Christchurch City Council

Hadfield Courts Retirement Village BE 1126 EQ2

Detailed Engineering Evaluation

Quantitative Assessment Report

OPUS

Christchurch City Council

Hadfield Courts Retirement Village BE 1126 EQ2

Quantitative Assessment Report

Somerfield, Christchurch

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Status: Final

Summary

Hadfield Court Retirement Village
BE 1126 EQ2

Detailed Engineering Evaluation
Quantitative Report - Summary
Final

Background

This is a summary of the quantitative report for the Hadfield Court Retirement Village, and is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This assessment covers the 21 residential units on the site.

Key Damage Observed

Minor structural and non-structural damage was observed evenly around all blocks. The structural damage consisted mostly of minor cracking between ceilings and walls and minor cracking in the GIB-linings around window frames. Observed non-structural damage was limited to minor stepping of block masonry veneers. Some foundation settlement and separation of the foundation from the soil was noticed around Unit 21.

Critical Structural Weaknesses

No critical structural weaknesses were found in any of the buildings.

Indicative Building Strength

The buildings on site have identical layouts and they been assessed have a capacity of 37% NBS as limited by the in-plane capacity of the timber-framed walls in the top storeys of the buildings. The buildings are therefore not earthquake prone. The buildings have 5-10 times the risk of an equivalent 100% NBS building in a design level earthquake according to NZSEE guidelines. Based on the form of construction and the seismic load resisting systems present we do not believe that the building has a high risk of collapse. It is therefore considered that there is not a high risk imposed to building occupants.

Recommendations

It is recommended that all buildings rated less than 67% NBS be strengthened to at least 67% NBS, as per NZSEE guidelines.

A geotechnical investigation should be carried out as per the referenced geotechnical desktop study in this report in order to accurately assess the liquefaction potential of the site. A level survey of the buildings would be included in this investigation in order to assess any levels of differential settlement that have occurred during the Canterbury Earthquake sequence.

Contents

1 Introduction

Opus International Consultants Limited has been engaged by the Christchurch City Council to undertake a detailed seismic assessment of the Hadfield Courts Retirement Village, located at 15 Somerfield Street, Somerfield, Christchurch following the Canterbury Earthquake Sequence since September 2010.

The purpose of the assessment is to determine if the buildings in the village are classed as being earthquake prone in accordance with the Building Act 2004.

The seismic assessment and reporting have been undertaken based on the qualitative and quantitative procedures detailed in the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) [3] [4].

2 Compliance

This section contains a brief summary of the requirements of the various statutes and authorities that control activities in relation to buildings in Christchurch at present.

2.1 Canterbury Earthquake Recovery Authority (CERA)

CERA was established on 28 March 2011 to take control of the recovery of Christchurch using powers established by the Canterbury Earthquake Recovery Act enacted on 18 April 2011. This act gives the Chief Executive Officer of CERA wide powers in relation to building safety, demolition and repair. Two relevant sections are:

Section 38 – Works

This section outlines a process in which the chief executive can give notice that a building is to be demolished and if the owner does not carry out the demolition, the chief executive can commission the demolition and recover the costs from the owner or by placing a charge on the owners' land.

Section 51 – Requiring Structural Survey

This section enables the chief executive to require a building owner, insurer or mortgagee to carry out a full structural survey before the building is re-occupied.

We understand that CERA require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). CERA have adopted the Detailed Engineering Evaluation Procedure (DEEP) document (draft) issued by the Structural Engineering Society (SESOC) on 19 July 2011. This document sets out a methodology for both initial qualitative and detailed quantitative assessments.

It is anticipated that a number of factors, including the following, will determine the extent of evaluation and strengthening level required:

1. The importance level and occupancy of the building.

2. The placard status and amount of damage.
3. The age and structural type of the building.
4. Consideration of any critical structural weaknesses.

Christchurch City Council requires any building with a capacity of less than 34% of New Building Standard (including consideration of critical structural weaknesses) to be strengthened to a target of 67% as required under the CCC Earthquake Prone Building Policy.

2.2 Building Act

Several sections of the Building Act are relevant when considering structural requirements:

Section 112 - Alterations

This section requires that an existing building complies with the relevant sections of the Building Code to at least the extent that it did prior to the alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

The Earthquake Prone Building policy for the territorial authority shall apply as outlined in Section 2.3 of this report.

Section 115 – Change of Use

This section requires that the territorial authority is satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'.

This is typically interpreted by territorial authorities as being 67% of the strength of an equivalent new building or as near as practicable. This is also the minimum level recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Section 121 – Dangerous Buildings

This section was extended by the Canterbury Earthquake (Building Act) Order 2010, and defines a building as dangerous if:

1. In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
2. In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or
3. There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
4. There is a risk that other property could collapse or otherwise cause injury or death; or

5. A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone (EPB) if its ultimate capacity would be exceeded in a ‘moderate earthquake’ and it would be likely to collapse causing injury or death, or damage to other property.

A moderate earthquake is defined by the building regulations as one that would generate loads 33% of those used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

This section gives the territorial authority the power to require strengthening work within specified timeframes or to close and prevent occupancy to any building defined as dangerous or earthquake prone.

Section 131 – Earthquake Prone Building Policy

This section requires the territorial authority to adopt a specific policy for earthquake prone, dangerous and insanitary buildings.

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in October 2011 following the Darfield Earthquake on 4 September 2010.

1. The policy includes the following:
2. A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
3. A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
4. A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
5. Repair works for buildings damaged by earthquakes will be required to comply with the above.

The council has stated their willingness to consider retrofit proposals on a case by case basis, considering the economic impact of such a retrofit.

If strengthening works are undertaken, a building consent will be required. A requirement of the consent will require upgrade of the building to comply ‘as near as is reasonably practicable’ with:

- The accessibility requirements of the Building Code.
- The fire requirements of the Building Code. This is likely to require a fire report to be submitted with the building consent application.

Where an application for a change of use of a building is made to Council, the building will be required to be strengthened to 67% of New Building Standard or as near as is reasonably practicable.

2.4 Building Code

The Building Code outlines performance standards for buildings and the Building Act requires that all new buildings comply with this code. Compliance Documents published by The Department of Building and Housing can be used to demonstrate compliance with the Building Code.

On 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- increase in the basic seismic design load for the Canterbury earthquake region (Z factor increased to 0.3 equating to an increase of 36 – 47% depending on location within the region);
- Increased serviceability requirements.

2.5 Institution of Professional Engineers New Zealand (IPENZ) Code of Ethics

One of the core ethical values of professional engineers in New Zealand is the protection of life and safeguarding of people. The IPENZ Code of Ethics requires that:

Members shall recognise the need to protect life and to safeguard people, and in their engineering activities shall act to address this need.

1.1 Giving Priority to the safety and well-being of the community and having regard to this principle in assessing obligations to clients, employers and colleagues.

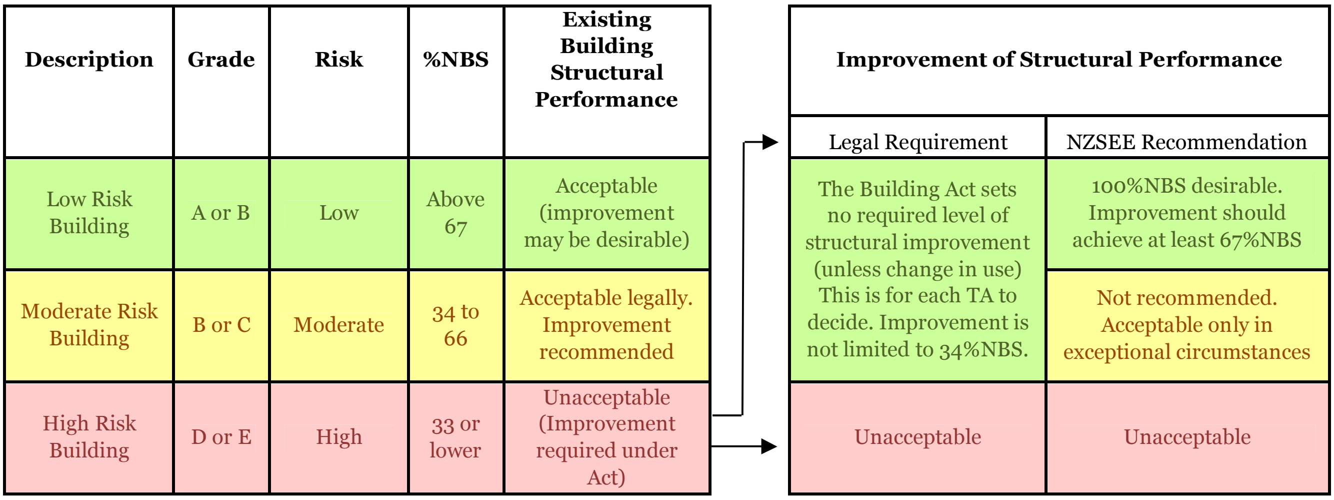
1.2 Ensuring that responsible steps are taken to minimise the risk of loss of life, injury or suffering which may result from your engineering activities, either directly or indirectly.

All recommendations on building occupancy and access must be made with these fundamental obligations in mind.

3 Earthquake Resistance Standards

For this assessment, the building's earthquake resistance is compared with the current New Zealand Building Code requirements for a new building constructed on the site. This is expressed as a percentage of new building standard (%NBS). The loadings are in accordance with the current earthquake loading standard NZS1170.5 [1].

A generally accepted classification of earthquake risk for existing buildings in terms of %NBS that has been proposed by the NZSEE 2006 [2] is presented in Figure 1 below.



Description	Grade	Risk	%NBS	Existing Building Structural Performance	Improvement of Structural Performance	
					Legal Requirement	NZSEE Recommendation
Low Risk Building	A or B	Low	Above 67	Acceptable (improvement may be desirable)	The Building Act sets no required level of structural improvement (unless change in use) This is for each TA to decide. Improvement is not limited to 34%NBS.	100%NBS desirable. Improvement should achieve at least 67%NBS
Moderate Risk Building	B or C	Moderate	34 to 66	Acceptable legally. Improvement recommended		Not recommended. Acceptable only in exceptional circumstances
High Risk Building	D or E	High	33 or lower	Unacceptable (Improvement required under Act)	Unacceptable	Unacceptable

Figure 1: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. 0.2% in the next year).

Table 1: %NBS compared to relative risk of failure

Percentage of New Building Standard (%NBS)	Relative Risk (Approximate)
>100	<1 time
80-100	1-2 times
67-80	2-5 times
33-67	5-10 times
20-33	10-25 times
<20	>25 times

3.1 Minimum and Recommended Standards

Based on governing policy and recent observations, Opus makes the following general recommendations:

3.1.1 Occupancy

The Canterbury Earthquake Order[1] in Council 16 September 2010, modified the meaning of "dangerous building" to include buildings that were identified as being EPB's. As a result of this, we would expect such a building would be issued with a Section 124 notice, by the

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[1] This Order only applies to buildings within the Christchurch City, Selwyn District and Waimakariri District Councils authority.

Territorial Authority, or CERA acting on their behalf, once they are made aware of our assessment. Based on information received from CERA to date and from the DBH guidance document dated 12 June 2012 [6], this notice is likely to prohibit occupancy of the building (or parts thereof), until its seismic capacity is improved to the point that it is no longer considered an EPB.

3.1.2 Cordoning

Where there is an overhead falling hazard, or potential collapse hazard of the building, the areas of concern should be cordoned off in accordance with current CERA/territorial authority guidelines.

3.1.3 Strengthening

Industry guidelines (NZSEE 2006 [2]) strongly recommend that every effort be made to achieve improvement to at least 67%NBS. A strengthening solution to anything less than 67%NBS would not provide an adequate reduction to the level of risk.

It should be noted that full compliance with the current building code requires building strength of 100%NBS.

3.1.4 Our Ethical Obligation

In accordance with the IPENZ code of ethics, we have a duty of care to the public. This obligation requires us to identify and inform CERA of potentially dangerous buildings; this would include earthquake prone buildings.

4 Background Information

4.1 Building Descriptions

The site contains 4 blocks with a total of 21 residential units. Block 1 consists of units 1-4, Block 2 units 5-12, Block 3 units 13-16 & 21 and Block 4 units 17-20. All units are similar in layout and construction with the exception of unit 21 which is a single storey unit. A site plan showing the locations of the units is shown in Figure 2. Units are typically grouped together as shown in Figure 3.

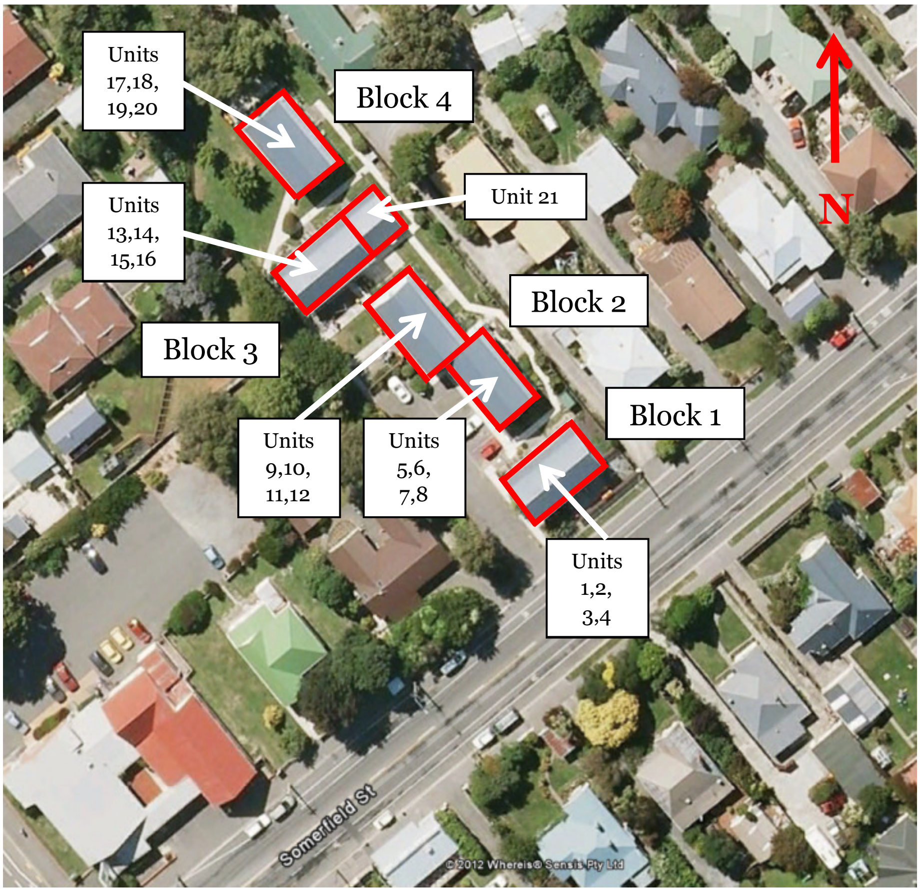

Figure 2: Site plan of Hadfield Court retirement village.

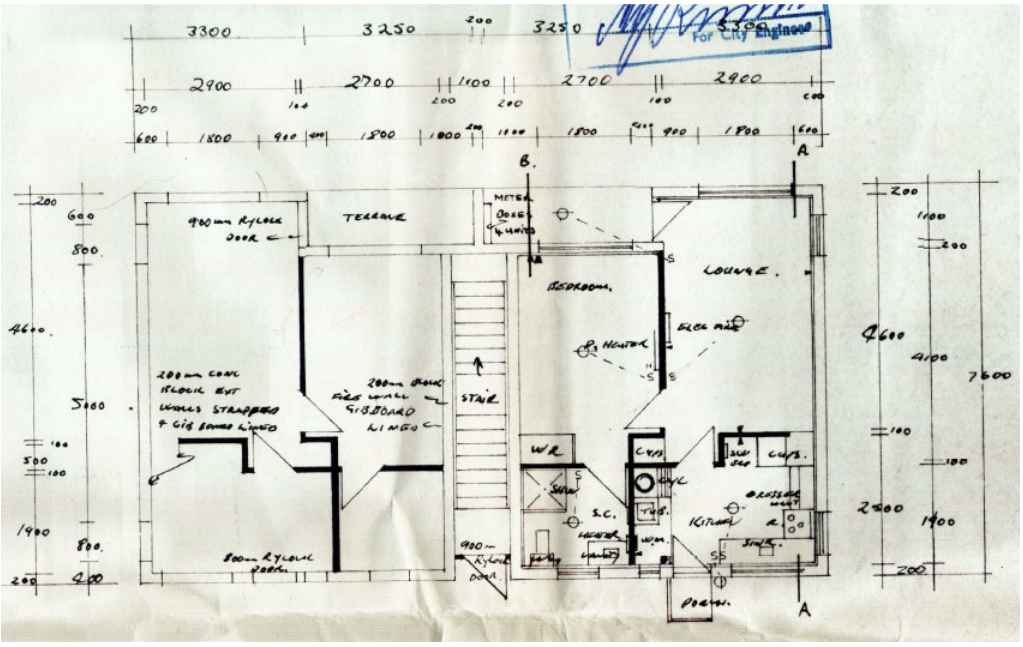

Figure 3: Floor plan of a sub-block of 4 units

In general, the buildings are constructed of reinforced concrete blockwork walls between the foundation and first floor and timber-framed walls with an unreinforced blockwork veneer between first floor and roof. The only exception being the single storey unit 21 which is constructed from timber framing with a blockwork veneer (Refer Figure 5). All first floors are 'unispan' reinforced concrete. Timber roof trusses support light-weight pressed metal cladding. Walls and ceilings are lined with plaster board. Cladding above high level windows is light-weight 'Durock' panels with the remaining wall areas clad with block veneer. Drawings prepared by Warren R Lewis indicate the foundations are reinforced concrete strip footings with concrete piled foundations to the south and west walls of unit 19, at the northern end of Block 4.

