PP229/2018-1

17 Great Ocean Road GREY RIVER

Lot: 1 TP: 220566 V/F: 8094/056

Construction of a Dwelling and Associated Works and Removal of One (1)Tree

G O'Brien

Officer - Bernadette McGovan

EXHIBITION FILE

Submissions to this planning application will be accepted until a decision is made on the application.

If you would like to make a submission relating to a planning permit application, you must do so in writing to the Planning Department

Colac Otway SHIRE

Planning Enquiries
Phone: (03) 5232 9400
Web: www.colacotway.vic.gov.au

Clear Form

Office Use Only

Application No.: Date Lodged: / /

Application for a **Planning Permit**

If you need help to complete this form, read MORE INFORMATION at the end of this form.

⚠ Any material submitted with this application, including plans and personal information, will be made available for public viewing, including electronically, and copies may be made for interested parties for the purpose of enabling consideration and review as part of a planning process under the *Planning and Environment Act 1987*. If you have any questions, please contact Council's planning department.

⚠ **Questions marked with an asterisk (*) must be completed.**

⚠ **If the space provided on the form is insufficient, attach a separate sheet.**

ⓘ Click for further information.

The Land ⓘ

Address of the land. Complete the Street Address and one of the Formal Land Descriptions.

Street Address *

Unit No.: St. No.: 17 St. Name: GREAT OCEAN ROAD

Suburb/Locality: GREY RIVER Postcode: 3234

Formal Land Description *
Complete either A or B.

⚠ This information can be found on the certificate of title.

If this application relates to more than one address, attach a separate sheet setting out any additional property details.

A Lot No.: [redacted] ○ Lodged Plan ○ Title Plan ○ Plan of Subdivision No.:
1 TP220566

OR

B Crown Allotment No.: 33A (PT) Section No.:

Parish/Township Name: WONGARRA

The Proposal

⚠ You must give full details of your proposal and attach the information required to assess the application. Insufficient or unclear information will delay your application.

ⓘ **For what use, development or other matter do you require a permit?** *

PERMIT REQUIRED FOR BUILDING A SINGLE DWELLING.
PROPOSED DWELLING IS AROUND 90 SQ METRES.
2 BED / 1 BATH.
A MODEST 'CABIN TYPE' DESIGN. SIMILAR TO NEIGHBOURING HOUSES.

Provide additional information about the proposal, including: plans and elevations; any information required by the planning scheme, requested by Council or outlined in a Council planning permit checklist; and if required, a description of the likely effect of the proposal.

ⓘ **Estimated cost of any development for which the permit is required** *

Cost $ 200,000

⚠ You may be required to verify this estimate. Insert '0' if no development is proposed.

Existing Conditions

Describe how the land is used and developed now *

For example, vacant, three dwellings, medical centre with two practitioners, licensed restaurant with 80 seats, grazing.

VACANT LAND WITH NO USE.

☑ Provide a plan of the existing conditions. Photos are also helpful.

Title Information

Encumbrances on title *

Does the proposal breach, in any way, an encumbrance on title such as a restrictrive covenant, section 173 agreement or other obligation such as an easement or building envelope?

○ Yes (If 'yes' contact Council for advice on how to proceed before continuing with this application.)

○ No

☒ Not applicable (no such encumbrance applies).

☑ Provide a full, current copy of the title for each individual parcel of land forming the subject site.
The title includes: the covering 'register search statement', the title diagram and the associated title documents, known as 'instruments', for example, restrictive covenants.

Applicant and Owner Details

Provide details of the applicant and the owner of the land.

Applicant *

The person who wants the permit.

Name:

Title: MR. | First Name: GERRY | Surname: O'BRIEN

Organisation (if applicable):

Postal Address: | If it is a P.O. Box, enter the details here:

Unit No.: | St. No.: 38 | St. Name: MELVILLE RD

Suburb/Locality: PASLOE VALE SOUTH. | State: VIC | Postcode: 3044

Please provide at least one contact phone number *

Contact information for applicant OR contact person below

Business phone: | Email: trez1ek@hotmail.com

Mobile phone: 0410787419 | Fax:

Where the preferred contact person for the application is different from the applicant, provide the details of that person.

Contact person's details*

Same as applicant ☐

Name:

Title: | First Name: | Surname:

Organisation (if applicable):

Postal Address: | If it is a P.O. Box, enter the details here:

Unit No.: | St. No.: | St. Name:

Suburb/Locality: | State: | Postcode:

Owner *

The person or organisation who owns the land

Where the owner is different from the applicant, provide the details of that person or organisation.

Same as applicant ☑

Name:

Title: | First Name: | Surname:

Organisation (if applicable):

Postal Address: | If it is a P.O. Box, enter the details here:

Unit No.: | St. No.: | St. Name:

Suburb/Locality: | State: | Postcode:

Owner's Signature (Optional): | Date: day / month / year

Declaration

This form must be signed by the applicant *

⚠ Remember it is against the law to provide false or misleading information, which could result in a heavy fine and cancellation of the permit.

I declare that I am the applicant; and that all the information in this application is true and correct; and the owner (if not myself) has been notified of the permit application.

Signature:

Date: 6 / 9 / 18
day / month / year

Need help with the Application?

General information about the planning process is available at planning.vic.gov.au

Contact Council's planning department to discuss the specific requirements for this application and obtain a planning permit checklist. Insufficient or unclear information may delay your application.

Has there been a pre-application meeting with a council planning officer?

☑ No ○ Yes If 'Yes', with whom?:

Date: day / month / year

Checklist

Have you:

☐ Filled in the form completely?

☐ Paid or included the application fee? ⚠ Most applications require a fee to be paid. Contact Council to determine the appropriate fee.

☑ Provided all necessary supporting information and documents?

- ☑ A full, current copy of title information for each individual parcel of land forming the subject site.
- ☐ A plan of existing conditions.
- ☐ Plans showing the layout and details of the proposal.
- ☐ Any information required by the planning scheme, requested by council or outlined in a council planning permit checklist.
- ☐ If required, a description of the likely effect of the proposal (for example, traffic, noise, environmental impacts).

☐ Completed the relevant council planning permit checklist?

☑ Signed the declaration above?

Lodgement

Lodge the completed and signed form, the fee and all documents with:

Colac Otway Shire
PO Box 283
Colac VIC 3250

2-6 Rae Street
Colac VIC 3250

Contact information

Phone: (03) 5232 9400
Email: inq@colacotway.vic.gov.au

Deliver application in person, by post or by electronic lodgement.

From: "gerry obrien" <trezlek@hotmail.com>
Sent: 16/10/18 2:36 AM
To: "inq@colacotway.vic.gov.au" <inq@colacotway.vic.gov.au>
Subject: Reference No: PP229/2018-1 - 17 Great Ocean Road, Grey River - ATTN: Bernadette
Attachments: Bushfire Management Statement.pdf, Council Requirement Documents.pdf, Land Capability Assessment Report.pdf, Title Search Certificate.pdf, Landslip Risk Assessment.pdf, 11. Elevations - 3.pdf, 12. Site Plan - 2.pdf

To Colac Otway Shire Planning Department,

My wife and I would like to build a single dwelling on 17 Great Ocean Rd Grey River. The block is currently vacant. The proposed dwelling would be used as a holiday/weekend getaway for our family and have no impact on adjoining land.

We have had extensive consultancy work completed to address the Land capability and Landslip Risk of the site (see attached reports). In these reports, land slip and waste water solutions have been demonstrated. We are aware that the land we seek to build on is also classified “rural conservation zone.”

We plan to build a small two bedroom one bathroom cabin type home and minimise impact on surrounding environment. The proposed building envelope is situated in an already cleared area where the least vegetation resides. All tree roots on the land will remain unless they fall within the building envelope. The larger trees on the block fall outside the building envelope and we would like those to remain. (See site plan for existing vegetation and proposed vegetation removal).

Our aim is to still obtain a cabin in the forest feel, which is what attracted us to the area in the first place. The design of the dwelling is similar to the two neighbouring houses. The dwelling is designed to sit on stumps, requiring no earth removal works resulting in minimal change to the current landscape. Building materials will be muted and non reflective. (see attached plans).

Thank you for your time and we look forward to hearing back from you,

Gerry and Tamara O’Brien
Mobile: 0410 7874 19
Email: trezlek@hotmail.com

BUSHFIRE MANAGEMENT STATEMENT – 17 GREAT OCEAN ROAD, GREY RIVER

REF: 2018-165

20th August 2018

South Coast Bushfire Consultants

South Coast Bushfire Consultants

P.O. Box 721, Torquay, Vic 3228

Phone: 0401 328 757 Email: mksteel@bigpond.com

Principal Consultant – Kylie Steel

Qualifications / Accreditations:

- Accredited Bushfire Consultant (BPAD level 2) with the Fire Protection Association Australia (FPA) (2014)
- Preparing and assessing an application under the Bushfire Management Overlay – Planet (Department of Planning and Community Development) (2013)
- Postgraduate Certificate in Bushfire Planning and Management – The University of Melbourne (2013)
- Postgraduate Certificate in Business – The University of Notre Dame, Broome (2002)
- Bachelor of Science, Honours – The University of Melbourne (1998)
- Native Vegetation Planning Permit Applications – Planet (Department of Planning and Community Development) Training Seminar (2013)

Disclaimer

This report has been made with careful consideration and with the best information available to South Coast Bushfire Consultants at the time of writing. Before relying on information in this report, users should evaluate the accuracy, completeness and relevance of the information provided for their purposes. South Coast Bushfire Consultants do not guarantee that it is without flaw or omission of any kind and therefore disclaim all liability for any error, loss or other consequence that may arise from you relying on any information in this report.

Requirements detailed in this document do not guarantee survival of the buildings or the occupants. The client is strongly encouraged to develop and practice a bushfire survival plan.

Information and assistance including a template for a Bushfire Survival Plan is provided as part of the 'Fire Ready Kit' available through the CFA website at http://www.cfa.vic.gov.au or through your local CFA Regional office.

Conditions of Use

Version Control

	Name	Date Completed	Comments
Report Version	Kylie Steel	20/8/18	Version 1
Field Assessment	Kylie Steel	16/8/18	
Report	Kylie Steel	16/8/18	
Mapping	Kylie Steel	16/8/18	

Contents

DEFINITIONS, ABBREVIATIONS AND ACRONYMS

AS 3959-2009 – Australian Standard AS 3959 -2009 Construction of buildings in bushfire-prone areas.

CFA – Country Fire Authority

Clause – A clause relates to a specific piece within the planning scheme.

Clause 44.06 – Bushfire Management Overlay

Clause 53.02 – Planning for Bushfire

DEPI – Department of Environment Planning and Infrastructure (now DELWP)

DELWP – Department of Environment, Land, Water and Planning

BAL – Bushfire Attack Level

BPA – Bushfire Prone Area

BMO – Bushfire Management Overlay

BMS – Bushfire Management Statement

Method 1 – refers to methodology in AS 3959-2009 for determining a BAL with a number of predetermined inputs.

Method 2 – refers to methodology in AS 3959-2009 for determining a site specific BAL

Pathway 1 – refers to an application pathway in Clause 53.02 of the planning scheme.

Pathway 2 – refers to an application pathway in Clause 53.02 of the planning scheme.

Planning Practice Note – a guide for using various sections of the planning scheme prepared by DTPI

RA – Responsible Authority

SCBC – South Coast Bushfire Consultants

Total Fire Ban Day – is declared by CFA on days when fires are likely to spread rapidly and could be difficult to control.

Bushfire Management Statement – 17 Great Ocean Road, Grey River

1. SUMMARY

This report has been prepared to accompany a planning permit application for a new dwelling at 17 Great Ocean Road, Grey River. The site is within the Bushfire Management Overlay (BMO) and as such needs to demonstrate that the development has regard for the associated bushfire risk.

This report presents a comprehensive assessment of the hazards and suggests mitigation measures to improve the protection of life and property for the proposed development. The site is within the Rural Conservation Zone and as such requires a pathway 2 application to meet the objectives and approval measures of Clause 53.02 of the Colac Otway Shire Planning Scheme.

The report includes the following components:

- A site analysis considering localised hazards, defendable space and the bushfire attack level.
- Assessment of the landscape risk.
- The bushfire management plan and the standard CFA permit conditions.
- The sites response to the relevant approval measures in Clause 53.02 from the Colac Otway Shire planning scheme.

Grey River is a small settlement along the Great Ocean Rd, the surrounding landscape is very hilly and there are several steep slopes and gullies with forest and rainforest vegetation in the wider landscape. The landscape risk is high due to the proximity of the forest vegetation, the size of the settlement area and the access and egress conditions.

There is a fire break approximately 30m in width between the forest to west and the property boundary. There are also power lines to the east of the development and the vegetation beneath these powerlines is regularly trimmed.

The proposed dwelling would be expected to be affected by radiant heat and severe ember attack in the event of a landscape bushfire and the building design will minimise areas for ember to penetrate the structure.

The site can meet the approval measures within clause 53.02 and provide defendable space for a **BAL of 29**, a 10,000L water supply and provide access requirements for emergency service vehicles.

2. INTRODUCTION

This document has been prepared to respond to the requirements of Clause 44.06 *Bushfire Management Overlay* (known from this point on as Clause 44.06), and associated Clause 53.02 *Bushfire Protection: Planning Requirements* (known from this point on as Clause 53.02) for a development at Grey River.

The site is located in the Bushfire Management Overlay (BMO) and as such requires a Bushfire Management Statement (BMS) to accompany a planning permit application.

3. METHODOLOGY

The methodology used to satisfy the requirements of the BMO include the following:

- A Bushfire Hazard Landscape Assessment
- A Bushfire Hazard Site Assessment
- A BAL Assessment
- Bushfire Management Plan
- Bushfire Management Statement (Clause 53.02)

4. PLANNING AND BUILDING CONTROLS

4.1 Planning and building controls

Clause Number	Name
35.06	Rural Conservation Zone (RCZ)
	Schedule
44.06	Bushfire Management Overlay
44.01	Erosion Management Overlay (EMO)
	Schedule 1

5. BUSHFIRE HAZARD LANDSCAPE ASSESSMENT

The Bushfire Hazard Landscape Assessment includes a plan that describes the bushfire hazard of the general locality surrounding the site (Map 1).

5.1 Vegetation extent in the broader landscape

The broader landscape surrounding the site is dominated by extensive areas of forest vegetation. Fire runs have the potential to be in excess of 30km from the north and 40km from the west.

Small settlements along the Great Ocean Road, are at an increased risk as they are close to large areas of unmanaged vegetation on complex topography. Steep slopes allow for prolific ember storm and the development of convection columns in the event of a large landscape bushfire.

The vegetation within the immediate site assessment area comprise of forest to the north and west and a large wide modified/cleared area to the west of the site that acts as a fire break. There are dwellings to the north and south and these support modified vegetation.

East of the site is the Great Ocean Road and an area of scrub vegetation between the ocean and the road. This vegetation has high fuel loads and is connected to areas of forest to the south.

5.2 Surrounding Road Network

The only road that provides access and egress from the site is the Great Ocean Rd and this road requires travel through heavily forested areas both to the south and north.

Evacuation along the Great Ocean Road during a bushfire event is considered extremely dangerous and is not recommended.

5.3 Bushfire History of the Area

Assessing historical bushfires can often give insight into likely bushfire behavior in the surrounding landscape.

There is no evidence of historic bushfires since 1970 in the surrounding landscape (Appendix 1). The last large landscape fire to impact the south west coast was the 1983 Ash Wednesday Bushfires. The Ash Wednesday bushfires did not affect Grey River, however they did affect other townships further along the Great Ocean Road including Lorne and Anglesea.

In recent years the 2015 Wye River bushfires show how devastating a bushfire under severe conditions can be for small coastal hamlets.

Since the devastating bushfires on Black Saturday in 2009 the number of prescribed burns or fuel reduction burns across the state has increased. The fuel reduction burns in the region can be seen in Appendix 1, most of these burns have occurred in the last 5-6 years. These offer some protection for the time being; however, it is uncertain if these practices will be ongoing.

5.4 Landscape Type

The surrounding landscape is characteristic of the 'Broader Landscape Type Four' as per *Planning Practice Note 65* (DTPLI 2014).

Table 2 – Broader Landscape Type Justification

Broader Landscape Type Four Description	Sites Response
The broader landscape presents an extreme risk.	The adjacent Great Otway National Park has the potential to facilitate a large bushfire front approaching this site with prolific ember attack.
Evacuation options are limited or not available.	Access to an appropriate place is not certain. The beach offers the best protection and it is 100m from the development site.

Map 1 – Bushfire Hazard Landscape Assessment

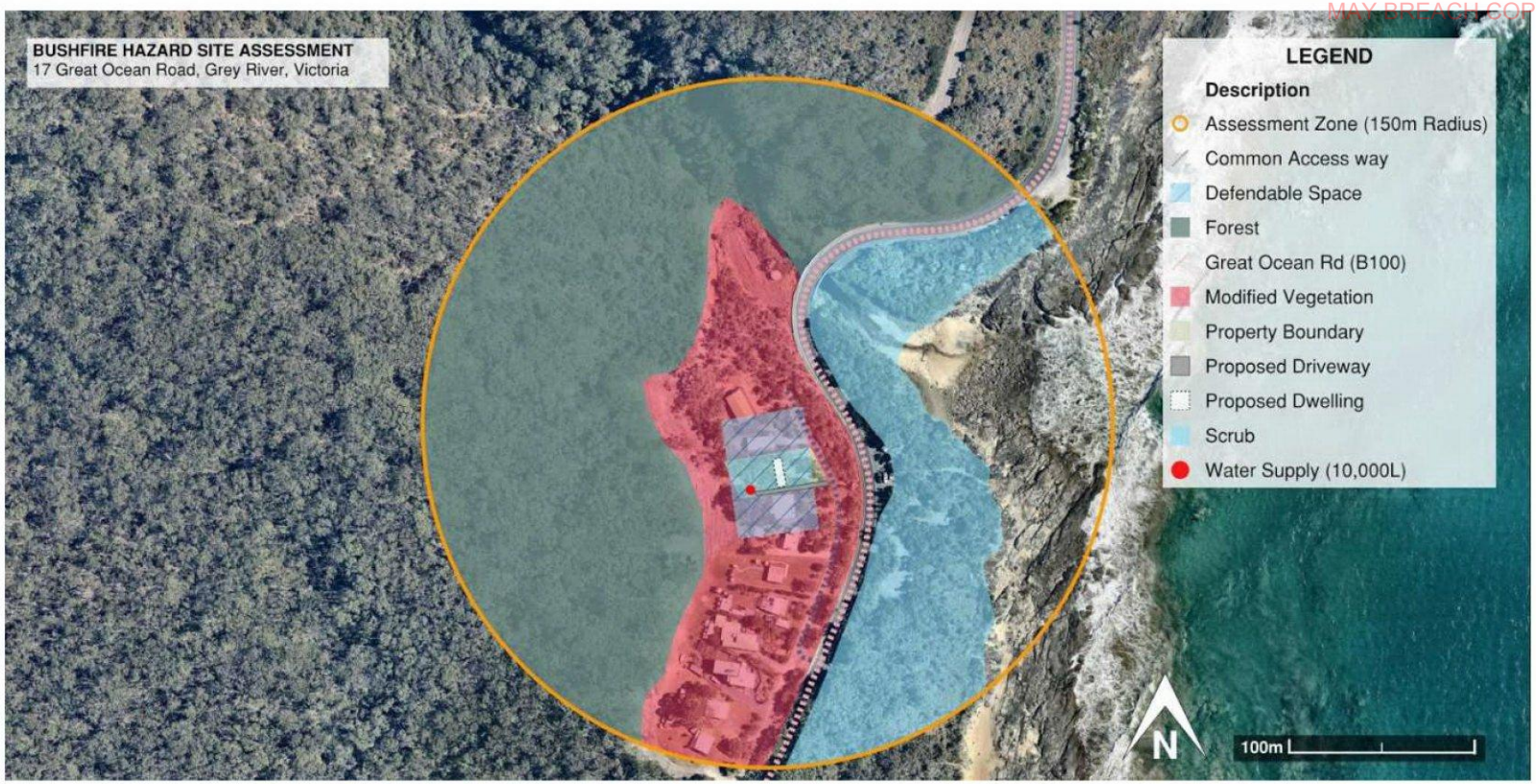
6. BUSHFIRE HAZARD SITE ASSESSMENT

The Bushfire Hazard Site Assessment includes a plan that describes the bushfire hazard within 150 meters of the proposed development. The description of the hazard is prepared in accordance with AS 3959-2009 Construction of buildings in bushfire prone areas (Standards Australia) excluding paragraph (a) of section 2.2.3.2 (Vegetation Exclusions).

6.1 Site Details

Address:	17 Great Ocean Road, Grey River 3234
Lot & Plan No:	Lot 1 TP220566
Municipality:	Colac Otway
BMO Schedule:	N/A
Existing Dwellings:	No
Private Bushfire Shelter:	N/A
Application Pathway:	Clause 53.02-2
Directory Reference:	VicRoads 101 F4

Map 2 – Bushfire Hazard Site Assessment



6.2 Vegetation

The vegetation within the 150 meter assessment area was classified according to AS 3959-2009, 'Practice note 65 (DTPLI 2014) and the 'Overall fuel hazard assessment guide' (DSE 2010).

The AS 3959-2009 approach uses a generalised description of vegetation based on the AUSLIG (Australian Natural Resources Atlas: No.7 Native Vegetation) classification system. According to this method, vegetation can be classified into seven categories. Each category indicates a particular type of fire behavior and these categories or classifications are then used to determine bushfire intensity.

The vegetation identified within the 150 meter assessment zone is detailed in table 3 and the locations of these vegetation types are evident in Map 2.

Table 3 – Vegetation Assessment

Scrub	**AS 3959-2009 Description** *Found in wet areas and /or areas affected by poor soil fertility or shallow soils; >30% foliage cover. Dry heaths occur in rocky areas. Shrubs >2m high. Typical of coastal wetlands and tall heaths.* **Site Description** The vegetation along the Great Ocean Rd can be classified as scrub. There are two different types of scrub, the first has a lower fuel load and is on the embankment between the Great Ocean Rd and the development. The second type has a higher fuel load and is located on a downslope from the Great Ocean Rd down to the ocean to the east. This scrub has a higher fuel load and supports some multi-stemmed eucalypts that are stunted in their growth habit due to the strong ocean winds from the east and south east. Figure 1 – Scrub along the embankment between the development and the Great Ocean Rd. 

	Figure 2 – Scrub vegetation with a higher fuel load on the eastern side of the Great Ocean Rd.  Figure 3 – Scrub vegetation to the north east along a rocky embankment. 
Forest	**<u>AS 3959-2009 Description</u>** *Trees over 30m high; 30-70% foliage cover (may include understorey ranging from rainforest and tree ferns to low trees and tall shrubs). Found in areas of high reliable rainfall. Typically dominated by eucalypts.*

AS 3959-2009 Assumes fuel loads for Forest of 25 t/ha surface fuel load and 35 t/ha overall fuel load. This assumption is considered appropriate for the forest within the assessment zone of this site.

Ecological Vegetation Classes (EVC)

Ecological Vegetation Classes (EVC) are the standard unit used by DELWP for classifying vegetation types in Victoria. The EVC's surrounding a site can give an indication of the likely fuels affecting a bushfire run within the landscape. The EVC's contain a 'typical' but not comprehensive list of species and species composition for each EVC in a certain bioregion.

The EVC's identified surrounding this comprises a number of different types of forest including Shrubby Wet Forest (EVC 201), Wet Forest (EVC 30), Shrubby Foothill Forest (45) and Riparian Forest (EVC 18).

The most dominant forest type was Shrubby Foothill Forest. Mapping of the EVC's surrounding the site and their general composition and description can be found in appendix 2 of this document.

Figure 4 – Forest vegetation on an upslope to the proposed development north of the creek line.

Modified

Clause 53.02 – Modified Vegetation

Modified vegetation refers to vegetation that is different from the other vegetation types shown in AS 3959-2009 and Table 1 and 2 of Clause 53.02-3.

Modified vegetation arises in townships where fuel loads are high but the vegetation is modified because of urban development, gardens, the way vegetation is configured or because fuel loads are different from the fuel loads assumed in AS 3959-2009.

Site Description

The vegetation within the small settlement is largely highly managed to a low threat condition, however, due to the age of the existing dwellings and the high landscape risk the vegetation within the settlement has been classified as modified.

Figure 5 – Existing development within the assessment zone, south of the proposed development.

