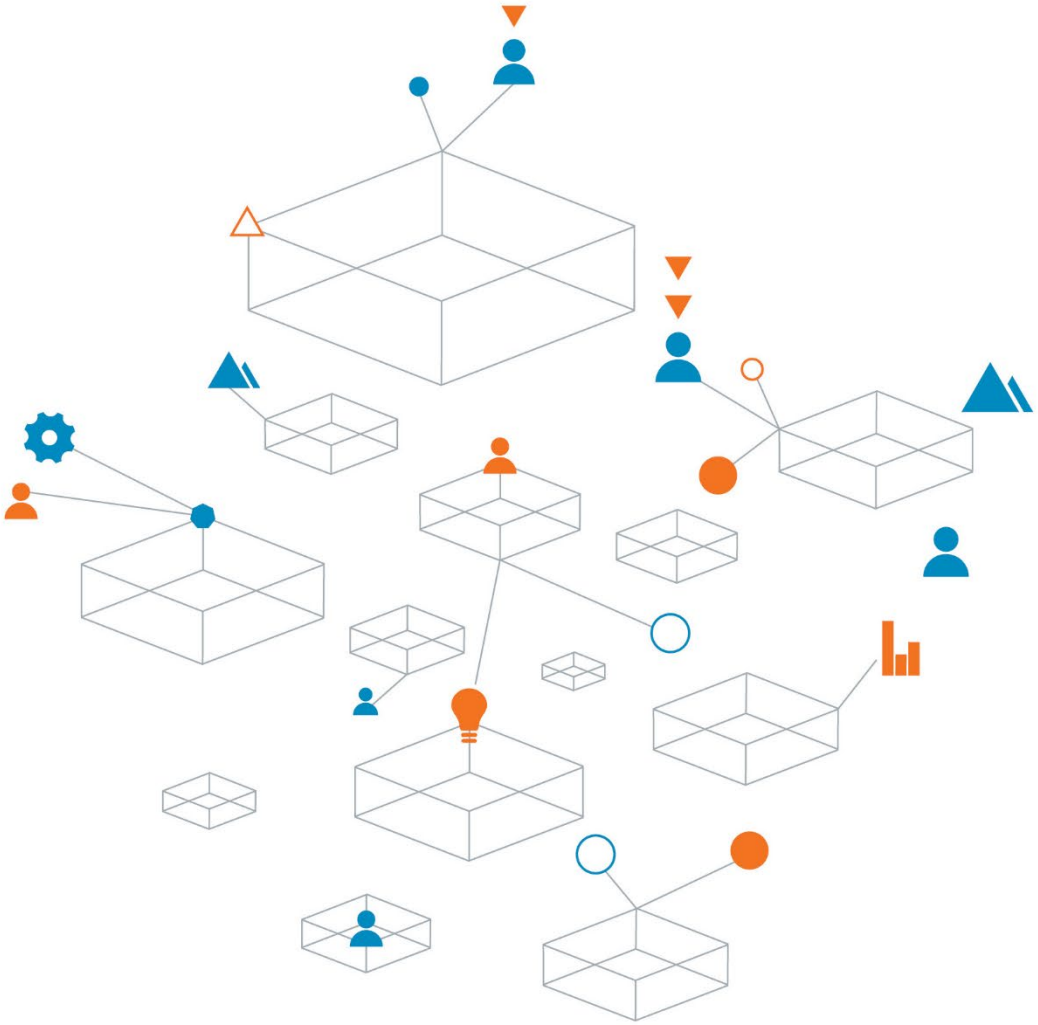
Appendix B

Geotechnical Assessment

coffey
A TETRA TECH COMPANY

Rolleston West Residential Ltd
Rolleston West Plan Change
773-CHCGE281253
Geotechnical Assessment Report

9 November 2020



Trust is the cornerstone of all our projects

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9 November 2020

Our ref: 773-CHCGE281253

Rolleston West Residential Ltd
ASB House, 166 Cashel Street
Christchurch Central

Attention: Tim Carter / Bruce Van Duyn

Executive Summary: Rolleston West – Geotechnical Assessment to support a Plan Change application

Rolleston West Residential Ltd has engaged Coffey Services (NZ) Limited to carry out a geotechnical investigation and assessment of suitability for the proposed Plan Change and future subdivision of the Holmes and Skellerup Blocks in Rolleston, Canterbury. The purpose of this report is to support a Plan Change application for the construction of approximately 2,100 new residential Lots at the site.

The site investigations and preliminary liquefaction assessment indicates that the site is TC1-like. Other geotechnical hazards (erosion, slippage and inundation) are considered low to very low risk with appropriate future engineering design.

Our assessment has considered the items required by Section 106 of the RMA and in our opinion the site is considered geotechnically suitable for Plan Change and future subdivision. Further investigations and design will need to be carried out at the subdivision consent stage.

If you have any queries, please contact the undersigned.

For and on behalf of Coffey

Chris Thompson
BSc (Tech)
Associate Engineering Geologist

Rolleston West Plan Change

Prepared for
Rolleston West Residential Ltd
ASB House, 166 Cashel Street
Christchurch Central

Prepared by
Coffey Services (NZ) Limited
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9 November 2020

773-CHCGE281253

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
V1	GAR	09/11/2020	CT	RB	CT
V0	GAR	05/11/2020	CT	RB	CT

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Final	1	PDF	Bruce Van Duyn – Rolleston West Residential	09/11/2020

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Appendices

1. Introduction

Rolleston West Residential Ltd has engaged Coffey Services (NZ) Limited to carry out a geotechnical investigation and assessment of suitability for a proposed Plan Change and future subdivision of the Holmes and Skellerup Blocks, referred to as the "site", in Rolleston, Canterbury. The purpose of this report is to support a Plan Change application for the construction of approximately 2,100 new residential Lots at the site.

