

## 22 February 2011 Lyttelton earthquake, Briefing 2

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The aim of the last few days was to quickly assess the impact of liquefaction to the accessible suburbs of Christchurch. The assessment was largely conducted from street side, either in the car or on foot, but on occasion assessment of the inside of homes was possible when invited inside by residents. An attempt was made to derive liquefaction impact categories: None evident, Minimal, Minor, Moderate or Major (Table 1). Categories were assigned based on the estimated percentage of properties in the suburb affected by liquefaction. To be classified as affected a property needed to have visible sand volcanoes in the yard, or have a shovelled pile of silt in front of it (there was no requirement for actually observing damage to the buildings). Numbers given should be considered as an approximation of the percentage of buildings potentially impacted by liquefaction. Table 2 lists the assessed suburbs (to date) along with their liquefaction categorisation and some field notes.

Table 1. Liquefaction categories.

Liquefaction category	Percentage of properties affected
None evident	0%
Minimal	0% – 5%
Minor	5% - 20%
Moderate	20% - 50%
Major	> 50%

To exemplify the type of internal damage liquefaction can cause Figure 1 shows a home in Halswell rendered uninhabitable by the quake. Every room on the lower storey was affected by ejected silt and water intrusion. All carpets were wet underfoot and needed removal, and a layer of silt on the order of 10 cm deep covered much of the floor. In this case liquefaction had caused the slab itself to crack, settle and tilt, and the owner had been advised his home would be written off. Although the overall impact of liquefaction in the Halswell region was less during this event compared with the September earthquake, the impact on this home was greater this time.

Liquefaction induced by the most recent earthquake was more extensive than during the 2010 event. Christchurch Mayor Bob Parker suggested the extent was 3 – 5 times greater this time around. Our observations show this estimate to be of the correct order. Considering Table 2 along with the potential liquefaction map of Christchurch (Figure 2), it is evident that many of the areas considered prone to liquefy, did so. This is in contrast to the September event where only about 20% of potentially liquefiable land did so.

Worst affected suburbs included Avondale, Wainoni, Avonside, Aranui, Shirley, Richmond, Dallington and Bexley all to the north-east and east of the city, with Charleston, to the south, also badly affected. The enormity of liquefaction, and the problems faced by residents is evident in the ejected silt piles shovelled from homes and yards to the streets of Avonside (Figure 3).

For Rugby mad New Zealand, the extensive liquefaction around and on the pitch of AMI Stadium (Figure 4) is a further cruel blow. Some structural damage to the stadium was evident, but is, reportedly, repairable.

Almost all suburbs surveyed showed some signs of liquefaction. The direct impact of liquefaction on the structural systems of housing was in several cases clearly evident. Figure 5 shows a home ominously leaning towards the Avon River, Figure 6 a home whose foundation was undercut by lateral spreading and Figure 7 a home where settlement has cracked brickwork. Unfortunately many other cases will exist where serious damage to foundations has occurred with no outward signs of distress to the building – discussion with several residents proved this to be so. Liquefaction induced slab failures, often leading to homes being written off, will again be a costly component of this event's losses. Major failure of roads due to liquefaction was wide spread (Figure 8).

Our collection of geo-located images of Christchurch will be made available soon. The list of suburbs and liquefaction categories (Table 2) will be updated as (if) new suburbs are assessed.



Figure 1. Damage to the living room (upper image) and bathroom (lower image) of a home in Halswell.

