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Project 85382.00
23 March 2016
85382.00.R.001.Rev0
RKL:pc

Attention: Richard Denton

Email: richard.denton@bigpond.com.au

Dear Sirs

Geotechnical Assessment
New Residence
81 Prince Alfred Parade, Newport

1. Introduction

This report presents the results of a geotechnical assessment carried out by Douglas Partners Pty Ltd (DP) for a proposed residence at 81 Prince Alfred Parade, Newport. The work was carried out at the request of Mr Richard Denton, acting on behalf of Patbay Pty Ltd.

It is understood that the project is to comprise demolition of the existing structures followed by the construction of a multi-level residence on a similar though larger footprint to occupy the central and upper portion of the site. The plans and section for the proposed development indicate that a stepped excavation will cut up to about 3 m required at the rear, upslope sides of both the basement/garage and the first floor levels.

A geotechnical assessment was carried out to provide information on subsurface conditions for preliminary design and costing purposes and to support a Development Application with specific reference to addressing the requirements of the Pittwater Geotechnical Risk Management Policy (GRMP) of December 2009.

The assessment comprised detailed inspection and photography of the site and accessible adjacent areas, together with a series of dynamic penetrometer tests (DPTs) at selected locations. Details of the field work are given in this report, together with comments relating to the inferred subsurface profile and type section, identification, description and reporting of geotechnical hazards, as well as preliminary design parameters for the excavation, retaining walls and foundations, drainage and maintenance requirements as well as construction practice.

Architectural plans for the project prepared by Joshua Mulders Architects (Drawings 01 to 04) and a survey plan by Geographic Solutions Surveyors (Ref 2552 dated 10/12/2014) were provided for use in the assessment.

2. Site Description and Geology

The site is a rectangular residential lot located on the high, southern side of Prince Alfred Parade, Newport. It has average plan dimensions of 36.2 m by 14.0 m and a total area of approximately 507.2 m^2 (refer to Drawing 1). The site is bounded by residential lots to the south, east and west with Prince Alfred Parade to the north.

The site slopes moderately steeply from the upslope southern boundary (RL 31.0 (relative to Australian Height Datum – AHD) to a dilapidated sandstone retaining wall at the street frontage boundary (RL about 22.5) with a grass covered batter with some areas of exposed rock (detached blocks/floaters) from the boundary wall to the nature strip (refer to Photo 1). There is an overall difference in elevation of approximately 18.3 m, resulting in an average slope angle of 13°.

The current site improvements include;

- a one storey fibro cottage in the centre of the site,
- a fibro shed upslope from the residence, and
- a metal shed towards the upper south-western boundary.

There are a number of dilapidated stone retaining/landscaping wall on the site creating a number of more gently sloping terraced areas.

Reference to the Sydney 1:100 000 Geological Series Sheet 9130 indicates that the site is underlain by the Newport Formation, which is the upper unit of the Narrabeen Group and typically comprises interbedded siltstone, shale, laminite and lithic to quartz-lithic sandstone. This is consistent with the topography and the rock observed in the general surrounding area.

3. Site Observations and Field Work

The site was inspected by a senior engineering geologist on 18 March 2016 and the field assessment comprised detailed geological inspection and photography of the site and adjoining areas as well four Dynamic Penetrometer Tests (DPT A to D).

The locations of the DPTs, site photographs and features are shown on Drawing 1. Additional information is provided on the photographic plates (Photos 1 to 10, Plates 1 to 4 attached).

The main site observations are:

- the site slopes from south to north generally at a relatively uniform slope angle (of about 13^0) from the southern boundary to the northern boundary with a steeper batter (of about 33^0) to a paved parking bay and the nature strip next to the concrete street kerb.
- there is currently no on-site parking and the cottage is accessed via a set of concrete steps along the western boundary (refer to Photo 1).

- there is no bedrock outcrop on the site; the rock in the street frontage is inferred to be sandstone floaters within a colluvium batter.
- mid-way along the western boundary there is an exposure of the natural underlying colluvial soil which comprises very stiff sandy, silty clay with numerous ironstone fragments/gravel.
- the site is occupied by a fibro cottage and shed, both of which show signs of minor movement in the form of rotated brick piers supporting the northern side of the cottage and cracking of the concrete floor slab of the shed as well as the formation of a 30 mm gap under the northern, downslope side of the shed.
- there are a number of dry stacked and mortar bonded landscaping walls on the site, all of which are distressed with evidence of rotation, bulging and partial collapse.
- sections of both the eastern and western boundaries are supported by concrete block walls (refer to Drawing 1), which are in apparently good condition and appear to have been constructed at the time of the adjacent developments.
- beyond (upslope of) the southern boundary there is a (relatively) recently constructed retaining wall of galvanised steel sections with timber infill panels. The structure appears to be in sound condition but does not extend fully to the eastern boundary. Approximately 2 m of the eastern end of the southern boundary comprises a steep, unsupported batter, immediately adjacent to a large tree (refer to Drawing 1).
- downslope of the southern boundary (on the subject property) there is a timber log fence which, towards the eastern end retains up to about 0.5 m of soil. The fence has a significant downslope rotation and there has been erosion around the central posts exposing the concrete of the post's "socket" (refer to Photos 9 and 10).
- there was no evidence of significant slope instability observed on the subject site. There was evidence of minor soil creep, rotation of the rear, southern fence, bulging of the low (less than 0.8 m high) landscaping wall and minor slumping of the roadside batter immediately adjoining the parking bay.

