



Douglas Partners

Geotechnics • Environment • Groundwater

Integrated Practical Solutions

**REPORT
on
GEOTECHNICAL ASSESSMENT**

**PROPOSED REDEVELOPMENT
WAHROONGA ESTATE**

**Prepared for
JOHNSON PROPERTY GROUP and
AUSTRALASIAN CONFERENCE ASSOCIATION**

**Project 45569
November 2008**



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GSY:mh
Project 45569
28 November 2008

**REPORT ON GEOTECHNICAL ASSESSMENT
PROPOSED REDEVELOPMENT
WAHROONGA ESTATE**

1. INTRODUCTION

This report details the results of a desktop geotechnical study for a proposed redevelopment of the Wahroonga Estate at the intersection of Fox Valley Road and Comenarra Parkway, Wahroonga. The redevelopment is to accommodate the expansion of the Sydney Adventist Hospital together with the provision of new educational and community facilities, residential dwellings and a village centre with increased recreation and commercial opportunities. The assessment was carried out at the request of Johnson Project Group, joint developers and project managers for Australasian Conference Association (SCA).

It is understood that redevelopment of the site is being considered. The assessment was carried out to provide preliminary geotechnical information for the concept masterplan and state significant site listing only. A document, "Wahroonga Estate Redevelopment, Preliminary Assessment Report" dated September 2007 was previously prepared for the site by Urbis in support of an application under Clause 6 of the State Environmental Planning Policy and the Preliminary Concept Plan within the document is used as the basis for discussing geotechnical issues on the site.

Douglas Partners has carried out a number of geotechnical investigations in the general area and the information from these investigations has been used to prepare this assessment. Intrusive geotechnical investigation for the proposed redevelopment of the site has not been

carried out for the present report but is considered necessary to determine actual subsurface conditions and properties for future detailed design purposes.

2. SITE DESCRIPTION

The site is an irregular shaped area of some 65 ha located on undulating land, divided into two sections by Coups Creek which runs in an approximately south-westerly direction through the site. The creek is located in a well vegetated, bushland valley some 20 – 30 m deep and about 150 wide.

The area north of the creek is currently known as the Mt Pleasant precinct and has been developed along the northern and north-eastern sections. Mt Pleasant Avenue provides access to the precinct. There are residential houses located along the northern boundary and Normanhurst Adventist Retirement Village is located in the north-western corner of the precinct. Site levels in this area tend to fall to Coups Creek to the south and also to the west.

The other section is the larger of the two and is located on both sides of Fox Valley Road and also south of Coups Creek. On the western side of Fox Valley Road, from north to south, are a number of residential dwellings, Seventh-day Adventist Churches, Sydney Adventist Hospital with specialist clinics and a primary school. The eastern side of Fox Valley Road is occupied from north to south by residential dwellings, the Pacific Regional Headquarters of the Adventist Church, Media Network Centre and the Adventist Development and Relief Agency, then more residential buildings including a hostel. There is a gentle fall in surface levels in a southerly direction of some 10 m over 600 m. To the east of the developed area, there is bushland where surface levels fall some 20 m towards a gully located in the south-eastern corner of the site.

As part of the existing developments on the site, there are some areas of cut and fill mainly associated with the buildings and carparks.

A site plan (courtesy of Bligh Volker Nield Architects) and a survey plan (courtesy of Medstead & Associates) are included in Appendix A as Drawings 1 and 2 respectively.

3. GEOLOGICAL SETTING

The site is mapped on the Sydney 1:100,000 Series Geological Sheet which indicates that it is underlain by Ashfield Shale on the higher areas and Hawkesbury Sandstone on the lower areas such as valleys. Ashfield Shale typically comprises black to dark grey shale and laminite. Hawkesbury Sandstone typically comprises medium to coarse grained quartz sandstone with very minor shale and laminate bands. An excerpt from the Geological Series sheet is shown on Drawing 3 which has been superimposed at a larger scale on a street directory plan on Drawing 4 in Appendix A.

