ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/79-2024

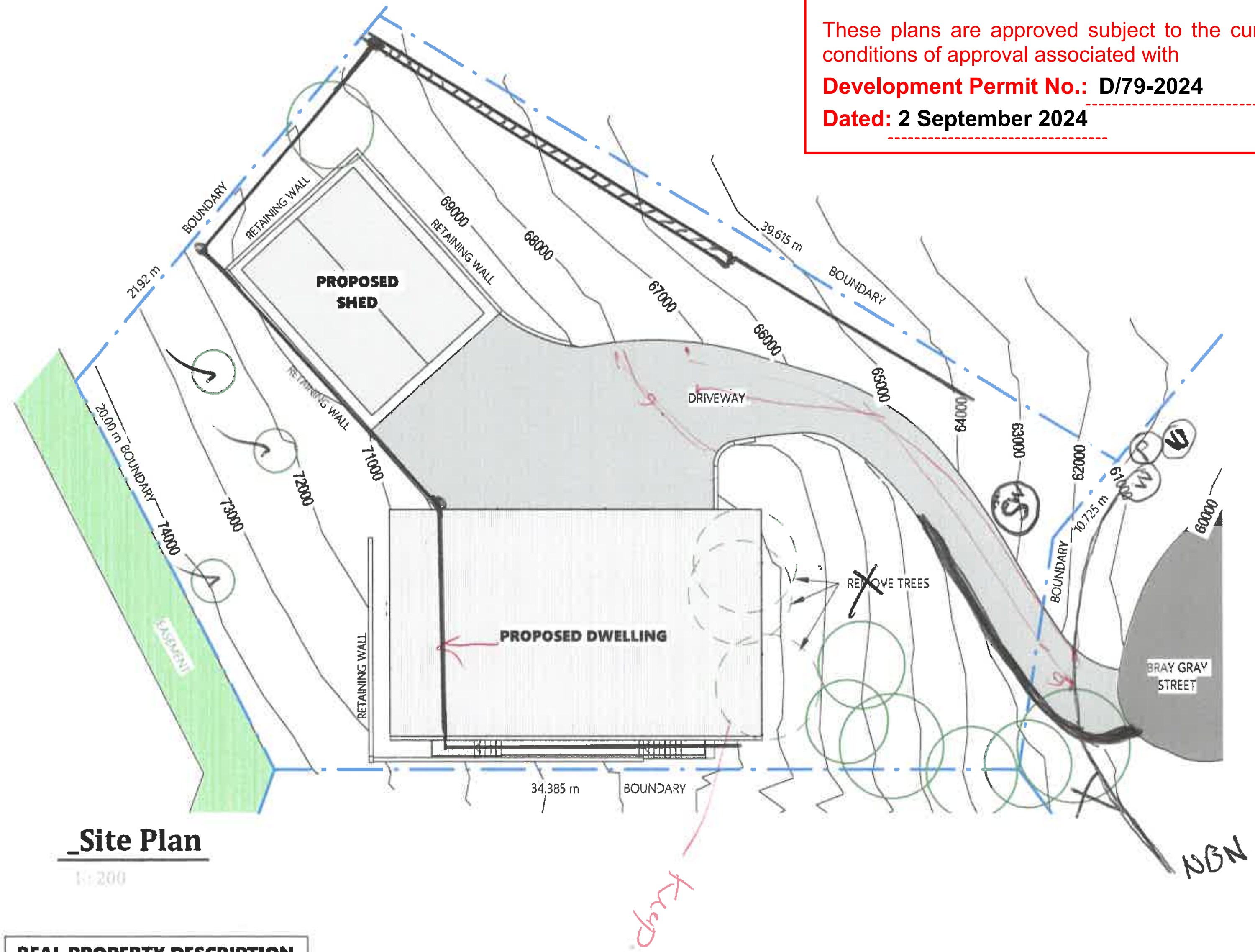
Dated: 2 September 2024

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

No:	Description:	Date:
1	PRELIMINARY	23/04/2024

REVISIONS



_Site Plan

1 : 200

REAL PROPERTY DESCRIPTION	
Lot Number:	46
Reg/Survey Plan Number:	RP855670

ISSUED FOR

PRELIMINARY

Project:

PROPOSED DWELLING

Address:

6 Bray Gray Pl, Frenchville, 4701

Drawing Title:

SITE PLAN

dezignelements BUILDING DESIGNERS

0407 271 336 M

info@dezignelements.com.au E

QBCC No: 1247120 BDAQ No: 0001677

Scale:	As indicated	Rev: 1
Date:	APRIL 2024	
Drawn:	NJB	
Project No: 24_077	Drawing No: S-01	

23/04/2024 4:38:10 PM

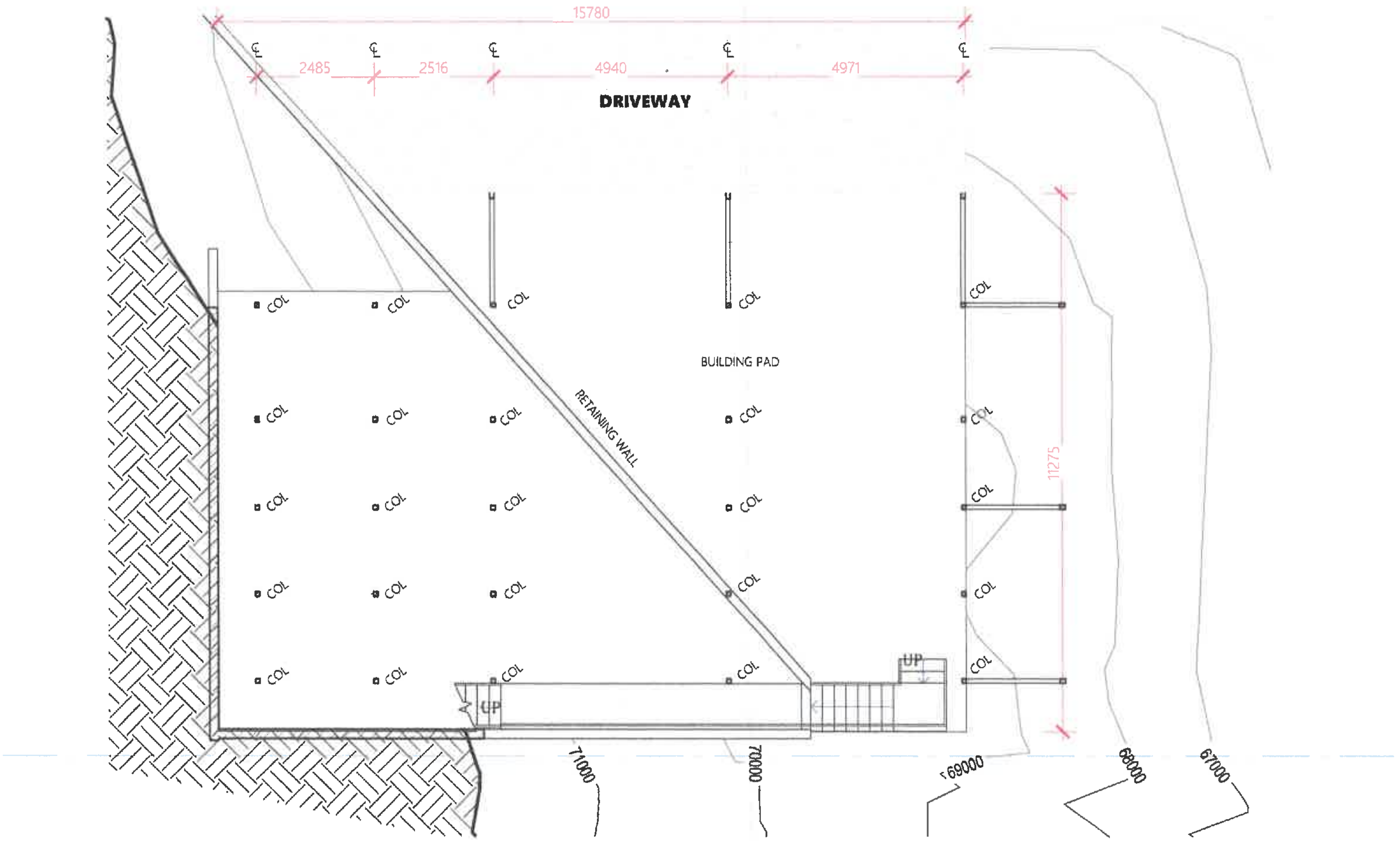
ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/79-2024

Dated: 2 September 2024



Ground Floor

1 : 100

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

No:	Description:	Date:
1	PRELIMINARY	23/04/2024

REVISIONS

ISSUED FOR

PRELIMINARY

Project: **PROPOSED DWELLING**

Address: **6 Bray Gray Pl, Frenchville, 4701**

Drawing Title: **GROUND FLOOR PLAN**

dezignelements BUILDING DESIGNERS

0407 271 336 M

info@dezignelements.com.au E

QBCC No: 1247120 BDAQ No: 0001677

Scale:	1 : 100	Rev:	1
Date:	APRIL 2024		
Drawn:	NJB		
Project No:	24_077	Drawing No:	S-02

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ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/79-2024

Dated: 2 September 2024

DO NOT SCALE DRAWING
ALL DIMENSION IN MILLIMETERS

No:	Description:	Date:
1	PRELIMINARY	23/04/2024

REVISIONS

ISSUED FOR
PRELIMINARY

Project:
PROPOSED DWELLING

Address:
6 Bray Gray Pl, Frenchville, 4701

Drawing Title:
PROPOSED FLOOR PLAN

dezignelements
BUILDING DESIGNERS
0407 271 336 M
info@dezignelements.com.au E
QBCC No: 1247120 BDAQ No: 0001677

Scale:	1 : 100	Rev:
Date:	APRIL 2024	1
Drawn:	NJB	
Project No: 24_077	Drawing No: S-03	

