Darfield Residential Deferred Zones

Selwyn District Council

Geotechnical Desk Study

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RE323

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Document history and status

Revision	Date	Description	By	Review	Approved
A	24/05/2019	Preliminary Issue	K Bartram	C Watts	C Redmond
B	10/06/2019	Issued to Client	K Bartram	M Engel	C Redmond
C	17/06/2019	Final Issue	K Bartram	M Engel	C Redmond

Contents

Important note about your report

The sole purpose of this report is to present the findings of a geotechnical investigation carried out by Jacobs for Selwyn District Council ('the Client') for the Darfield Residential site(s) ("The Sites"). This report was produced in accordance with and is limited to the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

An assessment or study of on-site conditions investigates the potential for exposure to the presence of sub-surface hazards. All reports and conclusions that deal with sub-surface conditions are based on interpretation and judgement and as a result have uncertainty attached to them. You should be aware that this report contains interpretations and conclusions which are uncertain, due to the nature of a desktop investigation. No study can investigate every risk, and even a rigorous assessment and/or sampling programme may not detect all problem areas within a site.

This report is based on assumptions that the site conditions as revealed through the desktop study are indicative of conditions throughout the site. The findings are the result of standard assessment techniques used in accordance with normal practices and standards, and (to the best of Jacobs' knowledge) they represent a reasonable interpretation of the current conditions on the site.

Conditions encountered when site work commences may be different from those inferred in this report, for the reasons explained in this limitation statement. If site conditions encountered during site works are different from those anticipated following Jacobs' desktop investigation, Jacobs reserves the right to revise any of the findings, observations and conclusions expressed in this report.

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

This report does not address environmental or geo-environmental issues including the presence of any contaminants or hazardous materials at the site unless Jacobs was specifically and expressly retained to do so.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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1. Introduction

This report has been prepared for Selwyn District Council (SDC) by Jacobs New Zealand Ltd (Jacobs). It presents a Geotechnical Desk Study for sites within the Darfield township which have been given “deferred” status. The deferred status can be lifted if an Outline Development Plan is developed for the sites and included in the District Plan.

1.1 Objective

This report aims to identify potential sub-surface hazards on the sites and an interpretation of the likely geological and geotechnical conditions has been provided. The report assesses possible geotechnical impact on the design of future residential developments at the sites.

1.2 Scope of Work

The scope of work comprised:

- Review of the following information:
  - Local geology based on geological maps;
  - Ground water level from monitoring wells;
  - Historical use of the sites based on aerial photography;
  - Seismicity, liquefaction and ground cracking; and
  - Ground conditions from nearby ground investigation data.
- Produce a report of the findings from the desk study and identify any considerations for future development on the sites.

2. Site Description

A total of eight sites within the Darfield township have been highlighted by SDC as having been given deferred status, these are shown in Appendix A. In the north of the township, two sites labelled by SDC as L2 Def and L2A Def will be referred to as L2 Def in this report. The site defined as LX Def below has been combined with the site to the south, labelled as L2A Def. This combined site is referred to collectively as LX Def throughout this report. Four smaller sites lie between these two, these have been labelled as sites A, B, C & D from west to east, and referred to as such within this report. The study area sites are predominantly farmland, often adjacent to existing residential areas. These sites are shown in Figure 2.1.

