

REPORT ON GEOTECHNICAL SITE INVESTIGATION

for

PROPOSED ALTERATIONS AND ADDITIONS

at

33 PACIFIC ROAD, PALM BEACH

Prepared For

Greg and Elizabeth Fowler

Project No.: 2021-004

January 2021

Document Revision Record

Issue No	Date	Details of Revisions
0	27 th January 2021	Original issue

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

Development Application for _____

Name of Applicant _____

Address of site _____ 33 Pacific Road, Palm Beach

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

I, Troy Crozier on behalf of Crozier Geotechnical Consultants 27th January 2021 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 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
- ☒ 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 I am of the opinion that the Development Application only involves Minor Development/Alteration that 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.
- ☐ have examined the site and the proposed development/alteration is separate from and is 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.
- ☐ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: Geotechnical Report for Proposed Alterations and Additions

Report Date: 27th January 2021

Project No.: 2021-004

Author: Jun Yan & Troy Crozier

Author's Company/Organisation: Crozier Geotechnical Consultants

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

Architectural drawing by Gartner Trovato Architects, Project No.: 2033, Drawing No.: DA-01 – DA-08, Revision: A,

Dated: 22/01/21

Survey Plan by Adam Clerke Surveyors Pty Ltd, Reference No.: 7820, Dated: 09/09/2020.

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.

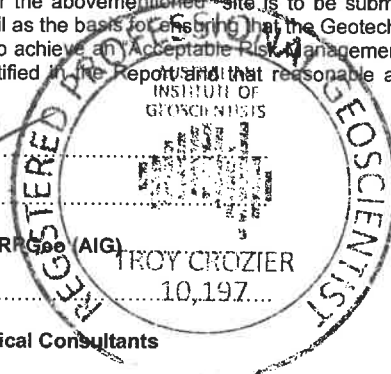
Signature _____

Name ... Troy Crozier ...

Chartered Professional Status... RPG (AIG) ...

Membership No.: ... 10197 ...

Company... Crozier Geotechnical Consultants



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 ____33 Pacific 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: Geotechnical Report for Proposed Alterations and Additions
Report Date: 27th January 2021 **Project No.:** 2021-004
Author: Jun Yan & Troy Crozier
Author's Company/Organisation: Crozier Geotechnical Consultants

Please mark appropriate box

- ☒ Comprehensive site mapping conducted ____12th January 2021_____
 (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 ...14th January 2021.....
- ☒ 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
☒ Other50 years.....
 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 ...Troy Crozier...
 Chartered Professional Status...RPGeo (AIG)
 Membership No. ...10197...
 Company... Crozier Geotechnical Consultants

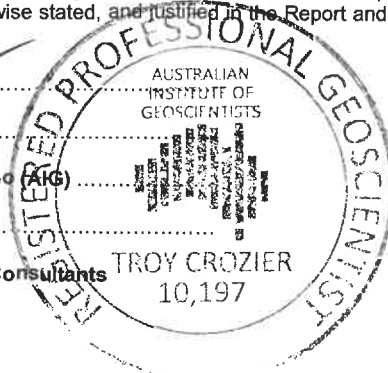


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Date: 27th January 2021

Project No: 2021-004

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**GEOTECHNICAL INVESTIGATION FOR PROPOSED ALTERATIONS AND ADDITIONS
33 PACIFIC ROAD, PALM BEACH, NSW**

1. INTRODUCTION:

This report details the results of a geotechnical investigation carried out for proposed alterations and additions at 33 Pacific Road, Palm Beach, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of the client Greg and Elizabeth Fowler.

It is understood that the proposed works involve alterations and additions to the existing residential dwelling, with the construction of an additional level at the front and a swimming pool at the rear. This new first level will contain a garage and will be accessed via a new suspended concrete driveway. It appears the proposed works will only require limited excavation for new footings.

The site is located within the H1 (highest category) landslip hazard zone as identified within Northern Beaches Councils precinct (Geotechnical Risk Management Policy for Pittwater - 2009) map and is located within Acid Sulphate Soils Hazard zone 'Class 5'.

To meet the Councils Policy requirements for land classified as H1 a detailed Geotechnical Report which meets the requirements of Paragraph 6.5 of that policy must be supplied with the Development Application. Therefore, this report includes a landslide assessment to the methods of AGS 2007 for the site and proposed works, plans, geological sections and provides recommendations for construction and to ensure stability is maintained for a preferred design life of 100 years. The Acid Sulfate Soils hazard is also assessed. It is recommended that the client make themselves aware of the Policy and its requirements.

The investigation and reporting were undertaken as per the Proposal No.: P20-591, Dated: 21st December 2020.

The investigation comprised:

- a) A detailed geotechnical inspection and mapping of the site and adjacent properties by a Geotechnical Engineer.
- b) DBYD plan request and review.

