



# GEOTECHNIQUE PTY LTD



Member of  
Australian Contaminated  
Land Consultants Association Inc



Job No 12312/1  
Our Ref 12312/1-AA  
10 August 2010

ABN 64 002 841 063

Woniara Investments Pty Ltd  
140 Warners Avenue  
BONDI BEACH NSW 2026  
Email [w.investments@bigpond.com](mailto:w.investments@bigpond.com)

Attention Mr A Fahey

Dear Sir

re **Proposed Extension/Addition to an Existing Residence  
13a Ocean Road, Palm Beach  
Preliminary Slope Stability Assessment and Preliminary Geotechnical Investigation**

This report presents the results of a preliminary geotechnical investigation and preliminary slope stability assessment for the proposed extension/addition to a residence at the above location

It is understood that the proposed development comprises the following

- Extension for a bedroom at ground level to the northern side of the existing residence
- Extension for a garage at the ground level to the southern side of the existing residence
- Addition of a second storey

We were provided with a site plan showing the layout of the existing residence and footprint of the proposed extension/addition for preparation of this report

A preliminary geotechnical investigation was required to assess sub-surface conditions in the vicinity of the residence in order to provide preliminary geotechnical advice for design and construction of the proposed extension

A preliminary slope stability assessment was required to assess the risk of slope instability within and in the vicinity of the site and to ascertain that the risk of slope instability is acceptable for construction of the proposed extension/addition

### **Regional Geology**

Based on the Geological Map of Sydney (1 100 000) bedrock at the site is anticipated to vary from Hawkesbury Sandstone to the Narrabeen Group of rocks. Hawkesbury Sandstone comprises medium to coarse grained quartz sandstone with very minor shale and laminite lenses and the Narrabeen Group of rocks comprises quartz sandstone with minor interbedded claystone

Reference to the Soil Landscape Map (1 100 000) of Sydney indicates that the landscapes at the site belong to the Hawkesbury Group in areas with Hawkesbury Sandstone and to the Watagan Group in areas with Narrabeen group of rocks. The Hawkesbury Group is characterised by rugged, rolling to very steep hills on Hawkesbury Sandstone with local relief of 40m to 200m ground surface slopes more than 25%, rock outcrop more than 50% narrow crests and ridges narrow incised valleys, steep side slopes with rocky benches and broken scarp and boulders. The sub-surface soil in this group is likely to be shallow less than 0.5m, stony, highly permeable and susceptible to extreme erosion and mass movement hazards

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The Watagan Group is characterised by rolling to very steep hills on fine grained Narrabeen Group sediments, with local relief of 60m to 120m ground slopes in excess of 25%, narrow crests and ridges, steep colluvial side slopes and occasional sandstone boulders and benches. There is likely to be occasional rock outcrops with sandy soils on sandstone and clayey soils on shale. This group is susceptible to mass movement and erosion hazard.

#### **Field Work**

Due to difficult site access, borehole drilling using a drilling rig and test pit excavation using an excavator could not be carried out at this stage. Therefore, the scope of work for the preliminary geotechnical investigation and preliminary slope stability assessment comprised a walk over survey to assess existing site conditions. The walk over survey was carried out by a Senior Geotechnical Engineer from this company on 30 July 2010.

#### **Site Conditions**

The site is trapezoidal measuring approximately 983 2m<sup>2</sup> in plan area. The attached Drawing No 12312/1-1 shows general site conditions and the following observations were made during the walk over survey.

- The site is bound by Ocean Road, Palm Beach, to the east, Sunrise Road to the west and residences on the two remaining sides.
- Ground surface elevation across the site varies from about RL 42.0m AHD along the western (rear) boundary to about RL 6.0m AHD along the eastern (front) boundary.
- The western portion of the site is vacant and ground surface in the western portion dips towards the east at about 30 to 35 degrees. The eastern portion of the site has been levelled for construction of the existing residence. The boundary between the levelled portion with the residence and vacant portion of site dips steeply at about 80 to 90 degrees.
- There are indications that some excavations were carried out during construction of the residence. The depth of excavation is more than 10.0m in the western side of the residence and about 3.0m to the northern and southern sides of the residence. Some fill might also have been placed in the eastern portion of the site where the residence is located. All excavation faces have been covered with shotcrete, with weep holes and/or retaining walls. Therefore, the nature of materials exposed after excavation could not be ascertained.
- There was no evidence of cracks and movements in the high excavation face in the western side, but minor cracks were noted in the retaining wall along the northern site boundary.
- There was a column adjacent to the retaining wall along the southern boundary. It is likely that the column is supporting the wall.
- The vacant western portion of site is densely vegetated.

We did not drill boreholes during this preliminary geotechnical investigation in order to ascertain the sub-surface profile across the site because all excavation faces have been covered with shotcrete most probably to reduce the risk of slope instability.

Based on review of the geotechnical investigation report for 6 Ocean Road, Palm Beach prepared by Douglas Partners (refer report for Project 71081 dated May 2009), the sub-surface profile across the site is anticipated to comprise a sequence of topsoil/fill and sandy clay, sand and bedrock sandstone. Although several sandstone boulders were encountered in boreholes the depth to bedrock was anticipated to vary from about 5.5m to 7.0m from existing ground surface, at elevation of about RL -1.0m to +3.5m AHD. A copy of Douglas Partners report was provided for preparation of this report.

