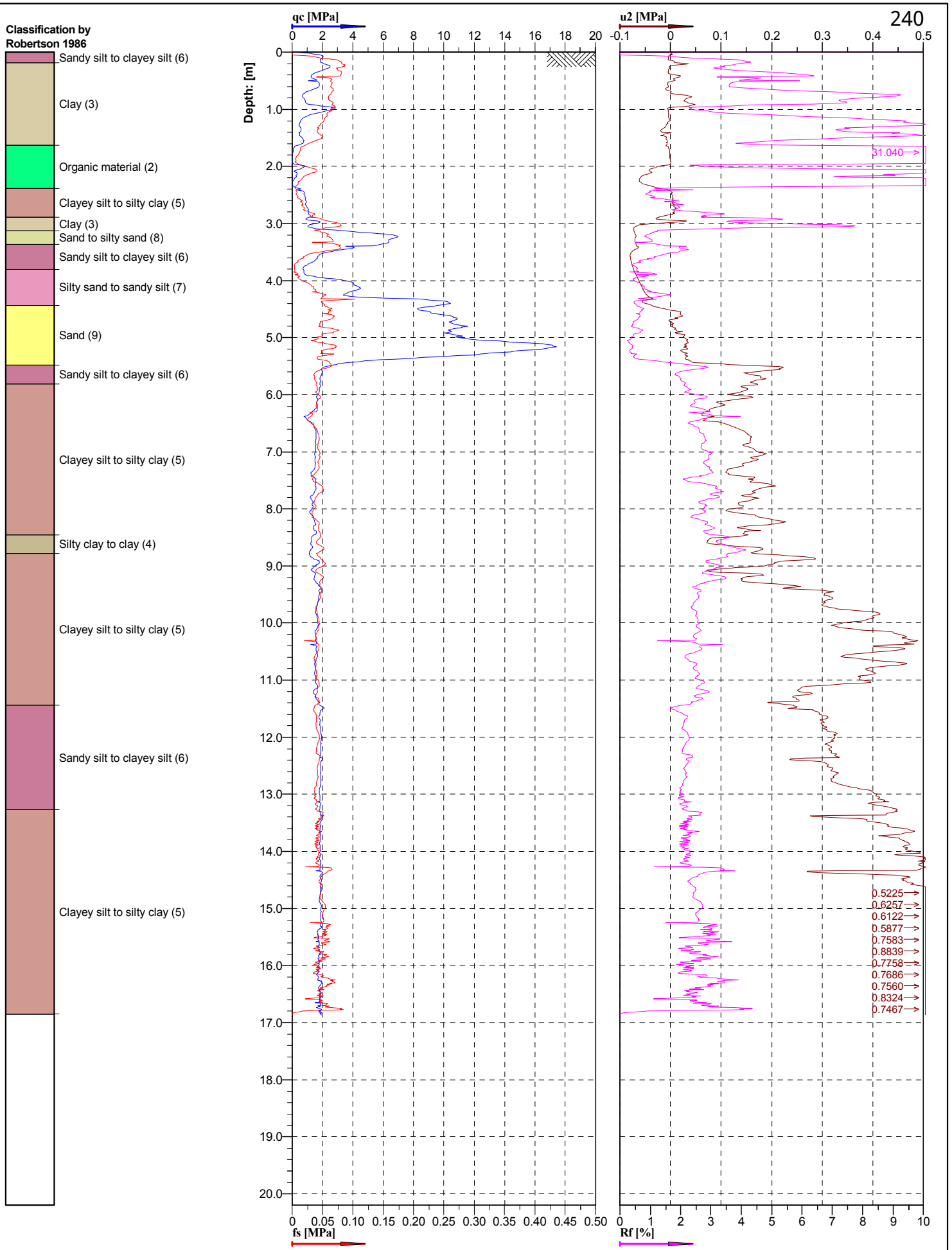


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT28a
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT28a.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

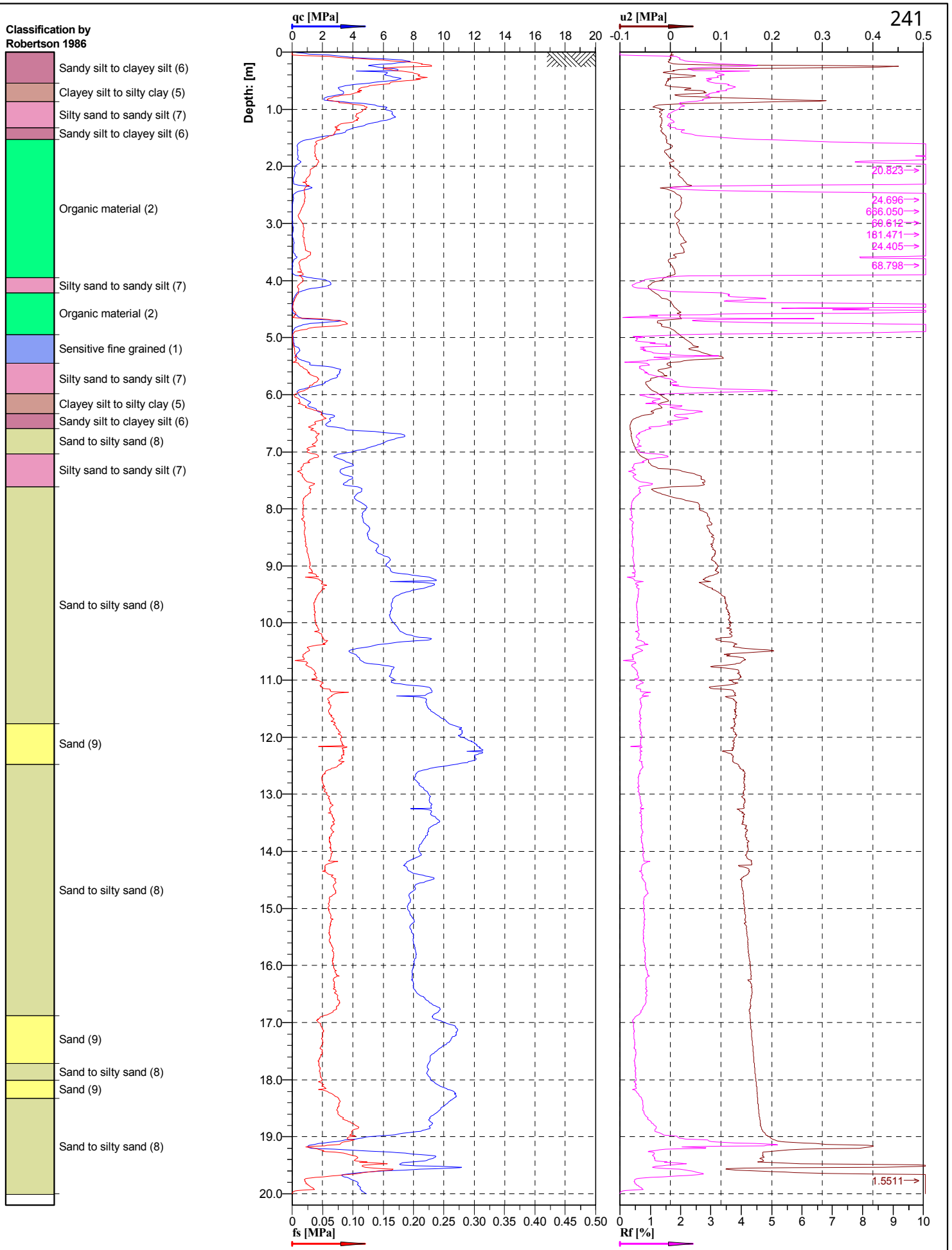


Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT29
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT29.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150



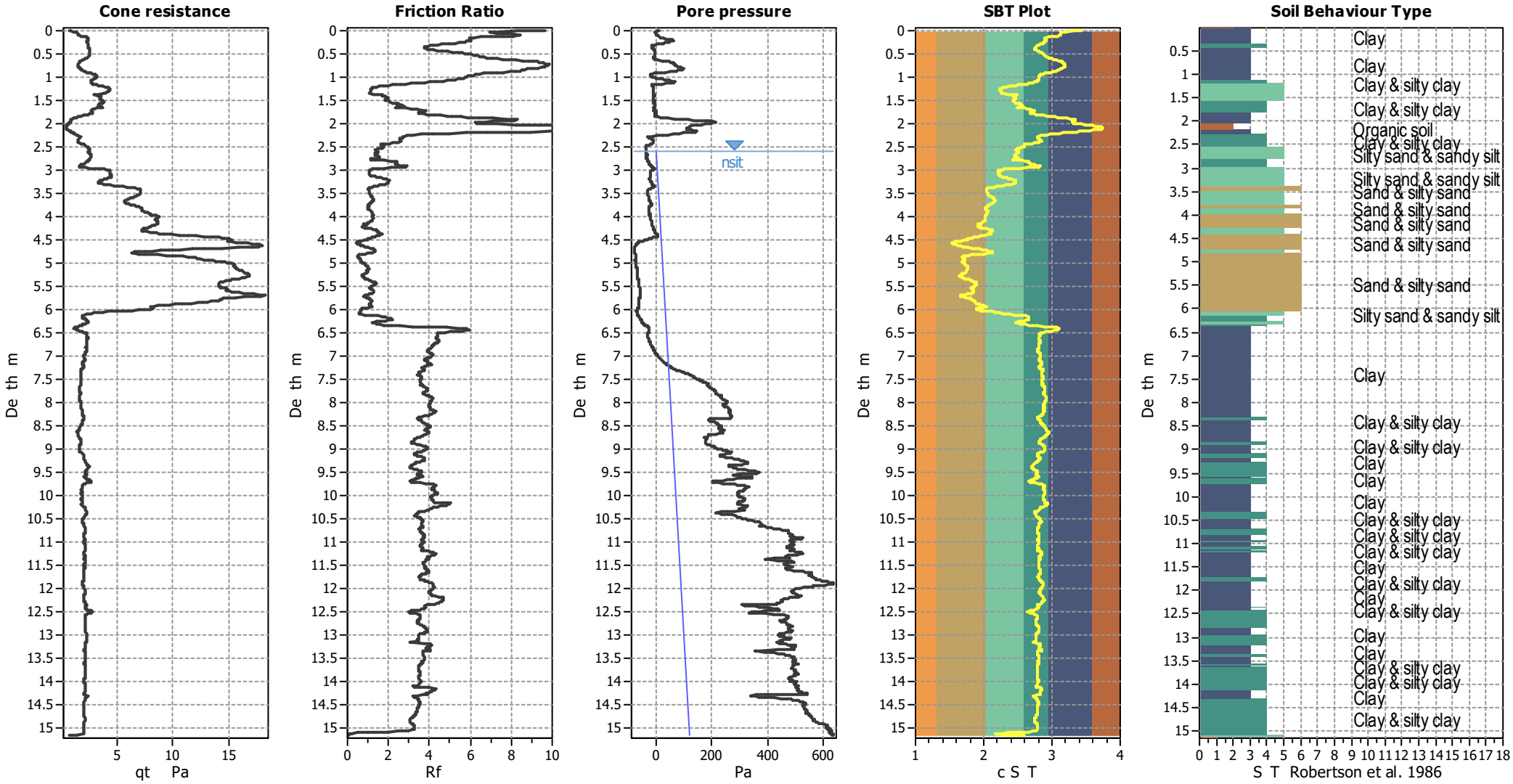
Location: Waipa Mill Rd Rotorua	Position: X: 0 m, Y: 0 m	Ground level: 0.000	Test No.: CPT31
Project ID: CMW TGA2019-0004	Client: CMW	Date: 26/02/2019	Scale: 1 : 85
Project: CMW TGA2019-0004		Page: 1/1	Fig.:
		File: CMW TGA2019-0004_CPT31.GEF	

