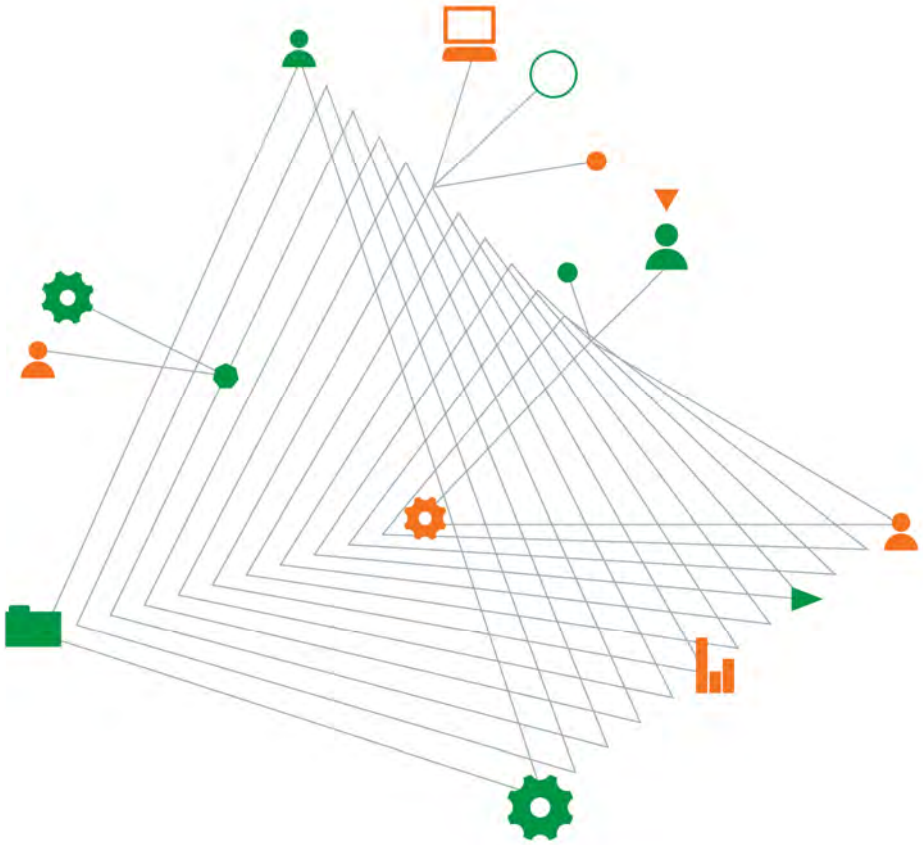
Christchurch City Council

Geotechnical Assessment Report (Addendum)

Review of the District Plan for R6 - East Belfast, Christchurch

20 August 2014



Experience comes to life when it is powered by expertise

131 Wrights Road, Addington
P O Box 1872 Christchurch 8140
t: +64 3 374 9600
coffey.com

20 August 2014

Christchurch City Council
53 Hereford Street
PO Box 73011
Christchurch
New Zealand

Attention: Fiona Eunson (email: fiona.eunson@ccc.govt.nz)

GEOTECHNICAL ASSESSMENT REPORT (ADDENDUM)

PROPOSED REZONING OF REVIEW OF THE DISTRICT PLAN FOR R6-EAST BELFAST, CHRISTCHURCH

Please find attached our geotechnical report addendum presenting the findings of our geotechnical investigation (Stage 2) for the south-west extents of the 60 ha area of land known as R6 - East Belfast Christchurch.

This report is an addendum to our main report for the R6 - East Belfast area (Ref. Coffey GENZCHRI15602AB; 12 June 2014).

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

For and on behalf of Coffey

Nick Harwood
BEng (Hons) MSc DIC MIPENZ CPEng
Principal Geotechnical Engineer

Distribution:	Christchurch City Council	1 Copy (electronic) 1 Hard Copy
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1 INTRODUCTION

Coffey Geotechnics (NZ) Limited (Coffey) was commissioned by Christchurch City Council (CCC) to provide geotechnical reporting pertinent to a proposed rezoning of land known as R6 – East Belfast for future urban development.

This report is an addendum to our main report for the R6 - East Belfast area (Ref. Coffey GENZCHRI15602AB; 12 June 2014).

The R6 - East Belfast project is being led by CCC. It covers a land area of 60 hectares (approx.) in the northern Christchurch suburb of East Belfast. The location and extents of the R6 - East Belfast area is shown on the appended plan.

The location of the area addressed by this addendum report is shown in Figure 1.

Figure 1 Addendum report site areas (north at top; scale as shown)

The CCC's scope and objectives for this report were set out in a Phase 2 brief dated 7 March 2014[1], the details of which are presented below.

Essentially, the work entails a high-level geotechnical overview of the ground in terms of its liquefaction and lateral spread hazard, a review of Section 106 Resource Management Act hazards and commentary on issues associated with proposed stormwater facilities.

[1] CCC's Brief Scope for Geotechnical Investigation of R6 – East Belfast area provided to Coffey on 7 March 2014.

A preliminary review of liquefaction susceptibility and associated earthquake-induced ground deformations has been carried out with the expectation that further (more detailed) geotechnical evaluation would be required at the subdivision design and building consent stages of development.

2 OBJECTIVES[2]

The Phase 2 geotechnical investigation is specifically required to advise on the geotechnical suitability of the land for residential and business activities and associated infrastructure. The investigation is to be sufficiently detailed to provide high-level advice on anticipated foundation types, infrastructure considerations and recommendations on ground improvement strategies where required[2].

The objectives of the Phase 2 geotechnical investigation are tailored to address the CCC's brief, and have been interpreted to include:

- Assess the ground conditions and develop a conceptual ground model for the site;
- Determine indicative MBIE Technical Category (TC) equivalent boundaries;
- Assess the lateral spread hazard for the Styx River margins;
- Comment on the impact of locating CCC stormwater assets in a high lateral spread hazard area (along the Styx River margin);
- Assess the geotechnical *natural hazard* risks in accordance with Section 106 of the Resource Management;
- Confirm the suitability of the land for residential and business development and/or provide recommendations on the type of ground-works/foundations needed for the intended use, and,
- Report in line with current MBIE requirements.

3 SCOPE OF WORKS

The scope of works pertinent to this addendum report is as follows:

1. Geotechnical desktop study including a review of:
    - Preliminary Site Evaluation (PSE)[3] and Environmental Preliminary Site Investigation (PSI)[4] as part of Phase 1 of the investigation works;
    - Published geological records;
    - Canterbury Geotechnical Database;
    - MBIE Residential Foundation Technical Category maps;
    - ECan's wellcard database for relevant bore records in the site and environs; and,

[2] Objectives relate to the full R6-East Belfast area

[3] Geotechnical Preliminary Site Evaluation R6 – East Belfast Christchurch prepared by Coffey for Christchurch City Council. Reference GENZCHRI15602AA, dated 9 December 2013.

[4] Coffey (2013) Environmental PSI R6 – East Belfast, Christchurch; Coffey, 9 December 2013.

- Groundwater monitoring results for the area.

2. Geotechnical site walkover assessment;

3. Geotechnical reporting to meet the objectives outlined in Section 2.

Where relevant, reporting has been conducted in accordance with the current Ministry of Business, Innovation and Employment (MBIE)[5] Guidance and CCC Subdivision Bulletin No. 23.2[6].

