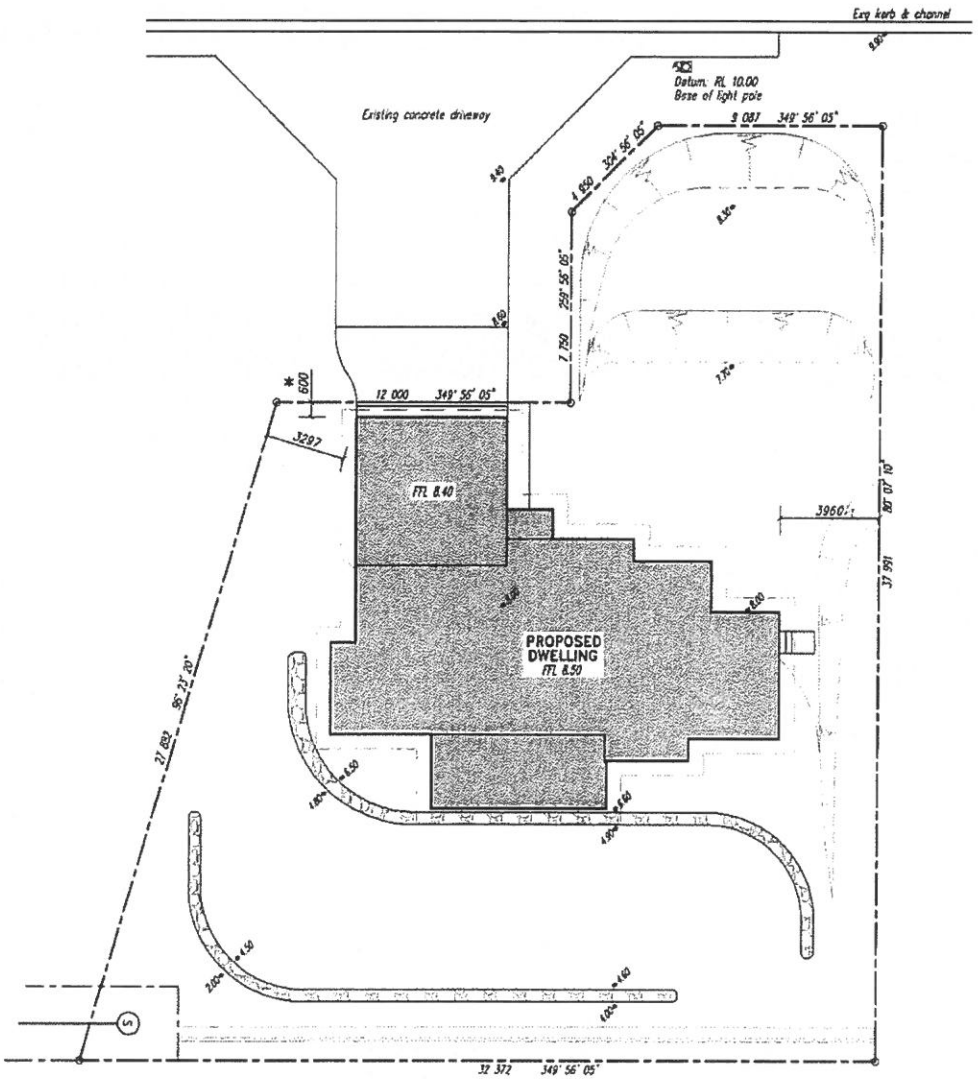
KILKENNY COURT



SITE PLAN 1:200

ROCKHAMPTON REGIONAL COUNCIL

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Development Permit No.: D/38-2018

Dated: 29 June 2018

SERVICES LEGEND:

- E Electricity turret
- T Telstra pit
- G Gully pit
- R Roof water pit
- H Fire hydrant
- K Kerb adaptor
- W Water meter
- Water house connection
- Stormwater gully pit
- Power Pole
- S Sewer manhole
- —S— Sewerage line
- —E— u/g power line
- —T— u/g telecom line
- —W— u/g water line
- —RW— u/g stormwater line
- —OHP— Overhead power line
- u/g gas line
- HC Sewer house connection
- Light Pole

SITE COVERAGE

Building Areas: 182.0m² (20.3%)

Roof Areas: 222.6m² (24.8%)

REAL PROPERTY DESCRIPTION

Lot 9 on SP 176990
Parish of ?
Area 897m²

SITE LEGEND & NOTES:

- Datum level: Top of existing manhole – RL 10.00
- Existing (approximate) contour
- Denotes approximate finished RL
- Denotes min. 50mm in 1000mm fall away from building
- Open earth drainage
- 90ø downpipe discharging into a stormwater drainage system to be dispersed out to stormwater pit at bottom of allotment

No.	Description	Date
0	First Issue	1/11/17

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PROPOSED NEW DWELLING AT Lot 7 KILKENNY COURT ROCKYVIEW, FOR BETTERWAY HOMES

Title: SITE PLAN
Scale: 1:200
Date: Oct 2017
Sheet: Sheet 2 of
Drawing: 17_746
Rev: –
Drawn: GJK
A3

ROCKHAMPTON REGIONAL COUNCIL

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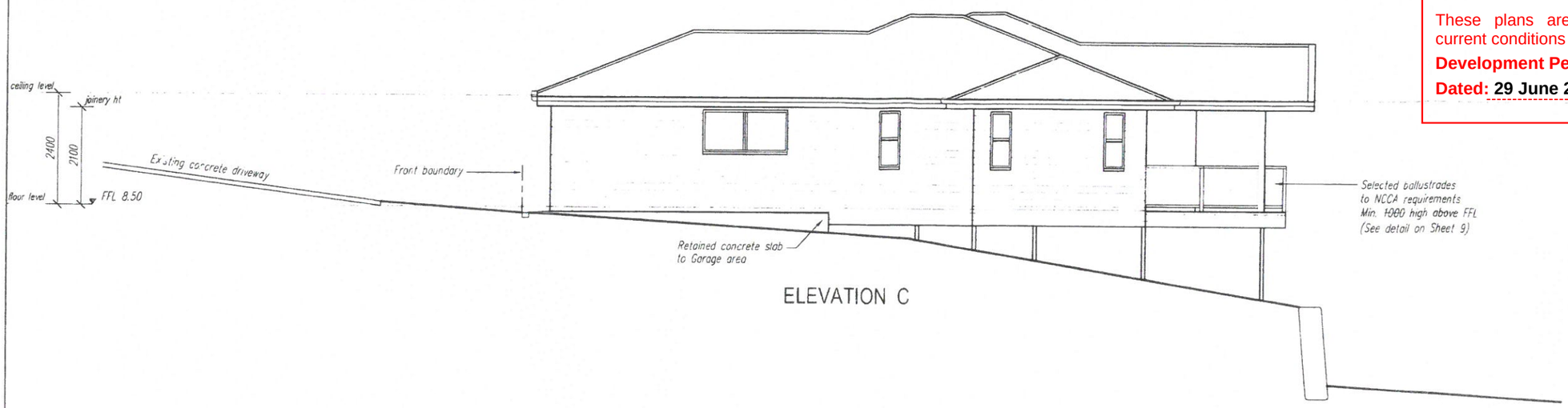
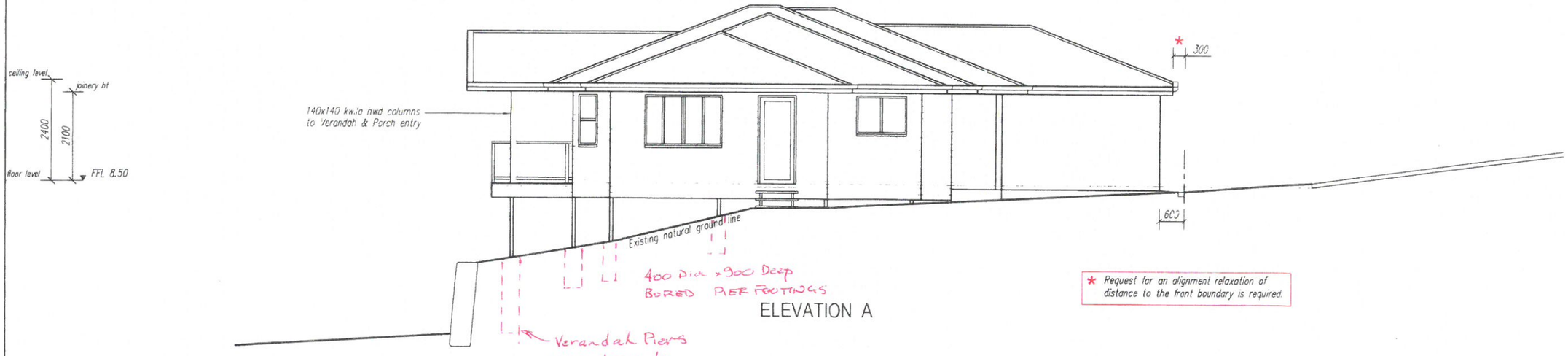
Development Permit No.: D/38-2018

Dated: 29 June 2018



ELEVATION C



ELEVATION A

* Request for an alignment relaxation of distance to the front boundary is required.