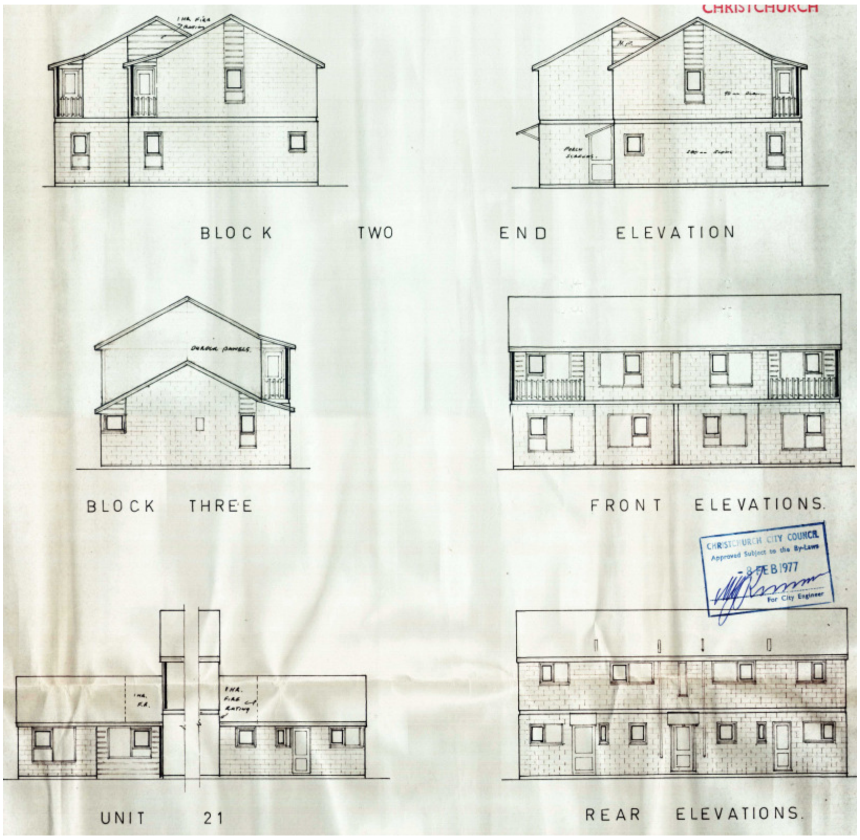

Figure 4: Floor plan of the residents lounge.

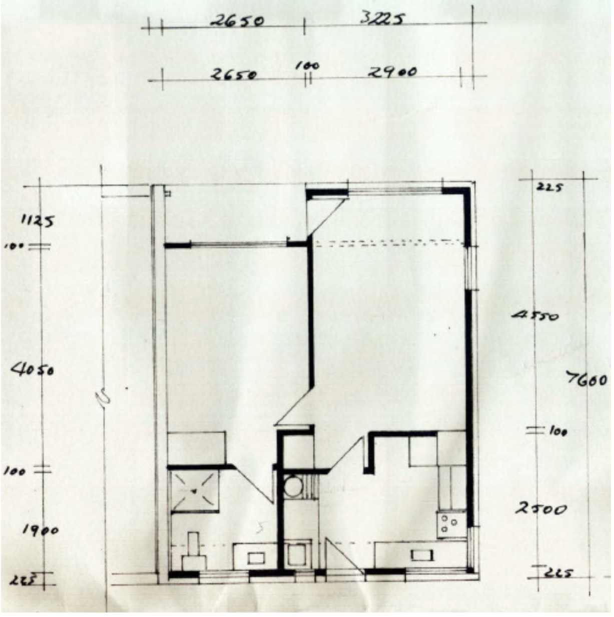

Figure 5: Floor plan of unit 21

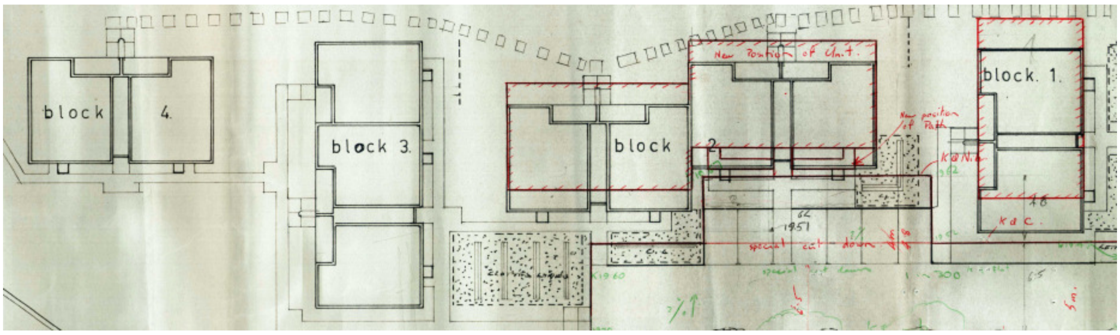

Figure 6: Partial floor plan of residential unit blocks.

Figure 6 shows how the 4-unit sub-block is repeated throughout the site. Between two-storey units, a full height reinforced blockwork firewall is constructed.

The structural engineer's drawings indicate that the buildings were constructed in 1976.

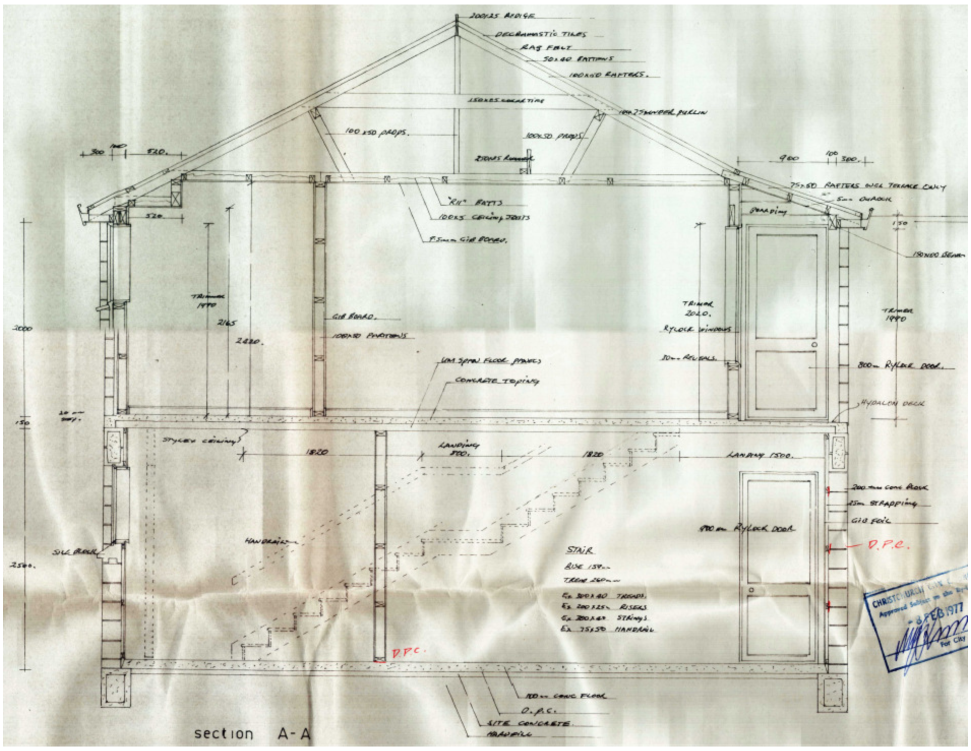

Figure 7: Cross-section through the storage garages.

4.2 Survey

4.2.1 Post 22 February 2011 Rapid Assessment

A structural (Level 1) assessment of the buildings/property was undertaken on March 9th, 2011 by Opus International Consultants. Minor cracking to walls and liquefaction were found on site. A summary of the damage to the buildings is provided in section 5.

4.2.2 Further Inspections

A structural (Level 2) assessment of the buildings/property was undertaken on November 2nd, 2012 by Opus International Consultants. This survey involved a more thorough inspection of the interior and exterior of the units to document the non-structural and structural damage to the buildings. The inspection did not involve the removal of wall/ceiling linings or investigation of roof spaces.

4.2.3 Geotechnical Survey

A geotechnical site walkover was conducted on October 16th to supplement a geotechnical desktop study. A summary of the geotechnical findings is given in section 8.

4.3 Original Documentation

Copies of the following construction drawings were provided by CCC:

- Plans, elevations, sections and details for the construction of all units by Warren R. Lewis Consulting Engineers.

The drawings have been used to confirm the structural systems, investigate potential critical structural weaknesses (CSW) and identify details which required particular attention.

Copies of the design calculations were not provided.

5 Structural Damage

This section outlines the damage to the buildings that was observed during site visits. It is not intended to be a complete summary of the damage sustained by the buildings due to the earthquakes. There may have been some forms of damage that were unable to be identified from visual inspections.

5.1 Residual Displacements

A level survey was deemed unnecessary for the structural assessment of the buildings on this property and so no residual displacement information is available. Some foundation settlement was noticeable around unit 21.

5.2 Foundations

The only noticeable foundation damage was the separation of the ground from the footing along the base of the north-eastern side of unit 21.

5.3 Primary Gravity Structure

No noticeable damage to the gravity structure of the buildings was observed.

5.4 Primary Lateral-Resistance Structure

Minor cracking of the ceiling-wall interface was noticed in some areas of most units. Minor cracking in GIB-linings around window-frame corners was also observed around at least one window of most units.

5.5 Non Structural Elements

Some minor stepping of block masonry veneers was observed around the buildings.

6 General Observations

The buildings appeared to have performed as reasonably expected during the earthquakes. They have suffered distributed amounts of minor damage which is consistent with the heavy nature of the cladding and the age of the buildings.

7 Detailed Seismic Assessment

The detailed seismic assessment has been based on the NZSEE 2006 [2] guidelines for the "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes" together with the "Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure" [3] draft document prepared by the Engineering Advisory Group on 19 July 2011, and the SESOC guidelines "Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes" [5] issued on 21 December 2011.

As 2 of the blocks are identical, 3 different analyses were carried out for the assessment of the ground floor reinforced blockwork walls. For the timber-framed wall assessment, only one analysis was carried out to determine the strength of each block. This was due to the lack of rigid diaphragm at roof/ceiling level so walls will only carry load in accordance with tributary area.

7.1 Critical Structural Weaknesses

The term Critical Structural Weakness (CSW) refers to a component of a building that could contribute to increased levels of damage or cause premature collapse of a building. During the initial qualitative stage of the assessment the following potential CSW's were identified for each of the buildings and have been considered in the quantitative analysis.

No critical structural weaknesses were identified in the buildings.

7.2 Quantitative Assessment Methodology

The assessment assumptions and methodology have been included in Appendix 3. A brief summary follows:

Hand calculations were performed to determine seismic forces from the current building codes. For the reinforced concrete blockwork walls, forces at first floor level were distributed to the ground via walls in accordance with their relative stiffness as the first floor can act as a rigid diaphragm. The first floor timber walls are considered to distribute forces from roof level to first floor level by methods given in NZS 3604. The capacities of the walls were calculated and used to estimate the % NBS.

7.3 Limitations and Assumptions in Results

The observed level of damage suffered by the building was deemed low enough to not affect the capacity. Therefore the analysis and assessment of the building was based on it being in an undamaged state. There may have been damage to the building that was unable to be observed that could cause the capacity of the building to be reduced; therefore the current capacity of the building may be lower than that stated.

The results have been reported as a %NBS and the stated value is that obtained from our analysis and assessment. Despite the use of best national and international practice in this analysis and assessment, this value contains uncertainty due to the many assumptions and simplifications which are made during the assessment. These include:

- Simplifications made in the analysis, including boundary conditions such as foundation fixity.
- Assessments of material strengths based on limited drawings, specifications and site inspections.
- The normal variation in material properties which change from batch to batch.
- Approximations made in the assessment of the capacity of each element, especially when considering the post-yield behaviour.

7.4 Assessment

A summary of the structural performance of the buildings is shown in the following tables. Note that the values given represent the worst performing elements in the building, as these effectively define the building's capacity. Other elements within the building may have significantly greater capacity when compared with the governing elements.

Table 2: Summary of Seismic Performance

Structural Element/System	**Failure Mode, or description of limiting criteria based on displacement capacity of critical element.**	**% NBS based on calculated capacity.**
Block 1, ground floor: Units 1, 3.	Bracing capacity of RC masonry shear walls.	60%
Block 1, 1st floor: Units 2, 4.	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	37%
	Bracing capacity of gib-lined timber stud walls in transverse direction.	57%

Block 2, ground floor: Units 5, 7, 9, 11.	Bracing capacity of RC masonry shear walls.	60%
Block 2, 1st floor: Units 6, 8, 10, 12.	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	37%
	Bracing capacity of gib-lined timber stud walls in transverse direction.	57%
Block 3, ground floor: Units 13, 15.	Bracing capacity of RC masonry shear walls.	60%
Block 3, 1st floor: Units 14, 16.	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	37%
	Bracing capacity of gib-lined timber stud walls in transverse direction.	57%
Block 4, ground floor: Units 1, 3.	Bracing capacity of RC masonry shear walls.	60%
Block 4, 1st floor: Units 2, 4.	Bracing capacity of gib-lined timber stud walls in longitudinal direction.	37%
	Bracing capacity of gib-lined timber stud walls in transverse direction.	57%
All buildings:	First floor fire walls between units subject to out-of-plane loading.	100%

8 Summary of Geotechnical Appraisal

8.1 General

Two Cone Penetrometer Tests (CPT's) within 85m of the site have been conducted on behalf of the Earthquake Commission (EQC). The Environment Canterbury (ECan) wells database showed three wells within approximately 130m of the site. These CPT's and borehole wells were used to infer the ground conditions at the site. The investigations show the soils comprise interbedded layers of silty Sands and Silts to 10m depth, underlain by interbedded layers of silty Clays and Sands from 10m to the end of the test holes at approximately 14m depth. Ground water levels were recorded at 0.3m depth and 1.4m depth. Summary of the inferred ground conditions is given in Table 3.

Table 3: Inferred ground conditions.

Stratigraphy	Thickness (m)	Depth Encountered from (m) below ground
TOPSOIL	0.1-0.3	0
SAND / silty SAND	1.2-3.4	0.1-0.6
CLAY / SILT	0.6-4.0	2.0-3.0
Silty SAND / sandy SILT	2.0-2.4	6.0-7.0
CLAY / SILT	1.5-1.8	8.4-9.0
SANDS	1.0	10.2-10.5
CLAY / SILT	0.5	11.5-11.7
SANDS / silty SAND	-	12.6-13.1

8.2 Liquefaction Potential

Examination of post-earthquake aerial photos taken by New Zealand Aerial Mapping (Project Orbit) identified significant quantities of ejected soils due to liquefaction after the February 2011 and June 2011 events. This is consistent with preliminary CLiq analyses conducted with data from the EQC CPT's which indicate a potential liquefaction induced subsidence of up to 400mm. Site inspections also showed ground heave in paved areas and liquefaction induced settlement.

Hadfield Courts has been zoned as 'N/A Urban – Non-residential' as it is council owned land. However the neighbouring residential properties have been zoned as Green-TC3 under the CERA classification system.

8.3 Summary

As a result of the 4th September 2010 Canterbury Earthquake and the following aftershocks; cracking, heaving and settlement has occurred at Hadfield Courts.

Due to the ground motion during the seismic events, the lateral movement that block 3 has undergone may have caused the soils to consolidate, resulting in the gaps observed between the perimeter foundation of Unit 21 and the ground. Alternatively, the void may have been caused as a result of liquefaction ejecta. The gap is about 70mm wide and 500mm deep. It was difficult to tell whether some differential settlement of the foundation has occurred from the exterior of unit 21. There was no evidence of cracking in the perimeter footing, where the gap was noted.