4 SITE DETAILS

The site is located within the suburb of Redwood, approximately 8km from the Christchurch city centre. The Styx River bisects the site into two land parcels:

Area	Address	Zone
Area A	470 Main North Road Section 1 SO 373925	Styx River Conservation Reserve
Area B	1/15 & 2/15 Cunliffe Road[7]. Site accessed from Cunliffe Road to the south Lot 4 DP 17683	Rural 3 (Styx-Marshland)

The site is undeveloped rural land used for stock grazing.

Area A is low-lying pastural flood-plain with areas of reeds that give a swampy appearance. The reeds are indicative of the low-lying nature of the land adjacent to the Styx River (Figures 2 & 3).

Area B is mostly an elevated river terrace with a land elevation >2 metres above Area A. The land elevation falls to the north down to the level of the Styx River where the land is swampy floodplain (Figure 4).

[5] Ministry of Business, Innovation and Employment, 2012: Repairing and rebuilding houses affected by the Canterbury earthquakes, December 2012. Particular reference to Part D: Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region.

[6] Christchurch City Council Resource Consents and Building Policy Unit, Subdivision Bulletin No. 23.2, May 2013.

[7] Address as per ECan LLUR data base http://www.llur.ecan.govt.nz/

Figure 2 Viewing east across Area A from Main North Road.

Figure 3 Viewing east across Area A from Main North Road

Figure 4 Viewing east across northern part of Area B. The river terrace to the left is the land to the north of the site (site of proposed Styx Town Centre).

5 DESK STUDY

The desk study report is appended (Appendix B). Key aspects of the site collated and deduced from the desk study and walkover inspection are presented below. The comments take into account Coffey's geotechnical assessments across the remainder of the R6-East Belfast site and the adjoining Styx Town Centre site (to the immediate north).

- The site is in CERA Green Zone.
- The MBIE residential category is *N/A – Urban Non-residential*
- The site is underlain by alluvial soil desposits.
- The ground is prone to liquefaction.
- The site is dominated by the Styx River channel that presents long convex boundaries that pre-dispose the site to lateral spread hazard.
- Area A is mapped within a CCC 50 Year Flood Extent area. It is a low-lying floodplain.
- The low-lying northern part of Area B is mapped within a CCC 100 Year Flood Extent area. This part of Area B is a floodplain.
- These two flood-prone areas are likely to be underlain by soft / swamp soil deposits. Foundation conditions will likely be poor in these areas.
- On the river terrace (Area B) where the land is elevated above the floodplain the soil profile most likely comprises interbedded silt and sand deposits, with groundwater ≥ 2 m depth[8].

6 EARTHQUAKE DAMAGE OBSERVATIONS

6.1 Walkover inspection

The land areas are rural. No reliable evidence of notable earthquake-induced land damage was observed during the walkover survey.

6.2 EQC mapped observations

There is no specific damage mapping on the site as it is rural, but adjoining residential areas are mapped as "no observed ground cracking or ejected liquefied material". Our observations on site are consistent with these findings in the neighbouring areas.

[8] Geotechnical records on northern Styx River terrace reviewed as well as 3rd party unpublished records from limited investigations in Area B.

7 GROUND MOTION

Using the MBIE[4] and Bradley & Hughes (2012)[9] procedures we have found that the site was "not sufficiently tested" to the Serviceability Limit State (SLS) level of earthquake demand during the Canterbury earthquake sequence.

The significance of this is that the land has not been put under particularly great earthquake demand so it is not surpsing that no earthquake-related ground damage is observable. Also, > 3 years have passed since the last major event (June 2011) so wearthering may have subdued evidence. However, we are confident that little if any land damage occurred.

8 MBIE LAND ZONING

The MBIE residential category is *N/A – Urban Non-residential* (See Figure 5).

Adjoining residential land is mapped as Technical Category 2 (TC2).

Given the site is dominated by the Styx River channel and the ground is prone to liquefaction it is prudent to consider the two land parcels as TC3 due to the lateral spread hazard potential. This category indicates that CPEng geotechnical engineer input is required for land develop and engineering projects on the land.

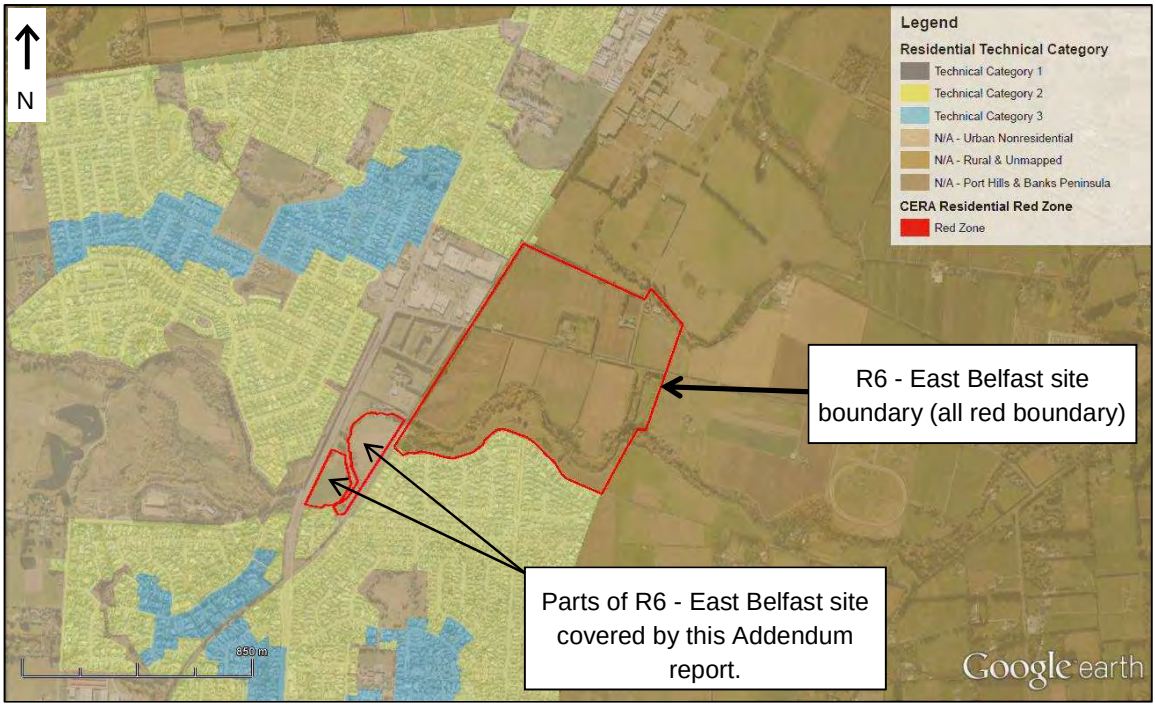


Figure 5 Site location plan showing MBIE Technical Categories (scale as shown)

[9] Bradley & Hughes (2012) *Conditional Peak Ground Accelerations in the Canterbury Earthquakes for Conventional Liquefaction Assessment*. Report for DBH (MBIE), April 2012.

9 NATURAL HAZARDS

Resource Management Act Section 106 issues relevant to this Plan Change assessment require an evaluation of whether:

(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.

9.1 Erosion

The erosive potential of the Styx River is expected to be low.

9.2 Falling debris

There are no sources of falling debris on the site.

9.3 Subsidence

Subsidence may occur due to construction on poor/soft/peat soil and earthquake-induced ground deformation.

Earthquake-induced settlement (subsidence) may occur as a result of liquefaction-related settlement as well as settlement associated with lateral spread.

