CLIENTS | PEOPLE | PERFORMANCE

Shelter/Shed – Ashgrove Terrace / Ashgrove Park

PRK_1084_BLDG_001 EQ2

Detailed Engineering Evaluation

Qualitative Report

Version Final

35 Ashgrove Terrace, Somerfield

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Ashgrove Shelter/Shed
PRK_1084_BLDG_001 EQ2

Detailed Engineering Evaluation
Qualitative Report
Version Final

35 Ashgrove Terrace, Somerfield

Christchurch City Council

Prepared By
Dale Donovan

Reviewed By
David Lee

Date
18th September 2012

Contents

Table Index

Figure Index

Appendices

Qualitative Report Summary

Ashgrove Park Shelter/Shed

PRK_1084_BLDG_001 EQ2

Detailed Engineering Evaluation

Qualitative Report - SUMMARY

Version Final

35 Ashgrove Terrace, Somerfield

Background

This is a summary of the Qualitative report for the building structure, and is based in part on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011 and visual inspections on 16 July 2012.

Key Damage Observed

Key damage observed includes:-

- Spalling at the edges of the concrete slab roof. The damage appears historical but spalls may have been dislodged by earthquakes.
- Some cracking in the adjacent concrete path at the top of slope possibly due to ground movement

Critical Structural Weaknesses

The following potential critical structural weaknesses have been identified in the structure.

Due to the ground conditions on site it is possible that liquefaction will occur. In addition due to the location of the structure near the top of a slope above the Heathcote River there is a significant risk of ground spreading, therefore in terms of the IEP the site characteristics have been deemed be significant.

Indicative Building Strength (from IEP and CSW assessment)

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the building's original capacity has been assessed to be in the order of 21% NBS and post-earthquake capacity in the order of 14% NBS. The building's post-earthquake capacity excluding critical structural weaknesses is in the order of 21% NBS.

The building has been assessed to have a seismic capacity in the order of 14% NBS and is therefore considered to be Earthquake Prone.

Recommendations

The building has achieved less than 34% NBS seismic capacity according to the initial IEP assessment and as a result is classified as potentially an Earthquake Prone building in accordance with the NZSEE guidelines. Therefore it is recommended that further detailed assessment be carried out on the structure to more accurately assess the buildings %NBS.

1. Background

GHD has been engaged by the Christchurch City Council (CCC) to undertake a detailed engineering evaluation of the Ashgrove Park shelter/shed.

This report is a Qualitative Assessment of the building structure, and is based in part on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011.

A qualitative assessment involves inspections of the building and a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available.

The purpose of the assessment is to determine the likely building performance and damage patterns, to identify any potential critical structural weaknesses or collapse hazards, and to make an initial assessment of the likely building strength in terms of percentage of new building standard (%NBS).

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. Construction drawings were made available, and these have been considered in our evaluation of the building. The building description below is based on a review of the drawings and our visual inspections.

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 carry out a full structural survey before the building is re-occupied.

We understand that CERA will 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). It is anticipated that CERA will adopt the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011. This document sets out a methodology for both qualitative and quantitative assessments.

The qualitative assessment is a desk-top and site inspection assessment. It is based on a thorough visual inspection of the building coupled with a review of available documentation such as drawings and specifications. The quantitative assessment involves analytical calculation of the buildings strength and may require non-destructive or destructive material testing, geotechnical testing and intrusive investigation.

It is anticipated that factors determining the extent of evaluation and strengthening level required will include:

- The importance level and occupancy of the building
- The placard status and amount of damage
- The age and structural type of the building
- Consideration of any critical structural weaknesses
- The extent of any earthquake damage

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 any alteration. This effectively means that a building cannot be weakened as a result of an alteration (including partial demolition).

Section 115 – Change of Use

This section requires that the territorial authority (in this case Christchurch City Council (CCC)) be satisfied that the building with a new use complies with the relevant sections of the Building Code 'as near as is reasonably practicable'. Regarding seismic capacity 'as near as reasonably practicable' has previously been interpreted by CCC as achieving a minimum of 67% NBS however where practical achieving 100% NBS is desirable. The New Zealand Society for Earthquake Engineering (NZSEE) recommend a minimum of 67% NBS.

