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Building 3.3/1 Dairy Street
CANBERRA. ACT 2609

Attention: **Scott Walsh**

Geotechnical & Stability Assessment
27 Gulliver Street, Brookvale

1) Introduction

This report presents a geotechnical and stability assessment report of the conditions that are likely to be encountered during the construction of a proposed new building at No. 27 Gulliver Street, Brookvale.

No detailed subsurface investigation has been undertaken on the site. The following comments are based on observations made both on-site and in the local vicinity as well as our experience with similar geotechnical environments, including geotechnical mapping of a large excavation on the adjacent property. This current assessment has been prepared on the understanding that the proposed new excavation works will need to be inspected by an experienced geotechnical engineer.

Approval for preparation of this assessment was given by Mr. Neil Ma of Walsh Architects, on behalf of the owner.

This is not a contamination assessment.

2) Topographical Conditions & Present Development

The site presently comprises a single occupancy residential property at No. 27 Gulliver Street, Brookvale.

It is located on the south eastern slope below Beacon Hill. Gulliver Street is on the lower flanks of the slope just above the Brookvale shopping area. The property is on the southern up hill side of Gulliver Street, close to the intersection with Consul Road to the west. It is situated some 660 m north of the Warringah Mall shopping centre. In this area the land generally falls down to the east.

The existing development comprises a single storey residence situated close to the northern end of the property. The building is of brick construction. The remaining area is grassed, paved or covered with gardens. No obvious distress was observed in the external walls of the house during our inspection.

Adjacent development includes a three storey block of units on the lot to the east. This structure extends to within 3 m of the common boundary. It appears to be in generally good condition. At the time of our inspection, June 2022, there was an open excavation on the lot to the west. This excavation extends up to the common boundary with No. 27. There is a two storey building to the south which is less than 1 m from the common boundary. Gulliver Street forms the northern boundary.

The lot is rectangular shaped with plan dimensions of about 12 m x 49 m. The block slopes gently down in a south east direction. There is an overall fall of less than 4.4 m, with an average slope of 5°.

2) Proposed Works

We understand that it is proposed to build a new multi occupancy residence on this property. The works will entail two stories above ground. There will be basement car parking below a large proportion of the building. A ramp will provide vehicular access to Gulliver Street to the north.

The proposed works will require excavation to a maximum depth of about 3 m.

The excavation will extend up to the common boundaries to the east and west. It will be over 6 m from the north and south boundaries. At its closest it will essentially extend up the side of the excavation on the property to the west, No. 29.

A number of retaining walls may be required as part of the new works.

4) Geotechnical Conditions

Reference to the Sydney geological series sheet, at a scale of 1:100,000, indicates that the site is underlain by the Triassic Age Hawkesbury Sandstone contained within the Wianamatta Group. Rocks within this formation comprise fine to medium grained quartz sandstone. The landform in this area is typical of that found in the Hawkesbury sandstone environment, with rock at shallow depth, some steep cliff faces and rock exposed in numerous locations.

We have inspected the recent 3.4 m deep excavation on the lot to the west. This excavation extends up to the common boundary with No. 27 and is for the full length of the proposed new basement excavation on No. 27. The exposures provide the equivalent of continuous boreholes along the total western side of this proposed new basement excavation.

The subsurface conditions comprise a thin layer of topsoil over very stiff to hard sandy clay, underlain by Hawkesbury Sandstone. The clay is a residual material derived from weathering of the underlying rock. The exposed sandstone is low to medium strength and generally competent. The eastern and western side of the excavation are presently both supported by a row of bored shoring piles. The southern end of this excavation is unsupported, standing essentially vertical for a height of just over 3 m.

On No. 29, along the common boundary with No. 27 the depth to rock below the existing ground surface varies from 1.3 m at the northern end of the lot to 1 m at the southern end of the proposed new excavation on No. 27. The shoring presently installed along this boundary on No. 29 comprise 400 mm diameter bored piers socketed into the sandstone below the base of the excavation. They are spaced at 700 mm centres along this common boundary.

