

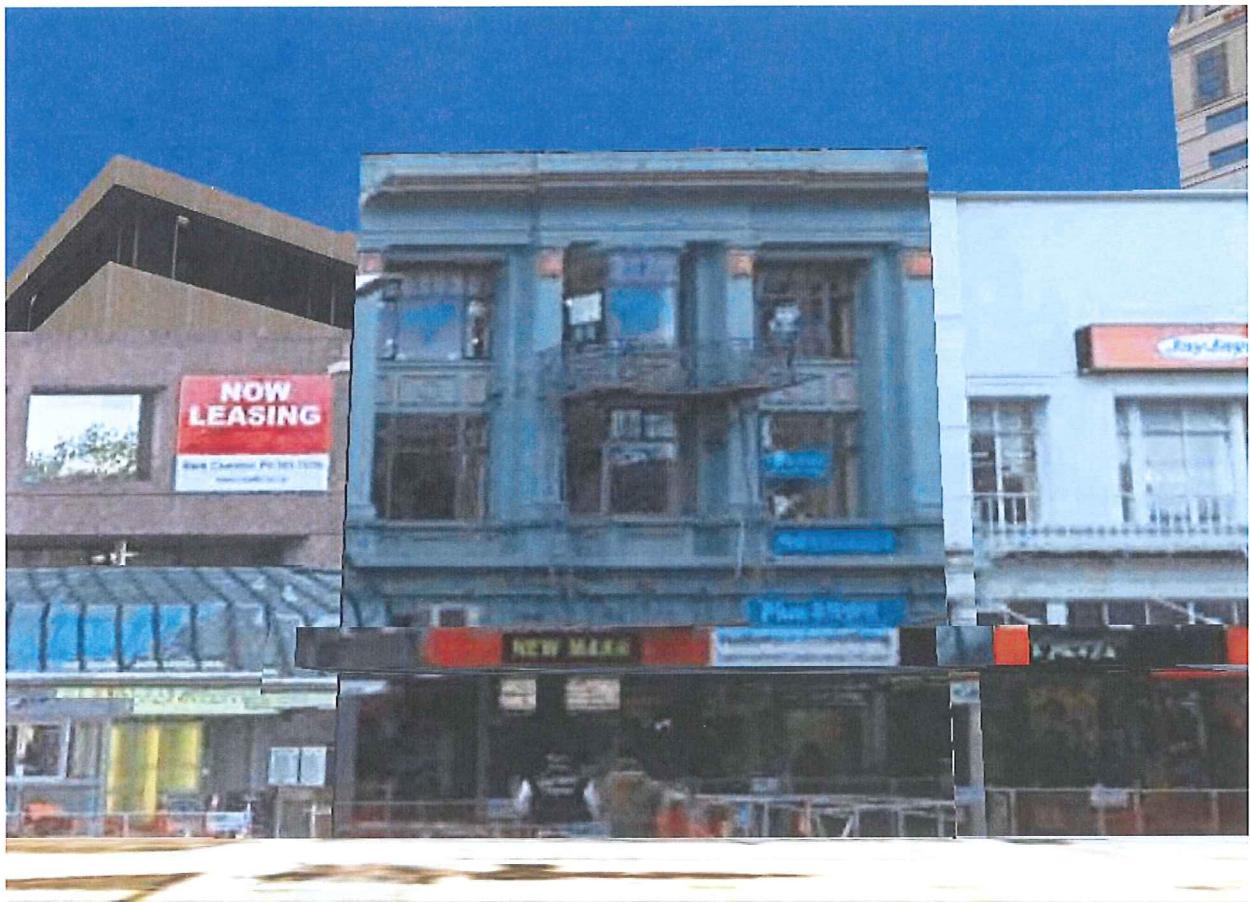
**INDEPENDENT ASSESSMENT ON EARTHQUAKE PERFORMANCE
OF
246 High Street**

**FOR
Royal Commission of Inquiry into building failure
caused by the Canterbury Earthquakes**

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Introduction

This report has been commissioned by the Royal Commission of Inquiry into building failure caused by the Canterbury Earthquakes to review the performance of the building at 246 High Street, Christchurch, during the Canterbury earthquake sequence and in particular, the collapse of the north west wall onto the building known as the Link Centre atrium at 152 Hereford Street.

The report is based on documentation provided by the Royal Commission of Inquiry into building failure caused by the Canterbury Earthquakes. No inspection of the building was possible prior to demolition.

Location of Building

The building was located on the north side of High Street between Cashel Street and Hereford Street. The location of the building in the Christchurch CBD is identified in the site plan in Appendix 1.

Description of Building

The building at 246 High Street was a 3 storey un-reinforced masonry building constructed with timber roof framing and timber floors. The building is recorded as having been constructed prior to 1880.

The building had a largely open ground floor façade to High Street and the façade to the upper storeys was also heavily penetrated.

The north-west wall of the building appears as if it may have been a party wall with the previous building on the site of the atrium to the Link Centre at 152 Hereford Street, prior to the construction of the Link Centre atrium.

Photographic records indicate that a metal cladding had been fixed to the face of the old masonry party wall to provide weatherproofing of the wall. We understand that the metal cladding was installed at the time the Link Centre atrium was constructed.

We are uncertain of the extent of the un-reinforced masonry party wall at the rear of the building 246 High Street as the rear building appears to be set back from the north western boundary and to be clad in corrugated iron.

It is possible that the un-reinforced masonry party wall extended above a typical parapet height in this area.

Compliance

The Christchurch City Council records establish that there have been many building permits and consents issued over the life of the building.

The majority of consents were for minor fit-out and signage. Some strengthening of the ground floor is recorded to have been undertaken in 1990.

A review of Christchurch City Council records indicates that the building complied with the requirements of the Building Act 1991 due to the building pre existing the Building Act and no alterations or change of use occurring since the introduction of the Building Act in 1991.

Christchurch City Council Policy on Earthquake Risk and Earthquake Prone Buildings

We understand that the Christchurch City Council applied for and was granted powers under the Section 301A of the Municipal Corporations Act and that the Christchurch City Council adopted a passive approach to the upgrading of earthquake risk buildings.

In June, 1976 the City Engineer of the Christchurch City Council wrote to the building owners advising that, in Councils opinion, the building at 244-246 High Street would not comply with the provisions of Section 301A of the Municipal Corporations Act and enquiring of the owners intentions with regard to the future of the building.

Following an enquiry by Coster & Milsom, lawyers acting on behalf of a prospective purchaser, the City Engineer confirmed that the building was not expected to comply with Section 301A of the Municipal Corporation Act in August, 1979. A similar enquiry was made by Berry, Alty & Neil in August 1980 on behalf of a prospective purchaser. The City Engineer responded by advising that *No formal notice had been served in terms of Section 624 of the Local Government Act but appendages such as parapets should be checked to see that they are not a hazard. If the appendages are not a hazard no immediate work is required, but provision should be made to secure the building to comply with the requirements of the Act within a five to ten year period.*

In July, 1989, a similar enquiry was made by T.D. Anderson, on behalf of a prospective purchaser. The city planner responded that *The existing building would require an engineers report if any significant structural work was to be undertaken.*

There is a copy of a letter from Alan Reay Consultants Limited to a Mr J Yankov of Mittons Fashions on the Christchurch City Council files commenting that

“We are advised that if the refurbishment includes any structural alteration work, the Council would require a programme and proposal for the complete strengthening of the building, and that any structural work undertaken now would be consistent with that proposal.

The overall seismic strengthening required would be to a load level of approximately 2/3 of the current design loads for new buildings. We consider the structural work necessary to achieve that level on this building would be substantial, involving building a new system of frames or walls within the shell. As an alternative, the strengthening proposal would not be required if the refurbishment excludes any significant structural alteration.”

In April 1990 Alan Reay Consultants Ltd wrote to the Christchurch City Council enclosing a proposed strengthening scheme. Stage 1 of the proposal included the installation of a new concrete frame to the lower floor along the High Street frontage and internal alteration to the timber and steel framed walls. The second stage was to include additional internal concrete frames at 7m centres extending up to the top floor. The second stage was to take place in 10 to 15 years, should the owner wish to extend the life of the building at that stage rather than demolish.

In May 1990 the Christchurch City Council record that the stage 1 strengthening works were completed. In August, 1990, Alan Reay Consultants Ltd wrote to the Christchurch City Council advising that their engagement had been terminated.

In September, 1990, there is a letter from Eliot Sinclair & Partners relating to alterations to the building at 242 High Street. The letter referred to Mr Yankov further revising his occupancy requirements reducing the need for structural alterations to a minimum. The letter refers to steel SHS columns in the front façade area which appear to have been installed around 1960. Also noted in the façade were several other original structural steel members, with concrete surround, providing some degree of continuity to the otherwise brickwork façade. The Christchurch City Council accepted Eliot Sinclair's revised plans on the understanding that the occupancy of the upper floors would not be significantly increased. The Christchurch City Council also commented that *The question of the longer term future of the building still remains to be answered but the intent of the agreement to address the problem is covered by the present caveat.* In September 1990 the Christchurch City Council wrote to Hanham & Philip Contractors Ltd approving revised plans.

In a letter to S K Baltrop on 19 March, 2003 the Christchurch City Council refers to an agreement with a previous owner which required the removal or strengthening of the existing earthquake prone building by 31 May, 2008. In the letter the Christchurch City Council advised that *in recognition of the substantial strengthening work already completed on the ground floor, Council agrees not to invoke the agreement requiring completion of the work by 31 May, 2008.*

This concession is conditional on the building not undergoing a change of use under the Building Act 1991 or any significant alterations prior to that date.

In July, 2006 John Buchan of Buddle Findlay acting for a prospective purchaser, emailed the Christchurch City Council over a LIM requirement that there was a Temporary Building Agreement relating to the earthquake strengthening or removal by 31 May, 2008 as per the Christchurch City Council's letter to S K Baltrop dated 19 March, 2003. The letter referred to a caveat on the title protecting Christchurch City Council's interest and enquired as to whether there was still a requirement for strengthening work to be done by that date or the building must be demolished. The email requested clarification of the Christchurch City Council's current position.

We have not been forwarded a copy of any response.

There is a Building Survey form on the Council records which attributes the building a numerical rating of 15 which is identified as an A Classification building. The Christchurch City Council survey forms indicate that an A Classification building required immediate action.

The Christchurch City Council's first policy in respect of earthquake-prone, dangerous and insanitary buildings policy was introduced in 2006.

This policy was reviewed in early 2010.

Events Subsequent to 4th September 2010 Earthquake

The building appears not to have been damaged in the 4th September, 2010 earthquake. A Rapid Assessment-Level-1 undertaken on the building at 248 High Street on the 5th September, 2010 recorded no damage and a Rapid Assessment-Level-1 undertaken on the building at 152

Hereford Street (The Link Centre atrium) on the 5th September, 2010 also recorded no damage. Both buildings were assigned green placards.

On the 10th September, 2010 Holmes Consulting Group undertook a structural assessment of the building at 242 to 246 High Street. Damage observed was generally limited to cracking of lathe and plaster ceilings. On top of the building there was damage to the parapet / chimneys. Holmes Consulting Group carried out a Level 2 Assessment and a yellow placard was assigned to the building.

On the 13th September, 2010 the building at 246 High Street is recorded as being assigned a yellow placard due to a dangerous parapet.

On the 15th September, 2010 there is a record of gates having been put around the site because it was unsafe.

On 20th September, 2010 Holmes Consulting Group issued a site report advising that a metal strap had been installed on the front parapet corner, and that the chimneys had been removed down to roof level. Once the securing work had been completed, Holmes Consulting Group considered the building to be *as stable as it was before the earthquake*. Longer term securing was recommended.

After an inspection by Holmes Consulting Group on 20th September, 2010, we understand the building was assigned a green placard.

Following the 26th December, 2010 earthquake, a Rapid Assessment-Level 1 on the building at 246 High Street of the same day identified no significant damage and assigned the building a green placard

The Christchurch City Council records indicate that the building at 152 Hereford Street was also assigned a green placard.

The building at 246 High Street was significantly damaged in the 22nd February, 2011 earthquake with the north-west wall collapsing on the Link Centre atrium at 152 High Street, causing a total collapse of the Link Centre atrium. (refer photos Appendix 2). The atrium structure to 152 Hereford Street was inspected by Allan Reay Consultants on 8th April, 2011. The atrium structure collapsed as a result of bricks falling from the adjacent buildings 246 High Street.

The building at 246 High Street was inspected by Aurecon on the 27th April 2011. Aurecon's report commented that The building has been severely damaged by 22nd February, 2011 earthquake. The north-west side wall has collapsed down to second floor level. It was not possible to assess all external walls but the top part of the rear wall has also collapsed. There is extensive cracking in the remaining bricks including the party walls.

Aurecon assessed the building to be an economic loss.

As a result of the building being significantly damaged in the 22nd February, 2011 earthquake, the building 246-254 High Street and the building at 172 Hereford Street were assigned red placards.

We understand that the building has been demolished.

Structural Failure

The upper levels of the north-west wall of the building at 246 High Street became disconnected from the roof and second floor structure and collapsed primarily outwards with masonry elements falling through the roof of the Link Centre atrium, which was a relatively new building at 152 Hereford Street.

The code lateral load coefficient for a façade to an elastic responding structure in Christchurch at the time of the earthquake sequence was 1.23g at roof level of a three storey building. The analysis of un-reinforced masonry construction is not covered in the NZ Building Code. The industry uses the New Zealand Society for Earthquake Engineering guidelines 'Assessment and Improvement of the Structural Performance of Buildings in Earthquakes' 2000 and 'Assessment and Improvements of un-reinforced Masonry Buildings for Earthquake Resistance' 2011. Calculations using these documents indicate that a sound 225 thick unreinforced masonry wall spanning from the third floor to roof level and effectively restrained at roof level would not meet code requirements without strengthening.

Based on GNS Science records of measurements of accelerations in the Christchurch CBD during the 22nd February, 2011 earthquake, the building is likely to have been subjected to a ground acceleration of 0.9g. This level of ground acceleration equates to 1.68g acceleration at roof level. In addition, significant vertical accelerations are known to have occurred and it is probable that the façades were subjected to a vertical acceleration at the same time as being subjected to severe horizontal acceleration. Clearly failure of the poorly restrained third floor walls was almost inevitable in the severity of shaking that occurred during the 22nd February, 2011 earthquake.

Issues Arising from Review

Upgrading of un-reinforced masonry buildings

The building at 246 High Street had remained in a relatively original condition up until the recent earthquakes. Some strengthening of the High Street façade had been undertaken at ground floor level. The damage that occurred to the building in the 22nd February, 2011 earthquake demonstrates the risk that un-reinforced masonry buildings pose to the occupiers of the building and the people in the vicinity of the building at the time of such an event.

The Building Act provides two opportunities for the structural upgrading of buildings. These opportunities are:

- upon a change of use
- implementation and enforcement of an earthquake prone building policy.

Improved public safety in a significant earthquake relies on territorial authorities adopting and implementing meaningful programmes for strengthening and upgrading of un-reinforced masonry buildings and enforcing the provisions for structural upgrading when a building is subject to change of use.

Records show that the Christchurch City Council had been aware of and had concern over the earthquake prone condition of the building for many decades. The delay in the Christchurch City Council implementing a policy on earthquake prone buildings may or may not have contributed to the damage which occurred as a result of the severe 22nd February, 2011 earthquake.

Undoubtedly the Christchurch City Council's attitude to earthquake risk buildings was influenced by the perception that Christchurch was a low seismic hazard zone.

In the interests of public safety, there is a need to adequately secure the upper level walls of un-reinforced masonry buildings, particularly the facades of buildings, which present a fall hazard over public spaces or adjoining buildings. These buildings pose a serious risk to the public and those that work in or near the building in the event of a significant earthquake.

Consideration should be given to prioritising the strengthening and upgrading of un-reinforced masonry parapets, facades and other elements that have the potential to cause loss of life in public spaces and adjoining buildings in a significant earthquake.

Basis of structural assessments following a significant earthquake

The Rapid Assessment process focuses on damage caused to the building by the recent earthquake. The process assumes that the risk that existed before the earthquake is acceptable in the period following the earthquake, subject to only limited damage having occurred to the building. Historically, aftershocks have caused lesser levels of shaking than the initial earthquake.

The earthquake of 22nd February, 2011 has demonstrated that the occupancy and public access in the vicinity of un-strengthened un-reinforced masonry buildings below a minimum strength level may involve an unacceptable risk to the public and occupants of these buildings. It is suggested that the central authority in control of the rapid assessment process assess the likelihood of a severe aftershock following any significant earthquake (say Richter magnitude 6 and above) and require detailed assessments of earthquake prone buildings, in particular un-reinforced masonry buildings, to a level appropriate to the level of aftershock expected, prior to occupancy or public access in the vicinity of those buildings.

Earthquake Prone Building Policy - Protection of Public Spaces

Tragically the earthquake sequence has highlighted the danger to the public of inadequately restrained facades to many un-reinforced masonry buildings. The 22nd February, 2011 earthquake demonstrated the need for greater caution in the occupancy of and access in the vicinity of un-reinforced masonry buildings following a significant earthquake.

The failure of many facades of un-reinforced masonry buildings was almost inevitable given the severity of shaking that occurred on 22nd February, 2011.

There is a need for territorial authorities to require building owners to adequately secure the upper level walls of un-reinforced masonry buildings, particularly the facades of buildings which present a fall hazard over public spaces or adjoining buildings. These buildings pose a serious risk to the public and those that work in or near the building in the event of a significant earthquake.

Improved techniques for improving the restraint of facades will be necessary if failure of such facades is to be prevented in future earthquakes of the severity of the 22nd February, 2011 earthquake.

Consideration should be given to prioritising the strengthening and upgrading of un-reinforced masonry parapets, facades and other elements that have the potential to cause loss of life in public spaces or adjoining buildings in a significant earthquake.

Street Addresses

In reviewing the reports for this property, there are conflicting addresses used for what we understand to be the building referred to in this report as 246 High Street and the adjoining building referred to as the Link Centre atrium, 152 Hereford Street.

In this and other reports, we have noted confusion over addresses when engineers have been undertaking a rapid assessment process.

It is suggested that the rapid assessment process would be more efficient and reliable if buildings had a clearly identified street address on the building frontage.

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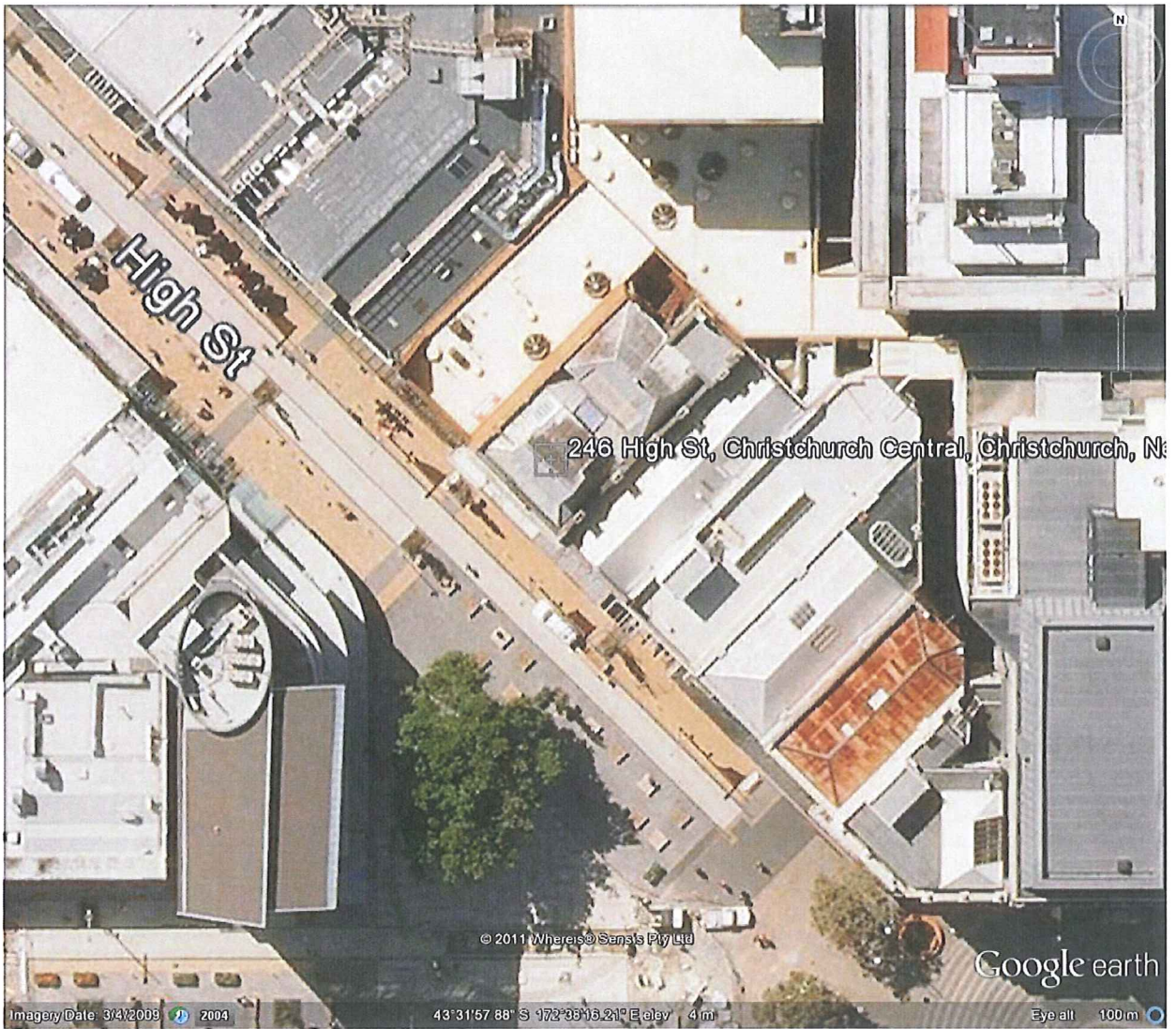


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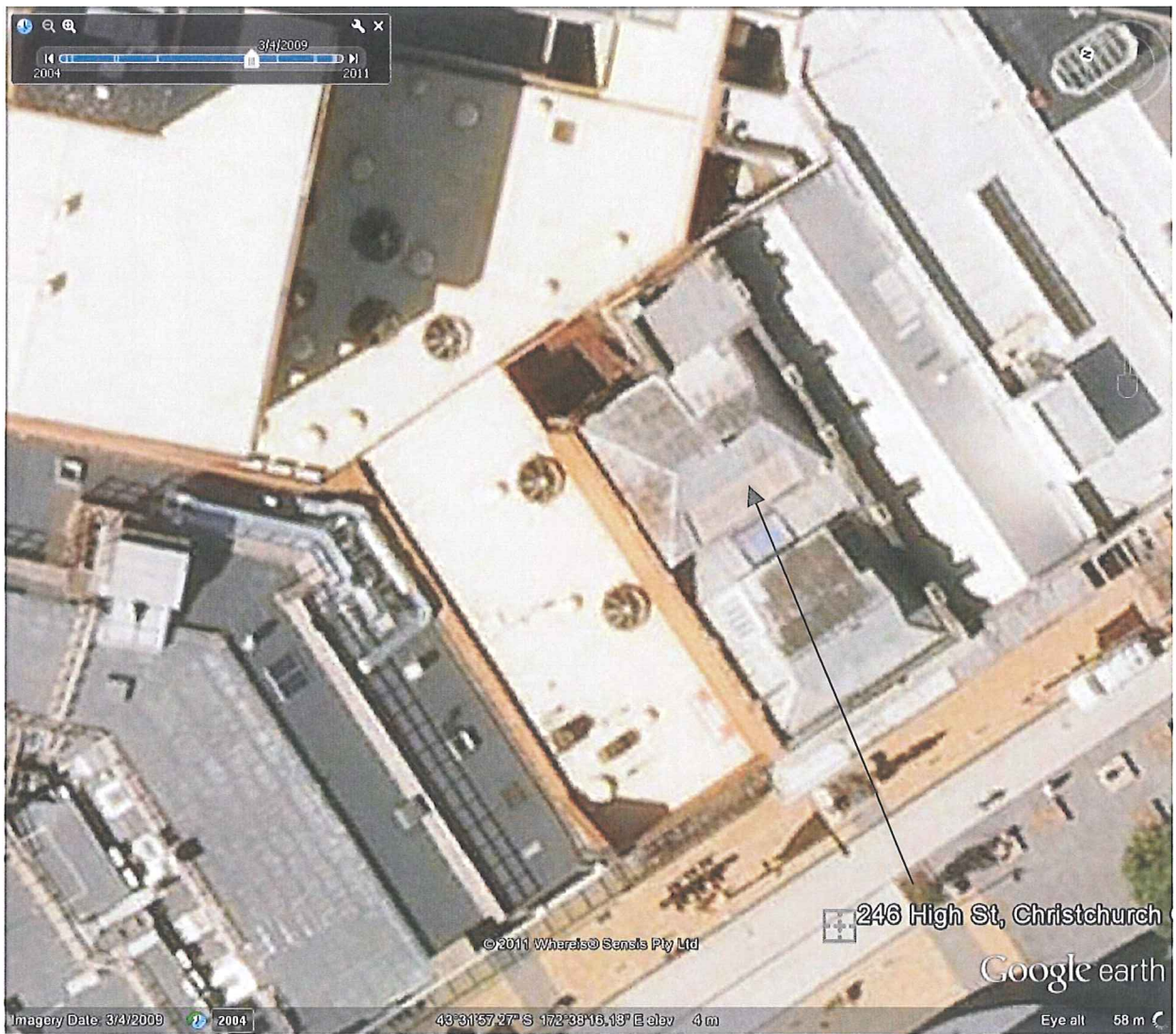
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APPENDIX 1

Site Plans







APPENDIX 2

Photographic record of damage following 22nd February 2011 earthquake