9.4 Slippage

Any buildings or other assets should set well back from the river channel edge to avoid the risk of river bank slippage.

9.5 Inundation

Area A is mapped within a CCC 50 Year Flood Extent area. It is a low-lying floodplain.

The low-lying northern part of Area B is mapped within a CCC 100 Year Flood Extent area. This part of Area B is a floodplain.

10 FOUNDATION CONSIDERATIONS

Area A is a floodplain that is likely underlain by soft swamp deposits and probably prone to lateral spread. The low-lying northern third of Area B has similar properties.

The elevated terrace part of Area B may have competent shallow soil depsoits for light-weight structures but is likely prone to lateral spread.

We understand that Area A may be set aside for stormwater storage facilities - either kept as is (as natural floodplain) or have earthworks to create a storage basin.

We understand that Area B may be set aside for reserve / recreational purposes.

It is likely that any construction on the sites would be Importance Level 1 (IL1) structures. MBIE TC2 foundations would be suitable. Any structures should be set back from the river edge as far as practicable.

Lateral spread hazard and foundation engineering requirements should be assessed by a CPEng geotechnical engineer.

11 STORMWATER FACILITIES

See comments above re Foundation Considerations.

Any structures should be set back from the river edge as far as practicable.

Lateral spread hazard and foundation engineering requirements should be assessed by a CPEng geotechnical engineer.

12 CONCLUSIONS AND RECOMMENDATIONS

The MBIE residential category is *N/A – Urban Non-residential*. Given the site is dominated by the Styx River channel and the ground is prone to liquefaction it is prudent to consider the two land parcels as TC3 due to the lateral spread hazard potential.

Area A is mapped within a CCC 50 Year Flood Extent area. It is a low-lying floodplain.

The low-lying northern part of Area B is mapped within a CCC 100 Year Flood Extent area. This part of Area B is a floodplain.

Due to the flood risk on much of the site it is probably only the upper river terrace level of Area B that is suitable for locating buildings, and these should be set well back from the river channel edge.

Lateral spread hazard and foundation engineering requirements should be assessed by a CPEng geotechnical engineer.

13 LIMITATIONS

This report has been prepared solely for the use of our client Christchurch City Council (CCC) and their professional advisers and 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.

Coffey Geotechnics (NZ) Ltd has not carried out a detailed structural inspection of any building(s) across the site nor has a topographical survey been undertaken. We had not visited the property prior to the earthquakes.

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 back to us immediately.

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

14 CLOSURE

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

For and on behalf of Coffey

Reviewed and approved by

Nick Harwood

BEng (Hons) MSc DIC MIPENZ CPEng

Principal Geotechnical Engineer

Attachments:

Important information about your Coffey Report

R6 – East Belfast location plan

Desk Study Report

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.

Important information about your **Coffey** Report

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.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Appendix

R6 – East Belfast location plan

Desk Study Report

Plan: Land Use Recovery Plan

Key

- Study Area Boundary
- Greenfield Areas
- Existing Railway Corridor
- River
- Key Activity Centre

Planning Status of Priority Areas

- Business Area - Zoned
- Business Area - Not Yet Zoned
- Residential Area - Zoned
- Residential Area - Not Yet Zoned

NORTH

BRIDGEND
CHANEYS
BELFAST
NORTHWOOD
STYX
REDWOOD
CHRISTCHURCH NORTHERN MOTORWAY
MAIN NORTH ROAD
WESTERN BYPASS
APPLEFIELDS
DESIGNATED NORTHERN ARTERIAL
GUTHRIES ROAD
MARSHLAND ROAD
KAPUTONE CREEK
BELFAST ROAD
JOHNS ROAD
BLAKES ROAD
RADCLIFFE ROAD
GARDINERS ROAD
STYX RIVER
STYX MILL ROAD
B5
R6
R7
R8

500 250 0 250 500
SCALE (m)

Original size mm
300 200 150 100 50 30 10 0

Christchurch City Council

BELFAST AREA PLAN SEPTEMBER 2013

Original Plan Size: A1
ISSUE. 1 Sept 2013
LP324002 Scale 1:12,000

Geotechnical Desktop Study

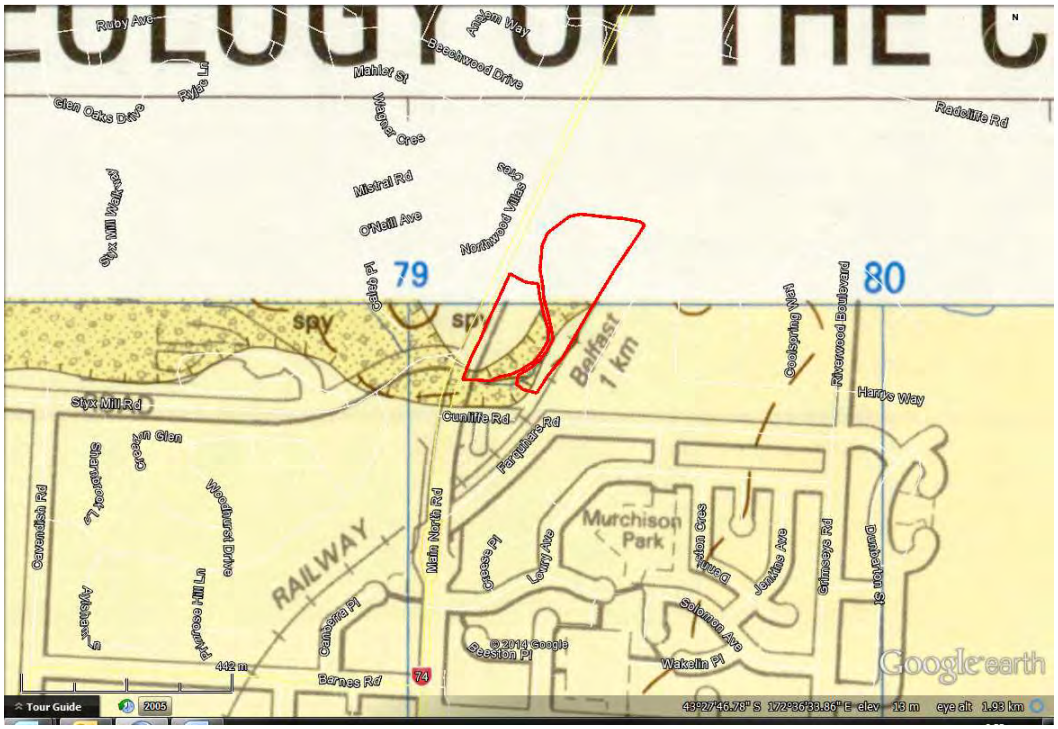
Project name:	REVIEW OF THE DISTRICT PLAN FOR R6-EAST BELFAST (ADDENDUM REPORT)
Project number:	GENZCHRI15602AB
Site address:	Main North Road Area A Section 1 SO 373925 Area B Lot 4 DP 17683
Date:	05/08/14
Author:	Raquel Miller

