PP263/2018-1

571 Wild Dog Road APOLLO BAY

Lot: 1 PS: 412913 V/F: 10518/342

Use and Development of a Dwelling

C Versteeg

Officer - Helen Evans

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

D18/110683

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.: 571 | St. Name: Wild Dog Road

Suburb/Locality: Apollo Bay | Postcode:

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.: 1 ○ Lodged Plan ○ Title Plan ◉ Plan of Subdivision No.: 412913

OR

B Crown Allotment No.: | Section No.:

Parish/Township Name: Krambruk

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?** *

Use and Development of a Dwelling

☑ 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 $ 450,000

⚠ 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.

Farm Shed and Agriculture

☑ 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:
First Name: Cornelis
Surname: Versteeg
Organisation (if applicable): c/o Coastal Planning
Postal Address:
If it is a P.O. Box, enter the details here:
Unit No.:
St. No.: 28
St. Name: Taits Road
Suburb/Locality: Barwon Heads
State: Vic
Postcode: 3227

Please provide at least one contact phone number *

Contact information for applicant OR contact person below

Business phone:
Email: shelly@coastalplanning.com.au
Mobile phone: 0408 734169
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: Shelly
Surname: Fanning
Organisation (if applicable): Coastal Planning
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: Roger
Surname: Hardley
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

D18/110683

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: 22/10/2018 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.

REGISTER SEARCH STATEMENT (Title Search) Transfer of Land Act 1958

VOLUME 10518 FOLIO 342

Security no : 124074517993K
Produced 21/10/2018 03:10 PM

LAND DESCRIPTION

Lot 1 on Plan of Subdivision 412913F.
PARENT TITLES :
Volume 09526 Folio 330 to Volume 09526 Folio 331
Created by instrument PS412913F 18/05/2000

REGISTERED PROPRIETOR

Estate Fee Simple
Sole Proprietor
ROGER JOHN HARDLEY of 571 WILD DOG ROAD APOLLO BAY VIC 3233
AN126453Y 23/09/2016

ENCUMBRANCES, CAVEATS AND NOTICES

Any encumbrances created by Section 98 Transfer of Land Act 1958 or Section 24 Subdivision Act 1988 and any other encumbrances shown or entered on the plan set out under DIAGRAM LOCATION below.

DIAGRAM LOCATION

SEE PS412913F FOR FURTHER DETAILS AND BOUNDARIES

ACTIVITY IN THE LAST 125 DAYS

NIL

----------END OF REGISTER SEARCH STATEMENT----------

Additional information: (not part of the Register Search Statement)

Street Address: 571 WILD DOG ROAD APOLLO BAY VIC 3233

See MI310191D for WATER FRONTAGE LICENCE details

DOCUMENT END

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	**PS412913F**
Number of Pages (excluding this cover sheet)	**2**
Document Assembled	**21/10/2018 15:13**

PLAN OF SUBDIVISION

STAGE NO. \

LTO use only
EDITION 1

Plan Number
PS 412913F

Location of Land

Parish: KRAMBRUK

Township:
Section 3 Crown Allotment 23A
Section 1 Crown Allotment 20F (Part)
Crown Portion:

LTO Base Record: DCMB
Title Reference:
VOL. 9526 FOL. 330 & FOL. 331
Last Plan Reference: PS408746W
Postal Address: WILD DOG ROAD
(at time of subdivision) APOLLO BAY, 3233

AMG Co-ordinates
(of approx. centre of land in plan)
E 731 500
N 5712 500
Zone: 54

Council Certification and Endorsement

Council Name: COLAC OTWAY SHIRE Ref: SUB/044/97

1. This plan is certified under section 6 of the Subdivision Act 1988.
2. ~~This plan is certified under section 11(7) of the Subdivision Act 1988.~~
~~Date of original certification under section 6 / /~~
3. This is a statement of compliance issued under section 21 of the Subdivision Act 1988.

OPEN SPACE

(i) A requirement for public open space under section 18 of the Subdivision Act 1988 ~~has~~/has not been made.

(ii) The requirement has been satisfied.

(iii) The requirement is to be satisfied in Stage.....

Council delegate
~~Council seal~~

Date 23 / 1 / 1998

Re-certified under section 11(7) of the Subdivision Act 1988

Council Delegate
Council Seal

Date / /

Vesting of Roads or Reserves

Identifier	Council/Body/Person

Notations

Staging This ~~is~~/is not a staged subdivision
Planning Permit No. 174/97

Depth Limitation 15.24 METRES BELOW THE SURFACE APPLIES TO ALL THE LAND IN THE PLAN

LOT 1 AND THE CONNECTION 197°40', 21.16 & LOT 3 AND THE CONNECTION 189°05', 61.44 ARE THE RESULT OF THIS SURVEY.
THE AREA OF LOT 2 WAS OBTAINED BY DEDUCTION FROM TITLE.

WATERWAY NOTATION: LAND IN THIS PLAN MAY ABUT CROWN LAND THAT MAY BE SUBJECT TO A CROWN LICENCE TO USE

Survey This plan is/~~is not~~ based on survey
This survey has been connected to permanent marks no(s)
In Proclaimed Survey Area No.

Easement Information

Legend: E - Encumbering Easement or Condition in Crown Grant in the Nature of an Easement or other Encumbrance
A - Appurtenant Easement R - Encumbering Easement (Road)

Subject Land	Purpose	Width (Metres)	Origin	Land Benefited/In Favour Of
E-1	POWERLINE	12	THIS PLAN & SECTION 44 OF THE ELECTRICITY INDUSTRY ACT 1993.	POWERCOR

LTO use only

Statement of Compliance/ Exemption Statement

Received ☑

Date 29 / 4 / 100

LTO use only

PLAN REGISTERED

TIME 4.35 PM

DATE 18 / 5 / 100

.....
Assistant Registrar of Titles

Sheet 1 of 2 Sheets

TONY JEAVONS SURVEYS
PO BOX 196
APOLLO BAY 3233
PHONE 03 52376 757
FAX 03 52376 949

LICENSED SURVEYOR (PRINT) ANTHONY H JEAVONS

SIGNATURE..... DATE 5 / 12 / 97

REF 00495A VERSION

DATE / /

COUNCIL DELEGATE SIGNATURE

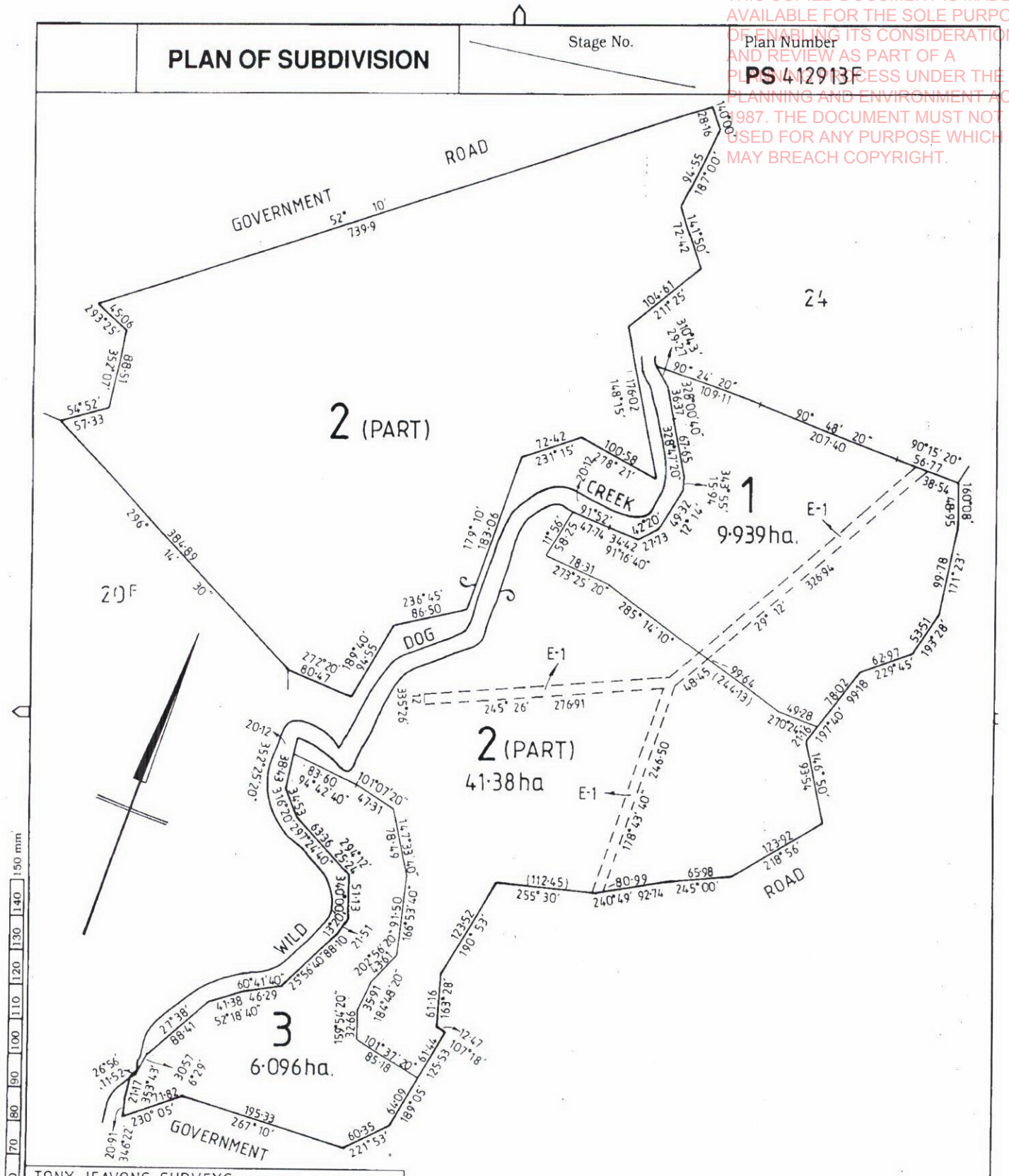
Original sheet size A3

T.O.1

PLAN OF SUBDIVISION

Stage No.

Plan Number **PS 412913F**



TONY JEAVONS SURVEYS
PO BOX 196
APOLLO BAY 3233
PHONE 03 52376757
FAX 03 52376949

ORIGINAL		SCALE	LICENSED SURVEYOR (PRINT) ANTHONY H. JEAVONS	Sheet 2 of 2 sheets
SCALE 1:4000	SHEET SIZE A3	40 0 80 160 LENGTHS ARE IN METRES	SIGNATURE ..... DATE 5/ 12 /97	DATE / /
			REF 00495A VERSION	COUNCIL DELEGATE SIGNATURE
				Original sheet size A3

T.O.2

Use and Construction of a Dwelling

571 Wild Dog Road, Apollo Bay

described as Lot 1 on PS412913

Permit Applicant:

C. Versteeg

Prepared by:

Coastal Planning

Date: October 2018

Our Reference: SF506

ABN 28 143 459 876
m: 0408 734 169 e: shelly@coastalplanning.com.au w: www.coastalplanning.com.au
28 Taits Road, Barwon Heads VIC 3227

CONTACT DETAILS

Coastal Planning

28 Taits Road

BARWON HEADS VIC 3227

M 0408 734 169

E shelly@coastalplanning.com.au

W www.coastalplanning.com.au

DISCLAIMER

Contents

Attachments

1. Copy of title
2. Concept Development Plan prepared by Guy Holman of Holman Designs
3. Land Risk Assessment by AGR Geosciences Pty Ltd dated 12 September 2018
4. Bushfire Management Statement by Terramatrix dated October 2018

1 Introduction

This planning report has been prepared for Cornelis Versteeg, the permit applicant of the proposed application described within the table below. The purpose of this planning report is to provide a town planning assessment under the provisions of the Colac Otway Planning Scheme in respect of the proposed use and development for a dwelling under the controls of the day.

The following information provides an overview of the site, proposal, and the planning framework applicable to the development.

Table 1.1 APPLICATION DETAILS

Subject Site	575 Wild Dog Road, Apollo Bay
Site Area	9.939ha
Title Description	Lot 1 on PS412913F
Encumbrances	Nil
Vol/Fol	Vol 10518 Folio 342
Applicant	Cornelis Versteeg c/o Coastal Planning 28 Taits Road BARWON HEADS VIC 3227
Owner	Roger Hardley
Zoning	Rural Conservation Zone
Level of Assessment	Overlays SPPF, LPPF, MSS
Approval Sought	Use and Construction of a Dwelling
Planning Scheme	Colac Otway Planning Scheme
Overlays	Erosion Management Overlay – Schedule 1 (EMO1) Bushfire Management Overlay (BMO) Significant Landscape Overlay Schedule 3
Existing Use	Rural land (cleared and vegetated) and existing shed

2 Characteristics of the Site and Surrounding Area

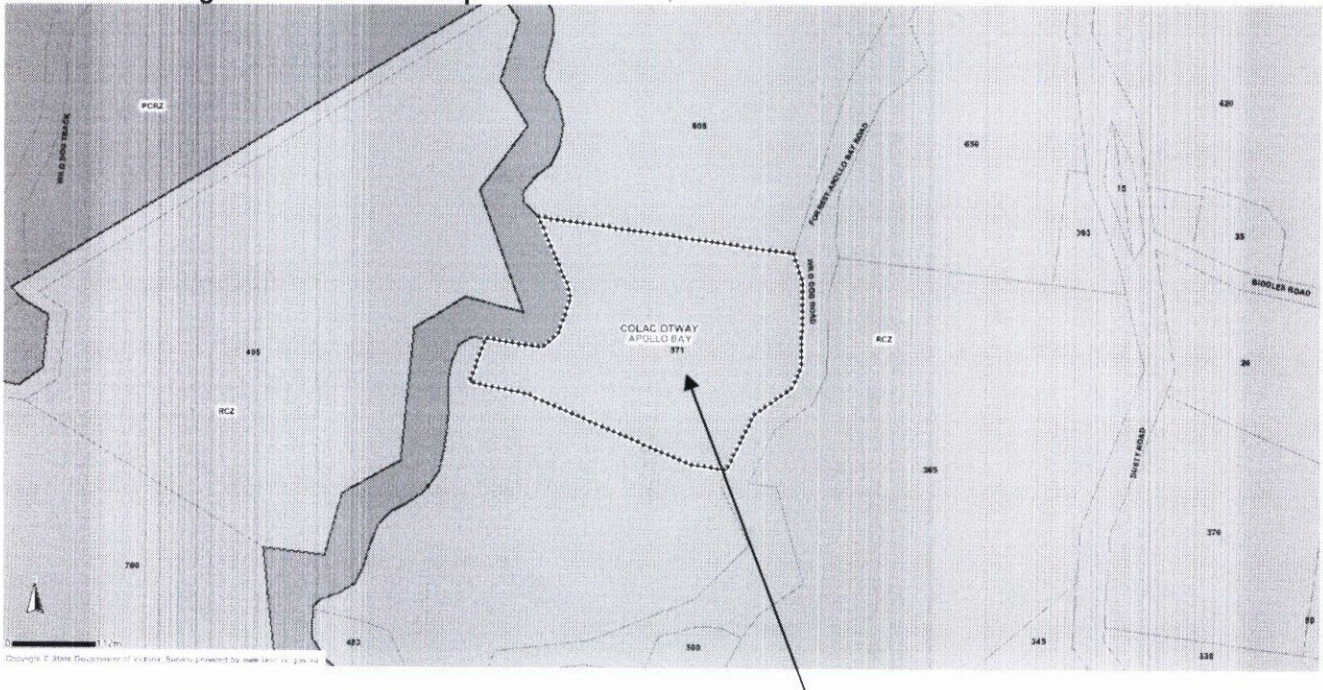
2.1 Description of the Site

2.1.1 Location

The site is located within an existing and established rural area of Apollo Bay up the Wild Dog valley.

A locality plan is provided within **Figure 1** of this report identifying the site within the surrounding area of Apollo Bay.

Figure 1 – Location Map



Source: Department of Planning and Community Development

571 Wild Dog Road, Apollo Bay

2.1.2 Land Use Designation & History

The site is contained within the Rural Conservation Zone (RCZ) under the provisions of the Colac Otway Planning Scheme.

On 26 August 2006 **PP347/04**, a planning permit was issued for the **Use and Construction of a Dwelling and Two Cabins and a Shed**. In 24 March 2011, the application was amended PP347/04-1. The shed and the effluent disposal field were completed, however the balance of the works was not and this permit is now expired.

The land has since been sold and the current application seeks approval, so the new owners can live on the property and undertake agricultural pursuits.

2.1.3 Existing and adjoining Features

The site does not include any existing features aside from the existing shed, water tanks, a large dam and usual agricultural paddocks for grazing of sheep. The site includes significant sweeping views across the landscape. The site is mostly void of vegetation with some bushland along the rise interface and along the Wild Dog Creek.

2.1.4 Vegetation

The application does not require removal of vegetation.

2.1.5 Flooding

The site is not located within a flood prone area, nor affected by any adverse flooding overlays. However, it is understood the Corangamite CMA recommends the floor of a new dwelling constructed along the Great Ocean Road to be a minimum height of 2.9 metres Australian Height Datum, which is 300mm above the Authority's best estimate of a reasonable flood level to apply to these properties. The Corangamite CMA believes that it is necessary to allow for possible future sea level rise when considering proposed residential development of coastal properties. The draft Victorian Coastal Strategy review (Victorian Coastal Council 2007) has assumed for planning purposes a sea level rise of 0.8 metres by the end of the century. The site will not be adversely affected by sea level rises due to its topography being well above the sea level.

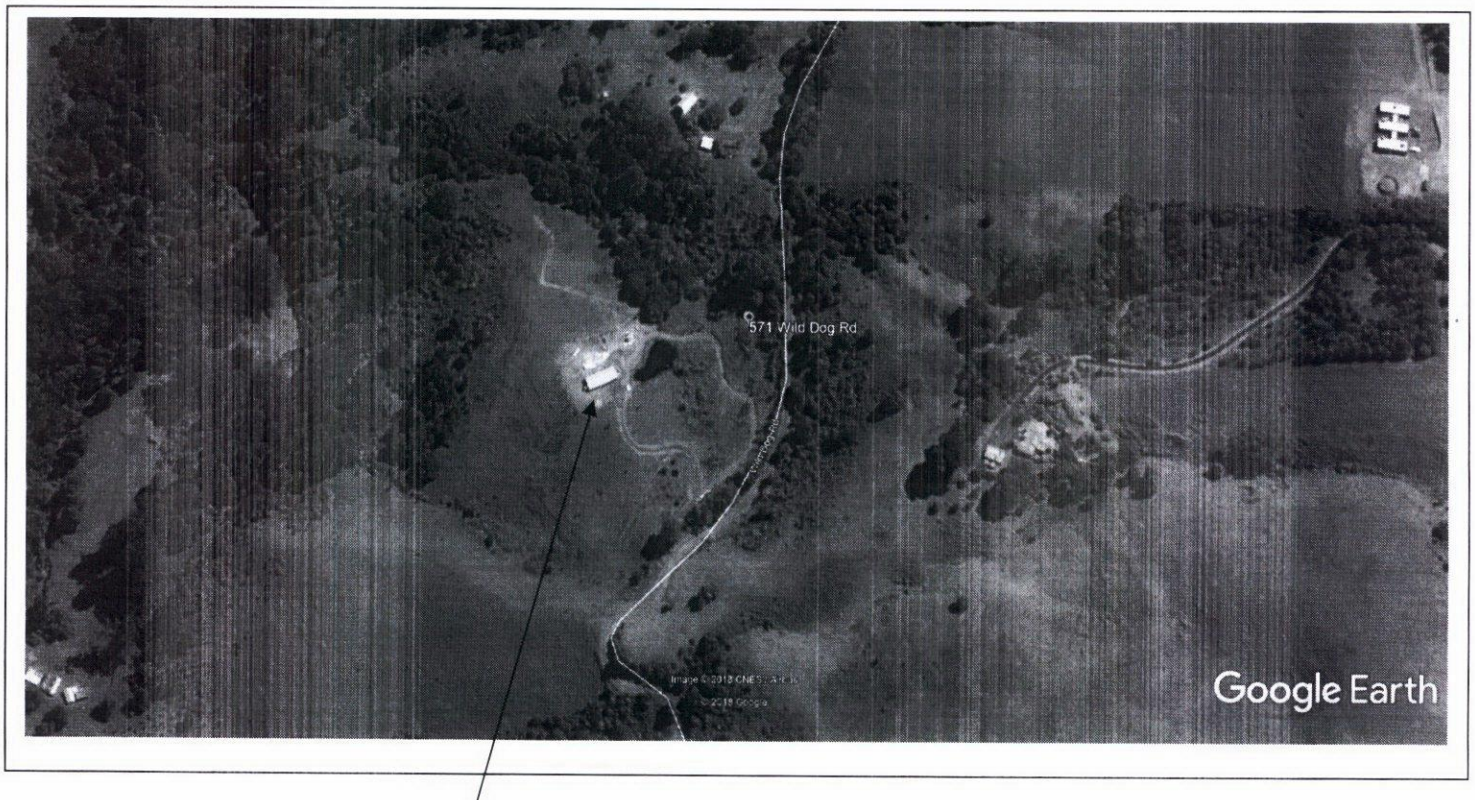
2.1.6 Soil Characteristics

There are no known adverse soil characteristics idenfified on the subject land.

2.2 Site Analysis

- The site is located along Wild Dog Road, Apollo Bay. The site is approximatley 7km from Apollo Bay.
- The road is seals however presents with informal edges in a rural setting. All surrounding land uses are used for both some agricultlural and ad hoc tourist accommodation within the vicinity.
- The site benefits from magnificant bushland views to the south and east.
- The site is already void of vegetation on the proposed dwelling site so no vegetation removal is needed.
- The proposed dwelling site will be visble from Wild Dog Road, however the site is set down low into the landscape. The proposed dwellings site is adjacent to the existing shed so there is already built from within this vicinity.
- The abutting land use include both existing dwellings and farmland for grazing purposes and one dwelling is sited to the west.
- There is a powerline easement located to the south of the dwelling site.
- The dwelling will be located approximatley 100m back from Wild Dog Road.

Image 1: Aerial from Google Earth 16.01.2017



Existing shed on site at 571 Wild Dog Road, Apollo Bay

3 Proposal

3.1 Summary of Use and Construction of a Dwelling

The proposed dwelling triggers a planning permit under clause 35.06-2 of the planning scheme and this will be addressed in the zoning provisions.

Development Plans included as prepared by **Guy Holman** of **Holman Designs**:

1. **Cover page (dwelling image)**
2. **Site Plan**
3. **Site Plan 2)**
4. **Site Plan (sections for driveway)**
5. **Defendable Space**
6. **Driveway Plan**
7. **Ground Floor Plan**
8. **North and East Elevation**
9. **West and South Elevation**
10. **Perspectives**
11. **Perspectives (with 10,000 Dam CFA water supply)**
12. **Perspectives (from road)**
13. **Perspectives**
14. **Perspectives (from Wild Dog Road)**
15. **BAL 40 notes**

The proposed dwelling includes the following configuration:

Single Level Dwelling - 266.62m^2 or 40.01squares

- Open plan living, dining, kitchen
- Office
- Rumpus
- Three (3) Bedrooms
- Master Bedroom with WIR & ensuite
- Laundry
- Study/craft room

4 Development Assessment

4.1 Compliance with State and Local Policy

The proposed dwelling (including shed) is supported from the following State and Local Planning Policies in summary.

