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GEOTECHNICAL ASSESSMENT REPORT FOR PROPOSED ALTERATIONS AND ADDITIONS AT 9 LOLITA AVENUE FORESTVILLE

1. INTRODUCTION.

1.1 This Geotechnical Assessment Report has been prepared to accompany an application for Development Approval with Northern Beaches Council - Warringah.

1.2 The methods used in this Assessment are based on those described in *Landslide Risk Management March 2007*, published by the Australian Geo-mechanics Society.

1.3 The experience of Jack Hodgson Consultants spans some 40 years in Pittwater/Warringah and the Greater Sydney area.

1.4 The site is located in land that is classified Areas B & C on the Landslip Risk Map published by Northern Beaches Council - Warringah. The methods used in this Assessment are based on those described in Landslide Risk Management March 2007, published by the Australian Geomechanics Society. Also Council checklist contained within Clause E10 of Warringah DCP and the WLEP Map identifying the Landslip Risk Class as highlighted (red) below:-

	LANDSLIP RISK CLASS *(Highlight indicates Landslip Risk Class of property)*
☐	*A Geotechnical Report not normally required*
■	*B Geotechnical Engineer (Under Council Guidelines) to decide if Geotechnical Report is required*
■	*C Geotechnical Report is required*
☐	*D Council officers to decide if Geotechnical Report is required*
☐	*E Geotechnical Report required*

2. PROPOSED DEVELOPMENT.

2.1 Construct new garage at north-eastern corner of block.

2.2 Construct new attic level covered deck.

2.3 Construct new lower ground floor extension and deck.

2.4 Demolish existing access stairs, Jacuzzi and half tennis court.

2.5 Construct new access stairs and tennis court.

2.6 Details of the proposed development are shown on a series of architectural drawings prepared by Red Rock Design, numbered DA 01-11 issue A, dated July, 2017.

3. DESCRIPTION OF SITE & SURROUNDING AREA.

3.1 The site was inspected on 13th December, 2016.

3.2 This property is located on the low side of the road and has a south-westerly aspect. From the road frontage, the slope of the land falls across the north-eastern half of the block at maximum average angles of some 10 degrees. The topography of the block is controlled by the shallow underlying sandstone bedrock. A large sandstone escarpment extends approximately north-west south-east half way along the block. Below the escarpment the average gradient of the slope continues at approximately 10 degrees.

3.3 Vehicular access to the block is via a short concrete vehicle crossing and driveway that provides access to a carport (Photo 1). The road reserve is largely level and lawn covered. A concrete inground swimming pool is situated at the northern corner of the block. The cut for the pool area is supported by a brick wall that extends along the northern boundary of the block (Photo 2). A paved patio and courtyard area extend along the northern side of the residence (Photo 3). Access to the rear of the block is via a corridor that extends along the south-eastern boundary. Timber stairs drop down to the lower yard level (Photo 4). A Hawkesbury Sandstone escarpment extends north-west south-east along the middle of the block (Photo 5). The escarpment is comprised of massive, horizontally bedded quartz sandstone. The escarpment is mildly undercut toward the base, and has a number of well-developed joints (Photo 6). A half tennis court is situated on the lower garden level (Photo 7). The slope below the tennis court is vegetated with native low shrubs.

3.5 The existing two storey brick residence is in good condition for its age. It is supported on brick walls and concrete piers that can be seen to be founded on the underlying sandstone bedrock that show no signs of cracking or movement.

4. GEOLOGY OF THE SITE.

4.1 The Sydney geological series sheet, at a scale of 1:100,000 indicates the site is underlain by Hawkesbury Sandstones which can be seen outcropping on site. These sandstones are of Middle Triassic age and were probably laid down in braided streams. The sand grains are mainly quartz with some sand grade claystone fragments. There are lenticular deposits of mudstones and laminates which are thought to have been deposited in abandoned channels of the main streams. The sandstones generally have widely spaced sub vertical joints with some current bedding. The joint directions are approximately north/south and east/west. The beds vary in thickness from 0.5 to in excess of 5 metres.

4.2 The slope materials are colluvial at the surface and residual at depth. They consist of sandy loams over sandy clays that merge into the weathered zone of the underlying rocks at depths expected to be in the range of shallow to ~0.5 metres or deeper where filling has be carried out.

5. SUBSURFACE INVESTIGATION.

Due to the presence of outcropping sandstone across the block no subsurface investigation was deemed necessary.

