Tonkin & Taylor

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Wellington City Council
PO Box 2199
Wellington 6140

Attention: Sarah Edwards

Dear Sarah

Geotechnical and Contamination Assessment, 55-85 Curtis Street, Karori - Stage 2 Report

1 Introduction

In accordance with our State 2 proposal dated 3 October 2012, this letter provides our Stage 2 report, setting out the conclusions of our assessment of the geotechnical and contaminated land information provided by you for the site at 55-85 Curtis Street, Karori.

The purpose of our assessments has been to provide you with high level advice on potential geotechnical and contaminated land issues for the site at 55-85 Curtis Street, Karori, to assist you in identifying potential issues in the preparation of a proposed plan change for the site. Our advice is based on existing information Wellington City Council (WCC) holds, obtained through a previous resource consent application for a Mitre 10 Mega store on the site. As requested, we have also provided advice on whether the existing WCC District Plan provisions are able to address any geotechnical or contaminated land issues we have identified.

This report is set out in four sections: summary, geotechnical, contaminated land, and a concluding section on District Plan implications.

2 Summary

In summary:

- Based on the information provided, we have identified no geotechnical fatal flaws that would prevent development of the site. We have identified a number of geotechnical hazards on the site that require mitigation.
- Based on the information provided, we have identified a number of contamination hazards on the site that require mitigation.
- We consider that District Plan provisions can be used to address the geotechnical and contaminated land issues identified, and have made recommendations on these.

3 Geotechnical

3.1 Background

We have undertaken a high level geotechnical assessment of the site at 55-85 Curtis Street, Karori. The purpose of this assessment is to:

- Identify the geotechnical hazards on the site that may impact on the development of the site for Business 2 Area purposes, and any potential 'fatal flaws' (from a geotechnical perspective) for development of the site for this purpose.
- Prepare a report that summarises our findings and provides advice on what, if any, further geotechnical investigations we consider are necessary.

In order to do this, we have undertaken the following works:

- A site inspection on 28 June 2012;
- Review of available published information;
- Consideration of the Aurecon report entitled "Geotechnical Investigation Report, 55-85 Curtis Street", reference 211507 dated 17 November 2010.

3.2 Site Description

The site is located within an infilled valley between Curtis Street and Old Karori Road. The valley has been infilled with soil, building debris and refuse.

The site is characterised by being relatively bare and flat in the centre and southern end, with localised stockpiles of rubble and demolition waste spread over the surface.

The site becomes more undulating and variable at the northern end, and the surface is characterised by stockpiles and mounds of fills, with thick vegetation and ponded water.

The site is bounded on its northern, eastern and southern sides by steep slopes. The northern slope is a fill slope created by historic landfill disposal. The valley slopes to the east and west are steep (over 35°), and are cut into natural ground comprising greywacke rock and overlying soils. The rock has been cut on the west side to form Old Karori Road. The cuts are at an angle of over 60°.

The slope to the east below Curtis Street is locally shallower (less than 35°).

Photograph 1 Looking north from southern (flat) end of site

Photograph 2 Undulating northern end (looking south)

3.3 Site Geology

The 1:50,000 scale Geological Map of the Wellington area [1] infers the site to comprise "fw" refuse landfill deposits. The site is bounded to the east and west by greywacke rock. The greywacke within Wellington typically comprises sandstone and siltstone with lesser mudstone. The rocks are steeply dipping and contain closely and very closely spaced fractures. Pleistocene Age (over 12,000 years old) alluvium is also recorded around the site (brown "ln" on Figure 1).

An inactive fault is identified running north / south along the western side of the site, with down throw to the east (i.e. onto the site).