0	First Issue	1/2/18
Rev.	Description	Date

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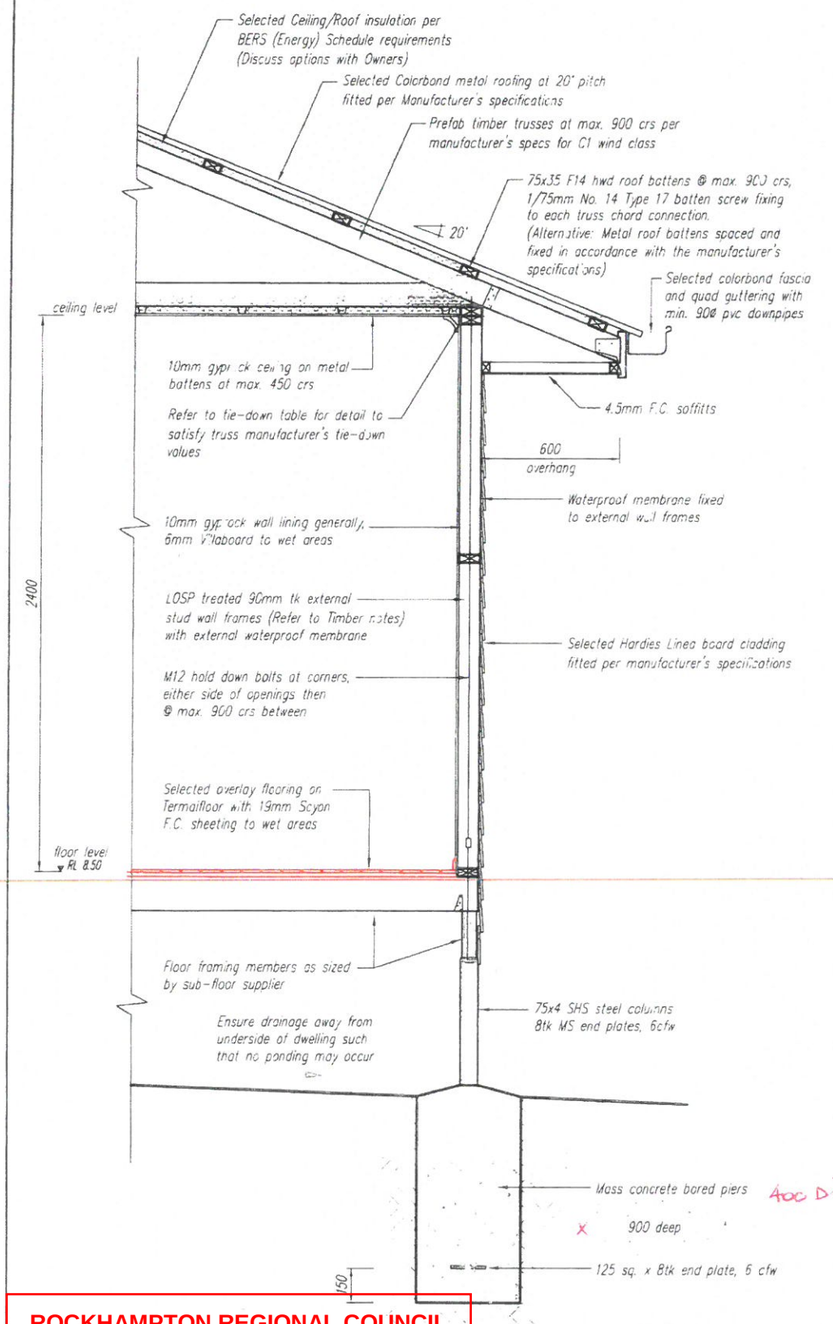
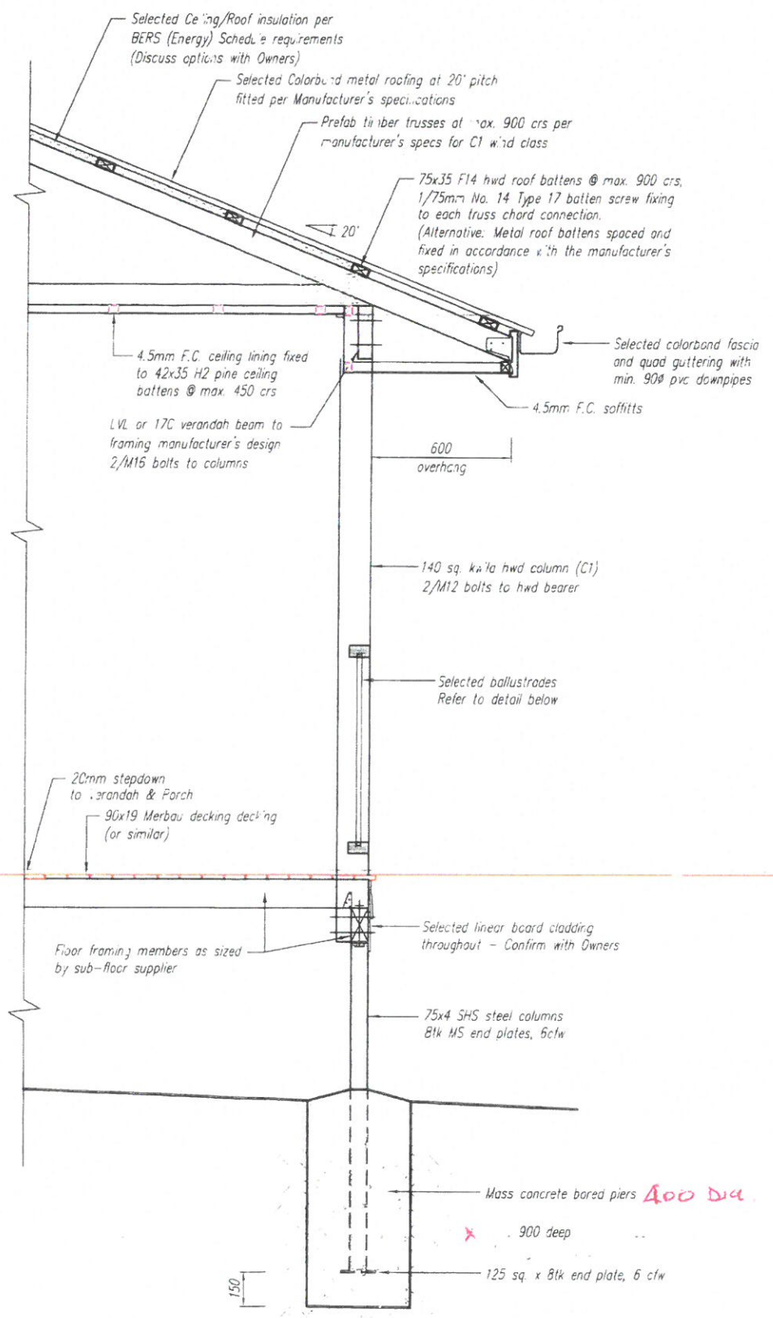
PROPOSED NEW DWELLING AT Lot 7 KILKENNY COURT KAWANA FOR RACHEL REABEL

RPEQ 2048

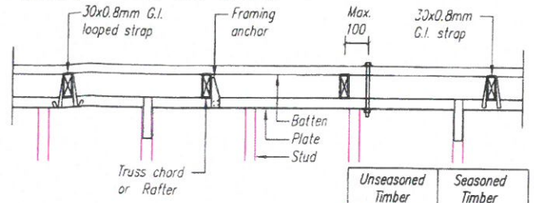
Title: ELEVATIONS (2 of 2)
Scale: 1:100
Date: January 2018
Sheet: Sheet 6 of 12
Drawing: 17_746
A3
Drawn: GJK
Rev: –





TYPICAL WALL / VERANDAH DETAILS & PIER DETAILS

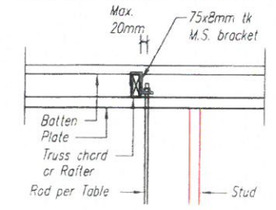
TRUSS/RAFTER TIE-DOWN:



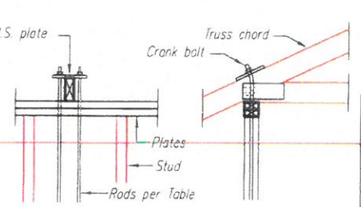
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD4	JD5	JD6
30x0.8mm G.I. strap, 2/2.8mmø nails each end		4.9	3.5	2.5	3.5	2.9	2.2
30x0.8mm G.I. strap, 3/2.8mmø nails each end		6.5	4.7	3.3	4.7	3.8	2.9
1/framing anchor, 4/2.8mmø nails each end		4.9	3.5	2.5	3.5	2.9	2.2
2/framing anchors, 4/2.8mmø nails each end		8.3	5.9	4.2	5.9	4.9	3.7
M10 cuphead bolt		16	14	10	10	7	5
M10 bolt		18	18	18	15	12	9
M12 bolt		27	27	26	20	16	12
30x0.8mm G.I. looped strap required nails for each end will be: 3/2.8mmø for J2, 4/2.8mmø for J3 & JD4, 5/2.8mmø for J4, JD5 & JD6	1 strap	13	13	13	13	13	13
	2 straps	25	25	25	25	25	25

Truss uplift values as per an approved truss manufacturer's design loads.