The Soil Conservation Service of NSW Soil Landscape Series Sheet for Sydney indicates that the site is underlain by Glenorie soil landscape group on the higher levels, Hawkesbury soil landscape group in the creek valley and possibly some West Pennant Hills soil landscape group on the eastern side of the site. Drawing 5 in Appendix A reproduces the relevant section of the Soil Landscape Series Sheet.

The Glenorie landscape is described as undulating to rolling low hills on the Wianamatta Group shales with slopes of about 5° to 20° and local relief of 50 – 80 m. The soils on the crests of this soil landscape unit are described as comprising about 1 m of red podzolic soils. The upper slopes of the landscape unit comprises red and brown podzodic soils while on the lower slopes the unit comprises yellow podzolic soils and humic clays. Limitations to development include high soil erosion, localized impermeable highly plastic subsoil and moderately reactive soils.

The Hawkesbury landscape is described as rolling to very steep hills on Hawkesbury sandstone with slopes of about 5° to 20° and local relief of 40 – 200 m. The slopes are moderately inclined to precipitous with rock outcrops and broken scraps up to 10 m high. Boulders and cobbles cover up to 50% of the ground surface. Valleys are narrow and incised. The soils are described as comprising loose, coarse quartz sand or earthy, yellow brown sandy clay loam. On sideslopes and benches, the soils are generally discontinuous and comprise 100 – 300 mm of sand over bedrock while on the outside of benches there may be 50 – 150 mm of sand overlying 500 mm clay. Limitations to development can be severe and include mass movement hazard, rock fall hazard, steep slopes and shallow soils.

The West Pennant Hills Hawkesbury landscape is described as steep, narrow, generally south-west facing, hill slopes on the Hornsby Plateau on the Wianamatta Group shales with slopes of about 20° to 35° and local relief of 40 – 100 m. Steep slopes with colluvial benches with southerly and south-westerly aspects are dominant landforms elements. The dominant soils comprise friable dark brown clay loam, whole coloured strongly pedal clays and mottled light grey, highly plastic clays. On upper slopes and midslopes, the typical profile comprises up to 0.5 m of clay loam overlying more than 1 m pedal clay with some highly plastic clay and shale at depth. Common soil depth is generally greater than 2 m. Limitations to development include steep slopes, erosion hazard, seasonal waterlogging, moderately to highly reactive soils.

The Soil Conservation Service of NSW Acid Sulphate Soil Risk Map for Hornsby – Mona Vale indicates that there are no known occurrences of acid sulphate soils at the site. It is noted that acid sulphate soils typically occur in areas with surface levels less than about RL 5, whereas surface levels across the site range from RS 170 to RL 100.

4. PREVIOUS INVESTIGATIONS

Douglas Partners has carried out previous geotechnical investigations on the site and some of these are summarised below.

Project 28258 Proposed Day Care Centre (June 1999)

The Day Care centre is located on the western side of Fox Valley Road adjacent to the nurse's accommodation and south of the hospital buildings with a surface level of about RL 165. The geological map showed the site was close to the geological boundary of Ashfield Shale and Hawkesbury Sandstone. Three test bores were drilled and they encountered a thin layer of topsoil overlying firm to stiff sandy clay with very low to low strength sandstone at depths of 0.6 - 1.1 m. Medium strength sandstone possibly occurred below 0.9 - 1.2 m depth.

Project 29292A Normanhurst Retirement Village (December 2001)

The retirement village is located in the Mt Pleasant precinct. The investigation was for an access road and a multi-level building within the village with a surface level about RL 170. The geological map indicated that the site was underlain by Ashfield Shale. The investigation,

however, comprising of three bores encountered sandy filling overlying sandy colluvium directly over sandstone bedrock at depths of less than 0.6 m. This suggested that the geological map at this location was incorrect.