2.2.1 Section 121 – Dangerous Buildings

The definition of dangerous building in the Act was extended by the Canterbury Earthquake (Building Act) Order 2010, and it now defines a building as dangerous if:

- 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
- 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
- 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
- There is a risk that that other property could collapse or otherwise cause injury or death; or
- 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 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 ground shaking 33% of the shaking 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 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

- A process for identifying, categorising and prioritising Earthquake Prone Buildings, commencing on 1 July 2012;
- A strengthening target level of 67% of a new building for buildings that are Earthquake Prone;
- A timeframe of 15-30 years for Earthquake Prone Buildings to be strengthened; and,
- 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.

We anticipate that any building with a capacity of less than 33% NBS (including consideration of critical structural weaknesses) will need to be strengthened to a target of 67% NBS of new building standard as recommended by the Policy.

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.

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.

After the February Earthquake, on 19 May 2011, Compliance Document B1: Structure was amended to include increased seismic design requirements for Canterbury as follows:

- Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)
- Serviceability Return Period Factor increased from 0.25 to 0.33 (80% increase in the serviceability design loads when combined with the Hazard Factor increase)

The increase in the above factors has resulted in a reduction in the level of compliance of an existing building relative to a new building despite the capacity of the existing building not changing.

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 new building standard load requirements have been determined in accordance with the current earthquake loading standard (NZS 1170.5:2004 Structural design actions - Earthquake actions - New Zealand).

The likely capacity of this building has been derived in accordance with the New Zealand Society for Earthquake Engineering (NZSEE) guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006. These guidelines provide an Initial Evaluation Procedure that assesses a buildings capacity based on a comparison of loading codes from when the building was designed and currently. It is a quick high-level procedure that can be used when undertaking a Qualitative analysis of a building. The guidelines also provide guidance on calculating a modified Ultimate Limit State capacity of the building which is much more accurate and can be used when undertaking a Quantitative analysis.

The New Zealand Society for Earthquake Engineering has proposed a way for classifying earthquake risk for existing buildings in terms of %NBS and this is shown 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	Unacceptable	Unacceptable

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

Table 1 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). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

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

Table 1 %NBS compared to relative risk of failure

4. Building Description

4.1 General

The shelter/shed is located at 35 Ashgrove Terrace, Ashgrove Park in Somerfield. The original construction date of the structure is unknown but based on site observation is estimated to be the mid to late 1960's. The shelter/shed is not connected to any other structure in the park. The park site is bordered by residential properties in the north, south and west directions. The Heathcote River is located to the East of the park at the base of the slope the structure is located on. The closest structure to the shelter/shed is a residential property to the west approximately 10m away.