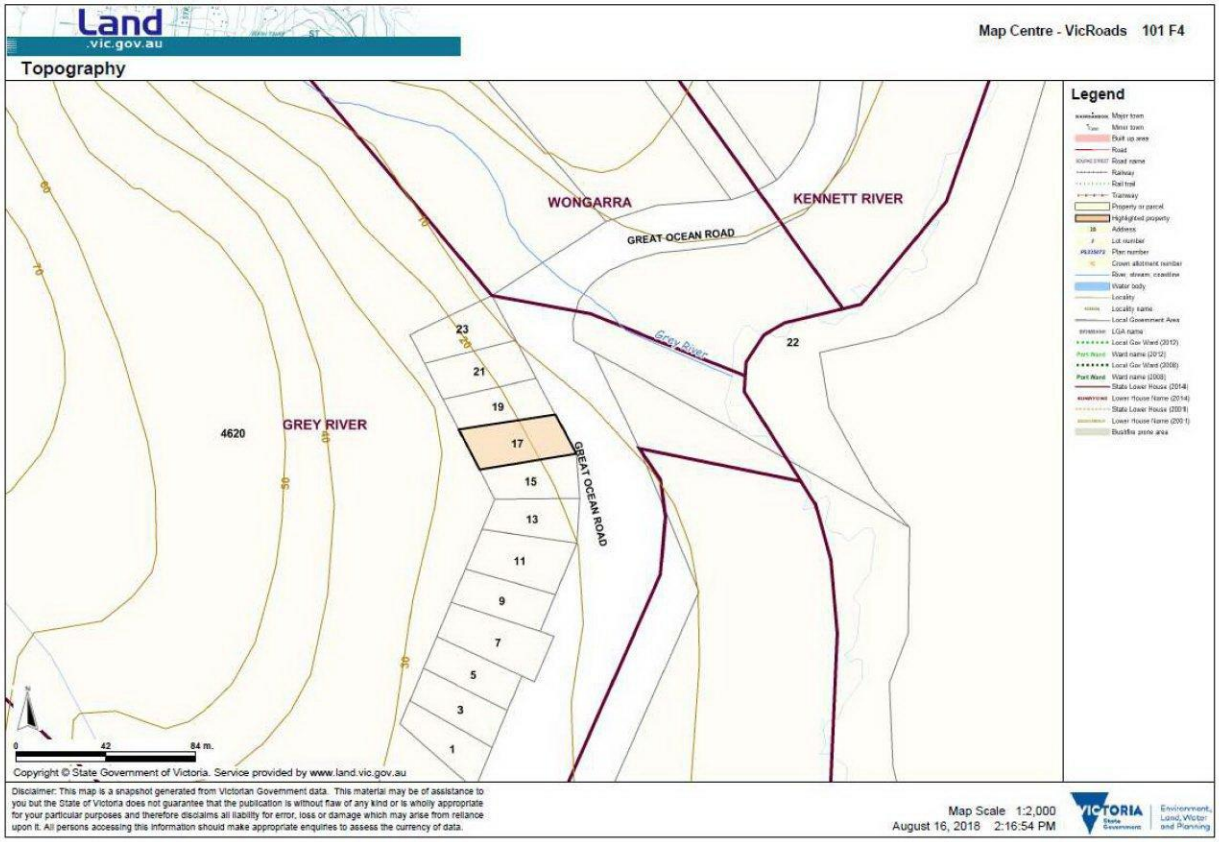
6.3 Topography

Topography of the land surrounding a site is particularly important as the topography influences the rate of spread and intensity of a fire. Fire burns faster uphill, as the slope increases so does the speed of the fire and its intensity. As a general rule for every increase 10° up a slope, the fire will double its speed and conversely down a slope. Fires tend to move more slowly as the slope decreases.

The topography of the landscape surrounding the site is typical of the Great Ocean Road scenic landscape that is characterised by rolling hills descending to the Ocean.

The largest areas of unmanaged vegetation are largely upslope of the proposed site. There is a steep down slope to the ocean to the east; however, it has a short run and a narrow band of scrub vegetation.

Map 3 – Topography of the surrounding area.



6.4 Bushfire Attack Level (BAL) for the proposed development

The bushfire attack level (BAL) is a means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per meter squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire.

The highest BAL determines the construction requirements for the dwelling. A reduction of one BAL level may be applied if facades of the house are shielded from the bushfire hazard, shielding is not applicable to this site.

The BAL for this site has been calculated using a 'Forest Fire Danger Index' (FFDI) of 100 and a Flame Temperature of 1090K. These parameters are in accordance with the risk parameters set in Clause 53.02.

Table 4 – BAL determination (from table 1 of clause 53.02-3)

Orientation	Highest threat vegetation	Slope under classifiable vegetation	Distance to vegetation.	Defendable Space	Bushfire Attack Level (BAL)
North	Forest	Flat / Upslope (Based on average slope over 150m of forest to the north)	81m	25m	29
East	Scrub	Downslope 5-10 °	35m	14m	29
South	Forest	Flat	160m	25m	29
West	Forest	Upslope	49m	25m	29

7. DEFENDABLE SPACE AND VEGETATION MANAGEMENT OBJECTIVES

Vegetation Management Requirements	Sites Response
1. Grass must be short cropped and maintained during the declared fire danger period.	Grass will be managed to a low threat condition (<100mm in height) during the declared fire danger period.
2. All leaves and vegetation debris must be removed at regular intervals during the declared fire danger period.	Regular debris removal will be undertaken during and prior to the declared fire danger period.
3. Within 10 metres of a building, flammable objects must not be located close to the vulnerable parts of the building.	The location of flammable objects such as; wood heaps, additional plastic water tanks and treated pine retaining walls will not be located within 10m of a vulnerable part of the building (including glazing and external doors).
4. Plants greater than 10 centimetres in height must not be placed within 3 metres of a window or glass feature of the building.	The landscape plan will ensure that plantings are located over 3m from a window or glass feature.
5. Shrubs must not be located under the canopy of trees.	Existing shrubs will be removed from beneath trees and addition shrubs will not be located under the canopy of trees.
6. Individual and clumps of shrubs must not exceed 5 square metres in area and must be separated by at least 5 metres.	Any further planting of shrubs will ensure that they are not planted in densities greater than $5m^2$.
7. Trees must not overhang or touch any elements of the building.	Trees will be managed or removed to ensure they do not touch an element of the building.
8. The canopy of trees must be separated by at least 5 meters.	The canopy of trees will have a 5m separation distance.
9. There must be a clearance of at least 2 metres between the lowest tree branches and ground level.	Trees will be managed to ensure a 2m clearance between the ground and the lowest branches.

8. BUSHFIRE MANAGEMENT PLAN AND STANDARD PERMIT CONDITIONS

Bushfire Management Plan – 17 Great Ocean Road, Grey River
(Prepared By – SCB Consultants 16th August 2018)

Bushfire Mitigation Measures

Construction - the dwelling will be constructed to a minimum BAL-29 from AS 3959-2009

Defendable space - An area of defendable space for the designated BAL around the proposed building / or to the property boundary where vegetation (and other flammable materials) will be modified and managed in accordance with the following distances from Table 2 Clause 53.02:
North – Forest – 25m
East – Scrub - 17m
South– Forest – 25m
West – Forest – 25m

- Grass must be short cropped and maintained during the declared fire danger period.
- All leaves and vegetation debris must be removed at regular intervals during the declared fire danger period.
- Within 10 metres of a building, flammable objects must not be located close to the vulnerable parts of the building.
- Plants greater than 10 centimetres in height must not be placed within 3 metres of a window or glass feature of the building.
- Shrubs must not be located under the canopy of trees.
- Individual and clumps of shrubs must not exceed 5 square metres in area and must be separated by at least 5 metres.
- Trees must not overhang or touch any elements of the building.
- The canopy of trees must be separated by at least 5 metres.
- There must be a clearance of at least 2 metres between the lowest tree branches and ground level.

Water Supply

The site is required to have 10,000 Litres of water supply for fire fighting purposes which meets the following requirements:

- Is stored in an above ground water tank constructed of concrete or metal.
- All fixed above-ground water pipes and fittings required for fire fighting purposes must be made of corrosive resistant metal.
- Incorporate a ball or gate valve (British Standard Pipe (BSP) 65mm) and coupling (64mm CFA 3 thread per inch male fitting).
- The outlet/s of the water tank must be within 4m of the access way and be unobstructed.
- Be readily identifiable from the building or appropriate identification signage to the satisfaction of CFA must be provided.
- Any pipework and fittings must be a minimum of 65mm (excluding the CFA coupling).

Access

Where fire authority access to the water supply is required under AM4.1, fire authority vehicles should be able to get within 4 metres of the water supply outlet. Where the length of access is greater than 30 meters but less than 100m the following design and construction requirements apply:

- All-weather construction.
- A load limit of at least 15 tonnes.
- Provide a minimum trafficable width of 3.5 metres.
- Be clear of encroachments for at least 0.5 metres on each side and at least 4 metres vertically.
- Curves must have a minimum inner radius of 10 metres.
- The average grade must be no more than 1 in 7 (14.4%) (8.1°) with a maximum grade of no more than 1 in 5 (20%) (11°) for no more than 50 metres.
- Dips must have no more than a 1 in 8 (12.5%) (7.1°) entry and exit angle.

9. BUSHFIRE MANAGEMENT STATEMENT – SITES RESPONSE TO APPLICABLE SUB CLAUSES OF 53.02

Clause 53.02 contains a range of sub clauses with objectives, approved measures (AM), alternative measures (AltM) and decision guidelines. The following section demonstrates how the requirements have been met for the relevant standards.

There are no relevant standards or clauses for the construction of a telecommunications facility. The facility has been considered as per a pathway 2 application.

Table 5 - Relevant clauses and measures applicable to the proposed development.

Clause	Approved Measure	Achieved	Justification
Clause 53.02-3 – Dwellings in existing settlements – Bushfire protection objective	AM 1.1	Not Applicable	
	AM 1.2	Not Applicable	
	AM 1.3	Not Applicable	
Clause 53.02-4.1 Landscape, siting and design objectives	AM 2.1	Applicable	The development is able to meet these clauses.
	AM 2.2	Applicable	
	AM 2.3	Applicable	
Clause 53.02-4.2 Defendable space and construction objective	AM 3.1	Applicable	
	AM 3.2	Not Applicable	
	AltM 3.3	Not Applicable	
	AltM 3.4	Not Applicable	
	AltM 3.5	Not Applicable	
	AltM 3.6	Not Applicable	
Clause 53.02-4.3 Water supply and access objectives	AM 4.1	Applicable	The development is able to meet this clause.
	AM 4.2	Not Applicable	
Clause 53.02-2.4 Subdivision objectives	AM 5.1	Not Applicable	
	AM 5.2	Not Applicable	
	AM 5.3	Not Applicable	
	AM 5.4	Not Applicable	
	AltM 5.5	Not Applicable	

9.1 53.02-2 Bushfire protection objectives

9.1.1 53.02-4.1 Landscape, siting and design objectives

Development is appropriate having regard to the nature of the bushfire risk arising from the surrounding landscape.

Development is sited to minimise the risk from bushfire.

Development is sited to provide safe access for vehicles, including emergency vehicles.

Building design minimises vulnerability to bushfire attack.

Approved Measure	Requirement
AM 2.1	**The bushfire risk to the development from the landscape beyond the site can be mitigated to an acceptable level.** **Response:** The development is in the very small settlement of Grey River adjacent to the ocean and approximately 3km from the township area of Skenes Creek to the east. The site is surrounded by forest vegetation and is surrounded by enough land to enable defendable space to achieve a BAL of 29. The ocean is located approximately 100m to the east. The site is largely surrounded by upslopes to the west and the land slopes down to the creek to the north and up a steep upslope beyond the creek. The site slopes down to the ocean to the east. The defendable space falls outside of the property boundary to the north and south, however, is largely within the property boundary to the east and west. Where the defendable space falls outside of the property boundary it falls on neighboring residential developments. There is a large fuel break to the west of the site that is approximately 30m in width and is in addition to the defendable space distance of 25m.
AM 2.2	**A building is sited to ensure the site best achieves the following:** • **The maximum separation distance between the building and the bushfire hazard.** • **The building is in close proximity to a public road.** • **Access can be provided to the building for emergency service vehicles.**

	Response: The dwelling has been located on the lot to ensure maximum defendable space to the east and west as these aspects present the most immediate hazards. The forest the west is the greatest hazard and a distance of 25m can be managed for defendable space and largely managed within the property boundary (see Bushfire Management Plan). The site can provide access for emergency service vehicles.
AM 2.3	**A building is designed to reduce the accumulation of debris and entry of embers.** **Response:** The proposed development is for a small dwelling with a simple roofline. The design is not complicated and does not enable areas for ember accumulation. All construction will be in accordance with BAL of 29 from AS 3959-2009 and the building design will be ember resistant. Due to the high landscape risk, where possible the cladding will be non combustible.

9.1.2 53.02-4.2 Defendable space and construction objective

Defendable space and building construction mitigate the effect of flame contact, radiant heat and embers on buildings.

Alternative measures	Requirement
AltM 3.1	**A building used for a dwelling (including an extension or alteration to a dwelling), a dependant person's unit, industry, office or retail premises is provided with defendable space in accordance with:** • **Column A, B or C of Table 2 to Clause 53.02-3 wholly within the title boundaries of the land; or** • **If there are significant siting constraints, Column D of Table 2 to Clause 53.02-3.** **The building is constructed to the bushfire attack level that corresponds to the defendable space provided in accordance with Table 2 to Clause 53.02-3.** **Response:** The defendable space requirements have been met in accordance with Table 2 to Clause 53.02-3 for a BAL of 29.

	Defendable space can be achieved largely within the property boundary to the east and west and overlaps neighboring properties to the north and south. There is reasonable assurance that the defendable space to the north and south will continue to be managed as they fall over existing developments.

9.1.3 53.02-4.3 Water supply and access objectives

Approval Measures	Requirement
AM 4.1	**A building used for a dwelling (including an extension or alteration to a dwelling), a dependent person's unit, industry, office or retail premises is provided with:** • **A static water supply for fire fighting and property protection purposes specified in Table 4 to Clause 53.02-5.** • **Vehicle access that is designed and constructed as specified in Table 5 to Clause 53.02-5.** **The water supply may be in the same tank as other water supplies provided that a separate outlet is reserved for fire fighting water supplies.** **Response:** The dwelling is able to meet the water requirements by providing 10,000 Litres of water solely for the purposes of fire fighting and will allow fire authorities to get within 4 meters of the supply. The site is able to provide access for emergency service vehicles.

10.REFERENCES

CFA (2011). FSG LUP 0003 Assessing vegetation in a bushfire management overlay (BMO. Country Fire Authority, Burwood East, Victoria.

CFA (2011). Landscaping for Bushfire: Garden design and plant selection. Country Fire Authority, Burwood East, Victoria.

CFA (2012). FSG LUP 0002 Requirements for water supply and access in the Bushfire Management Overlay (BMO). Country Fire Authority, Burwood East, Victoria.

Department of Transport, Planning and Local Infrastructure (September 2017) Planning Permit Applications – Bushfire Management Overlay, Technical Guide. Victorian Government, Melbourne.

Department of Transport, Planning and Local Infrastructure (2014) Planning Practice Note 65 – Preparing and Assessing a Planning Application under the Bushfire Provisions in Planning Schemes. Victorian Government, Melbourne

Standards Australia (2009). AS 39359-2009 Construction of Buildings in Bushfire Prone Areas. Standards Australia, North Sydney, New South Wales.

11.APPENDICES

11.1 Appendix 1 – Bushfire History and Prescribed Burns in the Area

(DEPI – Biodiversity Interactive Map – showing bushfire history).

Figure 1 – Natural Bushfires in the area since 1970. Pink areas on the map indicate wildfires.

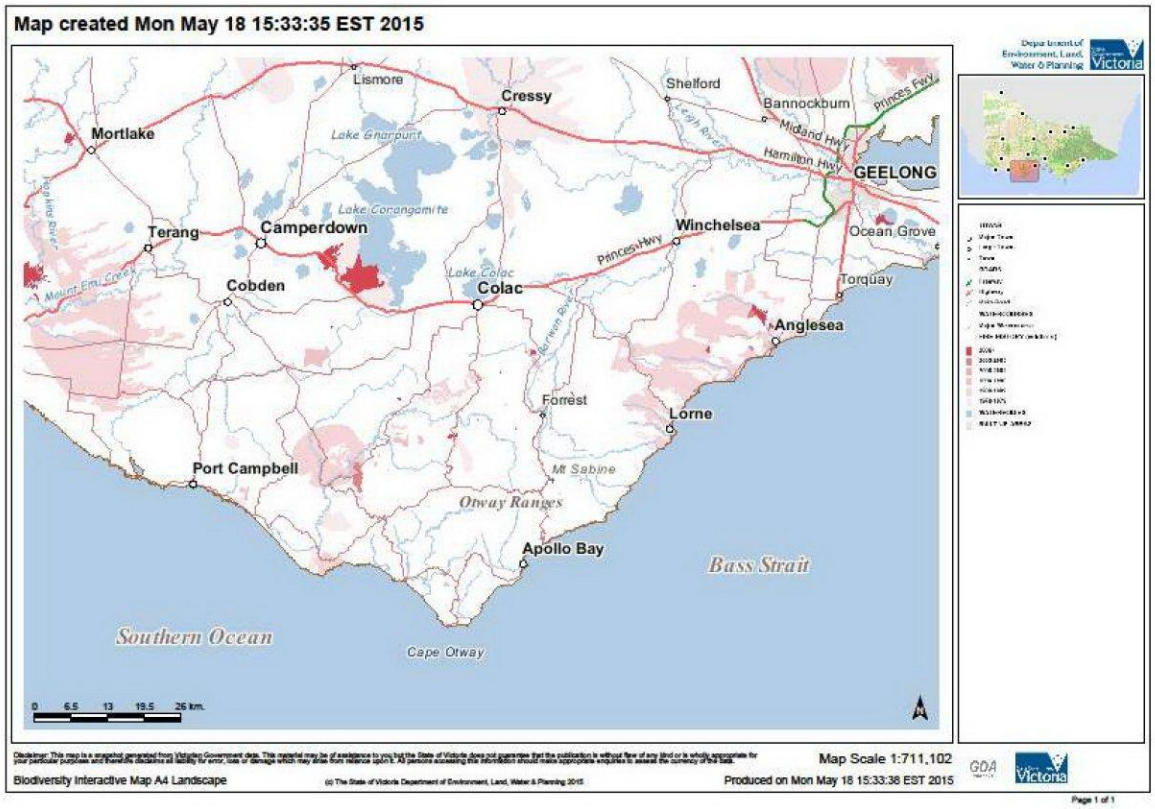
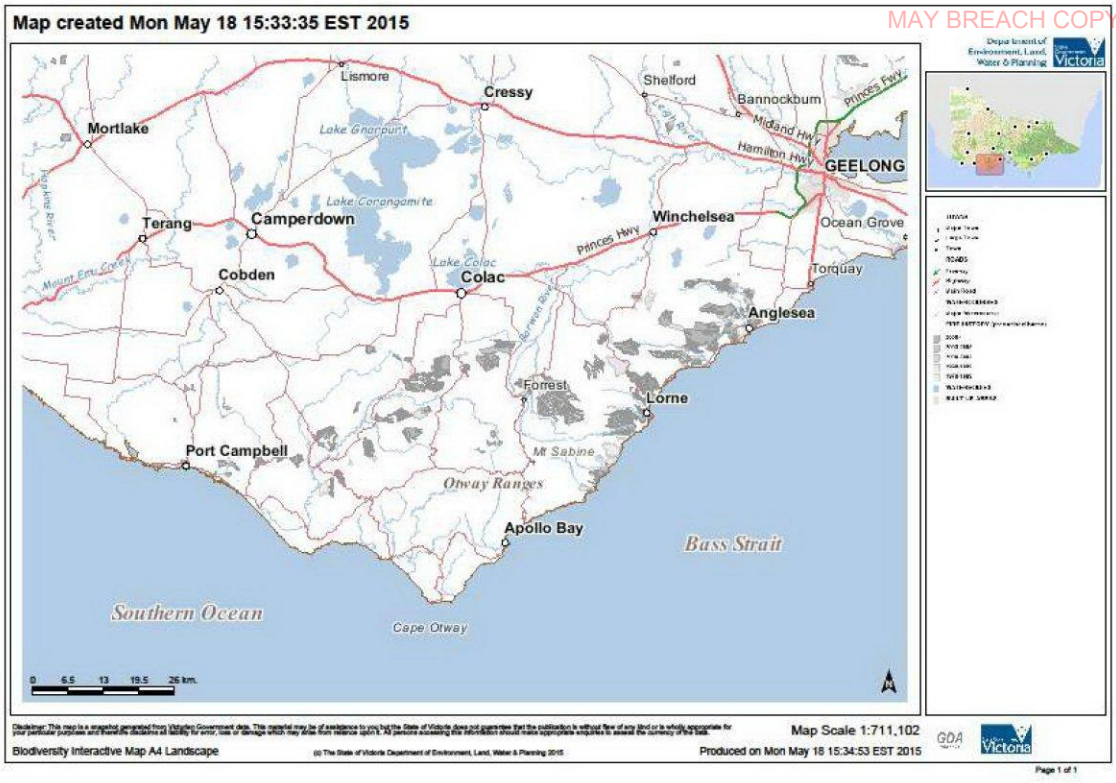


Figure 2 – Prescribed Burns in the area since 1970. Most of the prescribed burns indicated on the map shaded as areas of grey have occurred since the 2008 Black Saturday bushfires.



TITLE PLAN

EDITION 1

TP 220566G

Location of Land

Parish: WONGARRA
Township:
Section:
Crown Allotment: 33A(PT)
Crown Portion:

Last Plan Reference: LP 19361
Derived From: VOL 6094 FOL 056
Depth Limitation: 50 FEET

Notations

ANY REFERENCE TO MAP IN THE TEXT MEANS THE DIAGRAM SHOWN ON THIS TITLE PLAN

Description of Land / Easement Information

THIS PLAN HAS BEEN PREPARED FOR THE LAND REGISTRY, LAND VICTORIA, FOR TITLE DIAGRAM PURPOSES AS PART OF THE LAND TITLES AUTOMATION PROJECT
COMPILED: 18-11-1999
VERIFIED: AD

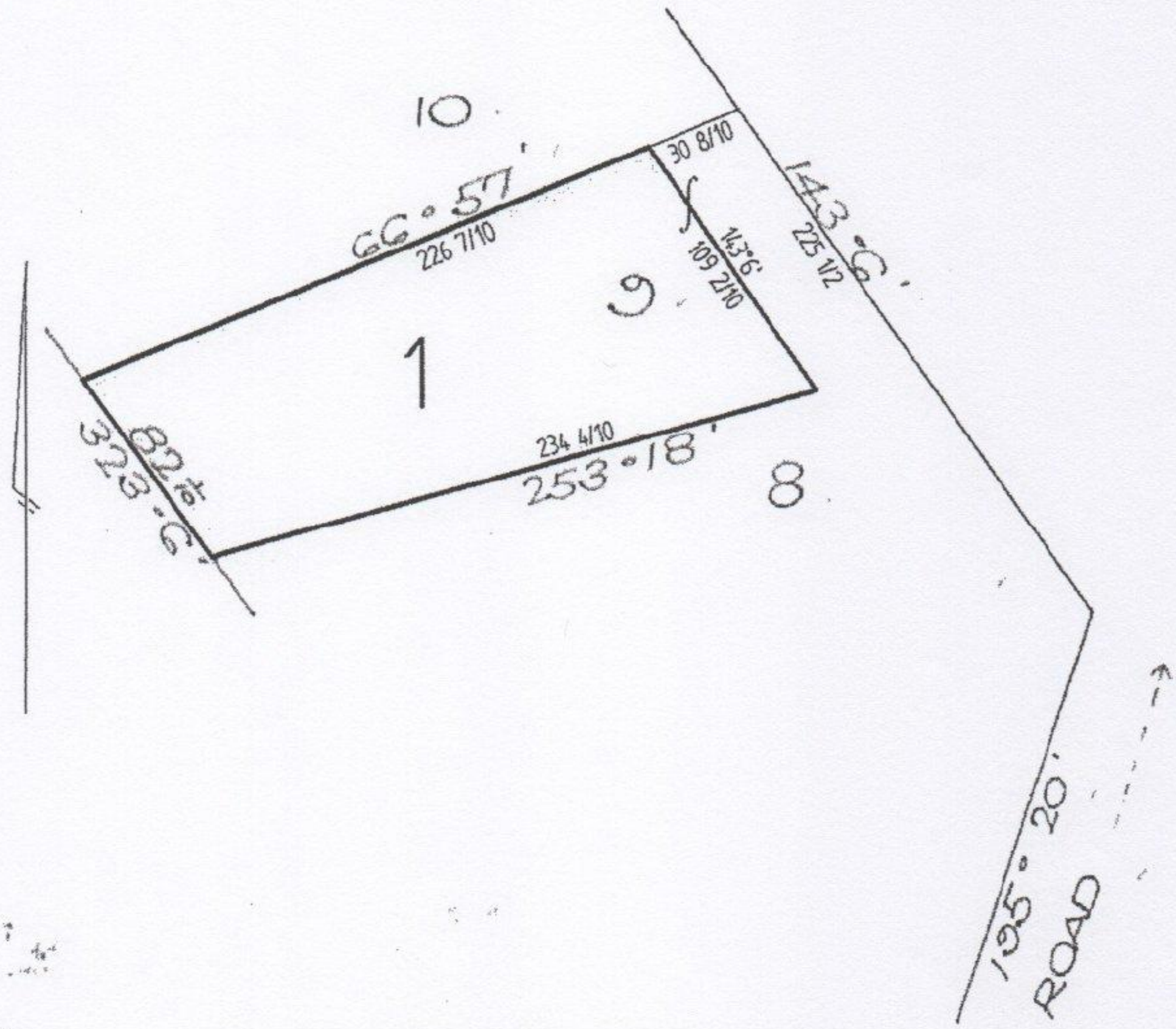


TABLE OF PARCEL IDENTIFIERS
WARNING: Where multiple parcels are referred to or shown on this Title Plan this does not imply separately disposable parcels under Section 8A of the Sale of Land Act 1962
PARCEL 1 = LOT 9 (PT) ON LP 19361

LENGTHS ARE IN LINKS	Metres = 0.3048 x Feet Metres = 0.201168 x Links		Sheet 1 of 1 sheets

Imaged Document Cover Sheet

The document following this cover sheet is an imaged document supplied by LANDATA®, Land Use Victoria.