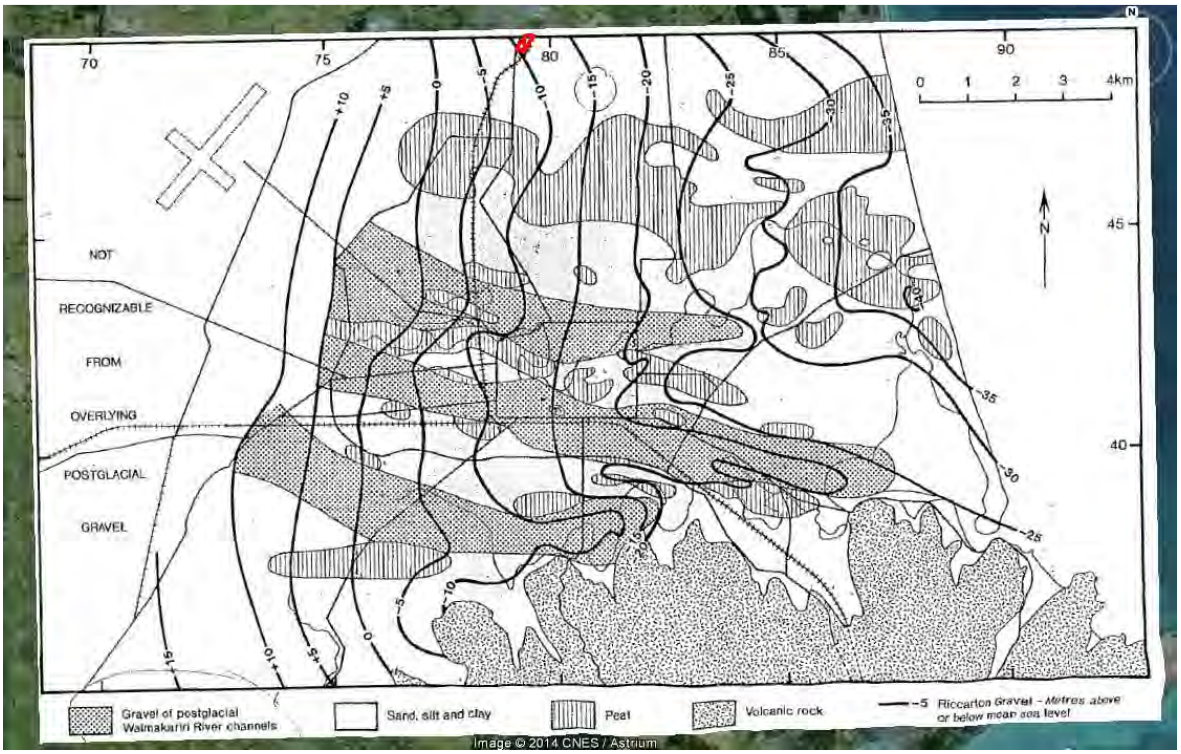
Coffey Geotechnics (NZ) Limited
131 Wrights Road, Addington, Christchurch, New Zealand
PO Box 1872 Christchurch 8140 New Zealand
T (+64) (3) 374 9600 F (+64) (3) 374 9601
www.coffey.com/geotechnics

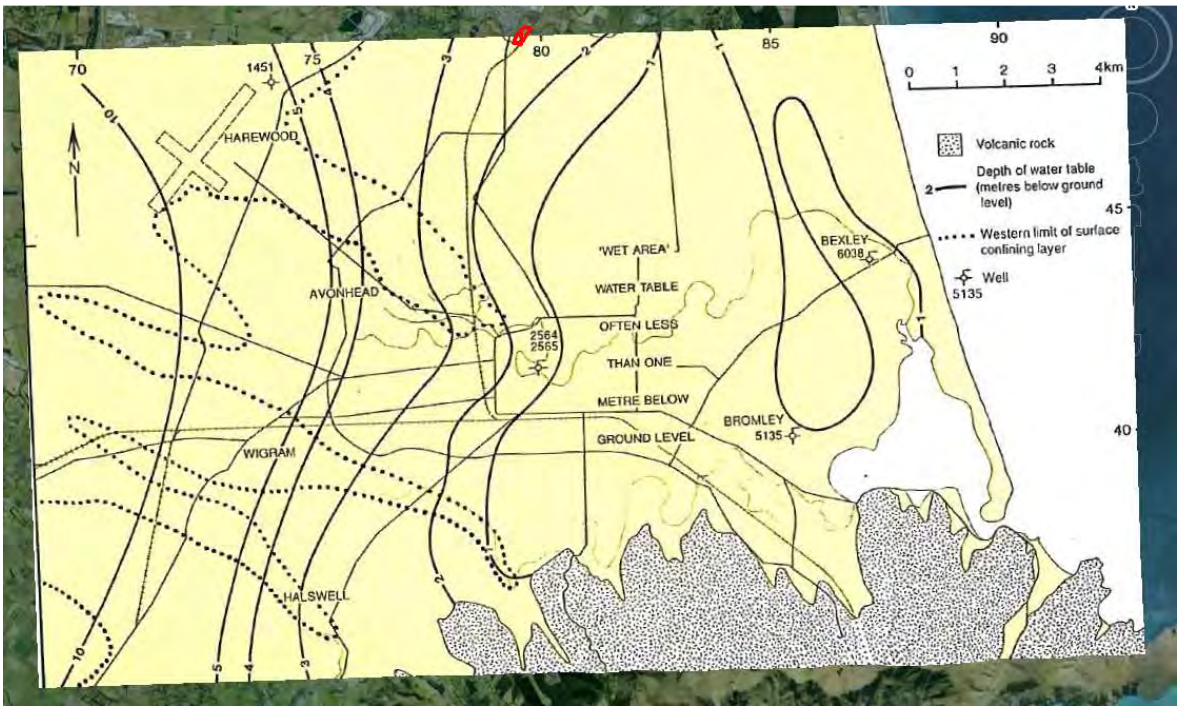
1 CANTERBURY GEOTECHNICAL DATABASE

1.1 Geological Maps

Brown, L.J. & Weeber, J.H. (1992), Geology of the Christchurch urban area. Scale 1:25000. Institute of Geological and Nuclear Sciences geological map 1. One sheet. Institute of Geological and Nuclear Sciences Limited, Lower Hutt, New Zealand. Canterbury Geotechnical Database Map CGD5122 - 27 Sept 2012