Project 43899 Extensions to Former Laundry Building (May 2006)

The former laundry building is associated with the hospital and is located to the west of the main buildings. Surface levels are approximately RL 170. The investigation comprised three bores which encountered filling over sandy clay with sandstone encountered at depths ranging from 0.65 m to 1.65 m.

5. OBSERVATIONS

A walkover of the site was carried out on 12 May 2008 and some of the features noted are listed below for the different areas.

Mt Pleasant Precinct

- Sandstone boulders are visible on the surface on the outside of the ring road around the village.

Coups Creek

- There are numerous sandstone outcrops on the valley sides (Photos 1 and 2);
- Sandstone boulders and floaters (buried boulders) are plentiful in the creek valley (Photo 3);
- Sandstone bedrock is exposed in the creek bed (Photo 4);
- The valley is undeveloped bushland.

Hospital and Church Precinct

- There is some exposed weathered shale under the nurses accommodation building (Photo 5);
- The car parking areas along the northern and western sides of the hospital appeared to have been formed by some cut and fill works. Most of the filling is on the Coups Creek side of the car parking area. In some instances the fill batters are relatively steep. In other areas, the

batters have “grown” with the addition of more filling and also the dumping of grass cuttings. Some of the fill areas are marked on the survey plan (Drawing 2). In most cases, filling is probably up to about 3 – 4 m deep (Photos 6, 7, 8, and 9);

- Sandstone block retaining wall separates bench levels (Photo 10).

Eastern side of Fox Valley Road

- There was no obvious outcropping of rock on the upper levels of the slope (above about RL 140) although some sandstone boulders were observed on the surface suggesting there is probably sandstone bedrock above about RL 140.
- Sandstone was exposed below RL 140 off the Comenarra Parkway
- Sandstone outcrops were present north of the houses on Comenarra Parkway in the side of the valley.

6. PROPOSED DEVELOPMENT

The proposed development is to upgrade and expand the health facilities and services, increase the number of dwellings; provide retirement living with a mixture of independent living, a hostel and nursing home; provide expanded retail, commercial and recreation opportunities and retain quality open space and bushland.

A Concept Plan was has been reproduced as Drawing 6 in Appendix A.

It is understood that the Coups Creek will be incorporated into an open space and retained bushland plan for the site.

7. COMMENTS

7.1 General

The purpose of the present assessment was to provide information for the development of a concept plan and state significant study only. The following comments are based on a site inspection and desktop review of available information. Therefore they are preliminary in nature and intended as a guide to geotechnical constraints associated with future development at the site.

For detailed design, comprehensive geotechnical investigations should be undertaken to provide information on the subsurface profile in order to more accurately determine design issues and parameters for specific locations and structures.

7.2 Geological Model

There are three main geological profiles which could be expected on the site; namely the Ashfield Shale, Mittagong Formation and Hawkesbury Sandstone profiles.

The Ashfield Shale profile generally comprises a moderately to highly reactive, residual clay grading into Ashfield Shale at depth. The depth to shale is expected to be relatively shallow, possibly of the order of 2 – 3 m. The Ashfield Shale profile is expected to be found on the higher levels around Fox Valley Road and parts of the hospital site as well as the residential properties off Mt Pleasant Avenue.

The Mittagong Formation comprises interbedded and laminated fine to medium grained quartz sandstone and black siltstone. It tends to vary in thickness from 0 to 6 m thick and, where present, grades conformably upwards for the Hawkesbury Sandstone and is overlain disconformably by Ashfield Shale. The formation generally outcrops poorly and is not obvious on the site. It is often not shown individually on the geological maps, otherwise it has been mapped as Ashfield Shale.

The Hawkesbury Sandstone profile generally comprises residual sandy clay over shallow

sandstone generally within a few metres of the surface. It is expected to be found in the Coups Creek valley, under the retirement village, under parts of the hospital and school site and in the lower areas on the eastern side of Fox Valley Road. On the steeper slopes, the residual sandy clay is often eroded leaving sandstone bedrock exposed. The sandstone exposures on the site suggest that the boundary with the Mittagong Formation/Ashfield Shale is higher than shown in the geological map.