It is our assessment that bedrock is exposed at least in the lower 4.0m to 5.0m of excavation carried out during construction of the residence. An inferred sub-surface profile is shown in the attached Drawing No 12312/1-2.

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**Proposed Extension/Additions**

It is our understanding that the residence was constructed in 1994 and the site did not have a history of slope failures. Based on review of proposed development plan and site inspection, we understand that the proposed extension/addition will involve the following:

- Extension for a bedroom at ground level will involve excavation of a triangular wedge of ground at the north western corner of the residence. This excavation is estimated to measure 2.0m (north south direction) by 1.0m in plan and about 3.0m in height.
- Extension for a garage at the ground level will involve excavation of a triangular wedge of ground at the south western corner of the residence. This excavation is estimated to measure 3.5m (east west direction) by 1.0m in plan and about 3.0m in height.
- Addition of an extra floor to the existing building.

Geotechnical risks associated with the proposed addition/extension will include the following:

- Slope failures (including creep, slide and flow) in the natural slope and excavation faces during proposed works.
- Slope failures (including creep, slide and flow) in the natural slope and excavation faces after proposed works.
- Failure (topple or sliding failure) of the proposed and/or existing retaining walls.
- Potential founding of footings on unsuitable foundation materials (including loose or detached sandstone boulders, floaters, uncontrolled fill, inconsistent foundation materials such as a combination of sandstone, clays or fill) resulting in differential movement of footings.

**Qualitative Risk to Property**

Site factors such as slope angles, depth of in situ soils, strength of sub-surface material and concentrations of water generally govern the stability of a site. The Australian Geomechanics Society (Reference 1) recommends that the landslide/slope failure risk of a site is assessed on the basis of the likelihood of a landslide/slope failure event and the consequences of that event. The guidelines on qualitative measures for the likelihood and consequence of landslides and assumed level of risk are provided in Reference 1.

As no evidence of slope movement was noticed during visual assessment, it is our assessment that failure of the existing slope is unlikely unless site conditions have changed significantly. Therefore, for the proposed development site, our assessment of risk to property based on assessed likelihood of slope failures/landslides and their consequences are presented in Table 1.

TABLE 1

Hazard	Likelihood	Consequences	Risk
Soil debris creep, slide or flow in the natural slope and excavation faces during proposed works	Unlikely	Minor	Low
Soil debris creep, slide or flow in the natural slope and excavation faces after proposed works	Unlikely	Medium	Low-Moderate
Failure of the proposed and/or existing retaining walls	Unlikely	Medium	Low-Moderate
Potential founding of footings on unsuitable foundation materials	Rare	Medium	Low

The likelihood of slope failures might increase if the proposed addition/extension works result in unstable cut and fill slopes. Therefore, unstable cut and fill slopes should be battered or retained appropriately. In addition, existing slopes should be properly maintained, including provision of proper drainage, to ensure that the risk of instability does not increase.

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The definitions of the risk levels are provided in Reference 1 and an abstract is presented below

Risk Level		Implication
VH	Very High Risk	Extensive detailed investigation and research planning and implementation of treatment options essential to reduce risk to acceptable levels, may be too expensive and not practical
H	High Risk	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels
M	Moderate Risk	Tolerable, provided treatment plan is implemented to maintain or reduce risks May be accepted Might require investigation and planning of treatment options
L	Low Risk	Usually accepted Treatment requirements and responsibility to be defined to maintain or reduce risk
VL	Very Low Risk	Acceptable Manage by normal slope maintenance procedures

Based on the above Qualitative Measures the site for the proposed addition/extension is assessed to have a " Low to Moderate Risk" to the property before and after completion of proposed works provided cut and fill slopes are appropriately battered or retained in accordance with recommendations provided in this report Therefore, the risk to property should be tolerable

#### Quantitative Risk to Life

The annual probability of loss of life for the person most at risk from the slope failures/landslide depends on frequency of slope failures/landslides and the consequences The individual risks, as determined by summing up the risk for the person most at risk from all the landslide hazards is used for comparison with the tolerable risk criteria

For loss of life the individual risk can be calculated using the following equation

$$R_{(LOL)} = P_{(H)} \times P_{(S,H)} \times P_{(T,S)} \times P_{(D,T)}$$

Where

$R_{(LOL)}$  = The risk (annual probability of loss of life/death of an individual)

$P_{(H)}$  = Annual probability of a slope failure/landslide

$P_{(S,H)}$  = Probability of spatial impact of the landslide impacting a building/location taking into account the travel distance and travel direction given the event

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

$P_{(D,T)}$  = Vulnerability of individual (probability of loss of life of the individual given the impact)

The most probable of all slope failure/landslide risks at the site include soil and debris creep slide and flow onto the existing residence, during and after proposed extension/addition works Assessed risks to loss of life due to various identified failure/landslides events during and after proposed extension/addition works are presented in Table 2

