

Christchurch City Council  
PRK\_1415\_BLDG\_001 EQ2  
Old School Reserve - Toilets  
172 Major Hornbrook Road



QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 23 May 2013



Christchurch City Council  
Old School Reserve - Toilets  
172 Major Hornbrook Road  
PRK\_1415\_BLDG\_001 EQ2

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Sinclair Knight Merz  
142 Sherborne Street  
Saint Albans  
PO Box 21011, Edgeware  
Christchurch, New Zealand  
Tel: +64 3 940 4900  
Fax: +64 3 940 4901  
Web: [www.skmconsulting.com](http://www.skmconsulting.com)

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Approver		23/05/2013	Nick Calvert	Senior Structural Engineer

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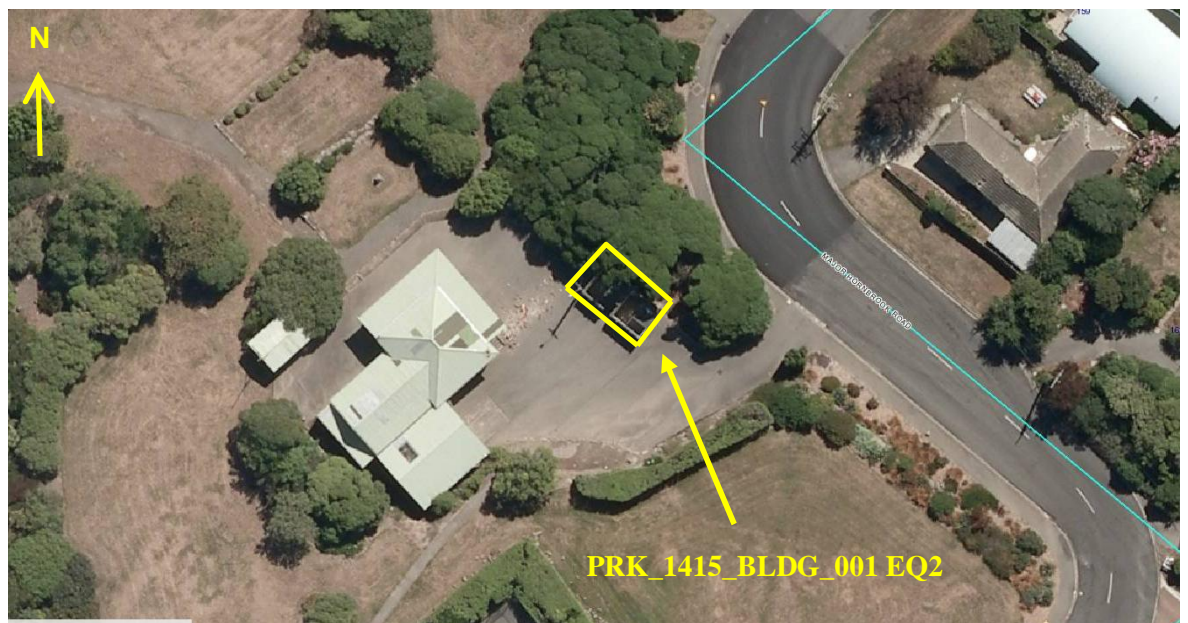
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# 1. Executive Summary

## 1.1. Background

A Qualitative Assessment was carried out on building PRK\_1415\_BLDG\_001 EQ2 located at 172 Major Hornbrook Road. The building is a toilet block within Old School Reserve constructed from masonry blocks with a timber framed roof and concrete foundations. An aerial photograph illustrating the location of the building is shown below in Figure 1. Detailed descriptions outlining the buildings age and construction type is given in Section 5 of this report.



### ■ Figure 1 Aerial Photograph of PRK\_1415\_BLDG\_001 EQ2 Old School Reserve-Toilets

The qualitative assessment includes a summary of the building damage as well as an initial assessment of the current seismic capacity compared with current seismic code loads using the Initial Evaluation Procedure (IEP).

This Qualitative report for the building structure is based on the Detailed Engineering Evaluation Procedure document (draft) issued by the Structural Advisory Group on 19 July 2011, and a visual inspection on 17<sup>th</sup> May 2012

## 1.2. Key Damage Observed

Key defects observed includes:-

- The northern womens toilet cubicle has a rotten timber frame, with rust stains seeping out.



- 0.5mm crack in pavement inside the womens toilet (appears to be caused by shrinkage movement and likely to pre-date recent earthquakes).

### **1.3. Critical Structural Weaknesses**

No potential critical structural weaknesses were identified for this building.

### **1.4. Indicative Building Strength (from IEP and CSW assessment)**

Based on the information available, and using the NZSEE Initial Evaluation Procedure, the buildings original capacity has been assessed to be in the order of >100%NBS and post earthquake capacity in the order of 100%NBS.

The building has been assessed to have a seismic capacity in the order of 100% NBS and is therefore not potentially earthquake prone.

### **1.5. Recommendations**

It is recommended that:

- a) There is no damage to the building that would cause it to be unsafe to occupy.
- b) We consider that barriers around the building are not necessary.

## 2. Introduction

Sinclair Knight Merz was engaged by Christchurch City Council to prepare a qualitative assessment report for the building PRK\_1415\_BLDG\_001 EQ2 located at 172 Major Hornbrook Road following the magnitude 6.3 earthquake which occurred in the afternoon of the 22nd of February 2011 and the subsequent aftershocks.

The Qualitative Assessment uses the methodology recommended in the Engineering Advisory Group document “Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury” (part 2 revision 5 dated 19/07/2011 and part 3 draft revision dated 13/12/2011). The qualitative assessment includes a summary of the building damage as well as an initial assessment of the likely current Seismic Capacity compared with current seismic code requirements.

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).

This report describes the structural damage observed during our inspection and indicates suggested remediation measures. The inspection was undertaken from floor levels and was a visual inspection only. Our report reflects the situation at the time of the inspection and does not take account of changes caused by any events following our inspection. A full description of the basis on which we have undertaken our visual inspection is set out in section 7.

The NZ Society for Earthquake Engineering (NZSEE) Initial Evaluation Procedure (IEP) was used to assess the likely performance of the building in a seismic event relative to the New Building Standard (NBS). 100% NBS is equivalent to the strength of a building that fully complies with current codes. This includes a recent increase of the Christchurch seismic hazard factor from 0.22 to 0.3<sup>1</sup>.

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 not made available, and these have been considered in our evaluation of the building. The building description below is based on visual inspections.

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<sup>1</sup> <http://www.dbh.govt.nz/seismicity-info>



### **3. Compliance**

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

#### **3.1. 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

#### **3.2. Building Act**

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



### **3.2.1. 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).

### **3.2.2. 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.

### **3.2.3. 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.

### **3.2.4. 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.

### **3.2.5. 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.

### **3.2.6. Section 131 – Earthquake Prone Building Policy**

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

### **3.3. 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 4<sup>th</sup> 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. Council recognises that it may not be practicable for some repairs to meet that target. The council will work closely with building owners to achieve sensible, safe outcomes;
- 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 34%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.

### **3.4. 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:

- a) Hazard Factor increased from 0.22 to 0.3 (36% increase in the basic seismic design load)



- b) 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.



## 4. 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 2 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 2: NZSEE Risk Classifications Extracted from table 2.2 of the NZSEE 2006 AISPBE Guidelines**

Table 1 below provides an indication of the risk of failure for an existing building with a given percentage NBS, relative to the risk of failure for a new building that has been designed to meet current Building Code criteria (the annual probability of exceedance specified by current earthquake design standards for a building of 'normal' importance is 1/500, or 0.2% in the next year, which is equivalent to 10% probability of exceedance in the next 50 years).



■ **Table 1: %NBS compared to relative risk of failure**

<b>Percentage of New Building Standard (%NBS)</b>	<b>Relative Risk (Approximate)</b>
>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

## **5. Building Details**

### **5.1. Building description**

Building PRK\_1415\_BLDG\_001 EQ2 is a single storey toilet block located at 172 Major Hornbrook Road. The building is within Old School Reserve and is constructed from filled masonry blocks with a timber framed roof and concrete foundations. There is also a scout hall in Old School Reserve which is close to the toilet block.

No structural drawings were available. Our evaluation was based on our visual inspection carried out on the 17<sup>th</sup> May 2012. Based on the apparent ageing of this building we estimate that it was constructed sometime in the 1980's, so have assumed a post-1976 construction date for the purposes of our assessment.

### **5.2. Gravity Load Resisting system**

The roof structure consists of timber rafters which span across the building and are being supported on the masonry walls. The masonry walls sit on a concrete foundation.

### **5.3. Seismic Load Resisting system**

Lateral Loads acting across and along this building will be resisted by the masonry walls via shear.

Note that for this building the “across direction” has been taken as North East - South West, whereas the “along direction” has been taken as North West - South East.

### **5.4. Geotechnical Conditions**

A geotechnical desktop study was carried out for this site. The main conclusions from this report are:

- The site has been assessed as NZS1170.5 Class C (shallow soil site) from adjacent borehole logs.
- Liquefaction risk is minimal for this site.
- No significant land damage was observed during the site walkover.