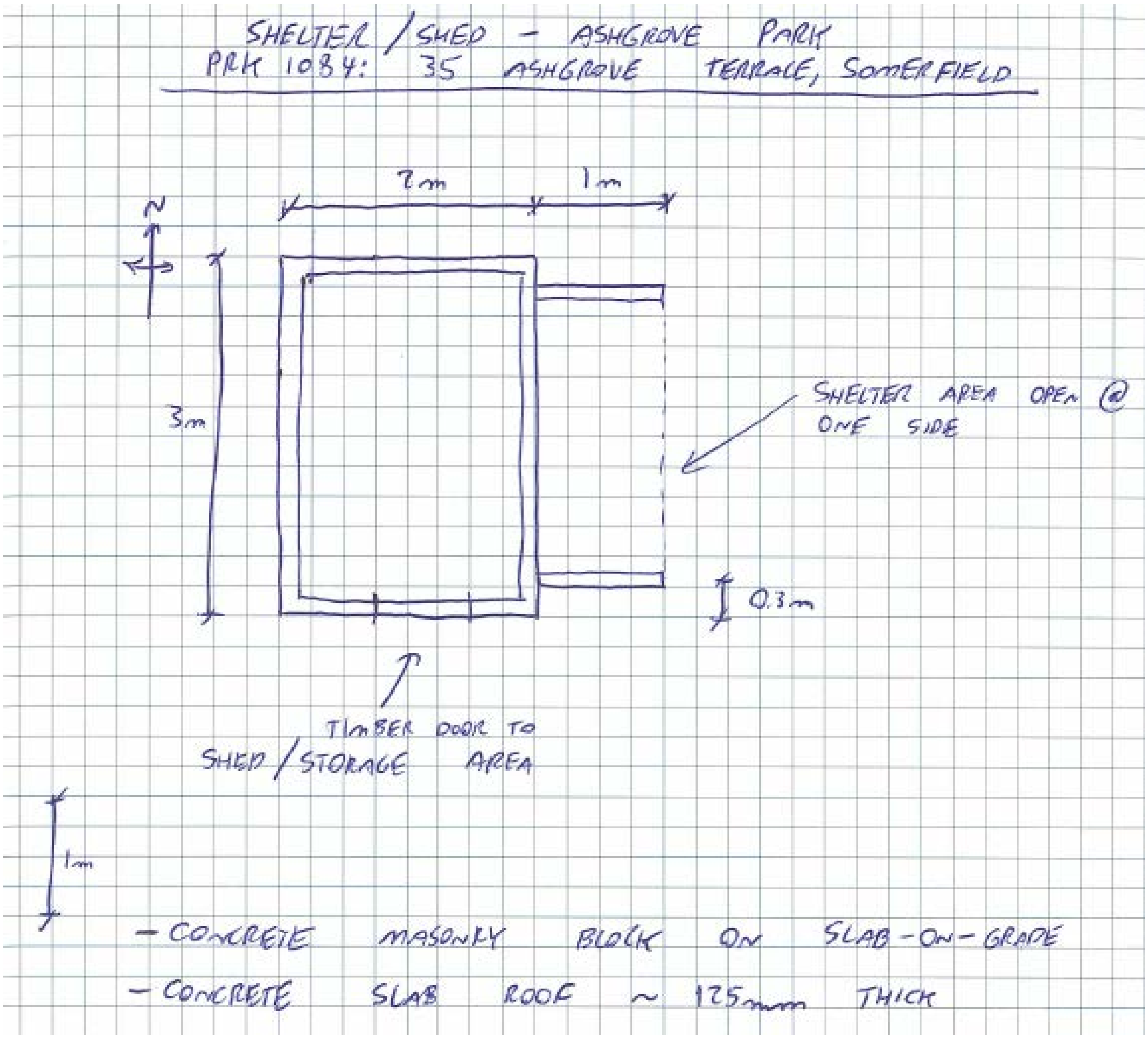

Figure 2 Plan Sketch Showing Key Structural Elements

The building is a single row of filled or partially filled concrete masonry block walls. The single storey construction has a concrete slab on grade floor. The heavyweight concrete slab roof is self-supported and has no other structural elements. The concrete slab rests on the concrete masonry block walls

The dimensions of the shelter are approximately 1m long by 3m wide and 2.6m in height. The shed attached to the shelter is 2m long by 3m wide and also 2.6m in height. There are concrete paths on the east and south sides of the structure.

The structure is located near the top of a slope above the Heathcote River. The Heathcote River is located only 50m east of the building.

It was not possible to enter the storage area on the western side of the structure. There is no visible damage or cracking in the block work walls or concrete slab on grade. The roof slab has number spalling at the edges with exposed reinforcement. The corrosion appears to be historic but the spalls may have been dislodged by earthquakes.

4.2 Gravity Load Resisting System

The gravity loads in the structure are resisted by 125mm think concrete slab roof. The slab roof rests directly on the concrete masonry block walls. The loads on the roof are transmitted directly into the concrete block walls. From the block walls the loads travel into the slab on grade pad footings and from there into the ground.

4.3 Lateral Load Resisting System

Lateral loads acting on the structure are resisted by concrete masonry walls both along and across the dimensions of the building.

5. Assessment

An inspection of the building was undertaken on the 16 July 2012. The exterior of the building was inspected, but the interior could not be accessed. The walls of the building were able to be viewed due to the exposed nature of the storage area section of the building. The half of the roof slab covering the shelter area could be fully inspected.

