GeoEnviro Consultancy Pty Ltd
Unit 5, 39-41 Fourth Avenue, Blacktown, NSW 2148, Australia
PO Box 1543, Macquarie Centre. North Ryde, NSW 2113

ABN 62 084 294 762
Tel : (02) 9679 8733
Fax : (02) 9679 8744

16th June 2020

Our Ref: JG20201A-r1(rev)

RJK Architects
PO Box 304
ANNANDALE NSW 2038

Attention: Mr Jiri Kure

Dear Sir

Re Geotechnical Assessment
Proposed Residential Dwelling
Proposed Lot 1 Kens Road Frenchs Forest

1. Introduction

This report presents our comments and assessment on site stability with respect to the proposed residential dwelling at Proposed Lot 1 Kens Road Frenchs Forest.

We understand that the site is currently vacant and the proposed development will include construction of a new residential dwelling.

As required by Council, this letter presents our comments and assessment on site stability impacts on the proposed development

2. Site Information

2.1 Site Locality

Proposed Lot 1 (The Site) is located on an existing vacant lot referred to as Lot 1 DP 439323 Kens Road Frenchs Forest as shown on Drawing No 1. Lot 1 is proposed to be subdivided into 2 lots (ie Proposed Lot 1 and Proposed Lot 2) as shown on the attached Drawing No 1. The site is roughly triangular in shape with an approximate 30m frontage to Kens Road and extending about 60m to the rear apex of the site.

The site is situated within an established residential area with surrounding properties consisting mainly of residential properties. Across the frontage road to the west is bushland and an existing creek (ie Carroll Creek). The adjoining northern property (ie Proposed Lot 2) is occupied by an old Sydney Water pipeline comprising of a twin 1m diameter concrete pipe with steel collars supported on concrete footings.

2.2 Site Topography

The site is situated on the middle slopes of a gentle hill with ground surface within the site sloping to the west to Carroll Creek at angles of between 5 and 8 degrees. Based on the survey drawing provided, the rear of the site is at about Reduced Level (RL) 91m above the Australian Height Datum (AHD) and the front of the site is at about RL 85m AHD.

2.3 Site Geology

Based on the 1:100,000 Geological Map of Sydney, the site is underlain by Hawkesbury Sandstone consisting of medium to coarse-grained quartz sandstone, very minor shale and laminite lenses.

2.4 Site Description

The site is part of an existing vacant block of land (ie Lot 1 DP 439323) which is understood to be part Sydney Water land.

At the time of our site inspection, site was vacant with the majority of the site covered with trees and a gravel track. There were no obvious signs of trees leaning that may suggests slope movements.

The ground surface slopes down to the frontage road at relatively uniform angle with no abrupt changes in the slope angle or hummocky ground that may suggest slope instability.

The ground surface is mainly blanketed by a thin discontinuous layer of colluvial soil (ie slope wash) with some sandstone outcrops evident in some locations. Organic litter and weeds partially cover parts of the site.

The adjoining southern property (ie No 72 Kens Road) is occupied by a double-storey cement rendered brick residential dwelling. Construction of this dwelling involved excavation up to 4.0m into the slopes and this excavation is retained by a concrete retaining wall which runs along the common property boundary with the subject site. The house and retaining walls appeared in relatively condition with no obvious signs of structural distress associated with slope instability.

3. Proposed Development and Landslide Risk Assessment

We understand that the proposed development will include construction of a new two -storey residential dwelling with a garage beneath the building. Building platform construction for the proposed dwelling will require excavation up to about 1.5m into the slope of the site. Based on the drawings provided, the proposed dwelling will be constructed to within about 2m of the retaining wall along the southern boundary.

Assessment on site classification in accordance to AS2870 “Residential Slabs and Footings’ and site stability in accordance with AGS 2007 Landslip Risk Management. The risk of slope instability is affected by three main factors;

- Slope angle
- Strength of the subsurface materials
- Concentration of water

The stability of an apparent stable block of land may be adversely affected by man made activities on or nearby the site such as;

Diversion of surface water onto the block by new roadways, houses or other landscaping activities.

- The addition of large volumes of filling to level the site.
- The excavation of soil from the downhill slope.
- The introduction of excess water into the ground by septic or other drainage systems.

The risk of slope instability may be generally classified into three categories;

Class	Implication
Low	A landslip is very unlikely
Moderate	A landslip is unlikely
High	Some risk of landslip

Refer to the attached Risk Matrix outlined in the AGS guidelines for landslip risk assessment.

