GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

FORM NO. 1 – To be submitted with Development Application

Development Application for _____
Name of Applicant

Address of site 57 ROBERTSON ROAD, SCOTLAND ISLAND

Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report

I, Peter Thompson (insert name) *on behalf of* Jack Hodgson Consultants Pty Ltd (Trading or Company Name)

on this the 10TH APRIL, 2018 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2million.

Please mark appropriate box

☒ Prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☒ I am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☐ Have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with paragraph 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.

☐ Have examined the site and the proposed development/alteration in detail and am of the opinion that the Development Application only involves Minor Development/Alterations that do not require a Detailed Geotechnical Risk Assessment and hence my report is in accordance with the Geotechnical Risk Management Policy for Pittwater – 2009 requirements for Minor Development/Alterations.

☐ Have examined the site and the proposed development/alteration is separate form and not affected by a Geotechnical Hazard and does not require a Geotechnical report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater – 2009 requirements

☐ Provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: RISK ANALYSIS & MANAGEMENT FOR PROPOSED DUAL LEVEL COVERED VERANDAH AT 57 ROBERTSON ROAD, SCOTLAND ISLAND – MT 31454

Report Date: 10/4/2018

Author : PETER THOMPSON

Author's Company/Organisation : JACK HODGSON CONSULTANTS PTY LTD

Documentation which relate to or are relied upon in report preparation:

Architectural drawings prepared by Stephen Crosby & Associates Dwg No: 2377 DA02 to DA03A dated March 2018

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature Peter Thompson

Name Peter Thompson

Chartered Professional Status MIE Aust CPEng

Membership No. 146800

Company Jack Hodgson Consultants Pty Ltd

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements for Geotechnical Risk Management Report for Development Application

Development Application for _____
Name of Applicant
Address of site **57 ROBERTSON ROAD, SCOTLAND ISLAND**

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotechnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: RISK ANALYSIS & MANAGEMENT FOR PROPOSED DUAL LEVEL COVERED VERANDAH AT 57 ROBERTSON ROAD, SCOTLAND ISLAND– MT 31455

Report Date: 10TH APRIL, 2018

Author: PETER THOMPSON

Author's Company/Organisation: JACK HODGSON CONSULTANTS PTY LTD

Please mark appropriate box

☐ Comprehensive site mapping conducted 5-4-18 (date)

☒ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)

☒ Subsurface investigation required
- ☐ No Justification SEE REPORT
- ☒ Yes Date conducted 5-4-18

☒ Geotechnical model developed and reported as an inferred subsurface type-section

☒ Geotechnical hazards identified
- ☐ Above the site
- ☒ On the site
- ☐ Below the site
- ☐ Beside the site

☒ Geotechnical hazards described and reported

☒ Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ☒ Consequence analysis
- ☒ Frequency analysis

☒ Risk calculation

☒ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.

☒ Design Life Adopted:
- ☒ 100 years
- ☐ Other ..... specify

☒ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater – 2009 have been specified

☒ Additional action to remove risk where reasonable and practical have been identified and included in the report.

☒ Risk Assessment within Bushfire Asset Protection Zone

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated, and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature Peter Thompson

Name Peter Thompson

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CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS
ABN: 94 053 405 011

RISK ANALYSIS & MANAGEMENT FOR PROPOSED DUAL LEVEL COVERED VERANDAH AT 57 ROBERTSON ROAD SCOTLAND ISLAND

1. INTRODUCTION.

1.1 This assessment has been prepared to accompany an application for development approval. The requirements of the Geotechnical Risk Management Policy for Northern Beaches Council - Pittwater, 2009 have been met.

1.2 The definitions used in this Report are those used in the Geotechnical Risk Management Policy for Northern Beaches Council - Pittwater, 2009.

1.3 The methods used in this Assessment are based on those described in Landslide Risk Management March 2007, published by the Australian Geomechanics Society and as modified by the Geotechnical Risk Management Policy for Northern Beaches Council - Pittwater, 2009.

1.4 The experience of Jack Hodgson Consultants spans a time period over 40 years in the Northern Beaches Council area and Greater Sydney region.

2. PROPOSED DEVELOPMENT.

2.1 Construct new dual level covered verandah.

2.2 Details of the proposed development are as per architectural plans prepared by Stephen Crosby and Assoc., Plan No: 2377 – DA 02 to 2377 – DA 03, dated March 2018.