The inspection consisted of scrutinising the building to determine the structural systems and likely behaviour of the building during an earthquake. The site was assessed for damage, including examination of the ground conditions, checking for damage in areas where damage would be expected for the type of structure and noting general damage observed throughout the building in both structural and non-structural elements.

The %NBS score determined for this building has been based on the IEP procedure described by the NZSEE and based on the information obtained solely from visual observation of the building due to the lack of available drawings.

6. Damage Assessment

6.1 Surrounding Buildings

The Ashgrove shelter/shed is located in Ashgrove Park in a residential area. There are residential properties to the north, south, and west of the shed. The Heathcote River is located only 50m east of the building. The nearest residential building is located approximately 10m to the west of the building. Based on visual inspections from property boundaries there was no damage evident to these buildings.

6.2 Residual Displacements and General Observations

No residual displacements of the structure were noticed during the inspection of the building. However the path on the southern side of the structure shows signs of cracking and possible differential movement. The path is located near the top of the slope above the Heathcote River. See Photographs 4 and 5 in Appendix A.

No damage was visible in the concrete block work exterior of the building.

Spalling was evident around the edges of the concrete slab roof structure. The corrosion appears to be historic but some of the spalls appear to have been displaced by earthquakes with fresh concrete exposed. See Photographs 6 and 7.

No cracks were visible in the slab on grade foundation.

6.3 Ground Damage

There was evidence of significant ground damage, settlement, liquefaction, and ground spreading all along Ashgrove Terrace. The Ashgrove Park does not have any clear ground damage, but has significant vegetation growth. The structure is located on a slope above the Heathcote River.

7. Critical Structural Weakness

7.1 Short Columns

No short columns are present in the structure.

7.2 Lift Shaft

The building does not contain a lift shaft.

7.3 Roof

The concrete slab roof is mostly visible. No access was available to area inside the shed, but the part over the shelter was visible. The roof slab structure is straightforward and due to the spalling some of the reinforcement is visible. The bracing can be assumed to be sufficient for small size of the structure and therefore the roof is not a critical structural weakness. See photographs 8 and 9.

7.4 Staircases

The building does not contain a staircase.

7.5 Pounding effect

The building is not located near other structures so there is no potential pounding risk.

7.6 Liquefaction

Liquefaction was observed on site and in the surrounding neighbourhood. As noted in Section 8.5 of this report it is possible that liquefaction will occur on site. The effect liquefaction will have on the structure may be a threat. In addition the location on a slope indicates potential ground spreading. Therefore in terms of the IEP the site characteristics have been deemed to be significant.

8. Geotechnical Consideration

8.1 Site Description

The site is situated in the suburb of Cashmere, south of Christchurch City centre. The site is relatively flat at approximately 20m above mean sea level. Gently sloping terrain are located to the southeast of the site. It is approximately 30m west of Heathcote River, 3.4km south of Main South Line Railway, and 11km west of the coast (Pegasus Bay).

8.2 Published Information on Ground Conditions

8.2.1 Published Geology

The geological map of the area[1] indicates that the site is underlain by:

- Yaldhurst member of the Springston Formation, dominantly alluvial gravel, sand, and silt of historic river flood channels, Holocene in age.

Due to the low-lying location of the site, shallow ground water table is anticipated.

8.2.2 Environment Canterbury Logs

Information from Environment Canterbury (ECan) indicates that there are four boreholes located within 200m of the site. There are three boreholes with significant information summarised in the table below (see Table 2).

These indicate that the area is underlain by layers of sand and clay with gravels at intermediate layers.

Table 2 ECan Borehole Summary

Bore Name	Log Depth	Groundwater	Distance & Direction from Site
M36-8694-WC	4.72 m	Not indicated	65m E
M36-8695-WC	2.13 m	Not indicated	80m E
M36-8696-WC	2. 74m	Not indicated	85m E

It should be noted that the boreholes were sunk for groundwater extraction and not for geotechnical purposes. Therefore, the amount of material recovered and available for interpretation and recording will have been variable at best and may not be representative. The logs have been written by the well driller and not a geotechnical professional or to a standard. In addition strength data is not recorded.

