

BEFORE THE HEARINGS PANEL

IN THE MATTER

of the Resource Management
Act 1991

AND

IN THE MATTER

of the Proposed District Plan
for Waimakariri District

HEARING STREAM 12: REZONING REQUESTS (LARGER SCALE)
STATEMENT OF EVIDENCE OF ANDREW JAMES SMITH (GEOTECHNICAL)
ON BEHALF OF
ANDREW CARR (SUBMITTER #158) 308 CONES ROAD
28 FEBRUARY 2024

1. INTRODUCTION

- 1.1 My full name is Andrew James Smith. I hold the position of Technical Director – Geotechnics at Pattle Delamore Partners Limited. I am based in the Christchurch office but have responsibility for work throughout the South Island.
- 1.2 My qualifications and experience are set out in my professional Curriculum Vitae, attached as Annexure A.
- 1.3 As a result of my experience, I consider that I am fully familiar with the characteristics of the scale and nature of activities that could establish if the submission is accepted and the land is rezoned.

2. CODE OF CONDUCT

- 2.1 Although this is a Council hearing, I confirm I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

3. SCOPE OF EVIDENCE

- 3.1 I have been engaged by the submitter, Mr Carr (#158) to provide geotechnical evidence with regard to his submission for the rezoning of 308 Cones Road (**the site**).
- 3.2 I am aware that the site was identified as being suitable for rural residential development through the Waimakariri Rural Residential Strategy 2019. Subsequently the Council notified the Proposed District Plan (**PDP**) with the site proposed to be zoned as Rural Lifestyle Zone (**RLZ**) and subject to a Large Lot Residential Zone Overlay (**LLRZO**). The submitter seeks that the site is rezoned to Large Lot Residential Zone (**LLRZ**), that is, that the overlay is removed.

- 3.3 I have previously supervised the preparation of a technical report regarding a geotechnical investigation of the site. This is attached as Annexure B to this statement of evidence.
- 3.4 The provisions of the PDP require that an Outline Development Plan (ODP) is produced for all new LLRZ, and that the ODP covers all of the LLRZ (under SUB-P6 of the PDP). In this case, part of the immediately adjacent lot at 90 Dixons Road was also notified as RLZ with LLRZO and a submission was made (#70) that this should also be rezoned to LLRZ. Accordingly, I supervised the preparation of a second technical report to address geotechnical matters relevant to that part of 90 Dixons Road if it was to be zoned as LLRZ. This report is attached as Annexure C to this statement of evidence.
- 3.5 I understand that my reports were provided to the council for the purposes of feedback (as per Hearing Panel Minute 1, paragraph 75) on 15 November 2023. However, an email received from the council on 9 February 2024 set out that the council had not reviewed them, due to not having the appropriate expertise.
- 3.6 Accordingly, I adopt these reports for the purposes of this evidence, subject to any points of difference, clarification or addition that are detailed below.

4. SUMMARY OF GEOTECHNICAL ASSESSMENT

- 4.1 In this section, I summarize the results of my assessment of the geotechnical matters relevant to the site rezoning as sought by the submitter.
- 4.2 At the outset, I note two minor corrections to my report for 90 Dixons Road. In paragraph 2.2.4, it was stated that there is part of the Ashley Fault Avoidance Zone 2020 within the property as shown on Appendix A of that report. While this is technically correct for the wider property of 90 Dixons Road, for clarity the comment relates to its northeastern part, and this is outside the area where rezoning is requested.
- 4.3 In paragraph 2.9, bullet 4, it was stated that “*areas of low to medium flood hazard*” are present in 90 Dixons Road. Again, this is technically true for the wider property, but there is no area of medium flood hazard within the

area sought to be rezoned (as shown on Appendix A of that report). Rather the closest areas of medium hazard lie 20m west of the southeastern boundary, and adjacent to the southeastern corner of the site (where a stormwater detention basin is shown on the Outline Development Plan).

4.4 In my reports I also noted that:

- a. The assessment area is not subject to significant erosion, nor to slippage or falling debris. Liquefaction risk is negligible, and the assessment area has a low subsidence risk.
- b. 308 Cones Road is within an area that is denoted as having a very low risk of being inundated in a 200-year flood event. Small areas of 90 Dixons Road subject to the rezoning request are denoted as having a low risk of being inundated in a 200-year flood event.
- c. Site investigation showed that 308 Cones Road did not achieve the NZS3604:2011 definition of 'good ground' and it is likely that the same situation will be present at 90 Dixon Road. This simply means that lot-specific geotechnical reports will be required for each desired building location. This can be undertaken at Building Consent stage, and provisional results show that a Geotechnical Ultimate Bearing Capacity of 200 kPa is available across the whole site.
- d. Neither 308 Cones Road nor the part of 90 Dixons Road subject to the rezoning request will be subjected to significant natural hazards (subject to the recommendations in my reports being followed).

5. CONCLUSIONS

5.1 Overall, I consider that the site is suitable for residential subdivision, subject to further assessment (specifically lot-specific shallow investigations to confirm bearing requirements). In my experience that can be (and usually is) carried out when land use / subdivision consents are sought.

5.2 I am therefore able to support the submission for the site to be rezoned as LLRZ.

ANDREW JAMES SMITH

Date 28 February 2024

ANNEXURE A: PROFESSIONAL CURRICULUM VITAE



Andrew Smith

TECHNICAL DIRECTOR – GEOTECHNICS

Andrew is a Technical Director for the Geotechnical Team at PDP and has more than 24 years' experience working across a wide range of projects ranging from mining to land development. Andrew has 11 years international experience and 13 years in New Zealand.

Andrew is a specialist at PDP in bulk earthworks, slope engineering, earthquake and landslide hazard assessments and residential / commercial land development. Andrew has excellent technical knowledge supplemented with extensive site experience in soil and rock mechanics and hydrogeological processes..

Qualifications

MSc (Distinction) Geo-environmental Engineering, University of Wales, Cardiff, 2004

BSc (Hons) Exploration Geology, University of Wales, Cardiff, 1997

Professional Register

Professional Engineering Geologist (PEngGeol)

Chartered Geologist Geological Society of London (CGeol)

Affiliations

Chartered Member Engineering New Zealand (CMEngNZ)

Training

Site Safe, First Aid, 4x4 Training

Career Summary

June 2015 – August 2019
Team Leader / Principal Engineering Geologist
– Davis Ogilvie, Nelson

August 2010 – May 2015
Senior Engineering Geologist
Golder Associates (NZ) Limited, Nelson

January 2008 – June 2010
Senior Engineering Geologist
Parsons Brinckerhoff Ltd, Cardiff, UK

November 2004 – December 2006
Senior Geo-environmental Engineer
White Young Green Ltd, Bristol, UK

January 1998 – September 2003
Engineering Geologist
Alluvial Mining Limited, UK

CORE EXPERTISE

- Understanding of the Building Act, Building Code, standards and guidance relating to land development and construction in NZ.
- Earthworks & foundation design.
- Slope stability assessments and remediation including reinforced soil slopes.
- Geohazards (identification, mapping and risk assessment).
- Geotechnical engineering, foundation and retaining wall design advice.
- Pervious geotechnical consent reviewer for Christchurch City Council, on-going for Environment Canterbury and Bay of Plenty Regional Councils.

MANAGEMENT EXPERIENCE

- Technical Director at PDP for the Geotechnical/Engineering Geology Team in the South Island.
- Proficient in health & safety and environmental management to current legislation.

CAREER SUMMARY

During his career Andrew he has worked on projects throughout New Zealand, the UK, international project experience in the Middle East, Europe, North America and PNG gaining experience in the following areas:

- Geotechnical site investigations to determine site specific characteristics including bearing capacity, static settlement, seismic analysis (liquefaction / lateral displacement), excavation stability and groundwater drawdown.
- Experienced in natural hazard risk assessment. Landslide hazard and slope stability risk assessments involving numerical analysis to develop acceptable remediation design solutions.
- Design and execution of slope stability remedial options for a wide range of geological conditions across NZ.
- Extensive experience in bulk earthworks operations for mining Engineering Landforms (ELF) and land development subdivisions.
- Dam safety assessments including PIC.
- Soil and groundwater investigations for contaminated land assessments.
- Expert witness in consent hearing and Environmental Court disputes.
- Extensive knowledge of current geotechnical and contaminated land site investigation techniques both onshore and offshore.

PROJECT EXPERIENCE

Engineering Services Team Christchurch City Council (2014-2019)

Geotechnical Engineer / Regulatory Reviewer

Provision of geotechnical engineering reviews as an external consultant to the Engineering Services Team at Christchurch City Council. Regulatory review of the geotechnical component of building consent applications to ensure the proposed works meet the requirements of the Building Code including review of rock fall protection structures and proposed developments within mass movement zones.

Consent Reviews for Environment Canterbury (2022-present) Technical Director - Geotechnics

Provided geotechnical engineering and geological expertise to Environment Canterbury to assist in compilation of Section 92 questions for the proposed Taiko Managed Landfill at Cave, Te Kaka Stadium and Christchurch Cathedral dewatering related ground settlement assessments.

Slip assessments and remediation design (On-going) for Wellington City Council

Technical Director - Geotechnics

Over-seeing landslide assessments for Wellington City Council along their roading network, provision of initial assessments, optioneering and detailed design including slope anchoring and mesh specification, tender documents and construction monitoring.

Grassmere Water Storage Facility (WSF), Christchurch (2023 – present)

Technical Director - Geotechnics

Assessment and foundation advice for a proposed WSF for Christchurch City Council on compressible organic soils including provision of liquefaction and static ground settlement estimations, foundation options to counter estimated differential settlements.

Superlots 9, 11 & 12 – Otakaro (2021 – 2022)

Technical Director

Geotechnical investigations and assessment for three city wide blocks proposed for multi-storey residential development along Manchester Street, Christchurch CBD.

Performance Art Precinct – Court Theatre, Christchurch (2019 – Present) Technical Director

Geotechnical assessment of ground conditions for the proposed new Court Theatre working as part of a team for Christchurch City Council. Temporary sheet pile design using Wallap, geogrid gravel raft design, related earthworks specification and sign off. Construction monitoring and design advice in conjunction with the structural engineers.

Sydenham Rezoning, Christchurch (2022 to 2023)

Technical Director – Geotechnics

Provision of a MBIE Level A / B desktop liquefaction assessment for the Sydenham Region of Christchurch. The purpose was to zone the existing commercial area into areas

for possible future high density residential zoning. CPT data and boreholes from the NZGD were used in conjunction with groundwater data to undertake an initial risk assessment to identify preferential areas for development from a liquefaction and static settlement assessment. Broad foundation options for high level pricing were provided for each area. A number of GIS layers conveying the assessment were created and supplied to the client to be included into their overall GIS system.

Savemart, Cranford Street, Christchurch, NZ (2015-2017) Project Manager /Senior Engineering Geologist

Design of geotechnical site investigation on potentially liquefiable and shallow compressible organics. Design of driven timber piles into dense sands and geogrid reinforced raft for concrete floor.

Wakapuaka Residential Subdivision, Nelson, NZ (2017-2019)

Geotechnical Project Manager

Geomorphological mapping, ground model creation, slope stability assessment, Australian Geomechanics Society landslide hazard assessment for a proposed residential subdivision involving 9 m cut to fills to form near level building platforms. On-going review of piezometric level loggers to inform required subdivision drainage design.

Land Development, Richmond Plains, Nelson, NZ (2016 - 2019)

Principal Engineering Geologist

Compile geotechnical Earthworks specification, supervise earthworks, contractor liaison, review of earthworks validation testing, final completion reporting and geotechnical sign off for a number of commercial and residential subdivisions and lifestyle village on the Richmond Plains.

Highfield Residential Subdivision, Christchurch (2011)

Senior Engineering Geologist

Geotechnical site investigation and reporting for a proposed residential subdivision in the Marshlands suburb of Christchurch.

Springlea Residential Subdivision, Nelson, NZ (2011-2019)

Supervising Engineering Geologist

Earthworks design, geo-hazard (geomorphological) mapping, slope stability modelling and assessments as required for a residential subdivision in Atawhai.

ANNEXURE B: GEOTECHNICAL REPORT FOR 308 CONES ROAD

308 Cones Road, Loburn – Geotechnical Report for Residential Subdivision

• Prepared for

Andy Carr

• December 2022



PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 345 7100
Website <http://www.pdp.co.nz>
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill



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DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE



Dave Wright

Reviewed and approved by

SIGNATURE



Andrew Smith

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Andy Carr. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This document has been prepared based on the ground testing as described in this report and field data gathered by PDP. The site conditions as described in this document have been interpreted from, and are subject to, this information and its limitations and accordingly PDP does not represent that its interpretation accurately represents the full site conditions.