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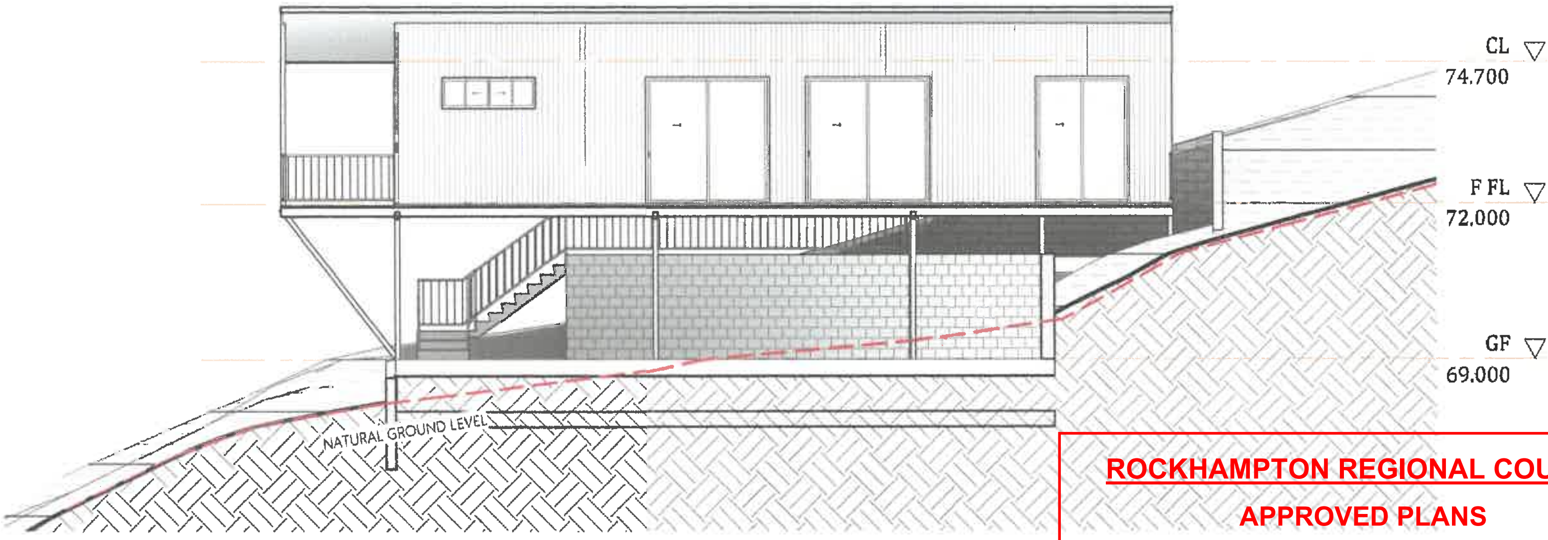


ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

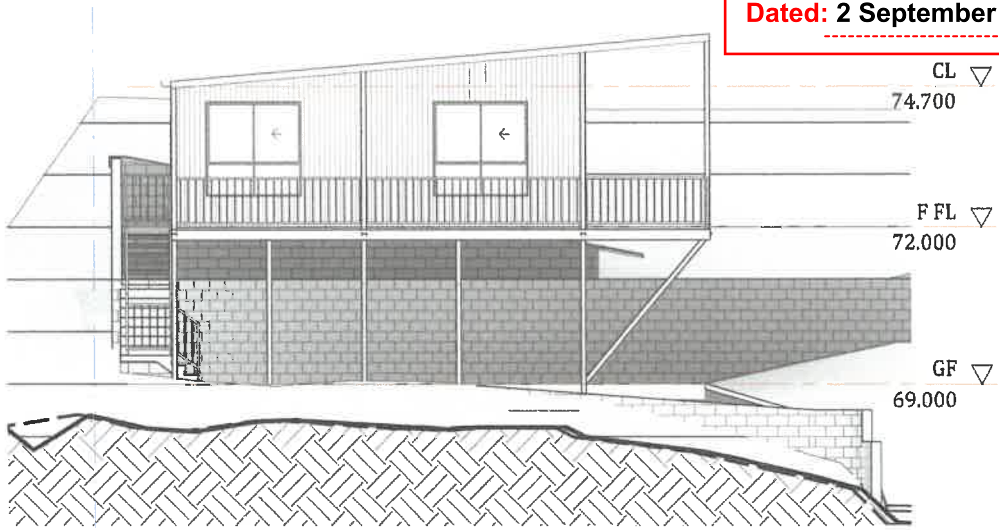
These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/79-2024

Dated: 2 September 2024

Elevation A

1 : 100



Elevation B

1 : 100

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

No:	Description:	Date:
1	PRELIMINARY	23/04/2024

REVISIONS

ISSUED FOR

PRELIMINARY

Project: **PROPOSED DWELLING**

Address: **6 Bray Gray Pl, Frenchville, 4701**

Drawing Title: **ELEVATIONS**

dezignelements
BUILDING DESIGNERS

0407 271 336 M
info@dezignelements.com.au E
QBCC No: 1247120 BDAQ No: 0001677

Scale:	1 : 100	Rev:
Date:	APRIL 2024	1
Drawn:	NJB	
Project No: 24_077	Drawing No: S-04	

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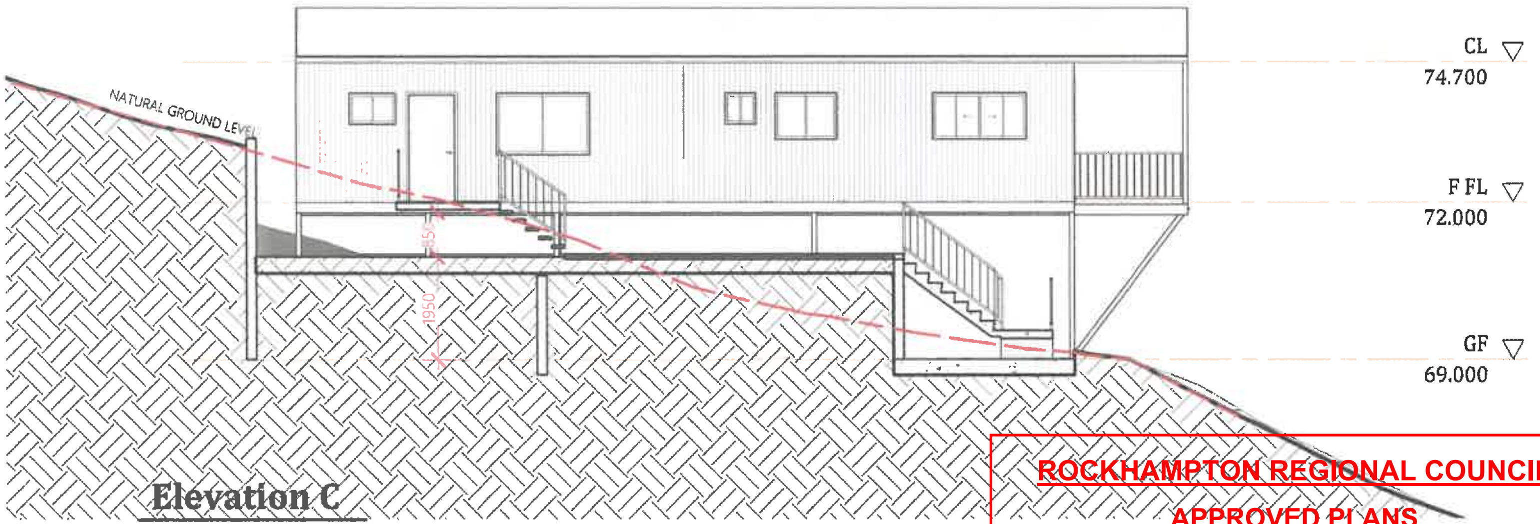


Elevation C

1 : 100

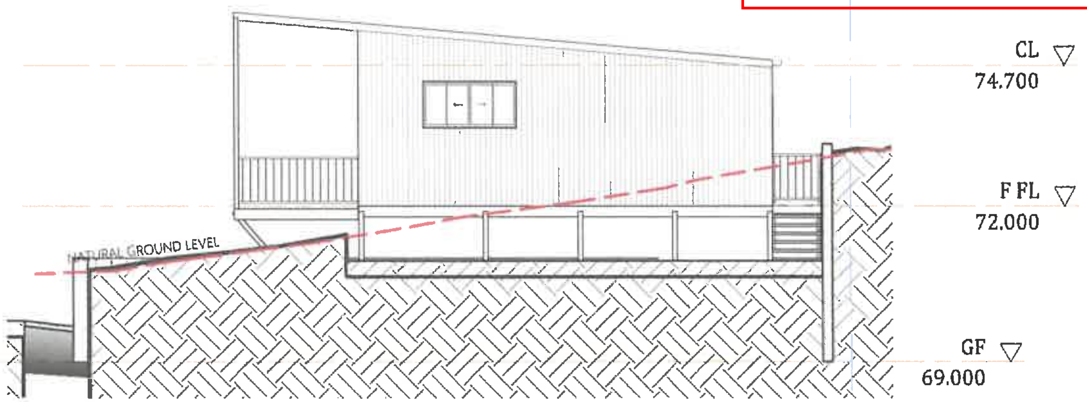
ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/79-2024

Dated: 2 September 2024



Elevation D

1 : 100

DO NOT SCALE DRAWING

ALL DIMENSION IN MILLIMETERS

REVISIONS

No:	Description:	Date:
1	PRELIMINARY	23/04/2024

ISSUED FOR

PRELIMINARY

Project:

PROPOSED DWELLING

Address:

6 Bray Gray Pl, Frenchville, 4701

Drawing Title:

ELEVATIONS

dezignelements BUILDING DESIGNERS

0407 271 336 M
info@dezignelements.com.au E
QBCC No: 1247120 BDAQ No: 0001677

Scale:	1 : 100	Rev:
Date:	APRIL 2024	1
Drawn:	NJB	
Project No: 24_077	Drawing No: S-05	

23/04/2024 4:38:15 PM

ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS
These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/79-2024
Dated: 2 September 2024

CQ SOIL TESTING

Landslide Susceptibility Assessment And Geotechnical Comments

SITE ADDRESS:	Lot 46 RP855670 6 Bray Gray Place, Frenchville
Prepared for:	D. Roberts
Job Number:	CQ24514 RevB
Issue Date:	28/02/2024

Certified System OHS ISO 45001 SAI GLOBAL
Certified System Environment ISO 14001 SAI GLOBAL
Certified System Quality ISO 9001 SAI GLOBAL

CQSOILTESTING.COM.AU

CQ SOIL TESTING technical excellence

ABN 87 656 845 448
QBCC License 15 305 465

PO Box 9654
Park Avenue QLD 4701

P (07) 4936 1163
F (07) 4936 1162

info@cqsoiltesting.com.au

Client & Document Information

Client: D. Roberts

Project: Lot 46 RP855670
6 Bray Gray Place, Frenchville

Investigation Type: **Landslide Susceptibility Assessment and Geotechnical Comments**

Job Number: CQ24514 RevB

Date of Issue: 28/02/2024

Contact Information

CQ SOIL TESTING ABN 87 656 845 448 PO Box 9654 PARK AVENUE QLD 4701	Telephone: (07) 4936 1163 Facsimile: (07) 4936 1162 Email: info@cqsoiltesting.com.au

Document Control

Version	Date	Author	Design Drawings	Reviewer	Reviewer Initials
A	28/02/2024	C Burke	NA	Scott Walton	SWW
		Ryan Kemp			

Table of Contents

QBCC SUBSIDENCE POLICY

In accordance with the QBCC "Queensland Building and Construction Commission" the contractor must supply the site classifier with the information in Table 1. The contractor, or the contractor representative (CR), may require the site classifier (SC) gather all or part of this information and the SC must satisfy themselves that all of the "relevant" information has been considered.