8.2.3 EQC Geotechnical Investigations

The Earthquake Commission has not undertaken geotechnical testing within 200m of the subject site.

8.2.4 CERA Land Zoning

Canterbury Earthquake Recovery Authority (CERA) has classified 35 Ashgrove Terrace, Cashmere-Beckenham as “Green Zone – Technical Category 2, yellow”. Land in this zone is generally considered

[1] Forsyth, P. J., Barrell, D. J. A., & Jongens, R. (2008): *Geology of the Christchurch Urban Area*. Institute of Geological and Nuclear Sciences 1:250,000 Geological Map 16. IGNS Limited: Lower Hutt.

suitable for land development, though some areas may require stronger foundations or design where rebuilding or repairs are needed. Technical Category 2, yellow means that minor to moderate land damage from liquefaction is anticipated for future significant earthquake.

8.2.5 Post February Aerial Photography

Aerial photograph taken following the 22 February 2011 earthquake shows signs of low to moderate liquefaction close to the site, as shown in Error! Reference source not found..

Figure 2 Post February 2011 Earthquake Aerial Photography[2]

8.2.6 Summary of Ground Conditions

From the information presented above, the ground conditions underlying the site are anticipated to comprise multiple strata of sand and silt deposits with intermediate layers of gravel.

8.3 Seismicity

8.3.1 Nearby Faults

There are many faults in the Canterbury region, however only those considered most likely to have an adverse effect on the site are detailed below.

[2] Aerial Photography Supplied by Koordinates sourced from http://koordinates.com/layer/3185-christchurch-post-earthquake-aerial-photos-24-feb-2011/

Table 3 Summary of Known Active Faults[3,4]

Known Active Fault	Distance from Site	Direction from Site	Max Likely Magnitude	Avg Recurrence Interval
Alpine Fault	140 km	NW	~8.3	~300 years
Greendale (2010) Fault	22 km	W	7.1	~15,000 years
Hope Fault	109 km	NW	7.2~7.5	120~200 years
Kelly Fault	109 km	NW	7.2	150 years
Porter Pass Fault	65 km	NW	7.0	1100 years

The recent earthquakes since 4 September 2010 have identified the presence of a previously unmapped active fault system underneath the Canterbury Plains, including Christchurch City, and the Port Hills. Research and published information on this system is in development and not generally available. Average recurrence intervals are yet to be estimated.

8.3.2 Ground Shaking Hazard

New Zealand Standard NZS 1170.5:2004 quantifies the Seismic Hazard factor for Christchurch as 0.30, being in a moderate to high earthquake zone. This value has been provisionally upgraded recently (from 0.22) to reflect the seismicity hazard observed in the earthquakes since 4 September 2010.

The recent seismic activity has produced earthquakes of Magnitude-6.3 with peak ground accelerations (PGA) up to twice the acceleration due to gravity (2g) in some parts of the city. This has resulted in widespread liquefaction throughout Christchurch.

8.4 Slope Failure and/or Rockfall Potential

The area to the southeast of the site is gently sloping. Further site investigation should be carried out to determine the specific slope instability potential of the site. However, given the site's distance to the sloping terrain, global slope instability is considered low.

8.5 Liquefaction Potential

The site is considered to have low to moderate susceptibility to liquefaction, due to the following reasons:

- Signs of minor to moderate liquefaction close to the site (evidence from the post-earthquake aerial photograph);
- Anticipated presence of alluvial deposits beneath the site; and,
- Anticipated shallow ground water table.

[3] Stirling, M.W, McVerry, G.H, and Berryman K.R. (2002): "A New Seismic Hazard Model for New Zealand", *Bulletin of the Seismological Society of America*, Vol. 92 No. 5, June 2002, pp. 1878-1903.

[4] GNS Active Faults Database, http://maps.gns.cri.nz/website/af/viewer

8.6 Conclusions & Recommendations

This assessment is based on a review of the geology and existing ground investigation information, and observations from the Christchurch earthquakes since 4 September 2010.

The site appears to be situated on alluvial deposits. Associated with this the site also has a moderate to high liquefaction potential, in particular where sands and/or silts are present.