The advice and opinions expressed in this document are based on the observation and sampling of a series of test pits and dynamic cone penetrometers at the site. The geological and associated environmental conditions interpolated between the test points (noted above) are not guaranteed to be accurate.

This report has been prepared by PDP on the specific instructions of Andy Carr for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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1.0 Introduction

1.1 Scope

Pattle Delamore Partners Limited (PDP) has been engaged by Andy Carr (the client) to undertake a comprehensive geotechnical assessment of the property located at 308 Cones Road, Loburn (i.e., the site). The purpose is to provide an assessment of the natural hazards to aid in the subdivision of the site.

The site has a total land development area of 40,850 m² comprising lot 3 DP 386430 (title: 345976), it is proposed to subdivide the site into seven lots, with lot 1 being reserved for the existing dwelling that fronts Cones Road; see Figure 1 below.

The objective of the assessment was to determine the following:

- ❖ Review of published information – site history, geological setting, and hydrogeological setting.
- ❖ The consistency and density of the soils underlying the site, based on shallow testing data acquired during ground investigations.
- ❖ Appropriate soil parameters to be used for foundation/subdivision design and whether the site meets the New Zealand Standard definition of “Good Ground”.
- ❖ Assessment of the suitability of the site for subdivision according to Section 106 of the Resource Management Act (1991).
- ❖ Statement of Professional Opinion on the Suitability of Land for Building Construction for the seven rural-residential lots (Ref: Waimakariri District Council Engineering Code of Practice, Part 4, Appendix A)

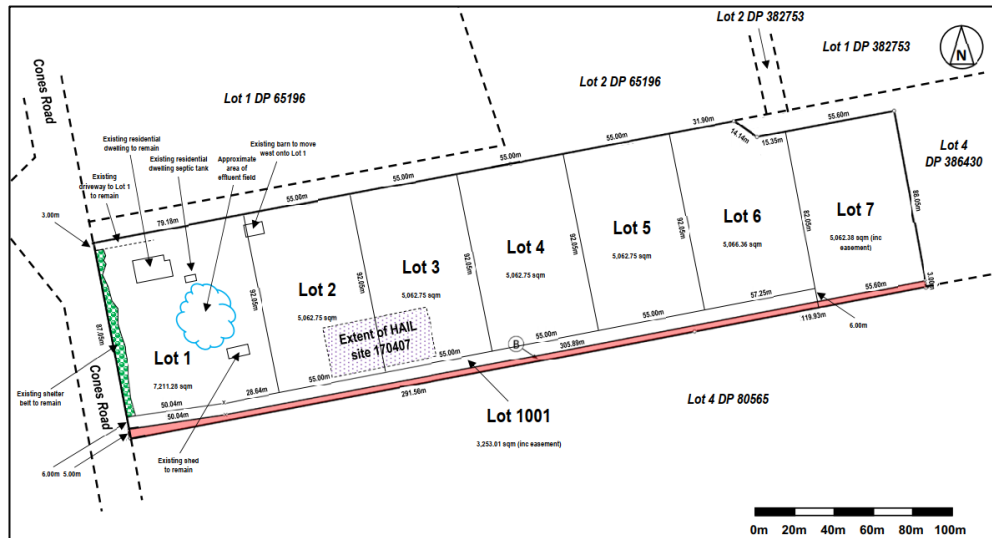


Figure 1 – 308 Cones Road Proposed Subdivision Layout. Town Planning Group August 2022.

1.2 Site Location and Description

The site details and description are summarised below in Table 1, while a site location map and an aerial photograph showing the current site layout (Figure 1) is attached.

Table 1: Site Identification	
Address	308 Cones Road, Loburn
Legal Description	LOT 3 DP 386430 BLK II RANGIORA SD
Site Owner	Sarah Jean Pallett
Grid Reference	NZTM BW24: 6608-0999
Land Area	40,850 m ²
Zoning	Rural
Land Use	Dwelling and several sheds/buildings located in the north-western corner of the site bounded by Cones Road to the west and an unnamed gravelled road to the north, while the remainder of the site comprises open paddocks.
Site Description	Open paddocks with gentle gradients.
Surrounding Land Use	The site is surrounded by rural residential properties and agricultural land. An unnamed road runs along (east / west) the northern boundary of the site.

2.0 Published Information

2.1 Site History

Historical aerial photographs from between 1941 and 2020 have been reviewed for the site. These photographs have been sourced from Canterbury Map Partners administered by Environment Canterbury (ECan).

- ∴ The 1941 aerial photograph shows the site being largely undeveloped, possibly used for pasture/stock grazing. A dwelling and shed are present in the north-western corner of the site. The surrounding properties are also largely used for agricultural purposes with open paddocks and grazing land.
- ∴ The 1963 aerial photograph shows a hedgerow leading south across the property from the dwelling, no other changes are evident from the previous aerial photograph.
- ∴ The 1976 aerial photograph shows three sheds have been constructed to the south-east of the existing dwelling.
- ∴ The 1980 aerial photograph shows two depressions located to the south-east of the sheds that were shown constructed in the 1976 aerial photograph. A shed has also been constructed to the east of the existing dwelling.
- ∴ The site remains largely unchanged in the 2000 aerial photograph.
- ∴ The depressions have been filled in/grassed over in the 2004 aerial photograph.
- ∴ The 2020 aerial photograph represents the site in its current layout, the three sheds to the west of the infilled depressions have been demolished/removed and the area of disturbed ground is shown in the area.

2.2 District Plan Hazard Map Review

A review of the hazard maps and district plan was conducted to ascertain whether the site and surrounding area had any underlying geotechnical risks that may affect the site and subsequent land development.

The site is:

- ∴ Immediately south of an unnamed road, that denotes the southern extent of the Ashely Fault avoidance zone (“Uncertain – constrained”).
- ∴ 2 km north-west of the “Damaging Liquefaction Unlikely” – therefore in a zone where damage from liquefaction is unlikely.
- ∴ Is within an area that is denoted as having a very low risk that the site will be affected by a 200-year flood event.

- ∴ Not within a tsunami evacuation zone.
- ∴ Not within an area that may be subjected to coastal erosion.

According to the Waimakariri district plan, there are no published or recorded natural hazards associated with the site.

2.3 Geological Setting

According to the published geological map, (1973) the site is underlain by late Pleistocene fluvial brown and blue gravel, sand, and silt deposits.

The Loburn active fault was identified on the Geological and Nuclear Science (GNS) active fault database approximately 200 m north of the site. This denotes the southern extent of the Ashely Fault avoidance zone noted above.

2.4 Hydrogeological Setting

A review of the Canterbury water bores map indicates two water bores (M34/0196 and BW24/0313) are located within 300 m of the site.

M34/0196 is located north of the site at 334 Cones Road, the water bore was drilled to a termination depth of 10.4 m below ground level (bgl). The calculated minimum 80th percentile water level is estimated to be 4.57 m bgl.

Bore BW24/0313 conversely was drilled to a deeper depth of 27.86 m bgl in March 2016, screened between 26.36 and 27.86 m bgl, with an initial water level of 6.02 m below ground.

These two bores provide a short term assessment of the hydrogeological setting that estimates the ground water table to be between 4.57 and 6.02 m bgl.

2.5 Listed Land Use Register (LLUR)

The site is currently being investigated by PDP with regards to that the site is listed upon the LLUR as “G3 – Landfill site”. The location of the potential source of contamination, is in the central southern portion of the site and is noted as verified hazard and has not been investigated.

This report should be read in conjunction with the PDP Preliminary Site Investigation report (Ref:C04719100L001_PSI) which presents recommendations and conclusions with regards to the proposed subdivision could be a **permitted activity** under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS).

2.6 Conceptual Geological Model

Based on published information the site is likely to be underlain by topsoil, overlying stiff silt which in turn is underlain by very dense gravel. The surrounding water bores (further afield than the ones noted above) infer that the gravel continues for some considerable depth, with a depth to water of >4.5 m bgl.

3.0 Geotechnical Investigations

3.1 Ground Investigations

A site walkover was undertaken during early November 2022 followed by a Ground Penetration Radar (GPR) scan to identify underground utilities and safe working areas which was conducted on the 8 November 2022.

Following identification of safe areas, the site investigation commenced with a combination of mechanically excavated test pits (TP) and Dynamic Cone Penetrometers (DCPs). A geotechnical site plan is presented in Appendix A.

3.1.1 Shallow Ground Investigations

Table 2 outlines the results of the PDP investigation; the rationale behind the test pit investigation was to identify the thickness of topsoil, overlying the natural deposits of silt and depth to ground water.

During the investigation the test pits were logged to New Zealand Geotechnical Society (NZGS) standards to provide information on the soils properties that can be used in design; logs are presented in Appendix B.

Table 2: Summary of PDP Shallow Soil Profile						
Soil Type	TP01	TP02	TP03	TP04	TP05	TP06
Topsoil	0.4 m	0.4 m	0.3 m	0.4 m	0.3 m	0.4 m
Natural silt	>3.0 m	>3.4 m	>3.2 m	>3.9 m	>3.2 m	>3.1 m
<p><i>Notes:</i> All depths noted above are to base of geological unit and in metres bgl. Average thicknesses; Topsoil 0.40m. TP04 taken to the reach of the excavator to find natural gravel.</p>						

3.1.2 Groundwater

Groundwater was not encountered in any of the test pits; TP04 was taken as deep as possible to find ground water (and natural gravel). The reach of the excavator was 3.9 m, with no ground water present.

3.2 Geotechnical Ground Model

The test pits of the investigation have proven the site is covered in an average thickness of 0.4 m of topsoil, this is underlain by a very stiff silt proven to at least 3.9 m.

All test pits remained stable throughout excavation, ground water was not encountered in any test pit, and back filled with arisings once complete.

3.3 Geotechnical Design Parameters

3.3.1 Soil Parameters

As can be seen Table 2 and the appended test pit logs, the ground conditions underlying the site are consistent with minor variations in depths and thicknesses of the overlying topsoil unit as can be expected. This data has been simplified into a unified geotechnical ground model with soil parameters as given in Table 3.

Table 3: Simplified Geotechnical Ground Model and Proposed Soil Properties					
Geotechnical Unit	Approximate base of Unit m bgl ^{1,2}	Relative Density/ Consistency ³	Unit Weight γ (kN/m ³) (Dry)	Internal Friction (degrees)	Cohesion (c) kPa
Topsoil	0.4 m (0.4 m)	n/a	n/a	n/a	n/a
Silt	3.9 m (>3.9 m)	Very stiff	17	28	2

Notes

() Unit thickness in metres

- Please note the base of the geotechnical unit given is a simplification from all test locations and there will be local variations both laterally and vertically across the wider site not tested.
- Average proven depth
- Relative density has been derived from DCP and hand diagnostic features.

The soil properties have been conservatively estimated based on in-situ information (geological descriptions) from field investigations, peer reviewed literature, experience with geologically similar sites and best engineering judgement. Additional parameters including modulus of subgrade reaction are available upon request.

4.0 Section 106 Resource Management Act 1991

In accordance with the Resource Management Act 1991 (RMA), the site has been assessed in accordance with Section 106 for natural hazards. It is understood the site is to be subdivided and therefore the RMA is applicable. Section 106 states under condition 1:

A consent authority may refuse to grant a subdivision consent or may grant a subdivision consent subject to conditions, if it considers that

- ∴ There is significant risk from natural hazards; or,
- ∴ Sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.

For the purpose of subsections 1a, an assessment of the risk from natural hazards requires a combined assessment of:

- ∴ The likelihood of natural hazards occurring.
- ∴ The material damage to land in respect of which consent is sought, other land or structures that would result from natural hazards; and,
- ∴ Any likely subsequent use of land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph b.

The proposed subdivision is considered based on, site investigations and local knowledge to have the following risk levels to the following hazards:

4.1 Erosion

The site is not subject to significant erosion as it has a generally flat grade with a gentle gradient towards the southeast. Therefore, it is considered that inundation poses a low risk to the development.

4.2 Falling Debris and Slippage

The proposed subdivision is located on flat ground, with no areas bordering the site being elevated; the site has no potential to create, or to be affected by, falling debris. Therefore, there is no risk from slippage and falling debris.