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TABLE 2

Slope Failure/Landslide Events	P <sup>(H)</sup>	P <sup>(S,H)</sup>	P <sup>(T S)</sup>	P <sup>(B T)</sup>	R <sup>(LOI)</sup>
Soil debris creep slide or flow in the natural slope and excavations during proposed works	1.0x10 <sup>-4</sup>	0.20	0.20	0.10	4.0x10 <sup>-07</sup>
Soil debris creep slide or flow in the natural slope and excavations after proposed works	1.0x10 <sup>-4</sup>	0.20	0.05	0.10	1.0x10 <sup>-07</sup>
Failure of the proposed and/or existing retaining walls	1.0x10 <sup>-4</sup>	0.20	0.05	0.05	5.0x10 <sup>-08</sup>
Potential founding of footings on unsuitable foundation materials	1.0x10 <sup>-5</sup>	1.00	0.05	0.05	2.5x10 <sup>-08</sup>

The sum of risk to life, from likely slope failure/landslide events for an individual most at risk is 5.7x10<sup>-7</sup> per annum. The estimated sum of risk for an individual most at risk is acceptable, in accordance with the Geotechnical Risk Management Policy for Pittwater (Reference 2).

Furthermore, it should be noted that the residence was constructed about 16 years ago and the residence does not show any signs of slope movements.

**Risk of Slope Failures/Landslides**

Based on "Low to Moderate" risk to property and an acceptable risk to loss of life, it is considered that the site is suitable for the proposed addition/extension, providing:

- Construction works are carried out in accordance with general guidelines to hillside construction, a copy of which is attached.
- The geotechnical assessments and recommendations presented in this report are considered as preliminary only and verified by inspection during the construction stage.
- Cut and fill slopes are minimised and all cut and fill slopes are battered appropriately or retained by engineered retaining walls, in accordance with recommendations provided in this report.
- All footings are founded in natural soil or bedrock and designed in accordance with recommendations provided in this report.

Therefore, completed Forms 1 and 1a from the Geotechnical Risk Management Policy for Pittwater-2009 are attached.

**Excavation Works**

Proposed development is anticipated to involve up to about 3.0m deep excavations. The attached Drawing No 12312/1-3 indicates areas of proposed excavations.

The excavation is in fact an extension of a previously excavated face. Materials to be excavated are expected to comprise natural soils and sandstone bedrock of varying strength. It is considered that excavation of soils and very low strength sandstone can be achieved using conventional earthmoving equipment, such as excavators and dozers. However, we suggest a rock saw for excavation into sandstone of medium strength or better, in order to minimise vibration that could adversely impact on the stability of existing excavation faces and residences.

Based on site observations, we do not anticipate significant inflow of groundwater during proposed excavation.

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### **Retaining Structures**

Proposed addition/extension involves up to about 3.0m deep excavations. The excavation faces should be battered appropriately or retained by engineered retaining structures for stability. However, available spaces will prohibit battering of slopes to desired slopes. Therefore, proposed excavation faces should be retained appropriately.

Natural slopes as well as existing excavation faces do not show any signs of movements. Furthermore, proposed excavation is anticipated to occur predominantly in sandstone. Therefore, it is our assessment that shotcrete, with appropriate reinforcements and weep holes, would be adequate to support the proposed excavation faces.

We suggest that a Geotechnical Engineer inspect the site during excavation to ascertain that shotcrete, with appropriate reinforcements and weep holes, is adequate to support the proposed excavation faces. If not, the Geotechnical Engineer should provide recommendations for an alternative retention system to ensure that the risk of excavation face failure is reduced to tolerable.

### **Footings**

It is desirable that additional loads due to addition of a storey to the residence are carried by existing footings. To assess whether existing footings are adequate to carry additional loads will require the following:

- Magnitude of additional loads
- Capacities of existing footings

We expect that a Structural Engineer will determine present and proposed additional loads on the existing footings.

Capacities of existing footings depend on the dimensions (length, width, depth) of the footings and the allowable bearing pressure for the foundation material at the founding depths. Determination of footing dimensions was beyond the scope of the preliminary geotechnical investigation. However, we expect that review of the as-constructed drawing for the existing residence should provide information on footing dimensions and capacities. If capacities of existing footings are not adequate for additional loads, new footings would have to be installed.

As sandstone bedrock is anticipated at ground level in the western portion of the residence, it is considered that the footings of the residence are founded in bedrock. Therefore, we recommend that the new footings, if required, are also founded in sandstone bedrock and designed for an allowable bearing pressure of 800kPa.

For footings founded in sandstone bedrock, total settlements under the recommended allowable bearing pressures are estimated to be about 1% of pier diameter or minimum footing dimension, and differential settlements are estimated to be about half the estimated total settlements.

An experienced Geotechnical Engineer should ascertain that the footings are founded on bedrock with recommended allowable bearing pressure on the basis of assessment made during footing excavation or pier hole drilling. The engineer should ensure that the footings are not founded on or in floaters.

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**Limitations**

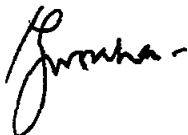
The recommendations presented in this report are based on a generalised sub-surface profile based on site observations and review of a geotechnical report prepared for a development in vicinity of the site. Therefore actual sub-surface conditions across the site could differ from those expected (generalised). If such differences appear to exist or are encountered during construction, we recommend that this office is contacted for further advice, as the recommendations presented in this report might have to be reassessed. This can also occur with groundwater conditions especially after climatic changes.