Our assessment has considered the items required by Section 106 of the RMA. In our opinion the site is considered geotechnically suitable for subdivision subject to further investigation and design at the subdivision consent stage.

2. Scope

A scope of assessment work for the approximately 160 Ha total area of the site was developed and carried out by Coffey, as outlined below:

- Review of previous geotechnical investigations including previous work on the site and surrounding area.
- Site walkovers to assess geotechnical hazards.
- Assessment of the geotechnical hazards at the site per Section 106 of the RMA.
- Geotechnical analyses and reporting.

Coffey have considered the following in the preparation of this report:

- Existing geotechnical investigation data available from the New Zealand Geotechnical Database (NZGD).
- Project correspondence with the wider Plan Change consultants engaged by Rolleston West Residential Ltd.

Reference has also been made to the MBIE Guidance Part D: Subdivisions, to confirm that the requirements outlined in these documents have been incorporated in this report.

3. Proposed development

The proposed Plan Change area comprises four land parcels totalling approximately 160 Ha located to the west of Rolleston, bordering the existing township. The Plan Change area is split into two blocks; the Holmes Block, bordered by State Highway 1, Dunns Crossing Road and Burnham School Road and the Skellerup Block, which is located to the west of Dunns Crossing Road.

The Holmes Block has a gentle slope to the southeast. An existing water race is located in the northwestern corner of the site and the West Rolleston Primary School is located in the southeastern corner. The site was used for forestry until the mid 2000's when it was converted to cropland.

The Skellerup Block also has a gentle slope to the south/southeast with a water race located along the western boundary. The site was used for forestry until the mid 2000's when it was converted to cropland.

4. Site investigation

The location of the geotechnical investigations carried out on the site to develop the ground models are provided in Figure 1 (in Appendix A) and are summarised below. Investigation logs are presented in Appendix B.

Table 1: Holmes Hub Block existing investigation data

Reference	Depth of test (metres below ground level)	Termination criteria
TP H-1	1.5	Target depth
TP H-2	1.4	Target depth
TP H-3	1.4	Target depth

Table 2: Skellerup Block existing investigation data

Reference	Depth of test (metres below ground level)	Termination criteria
TP S-1	1.4	Target depth
TP S-2	1.5	Target depth
TP S-3	1.4	Target depth
TP_100580	2.1	Effective refusal

5. Site performance

5.1. Ground motion

The site is not in an area mapped for ground damage effects as part of the Canterbury Earthquake Sequence response. However, the nearby Rolleston School strong motion sensor recorded the following peak ground accelerations (PGA):

- 4 September 2010: 0.34g
- 22 February 2011: 0.18g
- Later 2011 earthquakes: <0.11g

Based on the above, we consider that the site was “sufficiently tested” to the serviceability limit state (SLS) level of earthquake demand during the 4 September 2010 earthquake of the Canterbury earthquake sequence (CES) using the MBIE[1] and Bradley & Hughes (2012)[2] procedures.

An assessment has been made regarding predicted earthquake-induced deformation that may occur in a design earthquake based on geological setting, site terrain, and the level of “test” previously experienced. It is considered that:

- An SLS earthquake event is likely to cause less damage to that experienced in the 4 September 2010 earthquake and to be similar to the February 2011 earthquake.

[1] Ministry of Business, Innovation and Employment (MBIE), December 2012: Repairing and rebuilding houses affected by the Canterbury earthquakes
[2] Bradley & Hughes (2012) Conditional Peak Ground Accelerations in the Canterbury Earthquakes for Conventional Liquefaction Assessment. Report for DBH (MBIE), April 2012.

- Under ultimate limit state (ULS) conditions, the nature of land and building damage is likely to be similar to that already experienced in the 4 September 2010 earthquake of the CES.

6. Ground model

6.1. Geology

The geological map[3] of the area indicates that the site is underlain by "Brownish-grey river alluvium (Q2a)."

6.2. Groundwater

Based on geotechnical investigations carried out for the nearby Stonebrook development, groundwater was encountered between 10.3m and 13.1mbgl. We consider these groundwater levels to be relatively consistent and representative of the general area.

6.3. Subsurface profile

A summary of the ground model for each block is provided below:

Table 3: Holmes Block ground profile

Description	Strength/ consistency	Thickness (m)	Depth to top of layer (mbgl)
Silt (topsoil)		0.2	0.0
Sandy Gravel, with minor silt lenses	Dense to very dense	>30	0.2

Table 4: Skellerup Block ground profile

Description	Strength/ consistency	Thickness (m)	Depth to top of layer (mbgl)
Silt (topsoil)		0.2 to 0.4	0.0
Sandy Gravel / gravelly Silt (grading to sandy Gravel)	Dense to very dense	>30	0.2 to 0.4

6.4. Site sub-soil class

In accordance with NZS1170.5, Section 3.1.3, a subsoil classification of "Class D – Deep or soft soil sites" can be assumed for the site.

[3] Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers) 2008: Geology of the Christchurch area: scale 1:250,000. Lower Hutt: GNS Science. Institute of Geological & Nuclear Sciences 1:250,000 geological map 16. 67 p. + 1 folded map

7. Geotechnical hazard assessment

7.1. Erosion

The site has relatively flat topography and is bounded by newly developed residential areas as well as grassed paddock land. Provided appropriate stormwater systems are installed as part of the development, there will be few viable sources of erosion at this site.