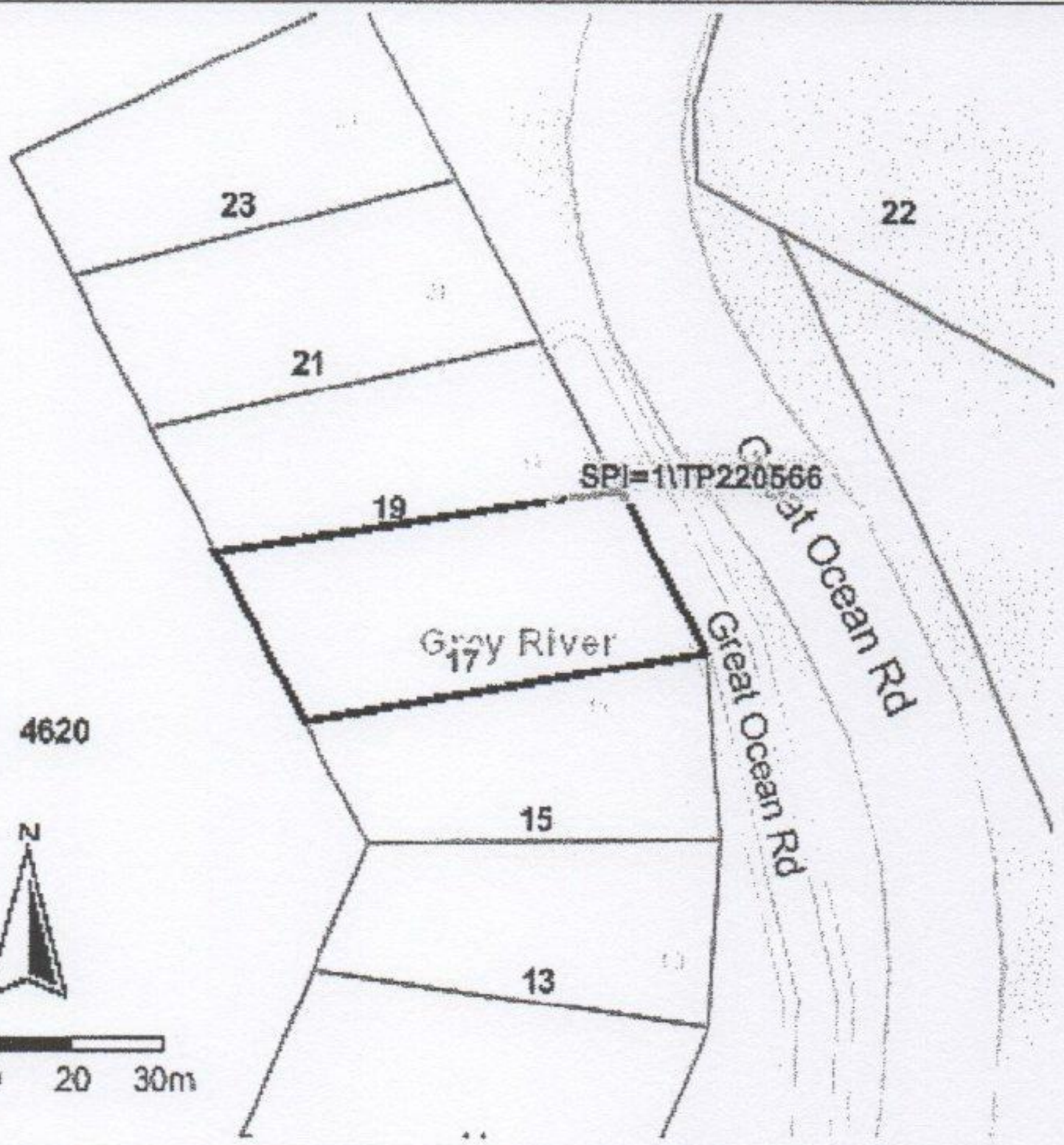
Document Type	**plan**
Document Identification	**TP220566G**
Number of Pages (excluding this cover sheet)	**1**
Document Assembled	**12/07/2018 11:59**

The attached certificate is issued by the Minister for Planning of the State of Victoria and is protected by statute.

The document has been issued based on the property information you provided. You should check the map below - it highlights the property identified from your information.

If this property is different to the one expected, you can phone (03) 9194 0606 or email landata.enquiries@delwp.vic.gov.au.

Please note: The map is for reference purposes only and does not form part of the certificate.



PLANNING CERTIFICATE

Official certificate issued under Section 199 Planning & Environment Act 1987
and the Planning and Environment Regulations 2005

CERTIFICATE REFERENCE NUMBER

527500

APPLICANT'S NAME & ADDRESS

BALFE & WEBB C/- INFOTRACK (FILEPRO) C/- LANDATA
MELBOURNE

VENDOR

BRADY, JUSTIN PAUL

PURCHASER

GERRY O'BRIEN

REFERENCE

354716

This certificate is issued for:
LOT 1 PLAN TP220566 ALSO KNOWN AS 17 GREAT OCEAN ROAD GREY RIVER
COLAC OTWAY SHIRE

The land is covered by the:
COLAC OTWAY PLANNING SCHEME

The Minister for Planning is the responsible authority issuing the Certificate.

The land:
- is included in a RURAL CONSERVATION ZONE
- is within a BUSHFIRE MANAGEMENT OVERLAY
and a EROSION MANAGEMENT OVERLAY - SCHEDULE 1
- and abuts a ROAD ZONE CATEGORY 1

A detailed definition of the applicable Planning Scheme is available at :
(http://planningschemes.dpcd.vic.gov.au/schemes/colacotway)

Historic buildings and land protected under the Heritage Act 1995 are recorded in the Victorian Heritage Register at:
(http://vhd.heritage.vic.gov.au/)

12 July 2018

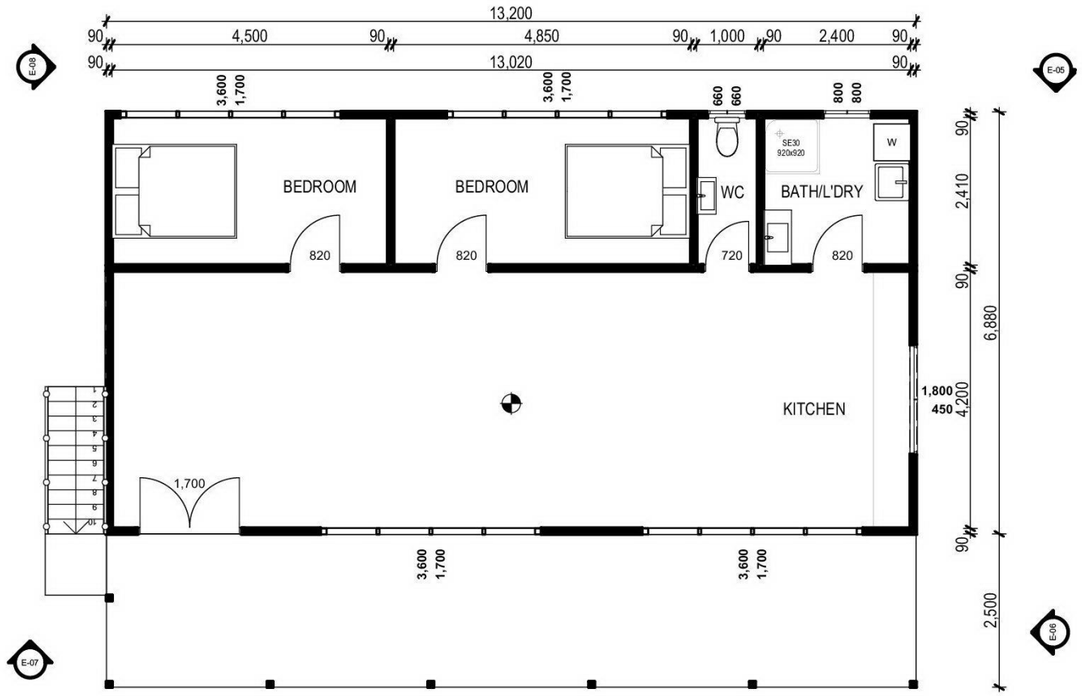
Hon. Richard Wynne MP
Minister for Planning

Additional site-specific controls may apply.
The Planning Scheme Ordinance should be checked carefully.
The above information includes all amendments to planning scheme maps placed on public exhibition up to the date of issue of this certificate and which are still the subject of active consideration

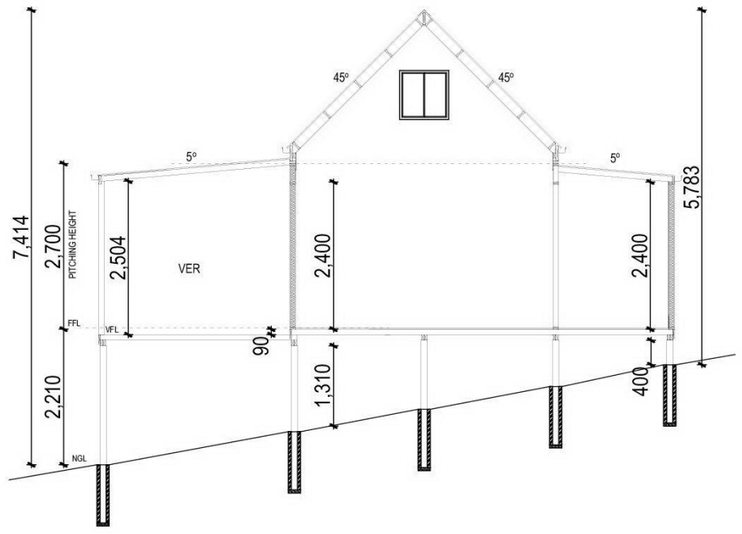
Copies of Planning Schemes and Amendments can be inspected at the relevant municipal offices.

LANDATA®
2 Lonsdale Street
Melbourne VIC 3000
Tel: (03) 9194 0606

VICTORIA
State Government



FLOOR PLAN 1:100



SECTION 1:100

NOTE:BUILDING IS TO BE COMPLETED TO LOCK-UP ONLY. INTERNAL FITOUT AND FINISHES TO BE SUPPLIED AND INSTALLED BY CLIENT

SPECIFICATION NOTES:

FLOORING

STUMP HOLES	1000MM DEEP X 300 X 300
STUMPS	600MM DEEP X 400 X 400
	90 X 90 TREATED PINE H5 AT 1700MM MAX. CTRS.
	SUPPORTING FLOOR ONLY & AT 1500MM MAX. CTRS, SUPPORTING L/BEARING WALLS.
SOLE PLATES	250 X 360 X 75 CYPRESS OR TREATED PINE
BEARERS	2/90 X 45 MGP10 TREATED PINE AT 1800MM MAX. CTRS.
MAIN JOISTS	90 X 35 MGP10 RADIATA PINE AT 450MM MAX. CTRS.
VERANDAH JOISTS	90 X 45 MGP10 TREATED PINE AT 450MM MAX. CTRS.
SHEET FLOORING	15MM F11 PLYWOOD / 19MM PARTICLE BOARD FLOORING
BASE BOARDS	150 X 25 TREATED PINE
DECKING	90 X 20 CYPRESS PINE

WALLING

BOTTOM PLATES	90 X 35 MGP10 TREATED PINE
TOP PLATES	90 X 35 MGP10 RADIATA PINE
COMMON STUDS	90 X 35 MGP10 RADIATA PINE AT 450MM CTRS.
JAMB STUDS	SUPPORTING OPENING UP TO 2000MM = 90 X 35 MGP10
	SUPPORTING OPENING 2001MM TO 4500MM = 2/90 X 35 MGP10
WALL BRACING	45MM METAL STRAPPING TO COMPLY WITH AS 1684.
LINTELS	90 X 45 F17 KDHW SPAN 1400MM.
	190 X 45 F17 KDHW SPAN 3000MM.
INSULATION	POLYESTER BATTS R1.5 PLUS SISALATION
INTERNAL LINING	PLASTER
EXTERNAL CLADDING	WESTERN RED CEDAR CLADDING
WINDOWS	ALUMINIUM SLIDING X NOM. SIZE - POWDER COATED
EXTERNAL DOORS	2100x800
INTERNAL DOORS	2100 X 820 & 2100 X 820 CAVITY SLIDER

DOORS TO SANITARY COMPARTMENTS TO COMPLY WITH BCA. CLAUSE 3.8.3.3 - OPEN OUTWARDS OR SLIDE OR BE READILY REMOVABLE FROM OUTSIDE UNLESS THERE IS A CLEAR SPACE OF 1200MM MIN. BETWEEN PAN AND NEAREST PART OF DOORWAY.

PROVIDE IMPERVIOUS SPLASHBACK MIN. 150MM ABOVE SINKS AND BASINS. WALLS TO SHOWERS TO BE IMPERVIOUS TO A HEIGHT OF 1800MM.

ROOF & VERANDAH

GABLE TRUSSES	REFER TRUSS MANUFACTURER
ROOF BATTENS	90 X 35 MGP10 RADIATA PINE ON EDGE
ROOFING	CORRUGATED COLORBOND SHEETING AT 25° TO CABIN & AT 5° MIN. TO VERANDAH
VERANDAH RAFTERS	90 X 35 MGP10 RADIATA PINE
VERANDAH BEAM	140 X 45 F7 TR. PINE
VERANDAH POSTS	100 X 100 F7 ON SUBFLOOR STRUCTURE
CAPPING/GUTTERS	SELECTED COLORBOND
INSULATION	FIBREGLASS BLANKET, SISALATION UNDER SELECTED ROOFING R2.3

SOIL CLASSIFICATION:

THIS SITE HAS BEEN CLASSIFIED AS ASSUMED

'CLASS H' IN ACCORDANCE WITH A.S. 2870 - 2011.

FOOTINGS TO BE FOUNDED AT 1000MM BELOW NATURAL GROUND LEVEL OR 100MM MIN. INTO THE NATURAL UNDERLYING STIFF SILTY CLAY. MIN. BEARING CAPACITY 100 Kpa.

THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE SOIL REPORT BY:

AREA SCHEDULE :

CABIN :	90.81 M ^{2}
VER. :	33.0M ^{2}

ON THE PLAN DENOTES SMOKE ALARMS TO BE INSTALLED IN ACCORDANCE WITH A.S. 3786 HARD WIRED TO ELECTRICAL SWITCHBOARD WITH BATTERY BACK-UP.

GENERAL NOTES:

1) ALL WORKS SHALL COMPLY WITH BUT NOT LIMITED TO THE FOLLOWING AUSTRALIAN STANDARDS :

A.S. 1288 - 2006	GLASS IN BUILDINGS - SELECTION AND INSTALLATION
A.S. 1562 - 1992	DESIGN AND INSTALLATION OF SHEET ROOF AND WALL CLADDING.
A.S. 1684 - 2010	NATIONAL TIMBER FRAMING CODE.
A.S. 1860 - 2006	INSTALLATION OF PARTICLEBOARD FLOORING.
A.S. 2870 - 2011	RESIDENTIAL SLABS AND FOOTINGS. *PART 1*
A.S. 2904 - 1995	DAMP-PROOF COURSES AND FLASHING.
A.S. 3600 - 2009	CONCRETE STRUCTURES.
A.S. 3660.1 - 2000	CODE OF PRACTICE FOR PHYSICAL BARRIERS USED IN THE PROTECTION OF BUILDINGS AGAINST
A.S. 3700 - 2011	SUBTERRANEAN TERMITES.
A.S. 3740 - 2010	MASONARY IN BUILDINGS. WATERPROOFING OF WET AREAS IN RESIDENTIAL
A.S. 3786 - 1993	BUILDINGS.
A.S. 4055 - 2012	SMOKE ALARMS.
A.S. 4100 - 1998	WIND LOADINGS FOR HOUSING. STEEL STRUCTURES.

2) WHERE THE BUILDING (OTHER THAN A CLASS 10a) IS LOCATED IN A DESIGNATED TERMITE INFESTATION AREA THE BUILDING SHALL BE PROTECTED IN ACCORDANCE WITH A.S. 3660.1

3) SAFETY GLAZING IS TO BE USED IN THE FOLLOWING CASES :
- ALL ROOMS - WITH-IN 500 MM VERTICAL OF THE FLOOR.
- BATHROOMS - WITH-IN 1500 MM VERTICAL OF BATH BASE.
- LAUNDRY - WITH-IN 1200 MM VERTICAL OF FLOOR AND / OR WITH-IN 300 MM HORIZONTAL FROM ANY DOORS.
- DOORWAY - WITH-IN 300 MM HORIZONTAL FROM DOORS.
- SHOWER SCREENS SHALL BE GRADE A SAFETY GLASS.

4) STORM-WATER SHALL BE TAKEN TO THE LEGAL POINT OF DISCHARGE TO THE SATISFACTION OF THE RELEVANT AUTHORITY.

5) FOR BUILDINGS IN CLOSE PROXIMITY TO THE SEA ENSURE THAT ALL STEEL WORK, BRICK CAVITY TIES, STEEL LINTELS ETC., THAT ARE EMBEDDED OR FIXED TO MASONARY BE PROTECTED IN ACCORDANCE WITH A.S. 1650 OR A.S. 3700 - 2001 (TABLE 2.2), HOT DIP GALVANIZED, STAINLESS STEEL OR CADIUM COATED.

6) ALL WET AREAS ARE TO COMPLY WITH B.C.A. F1.7 OR A.S. 3740 - 1994. WALL FINISHES SHALL BE IMPERVIOUS TO A HEIGHT OF 1800 MM ABOVE FLOOR LEVEL TO ANY SHOWER ENCLOSURES AND 150 MM ABOVE BATHS, BASINS, SINKS AND TROUGHS IF WITH-IN 75 MM OF THE WALL.

7) PROVIDE THERMAL INSULATION TO THE B.C.A. VICTORIAN APPENDIX PART 6 TO COMPLY WITH A.S. 1904 AND HAVE A FLAMMABILITY INDEX OF NOT MORE THAN 5.

8) RISERS - 190 MM MAXIMUM, 115 MM MINIMUM.
GOING - 355 MM MAXIMUM, 240 MM MINIMUM.
(PRIVATE STAIRS AND 250 MM FOR PUBLIC STAIRS.)
RISERS AND TREADS ARE TO BE CONSTANT IN SIZE THRU-OUT FLIGHT.
PROVIDE NON-SLIP FINISH OR SUITABLE NON-SKID STRIP NEAR EDGE OF NOSINGS.
ENSURE A MAXIMUM GAP BETWEEN RISERS IS NOT TO EXCEED 125 MM OR USE CLOSED RISERS.
PROVIDE CONTINUOUS HANDRAILING 1000 MM MINIMUM HEIGHT TO BALCONIES AND DECKS WHICH ARE 1000 MM OR GREATER ABOVE GROUND LEVEL.
HANDRAILING IS TO BE A MINIMUM OF 865 MM ABOVE ANY STAIR NOSINGS AND LANDINGS. MAXIMUM GAP BETWEEN ANY BALUSTERS IS TO BE 125 MM.

9) SMOKE ALARMS ARE TO BE PROVIDED AND INSTALLED IN ACCORDANCE WITH A.S. 3786 - 1993, AND UNLESS INSTALLED IN AN EXISTING PART OF A

10) CLASS 1, 2 OR 3 BUILDING OR A CLASS 4 PART OF A BUILDING THE SMOKE ALARM SHALL BE HARD-WIRED WITH A BATTERY BACK-UP.

FOR TIMBER FLOORS, PROVIDE 7300MM MIN. SUB FLOOR VENTILATION PER 1000MM RUN OF EXTERNAL WALL.

TERMITE PROTECTION:

The Builder is responsible and MUST supervise the installation of the Termite barriers/treatment; to ensure Termite protection has be provided and installed in accordance with AS 3660 where required. Minimum 400mm sub floor clearance is to underside of bearer. Ant caps to be installed in between stumps & timber.

classic cabins

CLASSIC CABINS
KEVIN GARRETT
REG NO. DB-L36528
ABN 27 279 820 937
Address: 24 Bary St, Bayswater VIC 3153
P +1300 120 110 | F +(03) 9738 4970 | E sales@classiccabins.com.au
W www.classiccabins.com.au

NOTE:

CONTRACTORS & SUB-CONTRACTORS SHALL VERIFY ALL SIZES, LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING ANY WORK. DO NOT SCALE DRAWINGS, USE THE WRITTEN DIMENSIONS ONLY. DRAWINGS ARE TO READ IN CONJUNCTION WITH CONTRACT / SPEC. FOR ALL MATERIALS AND FINISHES.

PLEASE SIGN BELOW TO APPROVE THE CABIN DESIGN

AUTHORISEDF AGENT OF OWNER/OWNERS
SIGNATURE: _____ **DATE:** _____

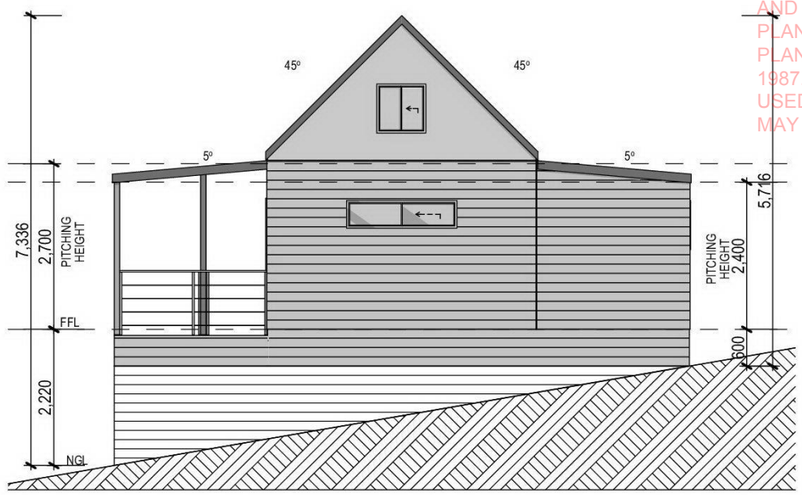
BUILDERS
SIGNATURE: _____ **DATE:** _____

TITLE	FLOOR PLAN
PROPOSED AT:	: 13.2m x 4.38 + 2.5m Verandah 17 Great Ocean Rd Grey River
DESIGN:	Dwelling
CLIENT :	Jerry O'Brien

SCALE	: 1:100			
DATE	: 16/10/2018			
DRAWN	: RW			
SHEET	: 01			
JOB NO.	: 1643			

D18/106837

E-05 WEST 1:100



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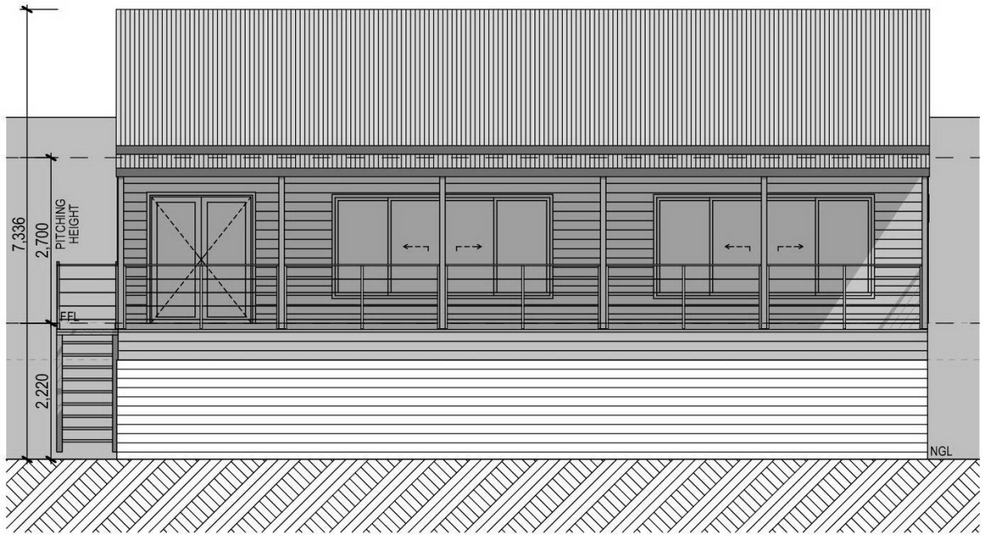

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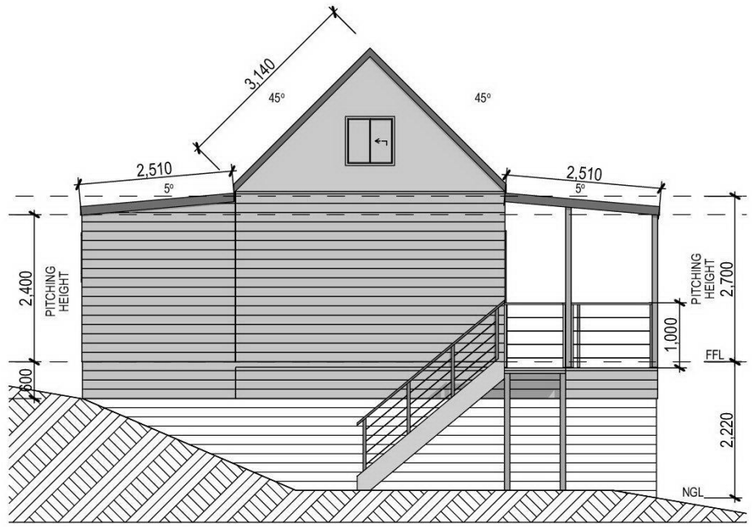

E-08 SOUTH 1:100

NOTE:BUILDING IS TO BE COMPLETED TO LOCK-UP ONLY, EXTERNAL PAINTING TO BE ARRANGED BY CLIENT.
EXTERNAL MATERIALS, COLOURS AND FINISHES TO BE MUTED AND NON-REFELCTIVE.