6. DRAINAGE OF THE SITE.

6.1 ON THE SITE.

The site is naturally well drained.

6.2 SURROUNDING AREA.

Overland stormwater flow entering the site from the adjoining properties was not evident. Normal surface stormwater runoff will be managed by the street gutter drainage system for the road above though stormwater overflow could enter the site from above during intense or extended rainfall.

7. GEOTECHNICAL HAZARDS.

7.1 ABOVE THE SITE.

No geotechnical hazards likely to affect the subject property were observed above the property.

7.2 ON THE SITE.

The excavations required for the proposed development are considered a potential hazard (**HAZARD ONE**).

7.3 BELOW THE SITE.

No geotechnical hazards likely to adversely affect the subject property were observed below the site.

7.4 BESIDE THE SITE.

The properties beside the site are at similar elevations and have similar geomorphology to the subject property. The house and grounds of the properties beside the site were in good condition as observed from the subject property and street. No geotechnical hazards likely to adversely affect the subject property were observed beside the site.

8. RISK ASSESSMENT.

8.1 ABOVE THE SITE.

As no geotechnical hazards likely to adversely impact upon the subject site were observed above the site, no risk analysis is required.

8.2 ON THE SITE.

8.2.1 HAZARD ONE Qualitative Risk Assessment on Property

An excavation to an approximate maximum depth of 2.50m will be required for the proposed development. The bulk of this excavation is expected to be through competent Hawkesbury Sandstone bedrock at the base of the escarpment. Provided the recommendations given in Section 10 are undertaken the likelihood of the cut failing and impacting on the worksite is assessed as 'Unlikely' (10^{-4}). The consequences to property of such a failure are assessed as 'Minor' (5%). The risk to property is 'Low' (5×10^{-6}).

8.2.2 HAZARD ONE Quantitative Risk Assessment on Life

For loss of life risk can be calculated as follows:-
$\mathbf{R_{(LoI)} = P_{(H)} \times P_{(SH)} \times P_{(TS)} \times V_{(DT)}}$ (See Appendix for full explanation of terms)

8.2.2.1 Annual Probability
Competent rock is encountered at the surface in the area to be excavated.
$\mathbf{P_{(H)}}$ = 0.0001/annum

8.2.2.2 Probability of Spatial Impact
People will be working below the cut.
$\mathbf{P_{(SH)}}$ = 0.15

8.2.2.3 Possibility of the Location Being Occupied During Failure
The average worksite is taken to be occupied by 6 people. It is estimated that 1 person is below the cut for 8 hours a day, 6 days a week. It is estimated 5 people are below the cut 5 hours a day, 5 days a week.
For the person most at risk:

$$\frac{8}{24} x \frac{6}{7} = 0.29$$

$P_{(TS)} = 0.29$

8.2.2.4 Probability of Loss of Life on Impact of Failure
Based on the volume of the batter that could fail and its likely velocity when it hits the worksite, it is estimated that the vulnerability of a person to being killed below the cut when it fails is 0.2
$V_{(DT)} = 0.2$

8.2.2.5 Risk Estimation
$R_{(LoI)} = 0.0001 \times 0.15 \times 0.29 \times 0.2$
$= 0.00000087$
$R_{(LoI)} = 8.7 \times 10^{-7}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'**. Provided the recommendations given in **Section 10.2** are undertaken.

8.3 BELOW THE SITE.

As no geotechnical hazards likely to adversely impact upon the subject site were observed below the site, no risk analysis is required.

8.4 BESIDE THE SITE.

As no geotechnical hazards likely to adversely impact upon the subject site were observed beside the site, no risk analysis is required.

9. SUITABILITY OF DEVELOPMENT FOR SITE.

9.1 GENERAL COMMENTS.

The proposed development is considered suitable for the site.

9.2 GEOTECHNICAL COMMENTS.

No geotechnical hazards will be created by the completion of the proposed development in accordance with the requirements of this Report and good engineering and building practice.

9.3 CONCLUSIONS.

The site and the proposed development can achieve the Acceptable Risk Management criteria as published by the Australian Geo-mechanics Society in March 2007, provided the recommendations given in **Section 10** are undertaken.

10. RISK MANAGEMENT.

10.1. TYPE OF STRUCTURE.

The proposed structures are considered suitable for the site.

