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12/03/2014

EN04222

Dear Robert

Subject: DoPI 2012/327; Geotechnical Assessment Life City High- Tech Holistic Cancer and Medical Hospital Facility MP10_0147: Review Report

1. Introduction

1.1 General

This report presents the findings of a further geotechnical review undertaken by Jacobs SKM for the NSW Department of Planning and Infrastructure (DoPI) associated with planning approval for the above mentioned proposed development at Berkeley in the southern suburbs of Wollongong, NSW. This further review is in response to the provision of additional geotechnical site data as requested in our initial review report submitted on the 11 July 2013. The current review has been undertaken in accordance with the Jacobs SKM proposal date 16 October 2013.

The purpose of the review work is to provide an opinion and appraisal of the suitability of the development proposal against the requirements of E12 (Geotechnical Assessment of Slope Instability) and E19 (Earthworks) of Wollongong Development Control Plan and Practice Note Guidelines for Landslide Risk Management Australian Geomechanics Society (AGS) 2007. It should be noted that these requirements are applied for Development Applications (DA's).

Since this development is still in the planning stage the focus of our review is to identify key geotechnical risks to assist DoPI in the project approval process.

1.2 Previous Review Findings

Our initial review report submitted on the 11 July 2013 should be read in conjunction with the current report to appreciate the results of our initial findings and limitations of the available geotechnical data at the time of issue of this earlier report. This previous review

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concluded that it was Jacobs SKM's opinion at the time that the pre-existing geotechnical information available for the site provided in a Preliminary Geotechnical Site Assessment Report by Coffey Geotechnics (GEOTWOLLO3229AC-AB) dated 7 February 2013 and their geotechnical review report dated 29 May 2013 GEOTWOLLO3229AD-AA) in response to the revised development concept was considered insufficient to enable an adequate assessment to be made with regard to slope risk assessment, engineering design, and environmental impact (e.g. noise and vibration) to nearby residences associated with the bulk excavation works

This conclusion was also made on the basis of the very substantial cut and filling works proposed for the site at the time and the only limited depth of investigations undertaken by Coffey Geotechnics restricted to shallow test pits. In view of this there was considered a high degree of uncertainty with regard to the site geotechnical model which would thus prevent a reliable assessment of the engineering and environmental implications for such a development during both the design and construction stages.

1.3 Scope of Current Review

In view of the above findings, further geotechnical investigations involving the drilling of new boreholes to greater depths have been undertaken by Network Geotechnics Pty Ltd (NG) and presented in a draft report dated 10 February 2014. Following review of this report, Steven Rosin of Jacobs SKM submitted by email a series of questions to Mr Vipul De Silva of NG who provided response on the 21 February 2014. An updated NG report was then submitted on the 28 February 2014. Thus, the purpose of the current review was to provide comment on all available investigations undertaken to date with regard to development feasibility.

Network Geotechnics Pty Ltd (NG) also submitted a Limited Stage 2 Contamination Investigation report dated January 2014. It is understood that the contaminated related issues are not critical to planning aspects of the development and thus Jacobs SKM were instructed by DoPI not to provide specialist advice in this area as part of this assessment.

2. Context

The proposed development is within vacant land which is classified as freehold title/ privately owned.

The land is characterised by a gentle ridge and gully topography. It is bounded by the F6 Southern Freeway in the west and the residential areas of Berkeley to the north, east

and south (Figure 1 and 2). The proposed development is to involve substantial infrastructure development comprised of various low and high rise buildings with basements, an access road into the site, internal roads, landscaped areas and drainage infrastructure such as detention basins. The development is proposed to be undertaken in several stages over a number of years and will include a medical centre, hospital facility, lecture, and various accommodation facilities.

According to the regional geological maps for the area (1; 100,000 sheet, 1985) and as confirmed by Coffey Geotechnics the site is underlain by two rock types;

- The Pheasants Nest Formation of Permian age (270 million years) comprised of sub-horizontally interbedded lithic sandstone, coal, carbonaceous claystone, siltstones and claystones.
- The Dapto Latite Member- which is a melanocratic, coarse grained and porphyritic igneous intrusive rock.

On 30 November 2012, TCG Planning submitted a Concept Plan and Environmental Assessment for the proposed development. A subsequent Environmental Assessment (EA) report was submitted to the DoPI in February 2013. The application for the development was then placed on public exhibition from the 6 March to 12 April 2013.

Several public submissions were received by various stakeholders including the DoPI and in response to these submissions the concept plan for the development was amended and issued in a revised TCG Planning Report dated 31 May 2013. This EA Planning Report and associated concept drawings formed the subject of the previous geotechnical review for the EA.