GIRDER TRUSS TIE-DOWN:



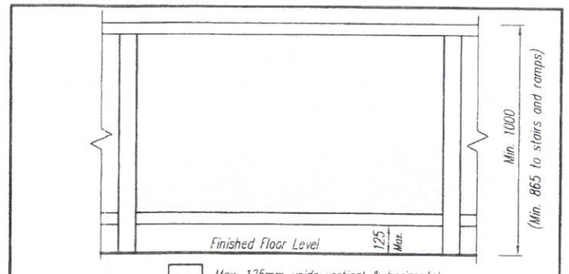
Rod	kN
M10	18
M12	27
M16	50
2/M10	36
2/M12	54
2/M16	100



Rod	kN	Plate
2/M10	30	150x75x12
2/M12	40	150x75x12
2/M16	70	150x150x16
2/M16	100*	150x150x16

Fixing design strength for JD4 joint group

* With double girder truss



MINIMUM BALLUSTRADE REQUIREMENTS

Must be installed IF the ground level to Verandah Deck level is ≥ 900mm

ROCKHAMPTON REGIONAL COUNCIL

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Dated: 29 June 2018

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0	First Issue	1/2/18

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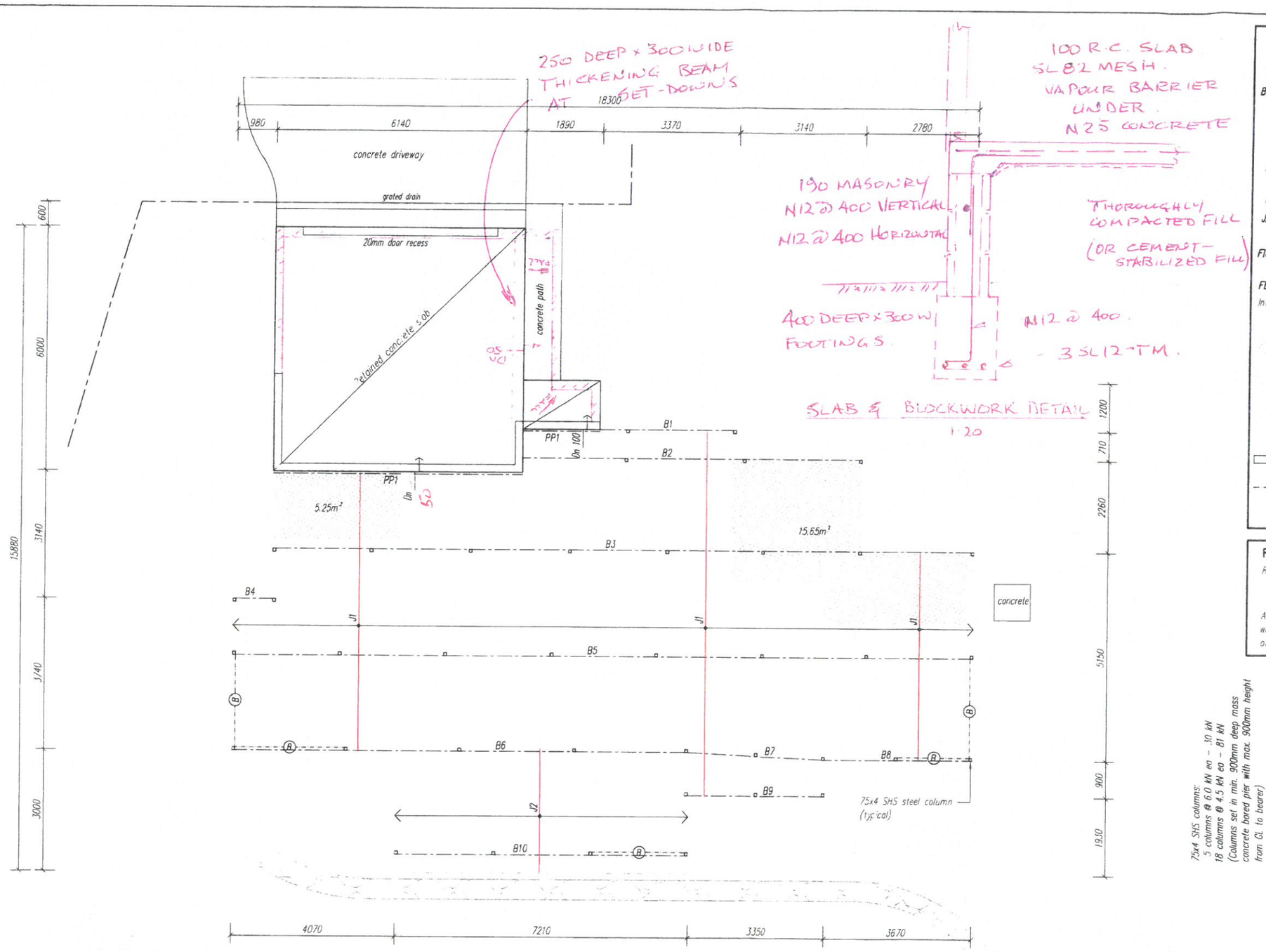
Amds RFER 2018

PROPOSED NEW DWELLING AT Lot 7 KILKENNY COURT KAWANA FOR RACHEL REABEL

Title: TYPICAL WALL SECTIONS & HOLD DOWN DETAILS
Scale: 1:25
Date: January 2018
Sheet: Sheet 9 of 12
Drawing: 17_746
A3
Drawn: GJK
Rev: –



FLOORING MEMBER SCHEDULE

- ▫ Denotes 75x4 SHS steel column set in concrete bored pier 8tk end plates, 6 ctw.
- **B1–8** LVL bearer (single & cont. spans) 2/M12 bolts SHS steel column & GI bracket fixed onto masonry block retaining wall at garage — 170x63 LVL
- **B10** Hwd bearer (cont. spans) 2/M12 bolts SHS steel column — 150x75 F14
- **PP1** LVL pole plate fixed in plane of joists to blockwork, chemset staggered M12 bolts @ max. 900 crs
- **J1** LVL floor joists (cont.) @ max. 450 crs — 130x45 LVL
- **J2** F14 sized hwd joists (cantilever single span) @ max. 450 crs 1/framing anchor each connection to bearer — 125x50 F14.

Floor framing members as sized and certified by supplier.

FLOORING:

Internal: Selected vinyl or T&G overlay throughout generally over 19mm Termifloor panel underlay

Denotes 19mm Scyon Internal flooring for areas to be tiled Scyon flooring to be fixed to joists, primed and sealed in accordance with BCA requirements and manufacturer's specifications. An approved water-proofing system is to be used in accordance with BCA requirements.

Denotes shot-edge decking fixed to hwd joists fixed in accordance with NCC requirements

Denotes 200 series masonry block retaining to slab

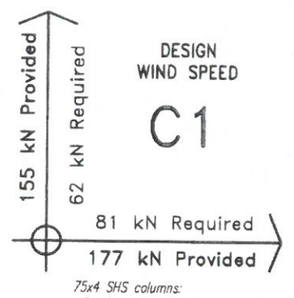
Ⓑ Steel cross bracing set achieving 22kN (Limit State) 16mmØ rod or 50x6 MS plate bolted through columns at max. 150mm from top & bottom.

FOOTINGS/SLABS:

Refer to Engineer's drawings for design & details of:
- Retained Garage/Porch slab and stiffened raft footings
- bored pier footings at column locations

All waterproofing, priming & sealing to be in accordance with the manufacturer's specifications and the requirements of the National Construction Code of Australia (NCC)

75x4 SHS columns:
5 columns @ 6.0 kN ea – 30 kN
18 columns @ 4.5 kN ea – 81 kN
(Columns set in min. 900mm deep mass concrete bored pier with max. 900mm height from GL to bearer)
Cross brace sets :
1 x sets @ 22 kN ea – 66 kN



DESIGN WIND SPEED

C1

75x4 SHS columns:
5 columns @ 6.0 kN ea – 30 kN
18 columns @ 4.5 kN ea – 81 kN
(Columns set in min. 900mm deep mass concrete bored pier with max. 900mm height from GL to bearer)
Cross brace sets :
3 x sets @ 22 kN ea – 66 kN

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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Development Permit No.: D/38-2018

Dated: 29 June 2018

SUB - FLOOR LAYOUT PLAN

Rev.	Description	Date
0	First Issue	1/2/18

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Austro RPEQ 2048

PROPOSED NEW DWELLING AT Lot 7 KILKENNY COURT KAWANA FOR RACHEL REABEL

Title:	SUB-FLOOR LAYOUT PLAN
Scale:	1:100
Date:	January 2018
Sheet:	Sheet 7 of 12
Drawing:	17_746
	A3
Drawn:	GJK
Rev:	–

tectonic
geotechnical & environmental engineers

8 June 2018

Project No. 18154-001-Rev0

CQ Soil Testing
Attention: Mr Scott Walton

Email: scott@cqsoiltesting.com.au

SLOPE STABILITY ASSESSMENT FOR PROPOSED RESIDENCE
11 KILKENNY COURT, KAWANA

Dear Scott,

1.0 INTRODUCTION

At the request of CQ Soil Testing (CQ), Tectonic has undertaken a slope stability assessment for a proposed residence at 11 Kilkenny Court, Kawana. This report presents the results of our slope stability assessment, together with geotechnical advice for the proposed residence. In summary, subject to implementation of the recommendations made herein, it is assessed that there would be a Low Risk of slope instability affecting the proposed residence in accordance with the Australian Geomechanics Society "*Guidelines for Landslide Risk Management*", dated March 2007 (AGS 2007).