Furthermore in accordance with Reference 2 an experienced Geotechnical Engineer/Engineering Geologist should conduct inspections of site works, as follows

- Inspection of all excavations at 1.0m depth intervals and on completion of excavations
- Inspection of all footings prior to placement of concrete, to confirm bearing materials
- An inspection following completion of all building and site works to confirm that risk levels anticipated in this report have been achieved

If you have any questions regarding this report, please do not hesitate to contact the undersigned

Yours faithfully  
GEOTECHNIQUE PTY LTD

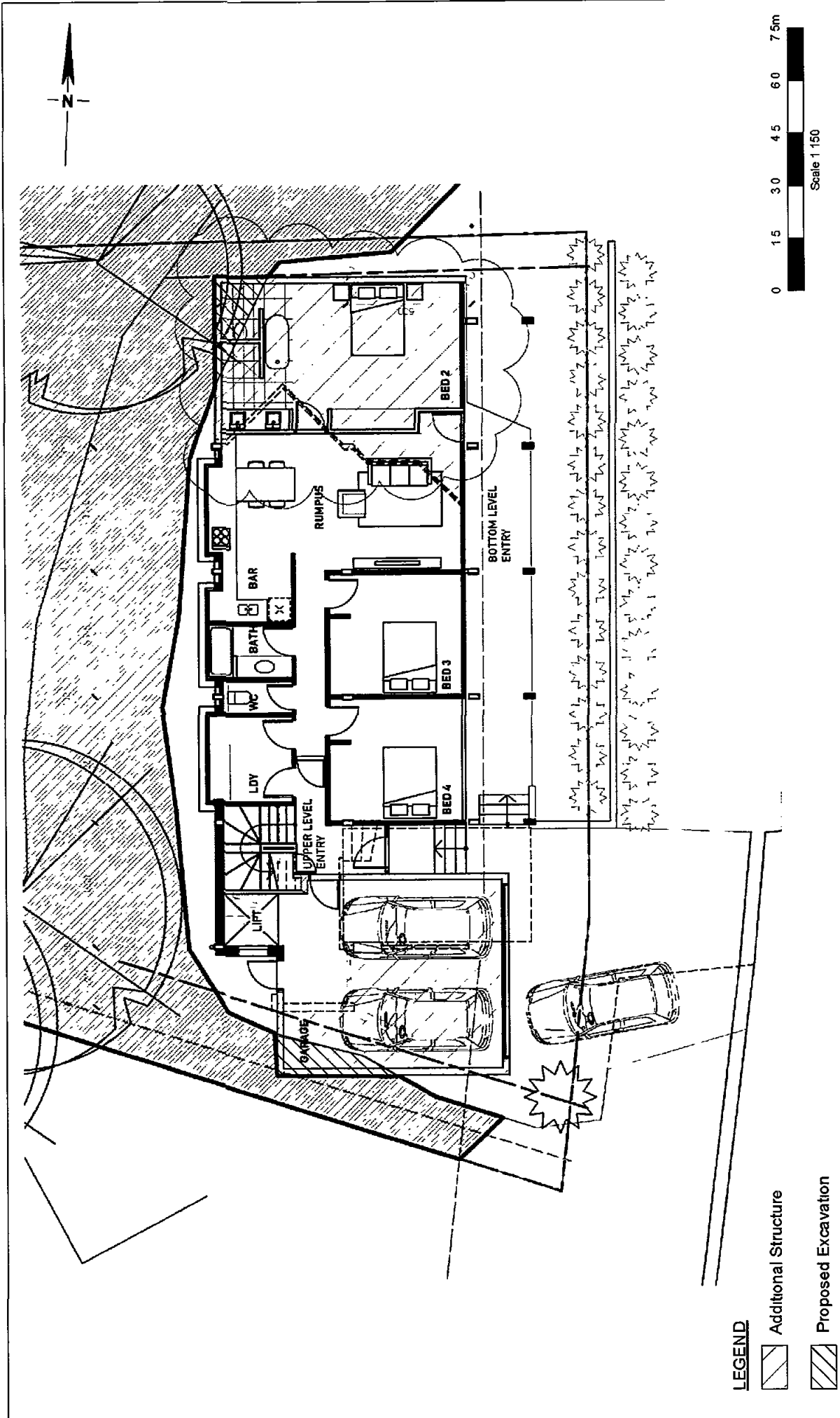


**INDRA JWORCHAN**  
Principal Geotechnical Engineer

Attached Proposed Development Plan  
Inferred Sub-surface Profile  
Forms 1 and 1a  
Guidelines for Hillside Construction


References

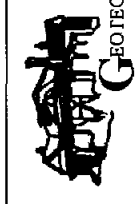
- 1 Australian Geomechanics Society (AGS) Landslide Zoning Working Group Guideline for Landslide Susceptibility Hazard and Risk Zoning for Land Use Planning Journal and News of Australian Geomechanics Society Volume 42 No 1 March 2007
- 2 Pittwater Council Geotechnical Risk Management Policy for Pittwater 2009



