

**CHRISTCHURCH CITY COUNCIL**  
PRK\_0348\_BLDG\_011 EQ2  
The Groynes – Workshop & Garage  
182 Johns Road



QUALITATIVE ASSESSMENT REPORT  
FINAL

- Rev B
- 08 November 2012



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# 1. Executive Summary

## 1.1. Background

A Qualitative Assessment was carried out on building PRK\_0348\_BLDG\_011 EQ2 located at The Groynes on 182 Johns Road. This building is a small single storey timber framed that is used as storage and a workshop by The Groynes staff. An aerial photograph illustrating the building's location is shown below in Figure 1. Detailed descriptions outlining the building's age and construction type are given in Section 5 of this report.



### ■ Figure 1 Aerial Photograph of PRK\_0348\_BLDG\_011 EQ2 Located at The Groynes

The qualitative assessment broadly includes a summary of the buildings 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 our visual inspection carried out on the 3 May 2012.

## 1.2. Key Damage Observed

No damage was observed during our site inspection.

## 1.3. Critical Structural Weaknesses

No critical structural weaknesses were observed during our site inspection.



#### **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 greater than 100%NBS. No structural damage was observed during our site investigation due to this we the post earthquake capacity will also be greater than 100%NBS.

#### **1.5. Recommendations**

It is recommended that:

- a) No placard was displayed on the building however we recommend that the current placard status of the building be Green 1.
- b) We consider that barriers around the building are not necessary.



## 2. Introduction

Sinclair Knight Merz was engaged by the Christchurch City Council to prepare a qualitative assessment report for building PRK\_0348\_BLDG\_011 EQ2 located at The Groynes 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 7.2

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 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 have been carried out. No structural drawings were available for this building and as a result the descriptions outlined in Section 5 are based on our visual inspection carried out on the 3 May 2012.

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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**

Our evaluation was based on our site investigation conducted on the 3 May 2012.

Building PRK\_0348\_BLDG\_011 EQ2 is a small single storey building that is used as storage and workshop by The Groynes staff. The roof is constructed from timber rafters that support timber purlins and a light weight corrugated steel cladding. The roof is supported on round timber columns that are set into the ground. The footprint of this structure is approximately 30.0m x 5.6m and it is approximately 4.0m high. Due to a lack of structural drawings a design era of 1976-1992 has been assumed based on the architecture and the condition of the structure.

### **5.2. Gravity Load Resisting System**

As noted above the roof structure consists of timber rafters that support timber purlins and a light weight corrugated steel cladding. The roof is supported on round timber columns that are set into the ground.

### **5.3. Seismic Load Resisting System**

For the lateral analysis of this building the ‘across direction’ has been taken as east-west whereas the ‘along direction’ has been taken as north-south.

Lateral loads acting across and along the building will be resisted the round timber columns. These columns are set into the ground and will act as cantilevering piles.

### **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 D (deep or soft soil) from adjacent borehole logs.
- Liquefaction risk appears to be low to moderate
- In general the structures on site appear to be relatively light construction supported on shallow footings. There is relatively good agreement on the geology of the soil below a depth of 5m from the available ground investigation data.

The full geotechnical desktop study can be found in Appendix 4 – Geotechnical Desk Study.



## **6. Damage Summary**

SKM undertook inspections on the 3 May 2012. The following was observed during the time of inspection:

### **6.1. Damage Summary**

#### **General**

- 1) No visual evidence of settlement was noted at this site. Therefore a level survey is not required at this stage of assessment.
- 2) No earthquake damage was observed during our site inspection.

## 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: IEP Risk classifications. 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 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 3 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 and inspection findings of the building.
- No structural drawings were available for this building.

The design criteria used to undertake the assessment include:

- The building was built according to good practices at the time.
- Standard design criteria 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 structure represents a low degree of hazard to life and other property.
- Ductility level of 1.0, 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 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.
- The IEP does not involve a detailed analysis or an element by element code compliance check.

## **7.3. Survey**

There was no visible settlement of the structure, nor were there any significant ground movement issues around the building. The site has been assessed as 'Rural and Unmapped' under the CERA Residential Technical Categories Map. However the worst areas near this site are classed as TC2. Due to these factors we do not recommend that any survey be undertaken at this stage of the assessment.

## **7.4. Critical Structural Weaknesses**

No critical structural weaknesses for the building were observed during our visual inspection.



## 7.5. Qualitative Assessment Results

The building has had its seismic 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.

**Table 3: Qualitative Assessment Summary**

<u>Item</u>	<u>%NBS</u>
Buildings likely Seismic Capacity	>100

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



## **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.



## 9. Conclusion

A qualitative assessment was carried out on building, PRK\_0348\_BLDG\_011 EQ2, located at The Groynes on 182 Johns Road. No damage to the structure was observed during our inspection. The structure has been assessed to have a likely seismic capacity greater than 100% NBS and is therefore are both 'Low Risk Buildings' (capacity greater than 67% of NBS).

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) No placard was displayed on the building however we recommend that the current placard status of the building be Green 1.
- 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: East Elevation



Photo 2: Close Up of Photo 1



Photo 3: Internal View of Structure



Photo 4: Structure along The Eastern Face

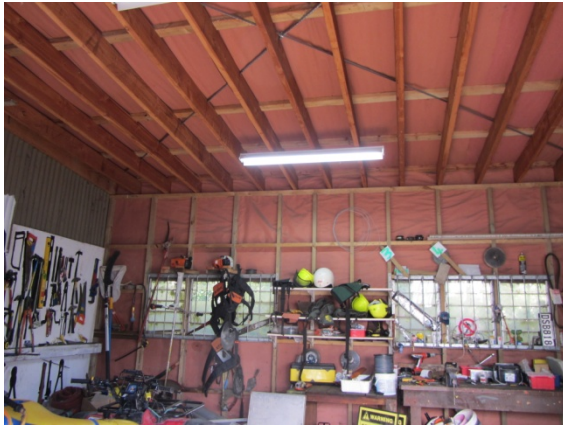


Photo 5: Internal View of Workshop



Christchurch City Council  
PRK\_0348\_BLDG\_011 EQ2  
The Groynes – Workshop & Garage  
182 Johns Road  
Qualitative Assessment Report  
08 November 2012



