ATTACHMENT B

GEOTECHNICAL REPORT

GEOTECHNICAL REPORT FOR PROPOSED PLAN CHANGE

340 Cranford St and 60 Croziers Rd, St Albans, Christchurch

For GM & M Case and RJ & LT Crozier

30 June 2015

Eliot Sinclair

surveyors | engineers | planners

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Table of Contents

1. INTRODUCTION

Eliot Sinclair were engaged by GM & M Case and RJ & LT Crozier undertake a geotechnical investigation and to prepare an interpretive report for the proposed Plan Change 340 Cranford St and 60 Croziers Rd, St Albans, Christchurch.

2. SCOPE OF WORK

The scope of work for this interpretive report was:

- Review available data from Canterbury Geotechnical Database (CGD), Environment Canterbury's GIS database, and the Institute of Geological and Nuclear Sciences (GNS) Active Faults Database,
- Undertake five shallow hand-auger holes to 2.6 to 4.6m below ground level (bgl) across the site,
- Arrange and analyse the data from one cone penetrometer test (CPTu) pushed to 15m bgl at 340 Cranford St,
- Arrange and analyse the data from one CPTu pushed to 10m bgl at 60 Croziers Rd,
- Arrange and analyse the results of one borehole, sampled to 10m bgl at 60 Croziers Rd,
- Prepare a geotechnical report to comment on the general geotechnical conditions encountered across the site, the suitability of the site for proposed plan change and to address the hazards outlined by Section 106 of the Resource Management Act 1991.

3. DISCLAIMER

Comments made in this geotechnical interpretive report are based on information shown on the Canterbury Geotechnical Database, Environment Canterbury's GIS, GNS Active Faults Database, the results of recent deep testing, our inspection of the general area and the Ministry of Business, Innovation and Employment (MBIE)'s guidelines[1].

Whilst every care was taken during interpretation of the subsurface conditions, there may be subsoil strata and features that were not detected. Additionally, on-going seismicity in the general area may lead to deterioration or additional ground settlement that could not have been anticipated at time of writing of this report. The exposure of such conditions, occurrence of additional strong seismicity, or any future updates of the guidelines may require a review or additional investigations. Should this occur then Eliot Sinclair should be advised in order to confirm the recommendations of this report.

This report has been prepared for the benefit GM & M Case and RJ & LT Crozier and the Christchurch City Council in accordance with the Scope of Work.

[1] Ministry of Business, Innovation & Employment. (2012). *Repairing and rebuilding houses affected by the Canterbury earthquakes* (version 3). New Zealand.

No liability is accepted by Eliot Sinclair or any employee of Eliot Sinclair with respect to the use of this report by any other party, for any other purpose other than outlined in the Scope of Work.

This report is specifically prepared for the proposed plan change, and shall not be used for design of foundations and/or building consent. Any future dwelling/s will require site specific geotechnical investigation, assessment and reporting.

4. PROPOSED PLAN CHANGE

This report has been prepared to support a Plan Change (Rural to Residential) for the site at 340 Cranford Street and the adjacent land to the east, referred to in this report as 60 Crozier Road.

This proposed plan change is limited to the higher ground on the site (shown in Figure 1 and Figure 2), which is generally south and east of the *'Floor Level and Fill Management Area'* and *'Flood Ponding'*. A possible subdivision layout for 340 Cranford Street is shown below. The low lying land, i.e the balance of the site would be included with one of the residential lots.

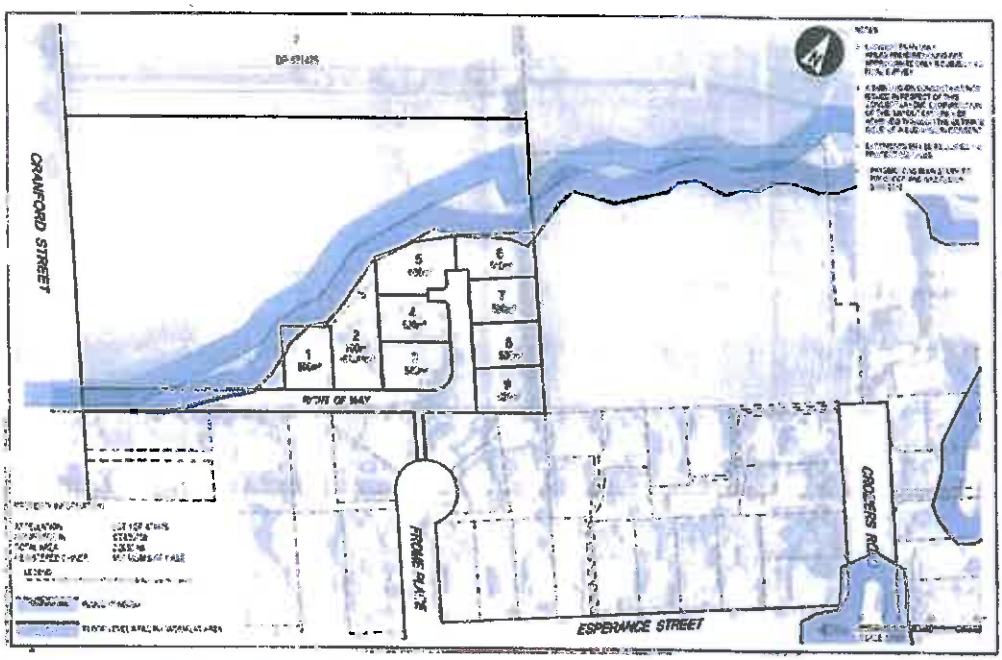


Figure 1: Possible subdivision layout for 340 Cranford Street, Christchurch.

A Possible subdivision layout for 60 Croziers Road is shown in Figure 2.

Figure 2: Possible subdivision layout for 60 Croziers Road, Christchurch.

5. SITE DESCRIPTION

5.1. Location

The site is located approximately 3.6km north of the Christchurch central city and is bounded by Cranford Street to the southwest, Croziers Road to the east, residential lots to the south and farmland to the north.

The site comprises *'Lot 1 Deposited Plan 471475'* to the southwest and is owned by GM & M Case Ltd, with *'Lot 3 Deposited Plan 17794'* and part of *'Section 2 Survey Office Plan 461421'* to the northeast owned by RJ & LT Crozier.

The high ground on the south and southeast parts of the site is an extension of the existing developed residential land.

Refer to Figure 3.

Figure 3: Site boundaries (yellow outline). Photo from 24 February 2011 (source: CGD, June 2015.)

5.2. Existing buildings

There is an existing dwelling located on the Case land and comprises single story, timber frame with concrete brick veneer cladding and a heavyweight tiled roof, over a concrete slab foundation system.

The site also contains a detached market garden shop, and multiple detached sheds used for farming.

A dwelling and further farm buildings located at the east part of the site were not inspected.

5.3. Watercourses

The Dudley Creek Diversion, is located along the northwest and northeast boundary of the site, approximately 110m north of the existing dwelling on the site, and approximately 55m north of the proposed new lot boundaries within the Case land.

The proposed lot boundaries in the Crozier land extend to the upper Dudley Creek Diversion amenity strip. Refer to Figure 3.

5.4. Topography

The site is generally flat, with a slight fall to the northwest of the site, towards the Dudley Creek Diversion.

5.5. Roads

The surface of Cranford Street and Crozier Road appeared to be in good condition for their age.

6. DESKTOP INVESTIGATION

6.1. Geological maps

The geological map of Christchurch indicates the majority of the site is underlain by *'modern river floodplain/low-level degradation tce. Unweathered, variably sorted gravel/sand/silt/clay'* with an area to the southwest underlain by *'peat, silt and sand; in swales between dunes and abandoned river channels'*. Refer to Figure 4.

Figure 4: Geological map of Christchurch[2]

1	***Modern river floodplain/low-level degradation tce. Unweathered, variably sorted gravel/sand/silt/clay. Surfaces <2 degree slope***
2	*Peat, silt and sand; in swales between dunes and abandoned river channels*

6.2. Active faults

The 4 September 2010, M7.1 earthquake occurred on the Greendale Fault, with its eastern limit of surface rupture located around 22km to the southwest.