- c) Drilling of three boreholes along with Dynamic Cone Penetrometer (DCP) testing to investigate the subsurface geology, depth to bedrock and identification of ground water conditions.
- d) Excavation of two test pits to expose the existing pad footings for assessment of founding conditions

The following plans and drawings were supplied by the Architect for the work;

- Architectural drawings by Gartner Trovato Architects, Project No.: 2033, Drawing No.: DA-01 – DA-08, Revision: A, Dated: 22/01/2021.
- Survey Plan by Adam Clerke Surveyors Pty Ltd, Reference No.: 7820, Dated: 09/09/2020.

2. SITE FEATURES:

2.1. Description:

The site is a trapezoidal shaped block located on the low east side of Pacific Road within moderate east dipping topography. It has a front west boundary of 16.1m, side north boundary of 70.4m, side south boundary of 79.8m and east boundary of 9.2m as referenced from the provided survey plan. An aerial photograph of the site and its surrounds is provided below, as Photograph 1.



Photograph: 1 – site view (NSW Gov't Six Map Spatial Data)

The site is occupied by a one and two storey brick and weatherboard house with the ground surface of the site falling from a high of approximately RL89.00 at the front west boundary to a low of approximately RL74.00 at the rear.

2.2. Geology:

Reference to the Sydney 1:100,000 Geological Series sheet (9130) indicates that the site is located near the boundary between the Hawkesbury Sandstone (Rh) and Upper Narrabeen Group rocks (Rnn). Hawkesbury Sandstone which is of Triassic Age typically comprises medium to coarse grained quartz sandstone with minor lenses of shale and laminite and commonly forms a capping to the ridges in this area. Newport Formation rocks (Upper Narrabeen Group) are slightly older and found lower in the stratigraphy than the Hawkesbury Sandstone. They comprise interbedded laminite, shale and quartz to lithic quartz sandstone and pink clay pellet sandstone.



Extract of Sydney (9130) Geological Series Map): 1: 100000 – Geology underlying the site

3. FIELD WORK:

3.1. Methods:

The field investigation comprised a walk over inspection and mapping of the site and adjacent properties by a Geotechnical Engineer. It included a photographic record of site conditions as well as geological/geomorphological mapping of the site and adjacent land with examination of existing site and neighbouring structures on 12th January 2021. It also included the drilling of three auger boreholes (BH1 to BH3) using a hand auger to determine sub-surface geology.

Dynamic Cone Penetrometer testing was carried out from ground surface adjacent to the boreholes and at separate locations, in accordance with AS1289.6.3.2 – 1997, “Determination of the penetration resistance of a soil – 9kg Dynamic Cone Penetrometer” to estimate near surface soil conditions and depth to bedrock.

Explanatory notes are included in Appendix: 1. Mapping information and test locations are shown on Figure: 1, along with detailed log sheets in Appendix: 2. A geological model/section is provided as Figure: 2, Appendix: 2.

3.2. Field Observation:

The site is located on the low east side of Pacific Road within moderate east dipping topography. Pacific Road contains a bitumen pavement and is gently ($<1^\circ$) south dipping where it passes the site. There were no signs of excessive cracking or deformation within the road pavement to suggest any movement or underlying geotechnical issues.

The road reserve is approximately 1.0m higher than the front of the site and is supported by a block wall in the north and a rendered wall in the south. The front of the site contains gently sloping lawns with a concrete driveway providing access to the front of the house. There were no signs of cracking or settlement within the walls and driveway.

The site is currently occupied by a one and two storey weatherboard and brick house. The building structure appears approximately 30 years of age and is in a good condition with no signs of cracking or settlement on its external walls.

The rear of the property is accessed via a concrete pathway along the north boundary of the site. It contains a timber deck adjacent to the house and a moderate east to south dipping soil slope to the rear of the site. Sandstone outcrops/bedrock/boulders of low to medium strength were noted below the timber deck and across the slope. An inspection of this area identified no obvious geotechnical problem, surface stormwater flow or excess seepage/wet areas with stormwater pipes running along the southern side of the site and off towards the south.

The neighbouring property to the north (No. 35) contains a two storey weatherboard and brick house located at the centre of the property with a carport at the front under construction. The structure appears of similar age as the site house and in a good condition with no signs of significant cracking or settlement on the external walls. The house is located approximately 1.00m off the common boundary with the carport adjacent to the boundary. The front of the property is up to 1.20m higher than the site along the common

boundary, whilst the rear of the property is at a similar ground level as the site along the common boundary with the remainder of the block having a similar topography to the site.

The neighbouring property to the south (No. 31) contains a one and two storey weatherboard and brick house located at the front of the property. The structure appears of similar age as the site house and is in a good condition with no signs of significant cracking or settlement on the external walls. The structure is located approximately 1.00m off the common boundary. The property is at a similar ground level as the site along the common boundary with the remainder of the block having a similar topography to the site.

The neighbouring buildings and properties were only inspected from within the site or from the road reserve however the visible aspects did not show any significant signs of large scale slope instability or other major geotechnical concerns which would impact the site or the proposed development.