1.1 Details of Site and Development

The property is described as Lot 7 on SP176990 and covers an area of 897 m^2. The allotment has frontage to Kilkenny Court along the western boundary. Based on Rockhampton Regional Council (RRC) online mapping and aerial images, the allotment appears to be surrounded by similar suburban properties, with some blocks developed recently to the north and west, and some longer standing properties to the east (Ref. Text Figure 1). A more detailed site description is given in Section 2.

Text Figure 1: 2016 image of surrounds (courtesy RRC)

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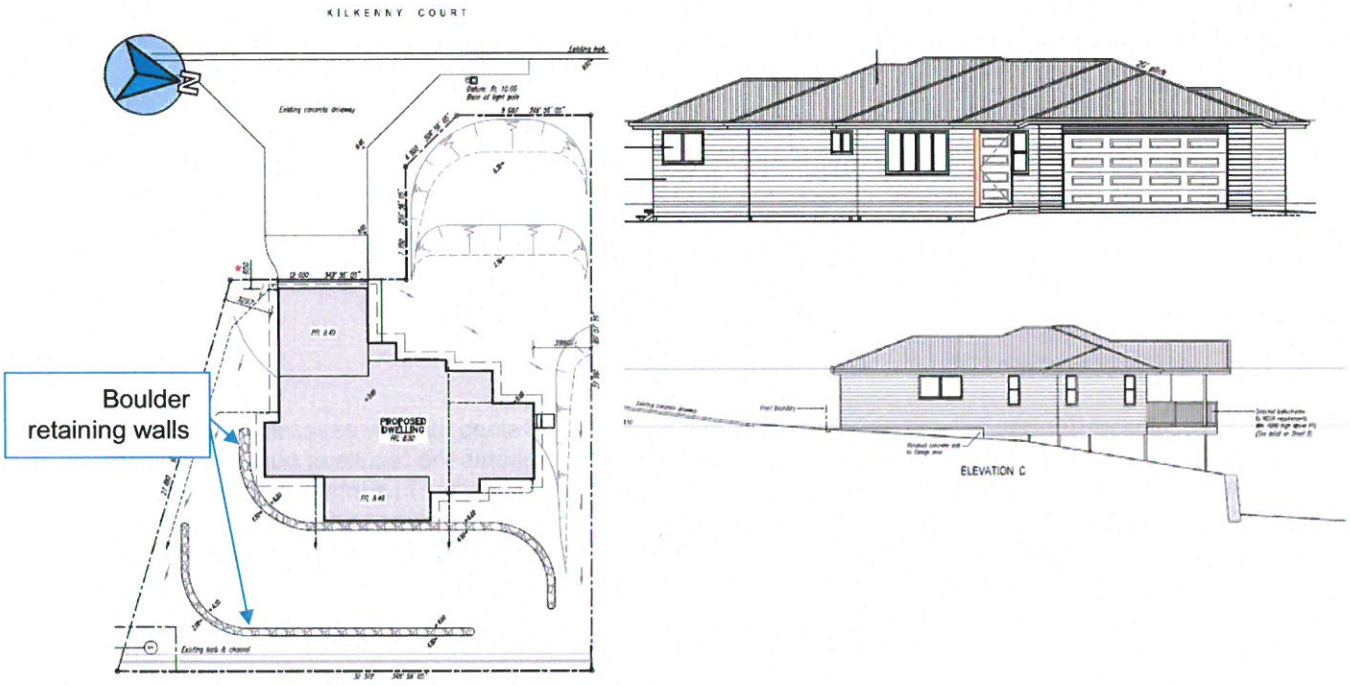
PO Box 899, Buderim, QLD 4556
Office: 07 5478 9016 Email: admin@tectonicgeo.com.au
www.tectonicgeo.com.au
A.B.N. 83 165 727 828

We have been provided with preliminary drawings (Gill Kerr Plan & Drafting Service, Schedule 17_746 Sheets 1 to 12, dated 1 February 2018) for the proposed residence, extracts of which are shown in Text Figure 2 below. It is understood that the proposed design for the house will include utilising an existing concrete/paved driveway entry, connecting to a garage formed using a retained concrete floor slab. The remainder of the house is shown to be of high-set construction graded to suit the natural falling slope profile. The house is shown on drawings to be constructed using predominantly lightweight cladding to walls and sheet metal roofing, and steel posts used beneath the house structure.



Text Figure 2: Design drawings extracts: layout; and west and south elevations (courtesy Gill Kerr Planning & Drafting)

1.2 Method and Scope of Investigation

As part of our slope stability assessment, a desk-top study was carried out comprising a review of published geology maps, aerial photographs, ground level contours, a soil test report by CQ dated 24 May 2018 (Job No. CQ14951), and site photographs provided by CQ.

The results of the desk-top study are included in Section 2 below.

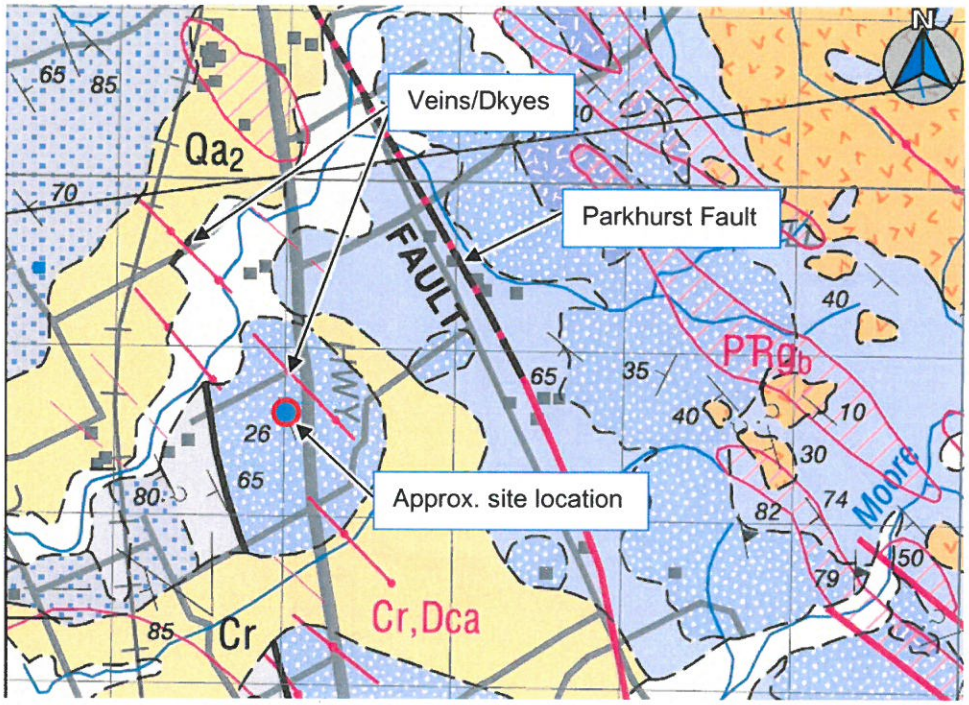
1.3 Qualifications of Responsible Engineer

This report has been reviewed by Mr Ashley Davey, an RPEQ with more than 20 years' experience in geotechnical engineering, including a number of slope stability projects.

2.0 DESCRIPTION OF EXISTING CONDITIONS

2.1 Geology

Available geological information[1] indicates that the site is underlain by the Permian age Lakes Creek Formation (stippled blue shading) comprising *"siltstone and lithic sandstone."* The Parkhurst Fault is mapped around 1.5 km to the east of the site, and several intrusive features, noted to be veins or dykes (pink lines with spots), are also shown to be prevalent in the general area.



Text Figure 3: Extract from Rockhampton Geology Map

The CQ investigation comprised three boreholes (designated BH1 to BH3) drilled to depths of 0.5 m to 2 m below ground level (BGL) spread across the proposed building footprint, along with dynamic cone penetrometer (DCP) testing at each borehole location. The locations of these are shown in Text Figure 4 on the following page, and the borehole reports are attached at the end of this report.