## **12. Appendix 2 – IEP Report**

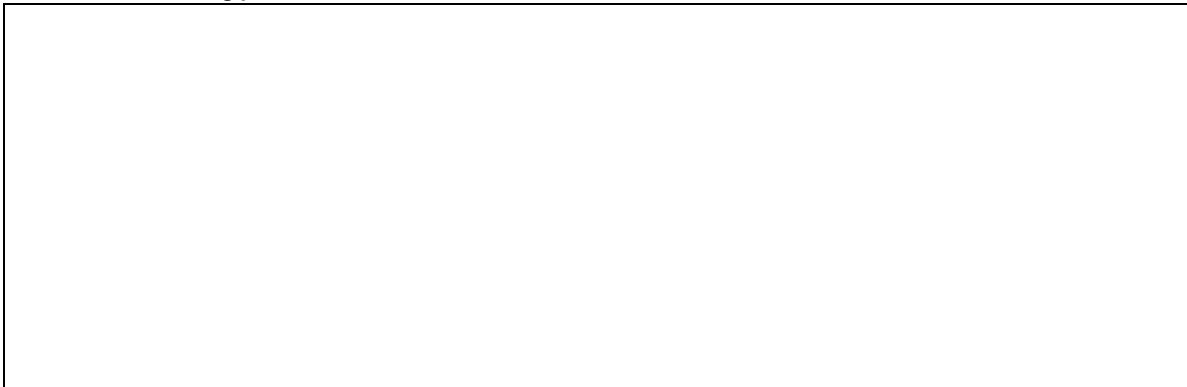
Building Name:	PRK_0348_BLDG_011 EQ2 Groynes- Workshop & Garage	Ref.	ZB01276.072
Location:	The Groynes - 182 Johns Road	By	KW
		Date	16/05/2012

**Step 1 - General Information**

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



**1.2 Sketch of building plan**



**1.3 List relevant features**

Building CCC-PRK-0348-011 is a small single storey building that is used as storage and workshop by The Groynes staff. The roof is constructed from timber rafters that support timber purlins and a light weight corrugated steel cladding. The roof is supported on round timber columns that are set into the ground. The footprint of this structure is approximately 30.0m x 5.6m and is approximately 4.0m high. Due to a lack of structural drawings a post 1992 construction date has been assumed based on the architecture and the condition of the structure. Lateral loads acting across and along the building will be resisted the round timber columns. These columns are set into the ground and will act as cantilevering piles.

**1.4 Note information sources**

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

Tick as appropriate

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

Date of Inspection - 3/05/2012

**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:	PRK_0348_BLDG_011 EQ2 Groynes- Workshop & Garage	Ref.	ZB01276.072
Location:	The Groynes - 182 Johns Road	By	KW
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	16/05/2012
( 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	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"/>	

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

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

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

**c) Estimate Period, T**

building Ht = **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 checked="" type="radio"/> Others	<input checked="" type="radio"/> Others
<input type="radio"/> CSW	<input type="radio"/> CSW
<input type="radio"/> MSW	<input 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
0.2	0.2

Seconds

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

Longitudinal	16.5	(%NBS ) <sub>nom</sub>
Transverse	16.5	(%NBS ) <sub>nom</sub>

<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	16.5	(%NBS ) <sub>nom</sub>
Transverse	16.5	(%NBS ) <sub>nom</sub>

Continued over page

Building Name:	PRK_0348_BLDG_011 EQ2 Groynes- Workshop & Garage	Ref.	ZB01276.072
Location:	The Groynes - 182 Johns Road	By	KW
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	16/05/2012
(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  
(from NZS1170.0:2004, Table 3.1 and 3.2)

1

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	$\mu$ Maximum = 6
Transverse	1	$\mu$ Maximum = 6

b) Ductility Scaling Factor

For pre 1976 =  $k_u$   
For 1976 onwards = 1  
(where  $k_u$  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;">Timber</span>
Transverse	<span style="border: 1px solid black; padding: 2px;">Timber</span>

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

Longitudinal	$S_p$	1.00
Transverse	$S_p$	1.00

b) Structural Performance Scaling Factor

Longitudinal	1/ $S_p$	Factor E	1.00
Transverse	1/ $S_p$	Factor E	1.00

**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	110.0	(%NBS) <sub>b</sub>
Transverse	110.0	(%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: <u>PRK_0348_BLDG_011 EQ2 Groynes- Workshop &amp; Garage</u>	Ref. <u>ZB01276.072</u>
Location: <u>The Groynes - 182 Johns Road</u>	By <u>KW</u>
Direction Considered: <b>a) Longitudinal</b>	Date <u>16/05/2012</u>
(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**

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.

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

b) Factor D2: - Height Difference Effect  
Select appropriate value from Table

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

Record rationale for choice of Factor F:

A F factor > 1 could be justified however since the %NBS is already > 100 it has been left as 1

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

PAR

Building Name:	PRK_0348_BLDG_011 EQ2 Groynes- Workshop & Garage	Ref.	ZB01276.072
Location:	The Groynes - 182 Johns Road	By	KW
Direction Considered:	<b>b) Transverse</b>	Date	16/05/2012
( 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**

**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		
	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

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:

A F factor > 1 could be justified however since the %NBS is already > 100 it has been left as 1

**3.7 Performance Achievement Ratio (PAR)**

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

PAR



Building Name:	PRK_0348_BLDG_011 EQ2 Groynes- Workshop & Garage	Ref.	ZB01276.072
Location:	The Groynes - 182 Johns Road	By	KW
Direction Considered:	<b>Longitudinal &amp; Transverse</b>	Date	16/05/2012
<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>110</b>	<b>110</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>110</b>	<b>110</b>
<b>4.4 Percentage New Building Standard (%NBS)</b> ( Use lower of two values from Step 4.3)		<b>110</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: PRK 0348 BLDG 011 EQ2	Unit No: Street	Reviewer: Nick Calvert
Building Address: Workshop & Garage - The Groynes		182 Johns Road		CPEng No: 242062
Legal Description:				Company: SKM
				Company project number: ZB01276.072
				Company phone number: 03 940 4900
GPS south: _____		Degrees	Min	Sec
GPS east: _____				
Building Unique Identifier (CCC): _____		Date of submission: _____		
		Inspection Date: 3/05/2012		
		Revision: A		
		Is there a full report with this summary? <input checked="" type="checkbox"/> yes		