4.3 Subsidence

The analysis of published data has provided a broad assessment of the site with regards to subsidence because of the process of liquefaction. As the site is located 2 km north-west of the “Damaging Liquefaction Unlikely” – in a zone where damage from liquefaction is unlikely, liquefaction risk is negligible and is unlikely to be subjected to liquefaction induced ground subsidence.

The site can be defined as having a low subsidence risk as the investigation has not identified any compressible soils therefore static settlements are likely to be within Building Code requirements of <25 mm for any residential development.

Therefore, it is considered that subsidence in the form of static and liquefaction induced subsidence poses a low risk to the development subject to the recommendations of this report.

4.4 Inundation

The site is not currently within a flood risk area according to the Waimakariri District Plan and is within an area that is denoted as having a very low risk that the site will be affected by a 200-year flood event.

Therefore, it is considered that inundation from flood or sea level risk will pose a low risk to the development.

4.5 Section 106 General Discussion

Based on the considerations it is determined that the site is suitable for subdivision under Section 106 of the RMA, if the recommendations given within this report are followed.

5.0 Development Recommendations

The following sub-sections give additional geotechnical recommendations to assist in the subdivision of the site.

5.1 NZS 3604:2011 - Good Ground

As defined in NZS 3604:2011 “Good Ground” means any soil or rock capable of permanently withstanding an ultimate bearing pressure of 300 kPa (i.e., an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

1. Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids;
2. Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested, from the liquid limit, in accordance with NZS 4402 Test 2.6; and,
3. Any ground which could foreseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, liquefaction, lateral spread, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots.

The general industry wide testing for good ground soil as defined in NZS 3604:2011 (excepting those described above) is by testing with a DCP in accordance with NZS 4402 Test 6.5.2, if penetration resistance is no less than:

- ∴ 5 blows per 100 mm at depths down to twice the footing width; and,
- ∴ 3 blows per 100 mm at depths greater than twice the footing width.

Based on the testing done to date the site can generally be defined as having “Good Ground” as defined in NZS3604:2011, with regards to the first three bullet points (1, 2, 3) noted above.

However, the DCP testing during the site investigation did not achieve the DCP testing requirements until depths of between 0.6 m (TP01) and 1.0 m (TP03 and TP06). As all DCP tests in all test pits did not achieve the required “blows / 100 mm” NZS3604 definition of Good Ground has not been achieved on site.

DCP results and the depth to ‘Good Ground’ across the suite are given in Table C1 of Appendix C. Note no results are presented for topsoil and no assumptions have been made to foundation widths therefore provides no interpretation as to the depth when 3 blows/100 mm is suitable indicator of Good Ground.

The DCP testing has not achieved the NZS 3604 good ground requirements: across the entire site until depths of up to 1.0 m bgl. As such, it is recommended that lot specific geotechnical reports will be required to confirm lot specific bearing requirements across a defined building location area (BLA) on each lot, this can be undertaken at Building Consent stage.

The provisional DCP results indicate that a Geotechnical Ultimate Bearing Capacity (GUBC) of 200 kPa is generally available across the whole site, this is subject to confirmation with additional testing across each lot BLA and calculation specific to the proposed foundations dimensions.

If NZS 3604:2011 style foundations are preferred than as stated in NZS 3604:2011 Section 3, if “Good Ground” is achieved at a depth greater than 0.6 m, the excavation between good ground and the foundation base may be filled with mass concrete having a minimum strength of 10 MPa at 28 days.

Waimakariri Statement of Professional Opinion is given in Appendix D of this report.

5.2 Finished Floor Levels

Finished floor levels should be confirmed during the consenting process to comply with current local authority flood requirements.

5.3 Site Earthworks

If any bulk earthworks are proposed a site-specific earthworks specification is recommended and beyond the remit of this report. However, any specification must meet the requirements of NZS 4431:2022 *Engineered fill construction for lightweight structures*, including suitable soil validation and compaction testing.

This standard covers fill construction for residential development in accordance with NZS3604:2011 and developments with similar foundation loadings and sensitivities to ground settlements. Therefore, specific engineer design will be required for fill associated with any structure beyond the scope of NZS3604:2011.

5.4 California Bearing ratio (CBR)

The scale penetrometers (DCP's) performed during the site investigation can be used to derive the site CBR. The test results of the natural sub-grade underlying the fill indicate a range of 2 to 3 blows per 100 mm penetration (Table C1 of Appendix C).

Correlations of DCP blow counts to California Bearing Ratio (CBR) are given in Section 3.3 of NZS 4404: 2010 '*Land Development and Subdivision Infrastructure*'. Figure 3.1 of NZS 4404 indicates firstly that fine-grained silts are generally considered as 'poor to fair sub-grade, the DCP results indicate the natural sub-grade to have a CBR of between 4% and 7%.

The CBR derived by DCP in fine grained soils are conservative based on this standard and should be used for preliminary design purposes only; for more accurate results soaked CBR values should be determined in an accredited soils laboratory or Clegg Hammers should be completed on the proposed sub-grade surface to assist in pavement design.

6.0 Conclusions

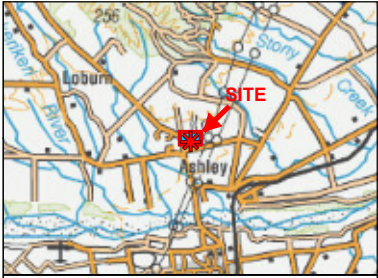
The following has been concluded from this geotechnical investigation.

- ∴ The ground conditions underlying the site are generally consistent with minor variations in depths. Topsoil is on average 0.4 m thick across the site, this is underlain by a very stiff silt.
- ∴ The shallow site investigation did not encounter the shallow groundwater – the water table is estimated to be between 4.57 and 6.02 m bgl based on surrounding water bores.

- ∴ DCP testing has not achieved the NZS3604 requirements until depths of between 0.6 and 1.0 m bgl across the wider site. A Geotechnical Ultimate Bearing Capacity (GUBC) of 200 kPa can be assumed at this stage based on testing done to date and material properties of the soils. A GUBC of 200 kPa is available directly beneath the topsoil, with a GUBC of 300 kPa being achieved between 0.7 – 1.1 m bgl, with vertical and lateral variations.
- ∴ If NZS 3604:2011 style foundations are preferred, than as stated in NZS 3604:2011 Section 3, if “Good Ground” is achieved at a depth greater than 0.6 m, the excavation between good ground and the foundation base may be filled with mass concrete having a minimum strength of 10 MPa at 28 days.
- ∴ A CBR of between 4% and 7% should be used in provisional pavement design; for more accurate results soaked CBR values should be determined in an accredited soils laboratory or Clegg Hammers should be completed on the proposed sub-grade surface to assist in pavement design.
- ∴ Lot specific testing and geotechnical reports will be required to confirm lot specific bearing requirements across a defined building location area (BLA) on each lot, this can be undertaken at Building Consent stage.
- ∴ An assessment of Section 106 of the Resource Management Act has identified that the site will not be subjected to significant natural hazards, if the recommendations outlined in this report are followed (Section 4).

7.0 References







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SITE LOCATION

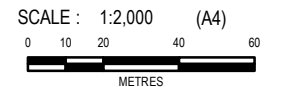


KEY :

-  FORMER CONSTRUCTED PONDS
-  SITE DRAIN
-  SITE BOUNDARY
-  PROPOSED SUBDIVISION LOTS
-  LAND PARCELS
-  TEST PITS

SOURCE:
 1. AERIAL IMAGERY (FLOWN 2021), PROVIDED UNDER LICENCE FROM LINZ WHO MAKES NO CLAIMS AS TO ITS RELIABILITY, ACCURACY OR ADEQUACY FOR ANY PARTICULAR PURPOSE.
 2. CADASTRAL/TOPOGRAPHICAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE <https://data.linz.govt.nz/> AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

FIGURE 1 : SITE LOCATION, SITE BOUNDARY, TEST LOCATIONS AND SITE FEATURES



INVESTIGATION LOG

Job No.: C04719700
 Test No.: TP02
 Sheet: 1 of 1
 Date: 08/11/22
 Ground Level mRL: Ground

Client: Andy Carr
 Project: 308 Cones Road, Loburn
 Site Address: 308 Cones Road, Loburn
 Coordinates: 1566062mE, 5209954mN (NZTM)

Interpretation	Geological Description	Graphic Log	Depth (m)	RL (m)	Squeeze Zone	Samples	Scala Penetrometer (Blows / 100mm)										Vane Shear Strength (kPa)				Water								
							2	4	6	8	10	12	14	16	18	50	100	150	200	Values									
Topsoil	SILT, dark brown, dry to moist, non-plastic.	TS TS TS TS TS TS TS TS TS TS						3																					
Alluvial Deposits	Clayey, SILT, light brown mottled light grey, orange brown, very stiff, moist, moderately plastic.	[Patterned Graphic Log]	1					2																					
									3																				
									3																				
									5																				
									6																				
									7																				
									10																				
									10																				
									12																				
									17																				
									22 >>																				
									15																				
									17																				
									20																				
									21 >>																				
	EOH: 3.40m Target Depth					EOS: 1.90m																							
			4																										

Groundwater Not Encountered

Remarks		Investigation Type		Water	
1. Groundwater not encountered on 8/11/2022. 2. Test pits sides remained stable during excavation. 3. Test pit backfilled with arisings.		<input type="checkbox"/> Hand Auger <input checked="" type="checkbox"/> Test Pit		<input checked="" type="checkbox"/> Standing Water Level <input type="checkbox"/> In flow <input type="checkbox"/> Out flow	
Contractor:	Rig/Plant Used:	Logged By:	Checked By:	Hole Depth:	
Protranz	Komatsu PC88MR	JG	DW	5.00 m	

Appendix C: Dynamic Cone Penetrometer Results

Table C1: Dynamic Cone Penetrometer Data (Blows / 100 mm Penetration)

Depth (metres bgl)	TP01	TP02	TP03	TP04	TP05	TP06
0.10	-	-	-	-	-	-
0.20	-	-	-	-	-	-
0.30	-	-	-	-	-	-
0.40	-	-	2	-	2	-
0.50	7	3	2	3	2	2
0.60	4	3	3	3	3	2
0.70	3	5	3	3	4	3
0.80	5	6	3	5	7	2
0.90	7	7	4	6	8	3
1.00	7	10	4	7	10	3
1.10	8	10	11	8	14	6
1.20	9	12	13	8	13	7
1.30	11	17	16	12	15	7
1.40	10	22	16	11	15	7
1.50	11	15	16	10	17	7
1.60	10	17	17	11	18	8
1.70	15	20	20	15	18	8
1.80	-	21	19	-	20	7
1.90	-	-	-	-	-	7
2.00	-	-	-	-	-	8
2.10	-	-	-	-	-	9
2.20	-	-	-	-	-	10
2.30	-	-	-	-	-	10
2.40	-	-	-	-	-	14

Notes: Upper 0.3 - 0.4 m denotes topsoil thickness; not suitable as founding soil. The red shaded cells indicate DCP results which do not meet the requirements of NZS 3604:2011

Appendix D: Statement of Professional Opinion



ENGINEERING CODE OF PRACTICE

**Statement of Professional Opinion on the Suitability of Land for Building
Construction**

ISSUED BY: David Wright
(Engineer)

OF: Pattle Delamore and Partners. Level 2, 134 Oxford Terrace, Christchurch Central, Po Box 389. Christchurch 8011
(Name and address of firm)

TO: Andy Carr
(Developer)

TO BE SUPPLIED TO: Waimakariri District Council
(Territorial Authority)

IN RESPECT OF: The Residential Subdivision of Lot 3 DP 386430
(Description of infrastructure/land development)

AT: 308 Cones Road, Loburn
(Address)

I hereby confirm that:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/developer as the geotechnical engineer on the above development.
2. The geotechnical report for subdivision, dated 14 December 2022 has been carried out in accordance with the requirements of the Waimakariri District Council and includes
 - (i) Review of published information.
 - (ii) Details and the results of shallow site investigations.
 - (iii) An assessment of any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.
3. In my professional opinion, not to be construed as a guarantee, I consider that (*delete as appropriate*):
 - (a) The original ground not affected by filling is suitable for the erection thereon of buildings that require specific engineer design provided that:
 - (i) Lot specific shallow geotechnical investigation and reports will be required to confirm bearing requirements across any building location areas.
 - (ii) Recommendations outlined in the PDP geotechnical report for subdivision titled '308 Cones Road, Loburn Geotechnical Report for Residential Subdivision' dated December 2022 are followed.