Clause 13.02 Bushfire

Objective

To strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life.

The proposed dwelling site is located within the BMO therefore an assessment against the provisions has been provided by Beacon Ecology. The result is a compliant design response thus compliant with the SPPF for Bushfire within Environmental Risk issues. All defendable space is located within the property boundary. Refer to discussion in the BMO section in this report.

Clause 13.04-2S Erosion and landslip

Objective

To protect areas prone to erosion, landslip or other land degradation processes.

This proposed use for a dwelling has been assessed by the respective Geotech engineer. His recommendation is to support the proposal and that the land could be used for a dwelling in the future in terms of meeting the LSA measures.

The Landslip Risk Assessment concludes there are no geotechnical reasons to prevent the issue of a planning permit for a proposed residence on this site. See also response to EMO.

Clause 11.03-5R Great Ocean Road Region

Objective

To manage the sustainable development of the Great Ocean Road region.

Strategy

Manage the impact of development on the environment and cultural values of the area.

Clause 12.01-2S Native Vegetation management

Objective

To ensure that there is no net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation.

There is no vegetation removal required.

Clause 21.02 Coastal Areas

Clause 12.02-2 appropriate development of coastal areas

***Objective**: To ensure development conserves, protects and seeks to enhance coastal biodiversity and ecological values.*

***Strategies:** Ensure development is sensitively sited and designed and respects the character of coastal settlements. Encourage revegetation of cleared land abutting coastal reserves. Maintain the natural drainage patterns, water quality and biodiversity within and adjacent to coastal estuaries, wetlands and waterways. Avoid disturbance of coastal acid sulfate soils. Protect cultural heritage places, including Aboriginal places, archaeological sites and historic shipwrecks.*

There is no vegetation removal required as part of this application.

The dwelling is low lying and siting to work within the existing site constraints and topography.

Clause 21.04-8 Landscape Character

Objectives

- *To retain the open and rural character of views and outlooks, particularly from main road corridors.*
- *To maintain the dominance of the natural landscape when viewed from main road corridors and tourist routes outside townships.*
- *To protect the variety of landscape features and landmarks of the precincts identified in the GORRLAS.*
- *To increase indigenous planting in the Landscape precincts to further emphasise natural features such as creeks.*
- *To protect ridgelines from inappropriate development and vegetation removal.*

The proposed dwelling will be slightly visible from Wild Dog Road, however will sit behind the shed. The dwelling is single storey and finished in muted tones which is sited into the landscape, therefore there are no visual impacts and the dwelling will be aesthetically pleasing within the landscape.

4.2 Compliance with Zoning

4.2.1 Zoning – Rural Conservation Zone

The site is included within the Rural Conservation Zone (RCZ) under the Colac Otway Shire Planning Scheme.

The purpose of the RCZ is as follows:

To implement the State Planning Policy Framework and the Local Planning Policy Framework, including the Municipal Strategic Statement and local planning policies.
To conserve the values specified in a schedule to this zone.
To protect and enhance the natural environment and natural processes for their historic, archaeological and scientific interest, landscape, faunal habitat and cultural values.
To protect and enhance natural resources and the biodiversity of the area.
To encourage development and use of land which is consistent with sustainable land management and land capability practices, and which takes into account the conservation values and environmental sensitivity of the locality.
To provide for agricultural use consistent with the conservation of environmental and landscape values of the area.
To conserve and enhance the cultural significance and character of open rural and scenic non-urban landscapes.

CLAUSE 35.06-2 USE OF THE LAND FOR A DWELLING

A lot used for a dwelling must meet the following requirements:

Standard	Response
Access to the dwelling must be provided via an all-weather road with dimensions adequate to accommodate emergency vehicles.	The subject site is accessed via Wild Dog Road and this road is a rural sealed road. The driveway to the dwelling site is existing. The driveway is approximately 120m long and accesses the shed. This is indicated on the plan labelled 'Driveway Details'. We anticipated a permit condition regarding discharge flow of water over the driveway to be directed to new drainage channels or similar (as recommended via infrastructure for rural driveways) and to be retained on site if considered necessary by infrastructure.

The dwelling must be connected to a reticulated sewerage system or if not available, the waste water must be treated and retained on-site in accordance with the State Environment Protection Policy (Waters of Victoria) under the Environment Protection Act 1970.	Grey water to be recycled for sanitary flushing and garden use. Waste water to be treated via the existing domestic sewer treatment plant with effluent dispersed and contained on site to the requirements of the relevant local authority. See land capability assessment for further detail.
The dwelling must be connected to a reticulated potable water supply or have an alternative potable water supply with adequate storage for domestic use as well as for firefighting purposes.	Storm water to be collected and stored in rain water tanks for domestic use, overflow to legal point of discharge. Planning permit conditions can be provided to satisfy further specifications.
The dwelling must be connected to a reticulated electricity supply or have an alternative energy source.	The proposed dwelling site would be connected to the reticulated electricity supply. Relevant referral procedures to Powercor is required via Section 55 of the *Planning and Environment Act 1987* are to be applied and an power line easement may need to be included.

CLAUSE 35.06-6 DECISION GUIDELINES

The proposed dwelling is prescribed as a Section 2 use, therefore is required to meet the parameters of Clause 35.06-6.

GENERAL ISSUES

Standard	**Response**
The VPP and LPPF including MSS and local planning policies.	Please refer to 4.1 of this report.
Any Regional Catchment Strategy and associated plan applying to the land.	None known.
The capability of the land to accommodate the proposed use or development.	Stormwater to be collected and stored in rain water tanks for domestic use, and the overflow to legal point of discharge. Grey Water to be recycled for sanitary flushing and garden use. Waste Water to be treated via the existing domestic sewer treatment plant with effluent

	dispersed and contained on site to the requirements of the relevant local authority. Please also refer to the Land Capability Assessment that is on Council file referring to the old permit. The existing septic system and effluent field will be used as part of this application.
How the use or development conserves the values identified for the land in the schedule.	The application is for one (1) dwelling only. The original permit was for a dwelling and two cabins. This application is less impacting, and the dwelling site is already flat and clear of vegetation and ready to be used for a dwelling.
Whether use or development protects and enhances the environmental, agricultural and landscape qualities of the site and its surrounds.	A land management plan (LMP) can be sought via a permit condition. An LMP would ordinarily include zones: Conservation Zone (forest revegetation); General Zone and Domestic Zone. The majority of the site could be in a Conservation Zone therefore will hold significant environmental benefits to the site and area.
Whether the site is suitable for the use or development and the compatibility for the proposal with adjoining land uses.	All adjoining properties include rural agricultural and rural living allotments within a natural sweeping landscape setting. This proposed mirrors other single dwellings on rural land holdings in this area.

RURAL ISSUES

The environmental capacity of the site to sustain the rural enterprise.	Not Applicable
The need to prepare an integrated land management plan.	A land management plan (LMP) can be sought via a permit condition. An LMP would ordinarily include zones: Conservation Zone (forest revegetation); General Zone and Domestic Zone. The majority of the site could be in a Conservation Zone therefore will hold significant environmental benefits to the site and area.
The impact on the existing and proposed infrastructure.	No adverse impacts known.
Whether the use or development will have an adverse impact on surrounding land uses.	No adverse impacts known upon surrounding land uses. The site is large at 9.939 hectares and whilst below the minimum lot size, the land is incapably of being productive agricultural land

	due to the size and also the degree of native vegetation on site that the owners want to retain and improve through weed management.

ENVIRONMENTAL ISSUES

An assessment of the likely environmental impacts on the biodiversity and in particular the flora and fauna of the area.	None as no vegetation is required to be removed.
The protection and enhancement of the natural env. of the area, including the retention of veg. and faunal habitats and the need to revegetate land including riparian buffers along waterways, gullies, ridgelines, property boundaries and saline discharge and recharge areas.	A land management plan (LMP) can be sought via a permit condition. An LMP would ordinarily include zones: Conservation Zone (forest revegetation); General Zone and Domestic Zone. The majority of the site could be in a Conservation Zone therefore will hold significant environmental benefits to the site and area.
How the use and development relates to sustainable land management and the need to prepare an integrated land management plan which addresses the protection and enhancement of native vegetation and waterways, stabilisation of soil and pest plant and animal control.	As required by relevant planning permit conditions in relation to the conservation values.
The location of onsite effluent disposal areas to minimise the impact of nutrient loads on waterways and native vegetation.	As existing and permitted under previous planning permit.

DESIGN AND SITTING ISSUES

The need to minimise any adverse impacts of siting, design, height, bulk, and colours and materials to be used, on landscape features, major roads and vistas.	The dwelling is single storey and sites on the flat part of the site with minimal visual prominence. The overall design response is a modern and simple design response with a traditional gable roof line which will complement the landscape and not detract from it. The vistas from the dwelling site are sweeping and the design response provides for visual interest within the rural setting. Given the house is single storey and include muted natural tones with earthy finishes, the design complements the landscape.
The location and design of existing and proposed infrastructure services which minimises the visual impact on the landscape.	The dwelling has been carefully located to avoid impact upon vegetation, to avoid impact on views and to also benefit from services.

The need to minimise adverse impacts on the character and appearance of the area or features of archaeological, historic or scientific significance or of natural scenic beauty or importance.	No impact known.
The location and design of roads and existing and proposed infrastructure services to minimise the visual impact on the landscape.	The driveway is approximately 120m long and is existing. This is indicated on the plan labelled 'Driveway Details' and 'Driveway Slope'. We anticipated a permit condition regarding discharge flow of water over the driveway to be directed to new drainage channels or similar (as recommended via infrastructure for rural driveways) and to be retained on site. There will be no infrastructure proposed that will detract from the landscape as the owner also does not want unsightly forms on the landscape.

4.3 Compliance with Overlays

The subject site is affected by Erosion Management Overlay Schedule 1, Bushfire Management Overlay and in part Vegetation Protection Overlay Schedule 2. The following provides an overview on the assessments against these planning scheme provisions.

4.3.1 Erosion Management Overlay – Schedule 1

The subject site is located within an Erosion Management Overlay, therefore, particular attention is required to address the overlay objectives and requirements. As part of the original planning permit, the proposed addressed the EMO.

A Land Slip Risk Assessment has been prepared by AGR GeoSciences Pty Ltd dated 12 September 2018 and confirms the subject includes low geotechnical risk therefore in their opinion, a Landslip Risk Assessment is not required. There were no geotechnical reasons to prevent the issue of a planning permit.

4.3.2 Bushfire Management Overlay

The subject site proposed for use and construction of a dwelling is located within the BMO. The bushfire assessment has been undertaken by Terramatrix. All defendable space is proposed within the title boundary so can be entirely maintained by the owner.

The dwelling construction is recommended to be from BAL 40 with a 31m to 60m defendable space area.

There are three (3) 10,000 CFA water tanks on site and the existing dam is also able to be used for static water supply for CFA.

4.3.3 Significant Landscape Overlay Schedule 3

The subject site is partly located within the SLO3 area along the western boundary only.

2.0 Landscape character objective to be achieved

☐ *To achieve the "Preferred Character" as specified above.*

☐ *To increase the use of indigenous vegetation to highlight natural features within the precinct.*

☐ *To consider the contrasts between landscape elements within the precinct.*

☐ *To ensure that development that occurs on hill faces or in other prominent locations is not highly visible and sensitively designed.*

☐ *To minimise the visual impact of signage and other infrastructure, particularly in coastal areas, hill faces and ridges.*

☐ *To protect the clear sweeping views to and from the ocean available from the precinct.*

☐ *To consider the dominance of an indigenous natural landscape in coastal areas, between townships, particularly from the Great Ocean Road and avoid ribbon development.*

5.0 Application requirements

All permit applications for buildings and works must be accompanied by a Site Description and Design Response which must address the 'preferred character' and the landscape objectives specified above.

A landscaping plan should be submitted with an application for buildings and works, or to remove, destroy or lop vegetation, utilising appropriate species and demonstrating how the affected area will be remediated after development.

Applicants are required to provide a realistic visual impact illustration of the view of the development from key viewpoints along the Great Ocean Road. An application is required to demonstrate the following:

☐ *Whether all new buildings and works are designed and constructed to avoid contrasting shape, colour, size and mass.*

☐ *Whether buildings and works are sited so that they do not dominate the visual landscape.*

☐ *Whether buildings and works on ridgelines can be avoided. It must be demonstrated that there is no alternative suitable site and that the buildings and works are essential.*

Please refer to the perspectives in the development plans prepared by Guy Holman to understand the visual impact from Wild Dog Road.

There will be no visual impact as the dwelling will be sited behind the existing shed and is single storey.

A landscape plan can be sought via a permit condition.

4.4 Aboriginal Heritage issues

The requirements under the *Aboriginal Heritage Act 2007* have not been triggered as part of the construction of one (1) dwelling.
Therefore, no Cultural Heritage Management Plan CHMP is triggered as these matters are not considered to be high impact activities.

5 Conclusion & Recommendation

This planning report has been prepared for the permit applicant Cornelis Versteeg. The application includes the Use and Construction of a dwelling at 571 Wild Dog Road, Johanna.

The planning report includes an assessment of the proposal against the relevant provisions of the planning scheme including the VPPs and LPPF, zoning controls, overlays under the Colac Otway Planning Scheme.

The proposal is consistent with the existing and emerging rural responses within this area of Great Ocean Road region generally and sustains the agricultural pursuits in the area.

In summary, the proposal is considered to have addressed the relevant Planning Scheme considerations. We therefore recommend favourable consideration of the proposal on the basis of the assessment provided within this report.

CONTACT DETAILS

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DISCLAIMER

6 Site Photographs

Photo 1: Subject site

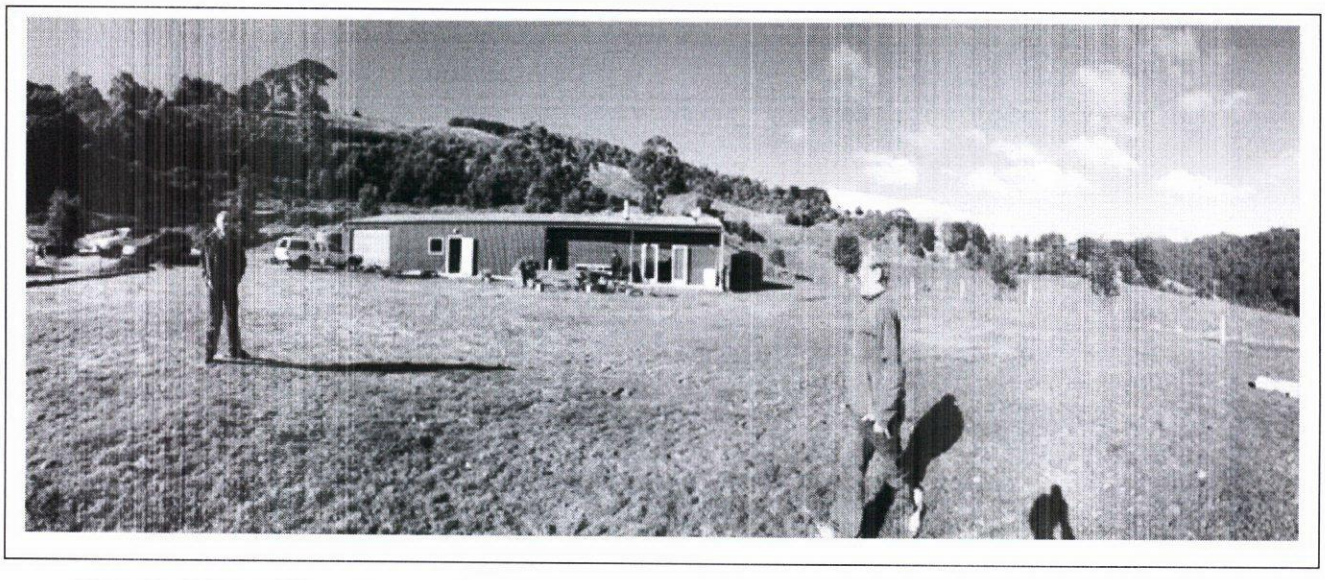

Photo 2: Subject Site - views north and existing shed

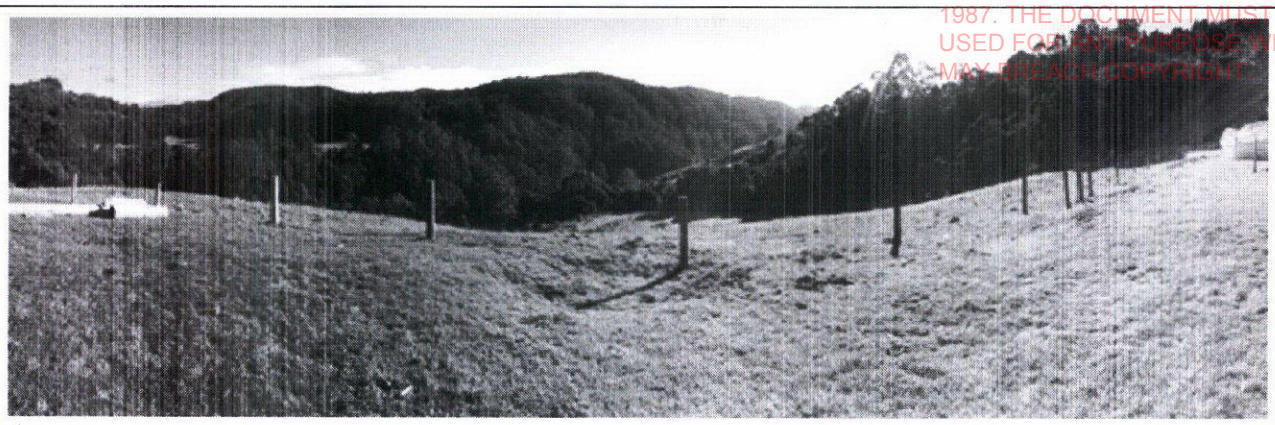

Photo 3: Subject Site - views south

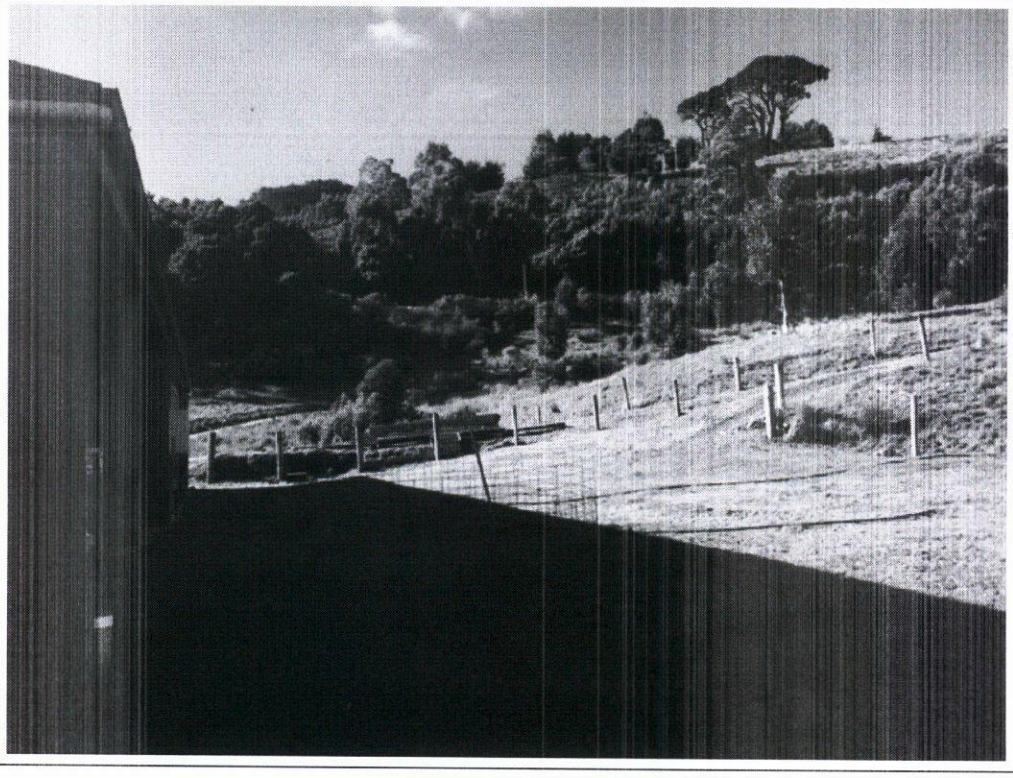

Photo 4: Subject Site - existing shed

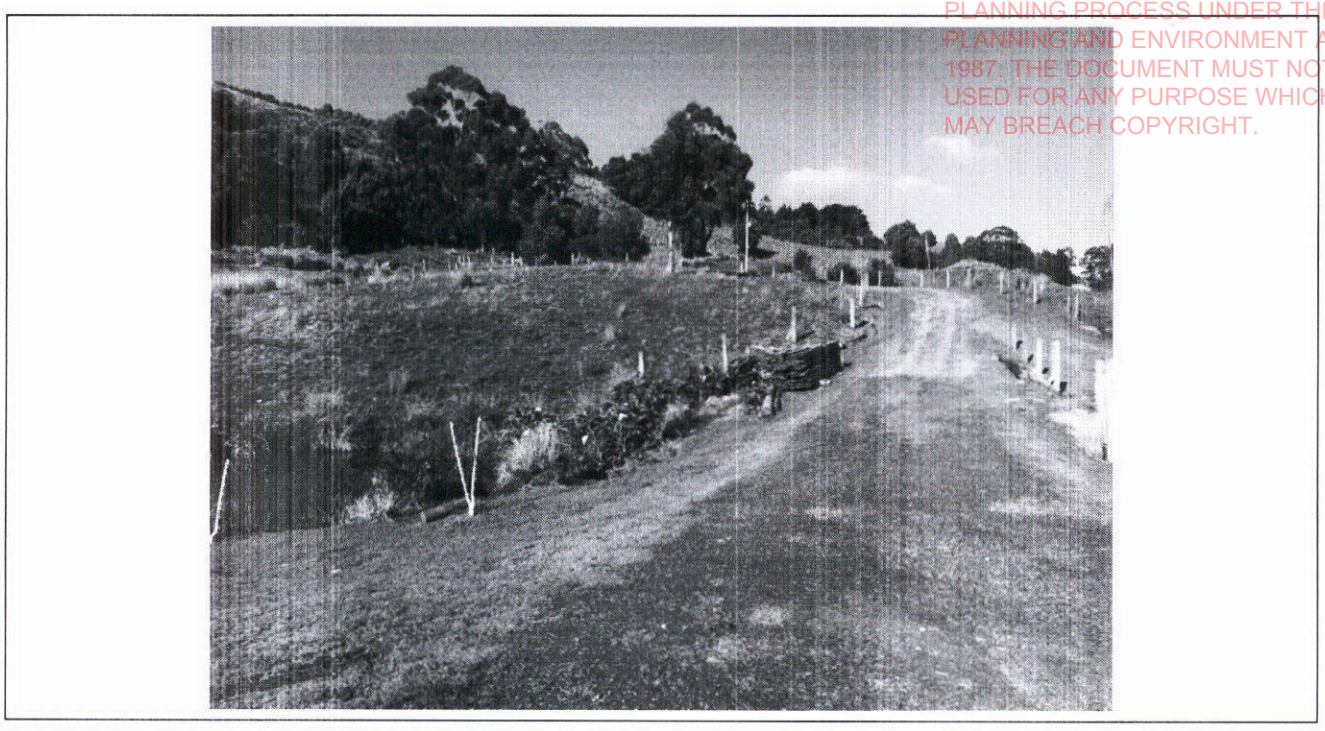

Photo 5: Driveway

571 Wild Dog Road, Apollo Bay

Land Management Plan 2019-2029

Report for Coastal Planning

March 2019

BeaconEcological

ACKNOWLEDGEMENTS

Beacon Ecological would like to acknowledge the following people for their contribution to the project:

- **Guy Holman** (Holman Designs) for site and project information.