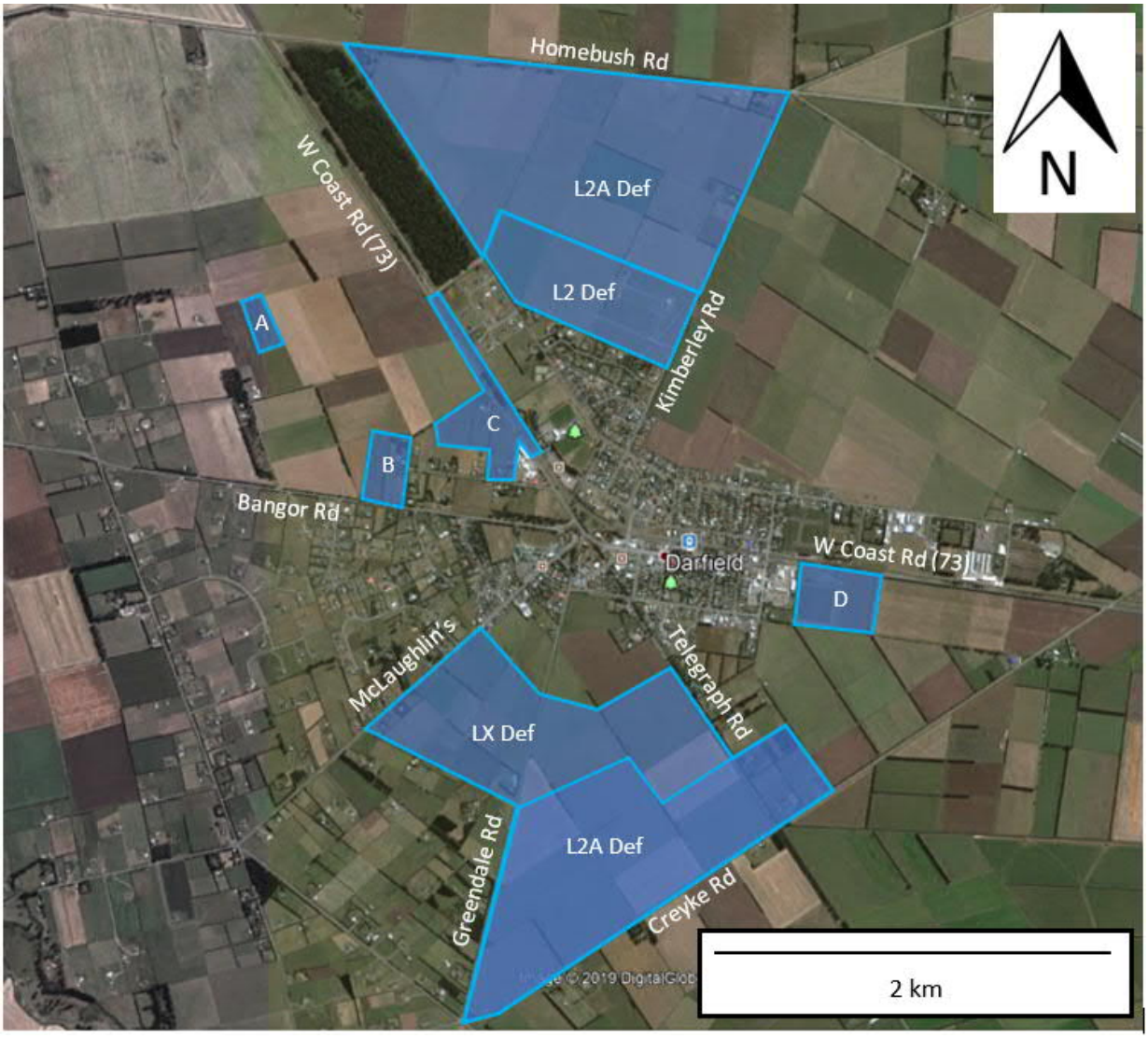


Figure 2.1: Location of the deferred sites in Darfield

3. Available Geotechnical Information

3.1 Regional Geology

The Institute of Geological and Nuclear Sciences (GNS) 1:250 000 geological map[1] of Christchurch shows the sites to be underlain by "Brownish-grey river alluvium" (Q2a). This is shown in Figure 3.1, with the location of the sites highlighted in blue.

