



Executive Summary

Westpark Rangiora Ltd is seeking a plan change to rezone a block of land at 100 Oxford Road and 198 Lehman's Rd in Rangiora from Rural to Residential 2 (see Figure 1). The site comprises two land parcels, both with the legal description of Pt RS 1175 and with a total area of approximately 15ha.

Aurecon New Zealand Ltd. (Aurecon) has been engaged to provide engineering services for the plan change, part of which is to carry out a geotechnical investigation. The purpose of the geotechnical investigations was to identify any geotechnical issues with the land, including addressing potential liquefaction risk or geological hazards and any remediation options that may be required as part of the development. This report will be used to support the plan change application.

The geotechnical investigation included a review of readily available geological and geotechnical information for the site, the excavation of eight exploratory test pits and drilling one geotechnical borehole. The number and depth of investigations is compliant with recommendations in the MBIE Guidelines for a plan change.

The geotechnical investigation identified that the site is typically underlain by 0.45m to 2.7m of silty/sandy material underlain by gravel. Groundwater was not encountered in any of the test pits, and was encountered in the borehole at 7m depth. As such, the site is assessed to have a low susceptibility to seismically induced liquefaction. This assessment is supported by the lack of observed ground damage following recent earthquakes in the Canterbury region.

Due to parts of the site being directly underlain by fine grained soils, there exists the potential for erosion and rilling of the sandy/silty soils if vegetation cover is removed for prolonged periods of time from both stormwater runoff if it is not discharged in a controlled manner, and from the wind. This susceptibility to erosion of the silty soils can be minimised by using appropriate industry standard design measures during construction. Due to the subsoil profile, and provided appropriate civil engineering design for stormwater control is implemented, the site has low potential for "subsidence", "and "inundation." The proposed rezoning of the land for residential development is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structures and therefore meets the requirements of Section 106 of the Resource Management Act (RMA, 1991)

As part of the site development, in particular during the subdivision consenting process it is recommended that additional geotechnical investigation is carried out to further quantify geotechnical parameters of the site.

Our limitations are given in Section 6 of this report. This report shall be read as a whole.



1. Introduction

Westpark Rangiora Ltd is seeking a plan change to rezone a block of land in Rangiora from Rural to Residential 2 (See Figure 1, Appendix A). The site has a legal description of Pt RS 1175 and has an area of approximately 15ha.

Aurecon has been engaged to provide engineering services for the plan change, part of which is to carry out a geotechnical investigation. The purpose of the geotechnical investigations described in this report is to identify any geotechnical issues with the land, including addressing potential liquefaction risk or geological hazards, and identifying any remediation options that may be required as part of the development. This report will be used to support the plan change application.

The investigation comprised the following scope of works:

- A detailed desktop study based on readily available geological and geotechnical information for the site.
- A site walkover and reconnaissance survey to assess any site specific hazards from a geotechnical perspective.
- Excavation of eight test pits to provide information on surficial soils and the groundwater level.
- Drilling one geotechnical borehole to a nominal depth of 15m depth to provide information on deep soils, with installation of a piezometer so groundwater can be monitored.
- The identification of any geotechnical issues with the site and the provision of recommendations for the development of the site.
- Assessment of the site for compliance with Section 106 of the RMA (1991).
- The preparation of this geotechnical report presenting the results of our investigation and commenting on the suitability of the site for residential development from a geotechnical perspective.

The conditions of our engagement and limitations are set out in our fee proposal dated 26 February 2014. Authorisation to proceed was given by Paul McGowan on behalf of Westpark Rangiora Limited via email on 27 February 2014.

Our limitations are given in Section 6 of this report. This report shall be read as a whole.



2. Site Conditions

2.1 Site Description

The site is located approximately 1km west of Rangiora township, North Canterbury, on the corner of Lehmans and Oxford Road (See Figure 1 in Appendix A). It is proposed to rezone the area for residential development and is a priority rezoning area, according to the Land Use Recovery Plan (LURP) from Canterbury Earthquake Recovery Authority.

The following is a brief overview of the site (total area investigated):

- The site has a legal description of Pt RS 1175.
- The northern side of the site is approximately 190m long and the western side is approximately 800m long. The total area of the site is approximately 15ha.
- The site is predominantly flat.
- The site is predominantly grassed fields, with a small farm shop and two residential properties in the southern section of the site.

2.2 Site Access

There are multiple access ways to the site, both from Lehmans Rd and Oxford Road.

2.3 Vegetation

The majority of the site is grassed and divided into paddocks. There are mature trees along fence lines and the site boundaries.

2.4 Surface Water

There is a water race near the southern site boundary which runs year round.

2.5 Regional Geology

The regional geology of the site is described in the 1:250,000 scale geological map – ‘Geology of Christchurch,’ published in 2008 by the Institute of Geological and Nuclear Sciences. The geological map indicates that the site is underlain by river deposits comprising “*Brownish-grey river alluvium* (Q2a).

The GNS Active Fault System database (GNS, 2011a & GNS, 2011b) indicates that the site is located approximately:

- 40km northeast of the epicentre of the Magnitude 7.1 Darfield (Canterbury) Earthquake of 4 September 2010.
- 31km north of the epicentre of the Magnitude 6.3 Christchurch Earthquake of 22 February 2011.
- 30km northwest of the epicentre of the Magnitude 6.0 Christchurch aftershock of 13 June 2011.
- 28km northwest of the epicentre of the Magnitude 6.0 Christchurch aftershock of 23 December 2011.

2.6 Land Classification

According to the MBIE Technical Category land zoning map, the site is classified N/A – Rural & Unmapped due to low population density and distance from Christchurch.

2.7 Environment Canterbury Borehole Logs

A review of the Environment Canterbury GIS System (ECan, 2013) was undertaken to identify borehole data within the vicinity of the site. There are numerous boreholes located within site or within 200m of the area investigated, but many did not have logs available to view. The boreholes indicate that the site is underlain by 'earth' and 'brown clay', with gravels starting at 1.6m – 2.1m and extending down to 18.7m. The ECan boreholes logs are summarised in Table 1 below. The borehole locations are shown in **Figure 3** and the logs are attached in **Appendix A**.

Table 1 ECan Borehole Log Summary

Hole No.	Distance from Site	Depth	Summary
M35/2905	On site	13.95m	'Earth' to 0.5m, clay to 1.6m, and gravels to termination depth at 13.5m below ground level. Groundwater calculated to be at minimum 6.0m below ground level.
M35/9560	20m west of the site	18.7m	'Earth' to 0.4m, clay to 2.1m, and gravels to termination depth at 13.5m below ground level. Groundwater calculated to be at minimum 6.2m below ground level.