3.3. Field Testing:

BH1 and BH2 were drilled in the rear of the site, whilst BH3 was drilled in the front. DCP testing was carried out adjacent to the boreholes and at separate locations. Test pits (TP1 and TP2) were excavated adjacent to the pad footings within the under-house storage area.

Based on the borehole logs and DCP test results, the sub-surface conditions at the project site can be classified as follows:

- **FILL** – this layer was encountered at all test locations to depths varying from 0.10m (BH3) to 0.40m (BH1). It is classified as dark brown, fine grained silty/clayey sand with roots and gravel.
- **Sandy/Silty CLAY** – this layer was encountered at all test locations to bedrock surface. It is classified as firm to stiff, brown to grey, medium to high plasticity, moist to wet sandy/silty clay.
- **Weathered SANDSTONE BEDROCK** – hand auger refusal was encountered on this layer in BH1 at 1.00m depth. Based on the DCP testing results, sandstone bedrock of at least very low strength was interpreted at varying depth from 0.70m (DCP4) to 1.42m (DCP5). However, auger and DCP refusal on detached sections of rock/boulders is also possible.

TP1 was excavated adjacent to a pad footing on the southern side of the storage area. It identified that the brick pad footing extends to 0.10m depth below the existing ground surface level and is founded on sandstone bedrock of low to medium strength.

TP2 was excavated adjacent to a pad footing on the northern side of the storage area. It identified that the brick pad footing extends to 0.25m depth below the existing ground surface level and is founded in dry, extremely weathered sandstone/sandy clay. Due to limited access, the strength of the foundation could not be tested.

Groundwater was encountered at 0.60m depth in BH1, which is considered as seepage at rock/soil interface.

4. COMMENTS:

4.1. Geotechnical Assessment:

The site investigation identified a shallow layer of fill (<0.40m depth) overlying firm to stiff silty/sandy clay to the sandstone bedrock surface. Sandstone of at least very low strength is interpreted at depth varying from 0.70m (DCP4) to 1.42m (DCP5) and dipping from RL85.9 (DCP3) at the front of the site house to RL78.9(DCP2) at the east end of the proposed pool. Groundwater in the form of seepage was encountered at 0.60m depth in BH1 in the rear of the site.

The proposed works involve alterations and additions to the existing house including construction of an additional storey at the front and a swimming pool at the rear. This new first floor level will contain a garage and will be accessed via a new suspended concrete driveway. It appears the proposed works will only require limited excavation for new footings.

Based on the investigation results, the proposed footing excavations are anticipated to encounter fill and firm to stiff silty/sandy clay to a relatively shallow bedrock surface. However, there is potential for variation between footing locations with detached sections of hard rock underlain by soil.

It is recommended that all new footings be founded on sandstone bedrock of similar strength and all new footings will require geotechnical inspection for confirmation.

The proposed construction of a new first floor level will increase the loading of the existing structure footings. The adequacy of the existing footings to support the increased loading should be checked by a Structural Engineer. Based on the investigation results, the existing structure footings appear to be founded on materials of different strength (i.e. sandstone bedrock and dry sandy clay). If the proposed structure could not tolerate any differential settlement, it is recommended that all existing footings be extended to sandstone bedrock of similar strength.

The site is also classified as being within an Acid Sulphate Soils Class 5 zone, however, due to the ground conditions encountered and the proposed works, there is a no likelihood of intersecting these soils or impacting the local water table. Therefore, no further investigation into these soils is considered necessary.

The proposed works are considered suitable for the site and may be completed with negligible impact to existing, nearby structures within the site or neighbouring properties provided the recommendations of this report are implemented in the design and construction phases.

The recommendations and conclusions in this report are based on an investigation utilising only surface observations and hand tools. This test equipment provides limited data from small isolated test points across the entire site with no penetration below very low strength rock, therefore some minor variation to the interpreted sub-surface conditions is possible, especially between test locations. However the results of the investigation provide a reasonable basis for the Development Application analysis and subsequent design of the proposed works.

4.2. Slope Stability & Risk Assessment:

Based on our site mapping no credible geological/geotechnical landslip hazards were identified which need to be considered in relation to the existing site and proposed development. As such a risk assessment is not required as the works are considered separate from, and not affected by, a geotechnical landslip hazard.

The entire site and surrounding slopes have been assessed as per the Pittwater Council Geotechnical Risk Management Policy 2009 and no credible landslip hazards were identified, therefore the site is considered to meet the 'Acceptable' risk management criteria for the design life of the development, taken as 50 years from the proposed upgrade, provided the property is maintained as per the recommendations of this report.

4.3. Design & Construction Recommendations:

Design and construction recommendations are tabulated below:

4.3.1. New Footings:	
Site Classification as per AS2870 – 2011 for new footing design	Class 'A' for footings to bedrock
Type of Footing	Strip/Pad or Pier
Maximum Allowable Bearing Capacity	- Weathered, ELS-VLS Bedrock: 700kPa - Weathered LS Bedrock: 1000kPa
Site sub-soil classification as per <i>Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia</i>	B _e – rock site
Remarks: All footings should be founded off material of similar strength to prevent differential settlement. All new footings must be inspected by an experienced geotechnical professional before concrete or steel are placed to verify their bearing capacity and the in-situ nature of the founding strata. This is mandatory to allow them to be 'certified' at the end of the project.	