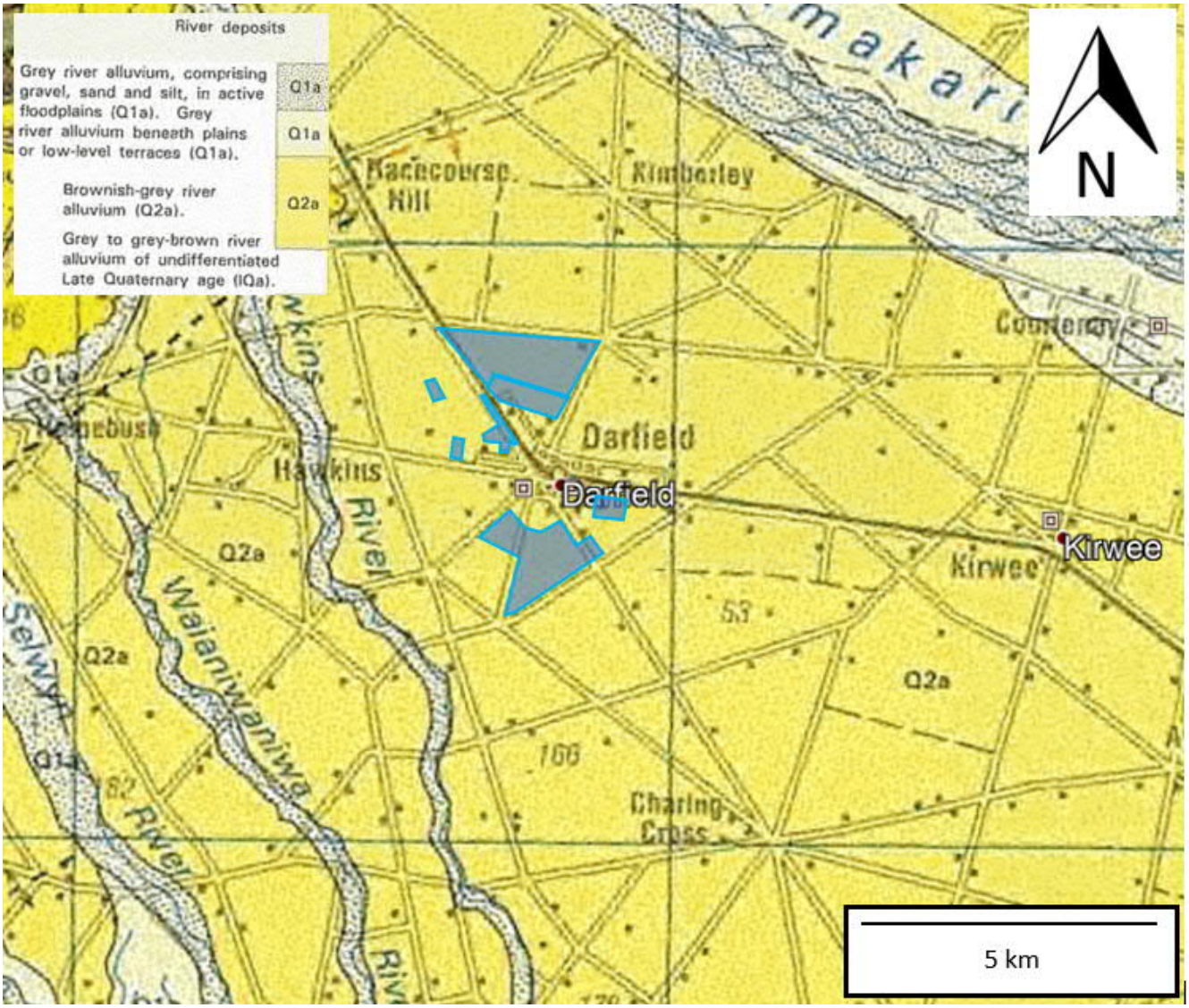


Figure 3.1: GNS 1:250,000 geological map 16 - Christchurch – Site extents highlighted in blue

[1] Christchurch – 1:250 000 Geological Map 16, (2008) Institute of Geological and Nuclear Sciences

3.2 Groundwater

Groundwater data is available from various wells near the sites via the ECan well database. The wells are predominantly cased to a significant depth (>100 mbgl) and not deemed to be relevant to this report. Three boreholes have been found with groundwater levels that are believed to be indicative of the level in the area. These positions are all more than 1 km from the study area (approximately 1.25 – 1.75 km) and shown in Figure 3.2. None of the ground investigation logs in the area (discussed in Section 5) record encountering ground water. These investigations are all shallow hand augers or trials pits with the deepest being 3.0 mbgl.