Some minor variations to the above profiles could be expected in localised areas. For example, some slopewash and colluvial material could be expected within the Coups Creek Valley. There are some areas of filling on the site generally associated with previous development and some of them are shown on Drawing 2.

7.3 Slope Stability

In the developed areas of the site which are generally the flatter areas, there are no obvious signs of major instability. There are, however, some slopes on the site which are relatively steep and these are generally filled areas especially along the northern edges of the car parks associated with the hospital. The existing slopes appear stable, but these should be reviewed as part of the future redevelopment of these areas of the site.

The areas earmarked for development in the Concept Plan are generally located on the flatter areas of the site. The one exception is in the north-eastern corner of the site. For all other areas to be developed, slope stability is not considered to be a major issue and should be adequately addressed by batters and engineering designed retaining walls. Individual slope stability assessments can be carried out at specific locations on request and any slope stability issues would be addressed during the geotechnical investigation for site specific developments.

The north-eastern corner is located on an area whose typical slope is 10° to 15°. Good engineering design and practice will be required to develop the precinct and provide a stable development. Some typical development guidelines from Australian Geomechanics Society are provided in Figure 1 in Appendix B.

In undeveloped areas, such as Coups Creek Valley, there are some relatively steep slopes generally within the Hawkesbury Sandstone profile which comprise sandstone ledges, cliffs and detached boulders within slopewash material. There are some boulders and outcrops in the steep slopes which could be considered potentially unstable but these are not affected by any development on the site and are part of the natural process of weathering and erosion of the landform.

The steep valleys on the site are not being developed under the Preliminary Concept Plan and are to be left as bushland. The proposed redevelopment is generally well away from the steep valleys and therefore any development is not expected to be affected by local slope instability which may occur within the valleys.

7.4 Site Preparation

Due to the gentle slope across the majority of the areas to be redeveloped, it is anticipated that some cut and fill techniques will be used to form level working benches for development of the site. In addition, there may be some excavation for basements. Interpolation of existing information suggests that stiff clays may be encountered within the first 1 – 2 m of excavation, however deeper excavation may encounter rock formation. This must be confirmed by drilling and testing during the geotechnical investigation stage for detailed design purposes. The clays should be readily removed using excavators and the rock will probably need large rippers and possibly rock breakers to remove.

Subject to review on site, it is expected that excavated material from site could generally be reused as filling. Filling should be placed in layers and compacted in accordance with AS 3798-2007 "Guidelines on earthworks for commercial and residential developments". Filling should only be placed on areas which have been suitably prepared by removing any vegetation, organic topsoils and other unsuitable material and providing relatively level benched areas.

Batters may be required on the site and these should generally be no steeper than 2H:1V in soil and very low to low strength rock. Steeper batters may be feasible in rock, however all batters should be reassessed when the layout is finalised. Where there is inadequate space for batters, retaining walls will be required and these should be designed by an engineer taking into account

the slope behind the wall and any surcharge loading.

The groundwater table is not expected to be encountered within the area of proposed redevelopment, however some water seepage out of slopes should be expected especially after periods of rain. Adequate surface and subsoil drainage will have to be provided to prevent accumulation of water on the surface and water logging.

7.5 Retaining Walls

If retaining walls are to be used on site, each case should be individually assessed. For relatively low walls, say up to 4 m high, cantilever walls may be possible where some movement of the wall and material behind the wall can be tolerated. Earth pressures acting on the cantilevered free-draining retaining walls can be calculated using a triangular pressure distribution based on an earth pressure coefficient of 0.3 for a level surface behind the wall and using an average bulk unit weight of 20 kN/m³ for the filling and soil.

Different type retaining walls types such as crib walls or soil reinforced walls may be required for higher walls and these can be individually assessed for each slope as required.