PRO-DRILL
SPECIALIST DRILLING ENGINEERS

u2

Cone No: S10CFIIP.1734
Tip area [cm2]: 10
Sleeve area [cm2]: 150

CPT basic interpretation plots



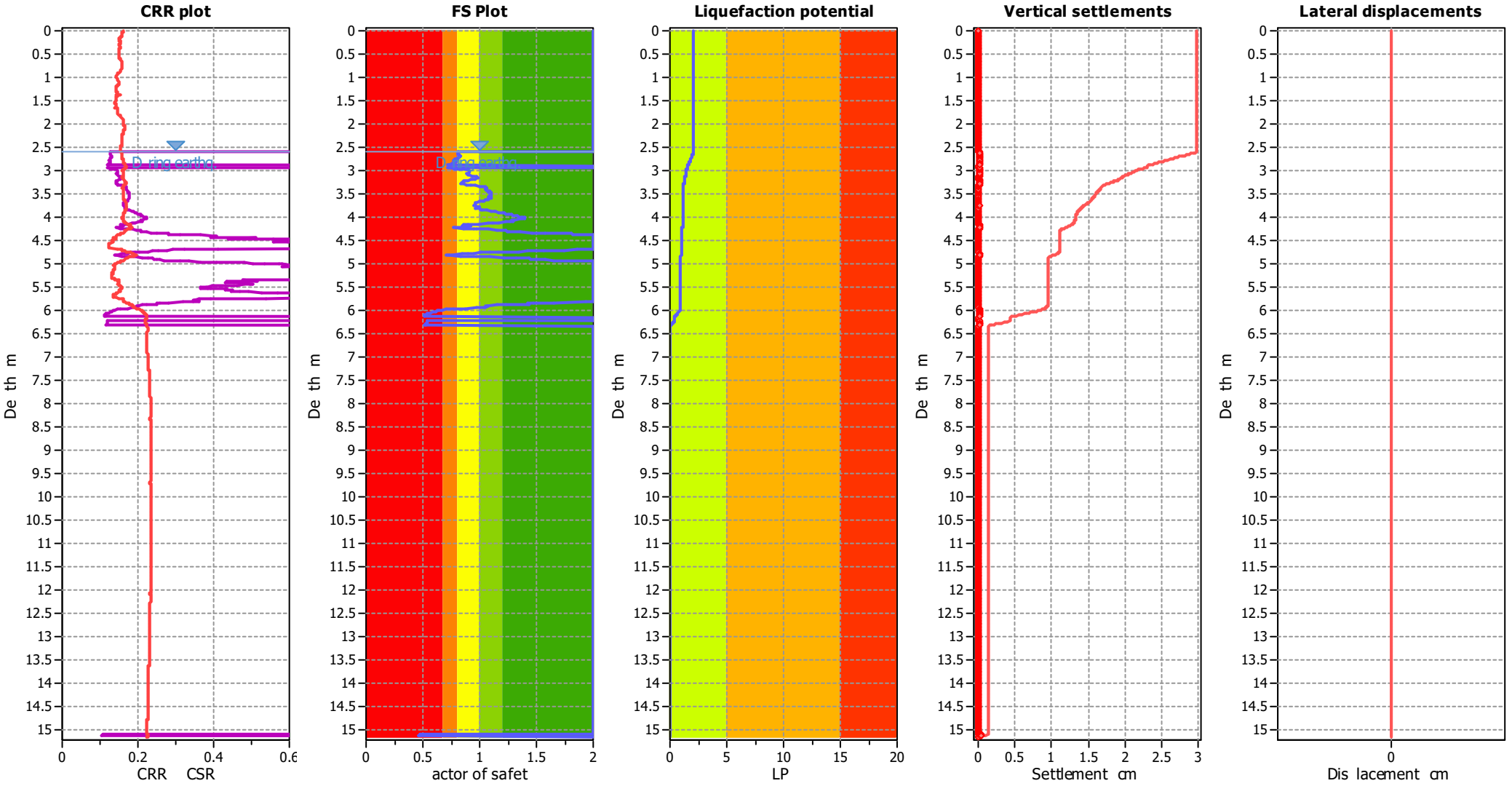
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.60 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.60 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained
2. Organic material
3. Cla to silt cla
4. Cla e silt to silt
5. Silt sand to sand silt
6. Clean sand to silt sand
7. Gra el sand to sand
8. Ver stiff sand to
9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.60 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.60 m	ill height:	A	Limit de th:	A

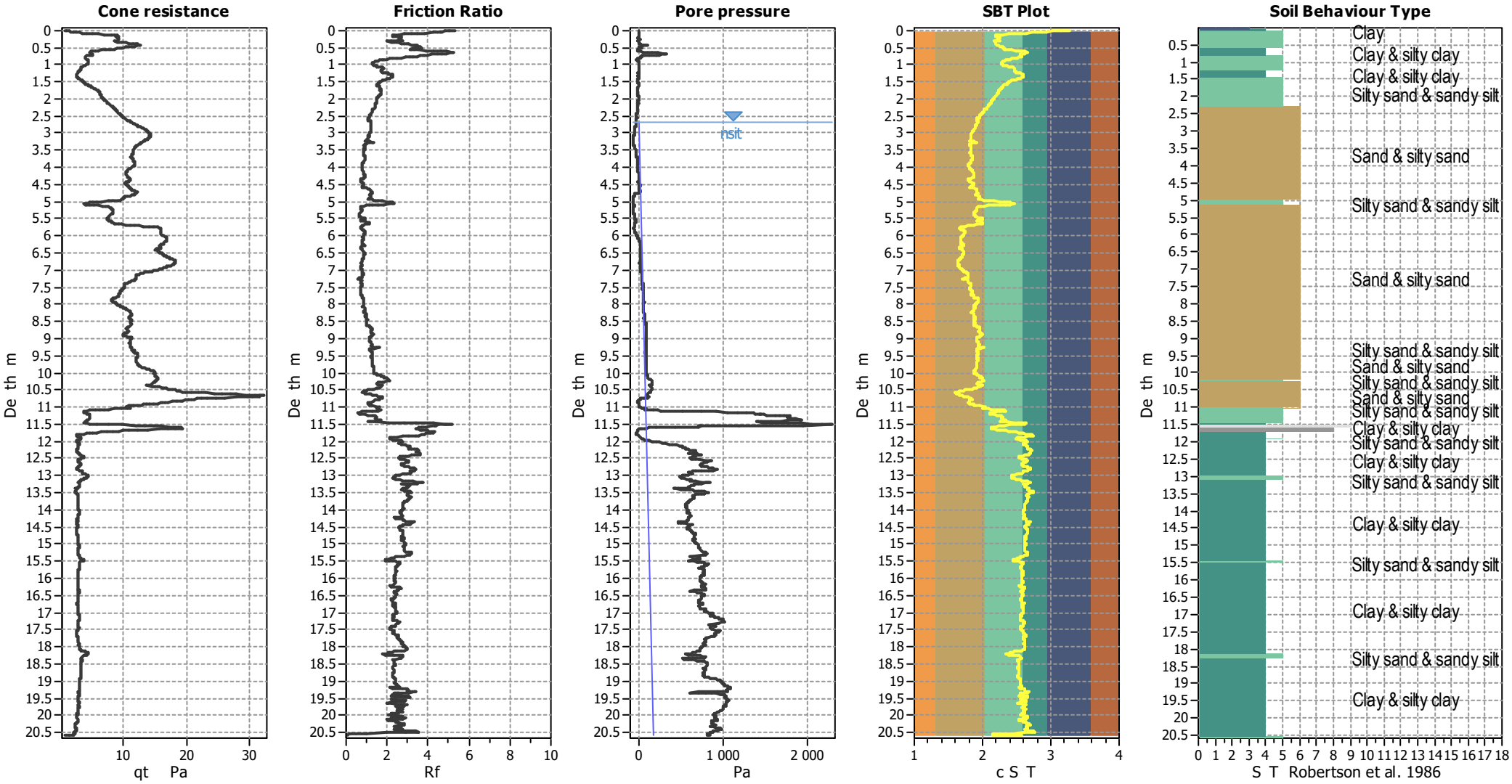
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



Input parameters and analysis data

Anal sis method: 2014
ines correction method: 2014
Points to test: ased on c al e
Earthq a e magnit de : 6.00
Pea gro nd acceleration: 0.30
De th to ater table insit : 2.70 m

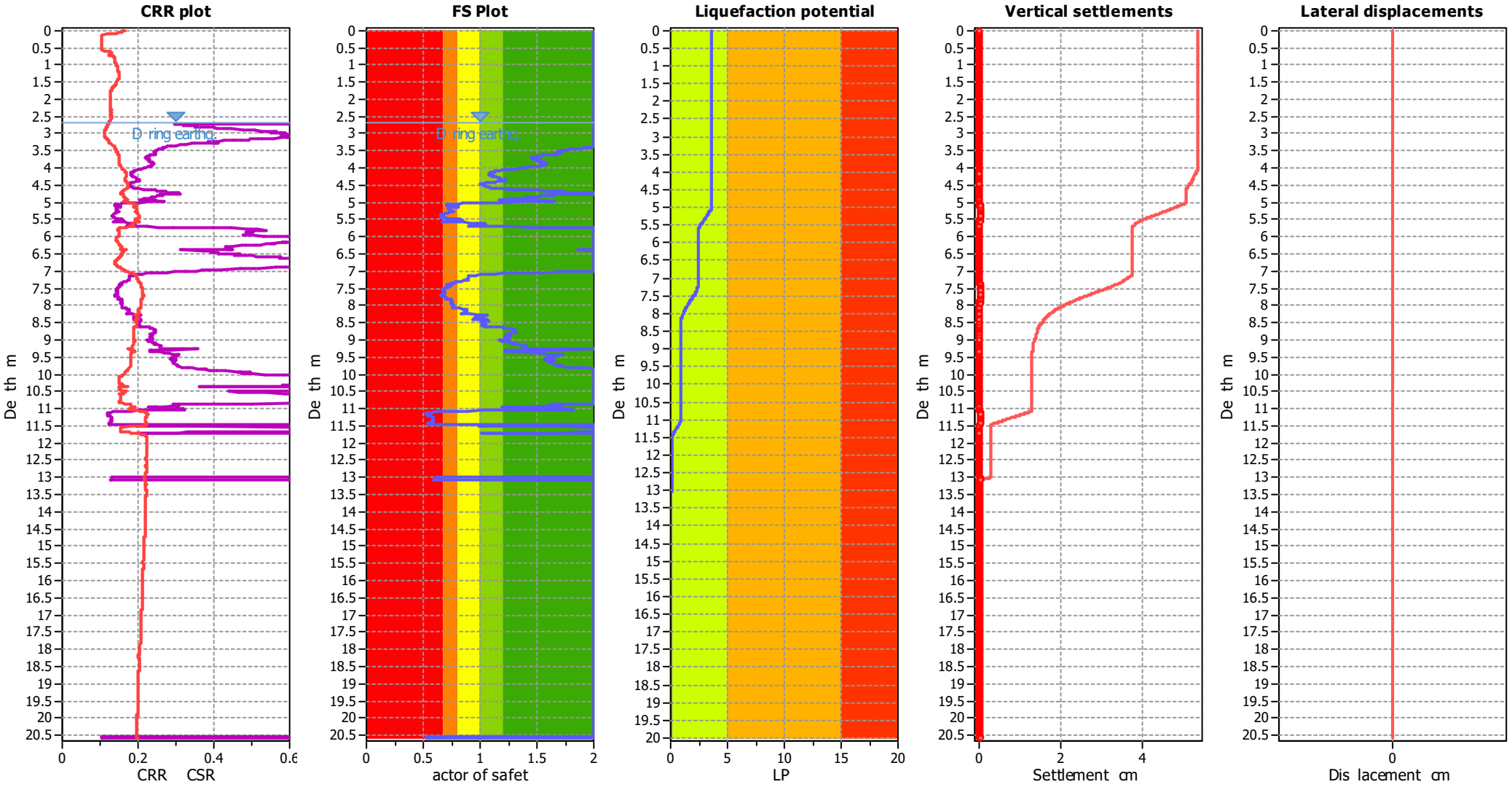
De th to G T erthq. : 2.70 m
A erage res lts inter al: 3
c c t-off al e: 2.60
Unit eight calc lation: ased on S T
Use fill: o
ill height: A

