

# APPENDIX THREE



T&T Ref: 85581  
05 October 2012

Wellington City Council  
101 Wakefield Street  
Wellington

Attention: Paul Davidson

Dear Paul

## 8-28 Jaunpur Crescent, Broadmeadows - Geotechnical Assessment and Peer Review

### Introduction

As requested, we have carried out a peer review and inspection of the land at 8-28 Jaunpur Crescent, Broadmeadows. This review and inspection has been undertaken in accordance with our letter of engagement dated 25 September 2012.

Abuild Consulting Engineers Ltd (Abuild) prepared a report in October 2011 with regard to the suitability for development of land between 8 to 28 Jaunpur Crescent, Broadmeadows. The land subject of the Abuild geotechnical report is 3,690m<sup>2</sup> of unformed legal road that Council is proposing to 'stop'.

The purpose of our report is to review the Abuild Consulting Engineers Ltd (Abuild) report and to assess whether the investigations carried out by Abuild are sufficient to determine whether the subject site is suitable for residential development.

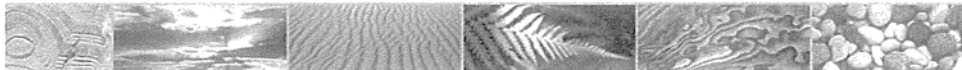
### Scope of Works

In order to prepare this report, we have completed the following work:

- Review of the Abuild geotechnical report entitled "Geotechnical Investigation – Site Suitability for Residential Development Road Land Between 8-28 Jaunpur Crescent, Braodmeadows, Wellington" reference 8400 dated October 2011 (Rev A);
- Site inspection by an Engineering Geologist on 28 September 2012;

### Site Description

The site is located on an east facing slope beside Jaunpur Crescent. The slope is approximately 20m high and has an average slope angle of approximately 30°. The site is circled in red on Figure 1 below.



Tonkin & Taylor Ltd - Environmental and Engineering Consultants, 265 Wakefield Street, Wellington 6011, New Zealand  
PO Box 2083, Wellington 6140, Ph: +64-4-381 8560, Fax: +64-4-381 2908, Email: well@tonkin.co.nz, Website: www.tonkin.co.nz

# APPENDIX THREE

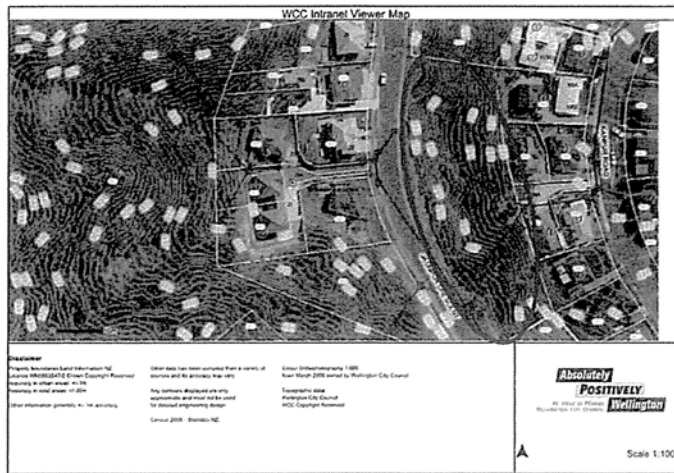
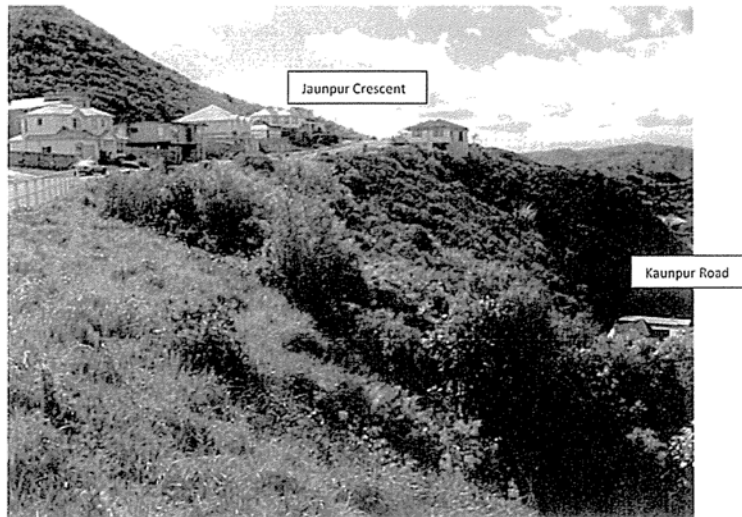