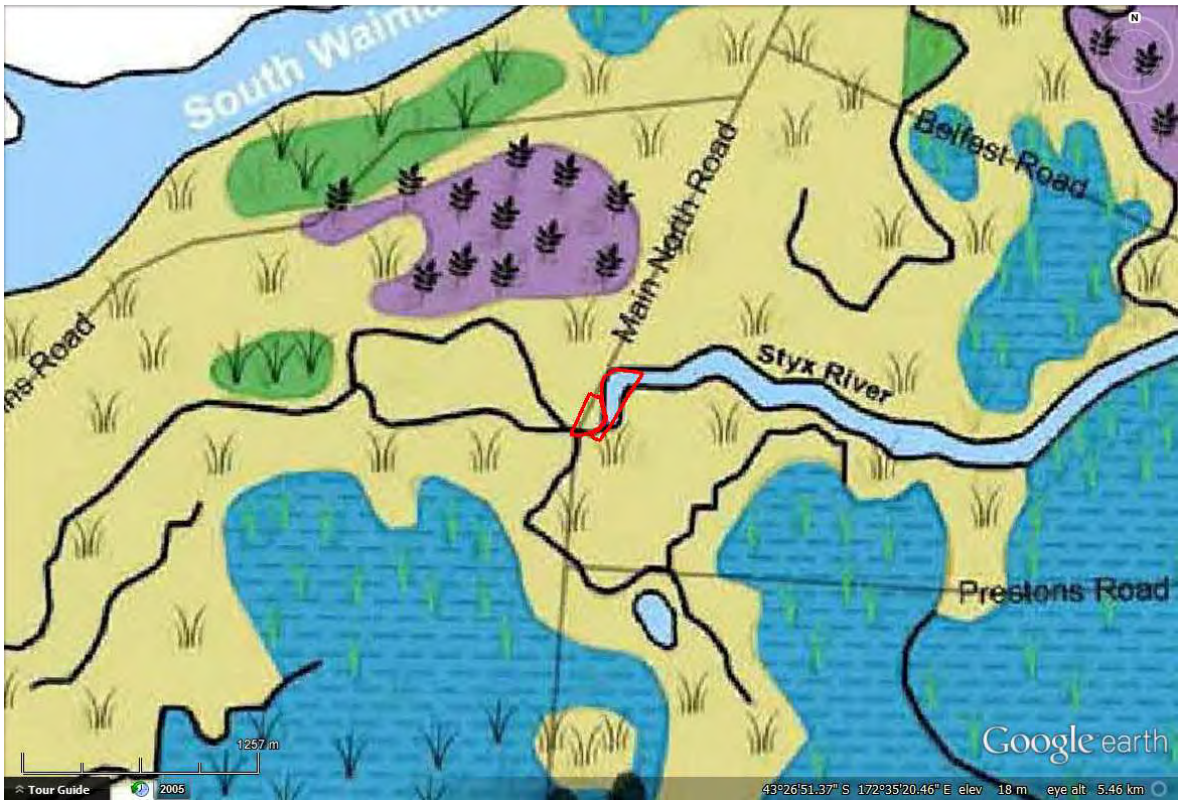






Brown & Weeber Memoirs	
Depth to Groundwater mbgl	~ 2.5mbgl
Depth to Riccarton Gravel Formation mbgl	~ 20mbgl

1.2 Black Maps



Waterways, Swamps and Vegetation Cover in 1856 Compiled from "Black Maps" approved by J Thomas and Thomas Cass, Chief Surveyors, 1856 – Christchurch City Council Information Services digitised Map Ap001725 compiled by Ken Sibley Jul 1989 and revised by G Tibble Apr 1996. Source: Christchurch City Council Retrieved 31 May 2011 http://resources.ccc.govt.nz/files/blackmap-environmentecology.pdf

1.3 Conditional PGA

Conditional Peak Ground Accelerations (PGA) developed for conventional liquefaction assessments by Bradley Seismic Ltd. and the University of Canterbury. Canterbury Geotechnical Database Map CGD5110 - 27 Sep 2013

Initial screening			Additional evaluation (10%ile test)					Other checks	
Auto calc	Auto calc	Auto calc	Auto calc	Auto calc	Auto calc	Auto calc	Auto calc	Auto calc	Auto calc
$PGA_{7.5}$	170% SLS_{Derian}	"Sufficiently tested" for an SLS event?	$-1.28*SD_{Can}$	e^c	$PGA_{10\%ile}$	$PGA_{10\_7.5}$	"Sufficiently tested" for an SLS event?	$PGA_{10\%ile\_7.5}$ as % over/under SLS_{Derian}	$PGA_{16\_7.5}$
A	B	A>B?	C			D	D> SLS_{Derian} ?		
g	g		g		g	g			g
0.17	0.22	No	-0.333	0.717	0.135	0.121	No	-7%	0.131
0.14	0.22	No	-0.384	0.681	0.133	0.094	No	-28%	0.102
0.07	0.22	No	-0.403	0.668	0.073	0.050	No	-62%	0.054
0.11	0.22	No	-0.416	0.660	0.111	0.073	No	-44%	0.080

Table 2 What was actual PGA at site?

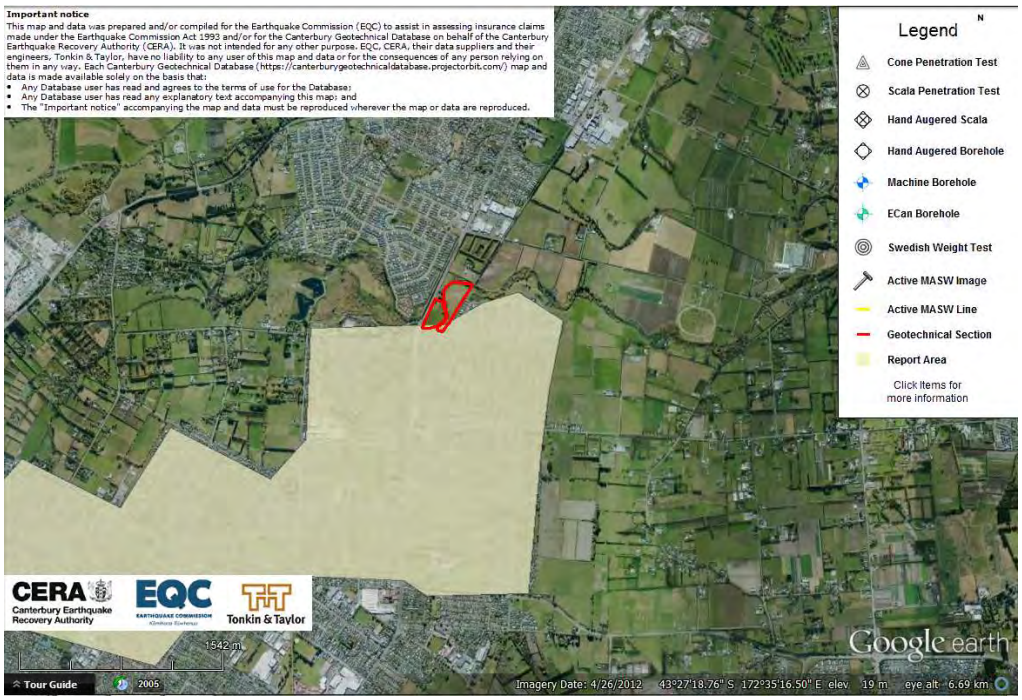
Bradley & Hughes 2012, Table 2				GoogleEarth contours		Auto calc	Auto calc	Auto calc	Auto calc	We can state with confidence of 68% that the actual PGA value was in this range
EQ Event	M_w	MSF	$PGA_{7.5}$ / PGA_{CH}	PGA_{CH}	SD_{Can}	-/+ 1*SD_{Can}	e^A	$PGA_{16\%ile}$	$PGA_{84\%ile}$	
						A				
				g	g	g		g	g	
4 Sept 2010	7.1	1.11	0.90	0.188	0.260	-0.260	0.771	0.145		0.14g to 0.24g
					0.260	0.260	1.297		0.244	
22 Feb 2011	6.2	1.41	0.71	0.195	0.300	-0.300	0.741	0.144		0.14g to 0.26g
					0.300	0.300	1.350		0.263	
13 June 2011	6.0	1.48	0.68	0.110	0.315	-0.315	0.730	0.080		0.08g to 0.15g
					0.315	0.315	1.370		0.151	
23 Dec 2011	5.9	1.52	0.66	0.169	0.325	-0.325	0.723	0.122		0.12g to 0.23g
					0.325	0.325	1.384		0.234	

Table 3 What was $PGA_{7.5}$ at site?