DPTs were carried out at four locations (DPT A to D) and, with the exception of DPT D, encountered refusal at depths ranging from 0.6 m to 1.2 m on what is inferred to represent the level of the top of extremely to highly weathered bedrock (ToR). DPT D extended to 1.2 m depth without reaching refusal.

4. Proposed Development

The supplied information indicates that the proposed development will comprise demolition of the existing structures followed by the construction of a multi-level residence. The plans and sections indicate that a stepped excavation will be required, up to about 3 m depth at the rear, upslope sides of both the basement/garage and the first floor levels. Reference should be made to the architectural drawings for the precise layout of the proposed development.

5. Comments

5.1 Geotechnical Model and Inferred Type Section

The interpreted geological model/type section for the site comprises a moderate to steep slope with a surface mantle of colluvium and possible residual clayey sand and sandy clay soil (expected thickness of less than 1 m to probably about 2m) underlain by initially highly weathered bedrock with a rock profile stepping down the slope. Bedrock (as exposed above and below the site boundaries) is likely to comprise lithic sandstone and siltstone with some shale beds. It is possible that higher strength and more thickly bedded layers of sandstone may be present and be encountered in the excavation.

It is considered that the sandstone floaters at the street frontage are detached boulders/floaters (within the colluvium) originating from further upslope and having moved downslope by naturally occurring erosional and slumping processes over a long geological timeframe.

5.2 Stability and Slope Risk Assessment

Inspection of the general slope on the subject and adjoining lots indicated no evidence of gross, large scale slope instability in the recent past. However, there is evidence of settlement and creep movements affecting all landscaping walls, the southern boundary fence and many areas of paving, pathways as well as the concrete slab for the fibro shed.

The site soils are subject to soil creep due to the steepness of the site and may be susceptible to erosion if disturbed. Care will therefore be required to ensure concentrated surface flows are not created. Recommendations for stormwater disposal are presented in Section 5.5.

The hazards above, adjacent to and on the site have been assessed for risk to property and life using the general methodology outlined by the Australian Geomechanics Society - Landslide Risk Management Subcommittee, 2007.

Identified hazards are summarised in Table 1, together with a qualitative assessment of likelihood, consequence and slope instability risk to property after completion of the proposed development and construction (assuming appropriate engineering design and construction works are adopted).

Table 1: Assessment of Slope Instability Risk to Property for Proposed Development (after Construction)

Hazard	Likelihood	Consequence	Risk
Erosion/slumping of slope resulting from surface water flow from adjacent upslope property	Unlikely - for properly installed and maintained surface drainage measures, and based upon past performance.	Minor (to Insignificant)	Low (to Very Low)
Collapse of excavation during construction of retaining walls	Unlikely - for appropriately designed, inspected and supported temporary excavations	Minor	Low
Rapid collapse of final retaining walls	Rare - for engineer designed, inspected and constructed wall.	Medium	Low
Slow, minor creep of colluvium and soil across the upper section of the site	Unlikely - for appropriately designed, constructed and maintained retaining/landscaping structures.	Minor	Low
Slow, minor creep of colluvium and soil across lower section of site	Possible - (subject to nature of landscaping works)	Insignificant	Very Low
Gross slope instability	Barely Credible - no evidence of past gross instability observed.	Major	Very Low

For loss of life, the individual risk can be calculated from:

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

where:

- $R_{(LoL)}$ is the risk (annual probability of loss of life (death) of an individual)
- $P_{(H)}$ is the annual probability of the hazardous event (erosion/ wall failure)
- $P_{(S:H)}$ is the probability of spatial impact by the hazard (e.g. of the failure reaching the residence the taking into account the distance for a given event)
- $P_{(T:S)}$ is the temporal probability (e.g. of the adjacent area being occupied by the individual) given the spatial impact
- $V_{(D:T)}$ is the vulnerability of the individual (probability of loss of life of the individual given the impact).

The assessed individual risk to life (person most at risk) resulting from slope instability is summarised in Table 2.

Table 2: Assessment of Slope Instability Risk to Life for the Proposed Development (after Construction)

Hazard	$P_{(H)}$	$P_{(S:H)}$	$P_{(T:S)}$	$V_{(D:T)}$	Risk $R_{(LoL)}$
Erosion/slumping of slope resulting from surface water flow from the upslope property.	10^{-4}	0.1	0.1	<0.01	$<1 \times 10^{-7}$
Collapse of excavation during construction of retaining walls	10^{-4}	1	0.1	0.1	1×10^{-6}
Rapid collapse of final retaining walls	10^{-5}	1	0.5	0.1	5×10^{-7}
Extremely slow, minor creep of colluvium and soil across upper section of the site	10^{-4}	1	0.1	<0.01	$<1 \times 10^{-7}$
Extremely slow, minor creep of colluvium and soil across lower section of site	10^{-3}	<0.1	0.1	<0.01	$<1 \times 10^{-7}$
Gross slope instability	10^{-6}	1	0.5	1	5×10^{-7}

When compared to the requirements of the AGS, it is considered that the proposed development will meet 'Acceptable Risk Management' criteria with respect to both property and life under current and foreseeable conditions.