If all of the information listed below is not supplied by the contractor or the contractor does not wish the SC to recover said information (at cost) the contractor may be in breach of the no fault provisions of the QBCC's Policy for Rectification of Building Work and may be held responsible for subsidence or settlement of a building.

Table 1- Supplied Information

Element	Supplied/ Considered	Remarks
Property description and site address	✓	Supplied by CR
Plan and/or survey	✓	Supplied by CR
Contour of the site	✓	Supplied by CR
Location of trees, vegetation etc identified	✓	Considered by SC
Location and identification of potential overland flow	✓	Identified by SC
The footprint of proposed building and platform levels	✓	Supplied by CR
Location of proposed or existing cut and fill	✗	Nil Supplied
Appropriate land searches	✗	Nil Supplied

The following (Table 2) is a summary of the information required under the QBCC relating specifically to the SC. Information supplied in this summary is to be read in conjunction with the entire report attached. All relevant data used to ascertain the classification is documented in the report.

Table 2 – Information Summary

Element	Remarks
Total number of excavations	3
Minimum of two excavations in building footprint	✓
Soil samples recovered	Disturbed
Laboratory test performed	Classification
Predicted Surface Movement in the absence of the effect of trees	31 – 40 mm
Expected movement potential for "P" sites in the absence of uncontrolled fill	NA

INTRODUCTION

This report outlines the results of the landslide susceptibility assessment geotechnical investigation undertaken by CQ Soil Testing for the proposed new dwelling to be constructed at 6 Bray Gray Place, Frenchville.

It is understood that the site has been cut and filled, reshaping the natural sloping topography to achieve the existing subgrade level for the construction of the proposed residential dwelling. Cut and fill batters have been formed between an estimated 1 meter and 3 meters high. It is noted that the provided documentation does not provide specific structural details, such as the layout of footings and the loading conditions for the proposed structures. However, for this report it has been assumed that the loading conditions will be consistent with those of a standard residential dwelling, with foundation pressures not exceeding 100 kPa.

This report outlines the results of the fieldwork, laboratory testing, analysis and interpretive reporting on the following items:

- Summary of subsurface conditions and adopted ground model.
- Foundation soil reactivity in accordance with AS2870 (Site Classification).
- Landslide Susceptibility Analysis.
- Earthworks and site preparation.
- Retaining wall design parameters.
- Allowable bearing pressures for high level footings.
- Ultimate base bearing and ultimate skin friction for the design of piles.

This report must be kept in entirety. This report relates exclusively to the proposed new dwelling at the address stated on page one of this report and has been prepared for the express purpose stated above. This document does not cover any other elements related to construction on the site.

SITE DESCRIPTION

The site is located at 6 Bray Gray Place, Frenchville on Lot 46 RP855670, and is positioned on the southeastern side of the Bray Gray Place cul-de-sac as shown on the attached cadastral mapping.

At the time of the investigation, the site was found to be vacant featuring vegetation that included a sparce grass ground cover and recently cut down trees. The building pad seemed to have been recently leveled and was free of any vegetation.

The contour and details survey plan (attached), along with the hillside shading data sourced from GeoResGlobe (attached), indicate that the site's natural topography slopes down from its eastern boundary towards the western boundary with an average calculated natural surface slope of approximately 20 degrees.

During the walkover, the site was visually inspected to assess the general topography for signs of previous landslide instability. No indications of previous landslides or slips were observed on this suggesting that there has been no recent soil creep or landslides in the upper soil mantle. No signs of instability were identified on the GeoResGlobe Hillside shading map.

Based on the review of regional surface geology presented on the Queensland Government website GeoResGlobe, the site is underlain by Early Permian aged Lakes Creek Formation (Pkl) comprising of '*Siltstone and lithic sandstone*'.

To improve the understanding and appreciation of the site conditions and features, this report is accompanied by photographs of the site taken during the fieldwork, site sketch and GeoResGlobe mapping and reports.

FIELDWORK

The fieldwork scope was undertaken on 2 February 2024 and included 4 boreholes (nominated Boreholes 1 to 4) at the approximate locations indicated on attached drawing. The boreholes were drilled using a 4WD utility-mounted rig equipped with 100mm diameter solid-flight augers. Borehole logs and test location plan are attached.

In summary, the subsurface conditions were as follows:

- **Fill:** Sandy clay fill material was encountered in all boreholes and continued to between 0.1 meters and 0.5 meters. As Level 1 certification has not been provided to confirm that the fill was placed and compacted under full-time Level 1 supervision and testing, it is considered 'uncontrolled'.
- **Residual:** Stiff silty clay was encountered below the fill in all boreholes and continued to depths between 0.5 metres and 0.5 meters, underlain by very dense clayey gravel continuing to depths between 1.1 metres and 1.4 metres.
- **Weathered Rock:** Weathered rock was encountered beneath the residual soils in all boreholes and continued to the termination depth ranging between 1.2 meters and 1.5 metres. The weathered rock was assessed as very low strength or stronger. It should be noted that the strength of the rock could potentially increase significantly at depths below the borehole depths. As the excavations were unable to penetrate beyond the refusal depths, it is important to consider the possibility of encountering stronger rock formations at greater depths.

No groundwater was encountered during drilling of the boreholes. Groundwater levels can be affected by a variety of factors, including seasonal changes, precipitation, and local geology.

It is important to note that the soil profile across the site may potentially differ from what is indicated in the bore logs. Therefore, in the event of encountering different conditions during construction, it is imperative to notify CQ Soil Testing.

LABORATORY TEST RESULTS

The laboratory testing undertaken on selected representative soil samples in accordance with AS1289-Methods of Testing for Engineering Purposes is aimed at determining the typical soil behavior characteristics required for the engineering assessment. The results of the laboratory tests are attached to this report.

CQ SOIL TESTING

GEOTECHNICAL COMMENTS

The geotechnical comments presented in this report are derived from factual information obtained during the fieldwork, along with the application of best practices, local expertise, and relevant published literature.

SITE CLASSIFICATION

In strict accordance with AS2798, the site would be classified Class P due to the recent removal of large trees, and as a result the foundation system needs to be designed by following appropriate engineering principles.

To provide an indication of potential shrink swell ground movements due to normal seasonal moisture variations that could be experienced at this site, a shrink-swell index (Iss) value of 1.9% was inferred (based on previous experience in the area). Based on the inferred shrink-swell value and empirical methods described in Section 2.3 of AS2870, the calculated surface movement (ys) in response to normal seasonal soil suction could potentially be up to 35 mm.

Proper site maintenance is crucial for the long-term performance of any building's foundation system. As such, the guidelines outlined in the attached CSIRO publication "Foundation Maintenance and Footing Performance: A Homeowners Guide" should be followed to ensure the site remains in optimal condition.

LANDSLIDE RISK ASSESSMENT

Rockhampton Reginal Council have developed a Planning Scheme mapping tool, designed to identify if a site requires a landslide hazard assessment before obtaining building approval. The attached Planning Scheme mapping reveals that the site is mapped as 'Steep Land 15% or greater'. Consequently, this triggers the need for a landslide susceptibility assessment as per the regulatory requirements.

The results of the attached Landslide Susceptibility Analysis (refer attached), including the relative susceptibility and correlated susceptibility rating, are summarised in Table 3 below. The analysis has been undertaken for the existing site conditions and based on a natural maximum site slope of approximately 20 degrees. The following are assumed to achieve the reported Correlated Susceptibility Rating:

- Existing cut batter slopes are between 30 and 45 degrees.
- Sewer and stormwater will be fully disposed off-site.

Table 3: *Results of AGS Qualitative Risk Assessment*

Relative Susceptibility	Correlated Susceptibility Rating
1.844	Moderate

Based on the relative susceptibility and correlated susceptibility rating, the site would be assessed as having a 'Moderate' landslide risk rating.

It is noted that constructing retaining structures designed and certified by a qualified structural engineer, with a minimum of 1.5 global stability factor of safety, would lower the correlated susceptibility rating to 'Low.'

The attached geomechanics hillside practices should be adopted for the dwelling.

EARTHWORKS

Any new fill that will support structural loads should be placed and compacted under full time supervision and testing in accordance with AS3798–2007 Guidelines on Earthworks for Commercial and Residential Hardstands. These guidelines recommend:

- Remove grass and vegetation.
- Remove uncontrolled fill.
- Subgrade preparation.
- Test rolling after subgrade preparation using specific plant and load conditions such as a static 12 Tonne smooth steel wheeled roller, a pneumatic-tired plant that weighs at least 20 tonnes and has a ground pressure not less than 450 kPa per tyre, or a highway truck with a rear axle loaded to not less than 8 tonnes, with tyres inflated to 550 kPa.
- Soft areas identified will need to be removed and replaced with select material, subject to site-specific conditions.
- Structural fill should be placed in near horizontal layers, with a maximum loose thickness of 300mm (uncompacted) and then compacted to a minimum of 98% DDR for general fill and 100% DDR in the upper 0.5m beneath slabs and pavements. Moisture variation should not exceed ±2% of the OMC.
- Maximum particle size should be limited to two-thirds of the compacted layer thickness or 125 mm (whichever is greater).
- If the structural fill abuts slopes steeper than 8H:1V, it is recommended to cut benches into the slope equal to the height of the fill layer before filling.

RETAINING WALLS

Retaining wall design parameters for the materials encountered during the investigation are provided in Table 4: Retaining Wall Parameters. These parameters are unfactored and drained, and have been inferred based on the information available.

Table 4: Retaining Wall Parameters

Material	Unit Weight (kN/m^3)	Friction Angle (Ø)	Drained Cohesion (c')
Uncontrolled fill	17	22	0
Silty clay	19	26	2
Clayey gravel	21	30	1
Weathered rock		35	5

To ensure the safety and stability of retaining walls, it is essential that they are designed and certified by a qualified structural engineer and built in accordance with the minimum requirements outlined in AS4678 - Earth Retaining Structures.

Global stability assessment must be undertaken on all retaining structures to ensure that suitable global stability FoS are reached.

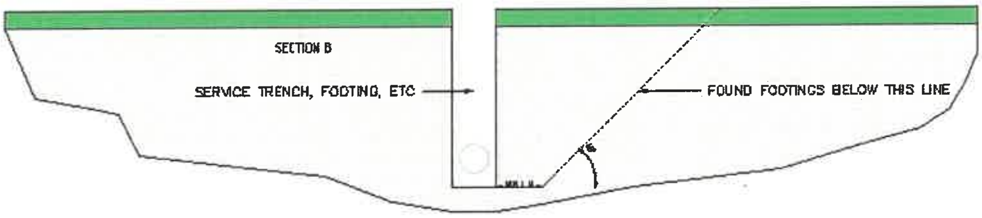
Passive pressures should be ignored in areas where disturbance may occur (ie. future trenching or earthworks processes).

