Leeston 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 Leeston 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.

This report has been prepared on behalf of, and for the exclusive use of, the Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

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 two sites within the Leeston 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

This report covers two deferred sites, labelled L1 Def and L2 Def by SDC, and are referred to as such in this report. The sites are to the western edge of the township and predominantly run between High Street to the south and Leeston Dunsandel Road to the north. A section of L2 Def also continues north of Leeston Dunsandel Road, as shown in Figure 2.1. Ellesmere College campus lies immediately to the East of the L2 Def site. There is a development on the site to the west of the College. Other than this development, the area is predominantly farmland.

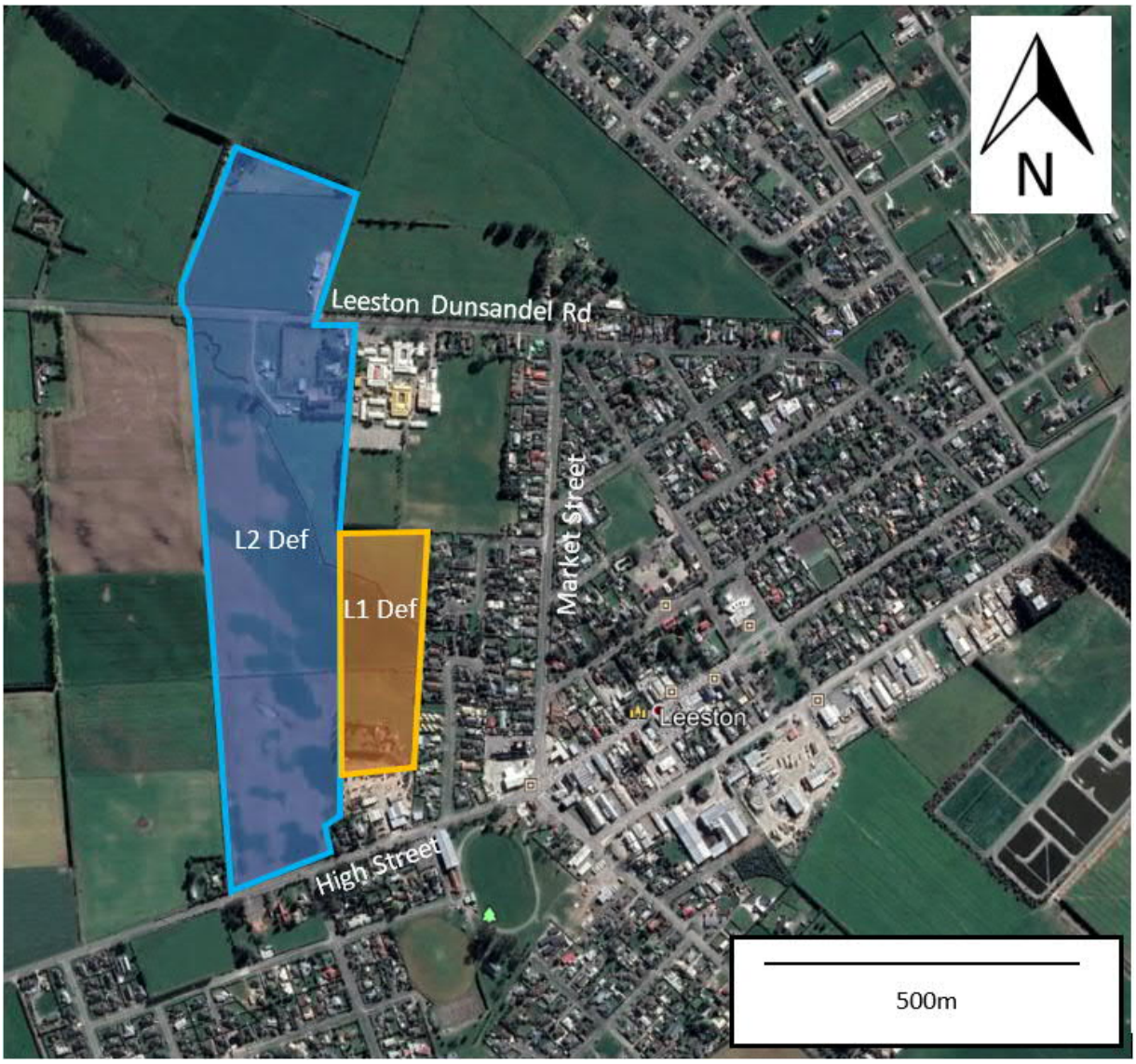

Figure 2.1: Location of the L1 Def and L2 Def sites to the west of Leeston

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 “Beach gravel and sand of post glacial shorelines, including those of Lake Ellesmere” (Q1b). This is shown in Figure 3.1, with the location of the sites highlighted in blue.