2.8 Flooding

The site is included in the Waimakariri District Council South Ashley Full-Catchment Model, which gives a maximum projected water level, and a hazard rating of low, medium or high for a 200 year flood. It has also been modelled in the Ashely River Floodplain Investigation, for a 200 year flood. The models indicate that the majority of the site is likely to be unaffected but there are sections which are low risk, with 0.1m – 0.25m maximum water level. The watercourse that runs between east to west between the two land parcels is modelled to have a maximum water level of 0.5m - 0.75m, and is medium risk. Provided that the storm water discharge is appropriately managed, the risk of inundation should not be exacerbated by developing the land. The outputs from the flood models are included in **Appendix C**.

3. Geotechnical Investigation

3.1 General

It is proposed to rezone via the plan change, approximately 15ha of land from Rural to Residential 2. As part of the plan change application, a geotechnical engineering assessment is required to assess the geotechnical suitability of the land for development. The objective of the geotechnical investigation was to assess the ground and groundwater conditions across the site and to identify any geotechnical issues that may affect future residential development.

The investigation was undertaken in general accordance with the MBIE (2012) Guidelines which require 0.2 to 0.5 investigation points per hectare or to three to eight test points across the 15ha site.

The geotechnical investigation comprised the following:

- A site walkover to assess the geotechnical hazards and to assist in locating the test pits.
- Excavation of eight test pits (designated TP1 to TP 8) to confirm the depth to gravel. Adjacent to each test pit a dynamic cone penetrometer test (designated DCP 1 to 8) was undertaken to obtain density information of the granular soils.
- Drilling one borehole (BH1) to a nominal depth of 15m to provide information on ground conditions at depth, and to allow the installation of a groundwater monitoring standpipe.

The logging of the test pits and boreholes was undertaken in accordance with NZ Geotechnical Society's "Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes: 2005". The coordinates of the exploratory holes were determined using the CERA Public Viewer, and are approximate only.

3.2 Site Walkover

Based on our site walkover the following was noted:

- No evidence of surface expression of liquefaction such as sand boils was apparent during the site walkover carried out as part of this investigation but the site walkover was carried out a significant period of time after the large seismic events. There was no apparent residual evidence, such as degraded sand boils or distinct mounds covered in recent grass growth that would indicate the former presence of sand boils.
- Other evidence of ground damage such as ground cracking or lateral spreading was not apparent at the site.

3.3 Test Pits

Eight test pits were excavated in March 2014 using a 14 tonne tracked excavator, to approximately 4.0m depth. The test pits were excavated across the site to determine the shallow subsurface conditions and to confirm the depth to gravel. They were carried out to give good coverage across the site where access was possible. The locations of the test pits are shown in **Figure 3**.

Attention was paid during the site works to recording areas of fill and any water-bearing strata and an assessment was made of the side wall stability of the pits. The test pits were backfilled with arisings following completion of logging.

The test pits encountered silty topsoil with thicknesses in the range of 0.3m to 0.4m underlain by interbedded silty and sandy soils. Gravel was then encountered in all test pits between 1.6m – 2.1m and continued to the termination depth in each pit.

All the test pits remained stable with selected pits remaining open for up to two hours. It should be noted that as the backfill materials were not compacted some long-term settlement is possible.

The test pit logs along with an explanatory sheet outlining the terms and descriptions used in the logs are attached in **Appendix C**.

3.4 Geotechnical Borehole

One sonic borehole was drilled from ground level by ProDrill in September 2013 under the supervision of an Aurecon Engineer to investigate the deeper subsurface conditions. The location of the borehole is shown on **Figure 3**.

The borehole was carried out to 15.0m depth and with Standard Penetration Tests (SPTs) at 1.5m intervals. The SPT 'N' values indicate that the gravel underlying the site is medium dense to very dense. The uncorrected 'N' values are included on the borehole logs. Some tests were terminated after only partial penetration of the SPT sampler due to effective refusal.

The borehole logs indicate that the site is underlain by sand and some silt underlain by sandy gravel to the depths investigated (15.0m depth). Groundwater was encountered at 7.1m below ground level. The borehole logs are attached in **Appendix C**.

3.5 Instrumentation

A PVC slotted and plain section standpipe was installed at 10m bgl to monitor groundwater level. A pea gravel filter was used to form a response zone and the top of the installation was sealed with bentonite pellets. The installation was secured at the surface with a standup cover set in concrete. The standpipe installation details are shown on the borehole log.

3.6 DCPs

The eight DCPs were carried out adjacent to each test pit, to provide bearing capacity information. The DCPs terminated at between 1.6m - 2.5m. Copies of the DCP logs are included in **Appendix C**.

3.7 Generalised Subsoil Profile

The generalised soil profile from the test pit and borehole logs is presented in Table 2 below.

Table 2 - Generalised soil profile on site

From	To	Description
Surface	0.3m – 0.4m	Topsoil – SILT; some sand, rootlets; dark brown. Moist; sand, fine.
0.3m – 0.4m	1.6m – 2.1m	Sandy SILT; light brown. Moist, low plasticity; sand, fine.
1.6m – 2.1m	15.0+	Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to subangular, well graded; sand, fine to coarse.



3.8 Groundwater

Groundwater was not encountered in the test pits. TP 4 was left open for two hours but no water seeped in during this time. Groundwater was encountered in borehole BH1 at 7.1m below ground level on 14 March 2014 and at 7.0m on 21 March 2014. It should be noted that groundwater levels are transient in nature and can show quite significant seasonal variations. The potential for changes in water levels should be considered in design.

4. Engineering Consideration

4.1 General

As part of the plan change application a geotechnical engineering assessment has been undertaken to quantify the underlying ground conditions and identify any potential geotechnical hazards that may affect the proposed residential rezoning and eventual development.

This section of the report outlines details of our assessment of potential geotechnical hazards at the site, makes recommendations for potential site development, and assesses the site against the requirements of Section 106 of the RMA (1991).

4.2 Liquefaction

Under cyclic loading (i.e. during an earthquake) loose non-cohesive materials (gravels, sands, silty-sands) tend to decrease in volume. This tendency to decrease in volume is much greater in loose than in dense soils. When loose non-cohesive soils are saturated and rapid loading occurs under undrained conditions, the soil densification causes pore water pressure to increase. The increase in pore water pressure results in a loss of soil strength due to a decrease in effective stress and once the effective stress drops to zero liquefaction occurs. Liquefaction can lead to large displacements of foundations, flow failures of slopes, ground surface settlement, sand boils, and post-earthquake stability failures.

For the site subdivision and residential development the main factors to be considered are:

- Will liquefaction occur?
- What level of liquefaction is expected to occur in the future?
- What options are available to limit or prevent the effects of liquefaction?

Each of these is considered below.

4.2.1 Liquefaction Potential

Soil Grading and Density

Liquefiable soils generally have a Coefficient of Uniformity of less than 5 and a low proportion of soil finer than 75 microns in size (typically less than 5% to 10% but up to 30%). The test pits are logged as showing silty and sandy material, underlain by gravel. As such, the sandy soils to depths of 0.4m to 1.6m bgl at the site are potentially susceptible to liquefaction from a grading and density perspective.