The sites sit between the Waimakariri and Hawkins Rivers, which are approximately 5 km and 2 km from the extents of the study area, respectively. The topographical map of this area shows both rivers to be running at a lower ground level than the sites, approximately 25 m for the Waimakariri and 10m for the Hawkins River. This may also suggest that the ground water level across the area is low (i.e. >10 mbgl), which corresponds with the lower groundwater levels stated in the wells shown in Figure 3.2.

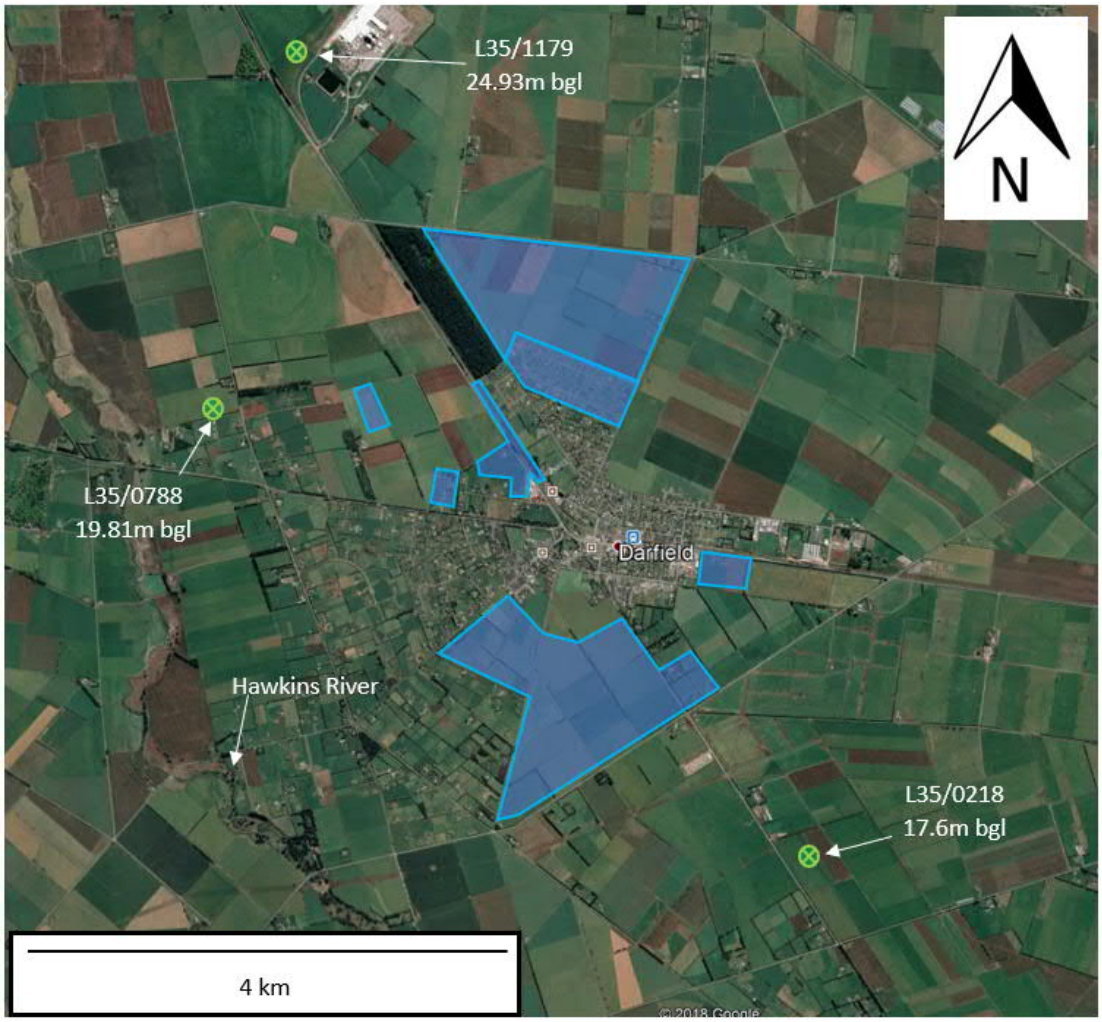


Figure 3.2: Groundwater levels near the sites. The highest recorded levels are listed next to each position.