ANNEXURE C: GEOTECHNICAL REPORT FOR 90 DIXONS ROAD

Desktop Study; Additional Development at 90 Dixons Road, Loburn

✦ Prepared for

Andy Carr

✦ October 2023



PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 345 7100
Website <http://www.pdp.co.nz>
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill



solutions for your environment

Quality Control Sheet

TITLE Desktop Study; Additional Development at 90 Dixons Road, Loburn

CLIENT Andy Carr

VERSION Final

ISSUE DATE 3 October 2023

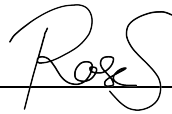
JOB REFERENCE C04719700

SOURCE FILE(S) C04719700R002.docx

DOCUMENT CONTRIBUTORS

Prepared by

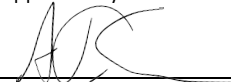
SIGNATURE



Rose Sudworth

Reviewed and approved by

SIGNATURE



Andrew Smith

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Andy Carr and publicly available geotechnical information. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Andy Carr for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Appendices

Appendix A: Site Plan
Appendix B: Published PDP Geotechnical Report
Appendix C: NZGD Investigations
Appendix D: Listed Land Use Register Property Statement

1.0 Introduction

1.1 Scope

Pattle Delamore Partners Limited (PDP) have been engaged by Andy Carr ('the client') to undertake a broad desktop study of published information of an area of land within the property located at 90 Dixons Road, Loburn ('the site'). The purpose of this desktop review is to produce a conceptual ground model and assess natural hazards, to inform the development of the Outline Development Plan and advise whether there are any issues that preclude the site from being rezoned.

A Geotechnical investigation has previously been undertaken by PDP for 308 Cones Road (Lot 3 DP 386430, title number 345976) as part of a previous subdivision application. Both 308 Cones Road and the area of land immediately south, this being the current site at 90 Dixons Road, are proposed to be zoned in the Waimakariri Proposed District Plan as Large Lot Residential Zone Overlay. This means that any Outline Development Plans for one parcel of land needs to be cognisant of the other.

The legal description of the site is Lot 4 DP 80565 (title number CB45C/1015), however the area of land proposed to be zoned as Large Lot Residential Zone Overlay does not cover the total area of Lot 4. A site plan showing the location of the previous geotechnical investigation, and the land associated with this desktop study is appended to in Appendix A.

The following information will be reviewed as part of the scope for this desktop study:

- ∴ Historical aerial imagery of the site.
- ∴ Available published information – geological setting, hydrogeological setting, the Waimakariri District Council Natural Hazard Maps, and the New Zealand Geotechnical Database (NZGD).
- ∴ The Listed Land Use Register (LLUR) and the natural hazards relevant to the site.
- ∴ PDP Geotechnical Report for the Residential Subdivision at 308 Cones Road, published December 2022 (ref: C04719700R001, attached in Appendix B).

1.2 Site Location and Description

The sites legal description is 90 Dixons Road, Loburn, North Canterbury, and the site has a total land area of approximately 208,000 m².

The site is bounded by Cones Road to the west and Dixons Road to the south, and land use around the site is presently a mix of agricultural land, rural residential properties, and large lot residential properties. The Loburn Lea Large Lot Residential subdivision lies immediately west of Cones Road. The site consists of four open paddocks that are generally flat with gentle gradients, separated by fences and small bushes/trees. Based on aerial photography, there are currently no dwellings or small buildings/sheds on the site, however there is an electrical transmission tower located near the eastern extent of the site.

2.0 Published Information

2.1 Site History

Historical aerial photographs of the site and surrounding area dating from 1940 have been sourced from RetroLens Historical Images and the Canterbury Maps Database (both accessed September 2023). A review of the imagery shows the following:

- ∴ 1940-44, there are several trees scattered across the site and the land is farmland/pasture used for agricultural purposes. There are clearly definite overland flow paths in the northeast corner of the site that flow northwest to southeast towards the Ashely River.
- ∴ 1960-1964, the trees across the site had been mostly removed, and the overland flow paths appear less defined.
- ∴ 1965-1969, the site is unchanged.
- ∴ 1970-1974, the site is still being used as farmland, with the eastern most paddock clearly being used for grazing.
- ∴ 1975-1979, the site is unchanged.
- ∴ 1980-1984, the overland flow paths are more pronounced and cover a larger section of the eastern half of the site. By 1980, the transmission tower located within the site had been constructed.
- ∴ From 1984 onwards, overland flow paths are less defined, potentially indicating reworking of the paddocks. The site has remained mostly unchanged from 1984 until the present day.
- ∴ Land use around the site has remained consistent over time and is primarily agricultural land, with residential rural developments increasing steadily since the early 2000s.

2.2 District Plan Hazard Map Review

A review of the Waimakariri District Natural Hazards Interactive Viewer and the Canterbury Maps Database (both accessed September 2023) is presented below.

2.2.1 Liquefaction and Lateral Spreading

The site is not mapped within any liquefaction susceptibility zones, and the boundary of a '*Liquefaction is Unlikely Zone*' is 1.5 km south of the site.

2.2.2 Flooding

The site is within the flood assessment zone of the Waimakariri District Council Plan, and there are overland flow paths across the east of the site that are now mapped as having low flooding hazard in the 200 Year Flood Hazard Map. The 200 Year Flood Hazard map incorporates the combined output localised flooding, Ashley River breakout flooding, and Coastal flooding, with the modelling using water depths for 200-year average recurrence interval floods. The areas of Low to High flood hazard within the property boundary and surrounding area are shown in the site plan in Appendix A.

There are no available aerial images of the site on the Flood Imagery Register (FIR) on the Canterbury Maps Database.

2.2.3 Tsunami

The site is not mapped within any tsunami evacuation zones.

2.2.4 Fault Rupture

A section of the Ashley Fault Avoidance Zones 2020 is mapped 100 to 200 m north of the site, with this section of the avoidance zone classified as '*Uncertain – Constrained*'. This zone is also mapped within the property boundary, as shown in the site plan presented in Appendix A.

Land classified as '*Well-defined*' within the fault avoidance zone is also nearby to the site, located 600 m northwest.

2.3 Geological Setting

A review of the GNS published map of the Christchurch Area (Forsyth et al., 2008) indicates the site is underlain by late quaternary river deposits described as *grey to grey-brown river alluvium* (IQa) across the majority of the site and *grey to brown fan alluvium* (IQa) in the north-east corner of the site.

The boundary between the river and fan deposits strikes northwest-southeast across the site, and is roughly located along the flow paths illustrated by the Flood Model 200 Year Low Hazard Zone in the site plan presented in Appendix A. According to the GNS online Qmap (accessed September 2023), the river alluvium deposits consist of *slightly weathered gravel, sand, silt, and clay*, and the fan alluvium deposits consist of *weathered, moderate to poorly sorted, silty subangular gravel and sand*.

2.4 Nearby Active Faults

The nearest active fault according to the GNS Active Fault Database (accessed September 2023) is the Loburn Fault which is mapped 100 to 200 m north of the site.

2.5 Hydrogeological Setting

The nearest large waterway to the site is the Ashley River, located 1.65 km south of the site. The Makerikeri River, a tributary of the Ashley River, is located 2.4 km west of the site.

The Canterbury Maps Database shows that there is a narrow overland flow path in the eastern corner of the site. Aerial imagery reviewed in Section 2.1 shows the flow path to be less defined since 1984 until the present day.

A review of the Environment Canterbury Regional Council Well Search (accessed September 2023) shows that the nearest active well (i.e., well with data recorded in the last 12 months) is BW24/0210 which is located 1.15 km southwest of the site. The groundwater monitoring data for the well indicates the average groundwater level is 3.09 m below ground level (bgl) as of August 2023, with a minimum groundwater level of 3.77 m bgl and a maximum of 1.94 m bgl. The average groundwater level has remained mostly consistent over time from the earliest data in September 2022 until the latest measurement in August 2023, and ranges from 3.09 to 3.86 m bgl.

2.6 New Zealand Geotechnical Database

The following outlines the nearest soil data available from the NZGD (accessed September 2023), relevant to the site.

A series of test pits and Scala penetrometers (Scalas) were conducted in January 2019, at 90 Dixons Road, Loburn, on land east and north-east of the site and within the same legal description (i.e., Lot 4 DP 80565). The investigations were completed approximately 70 – 250 m away from the site boundary. Locations of the investigation are shown in the site plan in Appendix A, and the logs of TP1 and TP2 are attached in Appendix C.

A review of the 2 test pits and associated Scala Penetrometers and shear vane tests completed by Riley Consultants is presented below:

- ∴ A silt topsoil covered the surface to a depth of 0.2 to 0.3 m bgl, underlain by a stiff to very stiff sandy SILT with trace clay, dry to moist proven to depths between of 1.25 and 2.0 m bgl.
- ∴ In the southern-most test pit (TP2), the sandy SILT was generally underlain by interbeds of very dense silty GRAVELS and very stiff SILTs with some gravel, to the base of the test pit at 3.8 m bgl. At 3.2 m bgl, a steady inflow of groundwater was recorded.

- ∴ In the northern most test pit (TP1), the initial layer of sandy SILT was underlain by a SILT with some gravel to the base of the test pit at 4.0 m bgl. The silt soil was logged as very stiff and moist, becoming wet at 3.5 m bgl. Groundwater was not encountered in this test pit.

2.7 Listed Land Use Register (LLUR)

A review of the LLUR indicates there are several results relevant to the total area covering the legal description of the site (i.e., Lot 4 DP 80565 Title Number CB45C/1015). The results show the following:

- ∴ HAIL Activity – ACT3464 – A17 Storage tanks or drums for fuel, chemicals or liquid waste.
- ∴ Sites – SIT2945 – DR Robertson Agricultural Contractor – Partially Investigated.
- ∴ Investigations – INV1529 – Detailed Site Investigation – Tank Removal Validation for DR Robertson, Ashley – September 2005 – Report Date 12 January 2006.

The property statement from the LLUR for Lot 4 DP 80565 indicates that the HAIL activity and associated investigations are located approximately 350 m east of the site boundary for this desktop study and are therefore not applicable to the study site. The property statement is attached in Appendix D.

2.8 PDP Geotechnical Report

PDP have previously conducted a geotechnical investigation and published an associated geotechnical report for the land immediately north of the site, at 308 Cones Road for a proposed subdivision. The geotechnical investigation was completed by PDP in November 2022, and the geotechnical assessment report was issued in December 2022 (ref: C04719700R001) and is attached in Appendix B.

The shallow ground investigations consisted of 6 mechanically excavated test pits with associated Scalas. The locations of the investigations are shown in the site plan presented in Appendix A, and a summary of the soil profile encountered is shown in Table 1.

The test pits of the investigation indicated that the 2022 site is covered by a silt topsoil with an average thickness of 0.4 m, which is underlain by a very stiff silt to a depth of at least 3.9 m bgl. All test pits remained stable throughout the excavation, and groundwater was not encountered in any of the test pits.

Table 1: Summary of Shallow Soil Profile

Soil Type	TP01	TP02	TP03	TP04	TP05	TP06
Topsoil	0.4 m	0.4 m	0.3 m	0.4 m	0.3 m	0.4 m
Natural Silt	> 3.0 m	> 3.4 m	> 3.2 m	> 3.9 m	> 3.2 m	> 3.1 m

Notes:

1. All depths noted are to base of geological unit and in metres bgl.
2. TP04 taken to the reach of the excavator (i.e., 3.9 m) to attempt to find natural gravel. Gravel was not encountered in any of the test pits.

2.9 Conceptual Geological Model

Based on the review of published materials relevant to the site, a conceptual geological model of the site has been hypothesised and is presented below.

- ∴ The 2022 PDP investigation north of the site indicates that the site is anticipated to be underlain by a silt topsoil to a depth of approximately 0.4 m bgl, below which a very stiff silt is expected to a depth of at least 3.9 m bgl.
- ∴ Based on the unit boundaries recorded by GNS and nearby investigations sourced from the NZGD, the soil profile in the northeast corner of the site may vary from the soil profile shown in Table 1 and consist of silt, sand, and gravel alluvial fan deposits. These have been described as interbedded sandy silt, silty gravel, gravel with some silt and sand, and silt with trace or some sand and gravel. Silt dominant soils are expected to be very stiff, and gravel dominant soils are expected to be very dense.
- ∴ Groundwater was not encountered in the 2022 PDP investigation, however the NZGD investigations northeast of the site recorded a steady inflow of groundwater at 3.2 m bgl. The nearest groundwater monitoring well (located 1.15 km southwest of the site) recorded an average groundwater level of 3.09 m bgl as of August 2023. Depths to groundwater onsite may range from 3.09 to >3.9 m bgl, with seasonal variation expected.
- ∴ A review of the natural hazard relevant to the site indicates that areas of low to medium flood hazard from the 200-year flood model are present on site, and low to high flood hazard are present within the greater property boundary. Fault rupture hazard is also relevant to the site, with an ‘Uncertain-Constrained’ fault avoidance zone mapped north of the site and mapped within the property boundary.