FOUNDATIONS

High-level footings can be designed using an allowable bearing pressure of 100 kPa in the residual soils. Elastic settlements under such applied loading are predicted to be less than 0.5% of the footing width.

If footings are positioned near an underground service or other structure, it is recommended to extend the footing at least 0.3 m below an imaginary line projected at a 45-degree angle from the lowest point of the service/obstruction. Figure 1 provides a visual representation for reference.

Figure 1:



The design of vertically loaded bored piles that are founded at least two pile diameters into the designated strata can adopted the ultimate values in Table 5: Deep Level Footings – Ultimate Geotechnical Parameters.

The upper meter of the pile skin friction should be ignored in the design. For example, the pile should be designed assuming a 1 meter length of pile is sticking out of the ground, cantilevering this upper meter of pile. This precaution is necessary due to the potential separation between the pile and the ground due to soil shrinkage during drying.

Table 5: Deep Level Footings – Ultimate Geotechnical Parameters

Material	Fb (kPa)	Fs (kPa)
Uncontrolled fill	Not recommended	Not recommended
Silty clay	Not recommended	20
Clayey gravel	Not recommended	10
Weathered rock	1500	50

To ensure the proper performance of piles, it is crucial to have them designed and certified by a qualified structural engineer and constructed according to the minimum requirements specified in AS2159 - Piling Design and Installation. This standard outlines guidelines for the design and construction of piles, including the necessary reduction factors and design considerations.

Settlements of piles that are loaded in a manner like the one described above are not expected to exceed approximately 1% of the diameter of the pile.

Most equipment, including excavators with auger attachments, should be able to excavate bored pile excavations in the fill and residual. However, if underlying rock is encountered during bored pile excavations), larger machinery with specialised rock auger attachments may be needed to excavate rock formations.

If you should have any queries regarding this report, please do not hesitate to contact the undersigned at your convenience.

Yours faithfully

Ryan Kemp
Geotechnical Consultant – RPEQ, CPEng, NER, MEIAust

Scott Walton
Laboratory Manager

LABORATORY FINDINGS

A. Classification by characteristic surface movement as per AS2780-2011

Site Classification Symbols	Y's Range Value	Generalized Description (Guide Only)
'S'	0 – 20 mm	Slightly reactive clay sites which may experience only slight ground movement due to moisture changes
'M'	21 – 40 mm	Moderately reactive clay or silt sites which may experience moderate ground movement due to moisture changes
'H1'	41 – 60 mm	Highly reactive clay sites which may experience high ground movement due to moisture changes
'H2'	61 – 75 mm	Highly reactive clay sites which may experience very high ground movement due to moisture changes
'E'	>75 mm	Extremely reactive clay sites which may experience extreme ground movement due to moisture changes
'P'	N/A	Problem sites which generally have soils associated with uncontrolled fill, abnormal moisture conditions (trees), soft or collapsing soils, landslip etc...

B. Laboratory Test Results

Borehole Location	2	Borehole Location	3	Borehole Location	
Depth Range of Sample (m)	0.5-0.8	Depth Range of Sample (m)	0.0-0.4	Depth Range of Sample (m)	
Natural MC %	17	Natural MC %	14	Natural MC %	
% Passing 75 um Sieve	ND	% Passing 75 um Sieve	42	% Passing 75 um Sieve	
Liquid Limit %	ND	Liquid Limit %	ND	Liquid Limit %	
Plastic Index %	ND	Plastic Index %	ND	Plastic Index %	
Linear Shrinkage %	ND	Linear Shrinkage %	ND	Linear Shrinkage %	
Shrink Swell Index	1.8	Shrink Swell Index	ND	Shrink Swell Index	
Pocket Penetrometer kPa	ND	Pocket Penetrometer kPa	ND	Pocket Penetrometer kPa	

C. Permeability Test Results AS1547-2000

Test Hole Number	Depth Of Test Hole	Range Tested	Permeability M/Day
NA	500 mm	250 – 500 mm	NA

APPENDIX A - SITE PHOTOGRAPHS

Image 1: Proposed Construction Site

Image 2: Proposed Construction Site

Image 3: Proposed Construction Site

Image 4: Proposed Construction Site

APPENDIX B - SITE PLAN

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

APPENDIX C - BOREHOLE LOGS

CQ SOIL TESTING

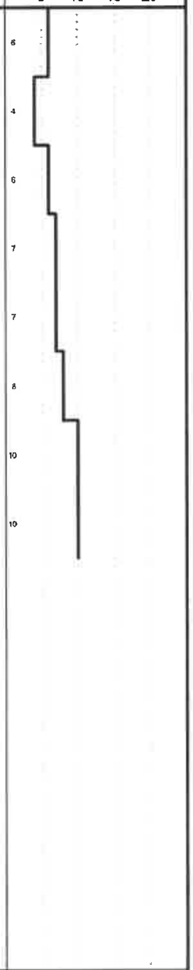
CLIENT: David Roberts
PROJECT: Geotechnical Investigation
ADDRESS: 6 Bray Gray Place, Frenchville
DRILL RIG: GT10

PROJECT #: CQ24514
LOGGED: M Walton
EASTING:
NORTHING:

BORE HOLE 1

TEST DATE: 02/02/2024

RL (m)	Depth (m)	Graphic Log	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments
	0.0–0.5			SILTY CLAY (CI): medium plasticity, trace fine to coarse grained sand, brown, dry, stiff.		
	0.5–1.3			CLAYEY GRAVEL (GC): fine to coarse grained, low plasticity fines, with fine to coarse grained sand, brown, dry, very dense.		
	1.3–1.4			WEATHERED ROCK		
	1.4			Bore Terminated at 1.4 m. Limit of Investigation.		



DRILLING METHOD: Solid Flight Auger

CASING:

GROUNDWATER: No groundwater seepage observed at time of drilling.

REMARKS: Tungsten carbide drill bit refusal on weathered rock at 1.4 m.

LEGEND:

- D - Disturbed Sample from Auger
- B - Bulk Sample from Auger
- C - Rock Core
- U_{50} - Undisturbed Sample (mm)
- SPT - Standard Penetration Test
- Is_{50} - Point Load Result (MPa)
- PP - Pocket Penetrometer (kPa)
- Groundwater Seepage Level
- Standing Groundwater Level
- Partial Groundwater Loss
- Perched Groundwater Level

CQ SOIL TESTING

CLIENT: David Roberts
PROJECT: Geotechnical Investigation
ADDRESS: 6 Bray Gray Place, Frenchville
DRILL RIG: GT10

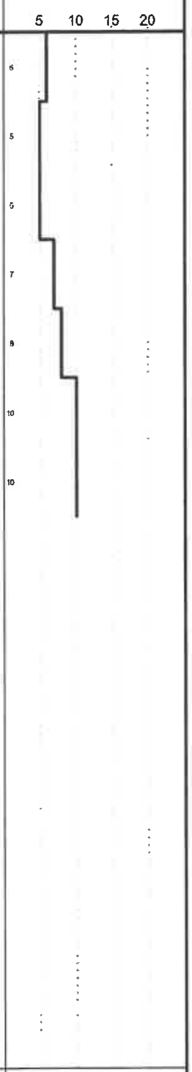
PROJECT #: CQ24514
LOGGED: M Walton
EASTING:
NORTHING:

BORE HOLE 2

TEST DATE: 02/02/2024

RL (m)	Depth (m)	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments
	0.0		SILTY CLAY (CI): medium plasticity, trace fine to coarse grained sand, brown, dry, stiff.		
	0.8		CLAYEY GRAVEL (GC): fine to coarse grained, low plasticity fines, with fine to coarse grained sand, brown, dry, very dense.		
	1.4		WEATHERED ROCK		
	1.5		Bore Terminated at 1.5 m. Limit of Investigation.		

DCP Results (blows per 100 mm)



DRILLING METHOD: Solid Flight Auger

CASING:

GROUNDWATER: No groundwater seepage observed at time of drilling.

REMARKS: Tungsten carbide drill bit refusal on weathered rock at 1.5 m.

LEGEND:

- **D** - Disturbed Sample from Auger
- **B** - Bulk Sample from Auger
- **C** - Rock Core
- **U_{50}** - Undisturbed Sample (mm)
- **SPT** - Standard Penetration Test
- **Is_{50}** - Point Load Result (MPa)
- **PP** - Pocket Penetrometer (kPa)
- Groundwater Seepage Level
- Standing Groundwater Level
- Partial Groundwater Loss
- Perched Groundwater Level

CQ SOIL TESTING

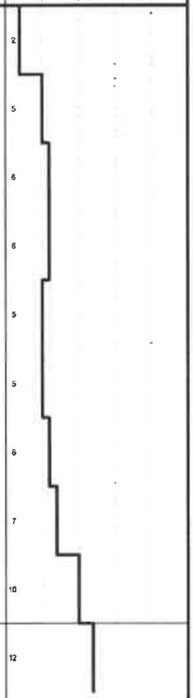
CLIENT: David Roberts
PROJECT: Geotechnical Investigation
ADDRESS: 6 Bray Gray Place, Frenchville
DRILL RIG: GT10

PROJECT #: CQ24514
LOGGED: M Walton
EASTING:
NORTHING:

BORE HOLE 3

TEST DATE: 02/02/2024

RL (m)	Depth (m)	Graphic Log	Water	Material Description	Sampling & Testing: Type	Sampling & Testing: Results & Comments	DCP Results (blows per 100 mm)
				GRAVELLY CLAY (CL): low plasticity, fine to coarse grained sand, brown, dry, very stiff.			2, 5, 6, 6, 5, 5, 6
			0.7	WEATHERED ROCK			7, 10
	1		0.9	Bore Terminated at 0.9 m. Limit of Investigation.			12
	2						



DRILLING METHOD: Solid Flight Auger

CASING:

GROUNDWATER: No groundwater seepage observed at time of drilling.

REMARKS: Tungsten carbide drill bit refusal on weathered rock at 1.2 m.