The consequences of slope instability as a result of downhill slope movements may be considered as MAJOR as it may cause extensive damage to the structure requiring significant stabilisation works.

As the subject property is situated on gentle slopes of between 5 and 8 degrees dipping to the frontage road and is situated within an established residential area with surface and subsurface water controlled by existing drainage system, the likelihood of a landslip is RARE, therefore the risk of slope instability is assessed to be Low.

Our assessment on the probability of loss of life after development is less than 10^{-6} and this is considered acceptable.

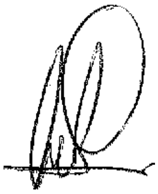
4. Geotechnical Recommendations

Our general comments and recommendations for the proposed development are as follows;

- Site excavation is likely to be mainly in sandstone bedrock. In view of the close proximity of the site to the Sydney Water main, site excavation should be carried out with care to ensure excessive vibration is not generated from the excavation resulting in damage to the water main, therefore the use of impact hammer should be avoided. We recommend excavation be carried out using a rock saw.
- All excavation and filling required for the proposed extension should be adequately retained by engineered retaining wall to ensure site stability is maintained. Care should be taken to ensure any excavation works will not undermine neighbouring properties.
- All unretained excavation and filling which are not retained should be adequately battered to not steeper than 1 Vertical to 2 Horizontal for compacted fill or natural soil and 1 Vertical to 0.5 Horizontal for sandstone.
- All footings for the proposed development should be supported on footings founded on sandstone bedrock with an allowable bearing capacity of 800kPa.
- Footings adjacent the existing retaining wall along the southern boundary should be taken below the zone of influence of the existing retaining wall and this may involve piering. The zone of influence may be taken as the area above the 1 Vertical to 1 Horizontal line from the toe of the retaining wall.
- Adequate surface and surface drains should be constructed as part of the proposed development to divert surface runoff away from footings and excavation.
- All design and construction works should be carried out and supervised by a suitably qualified and experienced engineer.

If you have any queries regarding this report, please contact the undersigned.

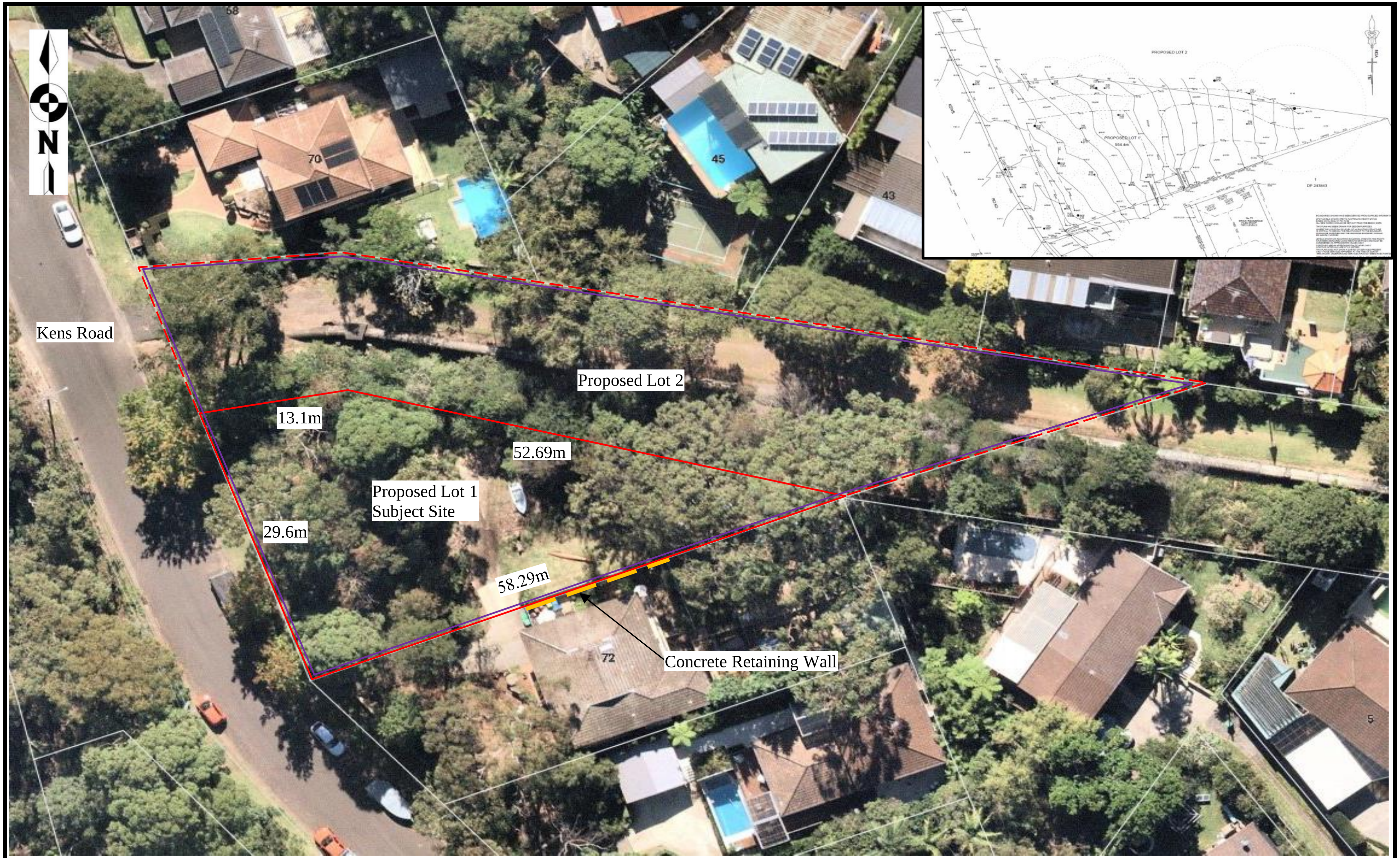
Yours faithfully
GeoEnviro Consultancy Pty Ltd