3. DESCRIPTION OF SITE & SURROUNDING AREA.

3.1 The site was recently inspected on 5th April, 2018 for purpose of this assessment.

3.2 This property is located on a moderate slope that rises from the water front towards the south. The slope continues beyond the properties on the high side of Robertson Road. The slope across the property is moderate averaging 17.2 degrees.

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3. DESCRIPTION OF SITE & SURROUNDING AREA. (Continued)

3.3 Access to the property is by water. A wooden jetty extends into Pittwater to the north from the north eastern corner of the property (Photo 1). A boat house sits next to the western side of the jetty (Photo 2). A pathway with steps leads up to the residence from the end of the jetty (Photo 3). The steps form an "S" shape and run past the western boundary in places (Photo 4). The slope is covered in grass and has several trees scattered across the front of the property. There are two tanks on the lower level beneath an existing deck area at the northern side of the residence (Photo 5). Behind these tanks are some utility rooms. Access to the rear of the property is through the residence. The dwelling is situated close to the southern boundary with water tanks between it and the boundary (Photo 6). Between the boundary and the tanks is a wooden retaining wall (Photo 6).

3.4 The two story timber house is in good condition. The supporting brick walls and piers show no signs of movement (Photo 7). No evidence of significant cracking or movement was observed at the time of our inspection.

4. GEOLOGY OF THE SITE.

4.1 Referencing the Sydney 1:100,000 Geological Series Sheet 9130 indicates the site is underlain by interbedded sandstones, siltstones and shales of the Newport Formation of the upper Narrabeen Group. The Narrabeen Group Rocks are Late Permian to Middle Triassic in age with the early rocks not outcropping in the area under discussion. The materials from which the rocks were formed consist of gravels, coarse to fine sands, silts and clays. They were deposited in a riverine type environment with larger floods causing fans of finer materials. The direction of deposition changed during the period of formation. The lower beds are very variable with the variations decreasing as the junction with the Hawkesbury Sandstones is approached. This is marked by the highest of persistent shale beds over thicker sandstone beds which are similar in composition to the Hawkesbury Sandstones.

4.2 The soil materials are sands, sandy loams and possibly some sandy fill material over thin sandy clays at the weathered interface. On this site the sandy clays merge into the weathered zone of the under lying rocks at depths expected to be in the range of shallow to 1.5m or deeper where filling has been undertaken.

5. SUBSURFACE INVESTIGATION.

5.1 Two 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:

5. SUBSURFACE INVESTIGATION. (Continued)

NUMBER OF BLOWS - Conducted using a 9kg hammer, 510mm drop and conical tip -		
DEPTH (m)	**DCP# 1**	**DCP# 2**
0.0 to 0.3	12	19
0.3 to 0.6	21	17
0.6 to 0.9	19	17
0.9 to 1.2	46	29
1.2 to 1.5	33 See Notes	74 See Notes
	End Test @ 1.352m	**End Test @ 1.49m**

DCP TESTING NOTES:

DCP#1	From 1.2m 25 blows to 1.337m, small bounce observed then 8 Blows for 0.015m Tip – Orange to red fine dust
DCP#2	From 1.2m 66 blows to 1.463 small bounce, then 8 blows for 0.027m, Test stopped due to risk of equipment damage. Tip – Cream to Orange fine dust
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.

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. Overland stormwater flow was evident on the property adjoining to the west. During heavy prolonged rain fall water may enter from this property. Normal overland flow may enter the property from the slope above.

7. GEOTECHNICAL HAZARDS.

7.1 ABOVE THE SITE.

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

7.2 ON THE SITE.

The site is classed slip affected under Council's Policy and is included in the council's H1 hazard zone. This is even though the whole block is not classified. A failure of the slope across the property is 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 areas beside the site are also classed slip affected hazard areas. These blocks have similar elevation and geomorphology to the subject property. No geotechnical hazards likely to adversely affect the subject property were observed beside the site to the south east. At the time of our inspection the property on the north western side of the property showed a lack of vegetation on some of the slope leading to the water's edge (Photos 8 & 9). Water paths were visible in the topsoil. Next to the north eastern corner boundary is a dead tree stump and root system with substantial erosion showing under the root system (Photos 10 & 11). This will require attention in the near term.