Provided the construction is undertaken in accordance with the recommendations contained in this report, is appropriately designed and incorporates sound engineering practice, it is considered that the project is technically feasible and that the construction would not be expected to adversely affect the overall stability of the site or negatively influence the geotechnical hazards identified in Tables 1 and 2.

5.3 Excavation and Retaining Structures

The architectural drawings indicate that excavation into the slope will be required for the proposed development. The excavation will be up to about 3 m deep on the upslope sides of both the basement/ garage and first floor levels.

It is expected that excavation into colluvial and residual clay soils will be readily achieved using conventional hydraulically operated earthmoving equipment down to the level of at least low strength

rock. However, the excavation may encounter medium strength rock (and possibly stronger) towards the lower parts of the excavation, which will require the use of appropriate sawing, ripping, rock milling and possibly rock breaking equipment.

To date the geotechnical assessment of the site has been limited to detailed site inspection and assessment using hand held equipment. Preliminary design, subject to onsite confirmation during construction (as needed as part of Pittwater Council Form 3 requirements) may be undertaken using the information and parameters detailed below and in the following sections of this report.

The existing clayey and sandy clay soils are currently subject to soil creep on many parts of the site, and will need to be appropriately supported. Any soil remaining exposed along the crest of any excavation cannot be relied upon to stand with batter slopes exceeding 1:1 (H:V) for other than the short term and support will be required where this batter slope cannot be achieved. If ongoing wet conditions are encountered similar localised instability could occur and it is recommended that the crest of all excavations be protected from surface water flows by the installation of appropriate dish drains to control and divert surface runoff around the excavation(s).

Engineer designed retaining walls should be used to retain all soils, filling or extremely weathered bedrock and particularly where the retained height is more than 1 m. Suggested retaining wall design parameters are given in Table 3.

Table 3: Retaining Wall Design Parameters

Material	Earth Pressure Coefficient		Bulk Density
	Short term	Long term	
Colluvium, filling or sandy clay soils	0.3	0.4	20 kN/m^3
Sandstone/siltstone/shale - very low strength	0.1	0.15	22 kN/m^3

It should be noted that no provision has been made in the above design parameters for water pressure acting on the walls or other surcharges or sloping ground above a wall. Drainage measures such as free draining backfill and discharge points through all walls should be incorporated into all wall designs.

Within the proposed excavation, sandstone/siltstone/shale bedrock of at least medium strength is generally expected to be able to stand near-vertically without support unless unfavourably oriented jointing is encountered which could give rise to localised instability requiring rock bolt or other support. Similarly, where there are intersecting joints, highly weathered zones within the rock mass or pockets of deeper soil cover, there could be a potential for local block or minor slip failures. Such features will require localised support such as rock bolts, underpinning or the application of shotcrete.

Regular inspections will be required during the progress of all excavation work, by an experienced geotechnical professional. It is recommended that inspection be carried out at no greater than 1.5 m vertical excavation intervals to delineate, where applicable, areas of potential instability requiring additional slope support works and stabilisation.

5.4 Foundations

The subsurface profile across the site is likely to be quite variable, comprising colluvial soil (sand and sandy clay), residual sandy clay and bedrock. The depth to bedrock, as well as the nature and strength of bedrock, will be variable, typical of a stepped bedrock profile developed on the Newport Formation.

It is recommended that all foundations be taken down to and also be either socketed (or dowelled) into the underlying, in situ bedrock. A design allowable bearing pressure of up to 1000 kPa is considered appropriate for bedrock (sandstone and siltstone) of at least low strength. It is possible that higher bearing pressures may be possible, subject to inspection during construction.

It is anticipated that footings are likely to comprise a combination of spread footings on the upslope sides of the excavation basement/garage and first floor levels and bored piers towards the outer, northern side of the benches and elsewhere for the proposed structure. Inspection of all footing excavations (spread and pier footings) for all retaining walls as well as the foundations for the residence, prior to pouring of concrete, will be required to enable completion of a Pittwater Council GRMP Form 3 (Final Geotechnical Certificate – Post Construction Geotechnical Certificate) prior to obtaining a final Occupation and Building Certificate upon completion of the works.

5.5 Stormwater Disposal and Site Drainage

The soils on the site are potentially susceptible to erosion by concentrated surface water flows and it is therefore recommended that appropriate surface runoff control measures are incorporated into the design of the works.

All roof water, any concentrated surface flows created by the proposed works and excess/overflow water from any water tanks must be discharged from site in a controlled manner using a piped stormwater system, into the Council drainage system.