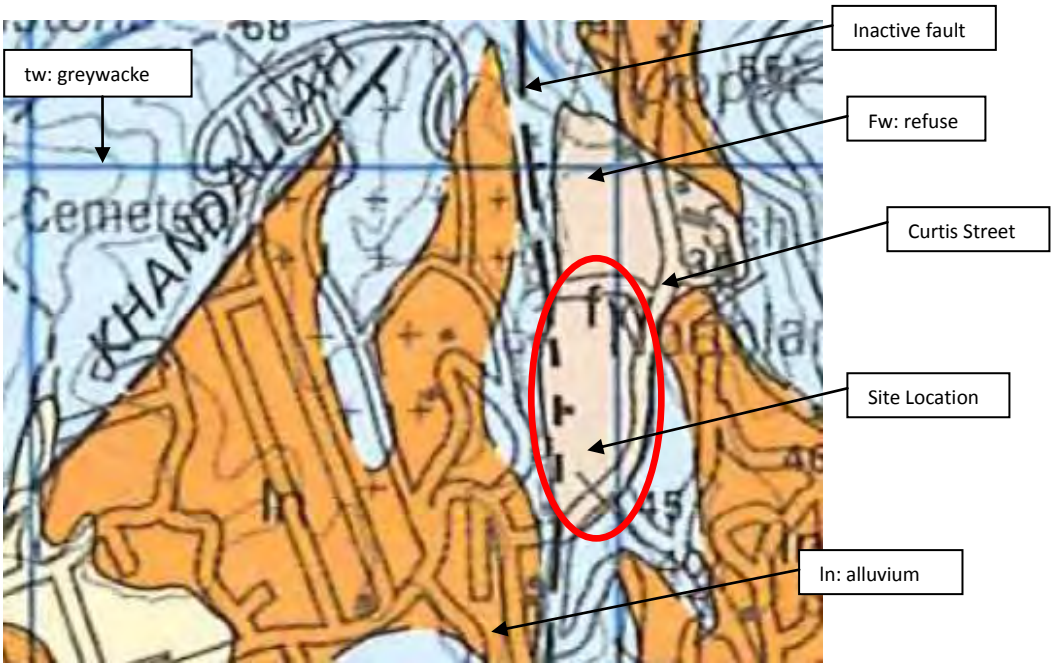

Figure 1 – Geology of the site (from Begg and Mazengarb 1996)

Based on the sub-surface investigations completed by Aurecon, the site has been infilled and raised up to its current profile with mainly loose granular soil and building debris (known hereafter as Type A fill). The Type A fill is recorded as being 0.9m to over 3.6m thick and comprises silt, sands and gravels with occasional brick, plastic and timber.

At the northern and north eastern end of the site, the Type A fill overlies landfill refuse (Type B fill). The Type B fill comprises silt, sand and gravel materials mixed with building waste and rubbish. A test pit at the northern end inferred the Type B fill was at least 4m thick. The thickness of Type B fill is likely to increase to the north.

The Type A and B fill deposits overlie silty, sandy and gravely alluvium soils. These in turn overlie greywacke sandstone rock. The alluvium is recoded to be in the order of 1 to 5m in thickness across the site, with the greywacke rock encountered at depths of between 1.7m and 6.65m at the investigation locations.

[1] Begg, J.G., Mazengarb, C., 1996. Geology of the Wellington area, scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 22. 1 sheet + 128p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

3.4 Geotechnical Hazards and Consequences

Based on our observations and understanding of the site, the geotechnical hazards identified and their likelihood and consequences are summarised in Table 1 below. Measures of likelihood are based on the AGS (2000) Landslide Risk Management Concepts and Guidelines.