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Report Version: FINAL V1 5 March 2019

Field assessment: Luke Hynes

Report: Luke Hynes

Photography: Luke Hynes

Mapping: Luke Hynes

Review and Auditing: Mark Stockdale

Cover Photo: Existing shed within the study area.

DISCLAIMER

The authors advise that the information presented in this report, including any management advice, has been prepared with all due diligence and care, and based on the best available knowledge and research.

However the author takes no responsibility for any loss, injury or financial damage resulting from the reliance and/or application of management advice provided in the report.

TABLE OF CONTENTS

1 INTRODUCTION

Beacon Ecological was engaged by Coastal Planning to provide a Land Management Plan (LMP) for 571 Wild Dog Road, Apollo Bay. A dwelling is proposed at the property which is currently vacant.

This LMP is required under the Rural Conservation Zone to detail environmental values and threats, and recommended management actions to satisfy planning permit requirements from the Colac Otway Shire Council.

The aims of the plan are to clearly delineate zones for domestic, production and conservation uses and protect and enhance the ecological values of the property.

1.1 SCOPE OF WORKS

The following tasks were completed during the preparation of the LMP:

- ***Background Review:*** A review of government databases and websites pertaining to biodiversity modelling and mapping.
- ***Field Assessment:*** The study area was traversed and dominant flora species and general vegetation condition recorded.
- ***Mapping:*** Ecological values and items of interest were mapped using aerial photography and GPS technology. Mapping was undertaken by a qualified and experienced botanist.
- ***Report Production:*** The findings of the field assessment are documented in this LMP. Recommendations to mitigate threats and protect and enhance ecological values are also provided.

1.2 STUDY AREA

The study area is located at 571 Wild Dog Road, Apollo Bay (Figure 1). The property is a 9.9 hectare irregularly shaped rural block that slopes to the west. The property supports a mix of native vegetation and pasture. Some revegetation has been undertaken with locally indigenous species of scattered eucalypts within pasture. The property supports an existing shed and a dam.

The property is located within Rural Conservation Zone (RCZ) of the Colac Otway Council and is covered by a Bushfire Management Overlay (BMO), Erosion Management Overlay (EMO1) and Significant Landscape Overlay (SLO3 - APOLLO BAY COASTAL VALLEY AND HILLS PRECINCT) (DELWP 2019a). The study area is located within the boundaries of the Corangamite Catchment Management Authority, the Otway Ranges Bioregion and Colac Otway Shire Council (DELWP 2019b).

2 METHODOLOGY

2.1 LITERATURE REVIEW

Relevant literature, such as Department of Environment, Land, Water and Planning (DELWP) modelling, Bioregional EVC mapping, benchmarks and relevant policies and legislation were reviewed as part of the assessment (DELWP 2019b, DELWP 2019c). *Proposed residence. Cornelis and Mieke Versteeg. 571 Wild Dog Road, Apollo Bay* (Guy Holman Designs 2018) was also reviewed.

Aerial photography was used in conjunction with GIS technology to develop figures of the study area and during the field assessment (Figure 2).

2.2 FIELD ASSESSMENT

The study area was traversed on foot by a qualified and experienced botanist, Luke Hynes, on 17 January 2019 to record dominant flora species and land management issues. Flora nomenclature follows *the Victorian Biodiversity Atlas* (DELWP 2019d).

2.3 LIMITATIONS

Field surveys provide an indication of what is present at the time of survey (i.e. a 'snapshot') and as such may not include species that may be dormant or absent due to seasonal or climatic conditions. For example, annual grasses, herbs and geophytes will often be undetected between the end of one season and the beginning of the next season's growth. Note that the west end of the property contained some steep and dense vegetation and was accessed as best as possible.

A fauna survey was not included in the scope of works, however an assessment of habitat within the study area was undertaken.

The field assessment and review of existing relevant information is considered sufficient to provide an indication and assessment of the ecological values and land management issues within the study area.

3 RESULTS

3.1 ECOLOGICAL VEGETATION CLASSES

Pre-1750 DELWP modelling indicates Wet Forest (EVC 30) is likely to have dominated the study area with Cool Temperate Rainforest (EVC 31) in the west. Extant (2005) DELWP modelling identifies that the east of eth study area may be devoid of native vegetation.

The field assessment identified modified and relatively intact native vegetation present within the property displaying affinities to Wet Forest (EVC 30) and pasture dominated by introduced species (Figure 2). A brief description of vegetation present within the study area is presented below.

Wet Forest (EVC 45)

Wet Forest generally *grows on fertile, well-drained loamy soils on a range of geologies and elevation levels. It is largely restricted to protected sites in gullies and on southern aspects of hills and mountains where rainfall is high and cloud cover at ground level is frequent. Characterised by a tall eucalypt overstorey to 30 metres tall with scattered understorey trees over a tall broad-leaved shrubby understorey and a moist, shaded, fern-rich ground layer that is usually dominated by tree-ferns* (DELWP 2019c).

Plate 1. Relatively intact Wet Foothill vegetation in the west of the property.

Relatively intact Wet Forest vegetation is present in the east and north of the property (Figure 2). This vegetation is dominated by an overstorey of Manna Gum *Eucalyptus viminalis,* Mountain Ash *Eucalyptus regnans* and Blackwood *Acacia melanoxylon* over a dense shrub layer of Snowy Daisy-bush *Olearia lirata,* Prickly Current-Bush *Coprosma quadrifida,* Austral Mulberry *Hedycarya angustifolia* and Rough Tree-fern *Cyathea australis* (Plate 1). The understorey supports a low cover including the native Mother Shield Fern *Polystichum proliferum,* Shade Nettle *Australina pusilla,* Mountain Clematis *Clematis aristata* and Forest Hounds-tongue *Austrocynoglossum latifolium* in association with introduced species Cocksfoot *Dactylis glomerata* and Blackberry *Rubus fruticosus* sp. agg.,

Modified Wet Forest is located in the centre and northeast of the property (Figure 2). This vegetation is characterised by a dense shrub layer of native species including Blackwood, Rough Tree-fern, Snowy Daisy-bush and Prickly Current-bush with moderate to intense infestations of Blackberry (Plate 2).

Plate 2. Modified Wet Foothill Forest within the study area with missing overstorey.

Introduced Pasture

The remainder of the property supports introduced pasture (Figure 2) dominated by Sweet Vernal Grass *Anthoxanthum odoratum* with scattered Yorkshire Fog *Holcus lanatus,* Cocksfoot and Rye Grass *Lolium* spp (Plate 3). Native species include scattered Common Wallaby-grass *Rytidosperma caespitosa,* Austral Bracken *Pteridium esculentum,* Bidgee Widgee *Acaena novae-zelandiae* and Finger-rush *Juncus subsecundus.* Scattered planted eucalypts are present within this area.

Plate 3. Introduced vegetation within the study area. Note planted eucalypts.

4 LAND MANAGEMENT ACTIONS

The objective of the plan is to protect and enhance the ecological values of the property while integrating this with a domestic living zone and small production area. Key conservation actions include fencing, revegetation using locally indigenous species and weed control.

The following land management recommendations detail values and/or threats to values within the study area and actions to protect and enhance ecological values during and post construction. To allow for the straightforward application of land management actions, information below is also listed in table form in Section 5 detailing the following information:

- ***Objective***: What is hoped to be achieved.
- ***Threat***: What is threatening the objective.
- ***Impact***: The potential/actual impact of the threat.
- ***Cause***: The source of the threat.
- ***Action***: Action to ameliorate the threat and achieve the objective.
- ***Measurable Target:*** Action outcome that can be easily assessed.
- ***Timing***: The timing of the action.

The property has been split into three zones to assist with planning: Domestic zone, Production Zone and Conservation Zone (Figure 2). These zones have been determined to best separate the domestic and production activities from conservation activities.

Domestic Zone:

- ***Location:*** Includes the building envelopes, defendable space associated with bushfire management, effluent disposal areas, landscaping, sheds, etc. The dwelling location has been selected as it is adjacent to the existing shed, is on a cleared flat area and has and existing driveway. Approximately 1.5 hectares.
- ***Objective:*** To be used as a residential area including dwelling, landscaping, Bushfire Management Overlay defendable space, vegetable gardens.

Production Zone:

- ***Location:*** Includes approximately 1.8 hectares of pasture surrounding the proposed dwelling.
- ***Objective:*** To be used as for sustainable grazing practices to manage existing pasture and reduce bushfire threat to the dwelling.

Conservation zone:

- ***Location:*** Areas of environmental importance such as remnant vegetation and revegetation. Approximately 6.0 hectares.
- ***Objective:*** To protect and enhance ecological values.

4.1 CONSTRUCTION (DOMESTIC ZONE)

Ecological values must be protected during any construction periods. All contractors should be made aware of ecological values on site and penalties imposed for contractors that disturb areas of native vegetation.

Management Actions

During the construction of the proposed dwelling the following actions are recommended to protect retained native vegetation:

1. Exclusion areas and 'no go' zones must be established and protected around areas of existing native vegetation and proposed revegetation. Stockpiles, machinery and personnel rest areas must be placed in designated areas away from native vegetation.
2. All vehicles, earth-moving equipment and other machinery must be cleaned of soil and plant materials before entering and leaving the site to prevent the spread of weed and soil and plant pathogens such as *Phytophthora cinnamomi*;
3. Inform any contractors of ecological values on site. Drainage lines and damp depressions are areas of ecological value or pathways to areas of ecological values (marine areas).
4. Ensure waste, skips and personnel rest areas are located away from drainage areas to prevent accidental movement of rubbish and construction materials within waterways.
5. Sedimentation and erosion controls must be undertaken to EPA standards (EPA 1991).

4.2 NATIVE VEGETATION (CONSERVATION ZONE)

The study area supports areas of relatively intact native vegetation that must be protected and enhanced.

While the site supports some areas of relatively intact native vegetation there is scope for improving the quality and extent of native vegetation using revegetation and weed control. Note that revegetation is to be implemented in a sensitive manner so as to not increase bushfire risk to the proposed dwelling.

Given the absence of eucalypt canopy in areas of *Modified Wet Forest* (Figure 2), gradually control of Blackberry infestations and planting of overstorey species is to be implemented within these areas (Figure 2). Canopy trees will be planted out with a rough density of 150 plants per hectare (DELWP 2017) to restore the vegetation structure and outcompete controlled weeds. Understorey regeneration appears to be adequate in these areas but additional understorey species should be considered if required. The area of *Modified Shrubby Foothill Forest* is approximately 1.4 hectares with 210 canopy trees of Manna Gum or Mountain Ash to be planted.

An additional 1.2 hectares of revegetation is proposed to the south and northwest of the proposed dwelling to increase habitat values and improve corridor linkages (Figure 2). This revegetation will include a suite of species from the Wet Forest EVC and species observed locally. Planting numbers and densities have been taken from *Native vegetation gain scoring manual. Version 2.* (DELWP 2017) and are detailed in Appendix 1.

Revegetation will have adequate site preparation and be undertaken during autumn and winter months to assist with plant survivorship. All revegetation will be implemented within three years of the planning permit being endorsed.

Livestock are currently kept on the property. New fencing will be installed and existing fencing will be repaired and maintained to protect revegetation and native vegetation from any stock. This includes completing the partially completed fence around the proposed dwelling.

Management Actions

1. Gradually remove Blackberry and plant out overstorey eucalypt species within areas mapped as *Modified Wet Forest* as per Figure 2 and Appendix 1 within 10 years of this plan being endorsed.
2. Implement revegetation areas as per Figure 2 and Appendix 1 within 3 years of the plan being endorsed.
3. Implement and maintain fencing as per Figure 2.

4.3 FAUNA HABITAT (CONSERVATION ZONE)

Areas of native vegetation provide habitat for a variety of native fauna. This habitat includes trees with hollows (dead or alive), fallen logs, branches and organic litter and should be protected to enhance and protect local fauna populations. Collection of fallen logs for firewood purposes should be kept to a minimum and for personal use only.

Management Actions

1. Continue to maintain habitat by retaining rocks, fallen logs and branches, dead trees and treess to provide refuge for fauna species.

4.4 PEST PLANTS (ALL ZONES)

The key weed for control at the site is Blackberry, a *regionally controlled* noxious weeds listed under the *Catchment and Land Protection Act 1994*.

Blackberry was noted as moderate to dense infestations within areas mapped as *Modified Wet Forest* and isolated plants within more intact native vegetation mapped as *Wet Forest* (Figure 2). Blackberry should be sprayed with herbicide and smaller plants removed by hand. Control should be applied during Spring and Autumn. Cover of this species will be reduced to less than 1% across the property within 10 years of implementing this plan and maintained at this level.

Control of other environmental weeds, particularly introduced pasture grasses may be considered in areas of remnant native vegetation where cover is low. Monitoring of pest plants is vital, as controlling new and emerging weed infestations is considerably more cost effective than controlling established infestations.

Issues to consider when planning and implementing weed control

Timing: Timing of control is critical, as weeds should be controlled before they set seed or spread vegetatively, and when they are at the weakest point of their life cycle. This is often during the flowering period of early spring. Ongoing weed control works are required during spring and autumn, over several years to ensure removal.

Weed Vectors: When controlling weeds, it is important to identify the potential source of the infestation and how weeds are moving across the landscape. Land managers should be aware of weed vectors and act appropriately to avoid reinfestation or spreading of weeds. Correct removal of any pulled or cut weed material must be undertaken to avoid spread and contamination. In situations where invasive weed sources lie outside of the study area it may be appropriate to contact neighbouring landowners to discuss coordinated control.

Native Vegetation: Off-target damage to native vegetation must be avoided. This particularly applies to the use of spray herbicides and access routes to controlled sites (i.e. trampling by contractors and vehicles). Impacts can be minimised by using qualified contractors who are experienced in flora identification and are aware of the ecological values within the study area.

Annual Works Plans*:* Annual works plans for weed control must be created to allow for the straightforward control of weeds. Works plans must include information such as the timing of control, species to be controlled, location, and preferred control method.

Monitoring and Evaluation: Monitoring and evaluation is necessary to ensure control programs are effective. Recording management actions including dates, type of management, and costs can be used in the evaluation process and are useful as a reference tool for future control.

Management Actions

1. Create annual works plans to treat pest plants within the study area.
2. Continue to implement annual works plan and control weeds using appropriately qualified personnel.
3. Record all weed control works.

4.5 BUSHFIRE MANAGEMENT REQUIREMENTS (DOMESTIC ZONE)

As a Bushfire Management Overlay under the Colac Otway Planning Scheme covers the study area, several vegetation management actions are required within a defendable space around dwellings to reduce risks associated with bushfire threat (Figure 2). The defined defendable space is to be maintained as per BMO requirements detailed below:

- 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 3m 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 sq. 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

Management Actions

1. Manage defendable space zone as per requirements.

4.6 PEST ANIMALS (ALL ZONES)

While considered low threat at the time of survey, pest animals that may visit the study area are likely to include rabbits, foxes and feral cats although in low numbers. These animals can cause serious environmental damage through overgrazing causing erosion and biodiversity loss, and predation on native fauna. Any effort to control pest animals within the study area must utilise multiple strategies and be undertaken in a coordinated manner with adjacent landholders to ensure the most effective control possible.

Local action groups may be able to assist in the implementation and coordination of pest animal control. Contact the Southern Otway Landcare Network for more information on local programs.

All methods must comply with relevant agricultural chemical, animal welfare and firearms legislation and be undertaken by appropriately qualified and experienced operators.

Fox Control:

- Baiting: A program using baits several a year, with bait replacement until the take is reduced, is an effective and environmentally conscious form of fox control in most rural areas. Any baiting programs should be implemented in conjunction with neighbouring properties.
- Fencing: Fox-proof fencing is effective for small areas only due to cost and requiring regular maintenance.
- Shooting: Shooting foxes can be beneficial, however it is likely to remove only a small proportion of the local population. Spotlighting can also underestimate fox populations and only foxes that are easily seen are shot.
- Den fumigation: Where den locations are known, fumigation is an efficient way to destroy cubs using carbon monoxide gas.
- Soft Jaw and Cage Trapping: Trapping may be useful for the control of nuisance animals but often not as effective as other fox control methods.

Rabbit Control:

- Baiting: Poison baits can be implemented using 1080 or Pindone. Qualified personnel must undertake poisoning. Baiting in late summer/early autumn provides best results as

feed is at a minimum requiring rabbits to forage for food, populations are substantially adult with young rabbits emerging from the burrow, breeding is usually finished and so rabbits range over greater distances. Any baiting programs should be implemented in conjunction with neighbouring properties.

- Shooting: Shooting is effective when rabbit populations are at extremely low levels.
- Trapping: Trapping is not recommended as it typically has a very short term effect on numbers.
- Fencing: Rabbit-proof fencing is effective for small areas only. Rabbit proof fencing is costly and requires regular maintenance.
- Fumigation: Inserting chemicals into warrens by qualified persons can be used to reduce populations.
- Warren destruction: Warrens can be destroyed using hand tools or machinery. Destroying warrens prevents rabbits from reinfesting warrens and repopulating areas after other control methods.

Feral Cat:

- Feral cat control methods are generally restricted to cage trapping for euthanasia or shooting.

Management Actions

1. Monitor rabbit, fox and feral cat populations and take the most appropriate action accordingly. Control of pest animals is most effective when undertaken in conjunction with neighbouring properties.

4.7 DOMESTIC CATS AND DOGS (ALL ZONES)

Domestic dogs and cats may cause injury and death of native fauna if allowed to roam freely. In some cases the scent left by domestic dogs in bushland areas may discourage native animals from undertaking natural activities.

Roaming domestic cats do tremendous amounts of damage to local wildlife populations. Putting a bell on your cat can help although keeping it inside or building an outdoor caged area for domestic cats is preferable.

Management Actions

1. Ensure that any domestic pets are under effective control and kept out of the area of native vegetation.
2. Monitor for roaming domestic dogs and cats and relocate accordingly (i.e. RSPCA, local vet, animal hospital or pound).

4.8 EROSION (ALL ZONES)

The study area is located on sandy, sloping topography and may suffer from erosion and associated problems if not managed appropriately. Erosion is caused through clearing vegetation and overgrazing

by stock and/or pest animals. To avoid erosion, groundcover of vegetation should be maintained as close as possible to 100 % including within Bushfire Management Overlay defendable space zones. If stock is to reintroduced to the property ensure that stubble is retained at all times and any pasture should comprise deep-rooted perennial species to prevent erosion.

If revegetation is considered necessary to maintain vegetation cover, Appendix 3 details recommended locally indigenous species.

Management Actions

1. Maintain adequate cover of vegetation across the site.
2. If stock are to be reintroduced to the property ensure overgrazing does not occur.

4.9 REPORTING AND REVIEW (ALL ZONES)

Following the completion of the dwelling, the landholder will be required to submit a yearly site condition report for each year, for the next five years and thereafter at the reasonable request of the relevant authority. Reports are to be submitted prior to the anniversary date of the endorsement of the Land Management Plan. Landowners must submit photographs that clearly depict management actions undertaken for the previous year. The following must be included in the yearly site condition report:

- Permit holder
- Planning permit number
- Reporting year (1-5)
- Date report is submitted
- Who completed the report
- Condition of site against each management commitment
- Actions taken during the year to achieve the management commitment
- Provide photographs.

Management Actions

1. Reporting and review of this management plan and management actions completed is to occur yearly for the first five years and thereafter at the reasonable request of the relevant authority.

5 LAND MANAGEMENT ACTION TABLE

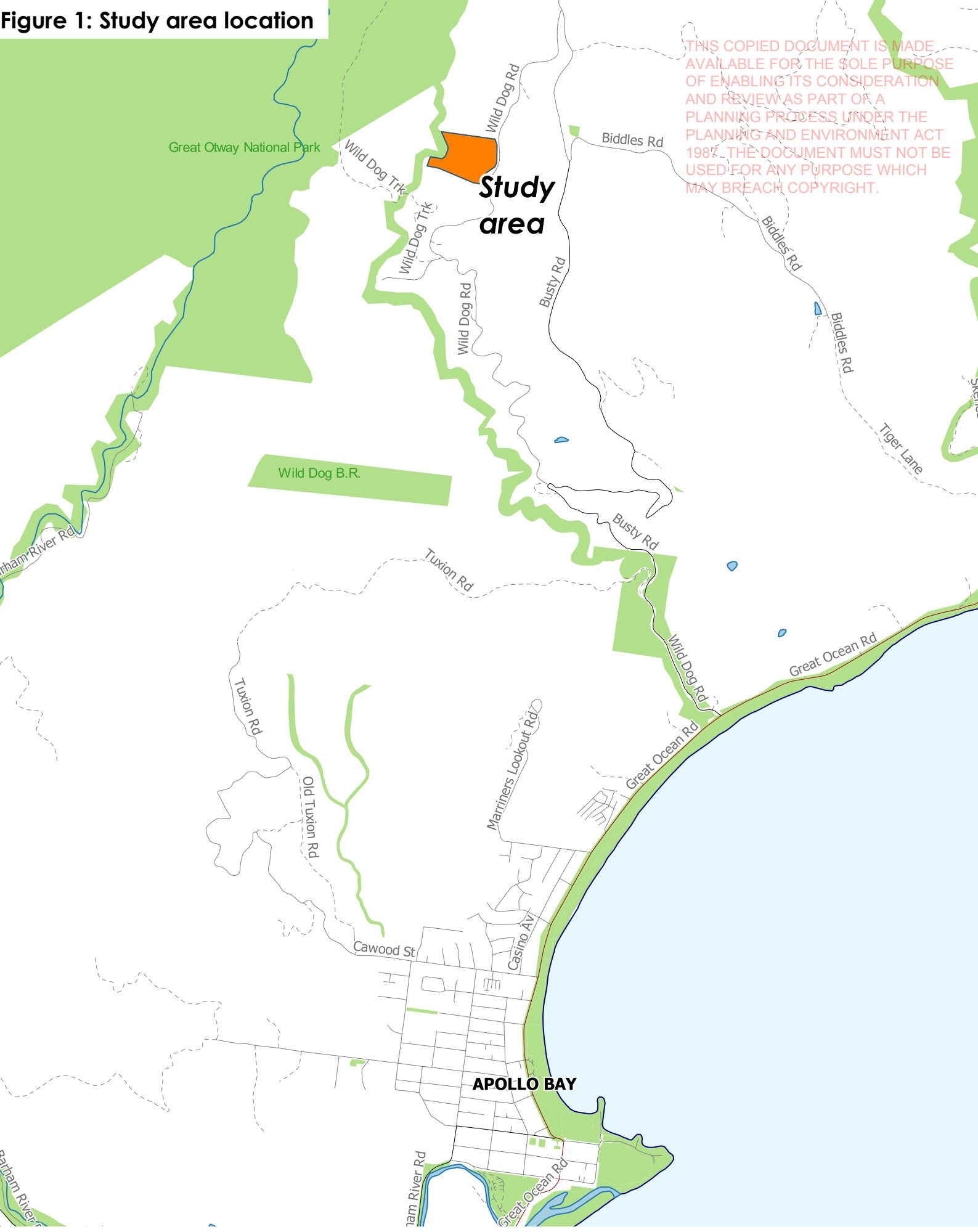
The table below details management actions from Section 4 and lists them by priority.