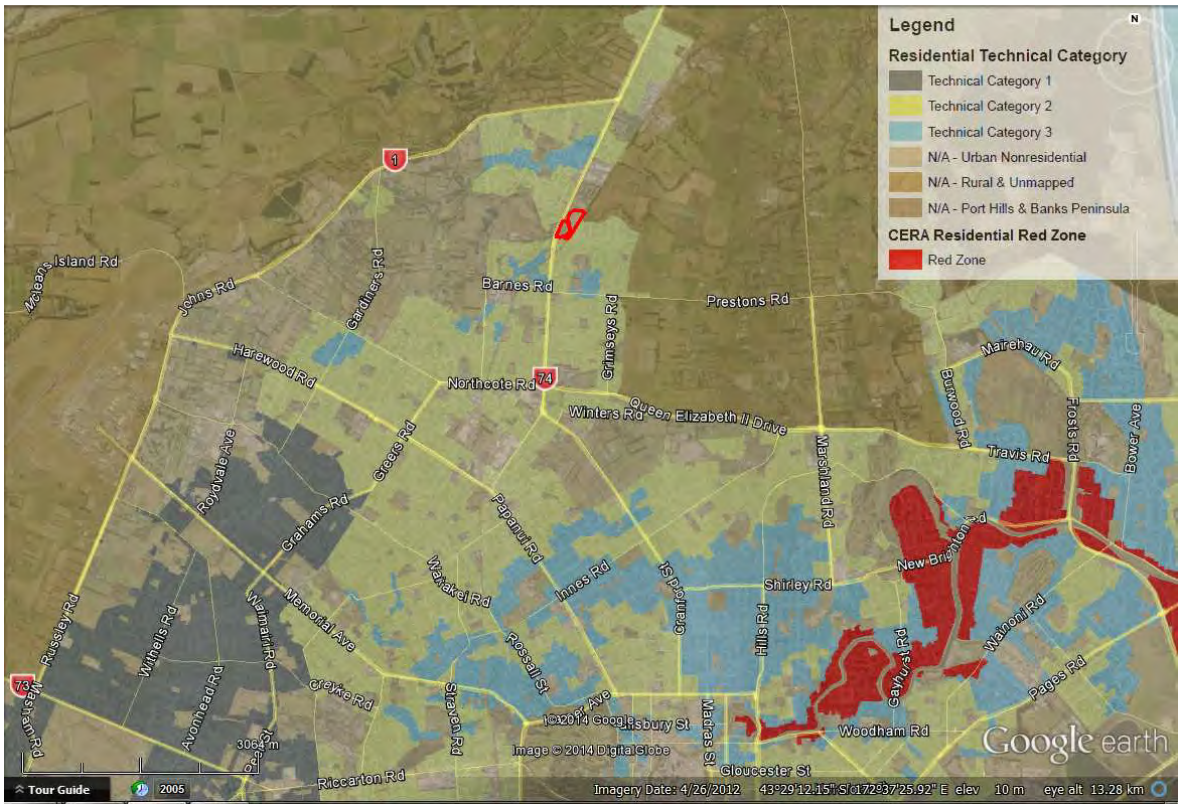
	Bradley &	GoogleEarth	Auto calc	Auto calc	Auto calc	Auto calc	We can state with confidence of 68% that the $PGA_{7.5}$ value was in this range
EQ Event	$PGA_{7.5}$	SD_{Can}	-/+ 1*SD_{Can}	e^A	$PGA_{16\%ile}$	$PGA_{84\%ile}$	
			A				
	g	g	g		g	g	
4 Sept 2010	0.169	0.260	-0.260	0.771	0.131		0.13g to 0.22g
		0.260	0.260	1.297		0.220	
22 Feb 2011	0.138	0.300	-0.300	0.741	0.102		0.1g to 0.19g
		0.300	0.300	1.350		0.187	
13 June 2011	0.07	0.315	-0.315	0.730	0.054		0.05g to 0.1g
		0.315	0.315	1.370		0.102	
23 Dec 2011	0.11	0.325	-0.325	0.723	0.080		0.08g to 0.15g
		0.325	0.325	1.384		0.154	

Earthquake Event	Median PGA (g)	Standard Deviation (g)
4 September 2010	0.188	0.260
22 February 2011	0.195	0.300
13 June 2011	0.11	0.315
23 December 2011	0.169	0.325