**LEGEND**

 Additional Structure

 Proposed Excavation



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**NOTES**

- 1 Site features are indicative and are not to scale
- 2 This drawing has been produced using a base plan provided by Smith & Tzannes (Ref 09\_154\_103 A) to which additional information e.g test pits borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

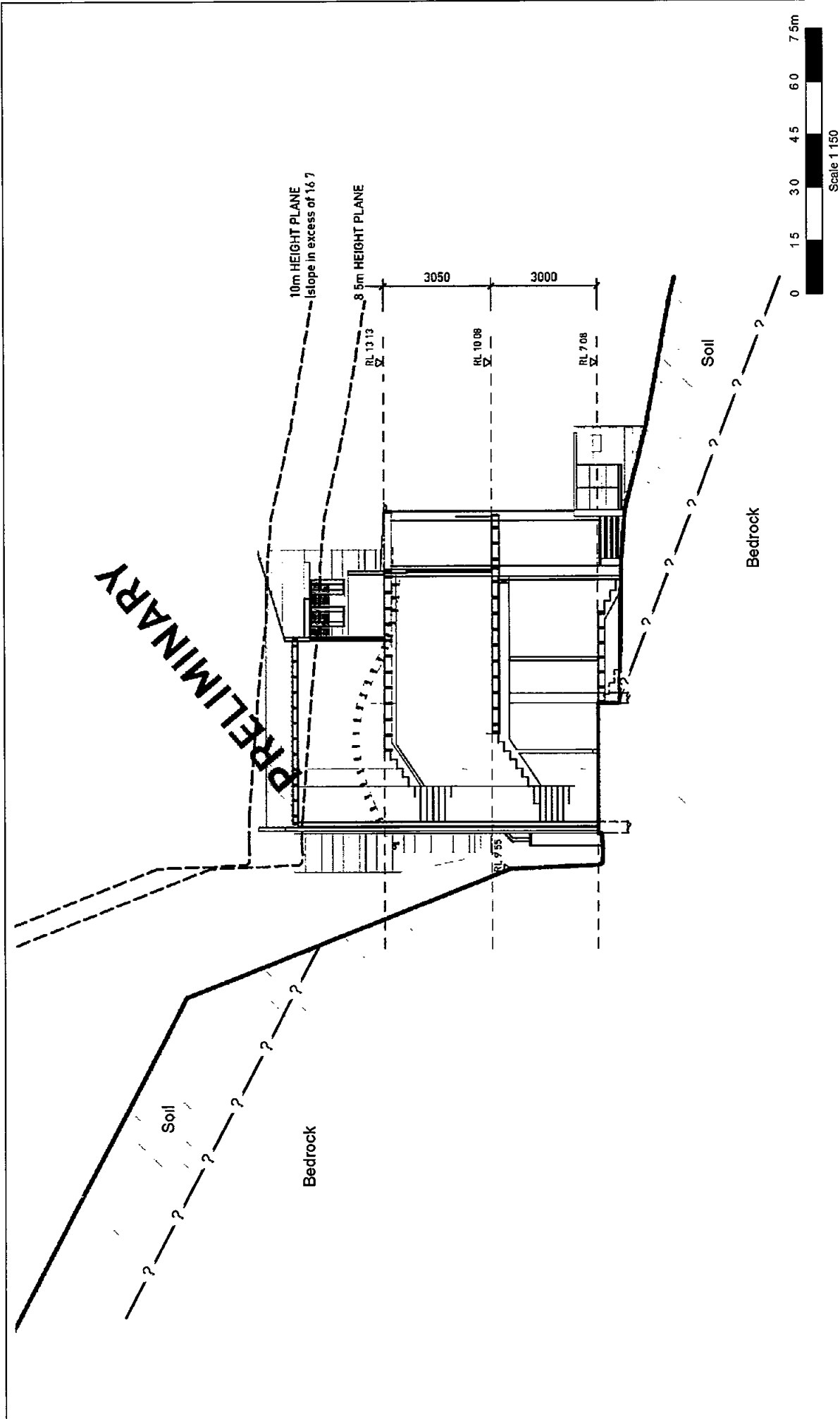
**Womora Investments Pty Ltd**  
**Proposed Extension / Addition**  
13A Ocean Road  
Palm Beach

Drawing No 12312/1 3  
Job No 12312/1  
Drawn By MH  
Date 10 August 2010  
Checked By IJ  
File No Drawing 12312 1  
Layers 0 Lays

