CHRISTCHURCH CITY COUNCIL
PRK_1311_BLDG_006 EQ2
North Beach Surf Club Toilets
93 Marine Parade, North New Brighton

QUALITATIVE ASSESSMENT REPORT

FINAL

- Rev B
- 23 May 2013

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Contents

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	Signature	Date	Name	Title
Author		23/05/2013	Willow Patterson-Kane	Structural Engineer
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1. Executive Summary

1.1. Background

A Qualitative Assessment was carried out on the building PRK_1311_BLDG_006 EQ2 located at 93 Marine Parade, North New Brighton. The building is divided into the two-storey North Beach Surf Club and the one storey toilet block and changing rooms. The toilet block is constructed from reinforced masonry block walls with timber rafters and a lightweight roof above. The lower storey of the Surf Club appears to be constructed out of masonry block walls as well, with timber-framed walls on the second storey and a lightweight roof above, therefore the two structures will be considered one building in this assessment. An aerial photograph illustrating this area 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_1311_BLDG_006 EQ2 North Beach**

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 9 May 2012.

1.2. Key Damage Observed

Key damage observed includes:-

- Gaps opening up between masonry walls at mortar joints.

1.3. Critical Structural Weaknesses

No potential critical structural weaknesses have been 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 61% NBS. The damage observed during the site investigation was not significant; therefore the post earthquake capacity will not change as a result of earthquake damage.

The building has been assessed to have a seismic capacity less than 67% NBS and is therefore a potential earthquake risk.

Please note that structural strengthening is required by law for buildings that are confirmed to have a seismic capacity of less than 34% NBS.

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) A quantitative assessment of the building, supported by intrusive investigations if required, be undertaken to determine the seismic capacity and to develop potential strengthening concepts.

c) 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 located at 91 Marine Parade 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 draft document "Guidance on Detailed Engineering Evaluation of Earthquake affected Non-residential Buildings in Canterbury", issued 19 July 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[1].

At the time of this report, no intrusive site investigation, detailed analysis, or modelling of the building structure had been carried out. The building description below is based on our visual inspections.

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[1] http://www.dbh.govt.nz/seismicity-info

3. 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.

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 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. 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 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.

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**

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

5. Building Details

5.1. Building description

The building is located at 91 Marine Parade. There is only one building on this site, which is divided into the two-storey North Beach Surf Club and the one storey toilet block and changing rooms. The toilet block is constructed from reinforced masonry block walls with a lightweight roof with timber framing that does not extend over the changing area. The lower storey of the Surf Club also appears to be constructed from masonry block walls, therefore this assessment will consider both of the structures acting as one building. Structural drawings obtained from the Christchurch City Council indicate the toilet building walls have epoxy starters into the existing Surf Club. The second storey walls appear to be timber-framed with weatherboard cladding and a lightweight roof. The block walls are supported on a concrete strip footing, with a concrete floor slab at ground level. The building was designed in 2000 and was assumed to be constructed soon after, while the Surf Club was assumed to be constructed in the 1970's.

Our evaluation was based on the external and partial internal visual inspection carried out on 9 May 2012 and a cover meter survey carried out on 14 May 2012. Internal inspection was not carried out on the Surf Club as it was outside the scope of this assessment and is not owned by the client. Drawings were not available to verify the foundation system and the date of construction of the Surf Club building.

5.2. Gravity Load Resisting system

It appears that the gravity loads are taken by the masonry block walls, with direct transfer into the concrete slab foundation below.

5.3. Seismic Load Resisting system

Lateral loads acting across and along the building will be resisted by the masonry walls in shear.

Note that for this building the 'across direction' has been taken as east-west and the 'along direction' has been taken as north-south.

5.4. Geotechnical Conditions

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

- In accordance with NZS1170.5 the site is likely to be seismic subsoil Class D (deep or soft soil) ground performance and properties.
- Liquefaction risk is expected to be low for this site. No significant evidence that liquefaction occurred on site was found in the aerial photograph taken shortly after the 22 February 2011 earthquake or during the external site walkover conducted by a SKM engineer.

If consent is required for this site, additional investigations are required in order to provide a more detailed and accurate assessment of ground properties. Additional investigations recommended are:

- Two CPT tests on site to a depth of 20m or refusal

6. Damage Summary

SKM undertook an inspection on 9 May 2012. The following areas of damage were observed during the time of inspection:

General

1) No visual evidence of settlement was noted at this site; therefore a level survey is not required at this stage of assessment.

Toilet Block and Changing Rooms – Damage

1) Cracking occurring as gaps between longitudinal and transverse masonry walls open up at mortar joints.
2) Paint removal throughout the structure was noted, but is not the result of earthquake-related damage.
3) Rusting on all steel elements was noted, but is not the result of earthquake-related damage.

North Beach Surf Club – External Damage

1) Buckling of soffit lining element on South wall.
2) Cracking at assumed external plasterboard cladding joints on north and east first storey walls.
3) Gap opening up between external concrete ground slab and first-floor wall on the south side.

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[2].

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 rank is indicated by the percent of the required New Building Standard (%NBS) strength that the building is considered to have. Earthquake prone buildings are defined as having less than 33% NBS strength which correlates to an increased risk of approximately 20 times that of 100% NBS[3]. Buildings that are identified to be 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[4].

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	

[2] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf
[3] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p 2-2
[4] http://resources.ccc.govt.nz/files/EarthquakeProneDangerousAndInsanitaryBuildingsPolicy2010.pdf

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 catastrophic 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[5]. This assessment concentrates on matters relating to life safety as damage to the building is a secondary consideration. SLS performance of the building can be estimated by scaling the current code levels if required.

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

- AS/NZS 1170 Structural Design Actions
- NZS 3101:2006 Concrete Structures Standard
- NZS 3404:1997 Steel Structures Standard

7.2. Available Information, Assumptions and Limitations

Following our inspection on 9 May 2012, SKM carried out a preliminary structural review. The structural review was undertaken using the available information which was as follows:

- SKM site measurements, cover meter survey, external and partial internal inspection findings of the building. Please note no intrusive investigations were undertaken.
- There were no drawings available for the Surf Club building to carry out our review.

The following assumptions and design criteria were used in this assessment:

- 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 2. This level of importance is described as 'normal' with medium or considerable consequence of failure.

[5] NZSEE 2006, *Assessment and Improvement of the Structural Performance of Buildings in Earthquakes*, p2-9

- Ductility level of 1.25 in both directions, based on our assessment and code requirements at the time of design.
- Site hazard factor, Z = 0.3, NZBC, Clause B1 Structure, Amendment 11 effective from 1 August 2011

This IEP was based on our external visual inspection of the building. 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.

7.3. Critical Structural Weaknesses

No critical structural weaknesses have been identified in this building.