Table 1: Geotechnical hazards

Geotechnical Hazard	Likelihood	Consequence	Mitigation Measures
Small scale natural slope instability i.e. less than $5m^3$ rockfalls from the rock slopes particularly to the east above Old Karori Road. Also shallow localised slumping of surfical soils	Very likely / Almost Certain	Minor rockfalls and debris accumulation on edge of site only. Debris is unlikely to cause any damage to buildings as volumes will be small and run out distance is also likely to be small.	Remove debris as part of ongoing site maintenance. Debris can be cleared quickly and for relatively low cost.
Larger scale natural slope instability over $5m^3$ in volume (Triggered by large earthquake or storm event) Planar or wedge failures along joints and fractures in rock, or saturated colluvium soils.	Possible / unlikely	Larger rockfalls or translational slides from valley sides running out across site, causing damage to buildings Damage is likely to comprise exterior cladding deformation, puncturing of cladding, silt and debris inundation inside the building	Specific slope protection measures or catch structures at base of slope. These could comprise anchored mesh facings, catch walls or fences, or anchored spray concrete walls (for rock faces) Building set backs to reduce the consequences of debris run out
Cut slope instability (Assumes cuts are up to 7m high)	Likely / Possible	Localised debris accumulation and run out at base of slope. Localised and minor damage to buildings etc	Design appropriate cut slope angles depending on the materials that are cut. Cut slopes in rock could be in the order of 63° (1V in 0.5H), whereas cuts in fills would need to be closer to 26° (1V in 2H). Setback buildings from base of cut to say 5m to reduce the consequences of debris run out
Existing Type B fill Slope instability (Likely to be triggered by large earthquake or storm event)	Possible / unlikely	Localised debris accumulation and run out at base of slope. Damage to buildings etc	Set back buildings from base of slope (allow minimum 5m) Improve drainage within fill slope face (i.e. trench or bored drains to keep pore pressures from building up) Toe buttressing. Likely to comprise geogrid reinforced earthfills keyed into bottom of

			slope with drainage behind.
Ongoing settlement of Type A fill (assuming no loading by future development)	Unlikely	Minor ground settlement	Undercut and recompact / replace upper layers of fill Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Ongoing settlement of Type B fill (assuming no loading by future development)	Likely / possible		Undercut and recompact / replace upper layers of fill Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Type A fill settlement following foundation loading Settlement of loose soils or coarse blocky fills with cavities (i.e. building rubble)	Very likely / likely and in localised pockets.	Localised / differential settlement causing cracking and deformation of building and platforms / pavements. Damage could be variable depending upon structure, Damage could affect functionality, waterproofing, stability or serviceability. Damage may require maintenance or part closure to remediate. Remediation costs could be high.	Undercut and recompact / replace upper layers of fill Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Type B fill settlement following foundation loading Settlement of loose, organic or blocky fills with cavities (i.e. building rubble and refuse)	Very likely / likely and in localised pockets.	Localised / differential settlement causing cracking and deformation of building and platforms / pavements See above	Undercut and recompact / replace upper layers of fill Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Organics in Fill Breakdown of vegetation or perishable materials in the fill.	Very likely / likely and in localised pockets.	Localised / differential settlement causing cracking and deformation of building and platforms / pavements See above	Undercut and recompact / replace upper layers of fill Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Inadequate bearing capacity of surface soils	Very likely / likely and in localised	Localised / differential settlement causing cracking	Undercut and recompact / replace upper layers of fill

	pockets.	and deformation of building See above	Foundation design to accommodate settlements (e.g piles to suitable founding soils (dense alluvium or rock)
Fault Rupture	Rare	Ground displacement and damage to buildings	No specific design or consideration required because likelihood is assessed to be rare.
Liquefaction	Unlikely	Differential settlement of building resulting in loss of use.	Requires specific investigation and design, but hazard is likely to be localised if present.
Collapse of underground services (stormwater pipe)	Likely / Possible	Flooding and settlement of fills caused by backing up of water in blocked pipe.	Investigate, and if necessary, replace services under site. Confirm location, integrity, and whether any remedial works are required. Consider building restrictions above the pipe to allow for future maintenance.
Obstructions in Fill	Likely / Possible	Difficulties installing foundations. Cost implications. Objects might include concrete structures, machinery parts etc	Investigate specific foundation positions during design. Drill boreholes or dig test pits at foundation location to confirm materials and condition. Test pits to be backfilled with engineered, compacted fills.

Photograph 3 Type B fill slope (to right) and thick vegetation

Photograph 4 Steep rock cut adjacent to Old Karori Road

Photograph 5 Slope below Curtis Street and example obstructions to be expected

Photograph 6 Example obstructions to be expected in the fills

3.5 Aurecon Report

The Aurecon report describes general ground conditions across the site, however it is specific to the proposed Mitre 10 development. The report discusses the geotechnical issues associated with that development, and cannot be used to assess the broader geotechnical issues across the site.

