GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

FORM NO. 1 – To be submitted with Development Application

Development Application for _____
Name of Applicant

Address of site 907 BARRENJOEY ROAD PALM BEACH

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 6/04/2016 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 fro 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 ALTERATIONS, ADDITIONS AND POOL AT 907 BARRENJOEY ROAD PALM BEACH
Report Date: 6/04/2016

Author : PETER THOMPSON

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

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

Drawings prepared by C+M Studio, project number 2015 058, Drawings numbered A102, A103, A109 & A110 to A07 and are dated 22nd February, 2016.

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 **907 BARRENJOEY ROAD PALM BEACH**

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 ALTERATIONS, ADDITIONS AND POOL AT 907 BARRENJOEY ROAD PALM BEACH

Report Date:6/04/2016

Author: PETER THOMPSON

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

Please mark appropriate box

☒ Comprehensive site mapping conducted 31/03/2016 (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 .....
- ☒ Yes Date conducted .....

☒ 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
Chartered Professional Status MIE Aust CPEng
Membership No. 146800
Company Jack Hodgson Consultants Pty Ltd

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

RISK ANALYSIS & MANAGEMENT FOR PROPOSED ALTERATIONS, ADDITIONS AND POOL AT 907 BARRENJOEY ROAD PALM BEACH

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 Pittwater, 2009 have been met.

1.2 The definitions used in this Report are those used in the Geotechnical Risk Management Policy for 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 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 Construct new detached extension at the eastern side of the existing residence.

2.2 Construct new inground swimming pool.

2.3 Alterations to the existing house and garage.

2.4 Details of the proposed development are shown on a set of Architectural drawings prepared by C+M Studio, project number 2015 058, Drawings numbered A102, A103, A109 & A110 to A07 and are dated 22nd February, 2016.

3. DESCRIPTION OF SITE & SURROUNDING AREA.

3.1 The site was inspected on the 31st March, 2016.

3.2 The block is situated on the low side of the road and has a westerly aspect. The property is situated towards the toe of a moderate slope that rises from the waterfront

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at Careel Bay to the crest of a north trending ridge near Bynya Road. From the road frontage the slope falls across the property at maximum average angles of some 10 degrees.

3.3 Primary vehicular access to the block is via the Thyra Road frontage. From the road frontage a short concrete vehicle crossing and driveway rise to a detached single garage situated toward the south-western corner of the block (Photo 1). The cut batter for the road was supported by a stable sandstone flagging wall. At the time of our inspection the wall was being removed and preparations for a retaining wall and fence were underway (Photo 1). A gently sloping lawn covered yard extends from the rear of the residence to the western boundary (Photo 2). The cut for the garage is supported by a stable formed concrete wall. While considered stable in its current condition, the wall shows evidence of significant cracking and failure at its south-eastern corner (Photos 3 & 4). We would recommend the wall be demolished as part of the proposed works. A paved and sandstone patio extends from the western side of the existing residence (Photo 5). Access around the house is possible along concrete pathways that extend along the northern and southern sides of the residence (Photos 6 & 7). A terraced garden area extends from the eastern side of the residence to a recently constructed timber fence (Photos 8 & 9). The paved and grassed terraces and garden beds are supported by stable concrete block walls. A clad shed is situated along the northern boundary (Photo 9). The eastern section of the block has been landscaped with the upper level terrace at road level supported by a low concrete block wall (Photos 10 & 11). Vehicular access to the block is also possible via a gate at the Barrenjoey Road frontage (Photo 12).

3.4 The part-two storey brick and clad residence is in average condition for its age. It is supported on brick walls and piers that displayed no evidence of cracking or significant movement that could be identified at the time of our inspection (Photos 13 & 14).

4. GEOLOGY OF THE SITE.

4.1 The site is underlain by interbedded sandstones, siltstones and shales 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 slope materials are colluvial at the surface and residual at depth. They consist of silty sands over sandy clays that merge into the weathered zone of the underlying rocks at depths expected to be 1.5 to 2.5 metres or deeper where filling has been carried out.