All drainage lines, including those behind retaining structures, should include inspection ports to permit periodic maintenance by the owners. It is considered that due to the steepness of the site and the underlying clayey colluvium soil the site is not suitable for on-site absorption or dispersion of stormwater.

6. Conditions Relating to Design and Construction Monitoring

To comply with the Pittwater Council Consent Conditions which are part of the design, construction, and post-construction certificate requirements of the Pittwater GRMP, it will be necessary for DP to:

- review all structural drawings to confirm that they adequately address the geotechnical issues identified in this report and then Complete a **Pittwater Form 2b**, and
- undertake progressive inspection of the bulk excavation (and exposed cuts) into the slope as well as all new footing excavations (house and retaining structures) to ensure founding strata is of adequate bearing capacity and stability and to confirm compliance to the structural design and to then complete a **Pittwater Form 3**.

7. Design Life and Requirement for Maintenance and Inspection

DP interprets the reference to design life requirements, as specified within the GRMP, to refer to structural elements designed to retain the subject slope and maintain the risk of instability within acceptable limits.

Specific structures that may affect the maintenance of site stability in relation to the proposed development on this site comprise:

- the proposed stormwater surface drains and buried pipes leading to the stormwater disposal system, and
- the proposed retaining walls on the site.

In order to attain a structural life of 100 years (as required by the Council Policy), it will be necessary for the structural engineer to incorporate appropriate construction detailing and for the property owner to adopt and implement a maintenance and inspection programme.

A typical programme for developments on sloping sites is given in Table 4.

Table 4: Recommended Maintenance and Inspection Programme

Structure	Maintenance/Inspection Task	Frequency
Stormwater drains, subsoil drains, pipes and pits	Owner to inspect to ensure that the drains, pipes and pits are free of debris and sediment build-up. Clear surface grates of vegetation/litter build-up.	Every two to three years or following each significant rainfall event.
Existing or proposed retaining walls	Owner to check wall for deviation from “as-constructed” condition.	Every two to three years or following each significant rainfall event.

Where changes to site conditions are identified during the maintenance and inspection programme, reference should be made to a relevant professional (e.g. structural engineer or geotechnical engineer).

8. Limitations

Douglas Partners (DP) has prepared this report for this project at 81 Prince Alfred Parade Newport in accordance with DP's proposal dated 23 February 2016 and acceptance received from Patbay Pty Ltd dated 24 February 2016. The work was carried out under DP's Conditions of Engagement.

This report is provided for the exclusive use of Patbay Pty Ltd and their design consultants for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or on other sites or by other third parties. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget and scope constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building and any demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction of all works (not just geotechnical components) and the controls required to mitigate risk. This report does, however, identify hazards associated with the geotechnical aspects of development and presents the results of a risk assessment associated with the management of these hazards. It is suggested that the developer's principal design company may wish to include the geotechnical hazards and risk assessment information contained in this report, in their own Safety Report.

If the principal design company, in the preparation of its project Design Report, wishes to undertake such inclusion by use of specific extracts from this subject DP report, rather than by appending the complete report, then such inclusion of extracts should only be undertaken with DP's express agreement, following DP's review of how any such extracts are to be utilised in the context of the project Safety Report. Any such review shall be undertaken either as an extension to the contract for the works associated with this subject DP report or under additional conditions of engagement, with either option subject to agreement between DP and the payee.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

Richard Lloyd
Senior Consultant

Reviewed by

John Braybrooke
Principal

Attachments: About this Report
Drawings 1 and 2
Photo plates 1 to 4
Forms 1 and 1A

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations 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.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report 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 or excavation. 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 and test pits 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 or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements 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 advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP 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 conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

Site Anomalies

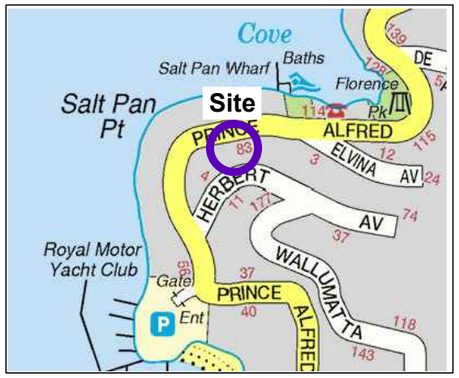
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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