A soil class of **D/E** (in accordance with NZS 1170.5:2004) should be adopted for the site.

Should a more comprehensive liquefaction and/or ground condition assessment be required, it is recommended that intrusive investigation be conducted.

9. Survey

No level or verticality surveys have been undertaken for this building at this stage.

10. Initial Capacity Assessment

10.1 % NBS Assessment

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity excluding critical structural weaknesses and the capacity of any identified weaknesses are expressed as a percentage of new building standard (%NBS) and are in the order of that shown below in Table 4. These capacities are subject to confirmation by a more detailed quantitative analysis.

Item	%NBS
Building excluding CSW's	21
Site Characteristics – Liquefaction and Spreading (30% reduction)	14

Table 4 Indicative Building and Critical Structural Weaknesses Capacities based on the NZSEE Initial Evaluation Procedure

Following an IEP assessment, the building has been assessed as achieving 14% New Building Standard (NBS). Under the New Zealand Society for Earthquake Engineering (NZSEE) guidelines the building is considered Earthquake Prone as it achieves less than 33% NBS. This score has not been adjusted when considering damage to the structure as all damage observed was relatively minor and considered unlikely to adversely affect the load carrying capacity of the structural systems.

10.2 Seismic Parameters

The seismic design parameters based on current design requirements from NZS 1170:2002 and the NZBC clause B1 for this building are:

- Site soil class: D, NZS 1170.5:2004, Clause 3.1.3, Silt
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011
- Return period factor R_u = 1.0, NZS 1170.5:2004, Table 3.5, Importance Level 2 structure with a 50 year design life.

An increased Z factor of 0.3 for Christchurch has been used in line with requirements from the Department of Building and Housing resulting in a reduced % NBS score.

10.3 Expected Structural Ductility Factor

A structural ductility factor of 1.25 has been assumed based on the structural system observed and the date of construction.

10.4 Discussion of Results

The results obtained from the initial IEP assessment are consistent with those expected for a building of this age and construction type. Although the original building construction date is unknown it was likely designed to the loading standard current at the time. The design loads used in those standards are likely to have been less than those required by the current loading standard. When combined with the increase in the hazard factor for Christchurch to 0.3, it would be expected that the building would not achieve 100% NBS. Due to the Critical Structural Weakness and the age of the building it is reasonable to expect the building to be classified as an Earthquake Prone.

.

11. Initial Conclusions

The building has been assessed to have a seismic capacity in the order of 14% NBS and is therefore potentially Earthquake Prone in accordance with the NZSEE guidelines. The park where the shelter/shed is located has no evidence of liquefaction but the surrounding area has significant ground damage. The potential effects of liquefaction and ground spreading on the shelter are considered major so the IEP risk has been deemed significant. The lack of any cracking in the main block suggests that the shelter/shed is well constructed. However the building requires further investigation to confirm that the walls and floor slab on grade are adequately grouted and reinforced.

12. Recommendations

The building has achieved less than 34% NBS seismic capacity according to the initial IEP assessment and as a result is classified as potentially an Earthquake Prone building in accordance with the NZSEE guidelines. Therefore it is recommended that further detailed assessment be carried out on the structure to more accurately assess the buildings %NBS.

13. Limitations

13.1 General

This report has been prepared subject to the following limitations:

- No intrusive structural investigations have been undertaken.
- No intrusive geotechnical investigations have been undertaken.
- No level or verticality surveys have been undertaken.
- No material testing has been undertaken.
- No calculations, other than those included as part of the IEP in the CERA Building Evaluation Report, have been undertaken. No modelling of the building for structural analysis purposes has been performed.

It is noted that this report has been prepared at the request of Christchurch City Council and is intended to be used for their purposes only. GHD accepts no responsibility for any other party or person who relies on the information contained in this reportrite a specific limitations section.

13.2 Geotechnical Limitations

This report presents the results of a geotechnical appraisal prepared for the purpose of this commission, and for prepared solely for the use of Christchurch City Council and their advisors. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical engineer before being used for any other purpose. GHD Limited (GHD) accepts no responsibility for other use of the data.