7.2. Falling debris

As there are no slopes or exposed hills or rock faces surrounding the site, there are no sources of falling debris at the site, or for the surrounding area.

7.3. Subsidence

7.3.1. Liquefaction induced settlement

Saturated, loose, uniform fine grained alluvial soils are subject to seismic (liquefaction-induced) settlement during a significant earthquake. Liquefaction typically affects saturated, loose granular soils ranging from sandy silts to sands, but seismic shaking can also result in strength losses in fine-grained, cohesive soils. Liquefaction does not occur in dense, well-graded alluvial gravel soils that are present at this site.

Due to the dense nature of the gravel encountered, and the depth to groundwater (expected to be below 10m bgl), liquefaction risk is considered to be negligible for this project.

7.3.2. Static settlement

Settlement is a crucial factor that can cause structure serviceability issues. Static load-induced settlement typically occurs in low-lying areas underlain by soft, compressible soils as a result of increased overburden loads. As the site is underlain by dense river gravels, static settlement is not deemed a hazard for the site provided any earthworks are carried out to the relevant standards.

7.4. Slippage

We have not observed any sources of land instability on the site and due to the flat site topography, we consider the risk of slope failure to be very low. The appropriate design of batter slopes near waterways will mitigate this risk further.

7.5. Inundation

In relation to stormwater inundation, we recommend that drainage design and management at the site be addressed by specialist consultants as it is beyond the scope of this report. We expect that with appropriate stormwater and flood control systems, the risk of inundation will be low.

8. Conclusions

We consider that the site is suitable for development subject to further investigation and design at the subdivision consent stage. Based on the mapped geology and on-site testing carried out to date, the site is considered TC1-like.

Additional geotechnical investigation will be required to refine the ground model and address any geotechnical risks for the proposed Lots once a subdivision plan has been further developed.

9. Limitations

This report has been prepared solely for the use of our client, Rolleston West Residential Ltd, their professional advisers and Selwyn District Council (SDC) in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity.

It is recommended that all other parties seek professional geotechnical advice to satisfy themselves as to its on-going suitability for their intended use.

As subsurface information has been obtained from discrete investigation locations, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred to us immediately.

Please also refer to the enclosed *Important Information about Your Coffey Report*.

10. Closure

If you have queries or require further clarification regarding aspects of this report, please contact the undersigned.

For and on behalf of Coffey

Prepared by

Chris Thompson
BSc (Tech)
Associate Engineering Geologist

Reviewed by

Richmond Beetham
BSc MSc Eng BE CMEngNZ CPEng PEngGeol
Principal Geotechnical Engineer

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

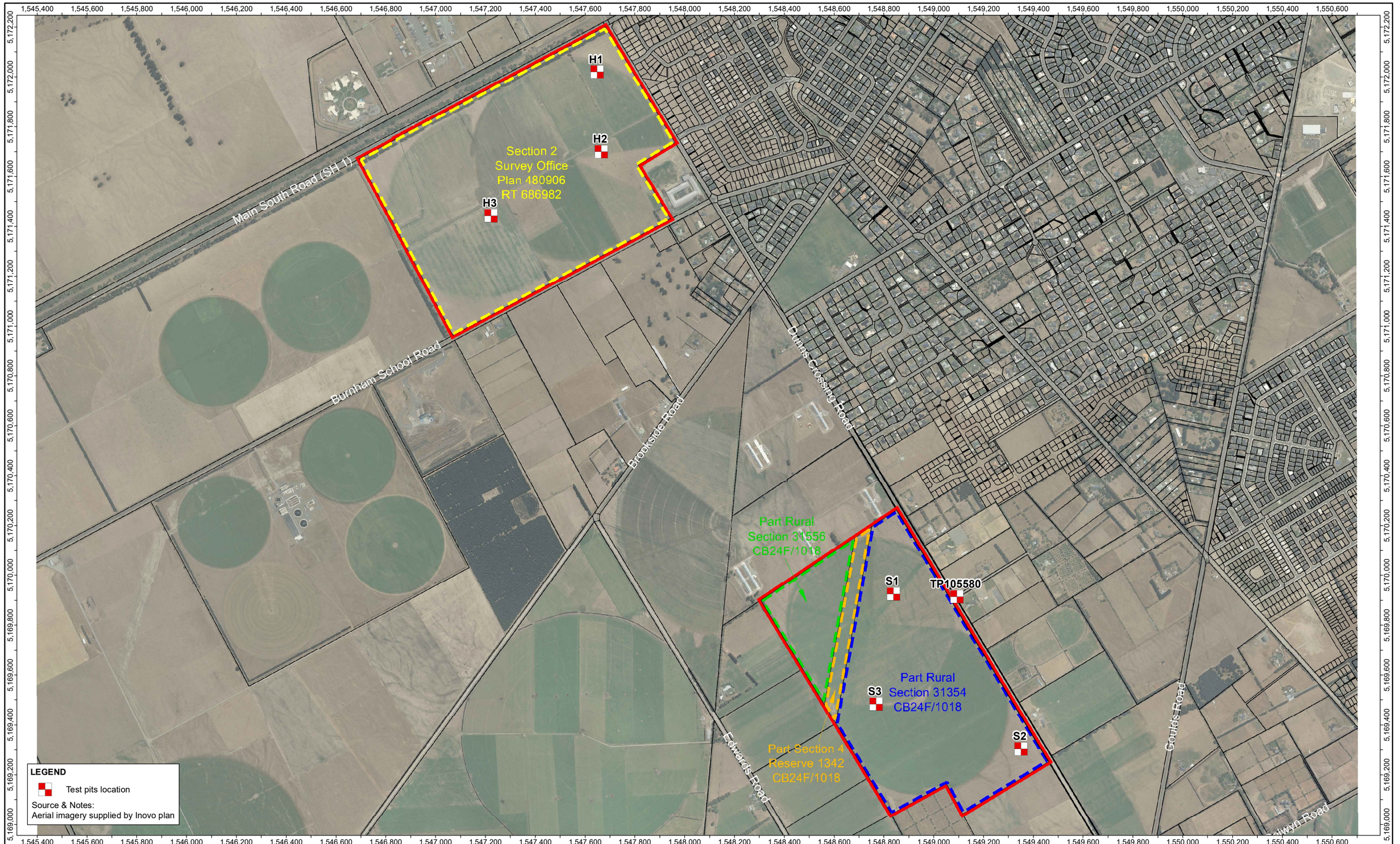
Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Appendix A - Site Plan