Information for Contractual Purposes

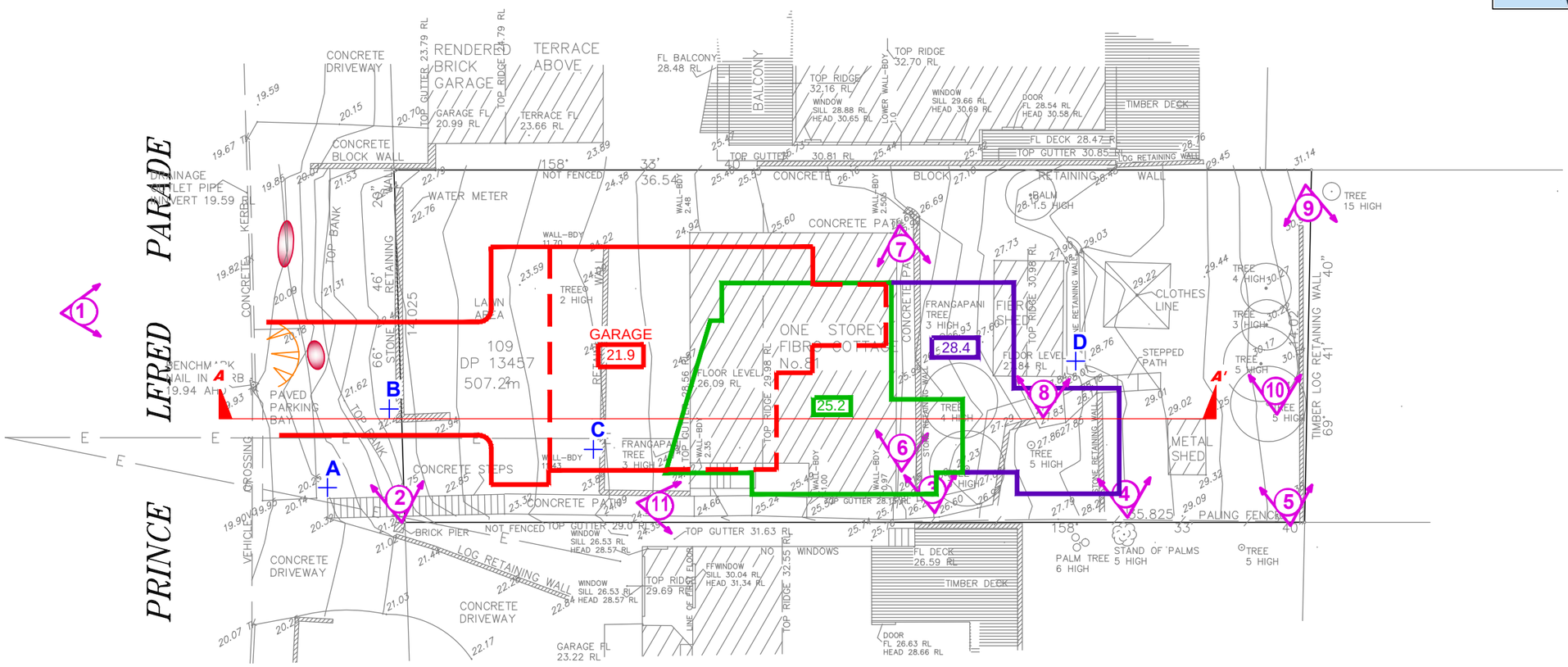
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP 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 and environmental 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.



Locality Plan



NOTE:

1: Base drawing from Geographic Solutions Surveyors Pty Ltd (Ref 2552, dated 10.12.2014)
2: Test locations are approximate only and are shown with reference to existing features.

0 1 2 3 4 6 8 10 15 20m

1:200 @ A3

LEGEND

- DPT location
- Floater
- 1 Photo number with direction of view
- A A' Geotechnical Cross Section A-A' (See drawing 2)

FOOTPRINT:

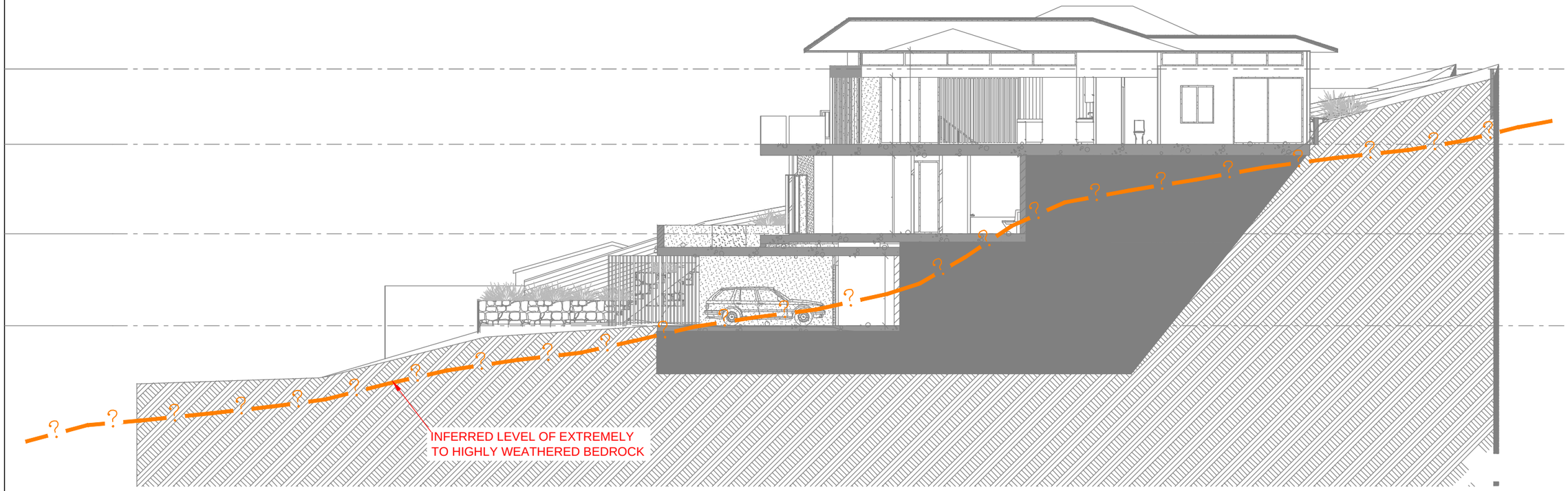
- Basement/ garage RL 21.9
- First floor RL 25.2
- Second floor RL 28.4