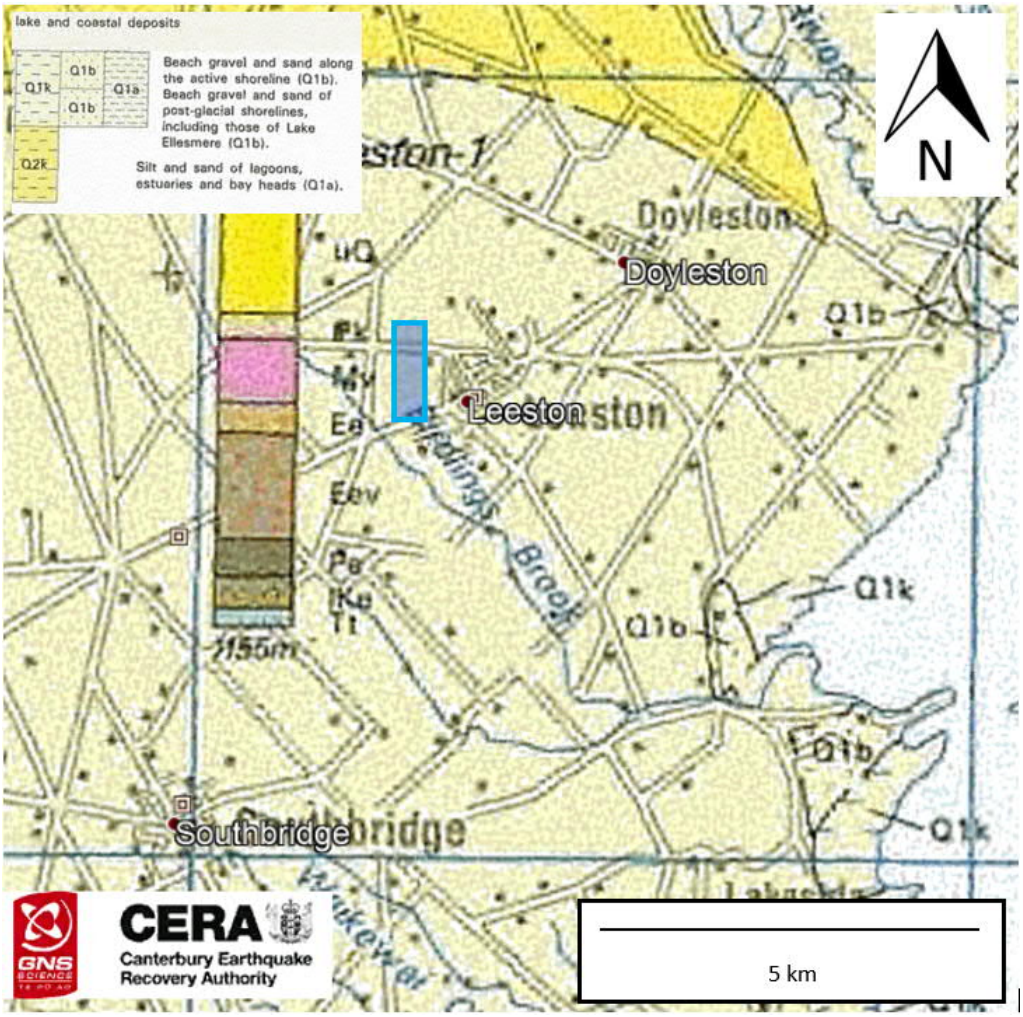

Figure 3.1: GNS 1:250,000 geological map 16 - Christchurch – Sites highlighted in blue

[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. One of the ground investigation locations in the area also recorded a groundwater level reading. The locations of these positions are shown in Figure 3.2, where the shallowest reading recorded for each position is listed.

