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UPDATED RISK ANALYSIS & MANAGEMENT FOR PROPOSED ALTERATIONS & ADDITIONS AT 61 DOLPHIN CRESCENT AVALON

1. INTRODUCTION.

1.1 This assessment has been prepared to accompany an application for Section 96 with Pittwater Council, in relation to a previously approved Development Application for secondary dwelling, DA N0565/09 Approved 21/01/2010. The requirements of the Geotechnical Risk Management Policy for Pittwater, 2009 have been met.

1.2 This updated report supersedes our previous Risk Analysis and Management Report (VU 26587, dated 6/11/2009), and this report in full is to be made available to the structural engineer and building contractor before works commence.

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 Pittwater, 2009.

1.4 The experience of Jack Hodgson Consultants spans a time period over 40 years in the Pittwater area and greater Sydney Region.

2. PROPOSED DEVELOPMENT.

2.1 Modifications to approved lower ground floor secondary dwelling.

2.2 Details of the proposed development are shown on a series of architectural drawings prepared by Michael King Design numbered DA-01 – DA-05 dated 17th December, 2015.

3. DESCRIPTION OF SITE & SURROUNDING AREA.

3.1 The site was inspected on the 17th May, 2016 and previously by this firm on the 6th November, 2009, April, 2007 and October, 1998.

3.2 The property is located on the high side of the road and has a southerly aspect. The block is situated near the top of the slope that rises from Careel Bay soccer fields

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to a north-west trending ridge that runs along Whale Beach Road. From the road frontage the slope rises across the property at maximum angles of 20 degrees.

3.3 Vehicular access to the block is via a concrete driveway that rises from the southern corner of the property and terminates in a garage as part of the main residence (Photo 1). A densely vegetated garden containing small shrubs, trees and outcropping Narrabeen Group sandstones and shales rises from the road frontage and driveway toward the residence (Photo 1). A paved pathway extends along the southern corner of the residence. While considered stable in its current condition, the pathway displays evidence of settlement and movement (Photo 2). A set of masonry stairs provides access along the south-eastern side of the residence (Photo 3). A paved pathway extends along the north-eastern side of the residence (Photo 4). A stable masonry retaining wall extends along the northern side of the residence and supports the cut for a garden that rises to the northern boundary of the residence (Photos 4 & 5). A series of treated timber stairs rises from the northern corner of the residence and provides access to an average sized garden vegetated with small shrubs and trees (Photo 6). A set of concrete stairs provides access along the north-western side of the residence (Photo 7). While considered stable in its current condition, the stairs display evidence of cracking and movement.

3.4 The existing, two storey, masonry house is in average condition for its age. It is supported by masonry walls and brick piers that display some signs of cracking or movement (Photo 8 & 9).

4. GEOLOGY OF THE SITE.

4.1 The site is underlain by the variable interbedded sandstones, siltstones and shales of the 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 slope materials are colluvial in origin at the surface and become residual with depth. They consist of topsoil over sandy clays and clays that merge into the weathered rock at depths varying from 0.50 to 1.5 metres or deeper where filling has been carried out.

5. SUBSURFACE INVESTIGATION

Due to the existing exposed cut batters in the subfloor area, no subsurface investigation was deemed necessary.

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 adversely affect the subject property were observed above the site.

7.2 ON THE SITE.

7.2.1 By reference to Pittwater Councils Geotechnical Hazard mapping, the block is identified as an H1 Hazard Zone. The slope of the land surface that falls across the property is considered a potential hazard (**HAZARD ONE**).

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

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.