ill eight: A
Transition detect. a lied: o
a lied: es
Cla li e beha ior a lied: Sands onl
Limit de th a lied: o
Limit de th: A

SBT legend

1. Sensiti e fine grained
2. Organic material
3. Cla to silt cla
4. Cla e silt to silt
5. Silt sand to sand silt
6. Clean sand to silt sand
7. Gra el sand to sand
8. Ver stiff sand to
9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.70 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.70 m	ill height:	A	Limit de th:	A

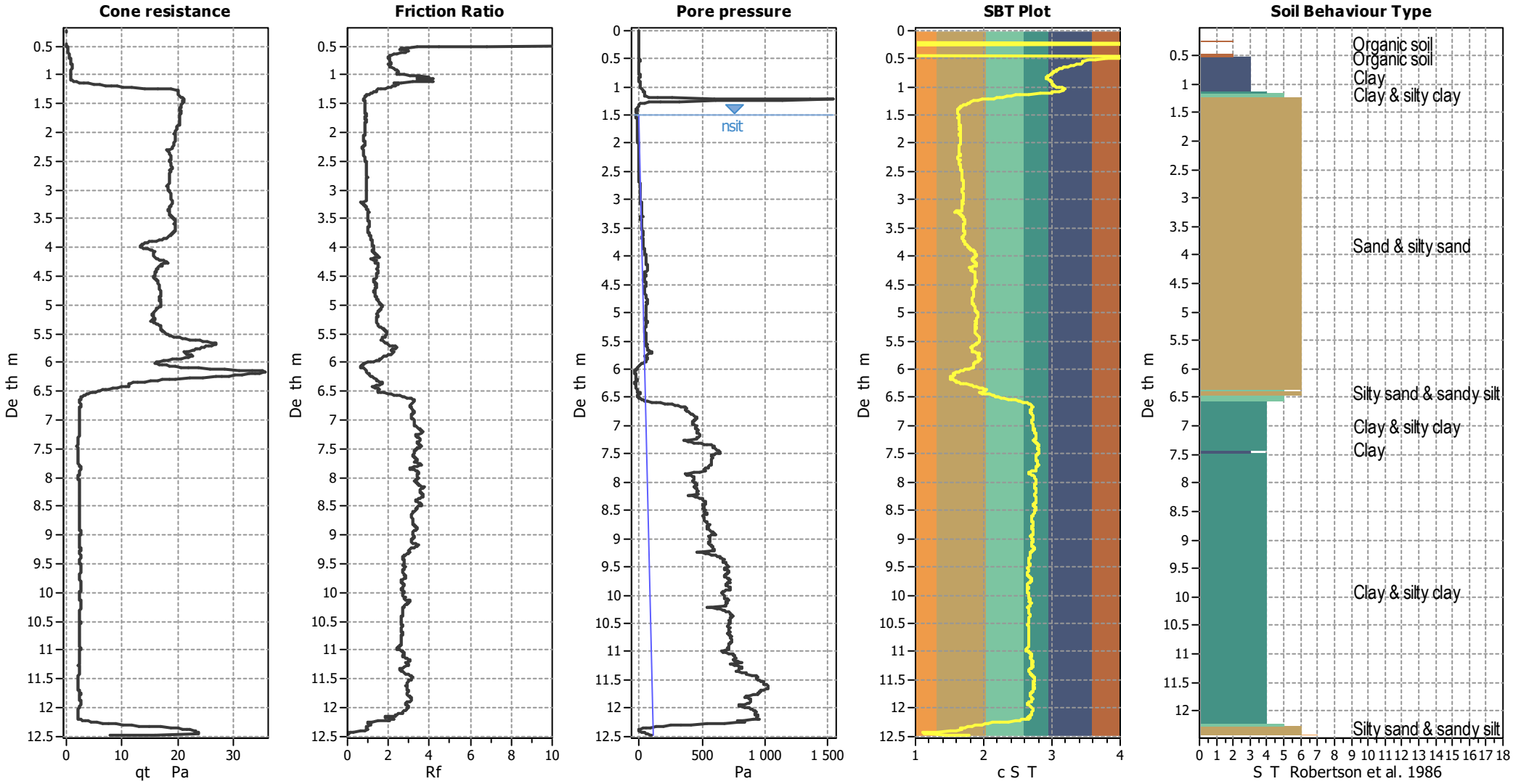
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



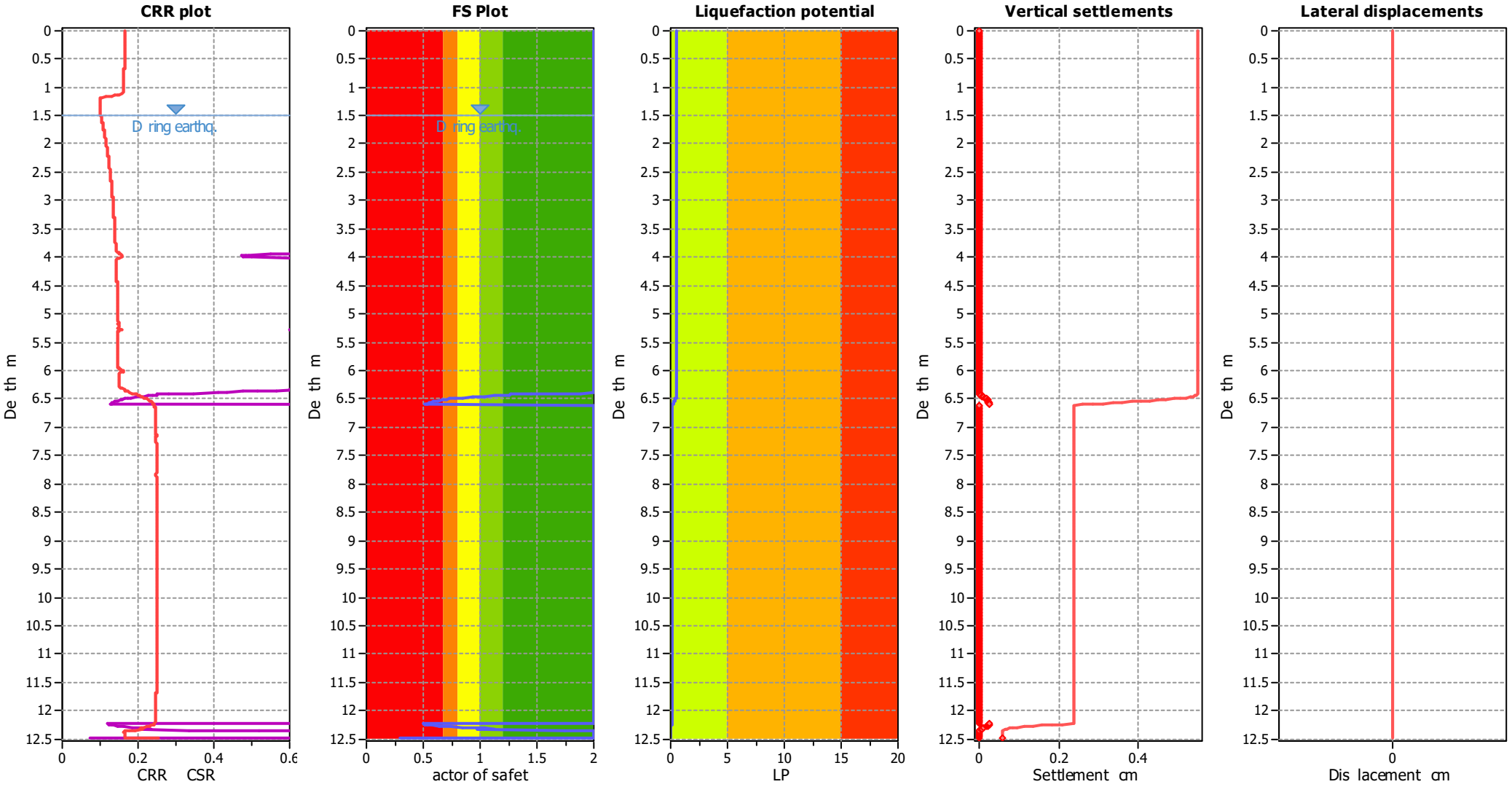
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.50 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained	4. Cla e silt to silt	7. Gra el sand to sand
2. Organic material	5. Silt sand to sand silt	8. Ver stiff sand to
3. Cla to silt cla	6. Clean sand to silt sand	9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla i e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.50 m	ill height:	A	Limit de th:	A