In response to various comments the TCG Planning Report was further updated and re-submitted on the 24 October 2013. The latest engineering report to support the latest planning report prepared by C & M Consulting Engineers dated August 2013 (Rev 5 PN00864.R01) forms part of this current review.

3. Proposed Development and Earthworks

The site development area is irregular in shape and about 150m wide (east-west) and 250m long (north south) and is bounded by a ridge line along the eastern boundary with a maximum RL 72m AHD. (Refer **Figure 1**). The slopes fall in a general north westerly direction off the ridge line locally by 20 to 30 degree angles near the crest and then more gently within the gully area proposed for a detention basin adjacent to the F6 Freeway at about RL 40m AHD.

Given the topographically site conditions, the current proposal involves cuts of up to 6m depth below the existing surface, and fills to a height of up to 6m above the existing surface for building platforms, basements and to meet acceptable road gradient and other development considerations (Refer **Figure 3**).

A summary description of the currently prosed development stages intended to be constructed progressively over a number of years as presented in **Figure 1** is as follows;

- **Stage 1: Medical Centre and Child Care Centre;** 2 storey buildings with basement car park involving 5m deep cuts.
- **Stage 2: Medical Accommodation;** 3-4 storey buildings with basement car parks involving 5m deep cuts.
- **Stage 3: Hospital Building;** 5 storey buildings with 4 levels of car parking. The lower level car park floor level would involve 5m cuts. Substantial filling of up to 6m is required upslope of these buildings for a parking area.
- **Stage 4: Seniors Independent Living Units;** Comprise 3 sections of 2 storey apartment buildings each with its own car park involving up to 6m depths of cut and about 1m of fill.
- **Stage 5: Senior Residential Care Facility;** Comprise 4 storey buildings with locally up to 6m cut depths.
- **Stage 6: Holistic Health Care Course;** Details not provided at this stage

In addition to the above, a main permanent site access road will be constructed off Nolan Street from east to west involving cuts over the main ridge of up to 4m to achieve acceptable grades.

The latest cut/ fill model (**Figure 3**) is from a drawing dated 24 September 2013 prepared by C & M Consulting Engineers for the latest EA submission and involves a cut volume including top soil of 69,100 m³ and fill volume of 44,100 m³. It is assumed that all topsoil (0,000 m³ of cut) will be re-used resulting in an off-site disposal volume of 15,000m³. This is a significant reduction in both cut and fill volumes and off-site disposal volumes compared the previous proposals dated 29 May 2013.

4. Scope of Jacobs SKM Review Work

To address the requirements of Jacobs SKMs scope of review the following key tasks have been undertaken to date;

- A review of various reports and drawings provided by DoPI associated with the development proposal including a review of the local geotechnical guideline documents from Wollongong Council and the AGS.
- A site walk over inspections was undertaken on the 19 June 2013 by Steven Rosin a Principal Geotechnical Engineer of Jacobs SKM. As part of the site visit, the double sided latite approximately 20m high cutting on the F6 Freeway directly west of the site was inspected and photographed as this is the only known exposure of rock outcrop in the immediate site area.
- Submission of geotechnical report review comments to NG report dated the 17 February 2014 and receipt of a response to comments on the 21 February 2014.
- Review of Network Geotechnics updated Geotechnical Report of 28 February 2014.
- Preparation of a report and summary of the findings of the review, documenting Jacobs SKM's opinion of the proposal and suitability for the site for the planned development from a geotechnical perspective including broad recommendations for consideration of further geotechnical related investigations for detailed design and construction.

5. Previous Geotechnical Related Investigations and Assessments

For the purpose of this development proposal the following summarises the geotechnical work undertaken by the various consultants to date;

Coffey Geotechnics

- A desk top study involving review of geological and soils maps for the area.
- Engineering geological walk-over surveys of the site.
- The excavation of twelve test pits through-out the site to between 1.1 -2.65m below the surface.
- Initial assessment and reporting as presented in the 7 February 2013 report. This report provides a general site profile, a Preliminary Landslide Risk Assessment to AGS 2007 Guidelines. The report also included a Site Soils Classification to AS2870-2011 (Residential Slabs and Footings). General comments were also made in this report on site earthworks requirements, rock excavability methods and rippability, site maintenance and drainage and general requirements for further geotechnical investigations.
- The 29 May 2013 Coffey report involved provision of review comments of the updated architectural drawings and updated bulk earthworks plans (16/5/2013) in relation to geotechnical aspects of the development mentioned by interpretation of available information. This subsequent report also provided a review of comments

from various stakeholders who raised geotechnical issues from the public submission.