<b>Site</b>	Site slope: flat	Max retaining height (m): _____
	Soil type: mixed	The regional geological map shows the site as underlain by river alluvium, comprising gravel, sand and silt, beneath plains or low level terraces.
	Site Class (to NZS1170.5): D	Soil Profile (if available): _____
	Proximity to waterway (m, if < 100m): _____	If Ground improvement on site, describe: _____
	Proximity to cliff top (m, if < 100m): _____	Approx site elevation (m): _____
	Proximity to cliff base (m, if < 100m): _____	

<b>Building</b>	No. of storeys above ground: 1	single storey = 1	Ground floor elevation (Absolute) (m): 0.00
	Ground floor split? no		Ground floor elevation above ground (m): 0.00
	Storeys below ground: 0		
	Foundation type: other (describe)		timber pole foundations - will act as cantilevers
	Building height (m): 4.00	height from ground to level of uppermost seismic mass (for IEP only) (m): 4	
	Floor footprint area (approx): 170		Date of design: 1992-2004
	Age of Building (years): 20		
	Strengthening present? no		If so, when (year)? _____
	Use (ground floor): other (specify)		And what load level (%g)? _____
	Use (upper floors): _____		Brief strengthening description: _____
	Use notes (if required): storage for various equipment		
	Importance level (to NZS1170.5): IL1		

<b>Gravity Structure</b>	Gravity System: frame system	
	Roof: timber framed	corrugated steel cladding on 200x50 timber purlins on dble 200x50 timber rafters.
	Floors: concrete flat slab	rafter type, purlin type and cladding slab thickness (mm): 125mm (assumed)
	Beams: timber	refer to roof details above
	Columns: timber	typical dimensions (mm x mm): 300 round
	Walls: Timber framed walls	

<b>Lateral load resisting structure</b>	Lateral system along: other (note)	Note: Define along and across in detailed report!	describe system: timber frame system
	Ductility assumed, μ: 1.00	0.00	estimate or calculation? estimated
	Period along: 0.20		estimate or calculation? estimated
	Total deflection (ULS) (mm): 5		estimate or calculation? _____
	maximum interstorey deflection (ULS) (mm): _____		
	Lateral system across: other (note)	0.00	describe system: timber frame system
	Ductility assumed, μ: 1.00		estimate or calculation? estimated
	Period across: 0.20		estimate or calculation? estimated
	Total deflection (ULS) (mm): 20		estimate or calculation? _____
	maximum interstorey deflection (ULS) (mm): _____		

<b>Separations:</b>	north (mm): _____	leave blank if not relevant
	east (mm): _____	
	south (mm): _____	
	west (mm): _____	

<b>Non-structural elements</b>	Stairs: _____	describe: n/a
	Wall cladding: other light	describe: corrugated steel
	Roof Cladding: Metal	describe: corrugated steel
	Glazing: _____	describe: n/a
	Ceilings: none	
	Services(list): n/a	

<b>Available documentation</b>	Architectural: none	original designer name/date: _____
	Structural: none	original designer name/date: _____
	Mechanical: none	original designer name/date: _____
	Electrical: none	original designer name/date: _____
	Geotech report: none	original designer name/date: _____

<b>Damage</b>	Site performance: 1	Describe damage: no damage observed during site inspection
Site: (refer DEE Table 4-2)	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): _____

<b>Building:</b>	Current Placard Status: green	
Along	Damage ratio: 0%	Describe how damage ratio arrived at: no structural damage noted during site inspection
Describe (summary):		
Across	Damage ratio: 0%	$Damage\_Ratio = \frac{(\%NBS\ (before) - \%NBS\ (after))}{\%NBS\ (before)}$
Describe (summary):		
Diaphragms	Damage?: no	Describe: _____
CSWs:	Damage?: no	Describe: _____
Pounding:	Damage?: no	Describe: _____
Non-structural:	Damage?: yes	Describe: hairline cracking to external cladding

<b>Recommendations</b>	Level of repair/strengthening required: minor non-structural	Describe: Refer to SKM Qualitative Report - Section 6
	Building Consent required: no	Describe: _____
	Interim occupancy recommendations: full occupancy	Describe: _____
Along	Assessed %NBS before: _____	%NBS from IEP below
	Assessed %NBS after: 100%	If IEP not used, please detail assessment methodology: NZSEE IEP used, refer to SKM Qualitative Report
Across	Assessed %NBS before: _____	%NBS from IEP below
	Assessed %NBS after: 100%	



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



## Christchurch City Council - Structural Engineering Service

### Geotechnical Desk Study

SKM project number	ZB01276
SKM project site number	063-080 inclusive
Address	Groynes, 182 Johns Road
Report date	20 April 2012
Author	Ross Roberts / Ananth Balachandra
Reviewer	Leah Bateman
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
- Council files
- 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>)**

These structures are located on 182 Johns Road.

## 5. Review of available information

### 5.1 Geological maps



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

The local geological map of the Christchurch area does not extend to the location of the site.

The regional geological map shows the site as underlain by river alluvium, comprising gravel, sand and silt, beneath plains or low level terraces.

### 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. However, the reconnaissance did not extend to the location of the site.



### 5.3 Aerial photography



- Figure 3 – Aerial photography from 24 Feb 2011 (<http://viewers.geospatial.govt.nz/>)



- **Figure 4 Aerial photograph showing liquefied material ejected near road way (<http://viewers.geospatial.govt.nz/>)**

The aerial photographs appears to show some evidence of liquefaction occurring on site due to the 22 February earthquake, with localised sand boils and liquefied material ejected near the road way visible in figure 4.

#### **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 (Rural & Unmapped) – the residential area south of the site is classified as TC2

#### **5.5 Historical land use**

Reference to historical documents (eg Appendix A) shows that parts of the site were classified as swamp or marshland. The area classified appears to be larger than lakes currently present on site. This could indicate that adjacent land on site could be underlain by soft or liquefiable deposits. With a number of creeks running through the site, it is possibly that much of the area would be underlain by soft river deposits.



## 5.6 Existing ground investigation data



- **Figure 5 – 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

Council documents and drawings relating to applied building permits, project memorandums, building consents and resource consent were available for this site. However, records including drawings and documents for only some of the structures were available.