Unless a change of use is intended for the site we do not believe that any further geotechnical investigations are required. Specific ground investigation should be undertaken if significant alterations or new structures are proposed. The full geotechnical desktop study can be found in Appendix 4.



## 6. Damage Summary

SKM undertook inspections on 17<sup>th</sup> May 2012. Defects observed during the time of inspection:

- 1) The northern womens toilet cubicle has a rotten timber frame, with rust stains seeping out (corrosion damage).
- 2) 0.5mm crack in pavement inside the womens toilet (appears to be caused by shrinkage movement and likely to pre-date recent earthquakes).

Photos of the above damage can be found in Appendix 1 – Photos.



## 7. Initial Seismic Evaluation

### 7.1. The Initial Evaluation Procedure Process

This section covers the initial seismic evaluation of the building as detailed in the NZSEE 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes'. The IEP grades buildings according to their likely performance in a seismic event. The procedure is not yet recognised by the NZ Building Code but is widely used and recognised by the Christchurch City Council as the preferred method for preliminary seismic investigations of buildings<sup>2</sup>.

The IEP is a coarse screening process designed to identify buildings that are likely to be earthquake prone. The IEP process ranks buildings according to how well they are likely to perform relative to a new building designed to current earthquake standards, as shown in Table 2. The building grade is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. A building is earthquake prone for the purposes of this Act if, having regard to its condition and to the ground on which it is built, and because of its construction, the building—

- a) will have its ultimate capacity exceeded in a moderate earthquake (as defined in the regulations); and
- b) would be likely to collapse causing—
  - i. injury or death to persons in the building or to persons on any other property; or
  - ii. damage to any other property.

A moderate earthquake is defined as 'in relation to a building, an earthquake that would generate shaking at the site of the building that is of the same duration as, but that is one-third as strong as, the earthquake shaking (determined by normal measures of acceleration, velocity and displacement) that would be used to design a new building at the site.'

An earthquake prone building will have an increased risk that its strength will be exceeded due to earthquake actions of approximately 10 times (or more) than that of a building having a capacity in excess of 100% NBS (refer Table 1)<sup>3</sup>. Buildings in Christchurch City that are identified as being earthquake prone are required by law to be followed up with a detailed assessment and strengthening work within 30 years of the owner being notified that the building is potentially earthquake prone<sup>4</sup>.

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<sup>2</sup> <http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf>

<sup>3</sup> NZSEE June 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p 2-13

<sup>4</sup> <http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf>



**Table 2: IEP Risk classifications**

Description	Grade	Risk	%NBS	Structural performance
Low risk building	A+	Low	> 100	Acceptable. Improvement may be desirable.
	A		100 to 80	
	B		80 to 67	
Moderate risk building	C	Moderate	67 to 33	Acceptable legally. Improvement recommended.
High risk building	D	High	33 to 20	Unacceptable. Improvement required.
	E		< 20	

The IEP is a simple desktop study that is useful for risk management. No detailed calculations are done and so it relies on an inspection of the building and its plans to identify the structural members and describe the likely performance of the building in a seismic event. A review of the plans is also likely to identify any critical structural weaknesses. The IEP assumes that the building was properly designed and built according to the relevant codes at the time of construction. The IEP method rates buildings based on the code used at the time of construction and some more subjective parameters associated with how the building is detailed and so it is possible that %NBS derived from different engineers may differ.

This assessment describes only the likely seismic Ultimate Limit State (ULS) performance of the building. The ULS is the level of earthquake that can be resisted by the building without collapse or other forms of failure. The IEP does not attempt to estimate Serviceability Limit State (SLS) performance of the building, or the level of earthquake that would start to cause damage to the building<sup>5</sup>. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration.

The NZ Building Code describes that the relevant codes for determining %NBS are primarily:

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard
- NZS4230:2004 Design of Reinforced Concrete Masonry Structures
- NZS 3603:1993 Timber Structures Standard
- NZS 3604:2011 Timber Framed Buildings

<sup>5</sup> NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p2-9

## 7.2. Design Criteria and Limitations

Following our inspection on the 17<sup>th</sup> May, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements and inspection findings of the building. Please note no intrusive investigations were undertaken.
- Structural drawings were not available

The design criteria used to undertake the assessment include:

- Standard design assumptions for typical office and factory buildings as described in AS/NZS1170.0:2002
  - 50 year design life, which is the default NZ Building Code design life.
  - Structure importance level 1 since the total floor area is <30m<sup>2</sup> and represents structures presenting a low degree of hazard to life and other property.
  - Ductility level of 1.25 in both along and across directions, based on our assessment and code requirements at the time of design. This represents a nominally ductile structure which is appropriate given the reinforcing in the structure.
  - Site hazard factor,  $Z = 0.3$ , NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our visual inspection of the building and a review of the available structural drawings. Since it is not a full design and construction review, it has the following limitations:

- It is not likely to pick up on any original design or construction errors (if they exist)
- Other possible issues that could affect the performance of the building such as corrosion and modifications to the building will not be identified
- The IEP deals only with the structural aspects of the building. Other aspects such as building services are not covered.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

## 7.3. Survey

There were no visible settlement of the structure, nor were there any significant ground movement issues around the building. Under the DBH Technical Category this building is zoned as: N/A (Rural & Unmapped). The combination of these factors means that we do not recommend that any survey be undertaken at this point.



#### **7.4. Critical Structural Weaknesses**

No Structural weakness have been identified in this building

#### **7.5. Qualitative Assessment Results**

The building has had its capacity assessed using the Initial Evaluation Procedure based on the information available. The buildings capacity expressed as a percentage of new building standard (%NBS) is in order of that shown below in Table 3.

**Table 3: Qualitative Assessment Summary**

<u>Item</u>	<u>%NBS</u>
Likely Seismic Capacity of Building	>100

Our qualitative assessment found that the building is likely to be classed as a 'Low Risk Building' (capacity greater than 67% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.



## **8. Further Investigation**

Due to the likely seismic rating of this building being greater than 67%, and the lack of any structural damage no further investigation is required at this stage of the assessment.



## 9. Conclusion

A qualitative assessment was carried out on building PRK\_1415\_BLDG\_001 EQ2 located at 172 Major Hornbrook Road. This building has been assessed to have a likely seismic capacity greater than 100%NBS and is therefore a 'low risk building'.

Due to the likely seismic rating of this building and the lack of any structural damage no further investigation is required.

It is recommended that:

- a) There is no damage to the building that would cause it to be unsafe to occupy.
- b) We consider that barriers around the building are not necessary.

## 10. Limitation Statement

This report has been prepared on behalf of, and for the exclusive use of, SKM's client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and the Client. It is not possible to make a proper assessment of this report without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to, and the assumptions made by, SKM. The report may not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this report by any third party.

Without limiting any of the above, in the event of any liability, SKM's liability, whether under the law of contract, tort, statute, equity or otherwise, is limited in as set out in the terms of the engagement with the Client.

It is not within SKM's scope or responsibility to identify the presence of asbestos, nor the responsibility of SKM to identify possible sources of asbestos. Therefore for any property pre-dating 1989, the presence of asbestos materials should be considered when costing remedial measures or possible demolition.

There is a risk of further movement and increased cracking due to subsequent aftershocks or settlement.

Should there be any further significant earthquake event, of a magnitude 5 or greater, it will be necessary to conduct a follow-up investigation, as the observations, conclusions and recommendations of this report may no longer apply. Earthquake of a lower magnitude may also cause damage, and SKM should be advised immediately if further damage is visible or suspected.



## 11. Appendix 1 – Photos



Photo 1: South-west elevation



Photo 2: South-west elevation



Photo 3: North-west elevation



Photo 4: North-East elevation



Photo 5: Entrance to women's toilet



Photo 6: Women's toilet basin



Photo 7: Women's toilet cubicle

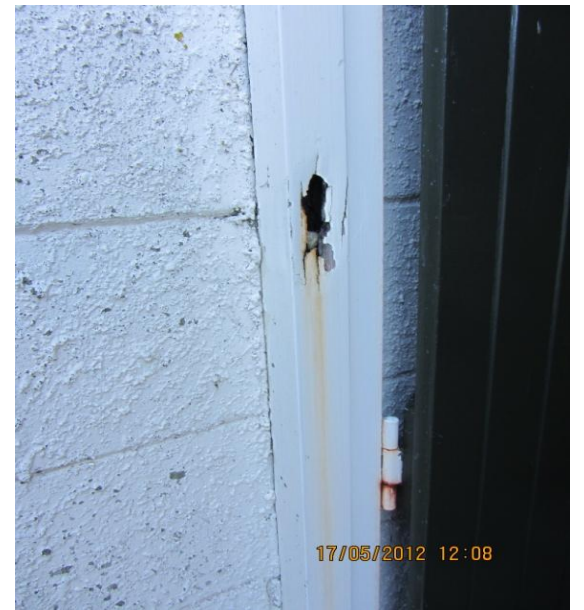


Photo 8: close up view of rotten timber framing





Photo 9: View of roof



Photo 10: Timber roof showing filled masonry



Photo 11: Crack in pavement in women's toilet



Photo 12: Close up view of photo 11 showing 0.5mm crack



Photo 13: Men's toilet entrance



Photo 14: Men's toilet



Photo 15: Men's toilet showing urinals and cubicle



Photo 16: North east elevation showing 250mm of foundation slab above ground

Christchurch City Council  
Old School Reserve - Toilets  
172 Major Hornbrook Road  
PRK\_1415\_BLDG\_001 EQ2  
Qualitative Assessment Report  
23 May 2013



