

**IN THE MATTER** of the Resource Management Act  
1991

**AND**

**IN THE MATTER** of Plan Change 30 to the  
Christchurch City Plan

---

**SUPPLEMENTARY EVIDENCE (POST 22 FEBRUARY 2011)  
OF DR JAN KUPEC ON BEHALF OF PRESTONS ROAD LIMITED**

---

---

**ANDERSON LLOYD**  
LAWYERS  
DUNEDIN

Solicitor: Lauren Semple

Level 10, Otago House  
Cnr Moray & Princes Street,  
Private Bag 1959,  
DUNEDIN 9054  
Tel 03 477 3973  
Fax 03 477 3184

## 1. **Introduction**

1.1 My full name is Dr Jan Kupec. I practice as a chartered geotechnical. I am a Lead Geotechnical Engineer and Executive with Aurecon New Zealand Ltd.

1.2 This supplementary evidence provides an update on the status of the land which is the subject of Plan Change 30 (PC 30) known as Prestons Road, as it relates to the effects of the recent seismic events in Canterbury since 22<sup>nd</sup> February 2011.

## 2. **Previous Evidence**

2.1 As a considerable amount of work has already been undertaken with respect to this site, this evidence should be read in conjunction with the following reports and evidence I have prepared previously, namely:

- Prestons Road Rezoning – Geotechnical Investigation Report. - Appendix 6 to the PC 30 application
- Evidence to PC 30 hearing – August 2010
- Supplementary Evidence to PC 30 hearing – November 2010

2.2 In my initial report I outlined the geotechnical assessment undertaken on the site which comprised detailed desktop studies, cone penetrometer testing (CPT), hand auger boring and test pitting. From that assessment I concluded that the site had a low susceptibility to earthquake induced liquefaction. Subsequent to that report being completed a number of seismic events have occurred and more detailed analysis has been done which confirm that finding.

2.3 On 4 September 2010, a 7.1 magnitude earthquake occurred 40km west of the Christchurch CBD. This earthquake constituted a large seismic event and a significant portion of the land situated within the proposed Greater Christchurch Metropolitan Urban Area was affected by seismically induced liquefaction and lateral spreading. This manifested itself as sand boils, mud volcanoes, ground settlement and large cracks in the ground surface. Infrastructure, roading and housing were all affected to varying degrees, with some damaged beyond economical repair.

2.4 On 14 September 2010 I carried out a visual assessment of the Prestons site across the southern, middle and northern areas. Localised liquefaction was noted outside the boundaries of the site but no liquefaction, lateral spreading or any other associated hazards were noted on the site itself. This was consistent with the initial predictive assessment undertaken by Aurecon in August 2008 which concluded that the site had a low susceptibility to liquefaction.

### 3. **February 2011**

3.1 On 22 February 2011 a 6.3 magnitude earthquake occurred 10km south-east of Christchurch. This earthquake constituted another very significant seismic event for Christchurch. Although of a lesser magnitude than the September 4 earthquake, the shallow depth and proximity to Christchurch of the rupture created significant peak ground acceleration resulting in widespread damage to infrastructure and built structures and subsequent loss of life.

3.2 Extensive liquefaction occurred throughout Christchurch City including within the CBD, New Brighton, Bexley, Ferrymead, St Albans, Linwood and much of the Eastern Suburbs, while Redcliffs, Sumner and Lyttelton were subject to slippage, renting and rockfall.

3.3 As a result of the 22 February 2011 event I carried out a further visual inspection of the Prestons Road site on 8 March 2011. Consistent with my earlier findings no liquefaction, lateral spreading or any other associated hazards were noted on the site

3.4 As I have outlined previously, liquefaction can only occur when a saturated soil (waterlogged soil) is being shaken (by a sufficiently large seismic event) and any excess pore water pressure cannot drain away. As shaking continues the soil densifies and the groundwater (pore water) pressure builds up further. Once it is equal to the weight of the material (soil and fill) above the soils liquefy. Where the non liquefied material (crust formed from soil and fill) cracks an escape path is created for pressurised water to erupt carrying with it silt and sands. Ground

settlement (vertical displacement) occurs causing damage to land and structures.

- 3.5 Where the ground is not contained horizontally and there is a free edge or a slope (for example where there is a river or stream or sloping ground) the ground can also move horizontally, 'riding' or 'floating' on the liquefied soil, referred to as lateral spreading.
- 3.6 Areas most susceptible to liquefaction and attendant lateral spreading are those areas comprising fluvial or alluvial deposits (low energy deposits typically found in estuaries and rivers). Such deposits are found in those areas affected by the 4 September 2010 and 22 February 2011 events.
- 3.7 As outlined in the Geotechnical Report and summarised in my previous evidence my investigations and desktop studies undertaken on the Prestons Road site indicated that the site was underlain by “dominantly sand of fixed and semi-fixed dunes and beaches”, which is typical for the Pegasus Bay foreshore and in line with published geology. These aeolian deposits (sand dunes) are much denser (and therefore less susceptible to liquefaction) than fluvial and alluvial deposits. This was confirmed by a preliminary high level analysis based on CPT data. Hence my initial assessment that the site had a low susceptibility to liquefaction and subsequent lateral spreading in its current form.
- 3.8 This initial assessment was borne out by my observations of the site post the 4 September 2010 event and my observations post the 22 February 2011 event.
- 3.9 In light of all of the above I remain satisfied that the use of the Prestons Road site for residential development is appropriate as per my previous evidence. Given the observed consequences of the 4 September 2010 and 22 February 2011 events, the site exhibited satisfactory performance from a geotechnical perspective.
- 3.10 As presented in my evidence more targeted and specific geotechnical site investigations will be required once development constraints are better defined, building foundations and infrastructure requirements have been finalised and structural form and loads of any specific developments are

known. However as previously outlined, this specific geotechnical investigation can be appropriately addressed at subdivision resource consent or building consent application stages.

Dr Jan Kupec

11 March 2011