7.4. Qualitative Assessment Results

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

Table 3: Qualitative Assessment Summary

Item	%NBS
Likely Seismic Capacity of Building	61

Our qualitative assessment found that the building is likely to be classed as a potential earthquake risk and probably a ‘Moderate Risk Building’ (capacity less than 67% of NBS). The full IEP assessment form is detailed in Appendix 2 – IEP Reports.

Further investigation is required to confirm our initial findings and establish possible strengthening concepts.

The Council regulations state that if the %NBS of the building is less than 34%, this building is considered earthquake prone and is required to be strengthened.

The Engineering Advisory Group notes:

> *“For buildings with insignificant damage, but that have %NBS<33%, and buildings with significant damage, a quantitative assessment is required. Note that according to*

the extent of damage, it may be possible to complete a quantitative assessment for part only of the structure, with a qualitative analysis for the structure as a whole. This could be sufficient when there is highly localised severe damage but the building has otherwise suffered little or no damage."

8. Further Investigation

Due to the lack of structural drawings for the Surf Club showing its layout, construction date and the connections between the buildings and the likely seismic capacity of the building being less than 67% NBS we recommend that a quantitative assessment is carried out due to the potential margin of errors that may be inherent in our initial assessment. This will allow us to confirm our findings and establish possible strengthening concepts.

If a quantitative assessment is carried out then intrusive investigations will be required to confirm the following structural details:

- Connection elements and layouts between the toilet block and the North Beach Surf Club.
- Wall elements and layouts, structural roof member sizes and layouts and connection sizes for the North Beach Surf Club.
- Construction date for the North Beach Surf Club.

9. Conclusion

A qualitative assessment was carried out on the building located at 93 Marine Parade, North New Brighton. The building has sustained minor damage to the external masonry wall with gaps opening up between masonry walls at mortar joints. The building has been assessed to have a seismic capacity in the order of 61% NBS and is therefore a potential earthquake risk and is likely to be classified as a 'Moderate Risk Building' (capacity less than 67% of NBS).

Further investigation is required to confirm our initial findings and to establish the layout and date of construction of the Surf Club building. This investigation will require carrying out a quantitative assessment on the building to determine if there is enough capacity in the structural elements to resist the required earthquake demand. If the building is to be strengthened, building consent will likely be required.

It is recommended that:

a) There is no damage to the building that would cause it to be unsafe to occupy.
b) A quantitative assessment of the building, supported by intrusive investigations if required, be undertaken to determine the seismic capacity and to develop potential strengthening concepts.
c) 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: Southwest elevation	Photo 2: West elevation
	
Photo 3: South elevation	Photo 4: East elevation

	
Photo 5: Timber-framed roof inside toilet block.	Photo 6: Timber-framed roof inside toilet block.
	
Photo 7: Rusting of timber-masonry steel connection (typical).	Photo 8: Cracking along mortar joint between internal and external wall.

Photo 9: Footing of masonry wall and concrete ground slab.

Photo 10: Changing room entrances.

Photo 11: Existing impact damage to masonry on changing room entrance.

Photo 12: Footing and gate connection on masonry wall and concrete ground slab.

<table>
<tr><td></td><td></td></tr>
<tr><td>Photo 13: Paint removal on timber edge roof beam and rusting of timber-masonry steel connection.</td><td>Photo 14: Internal wall between changing rooms connecting to shared wall between toilet block and North Beach Surf Club.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 15: Internal wall between toilets and changing room connecting to share wall between toilet block and North Beach Surf Club.</td><td>Photo 16: Masonry and weatherboard interface on shared south wall.</td></tr>
</table>

	
Photo 17: Gap opening up between shared wall and internal masonry wall along the mortar joint.	Photo 18: Gap opening up between shared wall and internal masonry wall along the mortar joint.
	
Photo 19: Buckling of soffit cladding element on south wall.	Photo 20: External changing room wall connecting to share wall.

	
Photo 21: Gap opening up between masonry wall and wall extension (material unknown).	Photo 22: Connection between the masonry wall of the toilet block and the Surf Club on the southern wall.
	
Photo 23: Gap opening up between external changing room masonry wall and Surf Club southern wall.	Photo 24: Gap opening up between Surf Club south wall and external ground slab.

Photo 25: East elevation of Surf Club

Photo 26: Cracking at assumed plasterboard joints on the first-floor east wall external cladding (typical).

Photo 27: Northeast elevation of Surf Club.

Photo 28: North elevation of Surf Club.

	
Photo 29: Cracking at assumed plasterboard joints on the first-floor east wall external cladding (typical).	Photo 30: West elevation of Surf Club.

12. Appendix 2 – IEP Reports

Table IEP-1 **Initial Evaluation Procedure – Step 1**

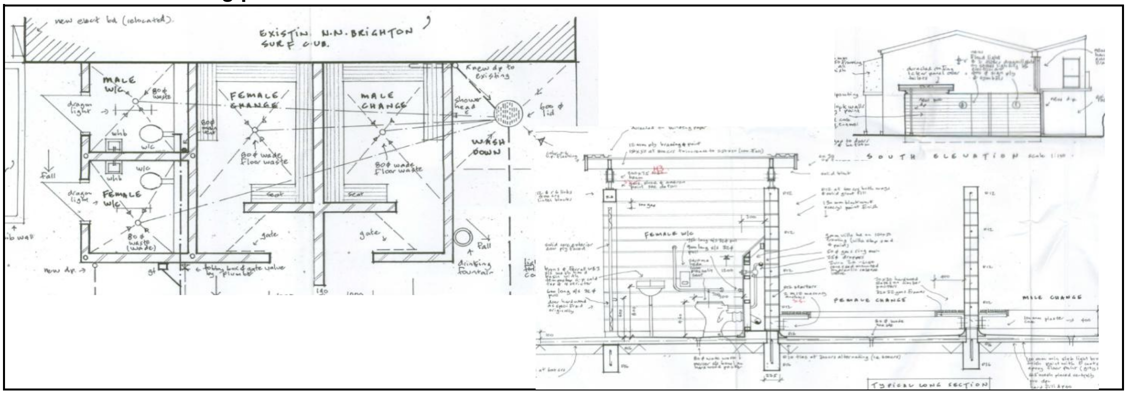
(Refer Table IEP - 2 for Step 2; Table IEP - 3 for Step 3, Table IEP - 4 for Steps 4, 5 and 6)

Building Name:	**PRK_1311_BLDG_006 EQ2 North Beach**	Ref.	**ZB01276.120**
Location:	93 Marine Parade, North New Brighton	By	WPK
		Date	11/05/2012

Step 1 - General Information

1.1 Photos (attach sufficient to describe building)

1.2 Sketch of building plan



1.3 List relevant features

The building is divided into the North Beach Surf Club building and a toilet block. The Surf Club is two storeys high, while the toilet block is one storey high. The toilet block also contains a changing area that is uncovered. The toilet block is constructed from reinforced masonry block walls with timber rafters and a lightweight roof above. The block walls are founded on reinforced concrete strip footings. The lower storey of the Surf Club also appears to be constructed from masonry block walls, therefore this assessment will consider both of the structures acting as one building. The second storey walls appear to be timber-framed, with a lightweight roof. The main lateral load-resisting system appear to be the walls. These act as shear walls in the north-south and east-west direction. Internal inspection of the Surf Club was not carried out as it was outside the scope of this assessment and is not owned by the client. The building is assumed to have been constructed in 2000 or after, based on Council drawings, while the Surf Club is assumed to have been building in the 1970's.