The 22 February 2011, M6.2 earthquake occurred on a blind fault located under the Port Hills, with its projected intersection with the ground surface located near the lower slopes of the Port Hills. Refer to Figure 5.

The 13 June 2011, M6.0 earthquake was located on a NW-SE fault that is estimated to be approximately parallel to the New Brighton and just off the coast. Refer to Figure 5.

[2] Geological and Nuclear Sciences. *New Zealand geology web map*. Retrieved from http://data.gns.cri.nz/geology/ June 2015.

The site is located well away from known active faults, as recommended by the Ministry for the Environment guidelines.

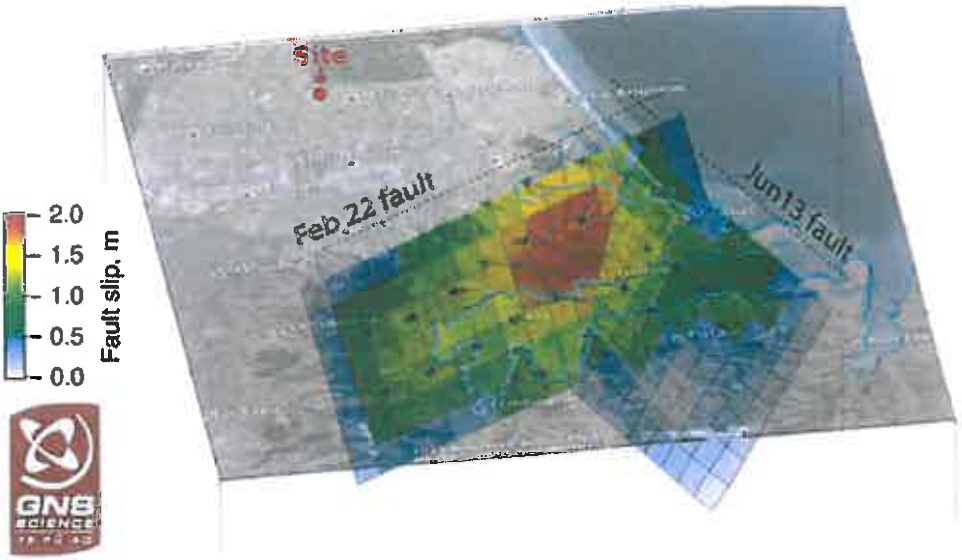


Figure 5: A simplified view of the two faults that caused the earthquakes on 22 February and 13 June 2011 in Christchurch (source: GNS website[3])

6.3. Canterbury geotechnical database

The Canterbury Geotechnical Database (CGD) contains a large range of photographic, topographic, geological, geotechnical, land classification, survey records and field observations that relate to the Canterbury earthquake sequence. The database is coordinated by MBIE. A number of the following comments are associated with information shown on the CGD.

6.4. EQC liquefaction interpreted from aerial photography

The CGD indicates '*no observed liquefaction*' in the 4 September 2010, 22 February 2011 and 13 June 2011 earthquakes, with no '*minor observed liquefaction*' recorded on the Case land after the 13 June 2011 earthquake.

6.5. Conditional PGA for liquefaction assessment

The Ministry for Business, Innovation and Employment's (MBIE) '*Guidance for repairing and rebuilding houses affected by the Canterbury earthquakes*' (December 2012) specifies, for residential land, the peak ground acceleration ($PGA_{M7.5}$) to be adopted for liquefaction assessment in a serviceability limit state (SLS) event as $PGA_{M7.5}$ = 0.13g, and $PGA_{M7.5}$= 0.35g for an ultimate limit state (ULS) event.

The conditional median peak horizontal ground accelerations in the September 2010, February and December 2011 earthquakes exceeded or were close to an SLS event but were less than a ULS event. Refer to Table 1.

[3] Geological and Nuclear Sciences. (2011). *Graphic shows two main Christchurch fault ruptures.* Retrieved from http://www.gns.cri.nz/Home/News-and-Events/Media-Releases/Two-main-faults

Table 1: Comparison of peak horizontal ground accelerations close to site

PGA (horizontal)	SLS (1/25, M7.5)	ULS (1/500, M7.5)	04 Sep 2010 (M7.1)	22 Feb 2011 (M6.2)	13 Jun 2011 (M6.0)	23 Dec 2011 (M5.9)
Design (as of April 2012)	0.13g	0.35g				
Conditional Median PGA			0.20g	0.29g	0.16g	0.20g
Magnitude Scaling Factor (MSF)			1.11	1.41	1.48	1.52
Equivalent to $PGA_{M7.5}$			0.18g	0.20g	0.11g	0.13g

6.6. Well logs

Well M35/14894, located at the south part of the Case land, recorded topsoil to 0.2m, silt to 2.7m over layers of peat and silt to 3.3m bgl where the log terminated.

Well M35/15176, located approximately 15m northeast of the Crozier land, recorded silt to 2m, peat and silt to 5.4m over silt to 6.8m bgl where the log terminated.

Well M35/14893, located approximately 50m north of the Case land, recorded topsoil to 0.2m peat to 1.9m over clayey silt to 3.9m bgl where the log terminated.

Well M35/15177, located near the northwest boundary of the site, recorded peat and silt to 2.4m over grey silt to 6m bgl where the log terminated.

Well M35/12375, located approximately 12m south of the Case land boundary, recorded brown black wet peat soil to 0.5m over brown saturated peat to 3.2m bgl where the log terminated.

Well M35/12579, located approximately 15m northeast of the Crozier land boundary, recorded dark grey wet silt to 2m, black wet silt with some peat to 5.5m over grey saturated silt to 6m where the log terminated.

Well M35/15019, located approximately 25m west of 340 the Case land boundary, recorded gravel and coarse sand to 2.5m, wet peat to 4.8m over we saturated silt to 6m where the log terminated.

Well M35/14895, located approximately 90m south from the Crozier land boundary, recorded topsoil to 0.3m, silt to 0.7m, silt to 3.1m over peat to 3.2m where the log terminated.

6.7. Ground water model

GNS's groundwater model indicates the median depth to groundwater is likely to be around 0 to 1m bgl at the southwest part of the site (on the Case land), lowering across the site to around 2-3m bgl at the southeast part of the site (on the Crozier land). Refer to Figure 6.

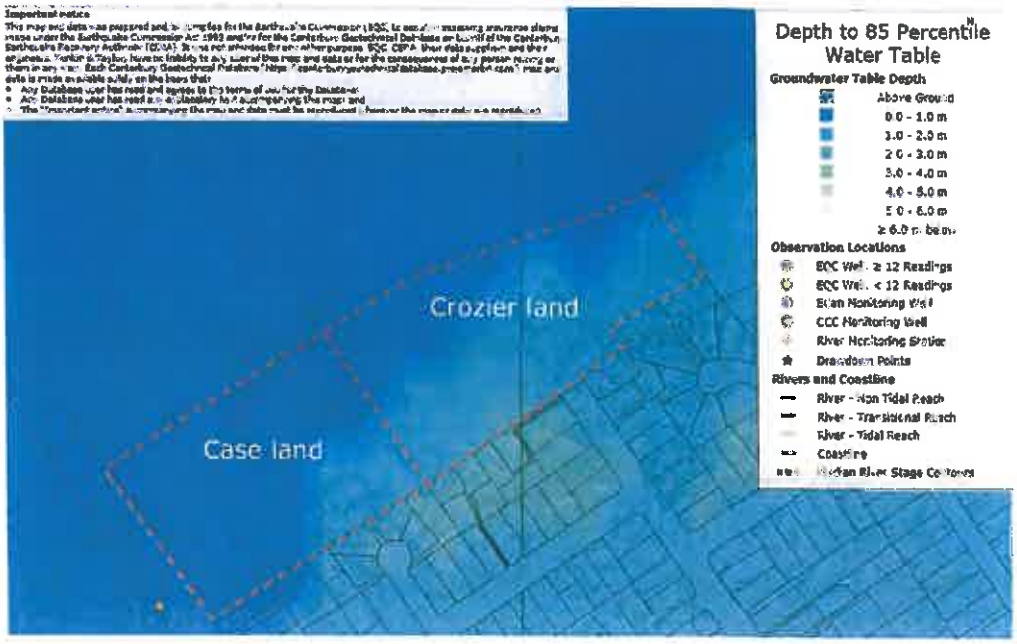


Figure 6: GNS median depths to water table

6.8. *Nearby geotechnical testing*

6.8.1. *Tests shown on the CGD*

There are a number of cone penetrometer tests (CPT) and deep boreholes (BH) shown on the CGD that were undertaken on the site and within the surrounding area, these are:

- CPT_55301 undertaken in February 2013 at 340 Cranford Street, inferred layers of sandy silt and silty sand to 2m, organics to 3m, clay to 6m over gravelly sand and sand to 7.2m bgl where the test terminated.
- CPT_21435, located approximately 35m south of the Case land, which terminated 7.9m bgl.
- BH_20993, located approximately 35m south of the Case land, and recorded sand to 1.5m, peat and organic silt and silt with minor organics to 5.7m over gravel 10.9m bgl where the test terminated.
- CPT_3920 and CPT_14625, located approximately 110m and 115m south of the Crozier land, and terminated at 20m and 10 bgl, respectively.
- BH_25411, located approximately 175m south of the Crozier land, and recorded sand to 4m, silt to 5m, sand to 7m, gravel to 11m over sand to 15.4m bgl where the test terminated.
- CPT_4365, located approximately 190m south of the Crozier land, and terminated at 7.8m bgl.
- BH_18283, located approximately 190m south of the Crozier land, and recorded sand to 2m, silt, peat and organic silt to 5m, sand to 19m and silt to 20m bgl where the test terminated.

6.8.2. *Tests provided by others*

Two CPT's (numbered CPT7 and CPT8) were undertaken across 340 Cranford Street in February 2007, these met practical at around 6.5m bgl.

We were unable to obtain the raw CPT data for these tests and as such they have not been included in our liquefaction assessment in Section 8 of this report.

6.8.3. *Analysis results*

For the sake of brevity the analysis of the CPTu tests and bore logs have not been included in this report but are available for inspection if required.

The locations of the nearby CPT's are shown in Appendix C.

6.9. CERA land classification

The Ministry of Business, Innovation and Employment (MBIE) defines three technical categories for residential foundation design described in its guidance for repairing and rebuilding earthquake damaged homes in Canterbury. These categories apply to liquefaction prone flat land in the green zone in the greater Christchurch urban area and surrounding communities.

The sites are classified by CERA as *'Green Zone, Technical Category N/A, Rural and Unmapped'*, and indicates *'properties in rural areas or beyond the extent of land damage mapping, and properties in parts of the Port Hills and Banks Peninsula have not been given a Technical Category'.*

6.10. Floor level

The site is not shown on the Christchurch City Council (CCC) Floor Level Viewer. However, correspondence from the CCC indicates that *'340 Cranford Street is not within the Christchurch City Plan Management Area (FMA). Minimum Finished Floor Levels (FFL) required are therefore currently assessed based on the 50 year annual recurrence interval (ARI) event for compliance with the New Zealand Building Code. Based on current modelling a minimum FFL of 14.69m RL (Christchurch Drainage Datum) (is) recommended for the site. This is based upon a modelled water level of 14.29m RL'.*

6.11. Proposed District Plan

We note the Christchurch City Council are currently reviewing and updating the existing Christchurch City Plan which includes requirements relating to natural hazards. Stage one of the Proposed Christchurch Replacement District Plan (PCRDP) shows the low lying areas at the northwest part of the site within the *'Floor Level and Fill Management Area'* and the *'Flood Ponding'* area. This low-lying part of the site is excluded from the proposed Plan Change, and as such, is outside the area of geotechnical investigation.

7. SITE INVESTIGATION

7.1. Site investigation density

Section D of MBIE's guidelines[1] recommend that that for sites greater than one hectare, 0.2 to 0.5 (minimum of 5) tests should be undertaken for a Plan Change investigation.

The site area subject to the Plan Change is approximately 5.3 hectares, and the site testing has including two recent CPT's tested to 10 to 15m bgl, three historic CPT's tested to 6.5 to 7.2m bgl, one deep borehole to 10m bgl as well as five shallow hand auger boreholes to 2.6 to 4.6m bgl.

As such, the testing undertaken on the site meets the MBIE guidelines.

7.2. Site inspection

An inspection of the site and surrounding area was undertaken in April and June 2015.

The inspection noted that the surrounding area and houses were in good condition for their age, with no obvious damage evident.

The inspection of the existing dwelling also concluded that there was little damage to the dwelling.

7.3. Floor levels

Floor levels were taken on 26 June 2015 across the existing dwelling at 340 Cranford Street, by Eliot Sinclair and recorded a maximum vertical difference of 54mm across the dwelling, with the general slope down to the southeast part of the dwelling (laundry and adjacent bedroom).

Floor levels were also undertaken market garden shop at 340 Cranford Street and recorded a maximum vertical difference of 32mm across the footprint of the building.

7.4. Shallow testing

In April 2015, Eliot Sinclair investigated the shallow soil conditions across the site with three shallow hand-auger boreholes.

Borehole one encountered topsoil fill to 0.35m, silt to 0.6m over sand to 2.6m bgl where the was terminated due to the test hole collapsing in saturated sand.

Borehole two encountered topsoil fill to 0.5m, layers of silt and sand to 3.1m, peat to 4.2m over silt to 4.6m where the test was terminated.

Borehole three encountered topsoil fill to 0.5m, layers of peat and organic silt to 3.4m, over layers of silt and sand to 4m where the test terminated.

A further two shallow hand-auger boreholes were undertaken across the site in June 2015.

Borehole four and five encountered topsoil to around 0.25m, over layers of sands and silt to around 2.3m, peat and organic silt to around 3.5m over silt with organic material to around 3.8m bgl where the test terminated.

Groundwater was encountered between 1.2m and 1.7m bgl across the site.

Refer to Appendix E for the shallow hand-auger boreholes.

7.5. Deep borehole

One borehole with continuous sampling to 10m bgl was undertaken on the Crozier land in June 2015.

The borehole recorded layers of silts and sands with trace organics and rootlets to 3.3m, over peat and organic silt to 6m, over layers of sand and gravel.

Refer to Appendix F.

7.6. Cone penetrometer testing (CPTu)

In June 2015, one cone penetrometer test was undertaken on the Case's land (CPTu01) and another on the Crozier's land (CPTu02).

The CPTu's generally inferred layers of silty clays, sandy silts and silty sands to around 3m, over clay and silty clay to around 6.5m, over sands and silty sands to 15.1m bgl where the test was terminated.

Refer to Appendix F for the CPTu locations.

8. LIQUEFACTION ASSESSMENT

A liquefaction assessment was undertaken for CPTu01 and CPTu02, refer to Table 2 for the results.

8.1. Method

The calculation of liquefaction triggering was undertaken using the method by Boulanger and Idriss (2014)[4] and the estimation of post-liquefaction induced settlements using the method by Zhang et al (2002)[5].

Based on both the GNS groundwater model and the results of the shallow test holes, the depth to groundwater was assumed for liquefaction-induced '*index*' settlements was 1.2m below ground level.

8.2. Vertical settlement due to liquefaction

Liquefaction-induced '*index*' settlement was calculated using CLiq[6], with the results summarised in Table 2.

[4] Boulanger, R. W. and Idriss, I. M. (2014). *CPT and SPT based liquefaction triggering procedures* (Report No. UCD/CGM-14/01), University of California, Davis, CA, 134 p.
[5] Zhang, G., Robertson, P. K., & Brachman, R. (2002). Estimating liquefaction induced ground settlements from CPT for level ground. *Canadian geotechnical journal, 39(5):* 1168-1180.
[6] CLiq (version 1.7.6.49). (2014). *Computer software.* Serres, Greece: GeoLogismiki.