CLASSIC CABINS
KEVIN GARRETT
REG NO. DB-L36528
ABN 27 279 820 937
Address: 24 Bary St, Bayswater VIC 3153
P +1300 120 110 | F +(03) 9738 4970 | E sales@classiccabins.com.au
W www.classiccabins.com.au

NOTE:

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PLEASE SIGN BELOW TO APPROVE THE CABIN DESIGN

AUTHORISEDF AGENT OF OWNER/OWNERS
SIGNATURE: _____ DATE: _____

BUILDERS
SIGNATURE: _____ DATE: _____

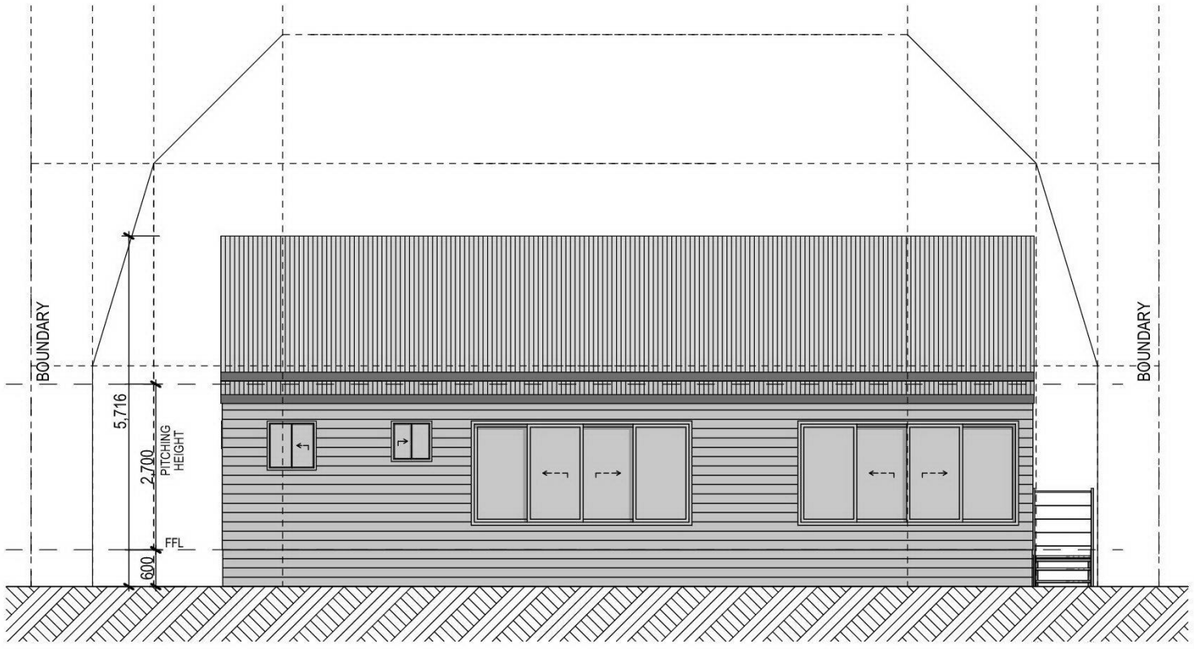
TITLE: ELEVATION

PROPOSED AT: 13.2m x 4.38 + 2.5m Verandah
17 Great Ocean Rd
Grey River

DESIGN: Dwelling

CLIENT: Jerry O'Brien

SCALE : 1:100	DATE	REVISION	BY	
DATE : 16/10/2018				
DRAWN : RW				
SHEET : 02				
JOB NO. : 1643				



E-05 REG 414 1:100

BUSHFIRE ATTACK LEVEL 29

AS3959-2009

1. EXTERNAL WALLS:

ANY PART OF AN EXTERNAL WALL WHICH IS LESS THAN 400MM ABOVE FINISHED GROUND LEVEL, OR LESS THAN 400MM ABOVE A DECK, SHALL BE CONSTRUCTED OF:
- NON-COMBUSTIBLE MATERIAL
- 6MM MIN. THICK FC EXTERNAL CLADDING OR:
- BUSHFIRE RESISTANT TIMBER

2. JOINTS:

ALL JOINTS IN THE EXTERNAL SURFACE MATERIAL OF WALLS SHALL BE COVERED, SEALED, OVERLAPPED, BACKED OR BUTT JOINTED TO PREVENT GAPS GREATER THAN 3MM. ALTERNATIVELY, SARKING-TYPE MATERIAL MAY BE APPLIED OVER THE OUTER FACE OF THE FRAME PRIOR TO FIXING ANY EXTERNAL CLADDING.

3. VENTS & WEEPHOLES:

GAPS IN THE SUBFLOOR OF EXTERNAL WALLS FOR VENTILATION, SHALL BE SCREENED WITH A MESH WITH A MAXIMUM APERTURE OF 2MM. MESH TO BE MADE OF CORROSION RESISTANT STEEL, BRONZE OR ALUMINIUM, EXCEPT WHERE THE GAP IS LESS THAN 3MM, OR ARE LOCATED IN AN EXTERNAL WALL OF A SUBFLOOR SPACE.

4. DECKS:

GAPS BETWEEN DECKING BOARDS TO BE 3MM.

DECKING LESS THAN 300MM (MEASURED HORIZONTALLY AT DECK LEVEL) FROM GLAZED ELEMENTS THAT ARE LESS THAN 400MM (MEASURED VERTICALLY) FROM THE SURFACE OF THE DECK SHALL BE MADE FROM-
- NON COMBUSTIBLE MATERIAL; OR
- BUSHFIRE-RESISTING TIMBER

5. BALUSTRADES & HANDRAILS:

THOSE PARTS OF THE HANDRAILS AND BALUSTRADES LESS THAN 125MM FROM ANY GLAZING OR ANY COMBUSTIBLE WALL SHALL BE:-
OF NON-COMBUSTIBLE MATERIAL, BUSH-FIRE RESISTING TIMBER OR A COMBINATION OF BOTH.

6. WINDOWS:

ALL WINDOWS (WHERE PART OF THAT WINDOW) IS LESS THAN 400MM FROM FINISHED GROUND LEVEL OR LESS THAN 400MM FROM A DECK, SHALL BE METAL.

ALL GLAZING (WHERE PART OF THAT WINDOW) IS LESS THAN 400MM FROM FINISHED GROUND LEVEL OR LESS THAN 400MM FROM A DECK, SHALL BE TOUGHENED SAFETY GLASS 5MM. WHERE DOUBLE GLAZED WINDOWS ARE USED, THE REQUIREMENT SHALL APPLY TO THE EXTERNAL FACE OF THE WINDOW ASSEMBLY ONLY.

THE OPENABLE PORTIONS OF THE WINDOWS SHALL BE SCREENED INTERNALLY OR EXTERNALLY WITH A MAXIMUM APERTURE OF 2MM, MADE FROM CORROSION-RESISTANT STEEL, BRONZE OR ALUMINIUM.

7. DOORS:

EXTERNAL SIDE-HUNG DOORS SHALL BE OF SOLID TIMBER, HAVING A MINIMUM THICKNESS OF OF 35MM FOR THE FIRST 400MM ABOVE THE THRESHOLD, OR: BE OF BUSHFIRE RESISTANT TIMBER. WEATHERSTRIPS, DRAUGHT EXCLUDERS OR DRAUGHT SEALS SHALL BE INSTALLED AT THE BASE OF SIDE-HUNG EXTERNAL DOORS.

ANY GLAZING IN SLIDING DOORS SHALL BE TOUGHENED GLASS, MINIMUM 5MM. THERE IS NO REQUIREMENT TO SCREEN THE OPENABLE PART OF THE SLIDING DOOR, HOWEVER, IF SCREENED, THE SCREENS SHALL BE MESH OR PERFORATED SHEET MADE OF CORROSION-RESISTANT STEEL, BRONZE OR ALUMINIUM.

8. ROOFS:

-ROOF SHEETING AND ACCESSORIES SHALL BE NON-COMBUSTIBLE
- THE ROOF/WALL JUNCTION SHALL BE SEALED, TO PREVENT OPENINGS GREATER THAN 3MM, EITHER BY USE OF FASCIA & EAVES LININGS OR BY SEALING BETWEEN THE TOP OF THE WALL AND UNDERSIDE OF THE ROOF AND BETWEEN THE TRUSSES AT THE LINE OF THE WALL.
- ROOF VENTILATION OPENINGS SHALL BE FITTED WITH EMBER GUARDS MADE OF NON-COMBUSTIBLE MATERIAL OR A MESH OR PERFORATED SHEET WITH A MAXIMUM APERTURE OF 2MM, MADE FROM CORROSION-RESISTANT STEEL, BRONZE OR ALUMINIUM.
- ROOF SHALL BE FULLY SARKED: SARKING TO HAVE FLAMMABILITY INDEX OF NOT MORE THAN 5
- FOIL-BACKED INSULATION BLANKET (MAY BE INSTALLED OVER THE THE BATTENS)
- SARKING TO COVER THE ENTIRE ROOF INCLUDING RIDGE
- SARKING TO BE INSTALLED TO PREVENT GAPS THAT WOULD ALLOW ENBERS WHERE SARKING MEETS FASCIAS, GUTTERS & VALLEYS.

9. VERANDAH:

THE SUPPORT STRUCTURE OF THE VERANDAH SHALL BE CONSTRUCTED OF BUSHFIRE-RESISTING TIMBER OR: TIMBER RAFTER LINED ON THE UNDERSIDE WITH FIBRE CEMENT SHEETING A MINIMUM OF 6MM THICK, OR WITH MATERIAL COMPLYING WITH AS 1530.8.1.

JOINTS IN ANY CEILING LININGS MAY BE SEALED WITH PLASTIC JOINING STRIPS OR TIMBER STORM MOULDS.

10. GENERAL:

THE ABOVE MEASURES TO BE TAKEN AS A MINIMUM. THE BUSHFIRE CONSTRUCTION REQUIREMENTS SHALL NOT BE LIMITED TO THESE NOTES. REFER TO AS 3959-2009 FOR FUTHER OPTIONS.

CLASSIC CABINS
KEVIN GARRETT
REG NO. DB-L36528
ABN 27 279 820 937
Address: 24 Bary St, Bayswater VIC 3153
P +1300 120 110 | F +(03) 9738 4970 | E sales@classiccabins.com.au
W www.classiccabins.com.au

NOTE:

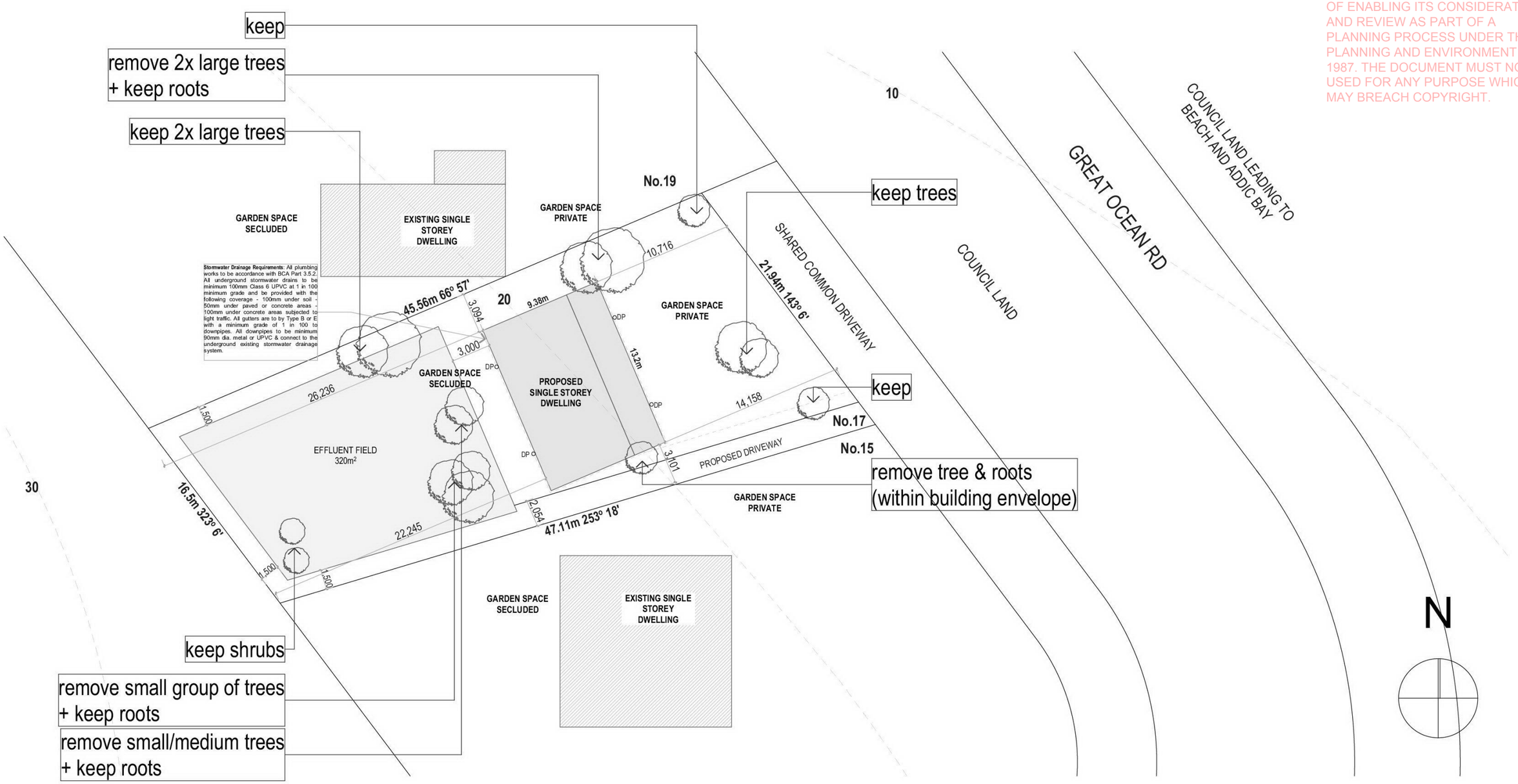
CONTRACTORS & SUB-CONTRACTORS SHALL VERIFY ALL SIZES, LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCING ANY WORK. DO NOT SCALE DRAWINGS, USE THE WRITTEN DIMENSIONS ONLY. DRAWINGS ARE TO READ IN CONJUNCTION WITH CONTRACT / SPEC. FOR ALL MATERIALS AND FINISHES.

PLEASE SIGN BELOW TO APPROVE THE CABIN DESIGN

AUTHORISEDF AGENT OF OWNER/OWNERS
SIGNATURE: _____ **DATE:** _____

BUILDERS
SIGNATURE: _____ **DATE:** _____

TITLE	**PROPOSED AT:** : 13.2m x 4.38 + 2.5m Verandah	**SCALE** : 1:100	**DATE**	**REVISION**	**BY**
BAL & REG 414	17 Great Ocean Rd Grey River	**DATE** : 16/10/2018			
		DRAWN : RW			
		SHEET : 03			
DESIGN: Dwelling	**CLIENT** : Jerry O'Brien	**JOB NO.** : 1643			



SITE PLAN 1:300

ALL TREE ROOTS TO STAY UNLESS IN BUILDING ENVELOPE. ALL VEGETATION TO CLOSE TO BUILDING ENVELOPE TO BE REMOVED. VEGITATION WHICH ARE WELL CLEAR OF DWELLING ARE TO REMAIN UNCHANGED (AS PER PLAN)

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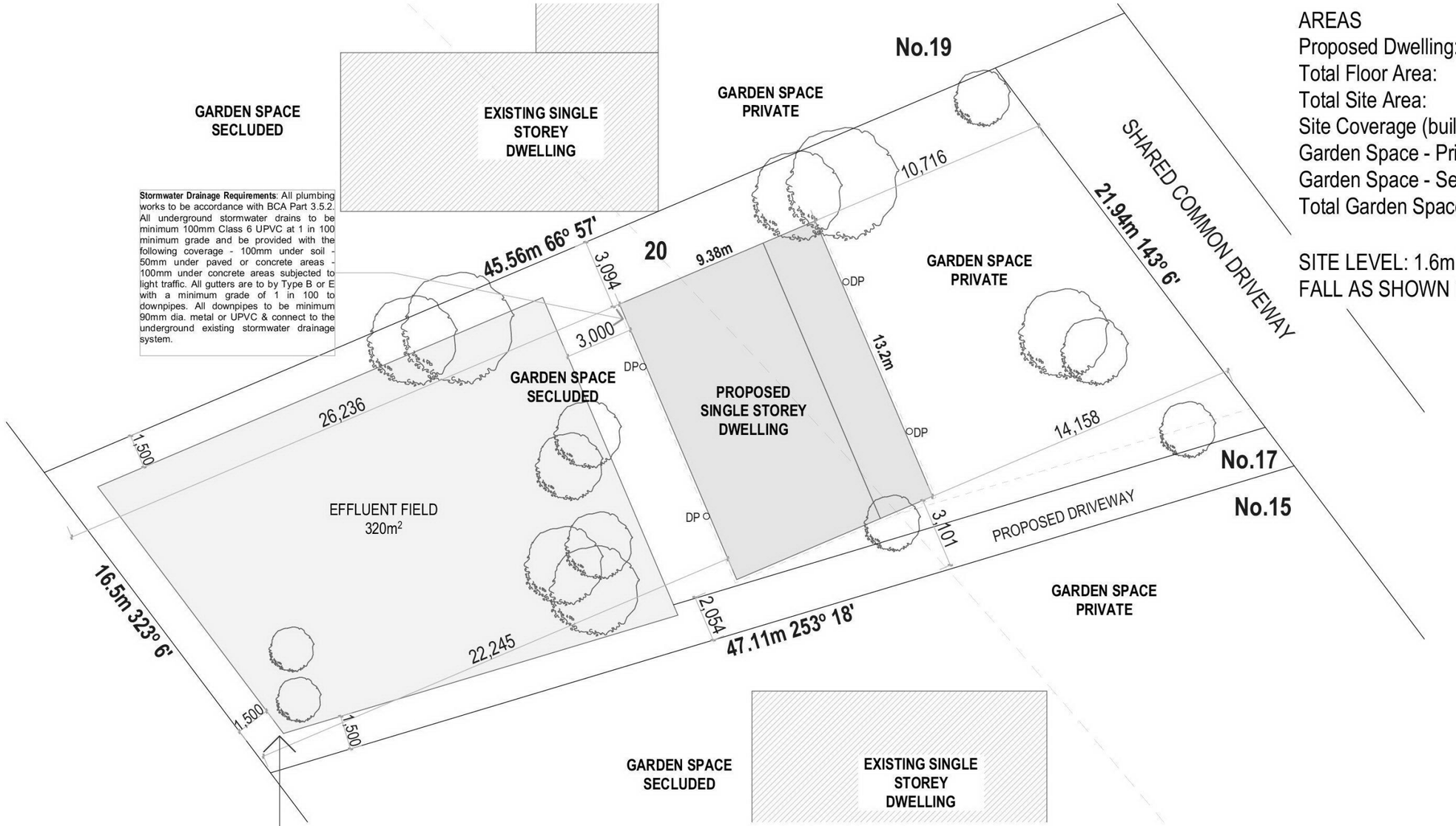
PLEASE SIGN BELOW TO APPROVE THE CABIN DESIGN

AUTHORISEDF AGENT OF OWNER/OWNERS
SIGNATURE: _____ **DATE:** _____

BUILDERS SIGNATURE: _____ **DATE:** _____

TITLE	**PROPOSED AT:** : 13.2m x 4.38 + 2.5m Verandah	**SCALE** : 1:300	**DATE**	**REVISION**	**BY**	
SITE PLAN	17 Great Ocean Rd Grey River	**DATE** : 16/10/2018				
		DRAWN : RW				
		SHEET : 01				
DESIGN: Dwelling	**CLIENT :** Jerry O'Brien	**JOB NO.** : 1643				



Stormwater Drainage Requirements: All plumbing works to be accordance with BCA Part 3.5.2. All underground stormwater drains to be minimum 100mm Class 6 UPVC at 1 in 100 minimum grade and be provided with the following coverage - 100mm under soil - 50mm under paved or concrete areas - 100mm under concrete areas subjected to light traffic. All gutters are to by Type B or E with a minimum grade of 1 in 100 to downpipes. All downpipes to be minimum 90mm dia. metal or UPVC & connect to the underground existing stormwater drainage system.

AREAS

Proposed Dwelling:	123.81m²
Total Floor Area:	123.81m²
Total Site Area:	851.85m²
Site Coverage (buildings only):	14% (123.81m²)
Garden Space - Private:	288.89m²
Garden Space - Secluded:	357.32m²
Total Garden Space:	646.21m² (75%)

SITE LEVEL: 1.6m FALL ACROSS BUILDING SITE.
FALL AS SHOWN IN ELEVATIONS

SITE PLAN 1:200

N

Proposed location for all site water works. Septic tank, effluent disposal field and water tank to meet the requirements of the BAL 29 rating. All to be arranged by client.

NOTE:BUILDING IS TO BE COMPLETED TO LOCK-UP ONLY. SITE AND CIVIL WORKS TO BE ARRANGED AND COMPLETED BY CLIENT. DWELLINGS LOCATION TO ALLOW FOR LEAST IMPACT ON SITE VEGETATION. ALL TREES THAT WILL AFFECT CONSTRUCTION TO BE REMOVED BY CLIENT.

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PLEASE SIGN BELOW TO APPROVE THE CABIN DESIGN
AUTHORISEDF AGENT OF OWNER/OWNERS SIGNATURE: _____ DATE: _____
BUILDERS SIGNATURE: _____ DATE: _____

TITLE: SITE PLAN	PROPOSED AT: 17 Great Ocean Rd Grey River	SCALE : 1:200	DATE	REVISION	BY
		DATE : 16/10/2018			
		DRAWN : RW			
		SHEET : 02			
DESIGN: Dwelling	CLIENT : Jerry O'Brien	JOB NO. : 1643			

LANDSLIP RISK ASSESSMENT

FOR

17 GREAT OCEAN ROAD GREY RIVER, VICTORIA

Prepared for:	Gerry O'Brian
Prepared by:	David J Horwood Senior Engineering Geologist *BAppSc (Geology); Dip.NRM; MAusIMM CP(Geo);*
Approved by:	 David J Horwood Director
Reference No.	18G289LRA
Date:	28/8/2018
Revised:	29/10/2018

Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

Our assessment has found that as with many sites in the Grey River area, there are risks to life and property due to conceivable landslide events on the subject site.

- Located on the west side of the Great Ocean Road, the site is accessed directly from a service road which runs parallel to the Great Ocean Road. The allotment has an easterly aspect and slope orientation. Lower level slopes on the south-eastern toe of a south-east trending ridge. The site is has approximately 12m local relief.