Subsurface conditions encountered in the CQ boreholes show that there is a deepening soil profile towards the downslope (eastern) part of the allotment.

Towards the top (west) of the slope (BH1) natural, medium dense to dense gravelly clayey sand is reported to a depth of 0.4 m BGL, overlying dense to very dense, clayey sandy gravel (inferred as possible extremely weathered (EW) material). It was possible to drill in to the dense to very dense gravel for 0.1 m before auger refusal at 0.5 m BGL, where inferred weathered rock was encountered.

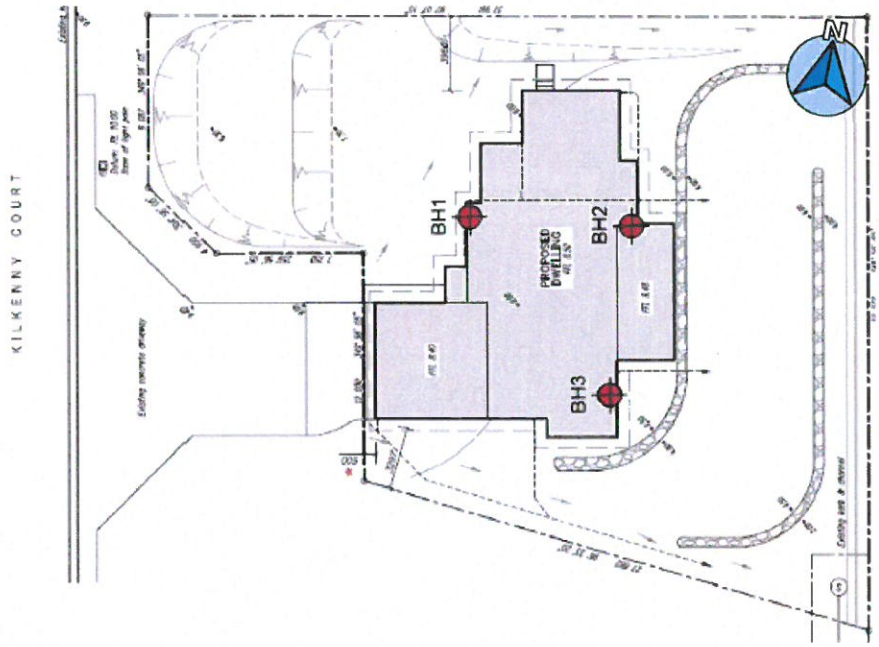
Further down the slope, at the eastern edge of the proposed house footprint, (BH2 & BH3) fill comprising mostly medium dense, silty sandy gravel was logged to around 1 m BGL; underlain by natural, dense, clayey sandy gravel, to around 1.8 m BGL; then dense to very dense clayey sandy gravel to depths of around 2 m BGL (inferred as EW material), where auger refusal was encountered and weathered rock again inferred.

[1] The State of Queensland, Department of Mines and Energy, Geological Survey of Queensland, 1:100,000 Rockhampton, Sheet 9051, Revised Edition 2006

DCP testing conducted by CQ adjacent to and within each borehole indicates that the natural soils are very dense (or denser) below 0.5 m BGL at the top of the slope; and are dense (or denser) below about 1.2 m BGL towards the lower parts of the proposed building footprint.

CQ have not provided an AS2870-2011 (*Residential Slabs & Footings*) site classification to us.

No groundwater was mentioned in the CQ borehole reports, with the soil generally described as dry.



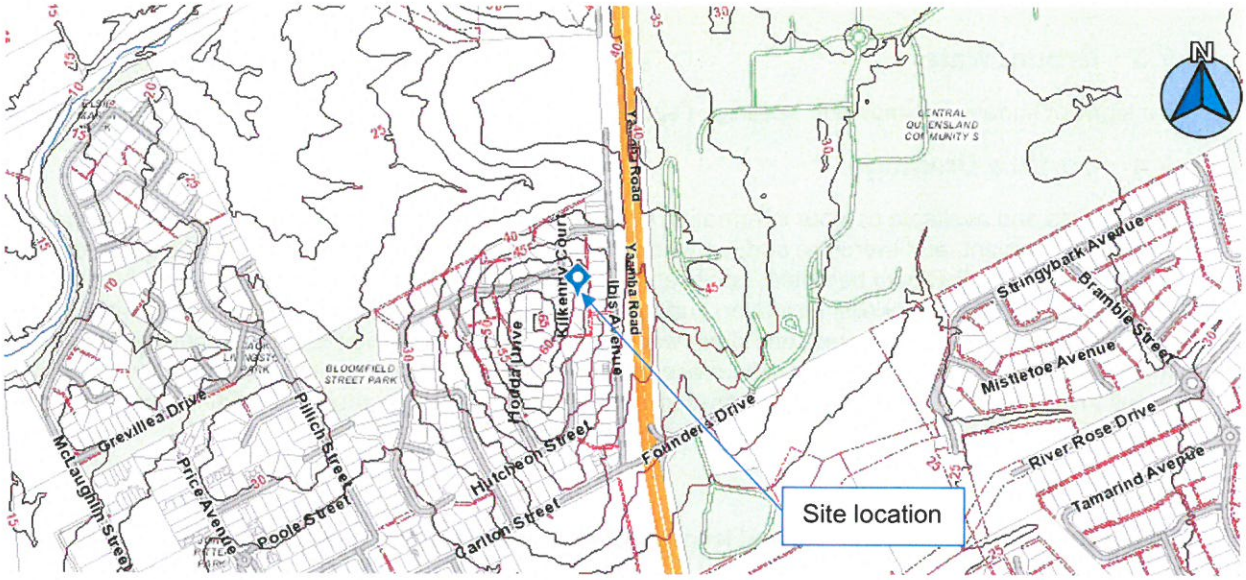
Text Figure 4: Borehole location plan (courtesy CQ)

2.2 Topography

As shown by the ground surface contours in Text Figure 5 on the following page, the site is located towards the crest of a localised knoll, with ground rising gently to the west, but generally falling to the north, south, and east. The predominant slope local to the site is to the east, and ground surface contours (RCC) show that the site falls between about RL 57 m and RL 50 m AHD, from west to east. Lower lying ground at the base of the knoll, to the north-west and north-east, is situated around RL 25 m to 30 m AHD.

The shape of the original natural ground surface was linear and slightly convergent. The contours indicate a relatively consistent slope of around 13° (23 %) towards the east/south-east is present on site. Two retaining walls (Ref. Text Figure 2) were present on site at the time of the investigation, which have created a gently sloping terrace to the east of the site.

As shown in Text Figure 7 on the following page, there appears to be a fill embankment associated with the road construction for Kilkenny Court along the front of the block. Although no boreholes were drilled in this area by CQ, we estimate that the fill ranges up to approximately 1 m high.



Text Figure 5: Image showing ground surface contours (courtesy RRC online mapping)

Text Figure 6: Site conditions at the time of investigation (rig at BH1) looking east from Kilkenny Court (photos by CQ)

Text Figure 7: View of north-west corner of site, showing possible road fill embankment (photos by CQ)

2.3 Groundwater

No signs of surface groundwater seepage ('springs') were reported by CQ, nor encountered in boreholes.

2.4 Surface Drainage

Site photos and available contour information indicate that the ground surface slope is generally linear and slightly convergent, and therefore surface water may be concentrated slightly towards the south-eastern corner of the site. It should be noted, however, that this may be affected locally by the more recent construction of retaining walls. However, surface runoff is expected to follow the overall ground surface contours towards the south-east, and drain well from the site considering the positive gradients, and only moderately permeable immediate subsurface materials (gravelly clayey sand). A stormwater easement is noted to begin within the site in the south-east corner, and drain to the south (Ref. RCC mapping, Text Figure 1), which may aid in providing a pathway for surface/stormwater.

2.5 Vegetation

The ground surface generally featured long grass, with no trees visible in the site photos provided by CQ.

