

9 May 2011

Lincoln Land Development Limited
PO Box 13 00 60
CHRISTCHURCH

Attention: David Schwartzfeger

Dear David,

**POST 22 FEBRUARY 2011 CHRISTCHURCH EARTHQUAKE GEOTECHNICAL ASSESSMENT
THE LINCOLN VILLAGE DEVELOPMENT, LINCOLN**

1. Introduction

Lincoln Land Development Limited is in the process of developing Stages 1a and 1b of the Lincoln Land Development residential subdivision in the township of Lincoln. Following the Magnitude 6.3 Christchurch Earthquake on 22 February 2011 Aurecon on behalf of Lincoln Land Development Limited assessed the for seismically induced ground damage, in particular for evidence of seismically induced liquefaction.

The agreed scope of works was:

- A site inspection of Lincoln Land Development Stages 1a and 1b looking for signs of obvious signs of seismically induced ground damage,
- Assessment of the impact (if any) of the recent earthquake of the proposed residential development, and
- Preparation of this report.

The conditions of Aurecon's engagement are as per our existing umbrella agreement with Ngāi Tahu Property Limited.

2. Site Observations

A site inspection of the Lincoln Land Development Stages 1a and 1b residential development was carried out by Aurecon Geotechnical Engineers following the 22 February 2011 earthquake.

During the site walkover no signs of surface manifestation of seismically induced liquefaction were observed, i.e. no sand boils, ground cracking/fissured, raised manhole lids in road pavements etc. were observed. Minor hair line cracks in the in the concrete kerb and channel were observed during the inspection.

Aurecon have been working with Lincoln Land Development on this project since 2007 and we were therefore very familiar with the site prior to the 22 February 2011 Earthquake. Aurecon engineers have visited the site four times between the 22 February 2011 and 8 April 2011. During these site visits no signs of surface manifestation of seismically induced liquefaction were observed.

3. Engineering Considerations

On 22 February 2011 the Canterbury Region experienced a Magnitude 6.3 earthquake, which had its epicentre in the region of the Heathcote Valley in south Christchurch (GNS, 2011) located approximately 20km northeast of the Lincoln Land Development Stages 1a and 1b. A review of Geonet (2011) indicates that there is a seismograph record of this earthquake from the nearby Lincoln Crop and Food Research site. This seismograph record indicates that the peak ground acceleration (PGA) was 0.16g. In comparison a review of Geonet (2010) indicates that the Lincoln Crop and Food Research site recorded a PGA of 0.43g during the Magnitude 7.1, 4 September 2010 Darfield Earthquake.

Following the Darfield Earthquake a similar geotechnical site walk over and report was prepared for the site by Aurecon (Aurecon, 2010). This indicated that there was no observed signs of liquefaction at the site, and topographical surveys of all key infrastructure elements constructed to date indicates that there were no changes in levels and inverts after the earthquake.

A geotechnical site investigations carried out by Connell Wagner (Aurecon's predecessor company) in 2008 (Connell Wagner, 2009). This investigation indicated that the site is typically underlain by 0.4m of topsoil, overlying 0.6 to 2.8m of very dense Silt and very Stiff Clay, overlying 0.7 to 3.0m of firm to stiff Sandy Silt and Silty Clay, overlying medium dense Sandy Gravel to depth. Within the sandy silty clay material there are the occasional lenses of Peat and Sand. The ground water is indicated to vary seasonally between the top of the gravel layer upwards. Based upon the observed clay content of the upper soil and density of the sandy silty material, the soil at the site is inferred to have a low susceptibility to seismically induced liquefaction.

The minor cracking in the kerb and channel is to be expected for roading infrastructure when exposed to the intensity of ground shaking that stemmed from the recent Christchurch Earthquake. As such it is inferred to be of little (if any) concern to further residential construction Lincoln Land Development site.

In summary, no signs of seismically induced liquefaction were observed on the site. Based upon our previous assessments of the site, the site walkover, and review of the recent Christchurch Earthquake we infer that there is only a very limited potential for seismically induced liquefaction in a future major seismic event. As such, it is inferred that there is no geotechnical reason associated with the recent Christchurch Earthquake that should preclude further residential development at Lincoln Land Development Stages 1a and 1b.

4. References

Aurecon, 2010. Letter to Ngāi Tahu Property Limited, *Post Canterbury Earthquake Geotechnical Assessment, the Lincoln Village Development, Lincoln*. Aurecon New Zealand Limited, Christchurch, New Zealand. Dated 26 October 2010.

Connell Wagner, 2009. *Geotechnical Interpretative Report Lincoln Land Development, Lincoln, Ngāi Tahu Property Joint Venture & Lincoln University Property Joint Ventures Ltd*. Connell Wagner New Zealand Limited, Christchurch, New Zealand. Dated 17 February 2009.

Geonet, 2010. <ftp://ftp.geonet.org.nz/strong/processed/Proc/2010/>

Geonet, 2011. <ftp://ftp.geonet.org.nz/strong/processed/Proc/2011/>

GNS, 2011. <http://www.gns.cri.nz/Home/News-and-Events/Media-Releases/earthquake-part-of-aftershock-sequence/February-22nd-earthquake-in-Christchurch>

5. Limitations

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it must be appreciated that actual conditions could vary from the assumed model.

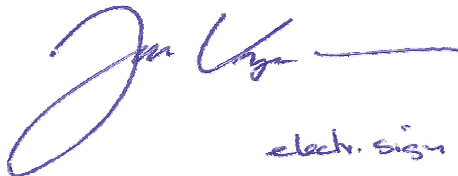
Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

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If you have any queries please do not hesitate to contact the undersigned.

Yours sincerely



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Dr Jan Kupec

Lead Geotechnical Engineer - Executive