7.6 Foundations

It is generally preferable to found footings on the same bearing stratum to reduce differential settlements. Due to the anticipated shallow depth to rock over most of the areas to be redeveloped, it is suggested that all major structures are founded on rock. Footing types could comprise shallow pad, strip or raft footings. Where the depth to rock increases bored piers or a combination of shallow and deeper footings could be adopted. It is expected that the majority of the rock on site will accommodate allowable bearing pressures well in excess of 1500 kPa.

For lightly loaded structures such as single storey dwellings, shallow footings on residual clays could be considered. For preliminary design purposes only, typical footings on clay could comprise those appropriate for a Class H site as indicated in AS2840 but this will require confirmation for detailed design.

7.7 Roads

As part of the redevelopment, some internal roads are proposed. The Concept Plan provides approximate routes of the roads, but exact locations are subject to review and preliminary design.

On the flatter areas of the site, the pavement would probably be founded on the existing subgrade which is mainly expected to comprise clay or sandy clay. For preliminary design purposes, a CBR of 2% is suggested for the natural clay on site, but this must be reassessed for detailed design purposes. In some cases, rock may be present as a subgrade and a CBR of 10% or more would be more appropriate for preliminary design.

In other areas, the road may cross a slope, in which case cut or fill or a combination of cut and fill may be required to provide a suitable road profile. Cut and fill works have been discussed in Section 7.4 above. For filling under pavements, it is suggested that the filling is compacted to at least 100% density ratio relative to standard compaction. If a road crosses a slope and filling is used, batters on the down slope may not be appropriate due to the volume of filling required to provide a batter. In this case, retaining walls should be used.

The CBR for filling is dependent on the material being used as filling and would have to be assessed at the time of construction.

More relevant advice can be provided on the design of the roads when the horizontal and vertical alignments have been determined.

7.8 Further Investigation

Intrusive geotechnical investigation for the proposed development site has not been carried out for this report but is considered necessary to determine actual subsurface conditions and soil properties when development details are further advanced and prior to detailed design.