5. SUBSURFACE INVESTIGATION.

Two Dynamic Cone Penetrometer (DCP) tests were put down to determine the nature of the ground materials. The locations of these tests are shown on the site plan provided and the results of these tests are as follows:

DEPTH (m)	NUMBER OF BLOWS - conducted with Pointed Tip	
	DCP1	DCP2
0.0 to 0.3	5	5
0.3 to 0.6	6	6
0.6 to 0.9	8	11
0.9 to 1.2	4 dropped	11
1.2 to 1.5	18	13
1.5 to 1.8	36/	26
1.8 to 2.1		44/
	End of test @1.8m on Very stiff clay/weathered rock	End of test @2.1m on Very stiff clay/weathered rock

NOTES:
DCP 1: End of test @1.8m on very stiff clay/weathered rock. White/grey impact dust on dry tip
DCP 2: End of test @2.1m on very stiff clay/weathered rock. Red/maroon impact dust on dry tip.

No standing water table encountered.

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.

The slope of the land surface that falls 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.

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 falls across the property at maximum average angles of 10 degrees. No significant evidence of slope instability was identified on site. 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 gentle to 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 hits the house, it is estimated that the vulnerability of a person to being killed when the slope fails is 0.01
$\mathbf{V_{(DT)}} = 0.01$

8.2.2.5 Risk Estimation
$\mathbf{R_{(LoI)}} = 0.0001 \times 0.2 \times 0.83 \times 0.01$
$= 0.00000017$
$\mathbf{R_{(LoI)}} = 1.7 \times 10^{-7}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'** provided the recommendations given 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 developments are 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.

Subject to detailed structural design and inspection the proposed retaining walls can be considered suitable for the site.

10.2. EXCAVATIONS.

10.2.1 The excavations required to install the proposed pool will extend to an approximate maximum depth of 2.0m. The cut is expected to be through medium stiff to very stiff clays. These materials will stand unsupported for short periods until permanent support in in place provided that they are covered and upslope run off is diverted from the cut face. Any unconsolidated soil portions of the cut are to be battered back.

10.2.4 All excavated material is to be removed from site.

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 for the proposed development are supported on the underlying stiff clays. The design ultimate bearing pressures are 300 kPa for spread footings or shallow piers.

10.5. STORM WATER DRAINAGE.

All storm water runoff from the development 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.

10.6.1 Any retaining walls are to be back filled 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.

10.6.2 Normal under pool drainage is sufficient. A hydrostatic valve is to be installed at the deepest point of the pool structure

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 the Development Approval:-

The work is to be carried out in accordance with the Risk Management Report MR 30529 dated 6th April, 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.

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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 30529 dated 6th April, 2016.

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

13. RISK ANALYSIS SUMMARY.

HAZARDS	Hazard One
TYPE	The slope that falls across the property is considered a potential hazard.
LIKELIHOOD	'Unlikely' (10^{-4})
CONSEQUENCES TO PROPERTY	'Minor' (5%)
RISK TO PROPERTY	'Low' (5×10^{-6}).
RISK TO LIFE	1.7×10^{-7}/annum
COMMENTS	**NOTE:** This level of risk is **'ACCEPTABLE'** provided the recommendations given in **Section 10** are undertaken.

JACK HODGSON CONSULTANTS PTY. LIMITED.