Objective	Threat (Zone)	Impact	Cause	Action	Measurable Target	Timing
Protect and enhance native vegetation	Construction (Domestic Zone)	Inadequately informed contractors cause impacts to native vegetation	Lack of information, education and awareness	Ensure all contractors are informed of ecological values on site and all native vegetation boundaries are defined (Figure 2). Sedimentation and erosion controls to be undertaken to EPA standards (EPA 1991) Avoid removal of and disturbance of native vegetation	No damage to ecological values.	Prior and during and post construction
	Pest Plants (All Zones)	Pest plant invasion can replace native plants and inhibit ecological processes	Human vectors and natural movement through birds, wind and water borne seeds.	Monitor for pest plants within areas of native vegetation and control existing weed species, particularly Blackberry	Cover of and Blackberry reduced to less than 1% across property.	Implement annual control during autumn and Spring. Target achieved within 10 years and maintained thereafter.
			Lack of replacement planting	Implement revegetation within Modified Wet Forest (Figure 2) with overstorey species as Blackberry infestation are removed.	Overstorey planted out at a density of 150 plants per hectare (Total of 210 for 1.4 hectares)	Implement gradually control and revegetation over a 10 year period.
	Livestock (Production Zone)	Livestock can overgraze native vegetation and ringbark trees.	Inadequate fencing of native vegetation areas	Implement and maintain fences around native vegetation as per Figure 2.	No damage to ecological values.	Prior to dwelling being constructed
Protect and enhance local fauna populations	Domestic Pets (Domestic Zone)	Predation of native fauna, disruption to natural ecological processes	Inadequate control of domestic animals.	Ensure domestic dogs and cats are kept under effective control at all times	No free ranging domestic pets at any time.	Ongoing
	Habitat destruction (Conservation Zone)	Loss of habitat for local fauna	Habitat removed of destroyed through inappropriate management	Maintain habitat by keeping rocks, fallen logs and branches, dead trees and trees with hollows to provide homes for fauna species.	Fauna habitat not damaged.	Ongoing
	Pest Animals (Conservation Zone)	Predation of native fauna, disruption to natural ecological processes	Inadequate control of pest animals.	Monitor fox, rabbit and feral cat populations and take appropriate action accordingly.	Pest animal levels continue to be negligible.	Monitor annually and implement appropriate control when required.

Objective	Threat (Zone)	Impact	Cause	Action	Measurable Target	Timing
	Isolation (Conservation Zone)	Lower ability to disperse through the landscape	Lack of habitat links	Implement revegetation as per Figure 2.	Planting numbers implemented as per Appendix 1 within 3 years and maintained over 10 year period of plan.	Implement plantings during Spring Autumn and Winter. Revegetation to be completed within 3 years.
Protect human life and study area from bushfire threat	Bushfire (Domestic Zone)	Loss of life, assets and biodiversity	Inadequately maintained bushfire protection measures	Maintain vegetation within defendable space zones as per requirements.	Defendable space maintained as per requirements.	Created prior to dwelling construction with ongoing maintenance
Prevent invasion of new pest plants	Introduction of pest plants during construction and beyond (All Zones)	Invasion and displacement of native vegetation by weed species	Inadequate vehicle hygiene. Importation of weed seed through construction materials (gravel, soil, sand)	Ensure all vehicles undergo appropriate hygiene treatment before entering the study area. Ensure any gravel or other materials brought to the study area is free of weed seed.	No new pest plant infestations.	During construction and ongoing
Prevent erosion and landslips	Erosion, Increased water turbidity, landslips (All Zones)	Loss of topsoil, land use and degradation of land	Vegetation removal and overgrazing	Ensure adequate cover of vegetation is retained in slashed areas.	No landslips.	Ongoing
				Ensure that pasture is not overgrazed		Prior to stocking

6 FIGURES

Figure 1: Study area location

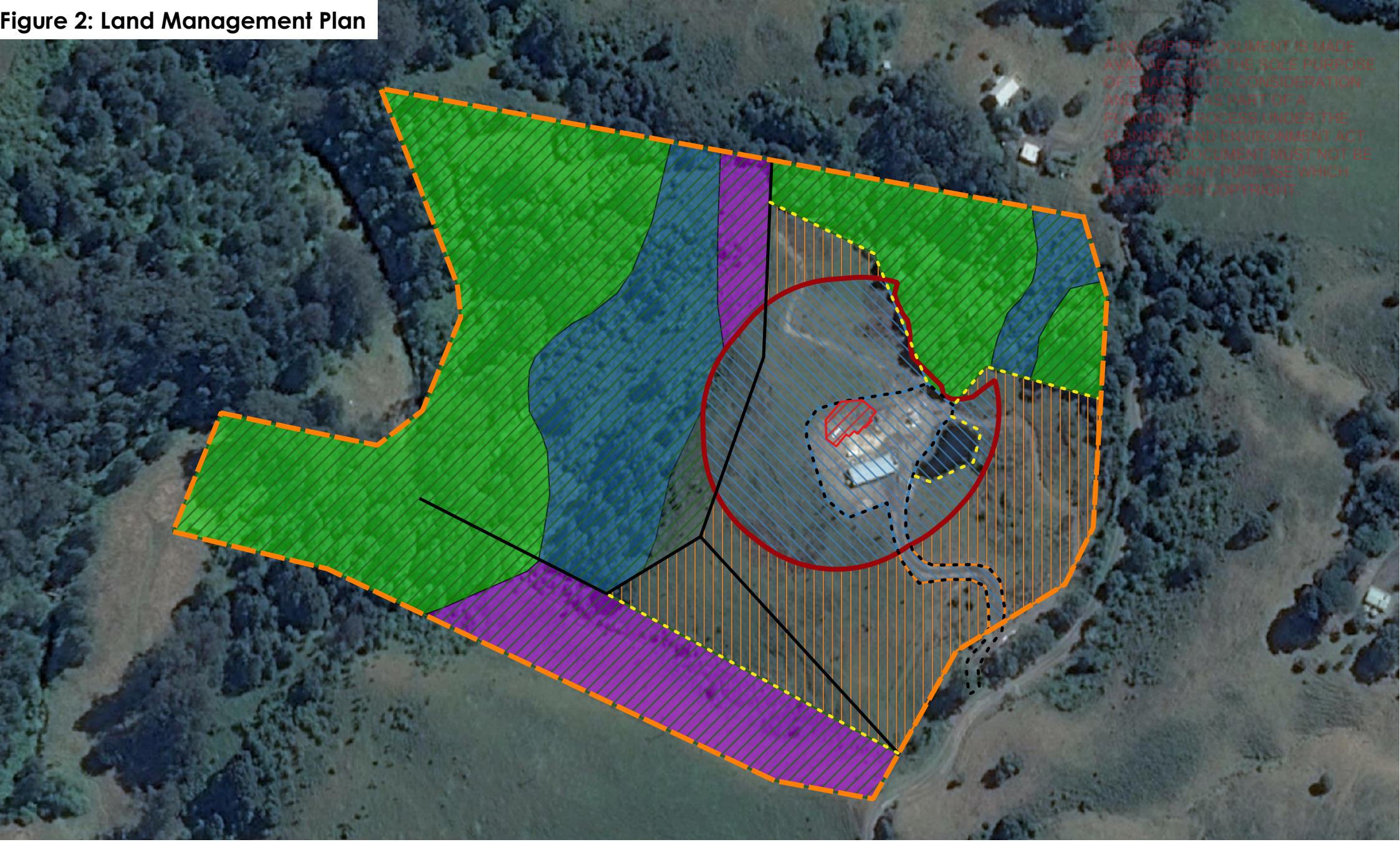


Study area

0 500 1000 m

Beacon Ecological

Figure 2: Land Management Plan



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8 APPENDICES

APPENDIX 1. PLANTING LIST FOR REVEGETATION OF WET FOREST

Life form	Common Name	Scientific Name	# of plants per hectare	# of plants in Revegetation Modified Wet Forest (Area 1.4 hectares)	# of plants in Revegetation Zone 2 (Area 1.1 hectares)
Overstorey Tree	Mountain Ash	*Eucalyptus regnans*	150	210	165
	Manna Gum	*Eucalyptus viminalis*			
Tree	Blackwood	*Acacia melanoxylon*	250	NA*	275
	Hazel Pomaderris	*Pomaderris aspera*			
	Musk Daisy-bush	*Olearia argophylla*			
Shrub	Bootlace Bush	*Pimelea axiflora*	800	NA*	880
	Mountain Pepper	*Tasmania lanceolata*			
	Dusty Miller	*Spyridium parvifolium*			
	Daisy Bush	*Olearia lirata*			
	Austral Mulberry	*Hedycarya angustifolia*			
	Prickly Current-bush	*Coprosma quadrifida*			
TOTALS			1200	210	1,320

Notes:

This species list has been selected using species listed in the Wet Forest EVC benchmark from the Otway Ranges bioregion and species noted within the study area suitable for revegetation. Planting density has been taken from *Native vegetation gain scoring manual. Version 2.* (DELWP 2017).

*NA – These species not required as existing natural regeneration is considered adequate in this area.

LANDSLIP RISK ASSESSMENT

FOR

571 WILD DOG ROAD APOLLO BAY, VICTORIA

Prepared for:	Cornelis Versteeg
Prepared by:	David J Horwood Senior Engineering Geologist *BAppSc (Geology); Dip.NRM; MAusIMM CP(Geo);*
Approved by:	 David J Horwood Director
Reference No.	18H295LRA
Date:	12/9/2018
Revised:	21/3/2019

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EXECUTIVE SUMMARY

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

- Large predominantly cleared rural property with existing tracks, dam, grazing infrastructure and shed.
- Located within the Wild Dog Valley in the steeply dissected hills of the Otway Ranges. Overall the property has a westerly aspect and over 100m of relief.
- Natural slope angles along the spur range from 8° to 30° to the north-west and south-west. The overall slope direction is to the west-north-west.
- Overall the property is nestled within a large concave landslide feature, the headscarp of which is located to the east of Wild Dog Road.
- The site is characterised by several other large concave landslide features and significant convex breaks in slope.
- The spur in the centre of the property is a flatter, rotated debris deposit with hummocky ground surface features and terracettes.
- Around the development site the natural soil profile is greater than 5m deep and may extend up to 30m below surface.
- Large historical landslides appear common place in the landscape to the north and south and there are signs of historical landslides having occurred within the property boundaries.
- Considering the geomorphology of the site and the surrounding area, the geological model formed implies that the soil profile at the development site has formed predominately from in-situ weathering of transported colluvial sediments.
- The local ground model for landslide hazards involves, reactivation of existing colluvium, regression of existing landslide scarps, translational and rotational debris slides and debris flows.
- 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 571 Wild Dog Road, Apollo Bay, 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 with 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 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 was commissioned by Holman Designs on behalf of Cornelis and Mieke Versteeg (the Client's) to provide a Geotechnical Assessment of No. 571 Wild Dog Rd Apollo Bay (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 Geotechnical Assessment, "the elements at risk" for the proposed development are defined as any proposed dwellings and any related infrastructure, drive ways, access roads or ancillary structures, and all users or residents of any proposed dwelling and any related infrastructure, drive ways, access roads or ancillary structures.

3.0 DEVELOPMENT DESCRIPTION

- Proposed four bedroom single storey, brick veneer dwelling with concrete slab floor and veranda.
- Large, non-habitable colourbond clad shed on concrete slab. This structure may be regarded as having a Level 1 importance level as defined in Appendix A of the AGS, Practice Note Guidelines for Landslide Risk Management, 2007.
- Minor widening of existing driveway.

A site plan for the proposed design response is provided as 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 Google and NearMaps.
- Previous investigations and reports by AGR and other consultants both published and unpublished.
- Architectural drawings prepared by Holman Designs.

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. More recently however a large extent of the Wiridjil Gravel has been re-interpreted as being marginal marine sediments. The current thinking is that these sediments are more likely to have been deposited in a submarine deltaic environment during periods of fluctuating sea levels rather than a fluvial 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. This formation conformably overlies the Timboon Sand Member of the Late Cretaceous and is known to be up to 70m thick.

Following a long erosional period rising sea levels lead to a renewed marine transgression 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. Marls of the Nirranda Group (Late Eocene to Early Oligocene) and the Heytsbury Group (Late Oligocene to Late Miocene) were deposited during a time when open marine conditions prevailed. 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.

Uplift during the Miocene-Pliocene period was the result of regional tectonic compressional stresses throughout Victoria. In the Otway region, these compressional stresses were directed from the south-east and north-west. During this time significant regional north-east/south-west trending compressional structural features developed by way of broad anticlines, synclines and monoclines.

Previous geological mapping infers that the entire subject site consists of local basement rocks of the Eumeralla Formation situated on the up slope limb of the regional Wild Dog Monocline which has a south facing scarp dipping at approximately 60°. Another regional tectonic feature also likely to have developed during Miocene-Pliocene compression is the Wild Dog Fault. This fault strikes south-west along the path of the Wild Dog Creek from its headwaters to near Wild Dog Track in the north-eastern corner of the subject property.

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.

Apollo Bay can be described as belonging to the Aire Land System or the deeply dissected upland ranges of the Southern Uplands. This land system is characterized by steeply dissected spurs and ridges forming a rugged landscape with steep slopes, cliffs and bluffs.

Geomorphic development of the landscape is heavily influenced by landslides. Rapid valley development by the rivers and creeks and their tributaries has 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.

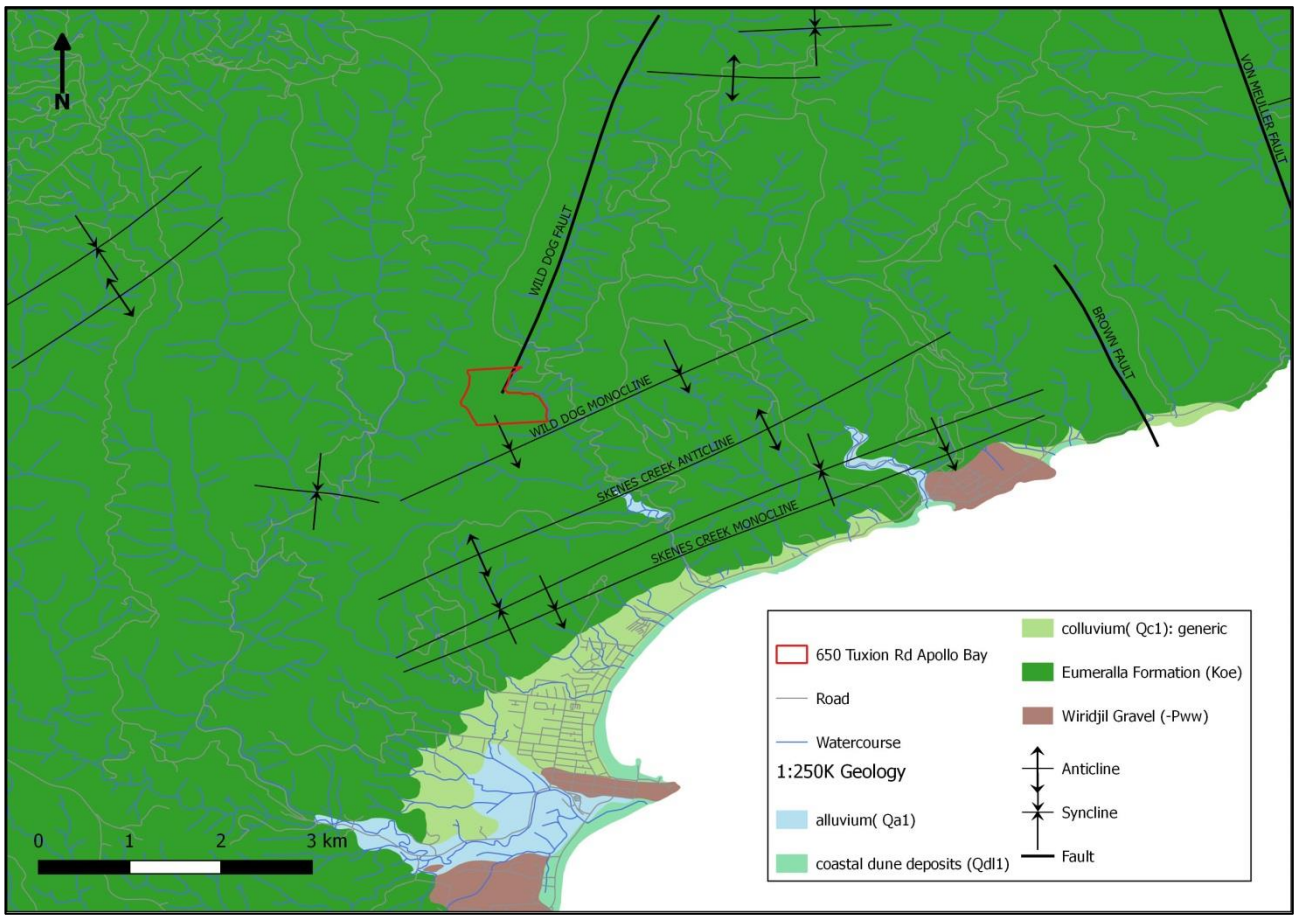


Figure 1: Regional geology of the greater Apollo Bay area

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 Apollo Bay area indicates that the site is subject to landslide susceptibility ranging from **Moderate** to **High**. Moderate on the crests of ridge and spur landforms, and High on the valley slopes.

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. In addition to heavy rainfall events, artificial concentrations of water have also been known to cause or contribute to landslips throughout the region. Such anthropogenic influences may include irrigation of horticultural land, failures of aqueducts, modification of water courses, poor storm water run-off design and in-ground waste water disposal.

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 Wild Dog 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. Past research suggests that an earthquake of a Magnitude 4.0 or greater originating from relatively shallow depth (<2km) would be required to trigger landslides.

Since 1902, there has been a single earthquake recorded within a 5km radius of the subject site. It was recorded in 1994, 2km to the east with a Magnitude of 2.3 originating from a depth of 15km below surface.

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 provides a general summary of some of the typical climatic and physiological features for the Soil Landform Unit 61 belonging to the Aire Land System of Otway Ranges which characterises the Apollo Bay area.

Table 1: Regional Features for Hills of the Soil Landform Unit 61

GEOMORPHIC UNIT	Dissected upland ranges of the Southern Uplands (3.1.2)		
LANDFORM	Hills		
LANDFORM ELEMENT	Lower slope and drainage line	Upper and middle slope	Crest
ELEVATION	90-560m		
LOCAL RELIEF	165m		
SLOPE ANGLE AND RANGE (%)	25 (5-40)	40 (25-80)	25 (5-30)
SLOPE SHAPE	Concave	Linear	Convex
RAINFALL	1100-1700mm Annual		
TEMPERATURE	11° Annual Average		

4.1.3 Previous Landslides Movements

Numerous landslide studies and geotechnical investigations have been previously conducted throughout the Apollo Bay and Wild Dog Creek area. Most of the landslide features mapped in the Wild Dog Creek area proximal to 571 Wild Dog Rd, were done so by either Cooney (1980) using stereo photogrammetry interpretation or Wood (1985) using stereo photogrammetry and direct observation.

The site is located within a large historical landslide which extends from west of Wild Dog Road right down to the Wild Dog Creek. Within this landslide there are several smaller more recent landslides resulting from reactivation of the displaced material from the older, larger feature.

Other well documented large landslides are located to the north (1952 landslide) and immediately south (The Big Slide) of the subject site. The landslide referred to as the "The Big Slide" is located between Busty Road and Wild Dog Road, extending west of the Wild Dog Road. This landslide is an active, large, complex landslide feature that has been regularly monitored and reported on over a period of decades including a geotechnical evaluation and risk assessment conducted by P.J Yttrup and Associates (2001).

Landslide failures of various sizes have been a common feature of the Wild Dog Road over the last 40-50 years with significant failures occurring in 1952, 1979, 1991 and 1993.

Figure 2 illustrates the density of historical landslides recorded in the landslide inventory while Figure 3 is a Hill Shade DEM image (azimuth 45° and 45° vertical illumination) highlighting the nature of The Big Slide, the 1952 Slide and the large landslide occupying the subject site.

