Geophysical Research Abstracts
Vol. 15, EGU2013-1488-2, 2013
EGU General Assembly 2013

Regional liquefaction hazard evaluation following the 2010-2011 Christchurch (New Zealand) earthquake sequence

John Begg (1), Hannah Brackley (1), Marion Irwin (2), Helen Grant (2), Kelvin Berryman (1), Grant Dellow (1), David Scott (2), Katie Jones (1), David Barrell (1), Julie Lee (1), Dougal Townsend (1), Mike Jacka (3), Nick Harwood (4), Ian McCahon (5), and Steve Christensen (6)

(1) GNS Science, Lower Hutt, New Zealand, (2) Environment Canterbury, Christchurch, New Zealand, (3) Tonkin & Taylor Ltd, Christchurch, New Zealand, (4) Coffey Geotechnics Ltd, Christchurch, New Zealand , (5) Geotech Consulting Ltd, Christchurch, New Zealand, (6) Beca Infrastructure Ltd, Christchurch, New Zealand

Following the damaging 4 Sept 2010 Mw7.1 Darfield Earthquake, the 22 Feb 2011 Christchurch Earthquake and subsequent damaging aftershocks, we completed a liquefaction hazard evaluation for c. 2700 km2 of the coastal Canterbury region. Its purpose was to distinguish at a regional scale areas of land that, in the event of strong ground shaking, may be susceptible to damaging liquefaction from areas where damaging liquefaction is unlikely. This information will be used by local government for defining liquefaction-related geotechnical investigation requirements for consent applications.

Following a review of historic records of liquefaction and existing liquefaction assessment maps, we undertook comprehensive new work that included: a geologic context from existing geologic maps; geomorphic mapping using LiDAR and integrating existing soil map data; compilation of lithological data for the surficial 10 m from an extensive drillhole database; modelling of depth to unconfined groundwater from existing subsurface and surface water data. Integrating and honouring all these sources of information, we mapped areas underlain by materials susceptible to liquefaction (liquefaction-prone lithologies present, or likely, in the near-surface, with shallow unconfined groundwater) from areas unlikely to suffer widespread liquefaction damage. Comparison of this work with more detailed liquefaction susceptibility assessment based on closely spaced geotechnical probes in Christchurch City provides a level of confidence in these results.

We tested our susceptibility map by assigning a matrix of liquefaction susceptibility rankings to lithologies recorded in drillhole logs and local groundwater depths, then applying peak ground accelerations for four earthquake scenarios from the regional probabilistic seismic hazard model (25 year return = 0.13g; 100 year return = 0.22g; 500 year return = 0.38g and 2500 year return = 0.6g). Our mapped boundary between liquefaction-prone areas and areas unlikely to sustain heavy damage proved sound.

In addition, we compared mapped liquefaction extents (derived from post-earthquake aerial photographs) from the 4 Sept 2010 Mw7.1 and 22 Feb 2011 Mw6.2 earthquakes with our liquefaction susceptibility map. The overall area of liquefaction for these two earthquakes was similar, and statistics show that for the first (large regional) earthquake, c. 93% of mapped liquefaction fell within the liquefaction-prone area, and for the second (local, high peak ground acceleration) earthquake, almost 99% fell within the liquefaction-prone area.

We conclude that basic geological and groundwater data when coupled with LiDAR data can usefully delineate areas susceptible to liquefaction from those unlikely to suffer damaging liquefaction. We believe that these techniques can be used successfully in many other cities around the world.