1.4 Note information sources

	Tick as appropriate	
Visual Inspection of Exterior	✓	
Visual Inspection of Interior	✓	
Drawings (note type)	✓	Structural
Specifications	☐	
Geotechical Reports	☐	
Other (list)	✓	

Partial visual inspection of interior only.
Cover meter survey

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:	**PRK_1311_BLDG_006 EQ2 North Beach**	Ref.	**ZB01276.120**
Location:	93 Marine Parade, North New Brighton	By	WPK
Direction Considered:	**Longitudinal & Transverse**	Date	11/05/2012

(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			○	See also notes 1, 3
1935-1965			○	
1965-1976	Seismic Zone;	A	○	
		B	○	
		C	○	See also note 2
1976-1992	Seismic Zone;	A	○	
		B	◉	
		C	○	
1992-2004			○	

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	○

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

a) Rigid	○	N-A
b) Intermediate	○	

c) Estimate Period, T

building Ht = **6.7** meters

	Longitudinal	Transverse	
Ac =	146	85	m2

Can use following:

		Longitudinal	Transverse
$T = 0.09h_n^{0.75}$	for moment-resisting concrete frames	○ MRCF	○ MRCF
$T = 0.14h_n^{0.75}$	for moment-resisting steel frames	○ MRSF	○ MRSF
$T = 0.08h_n^{0.75}$	for eccentrically braced steel frames	○ EBSF	○ EBSF
$T = 0.06h_n^{0.75}$	for all other frame structures	○ Others	○ Others
$T = 0.09h_n^{0.75}/A_c^{0.5}$	for concrete shear walls	○ CSW	○ CSW
T <= 0.4sec	for masonry shear walls	◉ MSW	◉ MSW

Where hn = height in m from the base of the structure to the uppermost seismic weight or mass.
Ac = ΣAi(0.2 + Lwi/hn)2
Ai = cross-sectional shear area of shear wall i in the first storey of the building, in m2
lwi = length of shear wall i in the first storey in the direction parallel to the applied forces, in m
with the restriction that lwi/hn shall not exceed 0.9

Longitudinal	Transverse	
0.4	**0.4**	Seconds

d) (%NBS)nom determined from Figure 3.3

Longitudinal	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

			Factor
Note 1:	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	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	1
Note 2:	For reinforced concrete buildings designed between 1976 -1984 (%NBS)nom by 1.2	No	1
Note 3:	For buildings designed prior to 1935 multiply (%NBS)nom by 0.8 except for Wellington where the factor may be taken as 1.	No	1

Longitudinal	16.5	$(\%NBS)_{nom}$
Transverse	16.5	$(\%NBS)_{nom}$

Continued over page

Building Name:	PRK_1311_BLDG_006 EQ2 North Beach	Ref.	ZB01276.120
Location:	93 Marine Parade, North New Brighton	By	WPK
Direction Considered:	Longitudinal & Transverse	Date	11/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

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 — 2
(from NZS1170.0:2004, Table 3.1 and 3.2)

b) Return Period Scaling Factor from accompanying Table 3.1 — **Factor C** 1.00

2.5 Ductility Scaling Factor, D

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

Longitudinal	1.25	μ Maximum = 6
Transverse	1.25	μ Maximum = 6

b) Ductility Scaling Factor
For pre 1976 = k_μ
For 1976 onwards = 1
(where k_μ 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: Masonry Block
Transverse: Masonry Block

a) Structural Performance Factor, S_p
from accompanying Figure 3.4

Longitudinal	Sp	0.90
Transverse	Sp	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, $(\%NBS)_b$
(equals $(\%NSB)_{nom}$ x A x B x C x D x E)

Longitudinal	61.1	(%NBS)b
Transverse	61.1	(%NBS)b

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:	**PRK_1311_BLDG_006 EQ2 North Beach**	Ref.	**ZB01276.120**
Location:	93 Marine Parade, North New Brighton	By	WPK
Direction Considered:	**a) Longitudinal**	Date	11/05/2012

(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

3.1 Plan Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor A**	1
Comment					

3.2 Vertical Irregularity

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor B**	1
Comment					

3.3 Short Columns

	Severe	Significant	Insignificant		
Effect on Structural Performance	○	○	◉	**Factor C**	1
Comment					

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 1

Table for Selection of Factor D1	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2	Severe	Significant	Insignificant
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

Factor D 1

(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)

	Severe	Significant	Insignificant		
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E**	1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1

Record rationale for choice of Factor F:

The Surf Club building is included in the analysis, due to the shared wall, therefore F=1 as the layout and construction date are unknown.

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

PAR 1

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:	**PRK_1311_BLDG_006 EQ2 North Beach**	Ref.	**ZB01276.120**
Location:	93 Marine Parade, North New Brighton	By	WPK
Direction Considered:	**b) Transverse**	Date	11/05/2012

(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**
	Severe	Significant	Insignificant	
3.1 Plan Irregularity Effect on Structural Performance	○	○	◉	**Factor A** 1
Comment				
3.2 Vertical Irregularity Effect on Structural Performance	○	○	◉	**Factor B** 1
Comment				
3.3 Short Columns Effect on Structural Performance	○	○	◉	**Factor C** 1
Comment				

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 1

Table for Selection of Factor D1

	Severe	Significant	Insignificant
Separation	0<Sep<.005H	.005<Sep<.01H	Sep>.01H
Alignment of Floors within 20% of Storey Height	○ 0.7	○ 0.8	◉ 1
Alignment of Floors not within 20% of Storey Height	○ 0.4	○ 0.7	○ 0.8

b) Factor D2: - Height Difference Effect

Select appropriate value from Table

Factor D2 1

Table for Selection of Factor D2

	Severe	Significant	Insignificant
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

Factor D 1

(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)

	Severe	Significant	Insignificant	
Effect on Structural Performance	○ 0.5	○ 0.7	◉ 1	**Factor E** 1

3.6 Other Factors

For < 3 storeys - Maximum value 2.5,

otherwise - Maximum value 1.5. No minimum. **Factor F** 1

Record rationale for choice of Factor F:

The Surf Club building is included in the analysis, due to the shared wall, therefore F=1 as the layout and construction date are unknown.