All this evidence suggests that No. 27 is underlain by Hawkesbury Sandstone at shallow depth. We consider that sandstone is likely to be encountered at similar depths to that found on No. 29 next door, over most of the new construction area.

It is also likely that that the existing building to the east, No. 25, is founded on rock. This structure appears to have basement car parking. How close this basement extends to the common boundary with No. 27 in unknown.

We have observed natural cliff faces and man made cuts in the general vicinity of significant height that have stood nearly vertical with no apparent signs of instability. In some places there has been minor undercutting of the face along relatively soft shaley layers, in other locations occasional individual blocks have become dislodged along the bedding and subvertical joint planes.

5) Comments on the Geotechnical Aspects of the Proposed Development

The following comments are based on the assumption that the geotechnical conditions typically found in this part of Brookvale are representative of the subsurface conditions at this site. It is important to note that even though no boreholes have been drilled on No. 27, there is considerable information available from the excavation on the adjacent site. When making an assessment of the subsurface conditions across a site from limited information it should be recognized that unforeseen variations may occur. The data derived from our observations and experience in the area have been extrapolated across the site to form a geotechnical model and then an engineering opinion is provided about overall subsurface conditions and their likely behaviour with the proposed development. The actual conditions may differ from those inferred herein, especially below existing buildings where there may have been previous excavation work. No observation, experience or even a very detailed subsurface exploration program, no mater how comprehensive, can reveal all the subsurface details and anomalies.

5.1) Landslip Assessment

This landslip assessment has been prepared in accordance with the Northern Beaches Council 2011 LEP Planning Rules, Section E-10 Landslip Risk.

The site is located in Risk Class Zone B (slopes 5^0 to 25^0). The average slope on this site is 5^0.

Using the Council flow chart check list (Section E-10) we note:

History of Landslip	- No/Unknown
Proposed Excavation > 2m	- Yes
Proposed Fill > 2m	- No
Site Developed	- Yes
Existing Fill > 1 m	- No
Existing Excavation < 2m	- No
Natural Cliff > 3 m	- No

There are no obvious signs of slope instability in the immediate vicinity of the site. The slopes on, immediately above and below the site are gentle. It is considered that a detailed Landslip Risk

Assessment is not required and that it is unlikely that the reported proposed new works will increase the risk of instability for this site assuming the recommendations made in this report are followed.

5.2) *Excavation*

It is expected that the excavation will encounter medium strong sandstone at shallow depth, possibly at depths in the order of 1 m. Typically the Hawkesbury Sandstone's are horizontally bedded with subvertical joints. This type of profile can be observed in many places in Sydney where Hawkesbury Sandstone is exposed.

Removal of the majority of the rock would normally require the use of rock excavation equipment such as rock breakers. Based on our experience it is unlikely that small excavators alone without assistance will be able to remove any significant amount of the rock. Hydraulic breakers mounted on an excavator or hand operated jack hammers are often required to break up the majority of the rock before it can be removed using an excavator.

Care will be required to ensure that both the adjacent roadway and the immediately adjacent structures are not damaged when excavating the rock. As previously mentioned the adjacent buildings are likely to be founded on rock. Buildings bearing on rock can be highly susceptible to damage from vibrations when rock excavations are made in the immediate vicinity.

It is extremely difficult to definitively predict the effect of the above type of excavation on adjacent buildings and structures. There are various relations available that have been used to carry out such predictions, but these do not easily take account of the natural variability of rock such as Hawkesbury Sandstone. There have been many cases in Sydney where predictions based on experience or the above relationships have been proved inaccurate, and adjacent structures have been damaged. For these reasons the following comments should only be taken as a guide, particular care must be exercised when removing the rock. It is worth noting that excavation contractors often claim that they can safely excavate very close to buildings in Sydney.

Excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10 mm/sec. Vibration monitoring will be required to verify that this is achieved. However, if the contractor adopts methods and/or equipment in accordance with the recommendations in Table 1 for a ground vibration (Peak Particle Velocity) limit of 5 mm/sec, vibration monitoring may not be required.

