Vehicle Garage Building – Christchurch Wastewater Treatment Plant
Detailed Engineering Evaluation
BU 0879-019 EQ2
Quantitative Report

Prepared for Christchurch City Council (Client)

By Beca Carter Hollings & Ferner Ltd (Beca)

4 October 2013

Revision History

Revision Nº	Prepared By	Description	Date
A	Andreas Trapezaris	Draft for CCC review	5 April 2013
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Document Acceptance

Action	Name	Signed	Date
Prepared by	Andreas Trapezaris		4 October 2013
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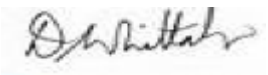
Approved by	David Whittaker		4 October 2013
on behalf of	Beca Carter Hollings & Ferner Ltd		

Vehicle Garage Building – Christchurch Wastewater Treatment Plant BU 0879-019 EQ2

Detailed Engineering Evaluation Quantitative Report – SUMMARY
Version 1

Address
Shuttle Drive
Bromley
Christchurch

Background

This is a summary of the Quantitative Assessment report for the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) Revision 7 issued by the Engineering Advisory Group (EAG) in 2012.

The Vehicle Garage Building is located at the Christchurch Wastewater Treatment Plant (CWTP), Shuttle Drive, Bromley and is being assessed and reported in two parts. Part 1 comprises two building areas and Part 2 only one building area.

Separate Qualitative Reports for Part 1 and Part 2 of the Vehicle Garage Building were issued to CCC on 06 June 2012.

The two building areas of Part 1 are referred to as Area 1 (including Extension) and Area 2. Area 1 consists of structural steel frames and timber framed walls with internal linings, and brick veneer. Each structure was treated as structurally independent as they were built at different stages. Area 2 comprises timber framed walls with brick veneer. The floor of both areas is slab on grade and the buildings have sliding steel doors. The approximate total internal floor areas for Area 1 and 2 are 380m^2 and 105m^2 respectively.

The Part 2 area was also treated independently and consists of a timber framed building, with internal linings, brick veneer and slab on grade. This building is located between the Area 1 and Area 2 buildings of Part 1, having an approximate total internal floor area of 80m^2.

Partial sets of architectural and structural drawings were available for the Vehicle Garage Building which indicates the building Parts were constructed in different stages prior to 1968. Calculations for Part 1 and Part 2 have been undertaken as part of the Quantitative Assessment.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

Key Damage Observed

Visual inspections on 1, 14 and 24 February 2012 indicate the Vehicle Garage Building has suffered minor damage. The key damage observed includes:

- Cracking to brick veneer including partial collapse of the rear wall of Part 1, Area 2 which has been removed and replaced with plywood.
- Differential settlement at the northwest corner of Part 1, Area 2.
- Cracking to adjacent retaining wall located to the north-east of the building.
- Splitting and cracking of timber framed walls at the north-east area of the Part 1, Area 1 Extension.
- Construction joint separation of approximately 25mm in Part 2.
- Minor cracking of Part 2 Gib-board lining.
- Separation between the Part 2 office area and Part 1, Area 1.

Critical Structural Weaknesses (CSW)

The following Critical Structural Weakness has been identified:

- Site Characteristics due to widespread liquefaction and tension cracks in the surrounding ground.

Indicative Building Strength (from Detailed Assessment)

The Vehicle Garage Building has been assessed to have a seismic capacity of 43%NBS, governed by Part 1, Area 1, using the New Zealand Society for Earthquake Engineering (NZSEE) Detailed Assessment guideline 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' (AISPBE), 2006, and is therefore classified as Earthquake Risk and Seismic Grade C.

The structural damage observed is predominantly minor and the seismic capacity is not considered to have materially diminished from its pre-earthquake level. However there are localised areas of damage such as a split stud framing in Part 1, Area 1 that should have temporary repairs to secure moderately damaged elements.

Our assessment has identified the structural components that have governed/limited the building's seismic performance, and their potential failure mechanisms, are as follows:

- Part 1, Area 1 transverse timber framed walls have a seismic capacity of 43%NBS, governed by the plasterboard bracing under in-plane loading.
- Part 1, Area 1 Extension longitudinal timber framed walls have a seismic capacity of 64%NBS, governed by the nailed connections of the timber bracing under in-plane loading.

Recommendations

In order that the owner can make an informed decision about the on-going use and occupancy of their building the following information is presented in line with the Department of Building and Housing document 'Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch', June 2012.

Part 1, Area 1 and Part 1, Area 1 Extension of the Vehicle Garage Building are considered to be Earthquake Risk, having assessed capacities between 33%NBS and 67%NBS and are classified as Seismic Grade C. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

Part 1, Area 2 and Part 2 of the Vehicle Garage Building are considered not to be Earthquake Risk, having assessed capacities greater than 67%NBS, and are classified as Seismic Grade B. The risk of collapse of a Grade B building is 2 to 5 times greater than that of an equivalent new building.

No significant damage was identified to the seismic or gravity load resisting system of the Vehicle Garage that would reduce its ability to resist further loads and therefore no general restrictions on use or occupancy are recommended. However the damaged brick veneer is considered a collapse hazard and requires attention as recommended below.

It is recommended that:

- A verticality and level survey could be carried out to determine the extent of settlement of the building for insurance purposes.
- The structural integrity of the adjacent retaining wall is investigated further (not considered part of this building or DEE).
- Partially collapsed brick veneer has been removed and temporarily lined/replaced with plywood. We recommend other damaged areas of brick veneer are removed or have barriers around, as advised in our Qualitative Report and by email on 26 October 2012.
- Split timber wall studs in Part 1, Area 1 should have local repairs (temporary or permanent) to stabilise them.
- According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

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Appendices

1 Background

Beca Carter Hollings & Ferner Ltd (Beca) has been engaged by the Christchurch City Council (CCC) to undertake a Quantitative Detailed Engineering Evaluation (DEE) of the Vehicle Garage building located at the Christchurch Wastewater Treatment Plant (CWTP) at Shuttle Drive, Bromley Christchurch.

This report is a Quantitative Assessment of the building structure, and is based on the document 'Guidance on Detailed Engineering Evaluation of Earthquake Affected Non-residential Buildings in Canterbury – Part 2 Evaluation Procedure' (draft) Revision 7 issued by the Engineering Advisory Group (EAG) on 2012..

A quantitative assessment involves analytical calculations of the building's strength and may involve material testing, geotechnical testing and intrusive investigation. The qualitative assessment previously carried out involved inspections of the building, a desktop review of existing structural and geotechnical information, including existing drawings and calculations, if available and an assessment of the level of seismic capacity against current code using the Initial Evaluation Procedure (IEP).

The purpose of these assessments 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).

Partial architectural and structural drawings were made available, and these have been considered in our assessment of the building. The building description below is based on a review of the drawings and our visual inspections.

The format and content of this report follows a template provided by CCC, which is based on the EAG document.

2 Compliance

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

2.1 Canterbury Earthquake Recovery Authority (CERA)

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

Section 38 – Works

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

Section 51 – Requiring Structural Survey

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

We understand that CERA will require a detailed engineering evaluation to be carried out for all buildings (other than those exempt from the Earthquake Prone Building definition in the Building Act). It is understood that CERA is adopting the Detailed Engineering Evaluation Procedure document (draft) Revision 7 issued by the Engineering Advisory Group in 2012, which sets out a methodology for both qualitative and quantitative assessments. We understand this report will be used in response to CERA Section 51.

The qualitative assessment includes a thorough visual inspection of the building coupled with a desktop review of available documentation such as drawings, specifications and IEP's. The quantitative assessment involves analytical calculation of the building's 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 that was assigned during the state of emergency following the 22 February 2011 earthquake
- The age and structural type of the building
- Consideration of any Critical Structural Weaknesses
- The extent of any earthquake damage

2.2 Building Act

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

Section 112 – Alterations

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

Section 115 – Change of Use

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

Section 121 – Dangerous Buildings

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

- In the ordinary course of events (excluding the occurrence of an earthquake), the building is likely to cause injury or death or damage to other property; or
- In the event of fire, injury or death to any persons in the building or on other property is likely because of fire hazard or the occupancy of the building; or

- There is a risk that the building could collapse or otherwise cause injury or death as a result of earthquake shaking that is less than a 'moderate earthquake' (refer to Section 122 below); or
- There is a risk that that other property could collapse or otherwise cause injury or death; or
- A territorial authority has not been able to undertake an inspection to determine whether the building is dangerous.

Section 122 – Earthquake Prone Buildings

This section defines a building as earthquake prone if its ultimate capacity would be exceeded in a 'moderate earthquake' and it would be likely to collapse causing injury or death, or damage to other property. A moderate earthquake is defined by the building regulations as one that would generate ground shaking 33% of the shaking used to design an equivalent new building.

Section 124 – Powers of Territorial Authorities

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

Section 131 – Earthquake Prone Building Policy

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

2.3 Christchurch City Council Policy

Christchurch City Council adopted their Earthquake Prone, Dangerous and Insanitary Building Policy in 2006. This policy was amended immediately following the Darfield Earthquake of the 4th September 2010.

The 2010 amendment includes the following:

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

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

It is understood that any building with a capacity of less than 33%NBS (including consideration of Critical Structural Weaknesses) will need to be strengthened to a target of 67%NBS of new building standard as recommended by the Policy.

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

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

2.4 Building Code

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

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.

3 Earthquake Resistance Standards

For this assessment, the building's Ultimate Limit State 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).

No consideration has been given at this stage to checking the level of compliance against the increased Serviceability Limit State requirements.

The likely ultimate 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 building's 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 3.1 below.

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

Figure 3.1: NZSEE Risk Classifications Extracted from Table 2.2 of the NZSEE 2006 AISPBE Guidelines

Table 3.1 below compares the percentage NBS to the relative risk of the building failing in a seismic event with a 10% risk of exceedance in 50 years (i.e. on average 0.2% in any year). It is noted that the current seismic risk in Christchurch results in a 6% risk of exceedance in the next year.

Table 3.1: %NBS Compared to Relative Risk of Failure

Building Grade	Percentage of New Building Standard (*%NBS*)	Approx. Risk Relative to a New Building
A+	>100	<1
A	80-100	1-2 times
B	67-80	2-5 times
C	33-67	5-10 times
D	20-33	10-25 times
E	<20	>25 times

4 Building Description

4.1 General

The Vehicle Garage Building is located at the Christchurch Wastewater Treatment Plant (CWTP), Shuttle Drive, Bromley and was previously considered as two parts. Part 1 comprises two building areas and Part 2 comprises only one building area (refer Figure A1 in Appendix A). Each area has a different structural system. Summary information about the buildings is given in Table 4.1.

Table 4.1: Building Summary Information

Item	Details	Comment
Building name	Vehicle Garage Building at CWTP	
Street Address	Shuttle Drive Bromley Christchurch	
Age	Part 1: Area 1 and Area 2 were originally designed prior to 1968. Area 1 was extended in 1968. Part 2: Originally designed prior to 1968 with internal alterations undertaken in 1987.	The drawings available are for Area 1 Extension and Part 2 only. Part 1 (Area 1 Extension) drawings indicate Part 2 was constructed prior to 1968. Part 2 alteration drawing is dated 1987.
Description	Single storey.	Applies to both Parts.
Building Footprint / Floor Area	Part 1: Area 1 and Area 2 have total internal floor areas of 380m^2 and 105m^2 respectively. Part 2: Approximate internal floor area of 80m^2.	Excluding roof canopies. Part 2 is located at the corner between the two areas of Part 1 (and is structurally independent).
No. of storeys / basements	1 storey no basement	Applies to both Parts.
Occupancy / use	Part 1 is used for workshops and storage. Part 2 is used as offices.	Importance Level 2.

Item	Details	Comment
Construction	Part 1, Area 1: Mix of steel portal frames and timber framed wall construction with brick veneer. Part 1, Area 2: Timber framed wall construction with brick veneer. Part 2: Timber construction with brick veneer.	Based on visual inspection and limited drawings available.
Gravity load resisting system	Part 1, Area 1 (including Extension): Timber purlins supported by steel rafters, spanning between steel columns and timber framed walls. Part 1, Area 2: Timber framed roof supported by timber framed walls. Part 2: Timber framed walls supporting timber rafters, purlins and lightweight roof.	Based on visual observations and the limited structural drawings of extension to Part 1, Area 1 available.
Seismic load resisting system	Part 1, Area 1 (including Extension): Timber framed walls with diagonal bracing longitudinally and plasterboard lined timber framed walls transversely. Timber sarking and timber roof bracing was observed. Part 1, Area 2: Timber framed walls with diagonal bracing in both directions. Part 2: Plasterboard lined timber framed walls in both directions. The roof is assumed to be braced by the plasterboard lined ceiling.	Part 1, Area 2 lateral system is based on visual inspection.
Foundation system	Reinforced concrete slab on grade with strip footings.	Based on the limited drawings available.
Stair system	N.A.	
Other notable features	Part 1: Perimeter of building is clad by brick veneer where roller doors are not present. Part 2: The north-east and north-west walls are clad by brick veneer. The south-west and south-east walls are shared with Part 1 of the Vehicle Garage Building.	Brick ties were noted during the visual inspection.
External works	Asphalt pavement, car parking and reinforced concrete retaining wall to the north-east of the building (wall located approximately 2m from the north-east elevation of Part 1, Area 1).	Investigation may be necessary to confirm the stability of the retaining wall.

Item	Details	Comment
Construction information	Partial architectural and structural drawings (Griffiths Moffat and Partners, 1968) available for Part 1, Area 1 Extension and Part 2. No architectural or structural drawings are available for the Part 1, Area 1 and Area 2 buildings.	
Likely design standard	Part 1, Area 1 Extension – NZSS 1900, Chapter 8:1965 Part 1, Area 1 and Area 2, and Part 2 – NZSS No. 95: 1955	Inferred from age of building (drawings dated 1968) Inferred from likely age of buildings.
Heritage status	No heritage status	
Other	A digester is to the west of the building (Part 1 Area 2)	

4.2 Structural 'Hot-spots'

Areas in which damage may be expected to occur from earthquake shaking are outlined below:

- Differential settlement / movement between adjacent buildings (Vehicle Garage Part 1 and Vehicle Garage Part 2 buildings)
- Wall bracing
- Brick veneer
- Interface between Part 1, Area 1 and Part 1, Area 1 Extension.

5 Site Investigations

5.1 Previous Assessments

This building had a Level 2 rapid assessment undertaken after the February 2011 earthquakes (refer to Appendix D). Another rapid assessment was undertaken following the June 2011 earthquake events, however, we have been unable to obtain a copy of this report.

A series of damage assessments have previously been undertaken including the following by Beca:

- CWTP Earthquake Damage - Minor Structural Repairs report dated 20 October 2010 issued after the September 2010 earthquake.
- CWTP: Post-Earthquake Structural Damage Assessment report dated 1 April 2011 issued after the February 2011 earthquake.
- CWTP: Claim Report – Civil and Structural Repairs issued 30 November 2011.

Visual inspections as part of the Level 4 damage assessment were undertaken on 1, 14 and 24 February 2012. A Qualitative Report was issued to CCC on 1 June 2012.

5.2 Level 5 Intrusive Investigations and Site Measures

As only a partial set of drawings was available for the Vehicle Garage Building, information used in the Level 5 Quantitative Assessment was obtained through site measurements of the building. No intrusive investigations were carried out as part of the Level 5 Quantitative Assessment.

6 Damage Assessment

6.1 Damage Summary

The table below provides a summary of damage observed during our limited inspection. Refer to Appendix A for photographs.

Table 6.1: Damage Summary

Damage type	Unknown	Minor	Moderate	Major	Comment
settlement of foundations		✓			Cracks were observed in the reinforced concrete retaining wall located 2m from the north-east face of Part 1, Area 1. Crack widths of up to 2mm were measured. Possible damage to the Part 1, Area 2 foundation due to observed instability in digester sloped ground. Separation / differential settlement noted between Vehicle Garage Part 1 and Part 2.
tilt of building	✓				None observed during visual inspection. Verticality survey may be required to confirm.
liquefaction	✓				Widespread liquefaction in surrounding site and neighbourhood. None observed during our visual inspection.
settlement of external ground		✓			Cracks in north-east face of adjacent concrete retaining wall as noted above.
lateral spread / ground cracks	✓				A previous damage assessment report noted tension cracks in the sloped ground at Digester No. 4 west of Part 1, Area 2. None observed during our visual inspection.
frame			✓		Part 1: Cracking and splitting of timber studs where the brick veneer ties and timber brace members are connected.
concrete walls		✓			Cracking in adjacent retaining wall as noted above.
cracking to concrete floors			✓		Part 2: Construction joint seperation of approximately 25mm in Part 2 - between the concrete slab floor built in 1987 and the original structure. (refer to Appendix A for typical damage)
bracing		✓			Cracking and splitting to timber bracing.
precast flooring seating					Not Applicable
stairs					Not Applicable

Damage type	Unknown	Minor	Moderate	Major	Comment
cladding /envelope			✓		Separation between Vehicle Garage Part 1 and Part 2 buildings (refer to Appendix A for typical damage). Widespread cracking in the brick veneer. This is considered to be a potential hazard for people walking around the outside.
internal fit out		✓			Part 1: Vertical crack of the original Part 1, Area 1 external wall now acting as a brick veneer partition to Part 1, Area 1 Extension. Part 2: Minor cracking in GIB lined partitions (refer to Appendix A for typical damage).
building services	✓				No inspection of services.
other					

6.2 Surrounding Buildings

The sloping ground around the digester, located approximately 10m to the west of the building, has experienced tension cracking as reported in the CWTP: Post-Earthquake Structural Damage Assessment report dated 1 April 2011. This report recommends an investigation into the stability of the sloped ground.

The retaining wall located approximately 2m from the north-east wall of the building has widespread vertical cracking. Failure of this retaining wall may affect the building's foundations. A full damage and stability check of the retaining wall is recommended.

6.3 Residual Displacements and General Observations

Differential movement and settlement between areas of the building was observed during our visual inspection. A global settlement survey may be required to determine the extent of settlement and displacement of the building.

6.4 Implication of Damage

Based on our visual inspection, the structure appears to have suffered minor structural damage only and therefore we believe the structural capacity has not materially diminished.

The damaged brick veneer is a hazard and should be removed or barricaded off. Some temporary works, where brick veneer has been removed and replaced with plywood, were completed prior to the issue of this report.

7 Generic Issues

The following generic issues referred to in Appendix A of the EAG guideline document have been identified as applicable to the Vehicle Garage Building:

- Structural irregularity

- Inadequate foundations

The building is clad with brick veneer. As part of further inspecting and repairing the damage, the adequacy of veneer ties to the whole building should be assessed.

8 Geotechnical Consideration

We have obtained previous geotechnical reports for the Christchurch Wastewater Treatment Plant: the Christchurch Wastewater Treatment Plant Upgrade 1998 Geotechnical Report, and the Proposed Biosolids Drying Facility: Geotechnical Interpretive Report dated March 2008. Neither of these reports have boreholes in the vicinity of the Vehicle Garage Building, however, the ground conditions across the site appear to be fairly consistent, with sand and silty sand logged to a depth of 20m. These reports state that liquefaction was considered likely in a significant earthquake, with potential damage occurring as a result of liquefaction and the resulting settlements. This is consistent with the damage observed following the recent earthquakes.

Widespread vertical cracking in the retaining wall adjacent to the building is most likely due to settlement or liquefaction of the ground caused by recent Canterbury earthquake events. In addition, there are tension ground cracks in the sloping ground by the digester behind Part 1, Area 2 of the Vehicle Garage Building. Differential settlement and movement between adjacent buildings were observed during our visual inspections.

9 Survey

No level or verticality surveys were carried out. CCC may wish to undertake a level survey as part of insurance entitlement considerations.

10 Detailed Seismic Capacity Assessment

10.1 Assessment Methodology

The building has had its seismic capacity assessed using the Detailed Assessment Procedures in the NZSEE 2006 AISPBE guidelines, based on the limited drawings available and site measurements undertaken.

The structure has suffered minor structural damage. The post-damage capacity is considered to be the same as the original capacity.

10.2 Assumptions

The following assumptions were used in our quantitative assessment:

- Concrete compressive strength, f_c = 20 MPa
- Timber compressive parallel strength, f_c = 20.9 MPa
- Timber tension parallel strength, f_t = 10.5 MPa
- Timber bending parallel strength, $f_{b=}$ = 17.7 MPa
- Timber brace connection comprises of 3 nails of 3.55mm diameter (from a typical connection review during site measurements)
- Plasterboard linings and fixings achieve 50% of current GIB values.

10.3 Critical Structural Weaknesses

The following Critical Structural Weakness was identified in the Qualitative Report:

- Site Characteristics due to widespread liquefaction and tension cracks in the surrounding ground.

The site characteristics have been identified as a potential CSW in our earlier Qualitative Report. We note that liquefaction is still considered a potential CSW however it has not been considered in this quantitative assessment as we believe it will not significantly impact the structure's ability to resist further loads or cause global failure of the structure.

10.4 Seismic Parameters

The seismic design parameters based on current design requirements from NZS1170.5:2004 and the NZBC clause B1 for this building are:

- Site soil class: D – NZS 1170.5:2004, Clause 3.1.3, Soft Soil
- Site hazard factor, Z = 0.3 – NZBC, Clause B1 Structure, Amendment 11 effective from 19 May 2011
- Return period factor Ru = 1 – NZS 1170.5:2004, Table 3.5, Importance Level 2 structure with a 50 year design life.
- Near fault factor N(T,D) = 1 – NZS 1170.5:2004, Clause 3.1.6, Distance more than 20 km from fault line.

10.5 Results of Seismic Assessment

The results of our quantitative assessment indicate that the Vehicle Garage Building Part 1, Area 1 has a seismic capacity in the order of 43%NBS. This is higher than the IEP assessment of 22%NBS given in the previous Qualitative Report. Table 10.1 presents the evaluated seismic capacity for Part 1, Area 1 in terms of %NBS of the individual structural system in each direction.

Note: Ductility factors are in accordance with values recommended in the NZSEE 2006 AISPBE guidelines.

Table 10.1: Summary of Seismic Assessment of Structural Systems for Part 1, Area 1

Item	Direction	Ductility, μ	Seismic Performance	Notes
Overall %NBS adopted from DEE	**Transverse**	**3.0**	**43%NBS**	**Governed by plasterboard lined timber framed walls.**
Plasterboard lined timber framed walls	Transverse	3.0	43%NBS	Assessed using GIB EzyBrace Systems and adopting a 50% reduction factor.
Timber frame wall bracing	Longitudinal	1.25	49%NBS	Governed by capacity of nailed connections in bracing members.

Part 1, Area 1 Extension has been assessed to have a seismic capacity in the order of 64%NBS. This is higher than the IEP assessment of 22%NBS given in the previous Qualitative Report. Table 10.2 presents the evaluated seismic capacity for Part 1, Area 1 Extension in terms of %NBS of the individual structural system in each direction.

Table 10.2: Summary of Seismic Assessment of Structural Systems for Part 1, Area 1 Extension

Item	Direction	Ductility, μ	Seismic Performance	Notes
Overall %NBS adopted from DEE	**Longitudinal**	**1.25**	**64%NBS**	**Governed by nailed connections.**
Plasterboard lined timber framed walls	Transverse	3.0	78%NBS	Assessed using GIB EzyBrace Systems and adopting a 50% reduction factor.
Timber frame wall bracing	Longitudinal	1.25	64%NBS	Governed by capacity of nailed connections in bracing members.

Part 1, Area 2 has been assessed to have a seismic capacity in the order of 78%NBS. This is higher than the IEP assessment of 30%NBS given in the previous Qualitative Report. Table 10.3 presents the evaluated seismic capacity for Part 1, Area 2 in terms of %NBS of the individual structural system in each direction.

Table 10.3: Summary of Seismic Assessment of Structural Systems for Part 1, Area 2

Item	Direction	Ductility, μ	Seismic Performance	Notes
Overall %NBS adopted from DEE	**Transverse**	**1.25**	**78%NBS**	**Governed by bracing tension capacity.**
Timber frame wall bracing	Both	1.25	78%NBS	Governed by transverse bracing tension capacity.
Timber frame wall bracing connections	Both	1.25	82%NBS	Governed by transverse timber brace nailed connections.

Part 2 has been assessed to have a seismic capacity in the order of 72%NBS. This is higher than the IEP assessment of 30%NBS given in the previous Qualitative Report. Table 10.4 presents the evaluated seismic capacity for Part 2 in terms of %NBS of the individual structural system in each direction.

Table 10.4: Summary of Seismic Assessment of Structural Systems for Part 2

Item	Direction	Ductility, μ	Seismic Performance	Notes
Overall %NBS adopted from DEE	**Transverse**	**3.0**	**72%NBS**	**Assessed to NZS 3604:2011**
Timber framed walls (plasterboard lined)	Both	3.0	72%NBS	Governed by transverse direction. Assessed to NZS 3604:2011

10.6 Discussion of results

The key findings of the assessment are as follows:

- Part 1, Area 1 transverse timber framed walls have a seismic capacity of 43%NBS, governed by the plasterboard bracing under in-plane loading.
- Part 1, Area 1 Extension longitudinal timber frame walls have a seismic capacity of 64%NBS, governed by the nailed connections of the timber bracing under in-plane loading.

Based on the results of our Quantitative Assessment, Part 1, Area 1 and Part 1, Area 1 Extension of the Vehicle Garage Building are considered Earthquake Risk as the seismic capacity of each structure was assessed to be between 33%NBS and 67%NBS, and are both classified as Seismic Grade C.

Part 1, Area 2 and Part 2 of the Vehicle Garage Building are considered not Earthquake Risk as the seismic capacity of each structure was assessed to be greater than 67%NBS, and are both classified as Seismic Grade B.

11 Recommendations

11.1 Occupancy

In order that the owner can make an informed decision about the on-going use and occupancy of their building the following information is presented in line with the Department of Building and Housing document 'Guidance for engineers assessing the seismic performance of non-residential and multi-unit residential buildings in greater Christchurch', June 2012.

Part 1, Area 1 and Part 1, Area 1 Extension of the Vehicle Garage Building are considered to be Earthquake Risk, having assessed capacities between 33%NBS and 67%NBS and are classified as Seismic Grade C. The risk of collapse of an earthquake risk building is considered to be 5 to 10 times greater than that of an equivalent new building.

Part 1, Area 2 and Part 2 of the Vehicle Garage Building are considered not to be Earthquake Risk, having assessed capacities greater than 67%NBS, and are classified as Seismic Grade B. The risk of collapse of a Grade B building is 2 to 5 times greater than that of an equivalent new building.

No significant damage was identified to the seismic or gravity load resisting system of the Vehicle Garage that would reduce its ability to resist further loads and therefore no general restrictions on use or occupancy are recommended. However there are localised areas of damage such as a split stud framing in Part 1, Area 1 that should have temporary repairs to secure moderately damaged elements. The damaged brick veneer is considered a collapse hazard and requires attention as recommended below.

11.2 Further Investigations, Survey or Geotechnical Work

It is recommended that:

- A verticality and level survey could be carried out to determine the extent of settlement of the building for insurance purposes.
- The structural integrity of the adjacent retaining wall is investigated further (not considered part of this building or DEE).
- Partially collapsed brick veneer has been removed and temporarily/replaced with plywood. We recommend other damaged areas of brick veneer are removed or have barriers around, as advised in our Qualitative Report and by email on 26 October 2012.
- Split timber wall studs in Part 1, Area 1 should have local repairs (temporary or permanent) to stabilise them.

11.3 Damage Reinstatement

According to the recent CCC Instructions to Engineers document (16 October 2012), Council's insurance provides for repairing damaged elements to a condition substantially as new. We suggest you consult further with your insurance advisor.

12 Design Features Report

Repairs will be required to reinstate the existing structural system. A repair methodology has not been prepared at this stage. No new load paths are expected as a result of the repairs required.

13 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only.
- Inspection of building services, pipework, pavement, and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing system, linings, carpets, claddings, finishes, suspended ceilings, partitions, tenant fit-out, or the general water tightness envelope is excluded from the scope of this report.
- The assessment of the lateral load capacity of the building is limited by the completeness and accuracy of the drawings provided. Assumptions have been made in respect of the geotechnical conditions at the site and any aspects or material properties not clear on the drawings. Where these assumptions are considered material to the outcome further investigations may be recommended. It is noted the assessment has not been exhaustive, our analysis and calculations have focused on representative areas only to determine the level of provision made. At this stage we have not undertaken any checks of the gravity system, wind load capacity, or foundations.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

Appendix A

Photographs

Figure A1: Site Layout

Photo 1: Exterior view of Part 1, Area 1

Photo 2: Interior view of Part 1, Area 1

Photo 3: Interior view of Part 1, Area 1

Photo 4: Exterior view of Part 1, Area 2

Photo 5: Interior view of Part 1, Area 2

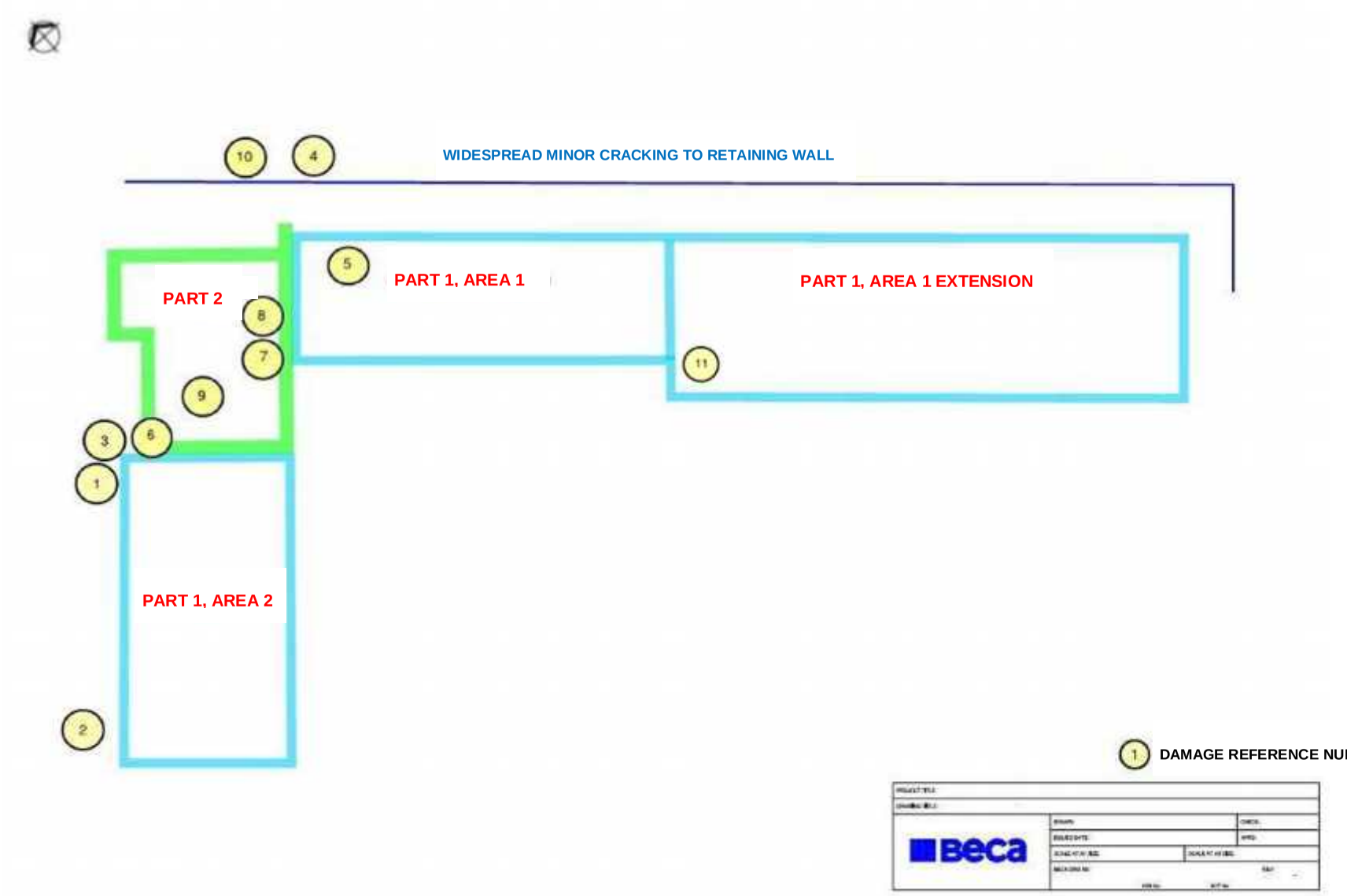


Figure A2: Plan of Damage Photos

Photo 6: Damage at location 1

General damage description: Damage to brick veneer.

Photo 7: Damage location 2

General damage description: Cracked brick veneer (30mm crack width) - has been removed and replaced with plywood.

Photo 8: Damage at location 3

General damage description: Differential settlement between adjacent walls.

Photo 9: Damage at location 4

General damage description: Cracking in retaining wall.

Photo 10: Damage at location 5

General damage description: Timber framed walls splitting of vertical stud members at brick veneer tie and bracing locations.

Photo 11: Damage at location 5

General damage description: Cracking and splitting of timber brace

Photo 12: Damage at location 7

General damage description: Separation at plaster board joint.

Photo 13: Damage at location 8

General damage description: Separation at slab joint.

Photo 14: Damage at location 8

General damage description: Separation at plaster board ceiling.

Photo 15: Damage at location 9

General damage description: Crack in concrete slab.

Photo 16: Damage at location 10

General damage description: Cracking in retaining wall.

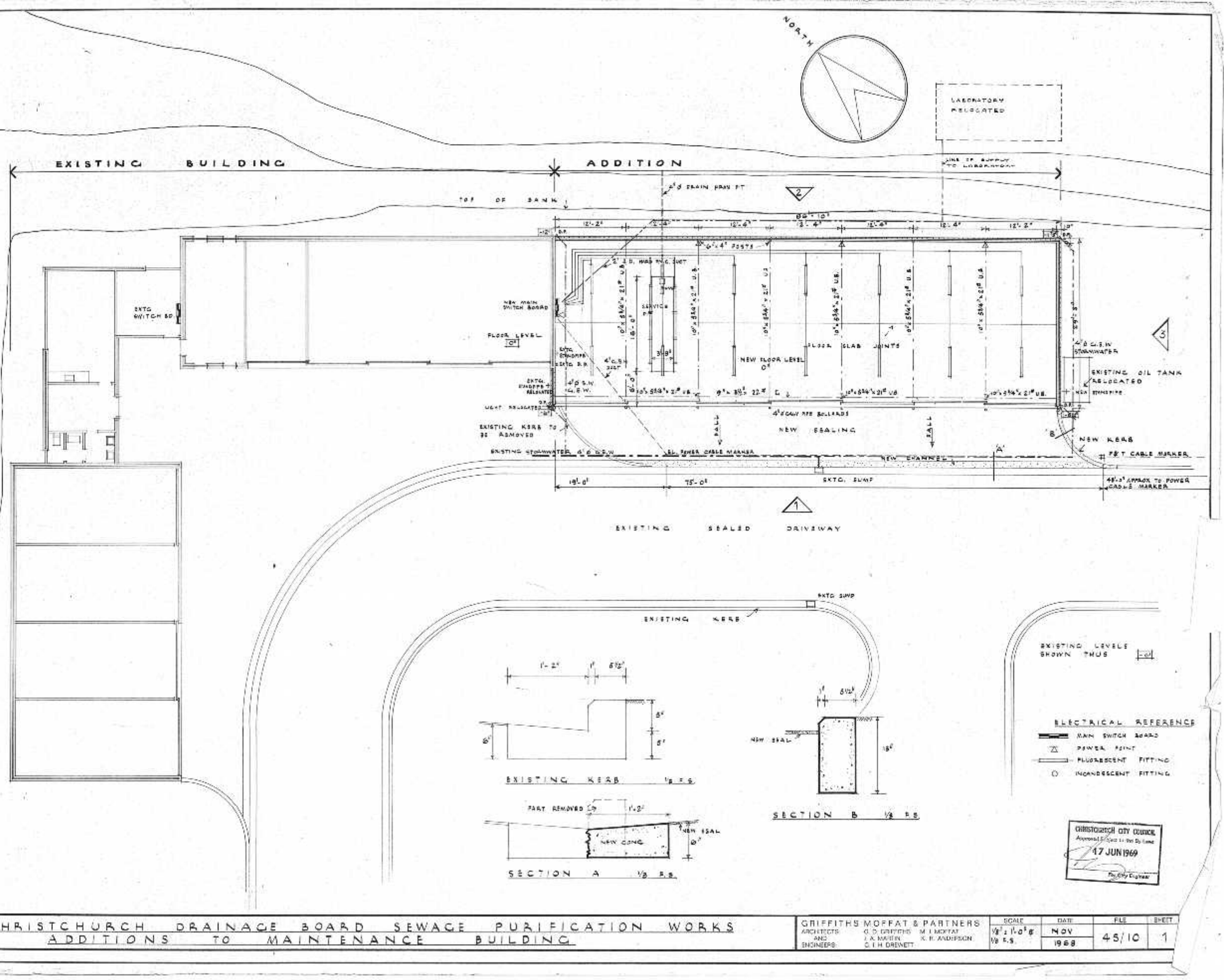
Photo 17: Damage at location 11

General damage description: Vertical crack in brick veneer between Part 1, Area 1 and Area 1 Extension.

Appendix B

Existing Drawings

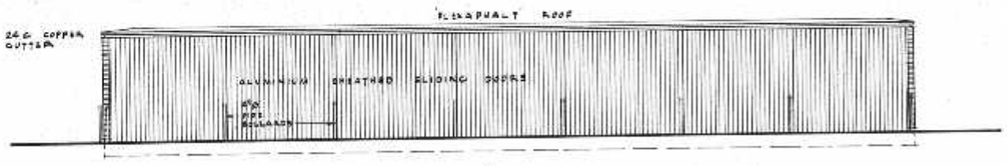
- Part 1, Area 1 Extension Drawings
- Part 2 Alteration Drawings



CHRISTCHURCH DRAINAGE BOARD SEWAGE PURIFICATION WORKS
ADDITIONS TO MAINTENANCE BUILDING

GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS AND ENGINEERS: G.D. GRIFFITHS M.I. MOFFAT J.A. MARTIN K.R. ANDERSON C.T.H. DREWETT

SCALE	DATE	FILE	SHEET
1/8" = 1'-0" & 1/8 F.S.	NOV 1968	45/10	1



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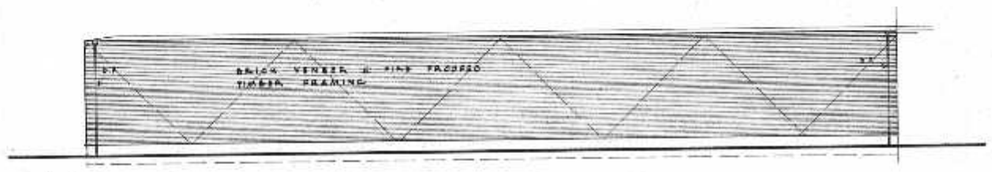

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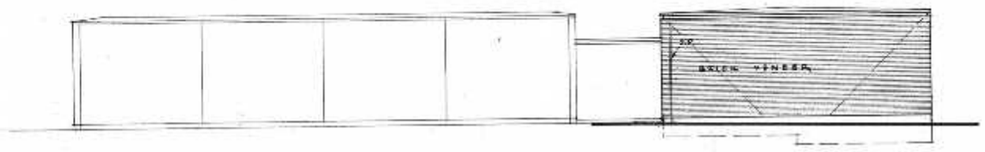

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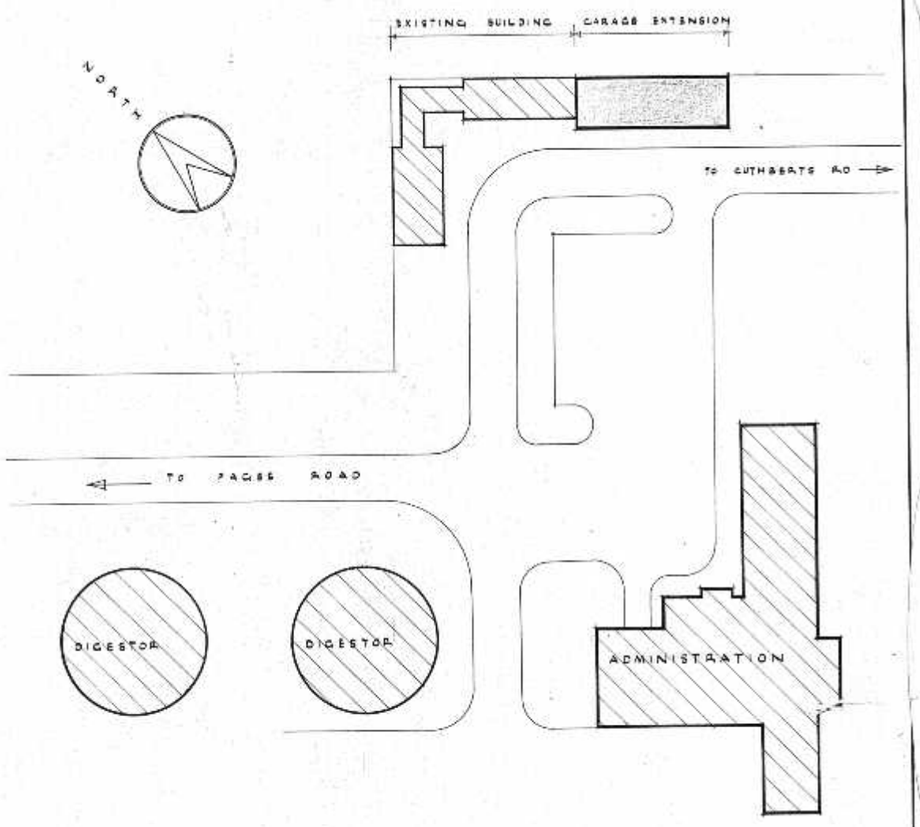


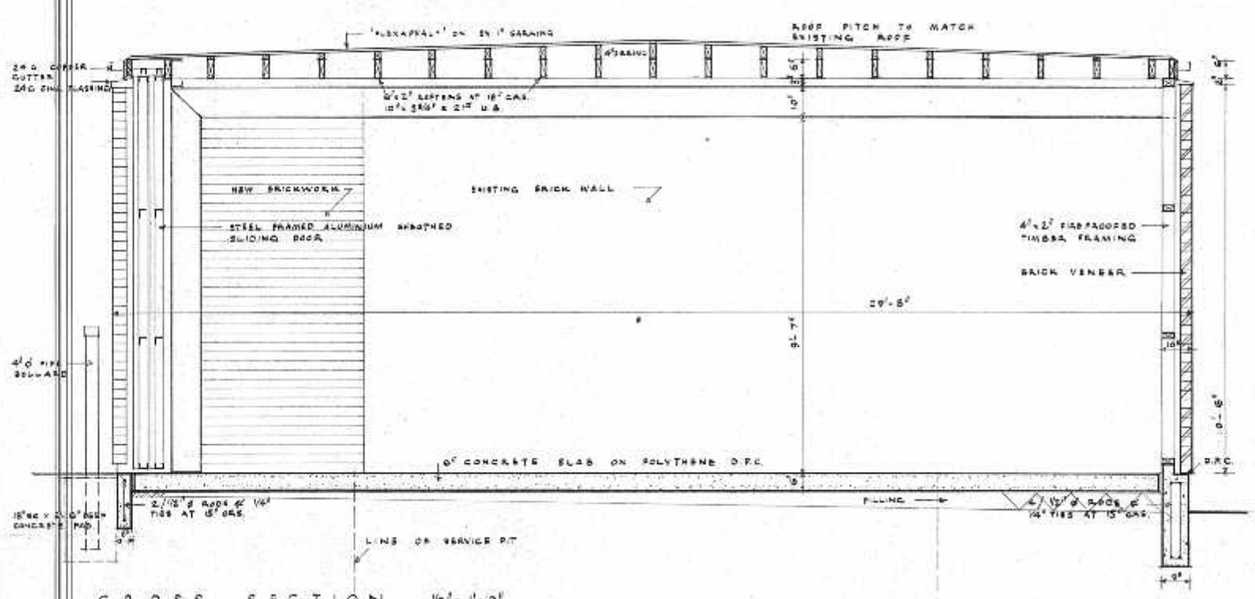
LOCATION PLAN 1/60" = 1'-0"

CHRISTCHURCH CITY COUNCIL
Approved subject to the By-Laws
17 JUN 1969
City Engineer

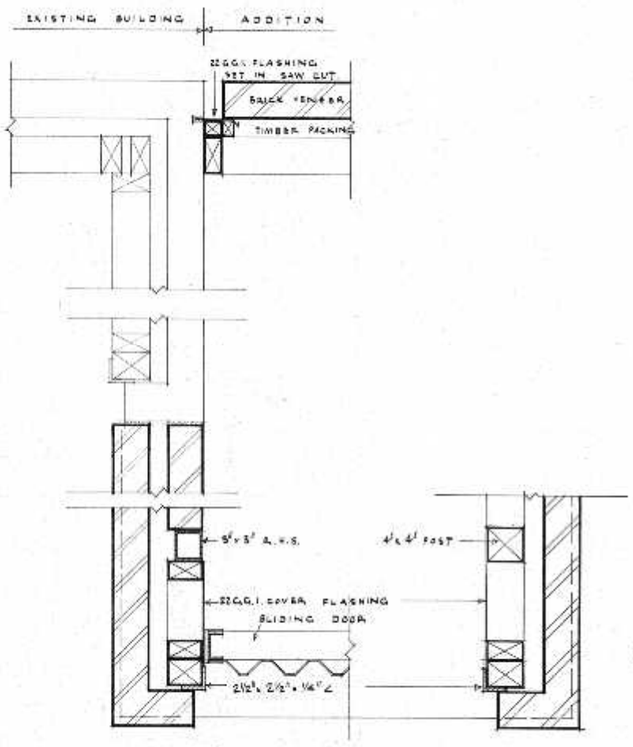
CHRISTCHURCH DRAINAGE BOARD SEWAGE PURIFICATION WORKS
ADDITIONS TO MAINTENANCE BUILDING

GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS: G.D. GRIFFITHS M.I. MOFFAT
AND I.A. MARTIN K.R. ANDERSON
ENGINEERS: O.J.H. DREWETT

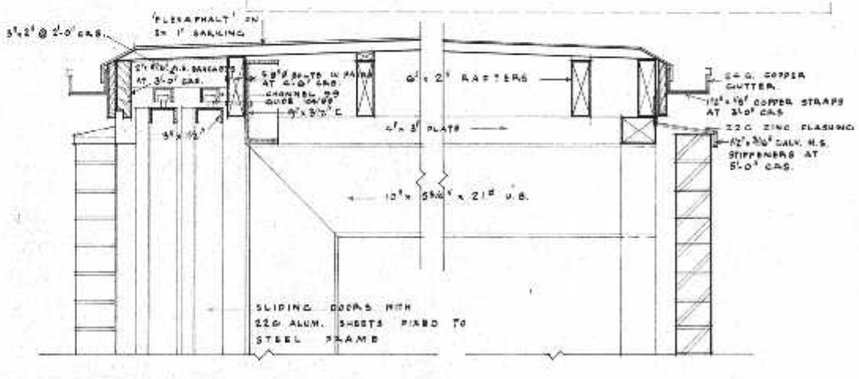
SCALE	DATE	FILE	SHEET	OF
1/60" = 1'-0" 1/8" = 1'-0"	NOV 1968	45/10	2	4

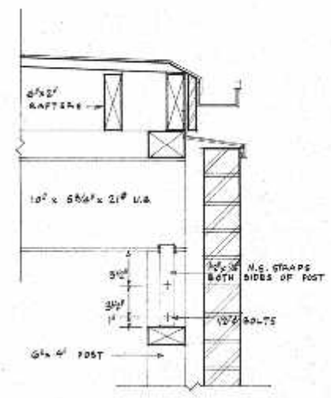


CROSS SECTION 1/2" = 1'-0"

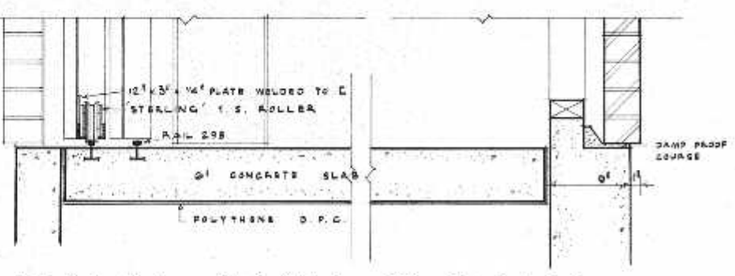


PLAN DETAILS AT JUNCTION OF BUILDING 1/8 F.S.