Table 2: Liquefaction-induced 'index' settlements

Test No. (depth of test)	Test location	SLS (M7.5, 0.13g)	SLS (M6.0, 0.19g)	ULS (M7.5, 0.35g)
CPTu01 (15.1m)	Case land	30mm	47mm	90mm
CPTu02 (10m)	Crozier land	51mm	77mm	112mm
CPT_55301 (7.3m)	Case land	28mm	43mm	52mm
CPT_21435 (7.9m)	~35m south of Case land	84mm	91mm	93mm
CPT_55299 (5.1m)	~50m north of Case land	51mm	54mm	55mm
CPT_3920 (20m)	~110m south of Crozier land	38mm	60mm	106mm
CPT_14625 (10m)	~190m south of Crozier land	34mm	61mm	96mm

The vertical settlements calculated by CLiq[6] use the method by Zhang et al (2002)[5] for a range of parameters that are estimated from the four basic CPT parameters (depth, cone tip resistance, skin friction and pore water pressure) and therefore the settlements shown are not guaranteed or an exact figure.

Liquefaction-induced settlement calculated using event specific conditional median pga values, for the larger Canterbury earthquake events is shown Table 3.

Table 3: Estimated liquefaction- induced settlements based on the Canterbury earthquake sequence. Groundwater at 1.2m bgl

Test No. (depth of test)	4 Sep 2010 M7.1, 0.20g,	22 Feb 2011 M6.2, 0.29g, GW at -2.1m	22 Jun 2011, M6.0, 0.16g, GW at -2.4m	23 Dec 2011 M5.9, 0.20g, GW at -2.4m
CPTu01 (15.1m)	64mm	82mm	36mm	50mm
CPTu02 (10m)	95mm	105mm	55mm	82mm
CPT_55301 (7.3)	48mm	52mm	32mm	46mm
CPT_21435 (7.9m)	92mm	93mm	86mm	91mm
CPT_55299 (5.1m)	54mm	54mm	53mm	54mm
CPT_3920 (20m)	84mm	102mm	40mm	65mm
CPT_14625 (10m)	80mm	90mm	38mm	64mm

Note for comparison, the groundwater was assumed at 1.2m bgl for all the earthquake events.

The liquefaction-induced settlements are over-estimated when compared to what was noted across the site and surrounding area. However, the above assessment indicates that the area was not tested beyond SLS levels in the earthquake sequence and this may be an explanation for some of the lower settlement results.

Further, it is likely that the upper layers of non liquefiable material has acted as a crust, supressing and reducing liquefaction-induced settlement across the ground.

8.3. Ground performance

8.3.1. *Surrounding area*

Inspection of the surrounding land within the developed residential areas northwest of Esperance Street confirmed very littler ground deformation within the existing streets. Further the CGD does not record the presence of CPTu or borehole tests within this area, indicating that the ground performed well and that there was little damage to existing house foundations.

The land is zoned TC2.

The site investigation records that are available within the existing residential area, the Case Land and the Crozier Land all confirm the underlying peat layer below 2.5 to 3.3m which are overlain by silts and sands.

8.3.2. *Existing building platforms*

Levels were undertaken over the floor of the Case dwelling to determine the extent of movement during the earthquake sequence. Levels were also taken over the floor of the market garden shop. Both these buildings are located within the Case Land proposed for residential development.

Whilst these levels indicated maximum differential settlement of 54mm across the footprint of the Case House and 32mm across the footprint of the shop, the floor gradients were not steeper than 1 in 200 and therefore did not require relevelling under the provisions of the MBIE guidelines[1].

The house is known to have been constructed possibly around the 1990's with conventional foundations and a concrete floor slab. It was not supported on piles.

8.4. Lateral spreading and stretch

We consider the site to be at '*minor*' risk of global lateral movement and lateral stretch (<50mm) in an ULS event as there was no evidence of lateral spread or stretch affecting the site. Although it was not tested much beyond SLS levels in the recent earthquake sequence.

8.5. MBIE investigation guidelines

MBIE's guidelines[1] outline repair and reconstruction options for various land categories across Canterbury. The philosophy of the guidelines is to construct resilient shallow foundations so they do not split apart, and are more easily repaired/re-levelled, following future ground deformation and foundation movement.

8.6. Provisional land classification

Based on the liquefaction analysis, the performance of the site, existing dwelling, and dwellings in the surrounding area, we consider the site to have a low to moderate risk of liquefaction damage, and can be considered equivalent to a **TC2** land classification (*i.e. 0-50mm settlement in a SLS event, and 0-100mm in a ULS event*).

9. RMA (1991) SECTION 106

9.1. Performance philosophy

In determining the requirement for future ground performance it is useful to outline the requirements of the New Zealand Building Code, Clause B1-Structure which advises that buildings, building elements and site work must;

(B.1.3.1) have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives. (Generally referred to as the Ultimate Limit State, ULS).

(B.1.3.2) have a low probability of causing loss of amenity through undue deformations, vibratory response, degradation or other physical characteristics throughout their lives, or during construction or alteration when the building is in use (generally referred to as the Serviceability Limit State , SLS).

9.2. Erosion and falling debris

Due to the location, geology and topography of the site and surrounding land, the site is not likely to be subject to material damage due to erosion or falling debris.

9.3. Inundation

We note that the Plan Change will not result in a significant increase in the risk of inundation to the surrounding area.

The proposed development of the site (and proposed building platforms) will be located across the higher ground at the site and will be situated outside the *'Flood Ponding'* or *'Floor level and Fill Management Area'.*

9.4. Subsidence

9.4.1. *Liquefaction*

We have assessed the risk of liquefaction at this site is consistent within the Ministry for Business, Innovation & Employment guidelines for TC2 land.

It is conceivable that earthquake shaking during periods of high groundwater could result in liquefaction of the shallow sandy silt, and therefore foundations should comply with the requirements of Ministry for Business, Innovation & Employment guidelines for TC2 land, or any updates of this guideline.

Providing this is undertaken then we are satisfied that the risk of liquefaction induced subsidence or minor differential settlement under static conditions, will be effectively mitigated for any future building.

9.4.2. *Peat, organic soils & historic fill*

Topsoil fill, peat, peaty silt and silt with organics were encountered in the shallow and deep testing undertaken across the site.

These soft organic and peat layers will be remediated at time of subdivision construction to mitigate the risk of subsidence. Options of mitigation included preloading the site by temporarily overloading the ground with introduced fill.

9.4.3. *Residential foundations*

Based on our assessment, all foundations for future dwellings should comply with the requirements for TC2 land. Proposed dwelling/s will require specific engineering investigation and foundation design to address the risk of subsidence, once the location and nature of any future building platforms has been confirmed.

9.5. Landsliding

The site generally comprises flat topography and is not at risk of landsliding.

9.6. Services

9.6.1. *Stormwater disposal*

Roof and driveway stormwater can be piped to an on-site stormwater management area and then to the Dudley Creek diversion.

Discharge of treated stormwater into the ground is not likely to be practical.

9.6.2. *Sewage disposal*

All sewage shall be piped or pumped to the Council's sewage network.

9.6.3. *Vehicle access*

There are no specific geotechnical requirements for formation of vehicle access to each lot, other than road formation requirements shall take the presence of any soft silt soils and peat. This can be undertaken as part of subdivision design and engineering approval.

10. TYPICAL REQUIREMENTS FOR RESIDENTIAL BUILDING FOUNDATIONS

Based on our assessment, all foundations for future dwellings will be able to be designed to comply with the requirements set out in MBIE's guidelines for TC2 land.

