Jack Hodgson Consultants Pty Limited
CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS
ABN: 94 053 405 011

GEOTECHNICAL ASSESSMENT REPORT FOR PROPOSED NEW RESIDENCE & POOL AT 10 POULTON PARADE FRENCHS FOREST

1. INTRODUCTION.

1.1 This Geotechnical Assessment Report has been prepared to accompany an application for Development Approval.

1.2 By reference to Clause E10 of Northern Beaches Council - Warringah DCP and the WLEP Landslip Risk Map, the site is located in land that is subject to Areas A & B. The methods used in this Assessment are based on those described in Landslide Risk Management March 2007, published by the Australian Geomechanics Society.

	LANDSLIP RISK CLASS *(Highlight indicates Landslip Risk Class of property)*
■ (highlighted)	*A Geotechnical Report not normally required*
■ (highlighted)	*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*

1.3 The experience of Jack Hodgson Consultants spans some 40 years in Northern Beaches Council and the Greater Sydney area.

2. PROPOSED DEVELOPMENT.

2.1 Demolish the existing residence and construct new residence.

2.2 Construct new pool near north-west corner of the property.

2.3 Details of the proposed development are shown on a series of eleven architectural drawings prepared by Hargroves Design Consultants, numbered DA-100, DA-102 to DA-107, DA-110 to DA-111, DA-113, and L-01 Revision C and dated April 2018.

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3. DESCRIPTION OF SITE & SURROUNDING AREA.

3.1 The site was inspected for the purpose of this assessment on 16th August, 2018.

3.2 The property is rectangular in shape with a northerly aspect and is situated on the low side of the road. The slope above the site rises moderately to the south-east to the high point that just above Valley View Road. From the road frontage, the block falls at maximum average angles of 8 degrees.

3.3 Vehicular access to the property is via a short concrete driveway that terminates in a single garage as part of the main residence (Photo 1). Pedestrian access to the residence is via the driveway and a concrete pathway that runs along the front of the existing residence (Photo 2). A small lawn area extends along the southern side side of the residence (Photo 2). A concrete pathway provides access along the eastern side of the residence to the rear of the property (Photo 3). A roofed timber deck is at the rear of the residence above the lawn area extends to the north of the residence (Photo 4). A lawn area to the west of the residence also provides access to the front and rear of the property (Photo 5).

3.4 The one story masonry residence is in good condition for its age. It is currently supported on brick piers and strip footings 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 of the Wianamatta Group near the transition from Hawkesbury Sandstone to shales of the same group. The Hawkesbury 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 laminites 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 loam topsoil over sandy clays and clays with rock fragments and some floaters throughout the profile. The sandy clays and clays merge into the weathered zone of the under lying rocks at depths expected to be in the range 0.5 to 1.0 metres or deeper where filling has been undertaken.

5. SUBSURFACE INVESTIGATION AND SITE CLASSIFICATION.

5.1 Four Dynamic Cone Penetrometer (DCP) test was conducted in the location shown on the site plan. The test was conducted to the Australian Standard for ground testing: AS 1289.6.3.2 – 1997 (R2013). The results of these tests are as follows:

NUMBER OF BLOWS - Conducted using a 9kg hammer, 510mm drop and conical tip				
DEPTH (m)	**DCP#1**	**DCP#2**	**DCP#3**	**DCP#4**
0.0 to 0.3	**10**	**21**	**26**	**6**
0.3 to 0.6	**20**	**23**	**40**	**26**
0.6 to 0.9	**9/0.055**	**33**	**29**	**26**
0.9 to 1.2		**35/0.170**	**16**	**23**
1.2 to 1.5			**14**	**24**
1.5 to 1.8			**24**	**6/0.010**
1.8 to 2.1			**22**	
2.1 to 2.4			**40/0.270**	
	End of Test @ 0.655m	**End of Test @ 1.070m.**	**End of Test @ 2.370m**	**End of Test @ 1.510m**