3.0 Conclusions & Recommendations

The desktop study presents a broad summary of the available geotechnical information relevant to the site, for the purposes of due diligence of the site only. The information reviewed as part of the desktop study indicates that there are no evident reasons why the site could not be considered for future development as Large Lot Residential, subject to appropriate future site investigations.

It is recommended that a geotechnical assessment comprising of shallow ground investigation is conducted to assist in subdivision consent for the site. This will aim to confirm the soil profile, key soil parameters, any evidence of land damage associated with a large earthquake etc, and depth to groundwater across the site.

As explained in section 2.2.1, the site is not mapped within any Environment Canterbury liquefaction susceptibility zones, and the boundary of a '*Liquefaction is Unlikely Zone*' is 1.5 km south of the site. Because of this, only shallow ground investigations will be required for subdivision consent as per guidelines from the *Earthquake geotechnical Practice – Module 2* (MBIE & NZGS, 2016). Shallow ground investigations may consist of mechanically excavated test pits and Scala Penetrometer tests, with Shear Vane tests if plastic soils are encountered. The density of shallow testing will be designed to be sufficient to satisfy the subdivision consent and identify any lateral and vertical changes across the site. The Module 2 guidelines suggest that generally, subdivision consents may require fewer and widely spaced investigations.

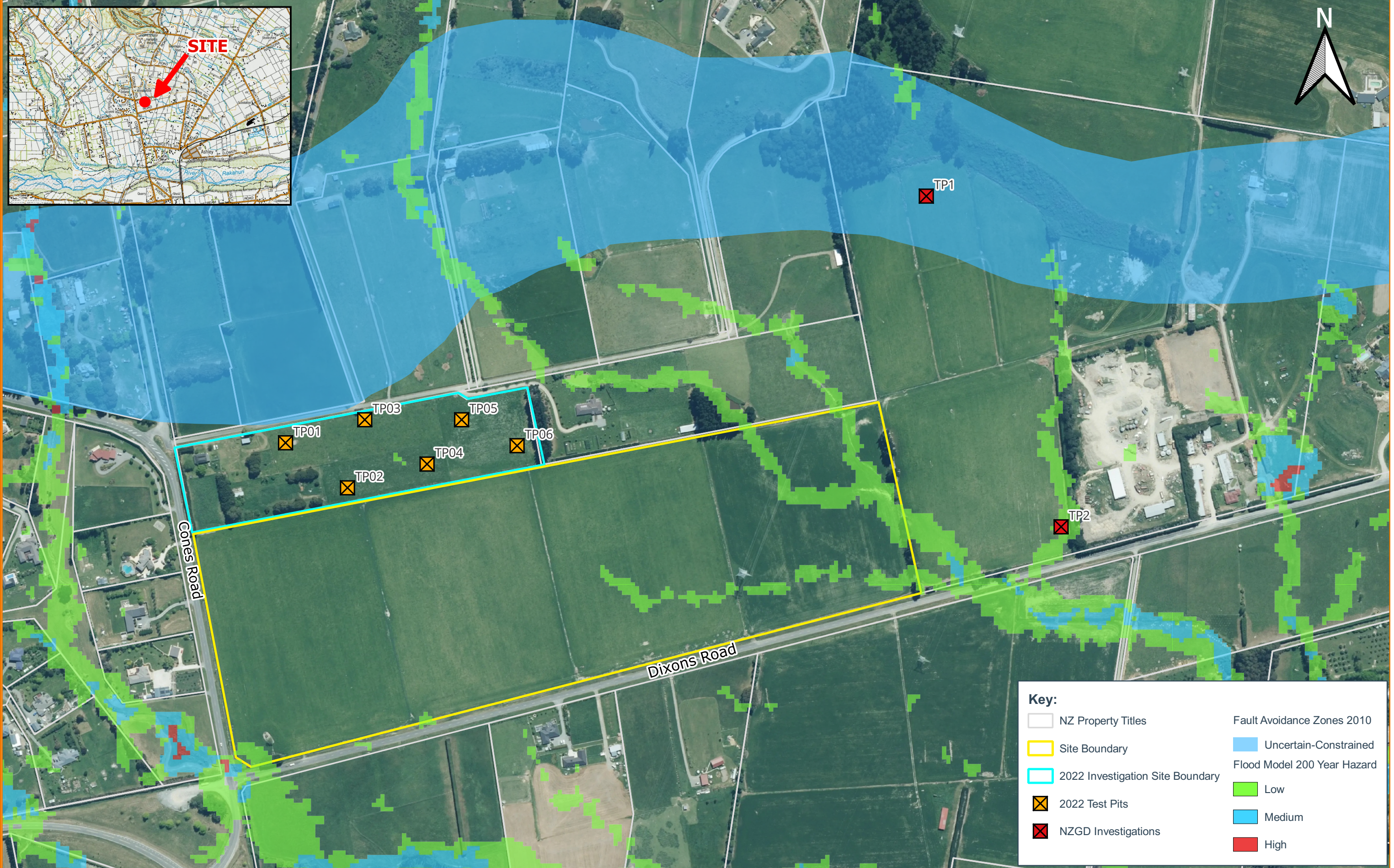
If, during the shallow investigation, any evidence of land damage associated with liquefaction is found, it is recommended that additional deep investigations are completed on site. These will be at a testing density of one investigation per house site, as per the Module 2 guidelines above for subdivision consents requirements for rural land.

The review of the Waimakariri District Council Natural Hazard Maps and the Canterbury Maps has identified that fault rupture and flooding hazard may be present within the site boundary and within the property boundary. The investigation recommended above will assist in identifying any other natural hazards that may be associated with the subdivision, as required for the subdivision consent by Section 106 of the Resource Management Act 1991.

The desktop study has identified a HAIL activity for storage tanks or drums for fuel within the greater property boundary for Lot 4 DP 80565, recorded on the LLUR. Upon review of the property statement provided by the LLUR, the HAIL activity and associated investigations are located approximately 350 m east of the site boundary for this desktop study and are therefore not applicable to the proposed subdivision.

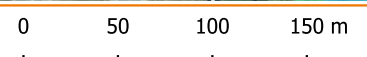
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Key:

NZ Property Titles	Fault Avoidance Zones 2010
Site Boundary	Uncertain-Constrained Flood Model 200 Year Hazard
2022 Investigation Site Boundary	Low
2022 Test Pits	Medium
NZGD Investigations	High



SCALE : 1:4000 @ A3

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5. LOCATION OF NZGD INVESTIGATIONS ARE APPROXIMATE BASED ON NZGD WEBSITE AND PUBLISHED LOGS.

CLIENT

ANDY CARR

FIGURE 1: SITE PLAN

C04719700 - GEOTECHNICAL DESKTOP STUDY; 308 CONES ROAD



308 Cones Road, Loburn – Geotechnical Report for Residential Subdivision

✦ Prepared for

Andy Carr

✦ December 2022



PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 345 7100
Website <http://www.pdp.co.nz>
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill



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Prepared by

SIGNATURE



Dave Wright

Reviewed and approved by

SIGNATURE



Andrew Smith

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Andy Carr. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This document has been prepared based on the ground testing as described in this report and field data gathered by PDP. The site conditions as described in this document have been interpreted from, and are subject to, this information and its limitations and accordingly PDP does not represent that its interpretation accurately represents the full site conditions.

The advice and opinions expressed in this document are based on the observation and sampling of a series of test pits and dynamic cone penetrometers at the site. The geological and associated environmental conditions interpolated between the test points (noted above) are not guaranteed to be accurate.

This report has been prepared by PDP on the specific instructions of Andy Carr for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Appendix A: Test Locations
Appendix B: Test Pit Logs
Appendix C: Dynamic Cone Penetrometer Results
Appendix D: Statement of Professional Opinion

1.0 Introduction

1.1 Scope

Pattle Delamore Partners Limited (PDP) has been engaged by Andy Carr (the client) to undertake a comprehensive geotechnical assessment of the property located at 308 Cones Road, Loburn (i.e., the site). The purpose is to provide an assessment of the natural hazards to aid in the subdivision of the site.

The site has a total land development area of 40,850 m² comprising lot 3 DP 386430 (title: 345976), it is proposed to subdivide the site into seven lots, with lot 1 being reserved for the existing dwelling that fronts Cones Road; see Figure 1 below.

The objective of the assessment was to determine the following:

- ❖ Review of published information – site history, geological setting, and hydrogeological setting.
- ❖ The consistency and density of the soils underlying the site, based on shallow testing data acquired during ground investigations.
- ❖ Appropriate soil parameters to be used for foundation/subdivision design and whether the site meets the New Zealand Standard definition of “Good Ground”.
- ❖ Assessment of the suitability of the site for subdivision according to Section 106 of the Resource Management Act (1991).
- ❖ Statement of Professional Opinion on the Suitability of Land for Building Construction for the seven rural-residential lots (Ref: Waimakariri District Council Engineering Code of Practice, Part 4, Appendix A)

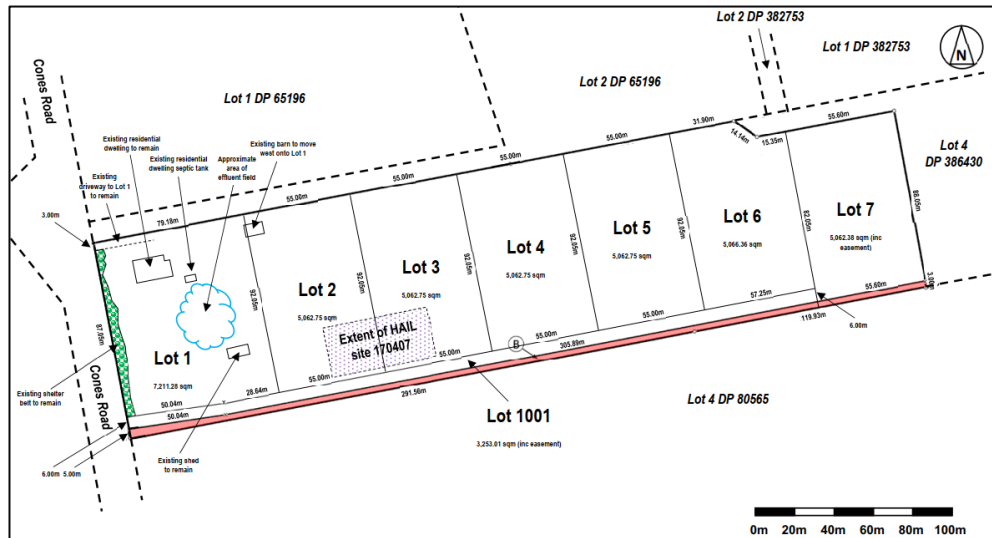


Figure 1 – 308 Cones Road Proposed Subdivision Layout. Town Planning Group August 2022.

1.2 Site Location and Description

The site details and description are summarised below in Table 1, while a site location map and an aerial photograph showing the current site layout (Figure 1) is attached.

Table 1: Site Identification	
Address	308 Cones Road, Loburn
Legal Description	LOT 3 DP 386430 BLK II RANGIORA SD
Site Owner	Sarah Jean Pallett
Grid Reference	NZTM BW24: 6608-0999
Land Area	40,850 m ²
Zoning	Rural
Land Use	Dwelling and several sheds/buildings located in the north-western corner of the site bounded by Cones Road to the west and an unnamed gravelled road to the north, while the remainder of the site comprises open paddocks.
Site Description	Open paddocks with gentle gradients.
Surrounding Land Use	The site is surrounded by rural residential properties and agricultural land. An unnamed road runs along (east / west) the northern boundary of the site.

2.0 Published Information

2.1 Site History

Historical aerial photographs from between 1941 and 2020 have been reviewed for the site. These photographs have been sourced from Canterbury Map Partners administered by Environment Canterbury (ECan).