4.3.2. Drainage and Hydrogeology		
Groundwater Table or Seepage identified in Investigation		Groundwater in the form of seepage at 0.60m depth in BH1
Excavation likely to intersect	Water Table	No
	Seepage	Minor (<0.5L /min) estimated
Site Location and Topography		Low east side of Pacific Road within moderately sloping topography
Impact of development on local hydrogeology		Negligible
Onsite Stormwater Disposal		Pending hydraulic design, possible via dispersion only

4.4. Conditions Relating to Design and Construction Monitoring:

To comply with Councils conditions and to enable us to complete Forms: 2b and 3 required as part of construction, building and post-construction certificate requirements of the Councils Geotechnical Risk Management Policy 2009, it will be necessary for Crozier Geotechnical Consultants to:

1. Review and approve the structural design drawings for compliance with the recommendations of this report prior to construction,
2. Inspect all new footings and earthworks to confirm compliance to design assumptions with respect to allowable bearing pressure, basal cleanness and the stability prior to the placement of steel or concrete,
3. Inspect completed works to ensure construction activity has not created any new hazards and that all retention and stormwater control systems are completed.

The client and builder should make themselves familiar with the Councils Geotechnical Policy and the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot sign Form: 3 of the Policy if it has not been called to site to undertake the required inspections.

4.5. Design Life of Structure:

We have interpreted the design life requirements specified within Council's Risk Management Policy to refer to structural elements designed to support the existing structures, control stormwater and maintain the risk of instability within acceptable limits. Specific structures and features that may affect the maintenance and stability of the site in relation to the proposed and existing development are considered to comprise:

- stormwater and subsoil drainage systems,
- retaining walls and instability,
- maintenance of trees/vegetation on this and adjacent properties.

Man-made features should be designed and maintained for a design life consistent with surrounding structures (as per AS2870 – 2011 (100 years)). It will be necessary for the structural and geotechnical engineers to incorporate appropriate design and inspection procedures during the construction period. Additionally, the property owner should adopt and implement a maintenance and inspection program.

If this maintenance and inspection schedule are not maintained the design life of the property cannot be attained. A recommended program is given in Table: A in Appendix: 3 and should also include the following guidelines.

- The conditions on the block don't change from those present at the time this report was prepared, except for the changes due to this development.
- There is no change to the property due to an extraordinary event external to this site
- The property is maintained in good order and in accordance with the guidelines set out in;

- a) CSIRO sheet BTF 18
- b) Australian Geomechanics “Landslide Risk Management” Volume 42, March 2007.
- c) AS 2870 – 2011, Australian Standard for Residential Slabs and Footings

Where changes to site conditions are identified during the maintenance and inspection program, reference should be made to relevant professionals (e.g. structural engineer, geotechnical engineer or Council). Where the property owner has any lack of understanding or concerns about the implementation of any component of the maintenance and inspection program the relevant engineer should be contacted for advice or to complete the component. It is assumed that Council will control development on neighbouring properties, carry out regular inspections and maintenance of the road verge, stormwater systems and large trees on public land adjacent to the site so as to ensure that stability conditions do not deteriorate with potential increase in risk level to the site. Also, individual Government Departments will maintain public utilities in the form of power lines, water and sewer mains to ensure they don't leak and increase either the local groundwater level or landslide potential.

5. CONCLUSION:

The site investigation identified the presence of a layer of fill to 0.40m depth overlying firm to stiff silty/sandy clay to sandstone bedrock of at least very low strength at varying depth from 0.70m to 1.42m. Groundwater was encountered at 0.60m depth in the rear of the property.

The proposed works involve alterations and additions to the existing house including construction of a with the construction of an additional storey at the front and a swimming pool at the rear. It appears the proposed works will only require limited excavation for the new footings.

Based on our site investigation and mapping, no credible geological/geotechnical landslip hazards were identified which need to be considered in relation to the existing site and proposed development. As such a risk assessment is not required as the works are considered separate from, and not affected by, a geotechnical landslip hazard.

It is considered that the site will meet the 'Acceptable' risk management criteria for the design life of the development taken as 50 years from the proposed works provided the property is maintained as per the recommendations of this report.

Provided the recommendations of this report and any future geotechnical directive are implemented, the proposed development can be maintained with negligible impact to neighbouring or site structures As such the site is considered suitable for the proposed construction works provided that the recommendations outlined in this report are followed.