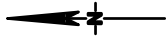
DOUGLAS PARTNERS PTY LTD


Reviewed by

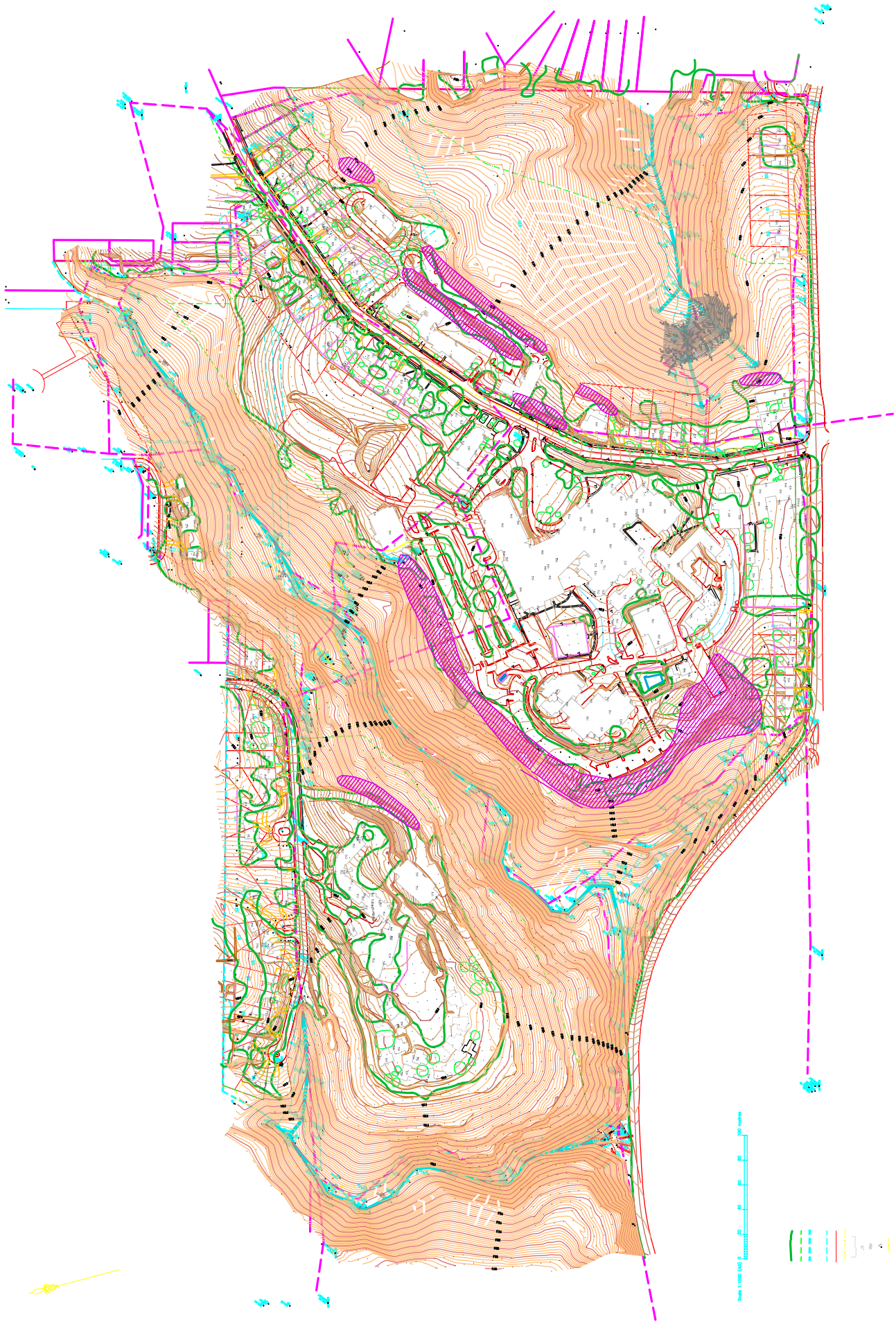
Geoff Young
Principal

Dr Terry Wiesner
Principal

APPENDIX A
Drawings



 Douglas Partners Geotechnics • Environment • Groundwater	CLIENT: Johnson Property Group	OFFICE: SYDNEY	TITLE: Aerial Map of Site Wahroonga Estate Fox Valley Road WAHROONGA	DRAWING No: 1
	PROJECT No: 45569.00	DRAWN BY: PSCH		
	DATE: 28.5.2008	SCALE: As shown	APPROVED BY:	