Anecdotal information gathered from the resident of unit 19 was a crack of up to 20mm wide of block 4 could also have been a result of the lateral movement of the ground during the quake. Evidence of cracking in the floor slabs was observed inside unit 12 on a visit on 20/8/12. No evidence of cracking of the externally exposed floor slabs was observed on the site visit of 13/9/12. No internal inspection of floor slabs was undertaken on the site visit of 13/9/12.

Construction drawings prepared by Warren R Lewis indicate the south and west wall foundations of unit 19 are underpinned with concrete piles. Based on site geometry and proximity of Wilderness Creek, it is anticipated that the piles are more likely to have been positioned under the northern and western walls of unit 19. Shallow inspection pits are recommended to confirm the presence of the piles.

No damage to the foundations was observed in any of the site inspections.

9 Conclusions

- None of the buildings on site are considered to be Earthquake Prone.
- Blocks 1, 2, 3 and 4 have seismic capacities of 37% NBS and are therefore deemed to be ‘moderate risk’ buildings in a design seismic event according to NZSEE guidelines. Their level of risk is 5-10 times that of a 100% NBS building (Figure 1). Based on the form of construction and the seismic load resisting systems present we do not believe that the building has a high risk of collapse. It is therefore considered that there is not a high risk imposed to building occupants.
- The site is likely to experience liquefaction in future seismic events and it is estimated that a possible 400mm of liquefaction induced settlement could occur during a design seismic event.

10 Recommendations

The following recommendations have been made for the site:

- Blocks 1-4 be strengthened to at least 67% NBS, as per NZSEE recommendations.
- A geotechnical site investigation, including shallow investigations and CPT’s, be carried out to more accurately determine the liquefaction potential of the site, the shallow bearing capacities of the soils and the presence of concrete piles beneath Unit 19.
- A level survey be conducted in conjunction with the geotechnical site investigation to determine the levels of differential settlement that have occurred during the Canterbury Earthquake sequence.
- The 70mm gap between the footings of unit 21 and the ground be backfilled.
- Carry out shallow inspection pits to confirm the presence of piles.

11 Limitations

- This report is based on an inspection of the buildings and focuses on the structural damage resulting from the 22nd February Canterbury Earthquake and its subsequent aftershocks only. Some non-structural damage may be described but this is not intended to be a complete list of damage to non-structural items.

- Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time.

- This report is prepared for the Christchurch City Council to assist in the assessment of any remedial works required for the Concord Place retirement village. It is not intended for any other party or purpose.

12 References

[1] NZS 1170.5: 2004, Structural design actions, Part 5 Earthquake actions, Standards New Zealand.

[2] NZSEE (2006), Assessment and improvement of the structural performance of buildings in earthquakes, New Zealand Society for Earthquake Engineering.

[3] Engineering Advisory Group, Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury, Part 2 Evaluation Procedure, Draft Prepared by the Engineering Advisory Group, Revision 5, 19 July 2011.

[4] Engineering Advisory Group, *Guidance on Detailed Engineering Evaluation of Non-residential buildings, Part 3 Technical Guidance*, Draft Prepared by the Engineering Advisory Group, 13 December 2011.

[5] SESOC (2011), Practice Note – Design of Conventional Structural Systems Following Canterbury Earthquakes, Structural Engineering Society of New Zealand, 21 December 2011.

[6] DBH (2012), Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch, Department of Building and Housing, June 2012.

Appendix 1 - Photographs

Block 1 Residential Unit		
1	South Elevation	
2	West Elevation	
3	Unit 1	

4	Step Cracking at Unit 2	

Block 2 Residential Unit		
1	Northern Elevation	

2	Step Cracking at Unit 6	
3	Cracking in Unit 7	
Block 3 Residential Unit		
1	Eastern Elevation	

2	Step Cracking	
3	Cracking in Path Outside Unit 21	

4	Movement at Unit 21	
Block 4 Residential Unit		
1	Southern Elevation	

2	Cracking in Unit 20	

Appendix 2 - Geotechnical Appraisal

17 January 2013

Michael Sheffield
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CHRISTCHURCH 8140

6-QUCC1.99

Dear Michael

Hadfield Courts – 15 Somerfield St, Somerfield - Geotechnical Desk Study

1. Introduction

The Christchurch City Council (CCC) has requested Opus International Consultants (Opus) provide a geotechnical desktop study and walkover inspection of the Hadfield Courts Elderly Persons Housing Units following the Canterbury Earthquake Sequence initiated by the 4 September 2010 earthquake.

The purpose of the geotechnical study is to assess the current ground conditions, the potential geotechnical hazards that may be present at the site, and determine whether further subsurface geotechnical investigations are necessary.

This Geotechnical Desk Study forms parts of a Detailed Engineering Evaluation prepared by Opus, and has been undertaken without the benefit of any site specific investigations and is therefore preliminary in nature.

2. Desktop Study

2.1 Site Description

The Hadfield Courts Elder Persons Housing Units are situated approximately 3.5km south-east of Christchurch City in the suburb of Somerfield at 15 Somerfield Street. It is a relatively flat site except for the backyard north of Block 4, where the ground slopes at 10° down towards Wilderness Creek (refer to Appendix B for Site Location Plan). Moreover, the site is bounded by Studhome Street approximately 200m northwest of the site, Barrington Street 160m to the west and Somerfield Street to the south.

The housing development was designed in 1977 and comprises 4 blocks with 21 units of a single storey and two storey configurations. The units are predominantly constructed of reinforced concrete masonry blocks with Gib board wall partitions on a 100mm x 50mm timber framing.

2.2 Available Building Drawings

Design drawings prepared by Warren R. Lewis for Hadfield Courts have been sourced from the CCC property file (refer to extract contained in Appendix C).

The drawings indicate the buildings foundations are reinforced concrete perimeter strip footings, typically 300mm wide for the front and rear walls and 400mm wide for the end wall and firewall. The footings were founded 500mm below the finished floor slab level, with a 100mm thick reinforced concrete floor slab laid on 150mm compacted hard fill.

The drawings indicate prestressed concrete piles have been installed under the south and west walls of unit 19, at the north end of Block 4. Based on site geometry and the proximity of Wilderness Creek, it is anticipated that the piles are more likely to have been positioned under the northern and western walls of Unit 19. Shallow inspection pits are recommended to confirm the presence of the piles.

2.3 Regional Geology

The published geological map of the area, (Geology of the Christchurch Urban Area 1:25,000, Brown and Weeber, Map 1, 1992) indicates the site is at the boundary between two surficial geological units; that being sand of fixed and semi-fixed dunes and beaches belonging to the Christchurch Formation and alluvial gravel sand and silt overbank deposits belonging to the Yaldhurst member of the Springston Formation.

A groundwater table depth of approximately 1m has been shown on the published map by Brown and Weeber (1992).

2.4 Earthquake Commission Subsurface Investigations

Two Cone Penetrometer Tests (CPT's) have been completed within 85m of the site on behalf of the Earthquake Commission (EQC). The CPT's indicate the soils comprise interbedded layers of silty Sands and Silts to 10m depth, underlain by interbedded silty Clays and Sands from 10m to the end of the test holes at approximately 14m depth (Refer Appendix D). Note that the groundwater levels were recorded to be 0.3m to 1.4m below ground level.

2.5 Expected Ground Conditions

A review of the Environmental Canterbury (ECan) Wells database showed three wells located within approximately 130m of the property boundary (refer to Appendix E). Material logs available from these wells in addition to the EQC CPT tests have been used to infer the ground conditions at the site, as shown in table 1 below.

Table 1: Inferred Ground Conditions

Stratigraphy	Thickness (m)	Depth Encountered from (m) below ground
TOPSOIL	0.1-0.3	0
SAND/silty SAND	1.2-3.4	0.1-0.6
CLAY/ SILT	0.6-4.0	2.0-3.0
Silty SAND/sandy SILT	2.0-2.4	6.0-7.0
CLAY/SILT	1.5-1.8	8.4-9.0
SANDS	1.0	10.2-10.5
CLAY/ SILT	0.5	11.5-11.7
SANDS/silty SANDS	-	12.6-13.1

The groundwater level was recorded in M36/1050 as 3.4m bgl.

2.6 Liquefaction Hazard

The 2004 Environment Canterbury Solid Facts Liquefaction Study indicates the Hadfield Courts site is in an area designated as having ‘moderate liquefaction ground damage potential’. According to this study, based on a low groundwater table, ground damage from liquefaction is expected to be moderate and may be affected by 100mm to 300mm of ground subsidence.

Examination of post-earthquake aerial photos taken by New Zealand Aerial Mapping (refer Project Orbit)) identified evidence of significant quantities of liquefied soils ejected at the ground surface of the site after the 22 February 2011 and 13 June 2011 events but not after the 4 September 2010 or 23 December 2011 events.

The Tonkin and Taylor Reconnaissance indicated evidence of moderate to severe liquefaction was observed at the site after the 22 February 2011.

Following the recent strong earthquakes in Canterbury, the Canterbury Earthquake Recovery Authority (CERA, 2012) has zoned land in the greater Christchurch area according to its ground performance in future large earthquakes.

The site was categorised as “Green” which is evaluated as repair/rebuild process can proceed and normal insurance and consenting processes apply.

The Department of Building and Housing has sub-divided the CERA “Green” residential land on the flat in Christchurch into technical categories. The three technical categories are summarised in Table 2 which has been adapted from the Department of Building and Housing guidance document (DBH, 2011).

Table 2: Technical Categories based on Expected Land Performance

Foundation Technical Category	Future land performance expected from liquefaction	Expected SLS land settlement	Expected ULS land settlement
TC 1	Negligible land deformations expected in a future small to medium sized earthquake and up to minor land deformations in a future to large earthquake.	0-15mm	0-25mm
TC 2	Minor land deformations possible in a future small to medium sized earthquake and up to moderate land deformations in a future moderate to large earthquake.	0-50mm	0-100mm
TC 3	Moderate land deformations possible in a future small to medium sized earthquake and significant land deformations in future moderate to large earthquake.	>50mm	>100mm

Hadfield Courts has been zoned as N/A-Urban Non-residential, as it is council owned land. The neighbouring residential properties have been zoned as Green-TC3 “blue zone”, which is determined to have a moderate to significant risk of land damage due to liquefaction in future significant earthquakes.

A preliminary CLiq analysis has been performed using the CPT 631 and CPT 628 data sets located 85m east and 35m south of the site, respectively. A summary of the results of the analysis are presented in Table 3 below.

Table 3: Results from a brief CLiq analysis

CPT	Distance from site boundary (m)	Direction	Event	Inferred Liquefiable Layers (bgl)	Total Liquefaction Induced Subsidence (mm)
CPT 631	85	East	ULS (0.35g)	Ground Water Level to 0.3m -0.6m to 3.7m (3.1m thk) - 4.6 to 8.4m (3.8m thk) -10m to 14m (4m thk)	210
CPT 628	35	South	ULS (Mg 7.5, PGA 0.35g)	-Ground Water level to 1.4m -1.5m to 3.3m (1.8m thk) -3.8m to 5.2m (1.4m thk) -6.6m to 9m (2.4m thk) -up to 500m lenses at 10.5m, 12m and 13.5m	400

3. Site Walkover Inspection

A walkover inspection of the exterior of the building blocks (1 to 4) and surrounding land was carried out by an Opus Geotechnical Engineer on 16 October 2012. Internal inspection of units was not undertaken. The following observations were made (refer to the Site Walkover Plan and Site Photographs attached to this report):

- Up to 70mm gap between the ground and perimeter foundation at the end elevation of Unit 21 (Photograph 6)
- Up to 10mm wide cracks on the asphalted footpath across the street from Hadfield Courts and up to 20mm of ground heave. (Photographs 9)
- Repaired liquefaction damaged asphalted ground by the driveway to Hadfield Courts (Photograph 10)
- Up to 15mm lift on the ground around buried services along Somerfield Street by the southern boundary of Hadfield Courts (Photograph 11)
- Localized depression on the road south of the property and slight depression on the trench where services are buried. (Photographs 12).
- 20mm lift on the concrete footpath with a 15mm wide gap west of the kitchen door of Block 2- Unit 5 (Photograph 13).
- Liquefaction damaged road south of the property has been resurfaced (Appendix B for Site Walkover Plan)
- Up to 4mm wide crack on the concrete kerb in various places within the car park area (Photograph 14)

- Minor cracking (<5mm) in various places within the car park area (Photograph 15)
- 20mm ground heave on the asphalted car park in front of Unit 7 (Photograph 16).
- Up to 15mm wide cracks on the concrete footpath east of Block 3-Unit 13. (Photograph 17).
- 50mm wide separation of the construction joints on the concrete footpath at the front elevation of Block 3-Unit 13. (Photograph 18)
- Historical crack approximately 20mm wide on the ground from 2010 earthquake now covered with grasses. Information gathered from resident. (Appendix B for Site Walkover Plan)
- Up to 10mm wide cracks and differential settlement of less than 10mm on the concrete patio by the lounge door entrance of Block 3 - Units 19 and 17. (Photograph 20)
- Concrete slab by the lounge doors of Unit 5 and 7 lifted up to 9mm (Photograph 21)
- No evidence of cracks or differential settlement in perimeter footings.

4. Discussion

As a result of the 4th September 2010 Canterbury Earthquake and the following aftershocks; cracking, heaving and settlement has occurred in Hadfield Courts.

Liquefaction has occurred in the car park areas, in the eastern boundary of the property and on Somerfield Street in the February 2011 earthquake. This is evident due to the ground heave in paved areas, liquefaction induced settlement, and liquefaction observed from aerial photographs.

The apparent settlement of the ground above the trench excavation traversing Somerfield Street and the localised depression on the car park area west of Block 2, appears to be due to liquefaction subsidence of the underlying soils. Information from residents that liquefaction ejecta was observed within the car park area and along the eastern boundary of the site. The magnitude of ground heave on the areas mentioned above is unknown as the areas affected has been repaired (e.g. car park) and the ground at the eastern boundary now levelled. However, up to 20mm of ground heave has been noted around the site, which is inferred to result from ejected soils accumulating under an impermeable surface, such as asphalt.

The cracks on the concrete patio of the most of the ground floor units of up to 7mm wide and settlement of up to 10mm is evident of liquefaction induced settlement of the underlying soils.

Due to the ground motion during the seismic events, the lateral movement that Block 3 has undergone may have caused the soils to consolidate resulting in the gaps observed between the perimeter foundation of Block 3 -Unit 21 and the ground on the eastern boundary of the site. Alternatively, the void may have been caused as a result of liquefaction ejecta. The gap was about 70mm wide and 500mm deep. It was difficult to tell whether some differential settlement of the foundation has occurred from the exterior of Unit 21.There was no evidence of cracks in the perimeter footing were the gap was noted.

Anecdotal Information gathered from the resident of Unit 19 was a crack of up to 20mm wide of Block 4 could also have been a result of the lateral movement of the ground during the quake. Refer to Appendix B for Site Walkover Plan.

Construction drawings indicate the western and southern walls of Unit 19 are supported on prestressed concrete piles. Shallow investigations are recommended to verify the presence of the piles.

The widening of the construction joint of the concrete footpath surrounding the blocks were up to 50mm also an evidence of lateral movement/stretch.

There is a creek which is located approximately 10m west of Block 4. The depth of the invert of the creek is 1.5m below floor level of Block 4. This free face represents a potential hazard for lateral spreading.

Due to the reinforced masonry block construction of the units, the structural form is not directly recognised in the DBH guidance document. Therefore, appropriate remedial solutions will be dependent on the integrity of the super structure and liaison with the Structural Engineer.

No evidence of cracking in the perimeter footings was observed. Areas inspected were limited only in the buildings' exterior.

There was no level survey carried out to date.

The CLiq analysis based on the CPTs located 85m east and 35m south of the site indicated that there is possible total settlement of up to 400mm during an Ultimate Limit State seismic event. Liquefiable layers have been identified from the ground water level to 14m below ground level.

The peak ground accelerations (PGA) applied for the Ultimate Limit State (ULS) and Serviceability Limit State (SLS) seismic events at the site are based upon extensive probabilistic modelling by GNS Science and observations of land and building damage caused during the Canterbury Earthquake Sequence. The values used are recommended in Appendix C of the Department of Building and Housing guidance document (DBH, April 2012). The PGA based on a Class D soil type (deep or soft soils), importance level 2 (IL2), is applicable to this site.

GNS Science indicates an elevated risk of seismic activity is expected in the Canterbury region as a result of the earthquake sequence following the 4 September 2010 earthquake. Recent advice (Geonet) indicates there is currently a 13% probability of another Magnitude 6 or greater earthquake occurring in the next 12 months in the Canterbury region. Ground damage similar to what has been observed is anticipated in such an event, dependent on the location of the epicentre. It is expected that the probability of occurrence is likely to decrease with time, following periods of reduced seismic activity.