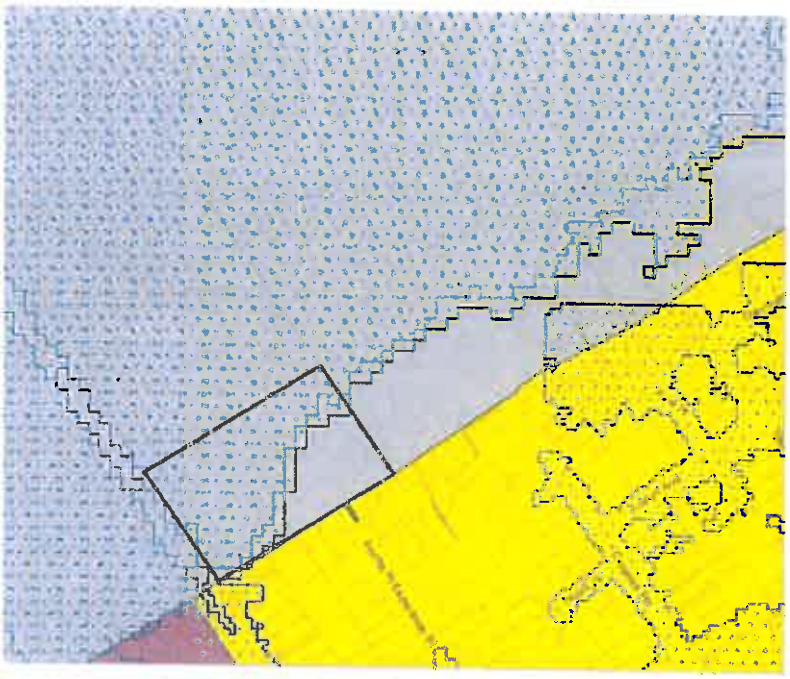
11. SUMMARY

Providing the recommendations made in this report are followed, we are satisfied that from a geotechnical perspective, the site is suitable for the plan change request, and that a future residential subdivision of the land could occur, subject to suitable mitigation measures to address the risks of inundation, and subsidence. This would be a normal part of subdivision engineering and design.

Appendix A : ECAN WELL LOCATIONS

Appendix B : PROPOSED DISTRICT PLAN OVERLAYS

The Proposed Christchurch Replacement District Plan: Stage one



Map Legend

Zone
Zone
Stage Two
Liquefaction Assessment Zone
Flood Hazard
Flood Ponding
Designation

340 Cranford Street Property Search Results

For the selected property this map shows the relevant planning zone, and any overlay that may apply. Click on the relevant zone name or any overlay for more details.

Zone
Zone
Stage Two
Liquefaction Assessment Zone
Flood Hazard
Flood Ponding

Click here to view the planning map for this area.

For further clarification phone 03 941 8999, email dpreview@ccc.govt.nz or read more on the relevant chapter in the Proposed Christchurch Replacement District Plan.

The Property Search function is a tool to assist with navigating to particular properties or areas. The data used in the Property Search tool has been derived from the proposed planning maps. All due care has been taken by the Christchurch City Council to ensure the information is accurate and reflects the information on the proposed planning maps. However, the information and maps shown through the Property Search function are not the proposed planning maps themselves. Users are recommended to refer also to the proposed planning maps. The Property Search function page provides a direct link to the proposed planning maps at the bottom of the information relevant to the property.

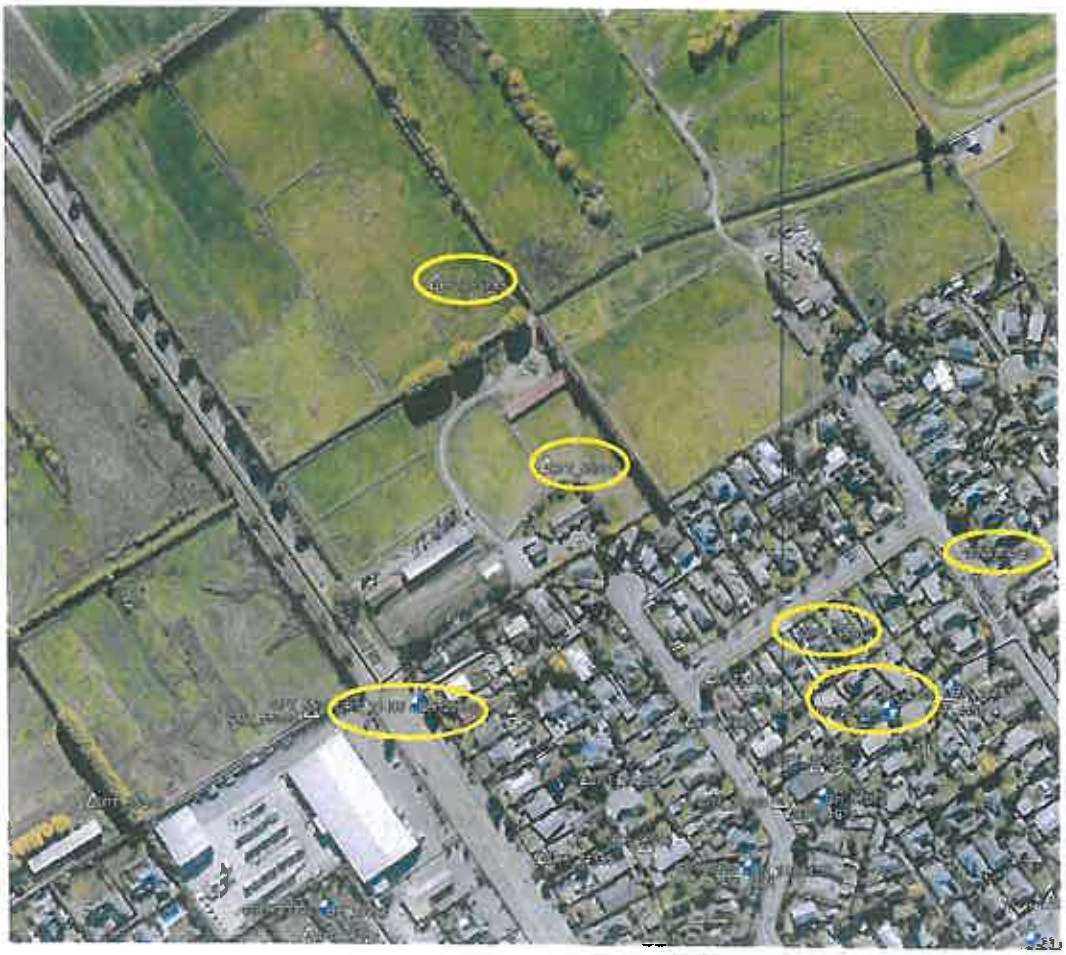
Christchurch City Council accepts no liability for any error, omission, or inaccuracy of the information or from any use of or reliance on the information provided through the Property Search function.

The proposed Christchurch Replacement District Plan

Christchurch City Council

3268

Appendix C : NEARBY CGD TEST LOCATIONS



Appendix D : CCC CORRESPONDENCE

Sarah Harding

From: Hewlett, Chris <Chris.Hewlett@ccc.govt.nz> on behalf of FloorLevels <FloorLevels@ccc.govt.nz>
Sent: Tuesday, 23 June 2015 2:17 p.m.
To: Sarah Harding
Subject: RE: [#405345] FFL at 340 Cranford Street and adjoing property

Hi Sarah,

340 Cranford Street is not within the Christchurch City Plan Flood Management Area (FMA). Minimum Finished Floor Levels (FFL) required are therefore currently assessed based on the 50 year annual recurrence interval (ARI) event for compliance with the New Zealand Building Code.

Based on current modelling a minimum FFL of **14.69 m RL** (Christchurch Drainage Datum) recommended for the site. This is based upon a modelled water level of 14.29 m RL.

Our flood modelling indicates a 200 yr ARI water level of 14.66 m RL, so you may want to set your levels higher to account for that risk.

Please note that the above FFL estimate is for flood limitation purposes only, and does not include consideration for other building consent aspects such as on-site drainage or service connections. Any building consent application lodged for this site will be assessed based on the most recent flood modelling information available at the time of lodgement, and the above level is subject to change if the flood modelling information for this area is updated.

If you have any further queries please don't hesitate to contact the floor level request team, floorlevels@ccc.govt.nz.

Regards,

Chris Hewlett
Consultant Engineer
Network Planning City Water and Waste
Email: Chris.Hewlett@ccc.govt.nz
Phone: +64 21 656 665
Web: www.ccc.govt.nz
Christchurch City Council
Civic Offices, 53 Hereford Street, Christchurch
PO Box 73014, Christchurch, 8154

From: Sarah Harding [mailto:Sarah.Harding@eliotsinclair.co.nz]
Sent: Tuesday, 23 June 2015 1:24 p.m.
To: FloorLevels
Subject: RE: [#405345] FFL at 340 Cranford and adjoing property

Hi Chris

Attached is the screen shot from the CCC floor level viewer.

Let me know if you require any further information.