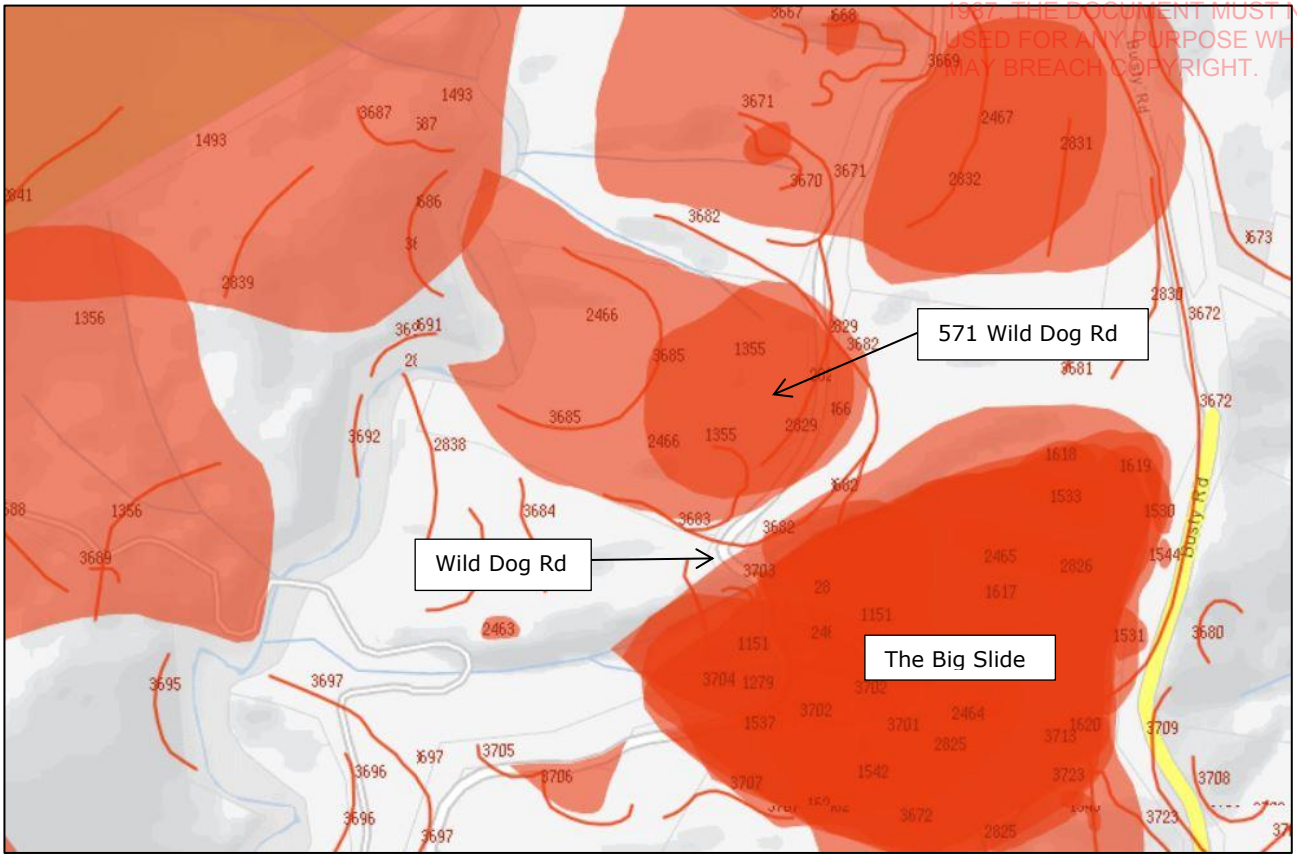


Figure 2: Previously recorded landslides on the landslide inventory

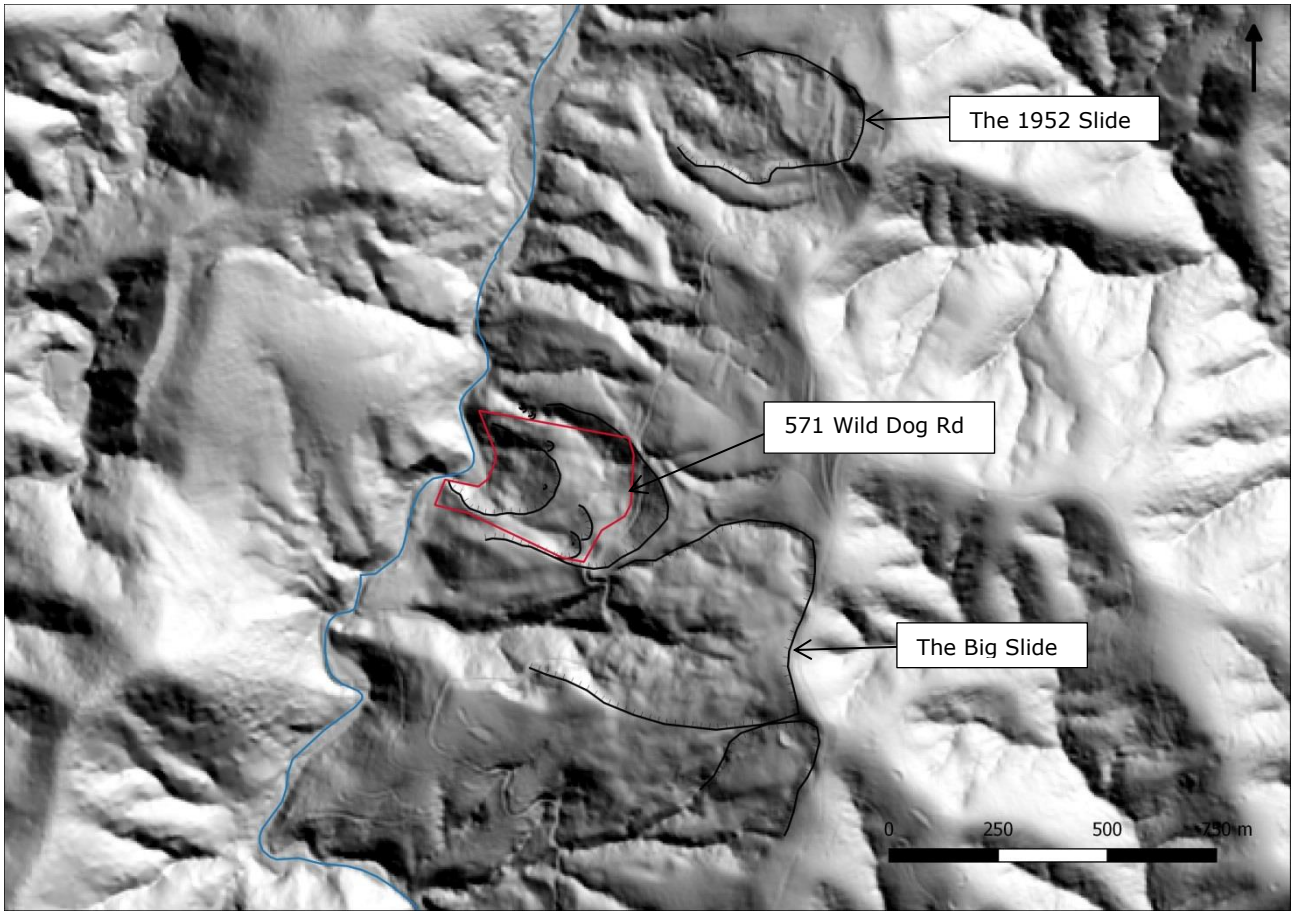


Figure 3: Hill Shade DEM of Major Landslides on Wild Dog Road.

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-sections in Figure's 5-7.

Site photographs are also attached as Appendix III.

4.2.2 Site Description and Physiography

Development:

- Large predominantly cleared rural property.
- Existing tracks, dam, grazing infrastructure and shed.
- Previous excavation for shed and dam construction.

Landscape position and Landforms:

- Located within the Wild Dog Valley in the steeply dissected hills of the Otway Ranges. Overall the property has a westerly aspect and over 100m of relief.
- Proposed development site is to be located proximal to existing shed on a levelled plateau or crest of a local spur landform.
- Spring fed dam and drainage line to the north of proposed building location.
- Steep gully to the south of building location.
- Prominent concave landslide scarps, slump and debris deposits.
- Wild Dog Creek flows south-west adjacent to the western boundary of the property.

Slopes:

- Natural slope angles along the spur range from 8° to 30° to the north-west and south-west. The overall slope direction is to the west-north-west.
- Steepest part of the property is below a prominent landslide scarp sloping at 30°.
- The flanks of the main spur below the proposed building location slope around 20°. The upper parts of the spur the slope to the west between 11° and 16° and up to 26° directly below the Wild Dog Road.
- The location of the existing shed has been excavated to create a virtually flat building pad.

Slope shapes:

- Overall the property is nestled within a large concave landslide feature, the headscarp of which is located to the east of Wild Dog Road.
- The site is characterised by several other large concave landslide features and significant convex breaks in slope.
- The spur in the centre of the property is a flatter, rotated debris deposit with hummocky ground surface features and terracettes.
- Regular changes in slope are can be observed across the property.

Drainage:

- Generally damp surface conditions over the majority of the site with observed ponding around the proposed building site. The development area is poorly drained with areas of ponding surface water present following rain.
- Very wet conditions in the gully immediately to the east of the development area.
- A dam is located immediately to the east of the proposed building envelope, fed by surfacing spring water and a developing drainage line concentrating surface water from Wild Dog Road and the steep landslide scarp to the east. The area between Wild Dog Road and the development area is poorly to moderately drained showing evidence of regular saturation.
- Incised slopes and natural drainage gullies to the north and south of the proposed development area drain surface water down to the Wild Dog Creek.
- Drainage infrastructure around the property including culverts and open spoon drains appear to be well maintained and effective in protecting the existing tracks.

Observations:

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

a) Boulder debris at surface.

b) Soil creep and terracettes.

c) Soil creep and terracettes below scarp on spur. Spur resulting from debris deposit.

d) Debris flow.

e) Landslide scarp with Wild Dog Creek located at toe incising debris. Pronounced soil creep, terracette development and hummock ground on steep scarp.

f) Part of massive debris deposit.

g) Fast flowing creek fed by seeping groundwater, and surface flow feeding the dam.

h) Dam fed by spring water and surface flow from run off over scarp above Wild Dog Road.

i) Dormant landslide with rotation. Hummocky scarp area sloping at 21°, concave break in slope and pronounced soil creep on toe.

j) Small debris flow on scarp of large feature.

k) Small landslide/debris flow with sharply defined scarp.

l) Virtually flat bench on crest or plateau of spur. Area has been excavated to create flat pad for building. Up to 4 meters removed. Area poorly graded/drained and surface water ponding is significant.

4.2.3 Sub-Surface Conditions

Subsurface conditions were investigated via inspection of soil and cuttings retrieved from boreholes established using a mechanical solid stem continuous flight auger.

- Around the development site the natural soil profile is between greater than 5m deep.
- Natural soils consist of a high plasticity pale yellow-brown and grey mottled silty CLAY with trace fine grained sand.
- Highly weathered mud fragments in a clay matrix were intersected around 4.5m below surface. Fragments were pebble size and angular to sub-round.
- Bedrock was not encountered during drilling.
- Bedrock is assumed to consist of fine to medium grained, sandstone and interbedded sandstone and very fine-grained siltstone/mudstone observed from outcrop exposures on the Wild Dog Creek and described by Wood (1982).
- The bedrock geology observed in outcrop is consistent with that of the Lower Cretaceous Eumeralla Formation referenced in published geological maps.
- The composition of the soil layers indicates the natural soils are transported in nature.
- Interpretation of the geomorphology on site infers a maximum depth of transported colluvium on site of around 30m.

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

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

4.2.4 Geological Structure

Geological mapping of outcrop exposure was undertaken to establish the likely geological structure.

- In outcrop on the Wild Dog Creek bedrock strata dip around 17° toward 206.2° (Dip/D'Dir: 17°/206.2°).
- Mapping conducted by Wood (1982) observed strata dipping between 21° and 24° in interbedded sediments on the Wild Dog Creek and in sandstone outcrop located above the Wild Dog Road near the south-east corner of the property. Bedding in these locations dip towards 256° and 238° respectively.
- Structurally the area is situated around the axis of a plunging anticline as described by Wood (1982). The folded geometry in this area is most likely forms a series of domes with secondary anticlines and synclines within larger antiformal structure.

- The bedding structure proximal to site dips oblique to the general slope direction (west-north-west). The apparent dip in cross section is sub parallel to the overall slope orientation.

- 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.

- A least four joint sets were observed in outcrop on the Wild Dog Road. These joint sets dip J_1: 87° towards 113.2°, J_2: 85° towards 41.2°, J_3: 85° towards 168.2° and J_4: 81° towards 88.2° respectively.

- Joint sets J_1 and J_2 are orthogonal joints measured in sandstone outcrop. Joints are undulating to planar and rough stained with limonite. Spacing ranges from 50-100mm.

- Joint sets J_3 and J_4 are conjugate joints measured in siltstone outcrop. Joints are planar to slightly undulating, smooth to slightly rough with limonite veneer coatings. These joints range from tight up to 5mm open spaced 100mm apart.

- Bedding partings were observed in outcrop as having planar to stepped and rough surfaces.

4.2.5 Groundwater Conditions

- Groundwater was not encountered during drilling activities although Soil conditions were typically moist to slightly moist.

- Mottling was observed in the silty CLAY soil suggesting surface water infiltration and periodic seepage of shallow groundwater through the profile although the profile does appear to be well drained.

- Groundwater seeps were observed freely discharging up slope of the dam at the base of the slope below Wild Dog Road. Anecdotal evidence suggests a spring line is also present approximately 85-100m upslope of the Wild Dog Creek (130m downslope of the proposed development area).

- Groundwater through flow tends to migrate along the bedrock surface. The presence of seeps may infer a shallower soil profile in these locations.

- 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 Wild Dog Road.

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

- There are no existing retaining walls or site cuts on the property with the exception of the earthworks undertaken on the crest of the spur to create a levelled pad for building. These activities were undertaken more than 15 years previous. Levelling of the crest has resulting in altering the elevation in this location by up to 4m.

- Fill embankments comprise of earthworks undertaken to fill minor gullies around the dam site and approaching the building pad as part of the construction of the existing track.

Culverts have been constructed in several locations where fill has been used to bridge minor gullies.

4.2.7 Existing Vegetation

- Approximately half of the property has been cleared for grazing and is now covered in pasture grasses.
- Forest vegetation existing in the drainage gully to the north of the development site and over the western half of the property down to the Wild Dog Creek.
- Patches of hydrophilic sedges and rushes are common around the track, up slope of the dam and along the eastern boundary.

4.2.8 Features of Adjacent Sites

- The subject site is surrounded by similar rural properties cleared of vegetation save for gully areas and drainage lines.
- Landslide features (scarps and areas of disturbance) appear common within the landscape surrounding the property. Numerous historical landslides have been interpreted form LiDAR imagery and recorded in the landslide inventory surrounding the property.

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 weathering of transported colluvial debris.
- Around the development site the natural soil profile is greater than 5m deep and may extend up to 30m below surface.
- Bedrock strata dip between 17° and 24° toward 206.2° to 256° proximal to the axis of a westerly plunging antiformal structure.
- A least four joint sets were observed in outcrop on the Wild Dog Road including orthogonal and conjugate joints.
- The subject site is positioned predominately within an interbedded sequence of sandstones and siltstones/mudstones.
- Large historical landslides appear common place in the landscape to the north and south and there are signs of historical landslides having occurred within the property boundaries.
- The local ground model for landslide hazards involves, reactivation of existing colluvium, regression of existing landslide scarps, translational and rotational debris slides and debris flows.

