4415
17 March 2021

GEOTECH
consulting ltd

Selwyn District Council
PO Box 90
Rolleston

Attention: Jessica Tuilaepa

Dear Ms Tuilaepa,

RE: Plan Change PC 68
174 – 250 Hamptons Road & 735 Shands Road, Prebbleton
Hughes Developments Ltd
Geotechnical Report Peer Review

Urban Estates Ltd has applied to rezone an area of about 70 hectares from Inner Plains to Living Z land use, with ultimately about 820 sections. Selwyn District Council has requested a peer review of the geotechnical report submitted with the application with respect to whether the investigations and conclusions are appropriate in the circumstances.

The geotechnical reporting submitted is by Engeo Ltd, tilted *Geotechnical Investigation, 174 – 250 Hamptons Road & 735 Shands Road, Prebbleton*, dated 22 October 2020, for Urban Estates Ltd. The site has a long frontage on Hamptons Road, a lesser one on Shands road, and also onto Trents Road (numbers 340 to 374).

Testing and subsoil conditions

The report includes research of available information and site testing. Ecan well logs on or close to the site show up to 2m of sand and silt over gravel extending to the base of the boreholes. The water table is reported as being 7 – 9m depth in the Ecan well logs, although some more distant ones indicate it could get as shallow as 4m. Reference to piezometric groundwater maps also suggest 4m to 9m depth to water. The NZGD has some data around the site, which is all consistent with the Ecan well log profiles.

The testing on all the site has consisted of 21 test pits and 10 hand auger boreholes with associated scala testing. They show 0.3 – 0.4m of topsoil over silt and sand with gravel contacted at variable depths yup to 1.7m but generally less than 1m.

> *Comment: The MBIE Guidance for plan change investigations for subdivisions suggests 0.2 – 0.5 deep test per hectare. The consistency of the referenced well logs in the area means that this density of deep tests is not needed, and the shallow testing, which confirms that gravel is present across the whole area, is 0.44 tests per hectare, at the higher end of the suggested range. The number of tests is subject to professional judgement and on this site the uniformity of the soil profile and the lack of any issue of geotechnical concern is such that we consider the amount of testing is suitable.*

Geotechnical Hazards

The report concludes that the site is not susceptible to liquefaction due to the deep groundwater and the soil profile, and that an equivalent Foundation technical category TC1 is appropriate. Other RMA section 106 hazards are considered, and shown to be either not present or easily mitigated.

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Comment: We accept that there is a very low risk of liquefaction at the site given the gravel soils and depth to groundwater, and that the site is sufficiently free of RMA section 106 hazards to allow development without any particular restriction.

Engineering design

Whether the site area complies with the definition of "good ground" in NZS3604:2011 is not commented on in the report, but the use of shallow foundation systems as per NZS3604 are deemed appropriate with specific design a possibility for sites over deeper surface silt and sand.

Conclusion

This site is geotechnically "benign" and we have little issue with the conclusions reached in the report. We consider that the extent of the site testing is adequate for the size and scale of the plan change on the particular soil profile present, and is adequate to demonstrate the geotechnical suitability of the site area for plan change consideration. The wider area is also known to be underlain with deep gravel.

We agree that there is minimal liquefaction hazard and the site is equivalent TC1 land. We conclude that the investigations are adequate and conclusions are appropriate to the site and proposed rezoning.

Yours faithfully
Geotech Consulting Limited

Ian McCahon

4415
27 March 2023

Selwyn District Council
PO Box 90
Rolleston

Attention: Justine Ashley,

Dear Ms Ashley,

RE: Proposed District Plan – Variation 1
V1 - 0029 G & L Burgess
93 Tosswill Road, Prebbleton
Geotechnical Evidence Peer Review

Geotech Consulting has been asked to carry out a peer review on the geotechnically related evidence submitted in support of the re-zoning of land to Medium Density residential Zone (MRZ) in the Proposed District Plan. The review is an assessment of the evidence presented and the appropriateness of the submitted land use for the site. Any information gaps are to be identified.

The geotechnical evidence submitted on behalf of G & L Burgess is

- *Natural Hazards Risk Assessment, 93 Tosswill Road, Prebbleton, Submission for Residential Rezoning,* dated 1 June 2022, by Eliot Sinclair & Partners Ltd, for G & L Burgess

Some additional background information has been obtained from

- *Planning report for residential Rezoning, 93 Tosswill Road, Prebbleton,* dated 3 August 2022, by Eliot Sinclair & Partners Ltd, for G & L Burgess

The geotechnical report covers Lot 4 DP 538252 with an area of about 16.5 hectares, which could accommodate 120 – 140 houses at standard densities, or 360 – 420 dwellings under medium density rules. It is essentially flat land in agricultural use, but with watercourses around the northeast, east and southern sides of the site, generally up to 1.5m deep.