Groundwater

Groundwater was not encountered in the test pits and is expected at depths greater than 7m. From saturation perspective soils between the surface and 7m depth are therefore not susceptible to liquefaction.

Earthquake Intensity and Soil Resistance to Liquefaction

The recent earthquake activity in the Canterbury Region includes over 10,000 individual shaking events. These were all of varying magnitudes (a measure of the energy released in the earthquake), centred around different locations and the energy released at different depths below the ground surface. The four most damaging seismic events were the Darfield Earthquake on 4 September 2010, the Christchurch Earthquake on 22 February 2011 and the aftershocks recorded on 13 June and 23 December 2011.

The levels of shaking recorded by a strong motion seismograph located in Ashley School, approximately 3.7km north east of the site are shown in Table 3, and are expressed as Peak Ground Accelerations (PGA). For comparison with the predicted levels of shaking expected in the future, the PGA values have been adjusted for an equivalent Moment Magnitude (M_w) 7.5 earthquake event based on the method of Idriss and Boulanger.

Table 3 - Earthquake Accelerations and Magnitudes

Earthquake	PGA	Moment Magnitude M_w	Equivalent PGA for M_w 7.5 Event
4 September 2010	0.15g	M_w 7.1	0.13g
22 February 2011	0.08g	M_w 6.2	0.06g
13 June 2011	0.05g	M_w 6.0	0.03g
23 December 2011	0.01g	M_w 5.9	0.01g
SLS Design Earthquake	0.13g	M_w 7.5	0.13g
ULS Design Earthquake	0.35g	M_w 7.5	0.35g

Based on equivalent PGA values in Table 3, the site has experienced one ground shaking event equivalent to than a SLS event, but has not been tested under an equivalent ULS event. Note that the recent earthquakes were of relatively short duration. A SLS level event caused by a large but distant earthquake, such as an Alpine Fault event, could cause significantly more damage than recent earthquakes with SLS level PGAs as it could be much longer duration with more load cycles.

As such at this stage we infer the site to have a low susceptibility to seismically induced liquefaction and therefore, no further liquefaction analysis has been undertaken at this stage.

4.3 Assessment Against the RMA

Section 106 of the Resource Management Act (RMA) states *inter alia*

1. ... "a consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that:
 - a) *the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
 - b) *any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
 - c) *sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision."*

Our assessment of the site against the requirements of Section 106 is presented in Table 4 below.

Table 4 - Assessment of the Site against the RMA

Hazard	Potential Susceptibility	
	Current (Section 106 1a)	Post Development (Section 106 1b)
Falling Debris	The site is essentially flat with small undulations so there is no risk of falling debris.	
Slippage	The site is essentially flat so there is no risk of slippage.	
Erosion	No erosion observed on site.	Silty soils have the potential to erode if topsoil is removed and the underlying soil is left unprotected.
Subsidence	The nature of the soil on site means the risk of subsidence is very low.	Low risk, provided building foundations are properly designed to ensure soils are not overloaded.
Inundation	The risk of inundation on the site is low. However, a full flood risk assessment is outside the scope of this report.	Provided that the storm water discharge is appropriately managed, the risk of inundation should not be exacerbated by developing the land.

In summary, the site is not at risk from falling debris, slippage, erosion, subsidence or inundation and therefore from a geotechnical perspective, the site complies with the requirements of Clause 106 (a).

Provided the appropriate engineering design measures are implemented, the man-made and natural hazards on the site resulting from the earthworks or general development are unlikely to accelerate, worsen, or result in further damage to the land and therefore the proposed development will comply with the requirements of Clause 106 1(b).

Section 106 (c) is not relevant to geotechnical appraisal and therefore has not been considered in this report.

Under Section 106 1 of the RMA, there are no geotechnical reasons to suggest that the site is unsuitable for development provided all necessary engineering design measures are implemented.



5. References

ECan, (2008). *Waimakariri District Flood Hazard Management Strategy, Ashley River Floodplain Investigation*. Christchurch, New Zealand. Environment Canterbury. ISBN 978-1-86937-804-2

ECan GIS, (2013). <http://arcims.ecan.govt.nz/ecanmapping/>

Forsyth, P.J., Barrell, D.J.A., Jongens, R. (2008) (compilers), *Geology of the Christchurch Area*, Institute of Geological and Nuclear Sciences 1:250 000 geological map 16. 1 sheet. Lower Hutt, New Zealand. GNS Science. ISBN 987-0-478-19649-8

MBIE (2012), Ministry of Business, Innovation and Employment *Repairing and rebuilding houses affected by the Canterbury earthquakes* – Version 3 dated December 2012

NZS1170.5:2004. Australia/New Zealand Standard, Structural Design Actions, Part 5: Earthquake Actions – New Zealand. Standards New Zealand, Wellington, New Zealand.

NZS 3604:2011. New Zealand Standard, Timber Framed Buildings. Standards New Zealand, Wellington, New Zealand.

NZS 4431:1989. Code of Practice for Earth Fill for Residential Development. Standards New Zealand, Wellington, New Zealand

NZGS, (2005). *Guidelines for the Classification and Field Description of Soils and Rocks in Engineering*. NZ Geotechnical Society Inc, Wellington, New Zealand.

Resource Management Act 1991 (RMA), Section 106.



6. Limitations

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

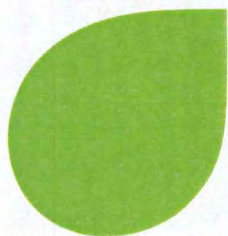
The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the assumed model.