Peter Thompson MIE Aust CPEng
Member No. 146800
Civil/Geotechnical Engineer

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

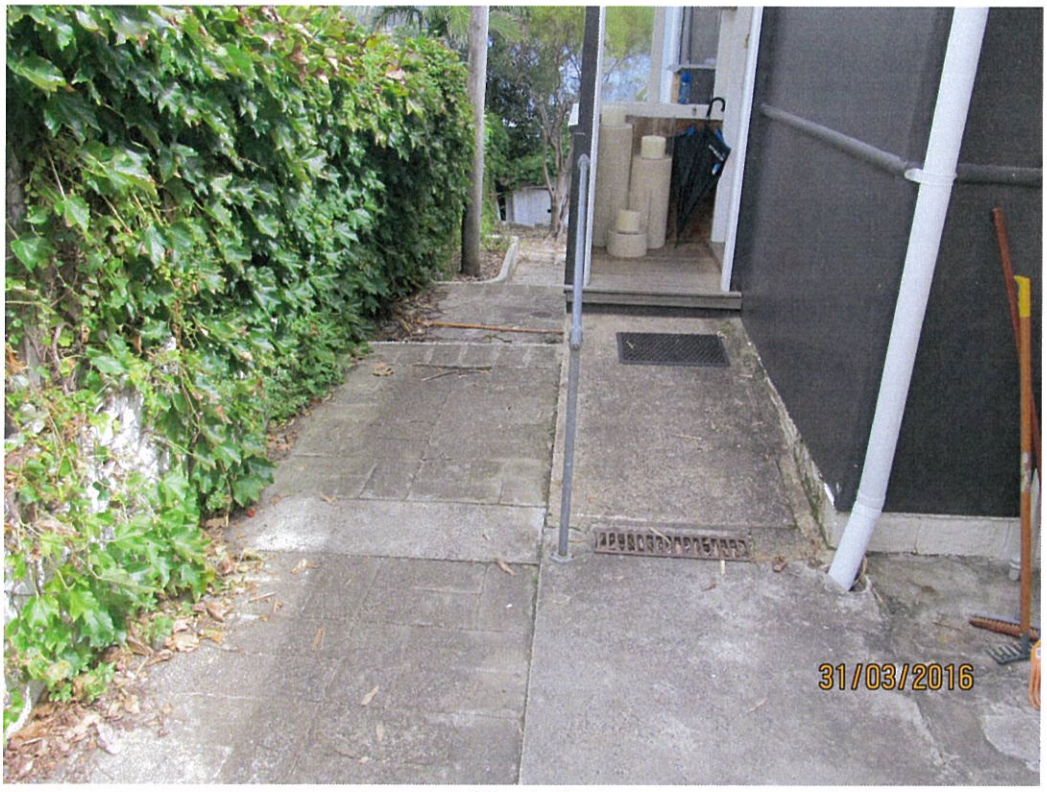


Photo 7

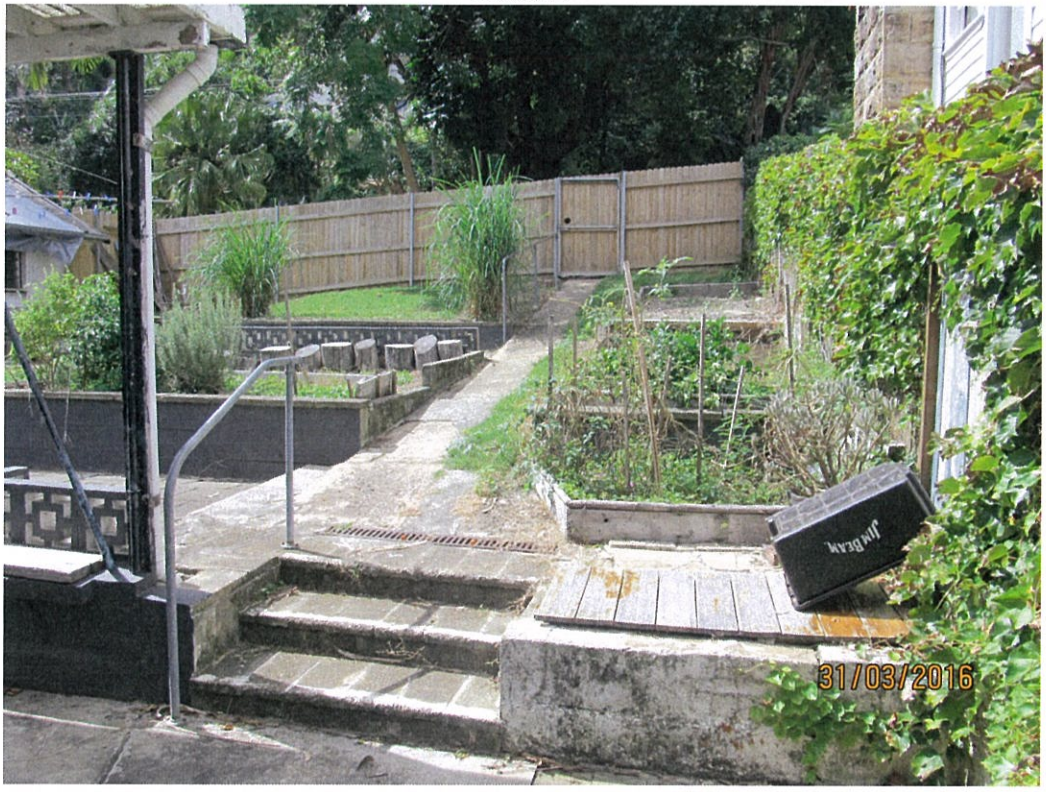


Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