LEGEND

-  FILL AREA

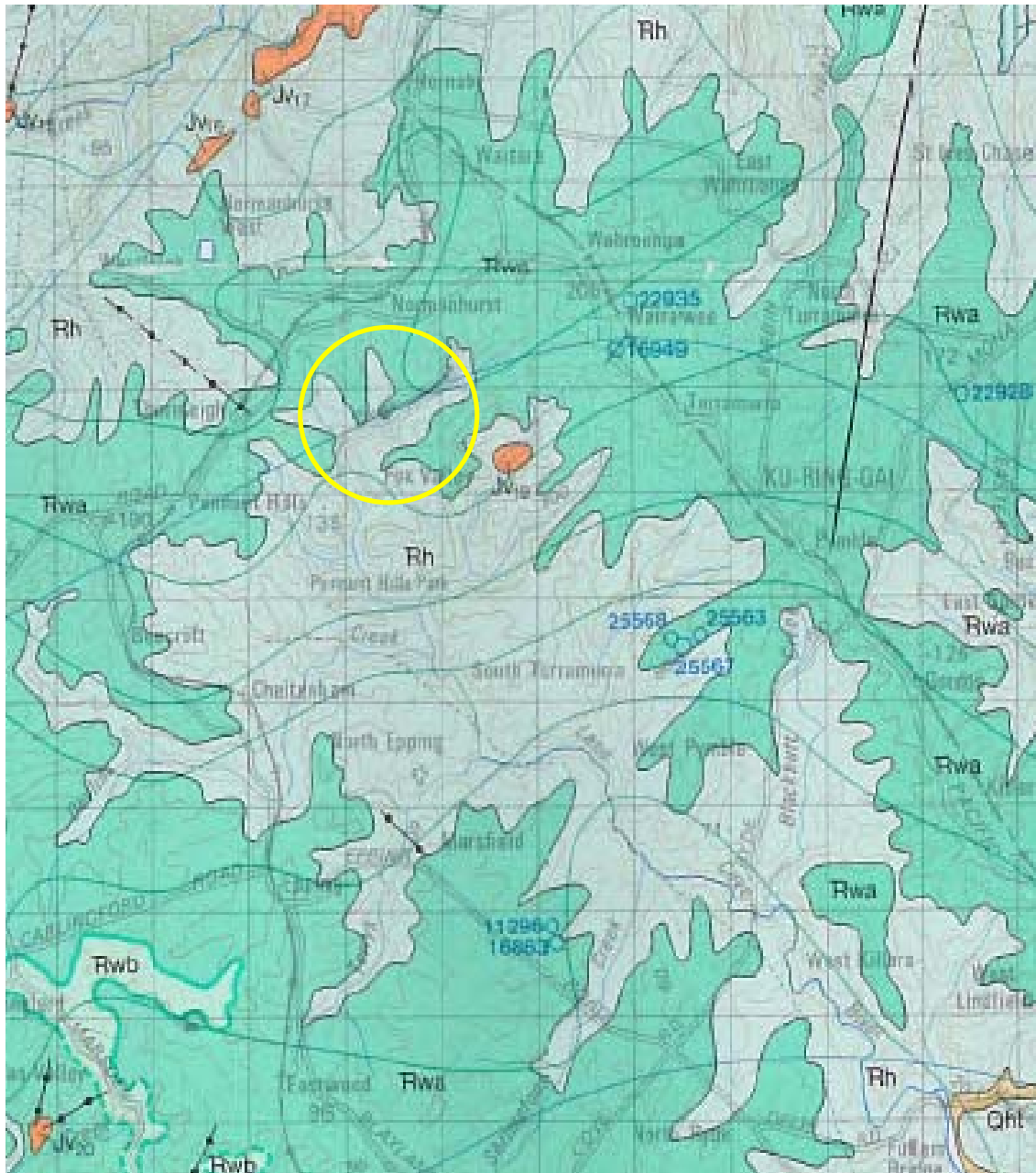


CLIENT: Johnston Property Group
 PROJECT No: 45668.00
 DATE: 27.5.2008 | SCALE: 1:400@A3 Approx.

OFFICE: SYDNEY
 DRAWN BY: PSCH
 APPROVED BY:

TITLE: Survey Plan
 Wairoonga Estate
 Fox Valley Road
 WAHROONGA

DRAWING No:
 2



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Geotechnics, Environment, Groundwater