**Area Showing Proposed Excavation**




**PRELIMINARY**

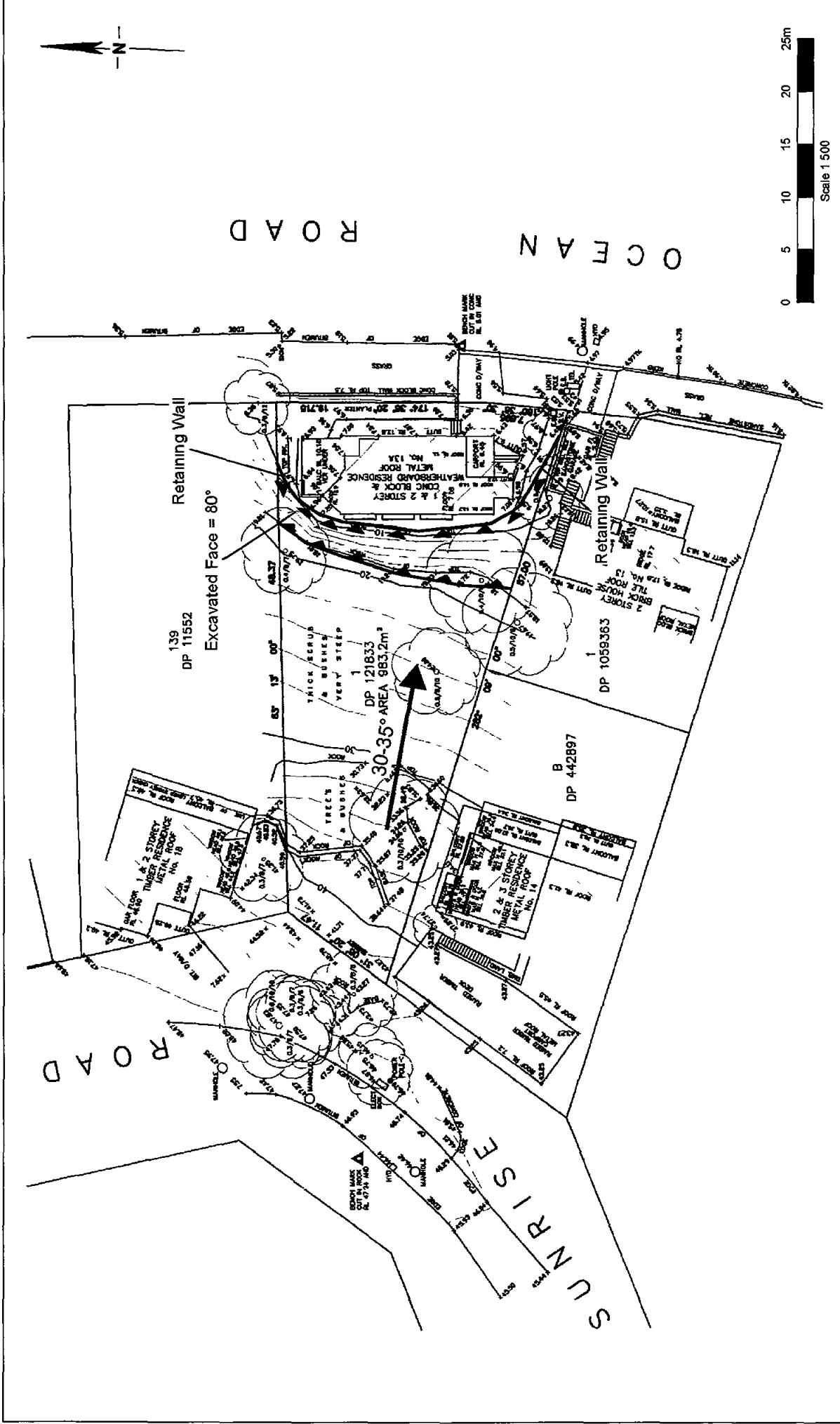


Drawing No. 12312/1 2  
 Job No. 12312/1  
 Drawn By MH  
 Date 10 August 2010  
 Checked By LJ  
 File No. Drawing 12312 1  
 Layers 0 Lay2

**Woniora Investments Pty Ltd**  
**Proposed Extension / Addition**  
**13A Ocean Road**  
**Palm Beach**  
**Inferred Subsurface Profile**

**NOTES**  
 1 Site features are indicative and are not to scale  
 2 This drawing has been produced using a base plan provided by Smith & Tzannes (Ref. 09\_154 A300A) to which additional information e.g. test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing


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<p><b>WONORA INVESTMENTS PTY LTD</b>  <b>Proposed Extension / Addition</b>  <b>13A Ocean Road</b>  <b>Palm Beach</b></p>	<p>Drawing No 12312/1 1          Job No 12312/1          Drawn By MH          Date 10 August 2010          Checked By JU          File No Drawing 12312 1          Layers 0 Lay1</p>
<p><b>NOTES</b></p> <ol style="list-style-type: none"> <li>1 Site features are indicative and are not to scale</li> <li>2 This drawing has been produced using a base plan provided by Bailenden Surveyors (Ref 90299) to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing</li> </ol>	<p><b>Geotechnique</b>          CONSULTING ENGINEERS          PTY LTD          PO Box 880          Penrith NSW 2750          Tel 02 4722 2700          Fax 02 4722 2777          e-mail info@geotech.com.au          www.geotech.com.au</p>