Solern Liew MIEAust CPEng NER
Director

C:\20JOB\201\JG20201A(rev).DOC

Attachment: Drawing No 1: Site Locality Plan
AGS Risk Matrix and Explanatory Notes



Legend

Subject Site

Existing Lot 1 DP 439323

GeoEnviro Consultancy Pty Ltd

Unit 5, 39-41 Fourth Avenue, Blacktown NSW 2148, Australia

Tel: (02) 9679 8733 Fax: (02) 9679 8744

Drawn By: AT	Date: 10/6/20
Checked By: SL	Date: 10/6/20
Revision By:	Date:
Scale: Not to Scale	A3

RJK Architects

Proposed Lot 1 Kens Road Frenchs Forest

Site Locality Plan

Project No: JG20201A **Drawing No: 1**

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 F- EXAMPLE OF VULNERABILITY VALUES

SUMMARY OF HONG KONG VULNERABILITY RANGES FOR PERSONS, AND RECOMMENDED VALUES FOR LOSS OF LIFE FOR LANDSLIDING IN SIMILAR SITUATIONS

The following table is adapted from P J Finlay, G R Mostyn & R Fell (1999). *Landslides: Prediction of Travel Distance and Guidelines for Vulnerability of Persons.* Proc 8^{th}. Australia New Zealand Conference on Geomechanics, Hobart. Australian Geomechanics Society, ISBN 1 86445 0029, Vol 1, pp.105-113.

Case	Range in Data	Recommended Value	Comments
Person in Open Space			
If struck by a rockfall	0.1 – 0.7	0.5	May be injured but unlikely to cause death
If buried by debris	0.8 – 1.0	1.0	Death by asphyxia almost certain
If not buried	0.1 – 0.5	0.1	High chance of survival
Persons in a Vehicle			
If the vehicle is buried/crushed	0.9 – 1.0	1.0	Death is almost certain
If the vehicle is damaged only	0 – 0.3	0.3	High chance of survival
Person in a Building			
If the building collapses	0.9 – 1.0	1.0	Death is almost certain
If the building is inundated with debris and the person buried	0.8 – 1.0	1.0	Death is highly likely
If the debris strikes the building only	0 – 0.1	0.05	Very high chance of survival

EXAMPLE OF VULNERABILITY VALUES FOR DESTRUCTION OF PEOPLE, BUILDINGS AND ROADS

The following table is adapted from Marion Michael-Leiba, Fred Baynes, Greg Scott & Ken Granger (2002). *Quantitative Landslide Risk Assessment of Cairns.* Australian Geomechanics, June 2002.