Prepared By:



Jun Yan
Geotechnical Engineer

Reviewed By:



Troy Crozier
Principal
MEng, BSc, Dip. Civ. Eng
MAIG, PRGeo – Geotechnical and Engineering
Registration No.: 10197

6. REFERENCES:

1. Australian Geomechanics Society 2007, "Landslide Risk Assessment and Management", Australian Geomechanics Journal Vol. 42, No 1, March 2007.
2. Geological Society Engineering Group Working Party 1972, "The preparation of maps and plans in terms of engineering geology" Quarterly Journal Engineering Geology, Volume 5, Pages 295 - 382.
3. C. W. Fetter 1995, "Applied Hydrology" by Prentice Hall. V. Gardiner & R. Dackombe 1983, "Geomorphological Field Manual" by George Allen & Unwin

Appendix 1

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

<u>Soil Classification</u>	<u>Particle Size</u>
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

<u>Classification</u>	<u>Undrained Shear Strength kPa</u>
Very soft	Less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

<u>Relative Density</u>	<u>SPT</u> “N” Value (blows/300mm)	<u>CPT</u> Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken

as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7 as 4, 6, 7 then $N = 13$
- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm then as 15, 30/40mm.

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross-sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

$$Q_c \text{ (MPa)} = (0.4 \text{ to } 0.6) N \text{ blows (blows per 300mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

$$Q_c = (12 \text{ to } 18) C_u$$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Dynamic Penetrometers

Dynamic penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.3). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is generally carried out in accordance with Australian Standard 1289 “Methods of Testing Soil for Engineering Purposes”. Details of the test procedure used are given on the individual report forms.

Borehole Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than ‘straight line’ variations between the boreholes.

Details of the type and method of sampling are given in the report and the following sample codes are on the borehole logs where applicable:

D	Disturbed Sample	E	Environmental sample	DT	Diatube
B	Bulk Sample	PP	Pocket Penetrometer Test		
U50	50mm Undisturbed Tube Sample	SPT	Standard Penetration Test		
U63	63mm “ “ “ “ “	C	Core		

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three-storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty-storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

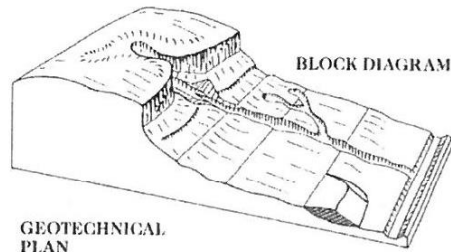
Reproduction of Information for Contractual Purposes

Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information in Tender Documents”, published by the Institution of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a special ally edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

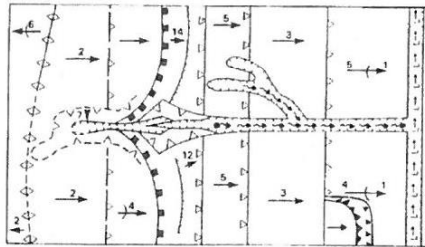
Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007