LEGEND:

- D - Disturbed Sample from Auger
- B - Bulk Sample from Auger
- C - Rock Core
- U_{50} - Undisturbed Sample (mm)
- SPT - Standard Penetration Test
- Is_{50} - Point Load Result (MPa)
- PP - Pocket Penetrometer (kPa)
- Groundwater Seepage Level
- Standing Groundwater Level
- Partial Groundwater Loss
- Perched Groundwater Level

APPENDIX D - ATTACHMENTS

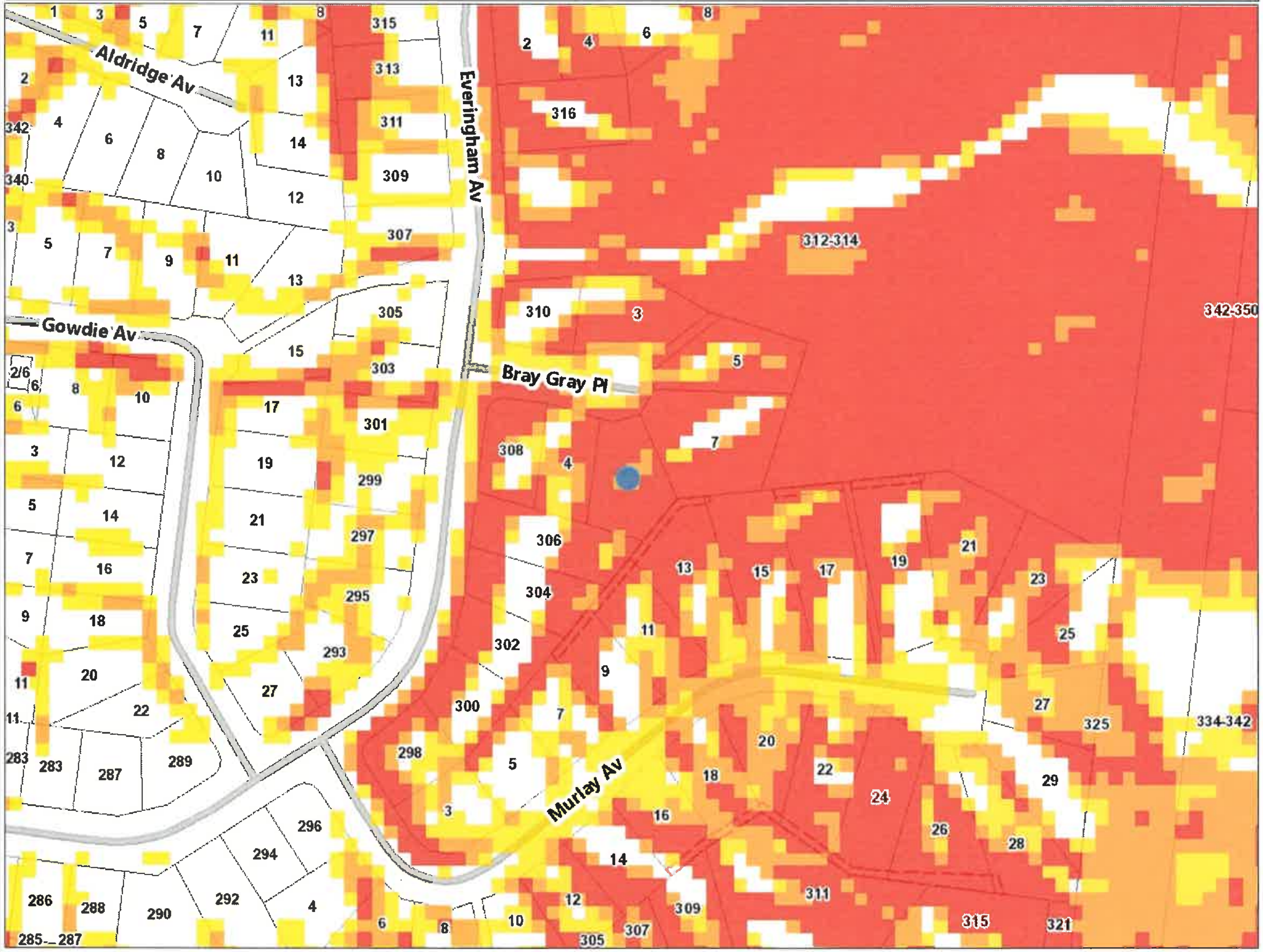
RichTextBox1

Spatial reference

GDA2020_MGA_Zone_56

A4 Page scale at 1: 2,196.69

Printed from RRPS on 12/02/24



Legend

Slope %
- 15-20%
- 20-25%
- 25%+

Roads1
- Main roads
- Major council roads
- Standard council roads
- Access roads
- Private roads

Easements

Property Parcels

Ocean

DCDB Parks

CQ LGA Boundaries

GDA 2020

Rockhampton Regional Council

8. APPENDICES

Appendix A – Landslide susceptibility analysis form

LANDSLIDE SUSCEPTIBILITY ANALYSIS

Analysis No.

Location: **Site No.** **Site Name:**

1 Natural Surface Slope

Site		Level	Factor
	Less than 5 degrees	L	0.1
	Between 5 and 15 degrees	M	0.5
x	Between 15 and 30 degrees	M	0.8
	Between 30 and 45 degrees	H	1.2
	More than 45 degrees	M	0.8

2 Slope Shape

Site		Level	Factor
	Crest or ridge	L	0.7
x	Planar / Convex	M	0.9
	Rough / Irregular	H	1.2
	Concave	H	1.5

3 Site geology

Site		Level	Factor
	Volcanic Extrusive rock	H	1.1
x	Sedimentary rock	M	1
	Low grade metamorphic rock	M	1
	High grade metamorphic rock	L	0.9
	Volcanic Intrusive rock	M	1

4 Soils

Site		Level	Factor
	Rock at surface	VL	0.1
	Residual soil < 1m deep	L	0.5
x	Residual soil 1-3m deep	M	0.9
	Residual soil > 3m deep	H	1.5
	Colluvial soil < 1m deep	H	1.5
	Colluvial soil 1-3m deep	VH	2
	Colluvial soil > 3m deep	VH	4

5 Fill height

Site		Level	Factor
	None	L	0.9
x	Less than 1m	M	1.1
	Between 1 and 3m	M	1.3
	Between 3 and 6m	H	1.7
	More than 6m	VH	2.5

6 Evidence of groundwater

Site		Level	Factor
x	None apparent	L	0.7
	Minor moistness	M	0.9
	Generally wet	H	1.5
	Surface springs	VH	3

7 Cut height

Site		Level	Factor
	None	L	0.9
x	Less than 1m	M	1.1
	Between 1 and 3m	M	1.3
	Between 3 and 6m	H	1.7
	More than 6m	VH	2.5

8 Slope of cut face

Site		Level	Factor
	Less than 30 degrees	L	0.5
x	Between 30 and 45 degrees	M	1
	Between 45 and 60 degrees	H	1.5
	More than 60 degrees	VH	3

9 Material in cutting

Site		Level	Factor
	High strength rock	L	0.5
	Medium strength rock	L	1
	Low strength rock	M	1.2
	Very low strength rock and soil	H	1.5
x	Soil	VH	2

10 Cut slope support

Site		Level	Factor
	Concrete wall	L	0.5
	Crib wall	M	0.9
	Gabion wall	M	1
	Rock wall	H	1.5
x	Unsupported	H	2

11 Concentration of surface water

Site		Level	Factor
	Ridge	L	0.7
	Crest	M	0.8
	Upper slope	M	0.9
	Mid slope	H	1.2
x	Lower slope	H	1.5

12 Wastewater Disposal

Site		Level	Factor
x	Fully Sewered	M	1
	Onsite disposal – Surface	M	1.2
	Onsite disposal – Soak Pit/Trenches	H	1.5

13 Stormwater Disposal

Site		Level	Factor
x	All stormwater piped into road drainage	L	0.7
	Rain water tank with overflows	M	1
	Stormwater discharge on site	H	1.5

14 Evidence of instability

Site		Level	Factor
x	No sign of instability	L	0.8
	Soil Creep	H	1.2
	Minor irregularity	VH	2
	Major irregularity	VH	5
	Active instability	VH	10

Summary

			Factor
1	Natural Surface Slope		0.8
2	Slope Shape		0.9
3	Site Geology		1.0
4	Soils		0.9
5	Fill Height		1.1
6	Evidence of Groundwater		0.7
7	Cut height		1.1
8	Slope of Cut Face		1.0
9	Material in Cutting		2.0
10	Cut Slope Support		2.0
11	Concentration of Surface Water		1.5
12	Wastewater Disposal		1.0
13	Stormwater Disposal		0.7
14	Evidence of Instability		0.8
Relative Susceptibility (1x2x3x4x5x6x7x8x9x10x11x12x13x14)			1.844

Appendix B – Correlation between relative susceptibility and susceptibility rating

Relative Susceptibility	Susceptibility Rating
Less than 0.2	Very Low
0.2 – 0.6	Low
0.6 – 2.0	Moderate
2.0 – 6.0	High
Greater than 6.0	Very High

AUSTRALIAN GEOGUIDE LR5 (WATER & DRAINAGE)

WATER, DRAINAGE & SURFACE PROTECTION

One way or another, water usually plays a critical part in initiating a landslide (GeoGuide LR2). For this reason, it is a key factor to be controlled on sites with more than a low landslide risk (GeoGuide LR7).

Groundwater and Groundwater Flow

The ground is permeable and water flows through it as illustrated in Figure 1. When rain falls on the ground, some of it runs along the surface ("surface water run-off") and some soaks in, becoming groundwater. Groundwater seeps downwards along any path it can find until it meets the water table: the local level below which the ground is saturated. If it reaches the water table, groundwater either comes to a halt in what is effectively underground storage, or it continues to flow downwards, often towards a spring where it can seep out and become surface water again. Above the water table the ground is said to be "partially saturated", because it contains both water and air. Suctions can develop in the partially saturated zone which have the effect of holding the ground together and reducing the risk of a landslide. Vegetation and trees in particular draw large quantities of water out of the ground on a daily basis from the partially saturated zone. This lowers the water table and increases suctions, both of which reduce the likelihood of a landslide occurring.

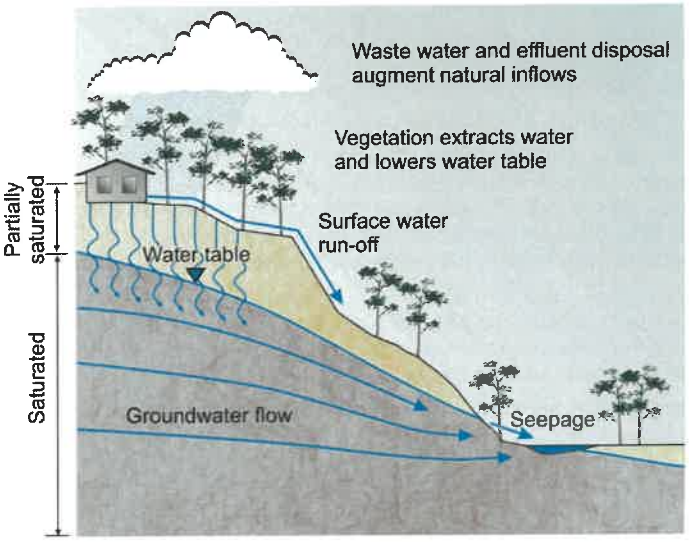


Figure 1 - Groundwater flow

Groundwater Flow and Landslides

The landslide risk in a hillside can be affected by increase in soak-away drainage or the construction of retaining walls which inhibit groundwater flow. The groundwater is likely to rise after heavy rain, but it can also rise when human interference upsets the delicate natural balance. Activities such as felling trees and earthworks can lead to:

- a reduction in the beneficial suctions in the partially saturated zone above the water table.
- increased static water pressures below the water table,
- increased hydraulic pressures due to groundwater flow,
- loss of strength, or softening, of clay rich strata,
- loss of natural cementing in some strata,
- transportation of soil particles.