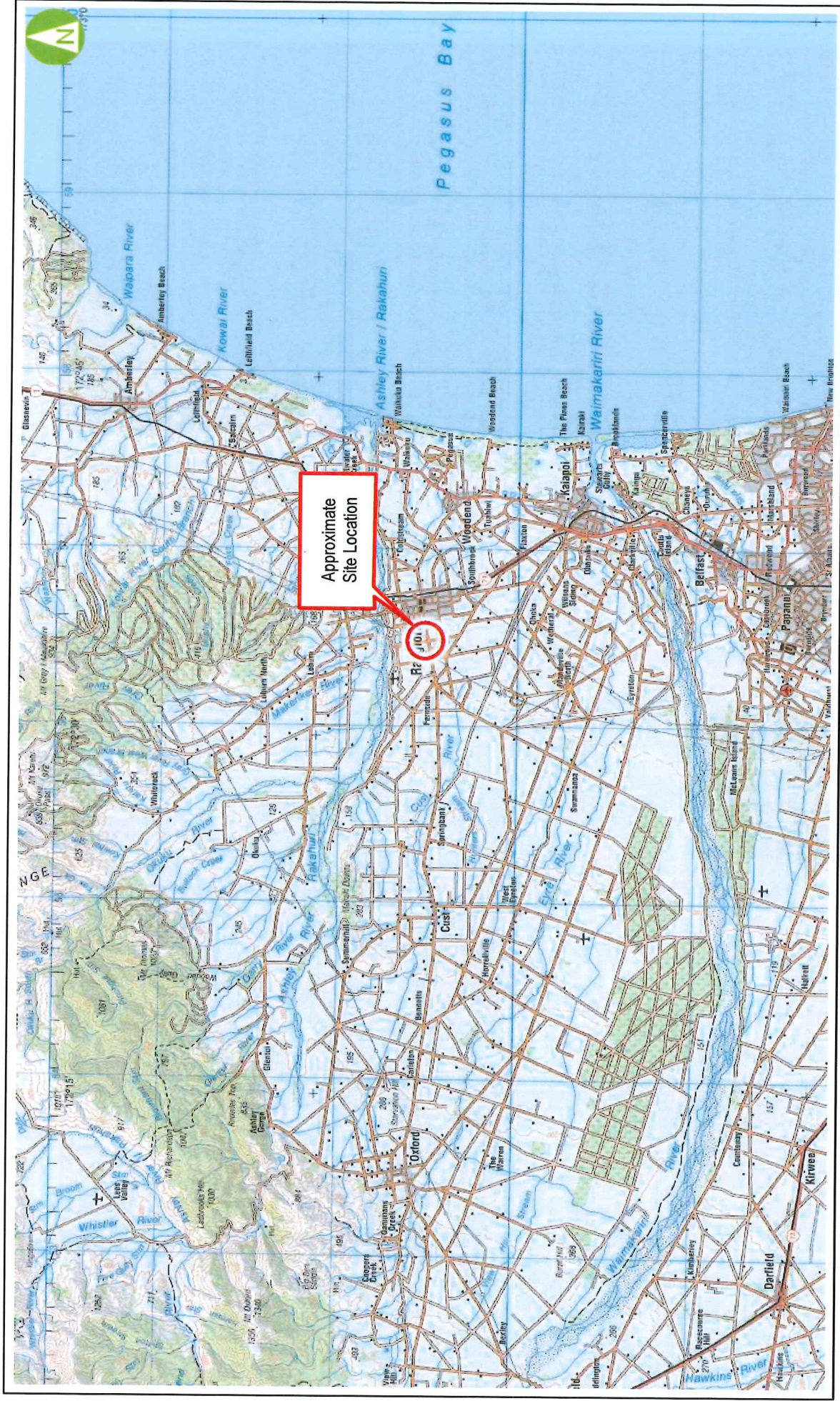
Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

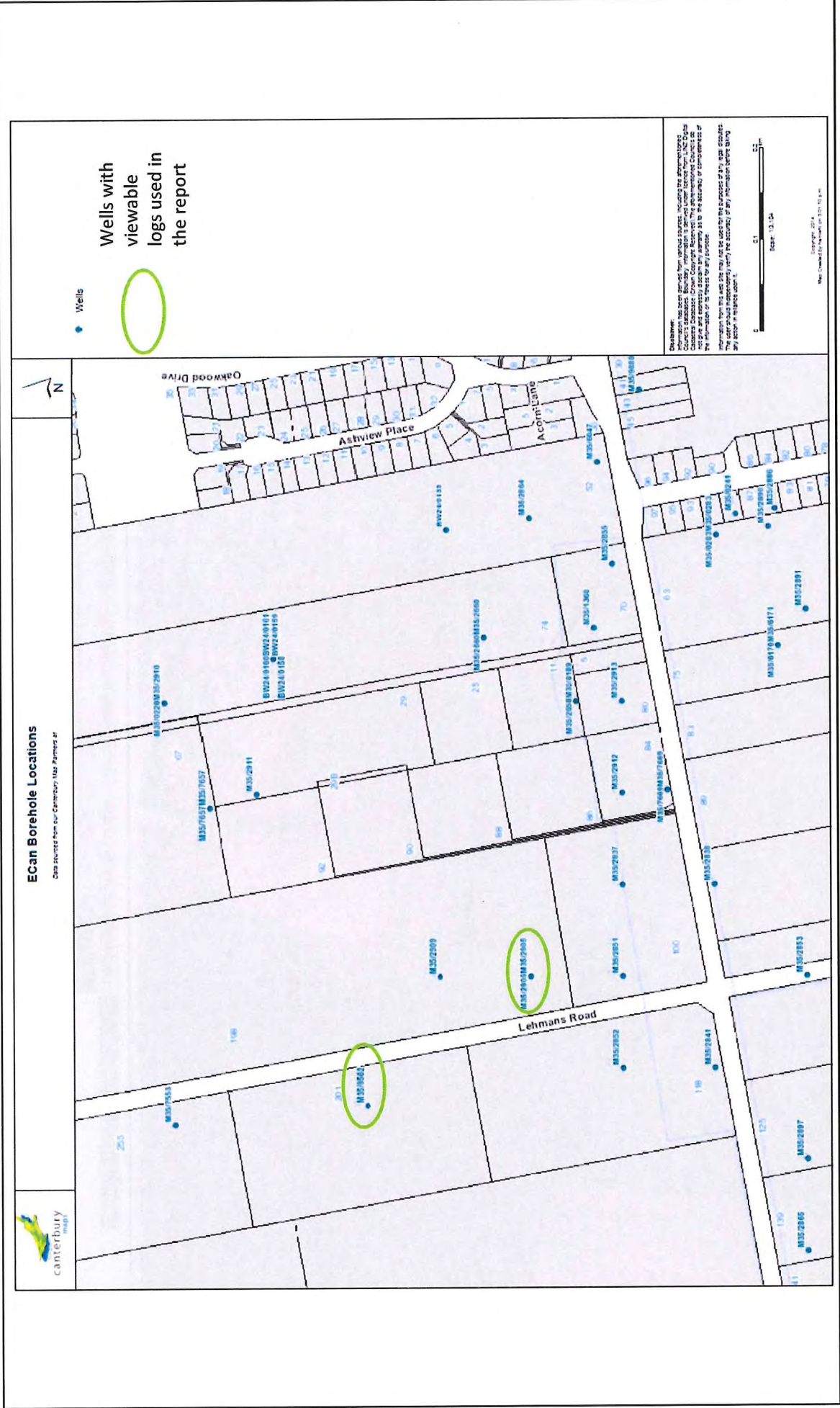
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Figures