Network Geotechnics

- Over the period 21 November 2013 to the 8 January 2014 a total of 33 boreholes were drilled across the site.
- Twelve of these holes (BH1-BH9 and BH 31-BH33) were drilled for geotechnical purposes. The depth of drilling for these holes ranged between 4.5m to 8.0m below the surface and was carried out using auger drilling to Tungsten Carbide “TC” bit refusal. At TC bit refusal boreholes were either terminated at the discretion of the site engineer or were continued by core drilling to the final required hole depth. Three boreholes (BH3, BH6 and BH8) drilled to depths ranging between 4.74 and 7.35m were converted to standpipes for long term groundwater monitoring.
- A range of soil index tests on disturbed samples and also point load rock strength tests were carried out on recovered core samples.
- Presentation and interpretation of results and geotechnical assessment.

6. Jacobs SKM’s Review Comments of February 2013 Network Geotechnics Report

In order to better communicate the key site geotechnical issues, we have re-interpreted the available data to provide a geotechnical model as presented in the attached **Figures 2** and **Figure 3**.

We then submitted five specific questions to NG (Questions 1-5) detailed below for them to address in their updated report of the 28 February 2014 to provide Jacobs SKM with the level of confidence that the key remaining geotechnical risks related to this project not covered in NG initial reporting were appropriately addressed to enable to project to be considered for approval by DoPI.

The questions and answers in relation to the NG report are outlined below. Based on the answers provided all questions have been “closed out”.

Question 1-Risk of Encountering Acid Sulphate Rocks; Has NG given consideration to the risk of acid sulphate rock generation (ACR) when exposing fresh sandstone in bulk excavations. This has significant handling and disposal implications for the project. **Figure 2** and **3** shows fresh sandstone in NG32 & NG33 near the surface within the vicinity of Stage 4 and 5. Jacobs SKM accepts that this type of problem is normally confined to the underlying Berry Siltstones forming part of the Shoalhaven Group of

rocks in NSW rather than Pheasant Nest Coal measure sandstones which is part of the Illawarra Coal Measures but there has been some local occurrence of ASR within the Illawarra Coal Measures in the region.

***Answer;** NG have recommended that ACR tests be undertaken for next investigation stage to resolve this potential risk. They have also recommended an appropriate ASR management plan be developed if ACR is identified as a problem.*

Question 2-Site Geotechnical Models; Further interpretation of the geotechnical data is suggested to be undertaken in the report to assist interpretation for planning and development so this key information is provided to assist with the detailed design for the project. Although not shown in the geotechnical plans provided in the NG report it may be inferred that there is a clear boundary between Sandstone and Latite as shown in **Figure 2** and **Figure 3**. Bulk excavations for Stage 4 and 5 cuts according to geotechnical drilling and the presence of a prominent latite ridge in the south and hard rock exposed along the cutting on freeway indicate likely shallow hard rock conditions for most of these cuts both in latite and possibly sandstone. Stages 1, 2 and 3 are more likely to encounter highly weathered and weak sandstone rock for the entire depth of cuts according to the available borehole data for the area. This has implications for batter stability design for cuts and noise and vibration impacts during excavation in view of proximity to nearby residents (easy digging versus blasting) and warrants discussion for planning and targeting further boreholes during detailed design.

***Answer:** NG have commented on the variability of ground conditions in their updated report and have recommended further investigations as part of detailed design and DA approval.*

Question 3- Potential for Large Scale Slope Stability; Extensive deep excavation cuts will be undertaken at the toe of the hillside. There is the potential for larger scale translational slide failures along weak clayey (shaley) seams within the sandstone if the bedding is adversely orientated. No discussion is provide in the report on the potential for this mechanism to occur which would have very significant impacts on the project. If the bedding is sub horizontal then there would be a very low risk of such a translational slide developing. But if the bedding dips are moderately steeply dipping to the north west in combination with the presence of a weak clayey shale seams along bed partings, this could contributed to large scale translational failures occurring in the long term posing a high risk on the project and warrants an assessment as part of the report.

Answer; *NG have confirmed that based on core drilling results that the bedding within sandstone is sub-horizontal and not unfavourably dipping. Based on our review of the core photos, Jacobs SKM agree with this assessment. Thus the risk of large bedding plane translational slides is a low risk for the site.*

Question 4-General Slope Stability; It is understood that the current recommendation as detailed in the report is that all upslope basement excavations be cut back with temporary batters and then backfilled with compacted fill and subsoil drains. This may not be the best solution because certain backfilled areas may have to be cut at 1:1 (H:V) temporary batters as prescribed in the initial report for weathered rock and backfilled to a depth of 4-5m. This would result in large lateral pressures on basement walls requiring significant structural support and risk of blocked drains and basement leakage problems. This may not be the best solution or to Council's approval. As an alternative consideration should be given to basement excavations remaining as fully or partially open cuts and supported by either toe retaining walls/piled walls and permanent type batter face support such as the use of rock bolts and shotcrete as an alternative option to complete backfilling of temporary cuts. It is suggested that a discussion be included to mention that all options for support and treatment of cuts and fills be based on best practice for hillside development rather than be too prescriptive at this stage.