Sydney, Newcastle,
Brisbane, Melbourne,
Perth, Wyong, Canberra

Campbelltown, Townsville,
Wollongong, Darwin, Cairns
Gold Coast, Sunshine Coast

TITLE: **Geological Map**
Wahroonga Estate, Fox Valley Road, WAHROONGA NSW

CLIENT: Johnson Property Group

OFFICE: SYDNEY

DRAWN BY: PSCH

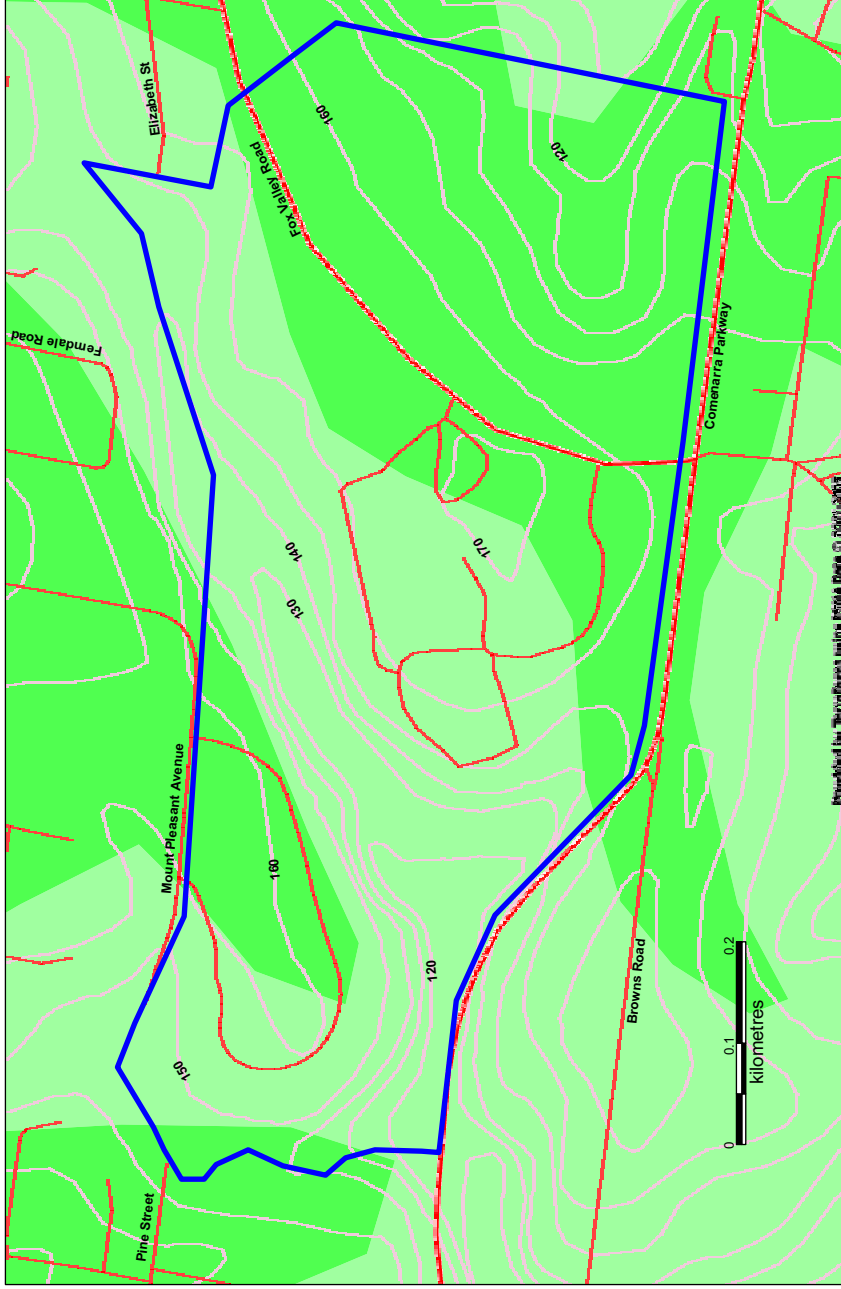
SCALE: As shown

PROJECT No: 45569.00

DRAWING No: 3




APPROVED BY:

DATE: 27.5.2008



NOTES: Contour and road data obtained from TerraPages WMS service; geological data is from Sydney 1:100,000 Geology Sheet, 1983

LEGEND

-  Approximate Site Boundary
-  Rwa - Ashfield Shale: black to dark-grey shale and laminite
-  Rh - Hawkesbury Sandstone: medium to coarse grained quartz sandstone, very minor shale and laminite lenses



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Sydney, Newcastle, Brisbane, Wollongong, Campbelltown,
 Melbourne, Perth, Wyong, Townsville, Cairns, Darwin, Canberra

Title:
 GEOLOGY MAP
 WAHROONGA ESTATE
 FOX VALLEY ROAD, WAHROONGA NSW

Client: JOHNSON PROPERTY GROUP

Drawn by: ALT

Project Number: 45569.00

Approved by:

Date: 21 MAY 2008

Office: Sydney

Drawing No: 4