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

PAR 1

Table IEP-4 **Initial Evaluation Procedure – Steps 4, 5 and 6**

(Refer Table IEP - 1 for Step 1; Table IEP - 2 for Step 2, Table IEP - 3 for Step 3)

SKM

Building Name:	**PRK_1311_BLDG_006 EQ2 North Beach**	Ref.	**ZB01276.120**
Location:	93 Marine Parade, North New Brighton	By	WPK
Direction Considered:	**Longitudinal & Transverse**	Date	11/05/2012

(Choose worse case if clear at start. Complete IEP-2 and IEP-3 for each if in doubt)

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

	Longitudinal	Transverse
4.1 Assessed Baseline $(\%NBS)_b$ (from Table IEP - 1)	61	61
4.2 Performance Achievement Ratio (PAR) (from Table IEP - 2)	1.00	1.00
4.3 PAR x Baseline $(\%NBS)_b$	61	61

4.4 Percentage New Building Standard (%NBS)
(Use lower of two values from Step 4.3) — **61**

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

%NBS ≤ 33 — NO

Step 6 - Potentially Earthquake Risk?

%NBS < 67 — YES

Step 7 - Provisional Grading for Seismic Risk based on IEP

Seismic Grade — **C**

Evaluation Confirmed by

Signature

NICK M. 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

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	Noreth Beach Surf Club Toilets	Reviewer:	NICK CALVERT
	Unit / No: / Street	CPEng No:	242062
Building Address:	93 Marine Parade, North New Brighton	Company:	SKM
Legal Description:		Company project number:	ZB01276.120
		Company phone number:	09 928 5500
	Degrees / Min / Sec		
GPS south:		Date of submission:	24-May
GPS east:		Inspection Date:	9/05/2012
		Revision:	B
Building Unique Identifier (CCC):	PRK_1311_BLDG_006	Is there a full report with this summary?	yes

Site

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

Building

No. of storeys above ground:	2	single storey = 1	Ground floor elevation (Absolute) (m):	6.72
Ground floor split?	no		Ground floor elevation above ground (m):	6.72
Storeys below ground	0			
Foundation type:	strip footings		if Foundation type is other, describe:	
Building height (m):	6.72		height from ground to level of uppermost seismic mass (for IEP only) (m):	6.72
Floor footprint area (approx):	285			
Age of Building (years):	45		Date of design:	1976-1992
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	recreational		Brief strengthening description:	
Use (upper floors):	recreational			
Use notes (if required):				
Importance level (to NZS1170.5):	IL2			

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Assumed timber rafters & purlins and lightweight steel cladding
Floors:	concrete flat slab	slab thickness (mm)	Unknown
Beams:	none	overall depth x width (mm x mm)	None
Columns:	none	typical dimensions (mm x mm)	None
Walls:	unreinforced concrete masonry	thickness (mm)	200

Lateral load resisting structure

Note: Define along and across in detailed report!

Lateral system along:	partially filled CMU		note total length of wall at ground (m):	25
Ductility assumed, μ:	1.25		wall thickness (m):	
Period along:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):	10		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	estimated
Lateral system across:	partially filled CMU		note total length of wall at ground (m):	13
Ductility assumed, μ:	1.25		wall thickness (m):	
Period across:	0.40	##### enter height above at H31	estimate or calculation?	estimated
Total deflection (ULS) (mm):	10		estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):			estimate or calculation?	estimated

Separations:

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

Non-structural elements

Stairs:	timber	describe supports	Unknown, assumed timber
Wall cladding:	plaster system	describe	Assumed
Roof Cladding:	Metal	describe	Assumed corrugated sheeting
Glazing:	aluminium frames		
Ceilings:			Unknown
Services(list):	Water, sewerage		

Available documentation

Architectural	none	original designer name/date	
Structural	partial	original designer name/date	Christchurch City Design, 2000
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:		Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:	none observed	notes (if applicable):	
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:	Current damage noted will not diminish the capacity of the building.
	Describe (summary):	Cracking along plasterboard cladding on Surf Club		
Across	Damage ratio:	0%		
	Describe (summary):	Cracking along mortar joints on toilet block		
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	Cracking along mortar joints on toilet block and external plasterboard wall cladding on Surf Club.

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

Recommendations

Level of repair/strengthening required:	minor non-structural	Describe:	
Building Consent required:	no	Describe:	
Interim occupancy recommendations:	full occupancy	Describe:	Not an immediate collapse hazard.

Along	Assessed %NBS before:	61%	%NBS from IEP below	If IEP not used, please detail assessment methodology:	Qualitative Assessment carried out includes NZSEE IEP (refer to SKM report).
	Assessed %NBS after:	61%			
Across	Assessed %NBS before:	61%	%NBS from IEP below		
	Assessed %NBS after:	61%			

14. Appendix 4 – Geotechnical Desktop Study

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Christchurch City Council - Structural Engineering Service

Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	120
Address	91 Marine Parade - Public Toilet block
Report date	29 June 2012
Author	Ananth Balachandra
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 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