- Natural slope angles on site range from 7° to 20° generally to the east. Overall ground slope is approximately 14°.

- The overall slope shape of site is gently concave with steeper slopes located at the rear of the site, gradually becoming shallower towards the front of the site.

- Generally damp to wet surface conditions over the eastern half of the site with major ponding near the eastern boundary. Site observations indicate a extensive of hydrophilic vegetation growing on the site and seeps surfacing from shallow concave slopes.

- The natural soil profile is between 1000mm 1400mm thick. Bedrock consists of weathered sandstone.

- The dip direction is oblique (south-east) to the site's slope direction (east). The apparent dip of the bedrock is slightly shallower than the overall slope angle.

- Bedding lineaments (trends) on the shore platform south of the Grey River estuary suggest the possible existence of a left lateral strike slip fault dragging bedding to the south-west and north-east.

- A medium sized landslide scarp and debris flow deposit is located 50m north of the subject site. The headscarp slopes at 32° towards the north. The feature is approximately 100m wide and 100m long stretching down to the river. Surface expression of the landslide is subdued and the headscarp is well rounded.

- Considering the geomorphology of the site and the surrounding area, the geological model formed implies that the soil profile on site has formed predominately from in-situ weathering of the Eumeralla Formation sediments.

- The local ground model for landslide hazards involves, shallow and deeper seated translational earth slides, shallow rotational earth slides and local failures in cutting.

- The Geotechnical Assessment was up graded to a Landslide Risk Assessment due to the steep slopes exceeding the tolerances specified within Schedule 1 to the Colac-Otway Ranges Shire EMO.

Concerning the proposed development at 17 Great Ocean Road, Grey River, we conclude that the risks to property assuming existing conditions remain or development is unmitigated, are considered "MODERATE" (for the most at risk elements). The risk to life is ABOVE the recommended "TOLERABLE" risk limit defined as 1×10^{-5} by the AGS Guidelines (2007) and Schedule 1 to the Colac-Otway Ranges Shire EMO.

The risks to property can be reduced if recommended mitigation measures are adhered to.

The risks to property associated with developing a residential dwelling on the subject site assuming risk management conditions are implemented, can be reduced to "LOW" and "VERY LOW" for most hazards while at least one hazard remains at a "MODERATE" risk level. In quantitative terms, the risk to life can be reduced to below the recommended "TOLERABLE" risk limit for all hazard elements.

Based on our assessments of the risks, we conclude that there are no geotechnical reasons to prevent the issue of a permit to develop on this site, subject to the implementation of the recommendations outlined in Section 9.0 of this report, which outline management strategies to reduce or maintain the likelihood and/or consequences of the major risk events.

1.0 INTRODUCTION

Landslides and other forms of earth and rock movements are common throughout the Otway Ranges and like erosion, they are a natural process of geological shaping of the environment.

Any building within a "geologically active" environment such as the Otway Ranges is potentially at risk of damage due to natural soil movements. In some circumstances, serious building damage, personal injury or even death may result from landslides. Whilst the risks due to soil movement can usually be identified and steps can often be taken to manage or reduce the risks to acceptable levels, it is not feasible to eliminate the risks of damage or injury entirely.

2.0 SCOPE OF REPORT

AGR Geosciences Pty Ltd (AGR) was commissioned by Mr Gerry O'Brian (the Client) to provide a Geotechnical Assessment of No. 17 Great Ocean Road Grey River (the Site) to meet the geotechnical assessment requirements of the Colac-Otway Shire Planning Scheme Amendment C68: Schedule 1 to the Erosion Management Overlay (EMO). A decision was reached to advance the Geotechnical Assessment to a Landslip Risk Assessment on the basis that automatic trigger conditions as defined in Schedule 1 to the EMO did exist on site.

The principles used in conducting the Landslip Risk Assessment follow the guidelines published in the Australian Geomechanics Society (AGS) journal Volume 42 No 1 of March 2007, entitled "Landslide Risk Management". This report contains all the information required for a Geotechnical Assessment as well as all additional information required for a Landslip Risk Assessment as defined by Schedule 1 to the EMO.

The purpose of the assessment is to identify possible landslide hazards within and near the elements at risk and to provide guidance and options on how the risks can be reduced, avoided or controlled.

For the purpose of this Landslip Risk Assessment, "the elements at risk" for the proposed development are defined as the proposed dwelling and any related infrastructure, drive ways, access roads or ancillary structures, and all users or residents of the proposed dwelling and any related infrastructure, drive ways, access roads or ancillary structures.

3.0 DEVELOPMENT DESCRIPTION

- New light weight colour bond clad 2 bedroom residential dwelling with timber floor.
- Approximate building footprint of 100m^2.
- Positioning of building assumed to be either set back 4-5m from eastern boundary or in line with existing neighbouring dwellings (approximately 14m setback from eastern boundary).

A floor plan of the proposed development is provided in Appendix II.

4.0 HAZARD ANALYSIS

4.1 DATA GATHERING – DESK TOP STUDIES AND PREVIOUS INVESTIGATIONS

Numerous landslide risk assessments and landslide studies have been conducted in the Otway Ranges, many by private consultants for individual clients and some published reports are also available. Many of these reports confirm that landslide hazards are present and that in some cases, inappropriate development can lead to slope failure.

In preparation for conducting a field investigation of the site, preliminary data was gathered from the following sources:

- Landslide and Erosion Susceptibility mapping published by the Corangamite Catchment Management Authority.
- Landslide and Erosion Inventory mapping published by the Corangamite Catchment Management Authority.
- Fed Uni Spatial Landslide and Erosion Database Online.
- Geological Reports and Maps published by the Geological Survey of Victoria and published 1:50,000 and 1:250,000 geological mapping published online via GeoVic and Earth Resources Victoria.
- Factor Data Sets such as slope, elevation, rainfall, aspect, land use, vegetation, geomorphology and soil landforms published by the Corangamite Catchment Management Authority.
- Geomorphological, landform, topographic, soil and climatic data published by the Department of Environment and Primary Industries available via Victorian Resources Online.
- Aerial photos and maps published by NearMaps and Google.
- Previous investigations and reports by AGR and other consultants both published and unpublished.
- Design plans prepared by Classic Cabins.

4.1.1 Geology and Geomorphology

Regional development of the Otway Ranges began as Australia pulled away from Antarctica during the Late Jurassic to Early Cretaceous initiating rift valley volcanism and deposition which ultimately formed the Otway Ranges. Lower Cretaceous sediments of the regionally expansive Otway Group make up most of the Otway Ranges in southwestern Victoria. The Eumeralla Formation, by far the most expansive formation in Otway Group, comprises mostly of fluvial channel deposited lithic sandstones, mudstones, siltstones and minor mud-clast conglomerate.

The sandstones and mudstones are characteristically quartz-poor volcanogenic sediments high in calcic feldspars derived from dacitic volcanic material which originated from contemporaneous rift valley volcanism to the north of the Otway Ranges. Post deposition the Otway Group has been gently folded, faulted and uplifted along a series of parallel faults trending north-east.

The composition of the Eumeralla Formation makes it highly susceptible to weathering producing clay rich soils typically 0.5-1m thick in sandstone dominant areas and up to and greater than 2m deep in siltstone/mudstone dominant areas. A typical soil profile is generally well developed overlying and sometimes grading into extremely and highly weathered rock. The weathering profile continues to progressively grade into fresh rock.

Following significant uplift during the Late Cretaceous a period of widespread erosion prevailed resulting in the deposition of the Wiridjil Gravel during the Paleocene in braided river systems belonging to a high energy fluviatile environment. The Wiridjil Gravel's are predominately diamictites consisting of unconsolidated coarse quartz sands, silt and clays as well as gravels and minor pebble and cobble layers

At the cessation of this erosional period, the sea again transgressed and a variety of sediments were deposited in the mostly marine conditions which existed on the flanks of the Otway Ranges throughout the Tertiary Period. At this time, these marine sediments were on-lapping the Otway Ranges which protruded from the sea like an island. During the Late Miocene the sea began to retreat giving way to shallower marine conditions.

During the Pliocene, following widespread uplift, a peneplain developed over Miocene sediments formed in shallow marine conditions following shallowing of the sea during the Oligocene. At this time sea level again rose depositing the sediments in a shallow marginal-marine environment extensively covering the Otway Basin and flanks of the Otway Ranges.

With reference to the 1:250 000 Colac geological map and Earth Resources 1:250 000 Seamless Geology, the local geology of the subject site is inferred to consist entirely of Eumeralla Formation sediments.

Since the end of the Tertiary sea levels have consistently fluctuated with the last major interglacial period occurring around 110,000BP (before present). Between 14,000 and 6,000BP sea levels rose rapidly following the last glacial maximum around 17,000 to 20,000BP. As the sea advanced it pushed coastal dunes in front of it on-lapping Tertiary aged sediments along the coast until sea levels again dropped slightly renewing erosion rates around 6,000 years ago.

Grey River can be described as belonging to the Lorne Land System or the deeply dissected upland ranges of the Southern Uplands (Geomorphic Unit 3.1.2). This land system occupies much of the coast line from Lorne to Grey River along the Great Ocean Road characterized by steep hills, coastal cliffs and rock shore platforms. Inland from the coast the topography consists of steeply dissected hills, spurs and ridges of moderate relief with cliffs and waterfalls.

Geomorphic development of the landscape is heavily influenced by landslides. Rapid valley development by the rivers and creeks and their tributaries resulted from uplift of the Otway Ranges and fluctuations in sea levels. Landslide activity is commonly correlated to over steepened valley slopes where their occurrence has continuously shaped the landscape over the

past 5000-6000 years since lower stream base levels and warmer (wetter) climates have prevailed.

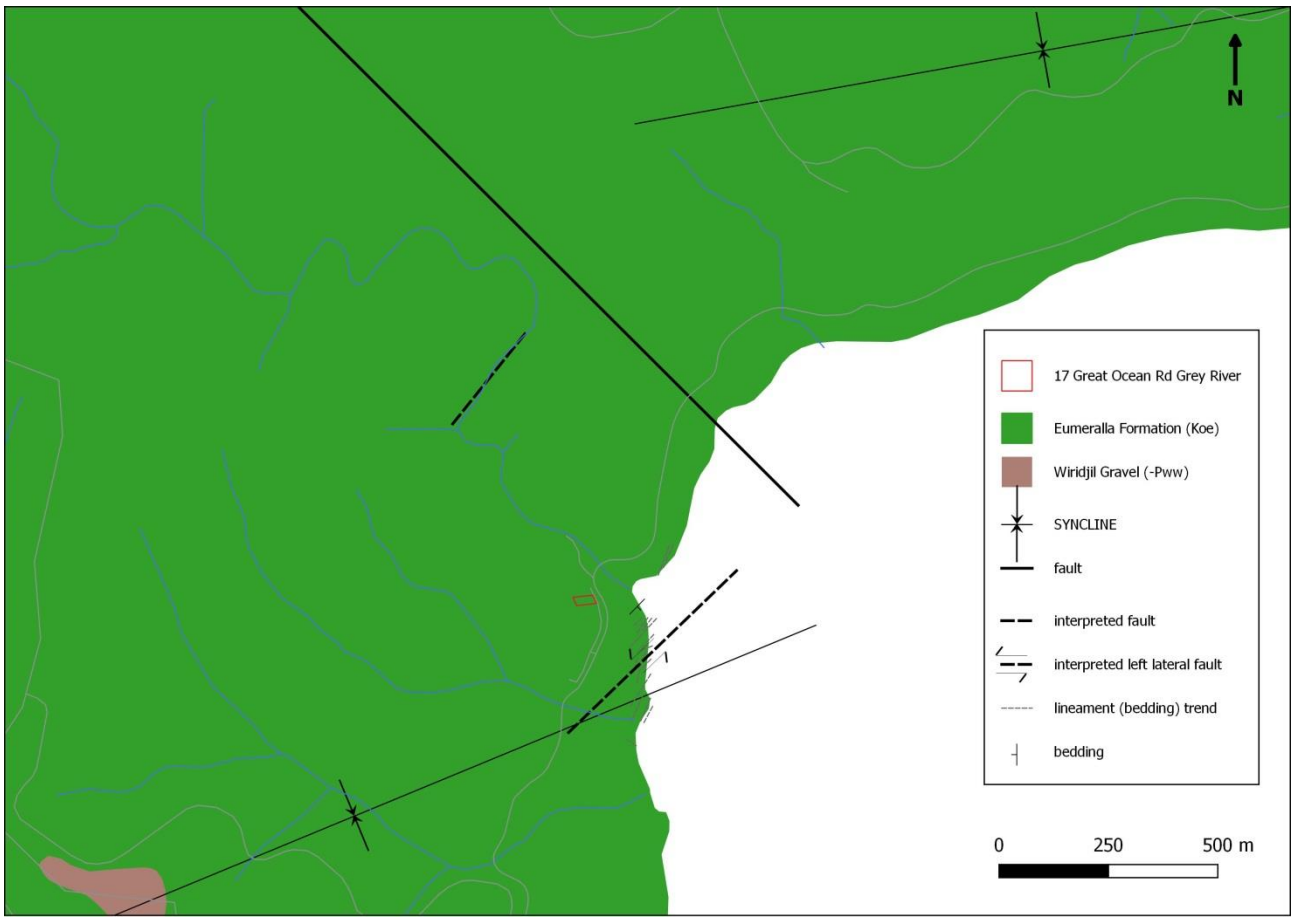


Figure 1: Regional geology of the greater Grey River area

4.1.2 Regional Landslide Factors

Landslides are rarely attributed to a single geomorphic factor alone and usually require a combination of factors to exist often with equal bearing on the susceptibility of a site to landslide activity. Terrain slope, aspect and rainfall along with the geology and geomorphology are all factors which can have a profound influence on the occurrence of landslides. Landslide susceptibility mapping conducted by A.S. Miner Geotechnical (2006) in the Grey River area indicates that the site has **HIGH** landslide susceptibility.

Slope angle has been attributed as a contributing factor in landslide occurrence (Cooney, 1980; Wood, 1980), although the steepest slope angles do not always pose the greatest risk.

The depth of weathering of a regolith profile can be related to slope aspect in the Otway Ranges and incised valleys of the Otway Ranges with deeper more weathered regolith profiles typically occurring on the wetter southwestern slopes. It is logical to assume some relationship between aspect and landslide activity although no direct correlation has been observed in previous studies.

Extreme rainfall is a dominant trigger for landslides in the Otway Ranges and previous studies locally, nationally and globally tend to confirm that intense or prolonged rainfall is the most common trigger of landslides in general.

Earthquakes attributed to active fault lines are another potential trigger for landslides on the Otway region. Intraplate earthquakes such as those experienced in Victoria are extremely unpredictable and occur unexpectedly. These types of earthquakes are caused by compressive stresses associated with thrust faults. The nearest large fault to the region is the Torquay Fault which is considered to be active and may be correlated to historical earthquake activity. Higher magnitude earthquakes could trigger landslides and townships proximal to a fault line with a history of higher magnitude earthquakes puts them at a higher risk than other localities. In the greater Grey River region more than 40 earthquakes have been recorded since 1837 with three measured as being greater than a magnitude of four.

While not a direct triggering event itself, fire is also a significant factor contributing to an areas susceptibility to landslides. Steeply sloping areas burnt by fires may be subject to increased risk of landslide in the months and even years following the fire event, especially if the fire is followed by a prolonged wet season or high rain fall event. The shallow soil layers become more susceptible to erosion and potential landslides following fires for several reasons including the removal of organic matter from the surface and upper soil layers which otherwise has a strong influence on soil structure. Drying and aeration of the soil structure following fire can weaken the shear strength of the soil making it more susceptible to failure given exposure to triggering events. When fires remove ground cover and lower storey vegetation, the root binding effects on soil structure are also removed. Fires expose bare soils to the impacts of surface run off and erosion without vegetation to bind the soils and intercept rain fall and surface water flow. A reduction in vegetation may also create medium to long term effects on soil moisture as the reduction in vegetation results in an increase in surface water infiltration and shallow sub-surface through flow. Increasing soil moisture (groundwater or surface infiltration) is a trigger of landslides.

Fires alter surface hydrology, especially in steep mountain catchments. The removal of vegetation from the landscape increases surface flow and run-off. Following fires, surface soils can also undergo chemical alteration and become hydrophobic. Hydrophobic soils contribute to surface run-off and increased surface flow velocity. High volume, high velocity surface run-off is one of the triggering factors of debris flows.

Other risk factors which may influence the initiation of landslides include unfavourable orientation of the rock strata, inherently weak rock mass, anthropogenic alterations to the slope morphology, hydrology and drainage.

Table 1 1 provides a general summary of some of the typical climatic and physiological features for the Soil Landform Unit 64 belonging to the Lorne Land System of Otway Ranges which characterises the Grey River area.

Table 1: Regional Features for Hills of the Soil Landform Unit 64

GEOMORPHIC UNIT	Dissected upland ranges of the Southern Uplands (3.1.2)		
LANDFORM	Hills		
LANDFORM ELEMENT	Lower slope and drainage line	South and east facing slopes	Steepest slopes
ELEVATION	0-400m		
LOCAL RELIEF	150m		
SLOPE ANGLE AND RANGE (%)	20 (1-35)	45 (5-65)	60 (20-70)
SLOPE SHAPE	Concave	Linear	Linear
RAINFALL	850-1300mm Annual		
TEMPERATURE	13^{o} Annual Average		

4.1.3 Previous Landslides Movements

Numerous landslide studies and geotechnical investigations have been previously conducted in the Grey River and Kennett River areas. Cooney (1980), Feltham (2004) have both identified landslide failures from aerial stereo photogrammetry interpretation within the broader Grey River/Kennett River area.

Figure 2 shows the main areas of historical landsliding surrounding the Grey River locality although no landslides have actually been recorded in the inventory proximal to the river itself. Cooney (1980) interpreted historical landslides along the Great Ocean Road between Kennett River and Grey River. This area is characterised by irregular large debris deposits exposed in the road cutting above the Great Ocean Road and sections of rocky cliff where rock falls or varying sizes are frequently observed.

Cooney (1980) identified a large landslide scarp south of Orchard Creek while Feltham (2004) identified additional smaller landslides within this larger, older failure.

Figure 2: Previously recorded landslides on the landslide inventory, University of Ballarat, 2008.
(from Miner, 2006)

Despite a paucity of inventory recorded landslides, interpretation of LiDAR derived digital elevation models during this investigation suggests that there are several other areas of historical landslide activity in the Grey River region. Figure 3 illustrates the distribution of landslide scarps north and south of Grey River.

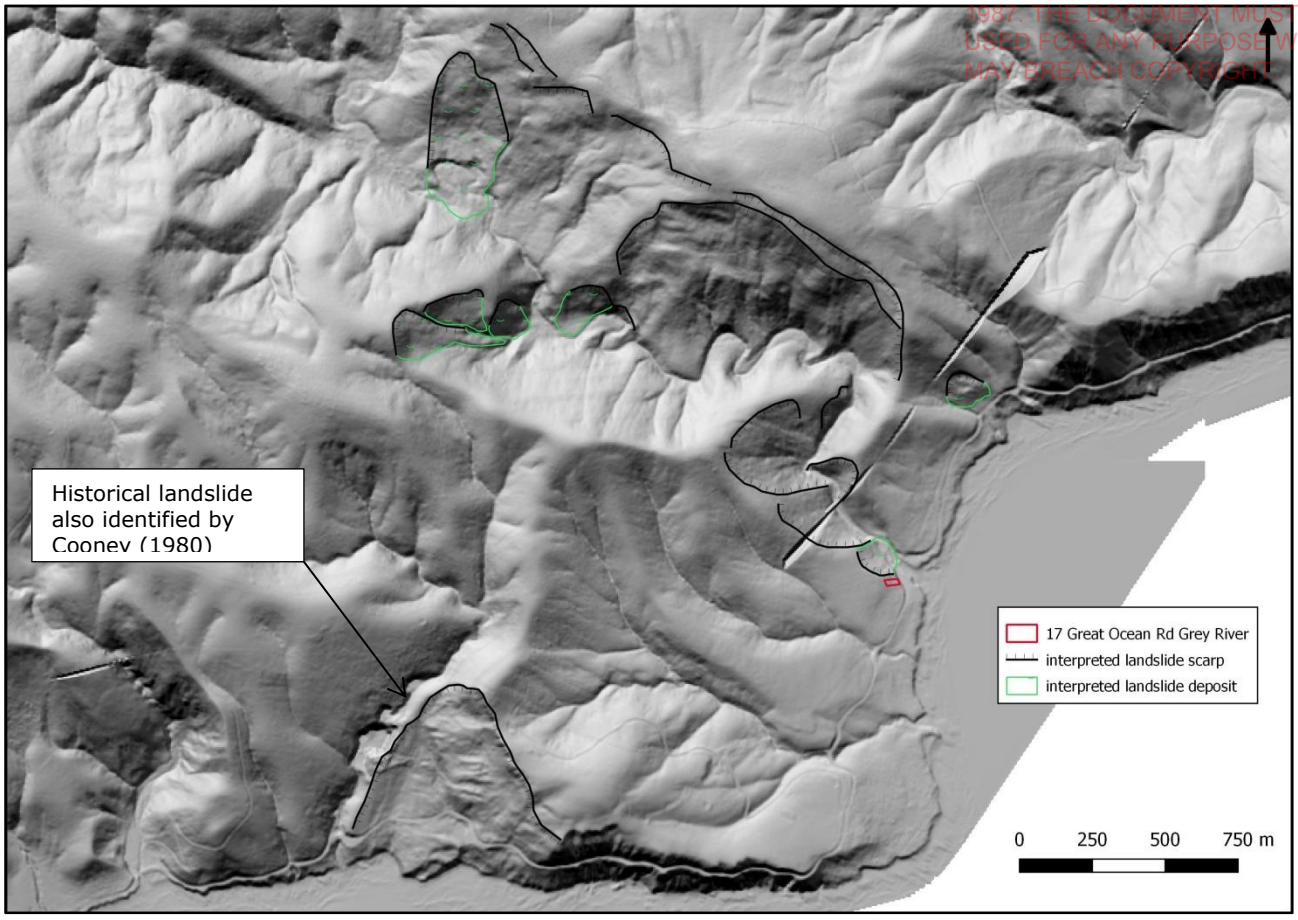


Figure 3: Interpreted historical landslides around Grey River. Hill shade DEM 315° azimuth, 45° vertical illumination.

4.2 FIELD INVESTIGATIONS

4.2.1 Site Inspection and Mapping

A thorough visual appraisal was made of the geomorphological features of the proposed development site and the surrounding area to search for evidence of slope instability and past slope failures. Slope angles were measured with a laser Forestry Range Finder and inclinometer and a Brunton geological compass.

A scaled engineering geology and geomorphology map showing the main features of the subject site is presented in Figure 4 while the local geological model is presented in cross-section in Figure 5. Site photographs are also attached as Appendix III.

4.2.2 Site Description and Physiography

Development:

- Vacant, undeveloped allotment.

Landscape position and Landforms:

- Located on the west side of the Great Ocean Road, the site is accessed directly from a service road which runs parallel to the Great Ocean Road. The allotment has an easterly aspect and slope orientation.
- Lower level slopes on the south-eastern toe of a south-east trending ridge. The site is has approximately 12m local relief.
- Shallow coastal sand dunes and a rocky shore platform are located 40 to 60m east of site.

Slopes:

- Natural slope angles on site range from 7° to 20° generally to the east. Overall ground slope is approximately 14°.

Slope shapes:

- The overall slope shape of site is gently concave with steeper slopes located at the rear of the site, gradually becoming shallower towards the front of the site.
- Major breaks in slope are subtle and no greater than 5° in any one location with the exception of a small cutting above the access road.
- An elongated depression is located through the centre of the site coinciding with a preferential drainage path.

Drainage:

- Typically moderately to poorly drained site due to consistent steep slope angles and the rear and concave shallow slopes at the front.
- Generally damp to wet surface conditions over the eastern half of the site with major ponding near the eastern boundary. Site observations indicate a extensive of hydrophilic vegetation growing on the site and seeps surfacing from shallow concave slopes.
- No obvious signs of surface erosion processes.
- Sub-surface soil conditions were typically wet to very moist across the eastern half of the site.

Observations:

Notable observations are described below and annotated on the engineering geology map in Figure 4.

a) Culvert across access road and drainage outlet to the Great Ocean Road. Well-constructed and rock lined drainage channel.

b) Seeps and surfacing perched surface water.

c) Neighbouring septic tank and distribution pits.

d) Sub-vertical cutting beneath neighbouring dwelling. 1m high supported with non-engineered corrugate iron and star picket retention system. Wet sub-space due to excessive surface water run on.

e) Very slightly depressed drainage line and pathway for concentrated surface flow.

f) Local surface water catchment. Source of significant run-off; bear soils and steeper slopes. High flow run-off.

g) Linear small breaks in slope. Possibly cause by fire break maintenance and vehicle access.

h) Landslide scarp and debris flow. Major convex break in slope with 32° scarp. Landslide over 100m wide and 90m long. Shallow sloping, flattened debris deposit visible down slope above river. Located 50m north-west of site.

i) Minor break in slope and shallow depression. Possible site of very small historical slide or flow. Shallow hummocky ground surface. Feature 20m side and 10m long. Ponding surface water and hydrophilic vegetation.