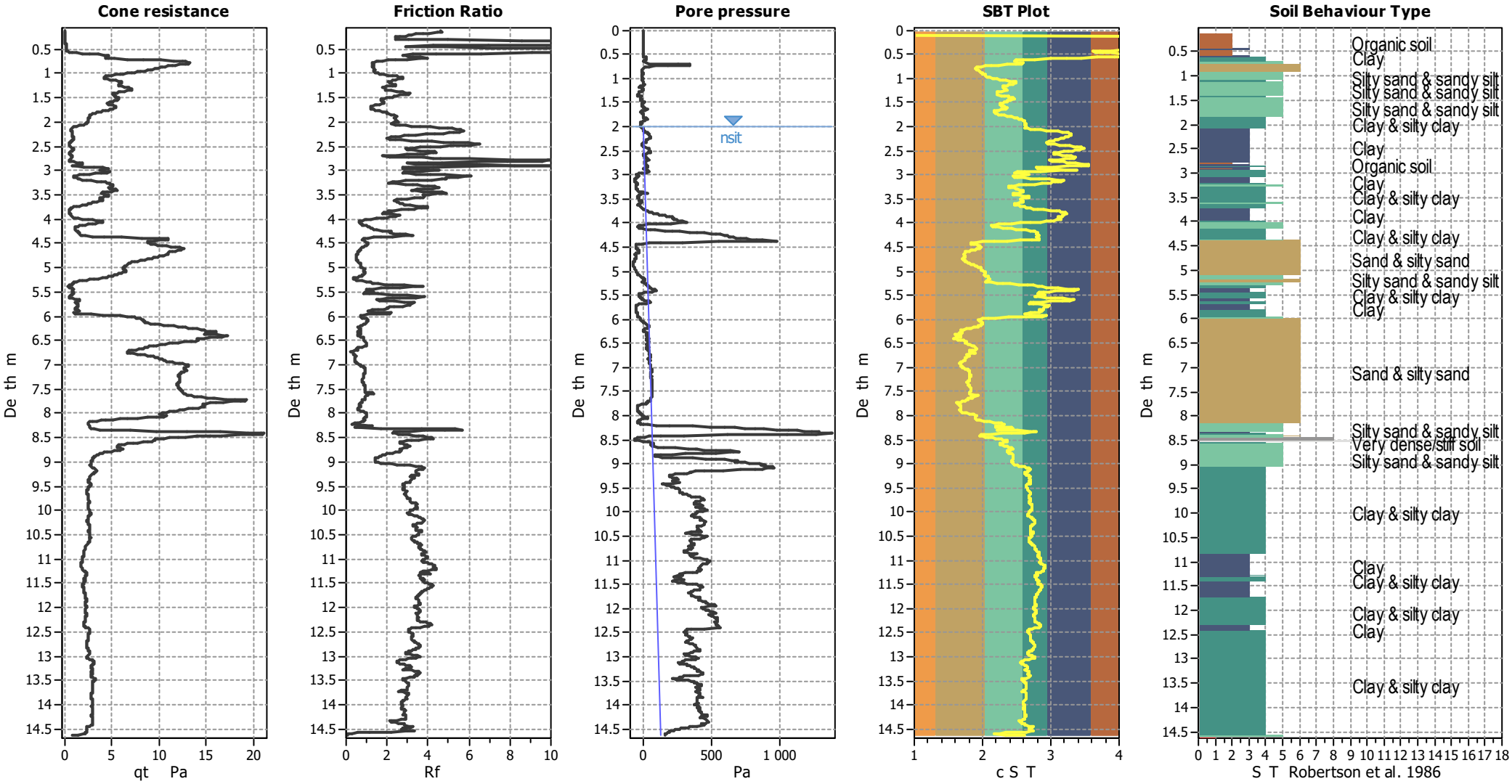
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



Input parameters and analysis data

Anal sis method: 2014
ines correction method: 2014
Points to test: ased on c al e
Earthq a e magnit de : 6.00
Pea gro nd acceleration: 0.30
De th to ater table insit : 2.00 m

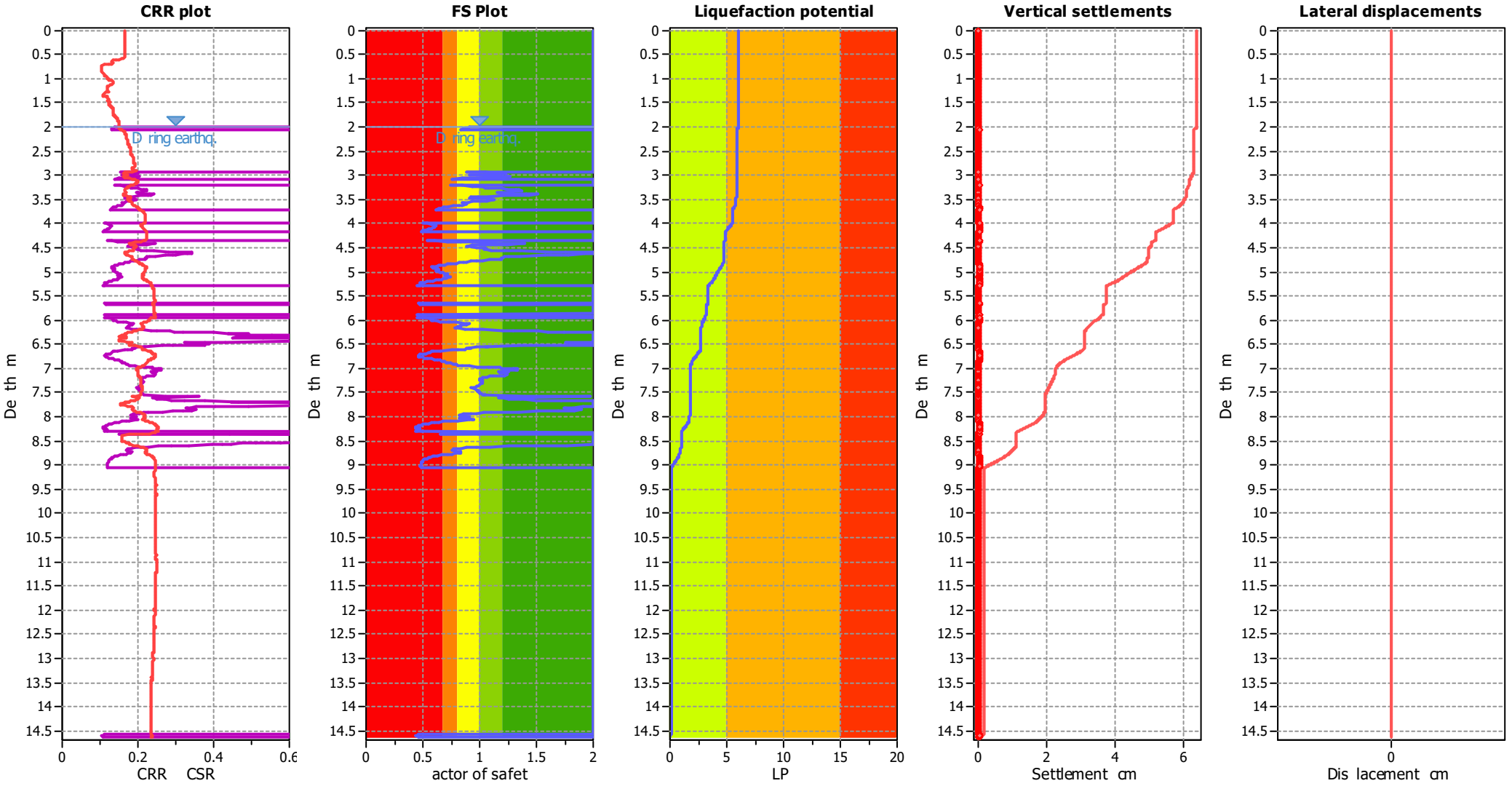
De th to G T erthq. : 2.00 m
A erage res lts inter al: 3
c c t-off al e: 2.60
Unit eight calc lation: ased on S T
Use fill: o
ill height: A

ill eight: A
Transition detect. a lied: o
a lied: es
Cla li e beha ior a lied: Sands onl
Limit de th a lied: o
Limit de th: A

SBT legend

1. Sensiti e fine grained
2. Organic material
3. Cla to silt cla
4. Cla e silt to silt
5. Silt sand to sand silt
6. Clean sand to silt sand
7. Gra el sand to sand
8. Ver stiff sand to
9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.00 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.00 m	ill height:	A	Limit de th:	A

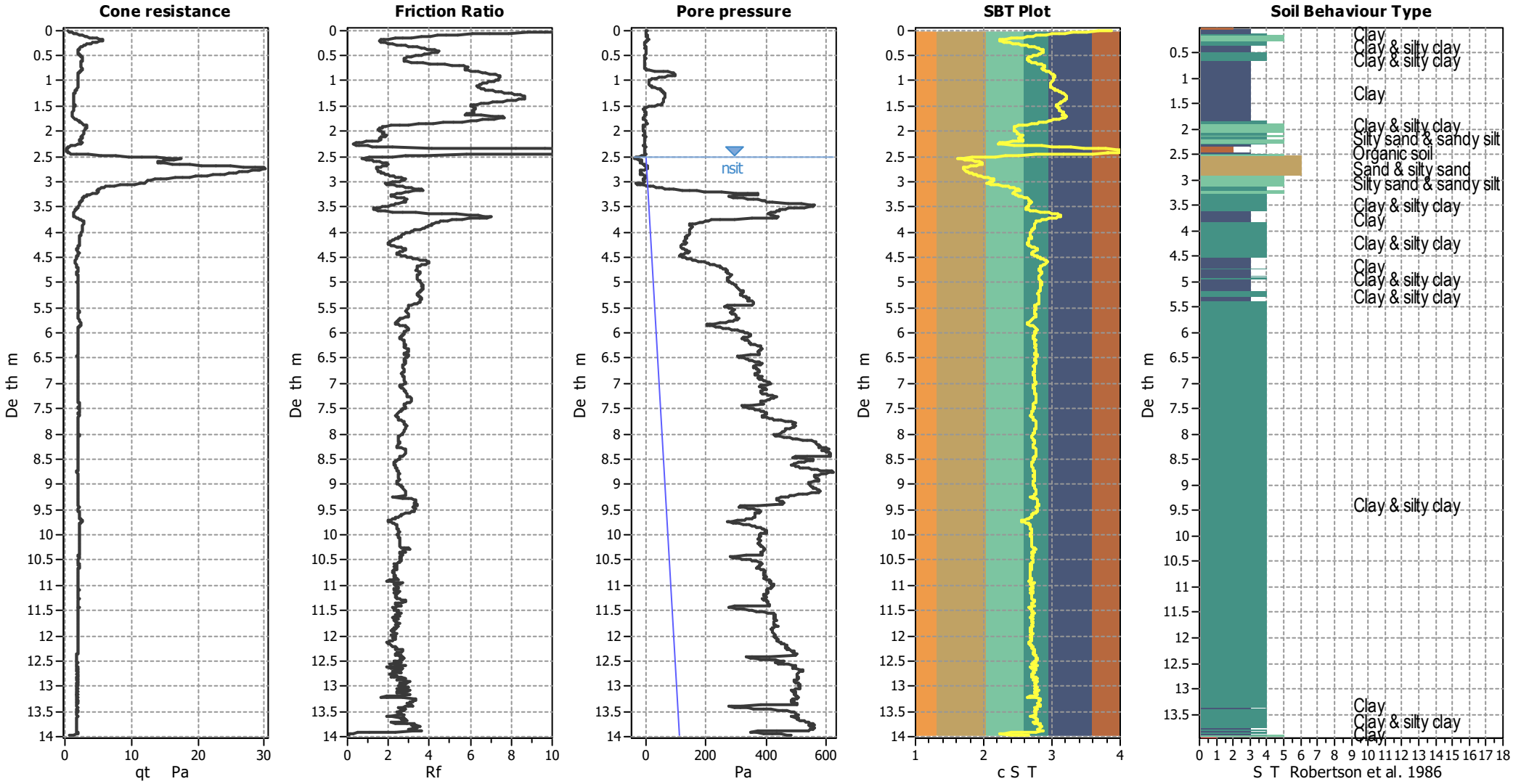
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