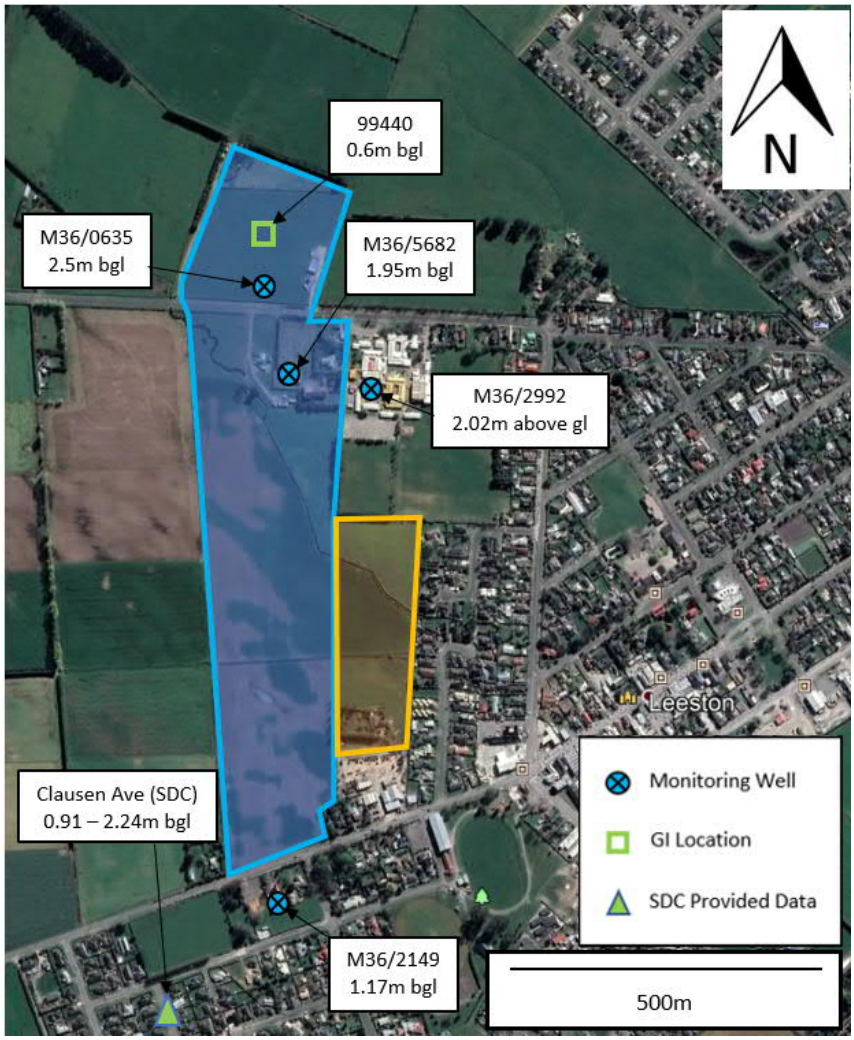

Figure 3.2: Groundwater reading locations and highest groundwater level recorded at each well

The groundwater readings recorded near the sites show a range of values from 0.6-2.5 m below ground level (bgl). Well M36/2992 which lies to the east of the L2 Def site shows readings of up to 2.02 m above ground level however, this well is measuring the pressure head of artesian ground water from 65 mbgl. SDC have provided groundwater data and a point on Clausen Avenue has been included within this report and shown on Figure 3.2. Automatic monitoring data has been provided for this position and shows the highest groundwater reading in this area within the last two years to be 0.91 mbgl.

A stream runs from northwest to southeast across the sites, this picks up stormwater runoff from a drainage ditch to the north of Leeston Dunsandel Road. Although the southern portion of the stream appears to be manmade, its alignment is consistent through the historical photographs back to 1940. No signs of this stream overflowing are evident on the historical photographs.

3.3 Historical Aerial Photographs

The historical aerial photographs from 1940-44 show the sites are predominantly farmland. The area of present-day development to the south of Leeston Dunsandel Road has some development at the time of these photographs. The southernmost building currently present is in place, as well as two smaller buildings adjacent to Leeston Dunsandel Road, as shown in Figure 3.1.