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Patbay Pty Ltd		TITLE: **Location of Site Features, Tests and Photos**	PROJECT No: 85382.00
OFFICE: Sydney	DRAWN BY: PSCH	**New Residence**	DRAWING No: 1
SCALE: 1:200 @ A3	DATE: 21.3.2016	**81 Prince Alfred Parade, NEWPORT**	REVISION: 0

A

A'



NOTE:

1: Base drawing from Joshua Mulders Architects Pty Ltd (Dwg PRE DA-06-01, dated 14.12.2015
2: Test locations are approximate only and are shown with reference to existing features.

0 1.0 2.0 3.0 4.0 5.0 7.5 10 15m

1:150 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Patbay Pty Ltd		TITLE: **Cross Section A-A'**	PROJECT No: 85382.00
OFFICE: Sydney	DRAWN BY: PSCH	**New Residence**	DRAWING No: 2
SCALE: 1:150 @ A3	DATE: 23.3.2016	**81 Prince Alfred Parade, NEWPORT**	REVISION: 0

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

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}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 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%	40%	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%	10%	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%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		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

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

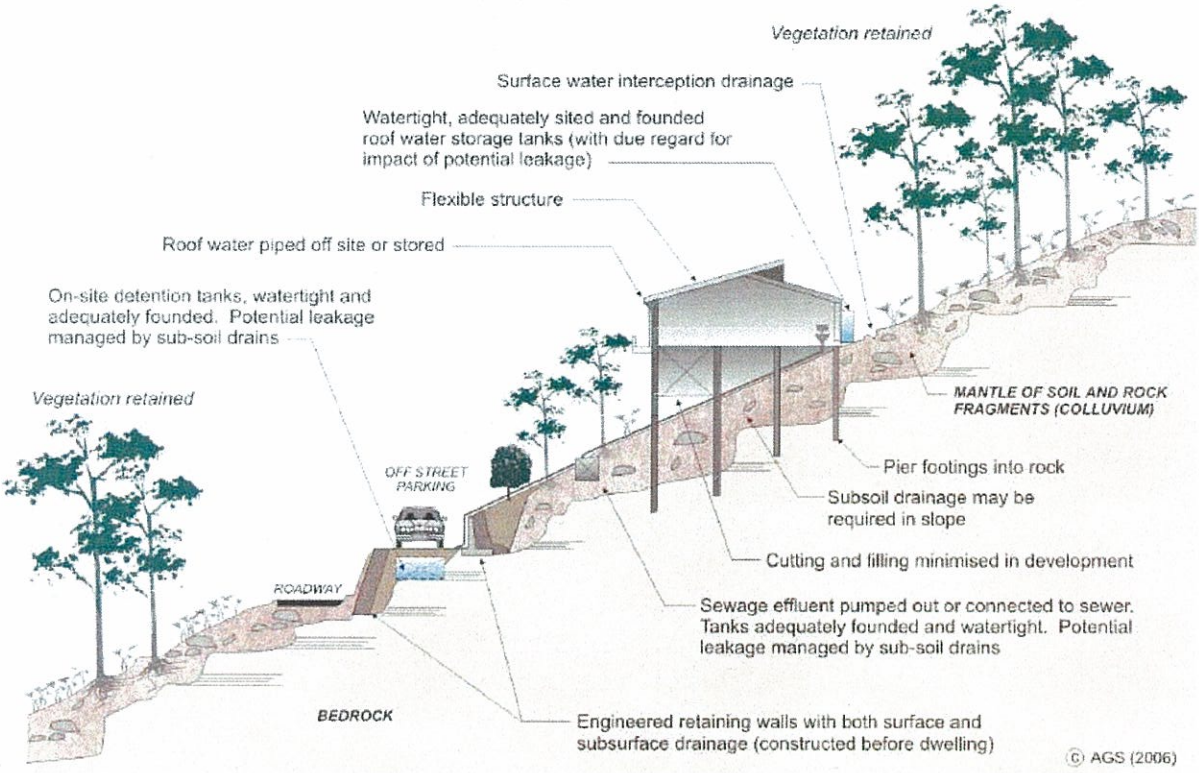
Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
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.