In general the proposed drawings for the toilets blocks indicate a 100mm thick concrete floor slab on a layer of compacted hardfill and reinforced concrete footings around the perimeter was used as the foundation solution. Footings varying between 170mm to 300mm wide and 500mm to 740mm deep, depending on the ground profile near the structure, were indicated in the council drawings. A minimum embedment depth of 300mm increasing up to 450mm was noted with two D12 rods indicated as the reinforcement proposed for the footings.

Likewise, the drawings for the yacht building and toilets show a 100mm thick on grade concrete slab and 300mm deep reinforced concrete footings below the internal walls of the structure. The width of the footing is shown to vary between 170mm to 300mm.

The drawing for the proposed kiosk structure shows the structure was to be supported by 150mm diameter timber posts around the perimeter of the building. Approximately 300mm of the pile is shown to be above ground level. However, the embedment depth of the pile is not clear from available drawings. 100mm by 50mm bearers are used to distribute the loading from the structure to the identified timber posts.

The proposed drawings for the carport storage sheds show 200mm by 200mm concrete “piles” to be the foundation solution for the structure. However, no further information was available from the drawing or





relevant council documents. There is some uncertainty on which building in the site inspection this record refers to. No map showing the location of the building on site was found.

The proposed drawing for the garage/ workshop indicates that a 100mm thick concrete slab on grade was proposed as the floor for the structure. A reinforced concrete footing that is 200mm wide was proposed beneath the walls of the structure. A minimum embedment depth of 300mm and height of 200mm above ground level is specified in the drawings for the footing. The recorded foundation information does not appear to match the garage/ workshop building inspected. No detailed map showing the location of the building was found in the available council records. It is expected that the exact location of the building would need to be verified to use this information.

The Ranger's office (dwelling 1) structure, labelled as the "relocated office" in the council records is indicated to be supported on 150mm diameter piles spaced at 1.4m centres over the footprint of the structure. The piles are indicated to be 525mm long with a minimum of 225mm of its length being embedded. Concrete corner foundations are also indicated for the office building. No other details about the foundation solution for the building were found during the review of available council records.

Drawing showing the extension to the dwelling 1 structure labelled as extension to the "information centre" indicates that short timber piles approximately 150mm in diameter below the bearer timber beam, embedded in 300mm by 350mm concrete footings was used as the foundation solution. The piles are shown to be approximately 900mm long. A minimum cover of 150mm above the concrete block to ground level and 300mm from ground level to the bearer beams is identified. The 125mm by 75mm bearers are shown to be tied into the foundations of the existing information centre structure.

In addition, some of the council documents indicate the presence of a septic tank near the toilet block structure. It is not clear where the respective toilet block is located. It is possible that additional septic tanks are present near toilet blocks spread throughout the foot print of the site.

No other ground investigation data or record of any excavation was found during the review of available council records.

## **5.8 Site walkover**

A site walkover was conducted by a SKM engineer in the week commencing 9 April 2012. A site plan showing the located of the inspected building is provided in Appendix D.

### **PRK\_0348\_BLDG\_007 EQ2**

The small timber frame building was noted to be constructed using fibre board clad, slab on grade foundation and sheet metal roof. Minor damage was noted with the roof iron lifting but this damage possibly could have occurred before the earthquake. The structure itself is located on level ground with no land damage noted during the external site inspection.

### **PRK\_0348\_BLDG\_005 EQ2**

The building was noted as being rangers' office. The structure was a timber frame building on timber pole piles, sheet metal clad and sheet metal roof. The building was noted to be on level land but driveway to the north slopes up towards the road. No apparent building or land damage was noted during the external site inspection.



#### **PRK\_0348\_BLDG\_012 EQ2**

The structure was observed to comprise a concrete base and concrete perimeter footing. The building was timber frame construction with sheet metal clad and roof. The structure appears to be in a state of disrepair; however this is not as a consequence of the recent earthquake. The structure was located on a water way but no evidence of liquefaction, lateral spreading or other form of land damage was observed during the external site inspection.

#### **PRK\_0348\_BLDG\_008 EQ2**

The structure was a masonry block building with sheet metal roof and slab on grade foundation. The building is located on flat ground close to a waterway to the east. No evidence of any land or building damage was observed during the external site inspection.

#### **PRK\_0348\_BLDG\_011 EQ2**

The building was observed to be a farm shed type construction comprising timber pole with timber frame and sheet metal clad roof. No access was available to the site on the day of the inspection. However, the site is adjacent to a waterway to the west and there was no evidence of any land damage in the surrounding vicinity.

#### **PRK\_0348\_BLDG\_006 EQ2**

The dwelling was located within an enclosed area. Therefore it was difficult to ascertain the construction type for the structure. However, the structure was likely to be weatherboard clad with sheet metal roof. A confirmation of the type foundation was not able to be made. The building was located adjacent to a waterway to the east. However, no evidence of land damage was visible during the external site inspection.

#### **PRK\_0348\_BLDG\_010 EQ2**

The building was a masonry block construction with sheet metal roof and slab on grade. It was located on relatively flat ground with no building or land damage noted during the site inspection.

#### **PRK\_0348\_BLDG\_004 EQ2**

The building was a masonry block construction with timber A frame, sheet metal roof and slab on grade foundations. The structure is located close to water ways. The ground was observed to be undulating in the area. However, no evidence of any liquefaction was noted near the site. Therefore it is possible that the undulations may not have been caused by the earthquake. No damage to the building was noted during the external site inspection.

#### **PRK\_0348\_BLDG\_014 EQ2**

The building was noted to be a timber frame construction with sheet metal clad / sheet metal roof. The foundation appears to be either a timber floor or no foundation/floor present for the building. During the external site inspection, there does not appear to be any building damage. The site is adjacent to a lake, with a wooden jetty that runs adjacent and perpendicular to the building. No significant damage to the perpendicular jetty was apparent. The jetty which is adjacent to the building however slopes toward the lake to the west of the building. It is not clear if this was a consequence of the earthquake. There was no clear evidence that any lateral spread or liquefaction occurred on site during the site walkover. However, some undulations of the ground were observed in the area.



**PRK\_0348\_BLDG\_017 EQ2**

The structure was a masonry block building with sheet metal roof and slab on grade foundation. The slab has approximately 400 mm thickness exposed above ground level. The building is located on flat ground, with no evidence of any land or building damage observed during the external site walkover.