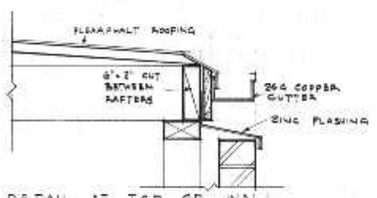


CONNECTION OF U.B. TO TIMBER FRAMING 1/8 F.S.

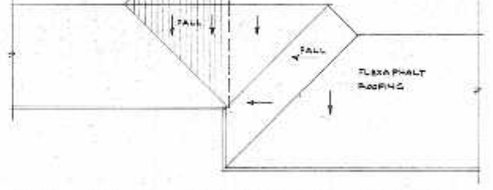


SECTION DETAILS TO GARAGE

1/8 F.S.



DETAIL AT TOP OF WALL ELEVATION B 1/8 F.S.

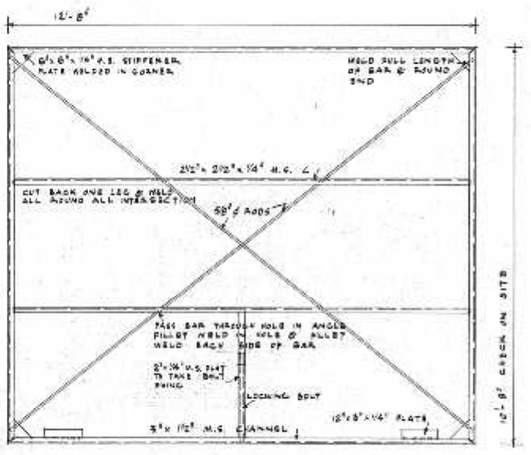


ROOF PLAN AT JUNCTION OF EXISTING AND NEW 1/8" = 1'-0"

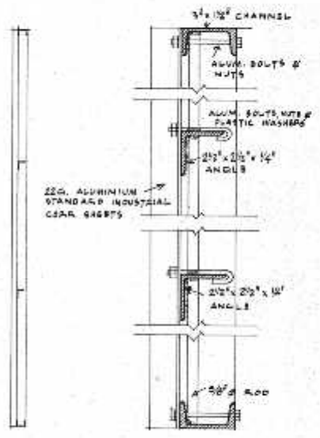
CHRISTCHURCH CITY COUNCIL Approved in terms of Bylaws 17 JUN 1968 For City Engineer

CHRISTCHURCH DRAINAGE BOARD SEWAGE PURIFICATION WORKS
ADDITIONS TO MAINTENANCE BUILDING

GRIFFITHS MOFFAT & PARTNERS			SCALE	DATE	FILE	SHEET	OF
ARCHITECTS AND ENGINEERS	G.D. GRIFFITHS M.I. MOFFAT I.A. MARTIN K.R. ANDERSON D.I.H. CREAGETT		1/8" = 1'-0" @ A1 1/8 F.S.	NOV. 1968	45/10	3	4



ELEVATION SLIDING DOOR 1/2" = 1'-0"



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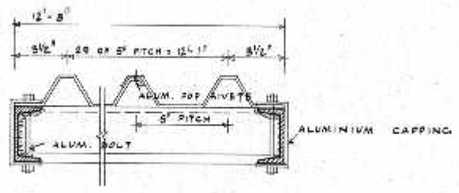
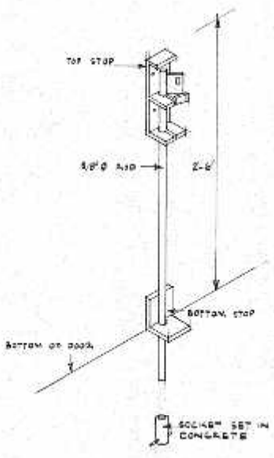
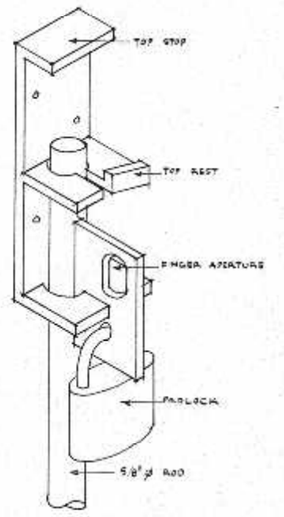


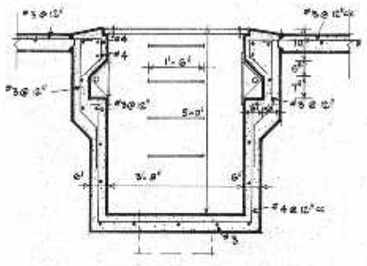
PLAN OF DOOR 1/4 F.S.



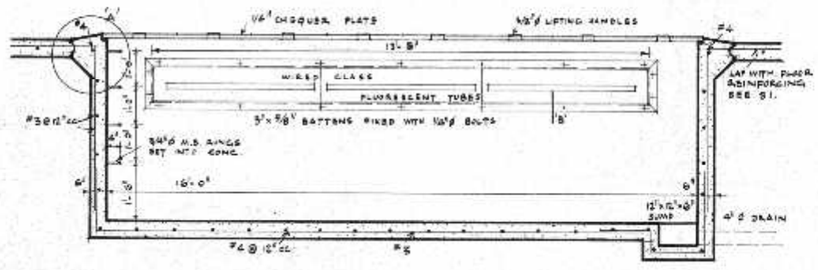


DOOR LOCKING BOLT DETAIL N.T.S.

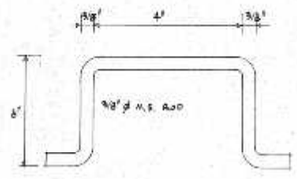
CHECK SIZES ON SITE



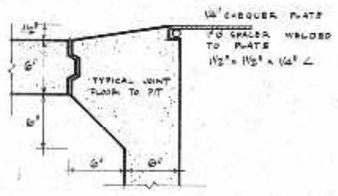
CROSS SECTION 1/2" = 1'-0"



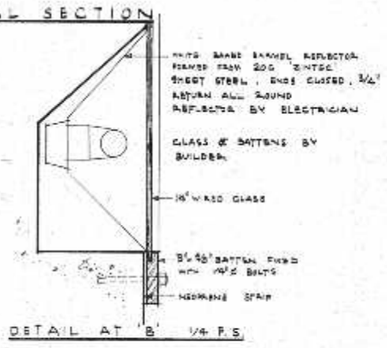
LONGITUDINAL SECTION 1/2" = 1'-0"



DETAIL OF HANDLE 1/2 F.S.



DETAIL AT 'A' 1/8 F.S.



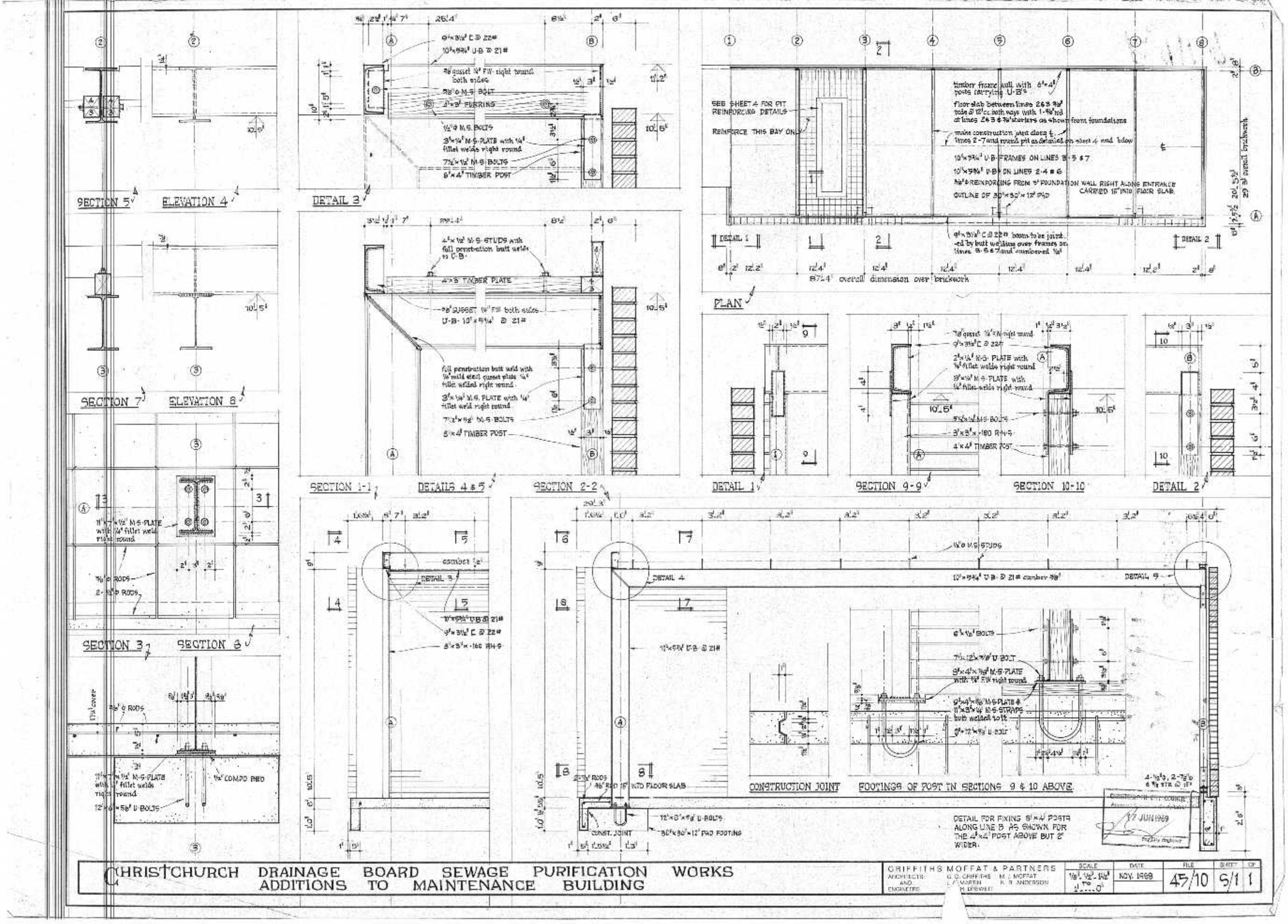
DETAIL AT 'B' 1/4 F.S.

CHRISTCHURCH CITY COUNCIL
17 JUN 1969
Per City Engineer

CHRISTCHURCH DRAINAGE BOARD SEWAGE PURIFICATION WORKS
ADDITIONS TO MAINTENANCE BUILDING

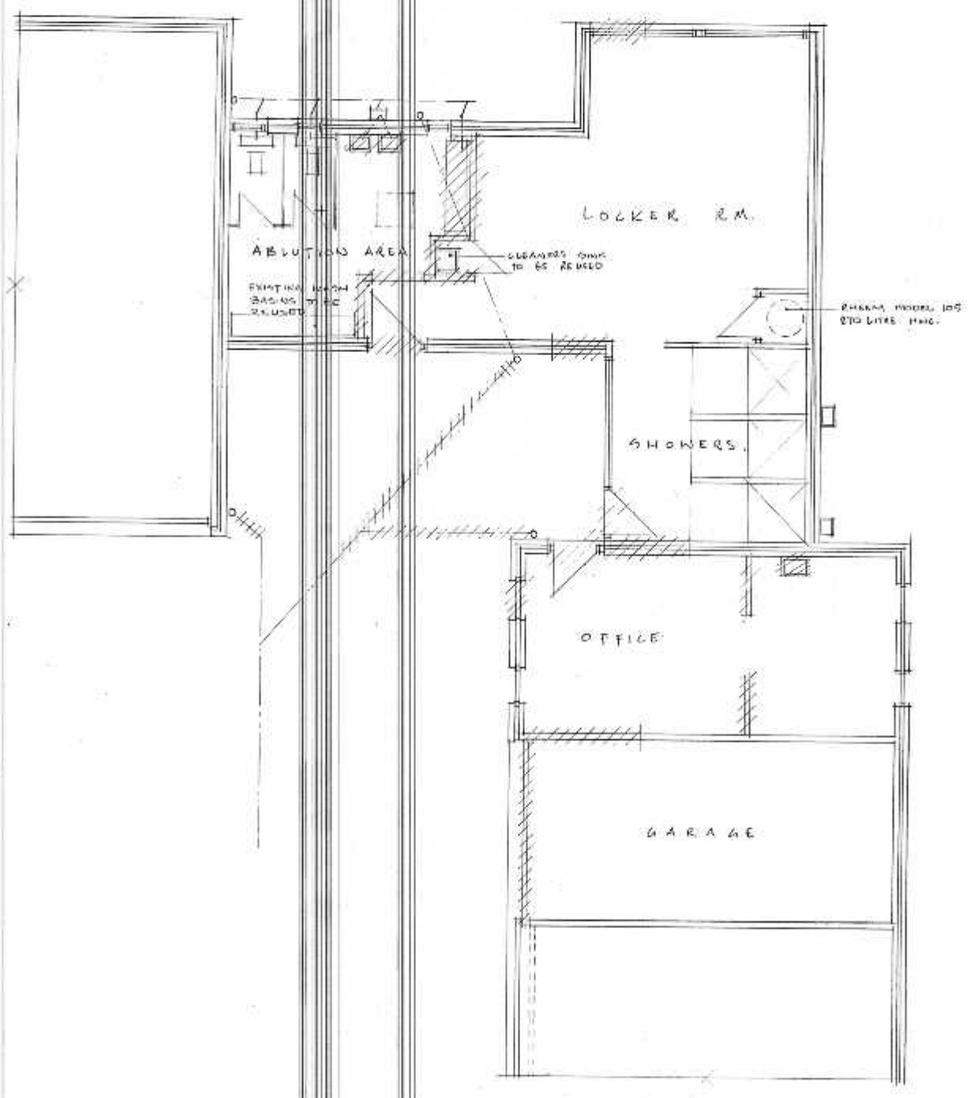
GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS AND ENGINEERS
G.D. GRIFFITHS M.J. MOFFAT
D.A. MARTIN R.R. ANDERSON
G.T.H. DREWITT

SCALE	DATE	FILE	SHEET	OF
AS SHOWN	NOV 1968	45/10	4	4

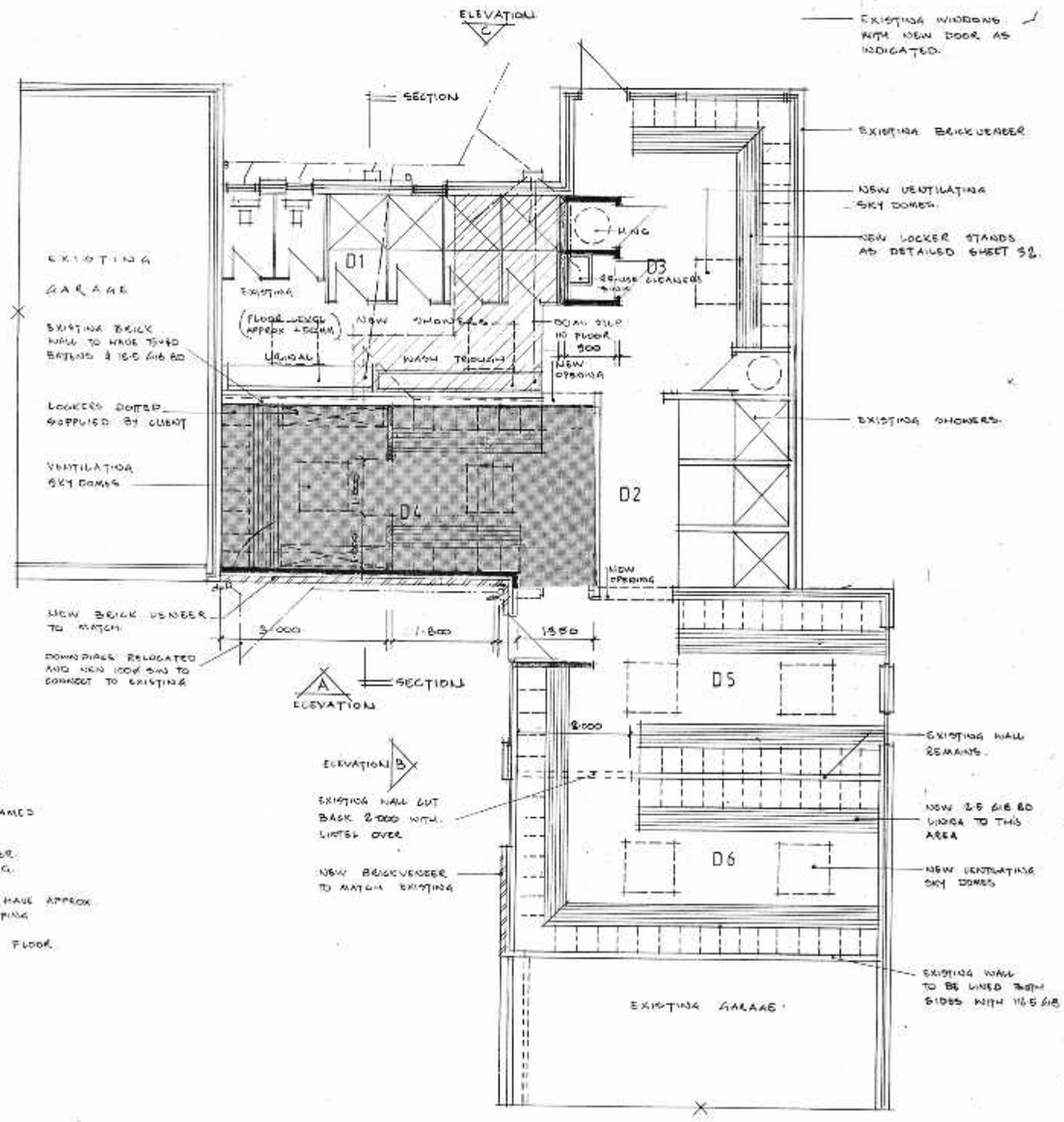


CHRISTCHURCH DRAINAGE BOARD SEWAGE PURIFICATION WORKS
ADDITIONS TO MAINTENANCE BUILDING

GRIFFITHS MOFFAT & PARTNERS ARCHITECTS AND ENGINEERS: G.G. GRIFFITHS, M.J. MOFFAT, L.P. MARTIN, R.B. ANDERSON, H. DREWETT	SCALE 1/8", 1/2", 1/4" to 1'-0"	DATE NOV. 1968	FILE 45/10	SHEET S/1	OF 1



EXISTING FLOOR PLAN



LEGEND.

- EXISTING WALLS TO BE REMOVED.
- NEW TIMBER FRAMED WALLS.
- NEW BRICK VENEER TO MATCH EXISTING.
- EXISTING FLOOR TO HAVE APPROX 50MM PLASTER TOPPING
- NEW 100Ø SLAB FLOOR

NEW FLOOR PLAN

87-3164
SHEET 7

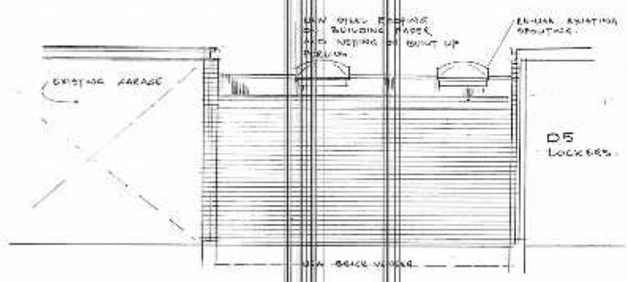
CHRISTCHURCH DRAINAGE BOARD
DEVELOPMENT AT TREATMENT WORKS

CONTRACTOR TO VERIFY DIMENSIONS BEFORE COMMENCING WORK

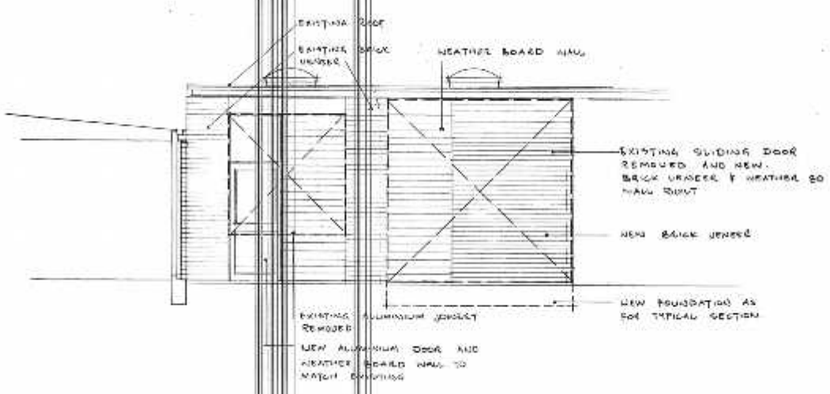
GMP
GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS & ENGINEERS
K. R. ANDERSON
G. I. H. DREWETT
E. A. M. PEYMEL
D. G. WINTER
232 ARMAGH STREET
P.O. BOX 155
CHRISTCHURCH, 1, N.Z.
TELEPHONE 798-830

CHRISTCHURCH CITY COUNCIL
Approved Subject to the By-laws
25 JAN 1988
For Engineer

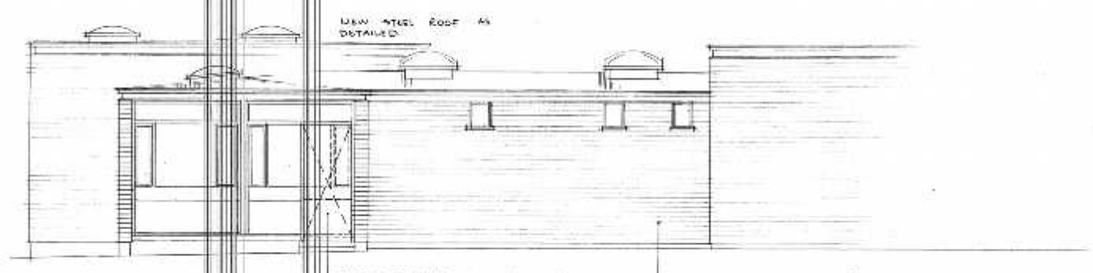
DETAIL	SCALE	DATE	FILE	SHEET
Building D Floor Plans	1/50	OCT 87	45/12	29 OF



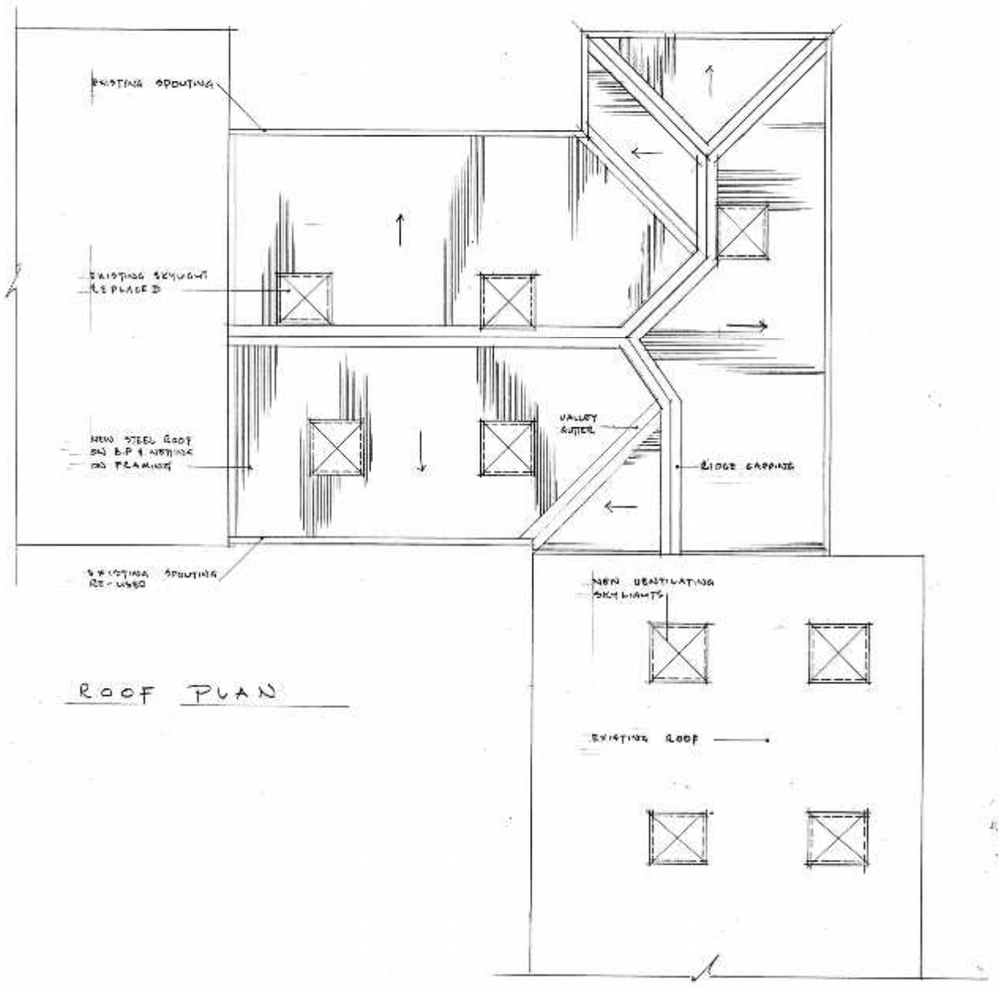
ELEVATION A



ELEVATION B



ELEVATION C



ROOF PLAN

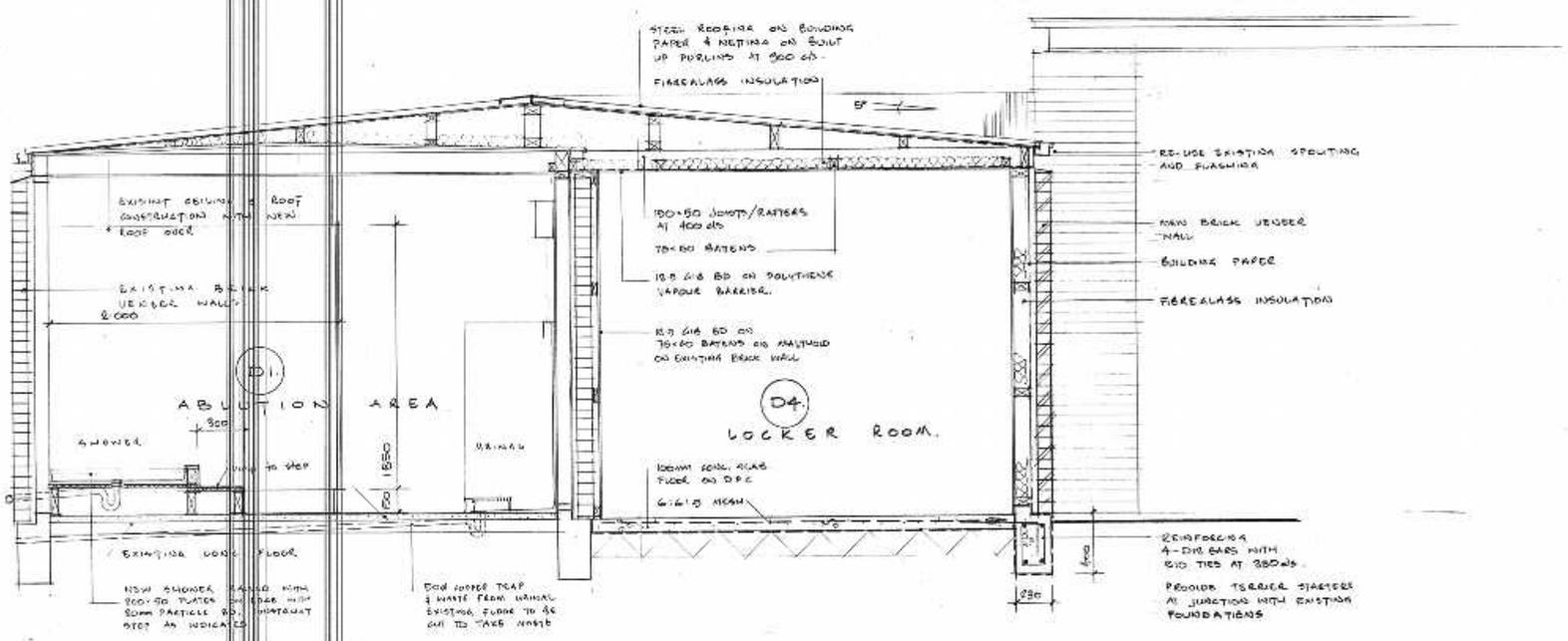
CHRISTCHURCH CITY COUNCIL
Approved Subject to the By-laws
26 JAN 1988
For Director

CONTRACTOR TO VERIFY DIMENSIONS BEFORE COMMENCING WORK

CHRISTCHURCH DRAINAGE BOARD
DEVELOPMENT AT TREATMENT WORKS

GM&P
GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS & ENGINEERS
K. R. ANDERSON
G. C. H. DREWETT
E. & J. MEYNEL
D. S. WINTER
232 ARMAGH STREET CHRISTCHURCH; 1, N.Z.
P.O. BOX 168 TELEPHONE 798-830

DETAIL	SCALE	DATE	FILE	SHEET
Building D Elevations Roof Plan	1/50	OCT 87	45/12	30 OF



SECTION

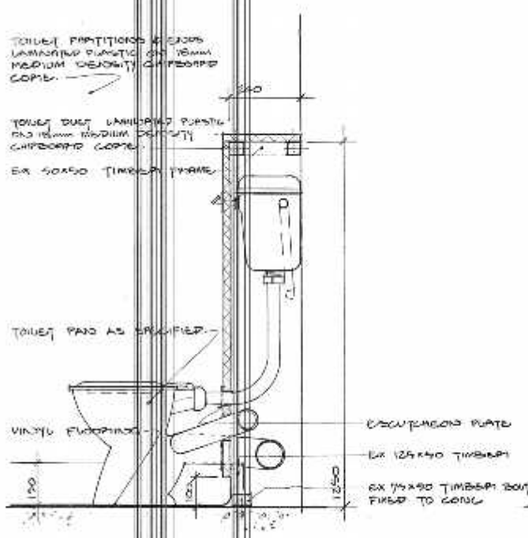
CHRISTCHURCH CITY COUNCIL
Approved Subject to the By-laws
26 JAN 1988
for Engineer

CONTRACTOR TO VERIFY DIMENSIONS BEFORE COMMENCING WORK

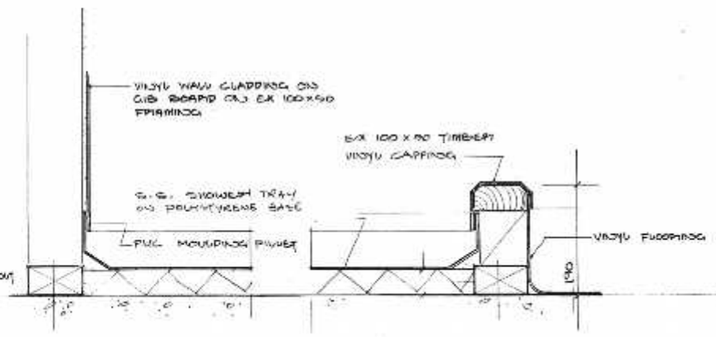
CHRISTCHURCH DRAINAGE BOARD
DEVELOPMENT AT TREATMENT WORKS

GM&P
GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS & ENGINEERS
K.R. ANDERSON
G.I.H. DREWETT
E.J.A. PETMEL
D.G. WINTER
232 ARMAGH STREET CHRISTCHURCH, 1, N.Z.
P.O. BOX 166 TELEPHONE 798-830

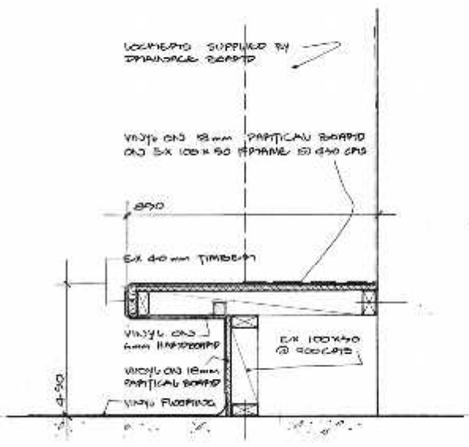
DETAIL	SCALE	DATE	FILE	SHEET
Building D Sections	1/20	OCT 87	45/12	31 OF



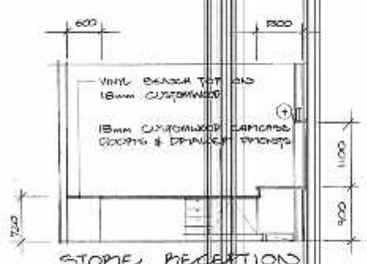
TYPICAL SECTION THRU' TOILET DUCT SCALE 1:10



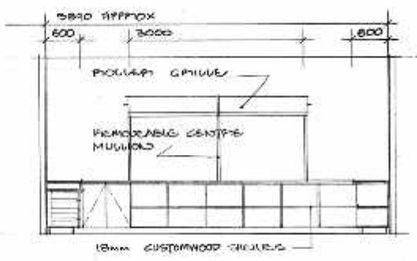
TYPICAL SECTION THRU' SHOWER SCALE 1:5



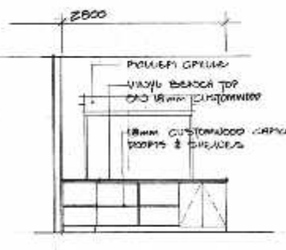
TYPICAL DETAIL THRU' LOCKER SUPPORT SCALE 1:10



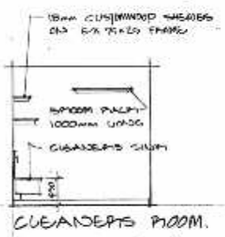
STORE RECEPTION ELEVATION A REFER SHEET 3.



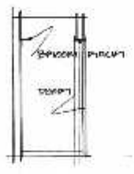
ELEVATION B



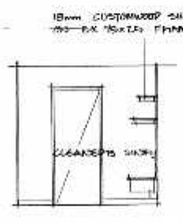
ELEVATION C



CLEANERS ROOM. ELEVATION A REFER SHEET 3.