10.2. EXCAVATIONS.

10.2.1 The cuts for the proposed tennis court and surrounds and proposed lower ground floor extension will reach maximum depths of approximately 2.50 metres (tennis court) and 1.50 metres (lower ground floor extension). These are expected to be through a superficial layer of topsoil before underlying competent Hawkesbury Sandstone is found at shallow depths.

10.2.2 It is imperative that an excavation contractor with demonstrable experience on projects of this scale, and experienced with the geology of the Hawkesbury Sandstone be engaged to undertake the work.

10.2.3 Due to the proximity of the escarpment we recommend an onsite meeting be scheduled with the geotechnical engineer and the excavation contractor to approve the excavation methodology and equipment before the commencement of any significant excavations.

10.2.4 Any minor excavations in unconsolidated soils are to be battered back and kept dry during the works.

10.2.5 Temporary support may be required in the subfloor area for the lower ground floor extension. The details of this support are to be designed and approved by the structural engineer prior to any demolition or excavation works.

10.2.6 All excavation through rock must be carried out using equipment that results in minimal vibration so as not to impact on the existing structures or neighbouring properties. A Rock Saw is ideally suited for this purpose. If hydraulic picks are to be used the energy input per blow should not exceed 300 Joules. A 300kg Rock Breaker produces 250 to 600 Joules depending on the type (brand) of breaker. This should be confirmed with the manufacturer. Rock breaking should be carried out in short bursts to prevent amplification of vibration.

10.2.7 Competent sandstone bedrock may stand at sub vertical or vertical angles permanently without support, but may require additional support should geological defects such and joints, faults or clay seams be present in the rock.

10.2.8 All excavated material is to be removed from the site or supported by engineered retaining walls.

10.3. FILLS.

10.3.1 If minor filling is required all fills are to be placed in layers not more than 250 mm thick and compacted to not less than 95% of Standard Optimum Dry Density at plus or minus 2% of Standard Optimum Moisture Content.

10.3.2 The fill batters are to be not steeper than 1 vertical to 1.7 horizontal or they are to be supported by properly designed and constructed retaining walls.

10.4. FOUNDATION MATERIALS AND FOOTINGS.

It is recommended that all footings be supported on the underlying sandstone bedrock. The design allowable bearing pressures are 1.0 MPa for spread footings or shallow piers. All footings are to be founded on material of equal consistency to prevent differential settlement.

All footings are to comply with minimum setbacks from existing sewer or any other infrastructure. Infrastructure owners are to be contacted regarding all requirements and standards in relation to works in proximity to their property.

10.5. STORM WATER DRAINAGE.

Storm water generated from any new works is to be managed on site utilising On-Site Detention and a discharge system appropriate for the soil/bedrock, topographic conditions onsite.

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10.6. SUBSURFACE DRAINAGE.

Retaining walls are to be backfilled with non-cohesive free draining material and slotted pipe to provide a drainage layer immediately behind the wall. The free draining material is to be separated from the ground materials by geotextile fabric.

10.7. INSPECTIONS.

The foundation materials of all footing excavations are to be inspected and approved before concrete is placed.

11. GEOTECHNICAL CONDITIONS FOR ISSUE OF CONSTRUCTION CERTIFICATE.

It is recommended that the following geotechnical conditions be applied to Development Approval:-

The work to be completed is to be carried out in accordance with the Risk Management Report MR 30957 dated 26th July, 2017.

The Geotechnical Engineer is to inspect and approve the foundation materials of all footing excavations before concrete is placed.

12. GEOTECHNICAL CONDITIONS FOR ISSUE OF OCCUPATION CERTIFICATE.

The Geotechnical Engineer is to certify the following geotechnical aspects of the development:-

The work to be completed was carried out in accordance with the Geotechnical Assessment Report MR 30957 dated 26th July, 2017.

The Geotechnical Engineer has inspected and approved the foundation materials of all footing excavations before concrete was placed.

13. RISK ANALYSIS SUMMARY.

HAZARDS	**Hazard One**
TYPE	The excavations required for the proposed development are considered a potential hazard.
LIKELIHOOD	'Unlikely (10^{-4})
CONSEQUENCES TO PROPERTY	'Minor' (5%)
RISK TO PROPERTY	'Low (5×10^{-6})
RISK TO LIFE	8.7×10^{-7}/annum
COMMENTS	This level of risk is **'ACCEPTABLE'** provided the conditions in **Section 10** are followed.

JACK HODGSON CONSULTANTS PTY. LIMITED.