## **12. Appendix 2 – IEP Reports**



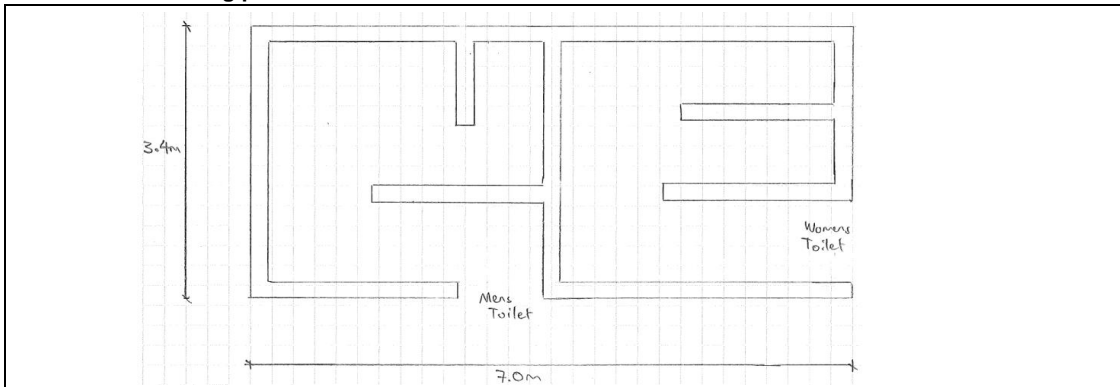
Building Name: <u>PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets</u>	Ref. <u>ZB01276.123</u>
Location: _____	By <u>NLC</u>
_____	Date <u>17/05/2012</u>

**Step 1 - General Information**

**1.1 Photos (attach sufficient to describe building)**



**1.2 Sketch of building plan**



**1.3 List relevant features**

This building is a single storey toilet block. It is constructed from reinforced filled masonry walls with a timber framed roof. Based on the design and the details of the building we believe it was built in the 1980's.

**1.4 Note information sources**

- Visual Inspection of Exterior
- Visual Inspection of Interior
- Drawings (note type)
- Specifications
- Geotechnical Reports
- Other (list)

Tick as appropriate

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<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

Inspection Date: 17/5/2012

**Table IEP-2 Initial Evaluation Procedure – Step 2**

(Refer Table IEP - 1 for Step 1; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	<b>PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets</b>	Ref.	<b>ZB01276.123</b>
Location:		By	<b>NLC</b>
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	<b>17/05/2012</b>
( Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)			

**Step 2 - Determination of (%NBS)b**

**2.1 Determine nominal (%NBS) = (%NBS)nom**

Pre 1935	Seismic Zone;	A
1935-1965		B
1965-1976		C
1976-1992	Seismic Zone;	A
		B
		C
1992-2004		

<input type="radio"/>	See also notes 1, 3
<input type="radio"/>	
<input type="radio"/>	
<input type="radio"/>	
<input type="radio"/>	See also note 2
<input type="radio"/>	
<input checked="" type="radio"/>	
<input type="radio"/>	
<input type="radio"/>	
<input type="radio"/>	

**b) Soil Type**

From NZS1170.5:2004, Cl 3.1.3	A or B Rock
	C Shallow Soil
	D Soft Soil
	E Very Soft Soil

<input type="radio"/>
<input checked="" type="radio"/>
<input type="radio"/>
<input type="radio"/>

From NZS4203:1992, Cl 4.6.2.2	a) Rigid
(for 1992 to 2004 only and only if known)	b) Intermediate

<input checked="" type="radio"/>	N-A
<input type="radio"/>	

**c) Estimate Period, T**

**building Ht = 2.4 meters**

Can use following:

$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames
$T = 0.06h_n^{0.75}$	for all other frame structures
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls
$T \leq 0.4\text{sec}$	for masonry shear walls

Longitudinal		Transverse	
<input type="radio"/>	MRCF	<input type="radio"/>	MRCF
<input type="radio"/>	MRSF	<input type="radio"/>	MRSF
<input type="radio"/>	EBSF	<input type="radio"/>	EBSF
<input type="radio"/>	Others	<input type="radio"/>	Others
<input type="radio"/>	CSW	<input type="radio"/>	CSW
<input checked="" type="radio"/>	MSW	<input checked="" type="radio"/>	MSW

Where  $h_n$  = height in m from the base of the structure to the uppermost seismic weight or mass.  
 $A_c = \sum A_i(0.2 + L_{wi}/h_n)^2$   
 $A_i$  = cross-sectional shear area of shear wall  $i$  in the first storey of the building, in  $m^2$   
 $L_{wi}$  = length of shear wall  $i$  in the first storey in the direction parallel to the applied forces, in m  
 with the restriction that  $L_{wi}/h_n$  shall not exceed 0.9

Longitudinal	Transverse
<b>0.4</b>	<b>0.4</b>

Seconds

**d) (%NBS )nom determined from Figure 3.3**

<b>Note 1:</b> For buildings designed prior to 1965 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.25.	No	Factor	1
For buildings designed 1965 - 1976 and known to be designed as public buildings in accordance with the code of the time, multiply (%NBS)nom by 1.33 - Zone A or 1.2 - Zone B	No	Factor	1
<b>Note 2:</b> For reinforced concrete buildings designed between 1976 -1984 (%NBS )nom by 1.2	No	Factor	1
<b>Note 3:</b> For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No	Factor	1

Longitudinal	21	(%NBS )nom
Transverse	21	(%NBS )nom

Longitudinal	21.0	(%NBS )nom
Transverse	21.0	(%NBS )nom

Continued over page



Building Name:	PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets	Ref.	ZB01276.123
Location:		By	NLC
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	17/05/2012
<small>(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)</small>			

**2.2 Near Fault Scaling Factor, Factor A**  
If T < 1.5sec, Factor A = 1

a) Near Fault Factor, N(T,D) 1  
(from NZS1170.5:2004, Cl 3.1.6)

b) Near Fault Scaling Factor = 1/N(T,D) Factor A 1.00

**2.3 Hazard Scaling Factor, Factor B**

Select Location Christchurch

a) Hazard Factor, Z, for site  
(from NZS1170.5:2004, Table 3.3)

Z =	0.3		
Z 1992 =	0.8	Auckland 0.6	Palm Nth 1.2
		Wellington 1.2	Dunedin 0.6
		Christchurch 0.8	Hamilton 0.67

b) Hazard Scaling Factor  
# For pre 1992 = 1/Z  
For 1992 onwards = Z 1992/Z  
(Where Z 1992 is the NZS4203:1992 Zone Factor from accompanying Figure 3.5(b))

Factor B 3.33

**2.4 Return Period Scaling Factor, Factor C**

a) Building Importance Level 1  
(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 Factor C 2.00

**2.5 Ductility Scaling Factor, D**

a) Assessed Ductility of Existing Structure,  $\mu$   
(shall be less than maximum given in accompanying Table 3.2)

Longitudinal	1.25	$\mu$ Maximum = 6
Transverse	1.25	$\mu$ Maximum = 6

b) Ductility Scaling Factor  
For pre 1976 =  $k_{\mu}$   
For 1976 onwards = 1  
(where  $k_{\mu}$  is NZS1170.5:2005 Ductility Factor, from accompanying Table 3.3)

Longitudinal	Factor D	1.00
Transverse	Factor D	1.00

**2.6 Structural Performance Scaling Factor, Factor E**

Select Material of Lateral Load Resisting System

Longitudinal	<span style="border: 1px solid black; padding: 2px;">Masonry Block</span>
Transverse	<span style="border: 1px solid black; padding: 2px;">Masonry Block</span>

a) Structural Performance Factor,  $S_p$   
from accompanying Figure 3.4

Longitudinal	$S_p$	0.90
Transverse	$S_p$	0.90

b) Structural Performance Scaling Factor

Longitudinal	$1/S_p$	Factor E	1.11
Transverse	$1/S_p$	Factor E	1.11

**2.7 Baseline %NBS for Building, (%NBS)<sub>b</sub>**  
(equals (%NSB)<sub>nom</sub> x A x B x C x D x E)

Longitudinal	155.6	(%NBS) <sub>b</sub>
Transverse	155.6	(%NBS) <sub>b</sub>

**Table IEP-3 Initial Evaluation Procedure – Step 3**

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 4 for Steps 4, 5 and 6)

Building Name: <b>PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets</b>	Ref. <b>ZB01276.123</b>
Location: _____	By <b>NLC</b>
Direction Considered: <b>a) Longitudinal</b>	Date <b>17/05/2012</b>
(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)	

**Step 3 - Assessment of Performance Achievement Ratio (PAR)**

(Refer Appendix B - Section B3.2)

**Critical Structural Weakness**

**Effect on Structural Performance**

(Choose a value - Do not interpolate)

**Building Score**

**Score**

**3.1 Plan Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor A

**3.2 Vertical Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor B

**3.3 Short Columns**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Factor C

**3.4 Pounding Potential**

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:

Values given assume the building has a frame structure. For stiff buildings ( eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1

Table for Selection of Factor D1

Separation	Factor D1		
	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant Sep>.01H
Alignment of Floors within 20% of Storey Height	<input type="radio"/> 0.7	<input type="radio"/> 0.8	<input checked="" type="radio"/> 1
Alignment of Floors not within 20% of Storey Height	<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2

Table for Selection of Factor D2

Separation	Factor D2		
	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant Sep>.01H
Height Difference > 4 Storeys	<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 1
Height Difference 2 to 4 Storeys	<input type="radio"/> 0.7	<input type="radio"/> 0.9	<input type="radio"/> 1
Height Difference < 2 Storeys	<input type="radio"/> 1	<input type="radio"/> 1	<input checked="" type="radio"/> 1

Factor D

(Set D = lesser of D1 and D2 or..

set D = 1.0 if no prospect of pounding)

**3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)**

Effect on Structural Performance

Severe	Significant	Insignificant
<input type="radio"/> 0.5	<input type="radio"/> 0.7	<input checked="" type="radio"/> 1

Factor E

**3.6 Other Factors**

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum.