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RZ	CT	04.11.20

0 150 300 450 600
SCALE 1:14,000 (A3) METRES

Projection: NZGD 2000 New Zealand Transverse Mercator

drawn	RZ
approved	CT
date	04.11.2020
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client:	ROLLESTON WEST RESIDENTIAL LTD.
project:	ROLLESTON WEST PLAN CHANGE
title:	SITE INVESTIGATION PLAN
project no:	773-CHCGE281253
figure no:	01
rev:	A

MXD ref: 281253_01_GIS001_1

Appendix B - Test Pit logs

Open Excavation Log

Test Pit No. **TP H-1**

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1547696 , 5172033		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over sandy TOPSOIL, brown, moist.
	0 – 1.5		Sandy GRAVEL with cobbles and minor boulders. Mid brown, medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist.
	1.5		End of Test Pit at 1.5m (Target Depth)

Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0.5		
	1		
	1.5		
	2		
	2.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
2.2m

Open Excavation Log

Test Pit No. **TP H-2**

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1547734, 5171797		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over silty TOPSOIL, brown, moist.
	0.5		Sandy GRAVEL with cobbles and minor boulders. Mid brown, medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist.
	1		
	1.5		End of Test pit at 1.4m (Target depth)
	2		
	2.5		

Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		
	0.5		
	1		
	1.5		
	2		
	2.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
2.0m

Connell Wagner

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Open Excavation Log

Test Pit No. **TP H-3**

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1547283, 5171554		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over silty TOPSOIL, brown, moist.
	0.5		Sandy GRAVEL with cobbles and minor boulders. Mid brown, medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist.
	1		
	1.5		End of Test pit at 1.4m (Target depth)
	2		
	2.5		

Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		
	0.5		
	1		
	1.5		
	2		
	2.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
2.1m

Open Excavation Log

Test Pit No. **TP S-1**

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1548839, 5169926		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.	Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over silty TOPSOIL, brown, moist with large tree roots.		0		
	0.5		Gravelly SILT with cobbles and minor clay and boulders. Light brown, cohesive. Gravel is medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist. Large tree roots in the upper part.		0.5		
	1				1		
	1.5		End of Test pit at 1.4m (Target depth)		1.5		
	2				2		
	2.5				2.5		

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
2.0m

Open Excavation Log

Test Pit No. **TP S-2**

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand
Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1549448, 5169261		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150
Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over silty TOPSOIL, with large tree roots up to 60mm diameter, brown, moist.
	0.5		Gravelly SILT with boulders and minor clay. Light brown, cohesive. Gravel is medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist. Large tree roots in the upper part.
	1		
	1.5		End of Test pit at 1.5m (Target depth)
	2		
	2.5		

Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		
	0.5		
	1		
	1.5		
	2		
	2.5		

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
1.9m

Connell Wagner

Connell Wagner Limited
195 Hereford St. (PO Box 1061
Christchurch New Zealand

Telephone: +64 3 366 0821
Facsimile: +64 3 379 6955

Open Excavation Log

Test Pit No. **TP S-3**

Client: Selwyn Plantation Board Ltd	Location (measured using hand held GPS): 1548668, 5169475		Date: 12/09/2008
Project: SPBL Rolleston Plan Change	Logged By: CG	Weather Conditions: cloudy & dry	Job Number: 36951-001

Water	Depth (m)	Soil Symbol	FACE 1 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		Grass over silty TOPSOIL, with large tree roots up to 60mm diameter, brown, moist.
	0.5		Silty Sandy GRAVEL with minor cobbles yellowish brown, rounded, gap graded, near horizontal long-axis pebble alignment. Sand is angular. Moist. Large tree roots in the upper part.
	1		
	1.5		End of Test pit at 1.4m (Target depth)
	2		
	2.5		

Water	Depth (m)	Soil Symbol	FACE 2 — SOIL DESCRIPTION: Colour, structure, weathering, subordinate/ main / minor COMPONENTS.
	0		
	0.5		
	1		
	1.5		
	2		
	2.5		

Undrained Shear Strength (kPa) ●
Measured Using a Hand Held Shear Vane[1]
25 50 75 100 125 150

Scala Penetrometer Test[2] ×
(Blows/ 150mm)
2 4 6 8 10 12

Test Description
1 - Hand held shear vane test in accordance with BS1377:1990
2 - Scala Penetrometer Test in accordance with NZS4402:1986 for the first three meters