Kind Regards

Sarah

From: Hewlett, Chris [mailto:Chris.Hewlett@ccc.govt.nz] **On Behalf Of** FloorLevels
Sent: Tuesday, 23 June 2015 12:29 p.m.
To: Sarah Harding
Subject: RE: FFL at 340 Cranford and adjoing property

Hi Sarah

Could you resend the image as an attachment?

Regards

Chris

From: Sarah Harding [mailto:Sarah.Harding@eliotsinclair.co.nz]
Sent: Thursday, 18 June 2015 10:46 a.m.
To: FloorLevels
Subject: FFL at 340 Cranford and adjoing property

Hello

Can you please provide the Fixed floor level requirements for the site at 340 Cranford street, and the adjoining property to the east. (See below, properties outlined in red)

Kind regards

3268

Appendix E : SHALLOW SITE INVESTIGATION RESULTS

Eliot Sinclair

surveyors | engineers | planners

20 Troup Drive, Tower Junction
PO Box 9339, Christchurch 8149
Ph. (03) 379-4014 Fax. (03) 365-2449

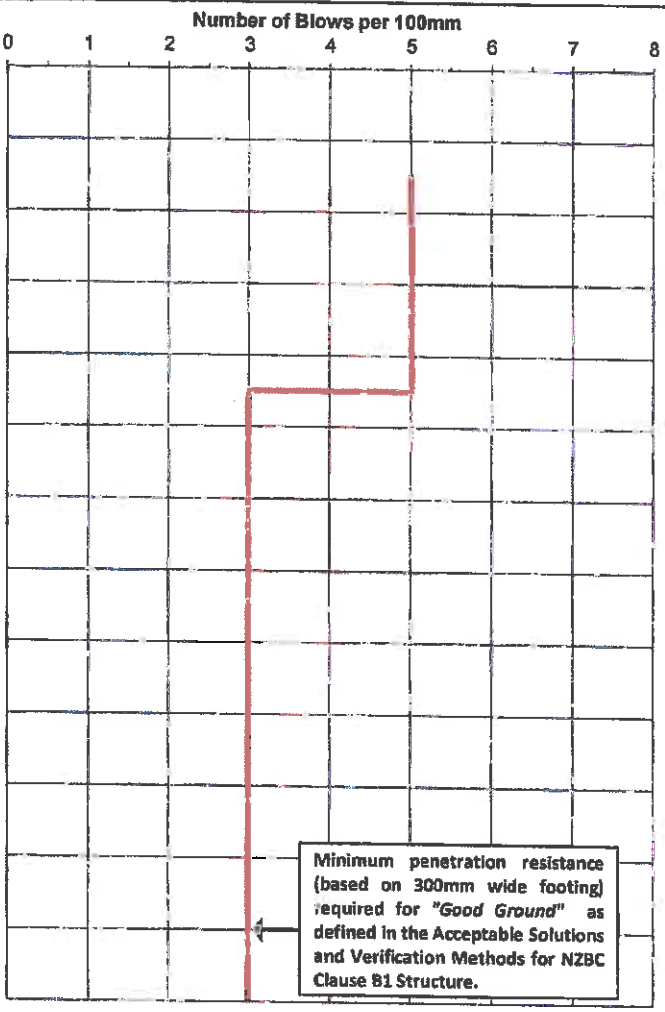
Job Number	323438
Date Tested	10-Apr-2015
Page	1 of 5
D.P	471475
Lot	1
Technical Category	N/A - Urban Nonresidential

SITE INVESTIGATION RECORD

Client GM & M Case Ltd

Site 340 Cranford Street, Mairehau

SCALA PENETROMETER TESTS



BORE LOGS

Hand Auger [X] Machine Auger [ ] Test Pit [ ]

(Borehole @ 1)

DEPTH [m]	
G.L.	
0.2	Brown silty TOPSOIL Fill, some stones
0.4	Dark grey sandy SILT, moist, iron staining
0.6	Grey sandy SILT, moist to wet, iron staining
0.8	Grey silty SAND, moist to wet, iron staining
1.0	Grey SAND, wet, iron staining
1.2	Water Table @ 1.2m
1.4	Grey silty SAND, wet to saturated
1.6	
1.8	
2.0	
2.2	Bluish grey SAND, minor silt, saturated
2.4	
2.6	STOP - Hole collapsing in saturated SAND
2.8	
3.0	
3.2	
3.4	

SITE PLAN (Not to Scale)

COMMENTS

LOGGED BY:	QJF	CHECKED BY:	JTA

3268

Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, Tower Junction
PO Box 4597, Christchurch N.Z.
Ph. (03) 379-4014 Fax. (03) 365-2449

Job Number	323438
Date Tested	10-Apr-2015
Page	2 of 5
D.P	471475
Lot	1

SITE INVESTIGATION RECORD

Client	Site	Technical Category
GM & M Case Ltd	340 Cranford Street, Mairehau	N/A - Urban Nonresidential

BORE LOG @ 2

Hand Auger ☒ Machine Auger ☐ Test Pit ☐

DEPTH [m]	
GL	Dark brown silty TOPSOIL Fill, moist
0.2	
0.4	
0.6	Grey sandy SILT, moist, iron staining
0.8	
1.0	Grey silty SAND, moist, iron staining
1.2	Grey sandy SILT, moist to wet, iron staining
1.4	Grey SILT, some sand, wet
1.6	
1.8	Bluish grey silty SAND, wet
2.0	
2.2	Bluish grey silty SAND, saturated
2.4	
2.6	
2.8	Bluish grey SILT, some sand, saturated
3.0	
3.2	Brown PEAT
3.4	

Water Table @ 1.8m

Hand Auger ☒ Machine Auger ☐ Test Pit ☐

DEPTH [m]	
3.4	
3.6	
3.8	
4.0	Brown PEAT, minor silt lenses
4.2	
4.4	Grey SILT, soft, saturated
4.6	STOP - High water pressure - hard to retrieve auger
4.8	
5.0	
5.2	
5.4	
5.6	
5.8	
6.0	
6.2	
6.4	
6.6	
6.8	

SITE PLAN (Not to Scale)

COMMENTS

LOGGED BY:	QJF	CHECKED BY:	JTA

3268

Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, Tower Junction
PO Box 9339, Christchurch 8149
Ph. (03) 379-4014 Fax. (03) 365-2449

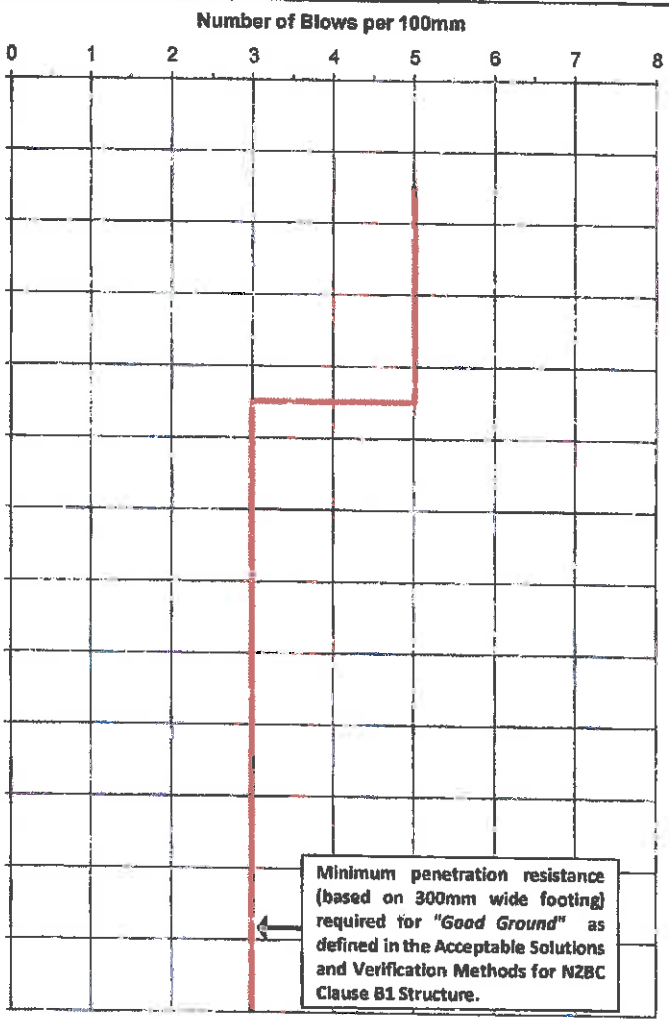
Job Number	323438
Date Tested	10-Apr-2015
Page	3 of 5
D.P	471475
Lot	1
Technical Category	N/A - Urban Nonresidential