The differential settlement that appears to have occurred in places surrounding the residential blocks particularly in the concrete patio and footpaths may be attributed to a temporary loss of bearing capacity during the seismic shaking. Shallow investigations including Hand Augers and Scalas should be undertaken to confirm the bearing capacity of the underlying material.

Externally the existing foundations appear to have performed well in the recent earthquake events.

5. Recommendations

It is recommended that:

- A level survey should be undertaken in the residential blocks to confirm the performance of foundations and identify any evidence of differential settlement.
- In order to obtain building consents for strengthening works, site investigations and assessment will be required. Investigations including 4 Hand Augers/Scalas, 3 Cone Penetrometer Testing (CPT) and shallow inspection pits are recommended to confirm the bearing capacity of the underlying material, to assess liquefaction potential of the site and to confirm the presence of the concrete piles under Unit 19. (Refer to Appendix F for the Site Investigation Location Plan)
- The 70mm wide gap noted in Block 3- Unit 21 should backfilled.

6. Limitation

This report has been prepared solely for the benefit of Christchurch City Council as our client with respect to the particular brief given to us. Data or opinions in this desk study may not be used in other contexts, by any other party or for any other purpose.

It is recognised that the passage of time affects the information and assessment provided in this document. Opus's opinions are based upon information that existed at the time of the production of this Desk Study. It is understood that the Services provided allowed Opus to form no more than an opinion on the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings or any laws or regulations.

7. Reference

Brown, LJ; Webber, JH 1992: Geology of the Christchurch Urban Area. Scale 1:25,000. Institute of Geological and Nuclear Sciences geological map, 1 sheet + 104p.

Environment Canterbury, Canterbury Regional Council (ECan) website:

ECan Well Card
http://ecan.govt.nz/services/online-services/tools-calculators/Pages/well-card.aspx

ECan 2004: The Solid Facts on Christchurch Liquefaction. Canterbury Regional Council, Christchurch, 1 sheet.

Project Orbit, 2011: Interagency/organisation collaboration portal for Christchurch recovery effort. https://canterburyrecovery.projectorbit.com/SitePages/Home.aspx

GNS Science reporting on Geonet Website: http://www.geonet.org.nz/canterbury-quakes/aftershocks/ updated on 15 October 2012.

‘Interim recommendations for PGA values for geotechnical design in Canterbury’: Department of Building and Housing New Zealand (2012) *Appendix C: Interim guidance for repairing and rebuilding foundations in Technical Category 3.*

Appendices:

Appendix A: Site Photographs
Appendix B: Site Location and Walkover Plans
Appendix C: Available Structural Drawings
Appendix D: Earthquake Commission Subsurface Investigations
Appendix E: Environment Canterbury Borehole Logs
Appendix F: Proposed Site Investigation Plan

Appendix A:
Site Photographs

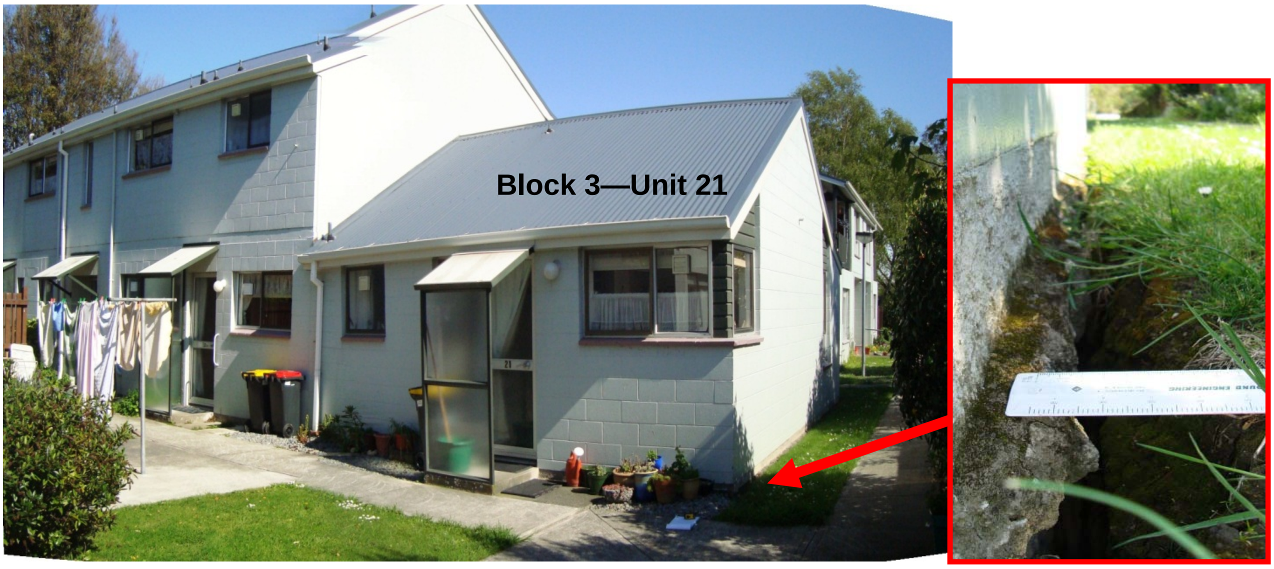
Photograph 1: Rear elevation of Block 1 – Unit 1 to 4

Photograph 2: Front elevation of Block 1 – Unit 1 to 4.

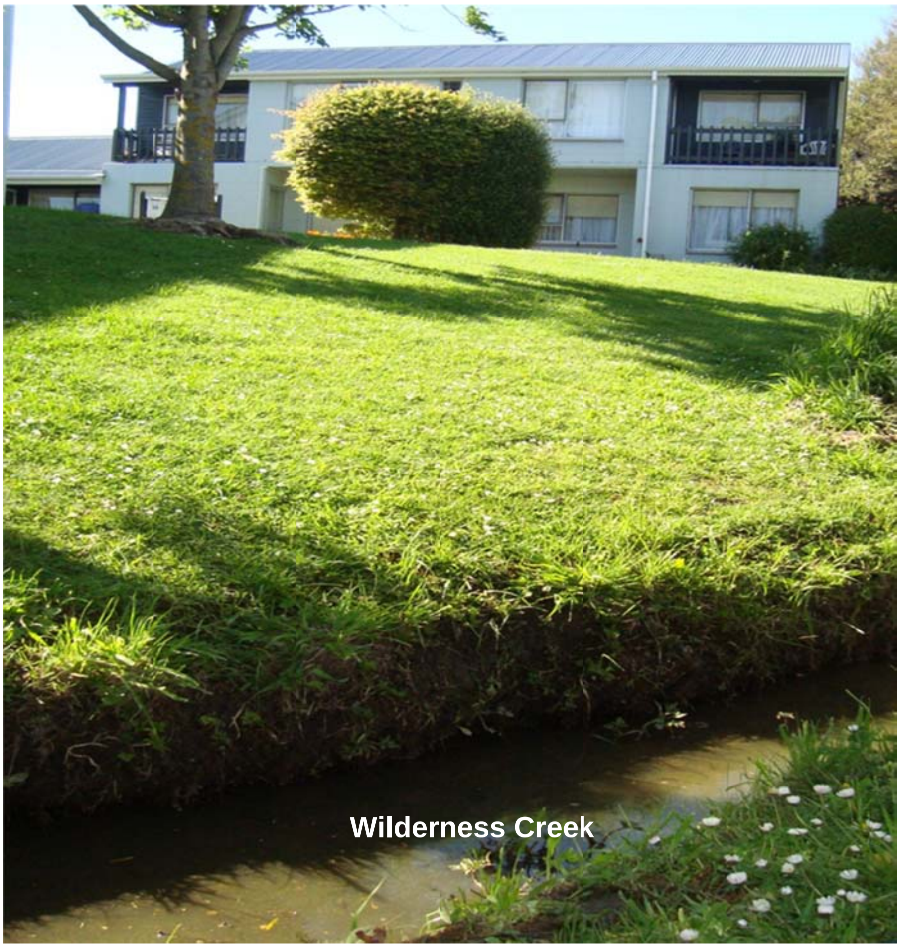
Photograph 3: Rear Elevation of Block 2 – Units 9 to 12.

Photograph 4: Rear Elevation of Block 2 – Units 5 to 8

Photograph 5: Front Elevation of Block 2 – Units 5 to 12 with Unit 11 and 12 in the foreground.

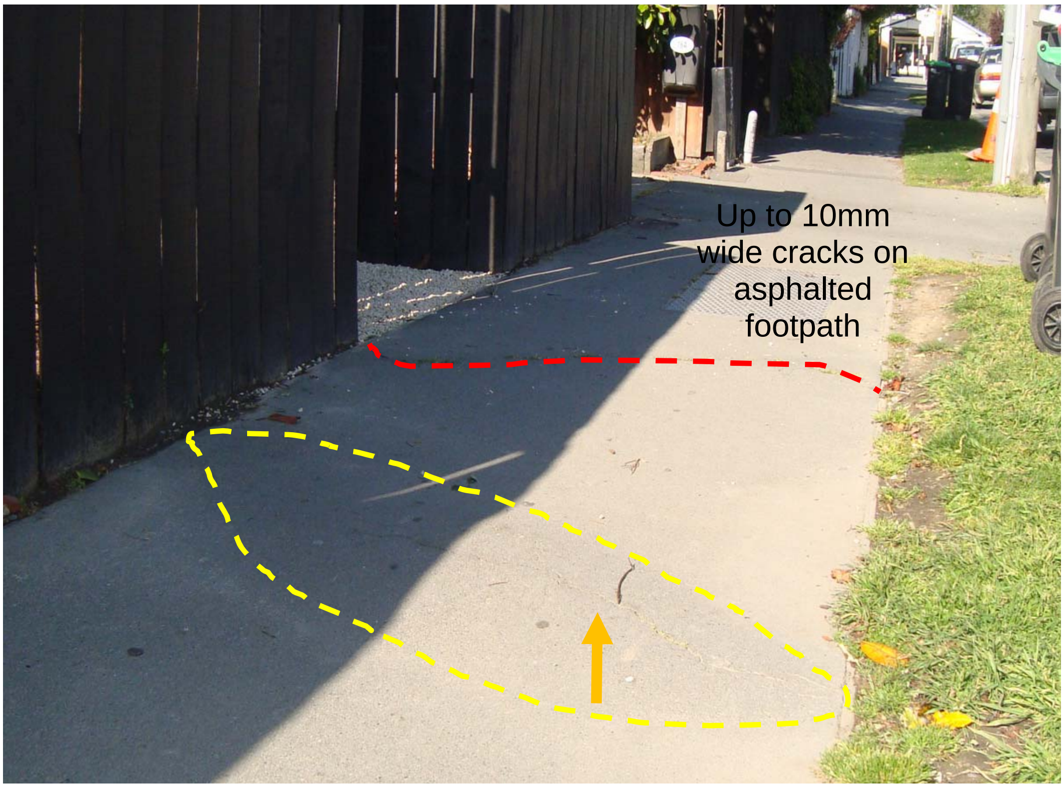


Photograph 6: Rear Elevation of Block 3 – Units 13 to 16, 21 (left photo). Up to 70mm gap between the ground and perimeter foundation at the end elevation of Unit 21 (right photo).



Photograph 7: Front elevation of Block 3 – Unit 13 to 16 with the Wilderness Creek in the foreground.

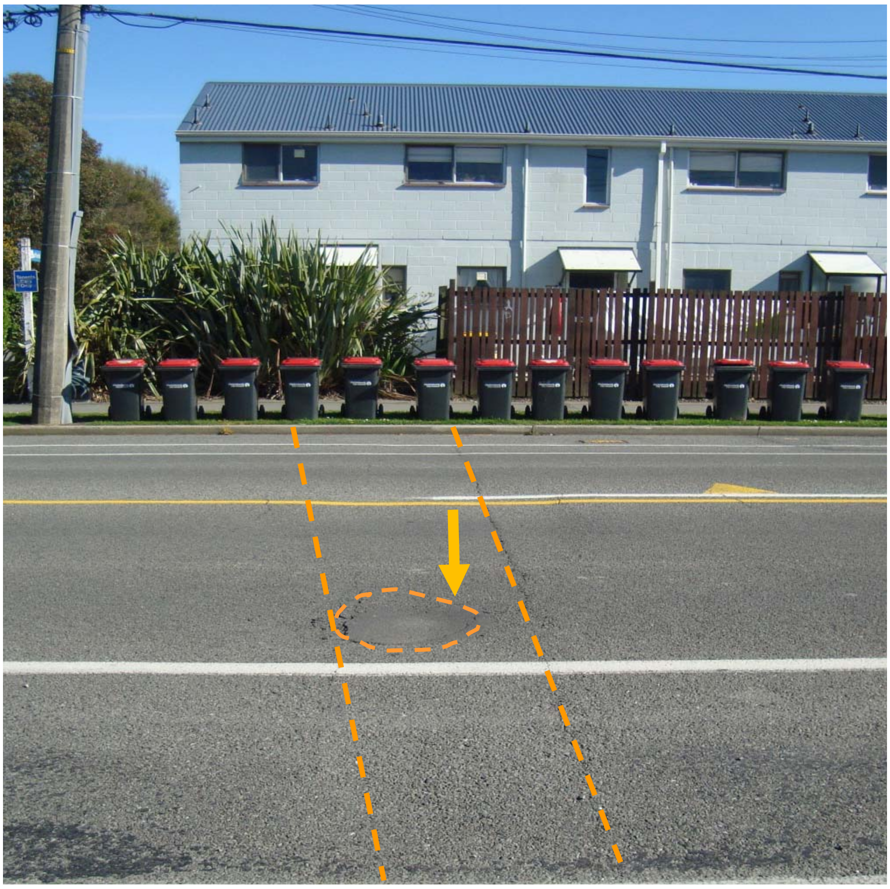
Photograph 8: Rear elevation of Block 4– Unit 17 to 20.



Photograph 9: Up to 10mm wide cracks on the asphalted footpath across the street from Hadfield Courts and up to 20mm of ground heave

Photograph 10: Repaired liquefaction damaged asphalted ground by the driveway to Hadfield Courts

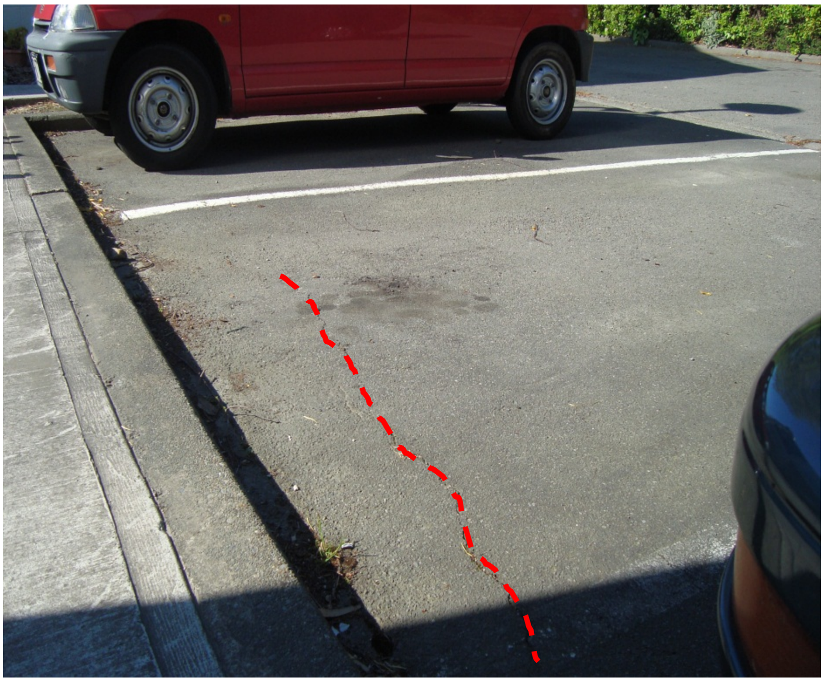
Photograph 11: Up to 15mm lift on the ground around buried services along Somerfield Street by the southern boundary of Hadfield Courts



Photograph 12: Up to 15mm localised depression and slight depression on the trench excavation where the buried services are.

Photograph 13: 20mm lift on the concrete footpath with a 15mm wide gap west of the kitchen door of Block 2- Unit 5

Photograph 14: Up to 4mm wide crack on the concrete kerb in various places within the car park area.



Photograph 15: Minor cracking (<5mm wide) in various places within the car park

Photograph 16. 20mm ground heave on the asphalted car park in front of Unit 7

Photograph 17. Up to 15mm wide cracks on the concrete footpath east of Block 3-Unit 13

Photograph 18. 50mm wide separation of the construction joints on the concrete footpath at the front elevation of Block 3-Unit 13

Photograph 19. View of the backyard taken from the end elevation of Block 4.