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

The slope of the land surface drops across the property at angles up to 15 degrees. The house and observable retaining structures were found to display

8. **RISK ASSESSMENT. (Continued)**

no evidence of significant cracking or movement. No evidence of significant slope instability was observed on the site. 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 'Minor' (5%). The risk to property is 'Low' (2×10^{-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
No evidence of significant movement was observed on the site.
$\mathbf{P_{(H)}} = 0.00001$/annum

8.2.2.2 Probability of Spatial Impact
The house is located toward the middle of a moderate to steep slope.
$\mathbf{P_{(SH)}} = 0.2$

8.2.2.3 Possibility of the Location Being Occupied During Failure
The average household is taken to be occupied by 4 people. It is estimated that 1 person is in the house for 20 hours a day, 7 days a week. It is estimated 3 people are in the house 12 hours a day, 5 days a week.
For the person most at risk:

$$\frac{20}{24} x \frac{7}{7} = 0.83$$

$\mathbf{P_{(TS)}} = 0.83$

8.2.2.4 Probability of Loss of Life on Impact of Failure
Based on the volume of land sliding and its likely velocity when it hits the house, it is estimated that the vulnerability of a person to being killed in the house when a landslide hits is 0.01
$\mathbf{V_{(DT)}} = 0.2$

8.2.2.5 Risk Estimation
$\mathbf{R_{(LoI)}} = 0.00001 \times 0.2 \times 0.83 \times 0.2$
$= 0.000000332$
$\mathbf{R_{(LoI)}} = 3.32 \times 10^{-7}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'**.

8. RISK ASSESSMENT. (Continued)

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.

Assessment of the tree stump mentioned in **Section 7.4** should be undertaken and appropriate action taken as necessary. It is not considered this issue provides any risk to the subject site that requires further assessment at this time. As no other 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 works are considered suitable for the site.

9.2 GEOTECHNICAL COMMENTS.

No geotechnical hazards will be created by the completion of the proposed works in accordance with the requirements of this Report.

9.3 CONCLUSIONS.

The site and the proposed development can achieve the Acceptable Risk Management criteria outlined in the Pittwater Geotechnical Risk Policy 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. RISK MANAGEMENT. (Continued)

10.2.2 Excavation of the verandah footings is expected to be through sandy soils and clays into weathered shale layers. Suitable materials for footings are expected to be found at approximate depths of 1.3m below current ground levels. See note below regarding soil conditions on site.

10.2.2 The cut batter of any unconsolidated portion of the cut, if exposed for an extended period, is to be covered to prevent loss of moisture in dry weather and to prevent excess 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 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 for the soil portion of the cut is 0.6. All temporary shoring will need to be discussed with the Geotechnical engineer before excavation works commence.

10.2.4 All excavated material removed from site is to be removed from the site in accordance with current Office of Environment and Heritage (OEH) regulations

Note: The Sydney geological series sheet, at a scale of 1:100,000 indicates the site is underlain by Newport formation, siltstones and shales of the Narrabeen Group. The local geology is comprised of highly variable interbedded clays, shales and sandstones. Conditions may alter significantly across short distances. This variability should be anticipated and accounted for in the design and construction of any new foundations.

10.3. FILLS.

10.3.1 If 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. FOUNDATIONS, FOOTINGS AND SITE CLASSIFCATION

10.4.1 It is recommended that footings are to be supported on and/or potted into the underlying weathered rock, using piers as necessary. The design allowable bearing pressures are 600 kPa for spread footings or piers. All footings are to be founded on material of similar consistency to minimise potential for differential settlement. It is expected that this material will be

10. RISK MANAGEMENT. (Continued)

encountered at approximate depths of 1.5m, though may be deeper. Alternatively, only for the lightweight timber deck structure, these footings may be supported on the stiff clays with design allowable bearing pressures of 300 kPa found approximately 0.9 metres below the surface but minor differential settlement may be possible.

10.4.2 We would recommend the site be classified as 'Class M' as outlined in AS 2870. Class M is defined as moderately reactive clay or silt sites which can experience moderate ground movement from moisture changes.

10.5. STORM WATER DRAINAGE.

Any storm water generated from any new works is to be piped to the existing street storm water system for the block through any water tanks, onsite detention or dispersion systems that may be required by the regulating authorities.

10.6. SUBSURFACE DRAINAGE.

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

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

10.7. INSPECTIONS.

It is essential that the foundation materials of any new footing excavations be inspected and approved by the geotechnical engineer before concrete is placed.

REPORT CONTINUED ON NEXT PAGE

11. GEOTECHNICAL CONDITIONS FOR ISSUE OF CONSTRUCTION CERTIFICATE.

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

The work is to be carried out in accordance with the Risk Management Report MT 31455 dated 10th April, 2018.