TABLE 1

## SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
<b>ADVICE</b>		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified experienced geotechnical consultant at early stage of planning and before site works	Prepare detailed plan and start site works before geotechnical advice
<b>PLANNING</b>		
SITE PLANNING	Having obtained geotechnical advice plan the development with the Risk of Instability and Implications for Development in mind	Plan development without regard for the Risk Instability
<b>DESIGN AND CONSTRUCTION</b>		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickworks timber or steel frames timber or panel cladding Consider use of split levels Use decks for recreational areas where appropriate	Floor plans which require extensive cutting and filling Movement intolerant structures
SITE CLEARING	Retain natural vegetation wherever practicable	Indiscriminately clear the site
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts fills retaining walls and drainage Council specifications for grades may need to be modified Driveways and parking areas may need to be fully supported on piers	Excavate and fill for site access before geotechnical advice
EARTHWORKS		
CUTS	Retain natural contours wherever possible Minimise depth Support with engineered retaining walls or batter to appropriate slope Provide drainage measures and erosion control	Large scale cuts and benching Unsupported cuts Ignore drainage requirements
FILLS	Minimise height Strip vegetation and topsoil and key into natural slopes prior to filling Use and compact clean fill materials Batter to appropriate slope or support with engineered retaining wall Provide surface drainage and appropriate sub-surface drainage	Loose or poorly compacted fill Block natural drainage lines Fill over existing vegetation and topsoil Include stumps trees vegetation topsoil boulders building rubble etc in fill
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may become unstable Support rock faces where necessary	Disturb or undercut detached blocks or boulders
RETAINING WALLS	Engineer design to resist applied soil and water forces Found on rock where practicable Provide sub-surface drainage within wall backfill and surface drainage on slope above Construct wall as soon as possible after cut/fill operation	Construct a structurally inadequate wall such as sandstone flagging brick or un reinforced block work Lack of sub surface drains and weep holes
FOUNDATIONS	Support on or within rock where practicable Use rows of piers or strip foundations oriented up and down slope Design for lateral creep pressures Backfill foundation excavations to exclude ingress of surface water	Found on topsoil loose fill detached boulders or undercut cliffs
SWIMMING POOLS	Engineer designed Support on piers to rock where practicable Provide with under drainage and gravity drain outlet where practicable Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes Discharge to street drainage or natural water courses Provide generous fall to prevent blockage by siltation and incorporate silt traps Line to minimise infiltration and make flexible where possible Special structures to dissipate energy at changes of slope and/or direction	Discharge at top of fills and cuts Allow water to pond on bench areas
SUB-SURFACE	Provide filter around sub-surface drain Provide drain behind retaining walls Use flexible pipelines with access for maintenance Prevent inflow of surface water	
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems absorption trenches may be possible in some low risk areas Storage tanks should be water tight and adequately founded	Discharge sullage directly onto and into slopes
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability Revegetate cleared area	Failure to observe earthworks and drainage recommendations when landscaping
<b>DRAWINGS AND SITE VISITS DURING CONSTRUCTION</b>		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction	
<b>INSPECTION AND MAINTENANCE BY OWNER</b>		
OWNER'S RESPONSIBILITY	Clean drainage systems repair broken joints in drains and leak in supply pipes Where structural distress is evident seek advice If seepage observed determine cause or seek advice on consequences	

This table is an extract from GEOTECHNICAL RISKS ASSOCIATED WITH HILLSIDE DEVELOPMENT as presented in Australian Geomechanics News Number 10 1985 which discusses the matter more fully

**GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER  
FORM NO 1 – To be submitted with Development Application**

Development Application for Woniara Investment Pty Ltd  
Address of site 13a Ocean Road, Palm Beach

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

*I Indra Jworchan, on behalf of Geotechnique Pty Ltd*

on this the **9 August 2010** 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  
I have

**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 Section 6.0 of the Geotechnical Risk Management Policy for Pittwater 2009. I confirm that 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
- Provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report


**Geotechnical Report Details**

Report Title Preliminary Geotechnical Investigation  
Report Date 9 August 2010  
Author Indra Jworchan  
Author's Company/Organisation Geotechnique Pty Ltd

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

Australian Geomechanics Society (AGS) Landslide Zoning Working Group Guideline for Landslide Susceptibility Hazard and Risk Zoning for Land Use Planning' Journal and News of Australian Geomechanics Society, Volume 42, No 1 March, 2007  
Pittwater Council Geotechnical Risk Management Policy for Pittwater- 2009

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  
Name Indra Jworchan  
Chartered Professional Status CPEng  
Membership No 806995  
Company Geotechnique 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 Woniora Investment Pty Ltd  
Address of site 13a Ocean 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 Preliminary Geotechnical Investigation  
Report Date 9 August 2010  
Author Indra Jworchan  
Author's Company/Organisation Geotechnique Pty Ltd