Factor F

Record rationale for choice of Factor F:

**3.7 Performance Achievement Ratio (PAR)**

(equals A x B x C x D x E x F)

PAR

Building Name:	<u>PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets</u>	Ref.	<u>ZB01276.123</u>
Location:	<u></u>	By	<u>NLC</u>
Direction Considered:	<b>b) Transverse</b>	Date	<u>17/05/2012</u>
<small>(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)</small>			

**Step 3 - Assessment of Performance Achievement Ratio (PAR)**  
(Refer Appendix B - Section B3.2)

**Critical Structural Weakness**

**Effect on Structural Performance**  
(Choose a value - Do not interpolate)

**Building Score**

**3.1 Plan Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="text"/>		

Factor A

**3.2 Vertical Irregularity**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="text"/>		

Factor B

**3.3 Short Columns**

Effect on Structural Performance

Comment

Severe	Significant	Insignificant
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
<input type="text"/>		

Factor C

**3.4 Pounding Potential**

(Estimate D1 and D2 and set D = the lower of the two, or =1.0 if no potential for pounding)

a) Factor D1: - Pounding Effect

Select appropriate value from Table

Note:

Values given assume the building has a frame structure. For stiff buildings ( eg with shear walls), the effect of pounding may be reduced by taking the co-efficient to the right of the value applicable to frame buildings.

Factor D1

Table for Selection of Factor D1	Separation		
	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant Sep>.01H
Alignment of Floors within 20% of Storey Height	<input type="radio"/> 0.7	<input type="radio"/> 0.8	<input checked="" type="radio"/> 1
Alignment of Floors not within 20% of Storey Height	<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2

Table for Selection of Factor D2	Separation		
	Severe 0<Sep<.005H	Significant .005<Sep<.01H	Insignificant Sep>.01H
Height Difference > 4 Storeys	<input type="radio"/> 0.4	<input type="radio"/> 0.7	<input type="radio"/> 1
Height Difference 2 to 4 Storeys	<input type="radio"/> 0.7	<input type="radio"/> 0.9	<input type="radio"/> 1
Height Difference < 2 Storeys	<input type="radio"/> 1	<input type="radio"/> 1	<input checked="" type="radio"/> 1

Factor D

(Set D = lesser of D1 and D2 or..  
set D = 1.0 if no prospect of pounding)

**3.5 Site Characteristics - (Stability, landslide threat, liquefaction etc)**

Effect on Structural Performance

Severe	Significant	Insignificant
<input type="radio"/> 0.5	<input type="radio"/> 0.7	<input checked="" type="radio"/> 1
<input type="text"/>		

Factor E

**3.6 Other Factors**

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum.

Factor F

Record rationale for choice of Factor F:

---



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**3.7 Performance Achievement Ratio (PAR)**  
(equals A x B x C x D x E x F)

PAR

Building Name:	<u>PRK_1415_BLDG_001 EQ2 Old School Reserve - Toilets</u>	Ref.	<u>ZB01276.123</u>
Location:	_____	By	<u>NLC</u>
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	<u>17/05/2012</u>
<small>(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)</small>			

**Step 4 - Percentage of New Building Standard (%NBS)**

	Longitudinal	Transverse
<b>4.1 Assessed Baseline (%NBS)<sub>b</sub></b> (from Table IEP - 1)	<b>155</b>	<b>155</b>
<b>4.2 Performance Achievement Ratio (PAR)</b> (from Table IEP - 2)	<b>1.00</b>	<b>1.00</b>
<b>4.3 PAR x Baseline (%NBS)<sub>b</sub></b>	<b>155</b>	<b>155</b>
<b>4.4 Percentage New Building Standard (%NBS)</b> ( Use lower of two values from Step 4.3)		<b>155</b>

**Step 5 - Potentially Earthquake Prone?**  
(Mark as appropriate)

%NBS ≤ 33 **NO**

**Step 6 - Potentially Earthquake Risk?**

%NBS < 67 **NO**

**Step 7 - Provisional Grading for Seismic Risk based on IEP**

**Seismic Grade** **A+**

Evaluation Confirmed by



Signature

**NICK CALVERT**

Name

**242062**

CPEng. No

**Relationship between Seismic Grade and % NBS :**

Grade:	A+	A	B	C	D	E
%NBS:	> 100	100 to 80	80 to 67	67 to 33	33 to 20	< 20



## **13. Appendix 3 – CERA Standardised Report Form**

<b>Location</b>		Building Name: <input type="text" value="Old School Reserve Toilets"/>	Unit: <input type="text" value=""/>	No: <input type="text" value=""/>	Street: <input type="text" value="172 Major Hornbrook Road"/>	Reviewer: <input type="text" value="NICK CALVERT"/>
Building Address: <input type="text" value=""/>						CPEng No: <input type="text" value="242062"/>
Legal Description: <input type="text" value=""/>						Company: <input type="text" value="Sinclair Knight Merz"/>
						Company project number: <input type="text" value="ZB01276.123"/>
						Company phone number: <input type="text" value="03 940 4900"/>
GPS south: <input type="text" value=""/>		Degrees: <input type="text" value=""/>	Min: <input type="text" value=""/>	Sec: <input type="text" value=""/>	Date of submission: <input type="text" value="24-May"/>	
GPS east: <input type="text" value=""/>						Inspection Date: <input type="text" value="17th May 2012"/>
Building Unique Identifier (CCC): <input type="text" value="PRK 1415 BLDG 001"/>						Revision: <input type="text" value="B"/>
						Is there a full report with this summary? <input type="text" value="yes"/>

<b>Site</b>		Site slope: <input type="text" value="slope &lt; 1 in 5"/>	Max retaining height (m): <input type="text" value=""/>
Soil type: <input type="text" value="mixed"/>		Soil Profile (if available): <input type="text" value="topsoil 0.3m, Silt 0.3m-3m, Basalt 3m+"/>	
Site Class (to NZS1170.5): <input type="text" value="C"/>		If Ground improvement on site, describe: <input type="text" value=""/>	
Proximity to waterway (m, if <100m): <input type="text" value=""/>		Approx site elevation (m): <input type="text" value="170.00"/>	
Proximity to cliff top (m, if < 100m): <input type="text" value=""/>			
Proximity to cliff base (m, if <100m): <input type="text" value=""/>			

<b>Building</b>		No. of storeys above ground: <input type="text" value="1"/>	single storey = 1	Ground floor elevation (Absolute) (m): <input type="text" value="170.00"/>
Ground floor split? <input type="text" value="no"/>				Ground floor elevation above ground (m): <input type="text" value="170.00"/>
Storeys below ground: <input type="text" value="0"/>				if Foundation type is other, describe: <input type="text" value="mat slab has been assumed"/>
Foundation type: <input type="text" value="mat slab"/>		height from ground to level of uppermost seismic mass (for IEP only) (m): <input type="text" value="2.4"/>		Date of design: <input type="text" value="1976-1992"/>
Building height (m): <input type="text" value="2.40"/>				
Floor footprint area (approx): <input type="text" value="24"/>				
Age of Building (years): <input type="text" value="32"/>				
Strengthening present? <input type="text" value="no"/>				If so, when (year)? <input type="text" value=""/>
Use (ground floor): <input type="text" value="other (specify)"/>				And what load level (%g)? <input type="text" value=""/>
Use (upper floors): <input type="text" value=""/>				Brief strengthening description: <input type="text" value=""/>
Use notes (if required): <input type="text" value="Toilet Block"/>				
Importance level (to NZS1170.5): <input type="text" value="IL1"/>				

<b>Gravity Structure</b>		Gravity System: <input type="text" value="load bearing walls"/>	rafter type, purlin type and cladding: <input type="text" value=""/>
Roof: <input type="text" value="timber framed"/>		slab thickness (mm): <input type="text" value=""/>	
Floors: <input type="text" value="concrete flat slab"/>		type: <input type="text" value=""/>	
Beams: <input type="text" value="timber"/>		#N/A	
Columns: <input type="text" value="load bearing walls"/>			
Walls: <input type="text" value="fully filled concrete masonry"/>			