3.3 Historical Aerial Photographs

The earliest historical photographs available for the Darfield area are from 1940-44, showing the sites are predominantly farmland.

L2 Def

- Small residential area in the corner of the site between Homebush and Kimberley Road. There is development here on all historical photographs from 1940-44 onwards.
- Residential building adjacent to Kimberley Road which is still present and is first visible on the 1975-79 photographs.
- The southern end of the L2 Def site currently has Whitcombe Place and Landsborough Drive running through it. Both roads have residential developments along them which appears to have started on the eastern end of the plot and is first visible in the 1995-99 photographs, expanding west in the 2010-15 photos.

LX Def

- Site LX Def has some smaller developments immediately east of Mclaughlin's Road and Telegraph Road. These developments consist of small residential buildings which are constructed gradually throughout the period the aerial photographs are available.

Zones A, B, C & D

- There is a small building in the north west corner of zone A, this first appears in the 2010-15 photograph.
- A residential development first becomes visible in Zone B on the 1980-84 photographs, this appears to still be present today.
- In Zone C there is a building present currently, adjacent to the West Coast Rd that is first visible on the 2010-15 photographs.
- The current residential development on Zone D, adjacent to West Coast Road, is first visible on the 1995-99 images.

Figure 3.3: Comparison between 1940-44 (Left) and 2018 (right) – The zones are outlined in blue in each image[2]

[2] Canterbury Maps Viewer, (2015): Available at; https://mapviewer.canterburymaps.govt.nz/

4. Seismicity and Liquefaction

4.1 Active Fault Lines

The GNS have mapped known active fault lines in the Canterbury region[3]. This shows that the closest known, active fault line to the sites is the Hororata Fault. This fault lies approximately 2.5 km northwest of the sites as shown in Figure 4.1, limited information is available about its historical activity. The Greendale Fault is approximately 11 km to the south of the sites. The last recorded rupture of this fault was the Darfield Earthquake which occurred on the 4th of September 2010. This earthquake struck with a magnitude of 7.1 and caused a 5 m horizontal and 1 m vertical offset of the ground surface. The epicentre of this earthquake was to the south-east of the Darfield township.

Figure 4.1: Closest active fault lines to the sites. The Darfield area is marked in blue (GNS 2015).

4.2 Regional Liquefaction, Lateral Spreading and Ground Cracking

Canterbury Maps[4] have undertaken liquefaction mapping based on aerial photographs, they have marked the sites and surrounding area as being unlikely to be subject to damaging liquefaction. The maps highlighting areas of concern for lateral spreading and ground cracking do not show anything in this area.

[3] Geological & Nuclear Sciences (2015) Available at: http://data.gns.cri.nz/af/
[4] Canterbury Maps (2011) Available at https://mapviewer.canterburymaps.govt.nz/

5. Previous Geotechnical Investigations

The historical ground investigations in the area are shown in Figure 5.1 and have identified alluvial gravels across the study area. The gravel layer is overlain with alluvial silt, the thickness of which is greatest at the southern end of the sites where the silt is recorded as up to 0.7 m thick (TP47477-80). Investigations further north show the silt thickness decreases and is as low as 0.3 m thick in hand augers undertaken approximately 150 m south of the L2 Def zone. The silt layer is not recorded in the trial pits to the North of L2 Def (TP-47443-47).

Figure 5.1: Positions of historical Ground Investigations in relation to the sites

There are further ground investigation positions in the area that have not been included in this report. These are often hand augers which are not deep enough to confirm the depth of the overlying silt. The findings match those in the investigations included. The investigations in the area that have been included within the report are listed in Table 5 1.