The advice tendered in this report is based on a visual geotechnical appraisal. No subsurface investigations have been conducted. An assessment of the topographical land features have been made based on this information. It is emphasised that Geotechnical conditions may vary substantially across the site from where observations have been made. Subsurface conditions, including groundwater levels can change in a limited distance or time. In evaluation of this report cognisance should be taken of the limitations of this type of investigation.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based. Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which have been modified in any way as outlined above.

Appendix A
Photographs

Photograph 1 North elevation.

Photograph 2 View of the shelter from the east.

Photograph 3 View of the shelter/shed from the south.

Photograph 4 The building is located near the top of the slope above the Heathcote River.

Photograph 5 Cracking in the concrete path on the south side may indicate differential movement.

Photograph 6 Corrosion on the edge of the concrete roof slab appears to be historic.

Photograph 7 The concrete exposed around the spall appears fresh.

Photograph 8 The heavyweight roof increased the height of the seismic mass.

Photograph 9 The simple structure appears to be adequately braced.

Photograph 10 No visible damage or cracking of the concrete slab on grade floor.

Appendix B

Existing Drawings

No existing drawings were available for the building.

Appendix C
CERA Building Evaluation Form

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Ashgrove Shelter/Shed			Reviewer:	David Lee
	Unit	No:	Street	CPEng No:	112052
Building Address:	Ashgrove Terrace	35		Company:	GHD
Legal Description:	PRK_1084_BLDG_001 EQ2			Company project number:	
				Company phone number:	
	Degrees	Min	Sec		
GPS south:				Date of submission:	24/08/2012
GPS east:				Inspection Date:	16/07/2012
				Revision:	
Building Unique Identifier (CCC):	PRK_1082_BLDG_001 EQ2			Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10	Max retaining height (m):	
Soil type:	silt	Soil Profile (if available):	
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):	50	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:	1	single storey = 1	Ground floor elevation (Absolute) (m):	
Ground floor split?	no		Ground floor elevation above ground (m):	
Storeys below ground	0			
Foundation type:	mat slab		if Foundation type is other, describe:	Slab on grade
Building height (m):	2.60		height from ground to level of uppermost seismic mass (for IEP only) (m):	2.4
Floor footprint area (approx):	9			
Age of Building (years):			Date of design:	1965-1976
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	public		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):				
Importance level (to NZS1170.5):	IL1			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	concrete	slab thickness (mm)	125
Floors:	concrete flat slab	slab thickness (mm)	
Beams:	none	overall depth x width (mm x mm)	
Columns:			
Walls:	partially filled concrete masonry	thickness (mm)	200

Lateral load resisting structure

Lateral system along:	partially filled CMU	**Note: Define along and across in**	note total length of wall at ground (m):	3
Ductility assumed, μ:	1.25	**detailed report!**	wall thickness (m):	0.2
Period along:	0.40	0.40 from parameters in sheet	estimate or calculation?	
Total deflection (ULS) (mm):			estimate or calculation?	
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	
Lateral system across:	partially filled CMU		note total length of wall at ground (m):	3

Ductility assumed, μ:	1.25	wall thickness (m):	0.2
Period across:	0.40	0.40 from parameters in sheet	
		estimate or calculation?	
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:		
Wall cladding:		Walls are unlined CMU
Roof Cladding:		Concrete slab
Glazing:	timber frames	
Ceilings:	none	
Services(list):		

Available documentation

Architectural	none	original designer name/date	
Structural	none	original designer name/date	
Mechanical	none	original designer name/date	
Electrical	none	original designer name/date	
Geotech report	partial	original designer name/date	

Damage

Site:
(refer DEE Table 4-2)

Site performance:	Good	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	0-1:350	notes (if applicable):	Concrete cracking on path at top of slope
Liquefaction:	none apparent	notes (if applicable):	
Lateral Spread:	none apparent	notes (if applicable):	
Differential lateral spread:	none apparent	notes (if applicable):	
Ground cracks:	none apparent	notes (if applicable):	
Damage to area:	none apparent	notes (if applicable):	

Building:

	Current Placard Status:	green		
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?:	no	Describe:	