1.4 EQC Investigative Areas



1.5 MBIE Technical Category

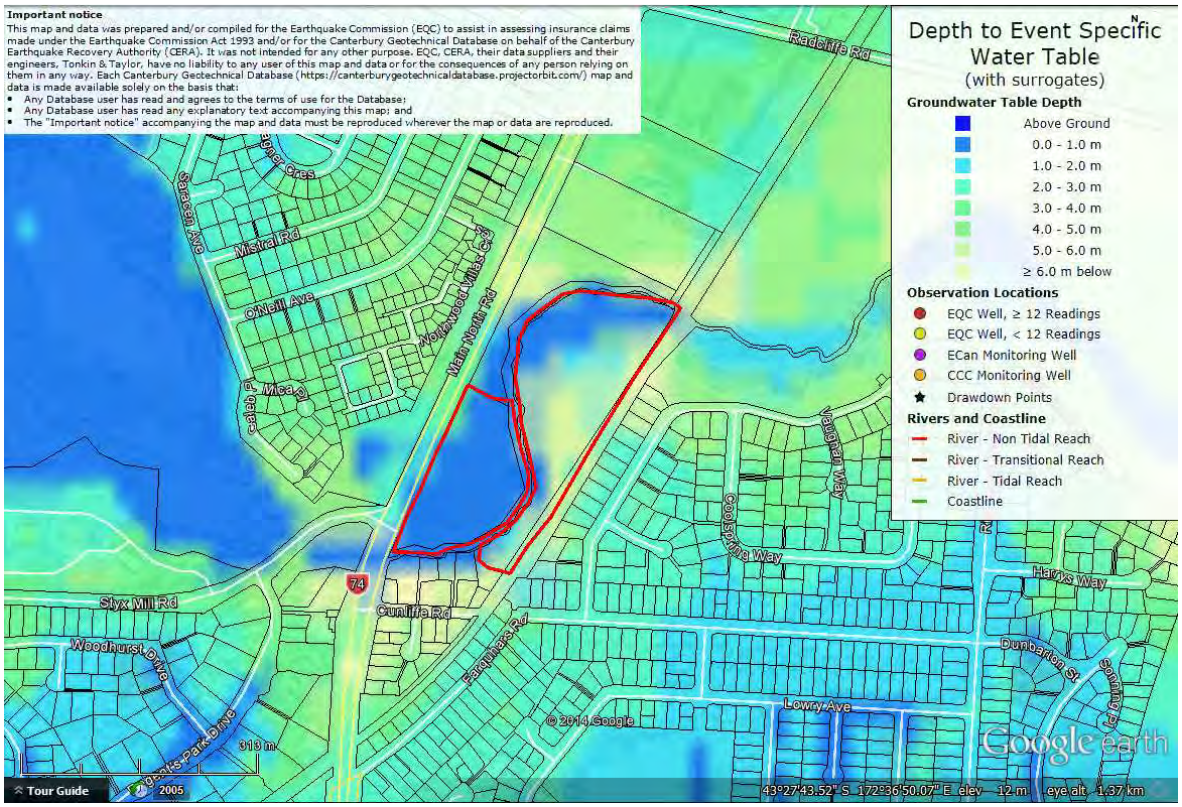


1.6 ECan Borehole Logs

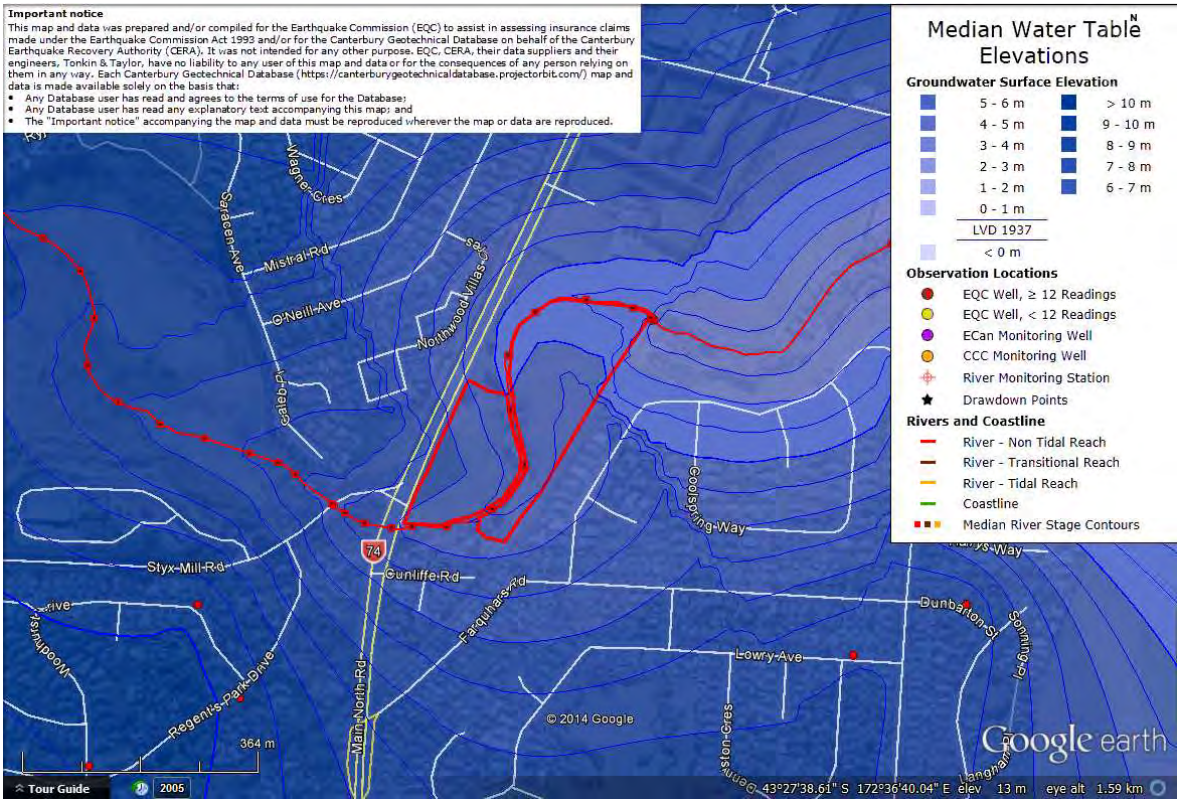
1.7 EQC Event Specific Groundwater Surface Depths

Groundwater surface depths based on Environment Canterbury (ECan) and Tonkin & Taylor Ltd (T&T) measurements. Canterbury Geotechnical Database Map CGD0800 - 16 Aug 2013

June 2011



1.8 GNS Median Depth to Water Table



The depth of the median water table surface relative to the Digital Elevation Model (DEM) for the ground surface (Canterbury Geotechnical Database Map CGD5160), this uses the most recent, Feb 2012 DEM, augmented with the additional extent of the Sept 2011 DEM. Canterbury Geotechnical Database Map CGD5160 - 07 Mar 2013

1.9 EQC Horizontal Ground Movements

Horizontal ground surface movements between LiDAR sets that approximate the movements during significant earthquakes. Canterbury Geotechnical Database Map CGD0700 - 23 Jul 2013

Earthquake Event	Observed from LiDAR (yellow)		"Local" Observed	
13 June 2011	0.25	133	0.21	135

1.10 EQC Vertical Ground Movements

Pre and post-earthquake Digital Elevation Models (DEM) created from Airborne LiDAR. Canterbury Geotechnical Database Map CGD0500 - 23 Jul 2013

N/A

1.11 EQC LiDAR and digital elevation models

Pre and post earthquake Digital Elevation Models (DEM) created from Airborne LiDAR. Canterbury Geotechnical Database Map CGD0500 - 23 Jul 2013

LiDAR Ground Surface Elevation February 2012

N/A

1.12 EQC Observed Ground Crack Locations

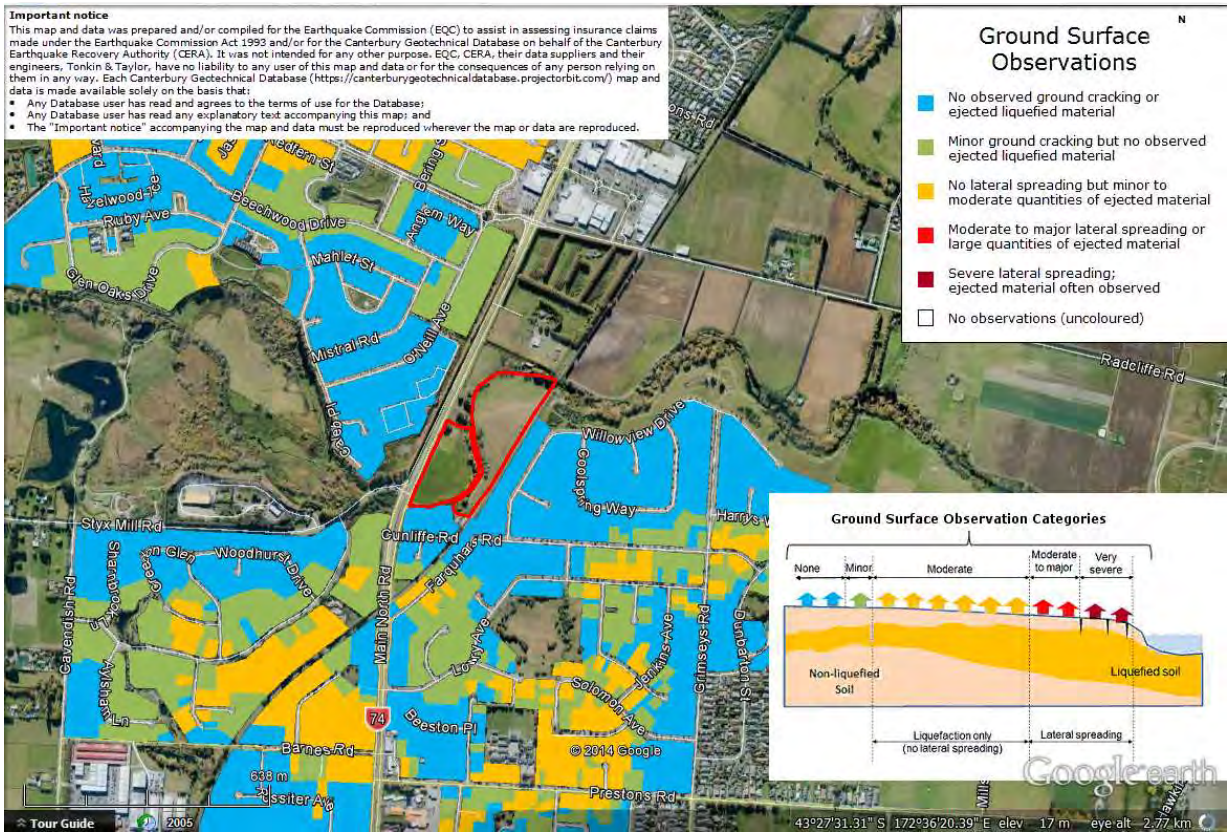
Digitized Ground Crack Locations following the 4 Sept 2010 and 22 Feb 2011 Earthquakes. Canterbury Geotechnical Database Map CGD0400 - 23 Jul 2013