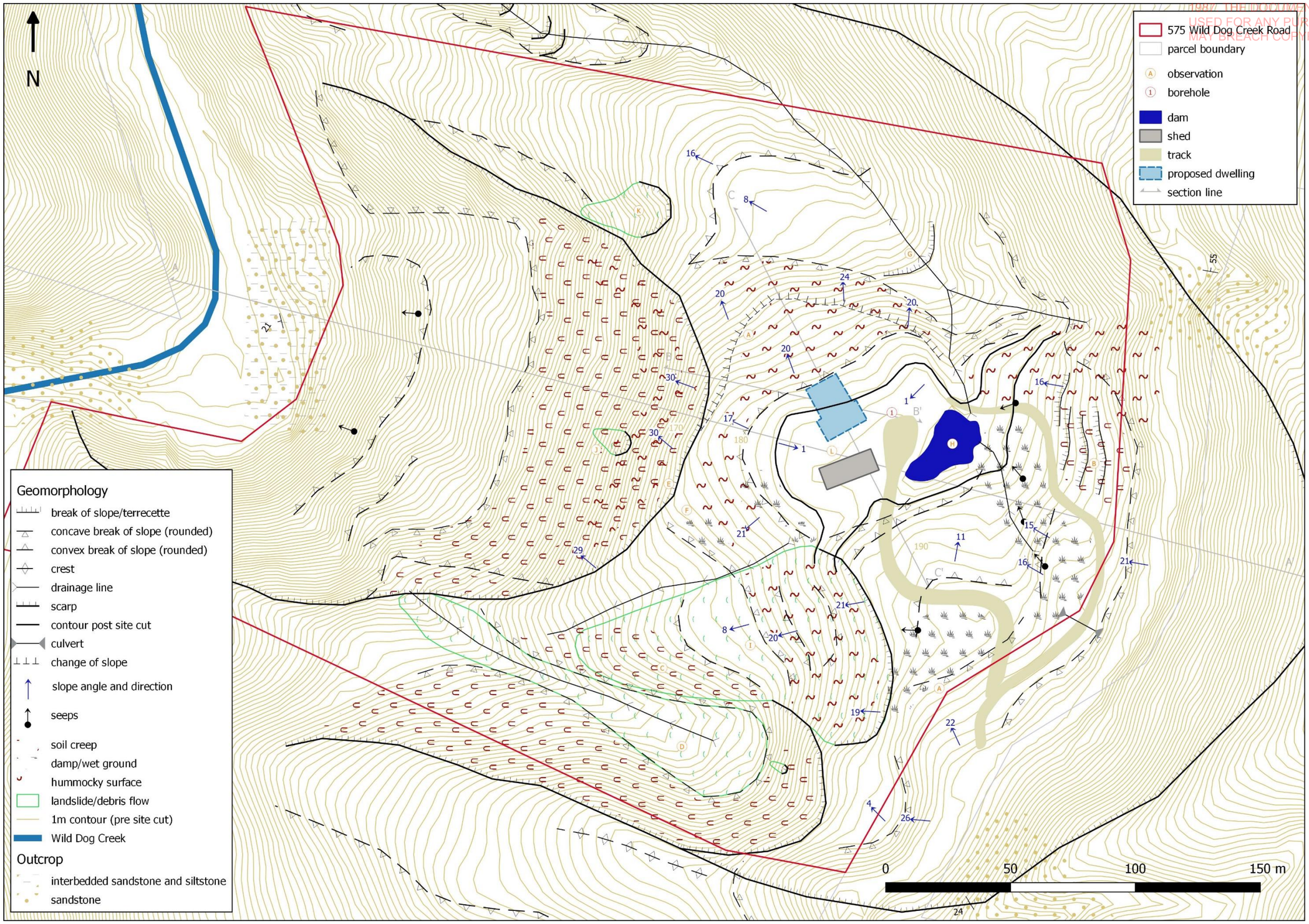


Figure 4: Engineering Geology and Geomorphology of 571 Wild Dog Road

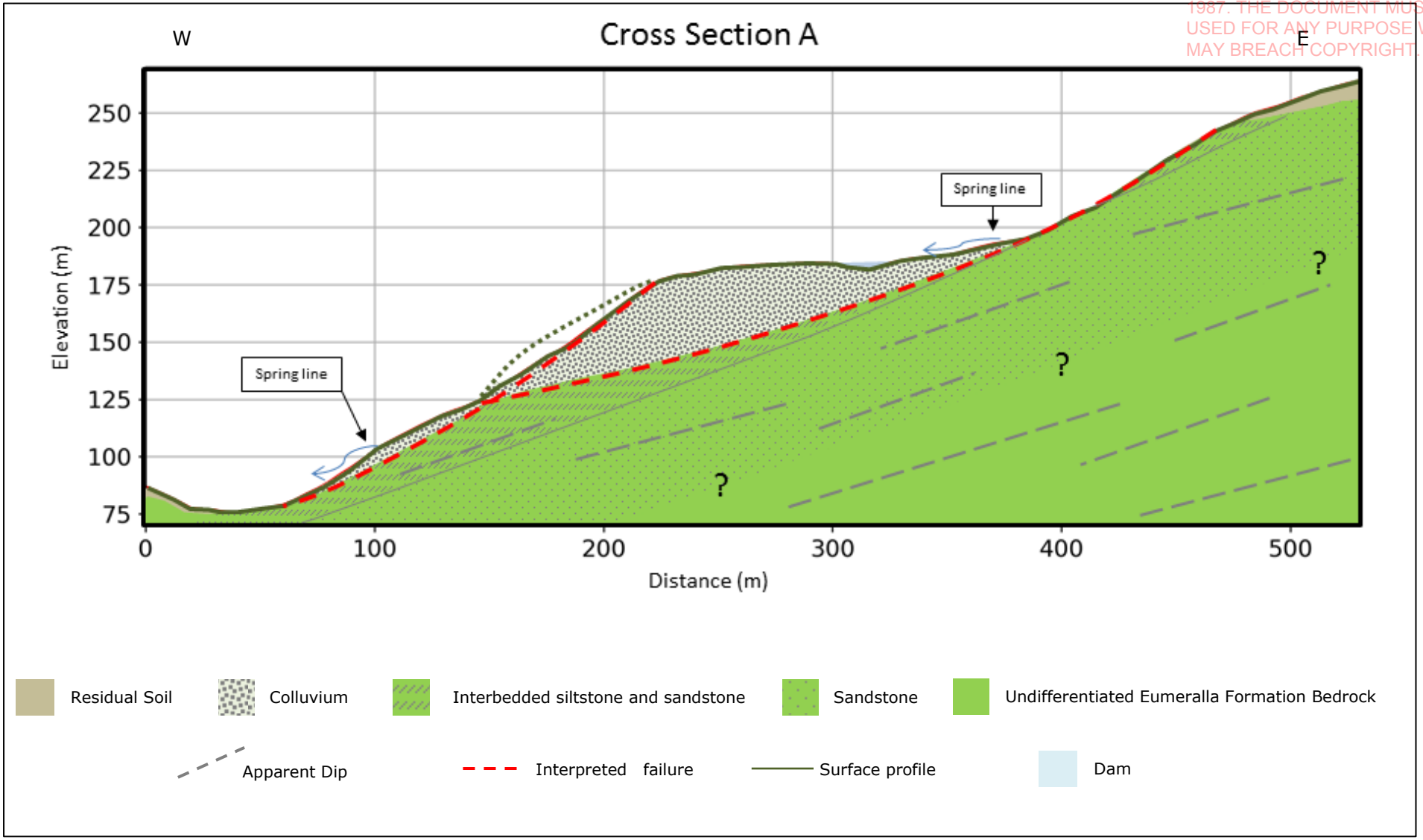


Figure 5: Cross-section A representing the local geological model

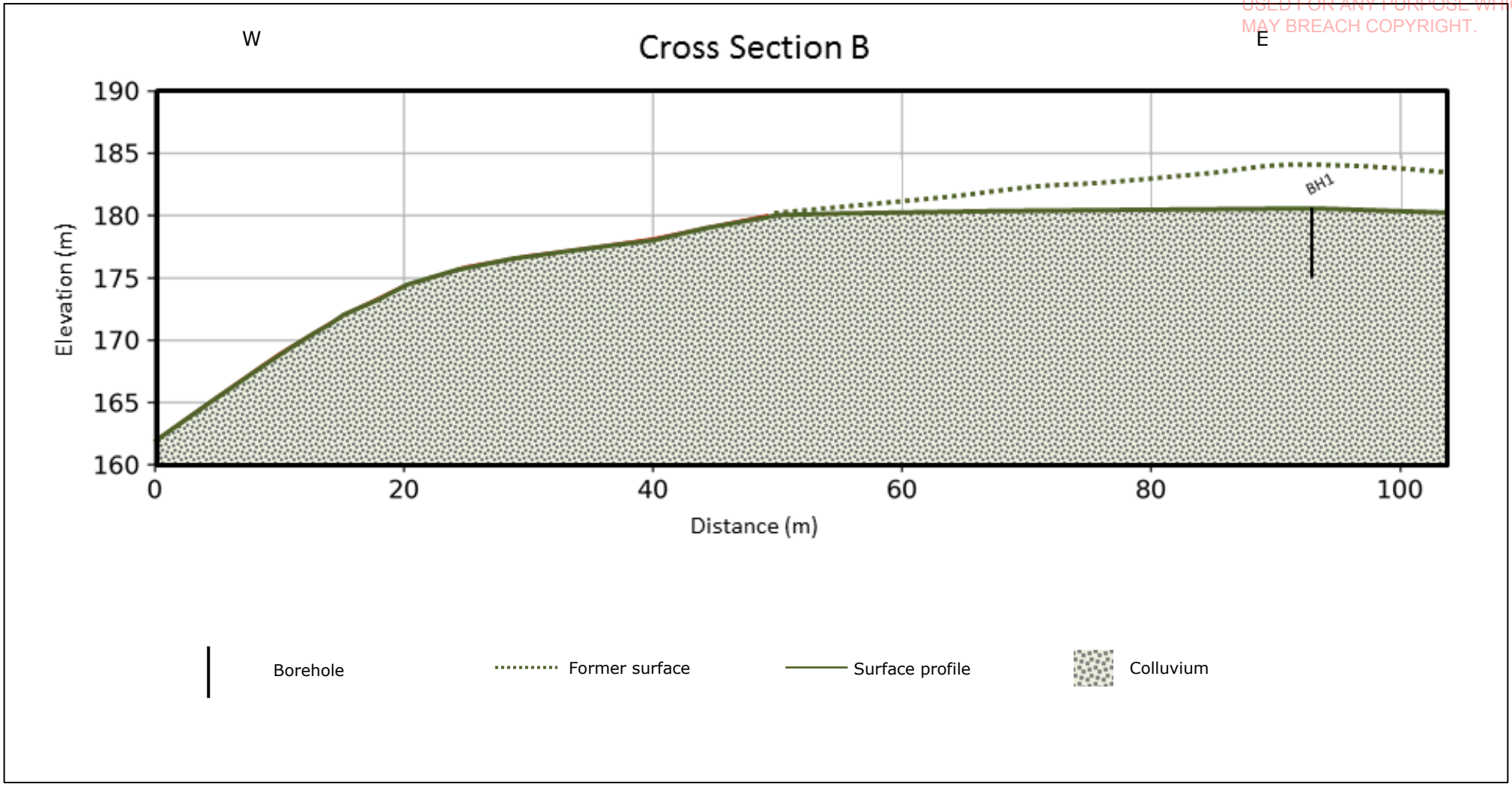


Figure 6: Cross-section B representing the local geological model

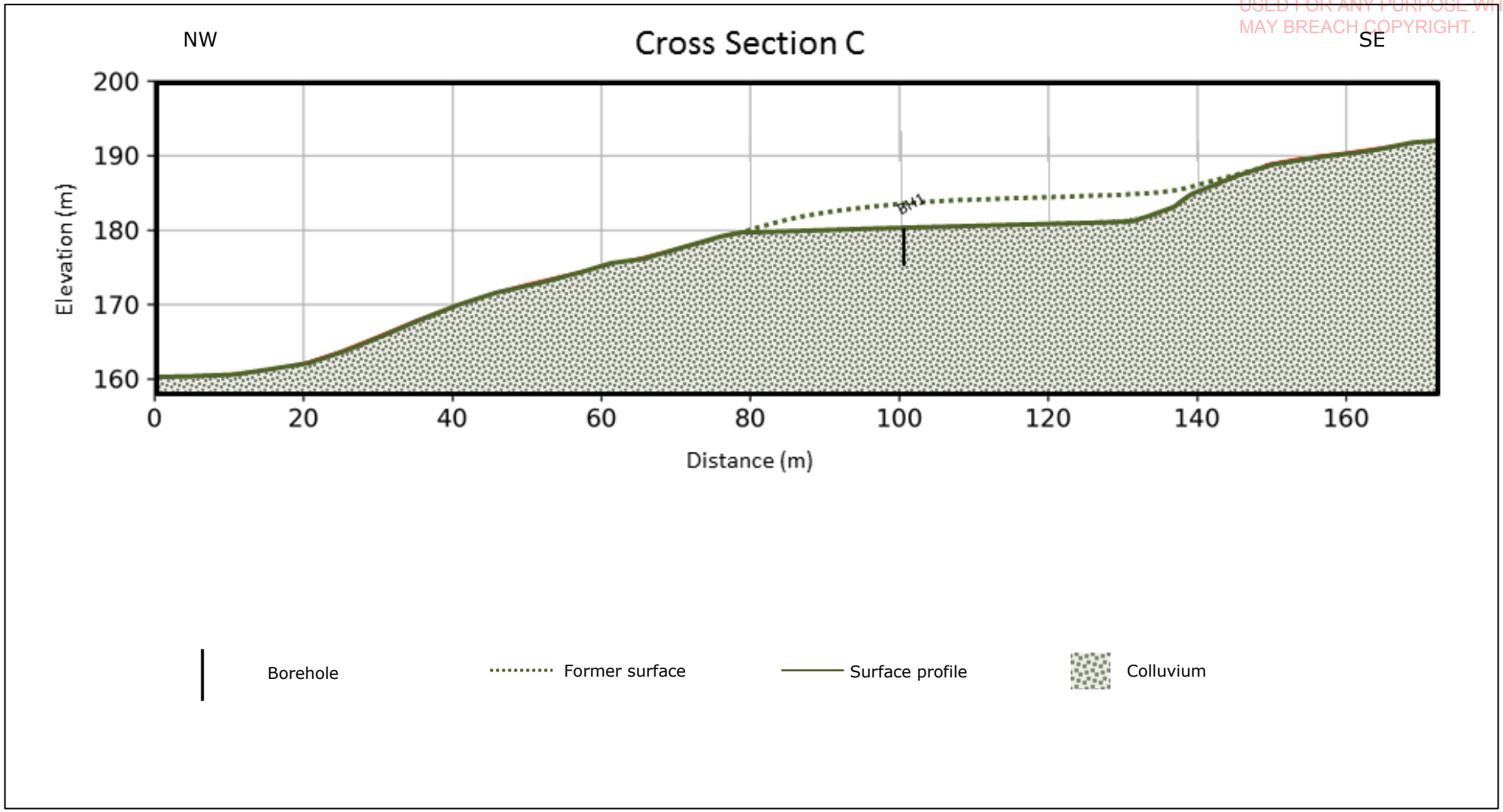


Figure 7: Cross-section C representing the local geological model

4.4 HAZARD IDENTIFICATION

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

HAZARD A. DEEP SEATED REACTIVATION OF LARGE HISTORICAL LANDSLIDE
HAZARD B. REGRESSION OF LANDSLIDE SCARP BELOW DWELLING
HAZARD C. DEBRIS FLOW ABOVE WILD DOG ROAD
HAZARD D. ROTATIONAL DEBRIS SLIDE BELOW DWELLING
HAZARD E. ROTATIONAL DEBRIS SLIDE ON STEEP SCARP SLOPES BELOW DWELLING
HAZARD F. ROTATIONAL DEBRIS SLIDE BELOW DWELLING ON LOWER SLOPES.

Hazard A. Deep seated reactivation of large historical landslide

- Large, deep seated translational debris slide reactivation of colluvial debris and silty CLAY soils.
- Movement likely to be slow and in small increments. May to move in slices. Horizontal displacement may be expected up to 1-5m.
- Mechanism for failure: Sliding along an existing failure surface well-defined competency contrast exists at the interface between colluvial debris soils underlying weathered bedrock.
- Trigger: Prolonged heavy rainfall and excessive groundwater through flow along bedrock surface. Infiltration causes rapid increase in pore water pressure, and softening/lubricating of colluvium/rock interface. May also be triggered by earthquake.

Hazard B. Regression of landslide scarp below dwelling

- Deeper, rotational debris slide and regression of existing landslide scarp.
- Movement likely to be initially slow to moderately fast in small increments. May move in slices.
- Regressive failure could occur up to 5m from existing head scarp.
- Mechanism for failure: Rotational sliding related internal shearing of cohesive colluvial soils with weakened or fully softened shear plane of low shear strength.
- Trigger: Prolonged soaking, high volume rainfall resulting high infiltration and sub surface through flow causing a build-up of excessive pore water pressure.

Hazard C. Debris flow above Wild Dog Road

- Small to medium sized debris flow from steep landslide scarp above Wild Dog Road. Size could range from small, shallow 10-30m wide, 30-40m long failures to medium to large failures similar to the 1952 slide.
- Movement likely to be fast to rapid. Run out could be expected to range from 50m for a small failure up to a few hundred meters.
- Debris expected to flow within existing well defined drainage lines and gullies.

- Mechanism for failure: Instantaneous failure of steep rock and soil slopes. Possible complex combination of rotational and translational sliding and rock fall.

- Trigger: Prolonged, very high to extreme intensive rainfall. May also be triggered by earthquake.

Hazard D. Rotational debris slide below dwelling

- Small, rotational debris slide with slope failure with back tilt and rotated toe heave (1-2 deep, 10-15 wide). Length of area affected up to 5m long.

- Failure may develop quickly or very slowly. Movement likely to be moderately fast to rapid in small increments but overall slow. Horizontal displacement may be expected up to 5m.

- Colluvial soil profile with low to moderate internal friction angles and low to moderate drained effective cohesion. Variable undrained shear strength.

- Mechanism for failure: Rotational sliding related internal shearing of cohesive soils with weakened or fully softened shear plane of low shear strength.

- Trigger: Prolonged soaking, high volume rainfall resulting high infiltration and sub surface through flow causing a build-up of excessive pore water pressure.

Hazard E. Rotational debris slide on steep scarp slopes below dwelling

- Small, rotational debris slide with slope failure (1-3 deep, 5-10 wide). Length of area affected up to 5m long. May become small debris flow with approximately 10-15m long run out distance. Estimated volume range of sliding/flowing mass between 25m^3 and 150m^3.

- Fast moving, instantaneous failure with release point mid slope.

- Colluvial soil profile with low to moderate internal friction angles and low to moderate drained effective cohesion. Variable undrained shear strength.

- Mechanism for failure: Rotational sliding related internal shearing of cohesive soils with weakened or fully softened shear plane of low shear strength.

- Trigger: Extreme to high intensity rainfall and excessive groundwater through flow or seepage. Increased pore water pressure causing shear failure and probable fluidised flow.

Hazard F. Rotational debris slide below dwelling on lower slopes.

- Small, rotational debris slide with slope failure with back tilt and rotated toe heave (1-2 deep, 10-15 wide). Length of area affected up to 5m long.

- Failure may develop quickly or very slowly. Movement likely to be moderately fast to rapid in small increments but overall slow. Horizontal displacement may be expected up to 5m.

- Colluvial soil profile with low to moderate internal friction angles and low to moderate drained effective cohesion. Variable undrained shear strength.

- Mechanism for failure: Rotational sliding related internal shearing of cohesive soils with weakened or fully softened shear plane of low shear strength.

- Trigger: Prolonged soaking, high volume rainfall resulting high infiltration and sub surface through flow causing a build-up of excessive pore water pressure.

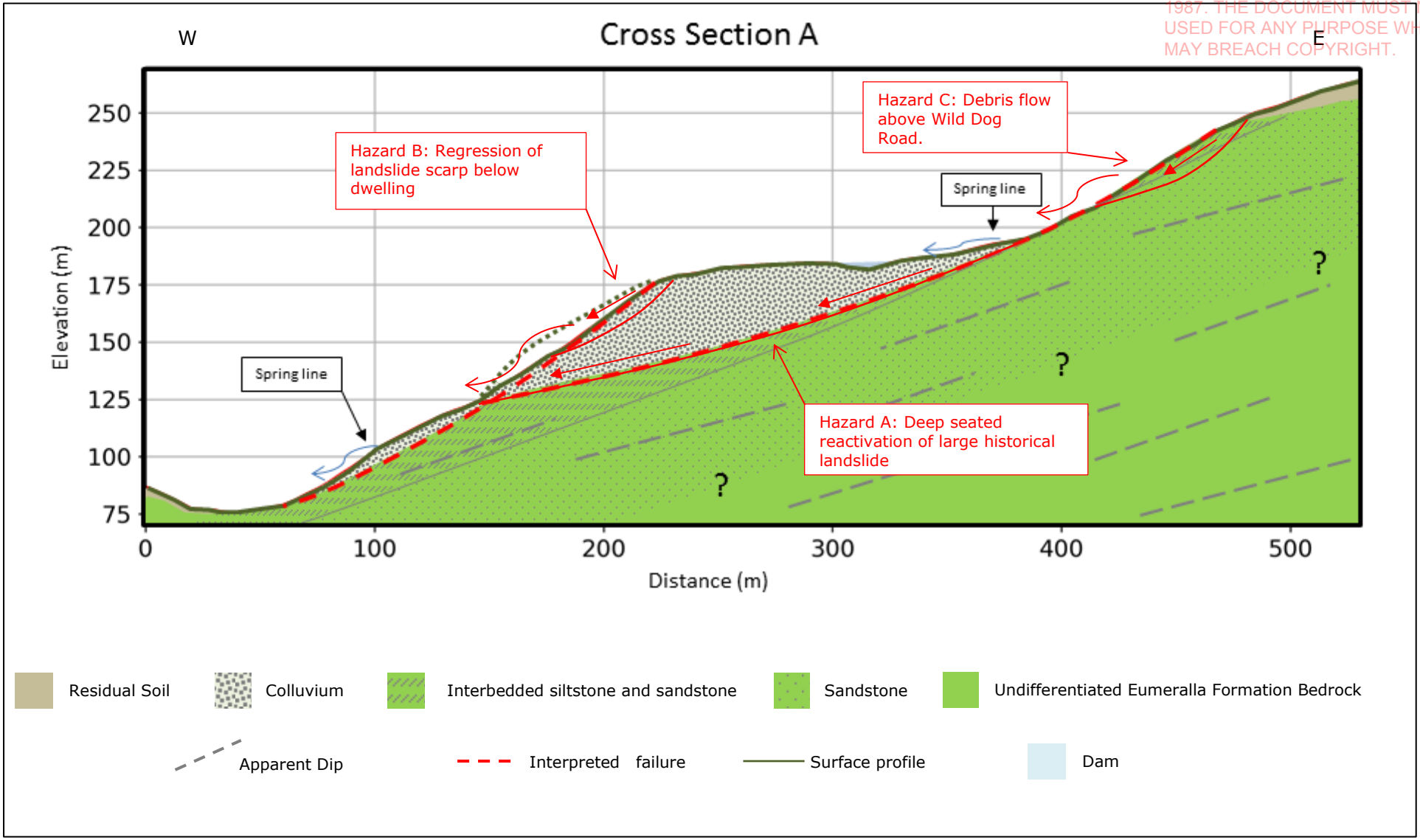


Figure 8: Schematic Cross-section A with possible hazards

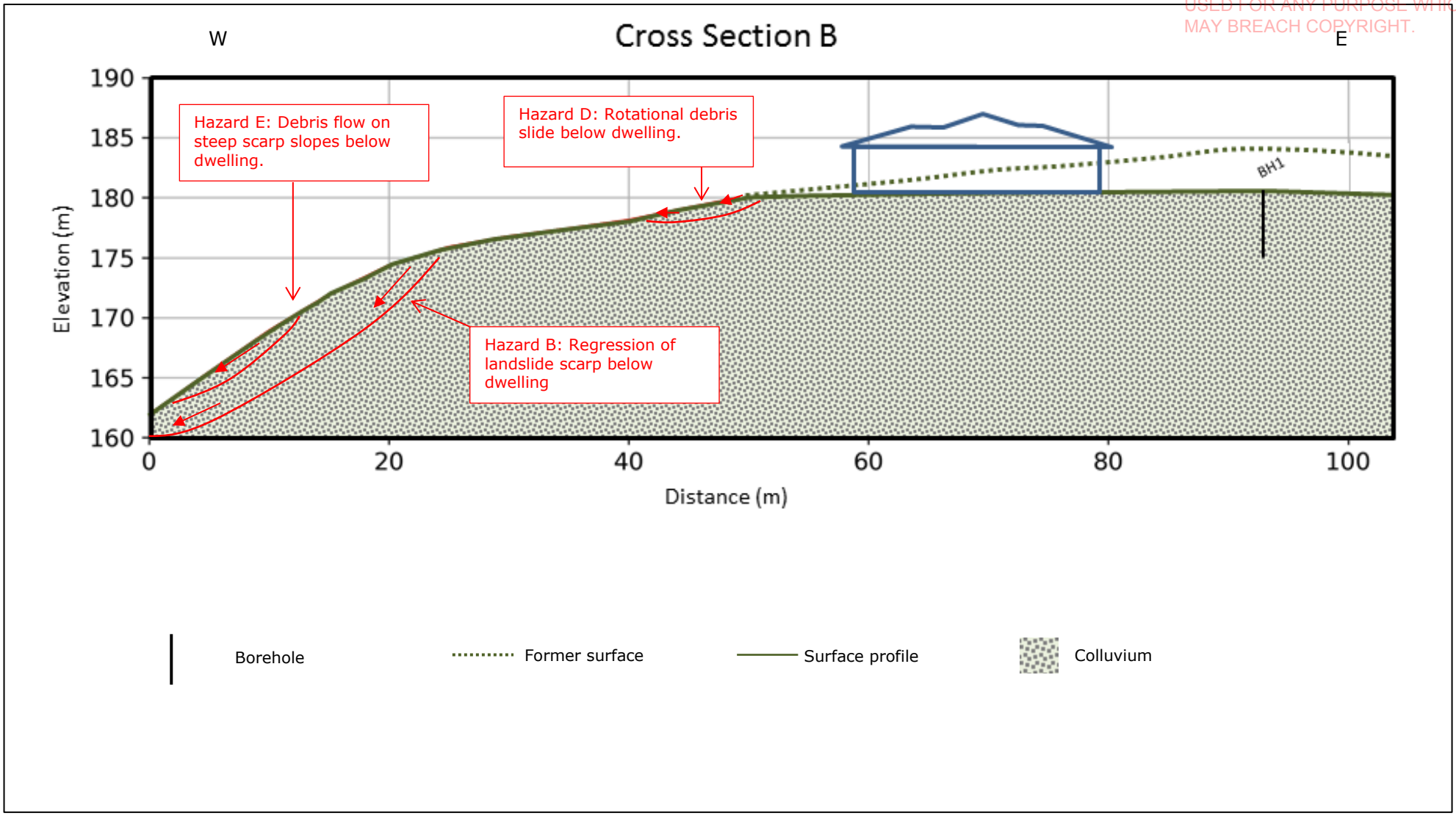


Figure 9: Schematic Cross-section B with possible hazards

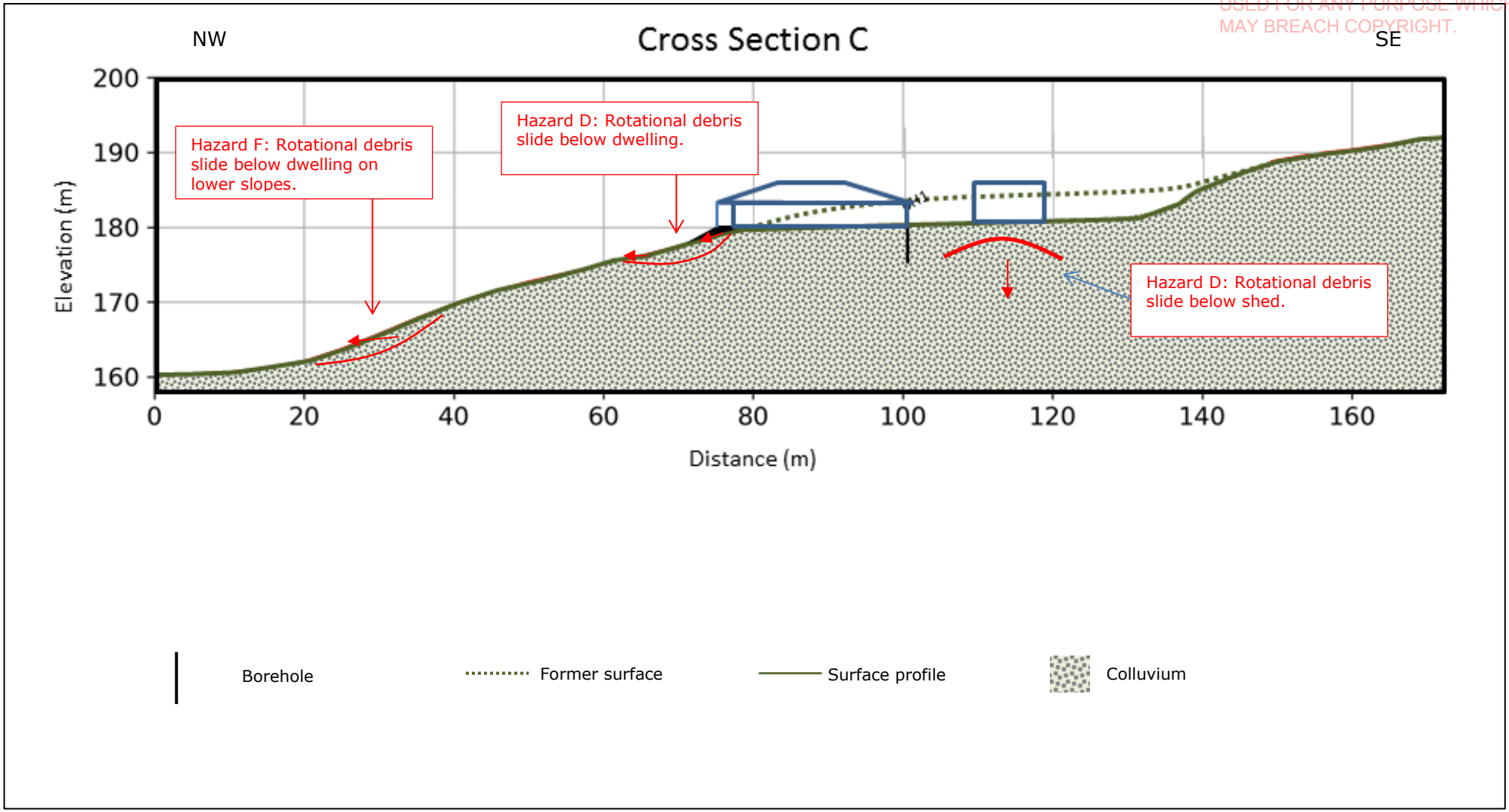


Figure 10: Schematic Cross-section C with possible hazards

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. Deep seated reactivation of large historical landslide

- Historical landslide with existing failure surface.
- Mature landslide with incised or dissected body but well defined features including steep head scarp.
- Groundwater seeps and spring lines present.
- High volume run on to spur from Wild Dog Road and landslide scarp observed and expected.
- No current evidence of any tension crack development.
- Terracettes and soil creep present on scarp and over flanks of debris deposit.
- Remobilisation of colluvium has occurred in the past 50 years within the area.
- Likelihood of occurring during design life: **POSSIBLE.**

Hazard B. Regression of landslide scarp below dwelling

- Very steep head scarp (up to 30°). Steep slopes above head scarp (up to 21°).
- Cleared of vegetation.
- Head scarp above spring line.
- Well drained colluvial material.
- No signs of existing tension cracks above crown.
- Rounded crown, no evidence of previous regression.
- Strong evidence of active soil creep and terracettes of scarp face.
- Large slope failures have occurred in recent history (1952 Slide).
- Likelihood of occurring during design life: **UNLIKELY.**

Hazard C. Debris flow above Wild Dog Road

- Very steep head scarp (up to 32°).
- Cleared and poorly vegetated.