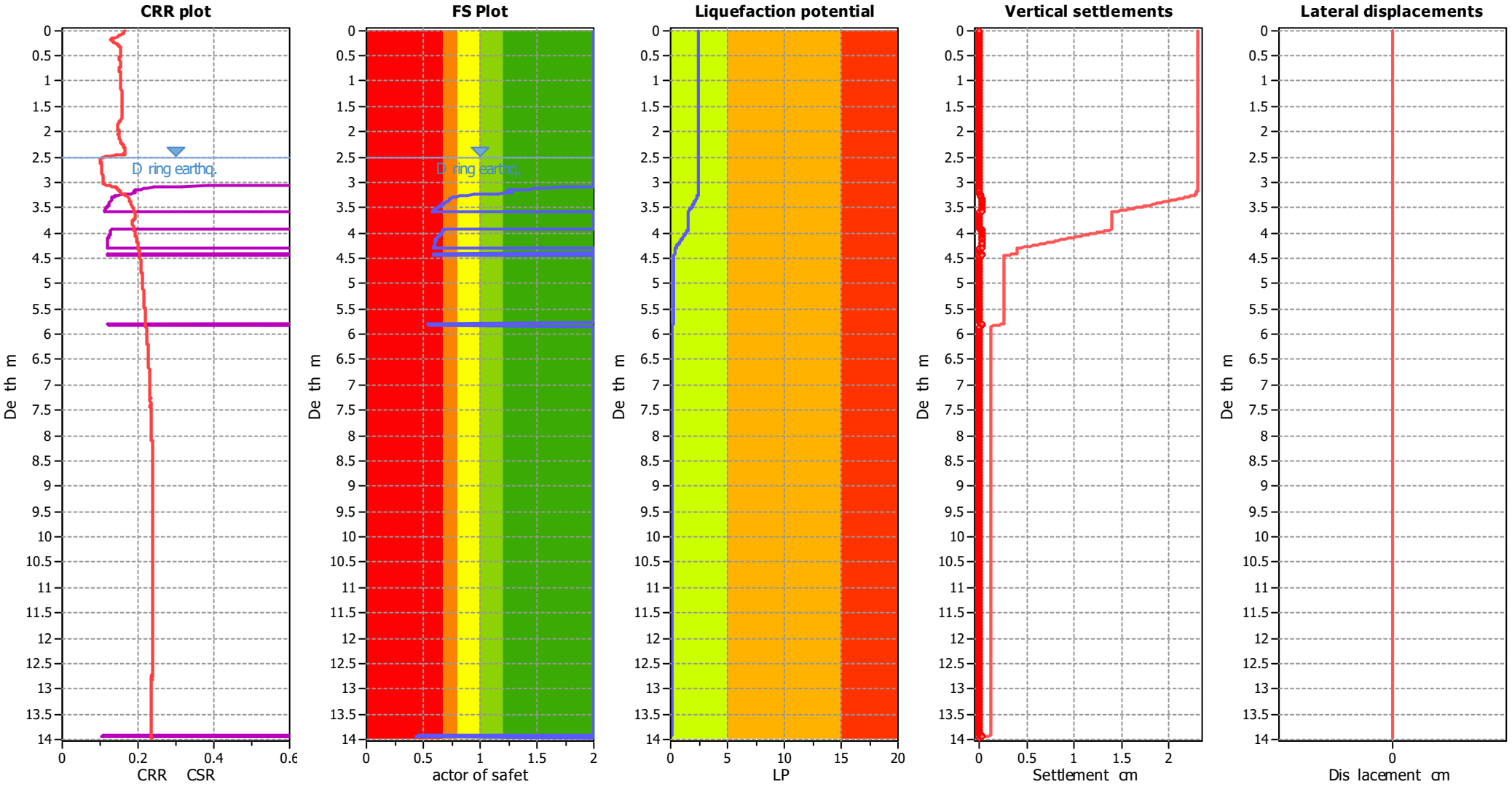
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.50 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained	4. Cla e silt to silt	7. Gra el sand to sand
2. Organic material	5. Silt sand to sand silt	8. Ver stiff sand to
3. Cla to silt cla	6. Clean sand to silt sand	9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.50 m	ill height:	A	Limit de th:	A

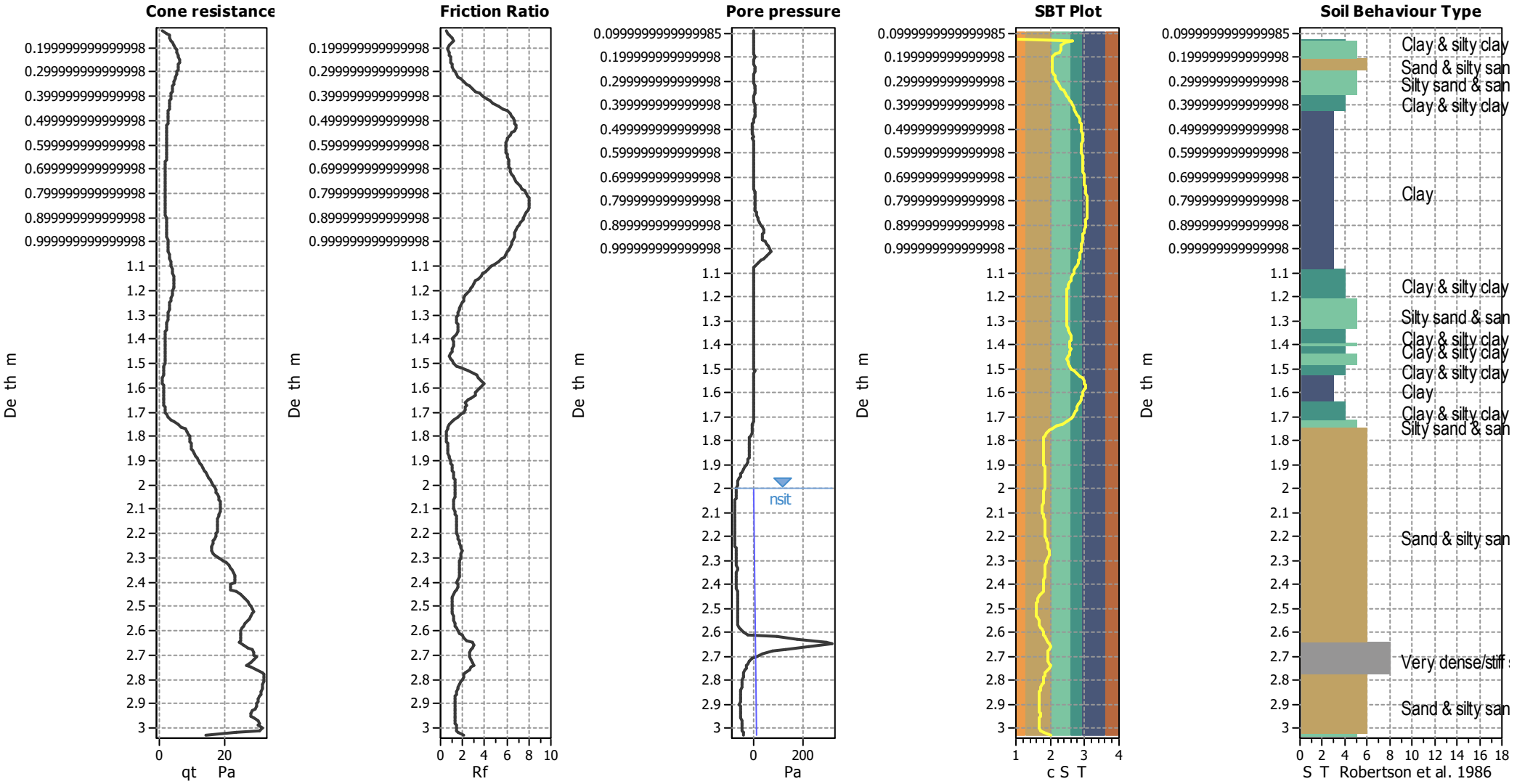
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



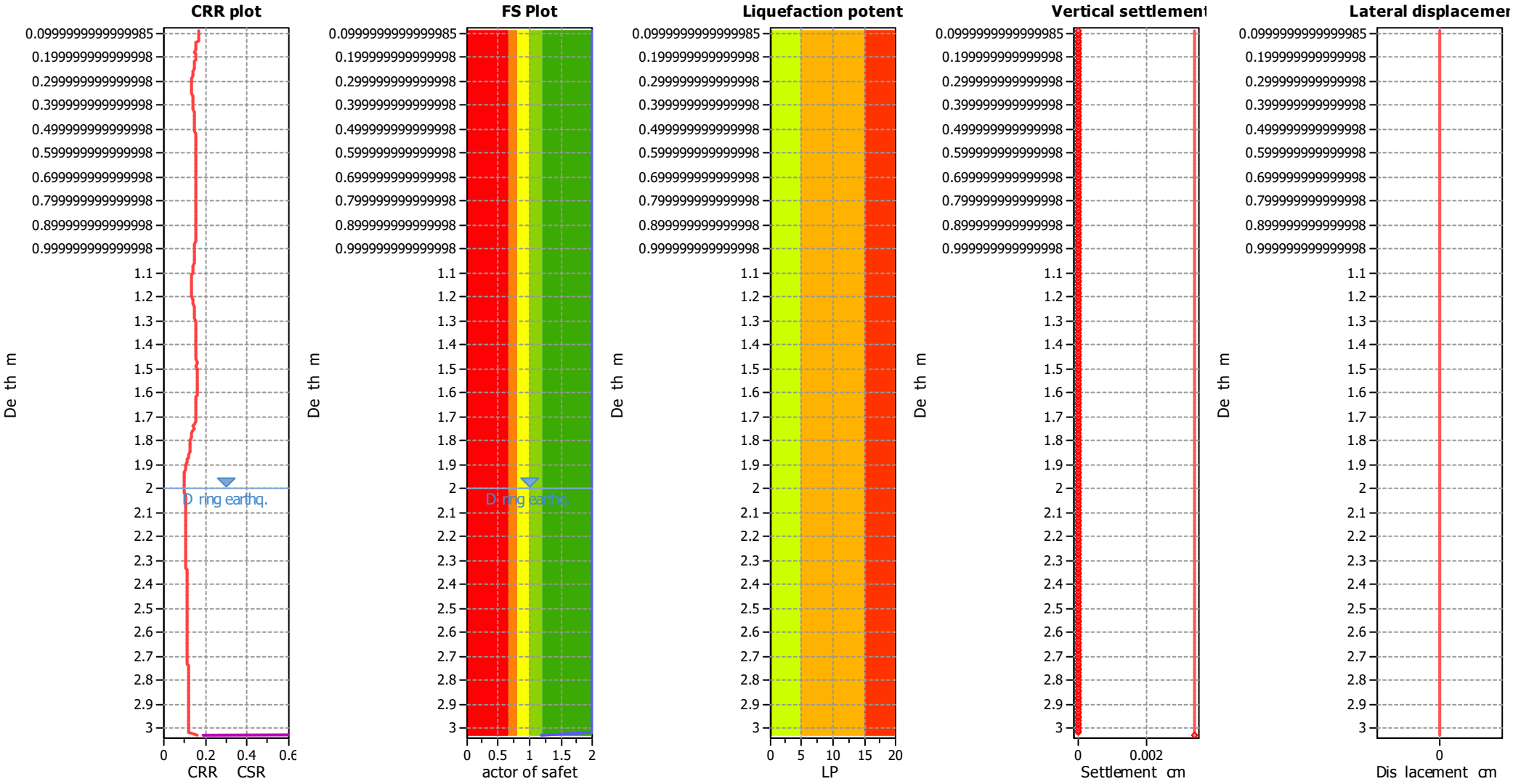
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.00 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.00 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained
2. Organic material
3. Cla to silt cla
4. Cla e silt to silt
5. Silt sand to sand silt
6. Clean sand to silt sand
7. Gra el sand to sand
8. Ver stiff sand to
9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.00 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.00 m	ill height:	A	Limit de th:	A