**PRK\_0348\_BLDG\_002 EQ2**

The building is a masonry block construction with sheet metal roof and slab on grade foundation. The structure is located on level ground. There does not appear to be any significant building damage from the external site inspection, however, cracking of the paving slabs to the west of the building was observed. The cracking was noted to be around the downpipe and across the pavement and looks to be relatively fresh (cracks range from 5-20mm). Settlement of the paving slab of up to 30mm was also noted.

**PRK\_0348\_BLDG\_009 EQ2**

The structure was a timber pole information kiosk. No significant land damage was observed during the site walkover.

**PRK\_0348\_BLDG\_013 EQ2**

The building was a timber frame construction with sheet metal walls and roof though the front of the building was mainly made up of 2 roller doors. Foundations appear to be railway sleepers. There was no building or land damage noted during the external site inspection.

**PRK\_0348\_BLDG\_016 EQ2**

The structure was a small timber frame shed with plywood clad, with no apparent foundations other than a timber floor or possibly timber slats and sheet metal roof. No building or land damage was noted.

**PRK\_0348\_BLDG\_003 EQ2**

The building was a masonry block construction with sheet metal roof and slab on grade foundation. The building was located on level ground but ground behind to the west slopes up an embankment (approximately 1.2m high). No land or building damage was noted during the external site walkover.

**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 - 4	Fill / peat and soft clay
4 - 15	Soft clay
15+	Sandy gravels from the riccarton formation

The water table was inferred to be approximately 2m below ground level from nearby boreholes.



## 6.2 Seismic site subsoil class

The site has been assessed as 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 preferred method has been used to make the assessment. As boreholes including measurement of geotechnical properties was not available for this desk study, site specific study in the future could result in a revision to the site subsoil class.

## 6.3 Building Performance

In general the existing foundations for the structures are adequate for their current purpose.

## 6.4 Ground performance and properties

Liquefaction risk appears to be low to moderate. Some evidence of liquefaction occurring on site was observed from the aerial photographs. However, no significant land damage or evidence of liquefaction was noted during the site walkover of the structures located on site. It should be noted, however, that the site walkover was conducted more than a year after the 22<sup>nd</sup> February earthquake and so it is possible that some liquefaction did occur but the evidence is no longer apparent. The clay layer inferred to lie between 4m to 15m is unlikely to be susceptible to liquefaction. Likewise, the lenses of sand that may be present in the sandy gravel layer below 15m may be susceptible to liquefaction but it is unlikely that any surface effects of this liquefaction would be observed. Therefore, any observed liquefied ejecta could be due to shallow silt or loose sand content.

As no geotechnical parameters were measured in the available ground investigation data, an estimation of the shallow ground properties has not been made in this desk study. Additional investigations are required, in order to assess the likely shallow ground properties.

## 6.5 Further investigations

In general the structures on site appear to be relatively light constructions supported on shallow footings. There is relatively good agreement on the geology of the soil below a depth of 5m from the available ground investigation data. However, as no geotechnical parameters are available, in order to perform a quantitative DEE, additional investigations are required. Additional investigations recommended are:

- Two CPTs near larger buildings such as the ranger's office and dwelling 2 are recommended. For small structures such as the kiosk and office building, two hand augers to infer the composition of shallow soils would be adequate.

If investigation is required for more than one asset it is advised to carry these out at the same time as scope may be able to be reduced by carrying out a site wide investigation.



## 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.

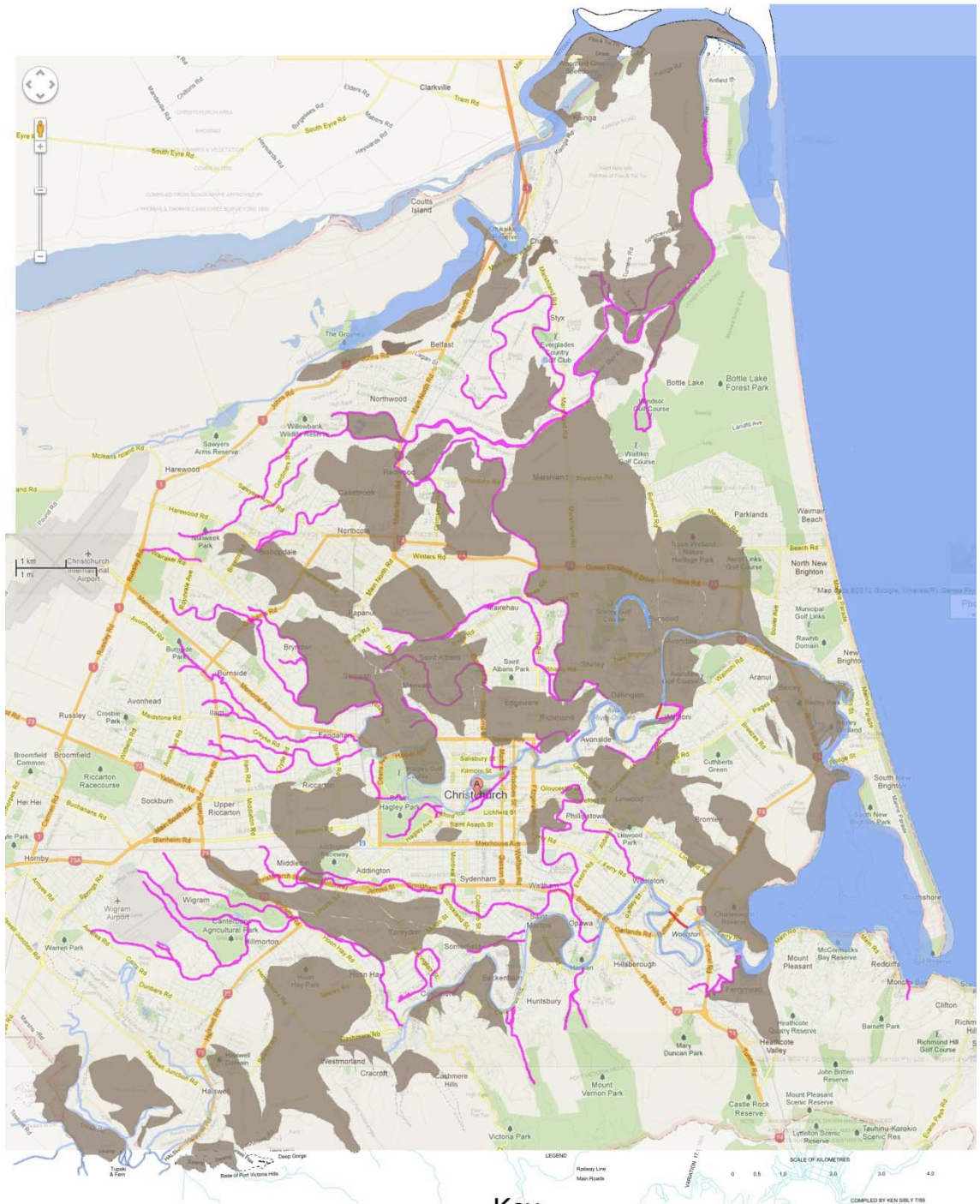
Forsyth PJ, Barrell DJA, Jongens R, 2008. Geology of the Christchurch area. Institute of Geological & Nuclear Sciences geological map 16.