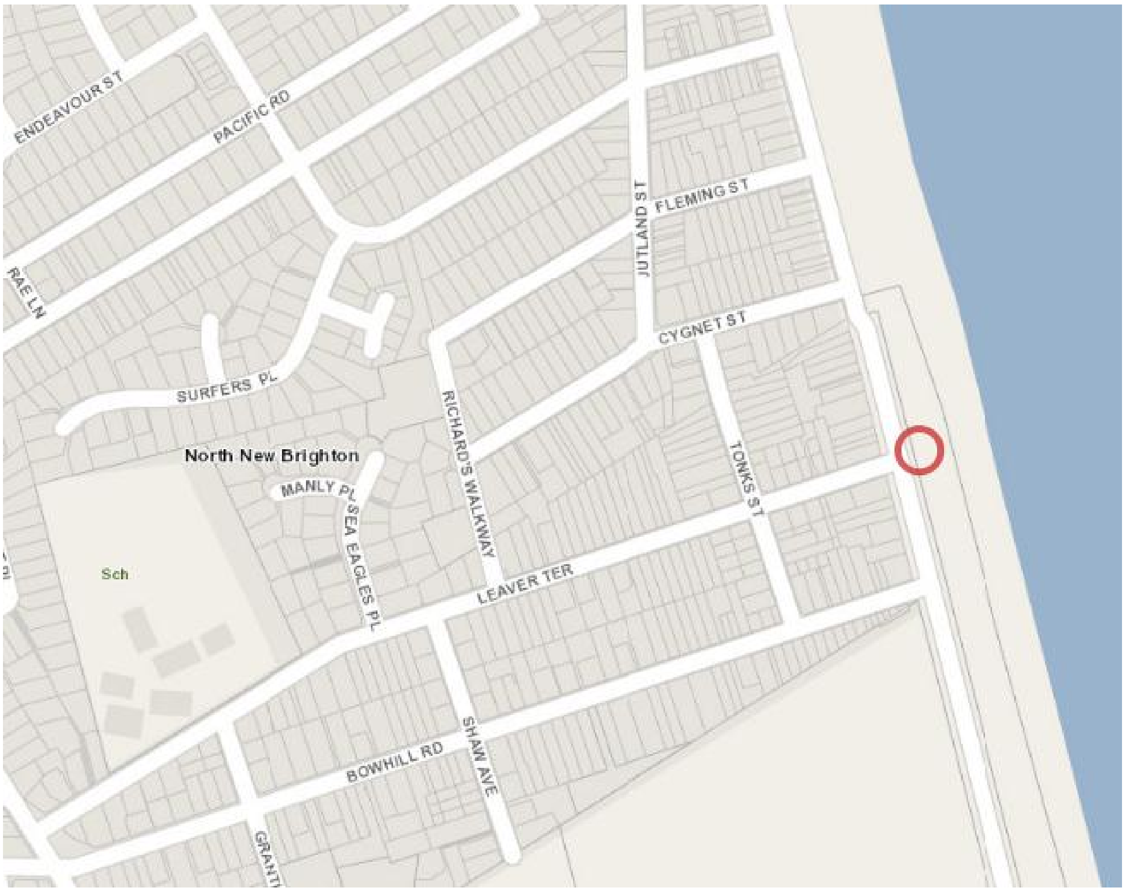
3. Limitations

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

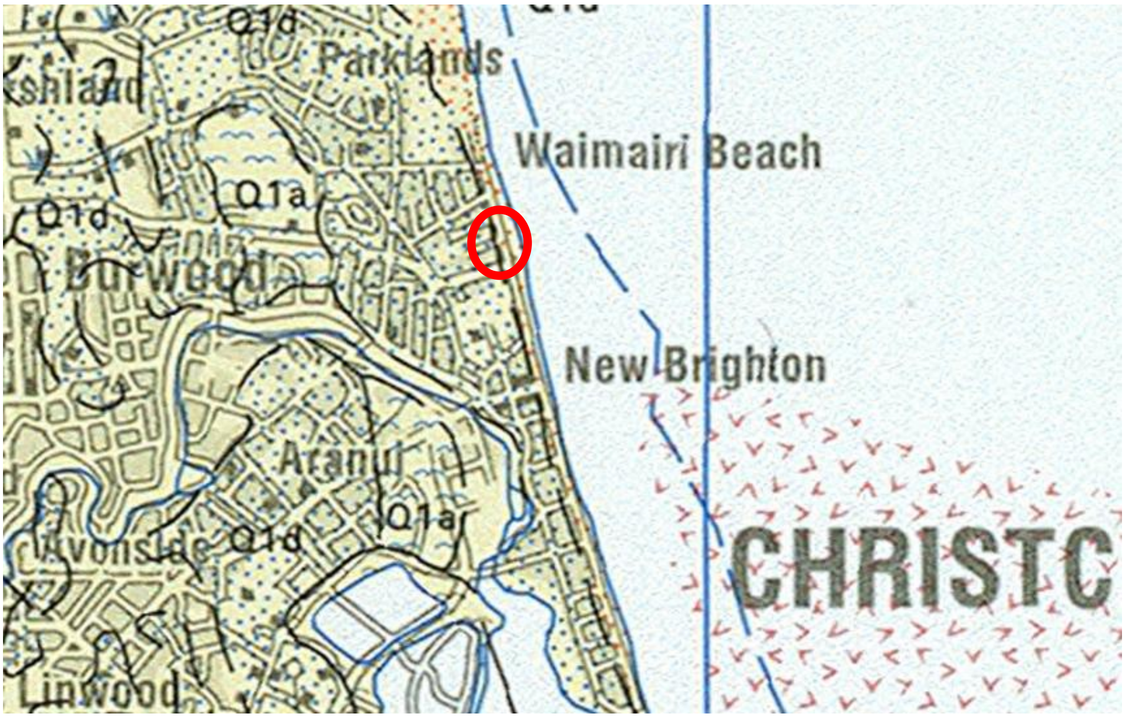


- **Figure 1 – Site location (courtesy of LINZ http://viewers.geospatial.govt.nz)**

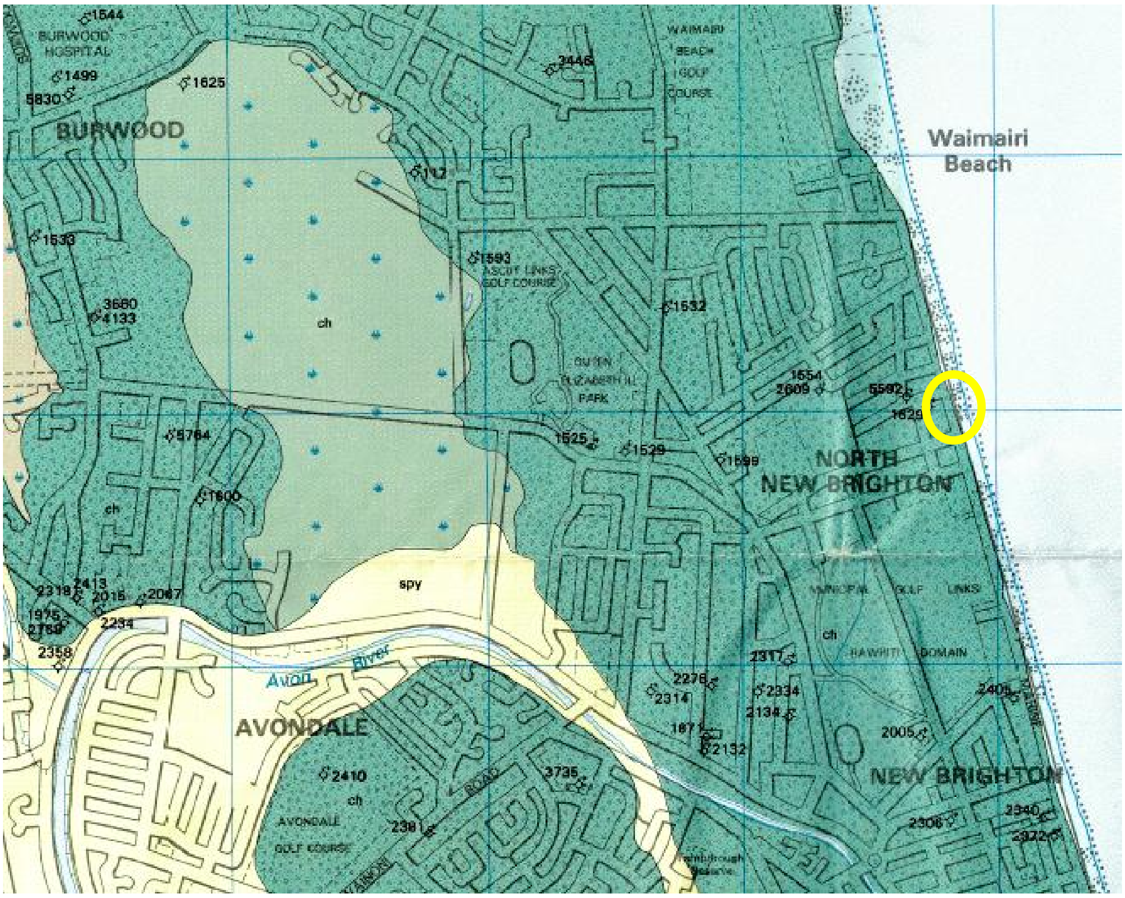
The structure is located on Marine Parade at grid reference 1577893 E, 5184277 N (NZTM).