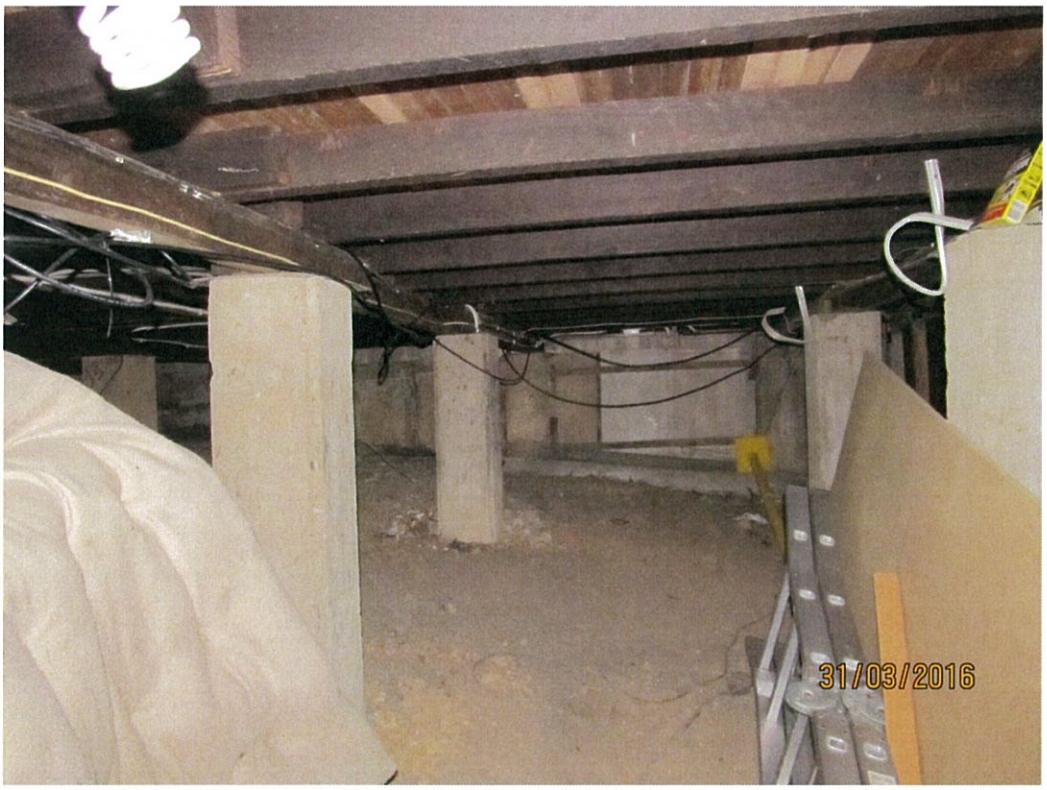


Photo 13

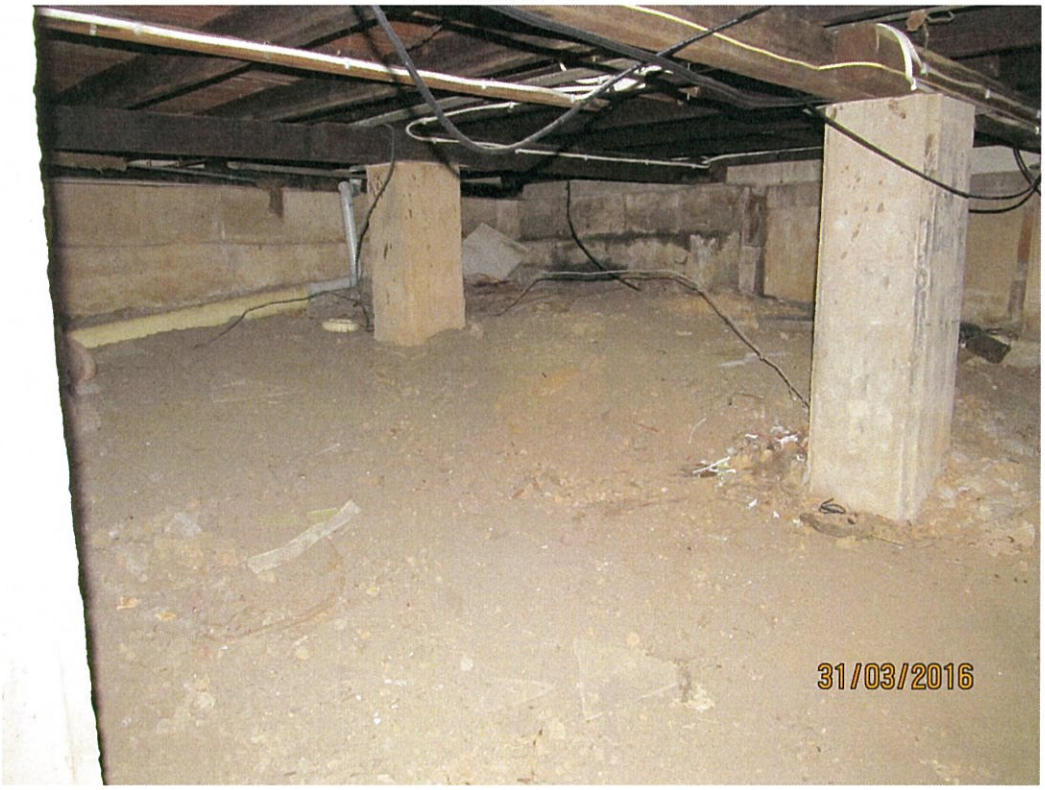
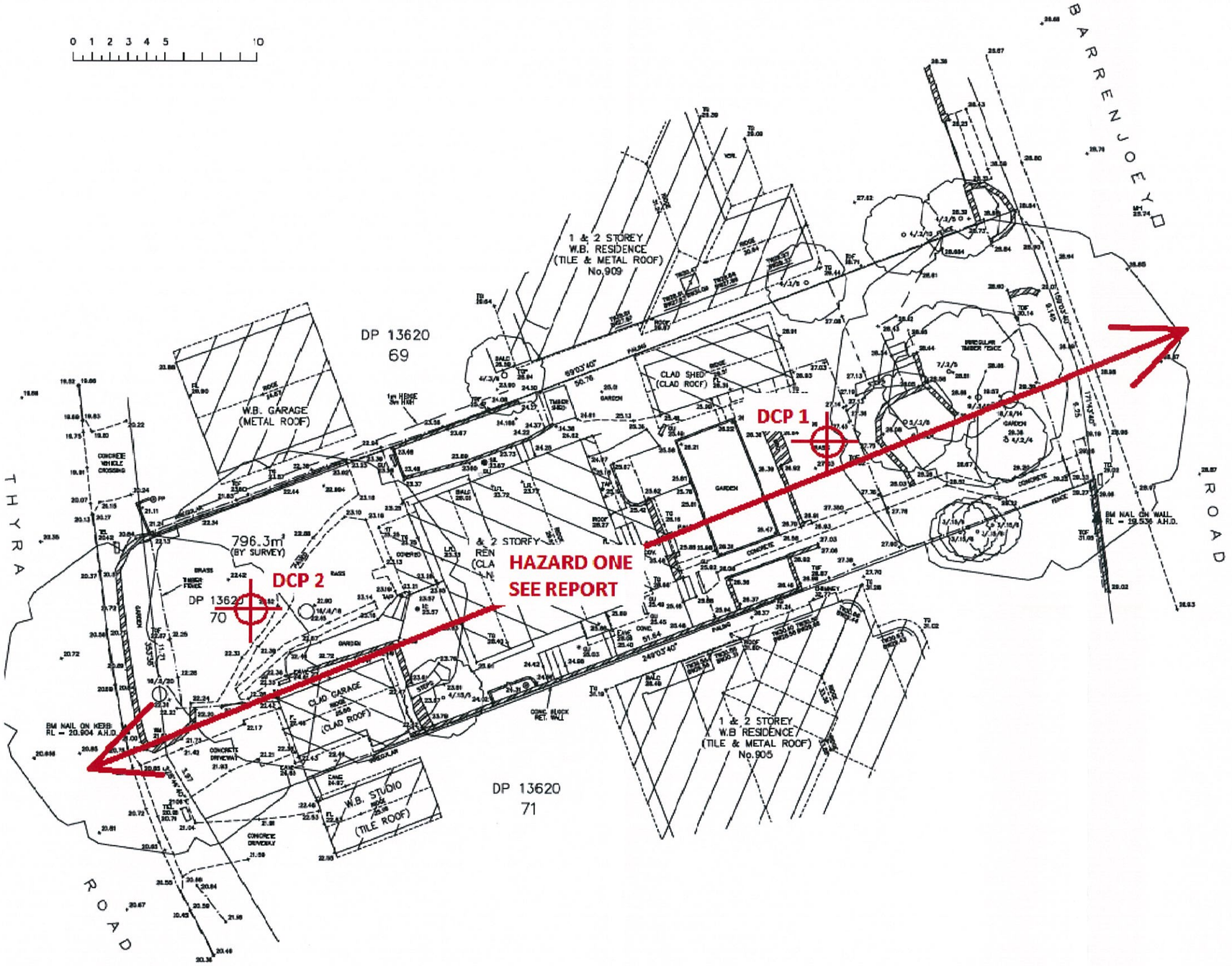