Notes
Groundwater not encountered
Soak test undertaken and reported separately

Pit dimensions
1.0m
2.0m

Soil&Rock Consultants
For well-grounded solutions

CLIENT: Myall & Thurlow Consultants Ltd

PROJECT: Geotechnical Investigation, Dunns Crossing Subdivision, Rolleston

Auger Hole No: TP15

Sheet 1 of 1

Drill Type:	6 Tonne Excavator	Project No:	C17231	Logged By:	MG
Drilled By:	R A Shearing Contractors Ltd	Coordinates:	1549094 E, 5169931 N	Reviewed By:	TK
Date Started:	12/10/17	Ground Elevation:	42m	Surface Conditions:	Near Level, Grass
Date Finished:	13/10/17	Water Level:	Groundwater not encountered	Shear Vane Number:	N/A

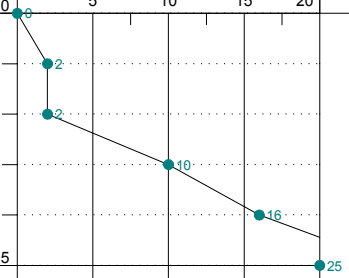
STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for Field Description of Soil and Rock in Engineering Use"
TOPSOIL	0.0		SILT, trace fine sand, dark brown. Very soft to soft, moist, non-plastic. (TOPSOIL)
ALLUVIAL DEPOSITS	0.5		Silty fine to coarse sub-rounded to rounded GRAVEL, light brownish grey. Dense to very dense, moist. (ALLUVIAL DEPOSITS)
	1.0		Fine to coarse sandy fine to coarse sub-rounded to rounded GRAVEL, brownish grey. Dense to very dense, moist to wet.
			Wet.
	1.5		Trace sub-rounded to rounded boulder.
	2.0		END OF BORE. 2.10 METRES. TOO DENSE TO EXCAVATE
	2.5		
	3.0		

WATER LEVEL (m)

DEPTH (m)

SCALA PENETROMETER TEST METHOD NZS4402: 1986 test 6.5.2

(Blows per 100mm Increment)



Comments

HAND AUGER WITH SCALA CHCH LOG C17231_TP01-TP20_12-11-2017_DRAFT.GPJ S+R_2012-AGS - REVISED.GDT 8/11/17

Unit 11, 114 Sawyers Arms Road, Christchurch 8542. Phone 03 352 4519

www.soilandrock.co.nz

NZGD ID: TP_100580

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25 January 2021

Our ref: 773-CHCGE281253

Rolleston West Residential Ltd
ASB House, 166 Cashel Street
Christchurch Central

Attention: Tim Carter / Bruce Van Duyn

Geotechnical Peer Review/RFI Response - Rolleston West Plan Change application

1. Peer review response

Rolleston West Residential Ltd has engaged Coffey Services (NZ) Limited to provide a response to the geotechnical peer review carried out as part of the current Plan Change submission. The peer review (carried out by Ian McCahon from Geotech Consulting) requests that Coffey provide comment on the continuity of the gravel layers across the separate Holmes and Skellerup blocks (the subdivision sites), the test density, and other items in relation to the Plan Change. Our comments are below.

1.1. Gravel continuity

Coffey has reviewed the Environment Canterbury (ECan) well logs in the vicinity of the sites. All logs reviewed indicate a minimum of 50m of gravel deposits beneath both sites. Two examples of the well logs are attached for reference; M36/8063 is located adjacent to Burnham School Road (on the southern boundary of the Holmes Block) and M36/8581 is located in the northern corner of the Skellerup Block. We conclude from the ECan borehole logs and from the investigation test pits that the dense gravels are continuous under the subdivision sites.

1.2. Test density

The subdivision sites are currently zoned rural residential (Living 3) and are proposed to be changed to a more intensive residential land use (Living Z). Test pit investigations on the sites (Coffey 2020 report) consistently show ~200mm of soil overlying dense, cobbly gravels. This is in agreement with the geological map (GNS Science), local knowledge and the ECan boreholes.

The previous Plan Change application for the subdivision of the sites in 2011 (PC8 and PC9), was for changing the sites from rural land to residential. This plan change assessed the sites as being geotechnically suitable for residential development. Therefore, in our professional judgement the MBIE testing density guide is not applicable to this plan change (PC73), as the land has already been assessed as geotechnically suitable for residential development.

The peer review (prepared by Geotech Consulting) for the previous 2011 Plan Change concluded the following:

- The near surface soils have suitable bearing capacity for houses
- Seismic liquefaction is extremely unlikely
- There are no known faults passing through the site
- The site is geotechnically suitable for residential development

We agree with these assessments. Geotechnical risk on the subdivision site is considered very low.

1.3. Site seismic performance

Section 5.1 in our 9 November 2020 geotechnical report indicated that the site was “sufficiently tested” by the 4 September 2010 earthquake.

In addition, we are not aware of any reports of ground damage within the plan change area of the Holmes and Skellerup Blocks.

Section 3 of the geotechnical assessment from 11 April 2011 by Geotech Consulting (Ian McCahon) addresses the site performance from both the 4 September 2010 and 22 February 2011 earthquakes. We agree with the Geotech Consulting report addressing the site performance.

There were no further earthquakes after the 11 April 2011 report that were considered significant enough to warrant reassessment of the sites’ seismic performance.

1.4. Practicality of construction

There are no known geotechnical issues for the sites that would impact on the practicality of constructing infrastructure or building foundations for the residential development of the sites.