Peter Thompson MIE Aust CPEng
Civil/Geotechnical Engineer

Photo 1

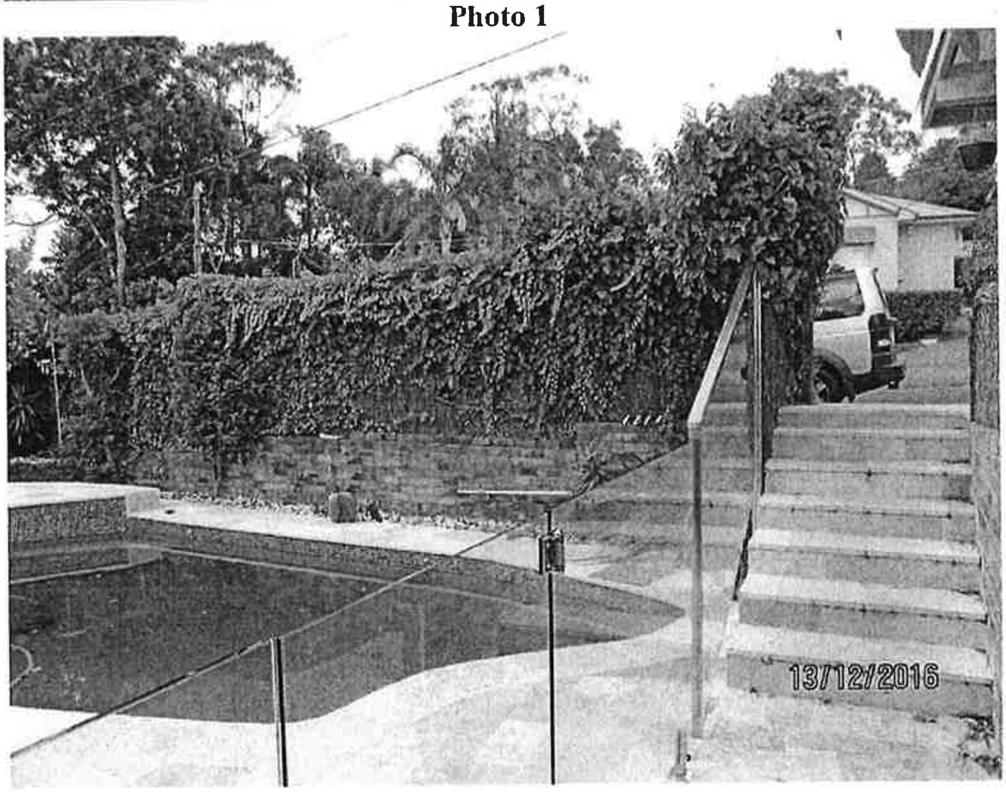
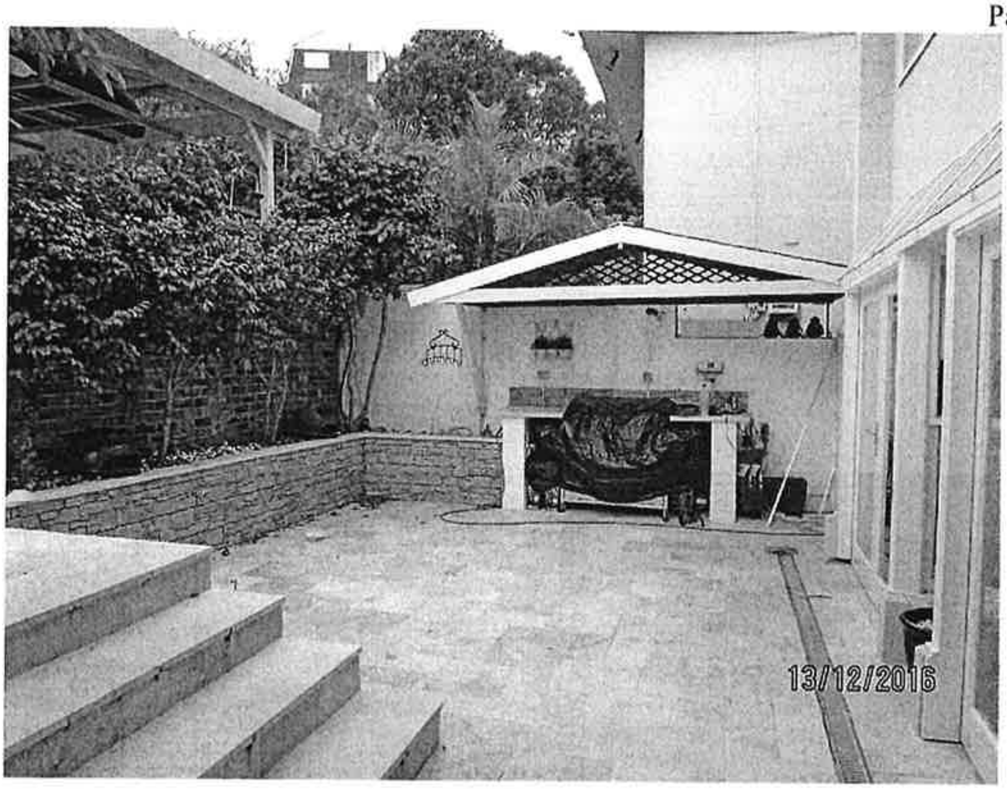