- ∴ The 1941 aerial photograph shows the site being largely undeveloped, possibly used for pasture/stock grazing. A dwelling and shed are present in the north-western corner of the site. The surrounding properties are also largely used for agricultural purposes with open paddocks and grazing land.
- ∴ The 1963 aerial photograph shows a hedgerow leading south across the property from the dwelling, no other changes are evident from the previous aerial photograph.
- ∴ The 1976 aerial photograph shows three sheds have been constructed to the south-east of the existing dwelling.
- ∴ The 1980 aerial photograph shows two depressions located to the south-east of the sheds that were shown constructed in the 1976 aerial photograph. A shed has also been constructed to the east of the existing dwelling.
- ∴ The site remains largely unchanged in the 2000 aerial photograph.
- ∴ The depressions have been filled in/grassed over in the 2004 aerial photograph.
- ∴ The 2020 aerial photograph represents the site in its current layout, the three sheds to the west of the infilled depressions have been demolished/removed and the area of disturbed ground is shown in the area.

2.2 District Plan Hazard Map Review

A review of the hazard maps and district plan was conducted to ascertain whether the site and surrounding area had any underlying geotechnical risks that may affect the site and subsequent land development.

The site is:

- ∴ Immediately south of an unnamed road, that denotes the southern extent of the Ashely Fault avoidance zone (“Uncertain – constrained”).
- ∴ 2 km north-west of the “Damaging Liquefaction Unlikely” – therefore in a zone where damage from liquefaction is unlikely.
- ∴ Is within an area that is denoted as having a very low risk that the site will be affected by a 200-year flood event.

- ∴ Not within a tsunami evacuation zone.
- ∴ Not within an area that may be subjected to coastal erosion.

According to the Waimakariri district plan, there are no published or recorded natural hazards associated with the site.

2.3 Geological Setting

According to the published geological map, (1973) the site is underlain by late Pleistocene fluvial brown and blue gravel, sand, and silt deposits.

The Loburn active fault was identified on the Geological and Nuclear Science (GNS) active fault database approximately 200 m north of the site. This denotes the southern extent of the Ashely Fault avoidance zone noted above.

2.4 Hydrogeological Setting

A review of the Canterbury water bores map indicates two water bores (M34/0196 and BW24/0313) are located within 300 m of the site.

M34/0196 is located north of the site at 334 Cones Road, the water bore was drilled to a termination depth of 10.4 m below ground level (bgl). The calculated minimum 80th percentile water level is estimated to be 4.57 m bgl.

Bore BW24/0313 conversely was drilled to a deeper depth of 27.86 m bgl in March 2016, screened between 26.36 and 27.86 m bgl, with an initial water level of 6.02 m below ground.

These two bores provide a short term assessment of the hydrogeological setting that estimates the ground water table to be between 4.57 and 6.02 m bgl.

2.5 Listed Land Use Register (LLUR)

The site is currently being investigated by PDP with regards to that the site is listed upon the LLUR as “G3 – Landfill site”. The location of the potential source of contamination, is in the central southern portion of the site and is noted as verified hazard and has not been investigated.

This report should be read in conjunction with the PDP Preliminary Site Investigation report (Ref:C04719100L001_PSI) which presents recommendations and conclusions with regards to the proposed subdivision could be a **permitted activity** under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS).

2.6 Conceptual Geological Model

Based on published information the site is likely to be underlain by topsoil, overlying stiff silt which in turn is underlain by very dense gravel. The surrounding water bores (further afield than the ones noted above) infer that the gravel continues for some considerable depth, with a depth to water of >4.5 m bgl.

3.0 Geotechnical Investigations

3.1 Ground Investigations

A site walkover was undertaken during early November 2022 followed by a Ground Penetration Radar (GPR) scan to identify underground utilities and safe working areas which was conducted on the 8 November 2022.

Following identification of safe areas, the site investigation commenced with a combination of mechanically excavated test pits (TP) and Dynamic Cone Penetrometers (DCPs). A geotechnical site plan is presented in Appendix A.

3.1.1 Shallow Ground Investigations

Table 2 outlines the results of the PDP investigation; the rationale behind the test pit investigation was to identify the thickness of topsoil, overlying the natural deposits of silt and depth to ground water.

During the investigation the test pits were logged to New Zealand Geotechnical Society (NZGS) standards to provide information on the soils properties that can be used in design; logs are presented in Appendix B.

Table 2: Summary of PDP Shallow Soil Profile						
Soil Type	TP01	TP02	TP03	TP04	TP05	TP06
Topsoil	0.4 m	0.4 m	0.3 m	0.4 m	0.3 m	0.4 m
Natural silt	>3.0 m	>3.4 m	>3.2 m	>3.9 m	>3.2 m	>3.1 m
<p><i>Notes:</i> All depths noted above are to base of geological unit and in metres bgl. Average thicknesses; Topsoil 0.40m. TP04 taken to the reach of the excavator to find natural gravel.</p>						

3.1.2 Groundwater

Groundwater was not encountered in any of the test pits; TP04 was taken as deep as possible to find ground water (and natural gravel). The reach of the excavator was 3.9 m, with no ground water present.

3.2 Geotechnical Ground Model

The test pits of the investigation have proven the site is covered in an average thickness of 0.4 m of topsoil, this is underlain by a very stiff silt proven to at least 3.9 m.

All test pits remained stable throughout excavation, ground water was not encountered in any test pit, and back filled with arisings once complete.

3.3 Geotechnical Design Parameters

3.3.1 Soil Parameters

As can be seen Table 2 and the appended test pit logs, the ground conditions underlying the site are consistent with minor variations in depths and thicknesses of the overlying topsoil unit as can be expected. This data has been simplified into a unified geotechnical ground model with soil parameters as given in Table 3.

Table 3: Simplified Geotechnical Ground Model and Proposed Soil Properties					
Geotechnical Unit	Approximate base of Unit m bgl ^{1,2}	Relative Density/ Consistency ³	Unit Weight γ (kN/m ³) (Dry)	Internal Friction (degrees)	Cohesion (c) kPa
Topsoil	0.4 m (0.4 m)	n/a	n/a	n/a	n/a
Silt	3.9 m (>3.9 m)	Very stiff	17	28	2

Notes

() Unit thickness in metres

- Please note the base of the geotechnical unit given is a simplification from all test locations and there will be local variations both laterally and vertically across the wider site not tested.
- Average proven depth
- Relative density has been derived from DCP and hand diagnostic features.

The soil properties have been conservatively estimated based on in-situ information (geological descriptions) from field investigations, peer reviewed literature, experience with geologically similar sites and best engineering judgement. Additional parameters including modulus of subgrade reaction are available upon request.

4.0 Section 106 Resource Management Act 1991

In accordance with the Resource Management Act 1991 (RMA), the site has been assessed in accordance with Section 106 for natural hazards. It is understood the site is to be subdivided and therefore the RMA is applicable. Section 106 states under condition 1:

A consent authority may refuse to grant a subdivision consent or may grant a subdivision consent subject to conditions, if it considers that

- ∴ There is significant risk from natural hazards; or,
- ∴ Sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.

For the purpose of subsections 1a, an assessment of the risk from natural hazards requires a combined assessment of:

- ∴ The likelihood of natural hazards occurring.
- ∴ The material damage to land in respect of which consent is sought, other land or structures that would result from natural hazards; and,
- ∴ Any likely subsequent use of land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph b.

The proposed subdivision is considered based on, site investigations and local knowledge to have the following risk levels to the following hazards:

4.1 Erosion

The site is not subject to significant erosion as it has a generally flat grade with a gentle gradient towards the southeast. Therefore, it is considered that inundation poses a low risk to the development.

4.2 Falling Debris and Slippage

The proposed subdivision is located on flat ground, with no areas bordering the site being elevated; the site has no potential to create, or to be affected by, falling debris. Therefore, there is no risk from slippage and falling debris.

4.3 Subsidence

The analysis of published data has provided a broad assessment of the site with regards to subsidence because of the process of liquefaction. As the site is located 2 km north-west of the “Damaging Liquefaction Unlikely” – in a zone where damage from liquefaction is unlikely, liquefaction risk is negligible and is unlikely to be subjected to liquefaction induced ground subsidence.

The site can be defined as having a low subsidence risk as the investigation has not identified any compressible soils therefore static settlements are likely to be within Building Code requirements of <25 mm for any residential development.

Therefore, it is considered that subsidence in the form of static and liquefaction induced subsidence poses a low risk to the development subject to the recommendations of this report.

4.4 Inundation

The site is not currently within a flood risk area according to the Waimakariri District Plan and is within an area that is denoted as having a very low risk that the site will be affected by a 200-year flood event.

Therefore, it is considered that inundation from flood or sea level risk will pose a low risk to the development.

4.5 Section 106 General Discussion

Based on the considerations it is determined that the site is suitable for subdivision under Section 106 of the RMA, if the recommendations given within this report are followed.

5.0 Development Recommendations

The following sub-sections give additional geotechnical recommendations to assist in the subdivision of the site.

5.1 NZS 3604:2011 - Good Ground

As defined in NZS 3604:2011 “Good Ground” means any soil or rock capable of permanently withstanding an ultimate bearing pressure of 300 kPa (i.e., an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

1. Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids;
2. Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested, from the liquid limit, in accordance with NZS 4402 Test 2.6; and,
3. Any ground which could foreseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, liquefaction, lateral spread, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots.

The general industry wide testing for good ground soil as defined in NZS 3604:2011 (excepting those described above) is by testing with a DCP in accordance with NZS 4402 Test 6.5.2, if penetration resistance is no less than:

- ∴ 5 blows per 100 mm at depths down to twice the footing width; and,
- ∴ 3 blows per 100 mm at depths greater than twice the footing width.

Based on the testing done to date the site can generally be defined as having “Good Ground” as defined in NZS3604:2011, with regards to the first three bullet points (1, 2, 3) noted above.

However, the DCP testing during the site investigation did not achieve the DCP testing requirements until depths of between 0.6 m (TP01) and 1.0 m (TP03 and TP06). As all DCP tests in all test pits did not achieve the required “blows / 100 mm” NZS3604 definition of Good Ground has not been achieved on site.

DCP results and the depth to ‘Good Ground’ across the suite are given in Table C1 of Appendix C. Note no results are presented for topsoil and no assumptions have been made to foundation widths therefore provides no interpretation as to the depth when 3 blows/100 mm is suitable indicator of Good Ground.

The DCP testing has not achieved the NZS 3604 good ground requirements: across the entire site until depths of up to 1.0 m bgl. As such, it is recommended that lot specific geotechnical reports will be required to confirm lot specific bearing requirements across a defined building location area (BLA) on each lot, this can be undertaken at Building Consent stage.

The provisional DCP results indicate that a Geotechnical Ultimate Bearing Capacity (GUBC) of 200 kPa is generally available across the whole site, this is subject to confirmation with additional testing across each lot BLA and calculation specific to the proposed foundations dimensions.

If NZS 3604:2011 style foundations are preferred than as stated in NZS 3604:2011 Section 3, if “Good Ground” is achieved at a depth greater than 0.6 m, the excavation between good ground and the foundation base may be filled with mass concrete having a minimum strength of 10 MPa at 28 days.

Waimakariri Statement of Professional Opinion is given in Appendix D of this report.

5.2 Finished Floor Levels

Finished floor levels should be confirmed during the consenting process to comply with current local authority flood requirements.

5.3 Site Earthworks

If any bulk earthworks are proposed a site-specific earthworks specification is recommended and beyond the remit of this report. However, any specification must meet the requirements of NZS 4431:2022 *Engineered fill construction for lightweight structures*, including suitable soil validation and compaction testing.

This standard covers fill construction for residential development in accordance with NZS3604:2011 and developments with similar foundation loadings and sensitivities to ground settlements. Therefore, specific engineer design will be required for fill associated with any structure beyond the scope of NZS3604:2011.

5.4 California Bearing ratio (CBR)

The scale penetrometers (DCP's) performed during the site investigation can be used to derive the site CBR. The test results of the natural sub-grade underlying the fill indicate a range of 2 to 3 blows per 100 mm penetration (Table C1 of Appendix C).

Correlations of DCP blow counts to California Bearing Ratio (CBR) are given in Section 3.3 of NZS 4404: 2010 '*Land Development and Subdivision Infrastructure*'. Figure 3.1 of NZS 4404 indicates firstly that fine-grained silts are generally considered as 'poor to fair sub-grade, the DCP results indicate the natural sub-grade to have a CBR of between 4% and 7%.

The CBR derived by DCP in fine grained soils are conservative based on this standard and should be used for preliminary design purposes only; for more accurate results soaked CBR values should be determined in an accredited soils laboratory or Clegg Hammers should be completed on the proposed sub-grade surface to assist in pavement design.