GEOTECHNICAL
PLAN



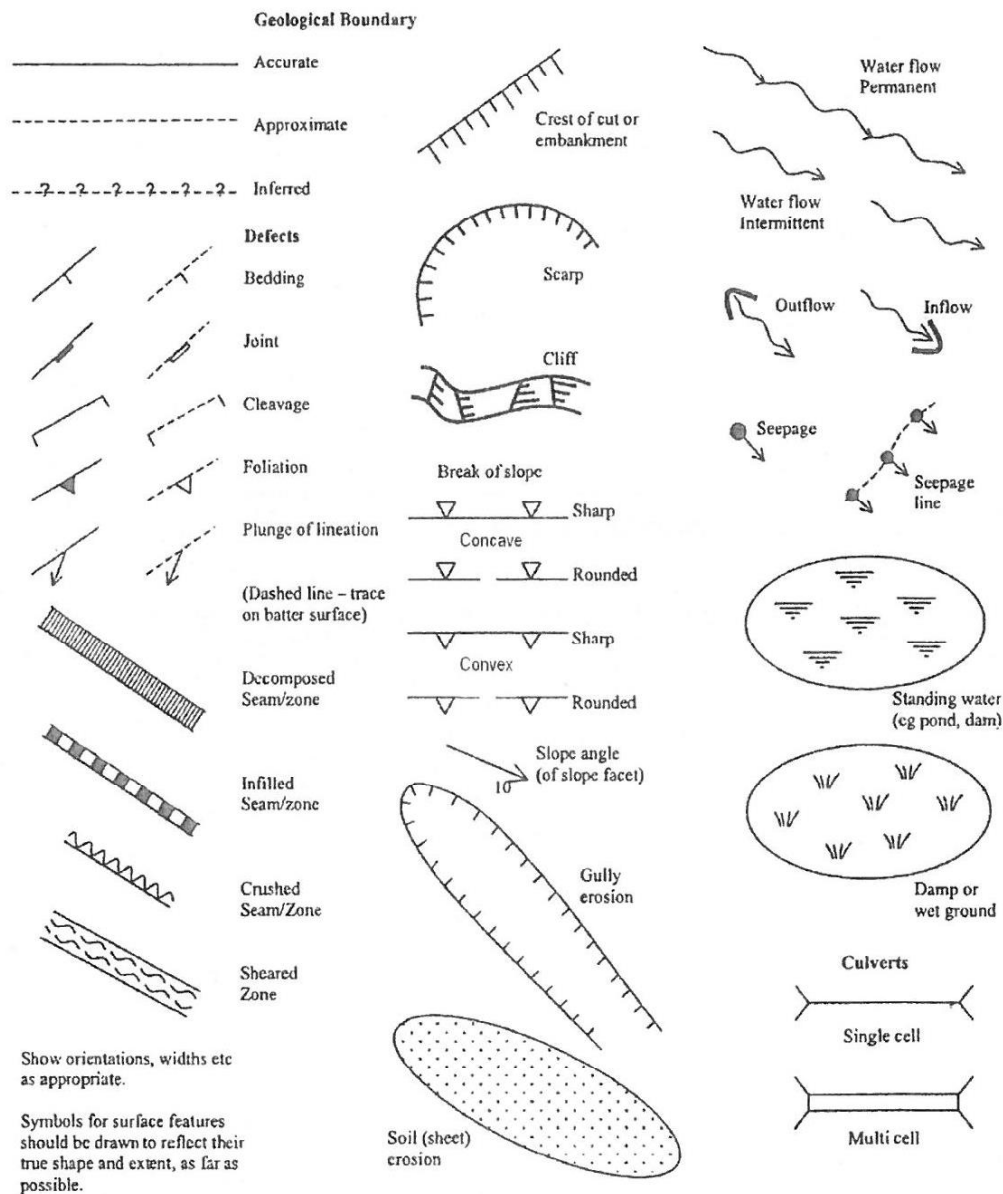
SYMBOL	GROUND PROFILE	
		Convex
		Concave
		Convex
		Concave
	Breaks of slope	} Convex and concave too close together to allow the use of separate symbols
	Changes of slope	
	Sharp	} Ridge crest
	Rounded	
	Cliff or escarpment or sharp break 40° or more (estimated height in metres)	
	Uniform slope	} Slope direction and angle (Degrees)
	Concave slope	
	Convex slope	
	Top	} Cut or fill slope, arrows pointing down slope
	Bottom	
	Hummocky or irregular ground	
	Open drain, unfilled	
	Open drain, lined	
	Fence line	
	Property boundary	
		Dry stone wall
		Major joint in rock face (opening in millimetres)
		Tension crack (opening in millimetres)

Example of Mapping Symbols

(after V Gardiner & R V Dackombe (1983). Geomorphological Field Manual. George Allen & Unwin).

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX E - GEOLOGICAL AND GEOMORPHOLOGICAL MAPPING SYMBOLS AND TERMINOLOGY