Photo 2



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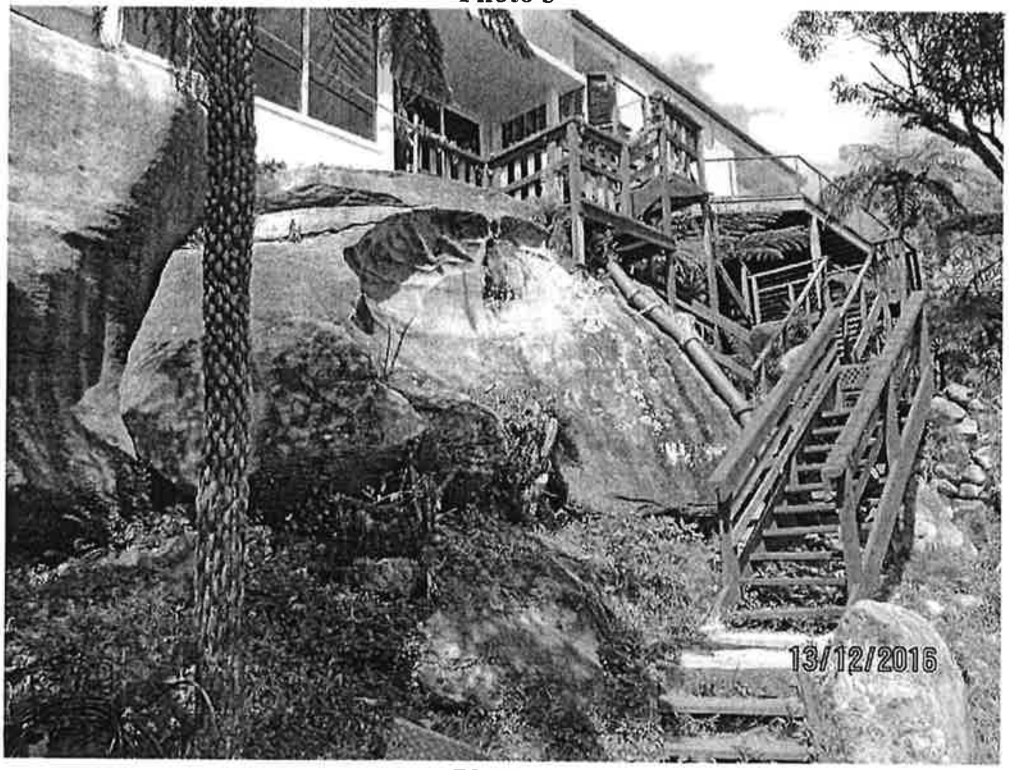