DCP TESTING NOTES:

DCP#1	9 Blows for 0.055m, double bounce then 8 blows for 0.020m. Refusal Tip – Dry with orange- red fragments
DCP#2	35 Blows for 0.170m, double bounce then 8 blows for 0.020m. Refusal Tip – Dry with orange- red fragments
DCP#3	40 Blows for 0.270m, double bounce then 8 blows for 0.015m. Refusal Tip – Dry with orange- red fragments Possible fill material or weathered rock with clay or extremely weathered seams.
DCP#4	6 Blows for 0.010m, double bounce then 8 blows for 0.010m. Refusal Tip – Dry with orange- red fragments
Further Notes	When ringing bouncing rock is not encountered, end of test occurs when there is less than 0.02m of penetration for 8 blows or danger of equipment damage is imminent. No significant standing water table was identified in our testing.

5.2 The equipment chosen to undertake ground investigations provides the most cost effective method for understanding the subsurface conditions. Our interpretation of the subsurface conditions is limited to the results of testing undertaken and the known geology in the area. While every care is taken to accurately identify the subsurface conditions on-site, variation between the interpreted model presented herein, and the actual conditions onsite may occur. Should actual ground conditions vary from those anticipated, we would recommend the geotechnical engineer be informed as soon as possible to advise if modifications to our recommendations are required.

5. SUBSURFACE INVESTIGATION AND SITE CLASSIFICATION. (Continued)

5.3 SITE CLASSIFICATION.

The natural soil profile of the existing site is classified Class M, defined as 'Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes' as defined by AS 2870 - 2011. This applies to areas where competent rock is not readily available. These competent rock areas are classified as Class A.

6. DRAINAGE OF THE SITE.

6.1 ON THE SITE.

The block is naturally well drained.

6.2 SURROUNDING AREA.

Overland stormwater flow entering the site from the adjoining properties was not evident. Normal overland runoff could enter the site from above during heavy 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 excavation for the proposed residence and swimming pool is identified as 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. GEOTECHNICAL HAZARDS. (Continued)

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.

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

8.2 ON THE SITE.

8.2.1 HAZARD ONE Qualitative Risk Assessment on Property

The excavations for the proposed residence and swimming pool have a maximum excavation depth of greater than 2.0 metres. The 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. Provided the recommendations in **Section 10** are followed the likelihood of the slope failing and impacting on the house is assessed as 'Unlikely' (10^{-4}). The consequences to property of such a failure are assessed as 'Low' (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:
$\mathbf{R_{(LoII)} = P_{(H)} \times P_{(SH)} \times P_{(TS)} \times V_{(DT)}}$ (See Appendix for full explanation of terms)

8.2.2.1 Annual Probability
No evidence of significant slope instability was identified at the time of inspection and competent rock is to be encountered at the shallow depths 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. RISK ASSESSMENT. (Continued)

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:

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

$\mathbf{P_{(TS)}} = 0.29$

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
$\mathbf{V_{(DT)}} = 0.2$

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

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.

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9. SUITABILITY OF DEVELOPMENT FOR SITE. (Continued)

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 All excavation recommendations as outlined below should be read in conjunction with Safe Work Australia's *'Excavation Work – Code of Practice'*, published March, 2015.

10.2.2 Excavations to an approximate maximum depth of ~2.5 metres are required to construct the new residence and swimming pool. The cuts are expected to be through sandy topsoil and clays before competent Hawkesbury sandstone is encountered at depths between 0.5 and 2.0 metres. The area where the swimming pool is to be excavated may contain fill or some extremely weathered rock material. This area may need to have some temporary shoring during the excavation stage.

10.2.3 Provided any soil portions of the cut are battered back and kept dry the underlying materials will stand unsupported for short periods until permanent support is in place.

