4415
24 June 2021

Selwyn District Council
PO Box 90
Rolleston

GEOTECH
consulting ltd

Attention: Rachel Carruthers

Dear Ms Carruthers,

RE: Plan Change 72
Birchs Village Ltd
142 – 214 Birchs Road, 57 Hamptons Road, Prebbleton
Geotechnical Report Peer Review

Geotech Consulting has been asked to carry out a peer review of the geotechnical report for the proposed plan change from rural Inner Plains to Living Z residential land use. If subdivided, the area could support about 400 new residential lots. In particular the peer review is to ensure compliance with the MBIE guidelines for the geotechnical assessment of subdivisions. The geotechnical report is:

- *Geotechnical Assessment Report, Birch's Village Plan Change*, dated 9 March 2021, by Coffey Services (NZ) Ltd, for Birch's Village Ltd

The site is essentially level and is made up of nine titles with frontages to Birches Road and Hamptons Road, and totals about 36.6 ha in area. The site lies to the south side of Prebbleton township. It is largely in agricultural use, but there are eight dwellings within the area. We note that the geotechnical report is for an area reported as 42.3 ha (5.7 ha more than the application) and includes a block of land at the south end which is not included in the application.

Site Testing and Soil Profile:
The site testing made for the assessment includes eight Cone Penetration (CPT) tests to between 1.5m and 6.7m depth and two hand auger boreholes to 1.5m and 2m depth. Use is also made of one 20m deep borehole, three CPT tests and eight hand auger boreholes, all on the site area and sourced from NZ Geotechnical Database. Coverage is not uniform and Coffey note that additional testing may be needed at subdivision stage.

Comment: The number of tests meets the MBIE guidance for density of deep tests

The site is essentially underlain with 0.3 - 0.4m of topsoil over 1.5m to 4.5m of interbedded mixtures of silt and sand, except that this is up to 9m thick on the eastern side, overlying medium dense to dense sand and gravel. The 9m depth to dense soil is based on the borehole and two CPT tests on 176 Birchs Road.

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Comment: Many of the CPTs stop on the top of a dense layer at a relatively shallow depth. Coffey make no mention of how thick this layer might be. A search of well logs on the Ecan GIS shows seven wells on the site. Several show gravel continuous below a 0.5 – 3m thick surface layer of silt, but two in the northeast part indicate the gravel found at about 2m extends to about 7m underlain with "pug & wood" to 10m where the bore re-entered gravel again. This sequence is also known from sites further north. The wells to the south and west indicate the gravel, once contacted, is continuous for many metres.

The water table is inferred to be below 2m depth, but 2m has been assumed for analysis purposes.

Comment: Depth to groundwater contours on the Ecan GIS site indicate a depth of 2.5m about 500m southeast of the southeast corner and 5m 250 – 300m to the northwest of the west side of the site. It is likely that the water table is 2.5 – 3m deep at the southeast corner and 3 – 4m deep on the western side. Water levels in some of the Ecan well logs indicate a depth to water of about 4.5m.

Liquefaction

The report includes the results of liquefaction analysis of the eleven CPT tests in the site area. The free field index settlements as calculated are generally low, with six well within the limits for TC1 land, and five within TC2 limits.

Comment: GCL has carried out an analysis on one of the CPTs as a check and obtained the same result as Coffey. It is noted that the analysis is likely to be conservative in that a C_{FC} value of zero has been used, whereas a value of 0.2 may well be more appropriate for the silty sands (research has indicated that this value is more typical for Christchurch as a whole[1] and if C_{FC} = 0.2 is used, there is a 20 – 25% reduction in index settlement), the layered soils is also likely to reduce the extent of liquefaction[2], and the depth to groundwater is likely to be deeper than the 2m used.

The thickness of the gravel in the northeast area, as indicated in the Ecan well logs does provide a good "raft" over the top of any liquefaction that might occur in the soft material below 6 – 7m depth, and thus the conclusions in the Coffey report are not materially affected by the gravel not being continuous to greater depths.

However, the work GCL did for SDC in late 2010 following the 4 Sep 2020 earthquake[3] maps liquefaction on the land north of Leadleys Road and east of Birchs road, and extending across Birches Road a short way into # 176. This was interpreted off aerial photographs which show isolated sand boils across the paddock, but was also ground truthed with liquefaction evident in the paddock and on the side of Birchs Road. This does correspond to the location where the site testing shows the greatest depth of looser finer grained soils and liquefaction down to 9m depth. The reason the CPT tests (dated October 2016) and borehole (October 2013) were carried out on #176 is not known, but probably relates to insurance issues with foundation

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[1] Leeves, J., van Ballegooy, S., Lees, J., Wentz, F.; 2015. *Effect of fines content correlations and liquefaction susceptibility thresholds on liquefaction consequence*, 6th International Conference on Earthquake Geotechnical Engineering, November 2015, Christchurch, New Zealand

[2] Cubrinovski, M., Rhodes, A., Ntritsos, N.; 2017. *System response of liquefiable deposits*. 7th International Conference on Earthquake Geotechnical Engineering, August 2017, Vancouver, Canada

[3] Geotech Consulting Ltd, (2011) *2010 Canterbury Earthquake Liquefaction report*, February 2011, report prepared for Selwyn District Council.

damage to the house. This is again suggestive of ground damage in the vicinity. The 2020 earthquake was probably equivalent to a ULS event in Prebbleton and the extent of liquefaction damage was not excessive, but this does suggest that this area should be considered in more detail at subdivision stage to ensure that either the worst area is avoided, or suitable foundation/mitigation work is made.

Natural Hazards

Natural hazards (RMA section 106) are assessed and found to be not present or able to be easily mitigated.

Conclusion

The report shows that the site has some liquefaction potential, but generally falls within MBIE Foundation Technical Categories TC1 and TC2. However, observations following the September 2010 earthquake suggest that a small part of the site may be more susceptible than the analysis suggests. We accept the Coffey conclusion that the site is suitable for residential development subject to further investigation and design at the subdivision consent stage, but emphasise that further testing and assessment is needed at subdivision stage, along the Birchs Road side in particular.

Yours faithfully
Geotech Consulting Limited

Ian McCahon