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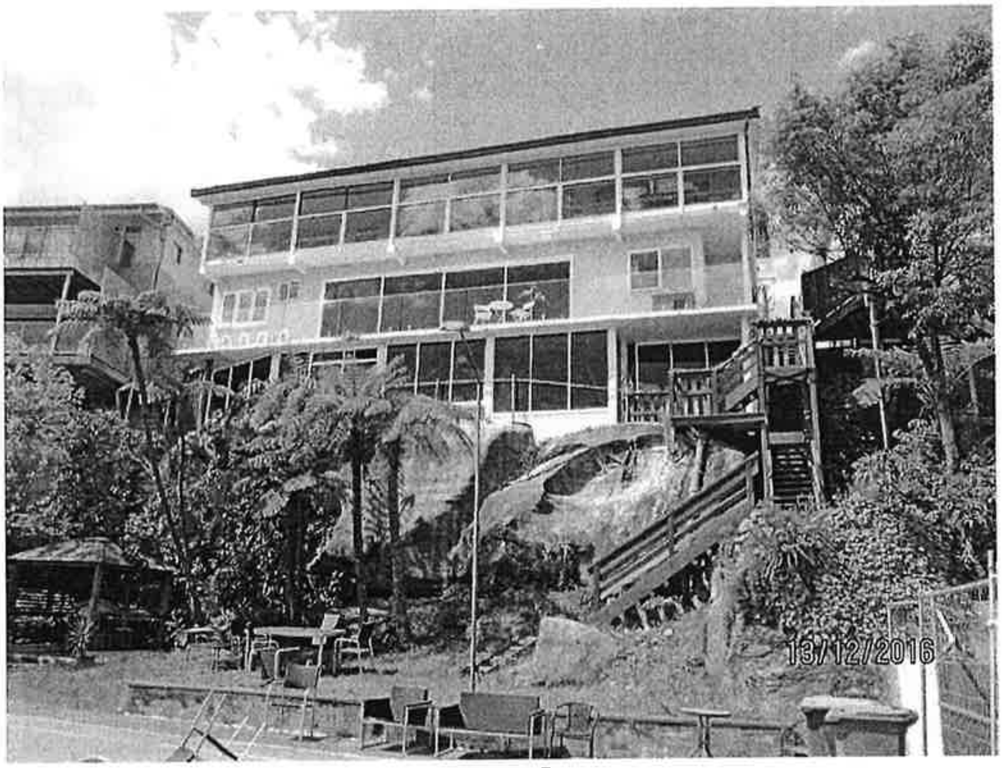