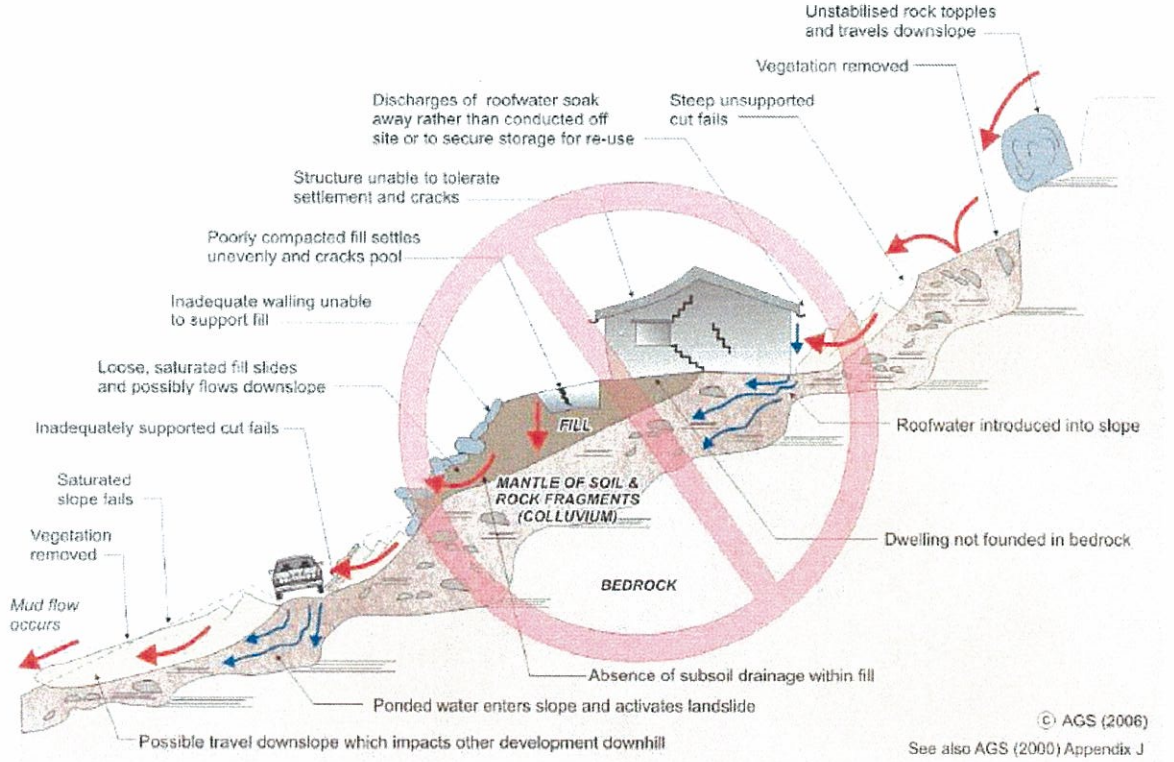
APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, 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	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
CUTS	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 clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. 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 have unacceptable risk. 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 subsurface 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 unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing 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 general falls 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.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE



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Results of Dynamic Penetrometer Tests

Client Patbay Pty Ltd
Project Proposed New Residence
Location 81 Prince Alfred Parade, Newport

Project No. 85382.00
Date 22/03/16
Page No. 1 of 1

Test Locations	A	B	C	D						
RL of Test (AHD)	20.4	22.2	24.0	28.1						
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 – 0.15	2	1	1	2						
0.15 – 0.30	2	1	3	3						
0.30 – 0.45	2	1	2	3						
0.45 – 0.60	10/150	2	4	5						
0.60 – 0.75	B	8	3	4						
0.75 – 0.90		3	6	4						
0.90 – 1.05		6	20/50	4						
1.05 – 1.20		20/150	B	5						
1.20 – 1.35		B								
1.35 – 1.50										
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										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑
AS 1289.6.3.3, Sand Penetrometer ☐

Tested By DEM
Checked By DEM

Remarks 20/50 indicates 20 blows for 50mm penetration. B indicates bouncing refusal

Photo 1. Panorama of the site viewed towards the south. Note marked boundaries are approximate only.

Photo 2. Panorama of the northern portion of the site viewed towards the east.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Patbay Pty Ltd		TITLE: **Site Photographs**	PROJECT No:	85382.00
	OFFICE: Sydney	DRAWN BY: RKL	**Proposed New Residence**	PLATE No:	1
	SCALE: NA.	DATE: 19.03.2016	**81 Prince Alfred Parade Newport**	REVISION:	-

Photo 3. 180 degree panorama of the upslope side of the existing cottage viewed towards the east.

Photo 4. 180 degree panorama of the upslope side of the fibro shed, viewed towards the east .

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Patbay Pty Ltd		TITLE: **Site Photographs** **Proposed New Residence** **81 Prince Alfred Parade Newport**	PROJECT No: 85382.00
	OFFICE: Sydney	DRAWN BY: RKL		PLATE No: 2
	SCALE: NA.	DATE: 19.03.2016		REVISION: -

Photo 5. Upper south-western corner of the site showing southern log boundary fence.