1. Geotechnical Investigation Report

The report summarises desk top study. The testing carried out on the site consists of six Cone Penetration (CPT) Tests to refusal at 2.9 – 9.9m depth, and ten hand auger boreholes 0.7 – 3.2m deep with associated scala penetrometer tests. This is supplemented with a number of CPT and well logs from NZGD and the Ecan database, reasonably close to the site. The testing shows soil profiles with topsoil over sandy and silts to the base of the tests on assumed medium to very dense gravels. The well logs in the area indicate the gravel extends to at least 15m depth.. Readings from six piezometer stand[pipes on the site and nearby wells indicates a depth to groundwater table of 1.6 – 1.7m.

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Liquefaction is assessed by analysis of the CPT data. Of the ten tests, one gave an index settlement in excess of TC1 limits at SLS and one at ULS with the remainder within TC1 limits. Overall, the site is predominately equivalent Foundation Technical Category TC1. Other natural hazards are summarized and an overall risk assessment made following the GNS riskbase toolbox. The risks (probability x consequence) for each hazard are found to be either acceptable or tolerable. The highest risks are earthquake shaking, which is effectively the same on this site as on all the surrounding area, and liquefaction, where the analysis suggests the hazard is within acceptable norms for new development (TC1 to TC2).

The report concludes that the site is not subject to risks from natural hazards that would be of concern for rezoning or future residential development. Buildings on the site should be supported by site-specific geotechnical investigation and reporting.

2. Comment

The variation in soil profile across the site is not well described. It appears from a scan of the CPT profiles that the gravel is shallowest through the middle of the site (CPTs 02, 03, 09) and deepest to both the west (CPT01) and east (CPTs 04, 07, 08) Generally the soils are sandier and denser below about 2m depth, but with some lenses of soft silty soils. The profile is clearly complex in a three dimensional sense, and appears to mark the boundary between the shallow gravels to the northwest and the greater thickness of finer grained silt and sand soils to the southeast. In general, the profiles are probably better in terms of inferred density than under much of south and east Christchurch.

The report does not comment on engineering aspects of development, but geotechnical bearing pressures are given as 200 kPa at 0.4m depth and 300 kPa at 0.6m depth. It is likely that specific foundation design will be needed for much of the site.

The risk of lateral spread is assessed as low, despite the watercourses on the eastern side. The situation is also not dis-similar to that within the recently developed land immediately to the northwest. It is noted that the concept plan shows much of the area closest to the drains as reserve land. Any buildings close to the watercourses, or retention ponds if constructed, will need lateral spread issues to be reviewed and may need mitigation. This can be addressed at subdivision consent stage if required.

3. Conclusion

The number of tests more than fulfils the MBIE recommended number for a site of this size. The combination of CPT and the deeper well-logs demonstrate a consistent deeper soil profile. The evidence submitted is sufficient to demonstrate that the proposed residential land is geotechnically suitable for development. The higher structures possible for MRZ zoning may impose greater loading on the soils than for normal housing, but ground conditions can support foundations to such buildings. No further information is required for Variation 1 consideration.

Yours faithfully
Geotech Consulting Limited

Ian McCahon

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

4415
29 March 2023

GEOTECH
consulting ltd

Selwyn District Council
PO Box 90
Rolleston

Attention: Justine Ashley,

Dear Ms Ashley,

RE: Proposed District Plan – Variation 1
V1 – 0098 Urban Estates No.21 Limited Group
Trices - Tosswill – Leadleys – Hamptons Roads, Prebbleton
Geotechnical Evidence Peer Review

Geotech Consulting has been asked to carry out a peer review on the geotechnically related evidence submitted in support of the re-zoning of land to Medium Density residential Zone (MRZ) in the Proposed District Plan. The review is an assessment of the evidence presented and the appropriateness of the submitted land use for the site. Any information gaps are to be identified.

The geotechnical evidence submitted on behalf of Urban Estates No.21 Ltd Group is

- *Geotechnical Investigation Report for Proposed Land Use Change, Trices Road, Prebbleton,* dated 21 September 2022, by LandTech Consultants Ltd, for Urban Estates Ltd

Some additional background information has been obtained from

- *Submission to Variation 1 to the proposed Selwyn District Plan, Urban Estates no. 21 Limited Group, Trices / Tosswill / Leadleys / Hamptons Roads, Prebbleton,* dated September 2022.

The geotechnical report covers an area of about 57.4 hectares in nine titles. We note that this differs from the area of 68.7 hectares in 12 titles as listed in the submission. The submission area not covered by the geotechnical report is Lot 1 DP 4582 at 289 Trices Rd, Lot 2 DP 5857 at 281 Trices Road, and Lot 1 DP 25827 at 265 Trices Road. These properties are on the northwest corner and north side of the submission area. The total area if developed could support about 950 houses (5.11 Submission). It is essentially flat land in agricultural use, but with some shallow watercourses.