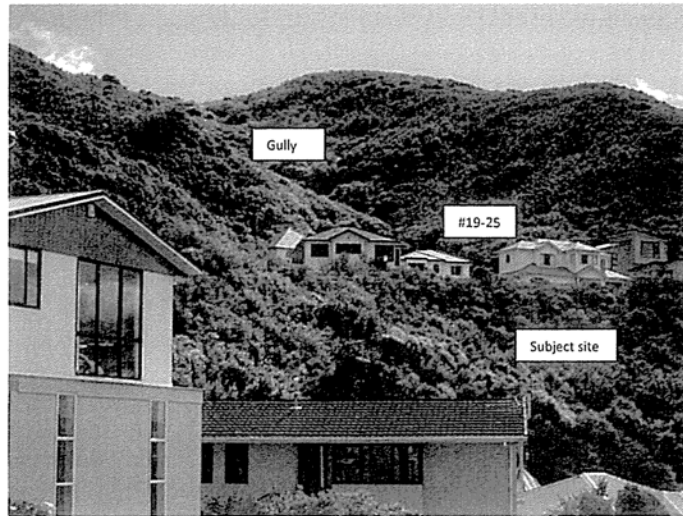
Figure 1 Site Location (taken from WCC City View Website)

The slope is well vegetated and it has been cut at the base to allow the formation of lots on Kanpur Road. We understand from the ABuild report that there is a bench extending across the slope at about mid height.



Photograph 1 Subject site (looking north)

At the top of the slope is Jaunpur Crescent, and on the inside of the road are a number of houses (#19 through to #25). Behind these houses (to the west and upslope), the natural topography is one of defined gullies and ridges. A large gully runs down behind #23 and #25. The gully profile is lost on the subject site below Jaunpur Crescent.



Photograph 2 Gullies and ridges above site

The site has been modified by subdivision earthworks. These earthworks were undertaken in the 1970's / 1980's and the extents of earthworks are shown on the TCB drawing in Appendix E of the ABuild report. The drawing indicates 9700m<sup>3</sup> of fill is placed in this area.

The earthworks have resulted in cuts being made to the ridges, and filling of the gully shown in Photograph 2. The fills have extended out to allow the construction of Jaunpur Crescent. They have also been placed to re contour the upper part of the subject site.

## Site Geology

The site is likely to comprise silty and gravely colluvium and alluvial gully deposits overlying variably weathered greywacke rock. These natural deposits have been overlain by earthworks fills to form Jaunpur Crescent, building platforms to a number of dwellings on the western side of the road, and the slope of the subject site.

The fills are likely to comprise a mixture of weathered greywacke rock fill and colluvium soils.

The depth of fill is not recorded on the TCB earthworks drawings (ABuild report Appendix E) and cannot be reliably inferred from ABuild's penetration test data.

In our opinion, the depth of fill in the infilled gully could be up to 4m deep, or possibly more. This contrasts with ABuild's assessed thickness of upper soils of 2m (Refer sections in Appendix C of ABuild's Report).

Based on the existing contours, it is inferred that the northern and southern ends of the subject site are likely to comprise shallower fills than the middle where the gully has been infilled. Fills will thicken towards the middle of the site.

Loose soils, vegetation and rubbish were observed to have been end tipped over the crest of the slope.

# APPENDIX THREE

4

## Geotechnical Hazards and Consequences

Based on our observations and understanding of the site, the geotechnical hazards, risks and consequences on the site are summarised in the table below. This assessment assumes the site is developed with housing of conventional construction without specific works to mitigate geotechnical hazards. It is assumed that any new cut or fill earthworks on the existing fill slope are retained.

Measures of likelihood and risk to structures are based on the AGS (2000) Landslide Risk Management Concepts and Guidelines.

Table 1 - Geotechnical Hazards and Consequences

Item	Geotechnical Hazard	Likelihood	Consequence
1	Soil Creep	Very likely / Almost Certain	Minor downslope movement of surficial soils (top 300mm)
2	Small scale, shallow slope instability	Very likely	Small scale mobilisation of loose soils particularly during heavy rainfall events.
3	Larger scale fill slope instability assuming fill up to 4m thick (Triggered by large earthquake or intense storm event)	Possible / unlikely <sup>(1)</sup>	Larger translational slide through middle of gully along natural soil / fill interface. Significant damage to buildings onsite and also at bottom of slope.
4	Fill thickness more than the assumed 4m	Possible	Deeper seated instability, more expensive to mitigate.
5	Fill settlement following foundation loading	Likely in localised pockets	Localised / differential settlement causing cracking and deformation of building
6	Fill inconsistency / localised organic pockets	Likely	Localised / differential settlement causing cracking and deformation of building
7	Fault Rupture	N/A (no known active faults on site)	N/A
8	Seismicity	Fault rupture nearby	Earthquake induced landsliding
9	Liquefaction	Not expected. Groundwater level likely to be low.	N/A
10	Rupture / blockage of underground services (stormwater pipes) due to ground creep	Likely / Possible	Localised saturation of fill resulting in possible landslides

# APPENDIX THREE

(1) ABuild have not investigated the full depth of the fill and thus the fill thickness and nature are unknown, as is whether or not a weak layer (topsoil horizon) underlies the fill. ABuild refers to TCB’s “Statement of Suitability” of the fill but advises that this information has not been sighted. We consider there is insufficient information available to discount the possibility of instability associated with the fill.