Photograph 20. Up to 10mm wide cracks and differential settlement of less than 10mm on the concrete patio by the lounge door entrance of Block 3 - Units 19 and 17

Photograph 21. Concrete slab by the lounge doors of Unit 5 and 7 lifted up to 9mm

Appendix B:
Site Location and Walkover Plans

Key:

△	EQC CPT
📌	Ecan Borehole

BH	ECan Ref
1	M36/9248
2	M36/9936
3	M36/9249
4	M36/9943
5	M36/1050
6	M36/9240

CPT	EQC Ref
1	CPT-631
2	CPT-628

SOURCE: 1) canterburyrecovery.projectorbit.com (Accessed on 15/10/12)
2) http://arcims.ecan.govt.nz/ecanmapping/ (Accessed on 15/10/12)

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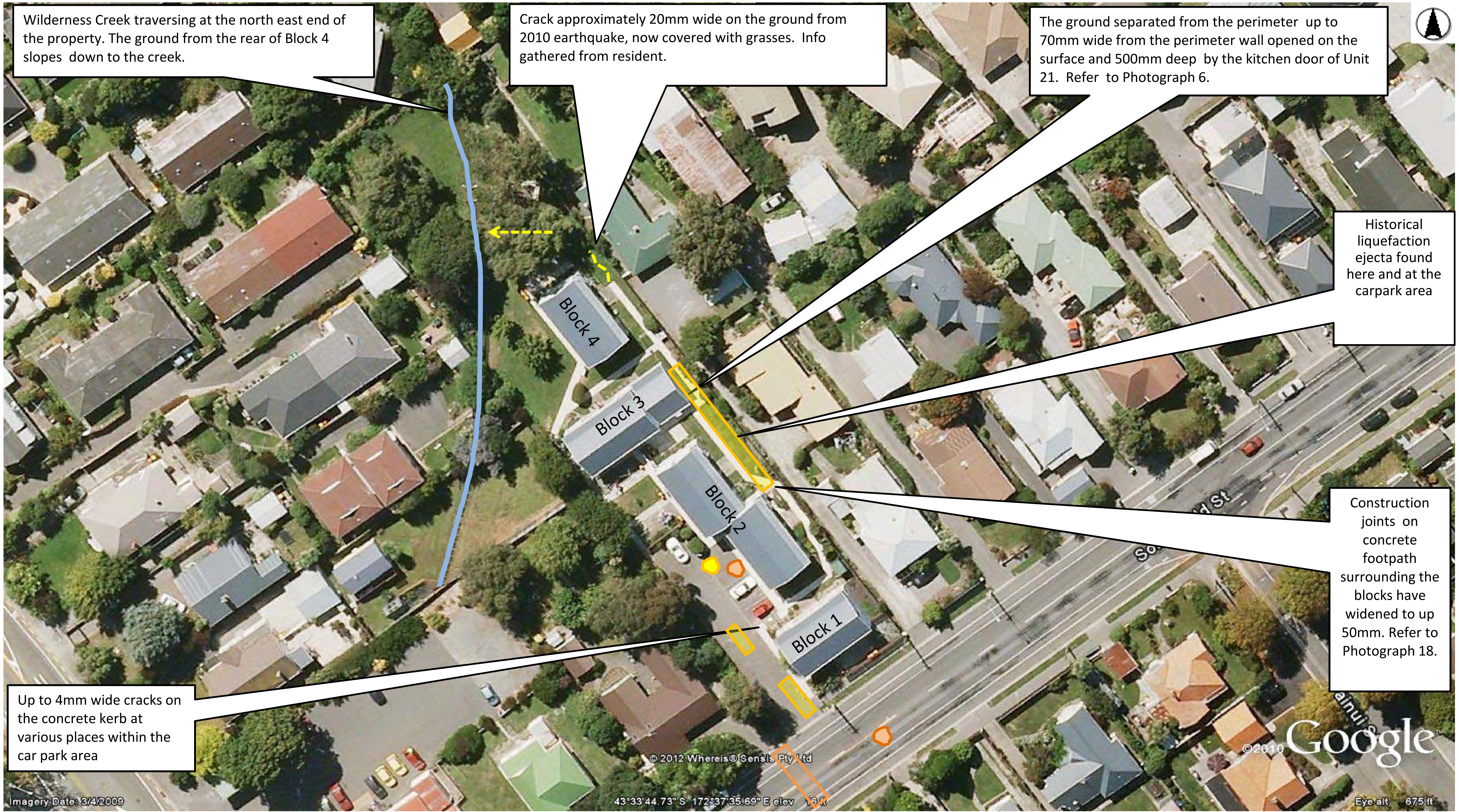
Project: CCC- 15 Somerfield Street , Somerfield, Christchurch
Geotechnical Desktop Study

Project No.: 6-QUCC1.99

Client: Christchurch City Council

Site Location Plan

Date: 15/10/2012



Wilderness Creek traversing at the north east end of the property. The ground from the rear of Block 4 slopes down to the creek.

Crack approximately 20mm wide on the ground from 2010 earthquake, now covered with grasses. Info gathered from resident.

The ground separated from the perimeter up to 70mm wide from the perimeter wall opened on the surface and 500mm deep by the kitchen door of Unit 21. Refer to Photograph 6.

Historical liquefaction ejecta found here and at the carpark area

Construction joints on concrete footpath surrounding the blocks have widened to up 50mm. Refer to Photograph 18.

Up to 4mm wide cracks on the concrete kerb at various places within the car park area

🟨	Repaired aphalted driveway damage by liquefaction (up to 3m^2)	●	Heave on asphalted carpark up to 20mm
🟦	Creek	●	localized depressions <20mm deep
🟧	Repaired road damage by liquefaction		

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Geotechnical Desktop Study
Project No: 6-QUCC1.99
Client: Christchurch City Council

Site Walkover Plan

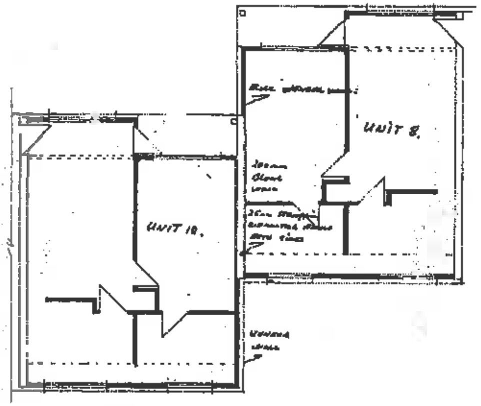
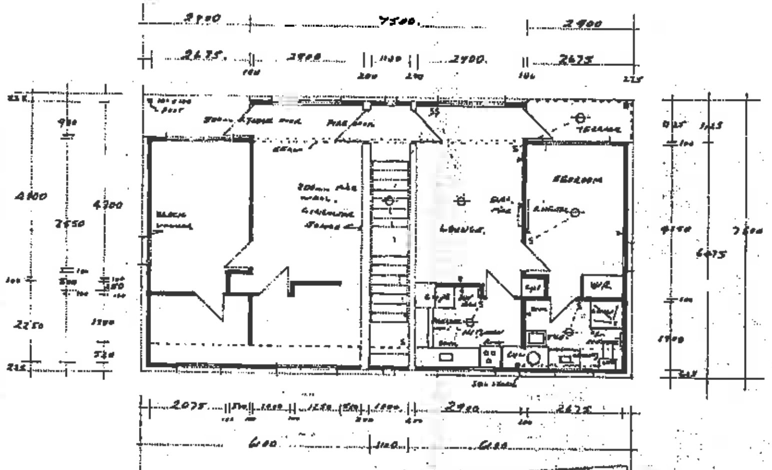
Drawn: Opus Geotechnical Engineer

Date: 15/10/2012

Appendix C:
Available Structural Drawings

BEECHEY HOMES LTD.
P.O. Box 25081, VICTORIA ST.,
CHRISTCHURCH

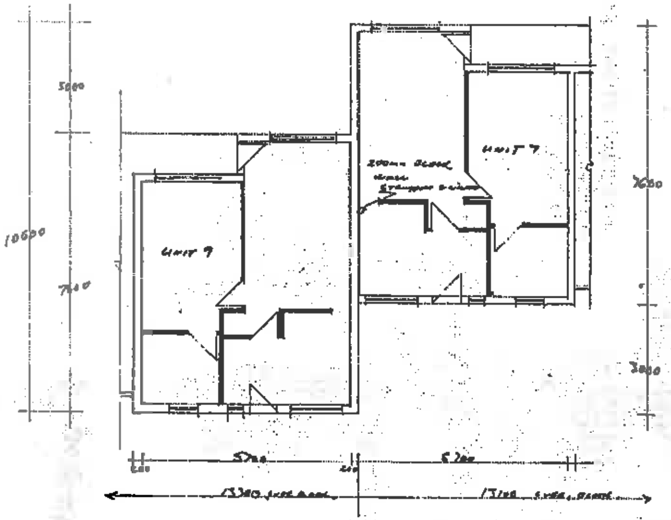
1 ST. FLOOR PLANS.

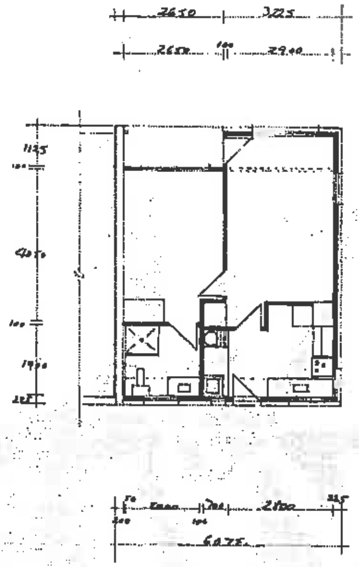
AREA.		
	GROUND FL	1STFL.
BLOCK.1.	101·08.	101·08
" . 2.	200·64	200·64
3.	145·73	101·08.
4.	101·08.	101·08.

TOTAL AREA. 3 1052·31 M²

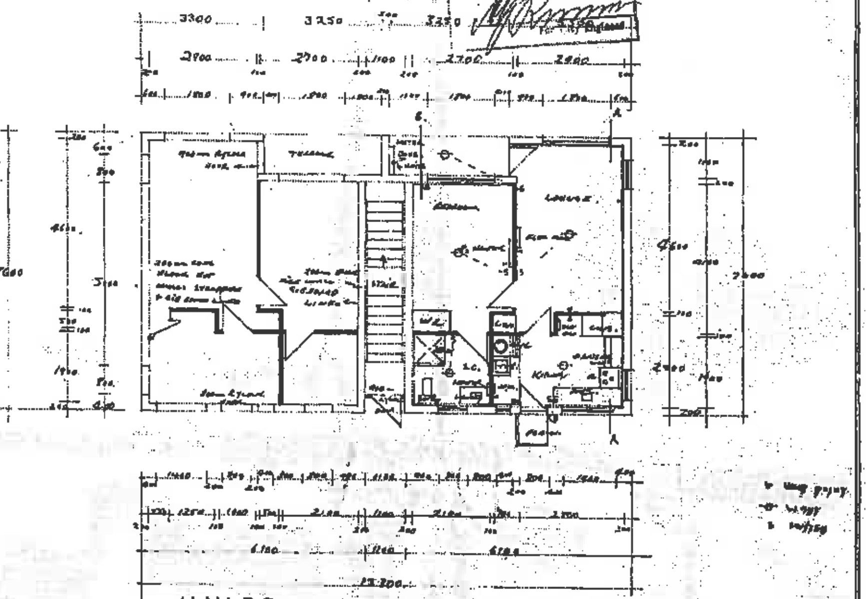
GROUND FLOOR PLANS.



UNITS 7, 8,9,10.



UNIT 21



UNITS 1.2.3.4. 5.6.11. 12.13.14.15.16.17.18.19. 20.

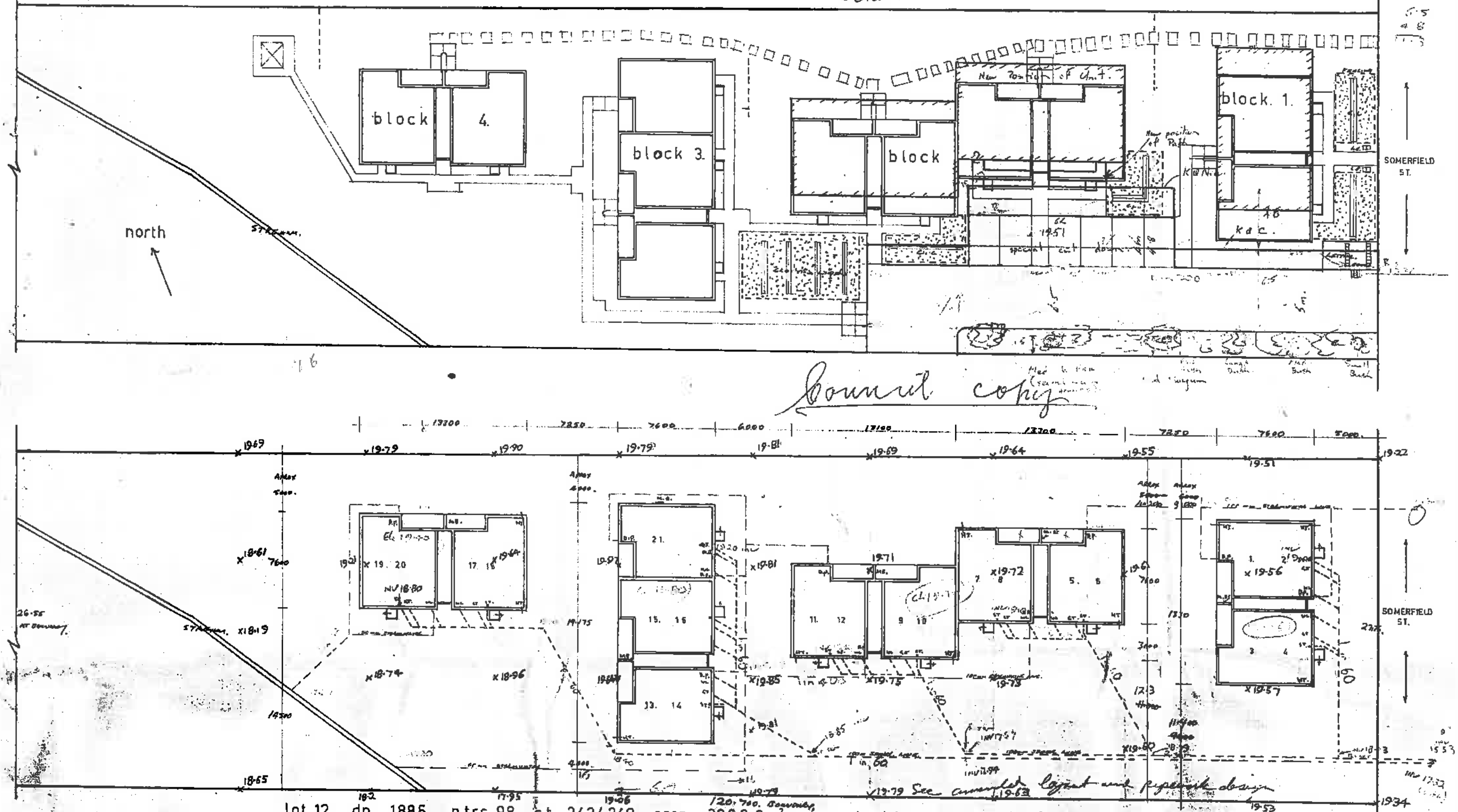
SOMERFIELD STREET ELDERLY. PERSONS HOUSING FOR CHRISTCHURCH CITY COUNCIL

scale 1 - 100

See amended design

SITE PLANS.

