KEIGHRAN GEOTECHNICS
Geotechnical • Pavements • Materials • Consulting Engineers

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Date: 4th May 2023 Your Ref: Our Ref: 23026/GK/1

Mr & Mrs Nguyen
C/- Sydney Geotechnics Pty Ltd
P.O. Box 823
HORNSBY NSW 1630

Attention: Mr S. Winter

Dear Sir,

Re: Geotechnical Assessment
Residential Re-Development
42 Homer Street - Earlwood

1. Introduction

At your request, our Mr. G. Keighran and Mr S. Winter from Sydney Geotechnics have inspected the above property on the 3rd and 12th April 2012. The property is located on the southern side of Homer Street in steeply dissected terrain which makes up the suburb of Earlwood.

The inspection was undertaken in order to assess:

* the suitability of the land for the additions to the residential dwelling with lift and pool construction
* the site stability and the necessity for site stabilisation works

and further, to make recommendations with regard to:

* the method of carrying out site development
* specific design data for the house designer/builder.

Our inspection is predominantly deductive, based on limited visual assessment, but also incorporates judgement based on experience with other sites within the Canterbury Council juristiction and the Sydney Basin Regions. The surface features, rock outcrops and vegetation of the site and adjoining land were carefully inspected with the existing excavations providing a suitable geological profile to assess the natural stability of the land in relation to the additions to the existing dwelling with lift and pool construction and garage alterations as detailed in the architectural drawings by Ergo Designs Pty Ltd.

2. Site Conditions and Proposed Re-Development

The subject property, 42 Homer Street is located on southern side about 75 metres west of the intersection with Reverview Road in Earlwood. The property is currently developed with a multi level residential dwelling above and cut in twin garages fronting Homer Street level.

The existing three (3) level dwelling is set back from the rear of the garages and outcrops of sandstone bedrock are exposed between the garages and the three (3) level dwelling of brick construction. A set up stairs rise centrally from the garage roof to the western side of the dwelling with a pathway along part of the western side where the entrace to the dwelling is located.

The property is accessed directly off Homer Street at Garage level and via a steps and a pathway from Homer Street Level to the roof of the garage and steps up to the dwelling which is roughly 3 metres above the garage roof and setback about 10 metres from the Homer Street frontage.

On the western side of the garages across the frontage a pathway and stairs lead up to the roof of the garages and the cut is supported by a 4 metre high concrete pebblecrete surfaced retaining wall butting into the side boundary wall. The dwelling is acceseds by centrally located steps leading and rising to the western side of the dwelling in the open area between the dwelling and the adjoining property to the west. .

The backyard of the dwelling I son the second level and then sterps up to the adjiing property to the south and a block retaining wall on the common boundary.

The adjoining properties with Homer Street frontages are both developed with residential dwellings, the property to the east contains a multi level rendered wall building located about 1.5 metre from the common boundary and the western side is lower with a single storey dwelling with a garage under is located within 1.5 metres of the common boundary.

The architectural drawings indictae that a new entry with stairs and a lift are proposed along the western side boundary which will require the demolition of the existing 4 metre high retaining wall and excavation into the hill side for the lift structure which is located at the front north western corner of the dwelling and modifications to the existing garages infront of the dwelling. The dwelling will also have modificates internally and on the upper level into the backyard.

3. Site Geology and Subsurface Conditions

The Ealrwood area around Homer Street is indicated on the Sydney 1:100,000 Geological Series Map as being underlain by Rh – Hawkesbury Sandstone from the Triassic Geological Period which is exposed throughout the property in the form of exposures in the stepped surface between the dwelling and the twin garages fronting Homer Street.

The exposures of the sandstone bedrock were inpected and are generally horizontal with some deviation in the bedding and jointing dipping up to 10 degrees to the east observed. The exposures are somewhat overgrowth particularly on the western side of the existing dwelling and in the backyard from poor mainteance and usage.

The proposed redevelopment will remove this vegetation to constructed the new additions and alterations to the front westerm side of the property.

4. Site Stability

In regard to the present stability of the subject property, it is considered that:

a) The existing dwelling appars to be well supported of strip footing or levelling pad founded directly on the sandstone bedrock exposed below the dwelling walls and in the cut areas. The exposures even though jointed are considered to be in a stable condition.

b) The subject property is suitable for construction of the proposed development provided that the various recommendations of this report are implemented;

c) the subject property presently has a **low risk** of experiencing instability, however, the risk increases to a **medium risk** as the property is developed with existing retaining walls are demolished and excavation occurs into the face of the slope for the lift and the new steps up the western boundary in the short term during construction.as detailed in the architectural drawings. The risk categories are defined by the classification system adopted by the Australian Geomechanics Society (refer Appendix A).