<b>Lateral load resisting structure</b>		Lateral system along: <input type="text" value="fully filled CMU"/>	#DIV/0! enter height above at H31	note total length of wall at ground (m): <input type="text" value=""/>
Ductility assumed, $\mu$ : <input type="text" value="1.25"/>		wall thickness (m): <input type="text" value=""/>		estimate or calculation? <input type="text" value="estimated"/>
Period along: <input type="text" value="0.40"/>		estimate or calculation? <input type="text" value="estimated"/>		estimate or calculation? <input type="text" value="estimated"/>
Total deflection (ULS) (mm): <input type="text" value="5"/>		estimate or calculation? <input type="text" value="estimated"/>		
maximum interstorey deflection (ULS) (mm): <input type="text" value=""/>				
Lateral system across: <input type="text" value="fully filled CMU"/>		#DIV/0! enter height above at H31	note total length of wall at ground (m): <input type="text" value=""/>	
Ductility assumed, $\mu$ : <input type="text" value="1.25"/>			wall thickness (m): <input type="text" value=""/>	estimate or calculation? <input type="text" value="estimated"/>
Period across: <input type="text" value="0.40"/>			estimate or calculation? <input type="text" value="estimated"/>	estimate or calculation? <input type="text" value="estimated"/>
Total deflection (ULS) (mm): <input type="text" value="5"/>			estimate or calculation? <input type="text" value="estimated"/>	
maximum interstorey deflection (ULS) (mm): <input type="text" value=""/>				

<b>Separations:</b>		north (mm): <input type="text" value=""/>	leave blank if not relevant
east (mm): <input type="text" value=""/>			
south (mm): <input type="text" value=""/>			
west (mm): <input type="text" value=""/>			

<b>Non-structural elements</b>		Stairs: <input type="text" value=""/>	describe (note cavity if exists) describe: <input type="text" value=""/>
Wall cladding: <input type="text" value="brick or tile"/>			
Roof Cladding: <input type="text" value="Metal"/>			
Glazing: <input type="text" value=""/>			
Ceilings: <input type="text" value=""/>			
Services(list): <input type="text" value=""/>			

<b>Available documentation</b>		Architectural: <input type="text" value="none"/>	original designer name/date: <input type="text" value=""/>
Structural: <input type="text" value="none"/>		original designer name/date: <input type="text" value=""/>	
Mechanical: <input type="text" value="none"/>		original designer name/date: <input type="text" value=""/>	
Electrical: <input type="text" value="none"/>		original designer name/date: <input type="text" value=""/>	
Geotech report: <input type="text" value="partial"/>		original designer name/date: <input type="text" value="SKM report dated 20 June 2012"/>	

<b>Damage Site:</b>		Site performance: <input type="text" value=""/>	Describe damage: <input type="text" value=""/>
(refer DEE Table 4-2)			
Settlement: <input type="text" value="none observed"/>		notes (if applicable): <input type="text" value=""/>	
Differential settlement: <input type="text" value="none observed"/>		notes (if applicable): <input type="text" value=""/>	
Liquefaction: <input type="text" value="none apparent"/>		notes (if applicable): <input type="text" value=""/>	
Lateral Spread: <input type="text" value="none apparent"/>		notes (if applicable): <input type="text" value=""/>	
Differential lateral spread: <input type="text" value="none apparent"/>		notes (if applicable): <input type="text" value=""/>	
Ground cracks: <input type="text" value="none apparent"/>		notes (if applicable): <input type="text" value=""/>	
Damage to area: <input type="text" value="none apparent"/>		notes (if applicable): <input type="text" value=""/>	

<b>Building:</b>		Current Placard Status: <input type="text" value="green"/>	
Along	Damage ratio: <input type="text" value="0%"/>	Describe how damage ratio arrived at: <input type="text" value=""/>	
Describe (summary): <input type="text" value="Small structure with no structural damage"/>			
Across	Damage ratio: <input type="text" value="0%"/>	$Damage\_Ratio = \frac{(\% NBS (before) - \% NBS (after))}{\% NBS (before)}$	
Describe (summary): <input type="text" value="Small structure with no structural damage"/>			
Diaphragms	Damage?: <input type="text" value="no"/>	Describe: <input type="text" value=""/>	
CSWs:	Damage?: <input type="text" value="no"/>	Describe: <input type="text" value=""/>	
Pounding:	Damage?: <input type="text" value="no"/>	Describe: <input type="text" value=""/>	
Non-structural:	Damage?: <input type="text" value="no"/>	Describe: <input type="text" value=""/>	

<b>Recommendations</b>		Level of repair/strengthening required: <input type="text" value="none"/>	Describe: <input type="text" value=""/>
Building Consent required: <input type="text" value="no"/>		Describe: <input type="text" value=""/>	
Interim occupancy recommendations: <input type="text" value="full occupancy"/>		Describe: <input type="text" value=""/>	
Along	Assessed %NBS before: <input type="text" value="100%"/>	%NBS from IEP below	If IEP not used, please detail assessment methodology: <input type="text" value="Qualitative Assessment carried out, this includes the NZSEE IEP - refer to SKM report"/>
Assessed %NBS after: <input type="text" value="100%"/>			
Across	Assessed %NBS before: <input type="text" value="100%"/>	%NBS from IEP below	
Assessed %NBS after: <input type="text" value="100%"/>			



## **14. Appendix 4 – Geotechnical Desktop Study**





## Christchurch City Council - Structural Engineering Service Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	123
Address	Toilet block, Old School Reserve, Mt Pleasant
Report date	20 June 2012
Author	Dominic Hollands
Reviewer	Ross Roberts
Approved for issue	Yes

### 1. Introduction

This report outlines the geotechnical information that Sinclair Knight Merz (SKM) has been able to source from our database and other sources in relation to the property listed above. We understand that this information will be used as part of an initial qualitative Detailed Engineering Evaluation (DEE), and will be supplemented by more detailed information and investigations to allow detailed scoping of the repair or rebuild of the building.

### 2. Scope

This geotechnical desk top study incorporates information sourced from:

- Published geology
- Publically available borehole records
- Liquefaction records
- Aerial photography
- A preliminary site walkover

### 3. Limitations

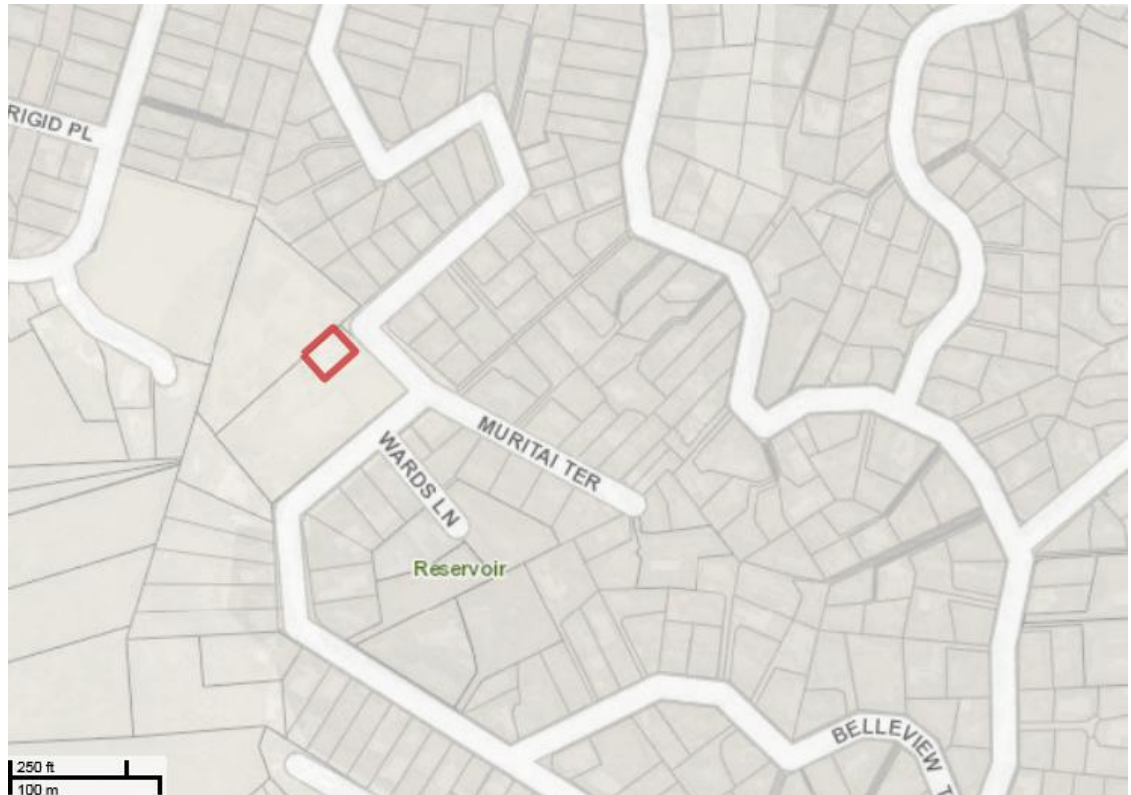
This report was prepared to address geotechnical issues relating to the specific site in accordance with the scope of works as defined in the contract between SKM and our Client. This report has been prepared on behalf of, and for the exclusive use of, our Client, and is subject to, and issued in accordance with, the provisions of the contract between SKM and our Client. The findings presented in this report should not be applied to another site or another development within the same site without consulting SKM.