Factual data (e.g. test pit records) included in the report have been applied in preparing this letter.

3.6 Suitability for development

The site is considered to be suitable for development from a geotechnical perspective.

There are no fatal flaws that would prevent development of this site.

The existing and likely geotechnical hazards that exist on the site can be addressed with standard engineering design and practice. Refer Table 1 above.

3.7 Further investigations

We do not consider that any further subsurface investigations are necessary in order to identify the geotechnical hazards and to identify if any fatal flaws exist.

At detailed design stage, further investigations would be required to assess the thickness and extents of the refuse waste, obtain more strength information, and assess for potential organic or liquefiable soils etc (see Table 1 above).

4 Contaminated Land

4.1 Scope of review

The purpose of this assessment was to review information provided by WCC and provide recommendations for additional investigations, if any.

We have reviewed the following information:

- WCC project brief, proposed Curtis Street District Plan Change, dated 27 June 2012, which includes an overview of the site history.
- Geotechnical Investigation Report, 55-85 Curtis Section 3.1.7 *Site Contamination Effects* of the *Application for Land Use Consent to Construct Mitre 10 Store, 55-85 Curtis Street, Wilton*, prepared by Spencer Holmes Ltd, dated April 2011
- Earthworks assessment report for 45 Curtis Street (SR230584) prepared by WCC (Rod Drumm), dated 24 May 2011.
- Email messages provided by WCC on 20 June 2012, including:
  - Message from Pattle Delamore Partners Ltd (Graeme Proffitt), to VRC Consultants, dated 1 March 2011, regarding potential for landfill gas generation from waste placed at the site.
  - WCC internal email exchange (Kareema Yousif/Johan Simeonov/Karen Williams) dated 27-29 April 2011 regarding recommended landfill gas and soil testing on the south side of Whitehead Road.
  - Email exchanges between URS (Kevin Tearney) and WCC staff (Karen Williams, Kareema Yousif, Johan Simeonov) dated 30 June 2011 to 2 August 2011, regarding requirements for a Contamination Site Management Plan for the site.
- Greater Wellington Regional Council GIS database of potentially contaminated sites.

4.2 Summary of site history

Based on the information provided by WCC, we understand the following regarding site history:

- The site is a filled stream gully. The Kaiwharawhara Stream is culverted beneath the site.
- The south part of site was filled and used as Council works depot since from the 1930s to 1995. The use of the site prior to 1930 is not specified.
- The source of fill placed is not specified. The consent application describes fill as containing bricks, plastic, and timber, with no putrescible material observed. The number and depth of samples/observations is not specified.
- The north part of site was used as a Council depot from 1986 to 1995. Use of this area prior to 1986 is not specified.
- The entire site was used as “an unauthorised dumping ground for spoil/fill” in 1995. In 1996, Council cleared buildings, rubbish, spoil, and vegetation from the site.
- The geotechnical report notes the following:
  - A layer of fill containing bricks, plastic, and timber up to 5 m thick is present across the surface of the site. The report describes this as “clean” fill. No testing was carried out to confirm this.
  - In the northeast part of the site, landfill waste material was encountered to a depth of 4m below ground level, but the bottom of the waste was not identified. Depth to rock ranged from 3.7 to 6.7 m below ground level at the borehole locations.
  - Depth to groundwater is 1.7 to 3.6 m below ground level.

- No investigation of landfill gas or ground contamination testing has been carried out.
- The northeast part of the site is listed on Greater Wellington Regional Council's database of potentially contaminated sites due to historical use for an activity listed on the Hazardous Activities and Industries (HAIL) list.
- WCC's Earthworks Assessment report does not address potential contamination. However, internal WCC communications in June 2011 recommend a Site Management Plan addressing contaminated soil and landfill gas is prepared and implemented before works begin, and that the SMP is provided before the hearing for the Mitre 10 consent application.

4.3 Contamination hazards and consequences

The contamination hazards and consequences for the site are summarised in Table 2 below.