Development in the area to the north of Leeston Dunsandel Road first appear in the 1975-79 aerial photographs. A building is constructed at this time, which does not appear to be either of the existing buildings. This remains until the 2010-15 images, which show the buildings that are currently in place. The area to the south of the Leeston Dunsandel Road also appears to undergo most of its current development in recent years, with two of the three buildings currently present only appearing from 2010-15 onwards.

Figure 3. 1 - Comparison between 1940-44 (left) and 2018 (right) – The site is outlined in orange and blue in each image (ECan, LINZ & Statistics NZ, n.d.)[2], (Google Earth, 2018).

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

4. Seismicity and Liquefaction

4.1 Active Fault Lines

GNS have mapped known active fault lines in the Canterbury region[3]. The closest known active fault line to the sites is the Greendale fault, which is approximately 18 km to the north of the sites as shown on Figure 4.1. The last recorded rupture of this fault occurred on the 4th of September 2010 in the Darfield earthquake. This earthquake struck with a magnitude of 7.1, caused a 5 m horizontal and 1 m vertical offset of the ground surface.

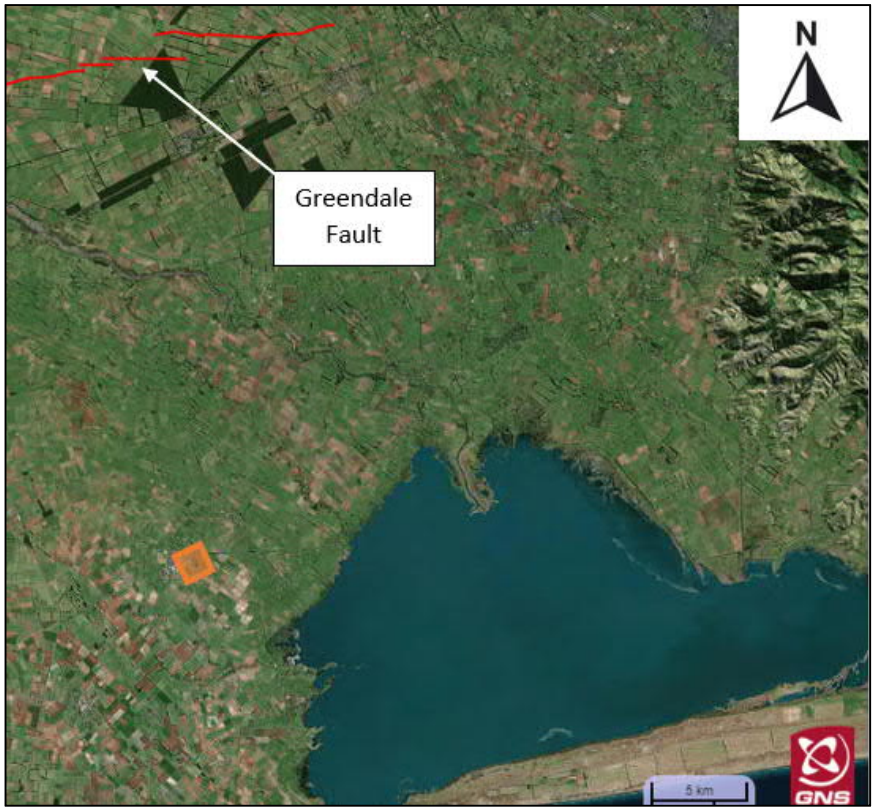

Figure 4.1: Closest active fault lines to the sites. The sites are marked in orange (GNS 2015)

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 identifying areas of concern for lateral spreading and ground cracking do not show anything in this area. However due to the low plasticity silts reported in the nearby investigations (discussed in Section 5) as well as the high groundwater in the area, liquefaction should be considered for future developments on the sites.

[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, these show a layer of alluvial silt immediately below the topsoil in the area. Most of the investigations only encounter the alluvial silt layer, however the trial pit (99440) in the L2 Def area, to the north of Leeston Dunsandel Road, logs an underlying deposit of dense sandy gravel. The borehole log for well M36/5682 shows this gravel layer extends to 11 mbgl, the termination depth of the borehole.