The Geotechnical Engineer is to inspect and approve the foundation materials of any new 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 was carried out in accordance with the Risk Management Report MT 31455 dated 10th April, 2018.

The Geotechnical Engineer inspected and approved the foundation material of any new footing excavations.

13. RISK ANALYSIS SUMMARY.

HAZARDS	HAZARD ONE
TYPE	The slope that rises across the property is considered a potential hazard
LIKELIHOOD	'Unlikely' (10^{-4})
CONSEQUENCES TO PROPERTY	'Minor' (5%)
RISK TO PROPERTY	'Low' (2×10^{-6})
RISK TO LIFE	3.32×10^{-7}/annum
COMMENTS	**NOTE:** This level of risk is **'ACCEPTABLE'**.

JACK HODGSON CONSULTANTS PTY. LIMITED.

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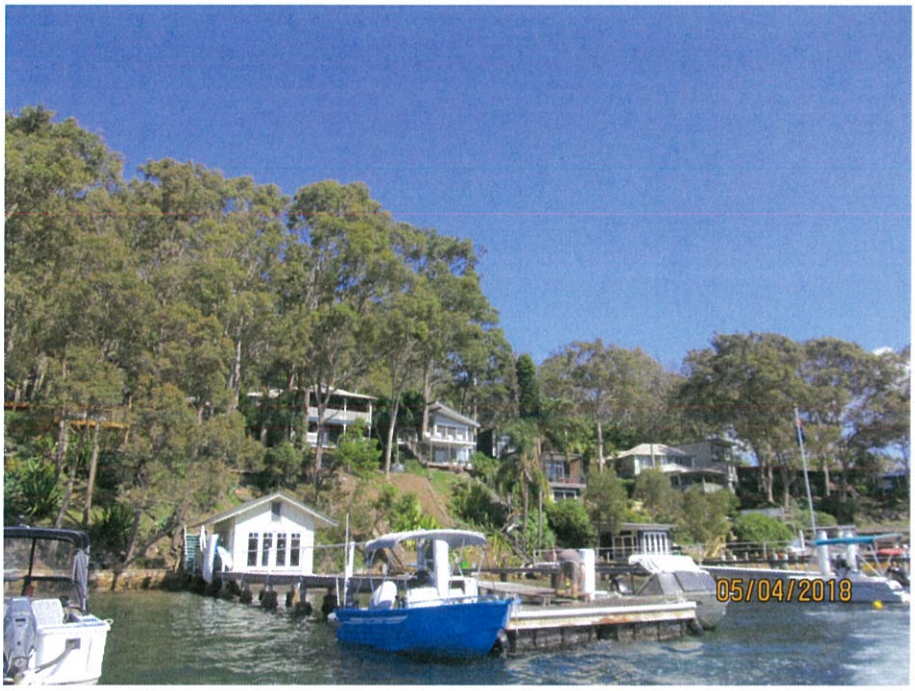


Photo 1

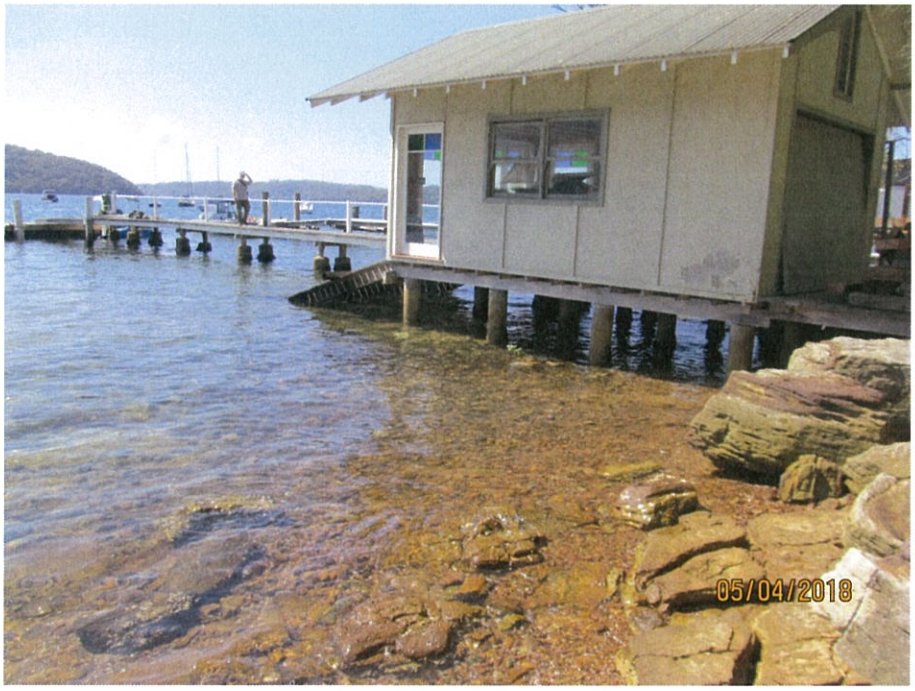


Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

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:

$$R_{(Prop)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(Prop:S)} \times E \quad (1)$$

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:

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

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.