Any of these effects, or a combination of them, can lead to landslides like those illustrated in GeoGuides LR2, LR3 and LR4.

Limiting the Effect of Water

Site clearance and construction must be carefully considered if changes in groundwater conditions are to be limited. GeoGuide LR8 considers good and poor development practices. Not surprisingly much of the advice relates to sensible treatment of water and is not repeated here. Adoption of appropriate techniques should make it possible to either maintain the current ground water table, or even cause it to drop, by limiting inflow to the ground.

If drainage measures and surface protection are relied on to keep the risk of a landslide to a tolerable level, it is important that they are inspected routinely and maintained (GeoGuide LR11).

The following techniques may be considered to limit the destabilising effects of rising groundwater due to development and are illustrated in Figure 2.

AUSTRALIAN GEOGUIDE LR5 (WATER & DRAINAGE)

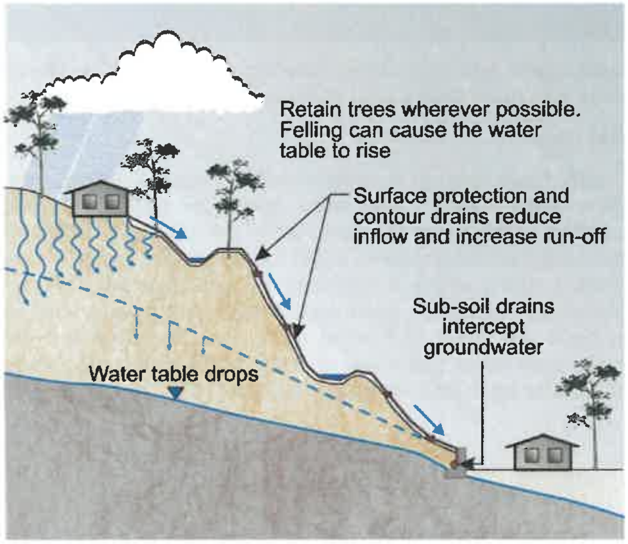


Figure 2 - Techniques used to control groundwater flow

Surface water drains (dish drains, or table drains) - are often used to prevent scour and limit inflow to a slope. Other than in rock, they are relatively ineffective unless they have an impermeable lining. You should clear them regularly, and as required, and not less than once a year. If you live in an area with seasonal rainfall, it is best to do this near the end of the dry season. If you notice that soil or rock debris is falling from the slope above, determine the source and take appropriate action. This may mean you have to seek advice from a geotechnical practitioner.

Surface protection - is sometimes used in addition to surface water drainage to prevent scour and minimise water inflow to a slope. You should inspect concrete, shotcrete or stone pitching for cracking and other signs of deterioration at least once a year. Make sure that weepholes are free of obstructions and able to drain. If the protection is deteriorating, you should seek advice from a geotechnical practitioner.

Sub-soil drains - are often constructed behind retaining walls and on hillsides to intercept groundwater. Their function is to remove water from the ground through an appropriate outlet. It is important that subsoil drains are designed to complement other measures being used. They should be laid in a sand, or gravel, bed and protected with a graded stone or geotextile filter to reduce the chance of clogging. Sub-soil drains should always be laid to a fall of at least 1 vertical on 100 horizontal. Ideally the high end should be brought to the surface, so it can be flushed with water from time to time as part of routine maintenance procedures.

Deep, underground drains - are usually only used in extreme circumstances, where the landslide risk is assessed as not being tolerable and other stabilisation measures are considered to be impractical. They work by permanently lowering the water table in a slope. They are not often used in domestic scale developments, but if you have any on your site be aware that professional maintenance is essential. If they are not maintained and stop working, the water table will rise and a landslide may even occur during normal weather conditions. Both an increase or a reduction in the normal flow from deep drains could indicate a problem if it appears to be unrelated to recent rainfall. If changes of this sort are observed, you should have the drains and your site checked by a geotechnical practitioner.

Documentation - design drawings and specifications for geotechnical measures intended to minimise landslide risk can be of great assistance to a geotechnical specialist, or structural engineer, called in to inspect and report on them. Copies of available documentation should be retained and passed to the new owner when the property is sold (GeoGuide LR11). You should also request details of an appropriate maintenance program for drainage works from the designer and keep that information with other relevant documentation and maintenance records.

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

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LANDSLIDE RISK

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 2: LIKELIHOOD

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

TABLE 1: RISK TO PROPERTY

Qualitative Risk		Significance - Geotechnical engineering requirements
Very high	VH	**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 the value of the property.
High	H	**Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.
Moderate	M	**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 possible.
Low	L	**Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.
Very Low	VL	**Acceptable**. Manage by normal slope maintenance procedures.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

TABLE 3: RISK TO LIFE

Risk (deaths per participant per year)	**Activity/Event Leading to Death** (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

More information relevant to your particular situation may be found in other AUSTRALIAN GEOGUIDES:

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- GeoGuide LR4 - Landslides in Rock
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- GeoGuide LR6 - Retaining Walls
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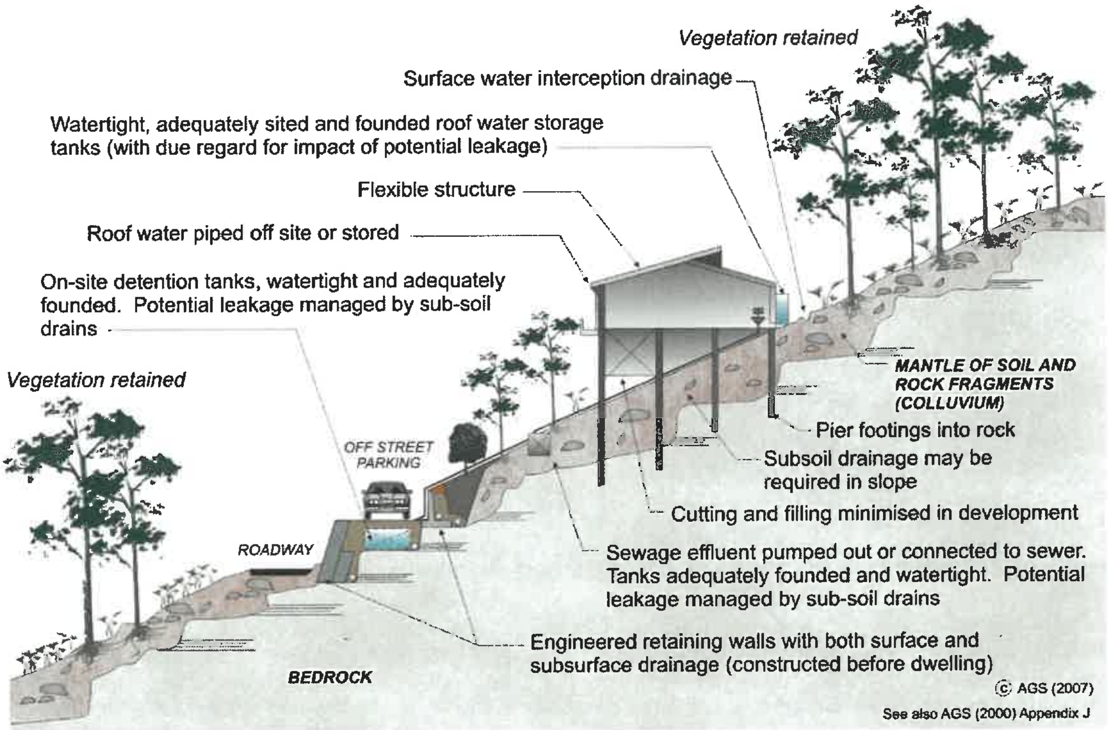
AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.

EXAMPLES OF GOOD HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

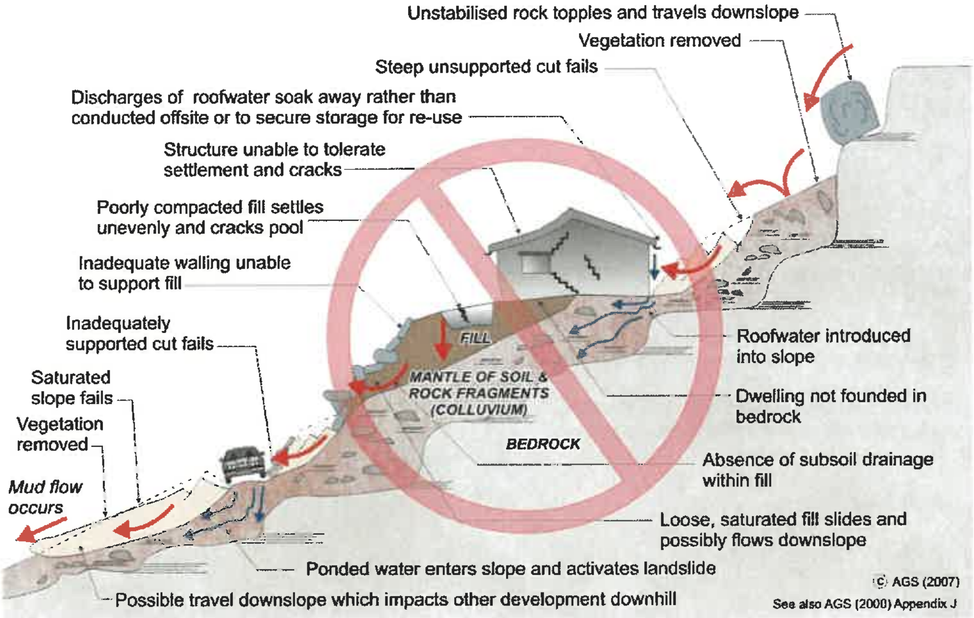
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

EXAMPLES OF POOR HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

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- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

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AUSTRALIAN GEOGUIDE LR9 (EFFLUENT DISPOSAL)

EFFLUENT AND SURFACE WATER DISPOSAL

EFFLUENT AND WASTEWATER

All households generate effluent and wastewater. The disposal of these products and their impact on the environment are key considerations in the planning of safe and sustainable communities. Cities and townships generally have reticulated water, sewer and stormwater systems, which are designed to deliver water and dispose of effluent and wastewater with minimal impact on the environment. However, many smaller communities and metropolitan fringe suburbs throughout Australia are un-sewered. Some of these are located in hillside or coastal settings where landslides present a hazard.