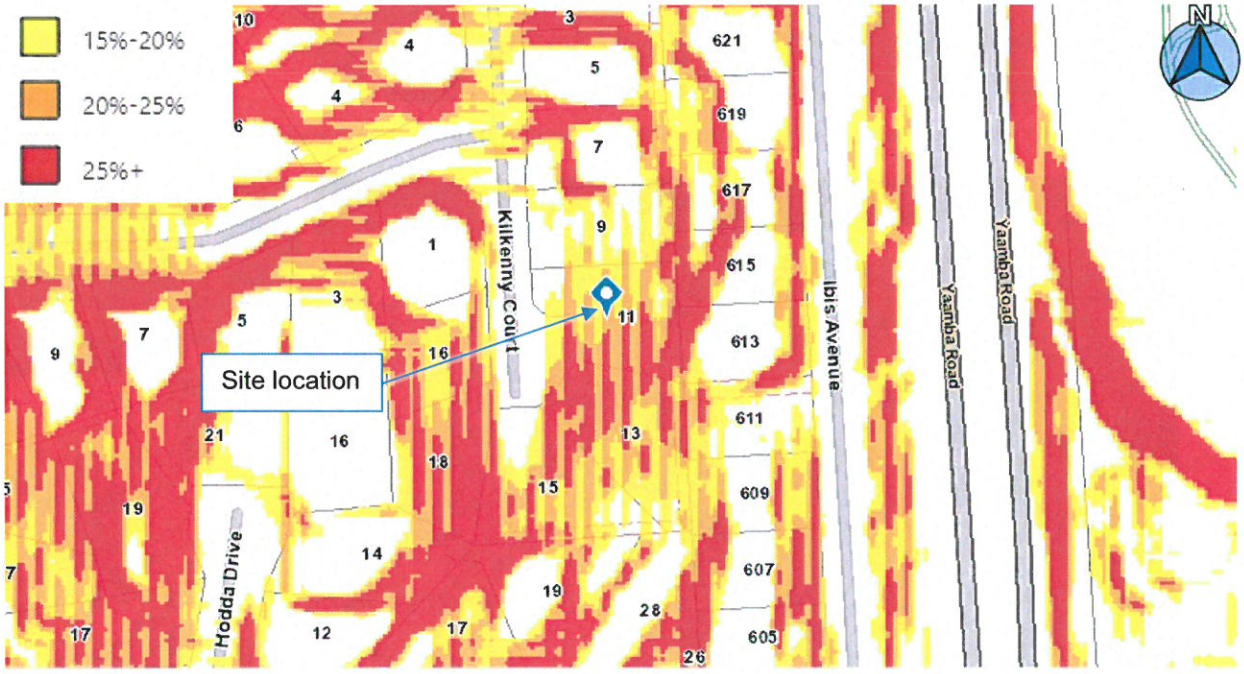
2.6 Buildings and Other Structures

It is apparent from aerial photos that a driveway consisting of small pavers and concrete was present to the western boundary, and that retaining walls were present within the eastern (downslope) part of the block. Notes or detailed photos of the condition of structures on site, or on adjacent blocks, were not provided to Tectonic by CQ prior to this assessment.

3.0 ASSESSMENT OF LAND STABILITY

3.1 Existing Conditions

RRC Planning Scheme Steep Land Overlay mapping (Ref. extract in Text Figure 8) indicates that the northern half of the site features land between 15 % and 20 % (8.5° and 11°) (yellow shading); while the southern half features land between 20 % and >25 % (11° and >14°) (orange/red shading).



Text Figure 8: Extract from RRC Steep Land Overlay

It should be noted that the RRC mapping is an indication of land slope (land >15%) rather than potential landslide susceptibility. For slopes over 15%, RRC requires a site specific geotechnical report to address slope stability. Based on available information, the site does not exhibit any indicators of slope instability. No landslide back scarps, tension cracks, or areas of naturally 'hummocky' ground are apparent in photographs or notes supplied by CQ, and slopes are moderate across the site (13°/23 %). The natural subsurface profile comprises inferred residual soils overlying EW rock at shallow depth.

3.2 Stability Assessment

The risk assessment for this project has been carried out following AGS 2007 Practice Note Guidelines for Landslide Risk Management. Relative levels of risk and their implications are given in Table 1 below and the *Qualitative Terminology for Use in Assessing Risk to Property* is also attached.

Table 1: Stability Risk Levels

Risk Level		Example Implications(1)
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 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 regulators' approval) but requires investigation, planning and implementation of treatment options to reduce 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 required.
VL	Very Low Risk	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) 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.

Considering the existing site information provided by CQ (Ref. Section 2), and subject to the implementation of the recommendations given below, it is assessed that there is a **Low (L) Risk** of global slope instability affecting the proposed residence. Regulators (RRC) normally require that a Very Low or Low Risk of landslide affecting property must be demonstrated to enable development approval.

Summarised in Table 2 on the following page is our qualitative assessment of landslide risk for the site. A summary of qualitative terminology for use in assessing risk to property is attached (taken from AGS 2007).

Table 2: Details of Qualitative Risk Assessment for Property (AGS 2007)

Hazard	Likelihood	Consequence	Assessed Risk	Comments
1: Shallow failure through existing fill materials or natural soils above foundation depths	**Unlikely**	**Minor**	**Low**	The likelihood of a failure through existing fill materials or natural soils in the vicinity of the proposed residence is assessed as **Unlikely** due to the moderate natural gradients, shallow depth to rockhead (<2 m), apparent lack of groundwater, and subject to our recommendations in Section 4 of this report. The consequence of such a failure would be **Minor** considering the anticipated limited effects of such shallow instability, with the resultant risk being **Low** as per AGS 2007.
2: Deep failure through weathered rock below the foundation depth	**Barely Credible**	**Major**	**Very Low**	The likelihood of a deep failure through the weathered rock is assessed as **Barely Credible** due to the strength and shallow occurrence of this material, moderate ground slopes, lack of evidence of such deep seated instability in the area, and subject to implementation of our recommendations in Section 4 of this report. Although the consequence of such a failure could be **Major**, the resultant risk is **Very Low** as per AGS 2007.

The potential impacts on slope stability of the development components have been assessed, and the measures recommended below in Section 4 have been designed to mitigate those impacts.

4.0 RECOMMENDATIONS

General recommendations to help maintain the stability of the site area also given in the document *"Some Guidelines for Hillside Construction"*, which is attached.

4.1 Site Layout

The proposed building location as shown in drawings provided to us (Gill Kerr Plan & Drafting Service, Schedule 17_746, Sheets 1 to 12, dated 1 February 2018), is considered suitable from a slope stability viewpoint. Should it be proposed to alter the building location, Tectonic must be notified to enable an assessment of the impact on slope stability.

4.2 Earthworks

Based on the drawings provided to us, cutting and filling would be restricted to the garage/driveway area and would not exceed 1 m in height. Cut excavations or fill heights greater than 1 m should be retained by engineer designed retaining walls. Should fill earthworks greater than 1 m high be proposed Tectonic must be notified to enable an assessment of the impact on slope stability.

Any organic rich topsoil and severely root affected soils must be stripped and removed from the proposed construction area. Tree roots must be grubbed out if they are within the proposed building footprint.

Any fill materials should be compacted at moisture contents within the range of -2% to +2% of optimum moisture content for Standard Compaction. Confirmatory testing must be carried out at regular intervals and further details for control and testing of fill are given in Australian Standard AS 3798-2007 "*Guidelines on Earthworks for Commercial and Residential Developments*". Select fill should have a maximum particle size of 100 mm for an uncompacted layer thickness of 200 mm and shall be compacted by repeated rolling with a small compactor to achieve a dry density ratio of at least 95% of the Standard Maximum Dry Density for cohesive soils, or 70% Dry Density Index for any imported cohesionless soils.

Sloping ground must be benched to 'key in' fill material. Fill batters should be over-filled by 0.5 m (horizontally) and then trimmed back to the well compacted material.

Temporary batter slopes could be constructed at a maximum grade of 1V:1H in soil materials on site; with permanent batters recommended at no steeper than 1V:2H. Permanent soil or fill batters will require erosion protection (e.g. revegetation or surface protection).

4.3 Retaining Structures

No details have been provided as to the condition of retaining walls currently on site, and if greater than 1 m height, it is recommended that the engineer certification is sighted. Future retaining structures greater than 1 m high shall be founded as described in Section 4.4 below, and would also require engineer design and certification of construction.

We suggest the parameters given in Table 3 below may be adopted for retaining wall design.

Table 3: Retaining Wall Design Parameters

Retained material	Unit weight (kN/m³)	Friction angle (Degrees)	Lateral earth pressure coefficients		
			K_a (Cantilever wall)	K_o (Non-yielding wall)	K_p
Medium Dense to Dense Gravelly Clayey Sand	19	30	0.33	0.5	3.0
Dense to Very Dense Clayey Sandy Gravel	21	36	0.26	0.41	3.85
Future Fill	*	*	*	*	*

*Depends on type of fill used, and level/quality of compaction

These parameters do not include allowance for surcharge above the wall, or additional loads imposed by sloping ground.

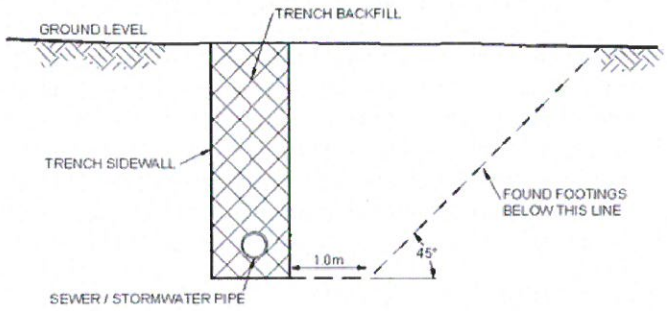
4.4 Footing Design

Footings for the residence and any retaining walls should penetrate through any fill placed on site, to found at least 300 mm into the very dense natural clayey sandy gravel (inferred EW material), or at drilling/excavation refusal in such materials. Footings, so founded, could be designed with an allowable bearing capacity of 400 kPa. Nominally this may mean footings at the top of the slope would be founded in the order of 1 m depth; with those furthest downslope being at least 2 m depth (below existing ground level).