The assessment undertaken by SKM was limited to a desktop review of the data described in this report. SKM has not undertaken any subsurface investigations, measurement or testing of materials from the site. In preparing this report, SKM has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by our Client, and from other sources as described in the report. Except as otherwise stated in this report, SKM has not attempted to verify the accuracy or completeness of any such information.



This report should be read in full and no excerpts are to be taken as representative of the findings. It must not be copied in parts, have parts removed, redrawn or otherwise altered without the written consent of SKM.

#### 4. Site location



■ **Figure 1 – Site location (courtesy of LINZ <http://viewers.geospatial.govt.nz>)**

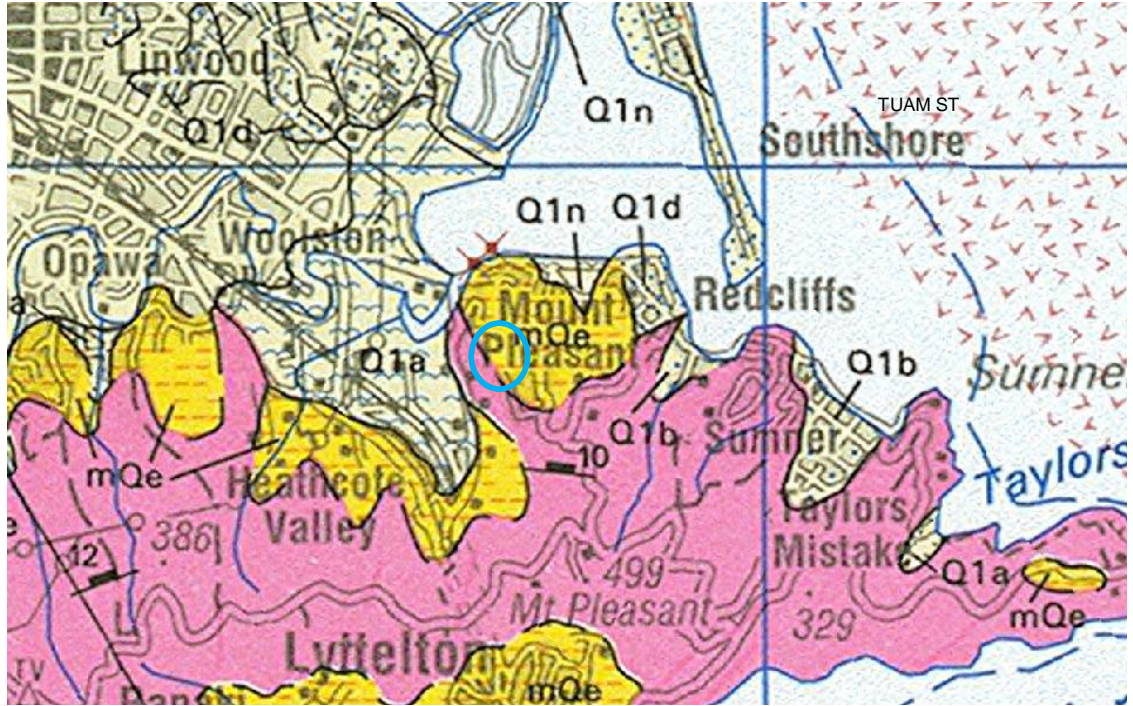
The structure is located on Major Hornbrook Road opposite Wardens Lane in Mount Pleasant at grid reference 1577012 E, 5176170 N (NZTM).



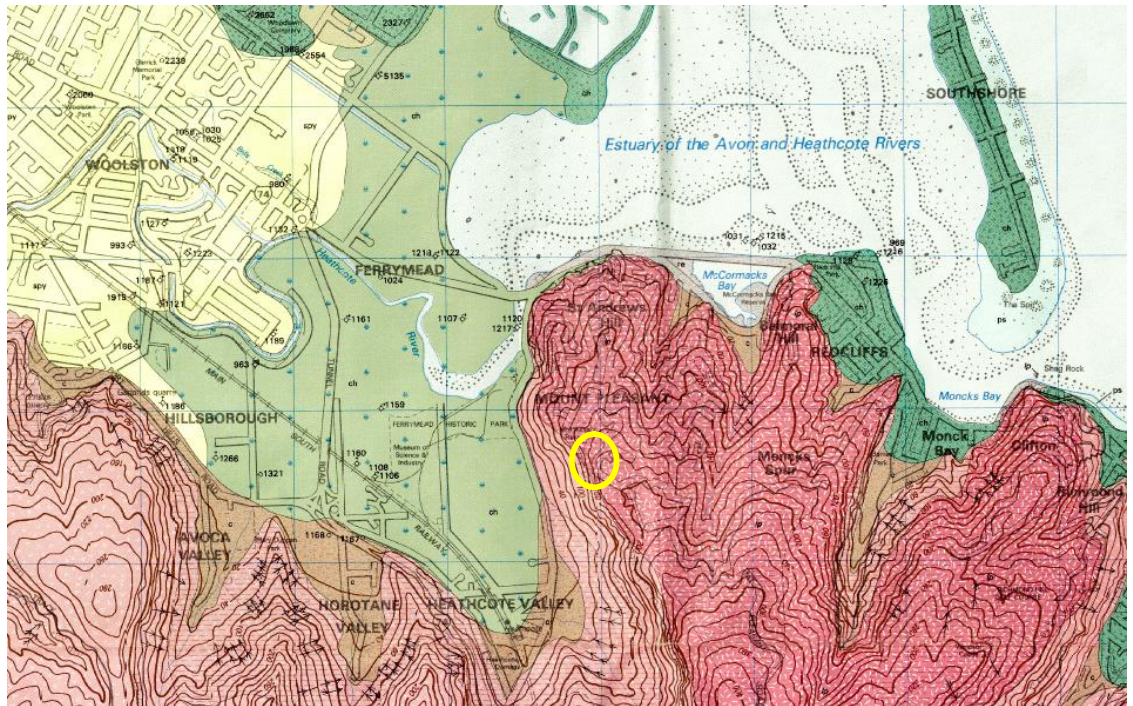


## 5. Review of available information

### 5.1 Geological maps



■ Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in blue.



■ Figure 3 – Local geological map (Brown et al, 1992). Site marked in yellow.





The site is shown to be underlain by Quaternary yellow blown silt (loess) over Lyttelton Volcanic Group basalt.

## 5.2 Liquefaction map

Following the 22 February 2011 event drive through reconnaissance was undertaken from 23 February until 1 March by M Cubrinovsko and M Taylor of Canterbury University. This survey did not extend to this site; however liquefaction is not associated with volcanic hill terrain that includes Mount Pleasant and the Port Hills.

## 5.3 Aerial photography



- **Figure 4 – Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)**

Aerial photography does not show any earthquake land damage i.e. rock fall or tension cracks after the 22 Feb 2011 event, however this type of damage may have occurred but not be visible. There has been shaking damage to roofs of some nearby dwellings.

## 5.4 CERA classification

A review of the LINZ website (<http://viewers.geospatial.govt.nz/>) shows that the site is:

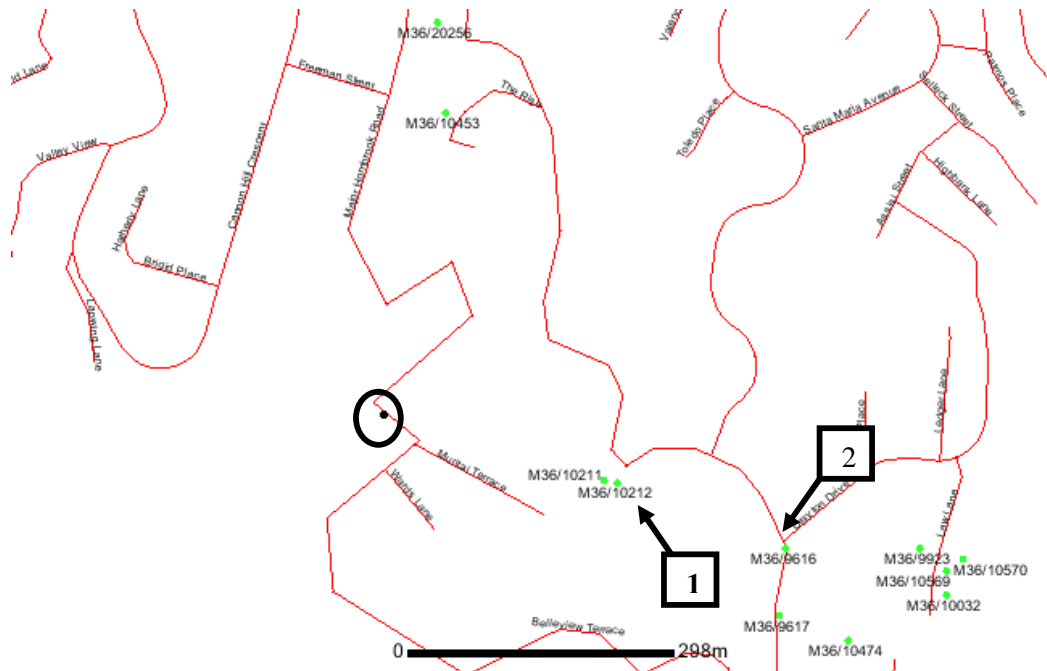
- Zone: Green
- Port Hills and Banks Peninsula



## 5.5 Historical land use

Historical land use documents (e.g. Appendix A) shows only lowland land use and not applicable for the hilly terrain of Mount Pleasant.