10.2.4 The following parameters are recommended for the design of retaining systems. In areas where adjacent structures are set back from the property boundary by at least the depth of the excavation so that some soil movement can be tolerated, we suggest 'active' (Ka) earth pressure coefficients be used to calculate lateral pressures. Where movement cannot be tolerated, 'at rest' (Ko) earth pressure coefficients will need to be adopted. These values are shown in the table below:-

10. RISK MANAGEMENT. (Continued)

Material	Unit Weight (kN/m³)	Loan Term Drained Value ∅'	Active Ka		At Rest K_0	Passive Kp
			Temporary	Permanent		
Clayey Soils	20	29	0.3	0.35	0.52	2.9
Weathered Rock	22	N/A	0.2	0.25	0.40	250 to 1000kPa

Weathered rock passive pressure is an Ultimate design load.

10.2.5 It is anticipated that the bulk of the excavations will be achieved with a bucket or ripper. Where sandstone on the property is too hard to be excavated with a bucket, we recommend the excavation 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 500 Joules. A 300kg Rock Breaker produces 250 to 600 Joules depending on the type (brand) of breaker. This should be confirmed with the manufacturer. Any rock breaking must be carried out only after the rock has been sawed and in short bursts (2-5 seconds) to prevent the vibration amplifying. Where this is not possible then we recommend that vibration be monitored and to limit vibration effects on the adjacent structures.

The Australian Standard AS2670.2-1990 "Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)" suggests a day time limit of 8 mm/s component PPV for human comfort is acceptable.

We would suggest allowable vibration limits be set at 5mm/s PPV. It is expected that rock hammers with an approximate weight of 600-800kg will be adequate to operate within these tolerances.

10.2.6 Any new or replaced retaining walls are to be installed as soon as possible after the excavations are complete. Any cut batters once excavated are to be covered to prevent loss of moisture in dry weather and to prevent access of moisture in wet weather. Upslope runoff must be diverted from the cut faces by sandbag mounds or similar diversion works. Temporary support may be necessary for the cut batters for the disabled access platform construction depending upon the material encountered in the cuts, the likelihood of heavy rain and the length of period before permanent support is installed. The design Coefficient of Lateral Pressure is 0.6.

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10. RISK MANAGEMENT. (Continued)

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 materials left onsite will need to comply with the conditions in **Section 10.3** or be retained by an engineer designed retaining wall or structure.

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.

Hawkesbury sandstone bedrock is expected to be encountered in the range of 0.5 to 2.0m below current surface levels or deeper where filling has been undertaken. 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 piped to the existing stormwater system for the block through any water tanks or onsite detention systems that may be required by the regulating authorities. As this is a property below the streel level the disposal of stormwater should be disposed of as to not adversely affect lower properties.

10.6. SUBSURFACE DRAINAGE.

10.6.1 All retaining walls are to have adequate back wall drainage.

10. RISK MANAGEMENT. (Continued)

10.6.2 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. Standard under pool drainage will be sufficient.

10.7. INSPECTIONS.

It is essential that the foundation materials of all footing excavations 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 MT 31547 dated 20th August, 2018.

The Geotechnical Engineer is to inspect and approve the support structures for the excavations before excavations commence.

The Geotechnical Engineer is to inspect and approve the foundation materials of any additional 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 MT 31547 dated 20th August, 2018.

The Geotechnical Engineer has inspected and approved the support structures for the excavations before excavations had commenced.

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 excavation for the proposed residence and swimming pool is 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	**'Acceptable'** level of risk. Provided the recommendations in **Section 10** are followed

JACK HODGSON CONSULTANTS PTY. LIMITED.

Peter Thompson

Peter Thompson MIE Aust CPEng
Civil/Geotechnical Engineer

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

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) x **P**(S:H) x **P**(T:S) x **V**(Prop:S) x **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 risk1.0< **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) x **P**(S:H) x **P**(T:S) x **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.