CLIENT WESTPARK RANGIORA LTD www.aurecongroup.com aurecon www.aurecongroup.com	PRELIMINARY NOT FOR CONSTRUCTION		ALL DIMENSIONS APPROXIMATE ONLY		SITE LOCATION			
	FIGURE	FIGURE 1			SCALE	SIZE		
	PROJECT	WESTPARK RANGIORA		NTS	A4	LINZ TOPO50 MAP		
				BY				
				B. SUCKLING				
				APPROVED				
				I. MCPHERSON				
				DATE				
				3 APRIL 2014				
				FIGURE No.				
240845	PROJECT	WBS	002	TYPE	FIG	DISC	NUMBER	REV
01	A							



 www.aurecongroup.com	CLIENT		PRELIMINARY NOT FOR CONSTRUCTION		ALL DIMENSIONS APPROXIMATE ONLY		SCALE	SIZE	ECAN BOREHOLE LOCATIONS						
	FIGURE		FIGURE 2				NTS	A4	TITLE						
	PROJECT		WESTPARK RANGIORA				BY		REFERENCE						
							B. SUCKLING								
APPROVED															
						I. MCPHERSON		http://canterburymaps.govt.nz							
						DATE									
						3 APRIL 2014									
								FIGURE No.		PROJECT	WBS	TYPE	DISC	TRA	RE
										240845	002	FIG			02

Appendix A.

ECan Borehole Logs



Gridref: M35:748-668 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 42 +MSD
Driller : McMillan Water Wells Ltd
Drill Method : Driven Pipe
Drill Depth : -13.5m Drill Date : 15/06/1983



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.50m	Earth	
		-1.60m	Brown clay	
		-3.13m	Large gravel, some clay	
		-5.98m	Large gravels, some clay	
-5	-6.0 Calculated	-8.84m	Claybound	
-10		-10.7m	Water-bearing gravels	
		-13.5m	No water below this	

Borelog for well M35/9562

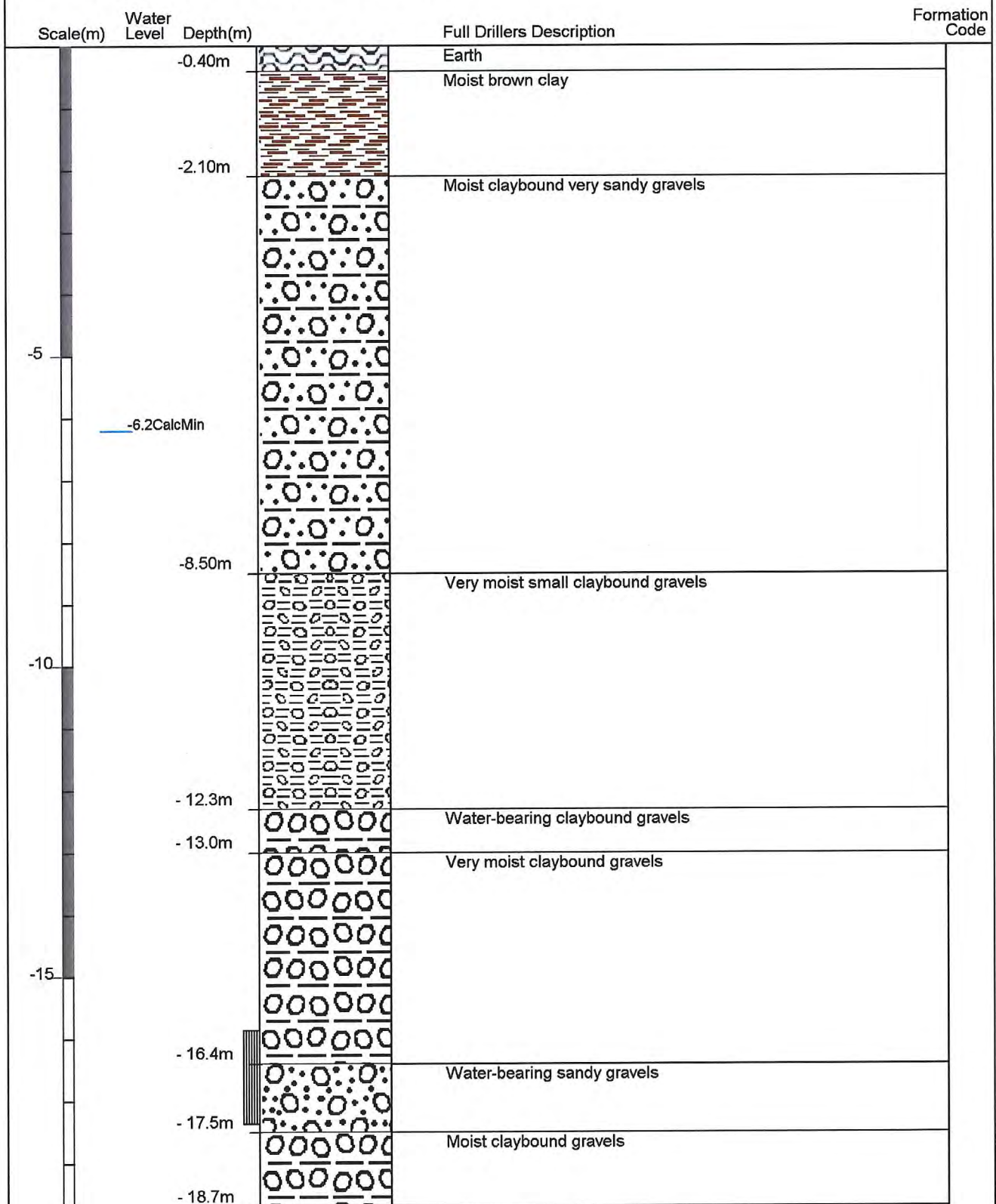
Gridref: M35:7466-6698 Accuracy : 4 (1=high, 5=low)

Ground Level Altitude : 44 +MSD

Driller : McMillan Water Wells Ltd

Drill Method : Rotary/Percussion

Drill Depth : -18.7m Drill Date : 31/03/2003



Appendix B. Flood Modelling Outputs







WAIMAKARIRI
DISTRICT COUNCIL

198 Lehmans Road and 100 Oxford Road
200 Year ARI Maximum Flood Depth
Data derived from WDC South Ashley Full-Catchment Model