N/A

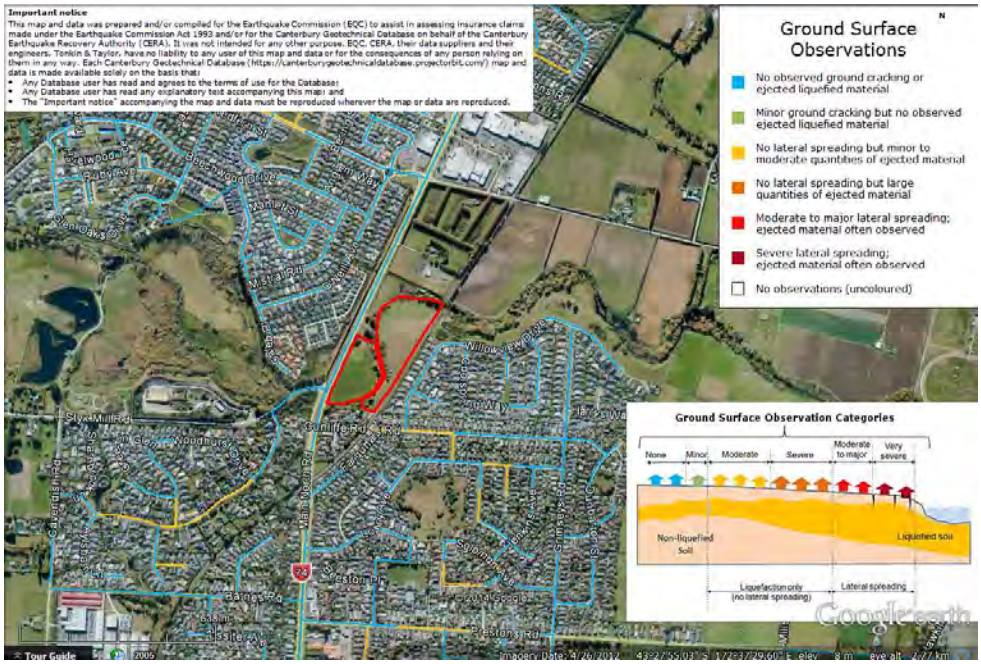
1.13 EQC Liquefaction and Lateral Spreading Observations

Property or road scale maps showing categorised quantities of ejected material and lateral spreading observed after the 4 Sept 2010, 22 Feb 2011 and 13 June 2011 Earthquakes. Canterbury Geotechnical Database Map CGD0300 - 23 Jul 2013

September 2010



June 2011



1.14 EQC Aerial Photography

High resolution aerial photographs of significant areas following each of the major earthquakes. Canterbury Geotechnical Database Map CGD0100 - 01 Jun 2013

4 September 2010

N/A

22 February 2011

13 June 2011

N/A

23 December 2011

1.15 Geotechnical Investigation Data

Coffey - Styx Super Centre Data (15084AB)

Database data and GENZCHRI15602AB:

Note: For the data closest to the site, refer to the folder GENZCHRI15084AB (Styx Super Centre)

2 CONTAMINATED LAND CONSIDERATIONS

2.1 ECan Listed Land use Register (LLUR)

Property Search Results

	Legal Description	Titles	Valuation No
1/15 CUNLIFFE ROAD			
1	Lot 4 DP 17683	CB14K/344, CB18B/463, CB18B/464	2180085500A
2/15 CUNLIFFE ROAD			
2	Lot 4 DP 17683	CB14K/344, CB18B/463, CB18B/464	2180085500B

Thank you for your enquiry.

The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel.

If you would like a property statement, please fill in your details below.

Property Search Results

	Legal Description	Titles	Valuation No	
470 MAIN NORTH ROAD				
1	Section 1 SO 373925	326255	2191700109	

Thank you for your enquiry.

The Listed Land Use Register does not currently have any information about a Hazardous Activities and Industries List site on this land parcel.

If you would like a property statement, please fill in your details below.

2.2 Christchurch Landfill Sites

F:\GENZ\Projects\CHRI Desk study\Desk study resources\CCC landfill sites list & plan

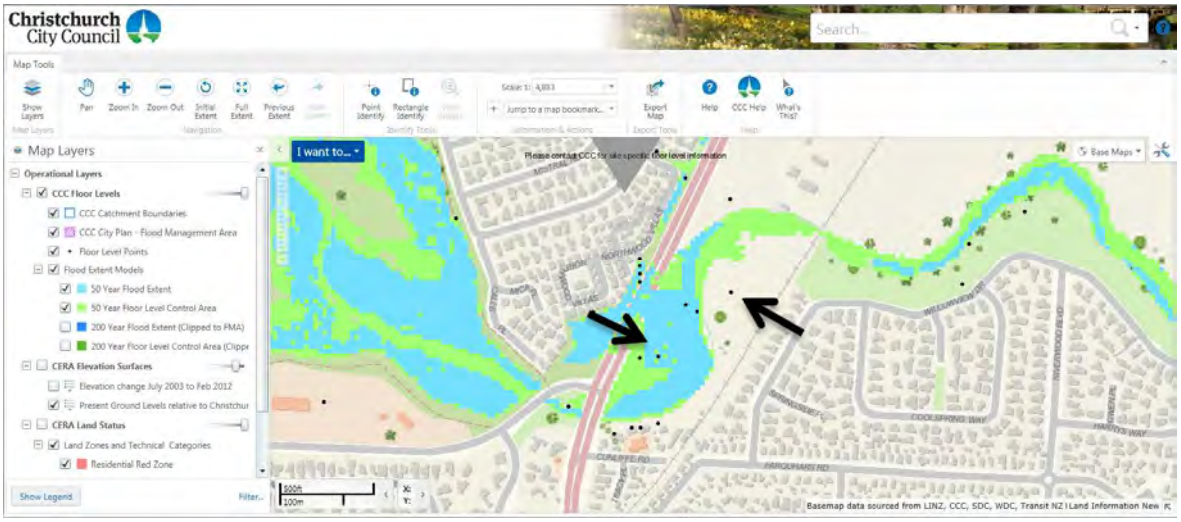
Site within 50m of CCC landfill site	Map does not extend as far as the site
Site located on a CCC landfill site	Map does not extend as far as the site
Type of fill	Map does not extend as far as the site
Details of landfill (from site list)	Map does not extend as far as the site

3 EXISTING INFORMATION

N/A

4 CCC FLOOD MANAGEMENT AREA

http://www.ccc.govt.nz/homeliving/goaheadbuildingplannings00/buildingandplanningprojects-s02/property-s02s0305/floorlevels-s02s0305-08.aspx



5 NEARBY COFFEY PROJECTS

\\CHRIFS02.corp.coffey.com.au\Data$\GENZ\Projects\Project Locations\CoffeyProjects.kmz

6 SITE SUMMARY

The site is located within the suburb of Redwood, approximately 8.1 kilometres from the Christchurch city centre. The Styx River runs through the site in a northeast to southwest direction.