BEECHEY HOMES LTD.
P.O. Box 25081, VICTORIA ST.,
CHRISTCHURCH



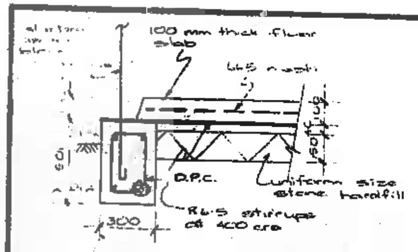
See amended layout and pipework design

Council copy

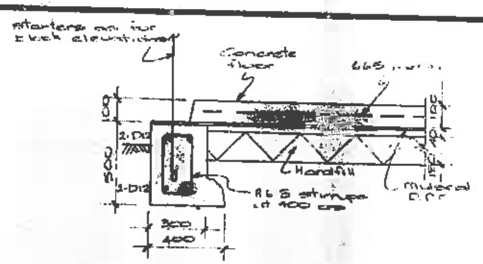
lot.12. dp. 1885 ptrs.98 c.t 242/240 area 3262·8m² area buildings 1052·31m²

SOMERFIELD STREET ELDERLY PERSONS HOUSING FOR CHRISTCHURCH CITY COUNCIL

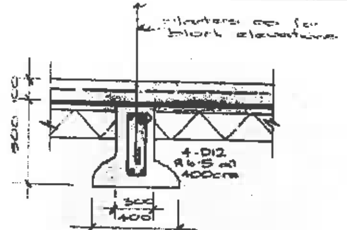
scale 1 - 200



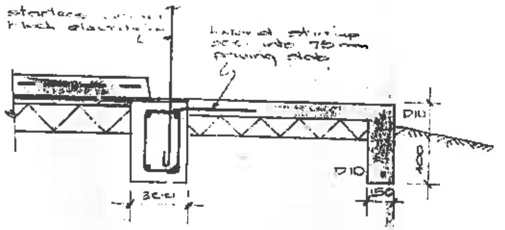
FRONT AND REAR WALL FOUNDATION



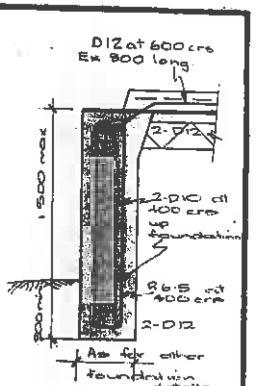
END WALL FOUNDATION



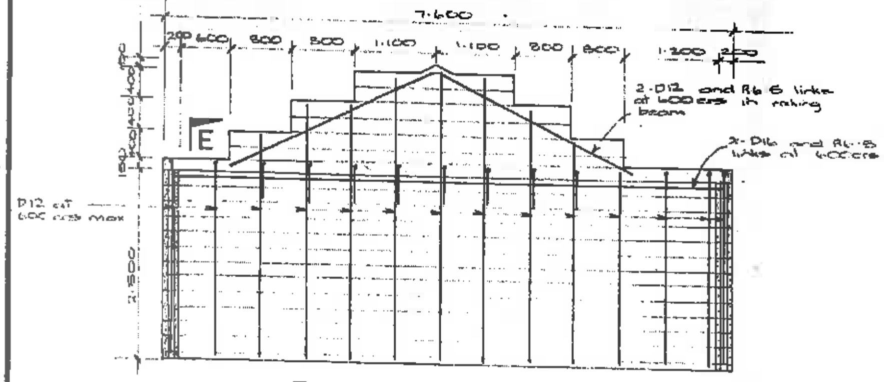
FIREWALL FOUNDATION



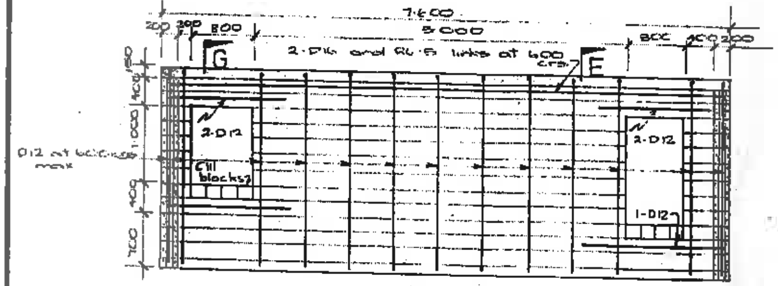
FOUNDATION AT TERRACE



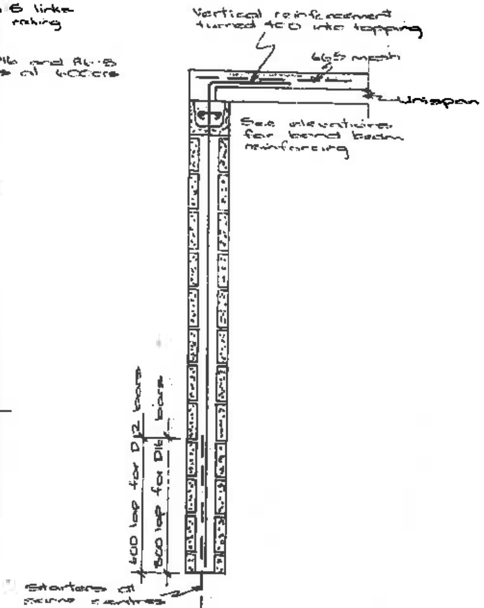
FOUNDATIONS WHERE GROUND LEVEL IS LOW



FIREWALL 15/16/21.



END WALL

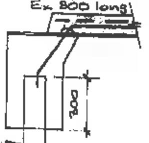


EXTERNAL WALL X SECTION

D12 at 600 crs
Ex 800 long

Foundation as per other details

Flat 19 shall have piles at 500 crs in west wall and at 800 crs in south wall



PILED FOUNDATION

Notes.

1. All foundations must be taken down to solid.
2. All work shall comply with the relevant chapters of N.Z.S.1900.
3. Where laps are not shown they shall be 40 diameters.
4. Except for stirrups and ties all reinforcement shall be deformed bars. All reinforcing steel shall be grade 275 complying with N.Z.S. 3402P, except steel designated H, which shall be grade 380.
5. Only those cores that are reinforced shall be grouted.
6. All blockwork grout for filling cores shall have a minimum compressive strength of 17.5 MPa at 28 days.
7. All mortar mixes shall have a minimum compressive strength of 12 MPa at 28 days.
8. All blockwork shall comply with N.Z.S. 1900. Chapter 9.2.
9. All foundation concrete shall have a minimum compressive strength of 17.5 MPa at 28 days.
10. All walls are viewed from the inside.
11. All concrete shall be thoroughly vibrated when placed.
12. All reinforcing steel shall be bent to return at all wall junctions.
13. Clean out pockets shall be provided at the bottom of all reinforced cores.
14. All piles shall be driven 100x75 prestressed concrete posts driven to a 16mm set with 4 blows of a 200kg hammer.

CHRISTCHURCH CITY [illegible]
Approved Subject to the [illegible]

BEECHEY HOMES LTD.
P.O. Box 25081, VICTORIA ST.
CHRISTCHURCH

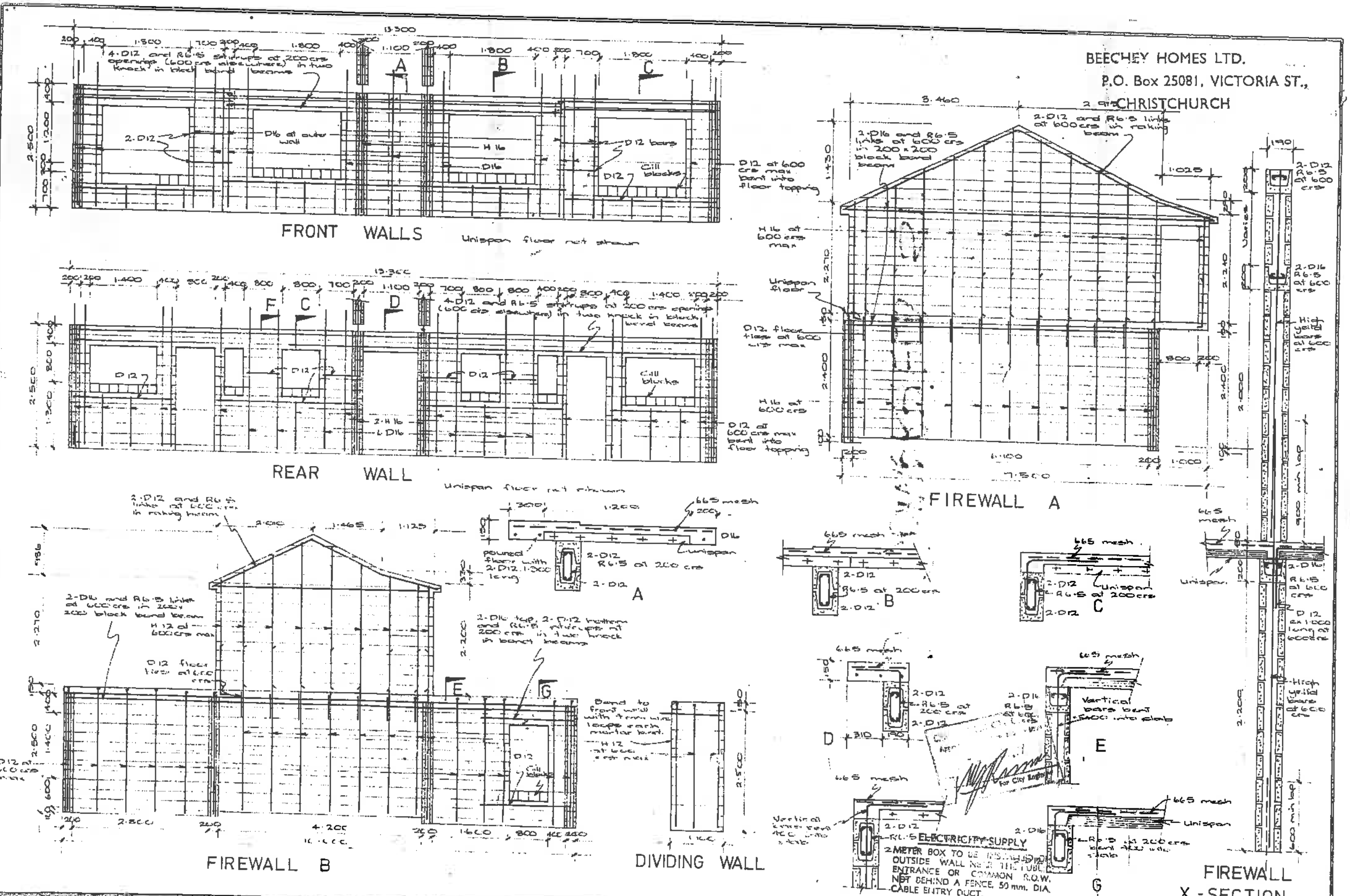
WARREN R LEWIS.
Registered Consulting Engineer.
151 Worcester Street.
P.O. Box 13-282.
Phone 64-320.

SOMERFIELD STREET ELDERLY PERSONS HOUSING.
FOR CHRISTCHURCH CITY COUNCIL.
STRUCTURAL.

	ISSUE	SCALES	FILE	DRAWING
DSN. W.L. DRN. W.L. TRCD. A.L. DATE. 10/76.	29/10/76	1:50. 1:20.	221	1

Contractor shall verify all dimensions before starting work.

BEECHEY HOMES LTD.
P.O. Box 25081, VICTORIA ST.,
CHRISTCHURCH



ELECTRICITY SUPPLY
2 METER BOX TO BE INSTALLED ON OUTSIDE WALL NEAR THE PUBLIC ENTRANCE OR COMMON R.O.W. NOT BEHIND A FENCE. 50 mm. DIA. CABLE ENTRY DUCT.

For City Engineer

WARREN R LEWIS.
Registered Consulting Engineer.
151 Worcester Street
P.O. Box 13-282.
Phone 64-320.

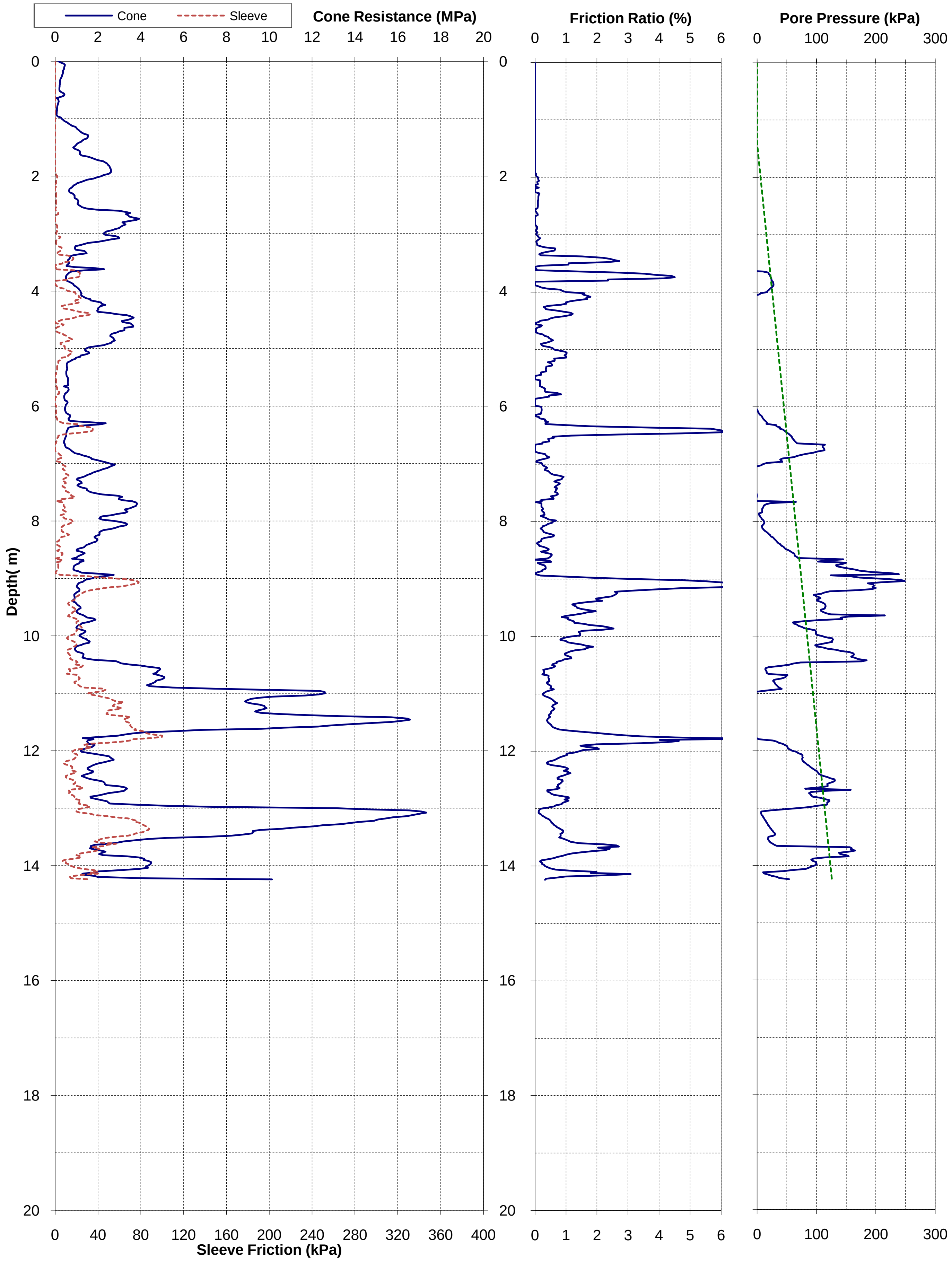
SOMERFIELD STREET. ELDERLY PERSONS HOUSING.
FOR CHRISTCHURCH CITY COUNCIL.
STRUCTURAL.

DSND. W.L. DRN. W.L. TRCD. A.L. DATE 10/76.	ISSUE	SCALES	FILE	DRAWING
	29/10/76	1:50 1:20	221	2

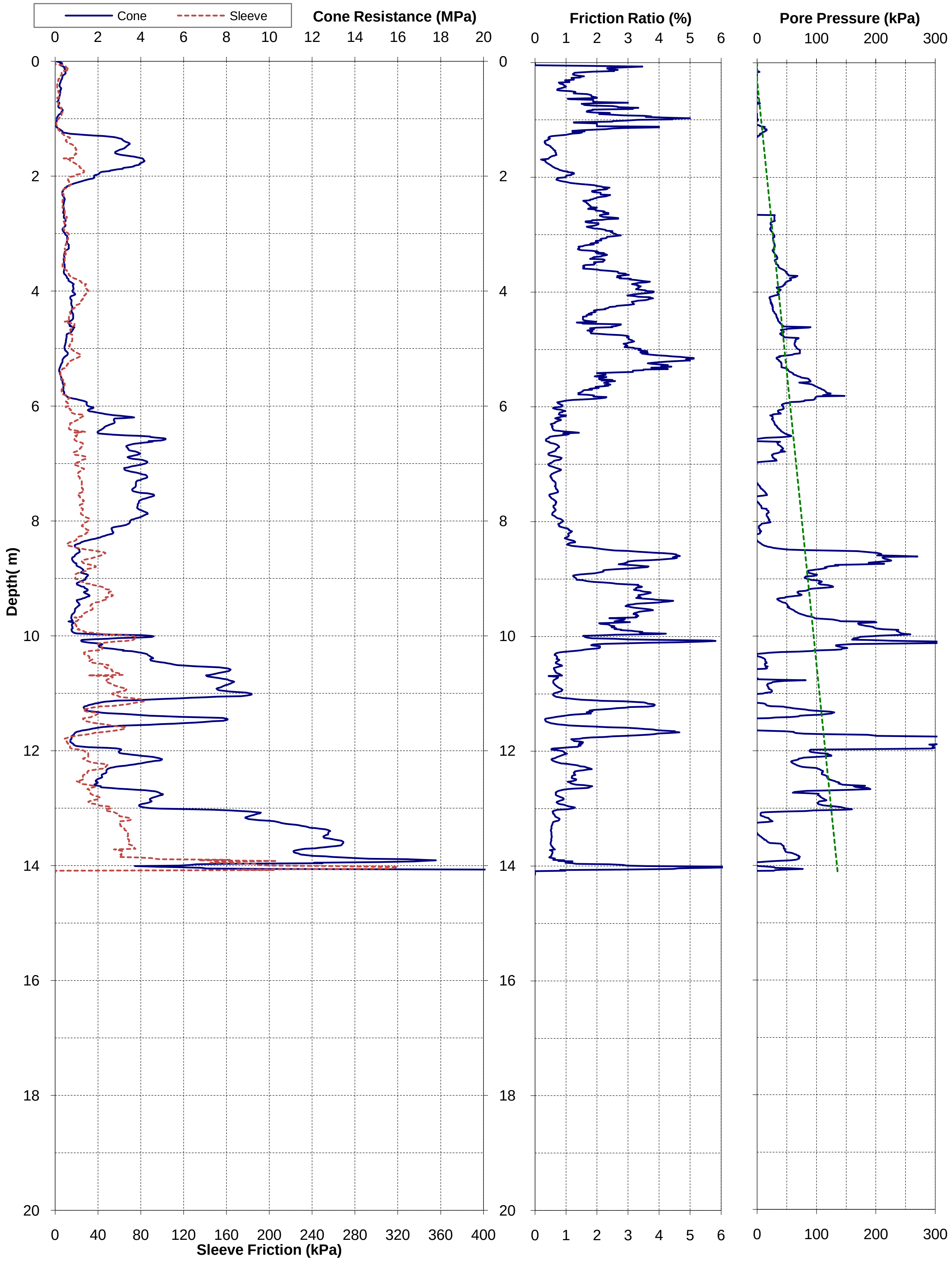
Contractor shall verify all dimensions before starting work.