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

Recommendations

	Level of repair/strengthening required:	none	Describe:	
	Building Consent required:	no	Describe:	
	Interim occupancy recommendations:	full occupancy	Describe:	
Along	Assessed %NBS before:	21%	14% %NBS from IEP below	If IEP not used, please detail assessment methodology:
	Assessed %NBS after:	21%		
Across	Assessed %NBS before:	21%	14% %NBS from IEP below	
	Assessed %NBS after:	21%		

IEP **Use of this method is not mandatory - more detailed analysis may give a different answer, which would take precedence. Do not fill in fields if not using IEP.**

Period of design of building (from above): 1965-1976

h_n from above: 2.4m

Seismic Zone, if designed between 1965 and 1992: B

not required for this age of building

not required for this age of building

	along	across
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:	5.0%	5.0%

Note:1 for specifically design public buildings, to the code of the day: pre-1965 = 1.25; 1965-1976, Zone A =1.33; 1965-1976, Zone B = 1.2; all else 1.0	1.00
Note 2: for RC buildings designed between 1976-1984, use 1.2	1.0
Note 3: for buildngs designed prior to 1935 use 0.8, except in Wellington (1.0)	1.0

	along	across
Final $(\%NBS)_{nom}$:	**5%**	**5%**

2.2 Near Fault Scaling Factor

	along	across
Near Fault scaling factor, from NZS1170.5, cl 3.1.6:		1.00
Near Fault scaling factor (1/N(T,D), **Factor A**:	1	1

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:	0.30
Z_{1992}, from NZS4203:1992	0.8
Hazard scaling factor, **Factor B:**	3.333333333

2.4 Return Period Scaling Factor

Building Importance level (from above):	1
Return Period Scaling factor from Table 3.1, **Factor C**:	1.00

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)	1.25	1.25
Ductility scaling factor: =1 from 1976 onwards; or =kμ, if pre-1976, fromTable 3.3:	1.14	1.14
Ductiity Scaling Factor, **Factor D**:	1.14	1.14

2.6 Structural Performance Scaling Factor:

	along	across
Sp:	0.925	0.925
Structural Performance Scaling Factor **Factor E**:	1.081081081	1.081081081

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$

	along	across
$\%NBS_b$:	**21%**	**21%**

Global Critical Structural Weaknesses: (refer to NZSEE IEP Table 3.4)

3.1. Plan Irregularity, factor A:	insignificant	1
3.2. Vertical irregularity, Factor B:	insignificant	1
3.3. Short columns, Factor C:	insignificant	1
3.4. Pounding potential	Pounding effect D1, from Table to right	1.0
	Height Difference effect D2, from Table to right	1.0
	Therefore, Factor D:	1
3.5. Site Characteristics	significant	0.7

Table for selection of D1	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Alignment of floors within 20% of H	**0.7**	**0.8**	**1**
Alignment of floors not within 20% of H	**0.4**	**0.7**	**0.8**

Table for Selection of D2	Severe	Significant	Insignificant/none
Separation	0<sep<.005H	.005<sep<.01H	Sep>.01H
Height difference > 4 storeys	0.4	0.7	1
Height difference 2 to 4 storeys	0.7	0.9	1
Height difference < 2 storeys	1	1	1

		Along	Across
3.6. Other factors, Factor F	For ≤ 3 storeys, max value =2.5, otherwise max valule =1.5, no minimum	1.0	1.0
	Rationale for choice of F factor, if not 1		

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)

List any: Liquefaction and ground spreading

Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

		Along	Across
3.7. Overall Performance Achievement ratio (PAR)		**0.70**	**0.70**
4.3 PAR x (%NBS)b:	PAR x Baselline %NBS:	**14%**	**14%**
4.4 Percentage New Building Standard (%NBS), (before)			**14%**

GHD

Level 11, Guardian Trust House
15 Willeston street, Wellington 6011
T: 64 4 472 0799   F: 64 4 472 0833   E: wgtnmail@ghd.com

© GHD Limited 2012

This document is and shall remain the property of GHD Limited. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Final	Dale Donovan	David Lee		Nick Waddington		18/09/12