Processes by which wastewater can affect slope stability

As explained in GeoGuides LR3 and LR5, groundwater variations have a significant impact on slope stability. Inappropriate disposal of effluent and wastewater may result in the ground becoming saturated. The result is equivalent to a localised rise of the groundwater table and may have the potential to cause a landslide (GeoGuides LR2, LR5 and LR8).

On-site effluent disposal

In un-sewered areas disposal of effluent must be achieved through suitable methods. These methods usually involve containment within the boundaries of the site ("on-site disposal"). State environment protection agencies and local government authorities can usually provide advice on suitable disposal systems for your area. Such systems may include:

- *Septic systems,* which involve a storage/digestion tank for solids, with disposal of the liquid effluent via absorption trenches and beds, leach drains, or soak wells. Such systems are best suited to areas not prone to landslides.
- *Aerobic treatment units* which incorporate an individual household treatment plant to aid breakdown of the waste into a higher quality effluent. Such effluent is further treated and disposed of by surface or sub-surface irrigation, sub-soil dripper, or shallow leach drain system.
- *Nutrient retentive leaching systems* which utilise septic tanks to process the solid and liquid wastes in conjunction with discharge of the effluent through sand filters, media filters, mound systems and nutrient retentive leaching systems, which strip the effluent of nutrients.

Toilet (and sometimes kitchen) waste is known as *black water.* Other, less contaminated, wastewater streams from showers, baths and laundries are known as *grey water. Grey water re-use systems* allow a household to conserve water from bathrooms, kitchens and laundries, for re-use on gardens and lawns.

Recommendations for effluent disposal

In areas prone to landslide hazard, it is recommended that whatever effluent disposal system is employed, it should be designed by a qualified professional, familiar with how such a system can impact on the local environment. Local council, and in some instances state environment protection agency, approval is usually required as well. Many local authorities require a site assessment report, which covers all relevant issues. If approved, the report's recommendations must be incorporated in the system design. Reduction in the volume of effluent is beneficial so composting toilets and highly rated (i.e. low consumption) water appliances are recommended. It should be noted that in some state and local government jurisdictions there are restrictions on the alternative measures that can be applied. Consideration should be given to applying treated wastewater to land at low rates and over as large an area as possible. Further guidance can be found in Australian Standard AS/NZS 1547:2000 On-site domestic wastewater management.

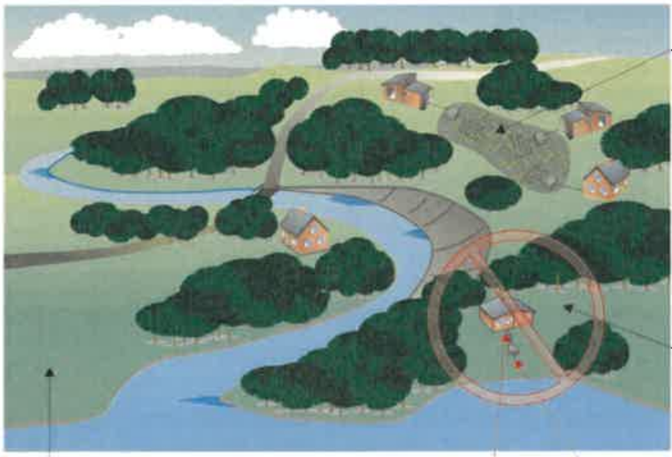
Effluent disposal fields should be sited with due consideration to the overall landscape and the individual characteristics of the property. Some guidance is provided. In particular, effluent fields should be located downslope of the building, away from stormwater, or *grey water,* discharge areas and where there is minimal potential for downstream pollution. Set backs and buffer distances vary from state to state and local requirements should be adhered to. All systems require regular maintenance and inspection. Efficient operation of the system must be a priority for property owners/occupiers to ensure safe and sustainable communities. Responsibility for maintenance rests with owners.

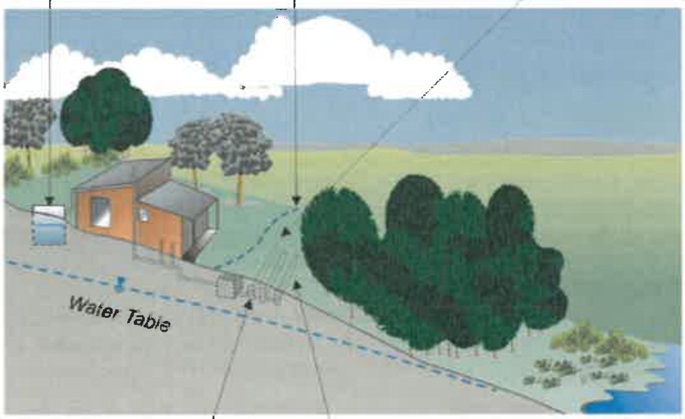
SURFACE WATER DRAINAGE

Attention to on-site surface water management is also important. Runoff from developments, including buildings, decks, access tracks and hardstand areas should be collected and discharged away from the development and other effluent disposal fields. Particular care must be given to the design of overflows on water tanks, as this is often overlooked. Discharge from any development should be spread out as much as possible, unless it can be directed to an existing natural water course. Ponding of water on hillsides and the concentration of water flows on slopes must be avoided.

It is recommended that a specific drainage plan and strategy should be developed in conjunction with the effluent disposal system for sites with a high potential for slope instability. Maintenance of the surface water drainage system is as important as maintenance of the effluent disposal system and again the responsibility rests with owners.

AUSTRALIAN GEOGUIDE LR9 (EFFLUENT DISPOSAL)



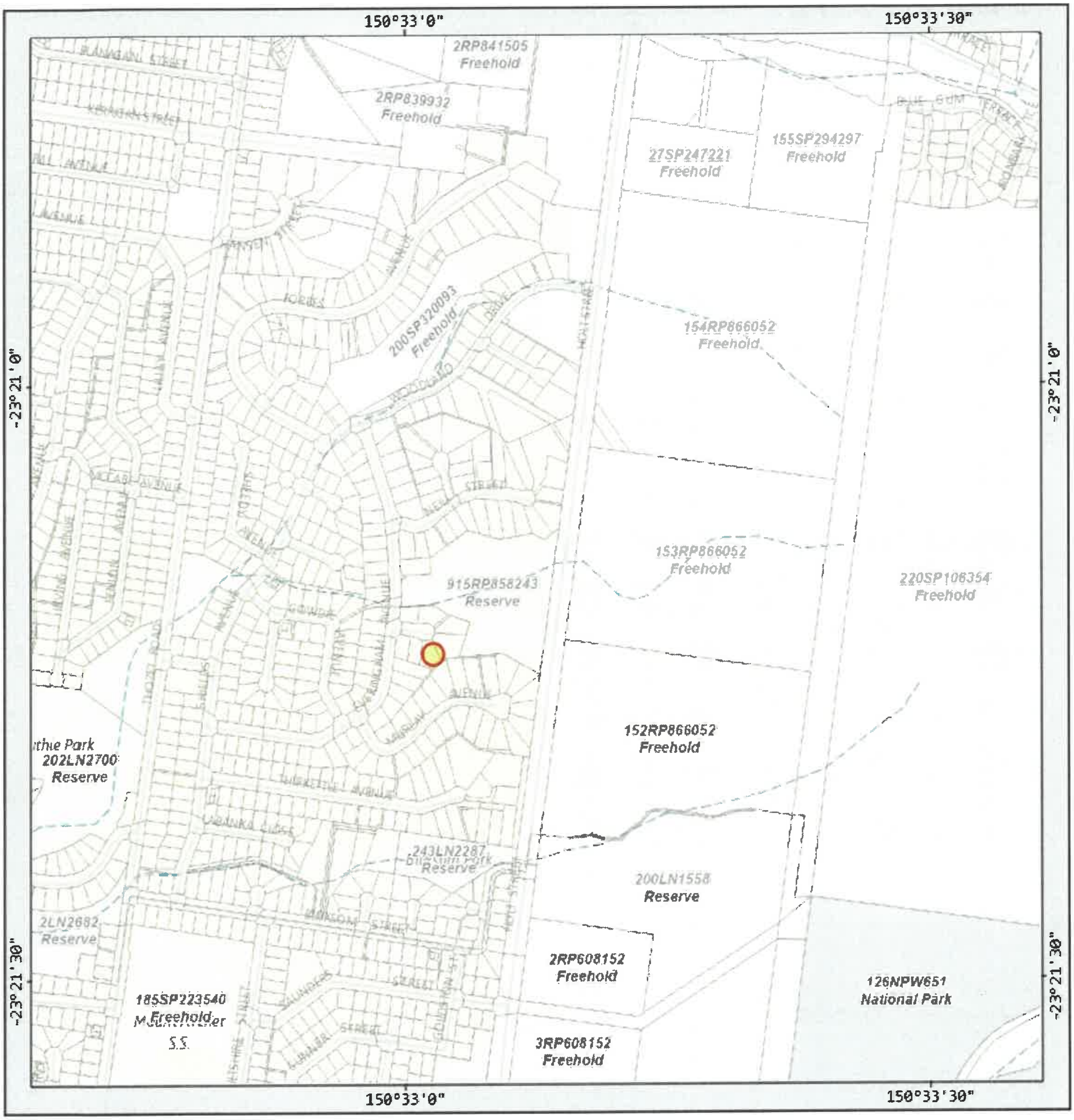


Note: Adapted from EPA Vic. Publication 451 (March 1996) "Code of Practice - Septic Tanks", which was sourced from Vic. Department of Planning and Loddon-Campaspe Regional Planning Authority.

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.