4.2.3 Sub-Surface Conditions

Subsurface conditions were investigated via inspection of soil and cuttings retrieved from boreholes established using hand held soil augers and inspection of exposed cuttings both on and near site.

- The natural soil profile is between 1000mm 1400mm thick.
- Natural residual soils consist of a very low plasticity dark brown to dark grey clayey SILT with sand overlying low to medium plasticity sandy CLAY to medium plasticity silty CLAY grading sandy with depth. Occasional dark grey, high plasticity silty CLAY.
- Very moist to wet, very soft to soft soil conditions in the upper 300-500mm.
- Residual soils grade into extremely weathered (EW) sandstone rock presenting with soil characteristics of clayey SAND, with abundant highly weathered sandstone rock fragments. EW rock typically persists for only 400-500mm.
- Bedrock consists of Low strength, highly weathered fine-medium grained sandstone.
- The underlying bedrock geology encountered is consistent with that of the Lower Cretaceous Eumeralla Formation referenced in published geological maps and confirmed by drilling.
- The composition of the upper soil layers indicates the natural soils are residual in nature.

Soil samples were not collected for laboratory testing during this investigation.

Full subsurface descriptions can be observed in the logs for Test Sites 1-3 in Appendix IV.

4.2.4 Geological Structure

Geological mapping of outcrop exposures and cuttings on and near site was undertaken to establish the likely geological structure.

- Bedrock strata dip around 14° toward 134.3° (Dip/D'Dir: 14°/134.3°). Bedding structure in this location strikes sub perpendicular to the main ridge. The dip direction is oblique (south-east) to the site's slope direction (east). The apparent dip of the bedrock is slightly shallower than the overall slope angle.

- Bedding lineaments (trends) on the shore platform south of the Grey River estuary suggest the possible existence of a left lateral strike slip fault dragging bedding to the south-west and north-east.

- Discontinuity development is related to flexural slip on open anticlinal folds and gentle monoclines typical of the regional structure of the Otway Ranges. Bedding plane shears, conjugate diagonal shear joints and open, longitudinal and traverse joints are common.

- The dominant joint sets in this location have not been observed due to the lack of suitable outcrop.

4.2.5 Groundwater Conditions

- A perched surface water table was present within the topsoil layers above the less permeable clay subsoil.

- Soil conditions were typically very moist to wet in the upper 300-500mm.

- Mottling was observed throughout silty CLAY subsoil suggesting surface water infiltration and periodic seepage of shallow groundwater through flow through the profile.

- A "perched water table" often develops in the soil layers after prolonged wet periods from surface water infiltrating the soil profile. Such a perched water table can prove problematic on many sites if construction is commenced after wet periods and deep excavations may collapse without warning.

- Surface water seeps and ponding surface water is common in the eastern part of the property on the lower, slightly depressed concave slopes.

- Groundwater seeps were observed discharging from the exposed rock cuttings along the Great Ocean Road. It is common for groundwater to seep from open joints and bedding shears in cuttings in the region.

- Regional groundwater exists as fractured aquifers throughout the Otway Group sediments of the Otway Ranges within fractures, open joints and discontinuities as well as between bedding layers of less weathered rock throughout the Otway Group bedrock strata. Seeps and discharging groundwater are often seen discharging out of steep rock cliffs and road cuttings such as the Great Ocean Road. Fractured rock groundwater can influence rock failures and create excavation hazards if encountered during deep excavations.

4.2.6 Existing Retaining Walls, Excavations, Embankments, Cuts/Fills

- The only existing cut or fill batter on site belongs to a small cutting above the access road immediately below site. The cutting is approximately 800mm high and slopes at 42°.

4.2.7 Existing Vegetation

- The site is variably covered by a variety of small to medium sized *Eucalyptus* trees, native shrubs, hydrophilic sedges, grasses and escaped agapanthus.

4.2.8 Features of Adjacent Sites

- Adjacent sites are developed with residential dwellings and minor landscaped gardens.
- Minor slope modification is evident on both the north and south adjoining properties.
- There are no signs of slope instability on either of the immediately surrounding properties.
- Heavily forested Crown Land is located up slope of the property separated by a wide cleared fire break.
- To the west, the gently plunging ridge slopes between 10-15° and between 5-10° nearing the crest.
- A medium sized landslide scarp and debris flow deposit is located 50m north of the subject site. The headscarp slopes at 32° towards the north. The feature is approximately 100m wide and 100m long stretching down to the river. Surface expression of the landslide is subdued and the headscarp is well rounded.

4.3 SUMMARY of GEOLOGICAL MODEL

- Considering the geomorphology of the site and the surrounding area, the geological model formed implies that the soil profile on site has formed predominately from in-situ weathering of the Eumeralla Formation sediments.
- The natural soil profile is between 1000mm 1400mm thick. Bedrock consists of weathered sandstone.
- The dip direction is oblique (south-east) to the site's slope direction (east). The apparent dip of the bedrock is slightly shallower than the overall slope angle.
- Highly weathered bedrock is inferred to transition to moderately and less weathered rock around 5-6m below surface. Depth to bedrock is variable across site.
- The subject site is positioned within a thickly bedded sandy or sandstone dominated sequence of the Eumeralla Formation in Grey River.
- A fault line with possible rotational, left lateral dip slip movement is located on the rock shore platform causing drag rotation of local bedding lineaments.
- The local ground model for landslide hazards involves, shallow and deeper seated translational earth slides, local failures in cuttings and deep seated rock sides.

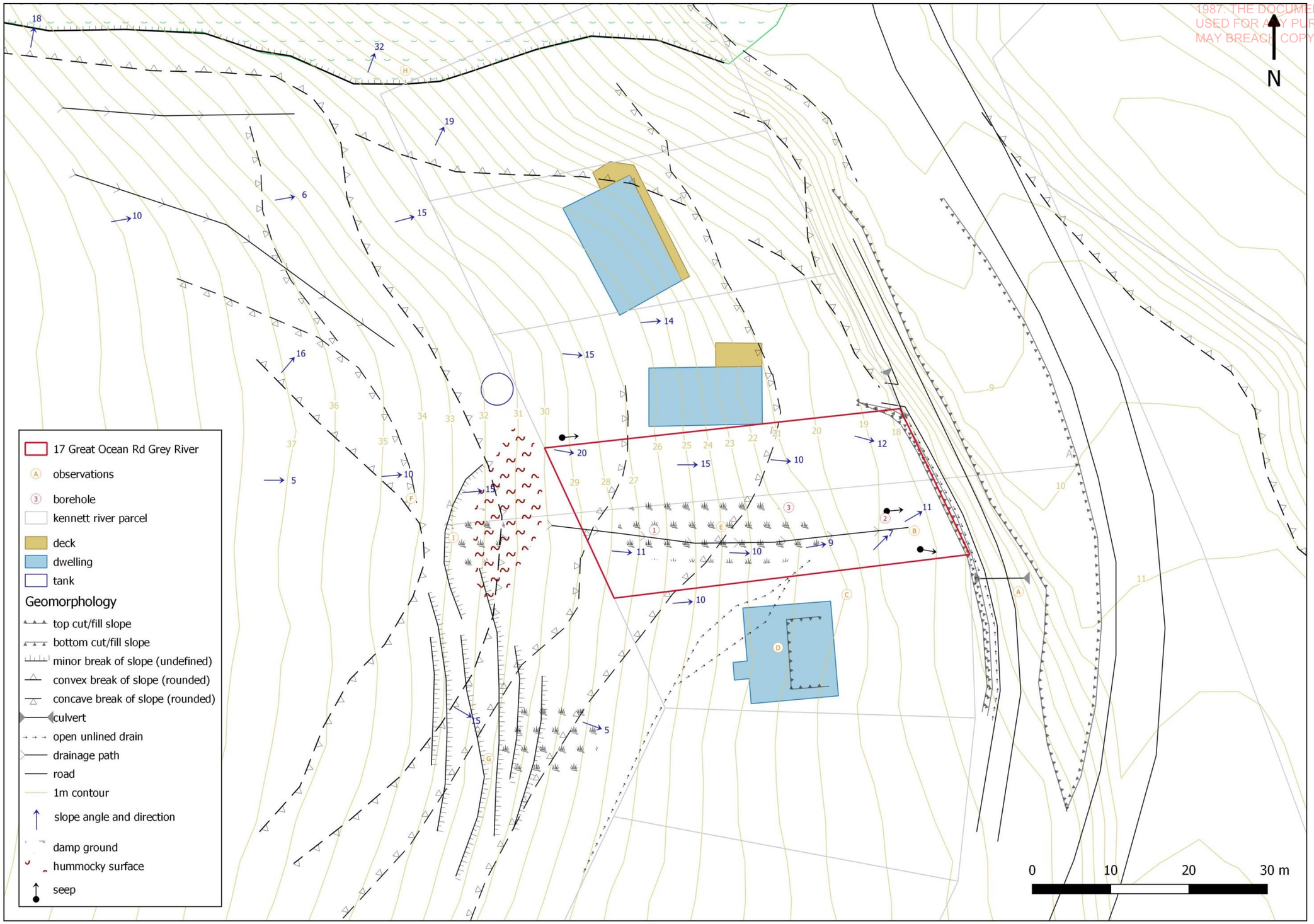


Figure 4: Engineering Geology and Geomorphology of 17 Great Ocean Road

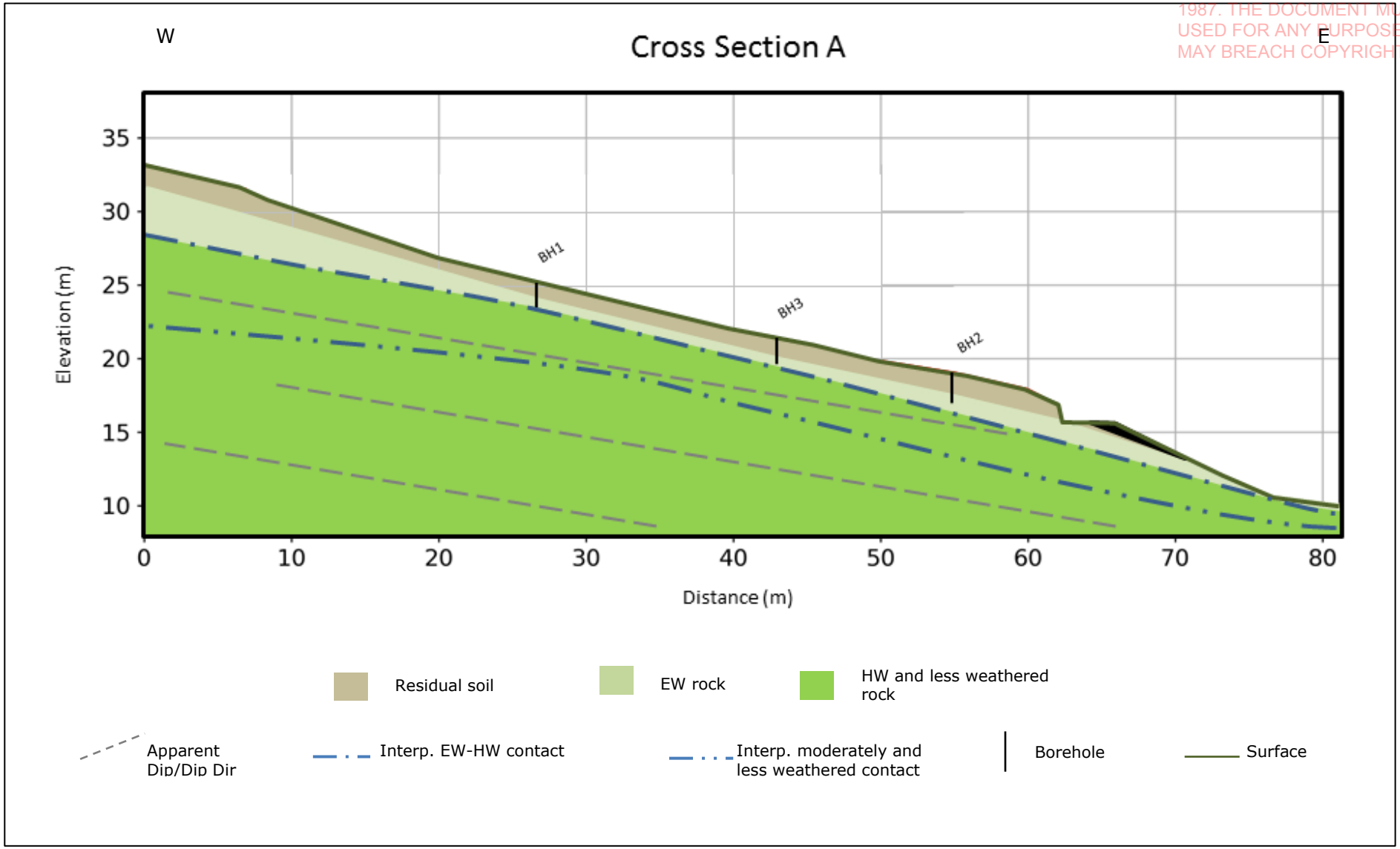


Figure 5: Cross-section A representing the local geological model

4.4 HAZARD IDENTIFICATION

The following **possible** hazards which **may** affect the subject site are:

HAZARD A. LOCAL FAILURE OF CUTTING ABOVE ACCESS ROAD
HAZARD B. ROTATIONAL EARTH SLIDE ABOVE DWELLING
HAZARD C. TRANSLATIONAL EARTH SLIDE-EARTH FLOW ABOVE DWELLING
HAZARD D. TRANSLATIONAL EARTH SLIDE BENEATH DWELLING
HAZARD E. DEEP SEATED TRANSLATIONAL ROCK SLIDE

Hazard A. Local failure of cutting above access road

- Very small, localized, shallow, slope or toe rotational earth slide or slump (0.5-1m deep, 1-3m wide, and 0.5-1.0 m high). Approximately 2m long run out distance. Estimated volume range of failing mass between 0.25m^3 and 3m^3.
- Fast moving, instantaneous failure.
- Residual silty CLAY soil profile with moderate internal friction angles and variable drained effective cohesion. Variable undrained shear strength.
- Mechanism for failure: Rotational slumping related internal shearing of cohesive soils. Induced by high cut angle exceeding friction angle of soils.
- Triggered: Gravity, high cut angle and heavy rainfall increasing pore water pressure due to high surface infiltration, surface run off and seeping perched surface water.

Hazard B. Rotational earth slide above dwelling

- Small, rotational earth slide (1–1.5 deep, 5-15 wide, and 5-10m long). Estimated volume range of sliding mass between 25m^3 and 225m^3.
- Slow to moderately fast moving, failure.
- Residual soil profile with moderate internal friction angles and moderate drained effective cohesion. Variable undrained shear strength.
- Mechanism for failure: Rotational slumping related internal shearing of cohesive soils with weakened or fully softened shear plane of low shear strength.
- Trigger: Prolonged soaking heavy rainfall increasing pore water pressure due to seeping groundwater through flow and perched surface water infiltration.

Hazard C. Translational earth slide-earth flow above dwelling

- Shallow (0.5-1.0m deep), narrow (5-6m wide), translational earth slide of residual silty CLAY soils. Length of area affected up to 10m long. Estimated volume range of sliding mass between 25m^3 and 60m^3. May become flow and run out up to 15m
- Failure may develop quickly or very slowly. Movement likely to be moderately fast to rapid in small increments but overall slow. Likely to move in slices. Horizontal displacement may be expected up to 1m. If becomes a flow will travel fast to rapid in a single event.

- Mechanism for failure: Translational sliding along a fully softened plane of weakness which may develop where a well-defined competency contrast exists at the interface between residual soils and underlying weathered bedrock or between soil types with contrasting consistency.

- Trigger: Prolonged extreme to heavy rainfall and excessive high flow run off resulting in high surface water infiltration causing increased pore water pressure, and particle detachment from overland flow. Seeping surface water through flow causing softening of soil/rock interface. May also be triggered by earthquake.

Hazard D. Translational earth slide beneath dwelling

- Deeper (1.5-2.0m deep), wider (15-20m wide), translational earth slide of residual soils. Length of area affected up to 30m. Estimated volume range of sliding mass between 675m^3 and 1200m^3.

- Failure may develop quickly or very slowly. Movement likely to be moderately fast to rapid in small increments but overall very slow. Likely to move in slices. Horizontal displacement may be expected up to 1m.

- Mechanism for failure: Translational sliding along a fully softened plane of weakness which may develop where a well-defined competency contrast exists at the interface between residual soils and underlying weathered bedrock. Possible release point at road cutting.

- Trigger: Prolonged soaking heavy rainfall resulting in increased groundwater through flow or seepage and increased surface water infiltration causing increased pore water pressure, and softening of soil/rock interface. May also be triggered by earthquake.

Hazard E. Deep seated translational rock slide

- Medium size, translational rock slide within weathered bedrock.

- Deeper (3-5m deep), wide (15-30m wide), translational rock slide. Length of area affected up to 40m long. Estimated volume range of sliding mass between 1800m^3 and 6000m^3.

- Failure may develop quickly or very slowly. Movement likely to be moderately fast to rapid in a single event. Initial horizontal displacement may be 10cm up to 10m.

- Depth of failure likely to be within to upper 5-6m of the bedrock weathering zone. Failure may occur deeper where thin interbedded mudstone layers have completely weathered to clay or are faulted. Deeper failure may occur at transition or unit contact between sandstone and mudstone units.

- Mechanism for failure related to translational sliding along weaker, differentially weathered bedding planes, bedding parallel faults and clay seams.

- Triggered by groundwater seeping into sheared bedding planes, open joint sets and other bedrock discontinuities, prolonged continuous heavy rainfall (extreme conditions) or large scale seismic activity and earthquakes.

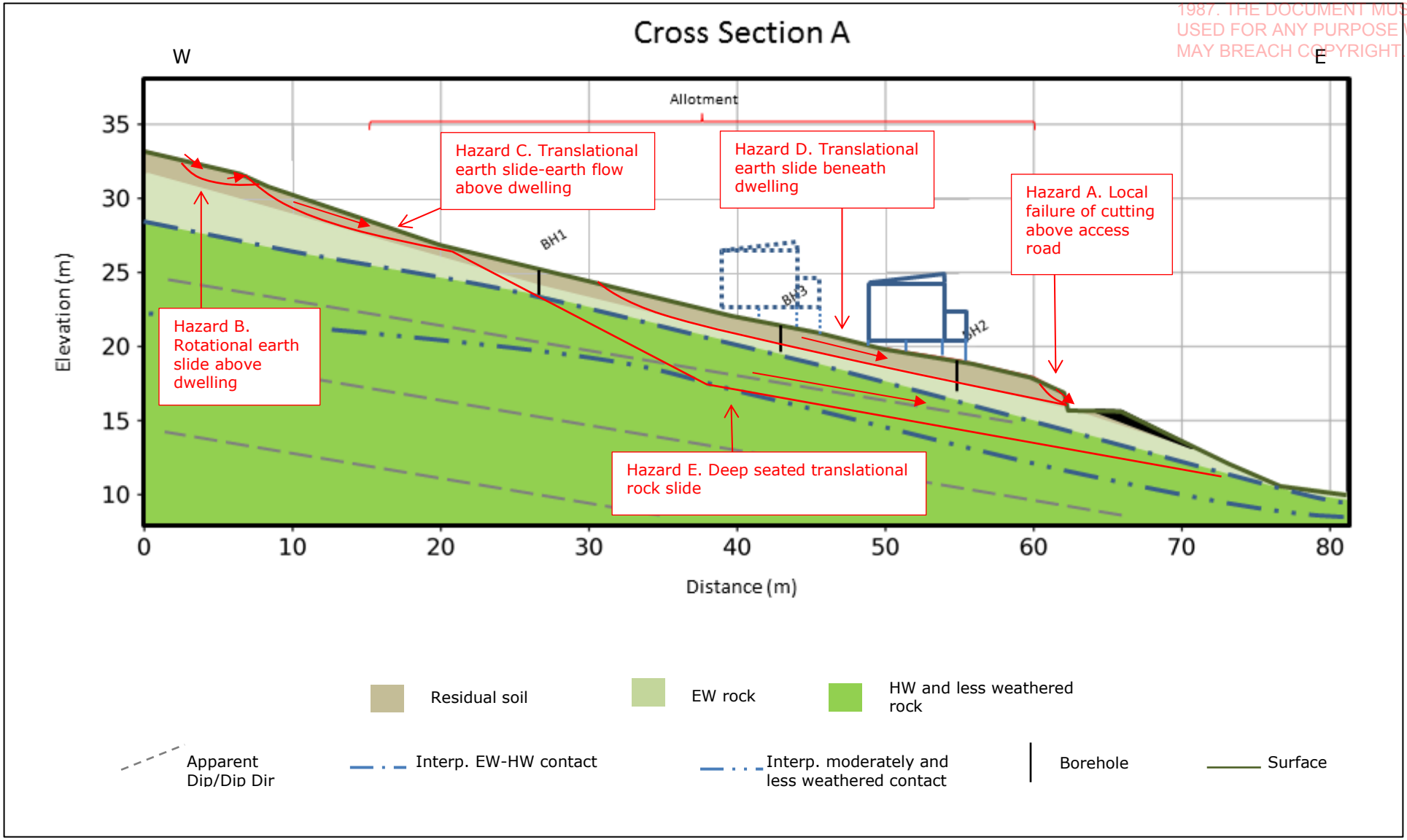


Figure 6: Schematic Cross-section A with possible hazards

5.0 FREQUENCY ANALYSIS

In order to conduct a frequency analysis for each hazard the terminology in Appendix C of the AGS Guidelines (2007) has been adopted to carry out a qualitative assessment as to the *Frequency* or number of hazard events occurring over a given time period This is also referred to as the *Likelihood* which is the qualitative measure of frequency or probability of an event occurring subject to a quantified measure of belief.

Hazard A. Local failure of cutting above access road

- Existing cutting 800mm high with over steep face.
- Moderately steep slopes above cutting (11-12^{o}).
- Run on expected and ponding, perched surface water observed.
- No evidence of recent or previous failure
- Likelihood of occurring during design life: **LIKELY.**

Hazard B. Rotational earth slide above dwelling

- Highly susceptible slopes with easterly aspect.
- Moderately steep slopes above cutting (11-15^{o}).
- Run on expected.
- Evidence of possible similar hazard occurring in the past.
- 1m soil profile
- Likelihood of occurring during design life: **POSSIBLE.**

Hazard C. Translational earth slide-earth flow above dwelling

- Moderately steep to steep slopes (15-20^{o}).
- High potential for surface water run on; bare soils and limited vegetation above. Expect high flow surface water.
- Highly susceptible slopes with easterly aspect.
- Existing medium sized trees but limited understorey for intercepting run on.
- Moist subsurface conditions.
- Evidence of small landslides occurring in the past above site.
- Likelihood of occurring during design life: **POSSIBLE.**

Hazard D. Translational earth slide beneath dwelling

- Moderately steep natural slopes (10-15^{o}).
- Bedrock structure dips oblique to slope direction.
- High potential for surface water run on. Ponding, perched surface water present.
- Thick grassy vegetation coverage. Existing large trees limited understorey for intercepting run on.
- Very moist subsurface conditions.
- No signs of existing tension cracks or signs of slope movement.
- Existing unsupported cuttings down slope.
- East facing slopes with high susceptibility.
- Likelihood of occurring during design life: **POSSIBLE.**

Hazard E. Deep seated translational rock slide

- Massive to thickly bedded sandstone.
- Bedrock structure dips 14^{o} oblique to slope direction.
- Bedrock planes do not daylight out of the onsite. Release point above Great Ocean Road
- Moderately steep natural slopes (10-15^{o}).
- No signs of tension cracks or soil creep.
- Historical evidence of larger deep seated failure nearby.
- Open joints, infilled and/or weathered clay seams are possible and have been observed along Great Ocean Road.
- Past seismic evidence suggests intraplate earthquakes are infrequent, off shore and of generally low magnitude in the Victorian coastal area. Probably requires an earthquake of high magnitude and shallow depth to initiate landslide.
- **E1**: Likelihood of 1cm of movement in a single event: **POSSIBLE**
- **E2**: Likelihood of 1m of movement in a single event: **UNLIKELY**
- **E2**: Likelihood of 10m of movement in a single event: **RARE**

6.0 CONSEQUENCE ANALYSIS

6.1 CONSEQUENCE TO PROPERTY

Consequence to property considers the potential damage and cost of the damage to the element at risk. This is done in relation to characteristics of the particular hazard such as the volume of the landslide, the position of the element at risk, the magnitude of the displacement of the landslide and the rate of movement of the landslide. Consequence has been evaluated qualitatively using the terminology in Appendix C of the AGS Guidelines (2007) and is summarised in Table 3 and Table 4.