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

From the road frontage the slope of the land rises across the property at maximum average angles of 20 degrees. While considered stable in their current condition, evidence of minor cracking was evident within some of the masonry supporting walls of the residence and signs of settlement and movement could be seen in the stairs extending along the north-western side of the property and paved pathway situated near the southern corner of the residence. The likelihood of the slope failing 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
No evidence of significant slope instability was detected onsite.
$\mathbf{P_{(H)}} = 0.0001$/annum

8.2.2.2 Probability of Spatial Impact
The house is situated towards the toe of a moderate 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 failing and its likely velocity when it impacts the house, it is estimated that the vulnerability of a person to being killed when the slope fails is 0.01

$V_{(DT)} = 0.01$

8.2.2.5 Risk Estimation

$R_{(Lol)} = 0.0001 \times 0.2 \times 0.83 \times 0.01$

$= 0.000000166$

$R_{(Lol)} = 1.66 \times 10^{-7}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'** provided the recommendations given in **Section 10** are followed.

8.2.3 HAZARD TWO Qualitative Risk Assessment on Property

The cut for the proposed lower ground floor secondary dwelling will reach maximum depths of approximately 2.5 metres. 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}).

8.2.4 HAZARD TWO Quantitative Risk Assessment on Life

For loss of life risk can be calculated as follows:

$R_{(Lol)} = P_{(H)} \times P_{(SH)} \times P_{(TS)} \times V_{(DT)}$ (See Appendix for full explanation of terms)

8.2.4.1 Annual Probability

Provided any soil portions of the cut are battered back and kept dry, batter failure is considered unlikely.

$P_{(H)} = 0.0001$/annum

8.2.4.2 Probability of Spatial Impact

People will be working below the cut.

$P_{(SH)} = 0.3$

8.2.4.3 Possibility of the Location Being Occupied During Failure

The average domestic worksite is taken to be occupied by 5 people. It is estimated that 1 person is below the cut for 10 hours a day, 6 days a week. It is estimated 4 people are below the cut 7 hours a day, 5 days a week.

For the person most at risk:

$$\frac{10}{24} x \frac{6}{7} = 0.36$$

$P_{(TS)} = 0.36$

8.2.4.4 Probability of Loss of Life on Impact of Failure
Based on the volume of land failing and its likely velocity when it hits the work area, it is estimated that the vulnerability of a person to being killed below the cut when the batter fails is 0.1
$V_{(DT)} = 0.1$

8.2.4.5 Risk Estimation
$R_{(Lol)} = 0.0001 \times 0.3 \times 0.36 \times 0.1$
$= 0.00000108$
$R_{(Lol)} = 1.08 \times 10^{-6}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'** provided appropriate support to the existing structure is installed before the excavation commences and the recommendations given in **Section 10** 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 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.

10.2. EXCAVATIONS.

10.2.1 An excavation to an approximate maximum depth of 2.5 metres is required for the proposed works on the lower ground floor level. The cuts are expected to be through sandy topsoils and stiff clays before encountering sandstones and shales of the Narrabeen Group.

10.2.2 Underpinning of the existing structure may be required where excavations are undertaken in the subfloor of the residence. Details of any temporary support are to be outlined and approved by the structural engineer before and significant excavation or demolition occurs.

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 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. Rock breaking should be carried out on pre-sawn sections of rock and in short bursts to prevent amplification of vibration.

10.2.5 Any retaining walls to support the cut are to be installed as soon as possible after the excavation is complete. The cut batters are to be covered to prevent loss of moisture in dry weather and to prevent access of moisture in wet weather. Any potential 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.

10.2.6 All excavated material is to be removed from the site.

10.3. FILLS.

10.3.1 If minor filling is required. Any 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 the footings for the proposed development be taken to the weathered rock of the natural profile. The design ultimate bearing pressure is 800kPa for piers. It is expected that material of sufficient bearing capacity will be found approximately 0.5-1.5m from existing surface levels or deeper where filling has been undertaken. All pier excavations are to be taken to material of a similar consistency to avoid differential settlement.

10.5. STORM WATER DRAINAGE.

Any additional storm water generated from the 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.

10.6. SUBSURFACE DRAINAGE.

Any retaining walls are to be back filled with non cohesive free draining material and 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.

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 the Development Approval:-

The work is to be carried out in accordance with the Risk Management Report MR 30609 dated 17th May, 2016.