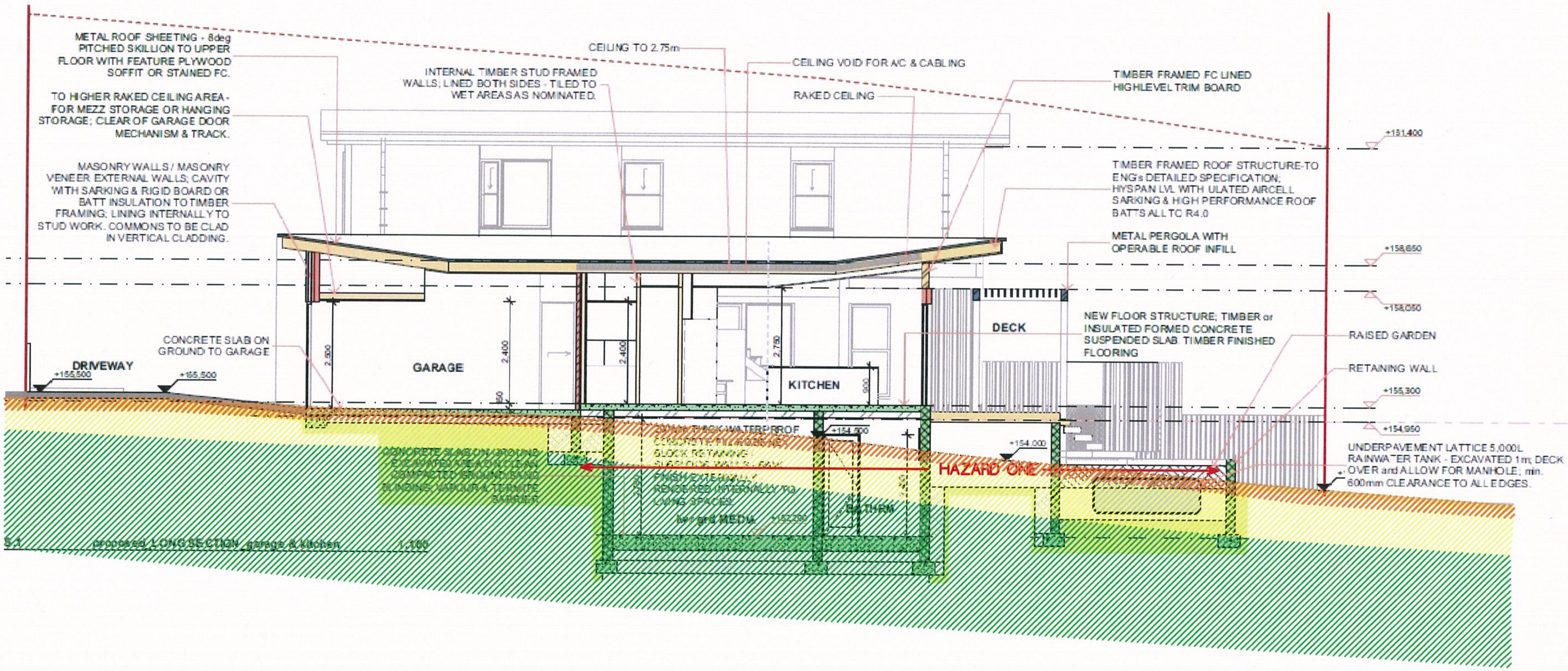
P(T:S) is the temporal spatial probability (e.g. of the building or location being occupied by the individual)
given the spatial impact and allowing for the possibility of evacuation given there is warning of the landslide occurrence.

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'.