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For more information, visit https://georesglobe.information.qld.gov.au/help-info/Contact-us.html

Queensland Government
Department of Resources

PDF report

Lot:	46
Plan:	RP855670
Lot plan:	46RP855670
Area (sq m):	1070
Tenure:	Freehold
Segment parcel:	33982181
Parcel indicator:	
Local government:	Rockhampton Regional
Locality:	Frenchville
Accuracy:	B&D PLOT CONTROLLED - 1.5M
Surveyed:	Y
Smart Map:	https://apps.information.qld.gov.au/data/v2/Cadastre/SmartMap?lot=46&plan=RP855670
Layer:	Cadastre (DCDB) parcel

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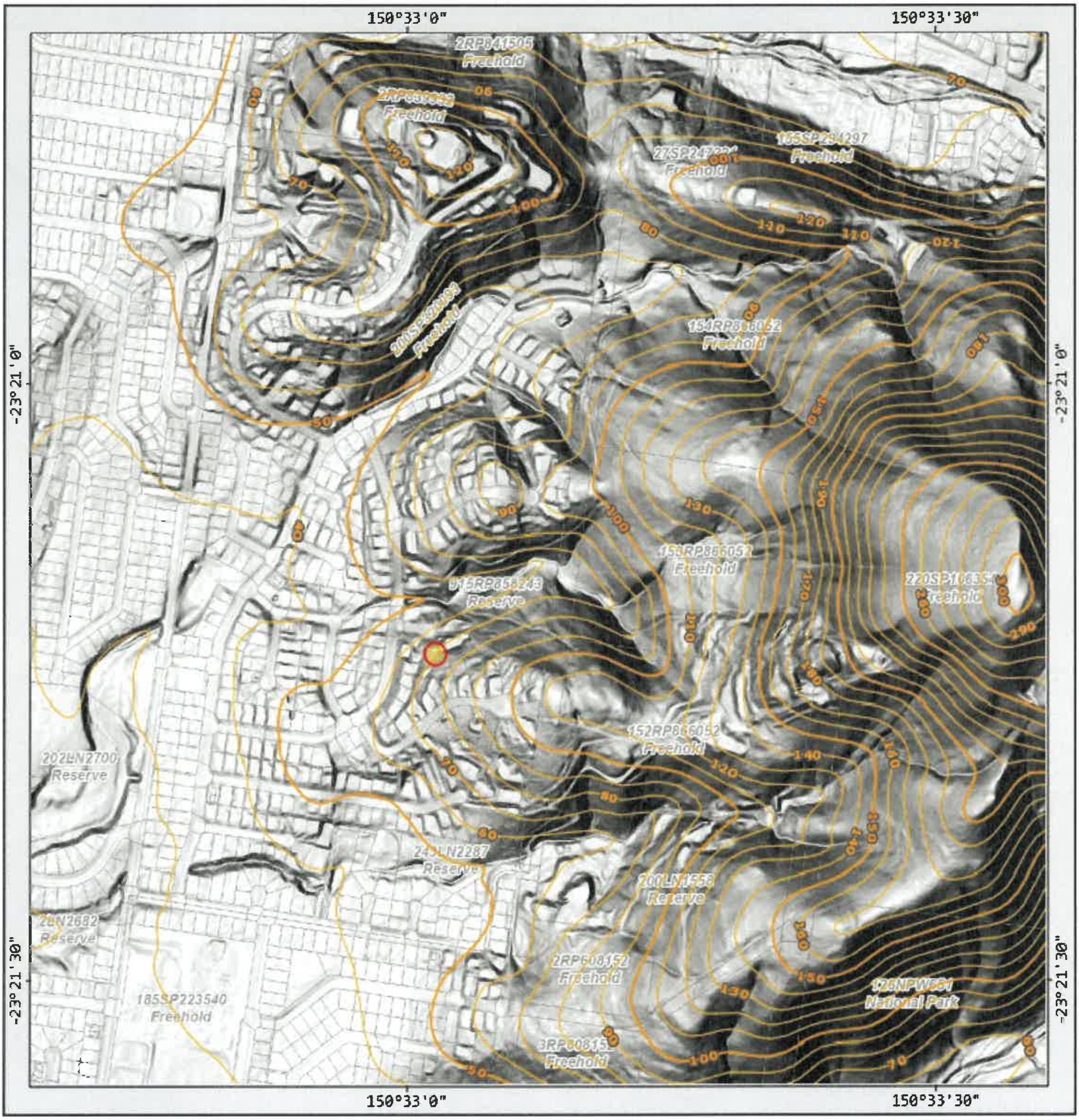

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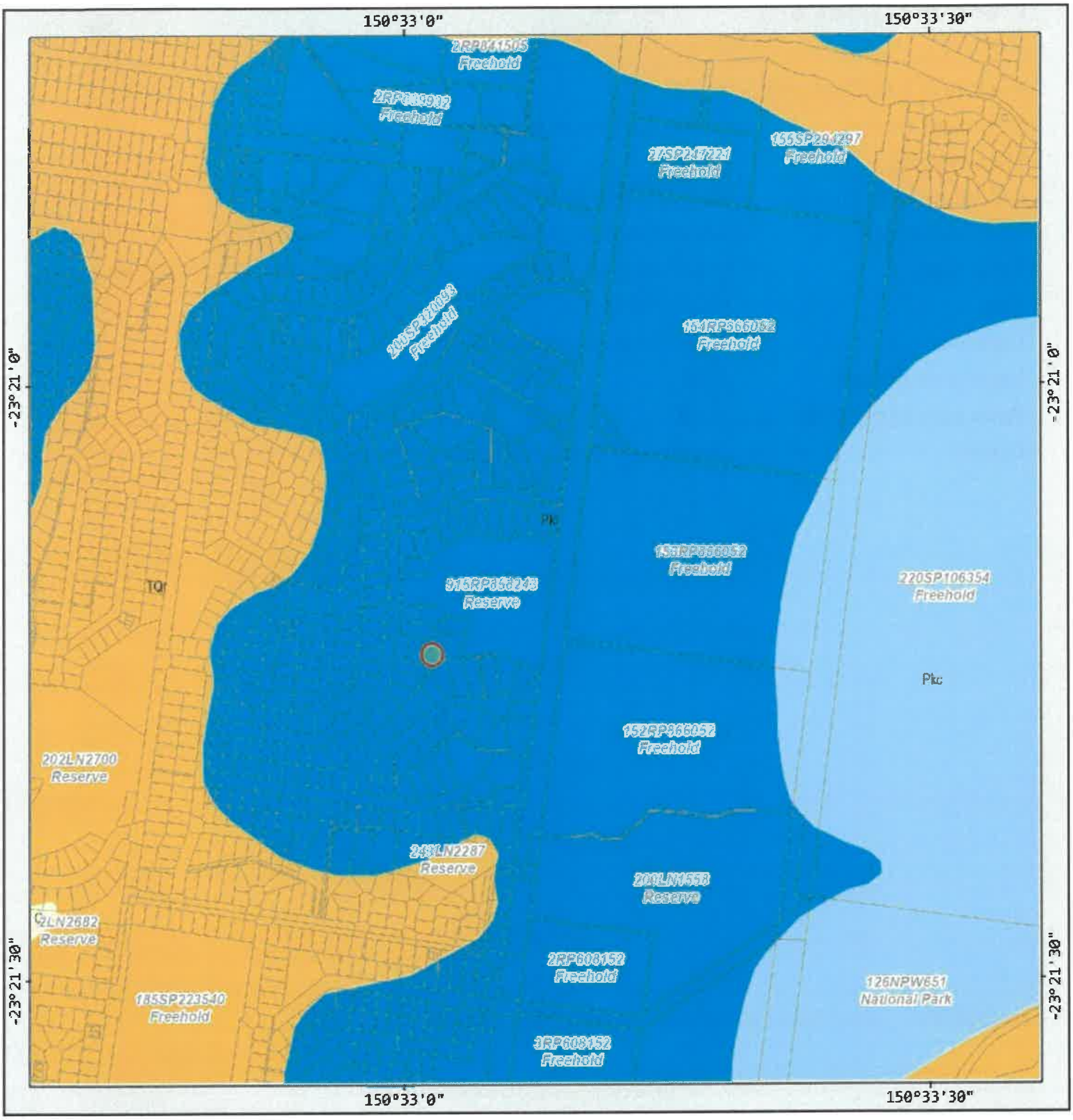

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Department of Resources

PDF report

Rock unit key (Surface):	11746
Rock unit name:	Lakes Creek Formation
Map symbol:	Pkl
Lithological summary:	Siltstone and lithic sandstone
Dominant rock:	ARENITE-MUDROCK
Rock type:	STRATIFIED UNIT (INCLUDING VOLCANIC AND METAMORPHIC)
Age:	EARLY PERMIAN
Legend:	Lakes Creek Formation (Pkl)
Legend sequence:	3290
Rock unit key (Solid):	11746
Layer:	Detailed surface geology

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APPENDIX E - LIMITATIONS

1. Recommendations given in this report are based on the information supplied by the client regarding the proposed building construction in conjunction with the findings of the investigation. Any change in construction type, building location or omission in the client supplied information, may require additional testing and/or make the recommendations invalid.

2. The recommendations herein may identify a target soil stratum into which the footings should be founded. The target stratum has been located by the depth in mm of the target stratum's upper horizon boundary below the existing ground surface level at the time of the site investigation. Any cutting or filling works and any surface erosion or deposits subsequent to the site investigation, will alter the measured location of the stratum relative to the surface. Where required, the author should be notified in such cases to confirm the location of the target stratum.

3. The description of the soil given in Section 3.0 of this report is intended as a brief overview of the soil's primary constituents. For a detailed classification of the soil, the reader should refer to the Soil Profile Reports and/or Borehole Reports.

4. Every reasonable effort has been made to locate the test sites so that the borehole profiles are representative of the soil conditions within the area investigated. The client should be made aware, however, that exploration is limited by time available and economic restraints. In some cases, soil conditions can change dramatically over short distances, therefore, even careful exploration programs may not locate all the variations.

5. If soil conditions different from those shown in this report are encountered or are inferred from other sources, then the author must be notified immediately.

6. This report may not be reproduced except in full, and only then with the permission of the entity trading as CQ Soil Testing. The information and site sketch shall only be used and will only be applicable for the development shown on the client-supplied information provided for this site.

7. All information contained within this report is the intellectual property of the entity trading as CQ Soil Testing. All information contained within can only be used for the express purposes of the commissioned scope of works.

8. Any dimensions, contours, slope directions and magnitudes shown on the site sketch plan shall not be used for any building construction or costing calculations. The purpose of the plan is to show the approximate location of field tests only.

9. Any changes made to these recommendations by persons unauthorized by the author will legally be interpreted by that person assuming the responsibility for the long-term performance of the footing system.

10. The recommendations contained in this report have not taken into consideration the long-term effects of any previous, current, or potential subsurface work by mining companies or potential slope instability problems. At the time of writing this report neither our client (nor his agent) nor the local authority had made the author aware that these problems may be affecting this allotment. If a mining subsidence or slope stability assessment is required for this allotment, the recommendations of a suitably qualified geotechnical engineer should be sought.

11. Removal of trees from a site before an investigation can cause significant swelling of the soil over large areas. The removal of large trees from a construction site during development is rarely picked up during the investigation phase and is generally outside the scope of AS2870. Sites affected by large trees are often classified "P". If, during the footing excavation, it is noticed that there are soils with varying moisture contents or evidence of large trees having been removed CQ Soil Testing should be notified immediately.

12. The following documents are available from the CSIRO and QBCC and shall be read and adhered to in relation to this site:

- Builder's Guide to Preventing Damage to Dwellings- Part 1 Site Investigation and Preparation
  http://www.publish.csiro.au/nid/22/pid/3621.html
- Builder's Guide to Preventing Damage to Dwellings- Part 2 Sound Construction Methods
  http://www.publish.csiro.au/nid/22/pid/3661.html
  - QBCC Subsidence Fact Sheet
    https://www.qbcc.qld.gov.au/sites/default/files/Homeowner%27s%20Guide%20to%20Subsidence.pdf