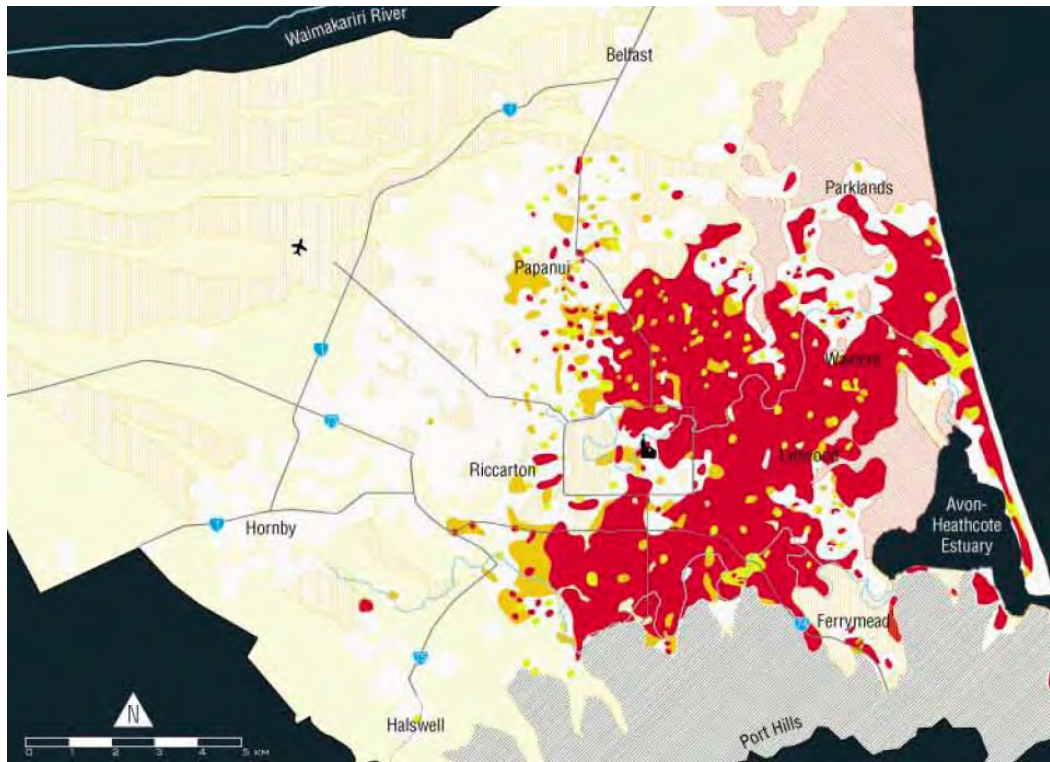


Figure 2. Potential Liquefaction map of Christchurch (Environment Canterbury).



Figure 3. Piles of shovelled silt from roads and homes, Avonside.



Figure 4. Sand volcanoes around AMI Stadium.



Figure 5. Tilting of home most likely due to lateral spreading.



Figure 6. Undermining of foundation through lateral spreading.



Figure 7. Cracking of building caused by liquefaction.



Figure 8. Damage to road along Avon River.

Table 2. Liquefaction categories and survey notes by suburb.

Suburb	Extent of liquefaction	Comments
Islington	None evident	No visible shaking or liquefaction damage
Westlake	Minimal	No visible damage to buildings
Oaklands	Minimal	Almost no evidence of liquefaction except on Dunbar Rd and Halswell Rd. Many brick chimneys still in good condition - signifies minimal shaking.
Halswell	Minor	Most damage was located east of Halswell Rd. Sand volcanoes observed in the school fields. Where liquefaction occurred volcanoes were evident in peoples yards and cracking of buildings was evident. Overall the liquefaction looked to be less than occurred during the September 2010 event.
Aidanfield	Minimal	Only very sporadic small signs of liquefaction. Most residents appeared to still be in homes.
Hillmorton	Minor	Much of the suburb would be classed as minimal impact, but major impact was evident near Kinnaird Rd where almost every house looked affected. Cracking in housing seen in worst affected area.
Spreydon	Moderate	Homes closest to the Heathcote River were worst affected. Evidence of major liquefaction in people's backyards suggesting damage to homes. Significant damage to roads and drainage systems.
Addington	Minor	Liquefaction to the north of the motorway could be considered minimal, but was extreme (i.e. > 50%) south of it. Parapet and URM failures of old commercial buildings due to shaking on both Lincoln Rd and Selwyn St.
Somerfield	Minor	Liquefaction was widespread but looked to be mild.
Beckenham	Minimal	Even by the Heathcote River there was little sign of liquefaction ejected soil. Minor visible signs of lateral spreading, but it was clear it had occurred. A footbridge was closed due to cracking at the deck to support joint due to support movement.
Sydenham	Minimal	Some evidence of ejected silt south of Brougham St in the residential area. Negligible liquefaction, but some instance of shaking damage to URM buildings north of Brougham St.
Waltham	Minor	Lateral spreading evident near the river. Spreading affected roads and bridges but there was little evidence it affected homes - my feeling is that it may have though. Ejected silt was evident in localised areas.
Opawa	Minimal	Only small, sporadic, piles of silt observed. Some shaking damage to URM (Church).
Woolston	Minor	Shaking damage to Industrial/commercial URM buildings observed.
Charleston	Major	Probably the worst affected suburb to the south of the city. Grounds of AMI stadium severely impacted by liquefaction - even on the field. Damage to non-structural sections of the stadium. Reports of repairable damage to the structure itself. Cracking of housing noted.
Hillsborough	Minimal or Minor	In the low lying area north of Centaurus Rd and south of the Heathcote river areas of major liquefaction were seen. South of Centaurus Rd, moving up into the hills liquefaction was minimal at worst but mostly negligible. Wider evidence (compared with other areas south of the city) of shaking