Appendix D:
Earthquake Commissions Subsurface Investigations

Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			**Page:** 1 of 1	**CPT-SMF-02**
Test Date:	4-May-2011	**Location:**	Somerfield	**Operator:**	Geotech
Pre-Drill:	1.2m	**Assumed GWL:**	1.4mBGL	**Located By:**	Survey GPS
Position:	2479852.6mE	5738191.9mN	10.071mRL	**Coord. System:**	NZMG & MSL
Other Tests:				**Comments:**	



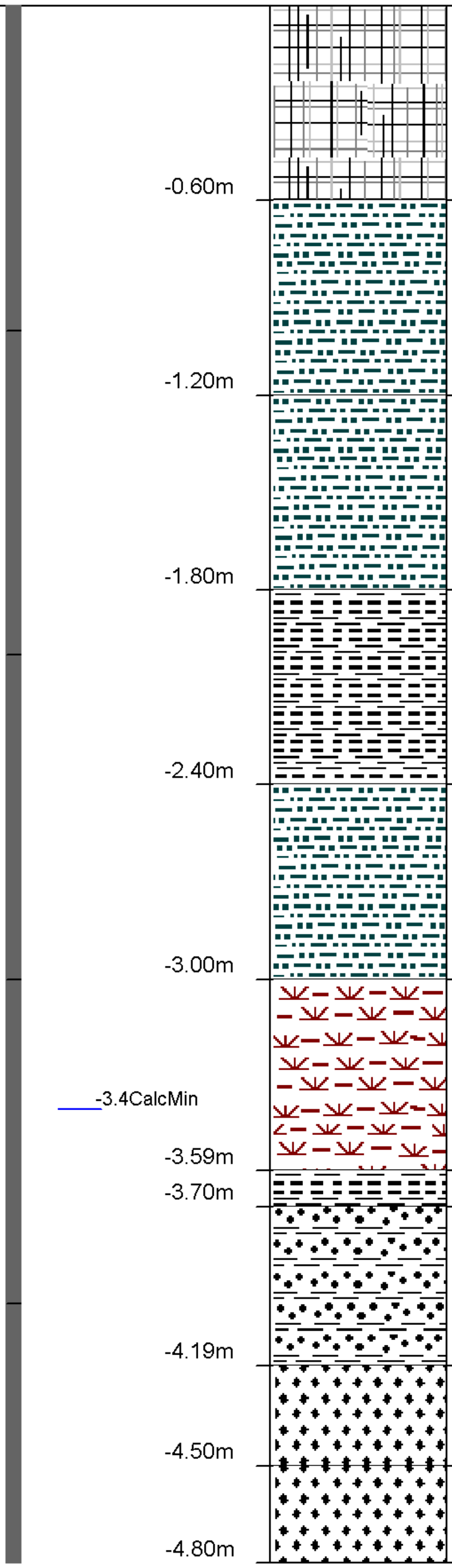
Project:	Christchurch 2011 Earthquake - EQC Ground Investigations			**Page:** 1 of 1	**CPT-SMF-05**
Test Date:	27-Jun-2011	**Location:**	Somerfield	**Operator:**	Perry
Pre-Drill:	1.2m	**Assumed GWL:**	0.3mBGL	**Located By:**	Survey GPS
Position:	2479938.4mE 5738264.2mN 9.875mRL			**Coord. System:**	NZMG & MSL
Other Tests:				**Comments:**	



Appendix E:
Environment Canterbury Borehole Logs

Borelog for well M36/1050

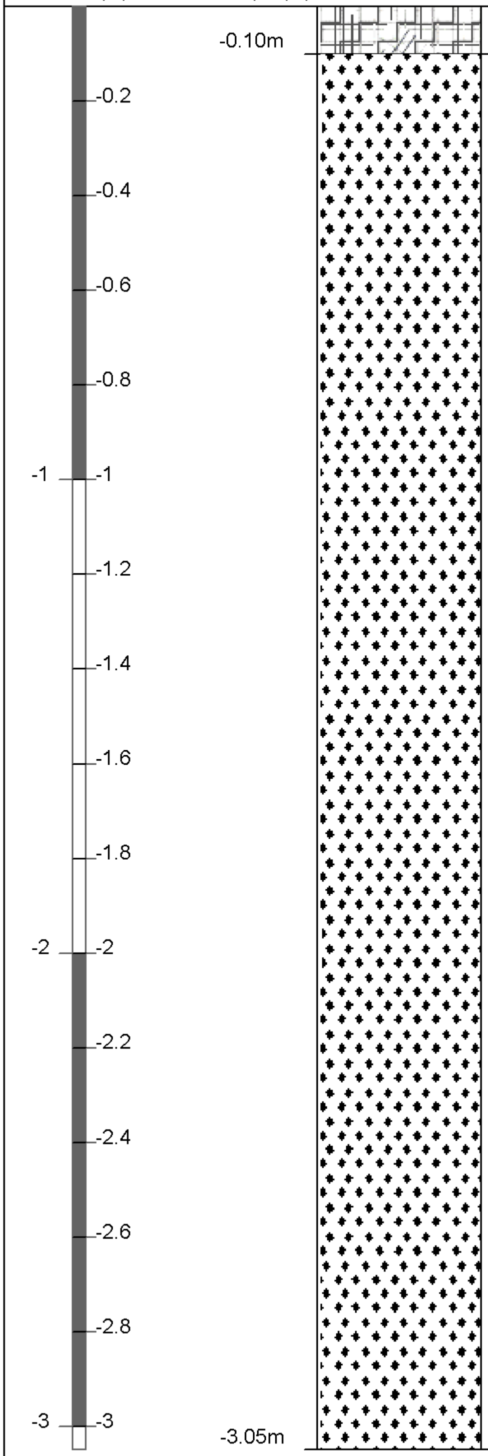
Gridref: M36:798-382 Accuracy : 4 (1=best, 4=worst)
Ground Level Altitude : 10.2 +MSD
Driller : not known
Drill Method : Unknown
Drill Depth : -4.8m Drill Date :



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		-0.60m	Fill	fi
		-1.20m	Silty sand	sp
		-1.80m	Sandy silt	sp
		-2.40m	Clay silt	sp
		-3.00m	Sandy silt	sp
	-3.4CalcMin			
		-3.59m	Organic clay	sp
		-3.70m	Silty clay	sp
		-4.19m	Sandy clay	sp
		-4.50m	Sand	sp
		-4.80m	Coarse sand	sp

Borelog for well M36/9240

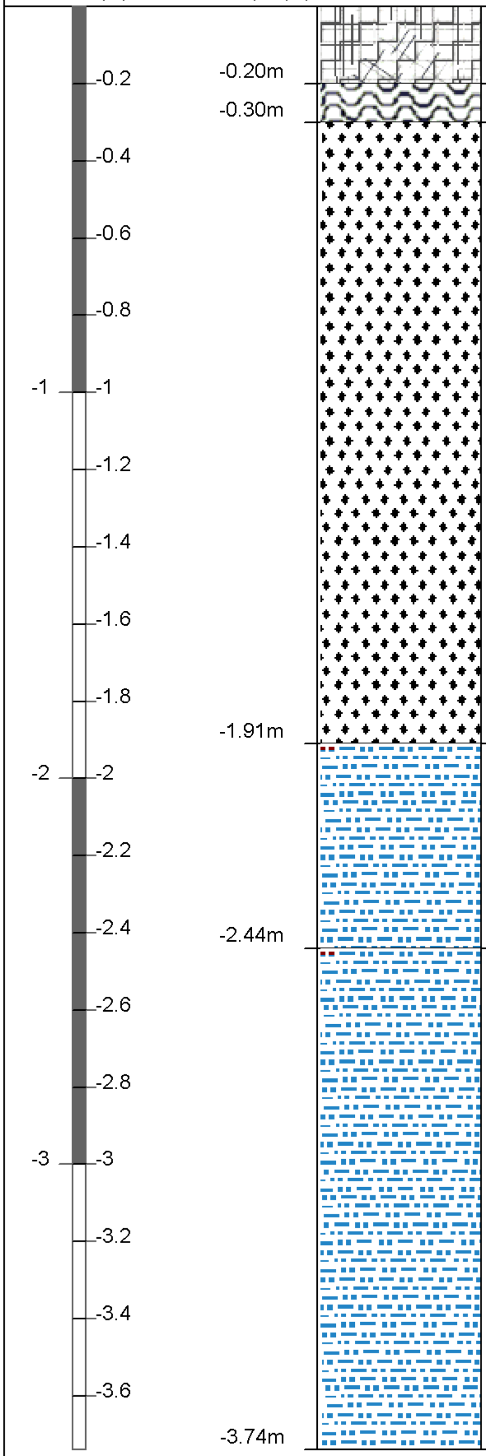
Gridref: M36:79748-38197 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 10.2 +MSD
Well name : CCC BorelogID 2622
Drill Method : Not Recorded
Drill Depth : -3.05m Drill Date :



Water Level	Depth(m)	Full Drillers Description	Formation Code
	-0.10m	road metal	
	-3.05m	sand	

Borelog for well M36/9248

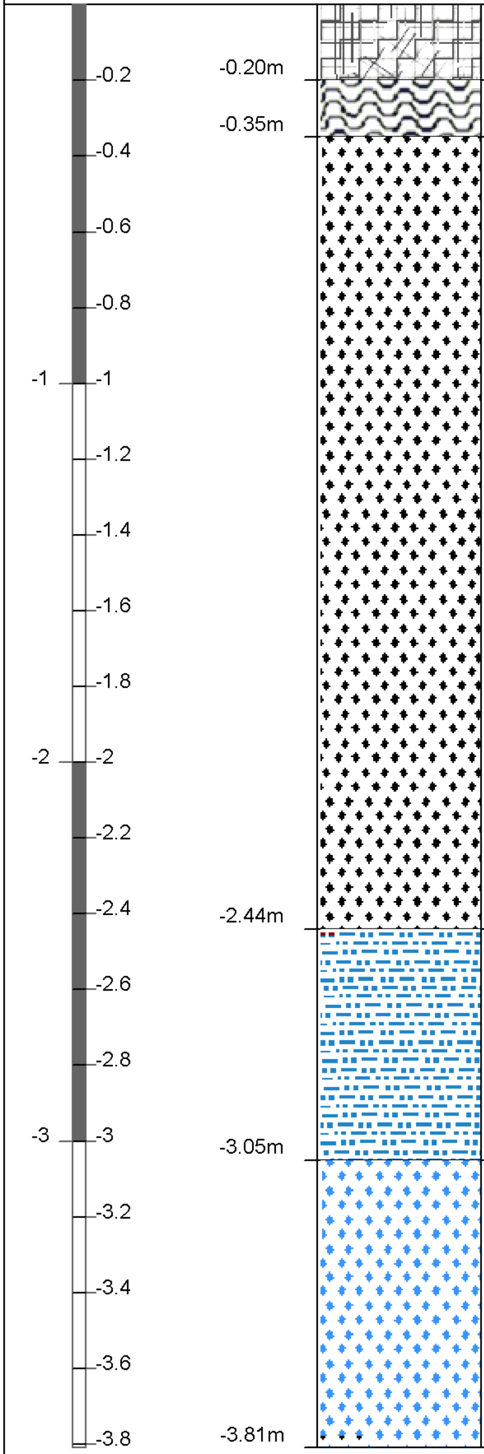
Gridref: M36:79921-38256 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 10.2 +MSD
Well name   : CCC BorelogID 2630
Drill Method : Not Recorded
Drill Depth   : -3.74m   Drill Date :



Water Level	Depth(m)	Full Drillers Description	Formation Code
		road metal	
	-0.20m	topsoil	
	-0.30m	sand	
	-1.91m	blue sand and fine sand and silt	
	-2.44m	blue fine sand and silt	
	-3.74m		

Borelog for well M36/9249

Gridref: M36:79854-38203 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 10.2 +MSD
Well name : CCC BorelogID 2631
Drill Method : Not Recorded
Drill Depth : -3.81m Drill Date :

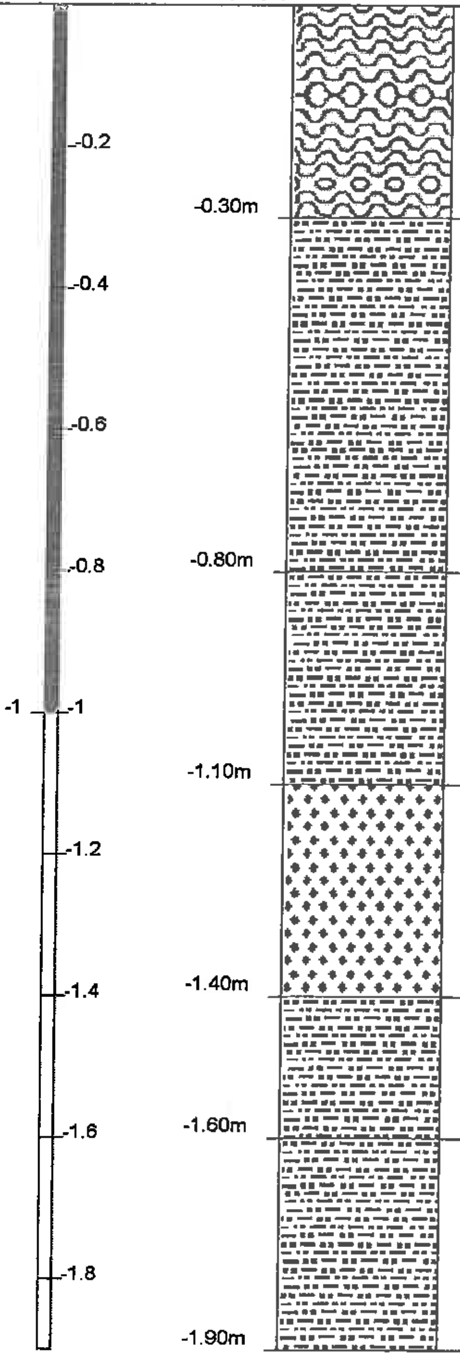


Depth(m)	Full Drillers Description	Formation Code
-0.20m	road metal	
-0.35m	topsoil	
-2.44m	sand	
-3.05m	blue sand and fine sand and silt	
-3.81m	blue sand	

Borelog for well M36/9936

Gridref: M36:79965-38234 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 10.2 +MSD
Well name : CCC BorelogID 5695
Drill Method : Not Recorded
Drill Depth : -1.9m Drill Date : 28/06/2005