However, it should be noted that excavation works particularly associated with the construction of the Lift and side steps across the western boundary will increase the risk of instability, at least for the limited period of construction.

Providing appropriate works are implemented to provided:-

- temporary support to the existing retaining wall on the escarpment
- excavation work close to the dwelling provides appropriate measure to limit instability of the exposed sandstone bedrock
- reduce vibrations from excavation equipment

as discussed/recommended in this report, then it is considered that no greater than the presently assessed risk of instability would be applicable in the long term;

In order that the risk of instability should not be increased and to limit the impact of future construction should instability occur, the guidelines and recommendations presented in Section 7 should be observed at the site be regularly inspected by an experienced geotechnical engineer during construction.

6. Site Classification

In view of the site geology and hillside location, the proposed earthworks for the development and the stability aspects of the land, it is considered inappropriate to classify the site in terms of the reactivity (shrink/swell) behaviour of the surficial soils alone, which is the basis of AS2870 - 2011"Residential Slabs and Footings".

The inferred soil profile at this property will generally have little potential for reactive behaviour (consistent with equivalent Class A site conditions), however, the geotechnical aspects associated with slope instability will govern the site re-development.

7. Development Recommendations

Attention is drawn to the general guidelines to hillside construction and drainage provided in the Appendix B to this report. The relevant sections of these guidelines should be regarded as 'recommendations' in addition to the specific recommendations which follow.

7.1 Excavations

Assuming the inferred depth to bedrock is typically exposed or less than 1.0 metres below natural surface, excavation for the proposed lift and stairs along the western boundary will largely involve removal of topsoil, shallow sandy soils and the majority excavation in moderately weathered to fresh sandstone bedrock material which may be undertaken with small earthmoving (e.g. Kato tracked excavator) equipment. Whilst such sandstone material can often be ripped, some use of hydraulic hammers may be required with initial sawcutting, particularly for close trimming work and the lift and additional footing excavations.

A deal of care will be required to maintain the stability of any detached boulders in or created by the excavation equipment by providing temporary support such as propping.

The use excavating equipment close to dwellings on adjoining properties and close to steep escarpments may have significant damaging effect. The extend of the effect is dependant on the frequency and amplitude of the excavation equipment, the stiffness of the underlying soil or bedrock and the distance from the structure. Other factors which need to be considered are the existing structures foundations and homogeneity of the founding strata. As the distance from the source increases the chance of the presence of discontinuity's in the stiffness of the strata may create a damping effect potentially reducing the vibrations felt.

The proposed bulk excavation for the alteration should be regularly inspected by an engineer from this firm during the course of the lift and stair construction to assess the temporary stability of the escarpment and excavation faces, support to the proposed dwelling, and confirm the temporary and permanent batter slopes recommended below.

However, we would recommend that the method and size of proposed excavation equipment are advised and inspected prior to excavation being undertaken to assess their possible impact.

All unsupported permanent excavations in the in situ material and/or fill batters should be sloped back at gradients not steeper than 2H:1V (soil and extremely weathered rock) and 0.25H:1V (sandstone bedrock). Temporary excavations should be sloped back at 1H:1V (soil and extremely weathered bedrock), vertically (moderately weathered rock or better) or retained by a suitable retaining structure

To facilitate the site earthworks it would be prudent to install a temporary catch drain above the proposed excavation to divert surface run-off away from the building area during construction.

The excavation will provide an exposure of the subsurface conditions beneath the building area and it would be necessary for a geotechnical engineer from this firm to inspect the property during the course of the excavation works, in order to confirm or adjust the recommendations provided in this report.

We recommend that all natural and filled soil surfaces are grassed as soon as practical after completion of construction to prevent erosion and scouring of the surface during times of inclement weather.

7.2 Retaining Walls

Retaining wall(s) supporting any proposed excavation and filled building platforms may be constructed of sandstone rock, timber, concrete or concrete blocks suitably founded on residual soils or weathered bedrock. These walls should be designed by a suitably qualified engineer and be constructed and backfilled to provide support as soon as possible following excavation.