SITE INVESTIGATION RECORD

Client GM & M Case Ltd

Site 340 Cranford Street, Mairehau

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

COMMENTS

LOGGED BY:	PLN	CHECKED BY:	JTA

BORE LOGS

Hand Auger ☒ Machine Auger ☐ Test Pit ☐

DEPTH [m]	
GL	(Borehole @ 3) Dark brown silty TOPSOIL Fill, some stones, some grey silt content with iron staining, moist
0.2	
0.4	Dark brown silty TOPSOIL Fill, some clasts of grey silt, moist to wet
0.6	Dark brown silty PEAT, wet
0.8	
1.0	Dark brown fibrous PEAT, minor grey silt clasts, traces of charcoal, wet
1.2	
1.4	Grey organic peaty SILT, very soft, peat <30%, wet to saturated, no resistance to auger
1.6	Water Table @ 1.7m
1.8	
2.0	
2.2	
2.4	Greyish brown silty PEAT, spongy, very soft, no resistance to auger
2.6	
2.8	
3.0	
3.2	Grey organic SILT, very soft, saturated
3.4	
3.6	Grey sandy SILT, soft, some organics <20%, saturated
3.8	Bluish grey silty SAND, satruated
4.0	Bluish grey sandy SILT, saturated STOP - Target Depth
4.2	

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Eliot Sinclair
surveyors | engineers | planners

20 Troup Drive, Tower Junction
PO Box 9339, Christchurch 8149
Ph. (03) 379-4014 Fax. (03) 365-2449

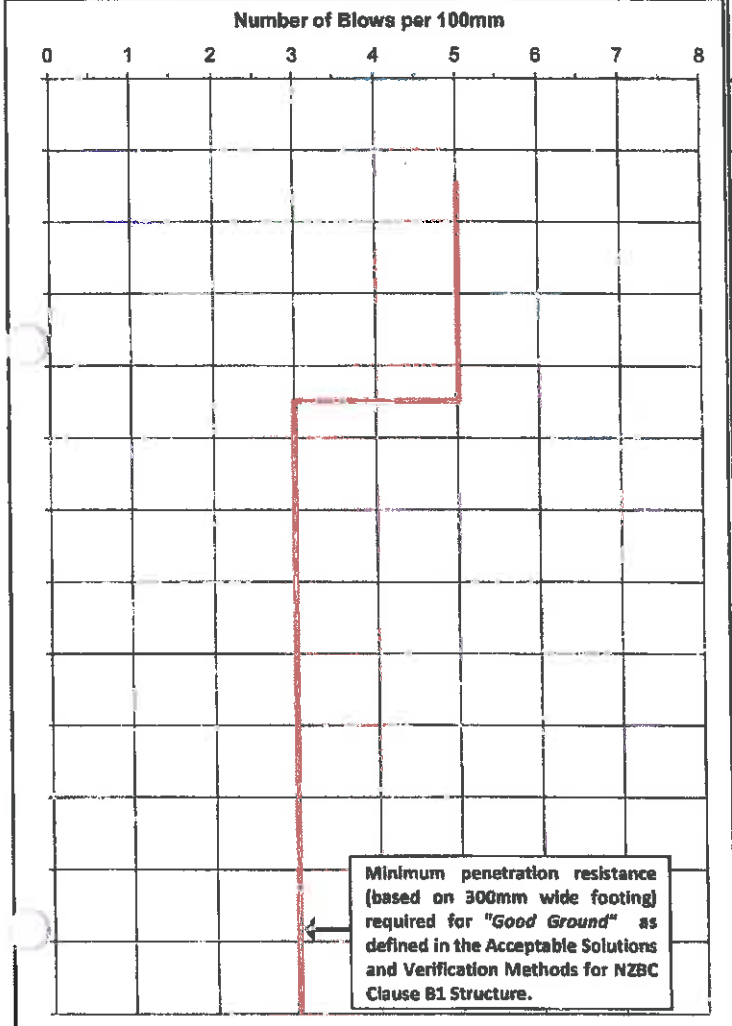
Job Number	323438
Date Tested	26-Jun-2015
Page	4 of 5
D.P	471475
Lot	1
Technical Category	N/A Urban Non Residential

SITE INVESTIGATION RECORD

Client GM & M Case

Site 340 Cranford Street

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

North

COMMENTS

LOGGED BY:	QJF	CHECKED BY:	MDS

BORE LOGS

Hand Auger ☒ Machine Auger ☐ Test Pit ☐

(Borehole @ 4)

DEPTH [m]	
GL	Brown silty TOPSOIL
0.2	
0.4	Silty SAND, grey, moist, iron staining
0.6	
0.8	SAND, grey, moist
1.0	SILT, grey, dry/damp, minor iron staining
1.2	
1.4	Sandy SILT, grey, damp, iron staining
1.6	SILT, grey, dry/damp, minor iron staining
1.8	
2.0	Sandy SILT, grey, dry/damp, minor iron staining
2.2	SILT, grey, moist, minor iron staining, plastic
2.4	
2.6	
2.8	
3.0	Fibrous PEAT, brown, moist
3.2	
3.4	
3.6	Organic SILT, brownish grey, moist/wet, organic content<40% (fine root fibres)
3.8	SILT, brownish grey, moist/wet, organic material <20% (very fine root fibres), soft to auger
4.0	STOP
4.2	

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Eliot Sinclair
surveyors | engineers | planners

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Ph. (03) 379-4014 Fax. (03) 365-2449

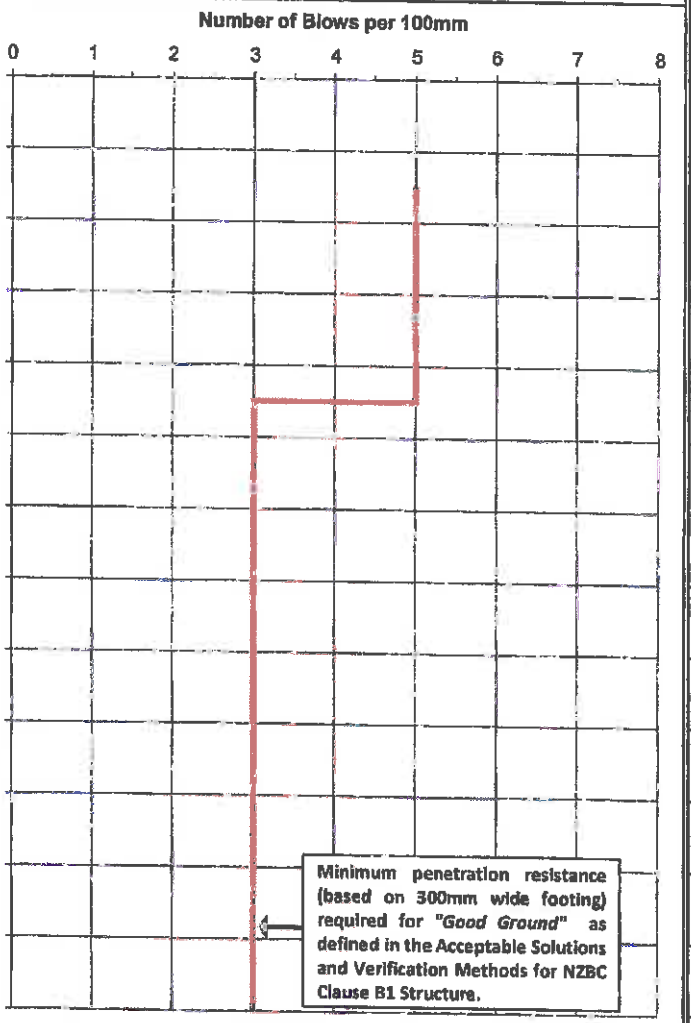
Job Number	323438
Date Tested	26-Jun-2015
Page	5 of 5
D.P	471475
Lot	1
Technical Category	N/A Urban Non Residential