Table 2: Ground contamination risks, implications, mitigation measures

Contamination hazard	Likelihood	Consequence	Mitigation measures
Contaminated material in uncontrolled fill	High	Exposure to site workers during construction. Contaminated soil not managed appropriately during construction (e.g., offsite disposal). Discharges of contaminants from site during construction works. Exposure to site users on completion of works. Discharge of contaminants from site on completion of works (dust, stormwater, ground water).	Desk study (Preliminary Site Inspection, PSI) to identify potential sources of contamination, in accordance with MfE guidelines. This would include identifying locations of fill, types of fill material placed, and details regarding stream culverting. Intrusive investigations (Detailed Site Investigation, DSI) to characterise contamination, in order to develop an appropriate Contamination Site Management Plan (CSMP). Prepare CSMP that sets out controls to minimise exposure to contaminants during work and discharges of contaminants, to minimise effects on human health and the environment. Implement CSMP during works. If contaminated material to remain on-site (e.g., encapsulated beneath imported fill), Long Term Site Management Plan (LTSMP) will be required to set out required controls and management, to minimise effects on human health and the environment. The LTSMP would be specific to the proposed development. Validation report to confirm the CSMP (and LTSMP, if required) have been implemented.
Landfill gas	Moderate - High	Hazardous gases in indoor air and confined spaces (e.g., service trenches). Potential for explosion, asphyxiation.	Desk study and intrusive investigations (as above) to identify location of fill. Landfill gas monitoring. Depending on the outcome of the landfill gas monitoring, the following may be required: – Landfill Gas Management Plan to minimise effects on human health during site works. – Gas protection measures included in the building design (Section F1 Building code).

4.4 Further investigations

Our assessment has identified a number of significant contamination hazards on the site. Further investigations and mitigation measures are required (as explained in Table 2) prior to development of the site. There are planning provisions in place to address further investigations and mitigation measures (see Section 5 below). These investigations can occur either as part of the plan change process or by a future applicant for resource consent.

5 District Plan Implications

We consider that the geotechnical and contamination hazards identified above are able to be addressed at resource consent application stage, through the use of rules in the Wellington City District Plan.

We have reviewed Chapter 30 Earthworks Rules and Chapter 32 Contaminated Land Rules of the District Plan, Chapter 34 Business Area Rules of Plan Change 73, as well as the National Environmental Standard for Contaminants in Soil to Protect Human Health (NES Soil), to assess whether these rules are adequate to address the issues we have identified. Our conclusion is that WCC could consider some additional provisions to ensure that the hazards identified can be adequately addressed at resource consent stage.

We make the following high level recommendations:

- Additional earthworks rules appear to be necessary, as the Chapter 30 Earthworks Rules do not appear to apply within the Business 2 Area.
- WCC should consider site-specific rules/standards to address selected geotechnical hazards on the site (refer to Table 1). Consideration should be given to the use of rules and/or standards that require geotechnical investigations and specific foundation design for developments on the site. Specific geotechnical assessment criteria should also be developed to assist with the application of site-specific rules/standards.
- We consider that no additional District Plan provisions are required to address the contaminated material hazard on the site. This is because resource consent would be required for any development of the site under both the NES Soil and Rule 32.2 of the Wellington District Plan. The existing provisions of Rule 32.2 and the NES Soil address the mitigation measures identified in Table 2 above, including PSI and DSI. Consideration of the applicability of the NES Soil should be triggered by the fact that the northern part of the site is listed on the GWRC database. However, WCC may wish to include specific reference to the applicability of the NES Soil to the site within the Plan Change.
- We consider that no additional District Plan provisions are required to address the landfill gas hazard on the site. This is because the Building Act (Hazardous Agents on Site, Clause F1) adequately addresses landfill gas protection measures. WCC may wish to include specific reference within the Plan Change to ensure any applications address Clause F1 of the Building Act.

We are happy to discuss these recommendations further and in more detail if required.

6 Applicability

Recommendations and opinions in this report are based on data from supplied investigation data and a site walkover. The nature and continuity of subsoil away from the investigation locations are inferred and it must be appreciated that actual conditions could vary from the assumed model.

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.

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