The design of these walls may be undertaken on the basis of the following soil/rock parameters are considered appropriate for assessing the design loads on the permanent retaining walls:

Residual clayey sands	C' = 0 kPa	Ø' = 30 degrees	Density = 22 kN/m^3
Highly weathered (or better quality) rock	C' = 0 kPa	Ø' = 45 degrees	Density = 24 kN/m^3

The wall design should allow for any surcharge loads due to sloping backfill and adjacent structural loads, which should be regarded as additional loads to the lateral earth pressure and calculated separately.

Appropriate drainage systems and free draining backfill should be provided to prevent the build-up of hydrostatic pressures behind all retaining walls. Backfill behind walls should be adequately compacted where the backfill is required to support floor slabs, perimeter paths etc.

7.3 House , Lift and Pool Footings

In view of the need to support the existing dwelling additions , lift and stair structures and swimming pool on a uniform bearing stratum and the likely 'sensitivity' of the structure to small differential movements, it will be necessary to support the entire structure on footings founded on the medium strength sandstone bedrock. As indicated in Section 3.

Excavations for a dwelling will likely result in competent (weathered sandstone or better quality) bedrock being exposed, or occurring within shallow depth of the cut surface.

All external and load-bearing/brick walls should be found on reinforced concrete footings founded in the weathered medium strength sandstone bedrock using a maximum bearing pressure of 2000 kPa. For design of supports to the pool and paved area we recommend that vertical loads are applied no closer that 0.6 metres to the edge of the

escarpment and design of anchors drilled or bolted into the sandstone bedrock in the escarpment face adopt a shaft adhesion of 200 kPa per metre length

Strip and piered footings should be founded at least 100mm into medium strength (or better quality) sandstone bedrock.

The quality of the founding stratum in all footing excavations is to be assessed by a structural or geotechnical engineer to confirm that the design parameters recommended in this report are appropriate. Footing excavations are to be cleaned out and inspected by a geotechnical engineer or the consulting design engineer prior to concrete placement. Concrete is to be placed within 24 hours of excavation, since the weathered bedrock may deteriorate rapidly upon exposure.

7.4 Drainage

All house roofwater and stormwater should be collected and piped to the Council stormwater system.

A combined stormwater catch-drain/subsoil drain system should be installed to intercept and divert surface flow and seepage away from the high side of the building area. The drains should preferably be installed prior to construction and ultimately connect to the house stormwater system.

Household effluents, and other liquid wastes should be removed from the site by the mains sewer.

8. General

It is to be noted that the recommendations, comments and opinions expressed in this report are based on predominantly visual assessment and a limited amount of analysis. Should the scope of the development works planned vary significantly from the residential structure detailed in the architectural drawings, then further geotechnical advice should be obtained.

Yours faithfully,
KEIGHRAN GEOTECHNICS
per:

_____
G.D. KEIGHRAN BE MIE(Aust)
Director - Principal Engineer

Attachments
Appendix A - Photographs taken during Inspections
Appendix B - Important Information about your Stability Assessment Report
Appendix C - Guidelines for Hillside Construction

APPENDIX A

Photo 1 - Looking towards Property from across Homer Street and has two (2) garages side by side

Photo 2 - Looking at property on Left with recently renovagted neighbouring property on Right

APPENDIX A

Photo 3 - Steps leading to the dwelling from the roof of the garages over sandstone outcrops

Photo 4 - Looking up to dwelling from the garage on Homer Street

APPENDIX A

Photo 5 - Looking at sandstone bedrock and retaining walls supporting the rear southern boundary

Photo 6 - Looking at sandstone bedrock and retaining walls supporting the front access and western boundary

Photo 7 - Looking at western boundary behind existing dwelling

APPENDIX J

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

APPENDIX G

LANDSLIDE RISK ASSESSMENT – EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

Qualitative Measures of Likelihood

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur	$>\approx 10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions	$\approx 10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions	$\approx 10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances	$\approx 10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances.	$\approx 10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful	$<10^{-6}$

Note: "≈" means that the indicative value may vary by say ±• order of magnitude, or more.

Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

Note: The "Description" may be edited to suit a particular case.