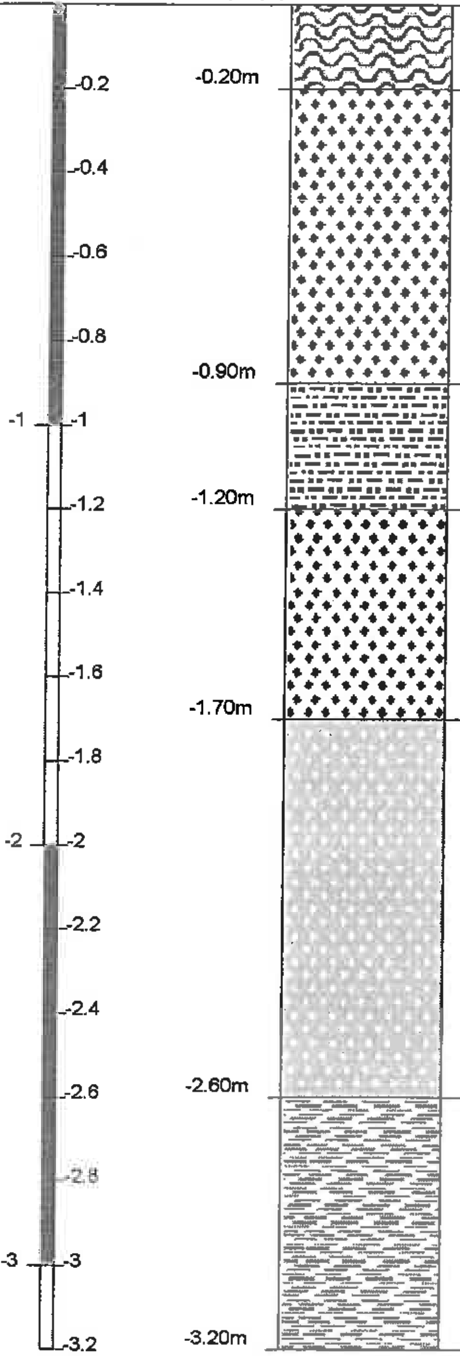
Environment Canterbury Regional Council



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			topsoil	
		-0.30m	brown silty sand	
		-0.80m	grey/brown silty sand	
		-1.10m	grey/orange sand	
		-1.40m	grey/orange sandy silt	
		-1.60m	grey/orange silty sand	
		-1.90m		

Borelog for well M36/9943

Gridref: M36:80019-38226 Accuracy : 3 (1=high, 5=low)
Ground Level Altitude : 10.2 +MSD
Well name : CCC BorelogID 5702
Drill Method : Not Recorded
Drill Depth : -3.2m Drill Date : 6/04/2005



Depth(m)	Full Drillers Description	Formation Code
-0.20m	topsoil	
-0.90m	mottled damp sand	
-1.20m	mottled wet silty sand	
-1.70m	mottled wet sand	
-2.60m	grey wet sand	
-3.20m	blue wet clay	

Appendix F:
Proposed Site Investigation Plan

● Hand Augers and Scalas to 4m depth

✕ Cone Penetrometer Test (CPT) to 20m depth

OPUS
Opus International Consultants Ltd
Christchurch Office
20 Moorhouse Ave
PO Box 1482
Christchurch, New Zealand
Tel: +64 3 363 5400 Fax: +64 3 365 7857

Geotechnical Desktop Study
Project No: 6-QUCC1.99
Client: Christchurch City Council

Proposed Site Investigation Plan

Drawn: Opus Geotechnical Engineer

Date: 15/10/2012

Appendix 3 - Methodology and Assumptions

Seismic Parameters

As per NZS 1170.5:

- T < 0.4s (assumed)
- Soil: Category D
- Z = 0.3
- R = 1.0 (IL2, 50 years)
- N(T,D) = 1.0

For the analyses of the reinforced concrete blockwork walls, a μ of 1.25 was assumed for walls subject to in-plane loading while a μ of 2 was assumed for walls subject to out-of-plane loading.

Analysis Procedure

For the reinforced concrete blockwork walls, capacities were based on the equivalent static method force-based approach whereby the seismic weight at first floor level was distributed to ground via the in-plane walls. The amount of force to each wall was determined in accordance with the relative stiffness of the wall due to the presence of a rigid diaphragm at first floor. Additional forces to walls arising from eccentricities of the wall layout were also considered.

For the timber framed walls, capacities were based on the NZS 3604 approach where base shears are converted to bracing units (1 kN = 20 BU's) and the bracing capacities were found by assuming a certain BU/m rating for the walls along each line. Due to the date of construction and material specified for the walls (gib-lined), the BU/m rating was taken as 57 for 2-sided internal walls and 42 for external 1-sided walls. %NBS values were then found through the ratio of bracing demand to bracing capacity along each line; with a single %NBS value applicable for each block being reported due to the similarity of the blocks.

Additional Assumptions

Further assumptions about the seismic performance of the buildings were:

- Foundations and foundation connections had adequate capacity to resistance and transfer earthquake loads.
- Connections between all elements of the lateral load resisting systems are detailed to adequately transfer their loads sufficiently and are strong enough so as to not fail before the lateral load resisting elements.

Appendix 4 – CERA DEE Spreadsheet

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Block 1			Reviewer:	John Newall
	Unit	No:	Street	CPEng No:	1018146
Building Address:	Block 1	15	Sommerfield St.	Company:	Opus
Legal Description:	Hadfield Courts			Company project number:	6-QUCC1.99
				Company phone number:	3635400
	Degrees	Min	Sec		
GPS south:				Date of submission:	8/02/2013
GPS east:				Inspection Date:	
				Revision:	Final
Building Unique Identifier (CCC):	BE 1126 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	
Soil type:	sandy silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	6.60		height from ground to level of uppermost seismic mass (for IEP only) (m):	
Floor footprint area (approx):	100			
Age of Building (years):	36		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	multi-unit residential		Brief strengthening description:	
Use (upper floors):	multi-unit residential			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber truss	truss depth, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	none	overall depth x width (mm x mm)	
Columns:	load bearing walls	typical dimensions (mm x mm)	
Walls:	fully filled concrete masonry	#N/A	

Lateral load resisting structure

Lateral system along:	other (note)	**Note: Define along and across in detailed report!**		filled masonry walls bottom storey
Ductility assumed, μ:	2.00		describe system	
Period along:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	other (note)			Light-weight timber walls top storey, fully filled masonry walls bottom storey
Ductility assumed, μ:	2.00		describe system	
Period across:	0.40	0.00	estimate or calculation?	estimated
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	

Separations:

north (mm):		leave blank if not relevant
east (mm):		
south (mm):		
west (mm):		

Non-structural elements

Stairs:	precast, full flight	describe supports	
Wall cladding:	brick or tile	describe (note cavity if exists)	block veneer
Roof Cladding:	Metal	describe	
Glazing:	other (specify)		
Ceilings:	fibrous plaster, fixed		9.5mm GIB
Services(list):			

Available documentation

Architectural		original designer name/date	
Structural	full	original designer name/date	
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report	partial	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
Liquefaction:	2-5 m³/100m²	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	0-20mm/20m	notes (if applicable):	
Damage to area:	slight	notes (if applicable):	

Building:

	Current Placard Status:			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	cracking of veneers and wall and ceiling linings

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Recommendations

	Level of repair/strengthening required:	minor structural		Describe:	
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	37%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	
	Assessed %NBS after e'quakes:	37%			
Across	Assessed %NBS before e'quakes:	57%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	57%			

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Block 2
Unit No: Street
Building Address: Block 2 | 15 | Sommerfield St.
Legal Description: Hadfield Courts

Degrees Min Sec
GPS south:
GPS east:

Building Unique Identifier (CCC): BE 1126 EQ2

Reviewer: John Newall
CPEng No: 1018146
Company: Opus
Company project number: 6-QUCC1.99
Company phone number: 3635400

Date of submission: 8/02/2013
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: sandy silt
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):

If Ground improvement on site, describe:

Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: strip footings
Building height (m): 6.60
Floor footprint area (approx): 200
Age of Building (years): 36

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):

if Foundation type is other, describe:
height from ground to level of uppermost seismic mass (for IEP only) (m):

Date of design: 1976-1992

Strengthening present? no

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss
Floors: concrete flat slab
Beams: none
Columns: load bearing walls
Walls: fully filled concrete masonry

truss depth, purlin type and cladding
slab thickness (mm)
overall depth x width (mm x mm)
typical dimensions (mm x mm)
#N/A

Lateral load resisting structure

Lateral system along: other (note)
Ductility assumed, μ: 2.00
Period along: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

describe system: filled masonry walls bottom storey
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Lateral system across: other (note)
Ductility assumed, μ: 2.00
Period across: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

describe system: Light-weight timber walls top storey, fully filled masonry walls bottom storey
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Separations:

north (mm): leave blank if not relevant
east (mm):
south (mm):
west (mm):

Non-structural elements

Stairs: precast, full flight
Wall cladding: brick or tile
Roof Cladding: Metal
Glazing: other (specify)
Ceilings: fibrous plaster, fixed
Services(list):

describe supports
describe (note cavity if exists) block veneer
describe

9.5mm GIB

Available documentation

Architectural
Structural full
Mechanical
Electrical
Geotech report partial

original designer name/date
original designer name/date
original designer name/date
original designer name/date
original designer name/date

Damage

Site:

(refer DEE Table 4-2)

Site performance:
Describe damage:

Settlement: none observed
Differential settlement: none observed
Liquefaction: 2-5 m³/100m²
Lateral Spread: none apparent
Differential lateral spread: none apparent
Ground cracks: 0-20mm/20m
Damage to area: slight

notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio: 0%
Describe (summary):

Describe how damage ratio arrived at:

Across Damage ratio: 0%
Describe (summary):

$$Damage\_Ratio = \frac{(\%NBS(before) - \%NBS(after))}{\%NBS(before)}$$

Diaphragms Damage?: no Describe:

CSWs: Damage?: no Describe:

Pounding: Damage?: no Describe:

Non-structural: Damage?: yes Describe: cracking of veneers and wall and ceiling linings

Recommendations

Level of repair/strengthening required: minor structural
Building Consent required: no
Interim occupancy recommendations: full occupancy

Describe:
Describe:
Describe:

Along Assessed %NBS before e'quakes: 37% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 37%

If IEP not used, please detail assessment methodology:

Across Assessed %NBS before e'quakes: 57% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 57%

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name: Block 3
Building Address: Block 3 | Unit No: 15 | Street: Sommerfield St.
Legal Description: Hadfield Courts
GPS south: Degrees | Min | Sec
GPS east:
Building Unique Identifier (CCC): BE 1126 EQ2

Reviewer: John Newall
CPEng No: 1018146
Company: Opus
Company project number: 6-QUCC1.99
Company phone number: 3635400
Date of submission: 8/02/2013
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: sandy silt
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):
If Ground improvement on site, describe:
Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: strip footings
Building height (m): 6.60
Floor footprint area (approx): 100
Age of Building (years): 36

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):
if Foundation type is other, describe:
height from ground to level of uppermost seismic mass (for IEP only) (m):
Date of design: 1976-1992

Strengthening present? no
Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss
Floors: concrete flat slab
Beams: none
Columns: load bearing walls
Walls: fully filled concrete masonry

truss depth, purlin type and cladding
slab thickness (mm)
overall depth x width (mm x mm)
typical dimensions (mm x mm)
#N/A

Lateral load resisting structure

Lateral system along: other (note)
Ductility assumed, μ: 2.00
Period along: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

describe system: filled masonry walls bottom storey
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Lateral system across: other (note)
Ductility assumed, μ: 2.00
Period across: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

describe system: Light-weight timber walls top storey, fully filled masonry walls bottom storey
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Separations:

north (mm): leave blank if not relevant
east (mm):
south (mm):
west (mm):

Non-structural elements

Stairs: precast, full flight
Wall cladding: brick or tile
Roof Cladding: Metal
Glazing: other (specify)
Ceilings: fibrous plaster, fixed
Services(list):

describe supports
describe (note cavity if exists) block veneer
describe
9.5mm GIB

Available documentation

Architectural
Structural full
Mechanical
Electrical
Geotech report partial

original designer name/date
original designer name/date
original designer name/date
original designer name/date
original designer name/date

Damage

Site:
(refer DEE Table 4-2)

Site performance:
Settlement: none observed
Differential settlement: none observed
Liquefaction: 2-5 m³/100m²
Lateral Spread: none apparent
Differential lateral spread: none apparent
Ground cracks: 0-20mm/20m
Damage to area: slight

Describe damage:
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio: 0%
Describe (summary):

Describe how damage ratio arrived at:

Across Damage ratio: 0%
Describe (summary):

$$Damage\_Ratio = \frac{(\% NBS\,(before) - \% NBS\,(after))}{\% NBS\,(before)}$$

Diaphragms Damage?: no Describe:
CSWs: Damage?: no Describe:
Pounding: Damage?: no Describe:
Non-structural: Damage?: yes Describe: cracking of veneers and wall and ceiling linings

Recommendations

Level of repair/strengthening required: minor structural
Building Consent required: no
Interim occupancy recommendations: full occupancy

Describe:
Describe:
Describe:

Along Assessed %NBS before e'quakes: 37% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 37%

If IEP not used, please detail assessment methodology:

Across Assessed %NBS before e'quakes: 57% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 57%

Detailed Engineering Evaluation Summary Data

V1.11

Location

Building Name: Block 4
Unit No: Street
Building Address: Block 4 15 Sommerfield St.
Legal Description: Hadfield Courts

Degrees Min Sec
GPS south:
GPS east:

Building Unique Identifier (CCC): BE 1126 EQ2

Reviewer: John Newall
CPEng No: 1018146
Company: Opus
Company project number: 6-QUCC1.99
Company phone number: 3635400

Date of submission: 8/02/2013
Inspection Date:
Revision: Final
Is there a full report with this summary? yes

Site

Site slope: flat
Soil type: sandy silt
Site Class (to NZS1170.5): D
Proximity to waterway (m, if <100m):
Proximity to clifftop (m, if < 100m):
Proximity to cliff base (m,if <100m):

Max retaining height (m):
Soil Profile (if available):

If Ground improvement on site, describe:

Approx site elevation (m):

Building

No. of storeys above ground: 2 single storey = 1
Ground floor split? no
Storeys below ground 0
Foundation type: strip footings
Building height (m): 6.60
Floor footprint area (approx): 100
Age of Building (years): 36

Ground floor elevation (Absolute) (m):
Ground floor elevation above ground (m):

if Foundation type is other, describe: driven pc piles to west and south walls
height from ground to level of uppermost seismic mass (for IEP only) (m):

Date of design: 1976-1992

Strengthening present? no

Use (ground floor): multi-unit residential
Use (upper floors): multi-unit residential
Use notes (if required):
Importance level (to NZS1170.5): IL2

If so, when (year)?
And what load level (%g)?
Brief strengthening description:

Gravity Structure

Gravity System: load bearing walls
Roof: timber truss
Floors: concrete flat slab
Beams: none
Columns: load bearing walls
Walls: fully filled concrete masonry

truss depth, purlin type and cladding
slab thickness (mm)
overall depth x width (mm x mm)
typical dimensions (mm x mm)
#N/A

Lateral load resisting structure

Lateral system along: other (note)
Ductility assumed, μ: 2.00
Period along: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Note: Define along and across in detailed report!

filled masonry walls bottom storey
describe system
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Lateral system across: other (note)
Ductility assumed, μ: 2.00
Period across: 0.40 0.00
Total deflection (ULS) (mm):
maximum interstorey deflection (ULS) (mm):

Light-weight timber walls top storey, fully filled masonry walls bottom storey
describe system
estimate or calculation? estimated
estimate or calculation?
estimate or calculation?

Separations:

north (mm):
east (mm):
south (mm):
west (mm):

leave blank if not relevant

Non-structural elements

Stairs: precast, full flight
Wall cladding: brick or tile
Roof Cladding: Metal
Glazing: other (specify)
Ceilings: fibrous plaster, fixed
Services(list):

describe supports
describe (note cavity if exists) block veneer
describe

9.5mm GIB

Available documentation

Architectural
Structural full
Mechanical
Electrical
Geotech report partial

original designer name/date
original designer name/date
original designer name/date
original designer name/date
original designer name/date

Damage

Site:
(refer DEE Table 4-2)

Site performance:

Settlement: none observed
Differential settlement: none observed
Liquefaction: 2-5 m³/100m²
Lateral Spread: none apparent
Differential lateral spread: none apparent
Ground cracks: 0-20mm/20m
Damage to area: slight

Describe damage:

notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):
notes (if applicable):

Building:

Current Placard Status:

Along Damage ratio: 0%
Describe (summary):

Describe how damage ratio arrived at:

Across Damage ratio: 0%
Describe (summary):

$$Damage\_Ratio = \frac{(\%NBS\,(before) - \%NBS\,(after))}{\%NBS\,(before)}$$

Diaphragms Damage?: no
Describe:

CSWs: Damage?: no
Describe:

Pounding: Damage?: no
Describe:

Non-structural: Damage?: yes
Describe: cracking of veneers and wall and ceiling linings

Recommendations

Level of repair/strengthening required: minor structural
Building Consent required: no
Interim occupancy recommendations: full occupancy

Describe:
Describe:
Describe:

Along Assessed %NBS before e'quakes: 37% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 37%

If IEP not used, please detail assessment methodology:

Across Assessed %NBS before e'quakes: 57% ##### %NBS from IEP below
Assessed %NBS after e'quakes: 57%

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