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 was carried out in accordance with the Risk Management Report MR 30609 dated 17th May, 2016.

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

13. RISK ANALYSIS SUMMARY.

HAZARDS	Hazard One	Hazard Two
TYPE	By reference to Pittwater Councils Geotechnical Hazard mapping, the block is identified as an H1 Hazard Zone. The slope of the land surface that falls across the property is considered a potential hazard.	The excavations required for the proposed development are considered a potential hazard.
LIKELIHOOD	'Unlikely' (10^{-4})	'Unlikely (10^{-4})
CONSEQUENCES TO PROPERTY	'Minor' (5%)	'Minor' (5%)
RISK TO PROPERTY	'Low'(5×10^{-6})	'Low (5×10^{-6})
RISK TO LIFE	1.6×10^{-7}/annum	1.08×10^{-6}/annum
COMMENTS	This level of risk is **'ACCEPTABLE'** provided the conditions in **Section 10** are followed.	This level of risk is **'ACCEPTABLE'** provided the conditions in **Section 10** are followed.

JACK HODGSON CONSULTANTS PTY. LIMITED.

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Photo 1

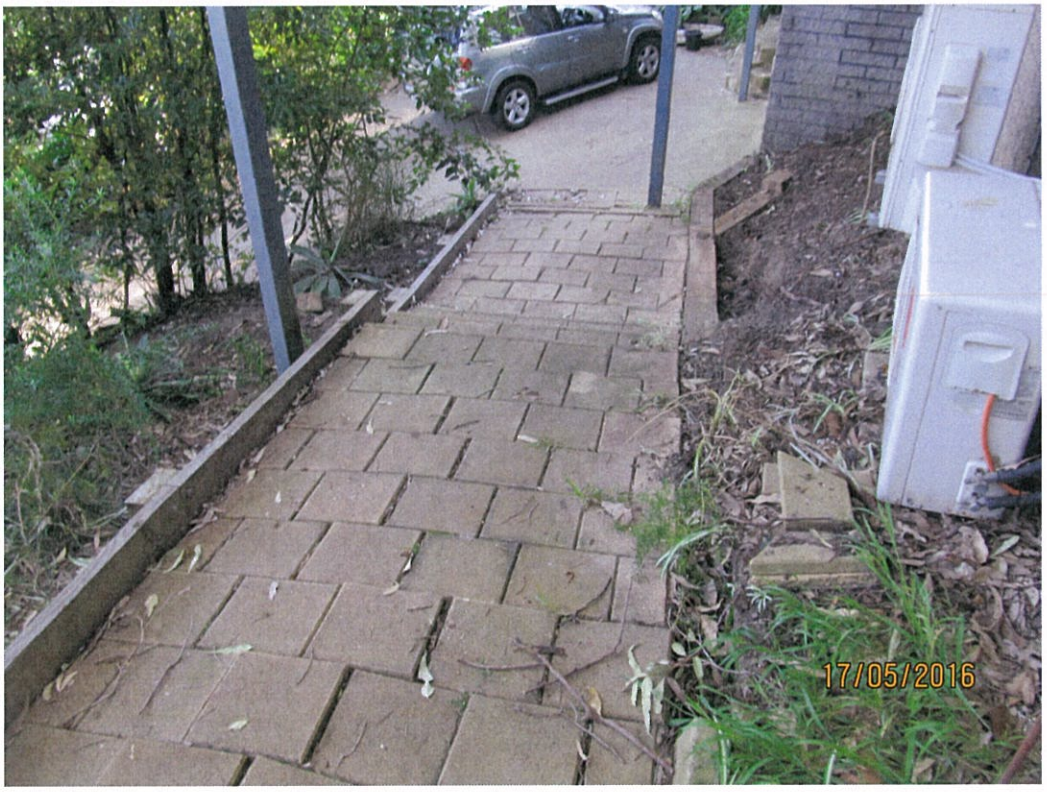

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9