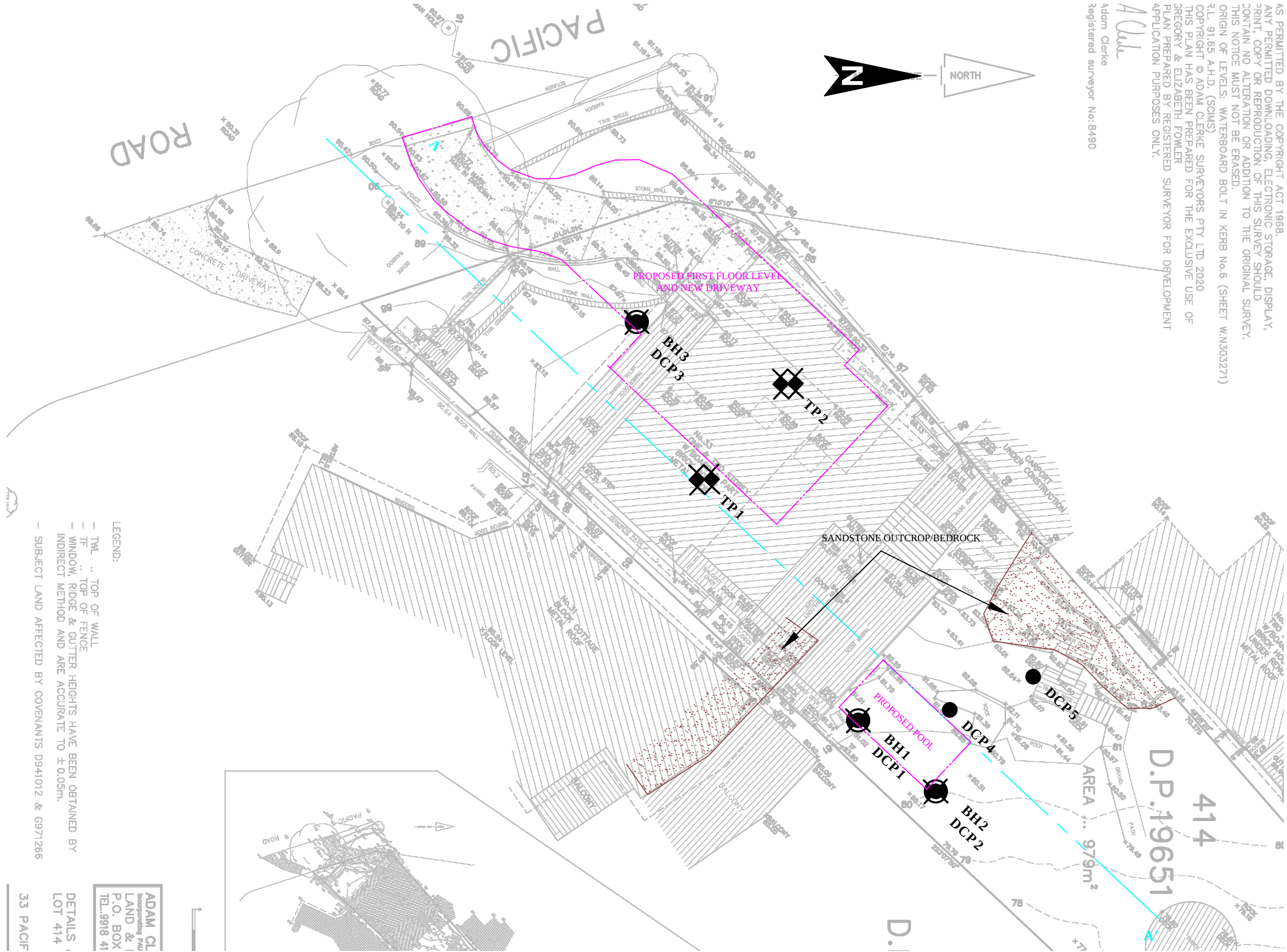


Examples of Mapping Symbols (after Guide to Slope Risk Analysis Version 3.1 November 2001, Roads and Traffic Authority of New South Wales).

Appendix 2

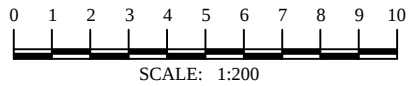
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ORIGIN OF LEVELS: WATERBOARD BOLT IN KERB No.6 (SHEET W/N303271)
3.L. 91.65 A.H.D. (SCIMS)
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THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF
GREGORY & ELIZABETH FOWLER
PLAN PREPARED BY REGISTERED SURVEYOR FOR DEVELOPMENT
APPLICATION PURPOSES ONLY.

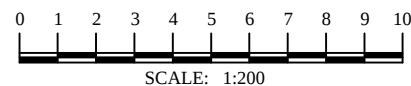
Adam Clarke
Registered surveyor No: 8490



SITE PLAN & TEST LOCATIONS FIGURE 1.

VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense	VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	ELS - Extremely Low Strength VLS - Very Low Strength LS - Low Strength MS - Medium Strength HS - High Strength VHS - Very High Strength	EW - Extremely Weathered HW - Highly Weathered DW - Distinctly Weathered MW - Moderately Weathered SW - Slightly Weathered FR - Fresh	fg - Fine Grained mg - Medium Grained cg - Coarse Grained MAS - Massive BD - Bedded OC - Outcrop
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NB. FOR LOCATION OF SECTION A-A', PLEASE REFER TO FIGURE 1. SITE PLAN AND TEST LOCATIONS



CROZIER
GEOTECHNICAL CONSULTANTS

LEGEND

SCALE:	1:200 @ A3
DRAWING:	FIGURE 2
DATE:	13/01/2021

APPROVED BY: TMC
DRAWN BY: JY
PROJECT: 2021-004

PREPARED FOR:

Greg and Elizabeth Fowler

ADDRESS:

33 Pacific Road, Palm Beach

DYNAMIC PENETROMETER TEST SHEET

CLIENT: Greg and Elizabeth Fowler

DATE: 12/01/2021

PROJECT: Alterations and additions

PROJECT No.: 2021-004

LOCATION: 33 Pacific Road, Palm Beach

SHEET: 1 of 1

Depth (m)	Test Location							
	DCP1	DCP2	DCP3	DCP4	DCP5			
0.00 - 0.15	1	0	3	1	1			
0.15 - 0.30	1	1	3	0	0			
0.30 - 0.45	2	2	4	1	1			
0.45 - 0.60	3	4	5	2	2			
0.60 - 0.75	2	3	4	3 (B) ref at 0.70m	3			
0.75 - 0.90	3	5	7		11			
0.90 - 1.05	3	8	22		10			
1.05 - 1.20	17 (B) ref at 1.10m	4 (B) ref at 1.13m	15 (B) ref at 1.10m		8			
1.20 - 1.35					8			
1.35 - 1.50					6 (B) ref at 1.42m			
1.50 - 1.65								
1.65 - 1.80								
1.80 - 1.95								
1.95 - 2.10								
2.10 - 2.25								
2.25 - 2.40								
2.40 - 2.55								
2.55 - 2.70								
2.70 - 2.85								
2.85 - 3.00								
3.00 - 3.15								
3.15 - 3.30								
3.30 - 3.45								
3.45 - 3.60								
3.60 - 3.75								
3.75 - 3.90								
3.90 - 4.05								