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

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



## Appendix A – Christchurch 1856 land use



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

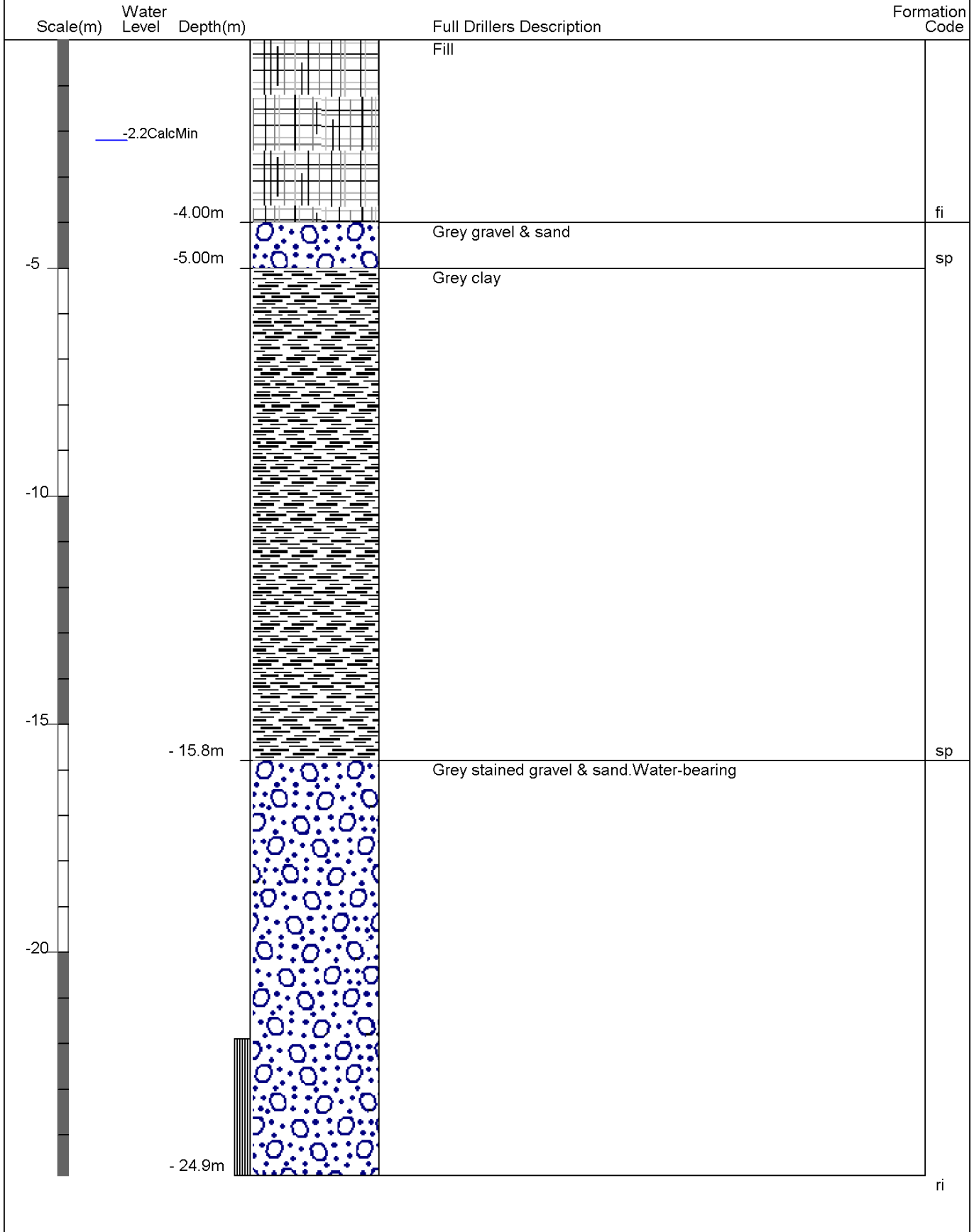
- Key**
- Previous creeks/riders
  - Existing creeks/riders
  - New creeks/riders
  - Swamp/Marshland