Photo 14



= DCP LOCATION

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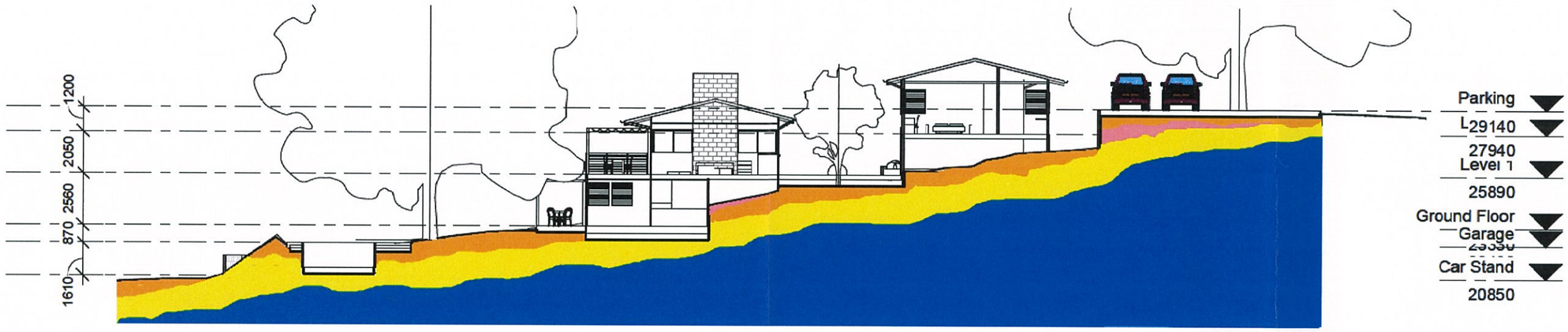
SITE PLAN - HAZARD AND DCP LOCATIONS

Job No	Address
MR 30529	907 BARRENJOEY ROAD
Scale	PALM BEACH
NTS	NSW



2 Section 5

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CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS

TYPE SECTION

Job No	Address
MR 30529	907 BARRENJOEY ROAD
Scale	PALM BEACH
NTS	NSW

Strata Profile Legend

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

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.

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'.