Table 5 1: Details of previous geotechnical investigations within the vicinity of sites (NZGD)

Reference	Date	Coordinates		Ground Level (mRL)	Termination Depth (m)
		Easting (mE)	Northing (mN)		
TP-47443	08/01/13	-43.4677	172.1232	-	2.5
TP-47444	08/01/13	-43.4677	172.1232	-	3.0
TP-47445	08/01/13	-43.4677	172.1232	-	2.9
TP-47447	08/01/13	-43.4677	172.1232	-	3.0
44747	10/04/13	-	-	-	3.0
TP-47477	23/04/13	-	-	-	2.8
TP-47478	23/04/13	-	-	-	2.3
TP-47479	23/04/13	-	-	-	2.4
TP-47480	23/04/13	-	-	-	2.5

The engineering descriptions given in the investigations available give limited descriptions of the in-situ density of the silt and gravel layers. A considerable amount of scala tests have been undertaken in the silt layer, giving an indication of the density of the strata. Limited scala values are recorded in the gravel layer due to the tests getting shallow refusal in that layer. The engineering soil decriptions and scala values obtained from the test pits included in this report are shown in Appendix B**.**

The scala results in the silt layer vary from 4 – 12 blows per 100 mm, suggesting that this material is stiff to very stiff. The gravel layer is described as being well graded. This description along with the test refusals in the layer suggest that this material is dense.