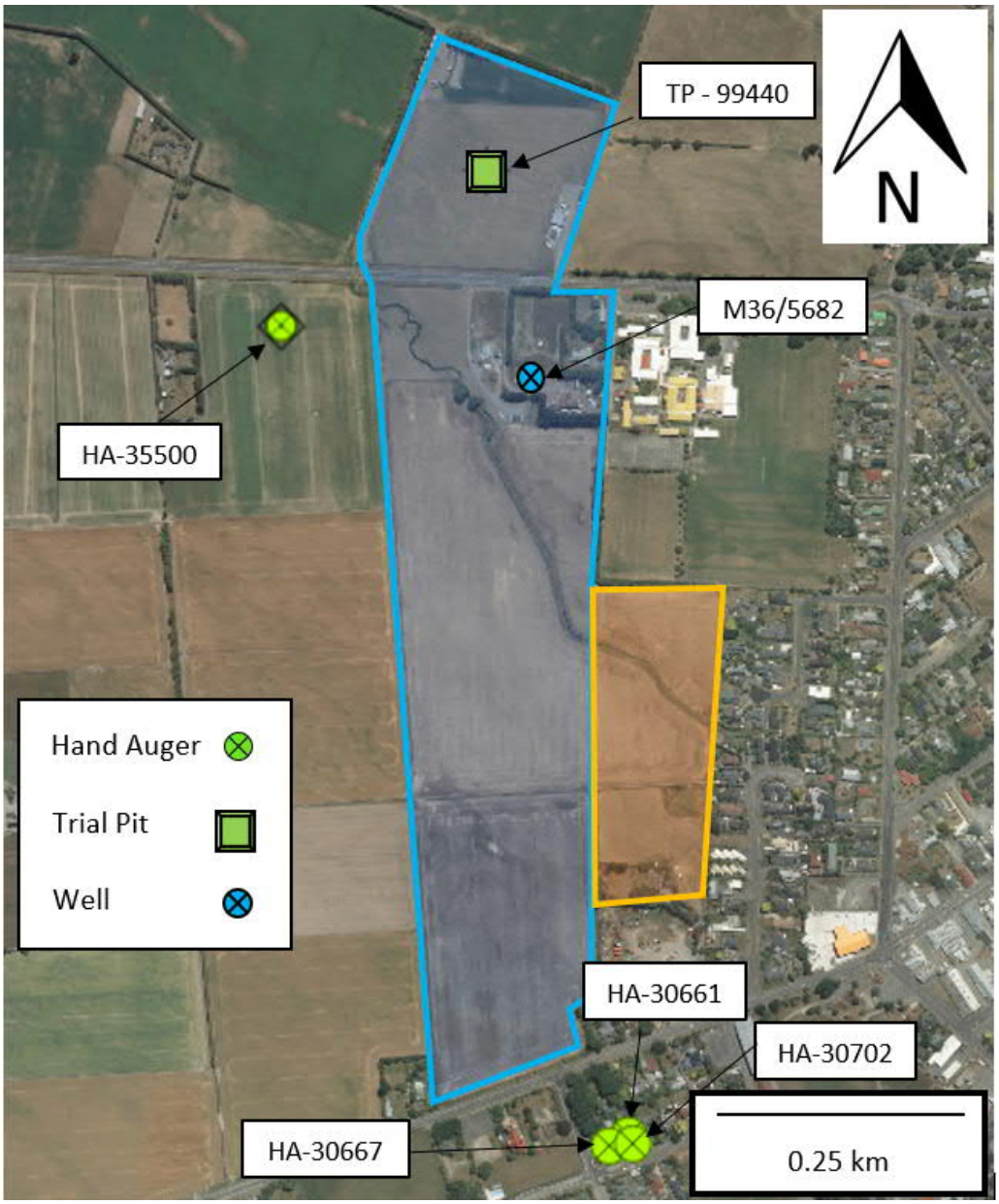

Figure 5.1: Positions of historical Ground Investigations in relation to the sites

The two positions that encountered the gravel, record the base of the silt layer at depths of 0.6 and 1.2 mbgl. The positions that terminated in the overlying silt varied in depth between 0.4 – 1.2 mbgl. A summary of the previous ground investigations is given 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)		
99440	08/08/17	1542833	5154999	26	1.6
35500 – HA1	22/01/13		-	-	0.6
35500 – HA2	22/01/13	-	-	-	0.5
35500 – HA3	22/01/13	-	-	-	1.2
35500 – HA4	22/01/13	-	-	-	0.4
35500 – HA5	22/01/13	-	-	-	0.6
30667	16/04/12	1542969	5153906	28	1.2
30661	16/04/12	1542990	5153918	28	1.3
30702	16/04/12	1542995	5153910	28	1.2
M36/5682	28/09/98	1542872	5154765	22.4	11.0

The geological descriptions from the investigations listed above are consistent across the sites. They show a sandy gravel, overlain by low plasticity silt. The descriptions and Scala values are given in Table 5.2 and Table 5.3.