## 5.6 Existing ground investigation data



■ **Figure 5 – Local boreholes from Project Orbit and SKM files**  
(<https://canterburyrecovery.projectorbit.com/>)

Where available relevant logs nearby these investigation locations are attached to this report (Appendix B), and the results are summarised in Appendix C.



## 5.7 Council property files

Council files were not available at the time of writing this report

## 5.8 Site walkover

An engineer from SKM undertook a site walkover on 19 May 2012.

The toilet block is a masonry block building with a flat wood roof with beams and a concrete slab on grade foundation.

Very little damage could be seen on the toilet buildings on site, with minor hairline cracks in the foundation. Nearby buildings also exhibit very minor damage.

The adjacent asphalt car park did not appear to have suffered earthquake damage.

The dry stack garden wall approximately 0.6 m high and approximately 1 m from the toilet block appears to have partially collapsed due to the earthquake events.

There was no other evidence in the nearby area of earthquake damage such as landslips and rock fall.

The site appears to be underlain by loess with bed rock at shallow depths. Bedrock outcrops were present in the reserve area.



■ **Figure 6** Toilet block at Old School Reserve.



■ **Figure 8** Failed dry stack garden wall behind the toilet block

## 6. Conclusions and recommendations

### 6.1 Site geology

An interpretation of the most relevant local investigation and geological map detail suggests that the site is underlain by:

Depth range (mBLG)	Soil type
0 – 0.3	Topsoil
0.3 - 3	Silt (loess)
3 +	Basalt

### 6.2 Seismic site subsoil class

The site has been assessed as NZS1170.5 Class C (Shallow soil site) from the regional geological map and adjacent borehole logs.

As described in NZS1170, the preferred site classification method is from site periods based on four times the shear wave travel time through material from the surface to the underlying rock. The next preferred methods are from borelogs including measurement of geotechnical properties or by evaluation of site periods from Nakamura ratios or from recorded earthquake motions. Lacking this information, classification may be based on boreholes with descriptors but no geotechnical measurements. The least preferred method is from surface geology and estimates of the depth to underlying rock.

In this case the absence of deep boreholes near the site has resulted in the use of the two least preferred methods. It is therefore possible that site specific investigation could revise the site class. For example, if shallower rock is confirmed at a depth of less than 3m bgl the site may be considered Class A or B.





### 6.3 Building Performance

Although detailed records of the existing foundations are not available, the performance to date suggests that they are adequate for their current purpose.

### 6.4 Ground performance and properties

Ground damage caused by earthquake on sloping land with this particular site's ground characteristics would likely be in the form of a slope failure, rock fall damage. However no evidence of slope failure such as surface ruptures or toe bulges were observed during the site walkover or on aerial photographs.

In addition information provided by Christchurch City Council indicates that the site was not affected by evacuation or inundation of rocks during the recent earthquake events.

The site is located on a negligible thickness of loess over significant thicknesses of basalt, and therefore there is minimal liquefaction risk.

For the purposes of carrying out a Quantitative Detailed Engineering Evaluation the engineer can assume this site is 'good ground' (as defined in NZS3604:2011) and therefore the following parameters are recommended for the shallow loess material:

Parameter	Estimated value
Effective angle of friction	28 degrees
Apparent cohesion	5 kPa
Unit weight	20 kPa
Ultimate bearing capacity of a shallow square pad footing	300 kPa

NOTE: These figures are based on geological data from outside the site for the purposes of preliminary structural assessment. These parameters should not be relied upon for any design work. Site specific investigations are required to confirm that these assumed values are correct. Additionally, further geotechnical investigation could potentially increase the ultimate bearing capacity stated above.

### 6.5 Further investigations

If future significant structure alterations or new structures are proposed which require building consent geotechnical investigations are recommended. For relatively small structures this would include:

- Two hand augers near to the building to a depth of approximately 3m deeper to in part confirm the ground conditions and the depth to the basalt layer.
- Two dynamic cone penetration tests to estimate likely properties of the soil near the surface.





## 7. References

Brown LJ, Weeber JH, 1992. Geology of the Christchurch urban area. Scale 1:25,000. Institute of Geological & Nuclear Sciences geological map 1.

Cubrinovski & Taylor, 2011. Liquefaction map summarising preliminary assessment of liquefaction in urban areas following the 2010 Darfield Earthquake.

Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

Land Information New Zealand (LINZ) geospatial viewer (<http://viewers.geospatial.govt.nz/>)

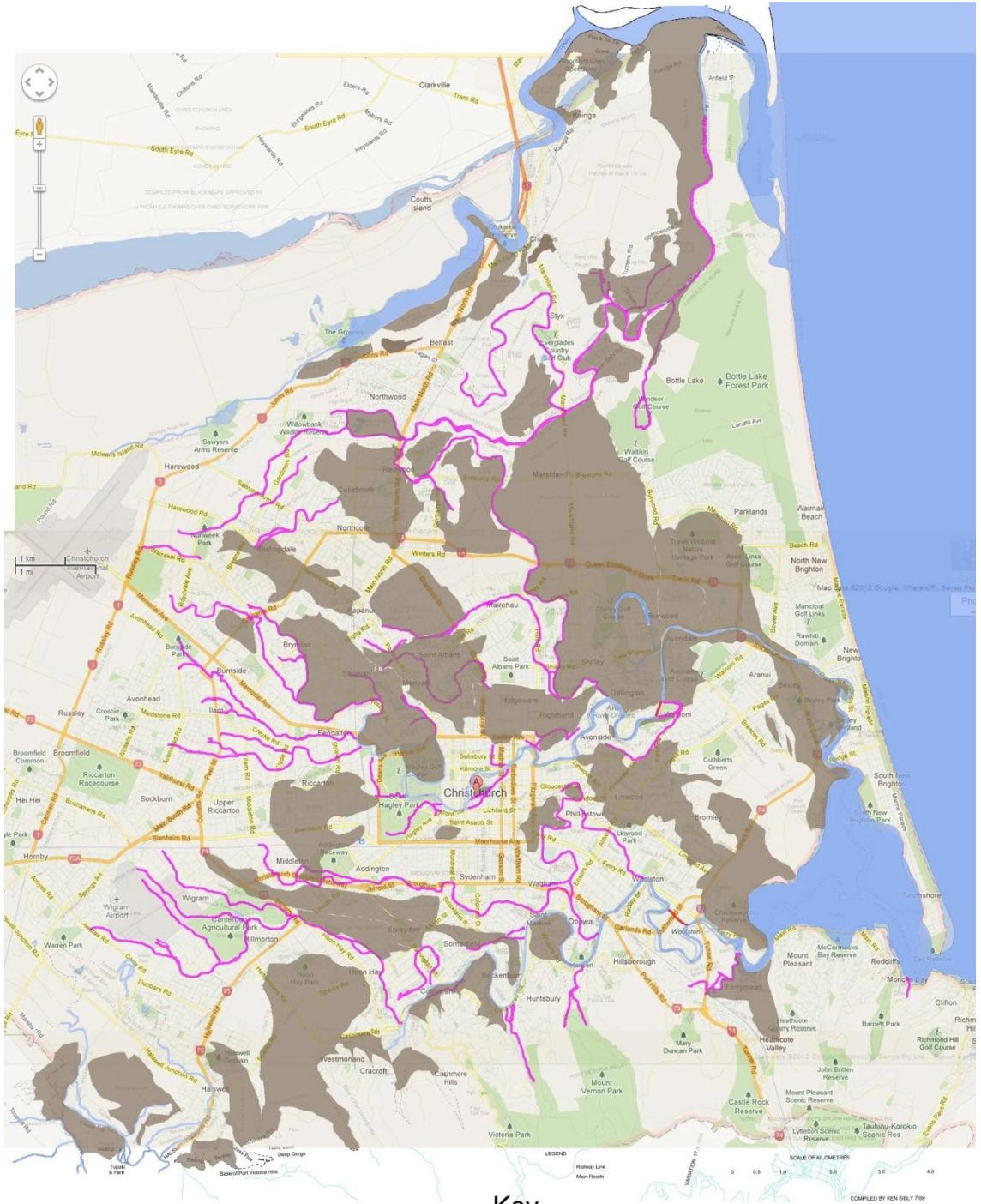
EQC Project Orbit geotechnical viewer (<https://canterburyrecovery.projectorbit.com/>)

Christchurch City Council

<http://www.ccc.govt.nz/homeliving/civildefence/chcheearthquake/earthquakerockfallmaps.aspx>



## Appendix A – Christchurch 1856 land use



The swamps and previous creeks/riders from 1856 have been overlaid onto a map of Christchurch in 2012

- Key**
- Previous creeks/riders
  - Existing creeks/riders
  - New creeks/riders
  - Swamp/Marshland