5. Review of available information

5.1 Geological maps



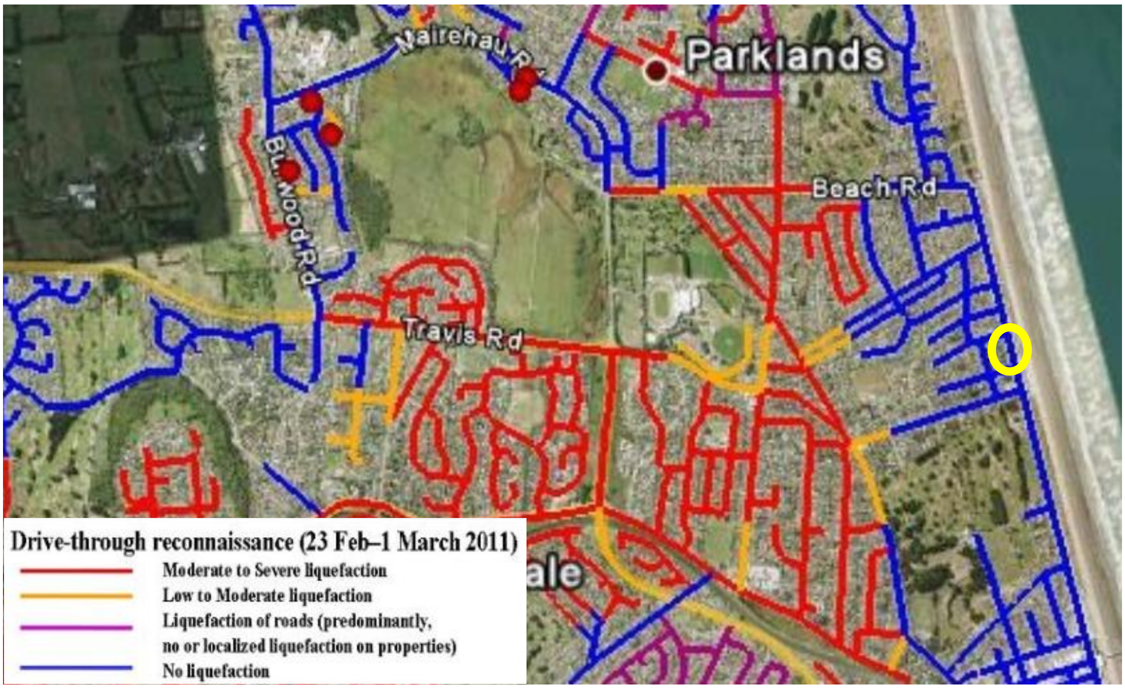
- **Figure 2 – Regional geological map (Forsyth et al, 2008). Site marked in red.**



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

The site is shown to be underlain by deposits from the Christchurch formations comprising dominantly sand of fixed and semi-fixed dunes and beaches.

5.2 Liquefaction map



- **Figure 4 – Liquefaction map (Cubrinovski & Taylor, 2011). Site marked in yellow.**

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. Their findings show no liquefaction at this site.

5.3 Aerial photography

- **Figure 5 – Aerial photography from 24 Feb 2011 (http://viewers.geospatial.govt.nz/)**

There appears to be no significant evidence in the aerial photographs that would suggest liquefaction occurred on site as a result of the 22 February 2011 earthquake. Likewise, no other significant damage to the land as a result of the recent earthquakes could be seen from the aerial photographs.

5.4 CERA classification

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

- Zone: Green
- DBH Technical Category: N/A (Urban Non-residential) – properties opposite to the site are classified as TC2

5.5 Historical land use

Historical land use document referred to is provided in Appendix A. No specific historical land use for the site is shown. It is possible that the area was used as general beach area before further development of the site.

5.6 Existing ground investigation data

- **Figure 6 – Local boreholes from Project Orbit and SKM files (https://canterburyrecovery.projectorbit.com/)**

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

5.7 Council property files

Relevant council property files for the sites included building consent documents and drawings for the proposed changing pavilion and public toilets.

The drawing show a shallow foundation solution for the public toilets comprising 100 mm concrete slab floor with 350 mm deep and 200 mm wide strip footing beneath the walls of the structure. The reinforcement for the footing are identified as 2D 16 with R10 stirrups at 300 mm centres for the strip footing and D10 floor ties at 600 mm centres.

Additionally, the site is classified as being located within the sea spray zone. No relevant information regarding ground conditions was attained from the review of available council files.

5.8 Site walkover

A site walkover was conducted by an SKM engineer on 4 May 2012.

The building comprised toilets and changing rooms attached to the south face of the existing surf club. The structure was a masonry block building with slab on grade foundations. The roof was constructed using timber frames and supported a light weight profiled cladding.

Some cracks in the masonry walls were observed during the external inspection of the site; otherwise no obvious structural damage was noted.

There were no signs of liquefaction on site, and no land damage was observed. Some patches of sand were observed around the site; however, they were likely to be windblown sand from the nearby beach. No undulations were observed in the asphalt surface of the parking area, with surface generally being in very good condition.

- **Figure 7 - External view of toilets (west elevation)**

- **Figure 8 - External view of changing rooms (south elevation)**

- **Figure 9 - Observed cracks in the wall**

- **Figure 10 - A walkway next to toilets**

6. Conclusions and recommendations

6.1 Site geology

An interpretation of the most relevant local investigation suggests that the site is underlain by:

Depth range (mBGL)	Soil type
0 - 25	Beach sand and sand/clay mixtures
25+	Alternating sand and clay layers. Riccarton gravel between depth of > 40m

6.2 Seismic site subsoil class

The site has been assessed NZS1170.5 Class D (deep or soft soil) from 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 third method has been used to make the assessment, with the borehole showing sand, clay and gravel being present below a depth of 100 m.

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

Liquefaction risk is expected to be low for this site. No significant evidence that liquefaction occurred on site was found in the aerial photograph taken shortly after the 22 February 2011 earthquake or during the external site walkover conducted by a SKM engineer.

Investigations that included geotechnical parameter measurements were not available for this site. However, the adjacent boreholes showed fairly consistent underlying soil profile mainly consisting beach sands and sand/ clay mixtures. As no significant land damage was noted, for the purposes of carrying out a quantitative DEE, following parameters are recommended:

Friction angle = 33 degrees

Apparent cohesion = 0 kPa

Unit weight = 18 kN / m^3

Ultimate bearing capacity = 250 kPa

These parameters should not be used for consent or design purposes, without further site specific investigations. The estimated bearing capacity was determined for a 1m wide strip footing using the recommended parameters.