SITE INVESTIGATION RECORD

Client GM & M Case

Site 340 Cranford Street

SCALA PENETROMETER TESTS



SITE PLAN (Not to Scale)

COMMENTS

LOGGED BY:	QJF	CHECKED BY:	MDS

BORE LOGS

Hand Auger ☒ Machine Auger ☐ Test Pit ☐

(Borehole @ 5)

DEPTH [m]	
GL	Silty TOPSOIL, brown, moist
0.2	
0.4	SILT, grey, moist, some sand, iron staining
0.6	
0.8	Sandy SILT, grey, moist, iron staining
1.0	
1.2	SILT, grey, moist, minor iron staining
1.4	
1.6	SILT, grey, moist, some sand, minor iron staining
1.8	
2.0	Sandy SILT, grey, moist, iron staining
2.2	
2.4	SILT, grey, moist/wet, slightly plastic
2.6	
2.8	Fibrous PEAT, brown, moist
3.0	
3.2	
3.4	Organic SILT, brownish grey, moist/wet, plastic, organic content <40% (fine root fibres)
3.6	SILT, grey, moist/wet, plastic, organic material <5%(fine root fibres)
3.8	SILT, grey, moist/wet, plastic. organic material <20%(fine root fibres)
4.0	STOP
4.2	

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Appendix F : CPTU AND DEEP BOREHOLE LOCATIONS

McMILLAN Drilling

Bore Log

Client: Eliot Sinclair and Partners Ltd

Project: Croziers Road, Christchurch

Bore No.: BH001

Job No.: 14780

Site Location: Croziers Road, Christchurch
Grid Reference: 1570098.88mE 5184023.17mN NZTM
Rig Operator: C. Nee
Rig Model & Mounting: AMS VTR9100

Date Commenced: 22/06/2015
Date Completed: 23/06/2015
Consent: -
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected)	In-Situ Tests (Uncorrected)	Samples / Permeability tests	Installation & Resources
TOPSOIL with some rootlets; dark brown. 0.00m	Dust tube			0.5					Bentonite (1.7 bags)
Sandy SILT with trace of organics and rootlets; brownish grey mottled orange. Firm; moist between the top and 1.0m then wet; low plasticity. 0.20m				1.0					
Silty fine SAND with trace of rootlets; brownish grey mottled orange. Dense; saturated. 1.40m				1.5					
Sandy SILT with trace of organics and wood; brownish grey, mottled orange between 2.10m and 2.30m. Firm; saturated; plasticity increases from 2.60m. 2.10m				2.0					
Silty PEAT; black with some thin grey layers. Firm; moist; low plasticity. 3.30m				2.5					
Organic SILT with some peat, rootlets and wood; dark grey. soft; moist. 4.30m				3.0					
Silty fine SAND with minor wood and rootlets; grey. Medium dense; saturated. 6.00m				3.5					
Medium SAND; grey. Loosely packed; wet. 7.20m				4.0					
Fine to coarse GRAVEL with some sand; grey. Very loosely packed; saturated; well graded; subrounded; sand, fine to medium. 7.50m				4.5					
Fine to medium SAND with minor silt; grey. Loosely packed; saturated. 8.20m				5.0					
Fine to medium GRAVEL with minor sand; grey. Very loosely packed; saturated; well graded; subangular to subrounded; sand, medium to coarse. 8.65m				5.5					
Gravelly medium to coarse SAND; grey. Medium dense; wet; gravel, medium to coarse, subangular to subrounded. 9.80m				6.0					
EOH: 10m				6.5					
				7.0					
				7.5					7.35m
				8.0					Surrounding ground collapse
				8.5					
				9.0					
				9.5					
				10.0					10.00m

Remarks

Geotechnical investigation borehole BH001

Static water levels:
1.81m bgl at casing depth of 10.00m; 23/6/2015, 10:00 am

No water added

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Additional Resources:

Plastic Liner / PVC Splits	m	10.8
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 10m

Created: 24/06/2015 2:18:22 p.m.

Generated by GEROC Core-GS

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ATTACHMENT C

PLANNING MAP 25

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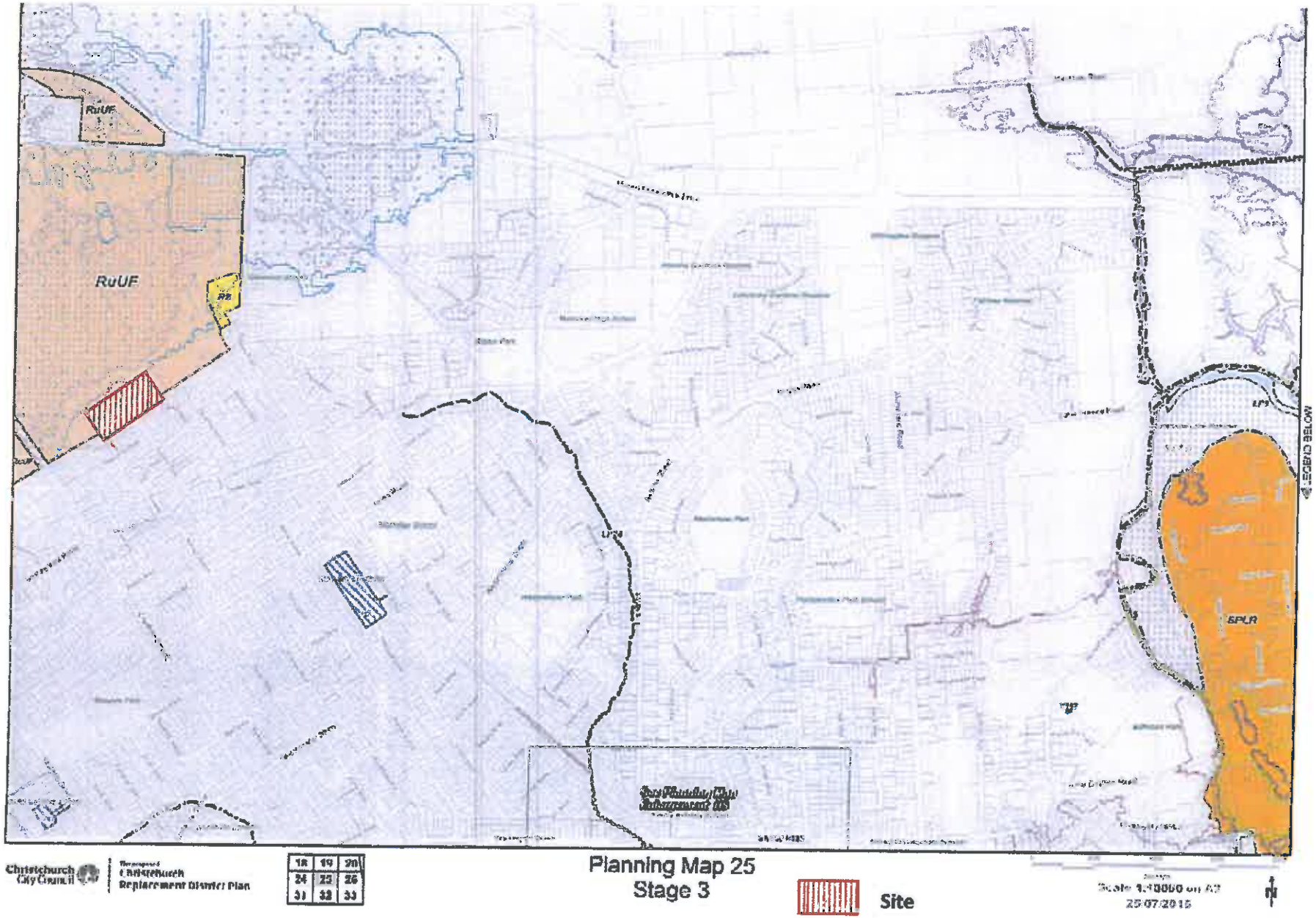

Christchurch City Council | Proposed Christchurch Replacement District Plan

18	19	20
24	25	26
31	32	33

Planning Map 25
Stage 3

Site

Scale 1:10000 on A3
25/07/2015