Photo 5

Photo 6

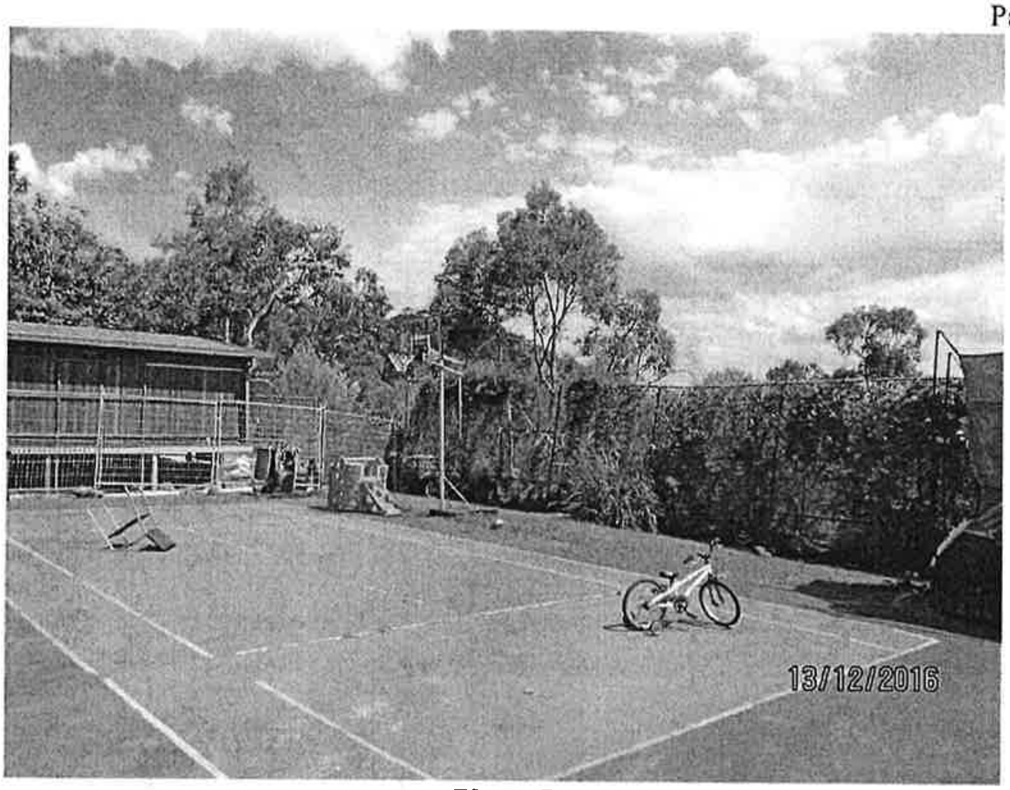
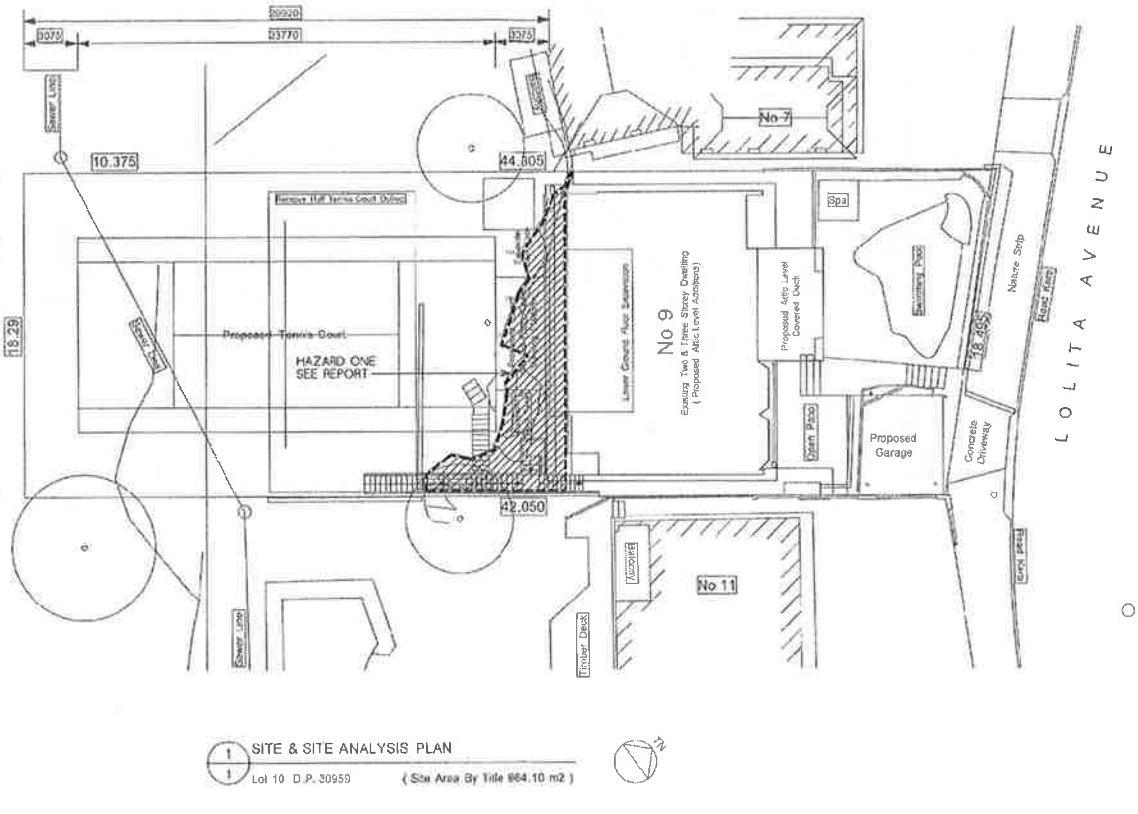