6.5 Further investigations

If consent is required for the site, addition investigations are required in order to provide a more detailed and accurate assessment of ground properties. Additional investigations recommended are:

- Two CPT tests on site to a depth of 20 m or refusal

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/)

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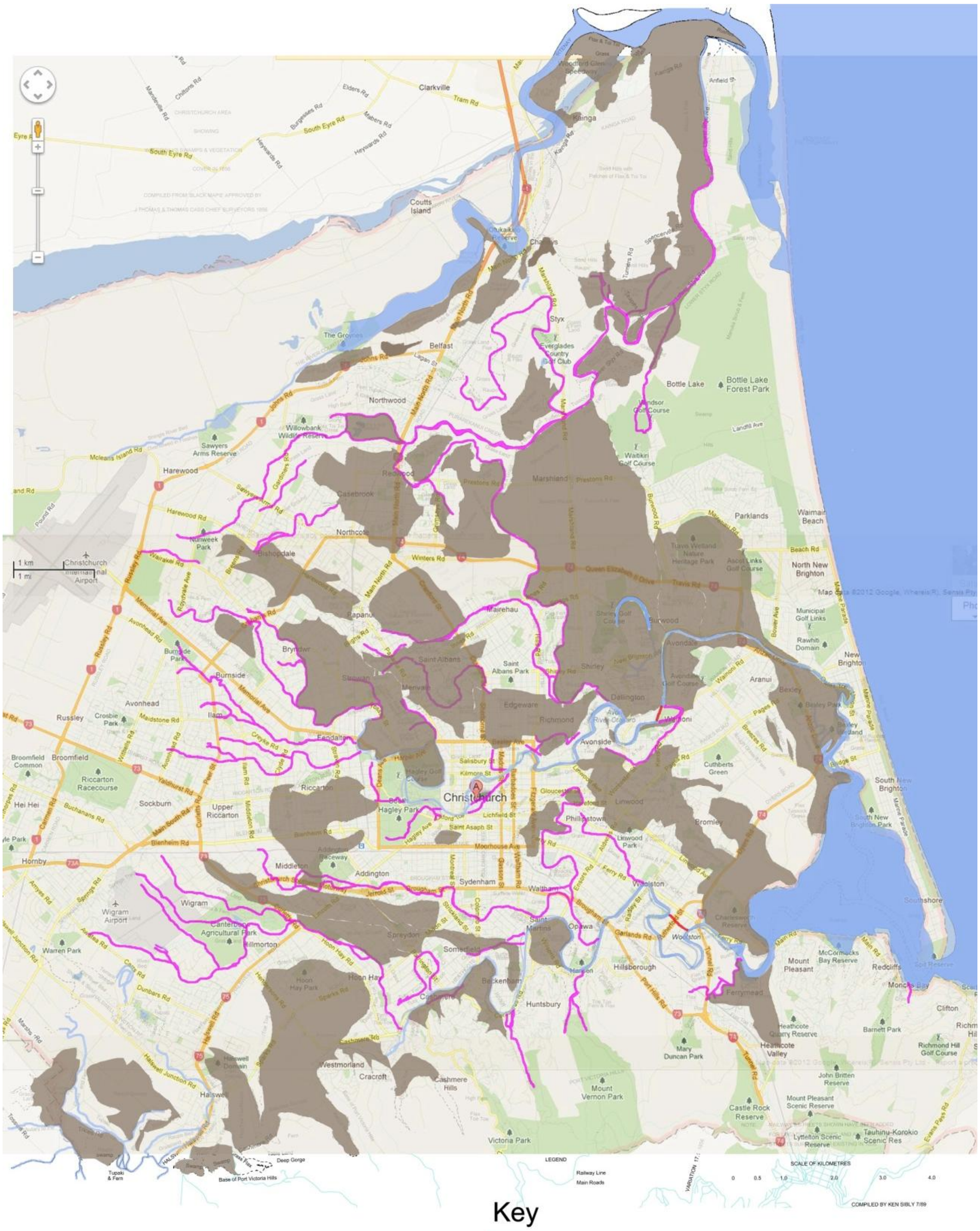
Appendix A – Christchurch 1856 land use



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

Key
- Previous creeks/rivers
- Existing creeks/rivers
- New creeks/rivers
- Swamp/Marshland