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

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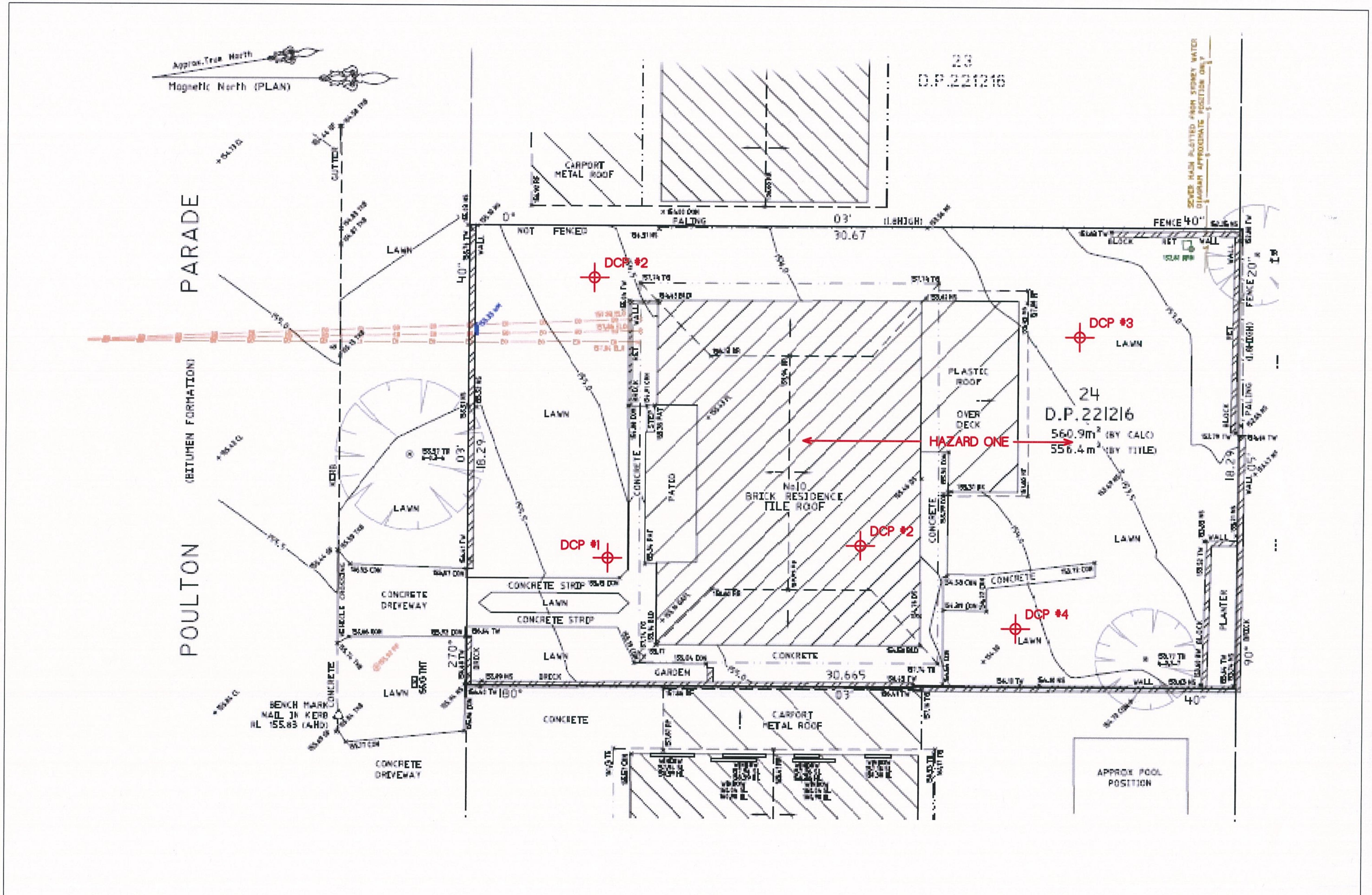
TYPE SECTION	
Job No MT 31547	Address 10 POULTON PARADE FRENCHS FOREST NSW
Scale NTS	

STRATA PROFILE LEGEND	
Fill	Narrabeen Group Rocks
Sandy Topsoil	Hawkesbury Sandstone
Sandy Clay	



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SITE PLAN - HAZARD ONE & DCP LOCATIONS	
Job No MT 31547	Address 10 POULTON PARADE FRENCHS FOREST NSW
Scale NTS	