1. Geotechnical Investigation Report

The report summarises a desk top study, which also refers to a geotechnical report for the property at 2 Hamptons Road, geological maps and geotechnical databases. The information available suggests silt and sand soils to about 3m depth over gravel, but with a layer of silt and sand within the gravel at 6.5m to 11m depth under the southern part.

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The shallow gravel over softer layers makes site testing difficult and the testing carried out on the site consists of 23 deeper tests with a combination of dynamic probe and 13 Cone Penetration (CPT) Tests to refusal at between 2.9 – 9.9m depth, and 20 hand auger boreholes 0.3 – 3.0m deep with associated scala penetrometer tests. This is supplemented with two CPT and well logs from NZGD and the Ecan database, reasonably close to the site.

The testing shows soil profiles with 0.3 – 0.6m of topsoil over sand and silts to between 1 and 2m depth, over gravel or sandy gravel which is between 2m and 5m thick over a looser sand layer before further dense gravel stopped the testing. The well logs in the area indicate the groundwater at depths of between 0.8m and 3m depth. Measurements in the field tests gave depths of between 0.4m and 1.6m.

GNS records of liquefaction observation in the 2010-11 earthquakes suggests some liquefaction south of the stream in the middle of the area in September 2010 (6.0). This earthquake was almost certainly greater than an SLS event, and the more likely pga at the site would make it close to ULS. The performance thus indicates little to no liquefaction at SLS and minor to moderate at ULS (10.0).

Liquefaction analysis of the CPT data has been done following the standard methodology, but is made of a combination of SPT and CPT data. Of the 23 tests, 7 gave an index settlement in excess of TC1 limits at SLS and 12 at ULS with the remainder within TC1 limits. Overall, the site is considered equivalent Foundation Technical Category TC2.

Other natural hazards are considered (12.0) to be either not present or at a level where they can be readily mitigated. The report concludes that the site is geotechnically suitable for rezoning or future residential development (13.0). Ground improvement is not considered necessary.

TC2 or TC1 foundations are considered suitable for the site (13.1). A static settlement analysis for narrow shallow foundations suggests settlements within tolerable levels (9.0). More detailed geotechnical investigations will be needed for subdivision consent and ay building consent stage (14.0).

2. Comment

The variation in soil profile across the site is not well described. It appears from a scan of the appended data that the gravel is shallowest in the north at about 0.4m to 1m depth, and becomes deeper to the south where it in excess of 2m in many tests and over 3m in three (this is a similar pattern to what has been found on nearby sites). The profile is clearly complex in a three dimensional sense, and appears to mark the boundary between the shallow gravels to the northwest and the greater thickness of finer grained silt and sand soils to the southeast. In general, the profiles are better in terms of inferred density than under much of south and east Christchurch.

The liquefaction analysis is based on normal methodology, that does not fully reflect the complexities of the layered soils. Research has shown that standard approaches tend to overpredict the extent of liquefaction in such multilayered soils with a high silt content (as is present in the layers below the upper gravel). The liquefaction may therefore be overpredicted for the deeper tests, but the shallow depth of test may underpredict for others. Our conclusion is that liquefaction is unlikely to be a significant hazard for this site and an equivalent Technical Foundation Category of TC2 is an

appropriate for the current investigation and purpose, but that further testing and analysis may be able to reduce this to TC1 for at least some of the site, as is stated in the report.

We also note that observations of liquefaction following the 2010 earthquake made by Geotech Consulting Ltd show an area of liquefaction to both the east and west sides on this site, but none on it. The GNS work was not well ground truthed and we suspect may reflect surface water which has been attributed to liquefaction rather than just surface water which was present over large areas at the time. We therefore suspect that no liquefaction occurred within this site itself.

The report comments only briefly on engineering aspects of development, but geotechnical bearing pressures are given as 200 kPa in the executive summary. It is likely that specific foundation design will be needed for much of the site.

The area tested does not encompass the whole area included in the submission. However, the pattern of tests and the size of the missing lots is such that the conclusions of the report can be assumed with some confidence to apply to the full area.

3. Conclusion

The number of tests more than fulfils the MBIE recommended number for a site of this size. The combination of CPT and the deeper well-logs demonstrate the deeper soil profile. The evidence submitted is sufficient to demonstrate that the proposed residential land is geotechnically suitable for development. The higher structures possible for MRZ zoning may impose greater loading on the soils than for normal housing, but the ground conditions can support foundations to such buildings. No further information is required for Variation 1 consideration.

Yours faithfully
Geotech Consulting Limited

Ian McCahon