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

# Borelog for well M35/5250

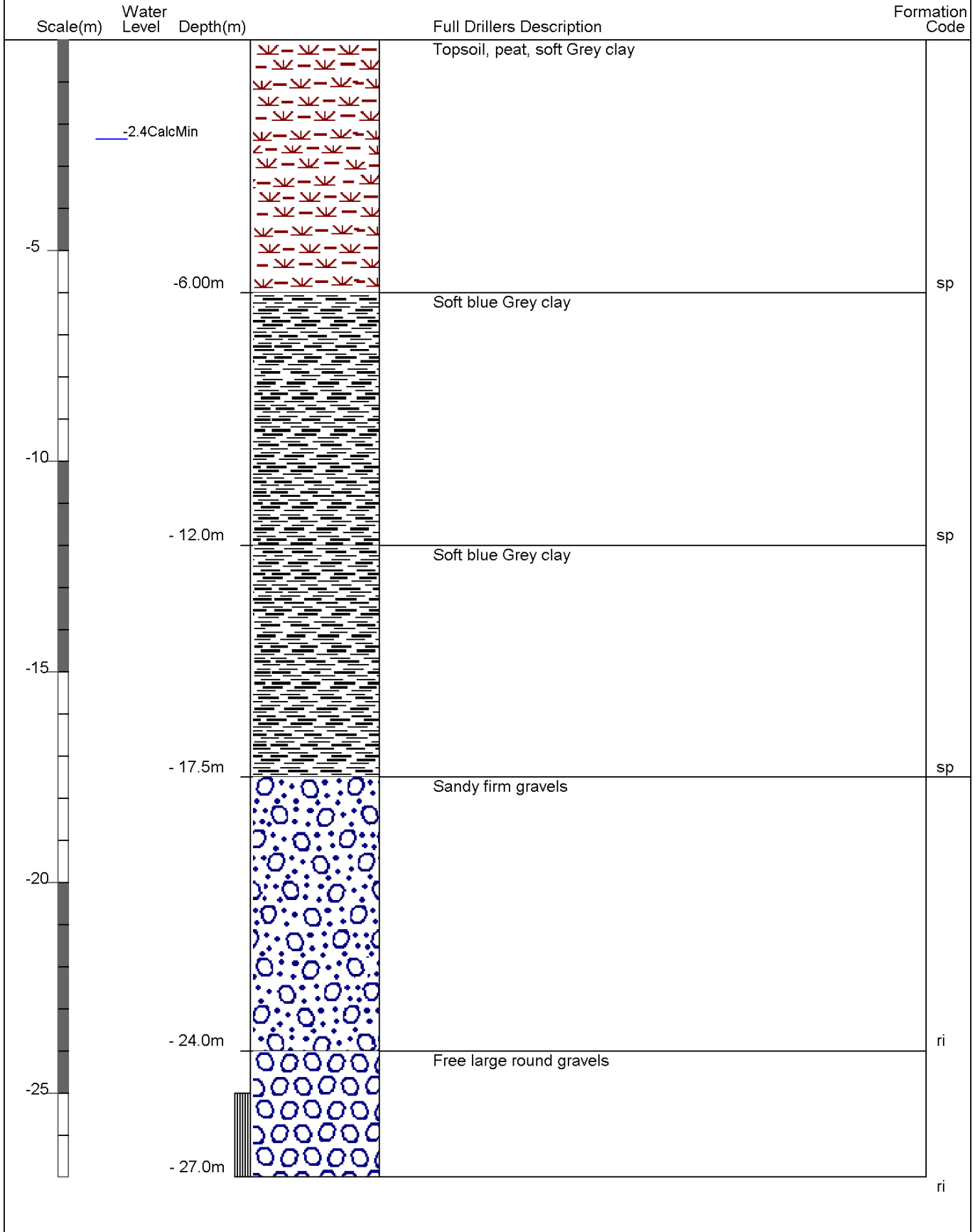
Gridref: M35:7810-5045 Accuracy : 4 (1=best, 4=worst)  
 Ground Level Altitude : 11.2 +MSD  
 Driller : A M Bisley & Co  
 Drill Method : Cable Tool  
 Drill Depth : -24.9m Drill Date : 25/06/1985





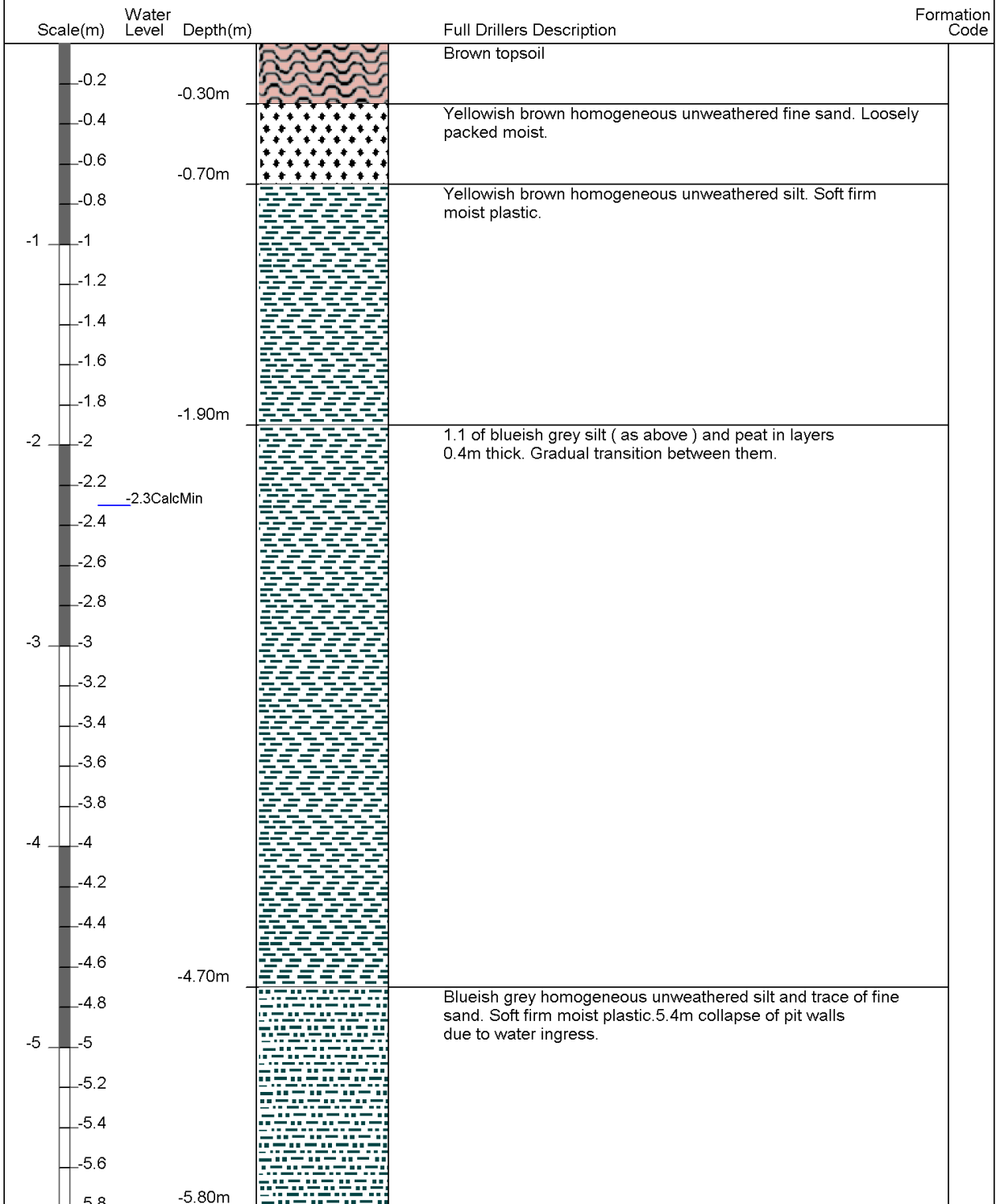
# Borelog for well M35/7885

Gridref: M35:7844-5053 Accuracy : 4 (1=best, 4=worst)  
 Ground Level Altitude : 13 +MSD  
 Driller : East Coast Drilling  
 Drill Method : Rotary Rig  
 Drill Depth : -27m Drill Date : 6/01/1998