SCALE (A3)
1:5,000
DATE
26/03/2014



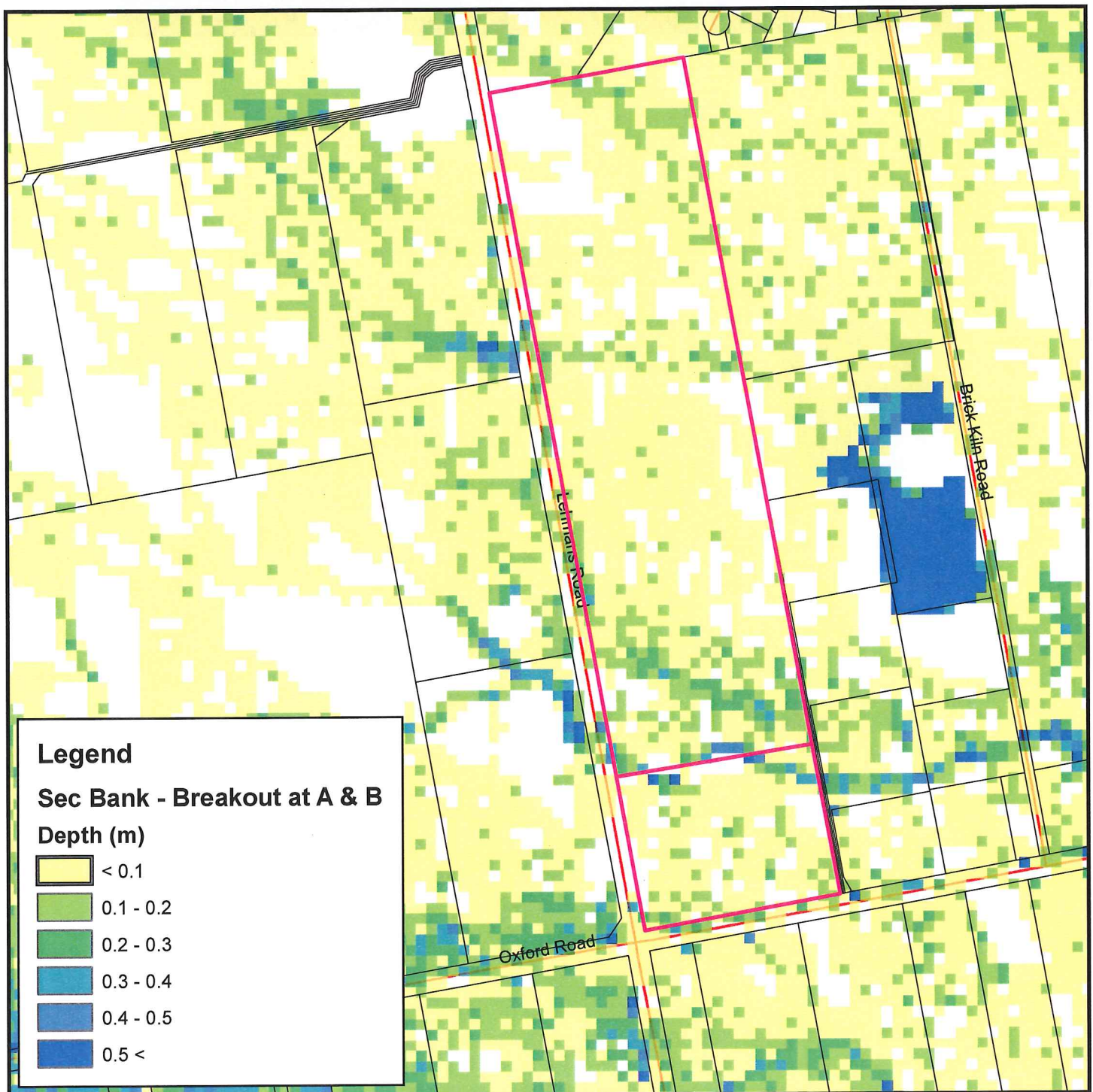
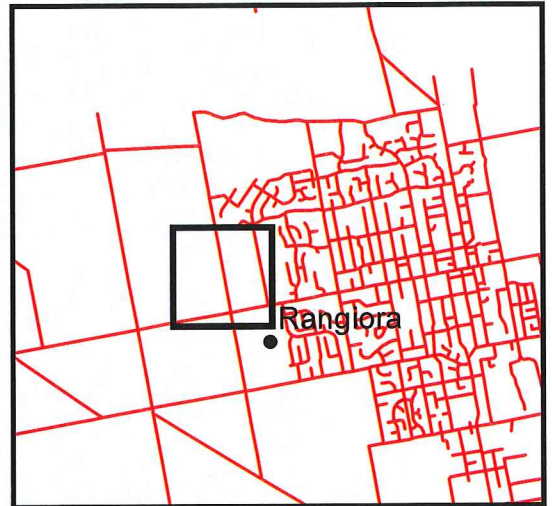


198 Lehmans Road & 100 Oxford Road - 0.5% AEP Modelled Depths

Legend

- Roads
- Land Parcels

0 100 200 400 Meters



Legend

Sec Bank - Breakout at A & B
Depth (m)

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 <

Appendix C. Investigation Logs





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BOREHOLE RECORD

HOLE NO. BH 1

PROJECT NO. 240845

PROJECT Westpark Rangiora
Rangiora

METHOD SNC

CO-ORDINATES (NZTM)

SHEET 1 of 2

MACHINE & NO. Geoprobe 6622

E 1564809

N 5205406

DATE from 14/03/2014 to 14/03/2014

FLUSHING MEDIUM Water

ORIENTATION VERTICAL

GROUND-LEVEL +40.00 m RL

Drilling Progress	Water level (m) shift start/end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR, STRUCTURE, STRENGTH, MOISTURE CONDITION, GRADING, BEDDING, PLASTICITY, ETC... (NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)	Instrument/ Backfill
			100					Type Ref Depth		0.00			
									+39.60	0.40		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)	
								SNC				Sandy SILT; light brown. Moist, low plasticity; sand, fine.	
							(3, 3, 3, 3, 4, 3) N = 13					1.00m SILT with minor sand. 1.20m Light brown mottled orange. 1.30m Sandy SILT. 1.50m Medium dense.	
			90						+38.10	1.90		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.	
							(5, 13, 14, 17, 19) N = 50/200 mm						
			100					SNC				3.40m Dry.	
							(6, 7, 7, 7, 7, 7) N = 28					4.50m Medium dense. 4.70m GRAVEL with some sand. Moist.	
			100					SNC					
							(6, 8, 7, 7, 6, 7) N = 27					6.50m GRAVEL with some silt and minor fine sand.	
			100					SNC	+32.90	7.10		Gravelly SILT; greyish brown. Very stiff, wet, low plasticity; gravel, fine to medium, subrounded to rounded.	
							(7, 10, 11, 10, 10, 11) N = 42		+32.50	7.50		GRAVEL with some silt and sand; greyish brown. Dense, wet, subrounded to rounded, well graded; sand, fine to coarse; silt, low plasticity.	
			90					SNC					
							(9, 10, 10, 11, 12, 11) N = 44					9.60m Saturated.	
			100					SNC					

Small Disturbed Sample

Large Disturbed Sample

SPT Liner Sample

Thin Wall Undisturbed Sample

U100 Undisturbed Sample

Pocket Penetrometer Test

Piston Sample

Water Level

Impression Packer Test

Standard Penetration Test

Permeability Test

Piezometer / Standpipe Tip

Packer Test

In-situ Vane Shear Test

LOGGED B. SUCKLING
DATE 14/03/2014
CHECKED T. MITCHELL
DATE 20/03/2014

REMARKS
Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater encountered at 7.1m on 14/03/2014.
Groundwater encountered at 7.0m on 21/03/2014.