2. Closure

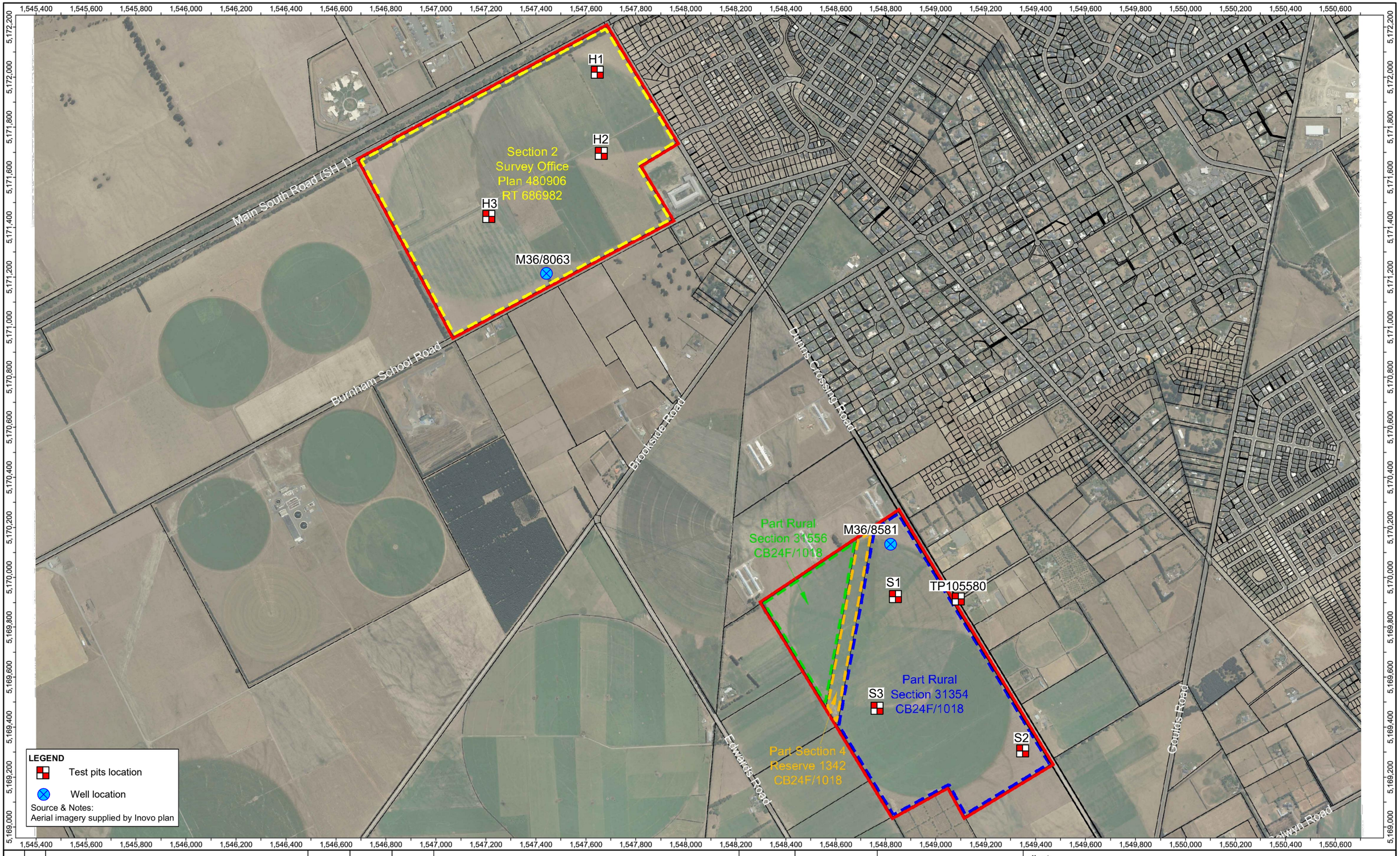
The current Plan Change Application from Living 3 to Living Z does not change the land use and further investigation testing is not deemed necessary until the subdivision consent phase. The sites are considered to be underlain by continuous deep gravels, to be low geotechnical risk and to be suitable for residential development.

If you have any queries, please contact the undersigned.

For and on behalf of Coffey

Chris Thompson
BSc (Tech)
Associate Engineering Geologist

Attachments: Site plan
M36/8063 log
M36/8581 log
11 April, 2011 – Geotech Consulting – PC8 (Holmes Block), PC9 (Skellerup Block) Geotechnical assessment by Ian McCahon



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RZ	CT	04.11.20

0 150 300 450 600
SCALE 1:14,000 (A3) METRES

Projection: NZGD 2000 New Zealand Transverse Mercator

drawn	RZ
approved	CT
date	04.11.2020
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client:	ROLLESTON WEST RESIDENTIAL LIMITED
project:	ROLLESTON WEST PLAN CHANGE
title:	SITE INVESTIGATION PLAN
project no:	773-CHCGE281253
figure no:	01
rev:	A

MXD ref: 281253_01_GIS001_1

Borelog for well M36/8063

Grid Reference (NZTM): 1547469 mE, 5171189 mN
Location Accuracy: 10 - 50m
Ground Level Altitude: 48.9 m +MSD Accuracy: < 0.5 m
Driller: McMillan Drilling Ltd
Drill Method: Rotary/Percussion
Borelog Depth: 97.8 m Drill Date: 11-Jan-2013