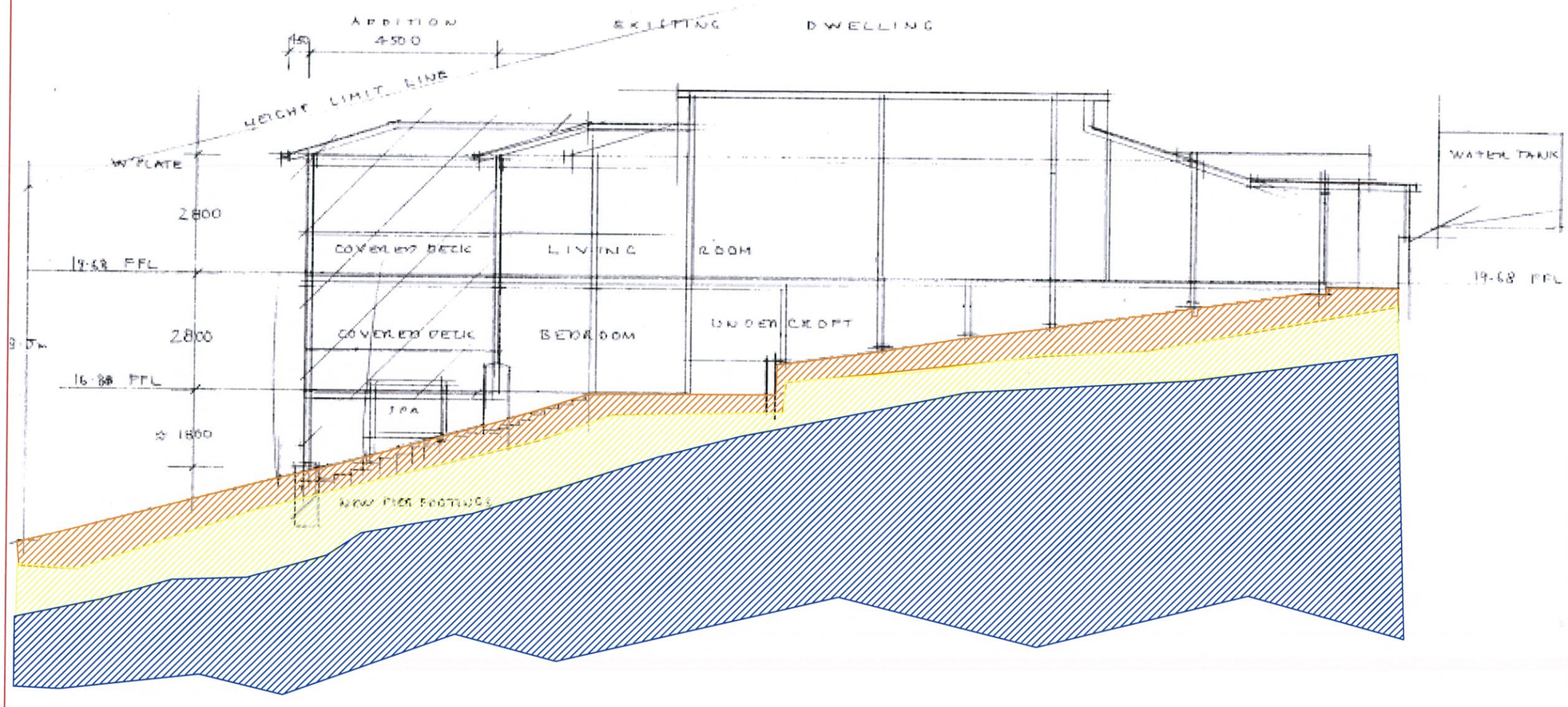
$P_{(S:H)}$ is the probability of spatial impact of the landslide impacting a building (location) taking into account the travel distance and travel direction given the event.