Report ID: AGS4 BOREHOLE RECORD WITH INSTALLATION | Project: TEST PIT AND BH LOG.GPJ | Library: AGS 4 0.GLB | Date: 1 April 2014

BOREHOLE RECORD

HOLE NO. **BH 1**
PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **SNC**

CO-ORDINATES (NZTM)

SHEET **2** of **2**

MACHINE & NO. **Geoprobe 6622**

**E 1564809
N 5205406**

DATE from **14/03/2014** to **14/03/2014**

FLUSHING MEDIUM **Water**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+40.00** m RL

Drilling Progress	Water level (m) shift start/end	Water Recovery %	Total core Recovery %	Solid core Recovery %	R.Q.D.	Fracture Index	Tests	Samples		Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR, STRUCTURE, STRENGTH, MOISTURE CONDITION GRADING, BEDDING, PLASTICITY, ETC.... (NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)	Instrument/ Backfill
								Type	Ref					
			100				(5, 8, 9, 10, 10, 11) N = 40	SNC			10.00		10.00m Dry to moist.	
			100					SNC			10.95			
							(7, 10, 10, 10, 7, 9) N = 36	SNC			12.45		12.00m Dry. 12.50m Wet.	
			90					SNC						
							(15, 20, 29, 21) N = 50/115 mm	SNC			13.95		14.00m Saturated.	
			100					SNC			15.00			
										+25.00	15.00		End of Sonic core drilling at 15.00m, on 14/03/2014 Termination Reason: Target depth achieved	

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **B. SUCKLING**

DATE **14/03/2014**

CHECKED **T. MITCHELL**

DATE **20/03/2014**

REMARKS

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater encountered at 7.1m on 14/03/2014.
Groundwater encountered at 7.0m on 21/03/2014.

TEST PIT RECORD

TEST PIT NO. **TP 1**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564801

N 5205758

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

DATE

14/03/2014

DATE

20/03/2014

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
0.60		Fine SAND with some silt; light brown. Loose, moist.			
1.80		Sandy SILT; light brown. Dry, low plasticity; sand, fine.			
		1.20 Becomes SILT with some sand.			
3.80		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.80m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

▷▷ Pocket Penetrometer Test
✓ Insitu Vane Shear Test

▼ Water Level

TEST PIT RECORD

TEST PIT NO. **TP 2**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564704

N 5205681

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

DATE

14/03/2014

DATE

20/03/2014

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
1.60		Sandy SILT; light brown. Dry to moist, low plasticity; sand, fine. 0.50 Becomes SILT with some sand, dry.			
3.90		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.90m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test

 Water Level

TEST PIT RECORD

TEST PIT NO. **TP 3**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564845

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

N 5205588

DATE

14/03/2014

DATE

20/03/2014

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.40		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
1.80		SILT with some sand; light brown. Dry to moist, low plasticity; sand, fine. 1.00 Becomes sandy SILT.			
3.80		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.80m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test

 Water Level

Report ID: AGS4 TEST PIT RECORD (NO SKETCH NO MAP) || Project: TEST PIT AND BH LOG.GPJ || Library: AGS 4 0.GLB || Date: 20 March 2014

TEST PIT RECORD

TEST PIT NO. **TP 4**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564743

N 5205476

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

DATE

14/03/2014

DATE

20/03/2014

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.35		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
0.50		Silty fine SAND; light brown. Medium dense, dry to moist.			
2.10		Sandy SILT; light brown. Dry, low plasticity; sand, fine.			
4.00		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
End of Trial pit/trench at 4.00m, on 14/03/2014 Termination Reason: Target depth achieved					

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test
 Water Level

Report ID: AGS4 TEST PIT RECORD (NO SKETCH NO MAP) || Project: TEST PIT AND BH LOG.GPJ || Library: AGS 4_0.GLB || Date: 20 March 2014

TEST PIT RECORD

TEST PIT NO. **TP 5**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564848

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

N 5205433

DATE

14/03/2014

DATE

20/03/2014

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with some sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
2.10		Sandy SILT; light brown. Moist, low plasticity; sand, fine. 0.60 Becomes dry.			
3.90		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.90m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test

 Water Level

Report ID: AGS4 TEST PIT RECORD (NO SKETCH NO MAP) || Project: TEST PIT AND BH LOG.GPJ || Library: AGS 4 0.GLB || Date: 20 March 2014

TEST PIT RECORD

TEST PIT NO. **TP 6**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

LOGGED

CHECKED

MACHINE & NO. **14T Excavator**

E 1564790

B. SUCKLING

T. MITCHELL

N 5205266

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

DATE

DATE

14/03/2014

20/03/2014

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with minor sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
0.60		Silty fine SAND; light brown. Medium dense, moist.			
2.10		Sandy SILT; light brown. Dry, low plasticity; sand, fine.			
		0.90 Becomes with minor rootlets; light brown mottled orange.			
		1.40 No rootlets			
3.90		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.90m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test

 Water Level

Report ID: AGS4 TEST PIT RECORD (NO SKETCH NO MAP) || Project: TEST PIT AND BH LOG.GPJ || Library: AGS_4_0.GLB || Date: 20 March 2014

TEST PIT RECORD

TEST PIT NO. **TP 7**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564930

N 5205137

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

DATE

14/03/2014

DATE

20/03/2014

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with some sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
		Sandy SILT with minor rootlets; light brown mottled orange. Moist, low plasticity; sand, fine. 0.50 Becomes dry.			
					
					
					
					
					
					
					
					
					
					
					
					
					
2.50					
		Sandy fine to coarse GRAVEL; brownish grey. Very dense, moist, subrounded to rounded, well graded; sand, fine to coarse.			
					
					
					
					
3.80					
		End of Trial pit/trench at 3.80m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

☞ Pocket Penetrometer Test
☑ Insitu Vane Shear Test

▼ Water Level

TEST PIT RECORD

TEST PIT NO. **TP 8**

PROJECT NO. **240845**

PROJECT **Westpark Rangiora
Rangiora**

METHOD **TP**

CO-ORDINATES (NZTM)

E 1564816

N 5205015

LOGGED

B. SUCKLING

CHECKED

T. MITCHELL

MACHINE & NO. **14T Excavator**

CONTRACTOR **Frews Contracting**

GROUND LEVEL **+40.00** m RL

DATE

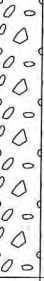
14/03/2014

DATE

20/03/2014

STRATA

SAMPLES & TESTS

Depth (m)	Legend	Description	Depth	No	Remarks/Tests
0.30		SILT with some sand and rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)			
2.70		SILT with some sand; light brown mottled orange. Moist, low plasticity; sand, fine.			
3.90		Sandy fine to coarse GRAVEL; brownish grey. Moist, subrounded to rounded, well graded; sand, fine to coarse.			
		End of Trial pit/trench at 3.90m, on 14/03/2014 Termination Reason: Target depth achieved			

GENERAL REMARKS

SHORING/SUPPORT: **None**
STABILITY: **Walls remain stable**

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Elevation recorded using handheld GPS accurate to +/- 10m.
Groundwater not encountered.