Qualitative Risk Analysis Matrix – Level of Risk to Property

LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1: CATASTROPHIC	2: MAJOR	3: MEDIUM	4: MINOR	5: INSIGNIFICANT
A – ALMOST CERTAIN	VH	VH	H	H	M
B – LIKELY	VH	H	H	M	L-M
C – POSSIBLE	H	H	M	L-M	VL-L
D – UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

Risk Level Implications

Risk Level		Example Implications(1)
VH	VERY HIGH RISK	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical
H	HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels
M	MODERATE RISK	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L	LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.

(2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.

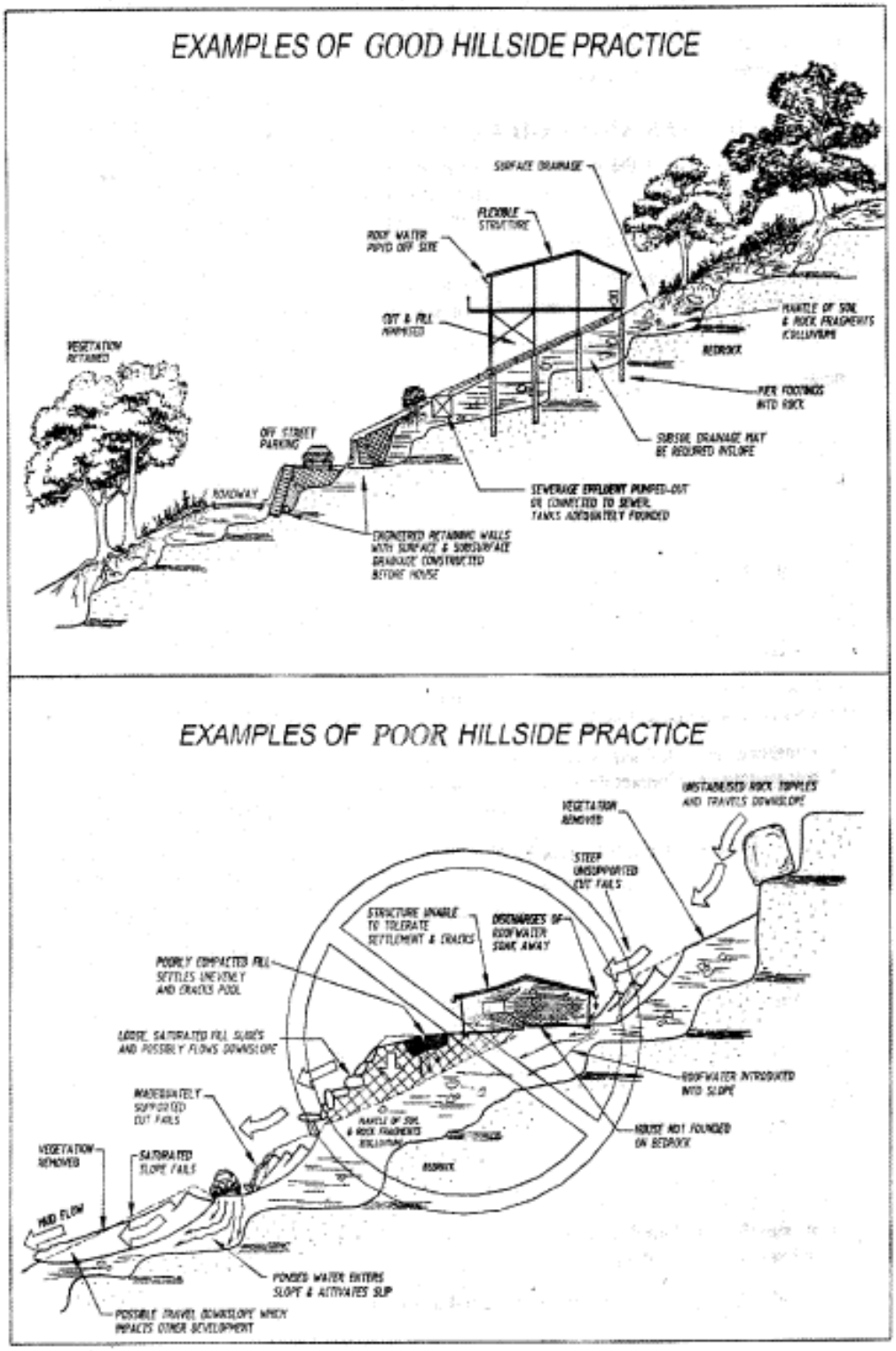

Figure J1: Illustrations of Good and Poor Hillside Practice