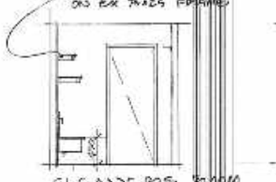


ELEVATION B



ELEVATION C

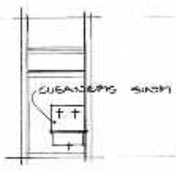
ELEVATION D



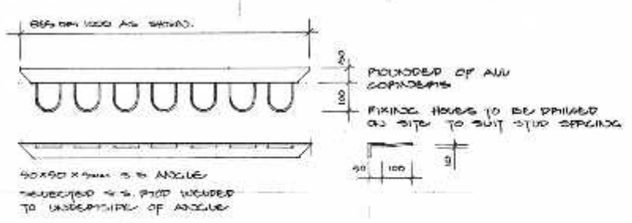
CLEANERS ROOM ELEVATION A REFER SHEET 4

ELEVATION B

ELEVATION C



ELEVATION D



BROOM RACK SCALE 1:10

CHRISTCHURCH CITY COUNCIL
Approved Subject to the Relaxation
26 JAN 1988
for Engineer

CONTRACTOR TO VERIFY DIMENSIONS BEFORE COMMENCING WORK

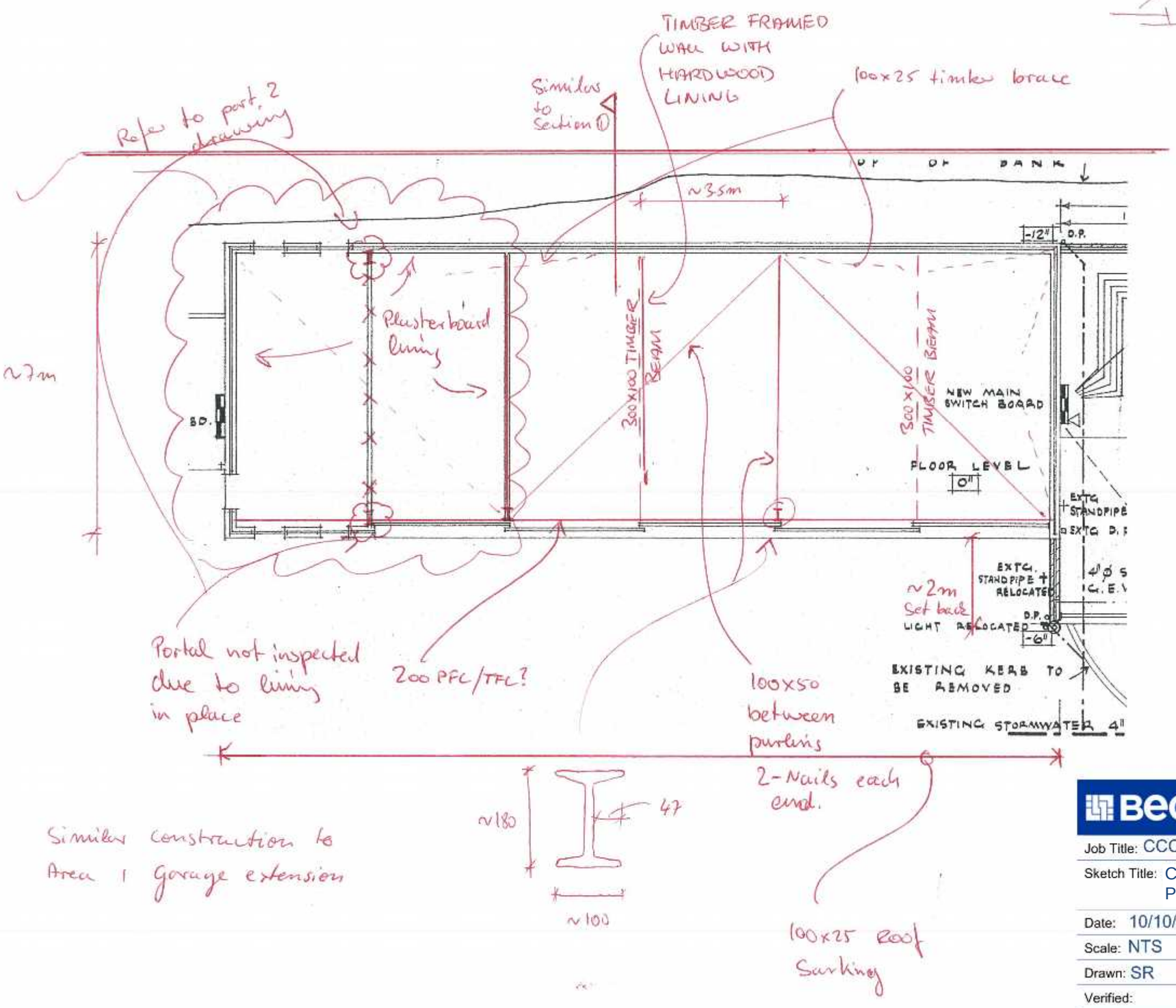
CHRISTCHURCH DRAINAGE BOARD
DEVELOPMENT AT TREATMENT WORKS

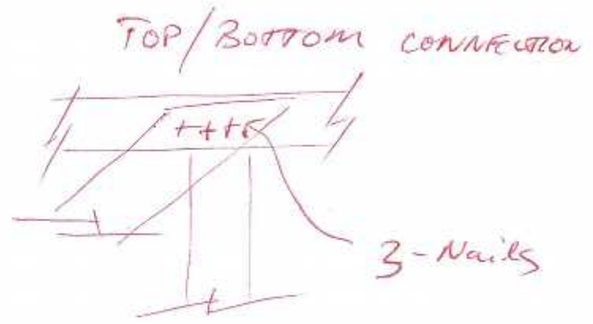
GMP
GRIFFITHS MOFFAT & PARTNERS
ARCHITECTS & ENGINEERS
K. R. ANDERSON
G. L. H. DREWETT
P. J. L. MEYMEL
G. S. WINTER
232 ARMAGH STREET CHRISTCHURCH, 1, N.Z.
P.O. BOX 156 TELEPHONE 788-830

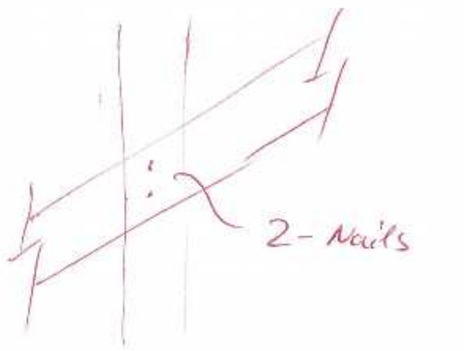
DETAIL	SCALE	DATE	FILE	SHEET
Joinery	1/5 1/10 1/50	OCT 87	45/12	32 OF

Appendix C

Site Measurements



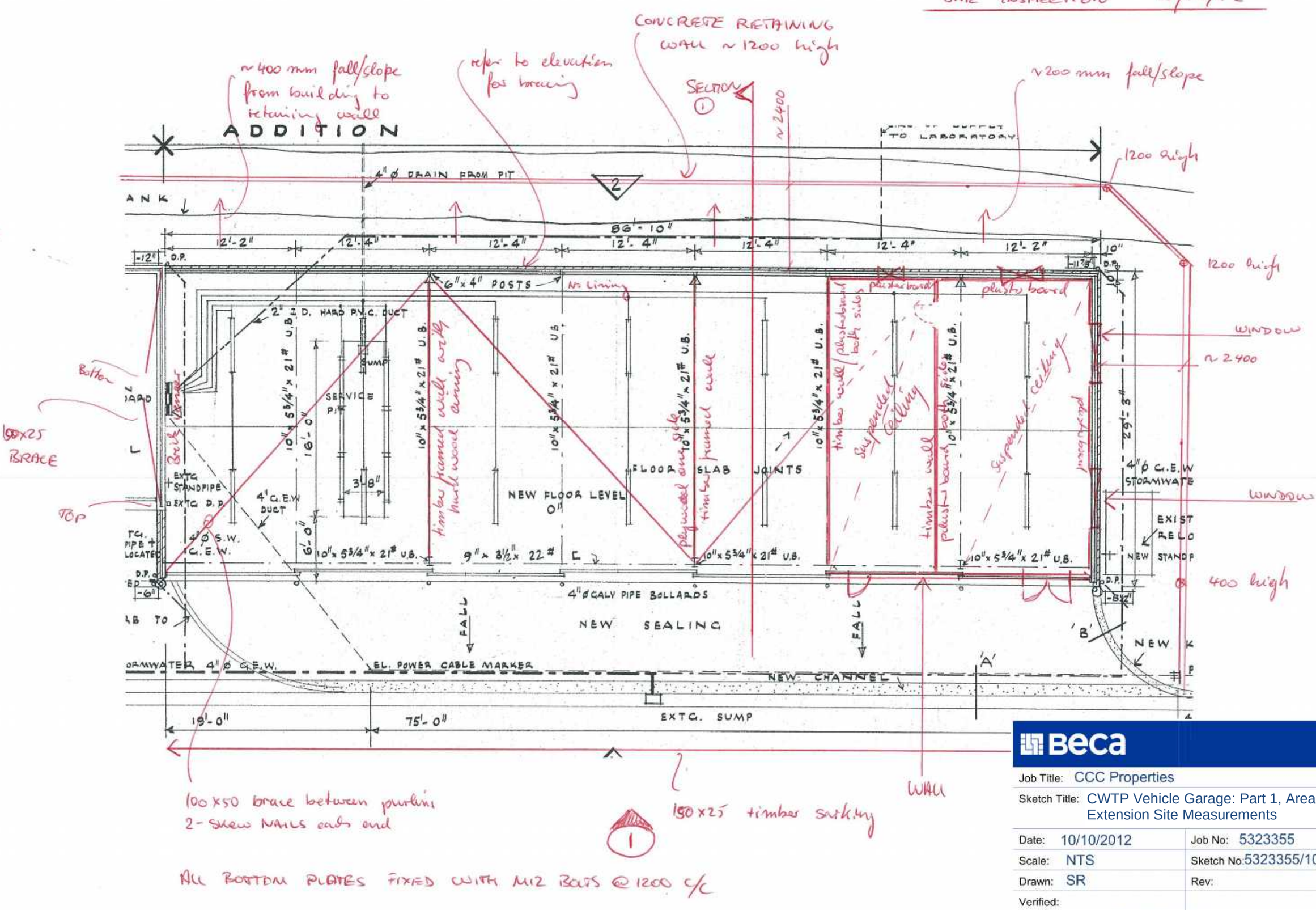




Beca

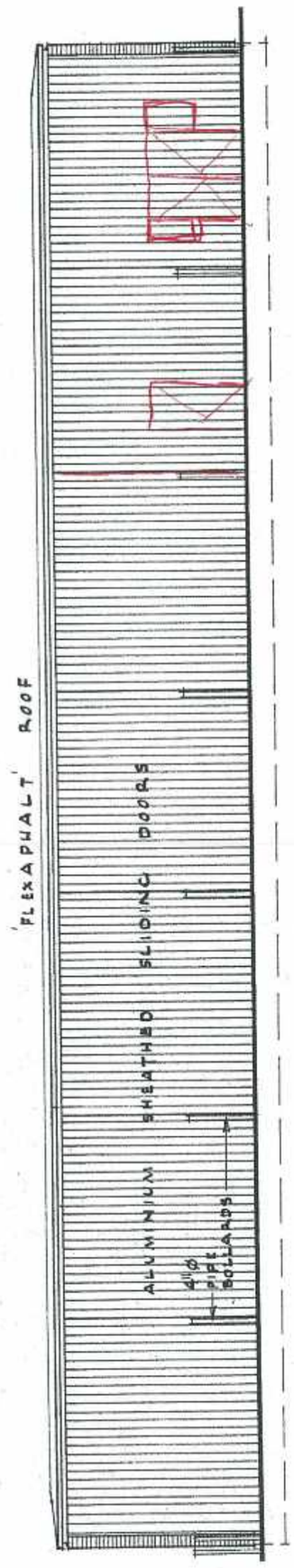
Job Title: CCC Properties	
Sketch Title: CWTP Vehicle Garage: Part 1, Area 1 Site Measurements	
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK01
Drawn: SR	Rev:
Verified:	
Reason for Issue: For Information	

SITE INSPECTION 10/10/12

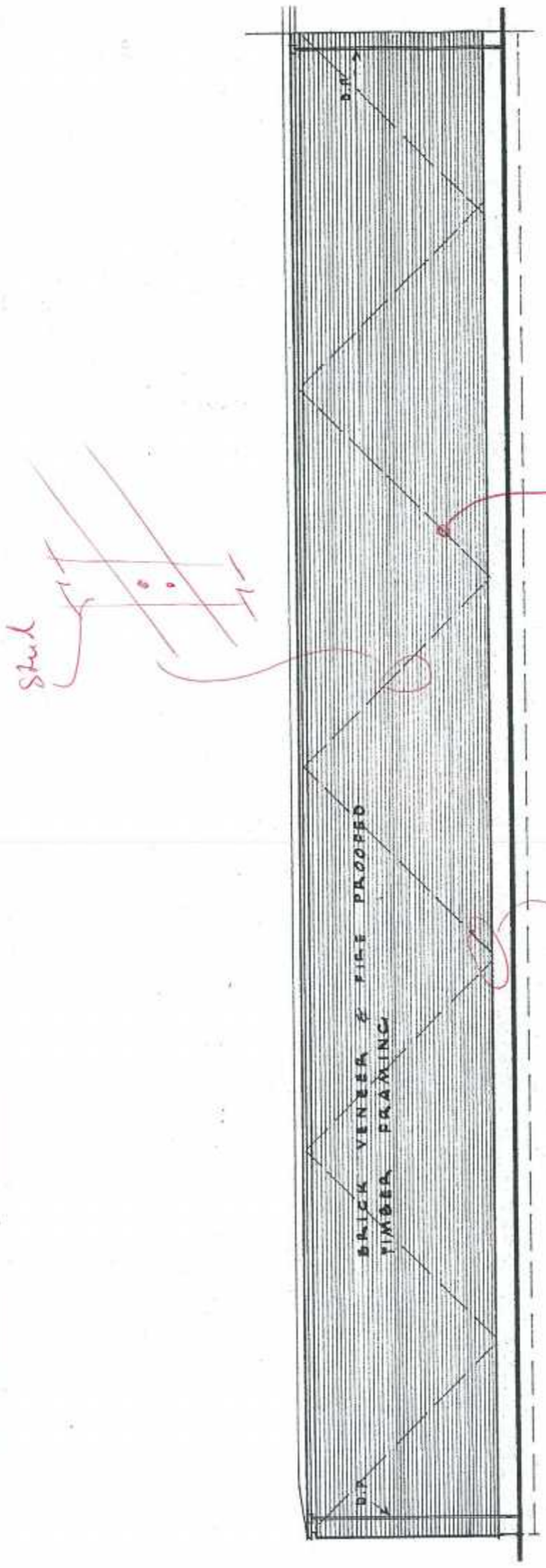


Beca

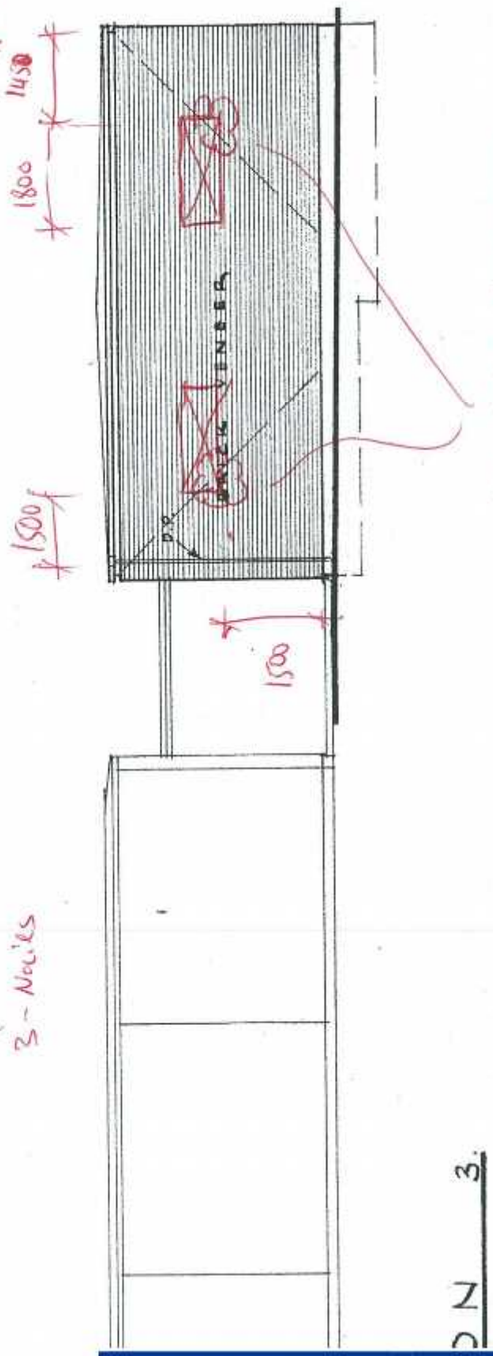
Job Title: CCC Properties	
Sketch Title: CWTP Vehicle Garage: Part 1, Area 1 Extension Site Measurements	
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK02
Drawn: SR	Rev:
Verified:	
Reason for Issue: For Information	



ELEVATION 1.



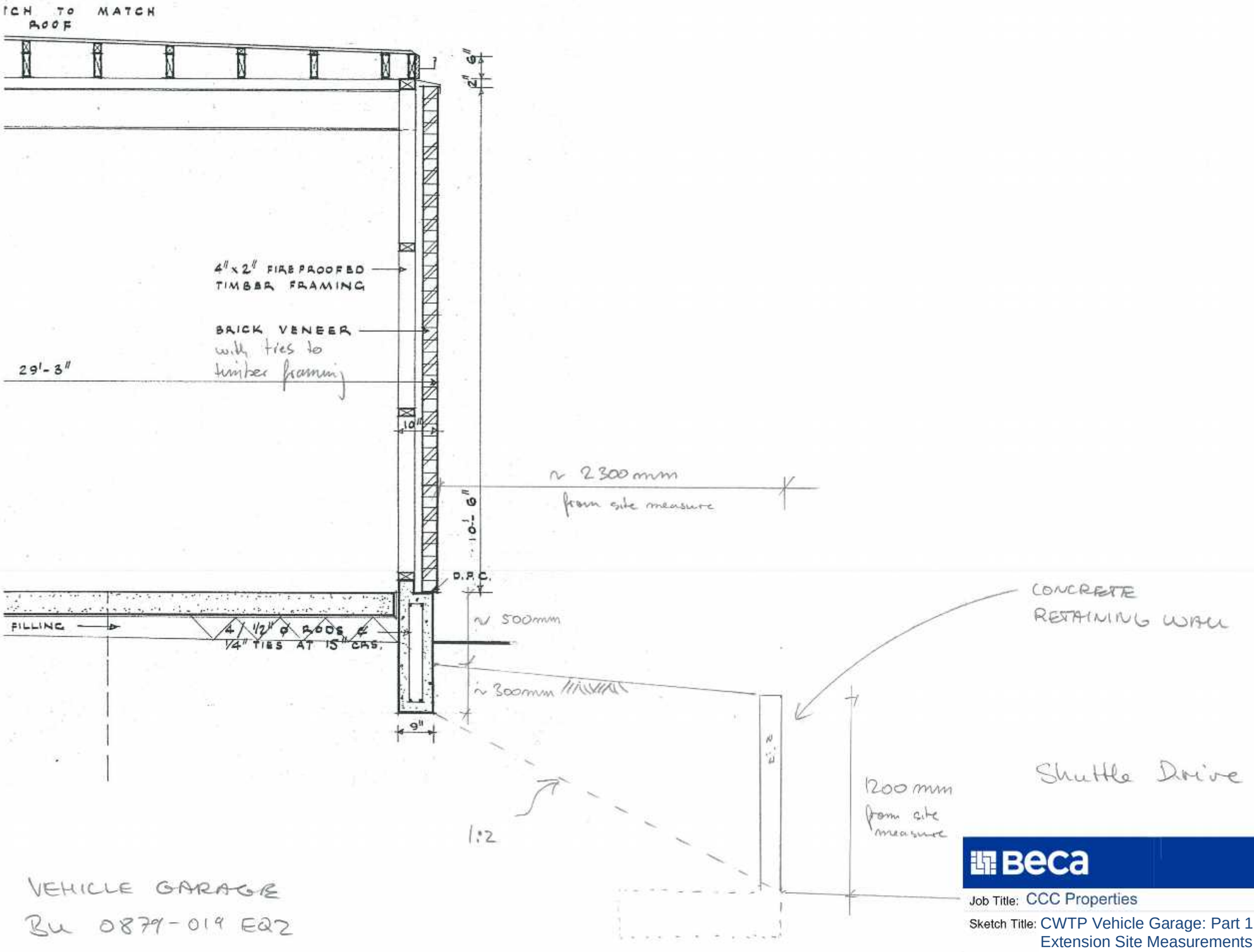
ELEVATION 2.



ELEVATION 3.

Beca

Job Title: CCC Properties	
Sketch Title: CWTP Vehicle Garage: Part 1, Area 1 Extension Site Measurements	
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK03
Drawn: SR	Rev:
Verified:	
Reason for Issue: For Information	

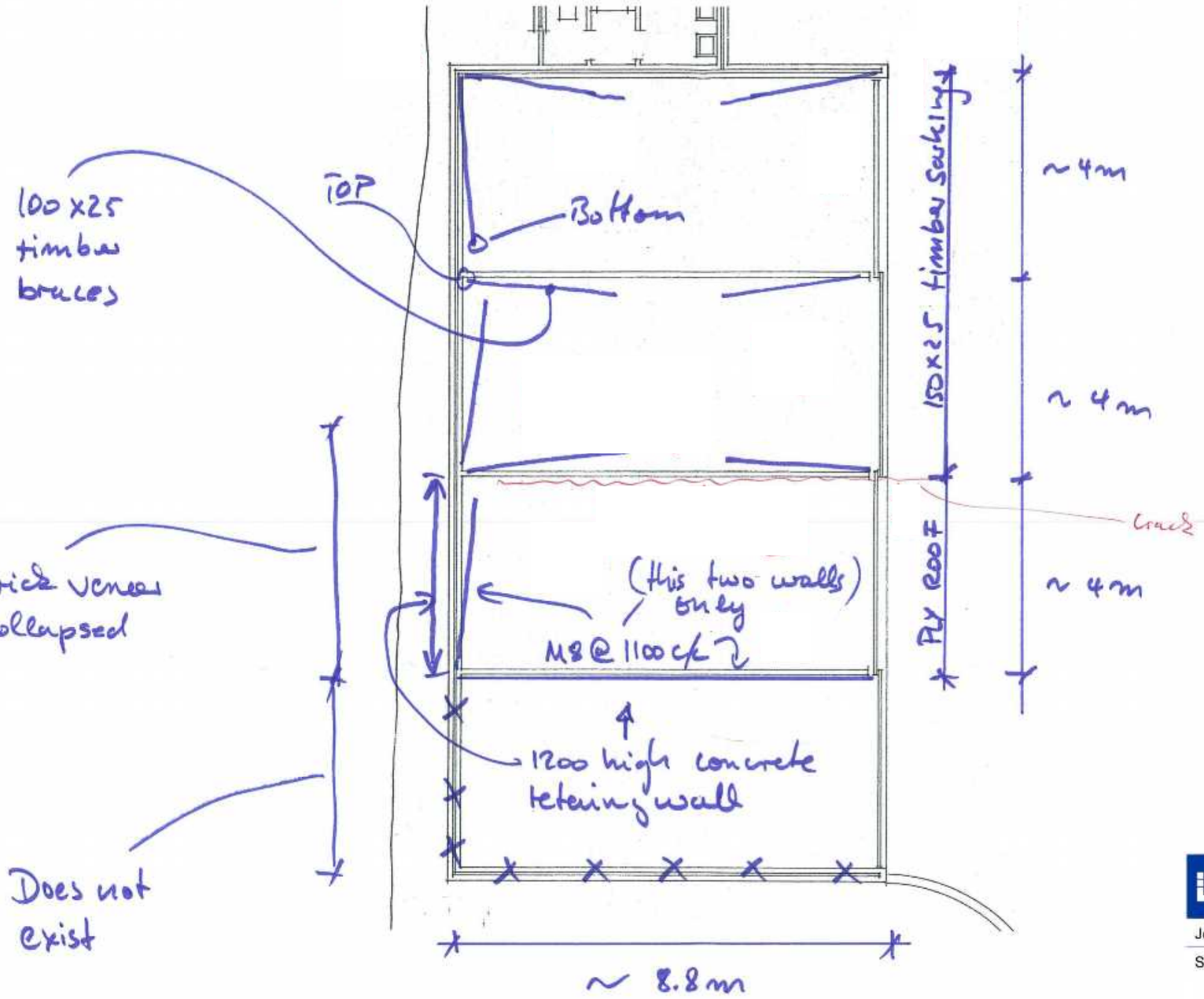


VEHICLE GARAGE
BU 0879-019 EQ2

SECTION ①
BECA 17/10/12

Beca

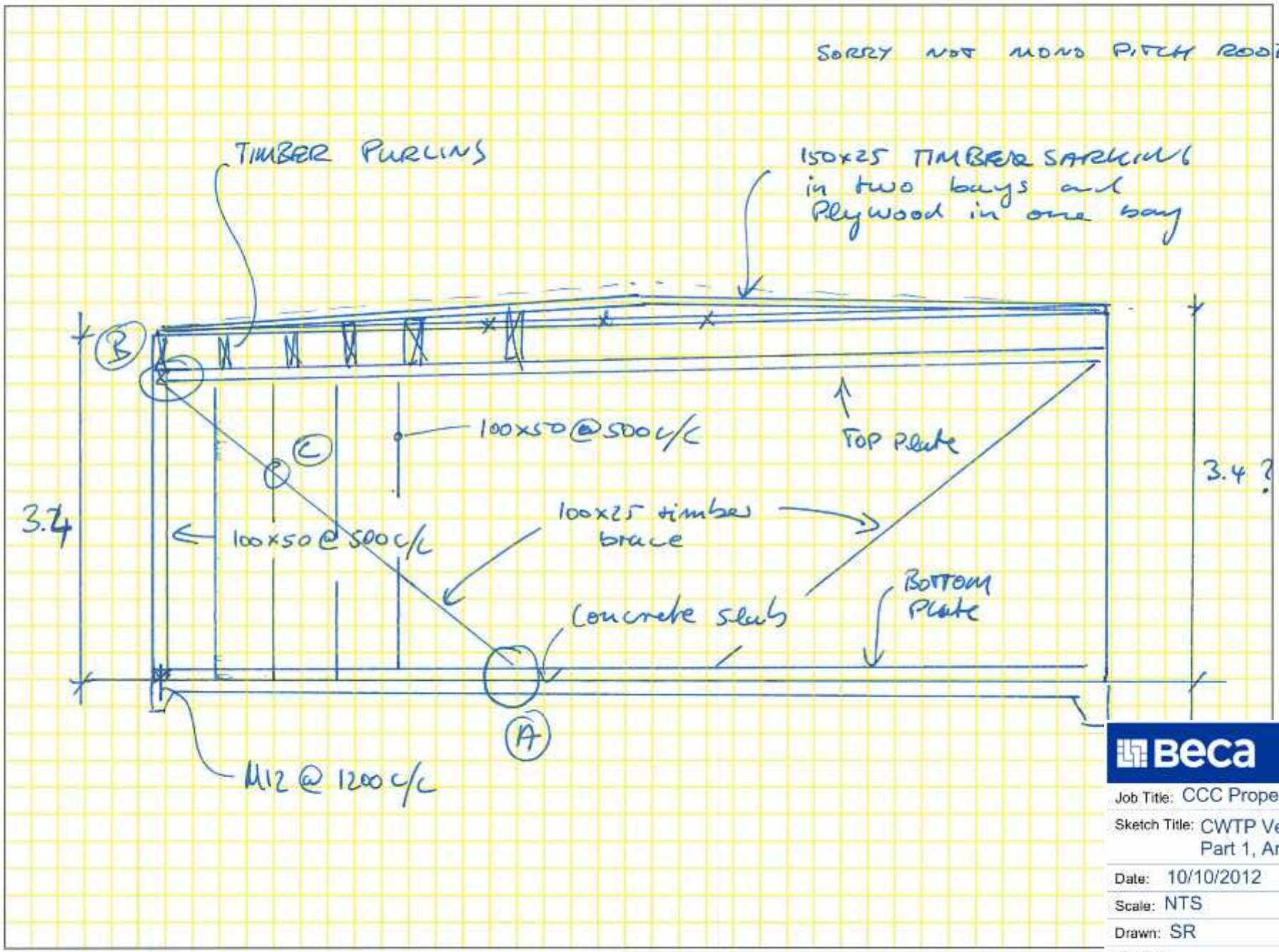
Job Title:	CCC Properties
Sketch Title:	CWTP Vehicle Garage: Part 1, Area 1 Extension Site Measurements
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK04
Drawn: SR	Rev:
Verified:	
Reason for Issue:	For Information



100 x 50 TIMBER framed walls with brick veneer cladding Bottom plate fixed with M12 @ 1200 c/c

Beca	
Job Title: CCC Properties	
Sketch Title: CWTP Vehicle Garage: Part 1, Area 2 Site Measurements	
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK05
Drawn: SR	Rev:
Verified:	
Reason for Issue: For Information	

SORRY NOT MONO PITCH ROOF



Beca

Job Title: CCC Properties	
Sketch Title: CWTP Vehicle Garage: Part 1, Area 2 Site Measurements	
Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK06
Drawn: SR	Rev:
Verified:	
Reason for Issue: For Information	

Beca

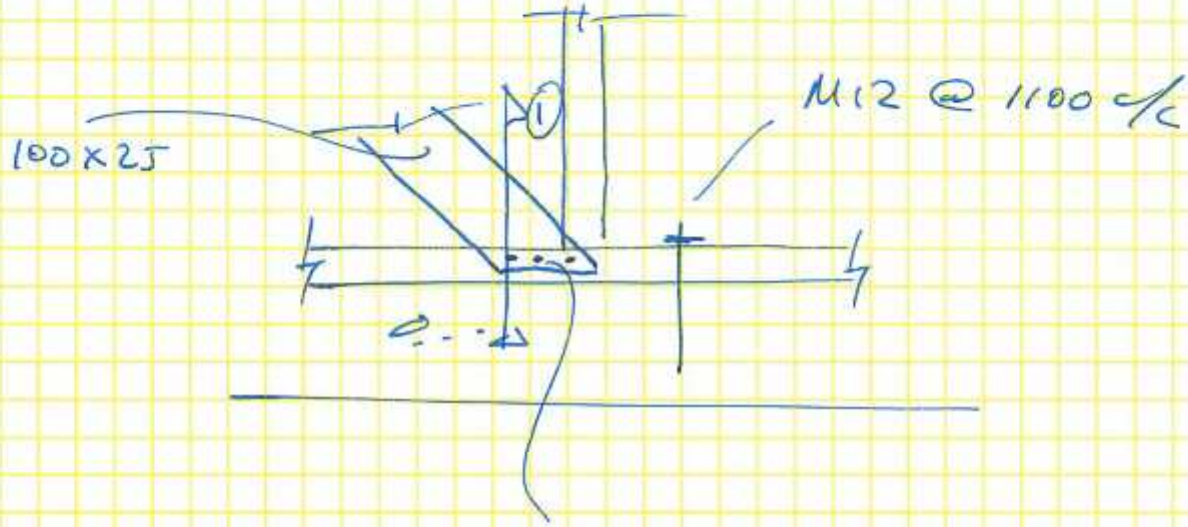
Job Title: CCC Properties

Sketch Title: CWTP Vehicle Garage:
Part 1, Area 2 Site Measurements

Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK07
Drawn: SR	Rev:
Verified:	

Reason for Issue: For Information

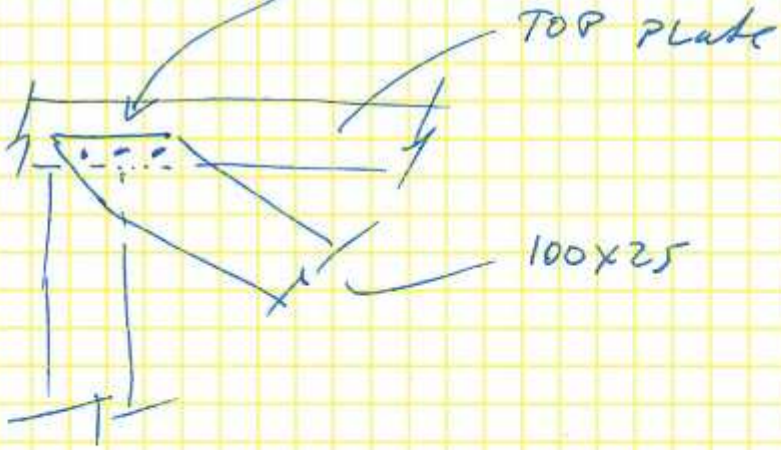
Detail (A)



3 - Nails (90 x 3.55) or
75 x 3.15

Section (1)

Detail B



Beca

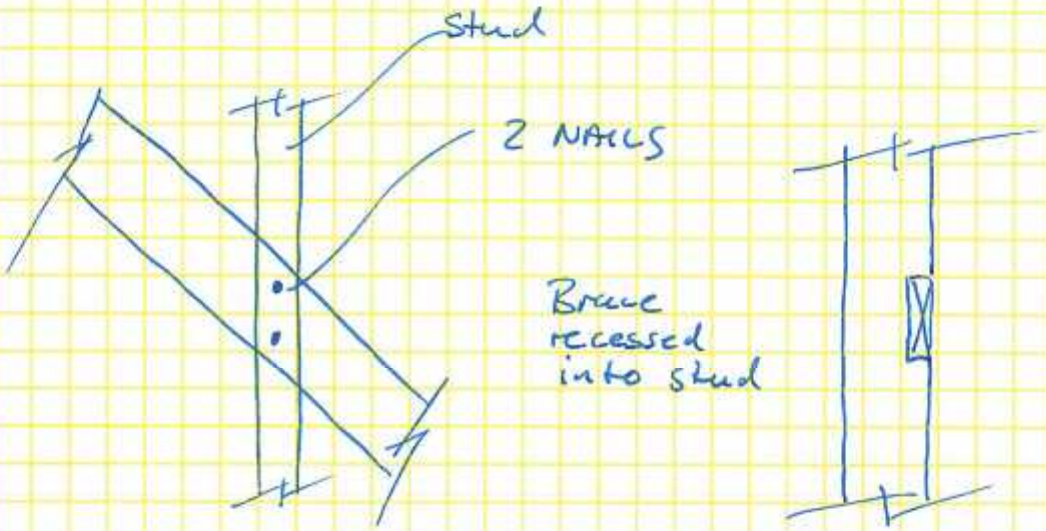
Job Title: CCC Properties

Sketch Title: CWTP Vehicle Garage:
Part 1, Area 2 Site Measurements

Date: 10/10/2012	Job No: 5323355
Scale: NTS	Sketch No: 5323355/109 SK08
Drawn: SR	Rev:
Verified:	

Reason for Issue: For Information

Detail C



Appendix D

CERA DEE Summary Data

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	CWTP Vehicle Garage Building Part 1, Area 1			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Christchurch Wastewater Treatment Plant		Shuttle Drive	Company:	Beca
Legal Description:	BU 0879-019 EO2			Company project number:	5323355
				Company phone number:	03 366 3521
	Degrees	Min	Sec		
GPS south:				Date of submission:	
GPS east:				Inspection Date:	1/02/2013, 14/02/2012, 24/02/2012
				Revision:	
Building Unique Identifier (CCC):				Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	3
Soil type:	silty sand	Soil Profile (if available):	Geotech report available for parts of site
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	17.00

Building

No. of storeys above ground:	1	single storey = 1		Ground floor elevation (Absolute) (m):	17.00
Ground floor split?	no			Ground floor elevation above ground (m):	0.00
Storeys below ground	0				
Foundation type:	other (describe)			if Foundation type is other, describe:	Pad footing and strip footing
Building height (m):	3.20		height from ground to level of uppermost seismic mass (for IEP only) (m):		3.2
Floor footprint area (approx):	133				
Age of Building (years):	50			Date of design:	1935-1965
Strengthening present?	no			If so, when (year)?	
				And what load level (%g)?	
Use (ground floor):	other (specify)			Brief strengthening description:	
Use (upper floors):					
Use notes (if required):	Storage				
Importance level (to NZS1170.5):	II.2				

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	UB rafters with timber purlins. Lightweight roof on timber sarking.
Floors:	concrete flat slab	slab thickness (mm)	150mm slab on grade
Beams:	steel non-composite	beam and connector type	Welded connection at one side and bolted connection at other side.
Columns:	other (note)	typical dimensions (mm x mm)	UB column at one side and timber post at other side.
Walls:	non-load bearing	0	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**			Diagonal timber bracing, no lining
Ductility assumed, μ:	1.25			note typical wall length (m)	19
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	lightweight timber framed walls				plasterboard lined
Ductility assumed, μ:	3.00			note typical wall length (m)	7
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	none
Wall cladding:	brick or tile	describe (note cavity if exists)	brick veneer
Roof Cladding:	Other (specify)	describe	flexaphalt on top of sarking
Glazing:	other (specify)		none
Ceilings:	none		
Services(list):			

Available documentation

Architectural			Griffiths Moffat & Partners 1968, for extension none for original section
Structural	partial	original designer name/date	Griffiths Moffat & Partners 1968
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site:	Site performance:	Widespread liquefaction on site	Describe damage:	
(refer DEE Table 4-2)				
	Settlement:	none observed	notes (if applicable):	
	Differential settlement:		notes (if applicable):	
	Liquefaction:		notes (if applicable):	Widespread liquefaction on site
	Lateral Spread:		notes (if applicable):	
	Differential lateral spread:		notes (if applicable):	
	Ground cracks:		notes (if applicable):	
	Damage to area:		notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	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:	Cracking to veneer

Recommendations

	Level of repair/strengthening required:	minor non-structural		Describe:	Damaged brick veneer
	Building Consent required:	no		Describe:	
	Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	49%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology:	Force Based Quantitative Assessment
	Assessed %NBS after e'quakes:	49%			
Across	Assessed %NBS before e'quakes:	43%	##### %NBS from IEP below		
	Assessed %NBS after e'quakes:	43%			

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

Period of design of building (from above): 1935-1965 — h_n from above: 3.2m

Seismic Zone, if designed between 1965 and 1992:

	along	across
	not required for this age of building	
	not required for this age of building	
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

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

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6:

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

Building Importance level (from above): 2
Return Period Scaling factor from Table 3.1, **Factor C:**

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =$k\mu$, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:

Structural Performance Scaling Factor **Factor E**:	#DIV/0!	#DIV/0!

2.7 Baseline %NBS, $(NBS\%)_b = (\%NBS)_{nom} \times A \times B \times C \times D \times E$ — **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential
Pounding effect D1, from Table to right
Height Difference effect D2, from Table to right
Therefore, Factor D: 0

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR) **0.00** **0.00**

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

4.4 Percentage New Building Standard (%NBS), (before) **#DIV/0!**

Official Use only:
Accepted By
Date:

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	CWTP Vehicle Garage Building Part 1, Area 1 Extension			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Christchurch Wastewater Treatment Plant		Shuttle Drive	Company:	Beca
Legal Description:	BU 0879-019 EO2			Company project number:	5323355
				Company phone number:	03 366 3521
	Degrees	Min	Sec		
GPS south:				Date of submission:	
GPS east:				Inspection Date:	1/02/2013, 14/02/2012, 24/02/2012
				Revision:	
Building Unique Identifier (CCC):				Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	3
Soil type:	silty sand	Soil Profile (if available):	Geotech report available for parts of site
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	17.00

Building

No. of storeys above ground:	1	single storey = 1	Ground floor elevation (Absolute) (m):	17.00
Ground floor split?	no		Ground floor elevation above ground (m):	0.00
Storeys below ground	0			
Foundation type:	other (describe)		if Foundation type is other, describe:	Pad footing and strip footing
Building height (m):	3.20	height from ground to level of uppermost seismic mass (for IEP only) (m):		3.2
Floor footprint area (approx):	208			
Age of Building (years):	50		Date of design:	1935-1965
Strengthening present?	no		If so, when (year)?	
			And what load level (%g)?	
Use (ground floor):	other (specify)		Brief strengthening description:	
Use (upper floors):				
Use notes (if required):	Storage			
Importance level (to NZS1170.5):	II.2			

Gravity Structure

Gravity System:	frame system		
Roof:	timber framed	rafter type, purlin type and cladding	UB rafters with timber purlins. Lightweight roof on timber sarking.
Floors:	concrete flat slab	slab thickness (mm)	150mm slab on grade
Beams:	steel non-composite	beam and connector type	Welded connection at one side and bolted connection at other side.
Columns:	other (note)	typical dimensions (mm x mm)	UB column at one side and timber post at other side.
Walls:	non-load bearing	0	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**			Diagonal timber bracing, no lining
Ductility assumed, μ:	1.25			note typical wall length (m)	26
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	lightweight timber framed walls				plasterboard lined
Ductility assumed, μ:	3.00			note typical wall length (m)	8
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	none
Wall cladding:	brick or tile	describe (note cavity if exists)	brick veneer
Roof Cladding:	Other (specify)	describe	flexaphalt on top of sarking
Glazing:	other (specify)		none
Ceilings:	none		
Services(list):			

Available documentation

Architectural	partial	original designer name/date	Griffiths Moffat & Partners 1968
Structural	partial	original designer name/date	Griffiths Moffat & Partners 1968
Mechanical		original designer name/date	
Electrical		original designer name/date	
Geotech report		original designer name/date	

Damage

Site: (refer DEE Table 4-2)

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

Building:

Current Placard Status:	green			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	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:	Cracking to veneer

Recommendations

Level of repair/strengthening required:	minor non-structural		Describe:	Damaged brick veneer
Building Consent required:	no		Describe:	
Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	64%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: Force Based Quantitative Assessment
	Assessed %NBS after e'quakes:	64%		
Across	Assessed %NBS before e'quakes:	78%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	78%		

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

Period of design of building (from above): 1935-1965 — h_n from above: 3.2m

Seismic Zone, if designed between 1965 and 1992:

	along	across
	not required for this age of building	
	not required for this age of building	
Period (from above):	0.4	0.4
(%NBS)nom from Fig 3.3:		

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

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6:

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =$k\mu$, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:

Structural Performance Scaling Factor **Factor E**: #DIV/0! #DIV/0!

2.7 Baseline %NBS, $(NBS\%)_b$ = $(\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential
Pounding effect D1, from Table to right
Height Difference effect D2, from Table to right
Therefore, Factor D: 0

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR) **0.00** **0.00**

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

4.4 Percentage New Building Standard (%NBS), (before) **#DIV/0!**

Official Use only:
Accepted By
Date:

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	CWTP Vehicle Garage Building Part 1 Area 2			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Christchurch Wastewater Treatment Plant		Shuttle Drive	Company:	Beca
Legal Description:	BU 0879-019 EO2			Company project number:	5323355
				Company phone number:	03 366 3521
	Degrees	Min	Sec		
GPS south:				Date of submission:	
GPS east:				Inspection Date:	1/02/2013, 14/02/2012, 24/02/2012
				Revision:	
Building Unique Identifier (CCC):				Is there a full report with this summary?	yes

Site

Site slope:	slope < 1in 10	Max retaining height (m):	3
Soil type:	silty sand	Soil Profile (if available):	Geotech report available for parts of site
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	17.00

Building

No. of storeys above ground:	1	single storey = 1		Ground floor elevation (Absolute) (m):	17.00
Ground floor split?	no			Ground floor elevation above ground (m):	0.00
Storeys below ground	0				
Foundation type:	other (describe)			if Foundation type is other, describe:	strip footing
Building height (m):	3.40	height from ground to level of uppermost seismic mass (for IEP only) (m):			3.4
Floor footprint area (approx):	106				
Age of Building (years):	50			Date of design:	1935-1965
Strengthening present?	no			If so, when (year)?	
				And what load level (%g)?	
Use (ground floor):	other (specify)			Brief strengthening description:	
Use (upper floors):					
Use notes (if required):	Offices				
Importance level (to NZS1170.5):	II.2				

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	Timber rafter with timber purlins. Lightweight roof on timber sarking.
Floors:	concrete flat slab	slab thickness (mm)	150mm slab on grade
Beams:	timber	type	timber frame walls
Columns:	timber	typical dimensions (mm x mm)	100x50
Walls:	non-load bearing		0

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls	**Note: Define along and across in detailed report!**			Diagonal timber bracing, no lining
Ductility assumed, μ:	1.25			note typical wall length (m)	4
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	lightweight timber framed walls				Diagonal timber bracing, no lining
Ductility assumed, μ:	1.25			note typical wall length (m)	4
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	none
Wall cladding:	brick or tile	describe (note cavity if exists)	brick veneer
Roof Cladding:	Other (specify)	describe	unknown
Glazing:	timber frames		
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Widespread liquefaction on site	Describe damage:	
Settlement:	none observed	notes (if applicable):	
Differential settlement:		notes (if applicable):	
Liquefaction:		notes (if applicable):	Widespread liquefaction on site
Lateral Spread:		notes (if applicable):	
Differential lateral spread:		notes (if applicable):	
Ground cracks:		notes (if applicable):	
Damage to area:		notes (if applicable):	

Building:

Current Placard Status:	green			
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	
	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:	Cracking to veneer

Recommendations

Level of repair/strengthening required:	minor non-structural		Describe:	Damaged brick veneer
Building Consent required:	no		Describe:	
Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: Force Based Quantitative Assessment
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	78%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	78%		

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

Period of design of building (from above): 1935-1965 — h_n from above: 3.4m

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building
not required for this age of building

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

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

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6:

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =$k\mu$, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:

Structural Performance Scaling Factor **Factor E**: #DIV/0! #DIV/0!

2.7 Baseline %NBS, $(NBS\%)_b$ = $(\%NBS)_{nom}$ x A x B x C x D x E **$\%NBS_b$:** **#DIV/0!** **#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential
Pounding effect D1, from Table to right
Height Difference effect D2, from Table to right
Therefore, Factor D: 0

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR) **0.00** **0.00**

4.3 PAR x (%NBS)b: PAR x Baselline %NBS: **#DIV/0!** **#DIV/0!**

4.4 Percentage New Building Standard (%NBS), (before) **#DIV/0!**

Official Use only:
Accepted By
Date:

Detailed Engineering Evaluation Summary Data V1.11

Location

Building Name:	CWTP Vehicle Garage Building Part 2			Reviewer:	David Whittaker
	Unit	No:	Street	CPEng No:	123089
Building Address:	Christchurch Wastewater Treatment Plant		Shuttle Drive	Company:	Beca
Legal Description:	BU 0879-019 EO2			Company project number:	5323355
				Company phone number:	03 366 3521
	Degrees	Min	Sec		
GPS south:				Date of submission:	
GPS east:				Inspection Date:	1/02/2013, 14/02/2012, 24/02/2012
				Revision:	
Building Unique Identifier (CCC):				Is there a full report with this summary?	yes

Site

Site slope:	flat	Max retaining height (m):	3
Soil type:	silty sand	Soil Profile (if available):	Geotech report available for parts of site
Site Class (to NZS1170.5):	D		
Proximity to waterway (m, if <100m):		If Ground improvement on site, describe:	None
Proximity to clifftop (m, if < 100m):			
Proximity to cliff base (m,if <100m):		Approx site elevation (m):	17.00

Building

No. of storeys above ground:	1	single storey = 1		Ground floor elevation (Absolute) (m):	17.00
Ground floor split?	no			Ground floor elevation above ground (m):	0.00
Storeys below ground	0				
Foundation type:	other (describe)			if Foundation type is other, describe:	strip footing
Building height (m):	3.40	height from ground to level of uppermost seismic mass (for IEP only) (m):			3.4
Floor footprint area (approx):	83				
Age of Building (years):	50			Date of design:	1935-1965
Strengthening present?	no			If so, when (year)?	
				And what load level (%g)?	
Use (ground floor):	other (specify)			Brief strengthening description:	
Use (upper floors):					
Use notes (if required):	Offices				
Importance level (to NZS1170.5):	II.2				

Gravity Structure

Gravity System:	load bearing walls		
Roof:	timber framed	rafter type, purlin type and cladding	
Floors:	concrete flat slab	slab thickness (mm)	150mm slab on grade
Beams:	timber	type	timber frame walls
Columns:	timber	typical dimensions (mm x mm)	
Walls:	non-load bearing	0	

Lateral load resisting structure

Lateral system along:	lightweight timber framed walls		**Note: Define along and across in detailed report!**		
Ductility assumed, μ:	3.00			note typical wall length (m)	4
Period along:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	
Lateral system across:	lightweight timber framed walls				
Ductility assumed, μ:	3.00			note typical wall length (m)	4
Period across:	0.40	0.00		estimate or calculation?	estimated
Total deflection (ULS) (mm):				estimate or calculation?	estimated
maximum interstorey deflection (ULS) (mm):				estimate or calculation?	

Separations:

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

Non-structural elements

Stairs:	other (specify)	describe	none
Wall cladding:	brick or tile	describe (note cavity if exists)	brick veneer
Roof Cladding:	Other (specify)	describe	unknown
Glazing:	timber frames		
Ceilings:	fibrous plaster, fixed		
Services(list):			

Available documentation

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

Damage

Site: (refer DEE Table 4-2)

Site performance:	Widespread liquefaction on site		Describe damage:	
Settlement:	none observed		notes (if applicable):	
Differential settlement:			notes (if applicable):	
Liquefaction:			notes (if applicable):	Widespread liquefaction on site
Lateral Spread:			notes (if applicable):	
Differential lateral spread:			notes (if applicable):	
Ground cracks:			notes (if applicable):	
Damage to area:			notes (if applicable):	

Building:

	Current Placard Status:	green		
Along	Damage ratio:	0%	Describe how damage ratio arrived at:	Damage to concrete slab
	Describe (summary):			
Across	Damage ratio:	0%		
	Describe (summary):			
Diaphragms	Damage?:	no	Describe:	
CSWs:	Damage?:	no	Describe:	
Pounding:	Damage?:	no	Describe:	
Non-structural:	Damage?:	yes	Describe:	Cracking to veneer

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

Recommendations

Level of repair/strengthening required:	minor non-structural		Describe:	Damaged brick veneer and slab
Building Consent required:	no		Describe:	
Interim occupancy recommendations:	full occupancy		Describe:	
Along	Assessed %NBS before e'quakes:	100%	##### %NBS from IEP below	If IEP not used, please detail assessment methodology: Assessed using NZS3604
	Assessed %NBS after e'quakes:	100%		
Across	Assessed %NBS before e'quakes:	72%	##### %NBS from IEP below	
	Assessed %NBS after e'quakes:	72%		

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

Period of design of building (from above): 1935-1965 — h_n from above: 3.4m

Seismic Zone, if designed between 1965 and 1992:

not required for this age of building
not required for this age of building

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

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

	along	across
Final $(\%NBS)_{nom}$:	**0%**	**0%**

2.2 Near Fault Scaling Factor

Near Fault scaling factor, from NZS1170.5, cl 3.1.6:

	along	across
Near Fault scaling factor (1/N(T,D), **Factor A**:	#DIV/0!	#DIV/0!

2.3 Hazard Scaling Factor

Hazard factor Z for site from AS1170.5, Table 3.3:
Z_{1992}, from NZS4203:1992
Hazard scaling factor, **Factor B:** #DIV/0!

2.4 Return Period Scaling Factor

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

2.5 Ductility Scaling Factor

	along	across
Assessed ductility (less than max in Table 3.2)		
Ductility scaling factor: =1 from 1976 onwards; or =k_μ, if pre-1976, fromTable 3.3:		
Ductiity Scaling Factor, **Factor D**:	0.00	0.00

2.6 Structural Performance Scaling Factor:

Sp:		
Structural Performance Scaling Factor **Factor E**:	#DIV/0!	#DIV/0!

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

$\%NBS_b$:	**#DIV/0!**	**#DIV/0!**

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

3.1. Plan Irregularity, factor A: 1

3.2. Vertical irregularity, Factor B: 1

3.3. Short columns, Factor C: 1

3.4. Pounding potential
Pounding effect D1, from Table to right
Height Difference effect D2, from Table to right
Therefore, Factor D: 0

3.5. Site Characteristics 1

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

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

3.6. Other factors, Factor F

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

Detail Critical Structural Weaknesses: (refer to DEE Procedure section 6)
List any: Refer also section 6.3.1 of DEE for discussion of F factor modification for other critical structural weaknesses

3.7. Overall Performance Achievement ratio (PAR)	**0.00**	**0.00**
4.3 PAR x (%NBS)b: PAR x Baselline %NBS:	**#DIV/0!**	**#DIV/0!**
4.4 Percentage New Building Standard (%NBS), (before)		**#DIV/0!**

Official Use only:
Accepted By
Date:

Appendix E

Previous Reports and Assessments

CWTP 8

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & IJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1400		

Building Name Christchurch Wastewater Treatment Plant
Short Name = Education centre, Garage, Technicians' workshop
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m²) ≈ 600
Year built ?
No of residential Units 0

Photo Taken (Yes) No

Type of Construction
- ☑ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☑ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☐	☑	☐	• Large gaps (≈30mm) in brickwork on north-western wall (by digester 4)
Overhead falling hazard	☑	☐	☐	Gaps in brickwork between walls on northern face. Cracks in brickwork / mortar at south-eastern edge.
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: **Existing Placard Type (e.g. UNSAFE)**

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Stewart (Beca)
Date & Time: 7/3/11
ID: NS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTPB Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections N/A	☐	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	• Evidence of slope movement next to Digesters 4
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

General Comment

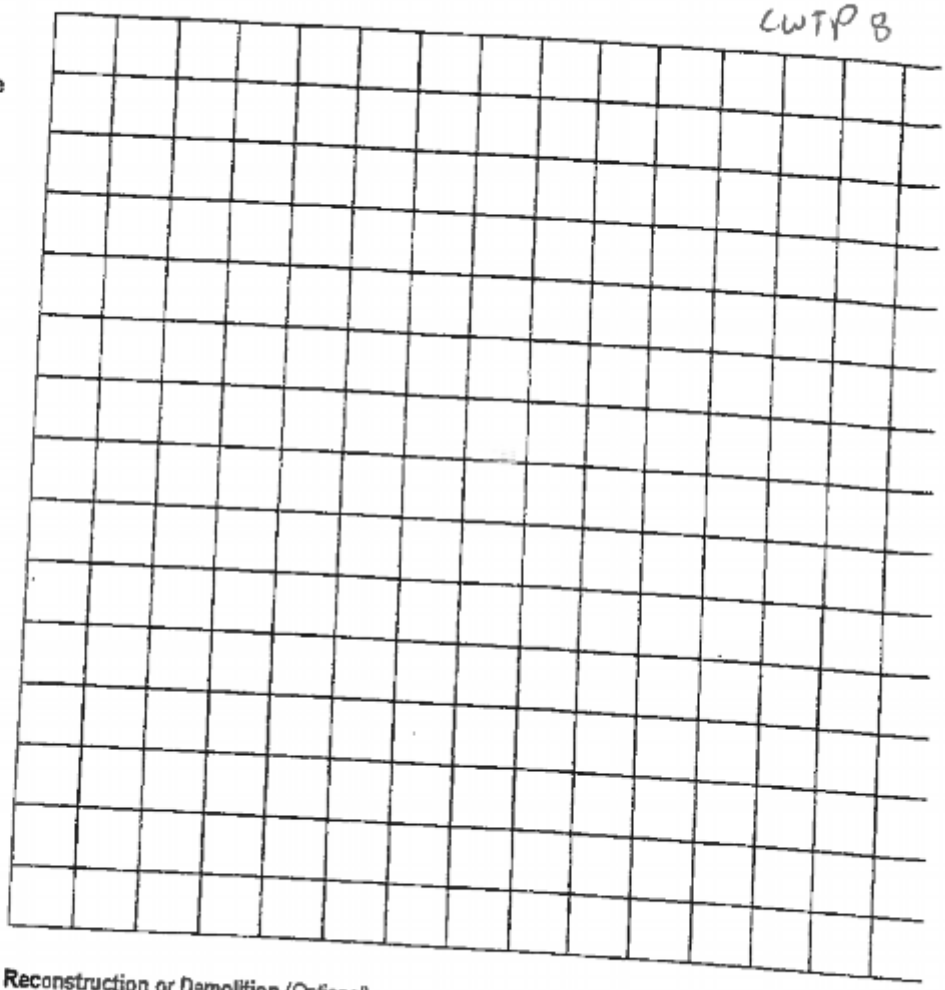
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 8



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the displaced brickwork on northern wall by Digester 4 be removed and re-instated.
- Recommend cracked mortar in brickwork be removed and the brickwork be re-pointed.

Report

Christchurch Wastewater Treatment Plant: Post-Earthquake Structural Damage Assessment

Prepared for Christchurch City Council (CCC)

By CH2M Beca Ltd (Beca)

1 April 2011

Revision History

Revision Nº	Prepared By	Description	Date
A	Nik Stewart	Draft	23 March 2011
B	Nik Stewart	Final	1 April 2011

Document Acceptance

Action	Name	Signed	Date
Prepared by	Nik Stewart		1 April 2011
Reviewed by	Ian Billings		1 April 2011
Approved by	Greg Offer		1 April 2011
on behalf of	CH2M Beca Ltd		

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Appendices

Appendix A – Structural Damage Register Spreadsheet

Appendix B – Christchurch Earthquake Level 2 Rapid Assessment Forms

Appendix C – Sika Products Technical Data Sheets

Executive Summary

CH2M Beca Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake post-earthquake structural assessments for buildings at the Christchurch Wastewater Treatment Plant (CWTP). These assessments were carried out due to damage caused by the magnitude 7.1 Canterbury Earthquake on 4 September 2010 and the magnitude 6.3 Christchurch Earthquake on 22 February 2011 and subsequent aftershocks

The scope of the structural assessment works include:

- Locating, describing and documenting earthquake damage to the structural components of the buildings to serve as a record to CCC.
- Review of the available construction drawings for the buildings.
- Identification of those areas that require structural remedial works and propose remedial methodologies for each typical defect. Repair methodologies are intended to bring the buildings back to, or as near as reasonably practical to, the buildings' condition prior to the earthquake events.

A visual inspection of damage to the structures at the CWTP and review of the construction drawings shows that in general the primary structural elements behaved adequately and sustained only relatively minor damage.

In general, to return the buildings to as near its original state as possible, all cracking to structural concrete and masonry should be grouted or epoxy injected.

However, a number of additional investigations are recommended which may result in identifying further damage. This damage may be significant. In particular additional investigations are recommended for the primary sedimentation tanks, solids contact tanks, north and south gallery structures, trickling filters and the clarifiers.

This summary is a limited précis of our observations and conclusions. Where any question arises as to the scope of the assessment undertaken by us, or the interpretation of this summary, the full report should be reviewed, or CH2M Beca Ltd consulted.

1 Introduction

1.1 Background

CH2M Beca Ltd (Beca) has been engaged by Christchurch City Council (CCC) to undertake post-earthquake structural assessments for buildings at the Christchurch Wastewater Treatment Plant (CWTP). These assessments were carried out due to damage caused by the magnitude 7.1 Canterbury Earthquake on 4 September 2010 and the magnitude 6.3 Christchurch Earthquake on 22 February 2011 and subsequent aftershocks. The 7.1 magnitude and in particular 6.3 magnitude earthquakes resulted in widespread damage to buildings and infrastructure in the Christchurch region.

CCC has requested all buildings at the CWTP to be assessed and structural evaluation reports for buildings be provided. Detailed inspections for buildings at the plant were carried out on 5 and 7 March 2011.

The structural assessment carried out by Beca fulfils the following function:

- Locate, describe and document earthquake damage to the structural components of the buildings to serve as a record to CCC. Identify those areas that require structural remedial works and propose remedial methodologies for each typical defect. Repair methodologies are intended to bring the buildings back to, or as near as reasonably practical to, the buildings' condition prior to the earthquake events.

Since the main earthquakes of 4 September 2010 and 22 February 2011, there have been a number of aftershocks. The information in this report provides a snapshot of building damage at the time the detailed inspections were carried out. No further inspections have been completed since these dates. Any questions regarding this report's validity should be referred to Beca in the first instance.

1.2 Scope of Work

This document serves as a record of the structural inspections undertaken and it may also be submitted to CCC as a basis for initial discussion prior to preparation of Building Consent documentation, if required.

The specific Beca scope of work for the detailed structural evaluation is as follows:

- Carry out detailed structural inspections and a damage survey of the structural elements for each building and provide recommendations for any further investigation that may be required.
- Review the original construction drawings for the buildings, if available. The purpose of this review will be to identify concealed structural components of the building that may have suffered damage and therefore warrant inspection.
- Upon completion of the above, prepare a report to that includes a record of the inspection undertaken, photos of the various areas of damage, findings, repair methodology and associated remedial works.
- The report will highlight areas requiring remedial work and will suggest a basic methodology with the intention of bringing the buildings up to, or as near as reasonably practical to, the buildings' condition prior to the earthquake.

1.3 Limitations

The following limitations apply to this engagement:

- Beca and its employees and agents are not able to give any warranty or guarantee that all defects, damage, conditions or qualities have been identified.
- Inspections are primarily limited to visible structural components. Appropriate locations for invasive inspection, if required, will be based on damage patterns observed in visible elements, and review of the construction drawings and structural system. As such, there will be concealed structural elements that will not be directly inspected.
- The inspections are limited to building structural components only. Structural components in this instance are primary, secondary or tertiary structural elements constructed from concrete, steel, timber or masonry.
- Inspection of building services, pipework, pavement and fire safety systems is excluded from the scope of this report.
- Inspection of the glazing systems, linings, carpets, claddings, finishes, suspended ceilings, partitions, and the general water tightness envelope is excluded from the scope of this report.
- The information in this report provides a snapshot of building damage at the time the detailed inspection was carried out. Additional inspections required as a result of significant aftershocks are outside the scope of this work.

This report is of defined scope and is for reliance by CCC only, and only for this commission. Beca should be consulted where any question regarding the interpretation or completeness of our inspection or reporting arises.

This report should be read in conjunction with the letter report entitled “CWTP Earthquake Structural Damage Assessment” dated 9 September 2010 and the report entitled “CWTP Earthquake Damage – Minor Structural Repairs” dated 20 October 2010 for the assessed damage and proposed repair methodologies following the 4 September 2010 earthquake.

It is noted that some of the damage noted in this current report may be associated with the 4 September earthquake and subsequent aftershocks.

This report should also be read in conjunction with The Oxidation Pond condition report for the September 2010 earthquake entitled "Christchurch Wastewater Treatment Plant - Damage to Oxidation Ponds in the 2010 Darfield Earthquake".

The damage assessment and reporting following the February 2011 earthquake for the Oxidation Ponds, Civil Works and Mechanical & Electrical Works was not completed at the time of writing this report.

2 Summary of Buildings and Structures

The Christchurch Wastewater Treatment Plant is located the end of Shuttle Drive in Bromley approximately 5 kilometres from central Christchurch. An aerial view of the plant is shown in Figure 1 below.

Figure 1 – Aerial View of CWTP

The plant comprises several buildings / structures as outlined below.

1) Administration Building
2) Operations Building
3) Pump Station A / Basement Storeroom / 11kV Switchroom
4) Workshop & Emergency Equipment Store (to the North of PS-A)
5) Screen Room
6) Engine Room & Workshop to the South
7) Thickener Building & Pump Station B
8) Education Centre / Garage / Technicians' Workshop
9) Dewatering Building
10) Dryer Building
11) Energy Centre Building
12) North Gallery
13) South Gallery

14) Primary Sedimentation Tanks and Solids Contact Tanks
15) Sludge Lagoons
16) Influent Structure
17) Trickling Filters 1 and 2
18) Digesters 1 - 4
19) Digesters 1 - 4 Control Building
20) Digesters 5 & 6 and Underground Gallery
21) Digesters 5 & 6 Control Building
22) Clarifiers 1 - 4
23) RAS / WAS Pump Station
24) Water Tank and Gas Holder Tank

3 Structure Inspection Overview

3.1 Inspection Methodology

The buildings were inspected around the full perimeter of the exterior from the ground. Buried foundation elements were not inspected, but based on observations at the ground level this is not considered to be necessary. All buildings were inspected internally with the exception of the Energy Centre building and the RAS / WAS Pump Station building. The interior of the Digesters, Clarifiers and several of the Primary Sedimentation Tanks could not be inspected. Most of the structural systems such as the concrete and masonry walls were not clad with any material and were typically only covered by paint.

3.2 Assessment Summary

In general based on the visual inspection, with respect structural load-carrying capacity, all buildings and structures appear to have performed adequately with generally only minor structural damage.

In general, to return the buildings to as near its original state as possible, all cracking to structural concrete and masonry should be grouted or epoxy injected.

However, refer to Section 6 for recommendations for additional investigations which may reveal additional damage which may be significant.

3.3 Damage Classification System

Table 1 below classifies damage into general categories. These categories have been chosen based on several factors, including:

- The effect of the defect on the strength and stiffness of the structure.
- The effect of the defect on the durability of the structural element.
- Suggested repair method.

Structural damage that falls outside the scope of the table will be considered on a case by case basis.

Table 1– Classification of Damage Type for Primary and Secondary Structural Elements

Damage Type	General Damage Description
Type 1	Cracks in concrete structures that do not exceed a width of 0.3 mm. These cracks are not likely to have any adverse effect on structure durability. The structural system will also perform satisfactorily without repair of the damage of this type. There is therefore no requirement to repair Type 1 cracks in order to meet Building Code compliance. However, both the building's aesthetic and stiffness are affected. If left unrepaired, the building's response to loading will not be the same as prior to the earthquake damage. The building will be more flexible than it was prior to the earthquake, and therefore the serviceability limits maybe exceeded in certain conditions i.e. strong winds; however building safety will not be compromised. In order to return the building to as near to the original performance as possible, the cracks should be repaired as far as is practical with an epoxy or grout injection system (Sikadur Injectokit-LV or equivalent). Note it is often not feasible to repair crack widths less than around 0.2 mm. For crack widths less than 0.2 mm the surface shall be cleaned and painted with Sikagard 550 elastomeric paint.
Type 2	Cracks in concrete structures that exceed a crack width of 0.3mm, but less than 1.0 mm. These cracks require remedial work. In order to restore Building Code durability requirements these cracks should be repaired with a surface treatment of grout or crack sealant, however the building's stiffness will not be improved with this repair and the building will remain more flexible than it was prior to the earthquake. In order to return the building to as near to its original performance as possible, the cracks should be repaired with an epoxy or grout injection system (Sikadur Injectokit-TH or equivalent).
Type 3	Cracks in a concrete structure that exceed a crack width of 1.0 mm. These cracks require remedial work to the visibly affected area, and further investigation to confirm if remedial work is required to unseen areas. The cracks should be repaired with an epoxy or grout injection system (Sikadur 52 epoxy grout or equivalent)
Type 4	Spalling to concrete elements. Spalling is unlikely to have a major effect on the structure unless it is particularly severe. However, spalling should be repaired using a structural mortar system to reinstate cover to reinforcement and for aesthetic reasons. Square off edges of concrete spalling with angle grinder to a minimum depth of 10mm. If reinforcement is visible, remove rust and corrosion products from reinforcement using cup brush or rust removing attachment on an angle grinder. Apply Sika MonoTop Primer to reinforcement and concrete substrate as per the manufacturer's recommendations. Apply Sika MonoTop Structural Mortar to build to original profile as per the manufacturer's recommendations. Equivalent products may be used.
Type 5	Damage to mortar in masonry elements. Mortar damage can reduce the resilience of a masonry façade to earthquake shaking. Damaged mortar should be removed and the masonry repointed.

Note: The 0.3 mm limit is sourced from Concrete Structures Standard NZS 3101 Commentary, stating that corrosion of reinforcing steel is not likely to be affected by crack widths less than 0.3 mm.

4 Detailed Inspection Observations

The following section outlines the results of the visual inspection, a description of the damage and likely repair methodologies. Refer to Appendix A for a damage summary and Appendix B for the Level 2 Rapid Assessment Forms.

It was noted there was general minor liquefaction around the site as evidenced by sand and silt and by observations by CWTP staff at the time of the earthquake. Ground settlement in the order of 50 mm to 300 mm was widespread around the site.

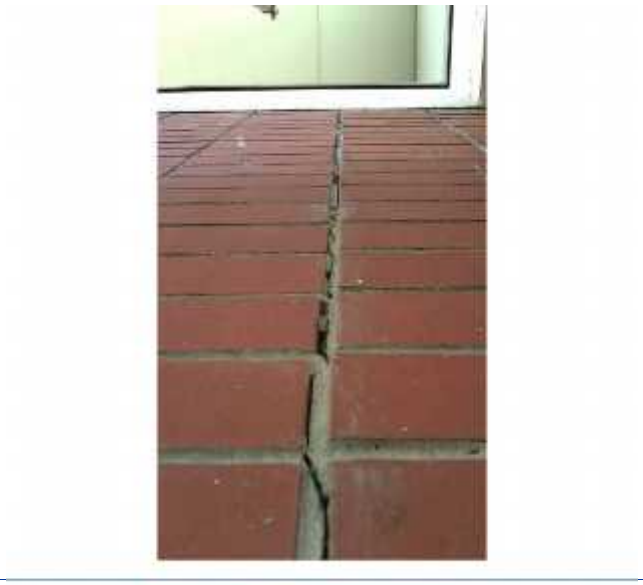
4.1 Administration Building

The administration building appears to be in good condition for its age and does not appear to show any signs of significant structural damage due to the earthquakes.

4.2 Operations Building

The operations building comprises the Control Room, laboratories and offices. Other than the relatively minor damage as outlined below the operations building appeared to be in good condition.

Ref.	Image	Description	Damage Type / Repair
S2.1		Diagonal cracking in wall next to opening near entrance to the Control Room (approx. 1 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system.

Ref.	Image	Description	Damage Type / Repair
S2.2		Mortar is cracked in brick cladding outside the south-west doorway (view looking upwards towards the eaves).	*Type 5*. Remove cracked mortar and repoint masonry.
S2.3		The timber purlins connecting to the western timber truss on the new roof structure have separated by approx 30 mm. (The roof structure was currently under construction).	Supply packers between purlins and truss. Install joist hangers.

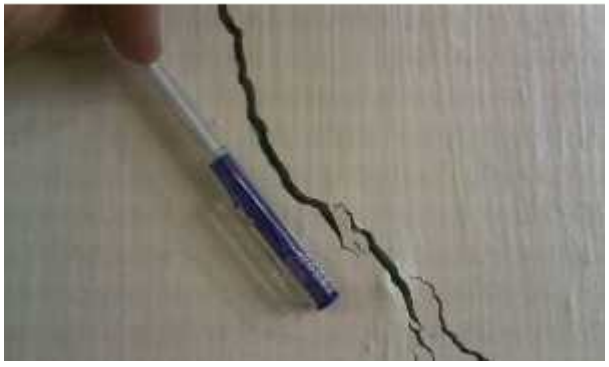
4.3 Pump Station A / Basement Storeroom / 11kV Switchroom

The building has reasonably large cracks (up to 5 mm) in the southern basement wall and the eastern ground floor wall. There is also a crack across the mezzanine floor from the basement stairs to the eastern wall. As outlined below the crack in the mezzanine floor does not weaken the vertical load-carrying capacity and the cracks in the wall do not compromise the stability of the walls.

The brick veneer cladding on the exterior walls appeared to be in good condition.

The ceiling panels above the pump station had fallen as a result of the earthquake.

It is recommended a level survey be carried out to better understand the damage behaviour. If significant settlement or heaving has occurred, it is recommended that subsurface investigation be carried out to assess the extent of damage to the structure below ground and the whether there are any voids beneath the foundation.

Ref.	Image	Description	Damage Type / Repair
S3.1		Large cracks in south basement wall (up to 5 mm crack width).	*Type 3*. Repair with an epoxy or grout injection system.
S3.2a & S3.3		Large cracks to eastern ground level wall next to men's changing room (up to 3 mm crack width). View from mezzanine floor.	*Type 3*. Repair with an epoxy or grout injection system.
S3.2b		Large cracks to eastern ground level wall next to men's changing room. View from inside men's changing room.	*Type 3*. Repair with an epoxy or grout injection system.
S3.2c		Close-up view of large cracks to eastern ground level wall next to men's changing room.	*Type 3*. Repair with an epoxy or grout injection system.

Ref.	Image	Description	Damage Type / Repair
S3.4	(no image)	Cracking to eastern basement wall (approx 0.3 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system.
S3.5		Cracking in mezzanine floor. The mezzanine floor is supported by a reinforced concrete beam spanning east-west. Therefore the cracks in the mezzanine floor do not compromise the vertical load capacity of the floor.	*Type 2*. Repair with an epoxy or grout injection system.
S3.5		Cracking in mezzanine floor with covering removed.	*Type 2*. Repair with an epoxy or grout injection system.
S3.5		Cracking in mezzanine floor with crack propagating from edge.	*Type 2*. Repair with an epoxy or grout injection system.

Ref.	Image	Description	Damage Type / Repair
S3.5		Cracking in mezzanine floor.	*Type 2*. Repair with an epoxy or grout injection system.
S3.6	(no image)	Cracks in basement floor slab (up to approx 1 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system.
S3.7 & S3.8		Cracks in southern column and cracks in reinforced concrete floor slab of 11 kV switchroom.	*Type 2*. Repair with an epoxy or grout injection system.

Ref.	Image	Description	Damage Type / Repair
S3.9		Gaps between the infill brickwork and the RC column in 11 kV switchroom.	*Type 5*. Remove cracked mortar and repoint masonry
S3.10		Cracks in walls of storeroom beside PS-A.	*Type 2*. Repair with an epoxy or grout injection system

4.4 Workshop & Emergency Equipment Store (to the North of PS-A)

Other than the cracking as outlined below, the workshop and emergency equipment store did not appear to have suffered significant structural damage as a result of the earthquakes.

Ref.	Image	Description	Damage Type / Repair
S4.1		Cracking to columns (at two locations).	*Type 2*. Repair with an epoxy or grout injection system
S4.2a		Cracking to walls at entrance to workshop and inside workshop.	*Type 2*. Repair with an epoxy or grout injection system
S4.2b		Cracking to walls at entrance to workshop.	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S4.2c		Cracking to walls at entrance to workshop.	*Type 2/3*. Repair with an epoxy or grout injection system
S4.2d		Cracking to walls in workshop.	*Type 2*. Repair with an epoxy or grout injection system
S4.3		Cracking in beam at one location	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S4.4	(no image)	Cracking to walls in emergency equipment store (up to 1 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system

4.5 Screen Room

Other than the cracking as outlined below, the screen room did not appear to have suffered significant structural damage as a result of the earthquakes.

Ref.	Image	Description	Damage Type / Repair
S5.1a		Diagonal cracks in north and south walls (approx 0.3 mm crack width)	*Type 2*. Repair with an epoxy or grout injection system
S5.1b		Diagonal cracks in north and south walls (approx 0.3 mm crack width)	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S5.2		Cracked mortar in blockwork on south-west wall.	*Type 5*. Remove cracked mortar and repoint masonry
S5.3		Horizontal cracks in walls (approx 0.3 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system

4.6 Engine Room and Workshop to the South

The engine room appears to show no signs of structural damage. However, most of the structure was hidden due to the sound-proof cladding. It is recommended a sample of cladding be removed and the structure behind it inspected for damage.

Other than the damage to the masonry infill the workshop appeared to be structurally sound.

Ref.	Image	Description	Damage Type / Repair
S6.1		In the workshop to the south of the engine room there was cracking in corner join between masonry wall and reinforced concrete columns. This was observed to be typical at all columns.	*Type 5*. Remove cracked mortar and repoint masonry.

4.7 Thickener Building & Pump Station B

The building does not appear to have suffered significant structural damage as a result of the earthquake. However, the cracked concrete at the pipe may be the result of differential settlement. It is recommended a level survey be carried out to determine the amount of structural differential settlement (if any). If the differential settlement is significant carry out sub-surface investigation to identify if there any voids underneath the structure.

Ref.	Image	Description	Damage Type / Repair
S7.1		Horizontal cracking next to windows on western side of building.	*Type 2*. Repair with an epoxy or grout injection system.
S7.2		Settlement of the ground at the north-eastern end of the building.	Remove loose soil and broken pavement, backfill, compact and replace pavement.
S7.3		Cracking (approx 0.2 mm crack width) on western wall near door on southern end of building.	*Type 1*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S7.4		Damage to concrete paving slab next to building at southern end of building.	*Type 4*. Repair with structural repair mortar system.
S7.5	(no image)	Cracking on eastern wall between roller doors (approx 0.3 mm crack width)	*Type 2*. Repair with an epoxy or grout injection system
S7.6		Cracking in eastern wall at northern end of building (approx 0.2 mm crack width)	*Type 1*. Repair with an epoxy or grout injection system
S7.7		Cracking to corbel supporting the crane rail beam on western side of building next to roller door.	*Type 4*. Inspect corbel, remove broken concrete and repair with structural repair mortar system.

Ref.	Image	Description	Damage Type / Repair
S7.8		Large crack to concrete where pump station pipe passes through wall.	Break out and replace concrete. Carry out level survey to assess whether the cracked pipe is the result of differential settlement or seismic shaking.
S7.9		Spalling to top of column at south-east end next to wall	*Type 4*. Repair with structural repair mortar system.
S7.10		Cracking in wall above internal door to southern room (0.2-0.3mm crack width)	*Type 1*. Repair with an epoxy or grout injection system.

4.8 Education Centre / Garage / Technicians' Workshop

Apart from the cracking to the masonry the buildings appear to have suffered minimal structural damage as a result of the earthquakes.

Ref.	Image	Description	Damage Type / Repair
S8.1a		Large cracks / gaps (30 mm) in brickwork on northern wall next to Digester 4. This appears to be the result of slope movement next to Digester No. 4 (as evidenced by tension cracks in the slope).	Investigate stability of slope. Remove and replace brickwork or remove brickwork completely and replace with timber framed wall (or similar).
S8.1b		Close-up view of large cracks / gaps in brickwork on north-western wall.	As above.
S8.2		Gaps in brickwork between walls on northern face.	*Type 5*. Remove cracked mortar and repoint masonry.

Ref.	Image	Description	Damage Type / Repair
S8.3		Cracks in brickwork mortar in eastern wall.	*Type 5*. Remove cracked mortar and repoint masonry.

4.9 Dewatering Building

Structural damage to the bio-solids dewatering building is minor.

Ref.	Image	Description	Damage Type / Repair
S9.1		Cracking / spalled concrete at base of concrete encased steel I-beam columns.	*Type 4*. Break out loose concrete and repair with structural repair mortar system.

Ref.	Image	Description	Damage Type / Repair
S9.2		Cracking in eastern walls (approx 0.3 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system.
S9.3		Cracking in columns.	*Type 2*. Repair with an epoxy or grout injection system.
S9.4		Large gap at steps at south-western corner of building.	Reinstate concrete and provide seal.

Ref.	Image	Description	Damage Type / Repair
S9.5		Cracks in walls at weld plate connections. This cracking was observed at several of the weld plate connections.	*Type 2*. Repair with an epoxy or grout injection system

4.10 Dryer Building

Other than the minor damaged areas as outlined below, the building appears to be structurally sound.

Ref.	Image	Description	Damage Type / Repair
S10.1		Spalling to top of interior wall panel on northern end of building.	*Type 4*. Break out loose concrete and repair with structural repair mortar system.
S10.2		Cracking in walls next to opening on western wall (approx 0.3 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S10.3	(no image)	Cracking above door on southern side of building (approx 0.3 mm crack width)	*Type 2*. Repair with an epoxy or grout injection system
S10.4	(no image)	Cracking to panels next to doors / windows on north face (approx 0.3 mm crack width)	*Type 2*. Repair with an epoxy or grout injection system

4.11 Energy Centre Building

The interior of the building could not be inspected. From the outside there were no apparent structural defects. However, from the inspection carried out by Beca after the 4 September 2010 earthquake, it was noted that the precast panels were cracked at the weld plate connections. It is likely further cracking to these panels will have occurred due to the 22 February 2011 earthquake.

These cracks will need to be repaired using an epoxy or grout injection system (Type 2 repair).

4.12 North Gallery

The most significant damage to the north gallery was the differential movement between the adjacent tunnel sections resulting in damage to the joint seals. This type of damage was observed at most of the joints. The joints did not appear to be leaking.

The construction drawings for the gallery structure show the joint in the channel floors comprises a square-ended slab with a 25 mm thick bitumen-impregnated fibre board with a PVC water-stop placed 75 mm from one edge and sealant on one edge. The drawings show the joint in the walls to have a tongue-and-groove type joint with a bitumen-impregnated fibreboard, a PVC water-stop placed centrally in the wall and sealant to both faces.

Given the amount of movement observed at the joints, it is likely the tongue and groove segments of the concrete and the PVC water-stop may have been damaged and it is recommended a local break out is undertaken on a joint with large movement to assess if there is any damage.

Above the gallery tunnel there is a bypass channel which could not be inspected. The joint requires inspection from inside this channel (if possible) to assess the extent of damage.

To assess the extent of damage on the exterior faces of the walls, it is recommended that local excavations be carried out at each of the joint locations.

Ref.	Image	Description	Damage Type / Repair
S12.1		Cracking around doorway near digester control room.	*Type 2*. Repair with an epoxy or grout injection system
S12.2a		Differential vertical and horizontal movement at control joints up to 20 mm. This type of damage was observed at most of the joints.	Remove seal, remove loose concrete, reinstate concrete and replace seal

Ref.	Image	Description	Damage Type / Repair
S12.2b		Differential vertical and horizontal movement at control joints.	As above
S12.2c		Differential vertical and horizontal movement at control joints.	As above

Ref.	Image	Description	Damage Type / Repair
S12.3		Large movement (approx 30 mm) at top of stairs next to Digester Control Room.	Remove seal, remove loose concrete, reinstate concrete or provide a cover plate and replace seal.

4.13 South Gallery

Similarly for the north gallery the most significant damage to the south gallery was the differential movement between the adjacent tunnel sections resulting in damage to the joint seals. This type of damage was observed at most of the joints. Two of these joints were leaking and adjacent to one joint there was evidence of sand infiltration.

At two locations the concrete had spalled at the top of the joints.

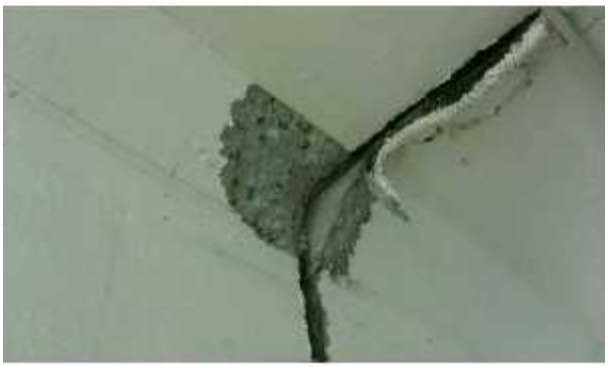
Above the gallery tunnel there is an influent channel and a return channel which could not be inspected. The joint requires inspection from inside these channels to assess the extent of damage. This will require the channels to be temporarily isolated and drained. To assess the extent of damage on the exterior faces of the walls, it is recommended that local excavations be carried out and the tanks drained at each of the joint locations.

The details of the joints are similar to the joints in the north gallery and it is recommended a local break out is undertaken on a joint with large movement to assess if there is any damage to either the water-stop or the concrete.

Damage to the seals may be such that the leakage cannot be eliminated completely. If this is the case, consideration should be given to providing internal bunds and drainage.

Ref.	Image	Description	Damage Type / Repair
S13.1a		Differential vertical and horizontal movement at control joints up to 20 mm. This type of damage was observed at most of the joints.	Remove seal, remove loose concrete, reinstate concrete and replace seal
S13.1b		Differential vertical and horizontal movement at control joints.	As above

Ref.	Image	Description	Damage Type / Repair
S13.1c		Differential vertical and horizontal movement at control joints.	As above
S13.1d		Differential vertical and horizontal movement at control joints.	As above
S13.1e		Differential vertical and horizontal movement at control joints.	As above

Ref.	Image	Description	Damage Type / Repair
S13.2		Cracking in walls (approx 0.3 mm crack width).	*Type 2*. Repair with an epoxy or grout injection system
S13.3a		Spalling at top of walls at control joints.	*Type 4*. Repair with structural repair mortar system.
S13.3b		Spalling at top of walls at control joints.	*Type 4*. Repair with structural repair mortar system.

Ref.	Image	Description	Damage Type / Repair
S13.4		Evidence of leakages at joints and sand infiltration.	Remove seal, remove loose concrete, reinstate concrete and replace seal.

4.14 Primary Sedimentation Tanks (PST) and Solids Contact Tanks (SCT)

The beams, walls and columns of the PSTs and SCTs that could be inspected visually did not appear to be cracked or spalled or show any signs of structural damage. Most tanks were full of wastewater or had sand or sludge on the bottom (with the exception of PST1). Therefore these could not be fully inspected.

The tanks had obviously moved during the earthquakes as evidenced by the separation at the joints between adjacent tanks. It is recommended the sealant in these joints be removed and replaced.

The central columns in the tanks appeared to be higher than the walls of the tanks. It is recommended that a level survey be carried out to determine if any structural differential settlement or heaving has occurred.

A leakage was observed in the base slab of PST1 (northern sedimentation tank). It is likely the slabs of the other tanks could be cracked and leaking. Therefore it is recommended that all tanks (PST and SCT) be emptied, cleaned and inspected for any cracks or signs of heaving or settlement. If cracks are present or vertical movement has occurred it is recommended that subsurface investigations (ground penetrating radar or similar) be carried out to ascertain if there are any voids underneath the slab. These voids (if present) will need to be filled using flowable grout.

If the level survey shows the ground has settled or heaved, consideration needs to be given to the operational ability of the tanks. If the function of the tanks is compromised, further investigation will be required and significant repair works may be needed to re-level the tanks.

Ref.	Image	Description	Damage Type / Repair
S14.1a		Separation at joints between tanks by up to approx 15 mm.	Remove and reinstate sealing strip.
S14.1b		Separation at joints between tanks by up to approx 15 mm.	As above.

Ref.	Image	Description	Damage Type / Repair
S14.1c		Separation at joints between tanks by up to approx 15 mm.	As above
S14.2		Leakage at bottom of PST1 (northern tank). Possible leakages at other tanks (could not observe most other tanks due to these either being full of wastewater or bottom being obscured).	Breakout and repair cracks / holes. If voids are present under slab fill these with flowable grout.

4.15 Sludge Lagoons

There was no apparent significant structural damage to the sludge lagoons as a result of the earthquakes. It was noted that the vertical manhole pipe at the southern end of the western tank had spalled concrete near the top of the pipe.

To assess the amount of overall and differential settlement of the sludge lagoons and the associated ability of the lagoons to function as intended, it is recommended a level survey be carried out.

4.16 Influent Structure

The structure was largely covered. Therefore only an external inspection of the top and sides was carried out. Based on this inspection no sign of significant structural damage to the influent structure was observed.

4.17 Trickling Filters 1 & 2

The interior of the filters could not be inspected. From the outside there was no apparent structural damage to the trickling filter structures. However, it was noted from discussions with CWTP staff that the central column in the filters has moved relative to the walls of the filter structure resulting in the rotating arm hitting the tank walls. It is recommended further investigation be carried out to determine whether the tank structure has settled differentially or whether the central column has moved resulting in possible damage to the column foundation or the column itself.

Ref.	Image	Description	Damage Type / Repair
S17.2a		Local heaving of ground or settlement of footing.	Non-structural. However, carry out level survey to confirm if any differential settlement has occurred. Re-grade as necessary.

Ref.	Image	Description	Damage Type / Repair
S17.2b		Evidence of movement at base of trickling filters.	Non-structural.
S17.3a		Cracked pavement at perimeter of trickling filters.	Remove damaged areas of pavement and replace.

Ref.	Image	Description	Damage Type / Repair
S17.3b		Cracked pavement at perimeter of trickling filters.	Remove damaged areas of pavement and replace.

4.18 Digesters 1 – 4

Generally only minor damage was observed. Differential ground settlement was noted around the perimeter of the Digesters. The maximum ground settlements were in the order of:

- Digester 1 up to 70 mm
- Digester 2 up to 40 mm
- Digester 3 up to 70 mm
- Digester 4 up to 130 mm

To the east of Digester No. 4 tension cracks were noted in the slope indicating the earthquake had resulted in slope instability. It is recommended the stability of this slope be checked and the tension cracks be infilled or the slope re-graded.

It is recommended a level survey be carried out to determine the amount of differential structure settlement.

Ref.	Image	Description	Damage Type / Repair
S18.1a		Spalled concrete at pipe on northern edge of Digester No. 3.	*Type 4*. Breakout loose concrete and repair with structural repair mortar system
S18.1b		Cracked concrete at pipe locations. This cracked concrete was observed at two locations.	*Type 4*. Breakout loose concrete and repair with structural repair mortar system
S18.2		Guide wheels and guides have broken off at a number of locations on the floating roof structure.	Reinstate guide wheels and install timber packers to stop pounding of lid against the sides of the tank (this was currently being undertaken at the time of the inspection).

Ref.	Image	Description	Damage Type / Repair
S18.3		Cracked pavement concrete around digester tanks.	Remove and reinstate pavement concrete.
S18.4a		Ground settlement around perimeter of digester tanks resulting in a trip hazard at the step foundation.	Provide inclines to step footing.
S18.4b		Ground settlement around perimeter of digester tanks.	Re-grade as necessary.
S18.4c		Ground settlement around perimeter of digester tanks.	Re-grade as necessary.

Ref.	Image	Description	Damage Type / Repair
S18.4d		Tension cracks indicating slope instability next to Digester No. 4	Infill the tension cracks and re-grade as necessary.
S18.4e		Ground settlement around perimeter of digester tanks.	Re-grade as necessary.

4.19 Digesters 1 - 4 Control Building

Other than the minor cracking to the walls, this building appears to have no significant structural damage.

Ref.	Image	Description	Damage Type / Repair
S19.1		Diagonal cracks in walls at corner of doors.	*Type 2*. Repair with an epoxy or grout injection system

4.20 Digesters 5 & 6 and Underground Gallery

Only minor structural damage was observed for Digesters 5 and 6 and the underground gallery. Differential settlement of the ground was observed around the perimeter of the digester tanks. It is recommended a level survey be carried out to determine the amount of structure differential settlement.

Ref.	Image	Description	Damage Type / Repair
S20.1		Spalled pavement concrete slab around perimeter of tanks.	*Type 4*. Breakout loose concrete and repair with structural repair mortar system
S20.2		Some leakages were observed at the base of the gallery walls.	*Type 2*. Repair cracks with an epoxy or grout injection system and provide sealant
S20.3a		Evidence of ground settlement around perimeter of digester tanks up to 80 mm.	Repair pavement slab and re-grade as necessary.

Ref.	Image	Description	Damage Type / Repair
S20.3b		Evidence of ground settlement around perimeter of digester tanks up to 80 mm.	Repair pavement slab and re-grade as necessary.

4.21 Digesters 5 & 6 Control Building

Only minor damage to the control building was observed as outlined below.

Ref.	Image	Description	Damage Type / Repair
S21.1 & S21.2	(no image)	Cracking to reinforced concrete walls on west face above doors and on north face.	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S21.3		Spalled concrete pavement slab on eastern side of building.	*Type 4*. Breakout loose concrete and repair with structural repair mortar system
S21.4	(no image)	Cracked concrete pavement on western side of building.	*Type 2 or 4*. Repair using reinstate-ment mortar or epoxy crack injection

4.22 Clarifiers 1 – 4

Due to all the clarifiers being full, the only areas of the clarifiers that could be visually inspected were the walls above ground and above the water level, the walkway structures over the clarifiers and the service trench structure from the RAS/WAS pump station to the clarifiers.

Other than the damage as outlined below, the clarifiers and walkway structures showed no signs of significant structural damage as a result of the earthquakes.

It was noted by CWTP staff that the scraper arms of the clarifiers were hitting the sides of the tank. There also appears to be a sideways bow in the walkway over clarifier number 2 and the centre of the bridge appears to be higher at the centre than at the ends for a number of clarifiers. This indicates there may be vertical and horizontal movement of the central pier which possibly indicates damage to the floor slab, pier and pier foundation.

A level survey has been carried out on the clarifiers to assess the levels of the tank walls, base slab and central pier. Preliminary results of the level survey indicate the bottom slab of the clarifier has

heaved upwards and differential settlement has occurred as shown below (these results are preliminary and need to be verified).

	Differential Settlement (maximum difference in levels on the top of the tank walls)	Heave (upward movement of base slab)
Clarifier 1	45 mm	154 mm
Clarifier 2	41 mm	5 mm
Clarifier 3	64 mm	315 mm
Clarifier 4	84 mm	113 mm

For Clarifier 3, the heave of 315 mm is significant and will require further investigation to assess the damage associated with this movement.

Based on the results of the level survey, further investigation is recommended to inspect all the clarifiers. This investigation may entail dewatering the area around the clarifiers and emptying the clarifiers one by one. A full inspection of the walls, base slab and central pier should be carried out and all damaged areas be repaired as necessary.

If the base slab shows signs of significant damage, consideration should be given to designing a more robust slab and one that does not require the area around the clarifiers to be dewatered prior to emptying the contents of the clarifier.

Ref.	Image	Description	Damage Type / Repair
S22.1		Cracking in exterior wall of clarifier No. 4 at southern edge	*Type 2*. Repair with an epoxy or grout injection system and replace seals

Ref.	Image	Description	Damage Type / Repair
S22.2		Steelwork to walkway stair landing is deformed due to differential settlement of the stair foundation.	Repair steelwork and provide packers.
S22.3a		There is general settlement around the clarifiers of between 100 and 300 mm. Local slumping was observed around clarifier number 4.	Backfill and re-grade as necessary.
S22.3b		There is general settlement around the clarifiers of between 100 and 300 mm.	Backfill and re-grade as necessary.
S22.3c		Significant settlement around the manhole structure.	Backfill and re-grade as necessary.

Ref.	Image	Description	Damage Type / Repair
S22.3d		Significant settlement around the manhole structure. There was evidence of liquefaction around the site especially to the west of clarifiers 3 and 4.	Backfill and re-grade as necessary.
S22.4a		There is cracking to the trench structure from the pump station to the clarifiers due to the differential settlement.	Epoxy crack injection and replace seals between adjacent precast units.
S22.4b		Differential movement between adjacent precast concrete sections resulting in damage to the seals.	Replace and repair seals.
S22.4c		Differential movement between adjacent precast concrete sections resulting in damage to the seals.	Replace and repair seals.

4.23 RAS / WAS Pump Station

The interior of the building could not be inspected. From the exterior inspection it appears the building has insignificant structural damage (minor cracking and separation at the joints as outlined below). However, it is recommended the interior be inspected to check whether there is any damage to the inside of the building.

Ref.	Image	Description	Damage Type / Repair
S23.1		Cracking to panel near entry door on western side.	*Type 2*. Repair with an epoxy or grout injection system
S23.2	(no image)	Diagonal cracks in wall at corner of east window.	*Type 2*. Repair with an epoxy or grout injection system
S23.3		Cracks above door in east side.	*Type 2*. Repair with an epoxy or grout injection system

Ref.	Image	Description	Damage Type / Repair
S23.4		Approx 10 mm separation at joint between walls on eastern side.	Remove and replace sealants.

4.24 Water Tank & Gas Holder Tank

Both the water tank and the gas holder tank appear to be in good condition with no apparent signs of structural damage due to the earthquakes.

There was evidence of 50 – 60 mm of ground settlement adjacent to the tanks. It is recommended a level survey be carried out to determine the amount of overall and differential structure settlement.

5 Remedial Methodology

The repairs outlined in the above detailed inspection tables provide an overview of the repair requirements to a level that is considered appropriate for preliminary costing. The repair methodologies outlined have been developed from a structural engineering perspective i.e. what is required to bring the building to as near to the original structural performance as possible.

All methodologies shall be approved by the Structural Engineer, and all proprietary products and repair systems must be installed in accordance with the manufacturer's recommendations, and by a person skilled in the application of such products or systems.

A rough-order cost estimate for the repairs is detailed in a spreadsheet issued on 9 March 2011 to CCC entitled "CWTP Earthquake Damage Feb 2011 Cost Assessment Rev04.xls".

6 Recommendations

The following is a summary of our recommendations to bring each of the structures up to, or as near as reasonably practical to, the structures' condition prior to the earthquake. In some cases further investigation is needed to determine the extent of reinstatement works and this is noted in the recommendations. Refer to Section 4 for details and location of the damage and Section 3.3 for details of the typical repair methodology.

Administration Building

- Building appears to have suffered minimal structural damage and does not require any structural repairs.

Operations Building

- Epoxy inject cracks to concrete walls
- Remove and repoint cracked mortar in brick cladding
- Provide packers and joist hangers to displaced purlins in new roof

Pump Station A / Basement Storeroom / 11kV Switchroom

- Carry out a level survey around the perimeter of the walls and over the base slab and mezzanine floor.
- Depending on the results of the survey, carry out subsurface investigation and further structural investigation to identify potential damage to the structure below ground
- Epoxy inject cracks to concrete walls
- Epoxy inject cracks to mezzanine floor and basement floor slab
- Epoxy inject cracks to columns and beams
- Remove and repoint cracked mortar in brickwork in 11kV switchroom

Workshop & Emergency Equipment Store (to the North of PS-A)

- Epoxy inject cracks to concrete walls
- Epoxy inject cracks to columns and beams

Screen Room

- Epoxy inject cracks to concrete walls
- Remove and repoint cracked mortar in blockwork on south-west wall

Engine Room and Workshop to the South

- Although the engine room appears to show no signs of structural damage, it is recommended a sample of the cladding be removed and the structure behind it inspected for damage. The location for the cladding to be removed will be chosen by the Engineer
- Remove and repoint cracked mortar in blockwork infill in the workshop to the south of the engine room

Thickener Building & Pump Station B

- Carry out a level survey around the perimeter of the walls and over the floor slab
- Depending on the results of the survey, carry out subsurface investigation and further structural investigation to identify potential damage to the structure below ground
- Epoxy inject cracks to concrete walls

- Inspect and repair cracking / spalling to corbel supporting the crane rail beam
- Repair crack at pipe / wall interface
- Reinstate the ground that has settled at the north-eastern end of building by removing loose soil and broken pavement, backfilling and compacting.
- Replace damaged pavement at north-eastern end and southern end of building

Education Centre / Garage / Technicians' Workshop

- Investigate the stability of the slope adjacent to Digester 4 and re-grade if necessary
- Remove and replace damaged brickwork on northern wall next to Digester 4. Consider demolishing if not required or using alternative timber framed wall.
- Remove and repoint cracked mortar in brickwork in northern wall and eastern wall

Dewatering Building

- Break out loose concrete at base of columns and repair with structural repair mortar system
- Epoxy inject cracks to concrete walls and columns
- Reinstate damaged concrete at step at south-west corner of building

Dryer Building

- Epoxy inject cracks to concrete walls
- Repair spalling to top of wall panel using structural repair mortar

Energy Centre Building

- Epoxy inject cracks to concrete walls
- Carry out interior inspection of building to assess whether there is any other damage

North Gallery and South Gallery Structures

- Temporarily isolate and drain the influent channel, return channel and bypass channels above the gallery and carry out an internal inspection of these structures
- Carry out local excavations at each of the joint locations to assess the extent of damage on the exterior faces of the walls
- Carry out a local break-out on a joint in the wall with large movement to assess if there is any damage to either the water-stop or the tongue-and-groove joint.
- Remove damaged seals, remove loose concrete, reinstate concrete and replace seals
- Epoxy inject cracks around doorway to control room
- Epoxy inject cracks to concrete walls
- Repair spalled concrete with structural repair mortar system
- If leakage cannot be eliminated completely, consider providing internal bunds and drainage

Primary Sedimentation Tanks (PST) and Solids Contact Tanks (SCT)

- Carry out a level survey on all tanks to determine if any structural differential settlement or heaving has occurred. Survey around the perimeter of the tank walls and down the centre of the tank.
- Empty and clean all tanks and inspect for any cracks or signs of heaving or settlement. If cracks are present or vertical movement has occurred it is recommended that subsurface investigations (ground penetrating radar or similar) be carried out to ascertain if there are any voids underneath the slab.

- Based on the results of the survey, it is recommended a detailed repair methodology be carried out in conjunction with the operational requirements of the tanks (tanks may need to be re-levelled). Repairs that may be required vary from simple epoxy crack injection to complete removal and reinstatement of the base slab.
- Remove and replace the damaged joint seals between the tanks

Sludge Lagoons

- Carry out a level survey to assess the amount of overall and differential settlement and the associated ability of the lagoons to function as intended

Influent Structure

- Structure appears to have suffered minimal structural damage and does not require any structural repairs

Trickling Filters 1 & 2

- Carry out a level survey to determine whether the tank structure has settled differentially or whether the central column has moved vertically or horizontally.
- Carry out an internal inspection of the central column and foundation to assess the extent of damage. This may involve coring through the filter media or accessing the foundation from underneath.
- Depending on the results of the survey and inspection, develop a detailed repair methodology to repair any damage
- Repair cracked / damaged pavement as necessary

Digesters 1 – 4

- Investigate the stability of the slopes around the digesters and re-grade if necessary
- Infill the tension cracks in the slope
- Re-grade the slumped/settled ground around the digesters
- Carry out a level survey to determine the amount of differential structure settlement.
- Breakout loose concrete around the pipes and repair with structural repair mortar system
- Reinstate guide wheels and install timber packers to stop pounding of lid against the sides of the tank (this was currently being undertaken at the time of the inspection).
- Remove and reinstate cracked pavement concrete
- Provide inclines to the raised step footing

Digesters 1 – 4 Control Building

- Epoxy inject cracks to concrete walls

Digesters 5 & 6 and Underground Gallery

- Repair cracks in wall / slab junction in the gallery with an epoxy or grout injection system and provide sealant
- Breakout loose concrete in cracked pavement, repair with structural repair mortar system and re-grade pavement to remove tripping hazard

Digesters 5 & 6 Control Building

- Epoxy inject cracks to concrete walls
- Breakout loose concrete in cracked pavement and repair with structural repair mortar system

Clarifiers 1 – 4

- Further investigation is recommended to inspect the clarifiers. In particular Clarifier 3 shows signs of significant heave (preliminary survey results indicate over 300 mm). This investigation may entail dewatering the area around the clarifiers and emptying the clarifiers one by one. A full inspection of the walls, base slab and central pier should be carried out and all damaged areas be repaired as necessary.
- Based on the detailed inspection it is recommended a detailed repair methodology be undertaken in conjunction with the operational requirements of the clarifiers. Consideration should be given to designing a more robust base slab.
- Epoxy inject cracks in exterior wall and replace seals
- Repair deformed steelwork to walkway stair landing
- Backfill and re-grade slumped / settled ground as necessary
- Epoxy inject cracks in the channels / service trenches and replace seals between adjacent precast units

RAS / WAS Pump Station

- Inspect the interior to check whether there is any damage to the inside of the building
- Epoxy inject cracks to concrete walls

Water Tank & Gas Holder Tank

- Carry out a level survey to determine the amount of overall and differential settlement

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Appendix A

Structural Damage Register Spreadsheet

Christchurch Wastewater Treatment Plant - Structural Damage Assessment

The following is a list of the observed structural damage at the Christchurch Wastewater Treatment Plant as a result of the 4 September 2010 Canterbury earthquake and the 22 February 2011 Christchurch earthquake and subsequent aftershocks. Inspections were carried out on 5 March and 7 March 2011 by Nik Stewart, Ian Billings and Mark Downie. This assessment covers only the structural damage that was observed during the inspections. Damage that could not be seen due to inaccessibility, or where the structure was hidden behind cladding, or where the tanks were full of wastewater could not be assessed. Damage to the civil works, services, mechanical and electrical are not included.

Note: Site North is taken to be parallel with Shuttle Drive

Description of Damage		Proposed Remedial Works
1.0	**Administration Building**	
1.1	No apparent structural defects	
2.0	**Operations Building**	
2.1	Cracking in wall outside entrance to the Control Room (approx 1 mm crack width)	Epoxy crack injection
2.2	Cracking in brick cladding outside the south-west doorway.	Remove cracked mortar and repoint
2.3	The timber purlins connecting to the western timber truss on the new timber roof structure have separated by approx 30 mm. (The roof structure was currently under construction).	Supply packers between purlins and truss. Install joist hangars.
3.0	**Pump Station A / Basement Storeroom / 11kV Switchroom**	
3.1	Large cracks in southern basement wall (up to 5 mm crack width)	Epoxy crack injection
3.2	Large cracks to eastern ground level wall next to men's changing room (up to 3 mm crack width)	Epoxy crack injection
3.3	Cracks to eastern ground level wall next to men's changing room (approx 0.3 mm crack width)	Epoxy crack injection
3.4	Cracking to eastern basement wall (approx 0.3 mm crack width)	Epoxy crack injection
3.5	Cracking in mezzanine floor	Epoxy crack injection
3.6	Cracks in basement floor slab (up to approx 1 mm crack width)	Epoxy crack injection
3.7	Cracks in southern column of 11 kV switchroom near bottom of column	Epoxy crack injection
3.8	Cracks in RC floor slab of 11 kV switchroom	Epoxy crack injection
3.9	Gaps between the infill brickwork and the RC column in 11 kV switchroom	Remove cracked mortar and repoint
3.10	Cracks in walls of storeroom beside PS-A (approx 0.3 mm crack width)	Epoxy crack injection
4.0	**Workshop & Emergency Equipment Store (to the North of PS-A)**	
4.1	Cracking to 2 columns (approx 0.2 mm crack width)	Epoxy crack injection
4.2	Cracking to walls at entrance to workshop and inside workshop (approx 0.3 mm crack width)	Epoxy crack injection
4.3	Cracking in beam at one location	Epoxy crack injection
4.4	Cracking to walls in emergency equipment store (up to 1 mm crack width)	Epoxy crack injection
5.0	**Screen Room**	
5.1	Diagonal cracks in north and south walls (approx 0.3 mm crack width)	Epoxy crack injection
5.2	Loose blockwork on south-west wall	Remove cracked mortar and repoint
5.3	Horizontal cracks in walls (approx 0.3 mm crack width)	Epoxy crack injection

Christchurch Wastewater Treatment Plant - Structural Damage Assessment

6.0	**Engine Room & Workshop to the South**	
6.1	Workshop to the south of the engine room - gaps between masonry block wall and reinforced	Epoxy crack injection
6.2	Engine room appears to show no signs of structural damage. However the structure was hidden due to the sound proof cladding. Assume an allowance for cracking to wall panels (say 0.3 mm wide cracks).	Epoxy crack injection
7.0	**Thickener Building & Pump Station B**	
7.1	Minor cracking (approx 0.3 mm crack width) to walls on western side of building near windows	Epoxy crack injection
7.2	Settlement of ground at north-eastern end of building	Backfill and replace pavement
7.3	Cracking (approx 0.2 mm crack width) on western wall near door on southern end	Epoxy crack injection
7.4	Damage to concrete paving slab next to building at southern end of building.	Break out and repair concrete slab
7.5	Cracking on eastern wall between roller doors (approx 0.3 mm crack width)	Epoxy crack injection
7.6	Cracking in eastern wall at northern end of building (approx 0.2 mm crack width)	Epoxy crack injection
7.7	Cracking to corbel supporting the crane rail beam on western side of building next to roller door.	Inspect corbel, remove broken concrete and replace
7.8	Large crack to concrete where pump station pipe passes through wall	Break out and replace concrete. Carry out level survey to assess whether the cracked pipe is the result of differential settlement or seismic shaking.
7.9	Spalling to top of column at south-east end next to wall	Break out loose concrete and replace
7.10	Cracking in wall above internal door to southern room (0.2-0.3mm crack width)	Epoxy crack injection.
8.0	**Education Centre / Garage / Technicians' Workshop**	
8.1	Large cracks / gaps (30 mm) in brickwork on north-western wall	Investigate stability of slope. Remove and replace brickwork or remove brickwork completely and replace with timber framed wall (or similar)
8.2	Gaps in brickwork between walls on northern face	Remove cracked mortar and repoint
8.3	Cracks in brickwork mortar in eastern wall	Remove cracked mortar and repoint
9.0	**Dewatering Building**	
9.1	Cracking / spalled concrete at base of concrete encased steel I-beam columns	Break out and removal of loose concrete and reinstate concrete
9.2	Cracking in eastern walls (approx 0.3 mm crack width)	Epoxy crack injection
9.3	Cracking in columns (approx 0.3 mm crack width)	Epoxy crack injection
9.4	Large gap at steps at south-western corner of building	Reinstatement of concrete / seal
9.5	Cracks in walls at weld plate connections	Epoxy crack injection
10.0	**Dryer Building**	
10.2	Cracking in walls next to opening on western wall (approx 0.3 mm crack width)	Epoxy crack injection
10.3	Cracking above door on southern side of building (approx 0.3 mm crack width)	Epoxy crack injection
10.4	Cracking to panels next to doors / windows on north face (approx 0.3 mm crack width)	Epoxy crack injection
11.0	**Energy Centre Building**	
11.1	The interior of the building could not be inspected. From the outside there were no apparent structural defects. However, from the inspection carried out by Beca after the 4 September 2010 earthquake, it was noted that the precast panels were cracked at the weld plate connections. It is likely further cracking to these panels will have occurred due to the 22 February 2011 earthquake.	Repair cracks in panels at weld plate connections

Christchurch Wastewater Treatment Plant - Structural Damage Assessment

12.0	**North Gallery**	
12.1	Cracking around doorway near digester control room (1 mm crack width?)	Epoxy crack injection
12.2	Differential vertical and horizontal movement at control joints up to 20 mm (at 3 - 4 locations).	Remove seal, remove loose concrete, reinstate concrete and replace seal
12.3	Large movement (approx 30 mm) at top of stairs next to Digester Control Room	Remove seal, remove loose concrete, reinstate concrete or provide a cover plate and replace seal
13.0	**South Gallery**	
13.1	Differential vertical and horizontal movement at control joints up to 20 mm (at 3 - 4 locations).	Remove seal, remove loose concrete, reinstate concrete and replace seal
13.2	Cracking in walls (approx 0.3 mm crack width)	Epoxy crack injection
13.3	Spalling at top of walls at control joints	Remove loose concrete, reinstate concrete and replace seal
13.4	Evidence of leakages at joints and sand infiltration	Repair / replace sealants
14.0	**Primary Sedimentation Tanks and Solids Contact Tanks**	
14.1	Separation at joints between tanks by up to approx 15 mm	Removal and reinstatement of sealing strip
14.2	Leakage at bottom of PST1 (northern tank). Possible leakages at other tanks (could not observe most other tanks due to these either being full of wastewater or bottom being obscured)	Breakout and repair of cracks / holes. Recommended that all tanks (PST and SCT) be emptied, cleaned and inspected for any cracks or signs of heaving or settlement. If cracks are present or vertical movement has occurred it is recommended that subsurface investigations (ground penetrating radar or similar) be carried out to ascertain if there are any voids underneath the slab. These voids (if present) will need to be filled using flowable grout.
15.0	**Sludge Lagoons**	
15.1	No apparent structural defects	
16.0	**Influent Structure**	
16.1	No apparent structural defects	
17.0	**Trickling Filters 1 and 2**	
17.1	Structurally no apparent structural issues with the trickling filters. However the central column may have moved or the tricking filter has moved which has resulted in the rotating arm hitting the sides of the tank.	Allow lump sum to cover costs of any associated investigative and remedial works.
17.2	Evidence of lateral movement, ground heaving / settlement or structure settlement.	Carry out level survey to confirm if any differential settlement has occurred. Regrade as necessary.
17.3	Pavement has cracked in several places around the perimeter of the trickling filters	Remove damaged areas of pavement and replace.
18.0	**Digesters 1 - 4**	
18.1	Spalled concrete at pipe on northern edge of Digester No. 3 and cracked concrete at two other pipe locations.	Breakout of loose concrete and replace spalled concrete
18.2	Guide wheels and guides have broken off at a number of locations on the floating roof structure.	Reinstatement of guide wheels and install timber packers to stop pounding of lid against the sides of the tank (this was currently being undertaken at the time of the inspection).
18.3	Cracked pavement concrete around digester tanks	Removal and reinstatement of pavement concrete

Christchurch Wastewater Treatment Plant - Structural Damage Assessment

18.4	Evidence of ground settlement around perimeter of digester tanks and slope instability next to Digester No. 4. Settlements were in the order of: Digester 1 up to 70 mm Digester 2 up to 40 mm Digester 3 up to 70 mm Digester 4 up to 130 mm	Carry out a level survey to ascertain the amount of differential settlement
19.0	**Digesters 1 - 4 Control Building**	
19.1	Diagonal cracks in walls at corner of doors	Epoxy crack injection
20.0	**Digesters 5 & 6 and Underground Gallery**	
20.1	Spalled pavement concrete slab around perimeter of tanks	Break out loose concrete and replace
20.2	Some leakages were observed at the base of the gallery walls	Epoxy inject any cracks and provide sealant
20.3	Evidence of ground settlement around perimeter of digester tanks up to 80 mm.	Carry out a level survey to ascertain the amount of differential settlement

Christchurch Wastewater Treatment Plant - Structural Damage Assessment

21.0	**Digesters 5 & 6 Control Building**	
21.1	Cracking to reinf concrete walls on west face above doors	Epoxy crack injection
21.2	Cracking to reinf concrete walls on north face of building	Epoxy crack injection
21.3	Spalled concrete pavement slab on eastern side of building	Repair using reinstatement mortar
21.4	Cracked concrete pavement on western side of building	Repair using reinstatement mortar or epoxy crack injection
22.0	**Clarifiers 1 - 4 and Walkways**	
22.1	Cracking in exterior wall of clarifier No. 4 southern edge	Epoxy crack injection and replace seals
22.2	Steelwork to walkway stair landing is deformed due to differential settlement of the stair foundation	Repair steelwork (provide packers?)
22.3	There is general settlement around the clarifiers of between 100 and 300 mm. Local slumping	Carry out a level survey to ascertain the amount of differential
22.4	There is cracking to the trench structure from the pump station to the clarifiers due to the differential settlement.	Epoxy crack injection and replace seals between adjacent precast units
22.5	Otherwise appears to be negligible / minimal structural defects to walls of tank and to walkways	
22.6	There is a possibility of damage to the floor slab and central pier of the clarifiers. If this is the case, the area around the clarifiers will need to be de-watered and the clarifier emptied.	De-water around the clarifiers and empty the clarifier
		Remove the broken foundation slab and pier footing
		Cast a new foundation slab (say 400 mm thick slab) and new pier footing.
		Consider anchors to resist ground water pressure so that the clarifiers can be emptied in the future without de-watering. Say 32 mm diam VSL CTR Stressbar ground anchors on a 3 m x 3 m grid (10 m long?)
		Provide sealants.
23.0	**RAS / WAS Pump Station**	
23.1	Cracking to panel near entry door on western side	Epoxy crack injection
23.2	Diagonal cracks in wall at corner of east window	Epoxy crack injection
23.3	Cracks above door in east side	Epoxy crack injection
23.4	Approx 10 mm separation at joint between walls on eastern side	Provide sealants
24.0	**Water Tank (adjacent to engine room) and Gas Holder Tank**	
24.1	No apparent structural defects	

Appendix B

Christchurch Earthquake Level 2 Rapid Assessment Forms

CWTP 1

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & JSB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G1
Territorial Authority	Christchurch City	Time	1230		

Building Name Christchurch Wastewater Treatment Plant
Short Name Administration Building
Address Shuttle Drive
Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 02) 22306?6

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m^2) ~800
Year built ??
No of residential Units 0

Photo Taken Yes (No)

Type of Construction
- [x] Timber frame
- [ ] Steel frame
- [ ] Tilt-up concrete
- [x] Concrete frame
- [ ] RC frame with masonry infill
- [x] Concrete shear wall
- [ ] Unreinforced masonry
- [ ] Reinforced masonry
- [ ] Confined masonry
- [ ] Other:

Primary Occupancy
- [ ] Dwelling
- [ ] Other residential
- [ ] Public assembly
- [ ] School
- [ ] Religious
- [ ] Commercial/ Offices
- [x] Industrial
- [ ] Government
- [ ] Heritage Listed
- [ ] Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: (G1) G2
RESTRICTED USE YELLOW: Y1 Y2
UNSAFE RED: R1 R2 R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- [ ] Barricades are needed (state location):
- [ ] Detailed engineering evaluation recommended
  - [ ] Structural
  - [ ] Geotechnical
  - [ ] Other:
- [ ] Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)
Date & Time 7/3/11
ID NLS

Inspection ID: _____ (Office Use Only)

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTP	Comments
Foundations	☑	☐	☐		
Roofs, floors (vertical load)	☑	☐	☐		
Columns, pilasters, corbels	☑	☐	☐		
Diaphragms, horizontal bracing	☑	☐	☐		
Pre-cast connections N/A	☐	☐	☐		
Beam	☑	☐	☐		
Non-structural Hazards / Damage					
Parapets, ornamentation	☑	☐	☐		
Cladding, glazing	☑	☐	☐		
Ceilings, light fixtures	☑	☐	☐		
Interior walls, partitions	☑	☐	☐		
Elevators N/A	☐	☐	☐		
Stairs/ Exits	☑	☐	☐		
Utilities (eg. gas, electricity, water)	☑	☐	☐		
Other	☐	☐	☐		
Geotechnical Hazards / Damage					
Slope failure, debris	☑	☐	☐		
Ground movement, fissures	☑	☐	☐		
Soil bulging, liquefaction	☑	☐	☐		• Evidence of liquefaction around site

General Comment The building appears to be in good condition with no apparent structural damage due to the earthquake.

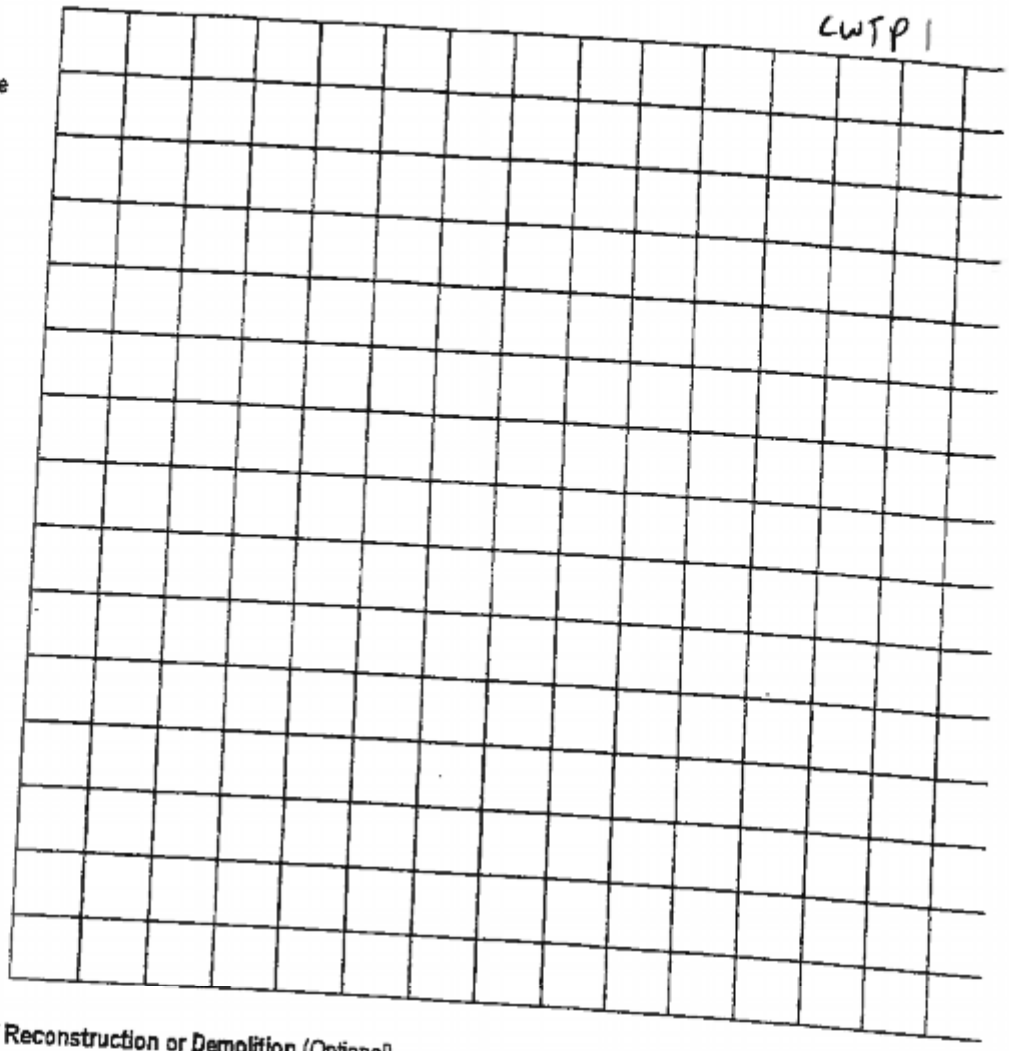
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 1



Recommendations for Repair and Reconstruction or Demolition (Optional)

N/A

 Inspection ID: _____ *(Office Use Only)*

CWTP2

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & JB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	10:30		

Building Name Christchurch Wastewater Treatment Plant
Short Name Operations Building
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bowke
Contact Phone 027 223 0646

Storeys at and above ground level: 2
Below ground level: 0
Total gross floor area (m^2): ≈ 900
Year built: ?
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• Cracking to wall outside entrance to Control Room
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN		RESTRICTED USE YELLOW		UNSAFE RED		
G1	(G2)	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: - see recommendations.

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)
Date & Time: 7/3/11
ID: NS

Inspection ID: _____ (Office Use Only)

Structural Hazards/ Damage		Minor/None	Moderate	Severe	CWTP 2 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	• The timber purlins connecting to the western timber truss on the new roof structure have separated by approx 30mm (The roof structure was currently under construction)
Columns, pilasters, corbels		☑	☐	☐	
Diaphragms, horizontal bracing		☑	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam		☑	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation		☑	☐	☐	
Cladding, glazing		☑	☐	☐	
Ceilings, light fixtures		☑	☐	☐	• Cracking in brick cladding outside south-west doorway
Interior walls, partitions		☑	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☐	☐	☐	
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

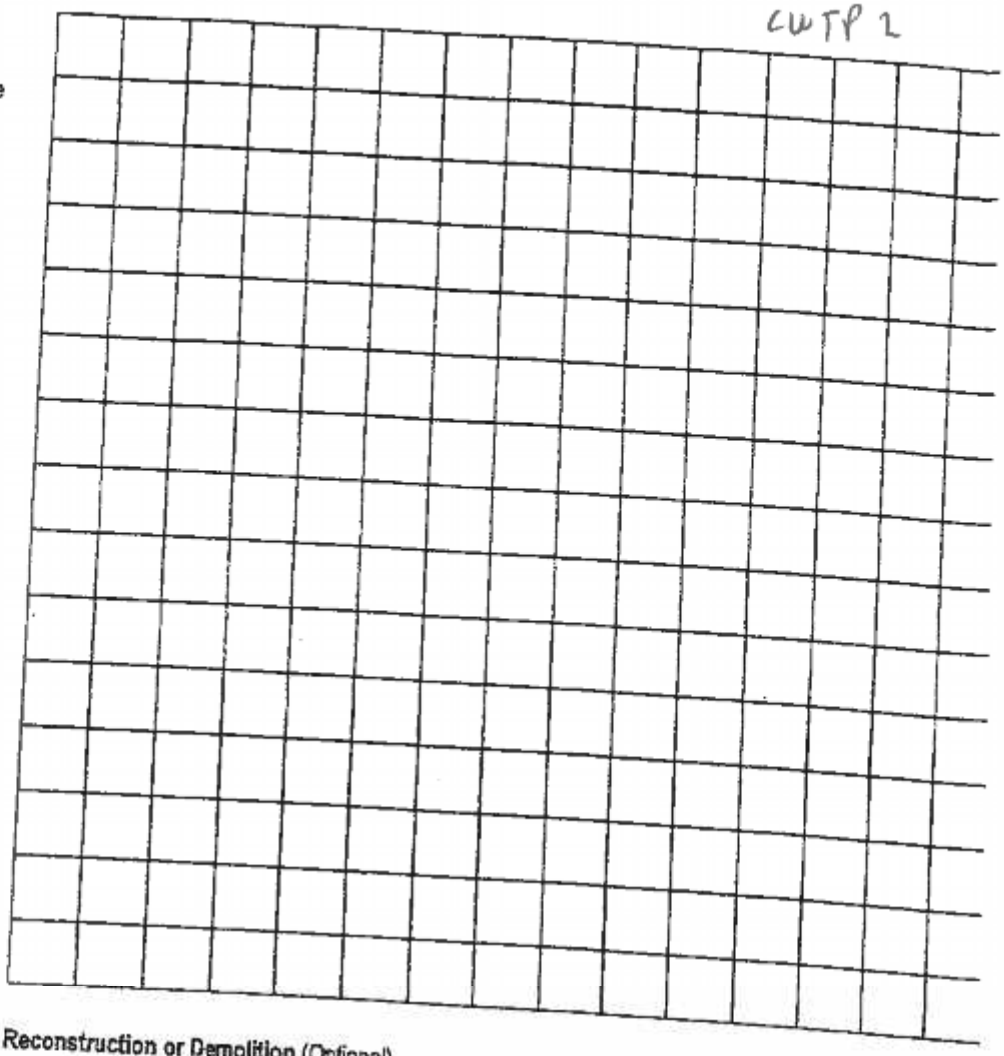
General Comment Other than the above minor damages, the building appears to be in good condition.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations.
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 2



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the cracked concrete be epoxy-injected, the cracks in the brickwork be mortar be re-pointed and joist-hangers (or similar) be installed to support the timber purlins

 Inspection ID: _____ *(Office Use Only)*

CWTP 3k4

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NLS K IJB
Territorial Authority: Christchurch City
Date: 5/3/11
Time: 0900
Final Posting (e.g. UNSAFE): G2

Building Name
Short Name: Christchurch Wastewater Treatment Plant
Address: Pump Station A (PS-A) & Workshop & Emergency Equip Store, 56 Akaroa, Bromley, Chch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230696

Storeys at and above ground level: 1
Below ground level: 1
Total gross floor area (m²): ≈1000
Year built:
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe
Collapse, partial collapse, off foundation	☑	☐	☐
Building or storey leaning	☑	☐	☐
Wall or other structural damage	☐	☑	☐
Overhead falling hazard	☑	☐	☐
Ground movement, settlement, slips	☑	☐	☐
Neighbouring building hazard	☑	☐	☐
Electrical, gas, sewerage, water, hazmats	☑	☐	☐

Comments
- Large vertical cracks in south basement wall (up to 5mm). Large cracks (2-3mm) to eastern wall at ground level next to men's changing room.

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended – see recommendations
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: Repairs as noted overleaf

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☐	31-60 %	☐
2-10 %	☑	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Stewart (Beca)
Date & Time: 5/3/11
ID: NLS

Inspection ID: _____ (Office Use Only)

CWTP 364

Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	• Some cracking to floor slab. (basement floor slab & mezzanine floor slab)
Columns, pilasters, corbels	☑	☐	☐	• cracking to columns in workshop area and to columns in HPD switchroom
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections N/A	☐	☐	☐	
Beam	☑	☐	☐	• cracking to end of beam in workshop area.
Non-structural Hazards / Damage				
Parapets, ornamentation N/A	☐	☐	☐	
Cladding, glazing	☑	☐	☐	• Brick veneer cladding appears okay
Ceilings, light fixtures	☐	☑	☐	• Ceiling panels have fallen above pump station
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☐	☐	☐	
Soil bulging, liquefaction	☐	☐	☐	• Evidence of liquefaction around slope

General Comment

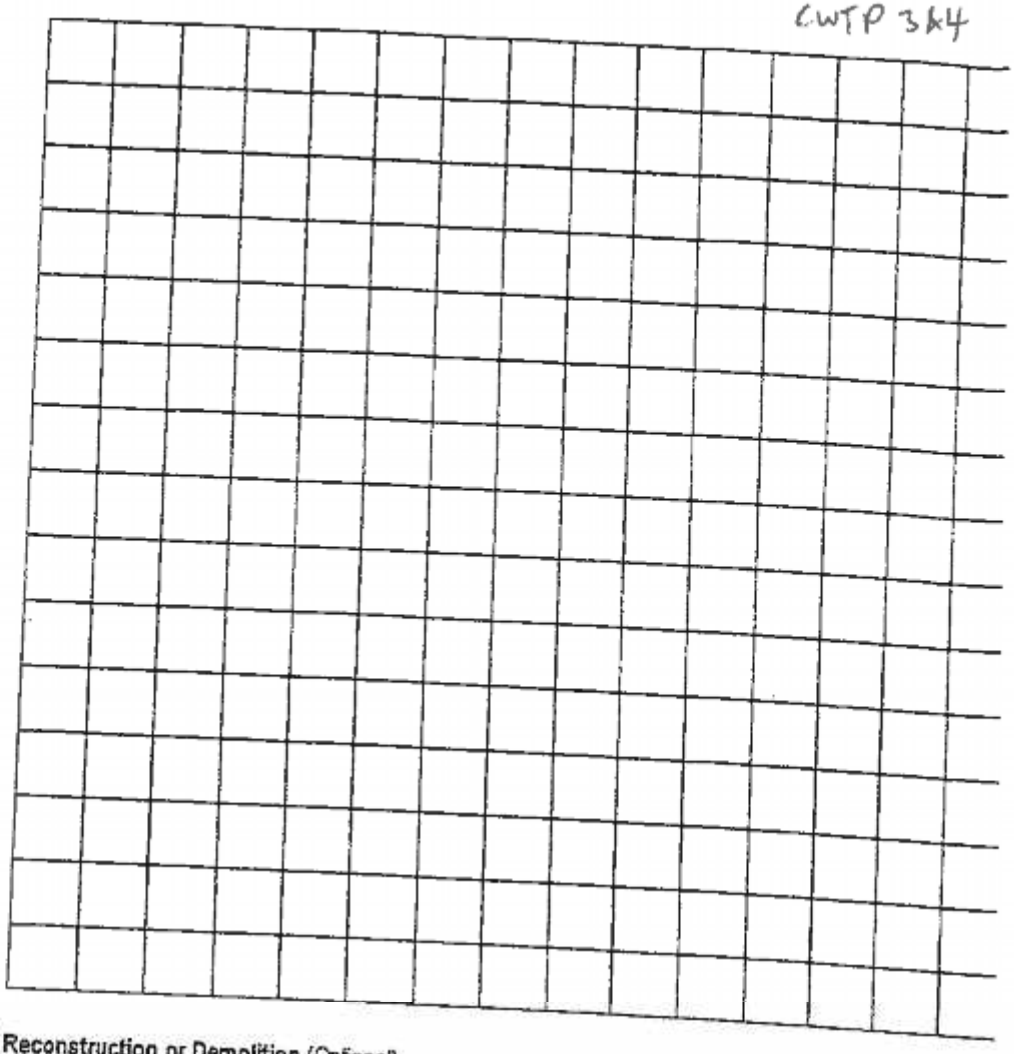
- Building does not have significant structural damage which caused a concern for safety
- Recommend repairs be carried out as noted overleaf.
- The mezzanine floor is supported by a reinf. concrete beam spanning east-west. Therefore the cracks in the mezzanine floor do not compromise the vertical load capacity of the floor.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

CWTP 3&4

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracks in walls and beams and columns be repaired by epoxy/grout injection
- Recommend cracks in floors be repaired if cracks are significant
- Recommend level survey be carried out to assess whether the cracks in the walls are the result of seismic shaking or differential settlement.

CWTP 5

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NLS K IJB
Territorial Authority: Christchurch City
Date: 5/3/11
Time: 0920
Final Posting (e.g. UNSAFE): G2

Building Name
Short Name: Christchurch Wastewater Treatment Plant
Address: Screen Room, Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: (W) 223 0696

Storeys at and above ground level: 1
Below ground level: 0
Total gross floor area (m^2): ≈150
Year built: ?
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• Diagonal cracking in north and south walls. Cracked mortar / loose blockwork in south-west wall.
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural
  - ☐ Geotechnical
  - ☐ Other:
- ☑ Other recommendations: See recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: Stewart (Beca)
Date & Time: 5/3/11
ID: NLS

Inspection ID: _____ (Office Use Only)

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTPS Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections N/A	☐	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation N/A	☐	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

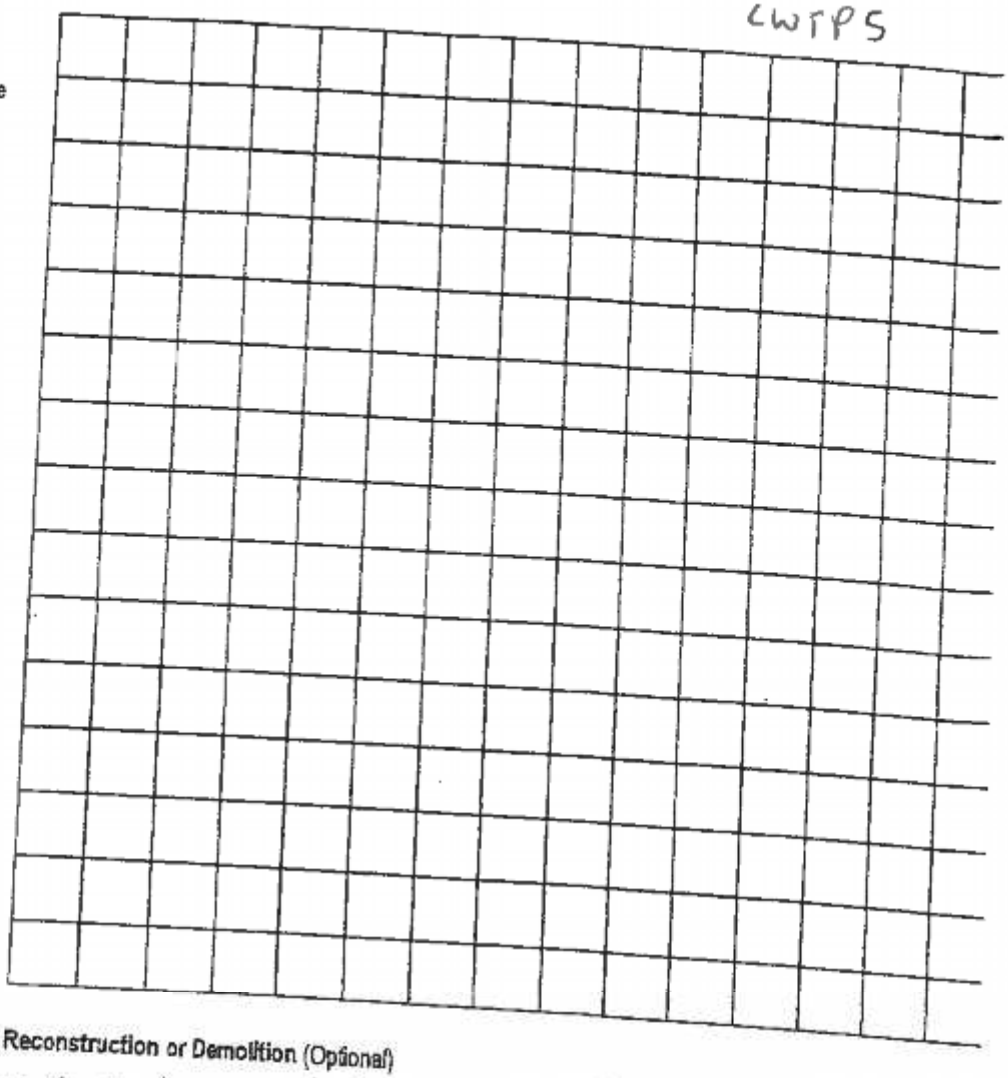
General Comment

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendation
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTPS



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracks in walls be repaired using epoxy crack injection
- Recommend cracked mortar be removed and the blockwork be re-pointed.

 Inspection ID: _____ *(Office Use Only)*

CWTP 6

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NJS & JB
Territorial Authority: Christchurch City
Date: 5/3/11
Time: 09:30
Final Posting (e.g. UNSAFE): G2

Building Name: Christchurch Wastewater Treatment Plant
Short Name: Engine room and workshop to the
Address: Shuttle Drive south, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2430696

Storeys at and above ground level: 2
Below ground level: 0
Total gross floor area (m^2): ~400
Year built:
No of residential Units: 0

Photo Taken: Yes / No

Type of Construction:
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy:
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• There are gaps between the masonry block wall and the reinf conc. columns.
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: Repairs as noted overleaf

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Becca)
Date & Time: 5/3/11
ID: NJS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTPB Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections N/A	☐	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around the site

General Comment

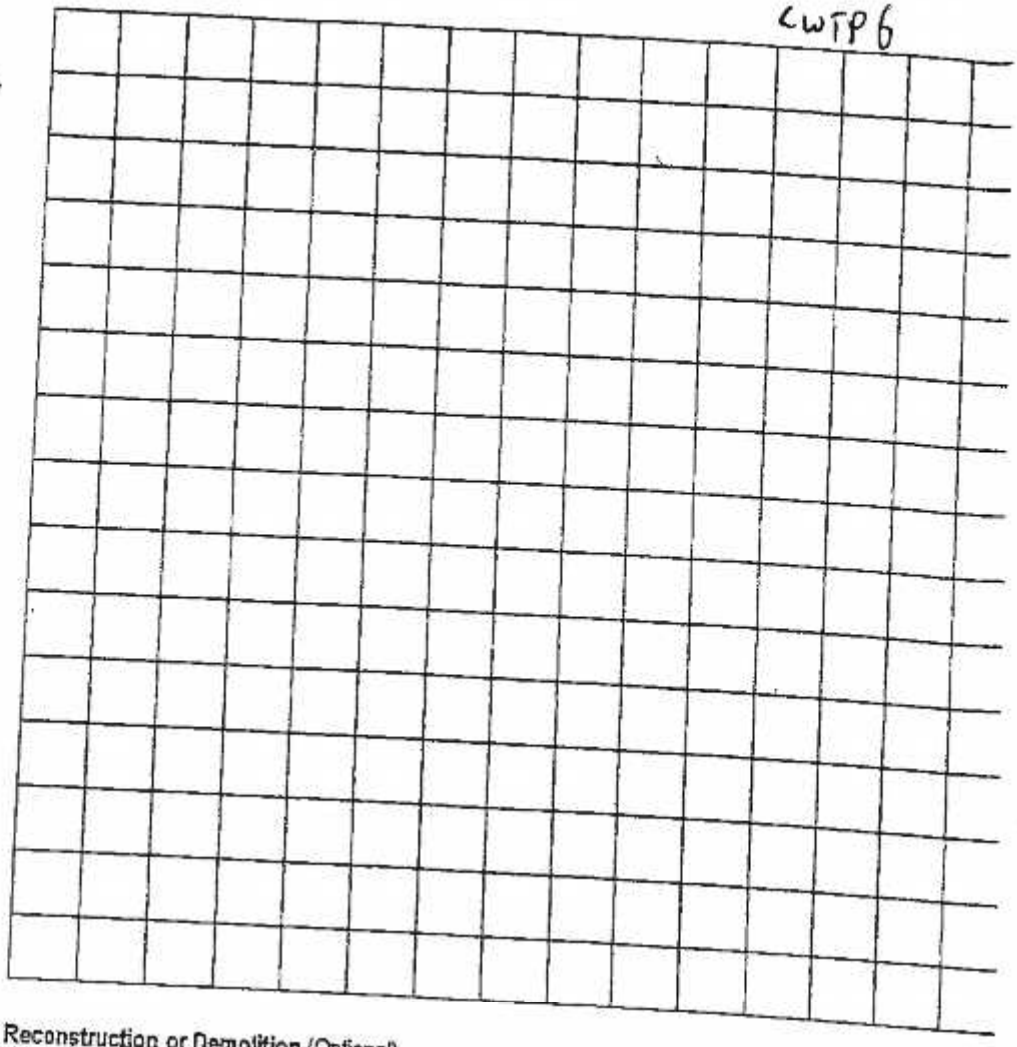
• Engine room appears to show no signs of structural damage. However, the structure was hidden due to the sound-proof cladding.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 6



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the gaps between the missing blocks and the reinf concrete frame be grouted.
- Recommend a sample of cladding be removed and the structure behind it be inspected for damage.

 Inspection ID: _____ *(Office Use Only)*

CWTP)

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & IJB	Date	5/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	0800		

Building Name: Christchurch Wastewater Treatment Plant
Short Name: Thickener Building / PS-B
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230696

Storeys at and above ground level: 1 | Below ground level: 1
Total gross floor area (m^2): ≈ 500 | Year built:
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction

- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall / Dykore roof
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy

- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	minor cracking to R.C. walls,
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended – see recommendations
  - ☑ Structural ☐ Geotechnical ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☐	31-60 %	☐
2-10 %	☑	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NHewett (Beca)
Date & Time: 5/3/11
ID: NLS

Inspection ID: _____ *(Office Use Only)*

CWTP 7

Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	• Cracking to corbel supporting crane monorail beam on northwestern side of roller door.
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	
Beam	☑	☐	☐	• minor cracking around precast wall panel connections
Non-structural Hazards / Damage				
Parapets, ornamentation N/A	☐	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☑	☐	☐	• Concrete pipe from pump station has cracked at wall.
Geotechnical Hazards / Damage				
Slope failure, debris	☐	☐	☐	
Ground movement, fissures	☑	☐	☐	• Settlement of ground at north-eastern end.
Soil bulging, liquefaction	☐	☐	☐	• Evidence of liquefaction around site

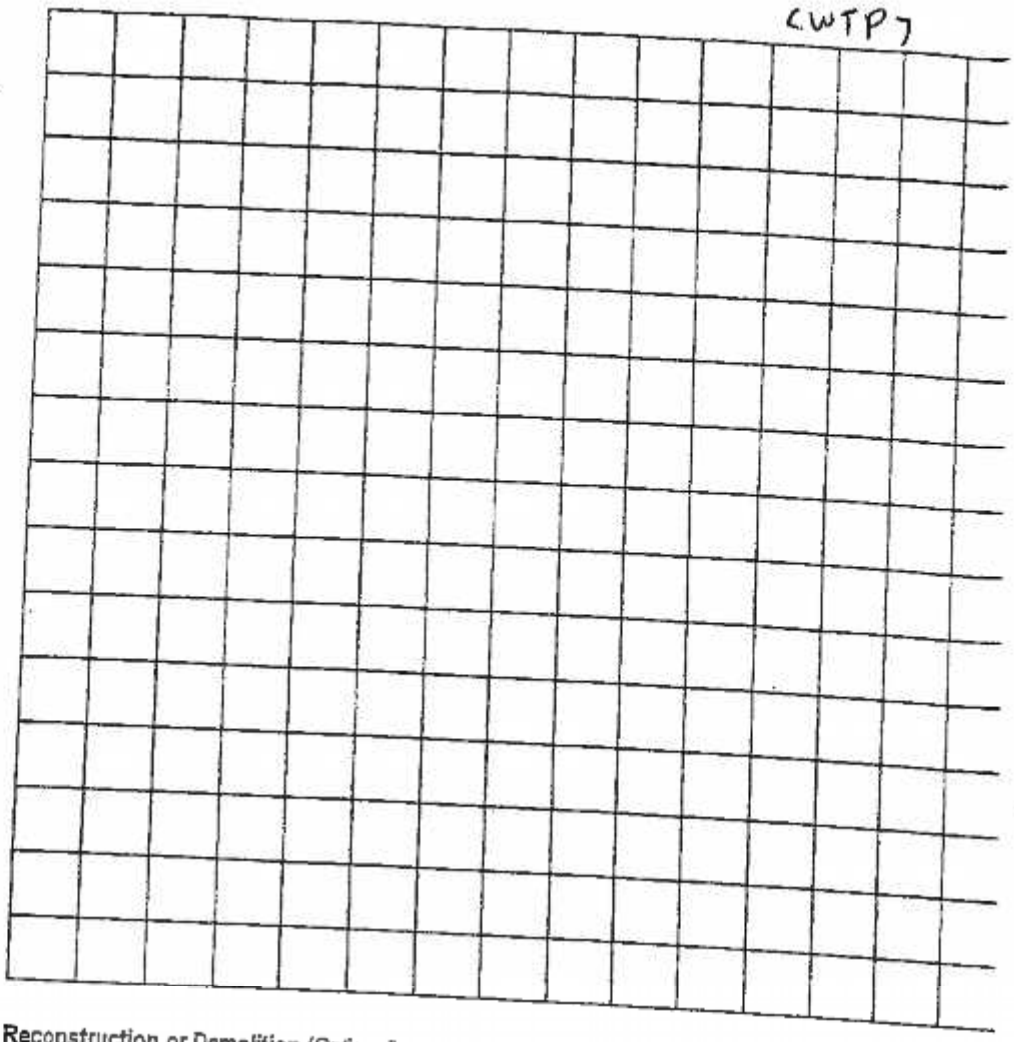
General Comment

- Building does not have significant structural damage which will cause a concern for safety.
- Recommend repairs be carried out as noted overleaf.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracked corbel be inspected and repaired as appropriate
- Recommend precast wall panel connections be inspected and repaired
- Recommend the cracks in the walls be repaired if these are likely to cause durability issues (> 0.3 mm)
- Recommend repairs to cracked pipe
- Recommend investigations be carried out into the reason for the cracked pipe – did the differential settlement occur? Carry out level survey?

 Inspection ID: _____ *(Office Use Only)*

CWTP 8

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & IJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1100		

Building Name Christchurch Wastewater Treatment Plant
Short Name • Education Centre, Garage,
Address Technicians' Workshop
Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level: 1
Below ground level: 0
Total gross floor area (m²): ≈ 600
Year built: ?
No of residential Units: 0

Photo Taken: Yes / No

Type of Construction
- ☑ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☑ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe
Collapse, partial collapse, off foundation	☑	☐	☐
Building or storey leaning	☑	☐	☐
Wall or other structural damage	☐	☑	☐
Overhead falling hazard	☑	☐	☐
Ground movement, settlement, slips	☑	☐	☐
Neighbouring building hazard	☑	☐	☐
Electrical, gas, sewerage, water, hazmats	☑	☐	☐

Comments
- Large gaps (≈30mm) in brickwork on north-western wall (by digester 4)
- Gaps in brickwork between walls on northern face. Cracks in brickwork/mortar at south-eastern edge.

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: P Stewart (CBEng)
Date & Time: 7/3/11
ID: PWS

Inspection ID: _____ (Office Use Only)

Structural Hazards/ Damage	Minor/None	Moderate	Severe	LWTPB Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections N/A	☐	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	• Evidence of slope movement next to Driveway 4
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

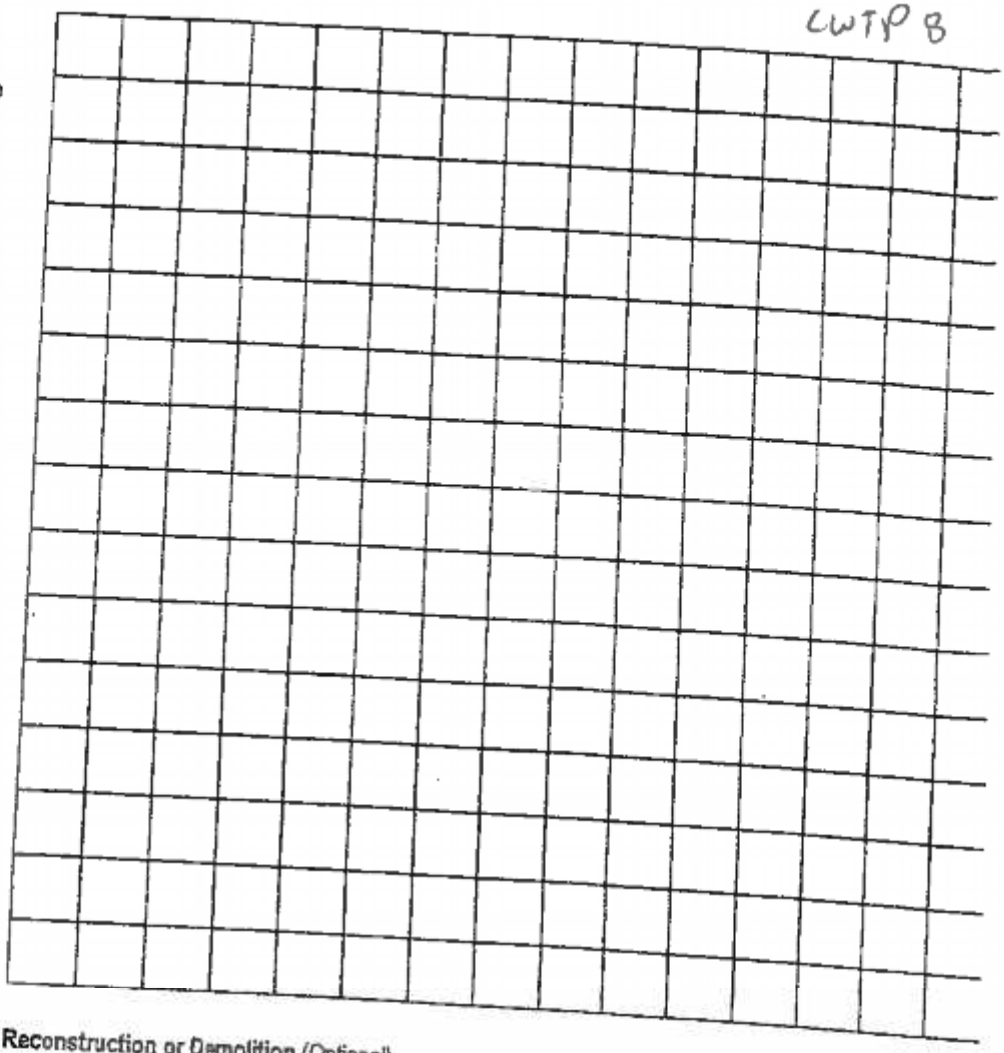
General Comment

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 8



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the displaced brickwork on northern wall by Digester 4 be removed and re-instated.
- Recommend cracked mortar in brickwork be removed and the brickwork be re-pointed.

 Inspection ID: _____ *(Office Use Only)*

CWTP 9

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NS KJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1330		

Building Name Christchurch Wastewater Treatment Plant
Short Name Dewatering Building
Address Shuttle Drive
Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Rourke
Contact Phone 027 2230696

Storeys at and above ground level: 1
Below ground level: 0
Total gross floor area (m^2): ≈ 400
Year built: ?
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☑ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• Cracking in eastern walls
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☐	☐	☐	
Electrical, gas, sewerage, water, hazmats	☐	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN		RESTRICTED USE YELLOW		UNSAFE RED		
G1	(G2)	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NSHAW (Becq)
Date & Time: 7/3/11
ID: NS

Inspection ID:

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTPG Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	• Cracking / spalled concrete at base of concrete encased steel I-beam columns
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	• Cracks in walls @ weld-plate connections
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	• Large gap at steps at south-west
Utilities (eg. gas, electricity, water)	☑	☐	☐	corner of building
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

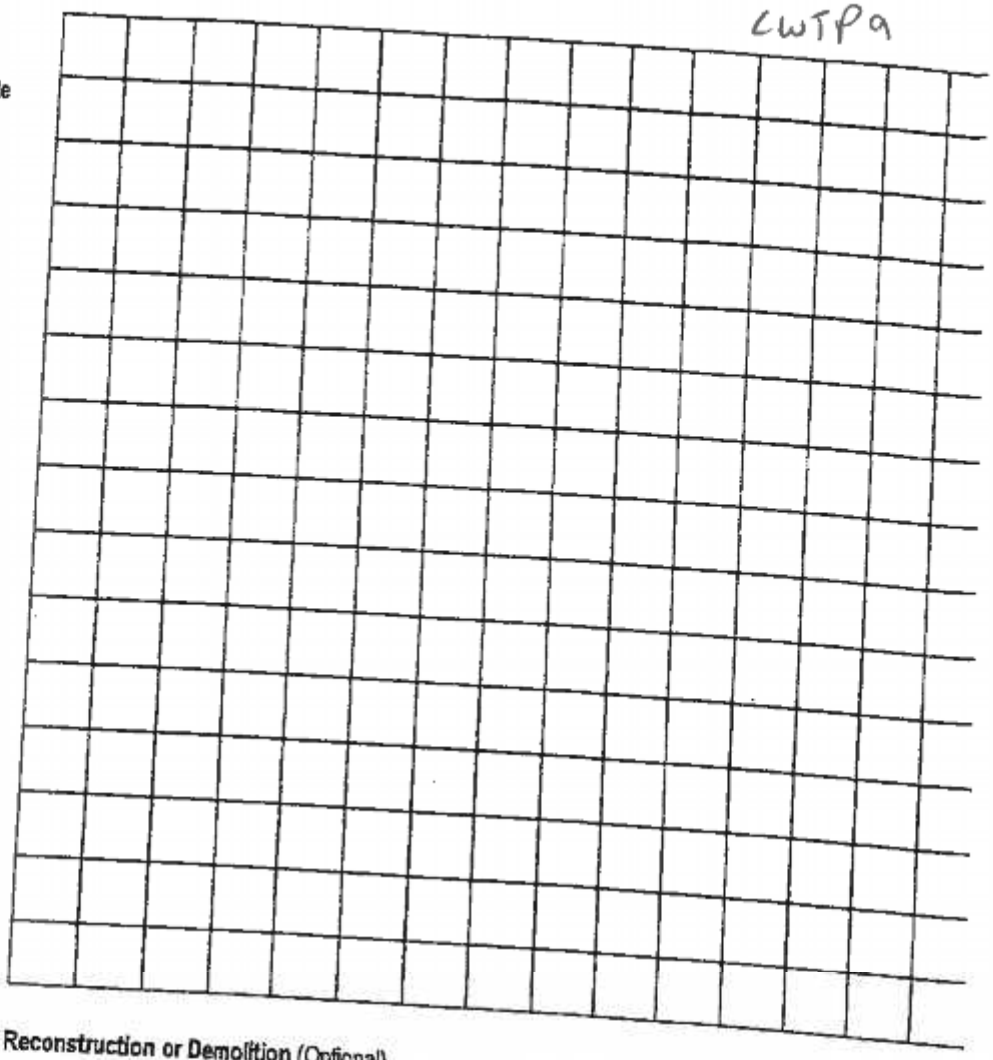
General Comment

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTPA



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the cracks in the walls be repaired using epoxy crack injection
- Recommend the loose/spalled concrete at the base of the columns be removed and re-instated.
- Recommend the gap at the steps be grouted.

CWTP10

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NBS K 156	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1350		

Building Name Christchurch Wastewater Treatment Plant
Short Name Dryer Building
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m²) 2 400
Year built ?
No of residential Units 0

Photo Taken (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe
Collapse, partial collapse, off foundation	☑	☐	☐
Building or storey leaning	☑	☐	☐
Wall or other structural damage	☑	☐	☐
Overhead falling hazard	☑	☐	☐
Ground movement, settlement, slips	☑	☐	☐
Neighbouring building hazard	☑	☐	☐
Electrical, gas, sewerage, water, hazmats	☑	☐	☐

Comments
- Cracking in walls next to opening on western wall, cracking above door on southern side of bldg, cracking to panels next to doors/windows on north face.

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED (GREEN)		RESTRICTED USE (YELLOW)		UNSAFE (RED)		
G1	(G2)	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended
- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: Sol. recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (BCEng)
Date & Time: 7/3/11
ID: NBS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTP10 Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation N/A	☐	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

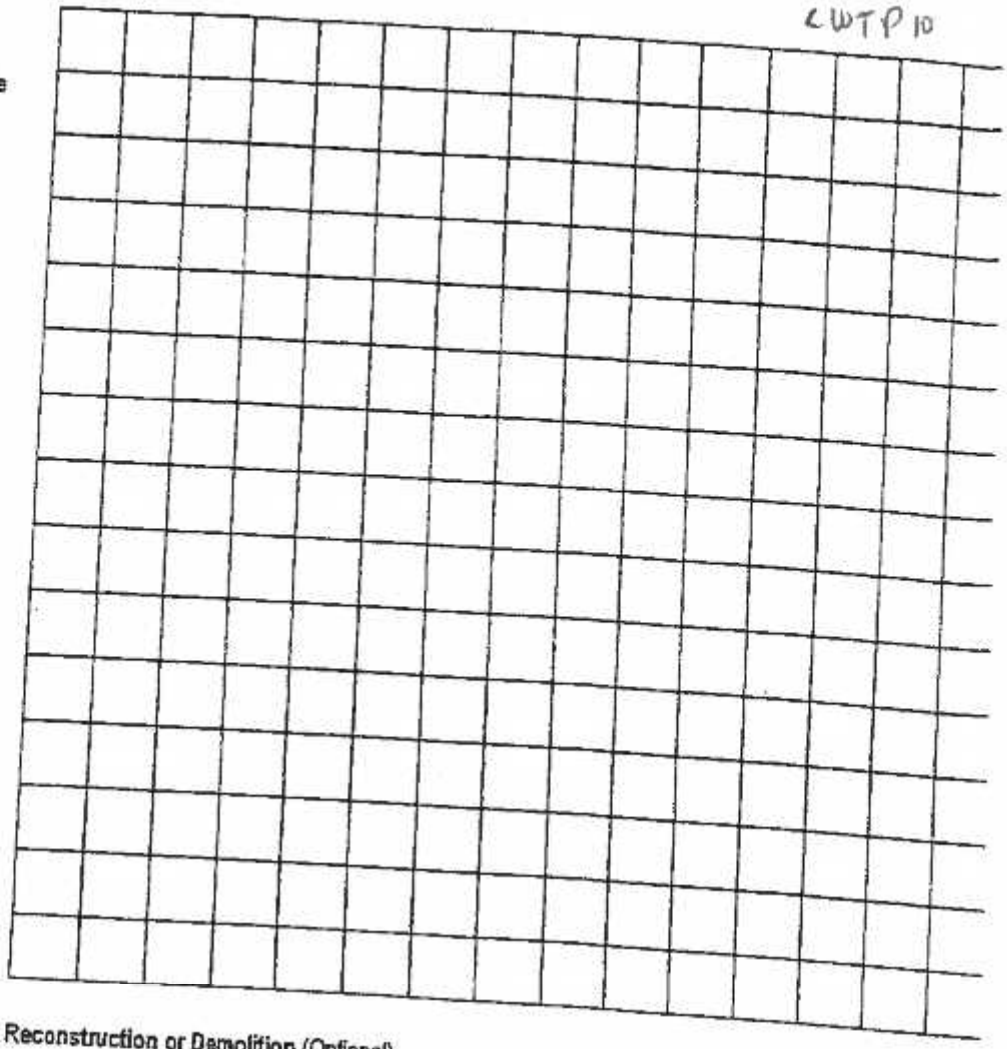
General Comment

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 10



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracks in walls be repaired using epoxy crack injection

 Inspection ID: _____ *(Office Use Only)*

CWTP 11

Christchurch Eg RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS K TJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1357		

Building Name Christchurch Wastewater Treatment Plant
Short Name Energy Centre Building
Address Shuffle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level: 1 | Below ground level: 0
Total gross floor area (m²): ~400 | Year built: 2009?
No of residential Units: 0

Photo Taken: Yes (No)

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: - see recommendations.

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStuart (Beca)

Date & Time ID: 7/3/11 NLS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTP11 Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	• see general comments
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☑	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

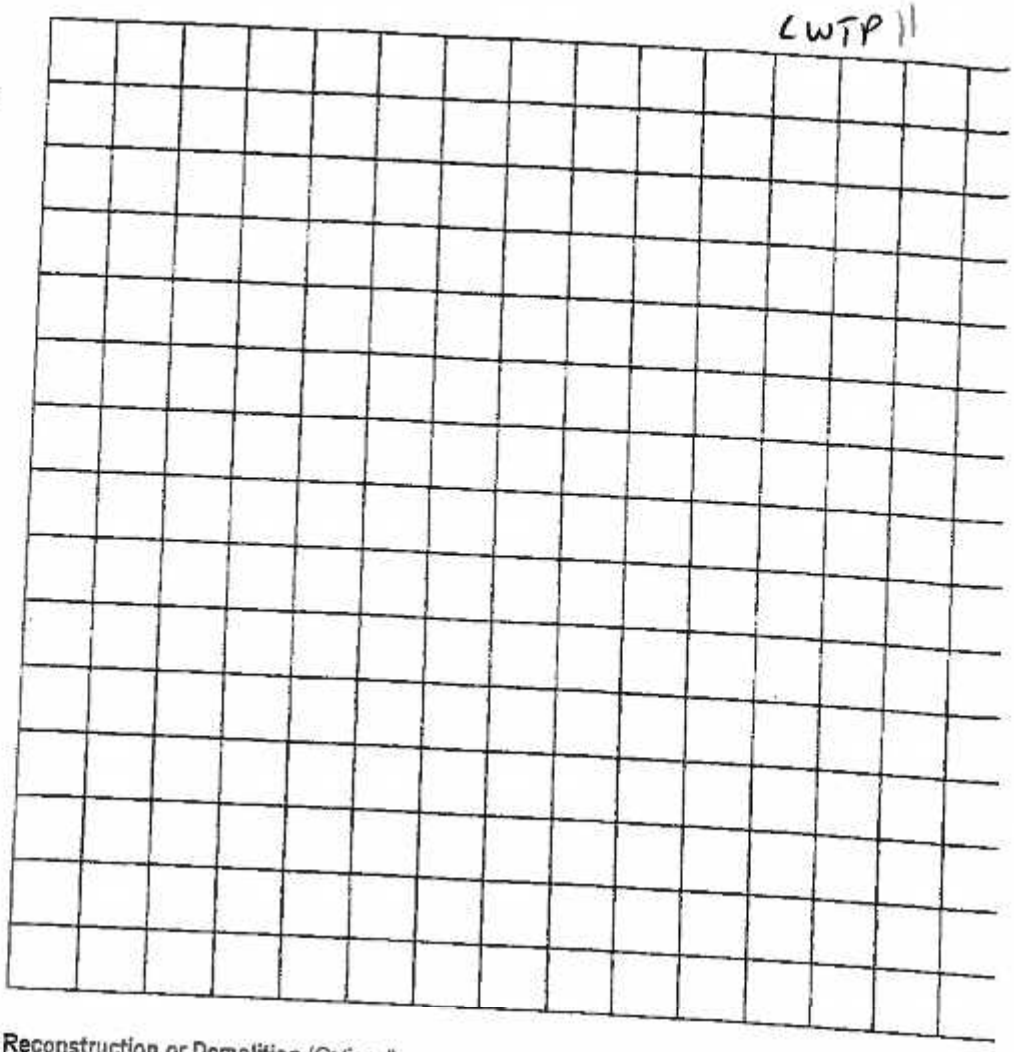
General Comment • The interior of the building could not be accessed. From the outside of the building there does not appear to be any structural damage caused by the earthquake. However, based on the inspection carried out after the 4 Sept 2010 earthquake, it was noted that the precast panels were cracked at the weld plate connections. It is likely further cracking to these panels will have occurred due to the 22 Feb 2011 earthquake.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

LWTP II



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend repairs to the cracked precast panels at the weld plate connections be carried out and any other cracks be repaired using epoxy crack injection.

 Inspection ID: _____ *(Office Use Only)*

CWTP 12

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NJS K 176	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1100		

Building Name Christchurch Wastewater Treatment Plant
Short Name North Gallery
Address Shuttle Drive
Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level: 0 Below ground level: 1
Total gross floor area (m^2): 2400 Year built: ?1
No of residential Units: 0

Photo Taken: Yes / No

Type of Construction

- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Reinf. concrete box tunnel structure

Primary Occupancy

- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: See recommendation

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStown (Beca)
Date & Time: 7/3/11
ID: NJS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage		Minor/None	Moderate	Severe	CWTP12 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures		☑	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• see general comments
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	• see general comments
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

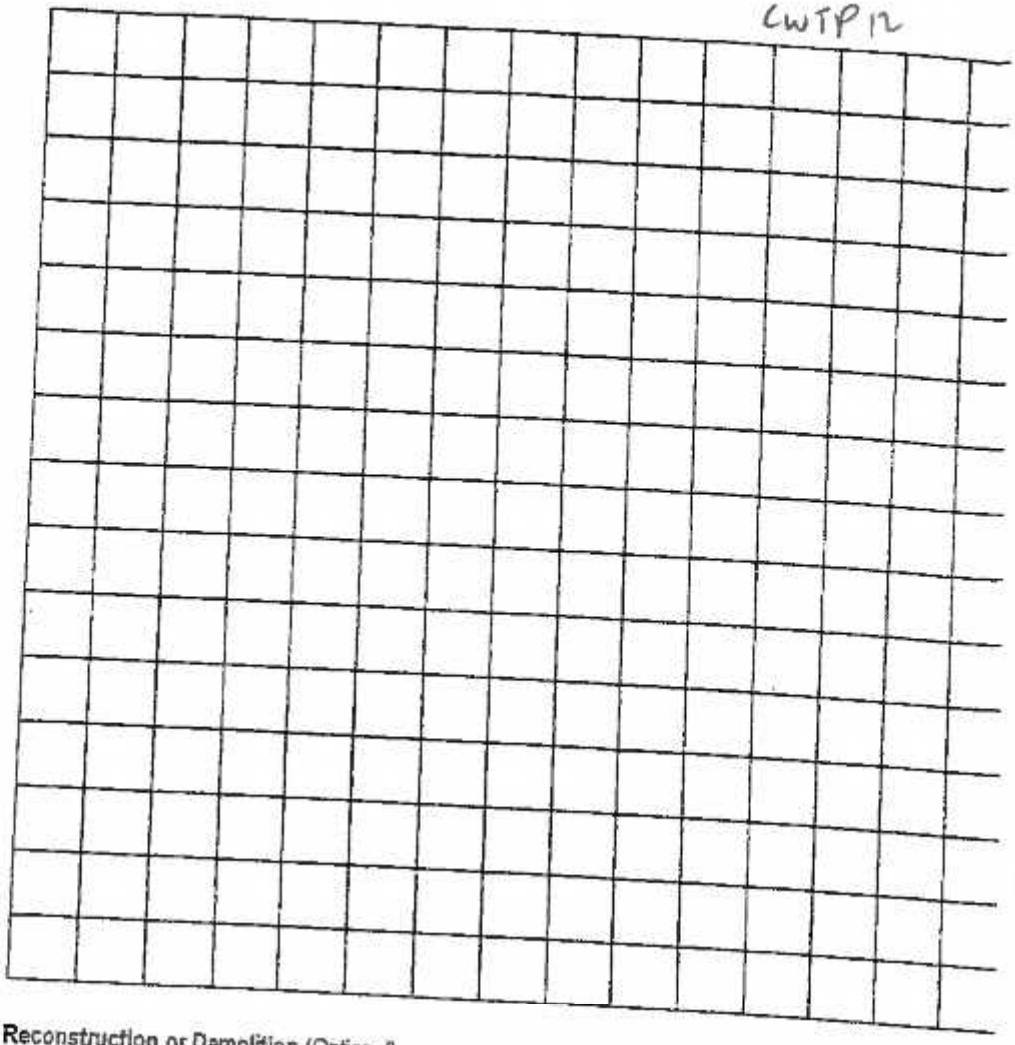
General Comment
- Differential vertical and horizontal movement between the concrete tunnel section was observed resulting in damage to the joint seals. This was typical at at most joints.
- Large movement (approx. 30mm) was observed at top of stairs next to Digester Control Room.
- Cracking was observed around doorway near Digester Control room.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 12



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend replacement of damaged joint seals
- Recommend cracks be repaired using epoxy crack injection
- Recommend gap at stairs be made good (Lower plate:)

 Inspection ID: _____ *(Office Use Only)*

CWTP 13

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NWS K 130
Territorial Authority: Christchurch City
Date: 7/2/11
Time: 1230
Final Posting (e.g. UNSAFE): G2

Building Name
Short Name: Christchurch Wastewater Treatment Plant - South Gallery
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230696

Storeys at and above ground level: 0
Below ground level: 1
Total gross floor area (m²): ≈ 600
Year built: ?
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Reinf. concrete box tunnel structure

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• minor cracking to walls
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED — GREEN: G1 | (G2)
RESTRICTED USE — YELLOW: Y1 | Y2
UNSAFE — RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural
  - ☐ Geotechnical
  - ☐ Other:
- ☑ Other recommendations: see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NSlown (Becy)
Date & Time: 7/2/11
ID: NWS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage		Minor/None	Moderate	Severe	CWTP13 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures		☑	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• See general comments
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	• see general comments
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

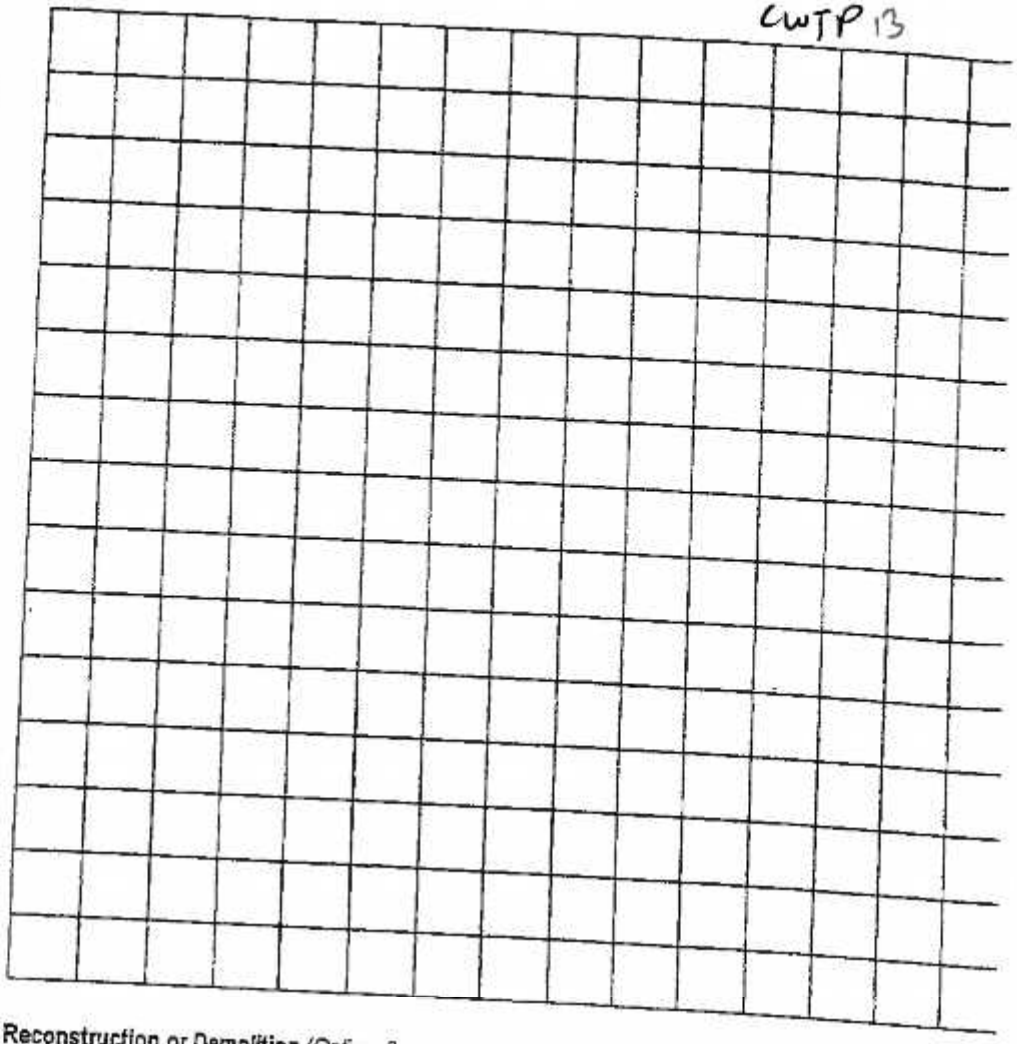
General Comment • Differential vertical and horizontal movement between the concrete tunnel sections was observed resulting in damage to the joint seals at several locations and spalled concrete at one location
• Evidence of leakages at joints and sand infiltration

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage; repairs, strengthening possible	
		R2. Severe damage; demolition likely	
		R3. At risk from adjacent premises or from ground failure	

CWTP 13

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend replacement of damaged joint seals
- Recommend cracks be repaired using epoxy crack injection
- Recommend spalled concrete be replaced using overlay mortar

CWTP14

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NWS & JTB	Date	5/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	0950		

Building Name Christchurch Wastewater Treatment Plant
Short Name Primary sedimentation tanks & solids contact tanks
Address Shuffle Drive Bromley Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Burke
Contact Phone 027 2230696

Storeys at and above ground level: 0 | Below ground level: 1
Total gross floor area (m^2): ~13000 | Year built: ??
No of residential Units: 0

Photo Taken: Yes / No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☑ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	* see general comments
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: See recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Howard (Beca)
Date & Time: 5/3/11
ID: NWS

Inspection ID: _____ (Office Use Only)

CWTP 14

Structural Hazards/ Damage		Minor/None	Moderate	Severe	Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	• see general comments
Columns, pilasters, corbels		☑	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam		☑	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions		☑	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits	N/A	☐	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• see general comments
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

General Comment

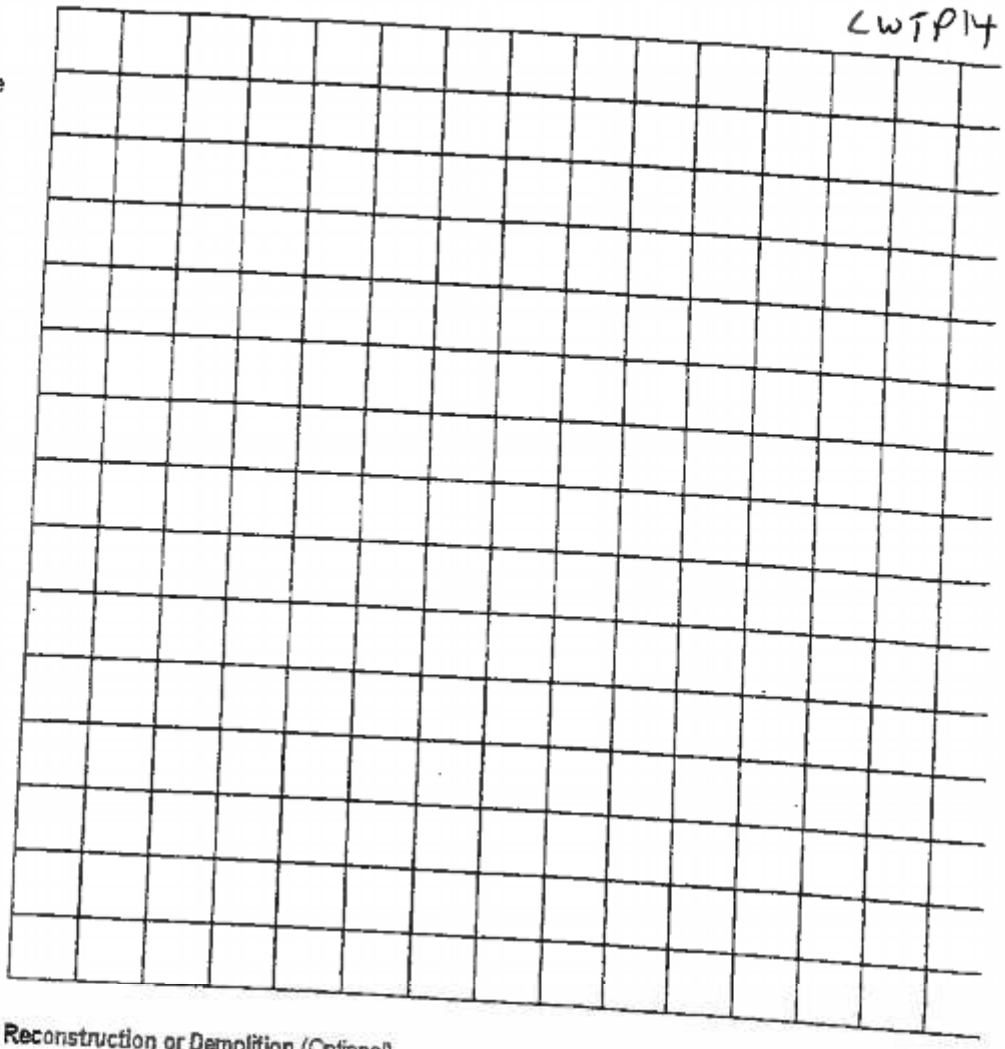
- Separation at the joints between the tanks was observed. This separation was up to approx 15mm. This was typical at most joints
- A leakage was observed at the bottom of PST1 (southern tank) where water was leaking into the empty tank. It is possible leakages could be on other tanks as well could not see other tanks as these were full or bottom was obscurred.
- The central columns appeared to be higher than the walls of the tank.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP14



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend joint seals be removed and replaced.
- Recommend the tanks be emptied at the tanks be inspected for any cracks in the walls and floor slab. Repair cracks as necessary using epoxy grout injection
- Recommend a level survey be carried out to ascertain whether the ground has settled or heaved. if ground has moved check if there are any voids beneath the slab and inject with grout as necessary to fill voids.

 Inspection ID: _____ *(Office Use Only)*

CWTP 15

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NW KJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G1
Territorial Authority	Christchurch City	Time	1430		

Building Name: Christchurch Wastewater Treatment Plant
Short Name: Sludge Lagoons
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230646

Storeys at and above ground level: 0
Below ground level: 1
Total gross floor area (m^2): ≈ 6000
Year built: ??
No of residential Units: 0
Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Reinf. concrete tank structure

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 G2	YELLOW	Y1 Y2	RED	R1 R2 R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Stewart (Beca)

Date & Time: 7/3/11
ID: NW

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage		Minor/None	Moderate	Severe	CUTP 15 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• The vertical manhole pipe at the southern end of the western lagoon has spalled concrete near the top of the pipe.
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

General Comment • There does not appear to be any structural damage as a result of the earthquakes.

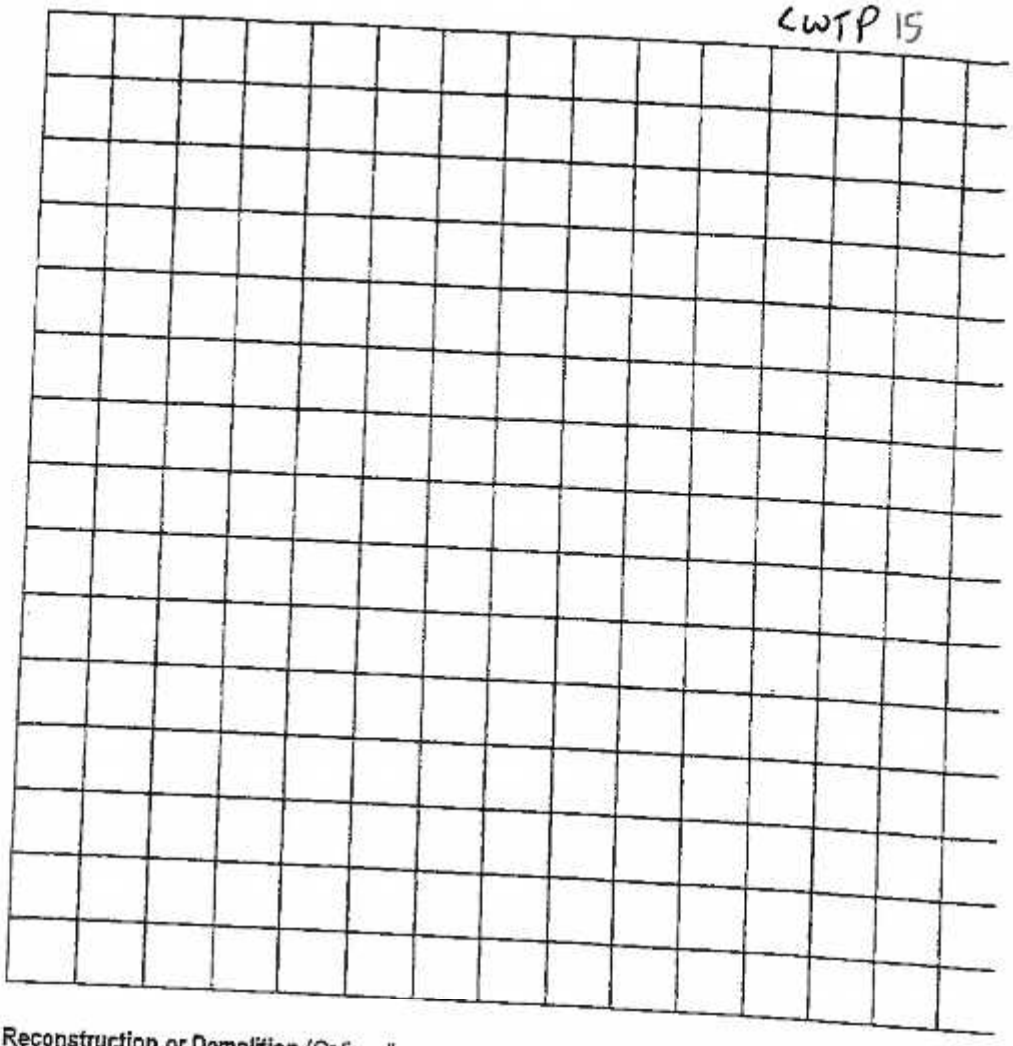
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 15



Recommendations for Repair and Reconstruction or Demolition (Optional)

N/A

 Inspection ID: _____ *(Office Use Only)*

CWTP 16

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NW K JSB
Territorial Authority: Christchurch City
Date: 7/3/11
Time: 1530
Final Posting (e.g. UNSAFE): G1

Building Name: Christchurch Wastewater Treatment Plant
Short Name: Influent Structure
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 223 0646

Storeys at and above ground level: 0
Below ground level: 1
Total gross floor area (m^2): ~300
Year built: 71
No of residential Units: 0

Photo Taken: Yes (No)

Type of Construction:
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Buried reinf concrete culvert structure

Primary Occupancy:
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED			RESTRICTED USE		UNSAFE		
GREEN	G1	G2	YELLOW	Y1	Y2	RED	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Stannard (Beca)
Date & Time: 7/3/11
ID: NS

Inspection ID: _____ (Office Use Only)

CWTP16

Structural Hazards/ Damage		Minor/None	Moderate	Severe	Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels		☑	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam		☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions		☑	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits	N/A	☐	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☐	☐	☐	
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	Evidence of liquefaction around site

General Comment: Structure is largely covered. Therefore only an external inspection of the top and sides was carried out. Based on this inspection no signs of structural damage was observed.

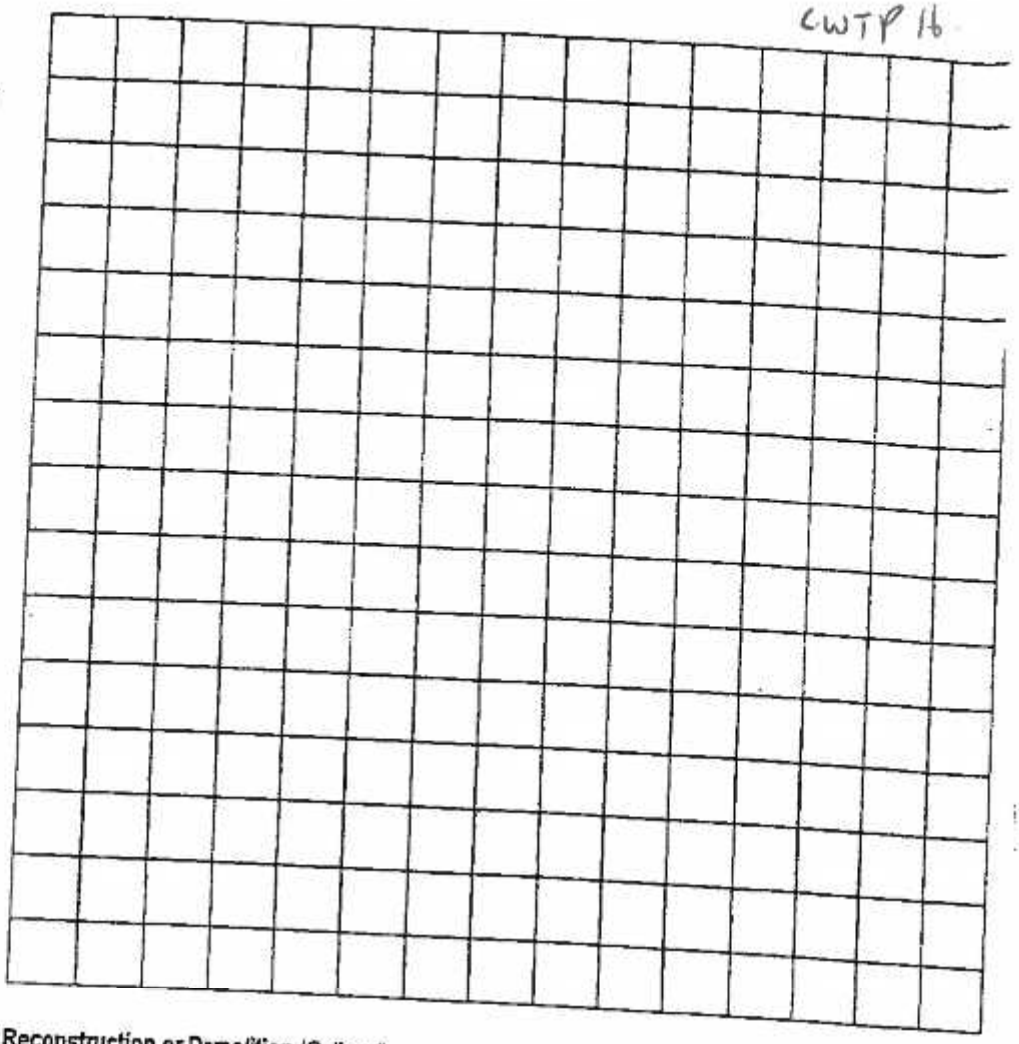
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 16



Recommendations for Repair and Reconstruction or Demolition (Optional)

N/A

 Inspection ID: _____ *(Office Use Only)*

CWTP 17

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS + JTB	Date	5/2/11	Final Posting (e.g. UNSAFE)	G1
Territorial Authority	Christchurch City	Time	0940		

Building Name Christchurch Wastewater Treatment Plant
Short Name Trickling Filters 1 & 2
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 223 0696

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m²) >5000
Year built ≤1980
No of residential Units 0

Photo Taken (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Circular concrete tanks (2 No)

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 G2	YELLOW	Y1 Y2	RED	R1 R2 R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended
  - ☑ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: - see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: Pstewart (Beca)

Date & Time: 5/3/11

ID: NLS

Inspection ID: _____ (Office Use Only)

Structural Hazards/ Damage	Minor/None	Moderate	Severe	LW1P17 Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☐	☐	☐	
Beam	☐	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation N/A	☐	☐	☐	
Cladding, glazing N/A	☐	☐	☐	
Ceilings, light fixtures N/A	☐	☐	☐	
Interior walls, partitions N/A	☐	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	• No problems noted
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

General Comment

• Structurally no apparent structural damage to the trickling filters. However could not access the interior of the tanks.
• It was noted the central column may have tilted which has resulted in the rotating arm hitting the sides of the tank. Recommend further investigation be carried out (see recommendations)

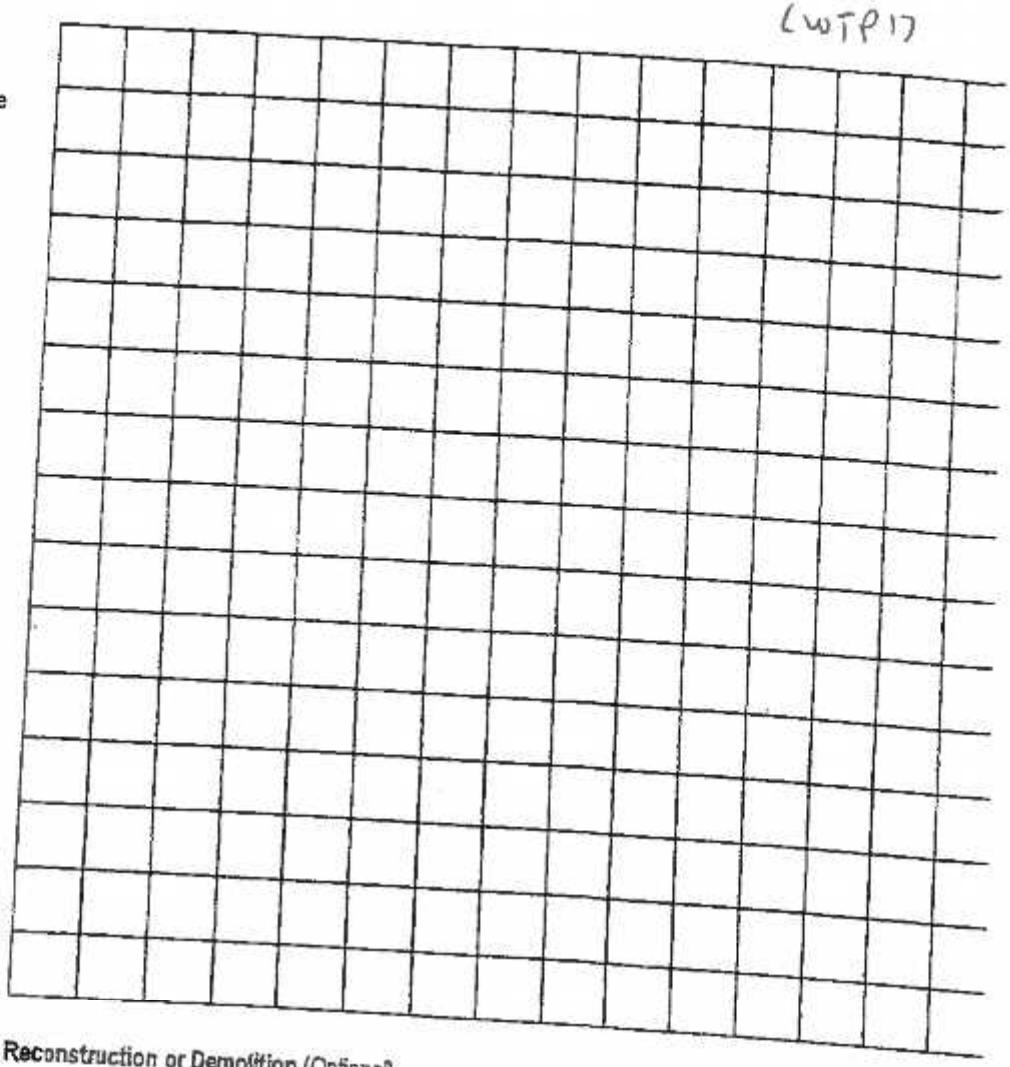
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, ~~no immediate~~ further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

LWTP17

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend further investigation be carried out into the reason why the top of the column has moved. There could be damage to the column or column foundation.
- Recommend a level survey be carried out to confirm the magnitude of overall and differential settlement.

CWTP 18

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NW KJTB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1120		

Building Name Christchurch Wastewater Treatment Plant
Short Name Digesters 1-4
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m²) ≈ 2000
Year built ??
No of residential Units 0

Photo Taken (Yes) No

Type of Construction

- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Circular reinf. concrete tanks (4 no.) approx 25m diam

Primary Occupancy

- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 / G2	YELLOW	Y1 / Y2	RED	R1 / R2 / R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: SCE recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Hamill (BCCA)

Date & Time: 7/3/11 1120

ID: NH

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage		Minor/None	Moderate	Severe	CWTP 18 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing		☑	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• see general comment
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	• Evidence of slope movement on eastern side
Ground movement, fissures		☑	☐	☐	• Evidence of ground settlement of up to 130mm
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

General Comment
- Spalled concrete @ pipe connection on northern edge of Digester 3 and cracked concrete at two other pipe locations
- Guide wheels and guides have broken off at a number of locations
- Cracked pavement concrete around perimeter of tanks.

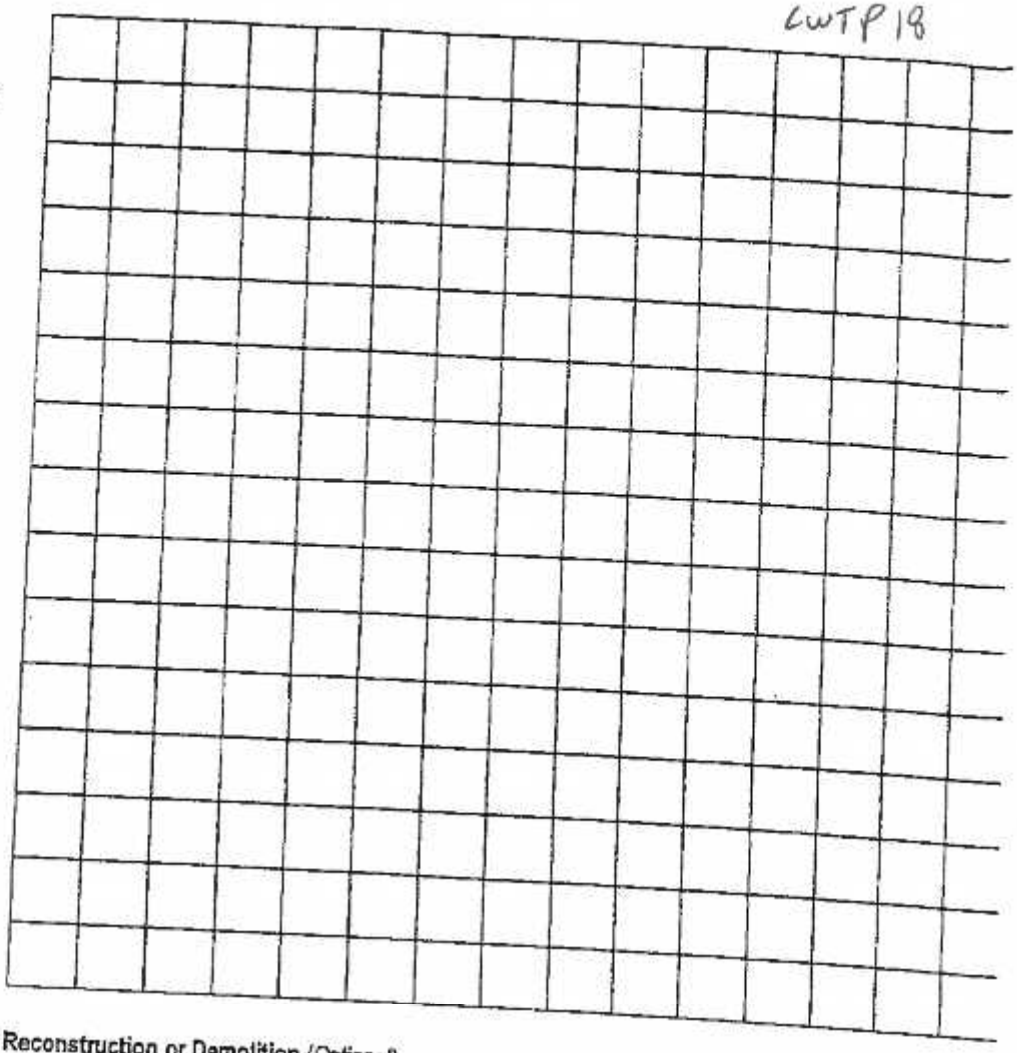
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 18



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend spalled concrete & cracked concrete @ pipe connection be repaired using reinstatement mortar and epoxy injection
- Recommend guide wheels and guides be repaired / replaced (Currently being undertaken)
- Recommend cracked pavement be repaired
- Recommend a Level survey be carried out to ascertain amount of differential settlement (if any)

CWTP19

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & ITB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1120		

Building Name
Short Name: Christchurch Wastewater Treatment Plant - Digesters 1-4 Control Building
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230696

Storeys at and above ground level: 1
Below ground level: 1
Total gross floor area (m²): ~150
Year built: ?
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	Minor diagonal cracking in walls at corner of doors
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: See recommendation

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)
Date & Time: 7/3/11
ID: NLS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CWTP19 Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

General Comment • Other than minor cracking to the walls, this building appears to have no significant structural damage.

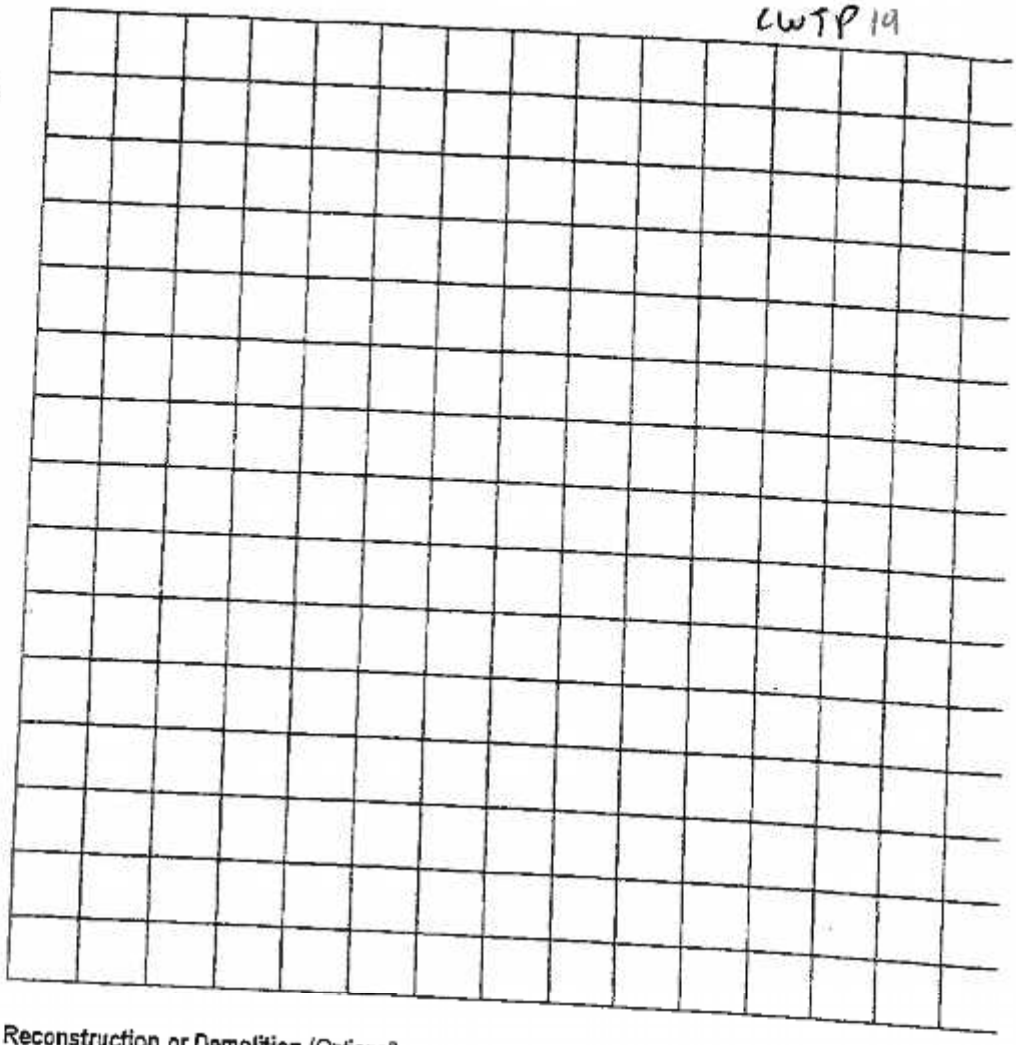
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP 19



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracks in walls be repaired using epoxy crack injection.

 Inspection ID: _____ *(Office Use Only)*

CWTP 20

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials: NCS K JTB
Territorial Authority: Christchurch City
Date: 7/3/11
Time: ~~Mine~~ 1440
Final Posting (e.g. UNSAFE): G2

Building Name: Christchurch Wastewater Treatment Plant
Short Name: Digesters 5-6 & underground
Address: Shuttle Drive Gallery, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230696

Storeys at and above ground level: 1
Below ground level: 1
Total gross floor area (m²): ≈1500
Year built: ≈2005
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction:
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Circular concrete tanks (2 No), approx 28m diam.

Primary Occupancy:
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☐ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE):

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN		RESTRICTED USE YELLOW		UNSAFE RED		
G1	(G2)	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: – see recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)
Date & Time: 7/3/11
ID: NCS

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage		Minor/None	Moderate	Severe	LWTP 20 Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures		☑	☐	☐	
Interior walls, partitions		☑	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☑	☐	☐	• see general comments
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	• Evidence of ground settlement of up to 80 mm
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

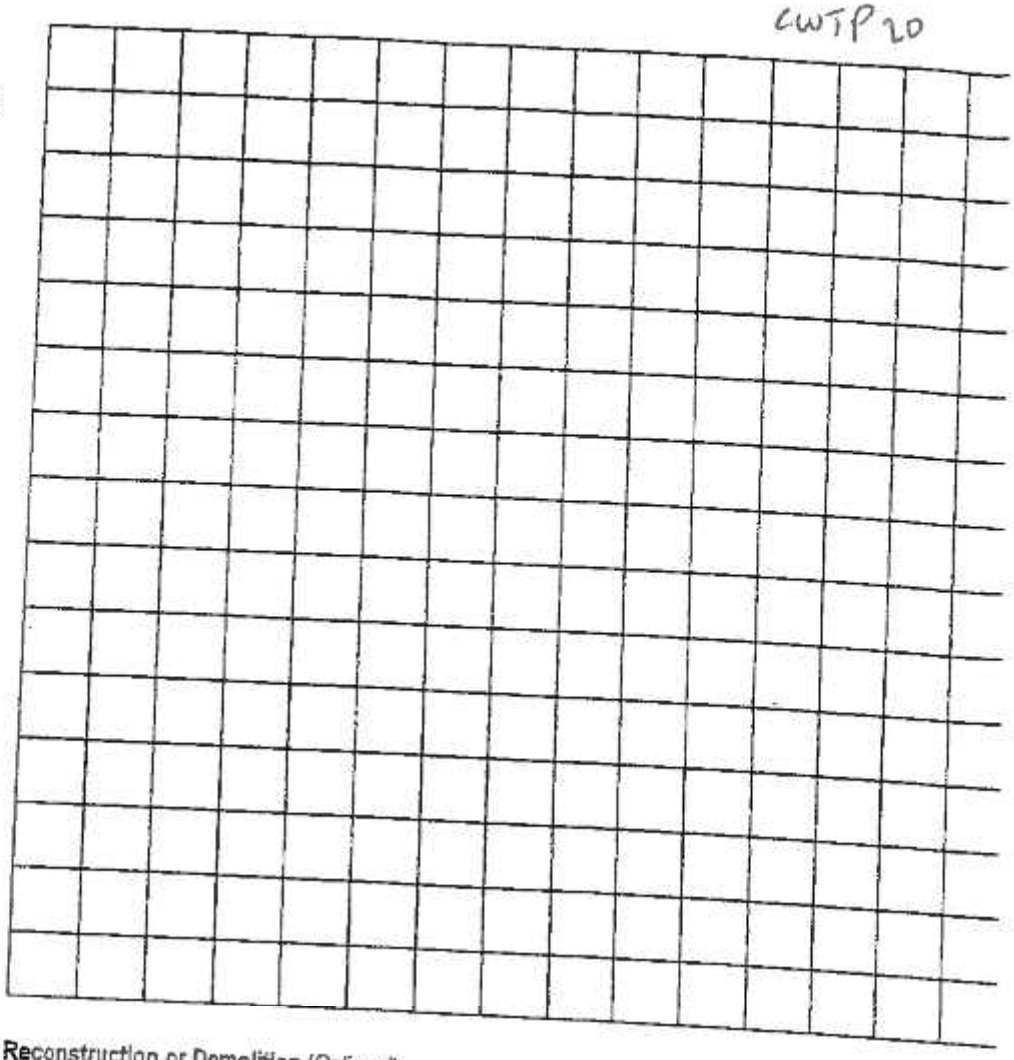
General Comment
- spalled concrete pavement slab around perimeter of tanks.
- some leakages were observed at base of gallery walls

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

CWTP 20

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend repairs to concrete basement slab be carried out
- Recommend the cracks / joints at base of gallery walls be repaired using epoxy crack injection and providing keyplants.
- Recommend a level survey be carried out to ascertain amount of differential settlement (if any).

 Inspection ID: _____ *(Office Use Only)*

CWTP 21

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NWS & IJB	Date	7/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1440		

Building Name
Short Name: Christchurch Wastewater Treatment Plant - Digesters 5 & 6 Control Building
Address: Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates: S° E°
Contact Name: Mike Bourke
Contact Phone: 027 2230646

Storeys at and above ground level: 1
Below ground level: 0
Total gross floor area (m^2): ≈ 200
Year built: ≈ 2005
No of residential Units: 0

Photo Taken: Yes No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	Diagonal cracking to walls on north face and above doorway on west face.
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN		RESTRICTED USE YELLOW		UNSAFE RED		
G1	G2	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: Level recommendation

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NSteward (Becca)
Date & Time: 7/3/11
ID: [illegible]

Inspection ID: _____ *(Office Use Only)*

Structural Hazards/ Damage	Minor/None	Moderate	Severe	CUTP 21 Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☑	☐	☐	• see comments
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

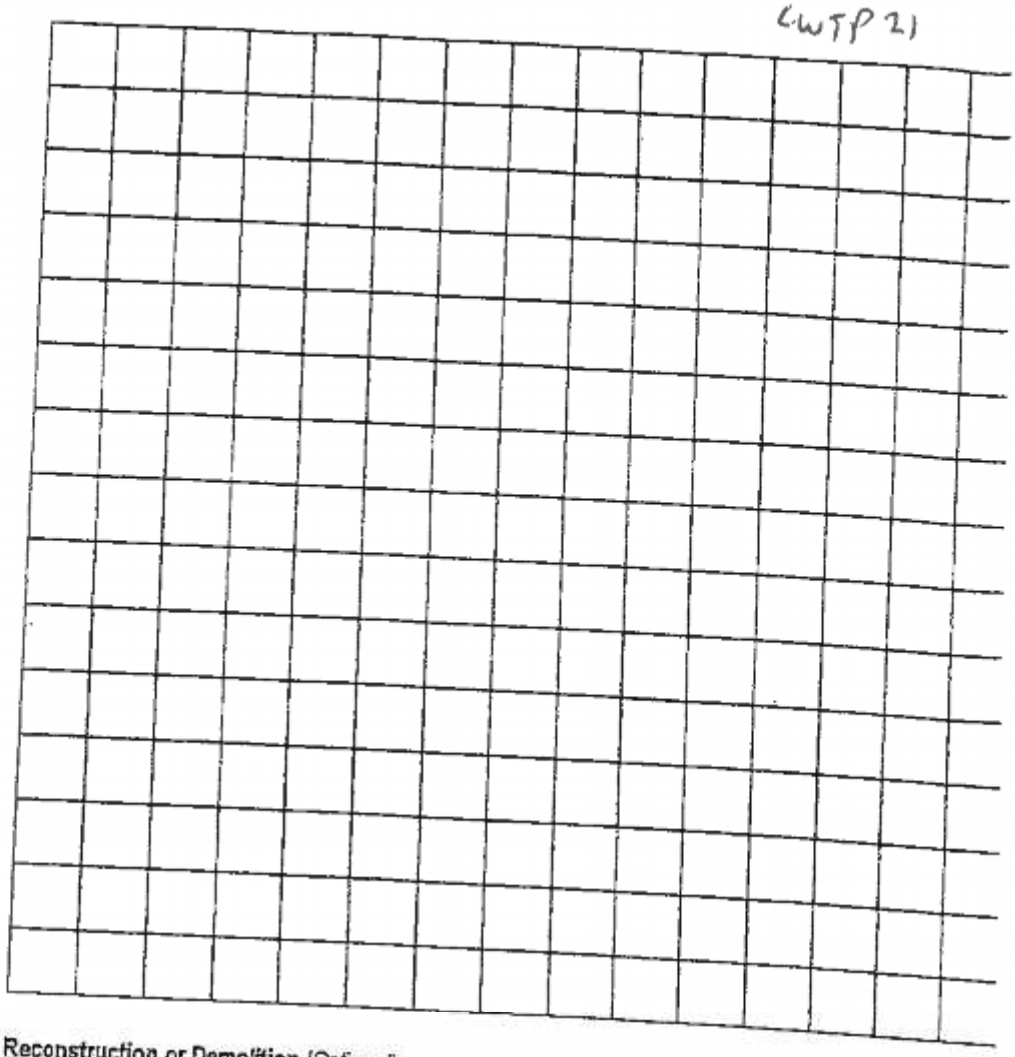
General Comment • Concrete pavement slab spalled on eastern side of building
" " " " " / cracked on western side of building

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• see recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

CWTP 21

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracks in walls be repaired using epoxy crack injection
- Recommend the spalled pavement concrete be replaced using reinstatement mortar

CWTP 22

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS KJTB	Date	5/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1030		

Building Name Christchurch Wastewater Treatment Plant
Short Name • Clarifiers 1-4 & walkways
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 223 0696

Storeys at and above ground level 0
Below ground level 1
Total gross floor area (m²) approx 9000
Year built ?
No of residential Units 0

Photo Taken (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Buried circular concrete tanks, approx 50m diam, 4 No

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• There is cracking in the external wall of clarifier #4 on southern edge.
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	• There is general settlement around the clarifiers of between 100 to 300mm
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN		RESTRICTED USE YELLOW		UNSAFE RED		
G1	(G2)	Y1	Y2	R1	R2	R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☑ Detailed engineering evaluation recommended - see recommendations
  - ☐ Structural
  - ☑ Geotechnical
  - ☐ Other:
- ☑ Other recommendations: see recommendation

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: N Harwood (Beca)
Date & Time: 5/3/11
ID: NLS

CWTP22

Structural Hazards/ Damage		Minor/None	Moderate	Severe	Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)	N/A	☐	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam		☑	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits		☑	☐	☐	• steelwork to the walkway stair landing adjacent to the Energy Centre is deformed due to settlement of the landing
Utilities (eg. gas, electricity, water)		☐	☐	☐	
Other		☑	☐	☐	• see general comments
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	• Local slumping around clarifier 4
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site especially to the west of clarifiers 3 & 4

General Comment

- There is cracking to the trench structure from the pump station to the clarifiers due to differential settlement.
- Otherwise no signs of structural damage as a result of the ~~eq~~ earthquakes.

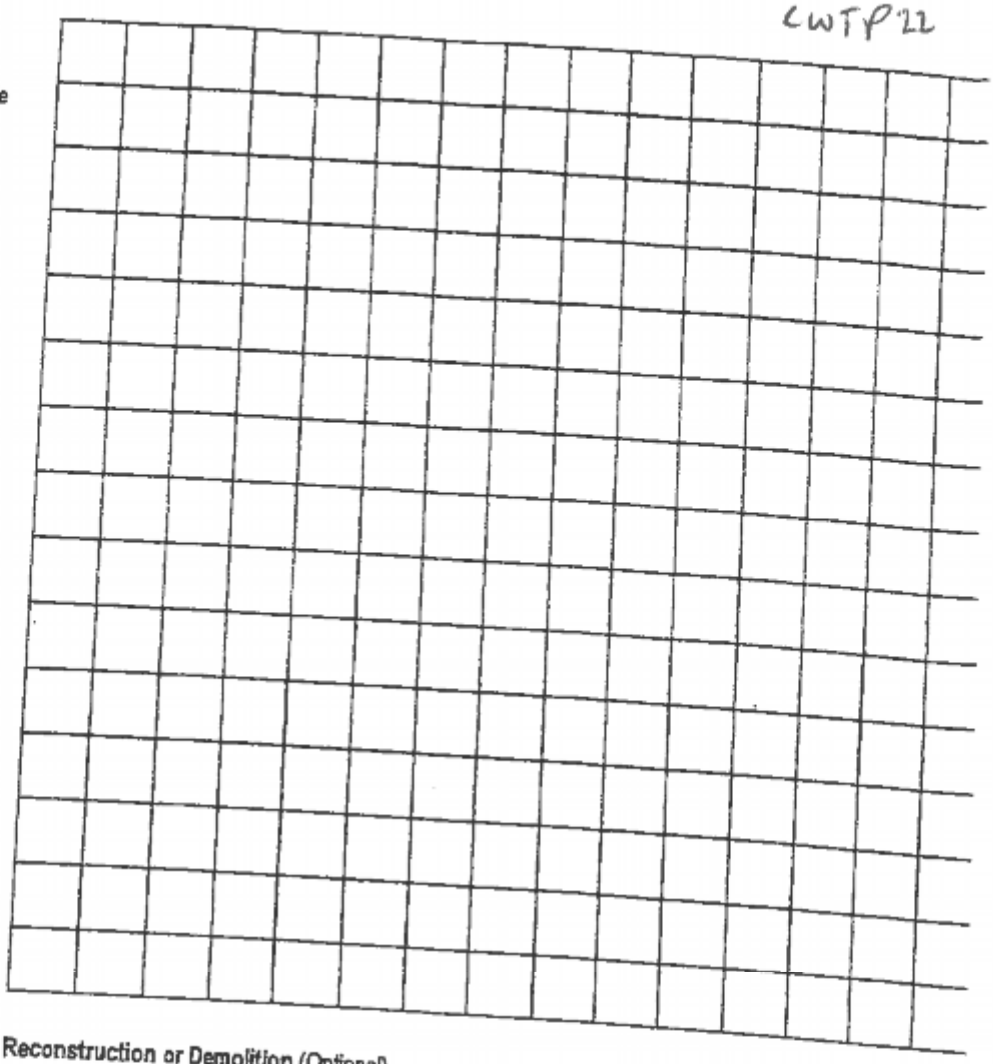
Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

 Inspection ID: _____ *(Office Use Only)*

CWTP 22

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend the crack to the external wall of clarifier 4 be repaired using epoxy injection with a sealant
- Recommend the deformed steel work at the stair landing be repaired using packers and grout pad.
- Recommend the trench/ducting structure be repaired by epoxy injecting the cracks and provide sealants.
- Recommend a level survey be carried out on all clarifiers to assess the levels of the tank walls, floor slab and central pier.
- Based on the results of the level survey, if significant settlement of the clarifier has occurred or if significant lateral movement of the central pier has occurred, then recommend further investigation be carried out to inspect the clarifier. This may entail dewatering the area around the clarifier and emptying the clarifier, carry out of full inspection of the walls, base slab and central pier. Make repairs as necessary.

 Inspection ID: _____ *(Office Use Only)*

CWTP23

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NLS & ITB	Date	5/3/11	Final Posting (e.g. UNSAFE)	G2
Territorial Authority	Christchurch City	Time	1100		

Building Name Christchurch Wastewater Treatment Plant
Short Name RAS/WAS Pump Station
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level: 1
Below ground level: 0?
Total gross floor area (m^2): ~200
Year built:
No of residential Units: 0

Photo Taken: (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☑ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☐ Other:

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	• minor cracking in wall near door on western side, in wall at corner of east window and above door on east side
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building: Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED GREEN: G1 | (G2)
RESTRICTED USE YELLOW: Y1 | Y2
UNSAFE RED: R1 | R2 | R3

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural ☐ Geotechnical ☐ Other:
- ☑ Other recommendations: See recommendations

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)
Date & Time: 5/3/11
ID: NLS

Inspection ID:

CWTP 23

Structural Hazards/ Damage	Minor/None	Moderate	Severe	Comments
Foundations	☑	☐	☐	
Roofs, floors (vertical load)	☑	☐	☐	
Columns, pilasters, corbels	☑	☐	☐	
Diaphragms, horizontal bracing	☑	☐	☐	
Pre-cast connections	☑	☐	☐	
Beam	☑	☐	☐	
Non-structural Hazards / Damage				
Parapets, ornamentation	☑	☐	☐	
Cladding, glazing	☑	☐	☐	
Ceilings, light fixtures	☑	☐	☐	
Interior walls, partitions	☑	☐	☐	
Elevators N/A	☐	☐	☐	
Stairs/ Exits	☑	☐	☐	
Utilities (eg. gas, electricity, water)	☑	☐	☐	
Other	☐	☐	☐	
Geotechnical Hazards / Damage				
Slope failure, debris	☑	☐	☐	
Ground movement, fissures	☑	☐	☐	
Soil bulging, liquefaction	☑	☐	☐	• Evidence of liquefaction around site

General Comment

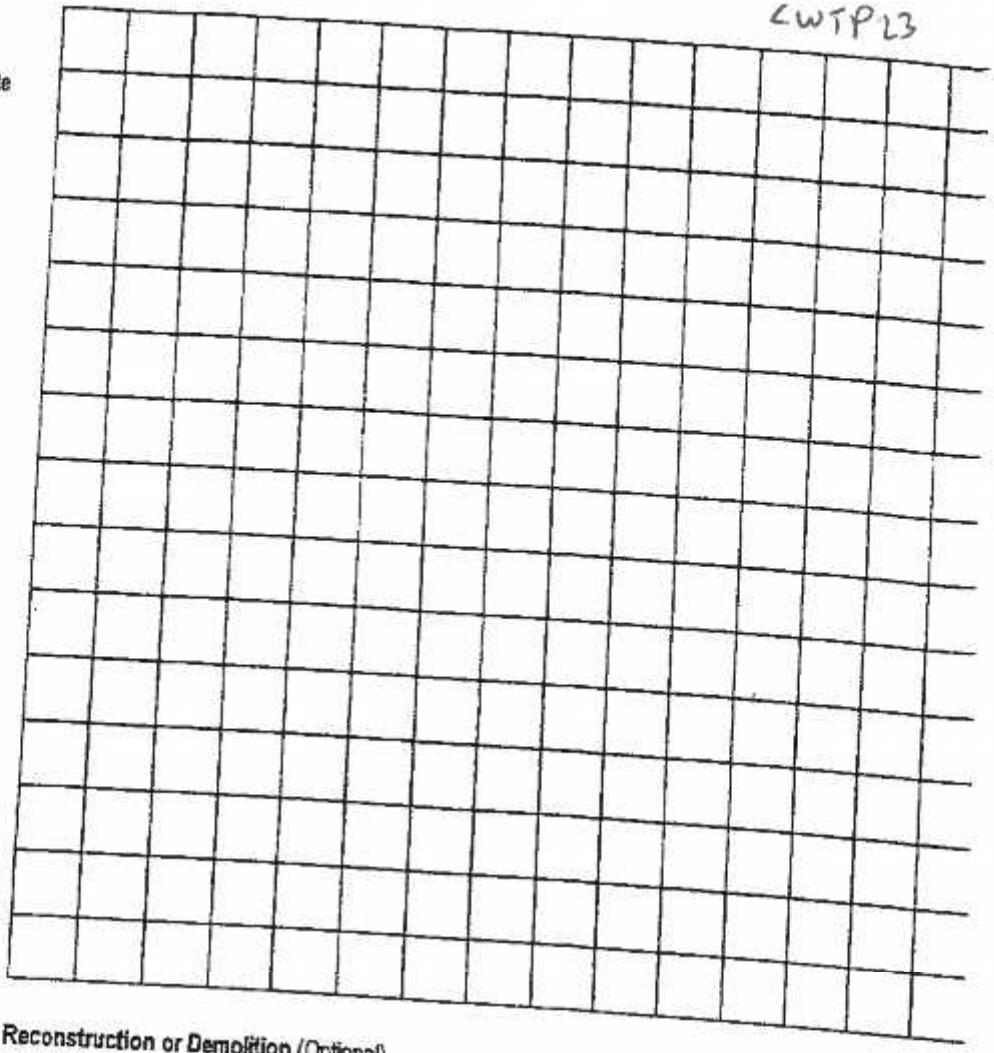
- Could not access interior of building.
- There was approx 10mm separation ~~between~~ at the joint between the walls on the eastern side, causing damage to the sealant

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	• See recommendations
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.

CWTP23



Recommendations for Repair and Reconstruction or Demolition (Optional)

- Recommend cracking to walls be repaired by epoxy crack injection
- Recommend the damaged sealant be replaced.
- Recommend interior be inspected for any other damages

 Inspection ID: _____ *(Office Use Only)*

CWTP 24

Christchurch Eq RAPID Assessment Form - LEVEL 2

Inspector Initials	NCS & JSB	Date	5/3/11	Final Posting (e.g. UNSAFE)	G1
Territorial Authority	Christchurch City	Time	0940		

Building Name Christchurch Wastewater Treatment Plant
Short Name • Gas Holder Tank & Water Tank
Address Shuttle Drive, Bromley, Christchurch
GPS Co-ordinates S° E°
Contact Name Mike Bourke
Contact Phone 027 2230696

Storeys at and above ground level 1
Below ground level 0
Total gross floor area (m²) ~100
Year built ?
No of residential Units 0

Photo Taken (Yes) No

Type of Construction
- ☐ Timber frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ RC frame with masonry infill
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Confined masonry
- ☑ Other: Circular reinf concrete tanks (2 No) clad in brick veneer. (Copper Gasholder)

Primary Occupancy
- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ School
- ☐ Religious
- ☐ Commercial/ Offices
- ☑ Industrial
- ☐ Government
- ☐ Heritage Listed
- ☐ Other

Investigate the building for the conditions listed on page 1 and 2, and check the appropriate column. A sketch may be added on page 3

Overall Hazards / Damage	Minor/None	Moderate	Severe	Comments
Collapse, partial collapse, off foundation	☑	☐	☐	
Building or storey leaning	☑	☐	☐	
Wall or other structural damage	☑	☐	☐	
Overhead falling hazard	☑	☐	☐	
Ground movement, settlement, slips	☑	☐	☐	• Evidence of 50-60 mm ground settlement adjacent to tanks.
Neighbouring building hazard	☑	☐	☐	
Electrical, gas, sewerage, water, hazmats	☑	☐	☐	

Record any existing placard on this building:

Existing Placard Type (e.g. UNSAFE)

Choose a new posting based on the new evaluation and team judgement. Severe conditions affecting the whole building are grounds for an UNSAFE posting. Localised Severe and overall Moderate conditions may require a RESTRICTED USE. Place INSPECTED placard at main entrance. Post all other placards at every significant entrance. Transfer the chosen posting to the top of this page.

INSPECTED		RESTRICTED USE		UNSAFE		
GREEN	G1 G2	YELLOW	Y1 Y2	RED	R1 R2 R3	

Record any restriction on use or entry:

Further Action Recommended:

Tick the boxes below only if further actions are recommended

- ☐ Barricades are needed (state location):
- ☐ Detailed engineering evaluation recommended
  - ☐ Structural
  - ☐ Geotechnical
  - ☐ Other:
- ☐ Other recommendations:

Estimated Overall Building Damage (Exclude Contents)

None	☐		
0-1 %	☑	31-60 %	☐
2-10 %	☐	61-99 %	☐
11-30 %	☐	100 %	☐

Sign here on completion: NStewart (Beca)

Date & Time: 5/3/11

ID: NCS

CWTP24

Structural Hazards/ Damage		Minor/None	Moderate	Severe	Comments
Foundations		☑	☐	☐	
Roofs, floors (vertical load)		☑	☐	☐	
Columns, pilasters, corbels	N/A	☐	☐	☐	
Diaphragms, horizontal bracing	N/A	☐	☐	☐	
Pre-cast connections	N/A	☐	☐	☐	
Beam	N/A	☐	☐	☐	
Non-structural Hazards / Damage					
Parapets, ornamentation	N/A	☐	☐	☐	
Cladding, glazing	N/A	☐	☐	☐	
Ceilings, light fixtures	N/A	☐	☐	☐	
Interior walls, partitions	N/A	☐	☐	☐	
Elevators	N/A	☐	☐	☐	
Stairs/ Exits	N/A	☐	☐	☐	
Utilities (eg. gas, electricity, water)		☑	☐	☐	
Other		☐	☐	☐	
Geotechnical Hazards / Damage					
Slope failure, debris		☑	☐	☐	
Ground movement, fissures		☑	☐	☐	
Soil bulging, liquefaction		☑	☐	☐	• Evidence of liquefaction around site

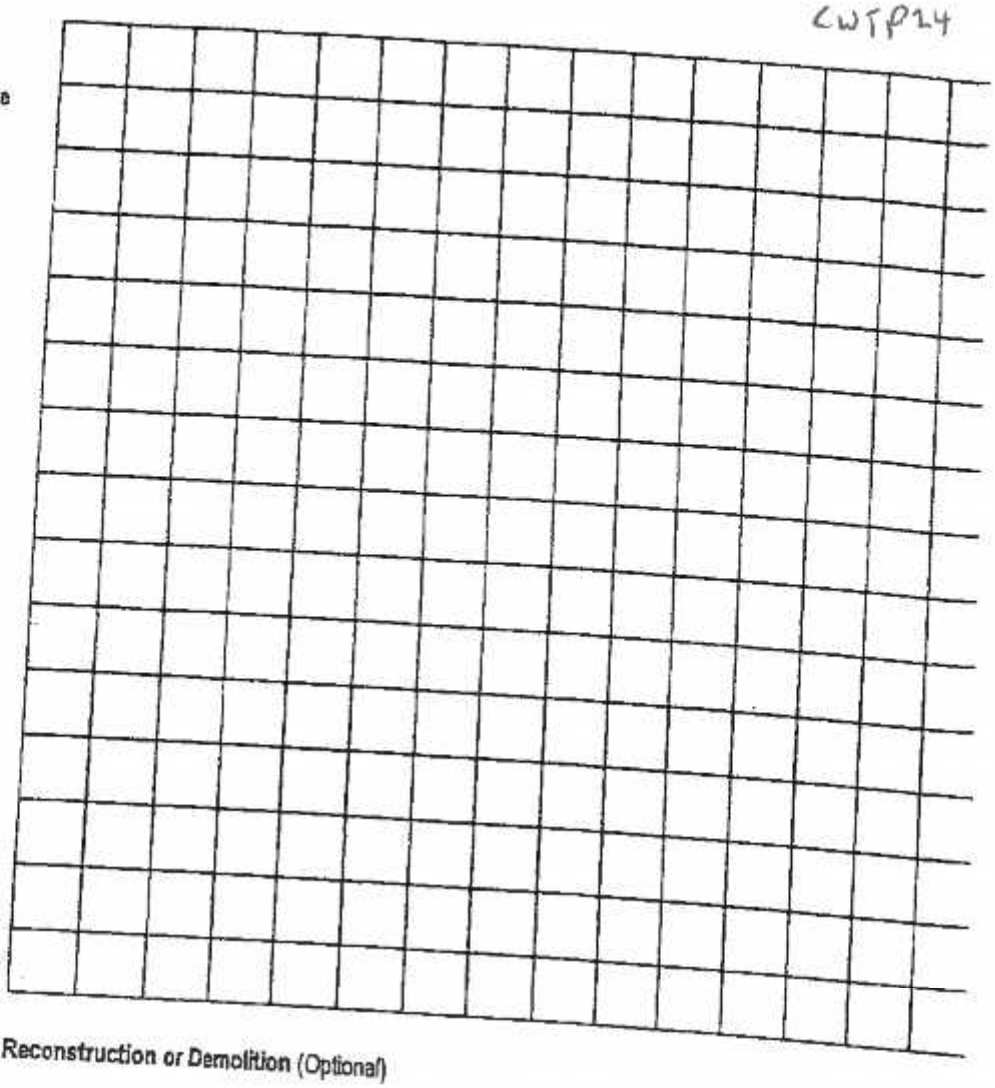
General Comment • Both water tank and gas holder tank appear to be in good condition with no apparent signs of structural defects due to the earthquakes.

Usability Category

Damage Intensity	Posting	Usability Category	Remarks
Light damage *Low risk*	Inspected (Green)	G1. Occupiable, no immediate further investigation required	
		G2. Occupiable, repairs required	
Medium damage *Medium risk*	Restricted Use (Yellow)	Y1. Short term entry	
		Y2. No entry to parts until repaired or demolished	
Heavy damage *High risk*	Unsafe (Red)	R1. Significant damage: repairs, strengthening possible	
		R2. Severe damage: demolition likely	
		R3. At risk from adjacent premises or from ground failure	

CWTP24

Sketch (optional)
Provide a sketch of the entire building or damage points. Indicate damage points.



Recommendations for Repair and Reconstruction or Demolition (Optional)

N/A

 Inspection ID: _____ *(Office Use Only)*

Appendix C

Sika Products Technical Data Sheets

Construction

Sikagard®-550 Elastic (NZ)

Crack bridging protective coating for concrete

Product Description	Sikagard®-550 Elastic (NZ) is a one part, plasto-elastic coating based on UV-curing acrylic dispersion with excellent crack-bridging properties even at temperatures below 0°C.
Uses	• Protection and enhancement of concrete structures (normal and lightweight concrete), especially exposed concrete surfaces with a risk of cracking • With concrete repair works as an elastic protective top coating on Sika® MonoTop mortar repairs (refer to separate Sika MonoTop product data sheet)
Characteristics / Advantages	• Crack-bridging even at low temperatures (-20°C) • High diffusion resistance against CO_2 reducing the rate of carbonation • Water vapour permeable • Very good resistance against weathering and ageing • Can be diluted with water • Environmentally friendly (solvent free) • Reduced tendency to dirt pick up and contamination

Product Data

Form

Appearance	Thixotropic liquid.
Packaging	20 litre plastic pails
Storage/Shelf Life	Twenty four (24) months from date of production if stored properly in undamaged and unopened original sealed packaging in cool and dry conditions. Protect from direct sunlight and frost.

Technical Data

Chemical Base	Acrylate dispersion
Colours	Available in a wide range of colours which are made to order
Appearance	Low semi-gloss finish
Density	~ 1.3 kg/l (at +20°C)
Solid Content by Volume	~ 50%
Solid Content by Weight	~ 65%
Layer Thickness	Minimum required dry film thickness to achieve the required anti-carbonation characteristics (CO_2 equivalent air thickness of 50 m) ≙ 160 microns. Minimum required dry film thickness to achieve full durability characteristics (CO_2 diffusion, adhesion after thermal cycling and crack bridging) ≙ 340 microns.

Carbon Dioxide Diffusion Co-efficient (μCO_2)

Dry film thickness	d = 160 µm
Equivalent air layer thickness	$S_{D,}$ CO_2 = 51 m
Diffusion coefficient CO_2	$\mu CO_2 = 3.1 \times 10^5$
Requirements for protection	S_D, $CO_2 \geq 50$ m

Water Vapour Diffusion Coefficient (μH_2O)

Dry film thickness	d = 230 µm
Equivalent air layer thickness	$S_{D,}$ $_2O$ = 0.35 m
Diffusion coefficient $_2O$	µ $_2O = 1.5 \times 10^3$
Requirements for breathability	S_D, $_20 \leq 5$ m

Mechanical / Physical Properties

Elongation at Break	Elongation at break at +20°C (not exposed to weathering): 120% Elongation at break at -20°C: 70%
Crack-Bridging Capacity	Class A1 (-20°C) EN1062-7
Total minimum recommended dry film build	200 microns (340 microns is required to achieve stated crack-bridging capacity)
Application rate	4-5m²/litre/coat
Minimum number of coats	2
Rain resistance time @ 70% - 80% relative humidity	10°C: 10 hours 15°C: 4 hours 20°C: 2 hours
Recoat time, 20°C, 75%Rh	4 hours
Clean Up	Water
Primer	Sika Primer W or Sika Primer S Note: For very difficult substrates (very dense or weak) and at low temperatures use Sika Primer S

Application Details

Substrate Preparation	▪ New concrete should be 28 days old ▪ The substrate must be sound, dry and free from any dust or other surface contaminants such as oil, grease, chemicals rust, unsound existing coatings etc. ▪ Honeycombing or surface irregularities should be filled and flushed off with Sika MonoTop Fairing Coat (NZ), Sika MonoTop High Build Mortar or Sika Meshkote to achieve a smooth and uniform surface.
Mixing	Sikagard-550 Elastic (NZ) and the primers are ready to use but must be stirred thoroughly before application

Construction

Application	• Sika Primer W or S may be applied by brush, roller or airless spray method. Provide adequate ventilation when using Sika Primer S, as it contains flammable solvents. Ensure that the primer penetrates completely into the substrate without forming a glaze on the surface. • If two coats of primer are required, due to substrate porosity, allow 2 hours to dry between coats – depending on temperature and air movement. • The primer should be completely dry (at least 4 hours at 20°C) before overcoating with Sikagard-550 Elastic (NZ). • Apply the Sikagard-550 Elastic (NZ) using either a brush, roller or airless spray equipment (see Important Notes) to achieve a uniform and even coating thickness. • Waiting time between coating applications is approximately 8 hours at 20°. At lower temperatures this time will be delayed.
Cleaning	• For Sika Primer S use Sika Colma Cleaner to clean brushes and equipment. • For Sikagard-550 elastic (NZ) and Sika Primer W use water to clean brushes and equipment.
Important Notes	• Sikagard-550 Elastic (NZ) is resistant to normal aggressive atmospheric pollutants however owing to its elastic nature slight surface contamination may occur, particularly on horizontal surfaces. • If applying Sikagard-550 Elastic (NZ) over existing coatings the surface must be thoroughly clean and sound. Adhesion and compatibility tests should be carried out first to determine the suitability of using Sikagard-550 Elastic (NZ). • Sika MonoTop repair systems should be allowed to dry for at least 48 hours before applying Sikagard-550 Elastic (NZ). • Application rates for Sika Primer S or W and Sikagard-550 Elastic (NZ) may vary depending on the surface texture of the substrate, the method of application and the coating thickness. • The primer coat must be thoroughly dry before overcoating . • Remove all concrete cure or release materials prior to coating.
Notes	All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.
Local Restrictions	Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.
Transportation Class	Sikagard-550 Elastic (NZ) is classified as non hazardous.
Important Notes	• Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities. • Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet
Legal Notes	The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika's recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the product's suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

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Product Data Sheet
Version no: 08/09

Construction

Sikadur® Injectokit-LV
Pre-packaged low viscosity epoxy crack injection system

Positioning

Description

The Sikadur Injectokit-LV system consists of a low viscosity two part epoxy crack injection resin contained in a patented single cartridge, complete with injection nipples, hoses, and air release pins. The kit is designed for those contracts where a complete injection system is required.

Use

For injecting cracks in concrete and masonry wherever there is a need to consolidate a structure or exclude water and air from contact with reinforcement. Due to its low viscosity, cracks down to 0.2 mm at the surface can be filled. Cracks tapering internally down to 0.01 mm can be filled. Ideal for small scale repairs on site. Can be used for insitu or precast concrete elements.

Advantages

- Convenient to use, disposable single cartridge contains both resin and hardener.
- Safe and clean to use, non return valves avoid leakage and spills.
- High strength, excellent bond to concrete, brickwork and masonry, either wet or dry.
- Modular nature, effective and economical use even for the smallest repair.

Product Data

Form:

Low viscosity two part crack injection resin

Storage & Shelf Life:

Shelf life 12 months when stored in original containers at 10°C – 40°C in dry conditions.

Packaging:

The following Sikadur Injectokit-LV components are sold as separate items:

- 0.25 litre cartridges
- Injection nipples
- Sikadur Injectokit-LV hoses
- Air release pins

Technical Data

	10°C	20°C	30°C	40°C
Usable Life (minutes)	100	50	25	15
Viscosity (mPas)	400-800	250-500	100-250	-
Set time (hours)	12	7	5	3

Compressive strength:	>70 N/mm^2 (BS6319)	(After 7 days curing at 20°C)
Flexural strength:	>45 N/mm^2 (ISO R178)	(After 7 days curing at 20°C)
Tensile strength:	>55 N/mm^2 (ISO527)	(After 7 days curing at 20°C)
Modulus of elasticity:	Approx. 2,800 N/mm^2	
Elongation at break:	2.5%	
Tensile bond strength:	When tested to BS3900 Pt E10 in both dry and wet states is greater than normal concrete.	

Application Conditions

Surface preparation

- The surface sealant needs to retain the injection system under pressure.
- Care must be taken to provide a bond surface which is clean, dry, sound and free from contamination by oil or grease.

Surface sealant

- 5 Minute Epoxy should be used where preparation and injection need to be completed in a short space of time.
- Where it is desirable or acceptable to inject the crack at least 24 hours after preparation, Sikadur UA CONCRETE FIX can be used as a surface sealant.

Application of the surface sealant

- Immediately after mixing, apply a small amount of compound to the back of each nipple making sure that the valve will not be blocked, and place the nipple over the crack.
- The valve (centre) should be placed over the crack.
- Nipples should be placed between 200 mm and 500 mm apart dependent on crack size.
- Additional sealant should be applied onto the flange of the nipple to ensure a resin tight seal to the substrate.
- Surface sealant should be knifed into the crack between nipples to ensure a resin tight seal.
- Continue the sealant 50 mm beyond the end of the line of the visible crack.
- Application of the injection system may be commenced as soon as the surface sealant has fully hardened (5 Minute Epoxy: 5 minutes at 20°C)

Injection of the Sikadur Injectokit-LV epoxy resin

- Hit the side of the capsule near the base with a hammer 2 or 3 times on different sides to break the internal glass container of hardener. (The glass can be heard moving when broken.)
- To mix the resin, invert the cartridge 20-30 times slowly.
- Do not shake vigorously otherwise air will be incorporated.
- Use the mixed material within the usable life.
- Pierce the foil seal in the threaded end of the cartridge.
- Screw the Sikadur Injectokit-LV hose onto the cartridge.
- Ensure that the rubber 'O' ring is in place on the cartridge.
- Do not over tighten the fitting as this may distort the 'O' ring.
- Place the cartridge into a standard gun.
- Push the free end of the Sikadur Injectokit-LV hose onto the first (lowest) nipple and tighten down the locking cap.
- Do not over tighten.
- Insert an air release pin into the next nipple above the injection point.
- Note: Do not start pumping until the air release pin is inserted to open the non return valve and release trapped air.
- Commence pumping slowly, do not use excessive pressure.
- The rate of acceptance on fine cracks may be very slow.
- When resin appears at the nipple next to the injection point:
  (a) stop pumping
  (b) release the pressure on the injection gun
  (c) remove the air release pin
  (d) unscrew the cap and with a twisting movement pull off the Sikadur Injectokit-LV hose.
- Attach the Sikadur Injectokit-LV hose to the next nipple.
- Insert air release pin in nipple beyond and recommence pumping.
- Repeat the process until the entire length of crack has been injected.
- On completion of pumping, the last cartridge can be left connected and pressurised slightly to allow for possible seepage into deep seated cracks.

Making good

- After the Sikadur Injectokit-LV injection resin has set, remove the nipples.
- These can be knocked off with a hammer.
- Make good any holes or voids with the selected surface sealant.
- The existing surface sealant can then be removed by either grinding or heating with a hot air gun and scraping the surface until the original substrate profile is restored.

Cleaning

Tools and application equipment should be cleaned using Sika Colma Cleaner.

Important Notes

Limitations

- Sikadur Injectokit-LV should only be used for cracks where access to all sides for sealing is available.
- In other cases Sikadur Injectokit-TH (thixotropic - see separate data sheet) should be used.
- Sikadur Injectokit-LV should not be used for cracks where movement is expected to continue.
- Sikadur Injectokit-LV is recommended for use only as described in the Uses section of this datasheet.

Construction

Notes	All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.
Local Restrictions	Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

Health & Safety Instructions

Protective Measures

- To avoid rare allergic reactions, we recommend the use of protective gloves. Change soiled work clothes and wash hands before breaks and after finishing work.
- Local regulations as well as health and safety advice on packaging labels must be observed.
- For further information refer to the Sika Material Safety Data Sheet which is available on request.
- If in doubt always follow the directions given on the pack or label.

Important Notes

- Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities.
- Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet.

Legal Notes

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Product Data Sheet
Version no: 08/09

Construction

Sikadur® Injectokit-TH
Pre-packaged thixotropic epoxy crack injection system

Positioning

Description

The Sikadur Injectokit-TH system consists of a thixotropic two part epoxy crack injection resin contained in a patented single cartridge, complete with injection nipples, hoses, air release pins, and stirring rods. The kit is designed for those contracts where a complete injection system is required.

Use

For injecting cracks in concrete and masonry wherever there is a need to consolidate a structure or exclude water and air from contact with reinforcement. Due to its thixotropic nature it can be injected into open ended cracks where depth and quantity of resin need to be controlled. Crack widths from 0.2 - 2 mm can be filled. Ideal for small scale repairs on site. Can be used for insitu or precast concrete elements.

Advantages

- Convenient to use, disposable single cartridge contains both resin and hardener.
- Thixotropic, can be injected into fine cracks where access to all sides for sealing is not available.
- High strength, excellent bond to concrete, brickwork and masonry, either wet or dry.
- Modular nature, effective and economical use even for the smallest repair.

Product Data

Form:

Thixotropic two part crack injection resin

Storage & Shelf life:

Shelf life 12 months when stored in original containers at 10°C – 40°C in dry conditions.

Packaging:

The following Sikadur Injectokit-TH components are sold as separate items:

- 0.25 litre cartridges
- Injection nipples
- Sikadur Injectokit-TH hoses
- Air release pins
- Stirring rods

Technical Data

	10°C	20°C	30°C	40°C
Usable life (minutes)	100	50	25	15
Viscosity (mPas)	400-800	250-500	100-250	-
Set time (hours)	12	7	5	3

Compressive strength: >70 N/mm^2 (BS 6319) (After 7 days curing at 20°C)
Flexural strength: >45 N/mm^2 (ISO R178) (After 7 days curing at 20°C)
Tensile strength: >55 N/mm^2 (ISO 527) (After 7 days curing at 20°C)

Modulus of elasticity: Approx. 2,800 N/mm^2

Elongation at break: 2.5%

Tensile bond strength: When tested to BS3900 Pt E10 in both dry and wet states is greater than normal concrete.

Application Conditions

Surface preparation

- The surface sealant needs to retain the injection system under pressure.
- Care must be taken to provide a bond surface which is clean, dry, sound and free from contamination by oil or grease.

Surface sealant

- 5 Minute Epoxy should be used where preparation and injection need to be completed in a short space of time.
- Where it is desirable or acceptable to inject the crack at least 24 hours after preparation, Sikadur UA CONCRETE FIX can be used as a surface sealant.

Application of the surface sealant

- Immediately after mixing, apply a small amount of compound to the back of each nipple making sure that the valve will not be blocked and place the nipple over the crack.
- The valve (centre) should be placed over the crack.
- Nipples should be placed between 200 mm and 500 mm apart dependent on crack size.
- Additional sealant should be applied onto the flange of the nipple to ensure a resin tight seal to the substrate.
- Surface sealant should be knifed into the crack between nipples to ensure a resin tight seal.
- Where cracks can be sealed on one side only, nipples should be placed at centres which are 80% of the depth to which the resin is required to penetrate.
- Application of the injection system may be commenced as soon as the epoxy has fully hardened. (5 Minute Epoxy: 5 minutes at 20°C)

Injection of the Sikadur Injectokit-TH epoxy resin

- Cut the top off the conical nozzle.
- Insert T-shaped rod and turn clockwise to engage stirring head in cartridge.
- Push rod down the full length of the cartridge to break the membrane separating the resin and hardener.
- Pump up and down 30 to 40 times to mix resin and hardener.
- Turn the T-shaped rod anticlockwise to disengage and then remove.
- Do not shake.
- Unscrew the conical nozzle and discard.
- Use the mixed material within the usable life.
- Screw the Sikadur Injectokit-TH hose onto the cartridge.
- Ensure the rubber 'O' ring is in place on the cartridge.
- Do not over tighten the fitting as this may distort the 'O' ring.
- Place cartridge into a standard gun.
- Push the free end of the Sikadur Injectokit-TH hose onto the nipple positioned over the widest point of the crack and tighten down the locking cap.
- Do not over tighten.
- Insert an air release pin into the nipple adjacent to the injection point.
- Note: Do not start pumping until the air release pin is inserted to release the non return valve and release trapped air.
- Commence pumping slowly, do not use excessive pressure.
- The rate of acceptance on fine cracks may be very slow.
- When resin appears at the nipple next to the injection point:
  (a) Stop pumping.
  (b) Release the pressure on the injection gun.
  (c) Remove the air release pin.
  (d) Unscrew the cap and with a twisting movement pull off the Sikadur Injectokit-TH hose.
- Attach the Sikadur Injectokit-TH hose to the next nipple.
- Insert air release pin in nipple beyond and recommence pumping.
- Repeat the process until the entire length of crack has been injected.
- On completion of pumping, the last cartridge can be left connected and pressurised slightly to allow for possible seepage into deep-seated cracks.

Making good

- After Sikadur Injectokit-TH injection resin has set, remove the nipples.
- These can be knocked off with a hammer.
- Fill any holes or voids with the selected surface sealant.
- The existing surface sealant can then be removed by either grinding or heating with a hot air gun and scraping the surface until the original substrate profile is restored.

Cleaning

Tools and application equipment should be cleaned using Sika Colma Cleaner.

Construction

Important Notes

Limitations	Sikadur Injectokit-TH should not be used for cracks where movement is expected to continue.
Notes	All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.
Local Restrictions	Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

Health & Safety Instructions

Protective Measures

- To avoid rare allergic reactions, we recommend the use of protective gloves. Change soiled work clothes and wash hands before breaks and after finishing work.
- Local regulations as well as health and safety advice on packaging labels must be observed.
- For further information refer to the Sika Material Safety Data Sheet which is available on request.
- If in doubt always follow the directions given on the pack or label.

Important Notes

- Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities.
- Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet.

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Product Data Sheet
Version no: 07/01 (reprinted 08/05)

Construction

Sikadur® 52

Low viscosity crack injection epoxy

Positioning

Description
A solvent free, two component, low viscosity liquid based on high strength epoxy resins. After mixing it becomes a deeply penetrative liquid with strong adhesive qualities.

Uses
For injecting and filling cracks (0.2 to 5 mm wide) in precast and insitu concrete components to bond the sections together, thereby restoring the structural integrity of the element.

Advantages
- Highly flowable, penetrating and solvent free.
- Shrinkage free hardening.
- Excellent adhesion to most substrates.
- High mechanical and adhesive strength.
- High early strength.
- Chemical resistance typical of epoxy resins.
- Does not become brittle – retains a very slightly flexible nature.

Tests
Approvals / Standards
Tested in accordance with BS6319. Complies with ASTM C881-78, Type 1, Grade 1, Class B + C.

Product Data

Type:
Solvent free epoxy resin liquid.

Colours:
Clear Straw colour when mixed.

Packaging:
Supplied in 0.9 litre (1.0kg), 2.78 litre (3kg), 7.43 litre (8kg) units (Component A + B)

Storage & Shelf Life:
Three (3) years in unopened, original containers when stored in dry conditions between 5°C and 25°C.

Technical Data

Density:	Approx. 1.1 kg/litre			
Service temp:	< 70°C			
Application temp:	5°C to 30°C			
Shrinkage:	Negligible			
Compressive strength:	24 hours = 35 MPa approx.			
(at 20°C)	7 days = 45 MPa approx.			
Flexural strength:	14 MPa approx.			
Tensile strength:	25 MPa approx.			
Elastic modulus:	3,500 MPa approx.			
Bond strength:	Sandblasted Steel = 15 MPa approx.			
	Sandblasted Concrete = 3.5 MPa approx.			
Pot life (1 Litre mix):	5°C	10°C	20°C	30°C
(approx. time)	75 mins.	60 mins.	20 mins.	10 mins.
Coverage rate:	Approx. 3 to 5 m²/litre/coat on floors, depending on porosity.			

Application Conditions

Surface Preparation
- All concrete surfaces must be clean and free from any loosely adhering particles, or contaminants such as dirt, oil, dust, grease, etc.
- All cement laitance should be removed by scabbling, sandblasting, etc.
- When Sikadur 52 is used for injection purposes the cracks must be blown out with oil free, dry compressed air. Crack widths between 0.2 mm and 5 mm may be successfully injected.

Mixing
- Add the entire contents of Component B to Component A. Using a Sika mixing paddle attached to a low speed electric drill (max. 500 rpm) mix together for at least 3 minutes.
- Part batching of Sikadur 52 is not recommended unless strict measurement of the components, in accordance with the mix ratio of the factory proportioned pack, is observed and adhered to.

Construction

Application

Basic guidelines for crack injection are as follows:

- Using Sikadur 31 epoxy adhesive, fasten Sika Injection Flanges over the cleaned and prepared cracks at 300 to 500 mm intervals. The remainder of crack is also sealed off with Sikadur 31.
- Once the Sikadur 31 has cured the flanges should be blown through in a continuous sequence with clean compressed air.
- After the Sikadur 52 has been mixed it can be loaded into a Sika bulk dispensing gun, adapted to take liquid epoxies.
- The Sikadur 52 should be injected (approx. 25 – 30 psi) into the first and lowest flange over the crack until epoxy starts oozing out of the flange immediately above.
- Seal off the lower flange and transfer the gun to the new flange above.
- Continue this sequence until all flanges have been injected and sealed.
- After Sikadur 52 has cured the flanges and Sikadur 31 can be ground from the surface of the crack using an angle grinder or similar.
- Allow 5 to 7 days curing for full structural integrity of the repair component to be achieved.
- Sika (NZ) Ltd can recommend approved applicators for this specialised work.

Cleaning

- Clean all tools and equipment immediately after use with Sika Colma Cleaner.
- It is recommended that protective gloves and clothing be worn during application, however, uncured Sikadur 52 may be removed from skin with Sikaflex Hand Cleaner or warm soapy water.
- Cured Sikadur 52 can only be removed mechanically.

Important Notes

- Crack injection work should be left for 5 to 7 days to fully cure before full structural integrity is achieved.
- Do not dilute Sikadur 52 with solvent.
- In cases where fine cracks occur it may be difficult to attain satisfactory injection of epoxy with hand operated equipment. We suggest a specialist applicator be used for this type of work.
- Sikadur 52 will not cure at temperatures below 5°C.
- The temperature at which Sikadur 52 is stored during the 24 hours before mixing will govern its pot life when mixed.

Notes

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

Local Restrictions

Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

Safety Instructions

Protective Measures

- To avoid rare allergic reactions, we recommend the use of protective gloves. Change soiled work clothes and wash hands before breaks and after finishing work.
- Local regulations as well as health and safety advice on packaging labels must be observed.
- For further information refer to the Sika Material Safety Data Sheet which is available on request.
- If in doubt always follow the directions given on the pack or label.

Transportation Class

Sikadur 52, Component B has a dangerous goods classification for transportation: Haz. Class 8, UN No. 1760, Haz. Chem. 2R, Packing Group III.

Important Notes

- Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities.
- Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet.

Legal Notes

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Product Data Sheet
Version no: 07/07

Construction

Sika® MonoTop® Primer (NZ)

1) Corrosion protection for steel reinforcement
2) Bonding slurry for concrete and mortar

Positioning

Description
A cement based, polymer modified, one component coating material containing microsilica and corrosion inhibiting materials.

Uses
Sika MonoTop Primer provides two primary functions in the Sika MonoTop Repair Mortar System.

- As a corrosion inhibiting coating for reinforcement in concrete repair.
- As a bonding slurry onto concrete surfaces prior to the application of MonoTop Repair Mortars.

Advantages

- One product for two different applications.
- One component - just add water.
- Excellent adhesion to concrete and steel.
- High resistance to water and chloride ion penetration.
- Silica fume and polymer modified.
- Contains corrosion inhibitors.
- Good mechanical strength.
- Non toxic, easy and safe to use.
- Can be brush or spray applied - long pot life.
- Waterproof once dry - will not re-emulsify when re-wetted.

Product Data

Form: Light Grey powder

Packaging: Available in 4 kg plastic pails.

Storage & Shelf Life: Six (6) months in unopened original container when stored in cool, dry conditions below 25°C.

Technical Data

Density: 1.15 kg/litre - bulk density of powder
2.1 kg/litre - density of freshly mixed mortar

Compressive strength: 45 - 55 MPa at 28 days

Flexural tensile strength: 5.5 - 7.5 MPa at 28 days

Adhesive tensile strength: 3 MPa approx. on concrete

Mixing ratio:

Brush application	Water	:	Powder
	Approx. 210 mls	:	1 kg
Spray application	Water	:	Powder
	Approx. 200 mls	:	1 kg

Pot life (at 20°C): Approx. 90 - 120 minutes

Application temp: Minimum 5°C – Maximum 30°C

Material consumption: 1 x 4 kg unit = approx. 2.5 litres when mixed with water.
As a bonding slurry - Approx. 0.9 - 1.2 litres/m^2 depending on condition of substrate.
As an anti-corrosion coating on reinforcement - Approx. 2 litres/m^2 for 2 coats at 1 mm dry film thickness per coat.

Application Conditions

Surface Preparation

Steel Reinforcement

- All reinforcement shall be clean, free from oil, grease, rust scale, pitting deposits and concrete.
- Optimum preparation = sandblasting to Sa 2.5.
- Minimum preparation = thorough scrubbing with a wire brush.

Note: Preparation of steel will depend on the extent of corrosion damage present.

Concrete Substrate

- All concrete or mortar substrates must be sound, clean and free from oils, grease or surface contaminants. All loose or weak materials and surface laitance must be removed.
- Dry substrates should be thoroughly pre-wetted, and the surface allowed to dry (to achieve what is referred to as a 'saturated surface dry' condition) before the bonding slurry is applied.

Construction

Mixing

Pour a measured volume of clean fresh water into a suitable mixing vessel. While stirring slowly add the weighed amount of powder. Mechanically mix using a Sika mixing paddle attached to a low speed electric drill (max. 500 rpm), for a minimum of 3 minutes, and until a smooth, lump free consistency is achieved.

Application

Reinforcement protection

- Apply the first coat of approx. 1 mm thickness using a medium/hard brush, roller or suitable spray equipment to the cleaned and prepared steel reinforcement. After a waiting time of 4 - 5 hours (at 20°C) to allow for drying, apply a second coat of MonoTop Primer at the same thickness, ensuring an even and uniform coverage has been achieved.

Bonding slurry for concrete/mortar

- Apply by brush, roller or suitable spray equipment to the prepared, pre-wetted ('saturated surface dry') surface. The slurry should be worked well into the substrate to ensure that the whole area has been fully coated to achieve maximum bond.
- Subsequent repair mortars must be applied while the bonding slurry is still wet/tacky.

Important Notes

- Any steel reinforcement should be exposed and treated approx. 20mm beyond its corroded length.
- It may be necessary to cut and remove concrete from behind affected steel reinforcement to expose all corrosion. This should be done only after consultation with the project engineer. This procedure is also required if concrete is contaminated with chloride ions.
- The exposed reinforcement should be cleaned to Sa 2.5 before applying MonoTop Primer.
- Generally it is recognised that reinforcement corroded to less than 80% of its original dimension should be cut out and replaced. If in doubt always consult the structural engineer for the project.
- In some cases, when delays occur, it may be necessary to apply a second coat of MonoTop Primer bonding slurry to the concrete or mortar substrate to ensure a "wet on wet" application for the subsequent repair mortar.
- It is recommended that chemical based rust removers/passivators are not used for the removal of rust from steel reinforcement, prior to the application of Sika MonoTop Primer.

Notes

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

Local Restrictions

Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

Safety Instructions

Protective Measures

- To avoid rare allergic reactions, we recommend the use of protective gloves. Change soiled work clothes and wash hands before breaks and after finishing work.
- Local regulations as well as health and safety advice on packaging labels must be observed.

Important Notes

- Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities.
- Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet.

Legal Notes

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Responsible Care

Certified Quality System ISO 9001/EN 29001 since 1986

Product Data Sheet
Version no: 07/07

Construction

Sika® MonoTop® Structural Mortar (NZ)

Fibre reinforced concrete repair mortar

Positioning

Description

Sika MonoTop Structural Mortar is a one component, synthetic fibre reinforced, polymer modified cementitious repair mortar that contains reactive microsilica. Sika MonoTop Structural Mortar is part of the MonoTop System for concrete repair and protection.

Uses

Sika MonoTop Structural Mortar is used for repair and reinstatement work to concrete structures and components where high performance and durability properties are required. Typical applications are:

- Building facades.
- Column and beam repair.
- Concrete bridges.
- Marine structures.
- Water retaining structures.
- Wastewater treatment plants.
- Concrete tunnels and culverts.

Advantages

- One component, mix with water only.
- Excellent non-sag properties for vertical and overhead applications – can be applied in layers up to 30 mm thick overhead without the use of formwork.
- Excellent workability - can be wet sprayed, if required.
- Contains non-corroding synthetic fibre reinforcement.
- Good mechanical strength.
- Microsilica and polymer modified.
- Shrinkage compensated.
- Improved sulphate resistance.
- High resistance to water and chloride ion penetration.
- Non toxic, non-corrosive.

Product Data

Form / Colour: Light grey powder / Mid grey when applied.

Storage & Shelf Life: Six (6) months in unopened original packaging when stored in cool dry conditions below 25°C.

Packaging: 25 kg multi-wall paper bags.

Technical Data

Density: Approx. 1.85 kg/litre - wet density of freshly mixed mortar.
Application temp: Minimum 5°C to maximum 30°C.
Compressive strength: > 40MPa at 28 days (when mixed with 4.0 litres of water).
Flexural strength: 7 MPa approx. at 28 days.
Bond strength: To concrete > 3 MPa (concrete failure).
Elastic modulus: 27,000 MPa approx.
Water permeability (ISAT): 0.002 ml/m^2/sec - (satisfies low classification).
Pot life: 50 - 60 minutes at 20°C.
Application thickness/layer: Minimum 5 mm; Max. unsupported thickness in overhead application 30 mm
Yield: 25 kg = approx. 15.7 litres when mixed with 4.0 litres of water.
Mixing ratio by weight: 1 part water : 6.25 parts powder (approx.)

Application Conditions

Surface Preparation

- Sika MonoTop Structural Mortar should be applied over a bonding slurry of Sika MonoTop Primer. Refer to the Sika MonoTop Primer technical data sheet for information on surface preparation and priming.
- All ‘feathered’ edges around the area to be repaired should be squared off with an angle grinder and chiselled down to a minimum depth of 10 mm.

Construction

Mixing

- For a hand applied mortar, pour 3.75 – 4.0 litres (maximum) of clean fresh water into a suitable mixing container and slowly add all of the powder while mixing continuously with a Sika Propeller Mixer attached to a slow speed (500 rpm) electric drill.
- Thoroughly mix until a smooth, lump free consistency is achieved. A minimum mixing time of 3 minutes is recommended.
- The water content can be reduced slightly to produce a stiffer mortar if desired.

Application

- While the bonding coat of Sika MonoTop Primer is still 'tacky', pack the mortar well into the cavity or repair. Use a placing rather than a rendering technique to fill all voids and ensure thorough compaction is achieved. Force the Sika MonoTop Structural Mortar against the edge of the repair and progressively work towards the centre.
- For overhead repairs in excess of 30mm thick and vertical repairs in excess of 40mm thick apply in layers.
- If more than one layer is required score the first layer and allow to harden. Dampen the surface before applying subsequent layer. If more than 48 hours lapses the first layer will need to be re-primed with Sika MonoTop Primer.
- Steel trowel the final layer, if required, to achieve a smooth, tight finish.

Cleaning

- Clean all tools and equipment with water immediately after use.
- Hardened Sika MonoTop Structural Mortar can only be removed mechanically.

Important Notes

- Only apply Sika MonoTop Structural Mortar to sound substrates that have been dampened and primed with Sika MonoTop Primer.
- Sika MonoTop Fairing Coat can be used to provide a very fine fairing/ levelling coat over the whole surface, if required, after repair work has been completely undertaken.
- As with all concrete and mortars, it is essential to protect Sika MonoTop Structural Mortar from water evaporation during the crucial early age curing period, with water spray, wet hessian or polythene sheets. If no further coatings are to be applied to the finished surface, a membrane curing compound may be used. Refer to Antisol data sheet for further information.
- High quality, long term repairs can only be achieved if they are carried out conscientiously by experienced applicators giving adequate detail to surface preparation, priming of concrete and steel, mixing of repair mortars, application and curing.

Notes

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

Local Restrictions

Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

Safety Instructions

Protective Measures

- To avoid rare allergic reactions, we recommend the use of protective gloves. Change soiled work clothes and wash hands before breaks and after finishing work.
- Local regulations as well as health and safety advice on packaging labels must be observed.
- If in doubt always follow the directions given on the pack or label.

Important Notes

- Residues of material must be removed according to local regulations. Fully cured material can be disposed of as household waste under agreement with the responsible local authorities.
- Detailed health and safety information as well as detailed precautionary measures e.g. physical, toxicological and ecological data can be obtained from the safety data sheet.

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