Off Kilkenny Court to the western side of the site, it is possible that following cutting to form a level pad for the garage slab, that normally dimensioned high level footings, or perhaps 'bucket piers' may achieve this requirement. However, with the sloping nature of the site, and high-set construction downslope from Kilkenny Court, bored piles (or similar) are recommended for design.

Design of the footing system must take the potential site reactivity to be advised by others.

All footings should found such that they are not adversely affected by any adjacent excavations, batter slopes, trenches, or retaining walls that are not designed to support building loads. Footings should found at least below a plane extending 1 m horizontally from the base of trenches/batter slopes/excavations/retaining walls, then rising up at 1V:1H, as illustrated in Text Figure 9 below.



Text Figure 9: Footing depth required to minimise risk of undermining

If any soil conditions encountered during construction are found to differ from those noted in the geotechnical investigation, CQ and Tectonic should be notified immediately and an inspection carried out to determine if changes to footing design are required.

4.5 Drainage

Temporary construction drainage should be implemented such as perimeter surface drains, and positive grades across building areas.

Surface diversion drainage should be constructed upslope of the residence and above the crest of any cut or fill embankments (e.g. grassed or lined swales or diversion mounds). Adequate site drainage should be installed to ensure that stormwater runoff is directed away from building walls and footings. Grated channel drains should also be constructed across the driveway and adjacent to any other sealed surfaces such as perimeter footpaths where there is sloping ground above.

Subsurface drainage must be installed behind future retaining walls in order to prevent the development of hydrostatic pressure (e.g. slotted 'aggi' pipe wrapped in filter 'sock' placed in gravel backfill). It is recommended that the drainage provision behind the existing retaining walls is assessed prior to construction.

All excess stormwater collected around the residence and tank overflow water must be directed by pipes or lined channels to the council stormwater system, with a possible collection point shown on RCC mapping, to the south-east corner of the site.

5.0 SUMMARY & CONCLUSIONS

Based on the findings of our assessment we consider, from a geotechnical viewpoint, that the site is suitable for the proposed residential development and that there should be a Low Risk of slope instability. This advice is subject to implementation of the recommendations given in this report, in particular:

- Minimising fill to not more than 1 m high and restricting filling to the driveway and garage building area unless assessed and approved by Tectonic.
- Cuts/fills in excess of 1 m depth/height are to be supported by engineer designed retaining walls.
- Supporting the residence on footings (likely short piles) taken at least 300 mm into very dense gravel/or weathered rock beneath the soil profile.
- Directing stormwater to the apparent infrastructure leading from the south-eastern corner of the property.

6.0 LIMITATIONS

Your attention is drawn to the document Limitations, which is attached to this letter report.

Please contact the undersigned should you wish to discuss any of the above matters.

Yours faithfully

TECTONIC GEOTECHNICAL PTY LTD

Robert Gibb BSc (Hons)
Engineering Geologist

Ashley Davey RPEQ 8159
Principal Geotechnical Engineer/Director

Attachments: CQ Report CQ14951, dated 24 May 2018
Qualitative Terminology for Use in Assessing Risk to Property
Some Guidelines for Hillside Construction
Limitations

CQ SOIL TESTING | Servicing all of Central Queensland

SOILS INVESTIGATION

CLIENT: N Edwards

SITE ADDRESS: Lot 7 (SP176990)
11 Kilkenny Court, Kawana

JOB NUMBER: CQ14951

ISSUE DATE: 24/05/2018

Client & Document Information

Client:	N Edwards
Project:	Lot 7 (SP176990) 11 Kilkenny Court, Kawana
Job Number:	CQ14951
Date of Issue:	24/05/2018

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Document Control

Version	Date	Author	Design Drawings	Reviewer	Reviewer Initials
A	24/05/2018	T Warne	NA	Scott Walton	SWW

Soil Logs

BOREHOLE 1		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0 0.4	SC	Gravelly Clayey SAND, fine to coarse grained, low plasticity fines, orange brown, D, D.
0.4 0.5	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD. **Weathered rock**
Tungsten carbide bit refusal at 0.5 m		

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	Blows per 100 mm	Indicative kPa
100	8	200
200	9	250
300	12	250
400	>15	>300
500		
600		
700		
800		
900		
1000		
1100		
1200		
1300		
1400		
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 2		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0	GM	Silty Sandy GRAVEL, fine to coarse grained, low plasticity fines, brown, D, MD.
1.1		**Fill**
1.1	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, brown, D, D.
1.9		**Natural**
1.9	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD.
2.0		**Weathered rock**

Tungsten carbide bit refusal at 2.0 m

LABORATORTY SUMMARY:

1.2–1.7 m

% Passing 75 um	23
Natural MC%	6
Liquid Limit	17.8
Plastic Index	3
Linear Shrinkage	1.6
Iss	ND
Emerson Class	ND
CBR (1pt standard)	ND

Test Methods:
AS 1289 2.1.1, 3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 3.6.1, 3.8.1, 3.9.1, 3.9.2: Moisture content (oven drying); liquid limit (Casagrande); plastic limit; plasticity index; cone plasticity index; linear shrinkage; sieve analysis; Emerson class number

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100	7	200
200	4	120
300	4	120
400	9	250
500	4	120
600	9	250
700	Drill	
800	Drill	
900	Drill	
1000	Drill	
1100	Drill	
1200	7	200
1300	9	250
1400	12	250
1500	12	250
1600	Drill	
1700	Drill	
1800	Drill	
1900	>15	>300
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

Soil Logs

BOREHOLE 3		
Depth (m)	**Visual Class'n Symbol**	**Visual Description of Material**
0.0	GM	Silty Sandy GRAVEL, fine to coarse grained, low plasticity fines, brown, D, MD.
1.0		**Fill**
1.0	GC	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, brown, D, D.
1.7		**Natural**
1.7	GC/XW	Clayey Sandy GRAVEL, fine to coarse grained, low plasticity fines, yellowish brown, D, VD.
1.9		**Weathered rock**
Tungsten carbide bit refusal at 1.9 m		

DCP TEST RESULTS		
Depth (mm)	**Blows per 100 mm**	**Indicative kPa**
100	Drill	
200	Drill	
300	Drill	
400	Drill	
500	Drill	
600	Drill	
700	Drill	
800	Drill	
900	Drill	
1000	7	200
1100	9	250
1200	12	250
1300	12	250
1400	>15	>300
1500		
1600		
1700		
1800		
1900		
2000		
2100		
2200		
2300		
2400		
2500		
2600		
2700		
2800		
2900		
3000		
3100		
3200		
3300		
3400		
3500		
3600		
3700		
3800		
3900		
4000		

MOISTURE CONDITION	CONSISTENCY	RELATIVE DENSITY
D – Dry	VS – Very Soft	VL – Very Loose
M – Moist	S – Soft	L – Loose
W – Wet	F – Firm	MD – Med Dense
	ST – Stiff	D – Dense
	V/ST – Very Stiff	VD – Very Dense
	H – Hard	

Allowable Bearing Pressure calculated using the guidelines in "Determination of Allowable Bearing Pressure under Small Structures" by MI Stockwell (NZ Engineering June 1997)

DCP test results are to be used as a guide only to relative density and consistency of soils. Changes in moisture contents or the presence of coarse grained material can greatly influence the outcome of this test.