- Numerous debris flow failures recorded in landslide inventory along Wild Dog Road in recent history (last 50 years).
- Large slope failures have occurred in recent history (1952 Slide).
- No clear evidence of recent debris flows occurring directly above subject site.
- High flow run off expected over scarp face.
- Active soil creep on scarp face.
- **C1**: Likelihood of small flow with 50m of movement in a single event: **LIKELY**
- **C2**: Likelihood of large flow with hundreds of meters movement in a single event: **POSSIBLE**

Hazard D. Rotational debris slide below dwelling

- Moderately steep to steep natural slopes (17-20^{o}).
- Highly weathered colluvial debris material.
- Above the spring line. Colluvium well drained.
- Cleared of vegetation.
- Hummocky surface expression but no signs of active soil creep.
- Some run off expected.
- No current signs of tension cracks. No signs of recent sumps or rotational failures in this location. Rotated slumps reported on similar slopes within the Wild Dog Road area.
- West to north-west facing slopes with moderate-high susceptibility.
- Likelihood of occurring during design life: **POSSIBLE.**

Hazard E. Rotational debris slide on steep scarp slopes below dwelling

- Very steep head scarp (up to 30^{o}).
- Cleared of vegetation.
- Head scarp above spring line.
- Well drained colluvial material.
- No signs of existing tension cracks above crown.
- Strong evidence of active soil creep and terracettes of scarp face.
- Evidence of past small rotational slumps and slides.
- Likelihood of occurring during design life: **LIKELY.**

Hazard F. Rotational debris slide below dwelling on lower slopes

- Steep natural slopes up to 24°).
- Highly weathered colluvial debris material.
- Approaching elevation of spring line. Colluvium well drained.
- Cleared of vegetation.
- Hummocky surface expression but no signs of active soil creep.
- Some run on expected.
- No current signs of tension cracks. No signs of recent sumps or rotational failures in this location. Rotated slumps reported on similar slopes within the Wild Dog Road area.
- West to north-west facing slopes with moderate-high susceptibility.
- Likelihood of occurring during design life: **POSSIBLE.**

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	Deep seated reactivation of large historical landslide	Dwelling	POSSIBLE	MINOR	**MODERATE**
B	Regression of landslide scarp below dwelling	Dwelling	UNLIKELY	MINOR	**LOW**
C_1	Small debris flow above wild dog road	Dwelling; shed	LIKELY	MINOR	**MODERATE**
C_2	Medium to large debris flow above wild dog road	Dwelling; shed	POSSIBLE	MEDIUM	**MODERATE**
D_1	Rotational debris slide below dwelling	Dwelling	POSSIBLE	MINOR	**MODERATE**
D_2	Rotational debris slide below shed	Shed	POSSIBLE	MINOR	**MODERATE**
E	Rotational debris slide on steep scarp slopes below dwelling	Dwelling	LIKELY	INSIGNIFICANT	**LOW**
F	Rotational debris slide below dwelling on lower slopes.	Dwelling	POSSIBLE	INSIGNIFICANT	**VERY LOW**

Table 4: Risk Assessment for Property in Mitigated Conditions

HAZARD		ELEMENT AT RISK	MITIGATION MEASURES	LIKELIHOOD	CONSEQUENCE	RISK TO PROPERTY
A	Deep seated reactivation of large historical landslide	Dwelling	Revegetate slopes above proposed dwelling, around existing track and along eastern boundary with deep rooted trees and shrubs; improve surface drainage with lined drainage channels above dam and along base of slope below Wild Dog Road to channel surface water into dam and natural drainage gullies to north and south of proposed building site; construct building with light weight flexible materials; use adjustable stump footings.	**UNLIKELY**	MINOR	**LOW**
B	Regression of landslide scarp below dwelling	Dwelling	Revegetate slopes below proposed dwelling, and above steep scarp with deep rooted trees and shrubs;	UNLIKELY	MINOR	**LOW**
C_1	Small debris flow above wild dog road	Dwelling; Shed	Install debris flow diversion barriers above dwelling and shed to reduce impact direct potential debris flow into gullies north and south of proposed dwelling.	LIKELY	**INSIGNIFICANT**	**LOW**
C_2	Medium to large debris flow above wild dog road	Dwelling; Shed	As above; avoid developing any structures within or proximal to natural drainage gullies north and south of the spur.	POSSIBLE	**MINOR**	**MODERATE**
D_1	Rotational debris slide below dwelling	Dwelling	Grade building pad so that surface water cannot concentrate or pond around building envelope; provide drainage around proposed dwelling and existing shed to remove surface water; discharge drainage into natural watercourse; provide a setback between the proposed dwelling and the crest of the building pad of no less than 5m; revegetate slopes below proposed dwelling with deep rooted trees and shrubs.	**UNLIKELY**	MINOR	**LOW**
D_2	Rotational debris slide below Shed	Shed	Grade area so that surface water cannot concentrate or pond around shed; provide drainage around existing shed to remove surface water; discharge drainage into natural	**UNLIKELY**	MINOR	**LOW**

HAZARD		ELEMENT AT RISK	MITIGATION MEASURES	LIKELIHOOD	CONSEQUENCE	RISK TO PROPERTY
			watercourse; provide a setback between the shed and the crest of the break in slope no less than 5m; revegetate slopes below proposed shed with deep rooted trees and shrubs.			
E	Rotational debris slide on steep scarp slopes below dwelling	Dwelling	Revegetate cleared slopes below dwelling with deep rooted trees and shrubs.	LIKELY	INSIGNIFICANT	**LOW**
F	Rotational debris slide below dwelling on lower slopes.	Dwelling	Revegetate cleared slopes below scarp with deep rooted trees and shrubs.	POSSIBLE	INSIGNIFICANT	**VERY 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	Deep seated reactivation of large historical landslide	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	0	0
B	Regression of landslide scarp below dwelling	Dwelling	UNLIKELY	10^{-4}	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_1	Small debris flow above wild dog road	Dwelling	LIKELY	10^{-2}	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
		Vehicle			0.6	5 min exposure 2 times daily	0.00345	May impact vehicle, may be crush or filled	0.7	**1.4×10^{-5}**
C_2	Medium to large debris flow above wild dog road	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, not expected to collapse	0.1	2.1×10^{-6}
		Vehicle			0.8	5 min exposure 2 times daily	0.00345	May impact vehicle, may be crush or filled	0.9	2.5×10^{-6}
D_1	Rotational debris slide below dwelling	Dwelling	POSSIBLE	10^{-3}	0.6	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Medium damage to the building, not expected to collapse	0.1	3.1×10^{-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
D_2	Rotational debris slide below dwelling	Shed	POSSIBLE	10^{-3}	0.4	Non habitable structure	0	Minor damage to the shed, not expected to collapse	0	0
E	Rotational debris slide on steep scarp slopes below dwelling	Dwelling	LIKELY	10^{-2}	0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0
F	Rotational debris slide below dwelling on lower slopes.	Dwelling	POSSIBLE	10^{-3}	0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0

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	Deep seated reactivation of large historical landslide	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	0	0
B	Regression of landslide scarp below dwelling	Dwelling	UNLIKELY	10^{-4}	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_1	Small debris flow above wild dog road	Dwelling	LIKELY	10^{-2}	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
		Vehicle			0.1	5 min exposure 2 times daily	0.00345	May impact vehicle, not expected to be crushed or filled	0.2	**6.9×10^{-7}**
C_2	Medium to large debris flow above wild dog road	Dwelling	POSSIBLE	10^{-3}	**0.2**	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Minor damage to the building, not expected to collapse	0.1	**1.0×10^{-6}**
		Vehicle			**0.4**	5 min exposure 2 times daily	0.00345	May impact vehicle, may be crushed or filled	0.9	**1.2×10^{-6}**
D_1	Rotational debris slide below dwelling	Dwelling	**UNLIKELY**	**10^{-4}**	0.6	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Medium damage to the building, not expected to collapse	0.1	**3.1×10^{-7}**

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
D_2	Rotational debris slide below dwelling	Shed	POSSIBLE	10^{-3}	0.4	Non habitable structure	0	Minor damage to the shed, not expected to collapse	0	0
E	Rotational debris slide on steep scarp slopes below dwelling	Dwelling	LIKELY	10^{-2}	0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0
F	Rotational debris slide below dwelling on lower slopes.	Dwelling	POSSIBLE	10^{-3}	0	Assume 20 hrs. occupancy per day for person most at risk; part building affected	0.052	Not expected to impact dwelling	0	0

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.

For the existing shed the ACCEPTABLE risk level for this assessment is defined as a MODERATE risk to property damage in accordance with Table C10, Acceptable qualitative risk to property criteria, of the AGS Commentary on Practice Note Guidelines for landslide Risk Management 2007, for a structure with an Importance Level of 1 (non-habitable structure). This level of risk is achievable for given the location and construction type for this pre-existing structure.

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 development we recommend the proposed building be constructed of flexible, lightweight materials that can tolerate small amounts of movement. We also recommend that consideration be given to a timber floor and adjustable stump footing arrangement.

Positioning of the proposed dwelling and the existing shed should maintain a minimum 5m setback from the crest of the excavated building pad (ie 5m from the break in slope from the virtually flat area to the steeper slopes). According the submitted plans, both structures comply with this requirement.

9.1.1 Debris Flow Diversion Barriers

One potential risk to the proposed development is the possible impact from a debris flow sourced upslope of Wild Dog Road. When they occur, large debris flows will typically concentrate and flow down established drainage lines and gullies. On this site we expect that because of the proposed building location on the crest of the spur in the centre of the property, there is a high probability that a debris flow may not impact the dwelling and instead concentrate in drainage gullies either side of the spur. Despite this, it is still possible for a debris flow to impact the site. As a precaution, we recommend that debris flow diversion barriers be considered up slope of the dwelling designed to divert debris north and south of the proposed development.

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

The client is advised that building in a geologically active environment such as the Wild Dog Valley comes with its own set of challenges. The proposed dwelling may require occasional releveling and site maintenance and client expectations of footing performance should be addressed at the design stage.

We recommend engineer-designed footings for the site designed according to the engineering principles of AS 2870-2011 Section 4 and constructed in accordance with Sections 5 & 6. The designer should assume **moderate** to **high** background soil profile reactivity with a characteristic surface movement (y_s) between 40-60mm. We also recommend allowing for some lateral soil pressures on the footing due to possible ongoing soil movement.

Our recommendation for this site is to use an adjustable stump footing arrangement. Stump footings should be founded **1500mm below finished surface level** or a minimum of **1000mm** into natural stiff clay **WHICHEVER IS DEEPER**.

At the above depths the designing engineer can assume an allowable bearing pressure of 200kPa

9.4 SITE EXCAVATIONS, CUT AND FILLS AND RETAINING STRUCTURES

It is recommended that any site excavations for the proposed dwelling should be kept to a minimum and that **all** new 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.

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 have been calculated without considering geotechnical reduction factors.

Table 7: Active Earth Pressure Coefficients

SOIL TYPE	ACTIVE EARTH PRESSURE COEFFICIENT (Ka)
silty CLAY	0.41

Table 8: Passive Earth Pressure Coefficients

SOIL TYPE	PASSIVE EARTH PRESSURE COEFFICIENT (Kp)
silty CLAY	2.46

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 9: At Rest Earth Pressure Coefficients

SOIL TYPE	AT REST EARTH PRESSURE COEFFICIENT (Ko)
sandy CLAY	0.58

The recommended parameters assume a vertical wall and an horizontal backslope with granular backfill behind the wall as well as an horizontal foreslope. 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 10: Typical Geotechnical Parameters

	silty CLAY
Wet or total unit Weight (γ_w)	19 kN/m^3
Effective Friction angle (Φ')	25^o
Effective Cohesion (c')	1kPa
Undrained shear strength (c_u or S_u)[1]	150-200kPa

[1] Not to be used for long term stability

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 11: 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[2]	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.

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 12: 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[3]	45° or 1(V):1(H)

[2] 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.

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.

An existing sleeper retaining wall supporting a fill batter above the driveway down to the dairy cottage should be replaced.

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 Apollo Bay 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 a site drainage system and discharge excess water in a non-destructive way into a natural watercourse. Discharge must be made well away from any buildings to an area where the water can be dispersed without causing erosion or accumulating in a concentrated area. It is very important that roof run-off is not allowed to run onto the ground near buildings.

Surface drainage (catch drains or diversion berms) are 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 and the existing shed. The site drainage system must discharge into a natural watercourse and not be allowed to pond anywhere on the excavated building pad.

As part of the overall drainage design for this site, we recommend surface water drainage be installed along the eastern boundary, below Wild Dog Road. It is highly recommended that lined drainage channels be used to direct surface water runoff and through flow seepage from the steep scarp above Wild Dog Road, into the existing dam and the drainage gully to the north of the building site.

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

[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.

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.

We recommend that a re-vegetation program be implemented for the development area especially immediately down slope of the building pad, on the steep scarp slopes below the proposed dwelling and are up slope of the dam. 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.

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;

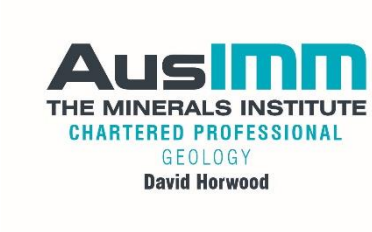
b) the provision of adequate retaining structures and drainage for all cut faces (or batter at an appropriate angle);

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.

DAVID J HORWOOD
BAppSc (Geology); MAusIMM CP (Geo); MAIG
SENIOR ENGINEERING GEOLOGIST



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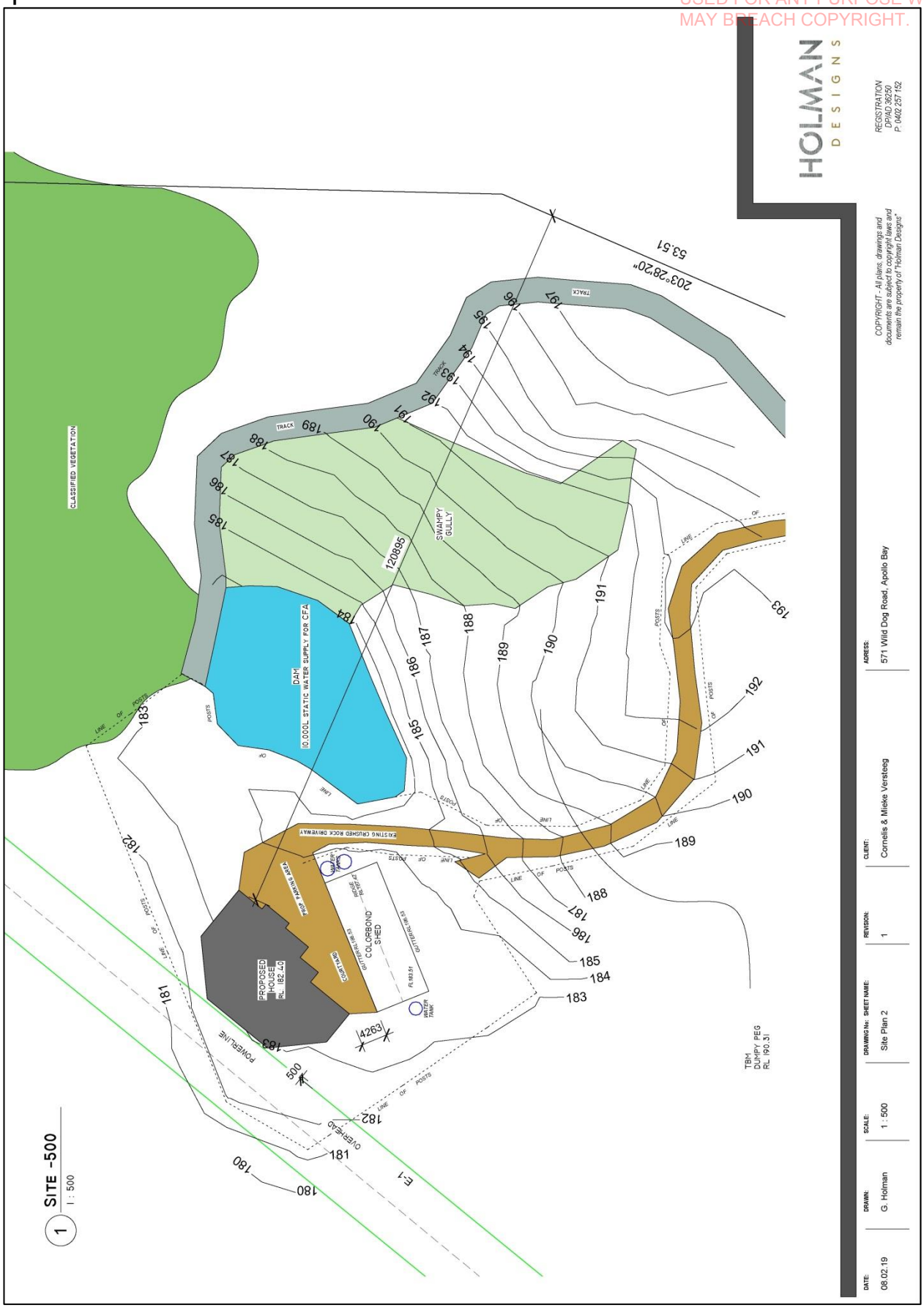
Appendix I: Aerial Photograph

Appendix II: Site Plan



Appendix III: Site Photographs

Photo 1: Overview of the spur from the access raod near the eastsern boundary.

Photo 2: Overview of the proposed development area.

Photo 3: View of the slopes above the dam and the steep landslide scarp above Wild Dog Road

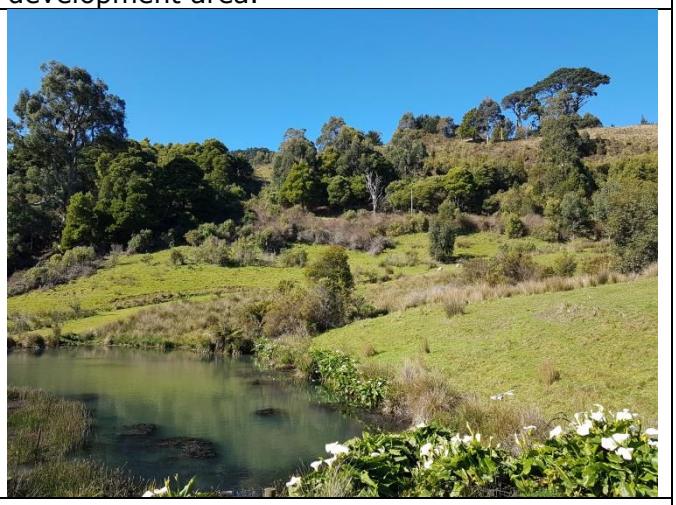


Photo 4: Dam and seeps behind proposed building site.

Photo 5: Debris flow, drainage gully and soil creep south of building site.

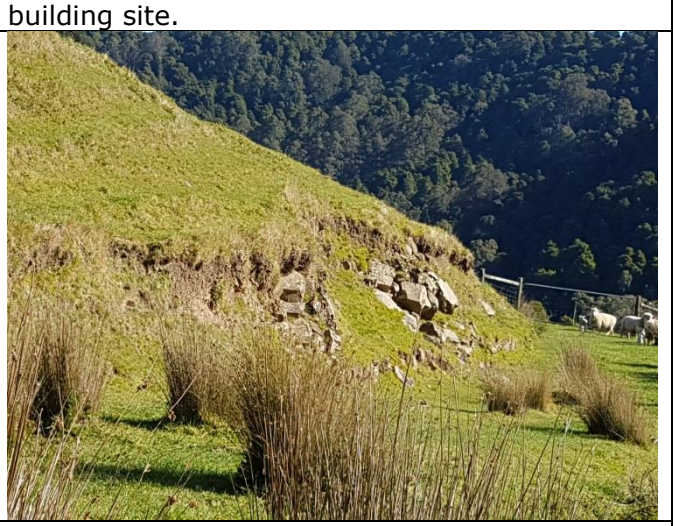
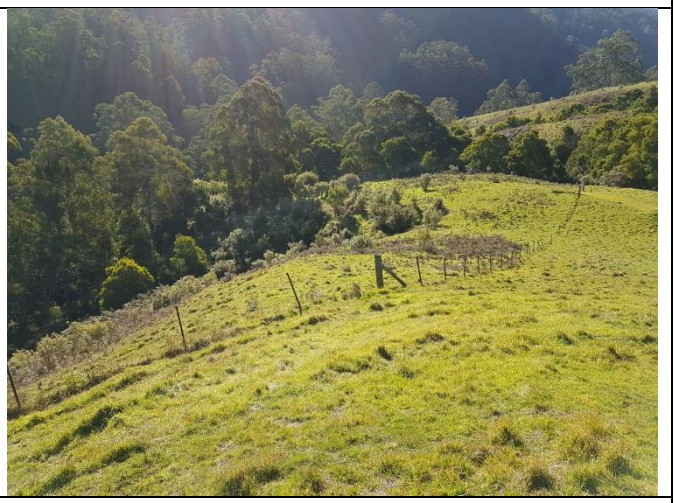


Photo 6: Cutting on neighboring property exposing typrical debris material.

	
Photo 1: Landslide scarp below building site looking north.	Photo 2: View of landslide scarp looking south
	
Photo 3: Head of small landslide to north-west of building site.	Photo 4: View of slopes below building site looking north-west.