All dimensions in metres

CLIENT **Westpark Rangiora Ltd**

 Pocket Penetrometer Test
 Insitu Vane Shear Test

 Water Level

Report ID: AGS4 TEST PIT RECORD (NO SKETCH NO MAP) || Project: TEST PIT AND BH LOG.GPJ || Library: AGS 4_0.GLB || Date: 20 March 2014

PROJECT **Westpark Rangiora
Rangiora**

PROJECT NO. **240845**

CO-ORDINATES (NZTM)

E 1564801

N 5205758

GROUND LEVEL **+40.00** m RL

TESTED / SUPERVISED BY **C. MANGOS**

DATE **14/03/2014**

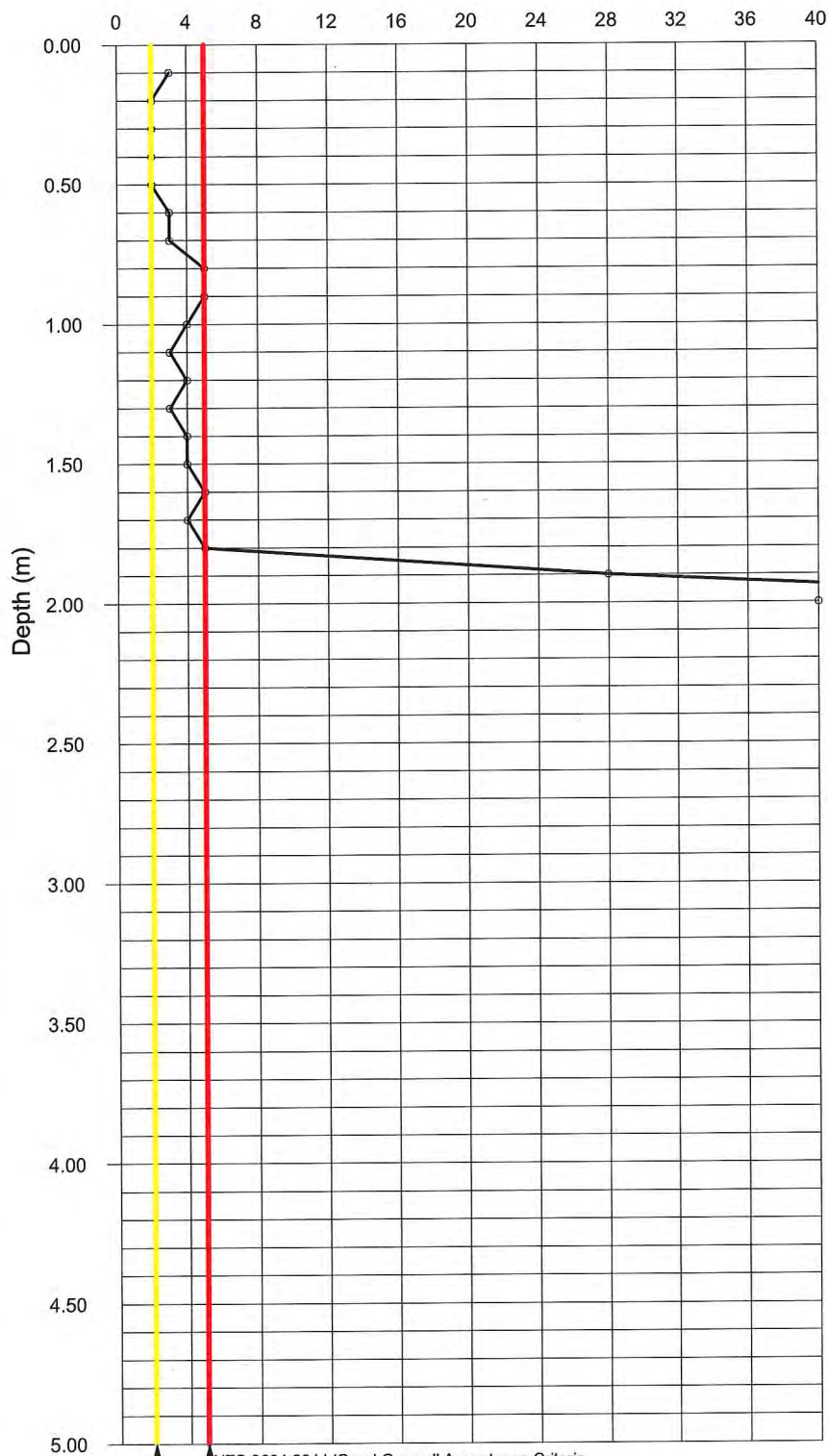
CHECKED BY **T. MITCHELL**

DATE **20/03/2014**

Results

Depth (m)	Blows per 100 mm	Depth (m)	Blows per 100 mm
0.0	3	3.5	
	2		
	2		
	2		
0.5	2	4.0	
	3		
	3		
	5		
	5		
1.0	4	4.5	
	3		
	4		
	3		
	4		
1.5	4	5.0	
	5		
	4		
	5		
	28		
2.0	62		
2.5			
3.0			
3.5			

Number of blows per 100mm



Remarks:

56 blows for 90mm in the last increment.

Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.

Elevation recorded using handheld GPS accurate to +/- 10m.

Effective refusal; 20+ blows per 100mm penetration.

NZS 3604:2011 'Good Ground' Acceptance Criteria
MBIE '200kPa geotechnical ultimate bearing capacity' Acceptance Criteria

PROJECT **Westpark Rangiora
Rangiora**

PROJECT NO. **240845**

CO-ORDINATES (NZTM)
**E 1564704
N 5205681**

GROUND LEVEL **+40.00 m RL**

TESTED / SUPERVISED BY **C. MANGOS**

DATE **14/03/2014**

CHECKED BY **T. MITCHELL**

DATE **20/03/2014**

Results

Depth (m)	Blows per 100 mm	Depth (m)	Blows per 100 mm
0.0	4	3.5	
	3		
	1		
	2		
0.5	3	4.0	
	3		
	4		
	4		
1.0	5	4.5	
	5		
	5		
	5		
1.5	15	5.0	
	31		
	43		
2.0			
2.5			
3.0			
3.5			

Remarks:

43 blows for 100mm in the last increment.
Coordinates approximated from CERA public viewer, accurate to +/- 1.0m.
Effective refusal; 20+ blows per 100mm penetration.

Number of blows per 100mm