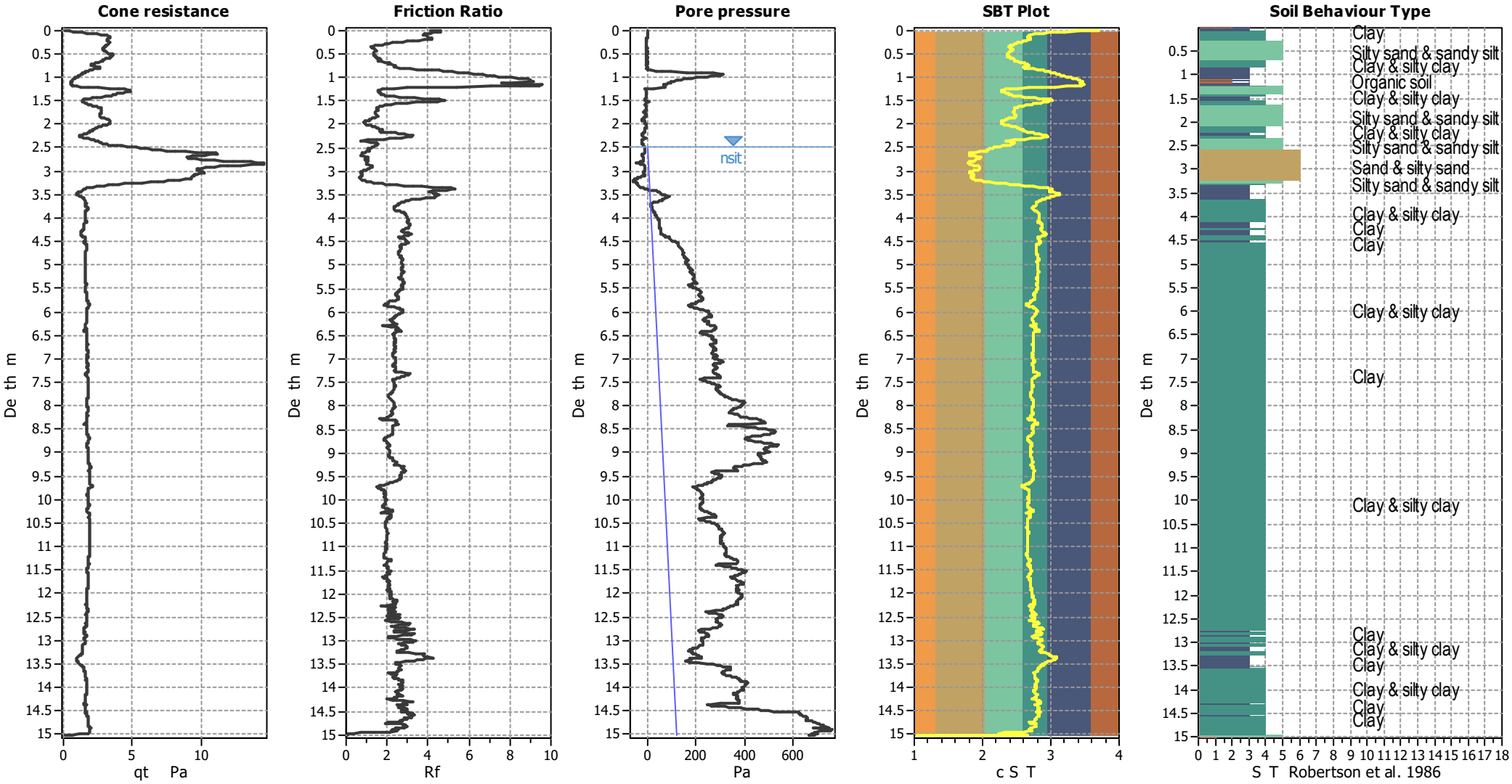
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



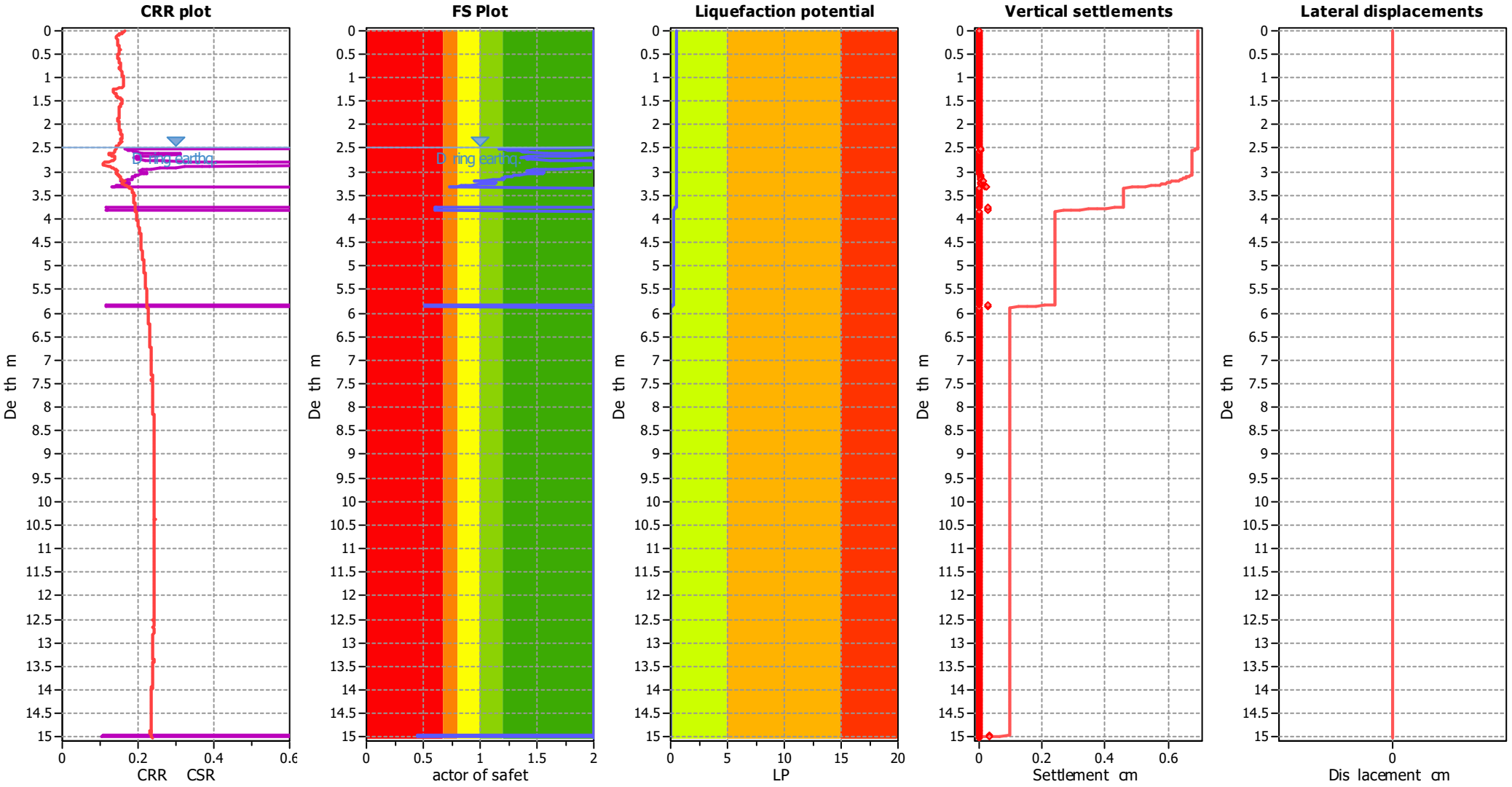
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.50 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained	4. Cla e silt to silt	7. Gra el sand to sand
2. Organic material	5. Silt sand to sand silt	8. Ver stiff sand to
3. Cla to silt cla	6. Clean sand to silt sand	9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.50 m	ill height:	A	Limit de th:	A

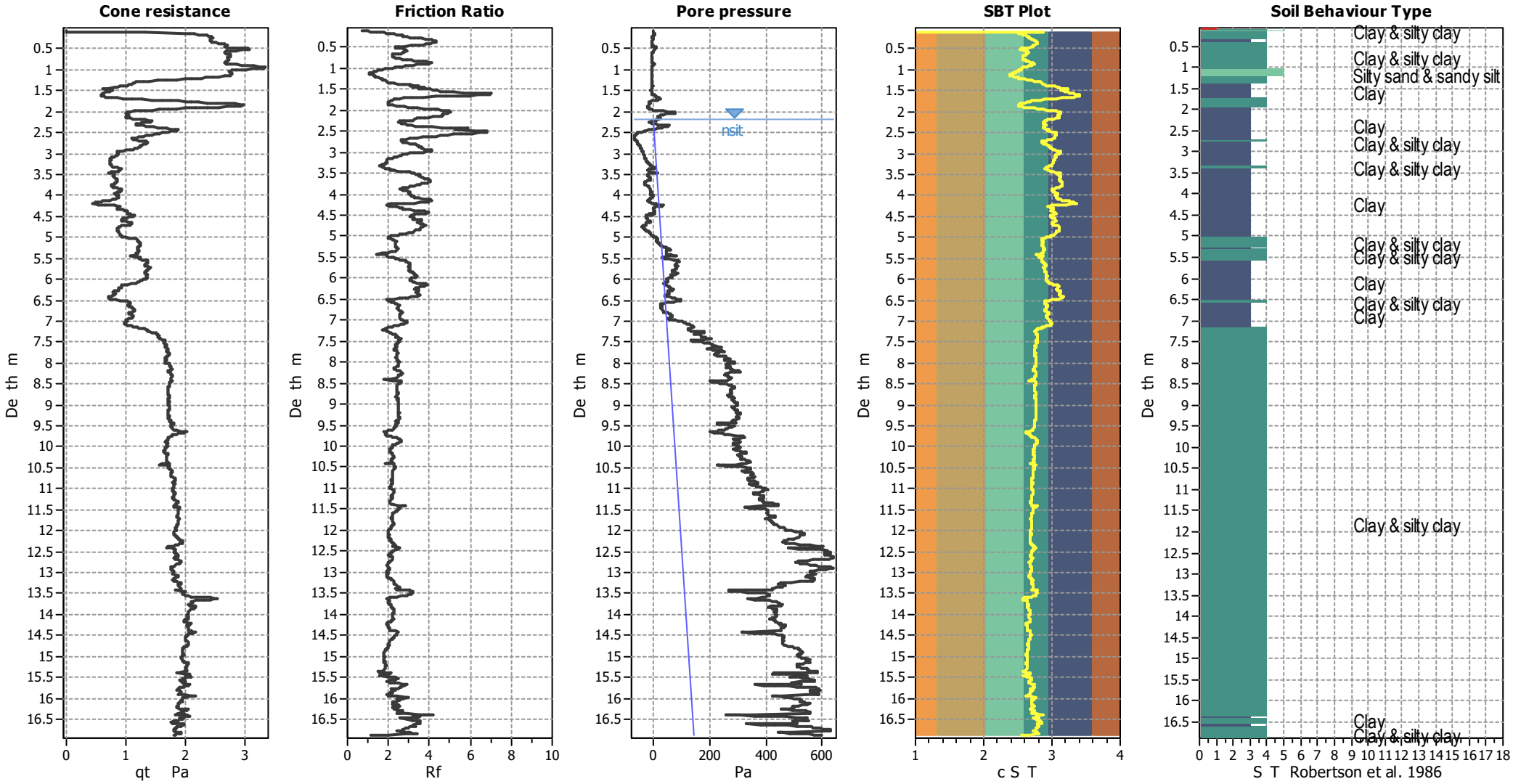
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