6.2 CONSEQUENCE TO LIFE

Consequence to life is evaluated quantitatively by considering the vulnerability ($V_{(D:T)}$) of the individual impacted by the landslide hazard. The *Vulnerability* of the individual may also be referred to as the likelihood of deaths or injury of the person subjected to the hazard.

Appendix F of the AGS Guidelines (2007) provides vulnerability values derived from data collected from studies of landslide events in Hong Kong, for a person in a building or in a vehicle. The relevant part of the study is reproduced below in Table 2:

Table 2: Hong Kong Vulnerability Recommended Values for Loss of Life

Case	Range in Data	Recommended Value	Comments
Person in a Vehicle If vehicle is buried/crushed	0.9 – 1.0	1.0	Death almost certain
If vehicle is damaged only	0 – 0.3	0.3	High chance of survival
Person in a Building If building collapses	0.9 -1.0	1.0	Death is almost certain
If building is filled with debris and person buried	0.8 – 1.0	1.0	Death is highly likely
If debris strikes building only	0 – 0.1	0.05 (5×10^{-2})	Very high chance of survival

7.0 RISK ASSESSMENT

7.1 RISK ASSESSMENT TO PROPERTY

Based on the measurements and observations that we have made, the conclusions drawn by other researchers and using the procedure and terminology from the AGS Guidelines (2007), the risks to property (over the design life of a building – nominally 50 years) can be summarised for each of the events described above, as shown in Table 3 and Table 4.

For an explanation of terms used and an example of a risk analysis matrix, refer to the attached "Appendix C" of the AGS Guidelines (2007) provided in this report as Appendix VI.

Table 3: Risk Assessment for Property in Unmitigated Conditions

HAZARD		ELEMENT AT RISK	LIKELIHOOD	CONSEQUENCE	RISK TO PROPERTY
A	Local failure of cutting above access road	Access Road	LIKELY	INSIGNIFICANT	**LOW**
B	Rotational earth slide above dwelling	Dwelling; Infrastructure	POSSIBLE	INSIGNIFICANT	**VERY LOW**
C	Translational earth slide-earth flow above dwelling	Dwelling; Infrastructure	POSSIBLE	MINOR	**MODERATE**
D	Translational earth slide beneath dwelling	Dwelling	POSSIBLE	MEDIUM	**MODERATE**
E_1	Deep seated translational rock slide with 10cm of movement	Dwelling; Infrastructure;	POSSIBLE	MINOR	**MODERATE**
E_2	Deep seated translational rock slide with 1m of movement	Dwelling; Infrastructure	UNLIKELY	MEDIUM	**LOW**
E_3	Deep seated translational rock slide with 10m of movement	Dwelling; Infrastructure	RARE	MAJOR	**LOW**

Table 4: Risk Assessment for Property in Mitigated Conditions

HAZARD		ELEMENT AT RISK	MITIGATION MEASURES	LIKELIHOOD	CONSEQUENCE	RISK TO PROPERTY
A	Local failure of cutting above access road	Access Road	Batter cutting on eastern boundary to safe batter angle and revegetate; provide surface drainage above cutting and around any future driveway to prevent surface water ponding above or running over the face to the cutting.	**POSSIBLE**	INSIGNIFICANT	**VERY LOW**
B	Rotational earth slide above dwelling	Dwelling; Infrastructure	Accept the risk	POSSIBLE	MINOR	**VERY LOW**
C	Translational earth slide-earth flow above dwelling	Dwelling; Infrastructure	Deepen footings into competent bedrock; provide cut off and surface drainage along western (up slope) boundary; revegetate slopes along western boundary with deep rooted trees and shrubs.	POSSIBLE	MINOR	**MODERATE**
D	Translational earth slide beneath dwelling	Dwelling	Deepen footings into competent bedrock; provide cut off and surface drainage along western boundary and immediately behind dwelling; raise dwelling above surface and avoid site cuts; ensure good drainage around dwelling to prevent surface water ponding or concentrating; drain all surface water and storm water to legal point of discharge	**UNLIKELY**	MEDIUM	**LOW**
E_1	Deep seated translational rock slide with 10cm of movement	Dwelling; Infrastructure;	Deepen footings into competent bedrock; provide cut off and surface drainage along western (up slope) boundary; revegetate slopes along western boundary with deep rooted trees and shrubs.	**UNLIKELY**	MINOR	**LOW**
E_2	Deep seated translational rock slide with 1m of movement	Dwelling; Infrastructure	As above; accept the risk	UNLIKELY	MEDIUM	**LOW**
E_3	Deep seated translational rock slide with 10m of movement	Dwelling; Infrastructure	As above; accept the risk	RARE	MAJOR	**LOW**

7.2 RISK ASSESSMENT TO LIFE

The AGS guidelines (2007) recommend that the risk of loss of life be calculated quantitatively to ensure that the value obtained does not exceed the value of "TOLERABLE RISK" which is defined as "the risk that society can live with" and has a value defined by Schedule 1 to the Otway Ranges Shire EMO as 10^{-5} per annum (a reassurance interval of 1 in 100, 000).

The quantitative risk for loss of life is calculated using the following formula:

$$\mathbf{R = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}}$$

Where
- **R** is the risk (the annual probability of loss of life)
- **$P_{(H)}$** is the annual probability of the hazardous event (the landslide)
- **$P_{(S:H)}$** is the probability of spatial impact by the hazard, given the event
- **$P_{(T:S)}$** is the temporal probability, given the spatial impact
- **$V_{(D:T)}$** is the vulnerability of the individual

For each of the conceivable events that may occur on this site as described above, the risk to life is calculated using the above mentioned formula. Results of the calculations are documented in Table 5.

7.2.1 Explanation of quantitative risk to life calculations

The values presented in the Table 5 are summed to achieve the estimated risk to life shown "R" in the table. Note that these calculations refer to an individual inside the building; the risks to a person outside have not been considered.

$P_{(T:S)}$ is calculated with respect to a person in a building as follows:

Annual occupancy of the dwelling: 6/12 months (part time/holiday residence)
Daily occupancy of the dwelling 20/24 hours
Building affected by the event: 1 (or 0.5 for part of the building)
Location of individual in the part of the building: 1/4
Location of individual in the residence if the building collapses: 1

Where part of the building is affected by the event, the calculation for $P_{(T:S)}$ is:
$P_{(T:S)}$ = 6/12 x 20/24 x 0.5 x 1/4 = **0.052 or $5.2\ 10^{-2}$**

Where part of the building is affected by the event and that part collapses, $P_{(T:S)}$ is:
$P_{(T:S)}$ = 6/12 x 20/24 x 0.5 x 1 = **0.21 or 2.1×10^{-1}**

Where the whole building is affected by the event but doesn't collapse $P_{(T:S)}$ is:
$P_{(T:S)}$ = 6/12 x 20/24 x 1 x 1/4 = **0.10 or 1.0×10^{-1}**

Where the whole building is affected by the event and the house collapses $P_{(T:S)}$ is:
$P_{(T:S)}$ = 6/12 x 20/24 x 1 x 1= **0.42 or 4.2×10^{-1}**

$P_{(T:S)}$ is calculated with respect to a person in a vehicle belonging to the subject Site as follows:

Annual occupancy of the dwelling: 6/12 months
Daily occupancy of the vehicle (0.16/24) hours (5 min, 2 times a day)

$P_{(T:S)} = 0.5 \times 6.9 \times 10^{-3} =$ **3.45×10^{-3}**

A vulnerability value of 0 (zero) has been adopted for hazards that are not expected to impact any building or vehicle. We have adopted a $P_{(S:H)}$ value of 0.05 for the small or distal hazards, values of 0.1-0.5 for medium scale or intermediate distance failure events and values of 0.5-1.0 for the large scale failure event or a proximal hazard which could result in collapse or destruction of the building.

Table 5: Risk Assessment for Loss of Life in Unmitigated Conditions

Hazard		Element At Risk	Likelihood	P(H) Annual Probability	P(S:H) Spatial Impact Probability	Temporal Considerations	P(T:S) Temporal Probability	Vulnerability Comments	V(D:T) Vulnerability	R Loss To Life Annual Probability
A	Local failure of cutting above access road	Vehicle	LIKELY	10^{-2}	0.3	5 min exposure 2 times daily	0.00345	Not expected to impact vehicle	0	0
B	Rotational earth slide above dwelling	Dwelling	POSSIBLE	10^{-3}	0.1	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0
C	Translational earth slide-earth flow above dwelling	Dwelling	POSSIBLE	10^{-3}	0.4	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Minor damage to the building	0.05	1.0×10^{-6}
D	Translational earth slide beneath dwelling	Dwelling	POSSIBLE	10^{-3}	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.1	Moderate damage to the building, not expected to collapse	0.4	**4.0×10^{-5}**
E_1	Deep seated translational rock slide with 10cm of movement	Dwelling	POSSIBLE	10^{-3}	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.1	Minor damage to the building, not expected to collapse	0.05	5.0×10^{-6}
E_2	Deep seated translational rock slide with 1m of movement	Dwelling	UNLIKELY	10^{-4}	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.21	Minor damage to the building, part may collapse	0.8	1.7×10^{-6}

Hazard		Element At Risk	Likelihood	P(H) Annual Probability	P(S:H) Spatial Impact Probability	Temporal Considerations	P(T:S) Temporal Probability	Vulnerability Comments	V(D:T) Vulnerability	R Loss To Life Annual Probability
E_3	Deep seated translational rock slide with 10m of movement	Dwelling	RARE	10^{-5}	1.0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.42	Expected to collapse	0.9	3.8×10^{-6}

Table 6: Risk Assessment for Loss of Life in Mitigated Conditions

Hazard		Element At Risk	Likelihood	P(H) Annual Probability	P(S:H) Spatial Impact Probability	Temporal Considerations	P(T:S) Temporal Probability	Vulnerability Comments	V(D:T) Vulnerability	R Loss To Life Annual Probability
A	Local failure of cutting above access road	Vehicle	**POSSIBLE**	**10^{-3}**	0.3	5 min exposure 2 times daily	0.00345	Not expected to impact vehicle	0	0
B	Rotational earth slide above dwelling	Dwelling	POSSIBLE	10^{-3}	0.1	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0
C	Translational earth slide-earth flow above dwelling	Dwelling	POSSIBLE	10^{-3}	0.4	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Minor damage to the building	0.05	1.0×10^{-6}
D	Translational earth slide beneath dwelling	Dwelling	**UNLIKELY**	**10^{-4}**	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.1	Moderate damage to the building, not expected to collapse	**0.1**	**1.0×10^{-6}**
E_1	Deep seated translational rock slide with 10cm of movement	Dwelling	**UNLIKELY**	**10^{-4}**	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.1	Minor damage to the building, not expected to collapse	0.05	**5.0×10^{-7}**
E_2	Deep seated translational rock slide with 1m of movement	Dwelling	UNLIKELY	10^{-4}	1.0	Assume 20 hrs. occupancy per day for person most at risk; whole building affected	0.21	Minor damage to the building, part may collapse	0.8	1.7×10^{-6}

Hazard		Element At Risk	Likelihood	P(H) Annual Probability	P(S:H) Spatial Impact Probability	Temporal Considerations	P(T:S) Temporal Probability	Vulnerability Comments	V(D:T) Vulnerability	R Loss To Life Annual Probability
E_3	Deep seated translational rock slide with 10m of movement	Dwelling	RARE	10^{-5}	1.0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.42	Expected to collapse	0.9	3.8×10^{-6}

8.0 SUMMARY OF RISKS AND CONCLUSION

Our assessment has found that there are risks to loss of life and to damage of property on the subject site due to conceivable landslide events.

The risks to property associated with developing a residential dwelling on the subject site assuming **existing conditions remain or development is unmitigated,** are considered "MODERATE" (for the most at risk element). The risk to life is also above the recommended "TOLERABLE" risk limit defined as 1 x 10^{-5} by the AGS Guidelines (2007) and Schedule 1 to the Colac-Otway Shire EMO.

The risks to property can be reduced if recommended mitigation measures are adhered to.

The risks to property associated with developing a residential dwelling on the subject site assuming **risk management conditions are implemented,** can be reduced to "LOW" or "VERY LOW" for most hazards while at least one hazard will remain at a "MODERATE" risk level. In quantitative terms, the risk to life can be reduced to below the recommended "TOLERABLE" risk limit for all hazard elements.

Based on our assessments of the risks, we conclude that there are no geotechnical reasons to prevent the issue of a permit to develop on this site, subject to the implementation of the following recommendations, which outline management strategies to reduce or maintain the likelihood and/or consequences of the major risk events.

9.0 RECOMMENDATIONS FOR RISK MANAGEMENT

It is not feasible to remove all of the risks of building on the site but the risks can be reduced by good engineering design, by following good hillside construction practices and by regular and frequent site maintenance. The following recommendations outline general good building practice for steep slopes and landslide prone areas.

9.1 SITE RECOMMENDATIONS

Note that an increase in landslide risk may be expected if an inappropriate development is undertaken or if site maintenance is neglected. Maintaining the site drainage and monitoring the site and buildings for any evidence of soil or slope movement are very important aspects of the ongoing site maintenance requirements.

For this site we recommend a light weight, flexible modular design raised on columns and supported on pier or pile footings.

9.2 SITE CLASSIFICATION

We have generally classified the soil profile as "Class P" in accordance with Section 2 of AS2870-2011 (Australian Standard on Residential Slabs and Footings). This classification is due to the potential risk of landslide hazards as defined by Clause 2.1.3(d) of the Standard.

Having all footings appropriately designed and founded may mitigate the risk of damage due to soil movement or slope failures.

9.3 FOOTINGS

Having all footings appropriately designed and founded will reduce the risk of damage due to soil movement or slope failures. As well as founding structures to a stable base, deep footings have the ability to provide similar root-binding effects to that of deep rooted trees, which contribute to minimising the likelihood of deep seated soil failures.

We recommend engineer-designed footings designed according to engineering principles. The designer should assume **moderate** soil profile relativity.

Footings must be founded through any fill and/or overlying residual soils, and embedded a **minimum** of 1000mm into the **highly weathered bedrock or Competent Rock**. At this depth a maximum Allowable Bearing Pressure of 400kpa may be adopted.

Minimum foundation depths can be expected between 2200mm and 2600mm (from the existing surface level) to ensure proper rock socketing.

Our investigation revealed that in the three test sites excavated on site proximal to the proposed building envelope, suitable founding depths exist as follows:

Table 7: Suitable Foundation Conditions

Test Site Number	Depth below existing surface to weathered rock	Minimum Founding Depth	Recommended Founding Material	Presumed Maximum Allowable Bearing Capacity	Presumed Maximum Allowable Skin Friction
1	1000mm	2500mm+	Competent Sandstone	400 kPa	40kPa
2	1400mm	2800mm	Competent Sandstone	400 kPa	40kPa
3	1400mm	2700mm+	Competent Sandstone	400 kPa	40kPa

Note: Competent Rock is expected to be found a **minimum** of 1000mm below the surface of highly weathered rock (refer to borehole logs in Appendix IV) and can be defined as rock which is difficult to excavate or auger with a 5 tonne excavator.

The above quoted depth to competent rock is estimated from our investigation and our previous experience, however the depth to competent rock can vary significantly. Founding depths more than twice the depths quoted above could occur due to natural soil and rock variability. Pile depths of up to 6000mm may be required where depth to less weathered bedrock naturally varies. The depth is measured from surface level at the time of testing and will vary if the site is cut and/or filled.

An experienced geotechnical professional (engineering geologist or geotechnical engineer) should be present **during** all footing excavations to ensure the appropriate foundation has been achieved.

9.4 SITE EXCAVATIONS, CUT AND FILLS AND RETAINING STRUCTURES

It is recommended that any new site excavations for positioning of the dwelling should be kept to a minimum and that **all** site excavations should be retained regardless of height unless battered at an appropriate safe shallow angle. **All** excavations equal to or greater than 1000mm must be supported by engineer-designed retaining walls with appropriate drainage features or battered at an appropriate safe shallow angle.

We highly recommend that the proposed site cuttings be inspected by an engineering geologist or geotechnical engineer immediately following excavation in order to assess bedrock structures and defects. Additional recommendations may be required subject to the findings of the inspection.

Retaining Walls

Retaining walls should be designed for active earth pressure conditions provided that some wall yield is acceptable. It is recommended that the following Active Earth Pressure Coefficients (Ka) be adopted for the wall design. The following earth pressure coefficients **do not** consider the application of any geotechnical reduction factors.

Table 8: Active Earth Pressure Coefficients

SOIL TYPE	ACTIVE EARTH PRESSURE COEFFICIENT (Ka)
silty CLAY	0.44

Table 9: Passive Earth Pressure Coefficients

SOIL TYPE	PASSIVE EARTH PRESSURE COEFFICIENT (Kp)
silty CLAY	2.15

If the retaining wall is to form part of the building structure restrained from movement above and below by the integral structure of the building, then the following At Rest Earth Pressure Coefficients (Ko) may be used.

Table 10: At Rest Earth Pressure Coefficients

SOIL TYPE	AT REST EARTH PRESSURE COEFFICIENT (Ko)
silty CLAY	0.7

The recommended parameters assume a vertical wall and an inclined backslope of 10^{o} with granular backfill behind the wall as well as a horizontal foreslope in front of the wall of at least 2.0m wide. Wall friction between soldier piles and soil/rock is based on the assumption that piles will be founded in rock. If retaining wall conditions differ from those described, then a change in design parameters will be required.

Any retention system should be designed so that the soil behind the retaining wall is completely and permanently drained. If this cannot be achieved, hydrostatic pressure must be included in the design. Retaining wall backfill should be comprised of free draining granular material. Under no circumstances should backfill comprise of poorly compacted non-granular material. It is recommended that a non-woven geotextile filter be installed in subsurface drains to minimize silting and erosion of backfill.

Specific Retaining Wall Design

Specific retaining wall design parameters should be determined by the application of an accepted design theory (e.g.: Rankin Earth Pressure Theory or Coulomb Earth Pressure Theory). The following geotechnical parameters are judged to be typical values for the types of ground materials present on site.

Table 11: Typical Geotechnical Parameters

	silty CLAY	EW Rock	HW sandstone Rock[1]
Wet or total unit Weight (γ_w)	19 kN/m^3	20 kN/m^3	25 kN/m^3
Effective Friction angle (Φ')	24°	30°	39°
Effective Cohesion (c')	2kPa	25kPa	50kPa
Undrained shear strength (c_u or S_u)[2]	25-100kPa		
Unconfined compressive strength (q_u)		0.7MPa	3MPa

Additional testing may be required to determine more site specific design parameters such as wet density, suction, cohesion and angle of internal friction, before the design of the retaining walls or the determination of a safe batter angle can be finalised.

Slope Stability – Short Term

In order to ensure adequate stability of filled or excavated slopes in the short term (i.e. 2 consecutive days, in fine weather) the following maximum batters should be adopted.

Table 12: Temporary Batter Angles

SOIL TYPE	MAXIMUM TEMPORARY SLOPE (To Horizontal)
Topsoil (clayey silts, silty sands, clayey sands)	45° or 1(V):1(H)
Subsoils (clay, sandy clay, silty clay)	45° or 1(V):1(H)
New or existing fill	45° or 1(V):1(H)
Highly weathered to fresh rock[3]	60° or 2(V):1(H)

All excavations should be inspected to ensure that stability is adequate and to identify any possible zone of instability e.g. unfavourable jointing, fault zones. The stability of vertically excavated slopes, e.g. for the insertion of precast panels, cannot be guaranteed.

If poor weather conditions are encountered (i.e. heavy rain, etc.) at the time of excavation or panel insertion, immediate shoring of the batters should be carried out.

Permeable soils that become inundated may lose form. If excavations are undertaken during wet periods a shoulder to shoulder pile system may be required **or** a proven diversion drainage system may need to be installed prior to site works.

[1] These strength parameters apply to failure through the rock mass and do not take into account failures controlled by geological structures such as along clay filled bedding planes, joints or faults.
[2] Not to be used for long term stability
[3] Steeper angles maybe possible in some less weathered rock depending on the nature of the geological structure, but would require site specific assessment during excavation by an experienced geotechnical professional.

Permanent Earthworks

Any fill introduced to the site should contain little or no organics and be placed in layers up to 200mm thick with each layer being well compacted at the appropriate moisture content. All permanent fill batters or cuts in natural soils must not exceed slope angels 27° or 1(V):2(H) or alternatively be retained by engineer designed retaining walls with appropriate footings and drainage works.

In order to ensure adequate stability of filled or excavated slopes in the long term the following maximum batters should be adopted.

Table 13: Permanent Batter Angles

SOIL TYPE	MAXIMUM PERMANENT SLOPE (To Horizontal)
Topsoil (clayey silts, silty sands, clayey sands)	27° or 1(V):2(H)
Subsoils (clay, sandy clay, silty clay)	27° or 1(V):2(H)
New or existing fill	27° or 1(V):2(H)
Highly weathered to fresh rock[4]	45° or 1(V):1(H)

All cut and fill batters should be revegetated with fast growing deep rooted plants as soon after construction as possible to protect the batter face.

Care must also be taken to ensure that any levelled areas have a slight fall to prevent surface water from ponding or seeping into the ground near the base of any site cut. The construction of appropriately designed walls or battered slopes will reduce the risk of soil movement and the collapse of any proposed site excavations.

9.5 VEHICLE PARKING AND ACCESS

It is recommended that suitably designed drainage accompany any design of access ways to minimise surface water run-off and overland flow. It is recommended that some consideration be given to a drainage system which may include the use of a spoon drain and culvert system as part of the overall drainage design for the site to ensure surface water is collected and diverted to an approved drainage system and discharged into the municipal stormwater network.

9.6 SITE DRAINAGE

Many researchers identify intense rainfall and/or poor site drainage as a common trigger of landslide events. Whilst nothing can be done to reduce the likelihood of intense rainfall in the Grey River area, steps can be taken to improve site drainage and minimise saturation of the soil layers which often triggers soil movement. Careful attention to drainage is essential to reduce the landslide risk and surface water must therefore be prevented from ponding anywhere on the site. We recommend that the drainage system for the site be fully engineer designed. We expect that the roof run-off will be collected in tanks and that overflows should be connected to the site drainage system and discharge excess water in a non-destructive way to an approved point of discharge. It is very important that roof run-off is not allowed to run onto the ground anywhere on site.

[4] Steeper angles maybe possible in some less weathered rock depending on the nature of the geological structure, but would require site specific assessment during excavation by an experienced geotechnical professional.

As part of the overall drainage design for this site, we recommend the use of subsurface cut off drainage and surface water diversion installed along the up slope western boundary and immediately behind the final position of the dwelling. Cut off drains should be designed to intercept potential groundwater seepage through the residual soil profile. The cut-off drains should be a minimum of 1m deep, (but may be shallower where bedrock is encountered) and contain a sub-surface drain wrapped in geofabric to minimise clogging. Inspection openings should be provided to enable periodic flushing. The drain should have sufficient fall to discharge completely into the Site's drainage infrastructure.

Surface drainage (catch drains or diversion berms) is recommended above the crest of all cut and fill embankments and within all levelled or benched areas to ensure surface water does not concentrate and pond anywhere on site or be allowed to run off over the face of any cut or fill batters.

Surface drainage should also be carefully designed and installed around proposed building. The site drainage system must discharge to a legal point of discharge and connect to local government drainage infrastructure in drainage easements where available.

Where the soil surface is altered to construct vehicle parking bays, recreation areas etc., precautions must be taken to ensure excess surface water cannot pond or soak into the ground but is diverted off site to a seal drainage network.

Careful attention to site drainage will reduce the risk of slope failures or soil movements.

9.7 SITE VEGETATION

Suitable vegetation contributes greatly to the stability of a site by reducing the soil moisture content, minimizing soil erosion and binding the soil structure together. Existing trees should remain unless they interfere with the building or the minimum defendable space for fire protection in which case they should be cut off at ground level and the root structures left intact.

Several trees have been marked for removal as part of the current proposal. Generally the root structures have been nominated to remain with the exception of one small tree which interferes with the building envelope. Removal of root structures for this one tree is not likely the impact the slope stability of this site as deepened footings penetrating through the overlying soils and socketing into rock will replace the root structures and provide similar stabilising effects. Additional drainage may be required along the southern boundary adjacent to the dwelling to ensure surface water does not seep into the disturbed soil where root structures have been removed.

We recommend that a re-vegetation program be implemented for the entire development area especially on cut and fill embankments and along the western boundary. Suitable deep rooted trees, shrubs and grasses should be established an appropriate distance from the building with regard to fire risk to assist the overall slope stability.