The limits of 5 mm/sec and 10 mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 1:

TABLE 1

RECOMMENDATIONS FOR ROCK BREAKING EQUIPMENT

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 5 mm/sec		Maximum Peak Particle Velocity 10 mm/sec*	
	Equipment	Operating Limit (% of Maximum Capacity)	Equipment	Operating Limit (% of Maximum Capacity)
1.5 to 2.5	Hand operated jackhammer only	100	300 kg rock hammer	50
2.5 to 5.0	300 kg rock hammer	50	300 kg rock hammer or 600 kg rock hammer	100 50

NOTE: * Vibration monitoring is recommended for 10 mm/sec vibration limit.

At all times, the excavation equipment must be operated by experienced personnel, according to the manufacturer's instructions and in a manner consistent with minimising vibration effects.

Use of other techniques (such as rock sawing), although less productive, will reduce or possibly eliminate risks of damage to property through vibration effects transmitted via the ground.

If rock sawing is carried out around excavation boundaries for the full depth of the excavation, in not less than say 1 metre deep lifts, a small rock hammer could be used at up to 50% maximum operating capacity with an assessed peak particle velocity not exceeding 5 m/sec. Importantly this is subject to observation and confirmation by a vibration specialist or geotechnical engineer at the commencement of excavation.

We would normally recommend for a site such as this that saw cutting is carried out, at a very minimum around the perimeter of the excavation before any rock breaking is commenced even when using small rock breakers. It is reported that saw cutting was used on the adjacent site. As already mentioned care will be required when removing any detached blocks so as not to dislodge either the block behind or above, or undermine the more competent rock in the area.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments.

5.2) *Excavation Support*

Based on our experience and the condition of the present rock exposures in the immediate area it is likely that a large proportion of the excavation in rock should remain stable unsupported, at least in the short term. This assumes that all the detached blocks will be removed once the excavation has been completed. Until the new excavation is commenced and the actual conditions are exposed it is not practical to be more definitive.

The excavation should be laid back in the residual soils above the more competent rock. A maximum temporary slope of 45^0 is suggested in these materials. There is the possibility that in the long term a low height retaining wall would need to be constructed at the top of the excavation to support these shallow soil strength materials above the underlying rock. It is likely that there will be insufficient room on the east and west sides of the proposed excavation to lay the sides back.

It is important that the development to the sides are supported both during the excavation process and in the long term. The proposed excavation must not be allowed to remove support for the faces especially on the east and west sides. If there is a basement on No. 25, that like No. 29, extends up to the common boundary, then there may well be no soil strength material on these sides of the new excavation that need to be supported. If there are any existing building loads close to the edge of the new excavation, or significant soil loading above the rock, then appropriately designed shoring will need to be installed.

It is recommended that an experienced geotechnical engineer or engineering geologist observes the excavation as it progresses. At that time he will be able to recommend any support that is required for either temporary or permanent conditions and help to finalise the design of the final cut slopes and any retaining walls/support that may be required.

As noted above experience has demonstrated that near vertical cuts in the sandstone found in this area will normally remain stable for long lengths of time. An allowance should be made for the installation of some passive grouted dowels in conjunction with possibly shotcrete. Without any other information it may be appropriate to assume that up to say 20% of the face will need support. If it is necessary to provide dowels or anchors for support, depending on their location these could extend below the neighboring properties if they are required along the sides of the property. Also if shaley seams are encountered they will need to be protected from long term undercutting using shotcrete and pins or infill concrete cut into the face. An allowance for the equivalent of say one seam, possibly 200 mm thick, extending around say the perimeter of the new excavation may be appropriate. Even with the above support there is always the chance that some small blocks which are not identified during excavation will become dislodged later with time. If the exposed conditions warrant it then an alternative may be to use the proposed new structure in front of the excavation face to provide permanent support.

If it proves necessary to install shoring, such as along the eastern side of the excavation, then a similar type to that used on No. 29 may be appropriate. It is likely that bored piers socked into the underlying rock may be practical. Consideration must be given to the potential adverse effect of the outward movement of the top of cantilevered type shoring piles. This movement will occur as the shoring develops its capacity. Typically the space between the piers is supported using reinforced shotcrete.