Answer; *NG have revised their initial report to accommodate a range of basement retention options as mentioned approve together with the specific requirements that such designs be undertaken in conjunction with an experienced geotechnical in accordance with good hillside engineering practice.*

Question 5-Groundwater; A discussion on relationship between the contact between sandstone and underlying latite as a path for groundwater seepage and its implication for the design of basement drainage requires further consideration.

Answer; *NG have mentioned in their updated report that while it is possible that seepage could be encountered at the latite/sandstone interface, the level of the interface is assessed to be below the various basement levels for the various stages. They also mention the potential for seepage flows locally during basement excavations which could be appropriately dealt with using sump pumps.*

7. Conclusions

7.1 Development Feasibility

It is Jacobs SKM's opinion that the current geotechnical information available for the site provided by the various development proponents is now considered sufficient to enable adequate assessment to be made with regard to slope risk assessment, engineering design, and environmental impact (e.g. noise and vibration) to nearby residences associated with the bulk excavation works and other relevant geotechnical assessment requirements.

7.2 Review of Compliance with Relevant Wollongong Council Guidelines for Development Applications

7.2.1 General

The relevant geotechnical related documents reviewed by Jacobs SKM form part of the Wollongong Development Control Plan 2009 (Part E- General Controls- Environmental Controls). These consist of Chapter E12 and E19 covering slope stability and earthworks respectively. Both these compliance documents are comprehensive and specifically related to Development Applications (DA) submission which usually requires a fairly detailed level of investigation and design to enable approval. The geotechnical investigations to date were however intended for project approval rather than for DA submission, however some guidance is provided herein for future planning purposes

7.2.2 Chapter E12: Geotechnical Assessment of Slope Instability

The DA requirements with regard to slope instability are detailed in **Section 5.2** of chapter E12. This section details the information requirements for a "geotechnical impact assessment report" and related design requirements for structures. The current information provided by the proponent is considered deficient with regard to in particular **Clauses b,c,e and g**.

Broadly, the deficiencies relate to currently insufficient information and interpretation made of the geotechnical site conditions for each of the development stages in terms of geotechnical conditions, local slope instability mechanisms and risk and how this will be addressed during design, construction and long term site maintenance and will need to be addressed for the DA.

7.2.3 Chapter E19: Earthworks (Land Reshaping Works)

The DA submission with regard to earthworks are detailed in **Section 3.0** of chapter E19. This section details the information requirements for lodgement of a DA for reshaping works such as cuts and fills to be supported by a Statement of Environmental Effects (SEE) report which demonstrates the need for the proposed earthworks and considers the potential impacts on the environment both on and off site including geotechnical stability.

The current information is considered deficient with regard to **Section 3.1, 3.2 and 3.3** with regard to a wide range of factors including such matters neighbourhood amenity, method of excavation, haulage routes, staging, material supply etc. and will need to be addressed for the DA.

7.3 General Recommendations Future Geotechnical Investigations

The following general recommendations are made with regard to future geotechnical investigations;

- Further borehole drilling throughout the site to assess ground conditions for detailed design and construction of foundations, site retention, earthworks, roads and other structures.
- Assessment of ASR risk within sandstone and development of an ASR Management Plan if required. The presence of ASR may require off-site disposal to a suitable landfill rather than onsite burial and thus this issue needs to be resolved early in the DA stage.
- Provision of sufficient geotechnical with borehole drilling and possibly seismic survey to define bedrock conditions for excavation characteristic to enable assessment of method of excavation with due consideration to environmental impacts for noise and vibration for all development stages. This will assist in the development of an Excavation Management Plan for the site which will assess appropriate methods of excavation and environmental compliance.
- An assessment of the quality and quantity of materials to be disposed of off-site to ensure that a suitable strategy is in place as part of planning for the development.

It is noted that further more specific comments on further investigations, design and construction requirements relevant to all developments of this type are provided in Section 14 of the NG 28 February 2014 report.

12/03/2014

We trust that the above report meets your requirements. Please contact the undersigned should you wish to discuss any aspects of the report.

Yours Sincerely

A handwritten signature in blue ink, reading "S Rosin". The signature is written in a cursive style with a small star-like mark above the 'i'.

Steven Rosin
Senior Principal Geotechnical Engineer.
Attachments – Figures 1-4