$P_{(T:S)}$ 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.

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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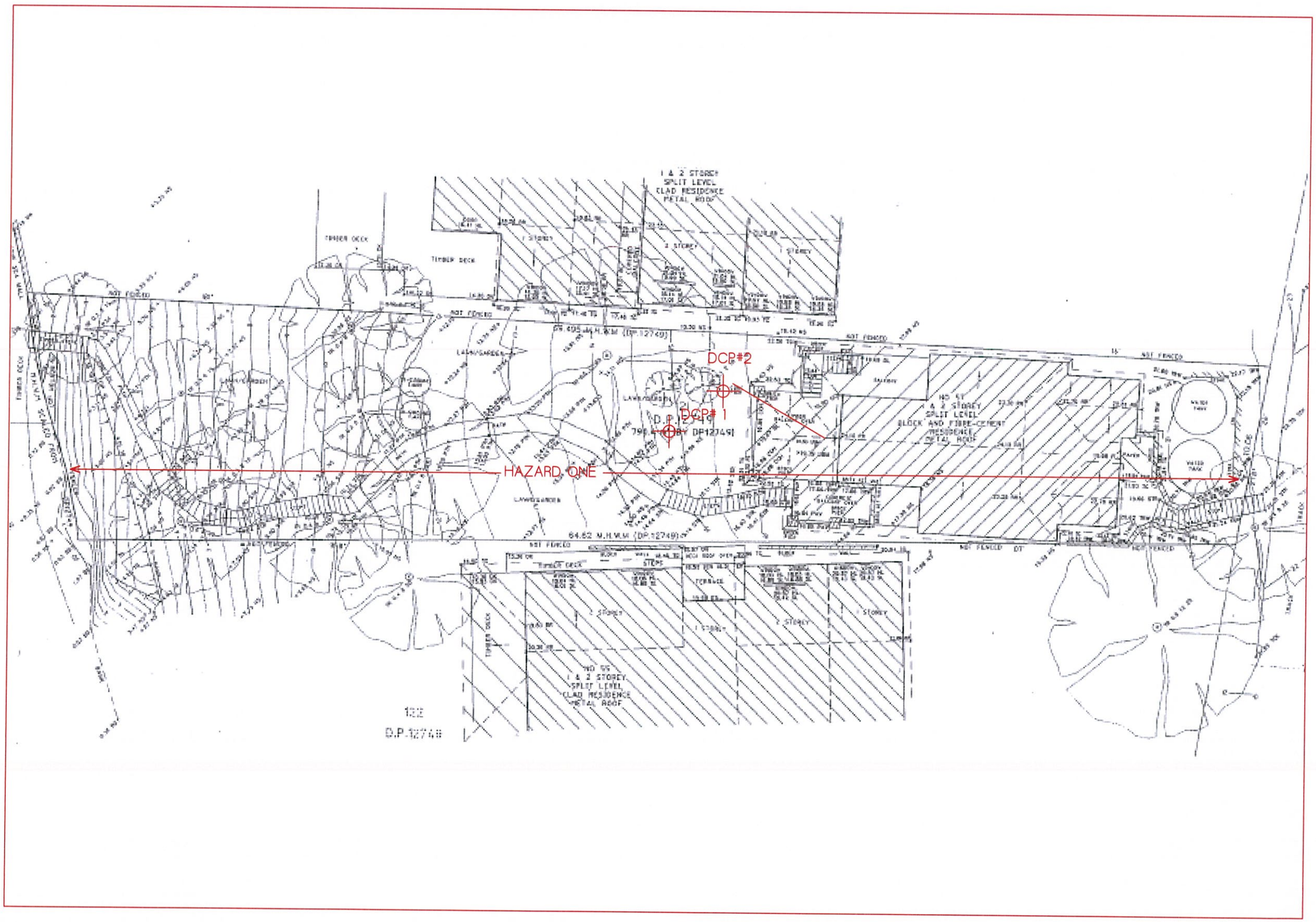
TYPE SECTION

Job No	Address
Mt 31456	57 ROBERTSON ROAD SCOTLAND ISLAND NSW
Scale NTS	

STRATA PROFILE LEGEND

- Fill
- Sandy Topsoil
- Sandy Clay
- Narrabeen Group Rocks
- Hawkesbury Sandstone



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SITE PLAN – DCP LOCATION & HAZARD ONE

Job No	Address
MT 31456	57 ROBERTSON ROAD SCOTLAND ISLAND NSW
Scale NTS	