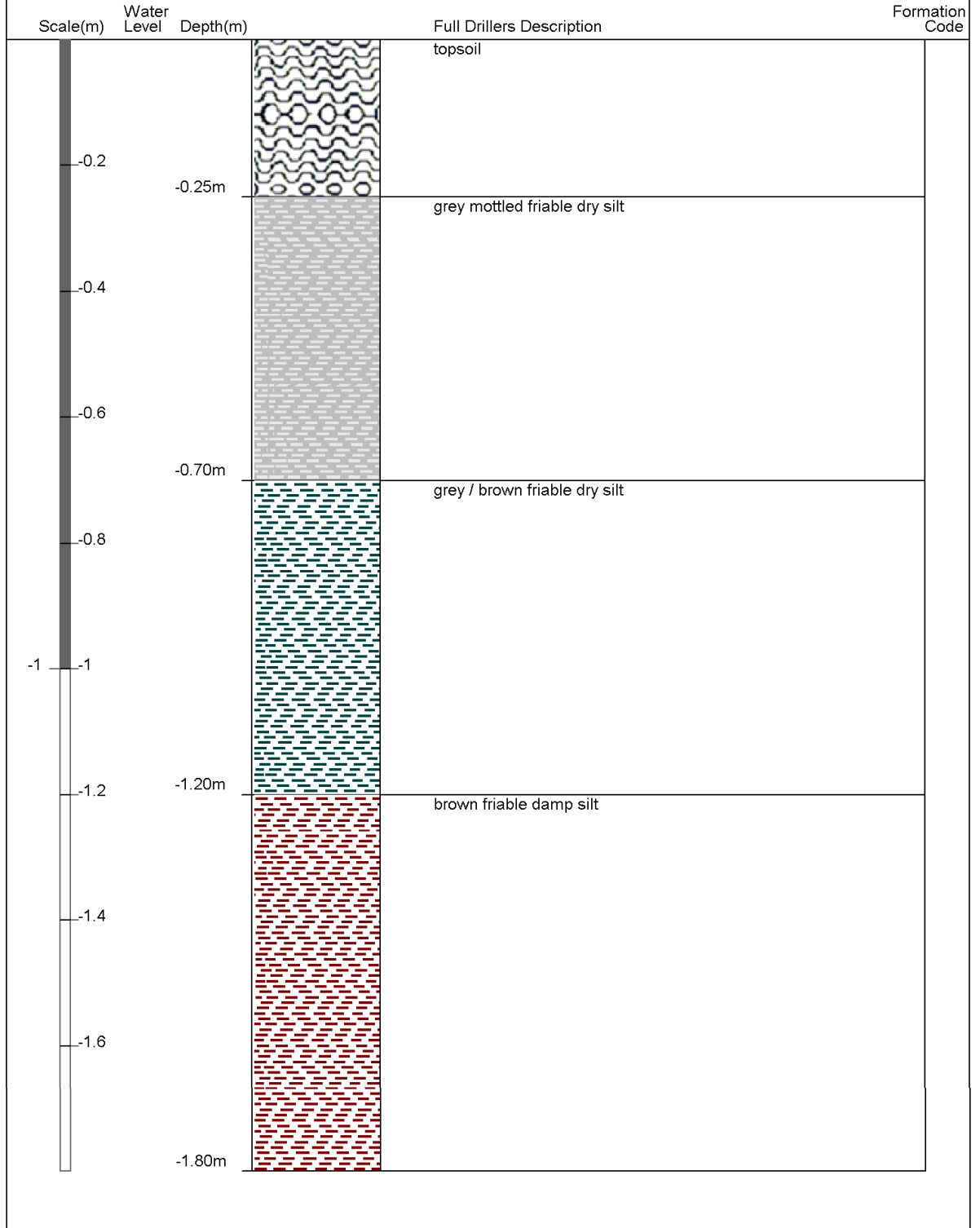


## **Appendix B – Existing ground investigation logs**



### Borelog for well M36/10212

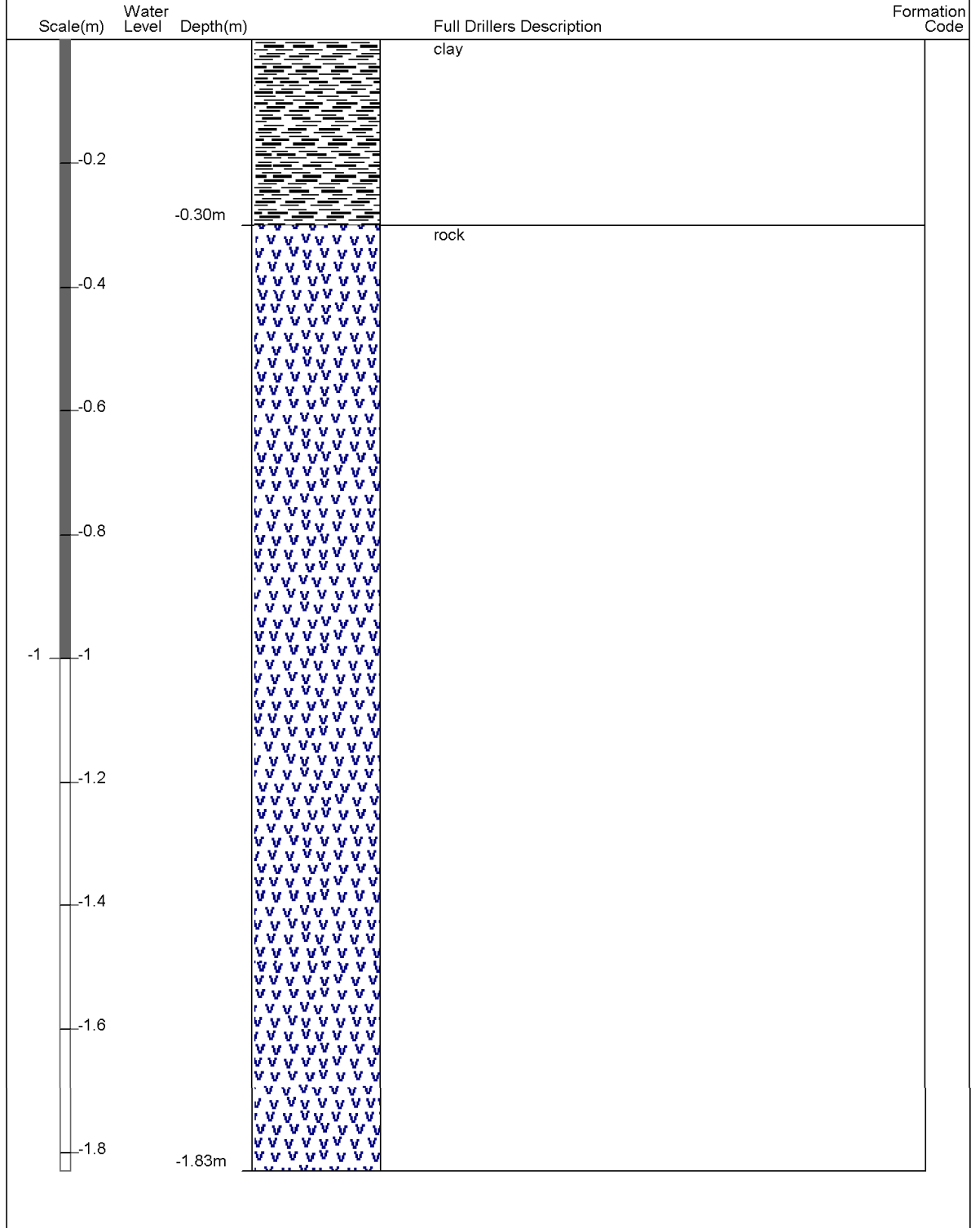
Gridref: M36:87311-37706 Accuracy : 3 (1=high, 5=low)  
 Ground Level Altitude : 153.01 +MSD  
 Well name : CCC BorelogID 6647  
 Drill Method : Not Recorded  
 Drill Depth : -1.8m Drill Date : 3/04/2007





### Borelog for well M36/9616

Gridref: M36:87499-37633 Accuracy : 3 (1=high, 5=low)  
 Ground Level Altitude : 165.58 +MSD  
 Well name : CCC BorelogID 4100  
 Drill Method : Not Recorded  
 Drill Depth : -1.83m Drill Date : 11/01/1973













## Appendix C – Geotechnical Investigation Summary

### Table 1 Summary of most relevant investigation data

ID	1	2
Type *	BH	BH
Ref	M36/10212	M36/9616
Depth (m)	1.8	5.7
Distance from site (m)	270	473
Ground water level (mBGL)	-	-
Simplified recorded geological profile (depth below ground level to top of stratum, m)	0	
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
25		
Greater depths		

\*BH: Borehole, HA: Hand Auger, WW: Water Well, CPT: Cone Penetration Test

 Loess (Silt)	 Clay to silty clay	 Clayey silt to silt	 Silty sand to silt
 Clayey sand	 Sand	 Gravelly sand or gravel	 Rock

VL = very loose, L = loose, MD = medium dense, D = dense, VD = very dense

VS = very soft, So = soft, F = firm, St = stiff, VS = very stiff, H = hard