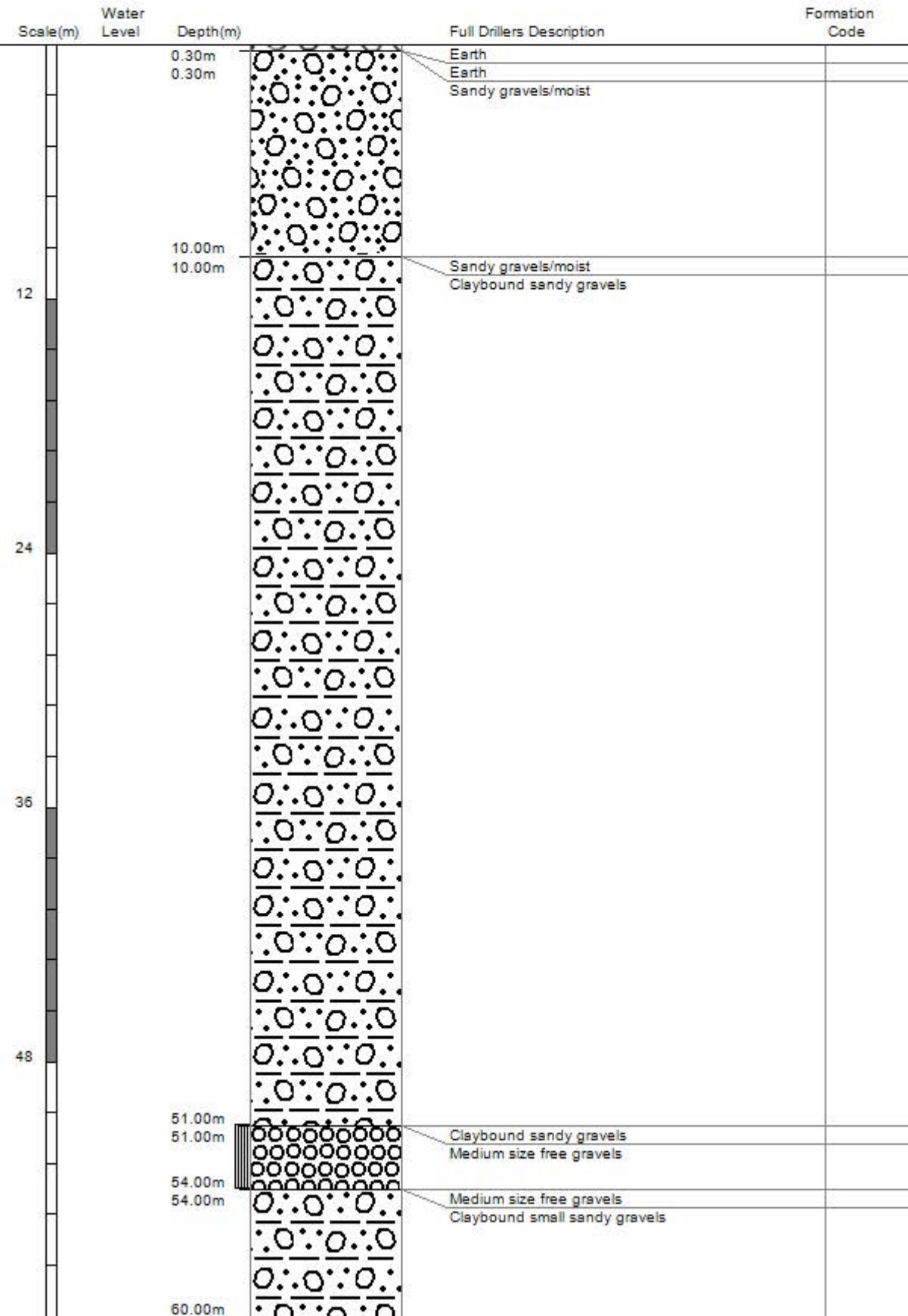
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.40m	EARTH	
		0.40m	EARTH	
			Sandy GRAVEL	
		4.00m		
		4.00m	Sandy GRAVEL	
5			Claybound GRAVEL with minor sand	
10	11.26			
15	13.53			
20				
25				
30				
35				
		36.00m		
		36.00m	Claybound GRAVEL with minor sand	
			Sandy med sorted free stained GRAVEL	
40				
		42.00m		
		42.00m	Sandy med sorted free stained GRAVEL	
45			Sandy med sorted free stained GRAVEL	
50		50.00m		
		50.00m	Sandy med sorted free stained GRAVEL	
		51.00m		
		51.00m	Yellow CLAY. Saturated (water-bearing).	
			Yellow CLAY. Saturated (water-bearing).	
55			Claybound GRAVEL, some sand	
		59.00m		
60		59.00m	Claybound GRAVEL, some sand	
			Coarse GRAVEL	
65				
		67.00m		
		67.00m	Coarse GRAVEL	
			Sandy med sorted freeish stained coarse GRAVEL	
70				
		72.00m		
		72.00m	Sandy med sorted freeish stained coarse GRAVEL	
75			Claybound GRAVEL some sand	
80				
		82.00m		
		82.00m	Claybound GRAVEL some sand	
			Sandy med sorted lightly stained GRAVEL	
85				
		86.00m		
		86.00m	Sandy med sorted lightly stained GRAVEL	
			Coarse GRAVEL	
90				
		91.00m		
		91.00m	Coarse GRAVEL	
			Sandy well/med sorted very free stained coarse GRAVEL	
95				
		97.85m		

Borelog for well M36/8581

Grid Reference (NZTM): 1548830 mE, 5170152 mN
Location Accuracy: 2 - 15m
Ground Level Altitude: 44.4 m +MSD Accuracy: < 0.5 m
Driller: McMillan Drilling Ltd
Drill Method: Unknown
Borelog Depth: 60.0 m Drill Date: 01-Apr-2008