## Suitability of ABuild Investigations

We have reviewed the ABuild report to assess whether they have addressed the geotechnical hazards we have identified in Table 1. ABuild have undertaken the following work as part of their investigations:

- Desk top review including a review of aerial photographs and earthworks drawings;
- Site reconnaissance by a geotechnical engineer;
- Tape and clinometer survey;
- Four cone penetration tests along the edge of the road
- Seven Scala penetrometer tests along section lines down the slope face;
- Stability analysis.

We consider that these investigations address the geotechnical hazards in Table 1 as follows:

**Table 2 – Investigations addressing geotechnical hazards**

Item	Geotechnical Hazard	Sufficiently addressed by ABuild investigations and report?	Further investigation required?
1	Soil Creep	Yes <sup>(1)</sup>	No
2	Small scale, shallow slope instability	Yes <sup>(1)</sup>	No
3	Larger scale fill slope instability	No	Yes (following a review of fill thickness)
4	Fill thickness	No	Yes
5	Fill settlement following foundation loading	Yes (Recommend piles to rock)	No
6	Fill inconsistency / localised organic pockets	No	Yes
7	Fault Rupture	Yes	No
8	Seismicity	Yes	No
8	Liquefaction	N/A	No

## APPENDIX THREE

6

9	Rupture / blockage of underground services (stormwater pipes)	No	No <sup>(2)</sup>
---	---	----	-------------------

- (1) The hazard of shallow slope instability is identified in the ABuild report (Section 6) but the consequences and mitigation measures are not discussed. We would recommend that foundation design make specific allowance for the potential for shallow instability.
- (2) Further investigation of the pipes is not considered necessary however to mitigate this hazard we would recommend that easements be provided as part of the subdivision to protect the services, and that as part of subdivision development, the pipes be inspected and repaired if necessary.

Whilst the investigation techniques provide adequate information on the surface and near surface profile, we believe that it does not provide sufficient information to determine the overall soil/rock profile.

Penetration tests (Scala and CPT) have been undertaken but no boreholes or excavations. Penetration tests can refuse on large particles and thus cannot be relied on to determine the depth to rock or dense ground.

### Fill Depth (Refer items 3 and 4 of Tables 1 and 2)

Based on our observations, we would expect that the middle part of the site (opposite 19-25 Jaunpur Crescent) to contain the greatest thickness of fill. This is because it aligns with the centre of the large gully observed on the hillside behind (see Photograph 2).

The investigations do not reflect this.

CPT2 on section line B-B is shallow and refuses at 1.0m. As this line is down the centre of the gully we would expect the fill to be deeper at this point. Likewise, the Scala penetrometers P3, P4 and P5 are inconclusive and could have refused in the rock fill.

The cross section lines provided in Appendix C of the ABuild report do not provide a definitive ground model. They show "Inferred layer boundary" rather than material types.

This does not confirm the depth of fill and depth to rock.

### Material Type (Refer item 6 in Tables 1 and 2)

CPT's and Scala penetrometers do not provide information on the material types. They do not indicate whether there are buried organic or compressible layers within or at the base of the fill.

## Further investigations and assessment

Based on the information provided, and our understanding of the site, we would recommend that some additional investigation work is completed.

These works would be focused on confirming the fill depth, profile and consistency in the middle of the site (across the gully). This will confirm whether there is likely to be significant cost implications to foundations affecting the middle lots.

Firstly we would recommend that a detailed review of the TCB monitoring and testing documentation is completed to confirm the fill type, strength and uniformity.

Physical investigations should comprise three machine boreholes drilled on the side of the road where the fill is expected to be at its thickest. Boreholes should be drilled to rock with standard penetration tests at close centres.

## APPENDIX THREE

7

We would also recommend pairs of scala penetrometers with pairs at say 0.5m spacings to confirm the consistency of the materials, and to ensure the scalas have not refused on obstructions.

Once the soil / rock profile has been established across the middle of the site, then further stability analysis can be completed.

### Suitability for development

We concur with Abuild that the site can be developed if the upper soils are shallow. However, based on our assessment, we believe that the fill is deeper across the middle of the site than is inferred in the Abuild sections. As such we recommend that further assessment is required.

Without completing the works recommended above, it is not possible to confirm the suitability of the land for housing development.

However, our expectation is that further investigation would determine that the northern and southern ends of the site would be suitable (relatively shallow depth of fill) while the central portion (the infilled gully) may not be suitable depending on the depth and nature of the fill.

If the fill is deep and includes weak layers, it may not be economic to stabilise the central gully section for housing development.

### Applicability

This report has been prepared for the benefit of Wellington City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:



Nick Peters

Senior Engineering Geologist



Stuart Palmer

Principal Geotechnical Engineer

4-Oct-12  
p:\85581\workingmaterial\jaunpur @ review rpt 1oct12.doc