Appendix B – Existing ground investigation logs

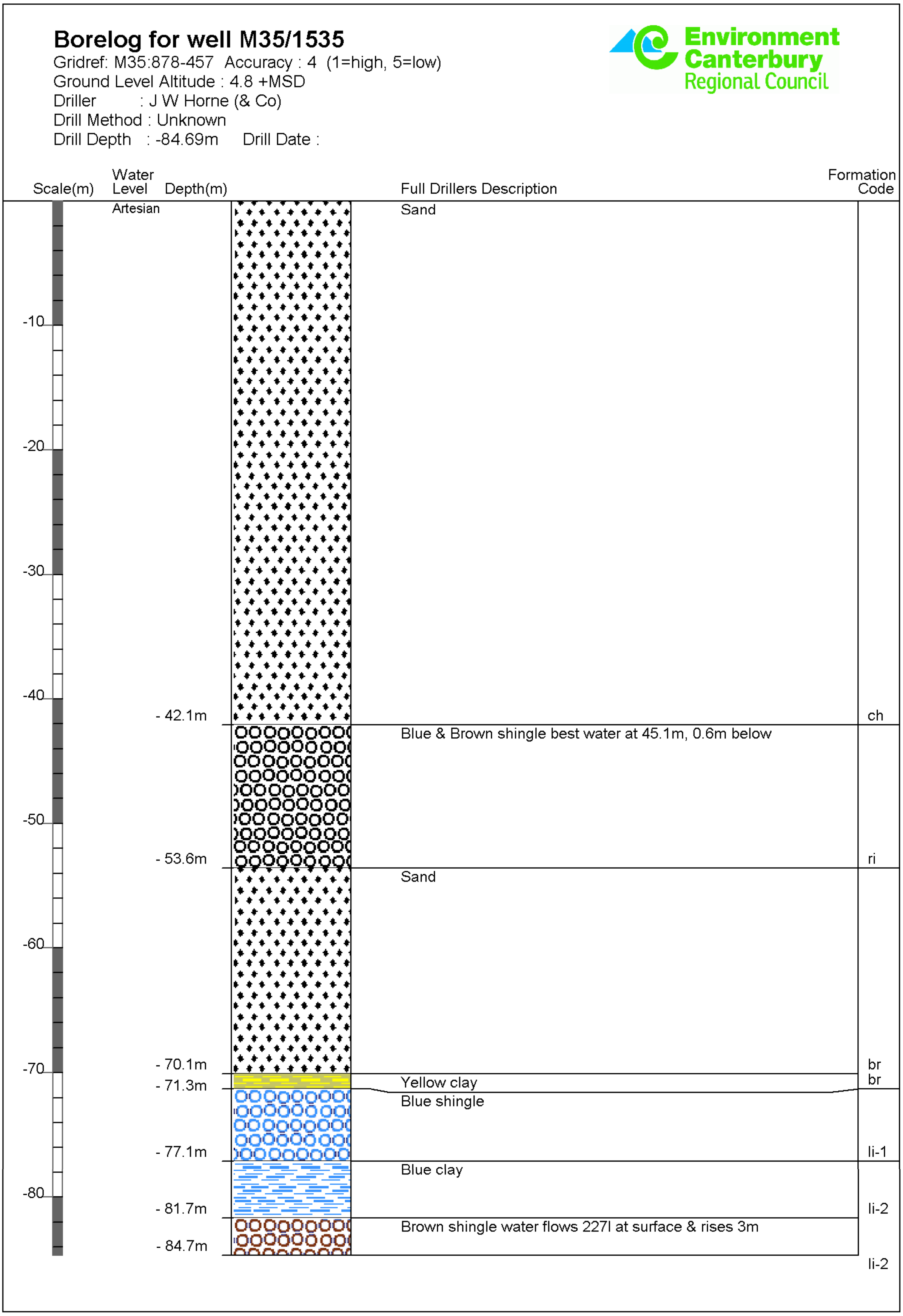
Borelog for well M35/1537

Gridref: M35:878-459 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 2.8 +MSD
Driller : not known
Drill Method : Unknown
Drill Depth : -102.1m Drill Date :

Water Level: Artesian

Depth(m)	Full Drillers Description	Formation Code
- 40.8m	Clay & sand	ch
- 52.4m	Blue shingle best water at 44.2m	ri
- 64.9m	Brown sand	br
- 71.3m	Brown sand & shingle	li-1
- 77.1m	Brown shingle	li-1
- 83.5m	Brown sand	li-2
- 95.4m	Brown shingle	li-2
- 98.5m	Yellow clay	li-2
- 102.1m	Brown shingle water 227l & rises 4.4m	li-3

Scale(m): -10, -20, -30, -40, -50, -60, -70, -80, -90, -100


Borelog for well M35/1535
Gridref: M35:878-457 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.8 +MSD
Driller : J W Horne (& Co)
Drill Method : Unknown
Drill Depth : -84.69m Drill Date :
Environment Canterbury Regional Council
Scale(m)
Water Level
Depth(m)
Full Drillers Description
Formation Code
Artesian
-10
-20
-30
-40
-50
-60
-70
-80
Sand
- 42.1m
ch
Blue & Brown shingle best water at 45.1m, 0.6m below
- 53.6m
ri
Sand
- 70.1m
br
Yellow clay
- 71.3m
br
Blue shingle
- 77.1m
li-1
Blue clay
- 81.7m
li-2
Brown shingle water flows 227l at surface & rises 3m
- 84.7m
li-2

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Borelog for well M35/1507

Environment Canterbury Regional Council

Gridref: M35:877-459 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.8 +MSD
Driller : not known
Drill Method : Driven Pipe
Drill Depth : -154.8m Drill Date : 1/07/1922

Depth(m)	Full Drillers Description	Formation Code
- 21.3m	Beach sand	ch
- 29.0m	Blue sand	ch
- 41.1m	Blue clay	ch
- 47.2m	Blue shingle	ri
- 51.8m	Brown shingle - water rose 0.3m above kerb	ri
- 71.3m	Yellow sand	br
- 73.8m	Brown shingle - water rose 2.7m above kerb	li-1
- 81.7m	Blue clay	li-2
- 111.3m	Brown shingle - water rose 3.7m above kerb, flow at depth of 83.8, 89.9, 97.5 & 108.5m	li
- 121.9m	Yellow sand	he
- 126.2m	Brown very hard shingle - no water	bu
- 137.2m	Yellow sand	sh
- 150.6m	Blue clay & sea shells	sh
- 151.2m	Timber	wa
- 151.8m	Brown very hard shingle	wa
- 160.9m		

Scale(m): -10, -20, -30, -40, -50, -60, -70, -80, -90, -100, -110, -120, -130, -140, -150

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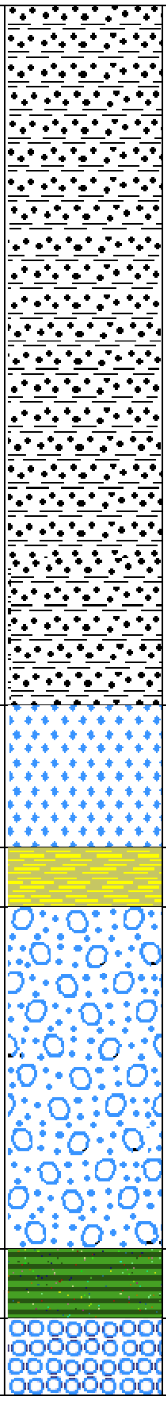
Borelog for well M35/1629 page 1 of 2

Environment Canterbury Regional Council

Gridref: M35:877-460 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.1 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -84.5m Drill Date : 25/10/1910



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
	Artesian		Sand & clay	
-5				
-10				
-15				
-20		- 21.3m		ch
			Blue sand	
-25		- 25.6m		ch
			Yellow clay	
		- 27.4m		ch
			Blue sand & gravel	
-30				
-35		- 37.8m		ch
			Clay & peat	
-40		- 39.9m		ch
			Blue shingle	
		- 42.3m		ri

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Borelog for well M35/1629 page 2 of 2

Environment Canterbury Regional Council

Gridref: M35:877-460 Accuracy : 4 (1=high, 5=low)
Ground Level Altitude : 4.1 +MSD
Driller : Job Osborne (& Co/Ltd)
Drill Method : Hydraulic/Percussion
Drill Depth : -84.5m Drill Date : 25/10/1910

Water Level: Artesian

Depth(m)	Full Drillers Description	Formation Code
- 43.3m	Blue shingle	ri
- 45.7m	Brown shingle	ri
- 50.6m	Blue shingle	ri
- 55.5m	Brown sand	br
- 57.9m	Yellow clay	br
- 62.2m	Brown sand	br
- 64.0m	Blue clay	br
- 67.7m	Blue sand & clay	br
- 70.7m	Yellow clay	br
- 74.1m	Brown shingle	li-1
- 75.6m	Yellow clay	li-2
- 81.1m	Blue clay	li-2
- 82.3m	Yellow clay & sand	li-2
- 84.5m	Brown shingle	li-2

Appendix C – Geotechnical Investigation Summary

Table 1 Summary of most relevant investigation data

ID		1	2	3	4
Type *		BH	BH	BH	BH
Ref		M35-1537	M35-1535	M35-1507	M35-1629
Depth (m)		102.1	84.7	154.8	84.5
Distance from site (m)		100	220	200	220
Ground water level (mBGL)		Artesian	Artesian	N/A	Artesian
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

Sensitive or organic clay/silt | Clay to silty clay | Clayey silt to silt | Silty sand to silt

Clayey sand | Sand | Gravelly sand or gravel

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