6.0 Conclusions

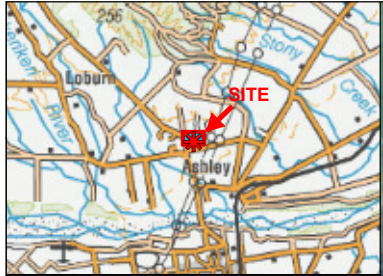
The following has been concluded from this geotechnical investigation.

- ∴ The ground conditions underlying the site are generally consistent with minor variations in depths. Topsoil is on average 0.4 m thick across the site, this is underlain by a very stiff silt.
- ∴ The shallow site investigation did not encounter the shallow groundwater – the water table is estimated to be between 4.57 and 6.02 m bgl based on surrounding water bores.

- ∴ DCP testing has not achieved the NZS3604 requirements until depths of between 0.6 and 1.0 m bgl across the wider site. A Geotechnical Ultimate Bearing Capacity (GUBC) of 200 kPa can be assumed at this stage based on testing done to date and material properties of the soils. A GUBC of 200 kPa is available directly beneath the topsoil, with a GUBC of 300 kPa being achieved between 0.7 – 1.1 m bgl, with vertical and lateral variations.
- ∴ If NZS 3604:2011 style foundations are preferred, than as stated in NZS 3604:2011 Section 3, if “Good Ground” is achieved at a depth greater than 0.6 m, the excavation between good ground and the foundation base may be filled with mass concrete having a minimum strength of 10 MPa at 28 days.
- ∴ A CBR of between 4% and 7% should be used in provisional pavement design; for more accurate results soaked CBR values should be determined in an accredited soils laboratory or Clegg Hammers should be completed on the proposed sub-grade surface to assist in pavement design.
- ∴ Lot specific testing and geotechnical reports will be required to confirm lot specific bearing requirements across a defined building location area (BLA) on each lot, this can be undertaken at Building Consent stage.
- ∴ An assessment of Section 106 of the Resource Management Act has identified that the site will not be subjected to significant natural hazards, if the recommendations outlined in this report are followed (Section 4).

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- Work Safe New Zealand. July 2016. Good Practice Guidelines: Excavation Safety.



SITE LOCATION

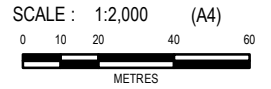


KEY :

-  FORMER CONSTRUCTED PONDS
-  SITE DRAIN
-  SITE BOUNDARY
-  PROPOSED SUBDIVISION LOTS
-  LAND PARCELS
-  TEST PITS

SOURCE:
 1. AERIAL IMAGERY (FLOWN 2021), PROVIDED UNDER LICENCE FROM LINZ WHO MAKES NO CLAIMS AS TO ITS RELIABILITY, ACCURACY OR ADEQUACY FOR ANY PARTICULAR PURPOSE.
 2. CADASTRAL/TOPOGRAPHICAL INFORMATION AND INSET SOURCED FROM THE LINZ DATA SERVICE <https://data.linz.govt.nz/> AND LICENSED FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

FIGURE 1 : SITE LOCATION, SITE BOUNDARY, TEST LOCATIONS AND SITE FEATURES



INVESTIGATION LOG

Job No.: C04719700
 Test No.: TP03
 Sheet: 1 of 1
 Date: 08/11/22
 Ground Level mRL: Ground

Client: Andy Carr
Project: 308 Cones Road, Loburn
Site Address: 308 Cones Road, Loburn
Coordinates: 1566082mE, 5210033mN (NZTM)

Interpretation	Geological Description	Graphic Log	Depth (m)	RL (m)	Squeeze Zone	Samples	Scala Penetrometer		Vane Shear Strength (kPa)		Water	
							(Blows / 100mm)		Vane: Values			
Topsoil	SILT, dark brown, dry to moist, non-plastic.	TS TS TS TS TS TS TS TS					2 4 6 8 10 12 14 16 18	50 100 150 200				
Alluvial Deposits	Clayey SILT, orange/brown mottled light grey, very stiff, moist, low plasticity.		1				2 2					
							3 3					
							4 4					
							11					
							13					
							16					
							16					
							16					
							17					
							20					
				19								
	EOH: 3.20m Target Depth		2				EOS: 1.80m					
			3									
			4									

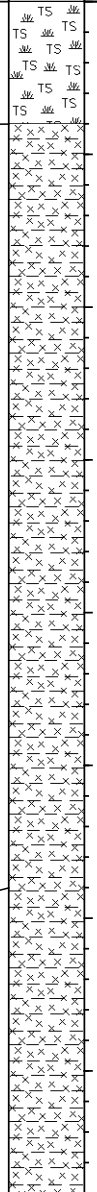
Groundwater Not Encountered

Remarks		Investigation Type		Water	
1. Groundwater not encountered on 8/11/2022. 2. Test pits sides remained stable during excavation. 3. Test pit backfilled with arisings.		<input type="checkbox"/> Hand Auger <input checked="" type="checkbox"/> Test Pit		<input checked="" type="checkbox"/> Standing Water Level <input type="checkbox"/> In flow <input type="checkbox"/> Out flow	
Contractor:	Rig/Plant Used:	Logged By:	Checked By:	Hole Depth:	
Protranz	Komatsu PC88MR	JG	DW	5.00 m	

INVESTIGATION LOG

Job No.: C04719700
 Test No.: TP04
 Sheet: 1 of 1
 Date: 08/11/22
 Ground Level mRL: Ground

Client: Andy Carr
Project: 308 Cones Road, Loburn
Site Address: 308 Cones Road, Loburn
Coordinates: 1566154mE, 5209982mN (NZTM)

Interpretation	Geological Description	Graphic Log	Depth (m)	RL (m)	Squeeze Zone	Samples	Scala Penetrometer		Vane Shear Strength (kPa)		Water
							(Blows / 100mm)		Vane: Values		
Topsoil	SILT, dark brown, dry to moist, non-plastic.	TS TS TS TS TS TS					2 3 3 2 3 3 3				
Alluvial Deposits	Clayey, SILT, light brown mottled light grey, orange brown, very stiff, moist, moderately plastic. EOH: 3.90m Machine Limit		1 2 3 4				5 6 5 6 7 8 8 12 11 10 11 15				Groundwater Not Encountered

Remarks		Investigation Type		Water	
1. Groundwater not encountered on 8/11/2022. 2. Test pits sides remained stable during excavation. 3. Test pit backfilled with arisings.		<input type="checkbox"/> Hand Auger <input checked="" type="checkbox"/> Test Pit		<input checked="" type="checkbox"/> Standing Water Level <input type="checkbox"/> In flow <input type="checkbox"/> Out flow	
Contractor:	Protranz	Rig/Plant Used:	Komatsu PC88MR	Logged By:	JG
Checked By:	DW	Hole Depth:	5.00 m		

Appendix C: Dynamic Cone Penetrometer Results

Table C1: Dynamic Cone Penetrometer Data (Blows / 100 mm Penetration)

Depth (metres bgl)	TP01	TP02	TP03	TP04	TP05	TP06
0.10	-	-	-	-	-	-
0.20	-	-	-	-	-	-
0.30	-	-	-	-	-	-
0.40	-	-	2	-	2	-
0.50	7	3	2	3	2	2
0.60	4	3	3	3	3	2
0.70	3	5	3	3	4	3
0.80	5	6	3	5	7	2
0.90	7	7	4	6	8	3
1.00	7	10	4	7	10	3
1.10	8	10	11	8	14	6
1.20	9	12	13	8	13	7
1.30	11	17	16	12	15	7
1.40	10	22	16	11	15	7
1.50	11	15	16	10	17	7
1.60	10	17	17	11	18	8
1.70	15	20	20	15	18	8
1.80	-	21	19	-	20	7
1.90	-	-	-	-	-	7
2.00	-	-	-	-	-	8
2.10	-	-	-	-	-	9
2.20	-	-	-	-	-	10
2.30	-	-	-	-	-	10
2.40	-	-	-	-	-	14

Notes: Upper 0.3 - 0.4 m denotes topsoil thickness; not suitable as founding soil. The red shaded cells indicate DCP results which do not meet the requirements of NZS 3604:2011

Appendix D: Statement of Professional Opinion



ENGINEERING CODE OF PRACTICE

**Statement of Professional Opinion on the Suitability of Land for Building
Construction**

ISSUED BY: David Wright
(Engineer)

OF: Pattle Delamore and Partners. Level 2, 134 Oxford Terrace, Christchurch Central, Po Box 389. Christchurch 8011
(Name and address of firm)

TO: Andy Carr
(Developer)

TO BE SUPPLIED TO: Waimakariri District Council
(Territorial Authority)

IN RESPECT OF: The Residential Subdivision of Lot 3 DP 386430
(Description of infrastructure/land development)

AT: 308 Cones Road, Loburn
(Address)

I hereby confirm that:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/developer as the geotechnical engineer on the above development.
2. The geotechnical report for subdivision, dated 14 December 2022 has been carried out in accordance with the requirements of the Waimakariri District Council and includes
 - (i) Review of published information.
 - (ii) Details and the results of shallow site investigations.
 - (iii) An assessment of any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.
3. In my professional opinion, not to be construed as a guarantee, I consider that *(delete as appropriate)*:
 - (a) The original ground not affected by filling is suitable for the erection thereon of buildings that require specific engineer design provided that:
 - (i) Lot specific shallow geotechnical investigation and reports will be required to confirm bearing requirements across any building location areas.
 - (ii) Recommendations outlined in the PDP geotechnical report for subdivision titled '308 Cones Road, Loburn Geotechnical Report for Residential Subdivision' dated December 2022 are followed.



Riley Consultants Ltd
4 Fred Thomas Dr
Auckland 0622
Tel: 09 489 7872

HAND AUGER LOG

Project: Proposed Cemetery		Location: 90 Dixons Road, Loburn 7472		Hole position: Refer to site plan.		No.: TP1
Job No.: 180588	Start Date: 30-01-19 Finish Date: 30-01-19	Ground Level (m LINZ): 69.00	Co-Ordinates (NZTM2000): E 1,566,731.96 N 5,210,292.14			
Client: Waimakariri District Council			Hole Depth: 4.00 m			Sheet: 1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12	15				
+69.00																		
+68.70	0.30		SILT with minor fine sand; light brown, homogeneous. Firmly packed; dry.															No. 1 5, 3, 3, 3, 3, 3, 3, 4, 3, 3, 2, 2, 2, 2, 2, 1, 2, 2, 1, 2 ✓ UTP
	1		Sandy SILT with trace to minor clay; light yellowish-brown with orange mottling. 'Stiff' to very stiff; moist; low plasticity. 0.50 m Grades to light grey with orange mottling. Moist to wet; low plasticity.															V= 131 ✓ R= 21.5 Vertical
+67.00	2.00																	No. 2 1, 1, 1, 1, 1, 1, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 6, 5 ✓ R= 20 Vertical
	3		SILT with some gravel, trace to minor sand; yellowish brown matrix; moist; gravel, brownish grey; subangular to subrounded, slightly to moderately weathered, very strong. 2.80 m Grades to "very stiff".															No. 3 1, 2, 3, 3, 2, 2, 2, 2, 2, 3, 2, 4, 4, 4, 7, 4, 6
	3.50		3.50 m Grades to gravelly; wet.															No. 4 1, 1, 2, 5, 5, 7, 6, 8, 9, 8, 3, 3, 3, 3, 5
+65.00	4.00		EOH @ 4.00 m															
	5																	

RILEYAKL_GLB_Log_RILEY HA (AKL) NO MAP_180588_90_DIXONS ROAD_SITE INVESTIGATIONS.GPJ <<DrawingFile>> 23/12/2019 15:52 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample ↓ Large Disturbed Sample ■ U100 Undisturbed Sample	▼ Scala Penetrometer - blows/50mm ◻ Permeability Test ▼ Schmidt Hammer ✓ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ↓ Water Strike (1st, 2nd ...) ↑ Water Rise (1st, 2nd ...) and ⏱ Rise Time (minutes)	GROUNDWATER ◻ None ◻ Slow Seep (depth) ◻ Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth	Remarks 1. Coordinates and elevations based on hand held GPS and subject to survey confirmation. 2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
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All dimensions in metres Scale 1:34	Shear Vane No. GEO 105	Logged by: DL	Checked by: AvD
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Riley Consultants Ltd
4 Fred Thomas Dr
Auckland 0622
Tel: 09 489 7872