Geomorphic Unit	Vulnerability Values		
	People	Buildings	Roads
Hill slopes	0.05	0.25	0.3
Proximal debris fan	0.5	1.0	1.0
Distal debris fan	0.05	0.1	0.3

EXAMPLE OF VULNERABILITY VALUES FOR LIFE FOR ROCKFALLS AND DEBRIS FLOWS FOR LAWRENCE HARGRAVE DRIVE PROJECT, COALCLIFF TO CLIFTON AREA, AUSTRALIA

The following table is adapted from R A Wilson, A T Moon, M Hendricks & I E Stewart (2005). *Application of quantitative risk assessment to the Lawrence Hargrave Drive Project, New South Wales,Australia.* Landslide Risk Management - Hungr, Fell, Couture & Eberhardt (eds) 2005. Taylor & Francis Group, London, ISBN 04 1538 043X.

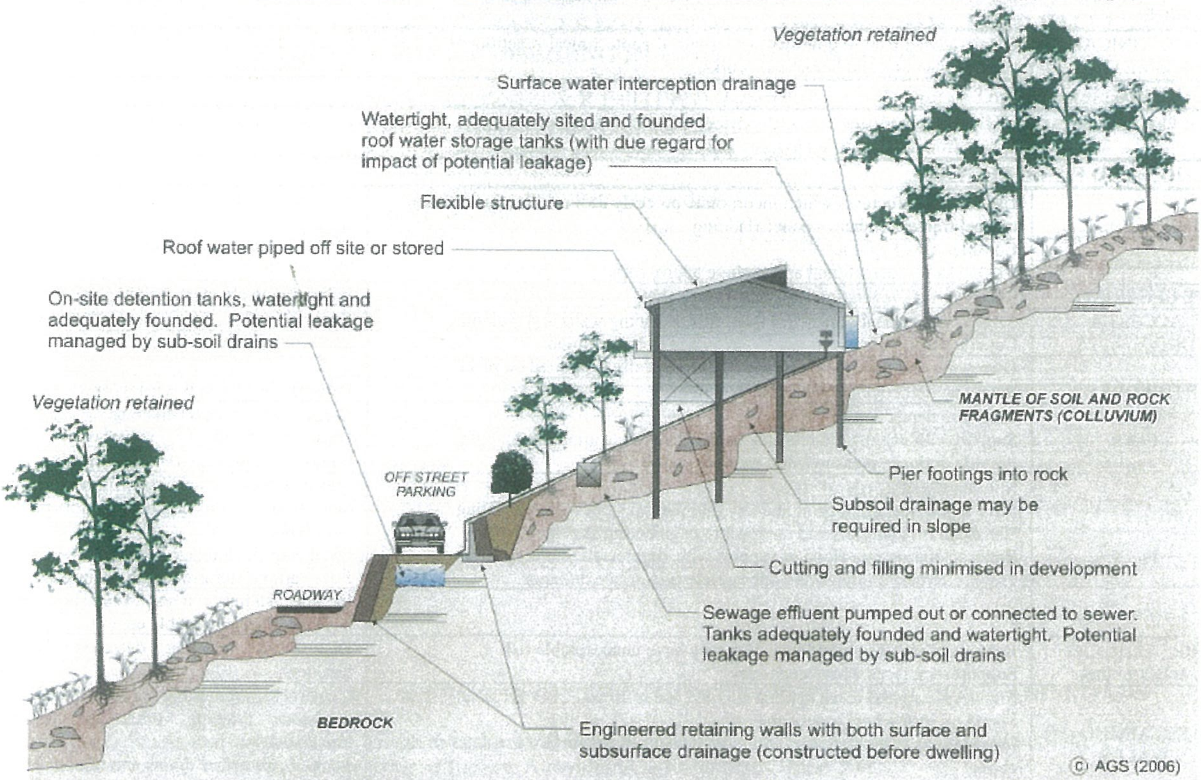
Order of magnitude of landslide crossing road (m^3)	**Rockfalls from Scarborough Cliff**		**Debris flow from Northern Amphitheatre**	
	Landslide hits car	**Car hits landslide**	**Landslide hits car**	**Car hits landslide**
0.03	0.05	0.006	–	–
0.3	0.1	0.002	–	–
3	0.3	0.03	0.001	–
30	0.7	0.03	0.01	0.001
300	1	0.03	0.1	0.003
3,000	1	0.03	1	0.003

NOTE: The above data should be applied with common sense, taking into account the circumstances of the landslide being studied. Judgment may indicate values other than the recommended value are appropriate for a particular case.

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