Photo 7



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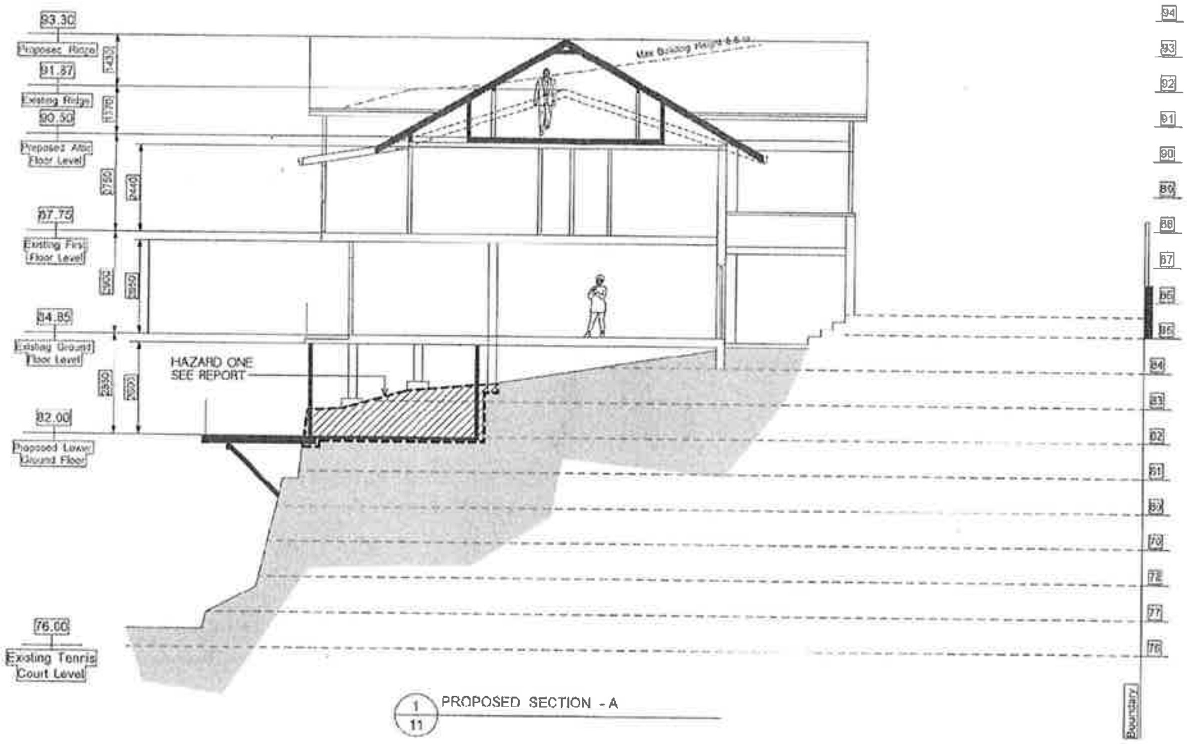
SITE PLAN - HAZARD LOCATIONS	
Job No MR 30957	Address 9 LOLITA AVENUE
Scale NTS	FORESTVILLE NSW



PROPOSED SECTION - A

NOTE
INTERPRETED SUB SURFACE SECTION ONLY.
ACTUAL GROUND CONDITIONS MAY VARY.

Jack Hodgson Consultants Pty Limited		TYPE SECTION		Strata Profile Legend
		Job No: MR 30957	Address: 9 LOLITA AVENUE FORESTVILLE NSW	Hawkesbury Sandstone
		Scale: NTS		

7 RISK ESTIMATION

7.1 QUANTITATIVE RISK ESTIMATION

Quantitative risk estimation involves integration of the frequency analysis and the consequences.
For property, the risk can be calculated from:
$R_{(Prop)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(Prop:S)} \times E$ (1)

Where
$R_{(Prop)}$ is the risk (annual loss of property value).

$P_{(H)}$ is the annual probability of the landslide.

$P_{(S:H)}$ is the probability of spatial impact by the landslide on the property, taking into account the travel distance and travel direction.

$P_{(T:S)}$ is the temporal spatial probability. For houses and other buildings $P_{(T:S)} = 1.0$. For Vehicles and other moving elements at risk $1.0 < P_{(T:S)} > 0$.

$V_{(Prop:S)}$ is the vulnerability of the property to the spatial impact (proportion of property value lost).

E is the element at risk (e.g. the value or net present value of the property).
For loss of life, the individual risk can be calculated from:

$R_{(LoL)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$ (2)
Where

$R_{(LoL)}$ is the risk (annual probability of loss of life (death) of an individual).

$P_{(H)}$ is the annual probability of the landslide.

$P_{(S:H)}$ is the probability of spatial impact of the landslide impacting a building (location) taking into account the travel distance and travel direction given the event.

$P_{(T:S)}$ is the temporal spatial probability (e.g. of the building or location being occupied by the individual) given the spatial impact and allowing for the possibility of evacuation given there is warning of the landslide occurrence.

$V_{(D:T)}$ is the vulnerability of the individual (probability of loss of life of the individual given the impact).
A full risk analysis involves consideration of all landslide hazards for the site (e.g. large, deep seated landsliding, smaller slides, boulder falls, debris flows) and all the elements at risk.

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

For comparison with tolerable risk criteria, the individual risk from all the landslide hazards affecting the person most at risk, or the property, should be summed.

The assessment must clearly state whether it pertains to 'as existing' conditions or following implementation of recommended risk mitigation measures, thereby giving the 'residual risk'.