HAND AUGER LOG

Project: Proposed Cemetery		Location: 90 Dixons Road, Loburn 7472		Hole position: Refer to site plan.		No.: TP2
Job No.: 180588	Start Date: 30-01-19 Finish Date: 30-01-19	Ground Level (m LINZ): 52.00		Co-Ordinates (NZTM2000): E 1,566,888.50 N 5,209,909.46		
Client: Waimakariri District Council			Hole Depth: 3.80 m			Sheet: 1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12	15				
+52.00			SILT with traces of clay; light grey. "Stiff"; dry; (rootlets)														No. 1 3, 3, 2, 3, 3, 4, 3, 3, 2, 2, 2, 2, 3, 4, 5, 9, 10, 7, 4, 6 No. 2 1, 2, 2, 2, 3, 5, 10, 12, 12	
	0.20		Sandy SILT with traces of clay; light grey with orange mottling. "Stiff"; dry; sand, fine to medium															
	1		0.70 m Sandy GRAVEL lenses, moderately thin (100mm-200mm); gravel, as below; sand as above.														No. 3 4, 4, 10, 4, 10, 10, 9, 7, 10, 15, 9, 10	
	1.25		Silty GRAVEL; brownish grey. Very dense; gravel, moderately to slightly weathered, medium to coarse, strong greywacke															
	1.80		SILT with some gravel; orange brown; gravel, as above														No. 4 4, 5, 3, 3, 3, 3, 7, 8, 10, 11, 12, 11	
	2.00		GRAVEL with some silt and sand; Very dense; moist to wet; gravel, as above; sand, fine to medium															
	2.50		SILT with trace of sand and gravel. "Very stiff"; wet; slightly plastic; gravel, as above; sand, fine to medium														No. 4 4, 5, 3, 3, 3, 3, 7, 8, 10, 11, 12, 11	
	3		2.80 m Slow seep from upslope side															
	3.20		3.20 m Steady inflow														No. 4 4, 5, 3, 3, 3, 3, 7, 8, 10, 11, 12, 11	
	3.35		3.35 m Silty GRAVEL/COBBLE. Saturated; gravel, subangular, as above															
	3.80		EOH @ 3.80 m															

RILEYAKL G.L.B. Log RILEY HA (AKL) NO MAP 180588 90 DIXONS ROAD SITE INVESTIGATIONS.GPJ <<DrawingFile>> 23/12/2019 15:52 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample ↓ Large Disturbed Sample ■ U100 Undisturbed Sample	▼ Scala Penetrometer - blows/50mm ◻ Permeability Test ▼ Schmidt Hammer ∨ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ↓ Water Strike (1st, 2nd ...) ↑ Water Rise (1st, 2nd ...) and ⏱ Rise Time (minutes)	GROUNDWATER ◻ None ◻ Slow Seep (depth 2.8 m) ◻ Rapid Inflow (depth) HOLE TERMINATED DUE TO: Machine Limit	Remarks 1. Coordinates and elevations based on hand held GPS and subject to survey confirmation. 2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
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All dimensions in metres Scale 1:34	Shear Vane No. GEO 105	Logged by: DL	Checked by: AvD
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**Appendix D: Listed Land Use Register
Property Statement**



Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry from our Listed Land Use Register (LLUR). The LLUR holds information about sites that have been used or are currently used for activities which have the potential to cause contamination.

The LLUR statement shows the land parcel(s) you enquired about and provides information regarding any potential LLUR sites within a specified radius.

Please note that if a property is not currently registered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR database is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; additional relevant information may be held in other files (for example consent and enforcement files).

Please contact Environment Canterbury if you wish to discuss the contents of this property statement.

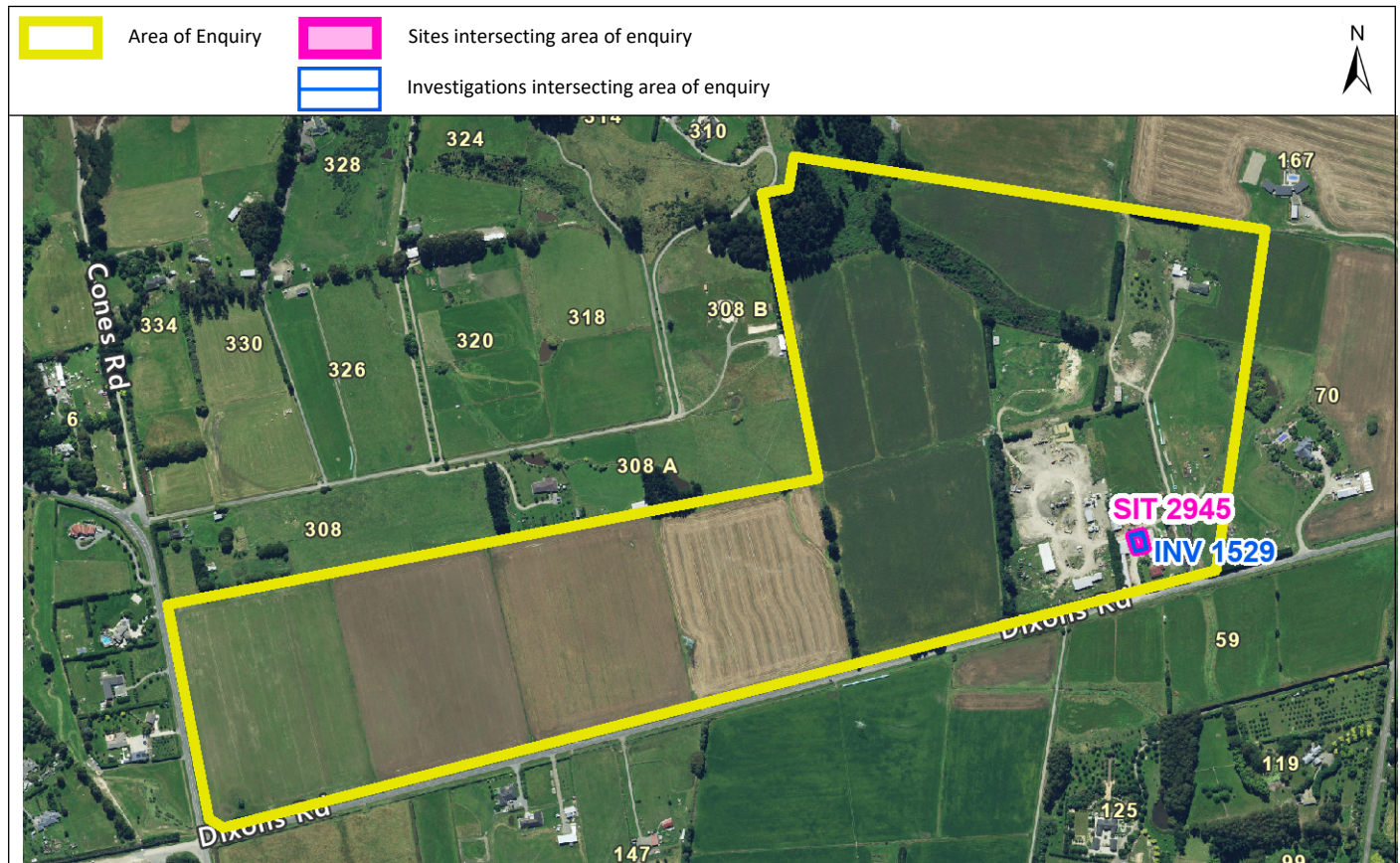
Yours sincerely

Contaminated Sites Team

Property Statement from the Listed Land Use Register

Visit ecan.govt.nz/HAIL for more information or contact Customer Services at ecan.govt.nz/contact/ and quote ENQ355271

Date generated: 26 September 2023
Land parcels: Lot 4 DP 80565



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Sites at a glance

 Sites within enquiry area

Site number	Name	Location	HAIL activity(s)	Category
2945	D R Robertson Agricultural Contractor	99 Dixons Road, Ashley	A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Partially Investigated

More detail about the sites

Site 2945: D R Robertson Agricultural Contractor (Intersects enquiry area.)

Category: Partially Investigated
Definition: Verified HAIL has been partially investigated.

Location: 99 Dixons Road, Ashley
Legal description(s): Lot 4 DP 80565

HAIL activity(s):

Period from	Period to	HAIL activity
1960s	current	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

1 Aug 2011

A 1,300 L petrol tank was removed from the agricultural site in September 2005. It is anticipated that the tank will be replaced with an above ground petrol tank. A 10,000 L diesel UST remains to the immediate south of the former petrol tank. The petrol tank was observed to be of a poor condition and was rusty with one hole. The presence of weathered diesel in the spoil removed from the petrol tank pit suggests that there may have been spills or leaks from the remaining tank or fill point.



Investigations:

INV 1529

Tank Removal Validation for DR Robertson, Ashley - September 2005

Montgomery Watson Harza - Detailed Site Investigation

12 Jan 2006

Summary of investigation(s):

A 1,300 L petrol tank was removed from the agricultural site in September 2005. It is anticipated that the tank will be replaced with an above ground petrol tank. A 10,000 L diesel UST remains to the immediate south of the former petrol tank.

The petrol tank was observed to be of a poor condition and was rusty with one hole. Spoil removed from the tank pit and site contained levels of TPH/BTEX above agricultural, residential, commercial and groundwater protection criteria. The chromatogram for the spoil sample showed a weathered petrol and diesel signature.

Ten soil samples were analysed for TPH and BTEX compounds. Two samples were also analysed for PAHs.

Two soil samples returned results that exceeded relevant Tier 1 guideline values in the Ministry for the Environment Hydrocarbons Guidelines (MfE 1999). Details were: Toluene and xylene exceeded the guideline value for protection of groundwater in sample T1E5. Benzene, toluene and xylene exceeded the guideline value for protection of groundwater in sample T1B1. Benzene in this sample also exceeded the guideline value for all pathways under an agricultural or residential land use and for indoor inhalation.

These results indicate that soil remaining in the eastern wall and base of the pit contained BTEX compounds above groundwater protection criteria. However, the MfE 1999 Tier 1 guideline values for protection of groundwater are based on a contaminated zone of 15m in length and 2m deep, and this conservative assumption may not be true on the basis of exceedances from two samples from such a small tank pit. Furthermore, Environment Canterbury's Well Card information indicates that the nearest four wells (M34/0195, M34/0193, M34/0224, M34/0212) are not used, making the nearest well 565m southeast of the tank. The risk to current groundwater users is therefore not considered to be significant.

The exceedances of the agricultural and residential land use acceptance value are considered to be acceptable given the lack of produce consumption associated with the area in which the tank is located. Likewise, with regard to the single exceedances of an indoor inhalation guideline value, the current distance of buildings from the tank means that the indoor inhalation pathway is currently incomplete. However, these matters are relevant to any future developments in the area of the tank.

The presence of weathered diesel in the spoil removed from the petrol tank pit suggests that there may have been spills or leaks from the remaining tank or fill point. It is recommended that the reconciliation data for the diesel tank be reviewed. If losses are noted an investigation should be undertaken.

Disclaimer

The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987.

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Listed Land Use Register

What you need to know



What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)¹. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

¹The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.



My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

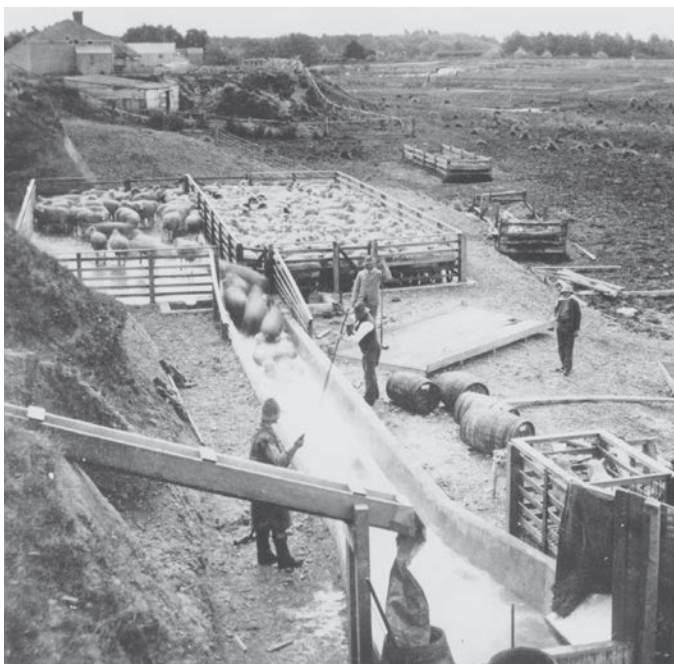
You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.



IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:

Calling from Christchurch: (03) 353 9007

Calling from any other area: 0800 EC INFO (32 4636)



Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz

E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz