

Report 10.602
Date 28 November 2010
File Z/01/04/19

Committee Civil Defence Emergency Management Group
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Darfield (Canterbury) earthquake observations and relevance to the Wellington region

1. Purpose

To provide the CDEM Group with some preliminary observations about the Darfield (Canterbury) earthquake on 4 September 2010 and their relevance to the Wellington region. In particular, a movement on the Wellington Fault.

2. Information sources

Information for this report has come from a number of sources including web pages, seminars and personal observations. It should be recognised that the quality of the information is variable and subject to change. In some cases, more detailed or authoritative information is expected to be published in due course.

3. Earthquake details

At 4.36am on 4 September 2010, a magnitude 7.1 (Richter scale) earthquake occurred near Darfield (Canterbury) approximately 40km west of central Christchurch. It resulted in a surface rupture 29km long and displacements of up to 4.6m horizontally and 1.6m vertically. Essentially, the surface rupture was across rural land.

As a comparison, a movement on the Wellington Fault is likely to result in an earthquake of approximately magnitude 7.5. (about 4x the energy of the Darfield earthquake), surface rupture over about 50km and displacements similar to the Darfield earthquake.



Clock tower of the previous Christchurch Railway Station, note cracking. Photo: M. Kennedy

From a planning perspective moderate-sized local earthquakes (magnitude 6.0-7.0) or larger distant earthquakes may be more important in terms of planning and preparedness than infrequent large local events (GNS It's Our Fault brochure).

An example is the two earthquakes in 1942, magnitudes 7.2 and 6.8 (or 7.0?) centred in the Wairarapa.

4. Key issues in Canterbury

Public safety, and by ensuring the public's confidence in the responding agencies' ability to provide that safety, remained the primary consideration. The priority areas were:

- the loss of water and sewerage services in the worst-affected areas
- immediate and longer term welfare and housing needs
- growing demand and ongoing need for psychosocial services
- business impacts and personal finances
- the need for coordinated, regular communication with the affected communities
- establishment of recovery structures.

5. Canterbury seismic event response

The Canterbury Group's Emergency Coordination Centre (at Environment Canterbury) was activated early on 4 September 2010. Both the Group Controllers were at that stage out of the region (Australia and Wellington). The Canterbury Civil Defence Emergency Management (CDEM) Group was the lead agency for the event.



Environment Canterbury Emergency Co-ordination Centre

Photo: F Turner

Christchurch City Council used their Art Galley as the Emergency Operations Centre (EOC) due to their new centre not being available. During the first few days of the event, this centre was occupied with between 160 to 180 emergency response staff per day.

Waimakariri, Timaru and Selwyn also activated their respective EOCs while Ashburton did not activate due to the limited impact on its area.

Christchurch City, Selwyn District and Waimakariri District declared states of local emergency in their respective areas until midday Wednesday 15 September 2010. The three councils reviewed the status daily and agreed to terminate their declarations at the same time.

The National Crisis Management Centre in Wellington was activated in support of the Canterbury regional response. As CDEM was the lead agency key support was provided by Police, New Zealand Fire Service, Health, NZ Defence Force National Welfare Coordination Group, and the Transport Cluster.

All responding agencies had their own emergency management systems in place (for example, communications, information management, etc.). A range of electronic and paper systems were applied.

The International Assistance Cell comprising the United Nations Disaster Assessment Co-ordination team (UNDAC) and the International Search and Rescue Advisory Group (INSARAG) was not activated.

Emergency services (Police, Fire, Health) were coping with additional specialist staff being sent from other parts of New Zealand to provide support. Police established a cordon in central Christchurch to keep people away from unstable structures and enable clean operations to be conducted safely.

The New Zealand Defence Force has activated air and land units in support of the civil defence emergency management response in Canterbury.

Additional building inspectors (more than eighty), public information officers, welfare officers and emergency operation centre staff from across New Zealand were providing support in the affected areas.

Wellington situation

As with all regions in New Zealand, the Wellington region has CDEM structures in place to manage and coordinate any disaster event.

Roles and responsibilities are clearly outlined in the CDEM Group Plan, which has flexibility to enable response to a variety of emergency events ranging from a small local event to a large scale event affecting the entire region.

The Wellington region's CDEM Group Plan makes provision for a Group declaration (as opposed to a single council declaration) to be made if two or more territorial authorities are affected. This allows for a more structured and coordinated response and sets up a clear protocol for major emergency events. This type of protocol was not in place in the Canterbury Group's Plan,

resulting in three separate declarations by different councils during the Canterbury earthquake.

In the event of a Group declaration, the Regional Council Centre becomes the Group Emergency Coordination Centre (ECC). The protocol also provides for the Masterton ECC to become the alternate should damage in Wellington City be too severe.

In terms of resources, EOCs vary in degree of adequacy across the region. The Ministry of CDEM conducted an audit of the Wellington CDEM Group's EOCs in 2009. The audit revealed that out of the ten EOCs in the region, three (Wellington Emergency Management Office in Wellington City, Kapiti Coast, Lower Hutt) are purpose-built facilities designed to withstand a major earthquake and operate relatively independently. The remaining EOCs (including the Group ECC in the Regional Council Centre, and Group alternative ECC in Greater Wellington's Masterton Office) are located in existing council buildings with lower levels of suitability and design.

While the report notes the excellent capability of the Group Emergency Management Office and its ECC, it raises concerns about the resilience and hazardous location of the building in the Wellington CBD. Other key findings include:

- The inability of retro-fitted EOCs to function as a stand alone unit, due to a lack of dedicated back up resources (e.g. food, water, sewage holding tanks)
- The need for local training, particularly in some of region's smaller centres
- The lack of dedicated room for operations and radio communications in retro-fitted EOCs.

6. Assessment of damage and needs

6.1 Urban Search and Rescue

The NZ Fire Service Task Force (TF2) is based in Christchurch and was deployed shortly after the earthquake. TF1, based in Palmerston North, was notified shortly afterwards to be prepared for deployment to Christchurch by air (half team, limited gear) and sea (half team, full gear). TF3 in Auckland was also preparing for deployment by air (half the team to Christchurch and the other half to Palmerston North awaiting further instructions).

Nelson-Tasman CDEM Group made their Response Team 2 available for deployment as well.

Several other search and rescue teams were deployed to Christchurch to assist with building safety (shoring, urgent demolitions, and other tasks).

Approximately 130 staff (20 teams), 7 search dogs, and 2 full caches of equipment were deployed to Canterbury. No people were found trapped in buildings.

Wellington situation

The extent of risk to people is dependent on the timing, scale, location and nature of the particular event. Notwithstanding this, an earthquake of similar magnitude to that in Christchurch would likely result in fatalities and significantly more injuries if it occurred in Wellington. This is due to the nature of the underlying geology, topography and the density of urban living, particularly in Wellington City.

International assistance will be required in Wellington to assist with the search and rescue operation, this may also include rescue from rail and road accidents (tunnels, bridge collapse, landslides, etc.).

Several scientific studies carried out over several years have shown that thousands of people may be trapped in Wellington due to the proximity of buildings to the fault line and the more than 700 suspect multi-level buildings in the Central Business District. There are also a number of vulnerable buildings in Hutt City, Upper Hutt City, Porirua and on the Kapiti Coast.

Rescue teams in the Wellington region are limited - only four light rescue teams – Wellington (2) and Hutt Valley (2).

Access into the impacted areas, the amount of debris and the demolition of structures to ensure safe search and rescue operations are also very limiting factors that need to be considered.

6.2 Treatment and movement of the injured

Only one serious injury and about one hundred light to moderate injuries were reported after the earthquake. Ambulance services returned to normal levels of operation very quickly.

Approximately 100 patients were seen at Christchurch Hospital with earthquake related injuries

Ambulance staff were made available to the welfare centres where they could provide any first aid when required.

Wellington situation

Major earthquakes around the world generally result in serious injuries needing immediate medical attention and moderate injuries including dust asphyxiation issues and burns. There is also a general increase in mortality from heart attacks, and critical needs for people in medical care

Studies have shown that in Wellington we would expect at least 1,200 people to be severely injured and up to 12,000 with moderate or light injuries. It is also likely to have up to 1,500 deaths (Wellington After the 'Quake, 1995 conference proceedings).

Road access will greatly reduce the ability to move injured people to medical care facilities.

6.3 Welfare

Within hours of the earthquake three welfare centres were opened in Christchurch City and one in Waimakariri District. Selwyn District activated two information centres.

The welfare centres were originally established in schools, but later moved to stadiums. Long term accommodation became a major problem

Several people self-evacuated to family and friends and to accommodation outside the region, although not necessarily turning up at welfare centres.

The Welfare Centres continued to support people in need with 350 people accommodated in the Christchurch City welfare centres.

It was estimated that about 20,000 homes could have been damaged, some severely enough to enforce evacuation for days, weeks or even months.

Psychosocial needs rapidly became major issues (especially among children and due to the continuous occurrence of large aftershocks). A psychosocial support strategy was developed and implemented while psychosocial information was provided on the Ministry of Health's website. The Ministry also enlisted experienced volunteers to provide support to individuals.

The Ministry of Education ensured that trauma counsellors for children were available at all schools when they re-opened again.

The Ministry of Social Development was contacting 18,000 superannuation clients who were living on their own to make sure they were safe.

After the first week the emphasis turned to immediate and longer term welfare requirements and needs (including psychosocial support to affected communities). There was an increase in welfare support requirements as residential housing inspections continued.

Wellington situation

In Wellington there are more than 30,000 inner-city residents and more apartments are under construction. Approximately 60,000 commuters travel to Wellington every day with several thousands commuting out of Wellington to the Hutt Valley, Porirua, Kapiti and the Wairarapa. On a normal day there are about 200,000 people in Wellington.

A major earthquake in Wellington could see wide spread displacement and the need for temporary accommodation and shelter - including displacement from modern apartment buildings where damage may be minor, but power, water and drainage may be disrupted. It will also result in the loss of family income (employers out of business, damaged work places, etc.) and family separation (people unable to get home for days while family members and friends are at home or somewhere else).

In Wellington it is expected that around 18,000 homes will be severely damaged or destroyed (not habitable) and another 50,000 with damage but habitable.

6.4 Medical/Health

Christchurch hospital was operating on generator power but was fully functional. The building had been damaged but that did not affect its response to the event. Another medical facility in the Canterbury District Health Board reported minor damage but was operational.

One person was taken to the Intensive Care Unit of Christchurch Hospital with serious injuries while a small number have been treated for fractures and lacerations.

Nelson-Marlborough, West Coast, South Canterbury and Southern District Health Boards have reported that all facilities were fully functional.

Within a few days after the event all hospitals and services reported business as usual and were coping well.

General Practitioners (GP) reported an increase in people approaching their family doctors with stress and anxiety issues, gastroenteritis and repeat prescriptions. GP practices and pharmacies were operational, and reported a normal demand for services.

Wellington situation

Community infrastructure (such as hospitals, medical centres and specialist care facilities) is an important consideration due to public reliance on them in an emergency. The key risks associated with a major earthquake include:

- :
- Inability of people gaining access to community infrastructure as a result of damage to key transport routes
- Significant increase in demand for services while dealing with a potential for reduced capacity of hospitals and emergency services because of damage to buildings and equipment, loss of utility services and staff fatigue
- No or limited water supply to hospitals

In Wellington it is expected that hospitals will be operating at a greatly reduced capacity due to possible damage to infrastructure, equipment, loss of services, access and the supply of medication, especially drugs. Studies have found that Wellington's medical facilities will run out of medical supplies by the end of the first day of the event. Access will also restrict those critical resources coming in to the region's medical facilities.

6.5 Sanitation

Public health remained a real issue in the early stages because of damage to sewerage and water systems. Some areas had limited capacity in their sewerage networks due to about 10% of the city's sewerage network being severely damaged. Assistance was provided from NZDF and Public Health Units who assessed areas that might have been contaminated.

Monitoring continued on gastroenteritis outbreaks. No abnormal trends were detected.

Public health concerns relating to water supply in Christchurch City, Banks Peninsula and Selwyn declined as soon as it was deemed safe. “Boil water” notices were kept in place for Kaiapoi, Kairaki and Pines Beach.

Wellington situation

In Wellington, plans are in place with regard to public health risks, particularly diseases emanating from damage to water and wastewater systems (cholera, dysentery), the disposal of refuse and the disposal of debris. A recent study revealed that the Wellington CBD alone could have as much as 2.25 million tonnes of debris.

6.6 Portable toilets (portaloos)

Because of the liquefaction factor a large number of commercial and residential buildings were impacted by the loss of water supply and a functional sewerage disposal network.

To provide for this need a large number of portable toilets (252) were placed at strategic places around the city and districts. Many of these ‘strategic places’ were at the end of the street initially where it could be accessed and easily serviced as only two tracks were available initially. However, it meant that the public needed to walk to these toilets, sometimes 400 to 600 metres away from their homes. Some of these walks were necessitated during night hours. It was also very difficult for disabled people to get to and use the toilets.

During the first days these toilets were not serviced regularly turning them into unacceptable smelly cubicles and resources allowed the toilets to be more evenly spread..

The situation was rectified shortly after several complaints were lodged with the respective councils.



Photo: S. Ashford

Residents were advised to follow the instructions and public health advice regarding portaloos and sanitation that was put up inside the toilets (many people placed plastic bags in the portaloos which caused blockages, thus leading to the odour issue).

Residents were also advised that they could construct a makeshift toilet in their garden or use their toilet by lining it with two or more plastic bags. The plastic bags needed to be closed tight after use and buried.

Wellington situation

The Wellington region has a sewage disposal plan in place providing advice on several methods of sewage disposal. The plan also makes provision for apartment buildings, hotels, restaurants, and other commercial entities.

7. Information management

The following is a personal account of the Wellington Region CDEM Group's Public Information Manager who assisted Canterbury in this event:

"All of the local staff had had personal trauma of varying degrees that they were dealing with between their Emergency Centre shifts. Despite that, they were without exception, consummate professionals while at work. While crisis may bring out the best in people, it takes its toll in other ways. I wish them all well as they try to get their jobs back to business-as-usual and their lives back to normal, whatever that may mean for quake-affected Canterbury.

The magnitude of the initial quake is hard for outsiders like me to comprehend. Some people talked of shaking so intense that they were unable to stand up, some saying the shaking went on for 15 or 20 minutes. A few said that while they were lying on the floor of their bedroom they thought "Goodness, if it's this bad here, I would hate to be in Wellington right now!" a sentiment generally interspersed with a few more unpublishable Anglo Saxon words.

Based on probability and geotechnicality, this Canterbury quake could have been Wellington's quake. It wasn't, but perhaps it has touched the hearts and minds of Wellingtonians more powerfully than most non-Cantabrians. It was humbling to be able to make a small contribution to what is a massive event, the effects of which will be felt by many for years. The psychological impacts will be more significant than a few big cracks in the ground, disrupted aquifers or demolished heritage buildings.

To quote from a media release I wrote on Saturday: "Send money!"

Thousands of people need to rebuild houses and replace damaged possessions. While insurance will help some to some extent, there are many who will need more assistance. Sending stuff is not much help, particularly when there is no infrastructure in place to store or distribute it. Having money to spend with local businesses will help get the local economy back on its feet.

I helped write media releases and strategy documents, updated web content, attended briefings - including the daily 3:00pm "Bob Parker Show" at Christchurch City and generally made ourselves available and useful. We

visited welfare centres, provided media management advice about some infamous family and not-so-infamous gastro family, liaised and advised as required. After a week, the locals were a bit tired and I think grateful to have a couple of fresh heads around.”

Radio and the electronic media played a major role in getting information out to affected communities. Within the first two days hundreds of thousands of visits were made to Canterbury and other related websites.

Trustworthy information was critical in keeping the public informed. Radio, TV, internet, written publications, televideo conferences, situation reports, media interviews, VIP visits, telecommunications, Face Book, Twitter – all were successfully used to get timely messages out to the public.

Wellington situation

Communicating with communities in the Wellington region after a major quake will be a significant issue to address.

Without power, telecommunications (via landline, internet or radio transmission) communication will be disrupted within the region until power and data links are restored. Initial communications (other than in the Wairarapa and Kapiti Coast) will rely on AM radio broadcasts from outside the region and particularly on National Radio whose transmitters are the most powerful for this purpose.

Fortunately Radio New Zealand and Television New Zealand are required by legislation to act as public service broadcasters in such situations, and will have to be relied on to broadcast from pre-prepared scripts until such time as they are able to be sent civil defence update information from the Wellington Group ECC or the National Crisis Management Centre. Both these agencies have set scripts and, as demonstrated by the immediate aftermath of the Canterbury quake, can deliver these quickly and reliably.

The Wellington Region CDEM Group has a Public Information Management Plan in place which has been exercised extensively over the last number of years.

Once a Group ECC is established, the Public Information Management function will coordinate key messages and their delivery to affected communities.

8. Recovery

The damage to a large number of residential houses was immediately identified as one of the key issues for recovery.

The Canterbury CDEM Group Recovery manager has put it this way: “The impacts of this event will be long lasting for the region, and the more effort we put into planning the recovery means a better outcome for every one of us.”

Christchurch, Selwyn and Waimakariri each formed recovery groups soon after the earthquake to plan and co-ordinate recovery efforts. The groups are supported by cluster groups which are focussing on recovery plans for their specialist areas. These specialist areas are: social, natural environments, economic, rural, built structures and infrastructure. Cluster group members include representatives of local authorities, government agencies and business

groups. The cluster group representing rural interests is operating from a base in the Selwyn District.

Early recovery initiatives in Christchurch included:

- The establishment of a building recovery office on the ground floor of the new Council offices. This office includes representatives of the Earthquake Commission (EQC), building inspectors, engineers etc and will be able to provide advice for residential and business owners needing to re-occupy their buildings, arrange demolition, major repairs or rebuilds. The office:
 - Registers the need for demolition, major repairs or rebuilds and quickly obtain consents needed to proceed
 - Provides architectural/engineering advice
 - Provides access to property records
 - Determines eligibility for financial assistance from the EQC and the Mayoral Relief Fund
- A business recovery website www.recoverycanterbury.co.nz which is a one stop shop for all business support issues.
- Planning for recovery assistance centres which will be small, locally based centres where people can get information and assistance on housing, welfare, finance and employment. These will help to strengthen community links and help channel support where it is most needed over the coming months.

A rural recovery group for the Canterbury region has been established and a rural recovery coordinator has been appointed. This group is providing coordination among the groups working in rural areas throughout the region. Water – there were some issues with water including wells with excessive volumes of silt locking up pumps and blocking filters.

Wellington situation

The Wellington Region CDEM Group has a Recovery Plan in place which has been exercised extensively over the last few years.

9. Utilities

The diagram below on lifeline performance was included in an address by Mr J Eidinger at Berkeley University, California on 18 October 2010. It was prepared from the observations he and others made during the time they spent in Canterbury following the earthquake.



Transpower	Orion (electricity network)	Christchurch water
Waimakariri water	Rockgas	Vodafone
Telecom Chorus	NZTA	Lyttleton Port
Kiwi Rail	Christchurch waste water	Waimakariri waste water

Most of the utility damage occurred in Christchurch City, Waimakariri and Selwyn Districts. Christchurch City’s damage costs will be approaching \$300M, with about 75% for waste water, 4% for water supply and the balance for roading.

9.1 Electricity

Transpower’s transformers all tripped within 45 seconds of the earthquake. About 90% of the electricity in Christchurch was restored by the network provider, Orion by 6pm on the day of the earthquake. Repairs in rural areas took longer. In most rural towns, electricity was restored within two days.

Wellington situation

Wellington’s power network is relatively secure, but Transpower’s main substations supplying urban areas are much closer to the Wellington Fault than was the case in Canterbury. Also, underground and overhead power lines owned by the network provider, Wellington Electricity, cross the Wellington Fault. In other parts of the region the security of supply varies.

9.2 Communications

Many cellphone towers had 2-3 hours of battery backup power. The tower owners brought in 60 backup generators to keep them operating until power was restored.

Telecom’s network business Chorus, brought in an extra 100 technicians to repair services. Forty damaged telephone cables were repaired in the first five days.

Wellington situation

This may be similar to Christchurch. For a Wellington Fault movement, communications services across the fault line are likely to be extensively damaged.

9.3 Water supply

There were extensive breaks in the water supply network in parts of Christchurch City and in the township of Kaiapoi, particularly where there was liquefaction. Services were also damaged within Selwyn District.

Within the first few days after the earthquake, Christchurch City took about 5000 service calls. Only some of these would have related to water supply. Apparently a normal week is about 500 service phone calls.

In the worst area, complete replacement of water pipes is necessary. Christchurch City's contractors, with assistance of staff from other areas, restored water supply to a large number of properties very quickly. A few weeks after the event, Christchurch City's website reported that water had been restored to all houses. On a proportionate basis, there was also significant water pipe damage in Waimakariri District, particularly in the township of Kaiapoi.

In terms of New Zealand cities, Christchurch City's water supply is relatively unique. A large number of wells across the city provide the area with secure (untreated) groundwater. This enabled undamaged sectors to be separated from extensively damaged sectors by valving.

Wellington situation

Most the cities and towns in the Wellington region rely on one or a very small number of water supply sources. For metropolitan Wellington, there are three main water treatment plant and a distribution network to the cities. For a Wellington Fault movement earthquake, the bulk water network is expected to be broken or leak in about 90 places. In Hutt and Wellington Cities, the estimated breaks in the distribution network are about 5000 and 8000 respectively. Many pipelines, of varying sizes, crossing the Wellington Fault would be severed.

9.4 Waste water

Liquefaction and lateral spreading caused extensive damage to sewer pipes. Also, because sewer pipes are usually laid to achieve a gravity flow, they are vulnerable to liquefaction disrupting their performance. In Christchurch, silt and sand entered many of the broken pipes making repairs more difficult and creating the need to often replace rather than repair pipes.

Sewer pipes, although subject to a hostile internal environment, are not usually under pressure like water pipes. This means their strength may be less than water pipes, though both types of pipes are often subjected to the same external loads.

It is expected reports will be published on the material performance of sewer and water pipes in due course. However, it appears asbestos cement pipes performed poorly.

Wellington situation

In addition to liquefaction that will take its toll in parts of the Wellington region, sewer pipes will also suffer where road embankments slip and at fault movements where pipes shear.

10. Transportation

10.1 Roading including bridges

It appears that bridges fared reasonably well, though the damage collectively will still be costly. In some areas, there was lateral spreading of approach embankments. These were fixed in the short-term by placing additional fill. In rural areas, there are many older single span bridges but no collapses have been noted. In the Christchurch CBD area, the damage to the roads at each end of bridges crossing the river Avon appears to have been minimal.

Where the fault surface crossed roads, the lateral movement was quite evident. Lateral spreading has caused extensive damage to roads in areas where there was liquefaction. This combined with buried services breakages means that in time, a number of roads will need to be rebuilt. There was a slip in the Rakaia Gorge on SH77 and photos of some fallen rocks on the Port Hills have been published.



Photo: S. Ashford

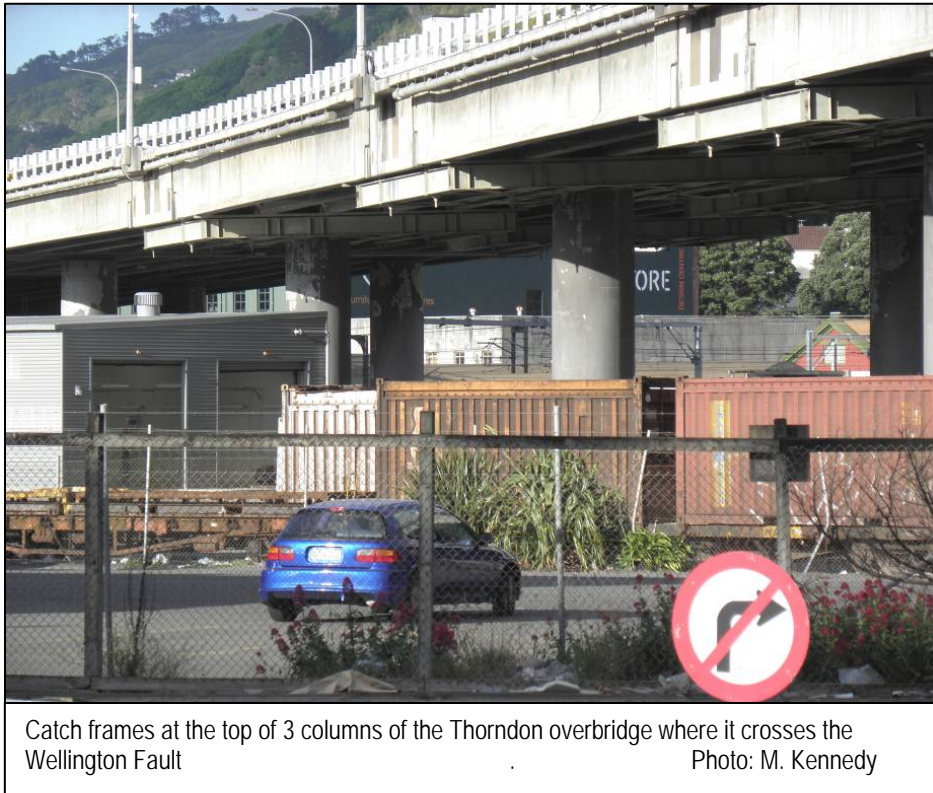


Photo: S. Ashford

Wellington situation

With the topography of the Wellington region slips, rock slides and embankment slumping are likely to be much more prevalent in a seismic event that was the situation in Canterbury. Major roads in and out of Christchurch were only briefly out of service, if at all. (Excluding an extensive slip near Kaikoura on SH1 a week after the earthquake.) With SH1 and SH2 effectively being the only major roads in and out of the Wellington region, blockages are likely.

SH1 is elevated as it crosses the Wellington railway yards at which point it also crosses the Wellington Fault. Catch frames have been constructed at the top of some piers to catch unseated spans. It is unlikely though the bridge will be serviceable following a movement on the Wellington Fault. For other bridges, not on fault lines, their performance should be similar to that experienced in Canterbury. Slips, embankment slumping, liquefaction are all to be expected.



10.2 Railways

Railway lines head north and south out of Christchurch and the line to the Midland Line (West Coast) branches off the Main South Line at Rolleston.



A 5km section of track was damaged near Kaiapoi (Main North Line) and there was lesser damage at Rolleston and near Belfast. The Main South line opened on the evening of 4 September, the Midland Line on 5 September and the Main North Line on 7 September.

Wellington situation

Like the roads, the topography of the Wellington region will affect the railway following a major seismic event. For example, rock falls on the North Island Main Trunk between Pukerua Bay and Paekakariki are a possibility. The Wairarapa line crosses the Wellington Fault between Petone and Ava and runs parallel and close to the fault near the Hutt River bridge at Silverstream. The main railway lines into the Wellington Railway Station cross the Wellington Fault at Thorndon. Wellington railway yards and the marshalling area (vehicles and railway) for the Interislander are all on reclaimed land. A more severe impact is expected on railways following a Wellington Fault movement than was the situation in Canterbury. For other faults, the extent of the damage will depend on the particular circumstances. Repairing the electrification system in the Wellington area is an added complexity that was not present in Canterbury.

10.3 Airport

Christchurch Airport was closed for inspection following the earthquake and reopened at 1.30pm on 4 September.

Wellington situation

It is more appropriate for the management of Wellington International Airport Ltd and provincial airports to make public any assessments they have of likely affects of an earthquake.

11. Structural damage

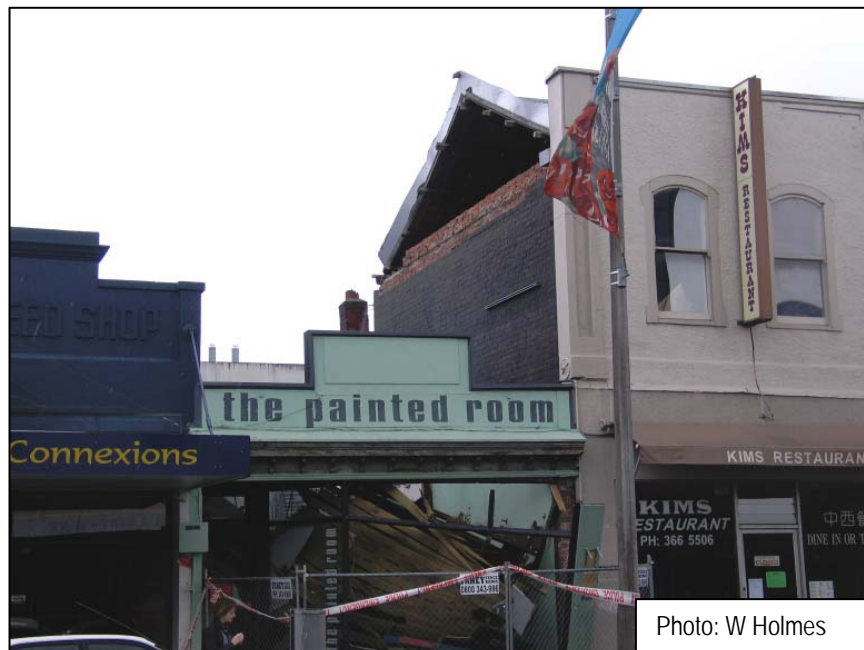
11.1 Older commercial buildings

Commercial buildings in central Christchurch and Kaiapoi that were constructed of unreinforced masonry and were not seismically strengthened appear to be the most damaged. About 125 buildings collapsed, will have to be demolished or were extensively damaged. (This number is still subject to confirmation.)



There are a number of issues surrounding unreinforced masonry buildings that have not been seismically strengthened:

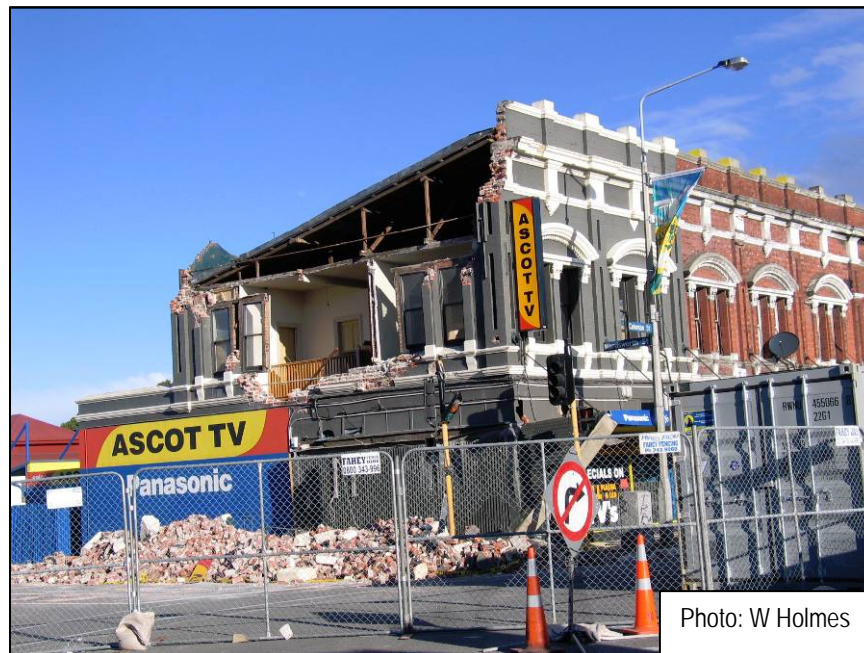
- Possible injury and loss of life, though there was no loss of life in Christchurch, almost certainly because of the time of the event.
- Business disruption and damage to adjoining properties



- Extent to which bricks/stone blocks were thrown. Anyone moving to the centre of a road to escape collapsing verandas would have stood a good chance of being hit by flying masonry.



- Business interruption to neighbouring properties where the subject property did not collapse immediately but could still collapse at any time, particularly following an aftershock.



There was damage to a considerable number of gables.



Photo: M. Kennedy



Photo: M. Kennedy

11.2 Middle aged commercial buildings

These could be defined as buildings constructed to a seismic standard following the 1931 Napier earthquake. What is not known is to what extent, if any, these buildings have been strengthened since they were built. Observations from street level within the Christchurch CBD suggests that, with the exception of some glazing systems, the buildings have suffered no or only minor damage. For a number of multi-storey buildings there was broken glass in the steel casement-style windows (non structural damage).



Photo: M. Kennedy



Photo: M. Kennedy

11.3 Modern commercial buildings Christchurch CBD

Most modern buildings show no external signs of damage. There are exceptions. Such as the concrete cover on the exterior column in the photograph below.



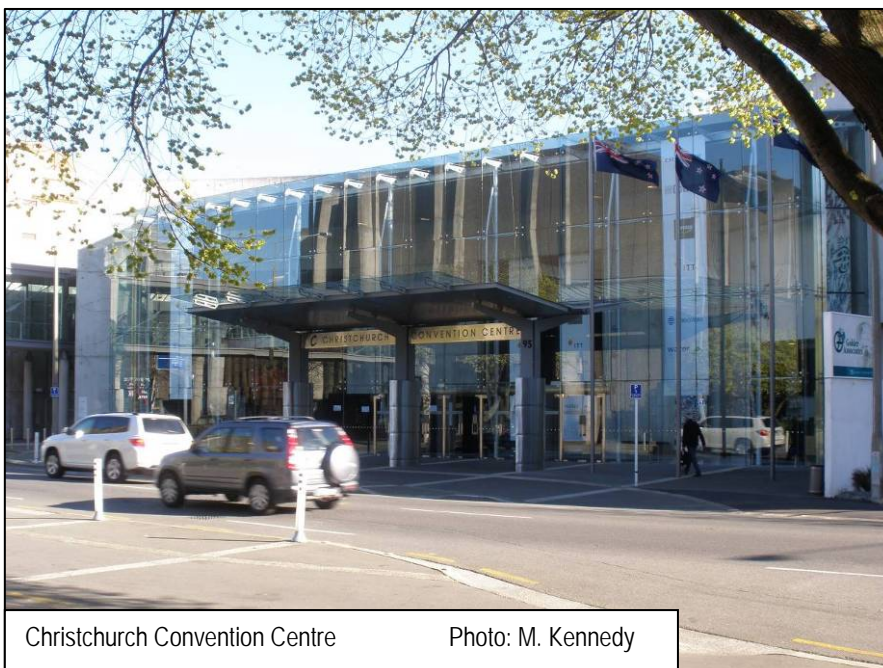
Photo: unknown



Photo: F. Turner

Limited information is known about the interior of some buildings as they are privately owned. One hotel was closed due to issues in the basement. Failure of concrete stairs was observed in another hotel. In fact, it appears a number of stairways were damaged in some buildings.

The Christchurch Town Hall complex and Christchurch convention centre (on opposite sides of Kilmore Street) were used for a conference two weeks after the earthquake. In public accessible areas, there was no signs of internal damage.



Christchurch Convention Centre

Photo: M. Kennedy

11.4 Housing

In areas where there was severe liquefaction, there was also damage to houses, even if they were built to current standards. A report for the EQC indicated there was land damage recorded to 6855 properties as at 1 October, and a slight increase in this number is expected. In other areas, damage was variable. The media has well documented the damage to modern houses. Many of those severely damaged had unreinforced concrete floors not tied to the perimeter foundations.



Photo: S. Ashford



Photo: Tai Lao

Very old properties with unreinforced masonry suffered, as did houses with brick chimneys. An unconfirmed report suggested damage to 14,000 chimneys.



Photo: M. Kennedy

Wellington situation

Because the earthquake code is national, as are many other standards, the performance of buildings in the Wellington region would be expected to be similar to those in Christchurch under the same circumstances. For a Wellington Fault movement earthquake though, the fault would be much closer to the CBD areas of Wellington, Lower Hutt and Upper Hutt Cities than was the case in Christchurch, and of greater intensity than the Canterbury earthquake. Large areas of the Wellington CBD are on reclaimed land that may react differently to the river gravels and other deposits that buildings in central Christchurch are founded on.

With regard to house chimneys, there were two powerful earthquakes in 1942 centred in the Wairarapa. A report indicates at least 10,000 Wellington chimneys were damaged. Even so, it is still likely there are many unreinforced brick chimneys in the older style Wellington houses.

Greater Wellington has previously published a series of hazard maps for metropolitan Wellington and the Kapiti Coast. Many of the residential areas prone to liquefaction are around the edges of various harbours. Some of these contain older style houses.

12. Non structural damage

12.1 Buildings

In many cases, damage is inside buildings and not accessible for general inspection. However, examples of some types of non structural damage have been reported at the University of Canterbury complex at Ilam, about 4km from the Christchurch CBD.

The following is a selection of photos.





Photo: New Zealand Herald



Photo: M Comerio

12.2 Warehouses

Some failures of storage racks in warehouses have been reported.



Photo: Christchurch Press



Photo: M Rowe, NZ Herald



Photo: W. Holmes

It is understood the Department of Labour is considering making NZ Standards mandatory for storage racks.

Wellington situation

Non structural damage is to be expected in any significant earthquake. To prevent such damage is unlikely to be cost effective.

With regard to industrial style storage racks, it is important these do not collapse, particularly if they contain food and essential supplies, given the impact on transport routes following a major earthquake. Lighter style storage units such as library book racks and taller items of office furniture can be made secure at relatively low cost.

13. Fires

One fire was reported after power was turned back on in a Christchurch CBD building where LPG was leaking.



In metropolitan Wellington, the reticulated natural gas network is much more extensive than the limited LPG piped network in Christchurch (+ some delivered bottled gas).

Unfortunately, many fires have been reported following earthquakes where gas pipes ruptured. One of the most notable was San Francisco in 1906 where 30 fires destroyed 25,000 buildings. The 1989 San Francisco earthquake caused on excess of \$5b in damage but the fires were far less than in 1906.

An Institute of Geological and Nuclear Sciences report (2002) prepared for the NZ Fire Service analysed various scenarios for post earthquake fires in Wellington City. With 27 randomly located ignition points, the model indicated between 358 and 1503 buildings burnt, the variant being the wind speed at the time. The report noted though that the model was not fully developed.

Fire fighting will be difficult given the damage expected to the water supply system. There is a case for raising public awareness about fires after an earthquake and how the public can assist.

14. Flood Protection

Extensive stop banks on the sides of the Waimakariri River were put in place to prevent flooding of Christchurch. Stop banks also protected the Kaiapoi area. As a result of the earthquake, there was slumping in some areas and the degree of protection dropped to a 1 in 15 year flood. Repairs raised this to a 1 in 30 years by mid October. It is expected that within a short period, 1-2 years, the 1 in 500 year flood protection standard will be restored. The most difficult damage to repair will be where there are major concrete structures passing under the stopbanks or embedded in them. These include culverts and headwalls for draining stormwater under the stopbanks and into the river and pump stations for both stormwater and wastewater. Retaining walls, used to minimise the width of the stopbank where space was a constraint, have also failed and will be expensive to repair.



Photo: S Ashford

Wellington situation

In the Wellington region, there are stop banks on many rivers and some damage can be expected depending on the intensity and location of an earthquake. The flood protection assets at risk include stopbanks, rock lines and groynes, flood walls, flood gates, detention dams, stormwater outlet structures, pump stations, drainage channels and the barrage gates.

The possible earthquake induced damages include, longitudinal and transverse cracking of stopbanks and flood walls, cracking of ground under stopbanks, existing protection works slumping into a river, settlement of structures as a result of liquefaction and major failure of structures located in the fault rupture zones.

The urban area most at risk will be in the Petone and Seaview area where stopbanks and structures are likely to fail as a result of liquefaction. The other significant area of risk to damage will be in the lower Wairarapa where there is an extensive stopbank and drainage network that protects highly productive farmland.

The procedure after an earthquake would be to assess the damages and prioritise the repair works on the basis of failure risk. The securing of the system to cope with an event of up to approximately a 50 year return period should be able to be achieved within three months of the event. If the event occurred in the wettest period of winter the repairs could take longer. Full repairs should be able to be achieved within 12 months, provided suitable earthmoving equipment was available for this type of work rather than being directed to other regional earthquake repair work.

The one exception to this is the barrage gates at the outlet of Lake Wairarapa. If the gates are damaged in a major way, settlement repairs could take up to two years. The key focus in the first instance would be to open the gates fully until such time as the repairs could be completed. This would have a significant impact on farming operations in the area.

15. Comment

Learnings from the Darfield earthquake will, where appropriate, be actioned by the CDEM Group Office, district and city councils and the Regional Council.

16. Recommendations

That the CDEM Group:

1. ***Receives the report.***
2. ***Notes the content of the report.***

Report prepared by:

Report prepared/approved by:

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Attachment 1: Wellington Region Earthquake Preparedness Planning