Retaining and shoring walls supporting any significant depth of soil can be designed assuming an earth pressure coefficient of 0.4 in the soil strength materials and a nominal pressure 10 kPa in rock of medium strength or greater. If stiff retaining walls are used they should be designed for an At Rest earth pressure of 0.55 in soil strength materials. A soil density of 20 kN/m^3 and rock density of 24

kN/m^3 is recommended. A passive pressure coefficient of 6 in the competent underlying rock can be assumed.

Adequate allowance must also be made for water pressures if appropriate drainage is not included, and also for the loading affects from adjacent buildings or sloping ground. All new retaining walls should be designed by an engineer and must found on rock.

5.3) *Hydrology/Groundwater*

If groundwater is encountered in the excavation it is likely to be observed at close to the soil/rock interface, at this site along the top of the rock. No obvious groundwater seepage was observed in the excavation on the adjacent property to the west.

It is considered unlikely that the proposed works will have any obvious affect on the local hydrogeological conditions. The adjacent newer buildings are likely to bear on the underlying sandstone and thus any unlikely short term minor change in ground water level should have little observable affect on these structures.

If significant water inflows are observed during excavation then advice should be sought from an experienced geotechnical engineer.

It will likely be necessary to install some form of sump and pump arrangement in the new basement area to control the long term seepage from the adjacent rock profile as well as runoff down the driveway ramp.

5.4) *Foundations*

The site has been classified in accordance with the guidelines set out in the "Residential Slabs and Footings", AS2870-1996. Based on the expected subsurface conditions the site is classified as Stable Non Reactive (A) provided the foundations bear on the insitu sandstone.

All new foundations should be founded on rock, this will alleviate the possibility of differential settlements.

Strip or pad footings bearing on the insitu sandstone can be proportioned assuming a maximum allowable bearing pressure of 1 MPa. This again should be verified by an engineer once the actual conditions are exposed. Footings should not be located any closer than 1 m from the edge of an unsupported rock face.

FINAL COMMENT

It is concluded that a detailed slope stability/slip assessment is not required for this site.

As already noted this geotechnical assessment has been provided on the basis that the excavation will be inspected during the works to ensure that appropriate measures are taken as the actual subsurface conditions become apparent. Should the actual subsurface conditions vary from those assumed in this report a suitably experienced geotechnical engineer should review both the site and this report in the light of the construction being undertaken.

Given the above comments it is considered that:

a. The insitu Hawkesbury sandstone at this site is capable of withstanding the proposed loading from the new works

b. The insitu rock is capable of withstanding the proposed excavation, though some support may be necessary depending on the final conditions exposed

c. If the recommendations made in this report are followed then adequate protection and support will be provided for adjacent properties

d. As noted above it may be necessary to install drainage inside the new basement to control potential long term seepage and runoff

e. There are no obvious signs of instability/landslip on the site.

The attached *Notes Relating To Geotechnical Report* are an intrinsic part of this report.

We do note that we have assumed in our costing for this investigation that you, the client, will contact us by phone on a number of occasions to discuss the proposed works, especially in regards to the findings presented in this report.

Please do not hesitate to contact the writer if you would like to discuss this report.

Yours Sincerely

Michael A Adler BSc, BE, MSc, DIC, MIEAust, CPEng

NOTES RELATING TO GEOTECHNICAL REPORTS
Michael Adler & Associates

Introduction

These notes outline some of the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel using information supplied or obtained. They are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work often supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (e.g.. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (e.g.. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by Michael Adler & Associates in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for all situations such as:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.
- Interpretation by others of this report.

If these occur, Michael Adler & Associates would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, Michael Adler & Associates should be notified immediately. Early identification of site anomalies generally results in most problems being more readily resolved, and allows reinterpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, rock core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacing and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of the available subsurface information and application to design/ construction should take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements not based on specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures such as rock coring or penetration testing mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information For Tendering Purposes

It is recommended that tenderers are provided with as much geological and geotechnical information as there is available. It is best practice to provide copies of all geotechnical related reports, opinions and data.

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