Revegetation of the site will provide root-binding effects, help mitigate excess moisture building up in the soil profile, increase suction and assist with rainfall and surface flow interception and reduce the velocity of overland flow in turn reducing the risk of slope failures.

9.8 EFFLUENT DISPOSAL

Effluent should be disposed of offsite where reticulated mains sewer is available.

If onsite waste water treatment is required then it should, where possible, be widely dispersed by subsurface irrigation well away from the development area to minimise the likelihood of

wastewater concentrating in the soil profile. Suitable dense, high transpiration vegetation will assist with evapotranspiration.

We recommend reducing the potential waste water loading as much as possible to minimise the required land application area. This could be achieved in a number of ways such as ensuring a minimum of three star water saving fixtures are installed throughout the dwelling, utilising a split blackwater/greywater treatment with minimum advanced secondary treatment, incorporating a third pipe for recycling advanced secondary treated greywater for use in toilets and laundry's or utilising incinerating toilets to reduce daily loading rates.

If an irrigation disposal field is to be constructed behind (up-slope of) the development then a cut-off drain **must** be constructed between the irrigation field and the dwelling. The cut-off drain should be a minimum of 1m deep (but may be shallower where bedrock is encountered) and contain a sub-surface drain wrapped in geofabric to minimise clogging. Inspection openings should be provided to enable periodic flushing. The drain should have sufficient fall to discharge completely to an area well away from the house.

9.9 EROSION

Re-vegetation of bare surface slopes is critical to minimising the effect of sheet, tunnel and rill erosion. Vegetation adds organic material back into the soil, improving soil structure and binding the topsoil layers. Surface vegetation and low shrubs also intercept surface water runoff and slow the rate of surface flow thus minimising the physical impact of surface water runoff across sloping sites.

Additional measures to help prevent erosion caused by surface water include implementing good drainage design to capture surface water runoff and using surface berms, vertical drops and energy dissipaters within the landscape design to reduce the velocity of runoff down slope.

9.10 GENERAL RECOMMENDATIONS

The satisfactory performance of buildings on this site depends on good engineering and building practice. This includes:

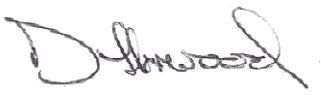
a) the design of an appropriate development for the site;

b) the provision of adequate retaining structures and drainage for all cut faces (or batter at an appropriate angle);

c) adequate site drainage is essential, surface water and excess roof water must not be allowed to pond or seep into the ground near buildings.

d) regular maintenance of open drains.

Refer also to the attached Appendices for more general advice.



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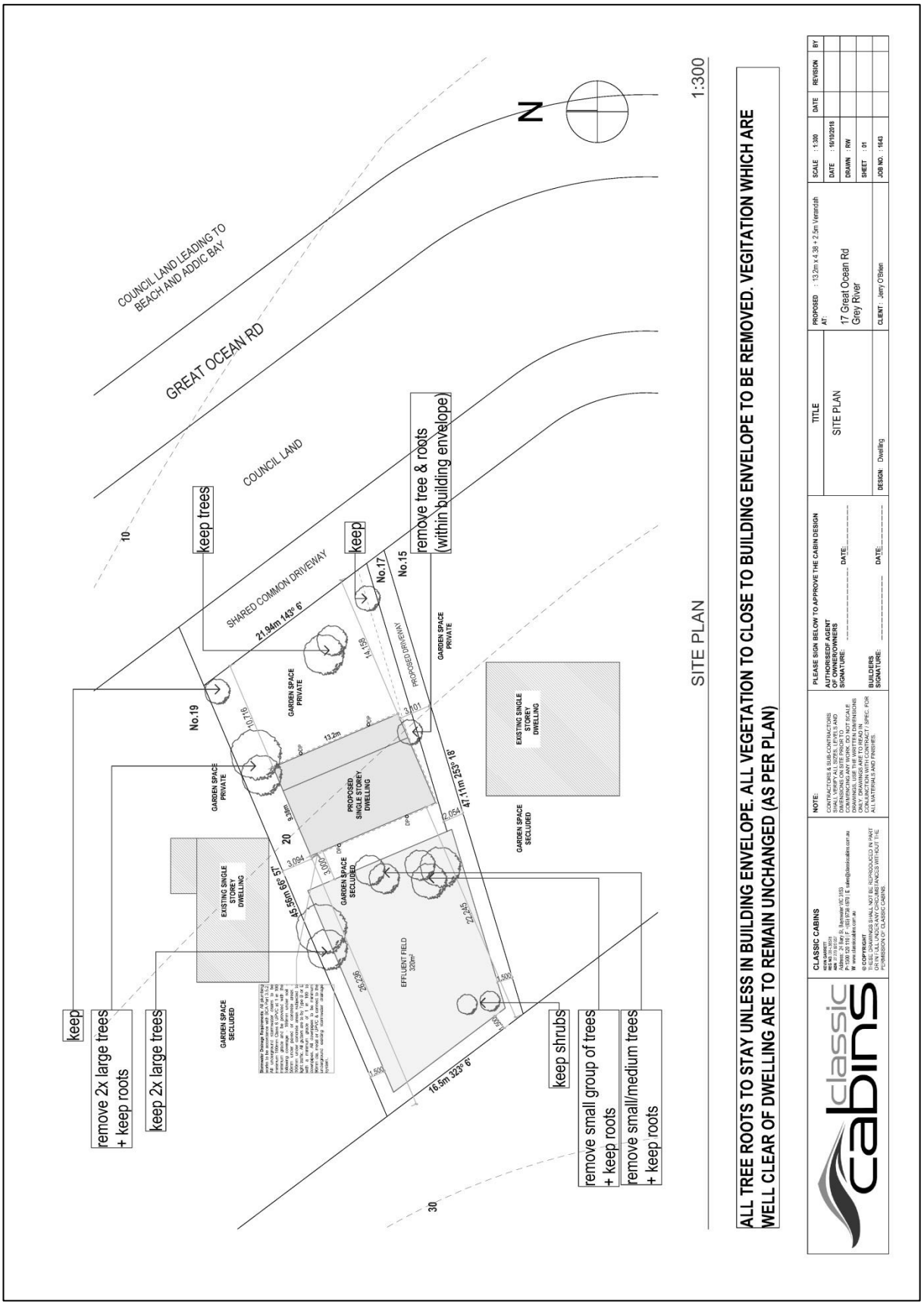
Appendix I: Aerial Photograph

Appendix II: Site Plan



Appendix III: Site Photographs

Photo 1: Over view of the site from the front of the property.

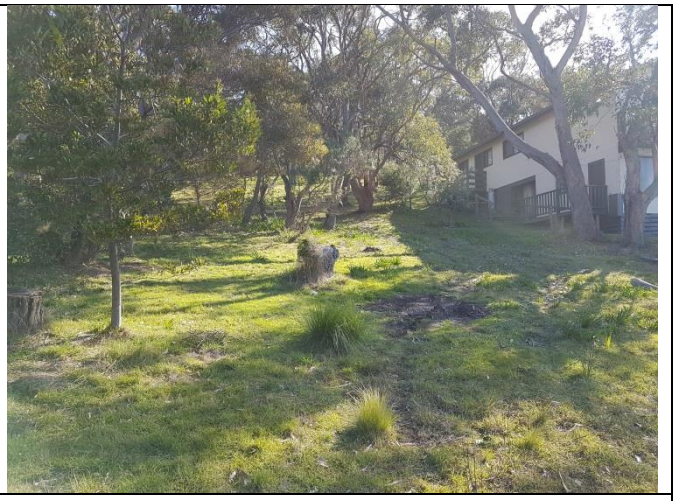


Photo 2: Overview site looking west.

Photo 3: View of the site looking east from the up slope (western) boundary.

Photo 4: Cleared area above site looking west.

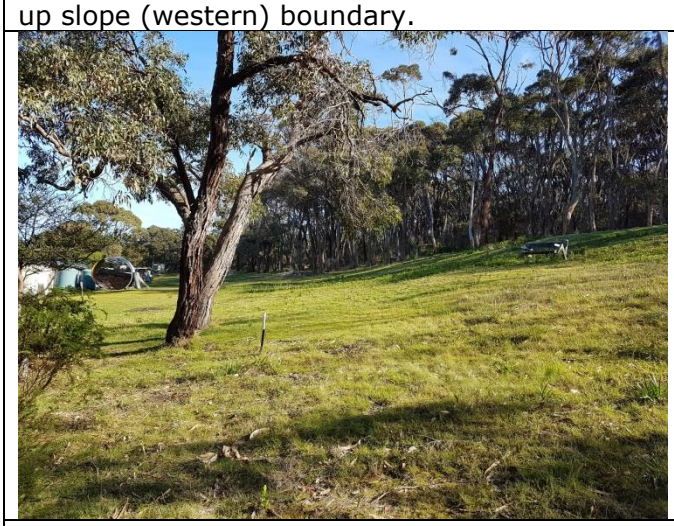


Photo 5: View from the western boundary looking south-west.

Photo 6: View from the western boundary looking north-west.

Appendix IV: Test Site Logs

Client:	Gerry O'Brian	Bore Hole No.	1
Project Address:	17 Great Ocean Road Grey River	Field Work Completed By:	DH
Reference No:	18G289GTA	Field Work Date:	225/8/2018
Drilling Medthod:	Continuous Flight Auger		
From	0	To	1600

Depth mm	Graphic Log	Group Symbol	Material Description			Shade	Colour	Mottle	Moisture	Consistency/ Density	Field Test
100			clayey SILT		very low plasticity	Dk	Br		VM	S	
200			with sand			Dk	Gy		VM	VS	PP 0.1
300			sandy CLAY		fine grained	Dk	Gy / Br	Or mottle	VM	VS	PP 0.1
400			with silt		low-med plasticity					VS	PP 0.2
500									M	F	PP 1
600										F	PP 1.2
700				Grading	Sandy		Gy / Br	Or mottle	M	St	PP 1.5
800										St	PP 2
900									M	VSt	PP 2.5
1000					fine-med grained	Pl	Yl / Br	Or mottle		VSt	VS 120
1100			clayey SAND	with	HW Sandstone Rock Fragments	Dk	Yl / Br		D	D	
1200			extremely weathered sandstone		Very Low strength						
1300			trace clayey pockets			Dk	Br		SM	S	
1400											
1500											
1600			Refusal Bedrock								
1700			Sandstone		Highly Weathered						
1800					Low strength						
1900											
2000											
2100											
2200											
2300											
2400											
2500											
2600											
2700											
2800											
2900											
3000											
3100											
3200											
3300											
3400											
3500											

Comment:

Graphic Log Granular A Horison; Cohesive A Horizon; Cohesive B Horizon; Granular B Horizon; EW Rock/C Horizon; Rock; Fill

Field Test and Sampling	Moisture:	Relative Density:	Consistency:
SPT Standard Penetration Test (Relative density N - blows/300mm)	D Dry	VL	VS Very Soft
PP Pocket Penetrometer (Force kgf/cm^2 - Unconfined Compressive Strength q_u)	SM Slightly Moist	L	S Soft
VS Vane Shear (Undrained cohesive (shear) strength Cu/Su kPa)	M Moist	MD	F Firm
DCP Dynamic Cone Penetrometer (Penetration resistance N_p - blows/100mm)	VM Very Moist	D	St Stiff
Disturbed Sample D Undisturbed Sample U	W Wet	VD	VSt Very Stiff
			H Hard

Compaction: PC Poorly Compacted MC Moderately Compacted WC Well Compacted VC Variably Compacted

Groundwater ▼

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green Pk Pink Wh White

Client:	Gerry O'Brian	Bore Hole	No. 2	Drilling Medthod:	
Project Address:	17 Great Ocean Road Grey River	Field Work Completed By:	DH	Continuous Flight Auger	
Reference No:	18G289GTA	Field Work Date:	225/8/2018	From 0	To 2000

Depth mm	Graphic Log	Group Symbol	Material Description			Shade	Colour	Mottle	Moisture	Consistency/ Density	Field Test
100			clayey SILT		very low plasticity	Dk	Gy / Br		VM	S	
200			with sand						W	VS	▼
300			silty CLAY		medium plasticity	Dk	Gy / Br	Yl mottle	VM	S	VS 24
400			trace sand		medium grained						
500											
600						Dk	Gy / Br	Or mottle	M	St	VS 66
700											
800											
900			sandy CLAY		med-coarse grained	Pl	Gy		M	St	VS 116
1000					low-med plasticity						
1100											
1200						Pl	Gy		M	VSt	VS 160
1300											
1400											
1500			clayey SAND	with	HW Sandstone Rock Fragments	Pl	Yl / Br		D	D	
1600			extremely weathered sandstone		Very Low strength						
1700											
1800											
1900			Sandstone		Highly Weathered	Dk	Or / Br				
2000					Low strength						
2100			Refusal Bedrock								
2200											
2300											
2400											
2500											
2600											
2700											
2800											
2900											
3000											
3100											
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3300											
3400											
3500											

Comment:

Graphic Log Granular A Horison; Cohesive A Horizon; Cohesive B Horizon; Granular B Horizon; EW Rock/C Horizon; Rock; Fill

Field Test and Sampling	Moisture:	Relative Density:	Consistency:
SPT Standard Penetration Test (Relative density N - blows/300mm)	D Dry	VL	VS Very Soft
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DCP Dynamic Cone Penetrometer (Penetration resistance N_p - blows/100mm)	VM Very Moist	D	St Stiff
Disturbed Sample D Undisturbed Sample U	W Wet	VD	VSt Very Stiff
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Compaction: PC Poorly Compacted MC Moderately Compacted WC Well Compacted VC Variably Compacted

Groundwater ▼

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green Pk Pink Wh White

Client:	Gerry O'Brian	Bore Hole	No. 3	Drilling Medthod:	
Project Address:	17 Great Ocean Road Grey River	Field Work Completed By:	DH	Continuous Flight Auger	
Reference No:	18G289GTA	Field Work Date:	225/8/2018	From 0	To 1700

Depth mm	Graphic Log	Group Symbol	Material Description	Shade	Colour	Mottle	Moisture	Consistency/ Density	Field Test
100			clayey SILT — very low plasticity	Dk	Gy / Br		M	S	
200			with sand				W	VS	▼
300									
400			silty CLAY — medium plasticity	Dk	Gy / Br	Or mottle	W	VS	▼
500			trace sand — medium grained						
600									
700							M	St	
800									
900									
1000			silty CLAY — high plasticity	Dk	Gy		M	St	
1100									
1200									
1300			sandy CLAY — medium grained	Pl	Gy		M	VSt	
1400			medium plasticity						
1500			clayey SAND with HW Sandstone Rock Fragments	Dk	Or / Br		D	D	
1600			extremely weathered sandstone — Very Low strength						
1700									
1800			Refusal Bedrock						
1900			Sandstone — Highly Weathered						
2000			Low strength						
2100									
2200									
2300									
2400									
2500									
2600									
2700									
2800									
2900									
3000									
3100									
3200									
3300									
3400									
3500									

Comment:

Graphic Log Granular A Horison; Cohesive A Horizon; Cohesive B Horizon; Granular B Horizon; EW Rock/C Horizon; Rock; Fill

Field Test and Sampling	Moisture:	Relative Density:	Consistency:
SPT Standard Penetration Test (Relative density N - blows/300mm)	D Dry	VL	VS Very Soft
PP Pocket Penetrometer (Force kgf/cm^2 - Unconfined Compressive Strength q_u,)	SM Slightly Moist	L	S Soft
VS Vane Shear (Undrained cohesive (shear) strength Cu/Su kPa)	M Moist	MD	F Firm
DCP Dynamic Cone Penetrometer (Penetration resistance N_p - blows/100mm)	VM Very Moist	D	St Stiff
Disturbed Sample D Undisturbed Sample U	W Wet	VD	VSt Very Stiff
			H Hard

Compaction: PC Poorly Compacted MC Moderately Compacted WC Well Compacted VC Variably Compacted — Groundwater ▼

Colour: Dk Dark Lt Light Bk Black Br Brown Gy Grey Or Orange Yl Yellow Re Red Bl Blue Gn Green Pk Pink Wh White

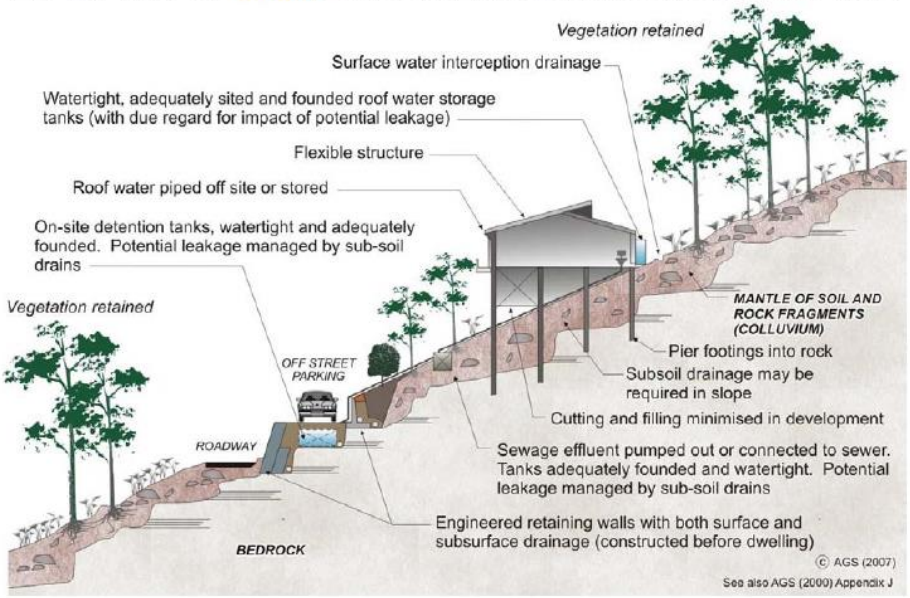
Appendix V: Hillside Construction Practice

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.

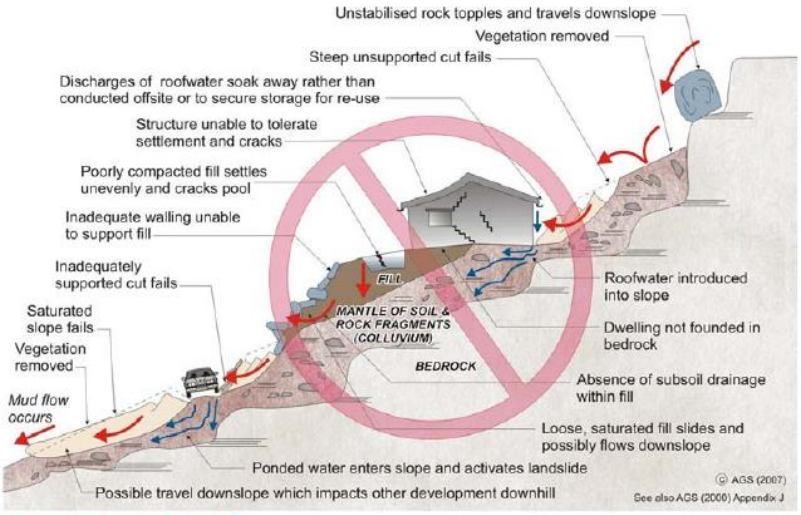
Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact 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

174 Australian Geomechanics Vol 42 No 1 March 2007

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

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 LR9 - Effluent & Surface Water Disposal
- 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.

Australian Geomechanics Vol 42 No 1 March 2007 175

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

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

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

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

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

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

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

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

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

Appendix VII: Geotechnical Declaration

FORM A	Geotechnical Declaration and Verification Development Application	
Office Use Only		Regulator: COLAC-OTWAY SHIRE

To be submitted with a development application. If this form is not submitted with the geotechnical report the report will be refused.
This form is essential to verify that the geotechnical report has been prepared in accordance with Schedule 1 to the Erosion Management Overlay and that the author of the geotechnical report is a geotechnical engineer or engineering geologist as defined by Schedule 1 to the Erosion Management Overlay. Alternatively, where a geotechnical report has been prepared for subdivision or is greater than two years old or by a professional person not recognized by Schedule 1 to the Erosion Management Overlay, then this form may be used as technical verification of the geotechnical report if signed by a geotechnical engineer or engineering geologist as defined by Schedule 1 to the Erosion Management Overlay.

Section 1 Related Application

Reference	
DA Site Address	17 Great Ocean Road GREY RIVER VIC
DA Applicant	Gerry O'Brian

Section 2 Geotechnical Report

Details	Title: Landslip Risk Assessment for 17 Great Ocean Road Grey River	
	Author's Company/Organization Name: AGR Geosciences Pty Ltd	Report Reference No: 18G289LRA
	Author: David J Horwood	Dated: 29 / 10 / 2018

Section 3 Checklist

The following checklist covers the minimum requirements to be addressed in a geotechnical report. This checklist is to accompany the report. Each item is to be cross-referenced to the section or page of the geotechnical report which addresses that item.

Yes	No	Geotechnical Requirements (Tick as appropriate, either Yes or No)
☒	☐	A review of readily available history of slope instability in the site or related land as per *section 4.1; 4.1.2; 4.1.3*
☒	☐	An assessment of the risk posed by all reasonably identifiable geotechnical hazards as per *Sections 4.4, 5.0, 6.0, 7.0*
☒	☐	Plans and sections of the site and related land as per *Figures 1-6, Section 4.0*
☒	☐	Presentation of a geological model as per *Figures 1-7 Section 4.1.1; Section 4.2 & Section 4.3*
☒	☐	Photographs and/or drawings of the site as per *Appendices ii-iii*
☒	☐	A conclusion as to whether the site is suitable for the development proposed to be carried out either conditionally or unconditionally as per *Section 8.0*
☐	☐	If any items above are ticked No, an explanation is to be included in the report to justify why. <*Add reference*>

Subject to recommendations and conditions relevant to:

Yes	No	
☒	☐	selection and construction of footing systems,
☒	☐	earthworks,
☒	☐	surface and sub-surface drainage,
☒	☐	recommendations for the selection of structural systems consistent with the geotechnical assessment of the risk,
☒	☐	any conditions that may be required for the ongoing mitigation and maintenance of the site and the proposal, from a geotechnical viewpoint,
☒	☐	highlighting and detailing the inspection regime to provide the Colac-Otway Shire and builder with adequate notification for all necessary inspections.
☒	☐	State Design life adopted: 50 Years

FORM **A**

Geotechnical Declaration and Verification Development Application

Section 4 List of Drawings referenced in Geotechnical Report

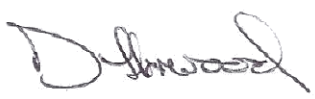
Design Documents

Description	Plan or Document No.	Revision or Version No.	Date	Author
Site Plan 1:300	Sheet 1		16/10/2018	Classic Cabins
Site Plan 1:200	Sheet 2		16/10/2018	Classic Cabins
Floor Plan	Sheet 1		16/10/2018	Classic Cabins
Elevation	Sheet 2		16/10/2018	Classic Cabins

Section 5 Declaration

Declaration (Tick all that apply) Yes		No	
☒	**I am a geotechnical engineer or engineering geologist as defined by the** Schedule 1 to the Erosion Management Overlay **and on behalf of the company below, I:**		
☒	am aware that the geotechnical report I have either prepared or am technically verifying (referenced above) is to be submitted in a support of a development application for the proposed development site (referenced above) and its findings will be relied upon by Colac-Otway Shire in determining the development application.	☐	
☒	prepared the geotechnical report referenced above in accordance with the AGS (2007c) as amended and Schedule 1 to the Erosion Management Overlay.	☐	N/A
☒	am willing to technically verify that the Geotechnical Report referenced above has been prepared in accordance with the AGS (2007c) as amended and Schedule 1 to the Erosion Management Overlay.	☐	N/A
☒	am willing to technically verify that the landslip risk assessment prepared for the development application for the site confirms the land will achieve the level of <*tolerable risk*> of slope instability as a result of the considerations described in Section 2.0 of Schedule 1 to the Erosion Management Overlay taking into account the total development and site disturbances proposed.	☐	No
☐	am willing to technically verify that the landslip risk assessment prepared for the site and related land being greater than two years old confirms the land will achieve the level of <*tolerable risk*> of slope instability as a result of the considerations described Section 2.0 of Schedule 1 to the Erosion Management Overlay *taking into account the total development and site disturbances proposed.*	☒	N/A
☒	have professional indemnity insurance in accordance with and Schedule 1 to the Erosion Management Overlay of not less than $1.0 million, being in force for the year in which the report is dated, with retroactive cover under this insurance policy extending back to the engineer's first submission to Colac-Otway Shire.	☐	No

Section 6 Geotechnical Engineer or Engineering Geologist Details

Company/ Organization Name	AGR Geosciences Pty Ltd	
Name (Company Representative)	Surname: Horwood	Mr /Mrs /Other: Mr
	Given Names: David John	
	Chartered Professional Status: **CP (Geo)**	Registration No: **321719**
Signature		Dated: 29 /10 / 2018