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



3680
11 April 2011

GEOTECH
consulting ltd

Selwyn District Council
PO Box 90
Rolleston 7614

Attention: Craig Friedel

Dear Sir,

PC8 – Holmes Block
PC9 – Skellerup Block
Geotechnical assessment

1 Introduction

My name is Ian Ferrier McCahon. I hold a degree of Bachelor of engineering (Hons) from the University of Canterbury and am a Chartered professional Engineer. I have more than 35 years of experience in civil engineering with 20 years specialising in geotechnical and hazard identification and mitigation work. I have investigated many sites in Christchurch and elsewhere for liquefaction potential and mapped the liquefaction zones for the Christchurch Engineering Lifelines Study and for the Canterbury Region. Since the 2010 Canterbury earthquake I have been advising Selwyn district Council on the liquefaction hazard in the district and how best to approach the issue in both planning and building consent processes.

The Selwyn District Council has asked for a brief statement on the geotechnical aspects of thse two private plan change requests seeking rezoning of rural land to rural residential densities. Both sites are on Dunns Crossing Road, on the western periphery of Rolleston.

A geotechnical investigation has been carried out on the sites by Connell Wagner – Geotechical Investigation report, proposed plan change at Rolleston, Selwyn Plantation Board Ltd, 25 September 2008.

This assessment is based on the contents of the CW report, information on the fault rupture and liquefaction from the 2010 Canterbury earthquake, and the application of personal experience and knowledge of the area. No specific site inspection has been made

2 Sites

PC8 Holmes block is an area of 92 ha, adjoining SH1 on the north side. PC9 Skellerup Block is 73 ha, 1.5 km to the south of Holmes block. Both sites are flat.

The shallow test pits reported by Connell Wagner confirm that the sites are underlain with predominantly gravel alluvium of the Canterbury plains, virtually to the surface with only 0.1 – 0.2m of topsoil over the gravel. The water table is likely to be 10 – 15m depth.

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Ian McCahon **E-mail** mccahon@geotech.co.nz

Tel (03) 9822 538
Fax (03) 3257 555
PO Box 130 122
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Christchurch 8141 New Zealand

3 Recent Earthquakes

The sites were strongly shaken by the M7.1 Canterbury earthquake of 4 September 2010. The Holmes Block is about 15km south east of the earthquake epicenter, and the Skellerup Block 17km. Distances from the surface trace of the Greendale fault are about 3 and 5km respectively. Peak ground accelerations recorded at Rolleston were 0.39g; an acceleration with return period of about 1,500 years.

I am not aware of any reports of ground damage in this area, beyond the ground rupture and deformation along and immediately adjacent to the Greendale fault. The closest confirmed liquefaction is over 11km away beyond Lincoln. With the low water table in the area, any lenses of liquefiable sand that may exist are at considerable depth and effects at the ground surface would be minimal. There is a very low risk of liquefaction.

There was little reported structural damage to buildings in Rolleston, despite the strong shaking. Provided that new houses on the sites are built to current codes, there is no reason why they would not also perform satisfactorily in future earthquakes.

The large aftershock of 22 Februaruy2001 (Christchurch earthquake) caused extensive ground and building damage in east and central Christchurch, because of the proximity of these areas to the epicenter and the particular geology underlying the city. The distance of these sites from the earthquake and the much firmer gravel soils under the sites meant that the shaking was much lower at Rolleston than in Christchurch, and for the September 2010 event. Peak ground accelerations recorded at Templeton and Lincoln in February 2011 were 0.16g compared with 0.9g in September 2010. There are no reports of any ground damage in the Rolleston area from the February earthquake.

Seismologists are suggesting that the Canterbury area is probably entering a period of enhanced seismic risk because of the recent earthquakes and the resulting strain redistribution in the bedrock. Geologists are also conducting research on other fault lines buried under the Canterbury Plains and have already identified two possible fat lines in the Christchurch – Lincoln area. This research does not materially affect the overall likelihood of earthquakes in the region, as a background seismicity was built into the previous seismic hazard model; it is just identifying in more detail where the earthquakes could occur. Because of the denser soils under Rolleston, the locality remains less susceptible to ground damage than much of the urban area of Christchurch.

4 Conclusion

The sites are underlain with shallow gravel soils which provide good foundation conditions for residential buildings. The Greendale is far enough away not to be any direct hazard. There is a very low risk of any liquefaction.

- The near surface soils have suitable bearing capacity for houses
- Seismic liquefaction is extremely unlikely
- There are no known faults passing through the site
- The site is geotechnically suitable for residential development

Yours faithfully
Geotech Consulting Limited

Ian McCahon

Disclaimer. This report has been prepared solely for the benefit of the Selwyn District Council. No liability is accepted by this Company or any employee or sub-consultant of this company with respect to its use by any other person. This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fufill a legal requirement

References

These papers are all recently published in the Bulletin of the NZ Society for Earthquake Engineering, Vol 43, No. 4, December 2010:

Gledhill et al:	*The Darfield Earthquake of September 2010: Preliminary Seismological Report*
Cousins & McVerry	*Overview of Strong Motion Data from the Darfield Earthquake*
Beavan et al	*The Darfield Earthquake: Geodetic Observations and Preliminary Source Model*
Quigley et al:	*Surface Rupture of the Greendale Fault during the Darfield earthquake: initial findings*
Allen et al	*Geotechnical Reconnaissance of the 2010 Darfield earthquake*