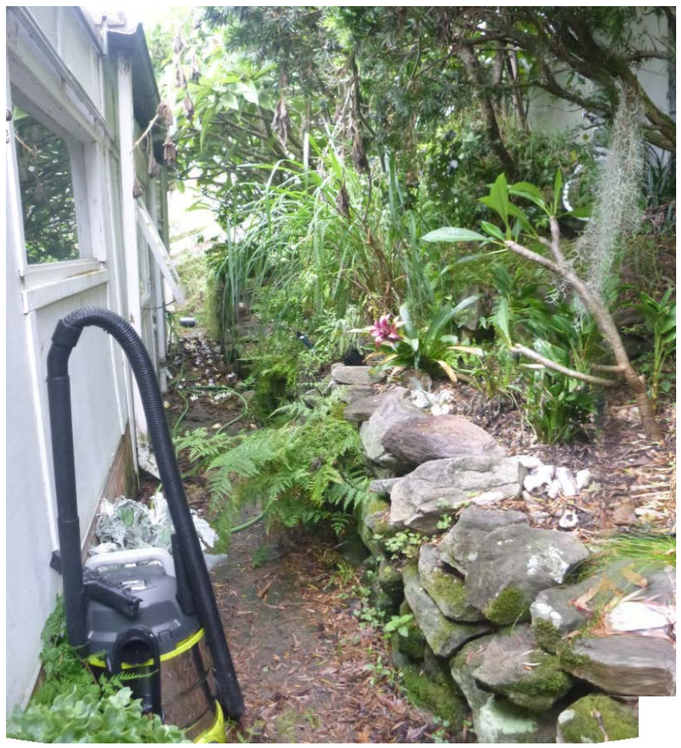

Photo 6. Stacked sandstone block wall on southern side of the cottage viewed towards the east.

Photo 7. Stacked sandstone block wall on southern side of the cottage viewed towards the west.

Photo 8. Cracked concrete floor of fibro shed.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Patbay Pty Ltd		TITLE: **Site Photographs**	PROJECT No: 85382.00
	OFFICE: Sydney	DRAWN BY: RKL	**Proposed New Residence**	PLATE No: 3
	SCALE: NA.	DATE: 19.03.2016	**81 Prince Alfred Parade Newport**	REVISION: -

Photo 9. Upslope side of the southern boundary fence, showing retaining wall on upslope property.

Photo 10. Eroded base of fence posts exposing part of the concreted "socket" of the posts. The posts and fence have rotated down slope.

Photo 11. Exposure of very stiff mottled yellow brown clay soil with ironstone bands. Exposed at mid-slope along the western boundary.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Patbay Pty Ltd		TITLE: **Site Photographs**	PROJECT No: 85382.00
	OFFICE: Sydney	DRAWN BY: RKL	**Proposed New Residence**	PLATE No: 4
	SCALE: NA.	DATE: 19.03.2016	**81 Prince Alfred Parade Newport**	REVISION: -

PITTWATER COUNCIL

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

Development Application for Patbay Pty Ltd
Name of Applicant
Address of site 81 Prince Alfred Parade, Newport

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 Assessment – Proposed Residence
Report Date: 22-3-16 Project 85382.00
Author: Richard Lloyd
Author's Company/Organisation: Douglas Partners

Please mark appropriate box

- [x] Comprehensive site mapping conducted 18-3-16 (date)
- [x] Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
- [x] Subsurface investigation required
  - [ ] No Justification .....
  - [x] Yes Date conducted ..... 22-3-16 .....
- [x] Geotechnical model developed and reported as an inferred subsurface type-section
- [x] Geotechnical hazards identified
  - [x] Above the site
  - [x] On the site
  - [ ] Below the site
  - [ ] Beside the site
- [x] Geotechnical hazards described and reported
- [x] Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
  - [x] Consequence analysis
  - [x] Frequency analysis
- [x] Risk calculation
- [x] Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- [x] Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- [x] Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009
- [x] Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
- [ ] Design Life Adopted:
  - [x] 100 years
  - [ ] Other .....
  - specify
- [x] Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified
- [x] 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 ..... RAY BLINMAN
Chartered Professional Status..... CPEng .....
Membership No. ..... 817088 .....
Company..... Douglas Partners P/L .....

PITTWATER COUNCIL

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

Development Application for Patbay Pty Ltd
Name of Applicant

Address of site 81 Prince Alfred Pde, Newport

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

I, RAY BLINMAN *on behalf of* DOUGLAS PARTNERS P/L
(Insert Name) (Trading or Company Name)

on this the 23 MARCH 2016 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2million.
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: Geotechnical Assessment - Proposed Residence
Report Date: 22 March 2016 - Project 85382.00
Author: Richard Lloyd
Author's Company/Organisation: Douglas Partners

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

Architectural Plans 01 to 04 by Joshua Mulders Arch.
Site Survey (Ref 2552 dated 10-12-14)
by Geographic Solutions Surveyors

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 ..... RAY BLINMAN .....
Chartered Professional Status..... CP Eng .....
Membership No. ..... 817088 .....
Company..... DOUGLAS PARTNERS P/L .....