The ground information available is limited in terms of depth, however it is consistent with the information presented on geological maps for the area. The geological descriptions available show the gravel to be classed as dense. The scala readings in the silt layer show this material to be soft at shallow depths, gaining stiffness with depth.

Table 5.2: Summary of Scala Results – 35500 HA1-4

Depth (mbgl)	35500 – HA1 Soil Description	Scala Blows	35500 – HA2 Soil Description	Scala Blows	35500 – HA3 Soil Description	Scala Blows	35500 – HA4 Soil Description	Scala Blows
0.1	SILT with trace gravel, organics and rootlets; light brown [TOPSOIL]	2	SILT; with trace organics and rootlets; brown [TOPSOIL]	2	SILT; dark brown. Low plasticity. [TOPSOIL]	2	SILT; with trace organics and rootlets; brown [TOPSOIL]	2
0.2		2		3		3		5
0.3		3		4		5		7
0.4		6	Silt with trace gravel and organics; brown with orange mottles.	6		6		14
0.5	SILT with trace gravel; greyish brown with orange mottles.	13		14	SILT with trace gravel; greyish brown with orange mottles.	8		
0.6		14				12		
0.7						7		
0.8						6		
0.9						11		
1						8		
1.1						10		
1.2						14		

Table 5.3: Summary of Scala Results – 35500 HA5, 30667, 30661, 30702

Depth (mbgl)	35500 – HA5 Soil Description	Scala Blows	30667 Soil Description	Scala Blows	30661 Soil Description	Scala Blows	30702 Soil Description	Scala Blows
0.1	SILT with trace rootlets; brown [TOPSOIL]	3	Organic SILT (TOPSOIL), dark brown. Soft, moist, low plasticity	1	Organic SILT (TOPSOIL); dark brown. Soft, moist. low plasticity	1	Organic SILT (TOPSOIL); dark brown. Soft, moist. low plasticity	2
0.2		3		3		1		3
0.3		5		2		2		3
0.4	SILT; greyish brown with orange mottles. *Trace gravel encountered from 0.5m depth	7		3		2		3
0.5		8	Clayey SILT, brownish yellow with orange mottling. Firm, moist, low plasticity	3		3	Clayey SILT, brownish yellow with orange mottling. Firm, moist, low plasticity	5
0.6		14		3	Clayey SILT, brownish yellow with orange mottling. Firm becoming soft below 0.9 mbgl, moist, low plasticity	3		6
0.7				3		3		7
0.8				3		4		8
0.9				3		4		8
1				5		4		7
1.1			Clayey SILT with minor gravel, brownish yellow with orange mottling. Firm, moist, low plasticity	8		6		8
1.2				4		7		17
1.3				10		18		
1.4				14				
1.5				14				
1.6				18				

6. Conclusions

The sites predominantly consist of sandy gravel as described by the geological maps and corroborated by the available ground investigation logs. This layer appears to be overlain by a low plasticity silt which has a maximum depth of 1.2 mbgl in the available ground investigation logs. The scala penetrometer results recorded for the underlying gravel show this to be a dense material.

Groundwater at the sites is relatively shallow, with readings as shallow as 0.6 mbgl recorded. No issues have been identified with the sites in the historical photographs. Some development in the project area has taken place to the west of the Ellesmere College campus, however, no historical issues have been identified. There are also no signs of ground damage historically due to seismic activity.

No geotechnical hazards have been identified which would stop the lifting of the deferred residential status. Due to the high groundwater and reported low plasticity of the overlying silt, it is recommended that the removal of this material beneath foundations is included as part of the requirements of the Outline Development Plan for this area. This material is of low strength when saturated and may be susceptible to liquefaction should a seismic event impact the sites. Any material removed should be built back up with engineered fill due to the high ground water level. This formation should then be checked and signed off by an appropriately qualified geotechnical engineer.