Photographs

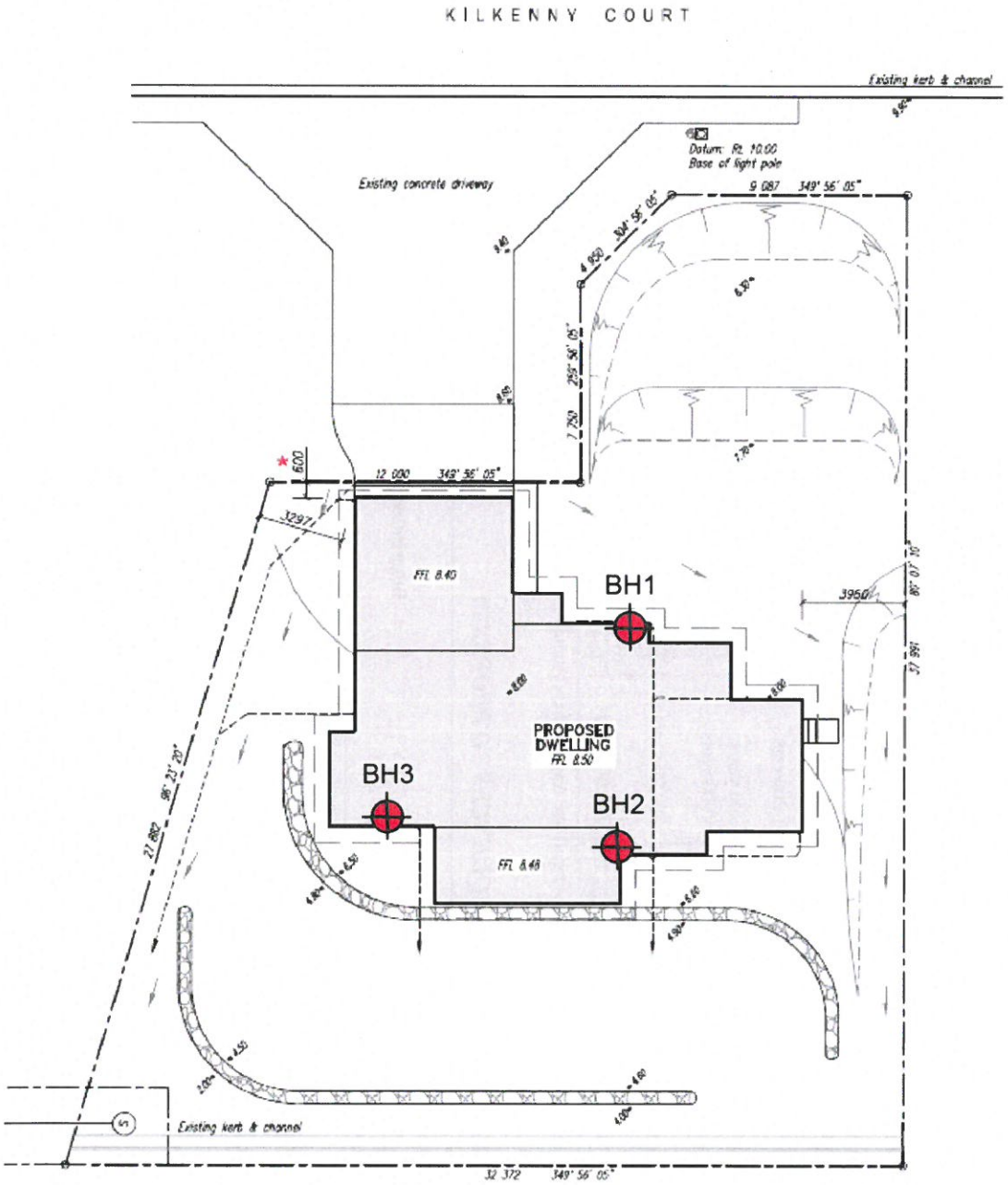
Figure 1 Proposed construction site

Figure 2 Proposed construction site

Photographs

Figure 3 Cut

Site Plan



- **Not to scale**
- **All measurements are to be used as a guide only**

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 2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-4}$	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}	$5x10^{-6}$	1,000,000 years	200,000 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

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.

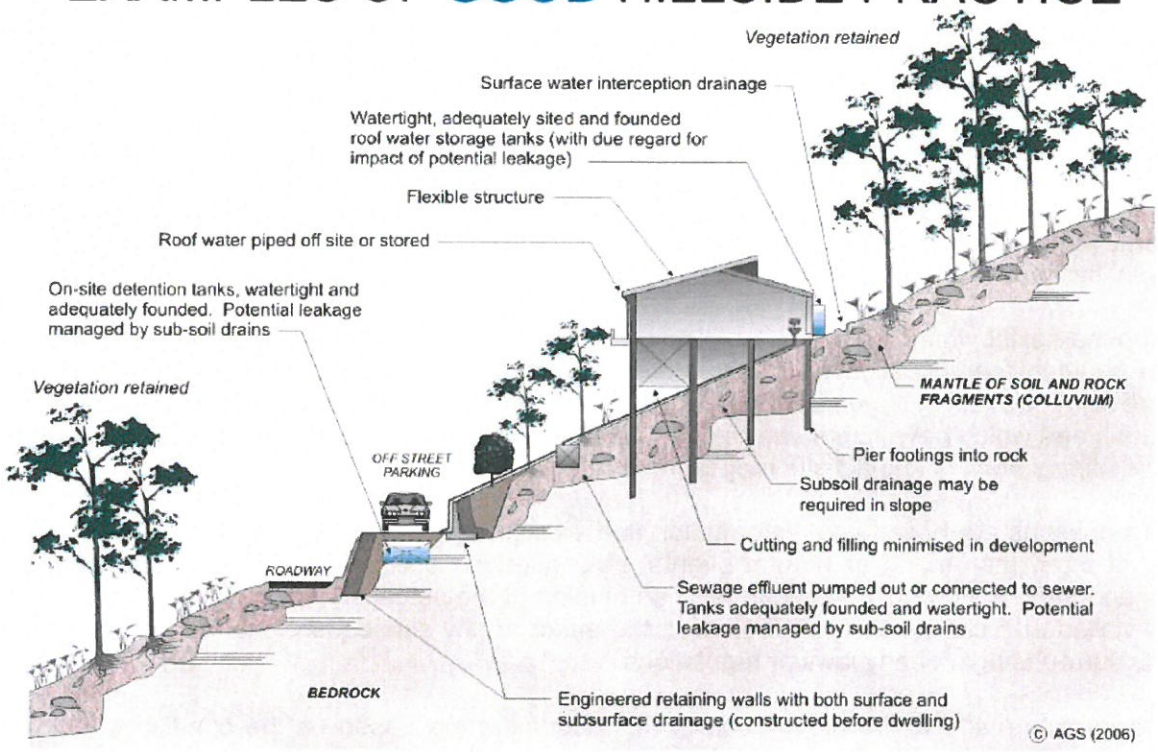
Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

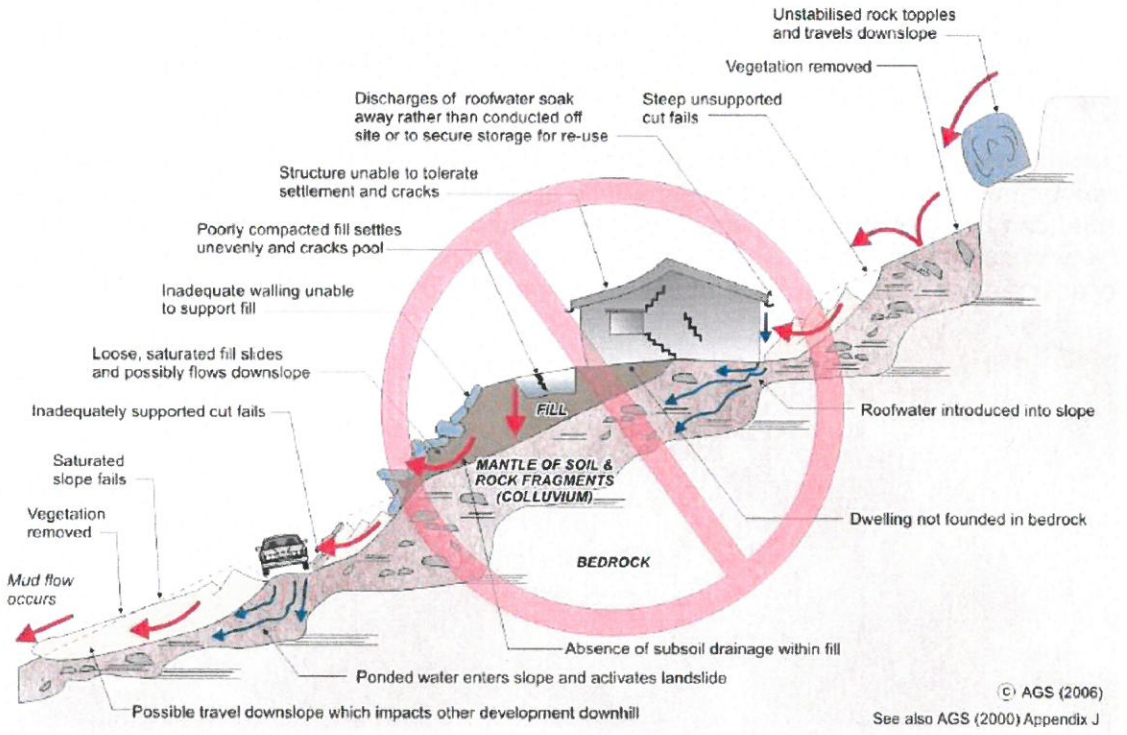
	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	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.	

Form No. 68029 RL2 August 2010

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



tectonic
geotechnical & environmental engineers

LIMITATIONS

This document has been prepared for the purpose outlined in Tectonic's proposal and no responsibility is accepted for the use of this document, in whole or in part, for any other purpose.

The scope of Tectonic's Services are as described in Tectonic's proposal, and are subject to restrictions and limitations. Tectonic did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the report. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Tectonic in regards to it.

Conditions may exist which were undetectable given that economic and time constraints limit the practical extent of geotechnical investigation. Variations in conditions may occur between investigation locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the document. Where variations exist on site, additional studies and actions may be required.

Tectonic's opinions are based upon information that existed at the time that the work was performed. The passage of time, man-made or natural events, may alter the site conditions. It is understood that the Services undertaken allowed Tectonic to form an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

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