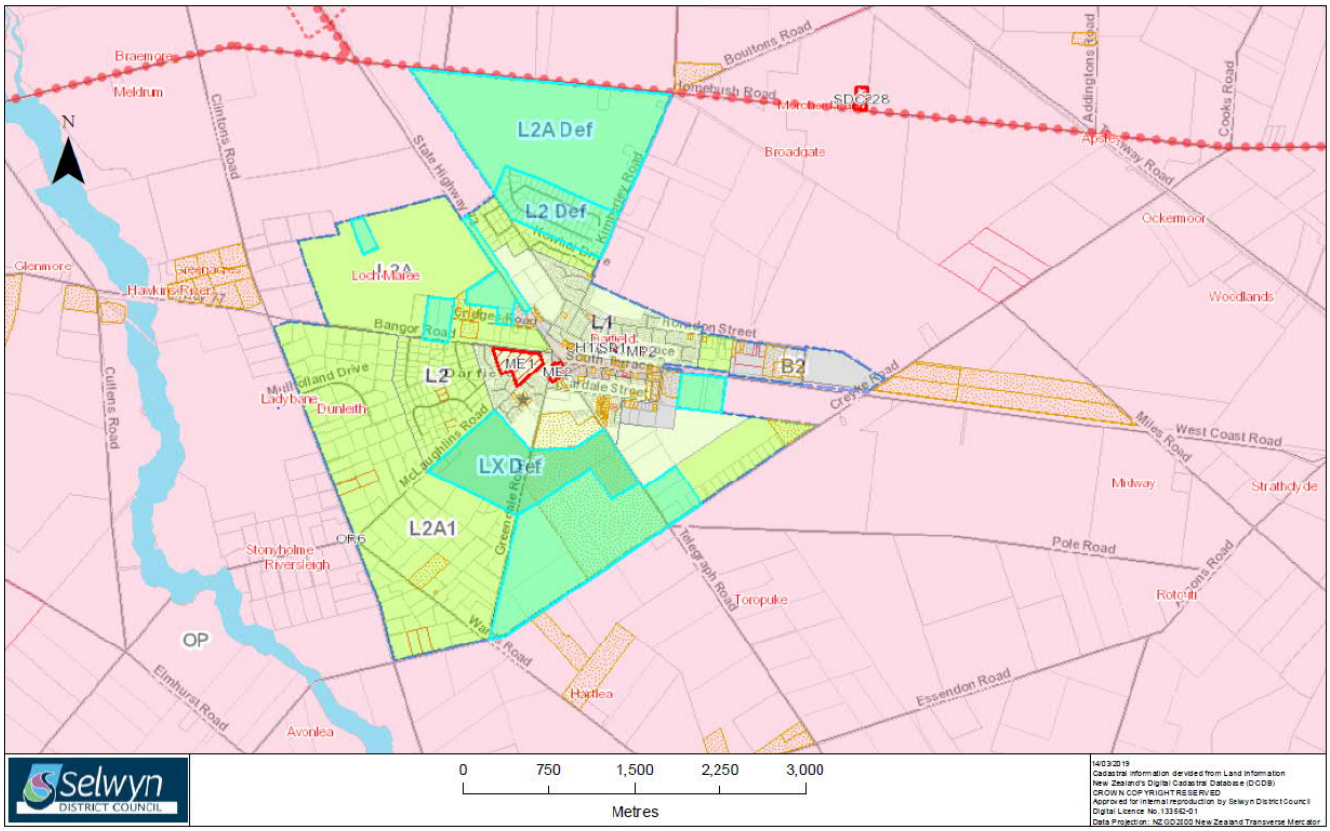
6. Conclusions

The sites are predominantly underlain by alluvial gravel which appears to be well graded and dense. There is also a layer of stiff silt overlying this in the southern end of the sites. The silt layer is not present in the ground investigation records to the north and is thickest to the south (0.7 m thick). The sites are however considered to be at risk of seismic activity, it is approximately 2.5 km and 11 km from the Hororata and Greendale fault lines respectively.

The groundwater level in the area appears to be deeper than 15 mbgl and is not considered to be a potential issue. The depth of groundwater suggest that liquefaction will not be an issue on the sites. Due to this, removal of the alluvial silt present in the southern end of the sites is not thought to be necessary. However, any soft spots should be removed and replaced with appropriate engineered fill.

This report has not identified any geotechnical constraints that may affect the lifting of the deferred residential status of the sites. There are also no site-specific rules to be carried through to the Outline Development Plan from the findings of this investigation.

Appendix A. Zone Layout (SDC, 2019)



Appendix B. Scala Test Results

Depth (mbgl)	TP 47443 Soil Description	Scala Blows	TP 47444 Soil Description	Scala Blows	TP 47445 Soil Description	Scala Blows	TP 47447 Soil Description	Scala Blows
0.1	SILT; dark brown. Low plasticity [TOPSOIL]	5	SILT; dark brown. Low plasticity [TOPSOIL]	6	SILT; dark brown. Low plasticity [TOPSOIL]	5	SILT; dark brown. Low plasticity [TOPSOIL]	4
0.2		6		7		5		5
0.3		10		10		7		12
0.4		12	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey, rounded, well graded. Sand is medium to coarse		Sandy fine to coarse GRAVEL with minor cobbles; brownish grey, rounded, well graded. Sand is medium to coarse		Sandy fine to coarse GRAVEL with minor cobbles; brownish grey, rounded, well graded. Sand is medium to coarse	
0.5	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey, rounded, well graded. Sand is medium to coarse							
1								
1.5								
2								
2.5								
3								

Depth (mbgl)	TP 47477 Soil Description	Scala Blows	TP 47478 Soil Description	Scala Blows	TP 47479 Soil Description	Scala Blows	TP 47480 Soil Description	Scala Blows
0.1	SILT with trace rootlets; brown. [TOPSOIL]	2	SILT with trace rootlets; brown. [TOPSOIL]	1	SILT with trace rootlets; brown. [TOPSOIL]	1	SILT with trace rootlets; brown. [TOPSOIL]	1
0.2		2		2		1		1
0.3		1		3		4		2
0.4	SILT with some gravel; brown. Fine to medium gravel, subrounded to subangular	5	SILT with some gravel; brown. Fine to medium gravel, subrounded to subangular	4	Sandy fine to medium GRAVEL with some silt; brown. Gravel well graded, subrounded to subangular. Sand poorly graded	7	Sandy SILT with minor gravel; brown. Fine to medium gravel, well graded, subrounded to subangular. Sand poorly graded	5
0.5		11		10		7		12
0.6			Sandy fine to coarse GRAVEL with trace silt; brown. Gravel well graded, subrounded to subangular. Sandy poorly graded			8	Sandy fine to coarse GRAVEL with trace silt; brown. Gravel well graded, subrounded to subangular. Sand poorly graded	12
0.7					Sandy fine to coarse GRAVEL with trace silt; brown. Gravel well graded, subrounded to subangular. Sandy poorly graded	12		
0.8	Sandy fine to medium GRAVEL with minor silt; brown. Gravel well graded, subrounded to subangular. Sand poorly graded							
0.9								
1								
1.1								
1.2								
1.3	Sandy fine to coarse GRAVEL with trace silt; brown. Gravel well graded, subrounded to subangular. Sand poorly graded							
1.4								
1.5								