		damage was noted, hypothesised to be driven by the more solid sub-surface geology of the area. We experienced a M 4.4 aftershock centred less than 5 km away while inspecting damage in the area.
Murray Aynsley	Minimal or Minor	As for Hillsborough
Huntsbury	Minimal or Minor	As for Hillsborough
Cashmere	Minimal or Minor	As for Hillsborough
Cracroft	Minimal or Minor	As for Hillsborough
Westmorland	Minimal or Minor	As for Hillsborough
St Martins	Minimal or Minor	As for Hillsborough
Hoori Hay	Minor	Sporadic signs of liquefaction impact but those areas affected looked to be severely so. Signs of shaking damage to fences and chimneys.
Area West of Carmen Rd	None evident	No visible signs of liquefaction or shaking damage. Most areas west of Carmen could be treated similarly, but some shaking damage could be expected.
Hyde Park	None evident	A few cases of fallen brick chimneys, but many were observed still intact.
Avonhead	None evident	A few cases of fallen brick chimneys, but many were observed still intact.
Ilam	Minimal	Very few signs of liquefaction, but the road was damaged in some areas. Shaking damage was noticeable but still minor and sporadic.
Upper Riccarton	None evident	Some shaking damage, particularly to chimneys. Some damage to old commercial URM buildings on Riccarton Road, but much less impact than after the September quake (this knocked many of the street's URM's down). Newer commercial buildings appeared to be largely ok. Conversation with retailer suggested extensive damage to non-structural elements (ceilings down etc).
Riccarton	None evident	As for Upper Riccarton
Fendalton	Minor	Much of the suburb had negligible signs of liquefaction, but localised areas significant impact were seen. Perhaps at the lower end of Moderate. Some shaking damage to older housing noted.
Brydwr	None evident	Minimal chimney damage.
Barnside	None evident	Minimal chimney damage.
Bishopdale	Minimal	Isolated spots of minor impact, focused in the NW near Oldwood Rd
Harewood	Minor	Localised instances of significant liquefaction impact. Minimal shaking damage observed.
Papanui	Moderate	Widespread liquefaction impact on roads and buildings. Some visible shaking damage of fences and chimneys, but this was sporadic.
Merivale	Moderate	Shaking, spreading and settling damage noted. Damage to shops as well as homes.
St Albans	Moderate	Liquefaction more noticeable in the southern parts of the suburb. Some damage to Chimneys etc.
Casebrook	Minimal	Minimal visible shaking damage and only a few silt piles seen.

Redwood	Minor	No shaking damage evident. Liquefaction was considered at the lower level of Minor.
Northcote	Minimal	Limited shaking damage to chimneys (cracked or failed).
Regents Park	Minor	No shaking damage evident. Liquefaction was considered at the lower level of Minor.
Queenspark	Moderate	Extensive liquefaction damage to roads. Much of the liquefaction damage appears to be limited to roads, but some signs of impact on housing exists. Some lateral spreading damage to roads and buildings observed. No evidence of shaking damage, but homes are newer so didn't have brick chimneys.
Parklands	Moderate	Extensive liquefaction evident on golf course - lower than most homes. Discussion with a resident: says his home is cracked in half - no evidence of this from street (new home). Major disruption to roads.
Waimairi Beach	Moderate	Liquefaction largely focussed in the south where the impact was on almost all homes. Little sign of liquefaction north of Beach Rd. Shaking damage to many chimneys. Surface rupture and lifting/sinking in the southern area leading to a number of visibly cracked slabs.
New Brighton	Moderate	Almost 100% of homes impacted west of Keyes Rd. Almost no liquefaction east of Keyes Rd but shaking damage was seen. Some complete failures of Church and old URM buildings. Damage to homes with URM walls. Many timber homes appear to be fine except for broken brick chimneys. Failure of a number of brick carport/garages.
South New Brighton	Minimal	Limited liquefaction evident on and west of Estuary Rd. Shaking damage evident to chimneys and some house cracking observed. Evidence of lateral spreading near the water.
Southshore	Moderate	Western side of peninsula most affected. Although many homes had piles of silt, it didn't appear too extensive. Some cracking of roads seen implying damage to homes in the area.
Aranui	Major	Much of the road had already been pulled up when assessed. Some shaking damage evident.
Avondale	Major	Very extensive liquefaction. Almost every road damaged to some extent. Extensive lateral spreading observed near the Avon River.
Wainoni	Major	Extensive liquefaction. Some areas had every home affected, others less complete impact was seen. Obvious cracking to a number of homes.
Avonside	Major	Lateral spreading severely damaged road near Avon River. Looked worse on the Dallington side though. Major damage to homes affected by liquefaction evident. Ejected silt looked to be less common near the river.
Linwood	Minor	Noticeable shaking damage.
Phillipstown	Minimal	Only a few small silt piles noted. Large number of shake damage homes observed - limited to chimneys and brick buildings.
North Linwood	Minor	Much of the suburb was unaffected but some areas where all home were impacted. Evidence of shaking damage.
Bromley	Minor	On a few roads sewer boxes were lifted, signifying liquefaction beneath the road, but only small amounts of silt seen. Ejected silt clearly seen in lower lying industrial yards. Shaking damage noted for houses, but not clearly visible for newer industrial buildings.
Burwood	Major	Very extensive liquefaction south of Travis Drive. Greater in

		the eastern parts. Shaking damage also seen. Liquefaction not as prevalent north of Travis Drive. A number of homes had damaged carpets in garbage piles.
Westhaven	Minimal	Little evidence of liquefaction north of the river as ground level seems higher than in Burwood.
Shirley	Major	Most focused in the south where impact was almost complete.
Richmond	Major	Extensive liquefaction damage throughout with most roads badly damaged. A number of carpets seen in rubbish piles at the front of houses.
Dallington	Major	Only a small portion of the suburb was seen, but given it is closed to non-residents the major damage rating is warranted.
Bexley	Major	Unable to gain access. Media reports and closing to non-residents warrants major rating.