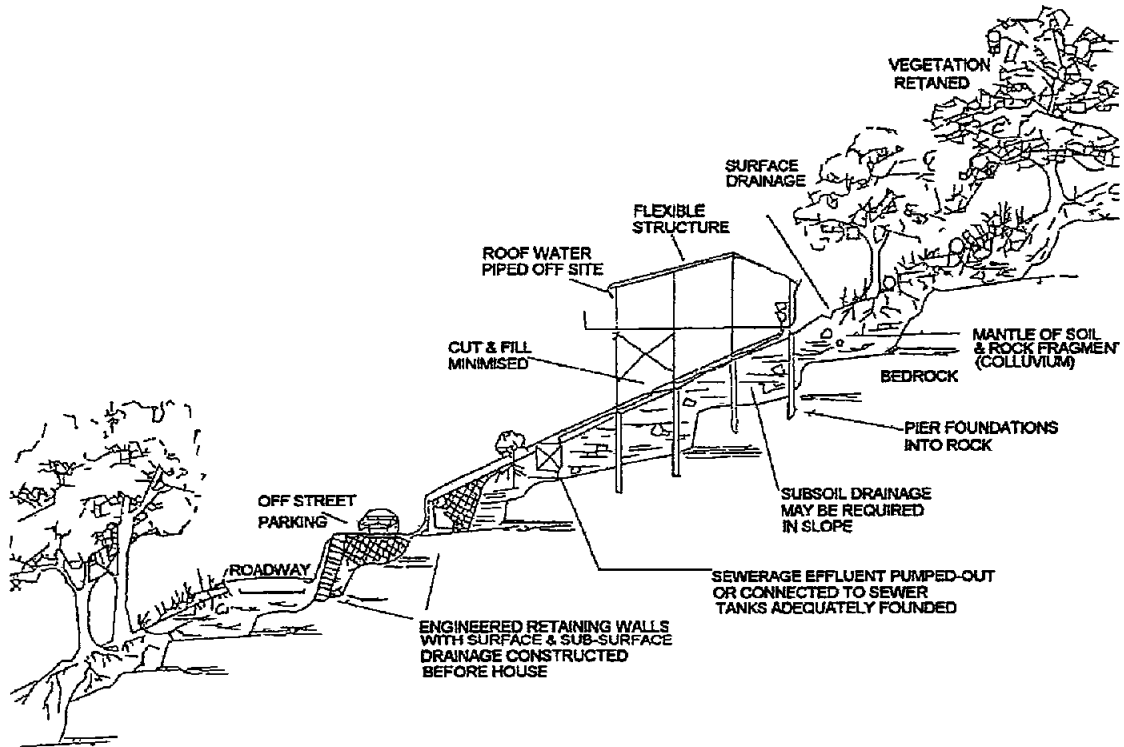
**Please mark appropriate box**

- ✓ Comprehensive site mapping conducted 30 July 2010
- ✓ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
- ✓ Subsurface investigation required
  - ✓ No Justification Difficult site access but excavation faces observed
  - 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  
Name Indra Jworchan  
Chartered Professional Status CPEng  
Membership No 806995  
Company Geotechnique Pty Ltd

## EXAMPLES OF GOOD HILLSIDE PRACTICE



## EXAMPLES OF POOR HILLSIDE PRACTICE

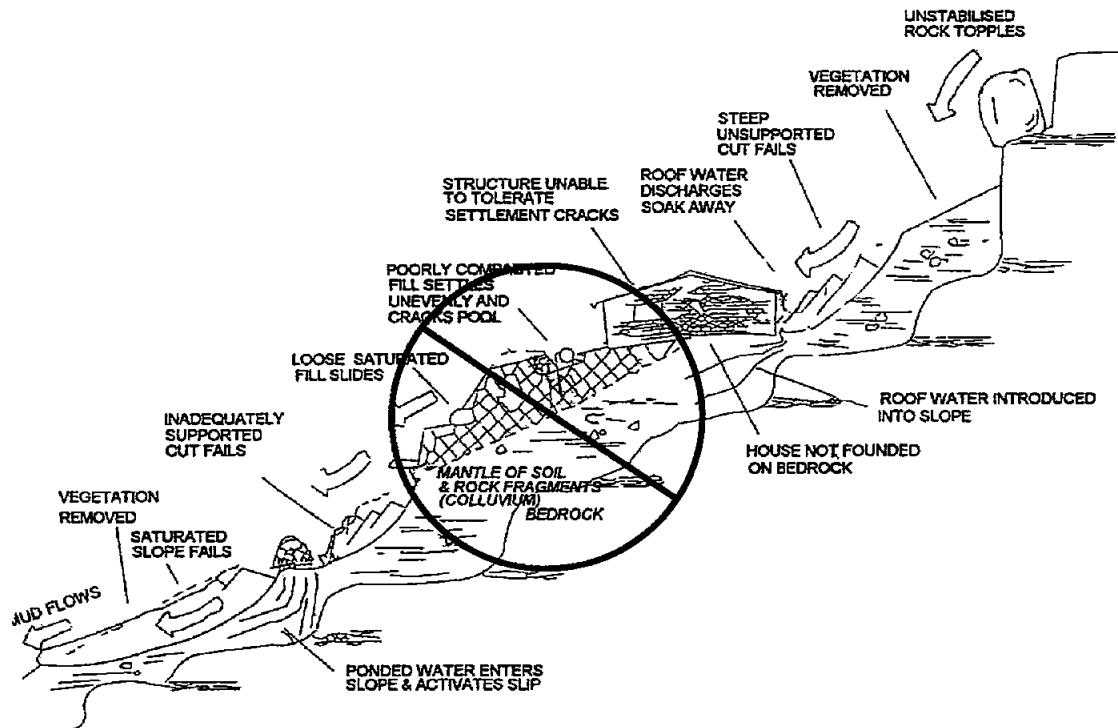


FIGURE 1 ILLUSTRATIONS OF GOOD AND POOR HILLSIDE PRACTICE