Input parameters and analysis data

Anal sis method: 2014
ines correction method: 2014
Points to test: ased on c al e
Earthq a e magnit de : 6.00
Pea gro nd acceleration: 0.30
De th to ater table insit : 2.20 m

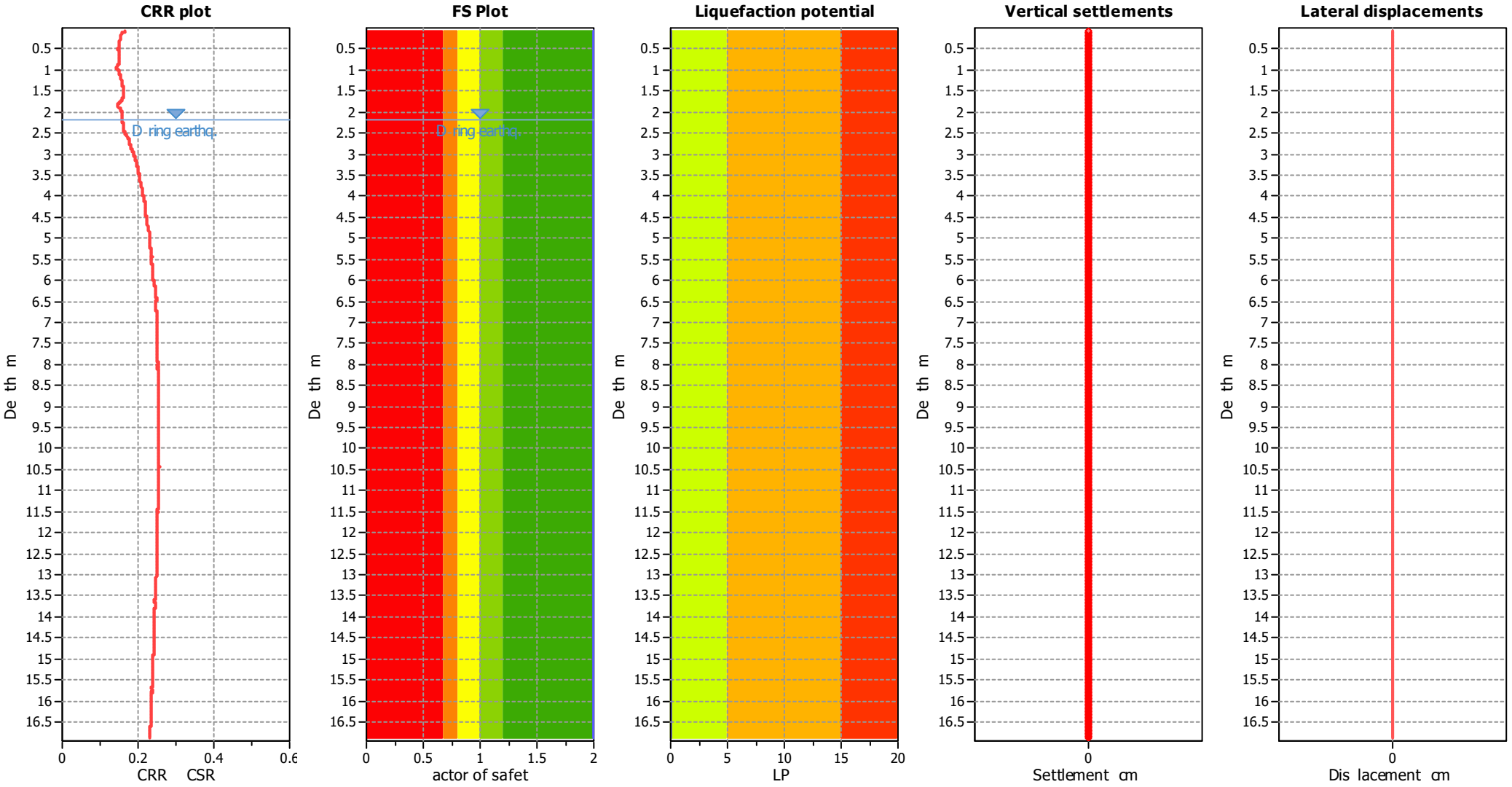
De th to G T erthq. : 2.20 m
A erage res lts inter al: 3
c c t-off al e: 2.60
Unit eight calc lation: ased on S T
Use fill: o
ill height: A

ill eight: A
Transition detect. a lied: o
a lied: es
Cla li e beha ior a lied: Sands onl
Limit de th a lied: o
Limit de th: A

SBT legend

1. Sensiti e fine grained
2. Organic material
3. Cla to silt cla
4. Cla e silt to silt
5. Silt sand to sand silt
6. Clean sand to silt sand
7. Gra el sand to sand
8. Ver stiff sand to
9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	2.20 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	2.20 m	ill height:	A	Limit de th:	A

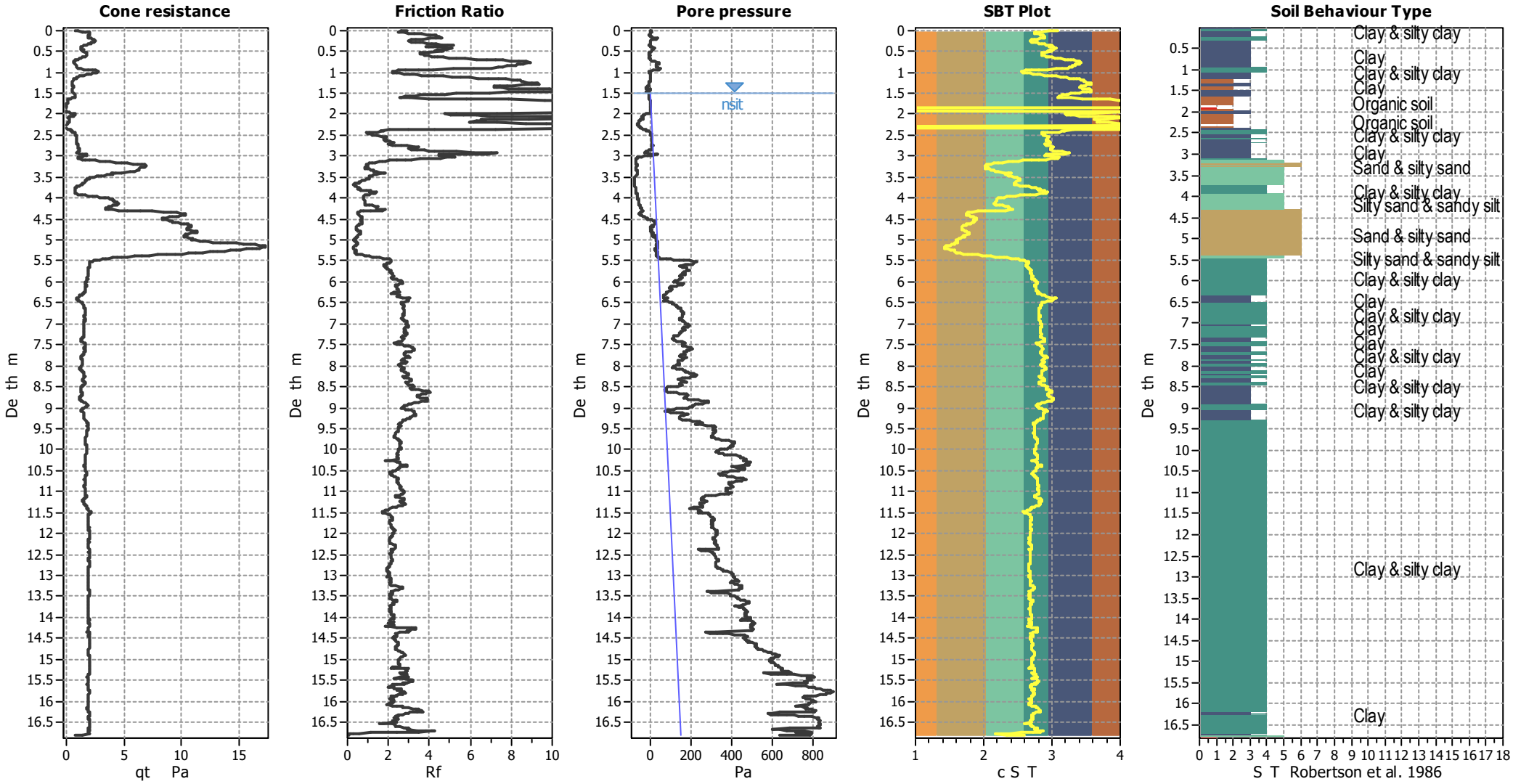
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