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils

Appendix 3

TABLE: A

Recommended Maintenance and Inspection Program

Structure	Maintenance/ Inspection Item	Frequency
Stormwater drains.	Owner to inspect to ensure that the open drains, and pipes are free of debris & sediment build-up. Clear surface grates and litter.	Every year or following each major rainfall event.
	Owner to check and flush retaining wall drainage pipes/systems	Every 10 years or where variation to retention system
Retaining Walls. or remedial measures	Owner to inspect walls for deveation from as constructed condition and repair/replace.	Every two years or following major rainfall event.
Large Trees on or adjacent to site	Arborist to check condition of trees and remove as required. Where tree within steep slopes (>18°) or adjacent to structures requires geotechnical inspection prior to removal	Every five years
Slope Stability	Geotechnical Engineering Consultant to check on site stability and maintenance	Five years after construction is completed.

N.B. Provided the above shedule is maintained the design life of the property should conform with Councils Risk Management Policy.

Appendix 4

APPENDIX A

DEFINITION OF TERMS

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES WORKING GROUP
ON LANDSLIDES, COMMITTEE ON RISK ASSESSMENT

Risk – A measure of the probability and severity of an adverse effect to health, property or the environment.

Risk is often estimated by the product of probability x consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form.

Hazard – A condition with the potential for causing an undesirable consequence (*the landslide*). The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material, and the likelihood of their occurrence within a given period of time.

Elements at Risk – Meaning the population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by landslides.

Probability – The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome, and 1 indicating that an outcome is certain.

Frequency – A measure of likelihood expressed as the number of occurrences of an event in a given time. See also Likelihood and Probability.

Likelihood – used as a qualitative description of probability or frequency.

Temporal Probability – The probability that the element at risk is in the area affected by the landsliding, at the time of the landslide.

Vulnerability – The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is affected by the landslide.

Consequence – The outcomes or potential outcomes arising from the occurrence of a landslide expressed qualitatively or quantitatively, in terms of loss, disadvantage or gain, damage, injury or loss of life.

Risk Analysis – The use of available information to estimate the risk to individuals or populations, property, or the environment, from hazards. Risk analyses generally contain the following steps: scope definition, hazard identification, and risk estimation.

Risk Estimation – The process used to produce a measure of the level of health, property, or environmental risks being analysed. Risk estimation contains the following steps: frequency analysis, consequence analysis, and their integration.

Risk Evaluation – The stage at which values and judgements enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risks.

Risk Assessment – The process of risk analysis and risk evaluation.

Risk Control or Risk Treatment – The process of decision making for managing risk, and the implementation, or enforcement of risk mitigation measures and the re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input.

Risk Management – The complete process of risk assessment and risk control (*or risk treatment*).

Individual Risk – The risk of fatality or injury to any identifiable (named) individual who lives within the zone impacted by the landslide; or who follows a particular pattern of life that might subject him or her to the consequences of the landslide.

Societal Risk – The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injuries, financial, environmental, and other losses.

Acceptable Risk – A risk for which, for the purposes of life or work, we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable.

Tolerable Risk – A risk that society is willing to live with so as to secure certain net benefits in the confidence that it is being properly controlled, kept under review and further reduced as and when possible.

In some situations risk may be tolerated because the individuals at risk cannot afford to reduce risk even though they recognise it is not properly controlled.

Landslide Intensity – A set of spatially distributed parameters related to the destructive power of a landslide. The parameters may be described quantitatively or qualitatively and may include maximum movement velocity, total displacement, differential displacement, depth of the moving mass, peak discharge per unit width, kinetic energy per unit area.

Note: Reference should also be made to Figure 1 which shows the inter-relationship of many of these terms and the relevant portion of Landslide Risk Management.

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007
APPENDIX C: LANDSLIDE RISK ASSESSMENT
QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10 ⁻¹	5x10 ⁻²	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10 ⁻²		100 years		The event will probably occur under adverse conditions over the design life.	LIKELY	B
10 ⁻³	5x10 ⁻³	1000 years	200 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10 ⁻⁴		10,000 years		The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10 ⁻⁵	5x10 ⁻⁵	100,000 years	20,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10 ⁻⁶		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%		Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	40%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%		Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%	1%	Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

- Notes:** (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.
- (3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.
- (4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not *vice versa*

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10 ⁻¹	VH	VH	VH	H	M or L (5)
B - LIKELY	10 ⁻²	VH	VH	H	M	L
C - POSSIBLE	10 ⁻³	VH	H	M	M	VL
D - UNLIKELY	10 ⁻⁴	H	M	L	L	VL
E - RARE	10 ⁻⁵	M	L	L	VL	VL
F - BARELY CREDIBLE	10 ⁻⁶	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.