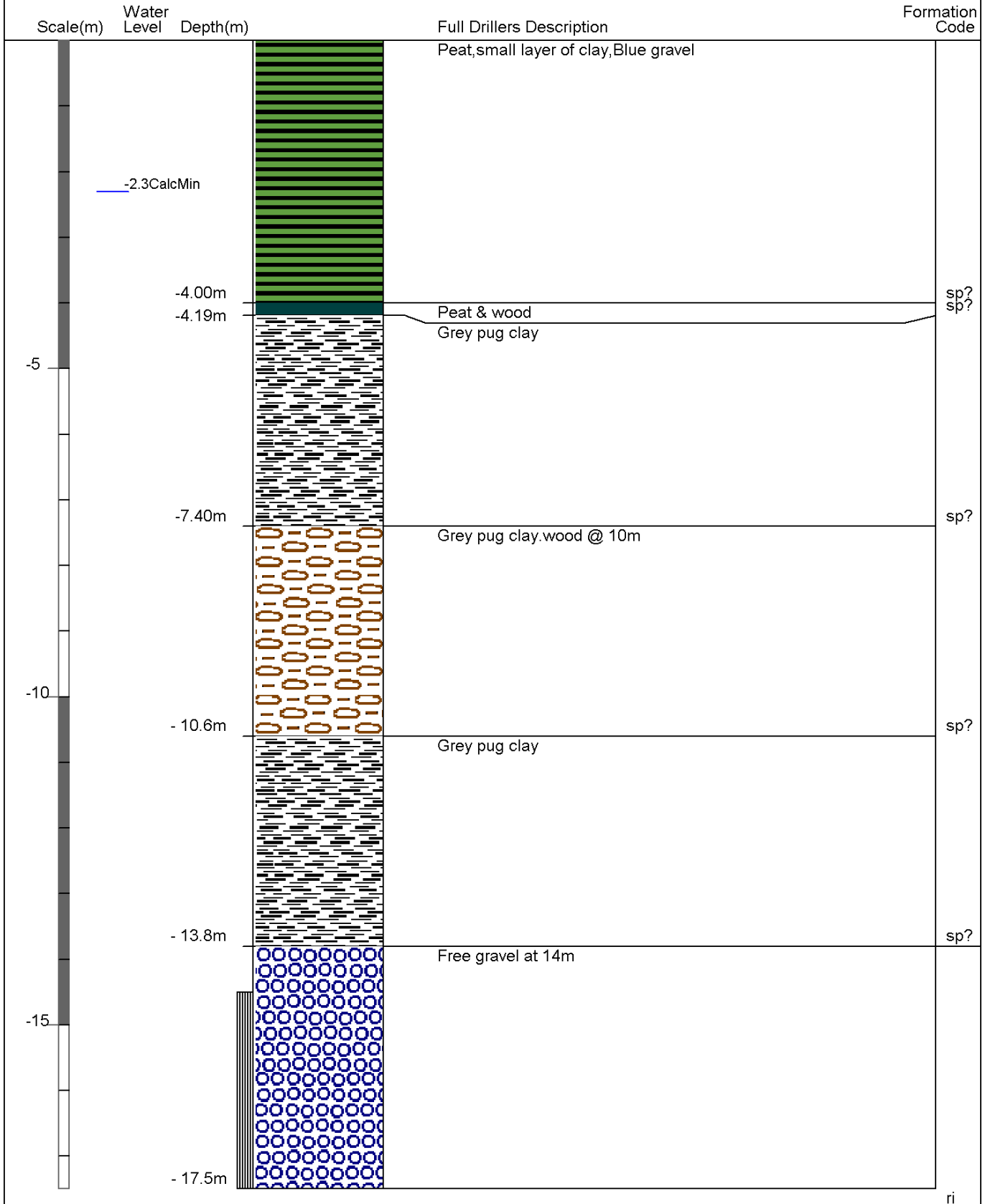
# Borelog for well M35/10305

Gridref: M35:78627-50764 Accuracy : 2 (1=high, 5=low)  
 Ground Level Altitude : 12.74 +MSD  
 Driller : Texco Drilling Ltd  
 Drill Method : Unknown  
 Drill Depth : -5.8m Drill Date : 6/07/2004



# Borelog for well M35/3475

Gridref: M35:785-505 Accuracy : 4 (1=best, 4=worst)  
 Ground Level Altitude : 13.1 +MSD  
 Driller : Smith, J R & I G  
 Drill Method : Cable Tool  
 Drill Depth : -17.5m Drill Date : 29/11/1983





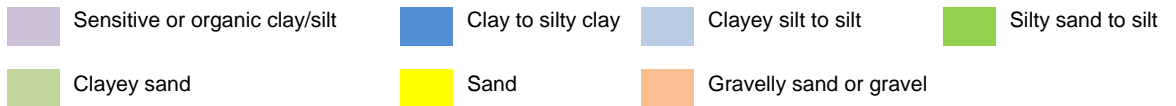
## **Appendix C – Geotechnical Investigation Summary**



■ **Table 1 Summary of most relevant investigation data**

ID	1	2	3	4
Type *	BH	BH	BH	BH
Ref	M35-5250	M35-7885	M35-10305	M35-3475
Depth (m)	24.9	27	5.8	17.5
Distance from site (m)	30	150	200	160
Ground water level (mBGL)	2.2	2.4	2.3	2.3
Simplified recorded geological profile (depth below ground level to top of stratum, m)	0	Fill		
	1	Fill		
	2	Fill		
	3	Fill		
	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



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

*Note the shortest distance from the site boundary to the investigation location is provided in the table due to the very large footprint of the site*



## **Appendix D – Site Plan outlining the location of the building as named in the external site walkover**



Could not find – Toilets Kimihia? Or Toilets – CLOSED (behind toilet block?)