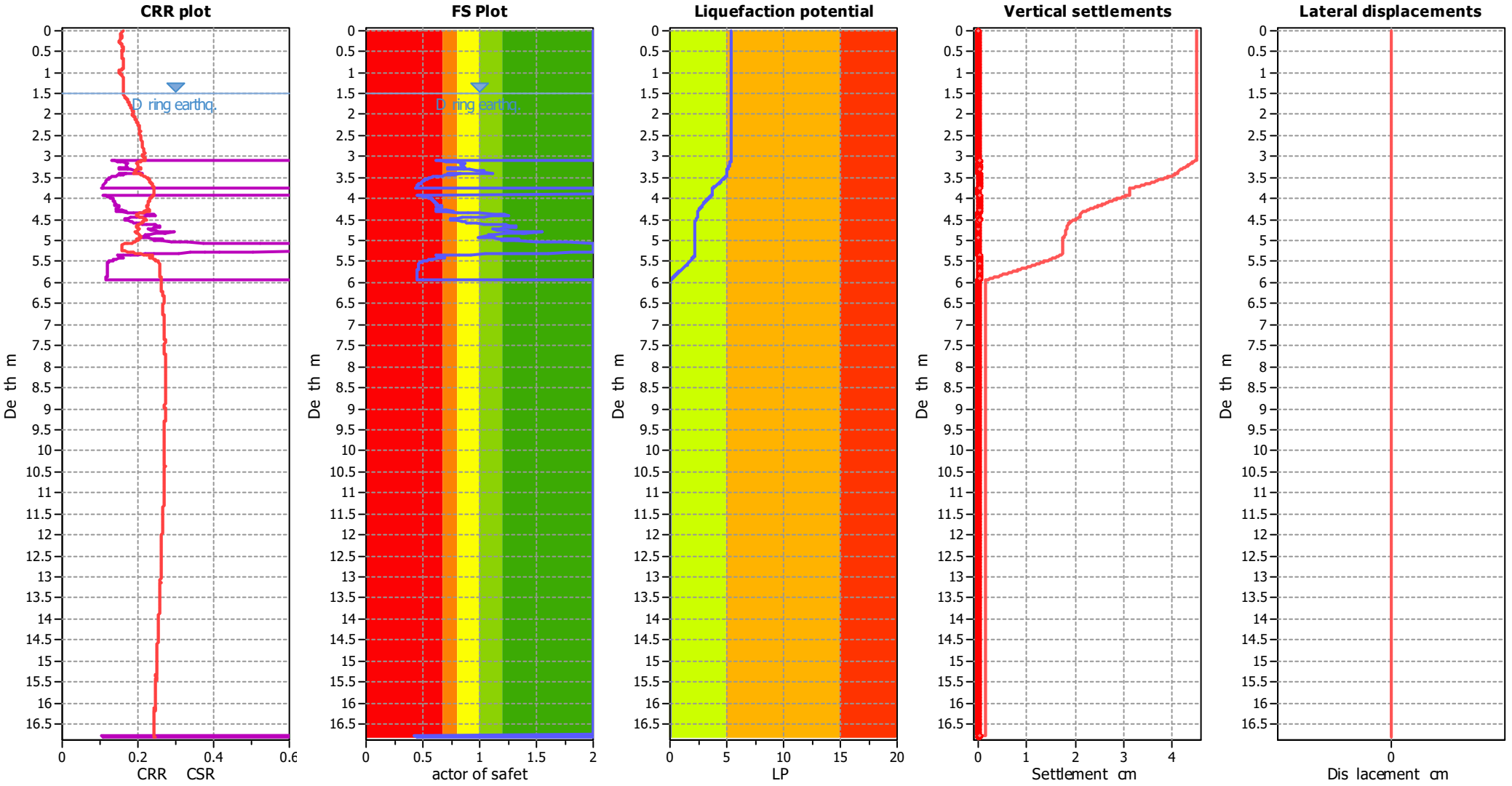
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.50 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained	4. Cla e silt to silt	7. Gra el sand to sand
2. Organic material	5. Silt sand to sand silt	8. Ver stiff sand to
3. Cla to silt cla	6. Clean sand to silt sand	9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.50 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla i e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.50 m	ill height:	A	Limit de th:	A

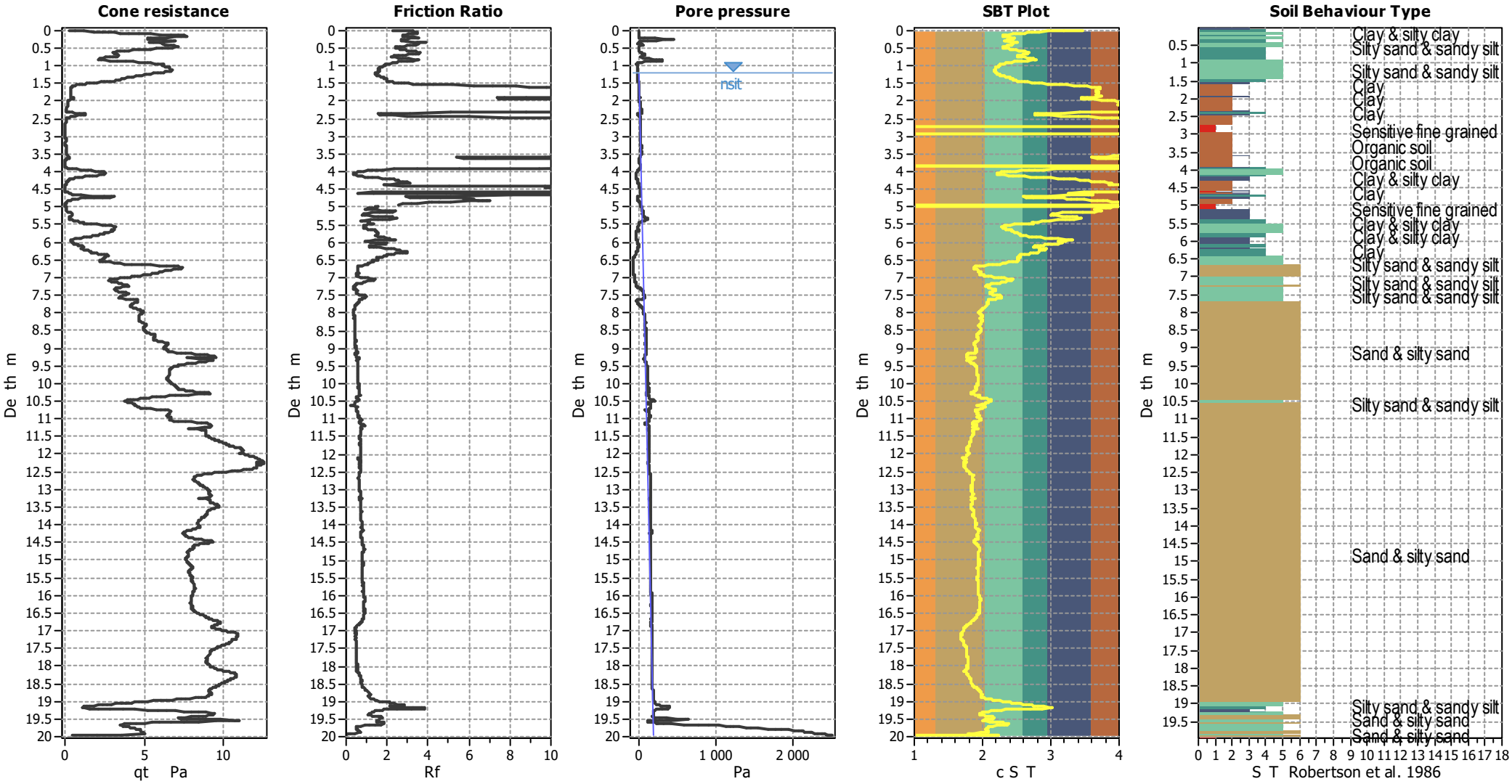
F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris

CPT basic interpretation plots



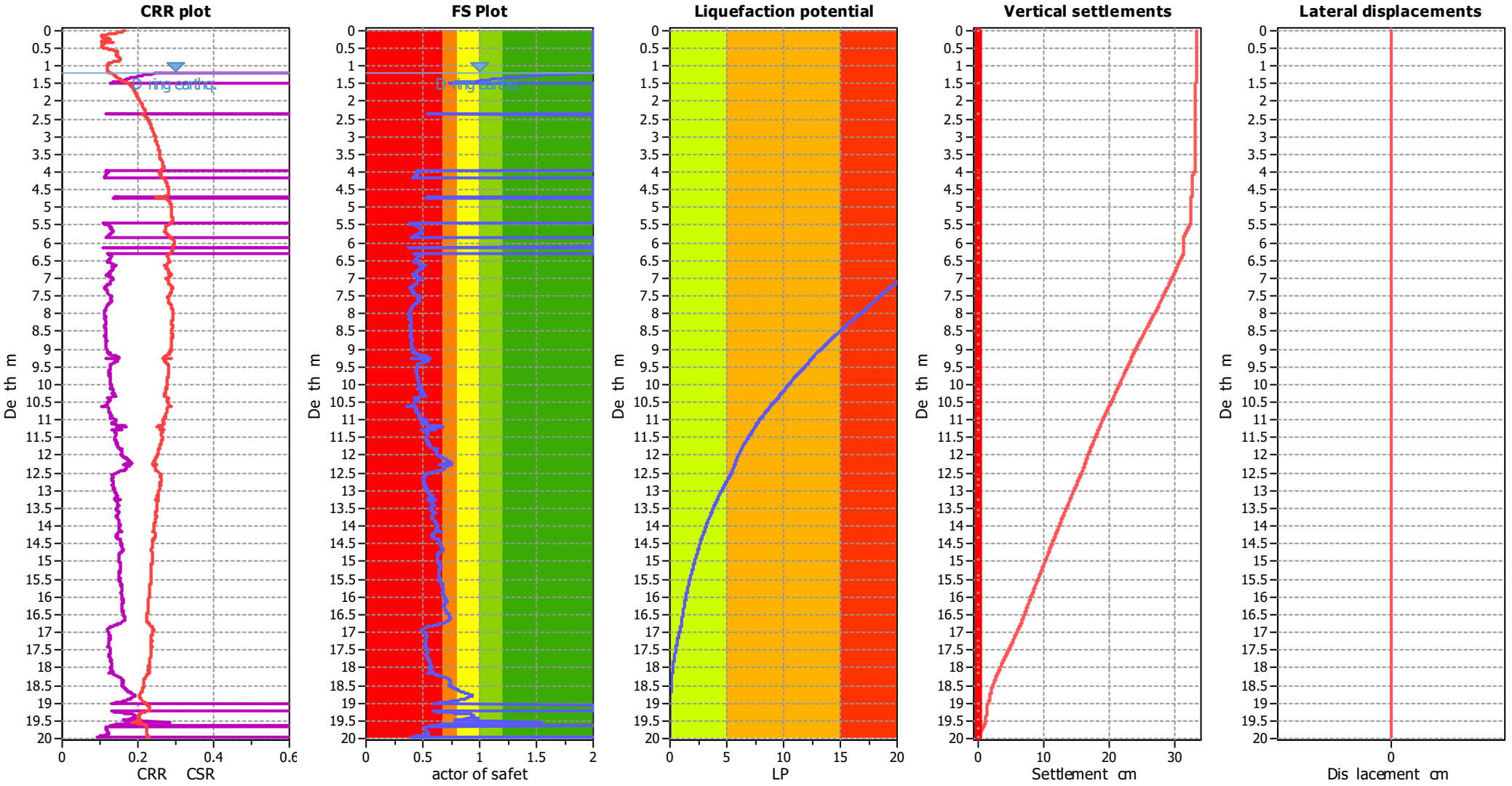
Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.20 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.20 m	ill height:	A	Limit de th:	A

SBT legend

1. Sensiti e fine grained	4. Cla e silt to silt	7. Gra el sand to sand
2. Organic material	5. Silt sand to sand silt	8. Ver stiff sand to
3. Cla to silt cla	6. Clean sand to silt sand	9. Ver stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Anal sis method:	2014	De th to G T erthq. :	1.20 m	il eight:	A
ines correction method:	2014	A erage res lts inter al:	3	Transition detect. a lied:	o
Points to test:	ased on c al e	c c t-off al e:	2.60	a lied:	es
Earthq a e magnit de :	6.00	Unit eight calc lation:	ased on S T	Cla li e beha ior a lied:	Sands onl
Pea gro nd acceleration:	0.30	Use fill:	o	Limit de th a lied:	o
De th to ater table insit :	1.20 m	ill height:	A	Limit de th:	A

F.S. color scheme

- Almost certain it ill liq ef
- Ver li el to liq ef
- Liq efaction and no liq. are eq all li el
- Unli e to liq ef
- Almost certain it ill not liq ef

LPI color scheme

- Ver high ris
- igh ris
- Lo ris