Appendix IV: Test Site Logs

Client:	Holman Designs	Bore Hole	No. 1	Drilling Medthod:	
Project Address:	575 Wild Dog Road	Field Work Completed By:	DH	Continuous Flight Auger	
Reference No:	18H295LRA	Field Work Date:	24.8.2018	From 0	To 3500

Depth mm	Graphic Log	Group Symbol	Material Description		Shade	Colour	Mottle	Moisture	Consistency/ Density	Field Test
100			silty CLAY	high plasticity	Pl	Yl / Br	Gy mottle	M	St	
200			trace sand	fine grained					St	PP 2.2
300										
400									VSt	PP 2.5
500										
600								SM	H	VS 220
700									VSt	PP 2.5
800									VSt	PP 2.6
900								M	VSt	VS 196
1000									St	PP 2
1100									St	PP 2
1200								SM	VSt	VS 182
1300									VSt	PP 3
1400									VSt	PP 3.5
1500								SM	H	VS 240
1600										
1700										
1800										
1900										
2000					Pl	Or / Br	Gy mottle	M	VSt	VS 180
2100										
2200										
2300										
2400										
2500										
2600										
2700										
2800										
2900						Or / Br		M	VSt	
3000										
3100										
3200										
3300										
3400										
3500										

Comment:

Graphic Log Granular A Horison; Cohesive A Horizon; Cohesive B; 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:	Holman Designs	Bore Hole	No. 1 cont.	Drilling Medthod:	
Project Address:	575 Wild Dog Road	Field Work Completed By:	DH	Continuous Flight Auger	
Reference No:	18H295LRA	Field Work Date:	24.8.2018	From 3600	To 5000

Depth mm	Graphic Log	Group Symbol	Material Description			Shade	Colour	Mottle	Moisture	Consistency/ Density	Field Test
3600				silty CLAY	high plasticity		Or / Br		M	St	
3700			trace	sand	fine grained						
3800											
3900											
4000											
4100											
4200											
4300											
4400				clay matrix							
4500			with	HW Mudstone Rock Fragments	gravel to pebble sized		Gy		D		
4600					angular to sub round						
4700			with	sand	coarse grained						
4800											
4900											
5000											
5100			EOH								
5200											
5300											
5400											
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6000											
6100											
6200											
6300											
6400											
6500											
6600											
6700											
6800											
6900											
7000											

Comment: Granular A | Cohesive A Horizon | Cohesive B | Granular B Horizon | EW Rock/C Horizon | Rock | Fill

Graphic Log

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

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

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

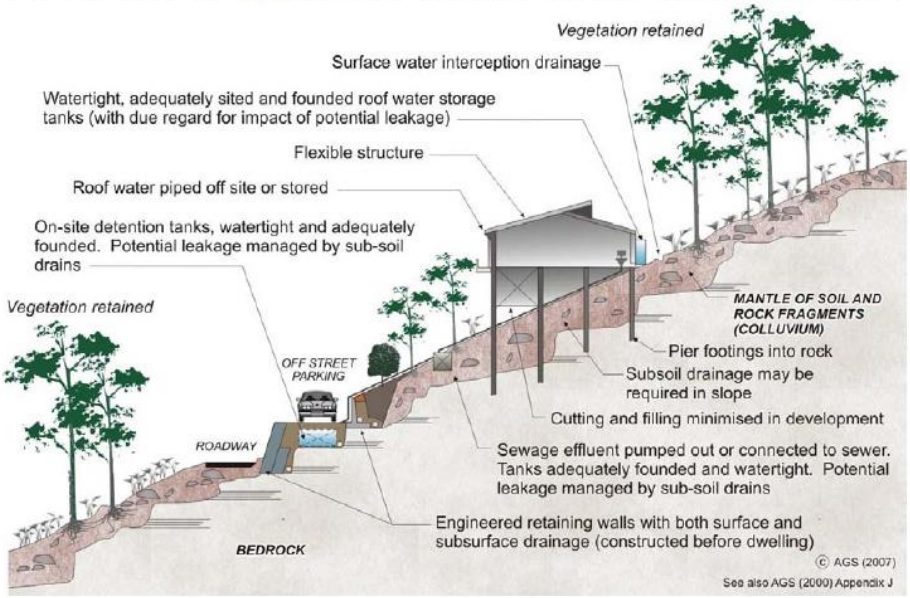
Appendix V: Hillside Construction Practice

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

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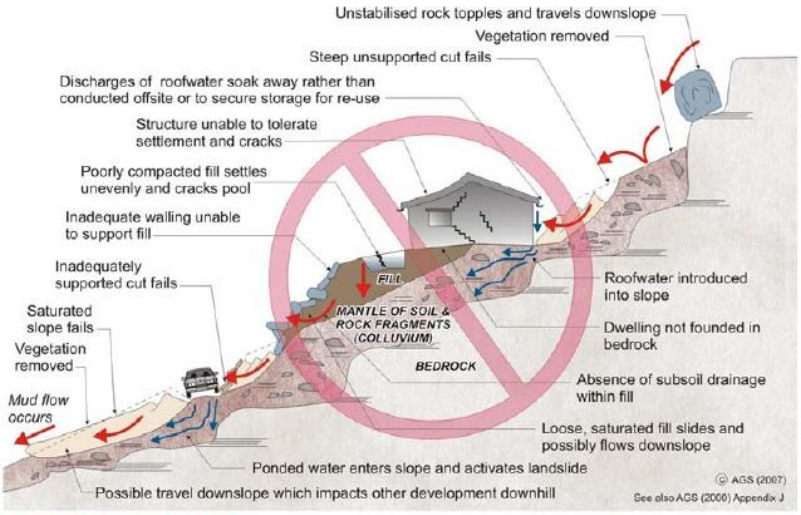
AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

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	571 Wild Dog Road APOLLO BAY VIC
DA Applicant	Cornelis and Mieke Versteeg

Section 2 Geotechnical Report

Details	Title: Landslip Risk Assessment for 571 Wild Dog Road Apollo Bay	
	Author's Company/Organization Name: AGR Geosciences Pty Ltd	Report Reference No: 18H295LRAv2
	Author: David J Horwood	Dated: 21 / 03 / 2019

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 1-9, Section 4.0*
☒	☐	Presentation of a geological model as per *Figures 1-9 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

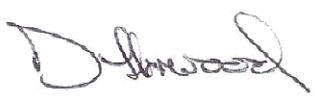
Section 4 List of Drawings referenced in Geotechnical Report

Design Documents	Description	Plan or Document No.	Revision or Version No.	Date	Author
	Site Plan		TP2	21/3/2019	Holman Designs
	Site Plan 2		TP2	21/3/2019	Holman Designs
	Defendable Space		TP2	21/3/2019	Holman Designs
	Floor Plan		TP2	21/3/2019	Holman Designs
	Elevations		TP2	21/3/2019	Holman Designs
	Elevations 2		TP2	21/3/2019	Holman Designs

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.
☒	☐	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.
☒	☐	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.
☐	☒	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.*
☒	☐	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.

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: 21/ / 03 / 2019

LAND CAPABILITY ASSESSMENT REPORT

FOR

571 WILD DOG ROAD, APOLLO BAY

Prepared for:	Cornelis Versteeg
Prepared by:	Nerida Harrison Graduate Engineering Geologist *BSc (Geology)*
Approved by:	David J Horwood Senior Engineering Geologist *BAppSc (Geology); MAusIMM CP(Geo); MAIG*
Reference No.	18H296LCA
Date:	21 February 2019
Revised:	4 March 2019

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1. INTRODUCTION

AGR Geosciences Pty Ltd (AGR) was engaged by Guy Holman (the Client) to undertake a Land Capability Assessment (LCA) for the 119982m² site at No. 571 Wild Dog Road, Apollo Bay. Due to the high landslide risk in the Wild Dog Creek area, AGR were engaged to provide specific advice regarding on-site wastewater management to conform to appropriate landslide risk management.

This report is a risk assessment for on-site waste water management undertaken in accordance with EPA Vic Publication 891.4 *Code of Practice Onsite Waste Water Management* (2016) and AS/NZ 1547:2012 *On-site Domestic Wastewater management* (2012).

The field investigation and report which accompany this review have been undertaken and prepared by suitably experienced staff. AGR has appropriate professional indemnity insurance for work of this type.

1.1. REPORT SUMMARY

This report will accompany an Application to Install a Septic Tank submitted to the Colac-Otway Shire Council for an onsite wastewater management system for a private residence. This document provides information about the site and soil conditions. It also provides a detailed LCA for the 119982m² lot, and includes a conceptual design for a suitable onsite wastewater management system, including recommendations for monitoring and management requirements.

A number of options have been considered for both the treatment system and land application area (LAA). Due to an existing, recently installed waste water system, 2 options have been prepared for this report, one in which an extension to the existing primary treatment absorption trench waste water system is implemented; and another in which a new secondary standard sub-surface drip irrigation system is installed. However, due to the previous landslip history on this site, our recommendation is that wastewater should be treated to a secondary standard by a suitable EPA-approved treatment system and in our opinion the effluent is best applied to the land via pressure compensated sub surface irrigation.

Secondary level treatment options may include an AWTS, single-pass sand filter, membrane bioreactor, with disinfection or any other suitable EPA approved alternative.

1.2. SITE OVERVIEW

Allotment	Currently undeveloped, excluding a shed, with a proposed new development consisting of a four bedroom single storey residential dwelling
Ground cover	Grass/pasture covered area surrounding the proposed dwelling.
Trees	A large wooded area exists 30m to the north east and 70m to the west of the proposed dwelling and along the road side
Topography	The site is positioned on the foot of a large westerly facing landslip scarp and is further surrounded to the west and south by smaller scarps and hummocky ground. Slope directions range from north west to south west below the foot of the landslip with up to 120m local relief across the site
Surface drainage	Generally good drainage conditions occur across the site, with little evidence of erosion onsite. Some water loving plants evident around the current wastewater system location. Dam on property is man made.
Ground condition	Healthy grass cover and established trees indicate good subsurface soil conditions.
Adjacent properties	Rural property with closest developed property 200m to the North and and 450m to the south west.
Aspect	Located on the west side of Wild Dog Road. The allotment has a south westerly to north westly aspect.
Exposure to sun and wind	Open with full sun, no shade and moderate wind protection.
Slope / form / gradient	The site exhibits predominately convex slope shape in the LAA with a gradient of 20° with the slope direction ranging from north west to south west. Major breaks in slope both convex and concave, around the site relate to historial landslips.
Other features	

2. DESCRIPTION OF THE DEVELOPMENT

Site Address:	571 Wild Dog Road, Apollo Bay, Victoria.
Owner/Developer:	**Mr Cornelis Versteeg**
Postal Address:	
Contact:	Guy Holman, Holman Designs 0402 257 152
Council Area:	Colac-Otway Shire Council.
Zoning:	Rural Conservation Zone (RCZ)
Overlays:	Bushfire Management Overlay (BMO) Erosion Management Overlay (EMO) Significant Landscape Overlay (SLO)
Allotment Size:	119982 m².
Domestic Water Supply:	Tank water only.
Availability of Sewer:	The area is unsewered and highly unlikely to be sewered within the next 10-20 years, due to low development density in the area and the considerable distance from existing wastewater services.
Proposed Development:	4 bedroom, single storey brick and cladding residential dwelling with front porch and verandas.
Anticipated Wastewater Load:	A 4 bedroom residence with full water-reduction fixtures @ 4 people per maximum occupancy will have a wastewater generation of 150L/person/day (full water saving fixtures) for a total design load = **750L/day** (Table 4 EPA Code of Practice).

3. SITE AND SOIL ASSESSMENT

David Horwood and Nerida Harrison undertook a site investigation on the 6 February 2019.

3.1. SITE KEY FEATURES

Table 1 summarises the key features of the site in relation to effluent management proposed for the site.

NOTE:

- The site is not within a special water supply catchment area.
- The site experiences moderate stormwater run-on.
- There is no evidence of a shallow water table.
- The risk of effluent transport offsite is low.

An aerial photograph is appended to provide recent and current site context (Appendix I).

A site plan describing the location of the proposed building envelope and other development works, wastewater management system components and physical site features is appended (Appendix II).

Table 1: Risk Assessment of Site Characteristics

Feature	Description	Level of Constraint	Mitigation Measures
Buffer Distances	Relevant buffer distances in Table 5 of the Code (2016) are achievable for nominated effluent fields.	Minor	Maximise the setback distance between effluent field and cutting. Reduce application rate to minimise through flow.
Climate	Average annual rainfall 1057mm, max. average 128 mm in August, min. average 50 mm in February. Average annual pan evaporation is 1230mm.	Major	Use water balance to size effluent fields. Utilize sub surface drip irrigation.
Drainage	Some moisture loving plants within the LAA. Percolation tests indicate well drained soil within the LAA	Minor to Moderate	Upgrade on site drainage. Install cut-off drains or berms up slope of the proposed effluent area to minimise surface water run on.
Erosion and Landslip	No erosion issues evident onsite	Minor	NN
	Located on an existing landslip. Slope angles are moderate but the previous history onsite raises the constraint level.	Moderate to Major	Reduce water loading as much as possible by utilising mandatory 3 star rated or better water efficient fixtures. Revegetate slopes and embankments. Disperse effluent as widely as possible.
Exposure	Site experiences full sun with minimal shading	Minor	NN

Feature	Description	Level of Constraint	Mitigation Measures
Aspect	Mainly west to south west facing slopes	Moderate	Treat effluent to a minimum secondary treatment standard.
Flooding (ARI)	Site is outside of the 1:100 year flood zone	Minor	NN
Groundwater	Closest known bores are outside of the setback distances required by the EPA Code of Practice 891.3	Minor	NN
Fill	No imported fill encountered onsite	Minor	NN
Land area available for LAA	Available land area exceeds the required LAA requirement including any buffers and or duplicate distances.	Nil	Use water balance and nitrogen balance. Configure disposal filed to comply with building and site boundary setbacks and buffer zones. Increase level of treatment.
Landforms	Several historical landslip scarps and toes are evident onsite, along with hummocky ground and stepped slopes. Soil creep is visible around the site	Moderate	Avoid installation of wastewater systems on or near existing scarps.
Rock outcrops	<10% rock outcrops in the LAA area	Minor	Preferred treatment system for rock outcrops is sub-surface irrigation.
Run-on and Run-off	Convex slope resulting in low likelihood of stormwater runoff on and pooling within the LAA	Minor	Determine appropriate run off coefficient for use in water balance. Increase catchment size.
Slope	Slopes within the LAA are convex and divergent	Minor	Increase effluent application area by 50% to allow for slope. Minimise application rate where possible. Install drainage above effluent disposal area.
Surface waters	Setback distances comply with EPA code of Practice 891.3	Minor	NN
Vegetation coverage over the site	LAA has full grass coverage	Minor	Site will require complete revegetation following wastewater system installation. Recommend dense native ground cover, low shrubs, native grasses and lawn for the effluent area.

NN: not needed

3.2. SITE ASSESSMENT RESULTS

The site is moderately constrained due constraining site features such as, climate, slope, and landslip risk.

Any risk of surface water run on may be addressed by installing a catch drain or alternative surface drainage above the proposed effluent field to intercept surface run on from the catchment area above Site.

Whilst the vegetation coverage within the proposed effluent field is healthy, this vegetation will need to be removed to facilitate installation. It is recommended that the entire site requires re-vegetation with high transpiration shrubs and grasses, especially over the proposed disposal area, upon completion of the installation works. Additional re-vegetation or the surrounding slopes with deep rooted trees and shrubs is also recommended.

The moderately steep slopes pose a very high constraint on the methods of effluent disposal available for use on this site for reasons such as construction difficulty, risk of effluent run off and uniform waste water dispersal. Methods of disposal which require soil absorption such as trenches and modified ETA beds/trenches are not suitable for steep slopes. They require near flat ground surfaces for satisfactory construction. Absorption trenches are also inappropriate for high landslide risk areas where it is critical to avoid high volumes of water from accumulating in a concentrated way within the soil profile. However, the site currently contains a recently installed existing absorption trench wastewater system. This fact has been taken into account in order to determine 2 options for the wastewater systems onsite. One where the existing system is utilised and extended to cope with the daily load, and another option to install secondary standard sub-surface drip irrigation.

Drip irrigation, surface or subsurface is generally the most appropriate way to disperse waste water in high landslide risk areas because it utilises evapotranspiration as well as absorption over a wide surface area within the near surface soil profile. The slopes of this site are too steep however for surface irrigation which poses a significant risk of effluent run off well beyond the minimum irrigation area and the site boundaries. Sub surface drip irrigation is therefore the best solution for waste water disposal but in order to accommodate the steep slopes, a 50% size increase in the effluent field is required in order to decrease the design application rate.

After consideration of all constraints, we consider the overall land capability of the site to sustainably manage all effluent onsite is satisfactory providing recommended mitigation measures discussed above and in Table 1 are implemented.

3.3. SOIL KEY FEATURES

Soils on site have been assessed for their suitability for onsite wastewater management by a combination of soil survey and desktop review of published soil survey information.

A soil survey was carried out at the site to determine suitability for application of treated effluent. Soil investigations were conducted at one (1) location in the vicinity of the proposed effluent field as shown in the Test Site and LAA Location Plan (Appendix III).

The single bore hole was established to a minimum depth of 1.5m or to effective refusal using manual hand augers. Seven (7) boreholes were established to a minimum depth of 150mm into the limiting layer for permeameter installation. This was sufficient to adequately characterise the soils as only minor variation would be expected throughout the area of interest. Permeameters were inserted to a minimum depth of 300mm or 150mm into the limiting layer, and constant head draw down was monitored over a period of up to 60 minutes in order to calculate saturated hydraulic conductivity for the limiting soil layer.

Samples of all discrete soil layers for each soil type were collected for subsequent laboratory analysis of pH, Electrical Conductivity, Sodicity, Cation Exchange Capacity, Sodium Absorption Ratio and Emerson Aggregate Classification.

Two soil types were encountered during this investigation. Full profile descriptions are provided in the Borelogs (Appendix IV). Soil descriptions may be summarised as follow:

- A residual topsoil (A-horizon) layer of dark grey/brown, weakly structured, dry clayey SILT (Category 4 CLAY LOAM); overlying,
- A residual subsoil (B-horizon) layer of pale orange/brown, moderately structured, dry silty CLAY (Category 5 LIGHT CLAYS), with sand, grading sandy.

Table 2 below provides an assessment of the physical and chemical characteristics of each soil type.

Table 2: Risk Assessment of Soil Characteristics

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Topsoil: **6.1 MEQ%** Soil structural stability is considered unsatisfactory.	Major	Recommend adding organic matter (compost/humus) to soil profile to increase CEC and nutrient availability and ameliorate soil structure. Typically >15 MEQ% is recommended for land application areas.
	Subsoil: **7.5 MEQ%** Soil structural stability is considered unsatisfactory.	Major	Recommend adding organic matter (compost/humus) to soil profile to increase CEC and nutrient availability and ameliorate soil structure. Typically >15 MEQ% is recommended for land application areas.
Electrical Conductivity	Topsoil: **0.033 dS/m** Soil conditions do not appear to be restricting plant growth.	Minor	NN
	Subsoil: **0.017 dS/m** Soil conditions do not appear to be restricting plant growth.	Minor	NN
Emerson Aggregate Class	Topsoil: **Class 2: Slaking and some dispersion**	Major	Soil amelioration required. Application of gypsum to improve soil structure and dispersity.
	Subsoil: **Class 2: Slaking and some dispersion**	Major	Soil amelioration required. Application of gypsum to improve soil structure and dispersity.

Feature	Assessment	Level of Constraint	Mitigation Measures
pH	Topsoil: **5.2**	Minor	Suitable range for many acid-loving plants.
	Subsoil: **5.4**	Minor	Suitable range for many acid-loving plants.
Rock Fragments	Topsoil: **<10% coarse fragments in the A Horizon.**	Minor	NN
	Subsoil: **<10% coarse fragments in the B Horizon.**	Minor	NN
Sodicity (ESP)	Topsoil: **3.7% Non-Sodic**	Minor	NN
	Subsoil: **2.8% Non-Sodic**	Minor	NN
Sodium Absorption Ratio (SAR)	Topsoil: **0.1** Low sodium absorption ratios	Minor	Recommend use of low sodium domestic products to reduce the SAR ratio.
	Subsoil: **0.08** Low sodium absorption ratios	Minor	Recommend use of low sodium domestic products to reduce the SAR ratio.
Soil Depth to rock or other impermeable layer	Depth: >1.5m Overall soil profile depth is >5000mm below surface.	Minor	Suitable for subsurface irrigation and trenching
Soil Permeability & Design Loading/ Irrigation Rates	Topsoil: clayey SILT (Category 4); **Indicative** Ksat permeability is **0.12-0.5m/day.** **3mm**/day Design Irrigation Rate (DIR) for subsurface irrigation (EPA, 2016). This is **2.5**% of lowest indicative Ksat for soil. Recommended application rate is <10% of measured Ksat (TVA, 2004)	Moderate	Use measured Ksat for limiting layer as seepage rate in water balance. Use up to 10% of Ksat value as comparison to maximum application rate.

Feature	Assessment	Level of Constraint	Mitigation Measures
	Subsoil: silty CLAY (Category 5); **Measured** Ksat permeability is **0.49m/d**; **3.0mm**/day Design Irrigation Rate (DIR) for subsurface irrigation (EPA, 2016). This is **0.6%** of measured Ksat for the soil. Recommended application rate is <10% of measured Ksat (TVA, 2004)	Minor	Use up to 10% of Ksat value as deep seepage rate in water balance. Maximum application rate to approximate **3mm**/day relative to soil category where measured Ksat is reflective of inferred Ksat in Table 9 EPA (2016)
Soil Texture & Structure	Topsoil: Clayey SILT (Category 5, Light Clay) EPA (2016) and AS/NZS 1547:2012. Topsoil is inferred to have a massive structure.	Minor	NN
	Subsoil: Silty CLAY (Category 5, Light Clay) EPA (2016) and AS/NZS 1547:2012. Subsoil is inferred to have a high to moderate structure.	Minor	Use up to 10% of Ksat value as deep seepage rate in water balance. Use measured Ksat to determine maximum application rate.
Gleying	Topsoil: Nil No evidence of gleying witnessed in soil samples	Nil	NN
	Subsoil: Nil No evidence of gleying witnessed in soil samples	Nil	NN
Mottling	Topsoil: Minor Generally uniform soil colouring	Minor	Soil amelioration recommended. Increasing organic content and apply gypsum to improve soil structure.
	Subsoil: Minor Very little grey mottling at depth	Minor	Soil amelioration recommended. Increasing organic content and apply gypsum to improve soil structure.
Water table Depth	Depth: >2m	Minor	Dispose of effluent via sub surface drip irrigation or trenches .

NN: not needed

3.4. SOIL ASSESSMENT RESULTS

For the soils in the proposed land application area (light clays), two features present a moderate or major constraint. Primary constraints relate to CEC and Emmerson Aggregate Class.

Measured Ksat for this site has been averaged at 0.49m/day which is overall very high and consistent with that expected for strongly structured light clay or a weakly structured clay loam. In-situ testing did however reveal some variable results with extremely high permeability recorded in some cases. The Code of Practice (EPA, 2016) is contradictive when it comes to recommended design loading rates for different soil texture classes with the same indicative permeability. The high permeability should indicate that a higher loading rate is applicable. Deep seepage rates should be carefully selected to reflect Ksat and soil structure and will be higher for absorption methods than for irrigation methods to take into account side wall seepage as well as vertical seepage.

Although the soil texture has been assessed as a Light Clay, the silty, sandy texture could also be interpreted as a clay loam as texturally, one class grades into the other. Applicable loading or application rates should be governed by measured Ksat permeability.

Soil chemistry elements such as CEC are a moderate constraint on this site. The cation exchange capacity is also a measure of plant nutrient availability. CEC may be below acceptable levels due to the loss of overlying soil horizons and organic matter during past fires. Adding organic compost and humus to the soil profile can help improve nutrient availability.

Soil characteristics relating to poor soil structure, soil drainage and dispersity can be mitigated or improved with the addition of gypsum. Gypsum adds bi-charged calcium ions to the soil which acts as a flocculating agent helping soil particles to clump together and aggregate, displacing singularly charged sodium ions which influence soil dispersity and potential soil erosion.

Based on the cation exchange capacity (CEC) and soil sodicity (ESP), a gypsum requirement of **0.0t/ha** has been calculated in order to ameliorate the soil profile to a desired level of 6% ESP to 600mm below surface, despite this, we recommend the application of 1kg of gypsum per sqm to the soil in order to ameliorate soil structure and dispersity issues evident in the Emmerson aggregate class tests. The application of gypsum requires removal to the A Horizon and where practical to do so, deep ripping to a minimum depth of 600mm. As this is not always practical in areas of steep terrain with limited access and where deep soil disturbance can create slope instability problems, we recommend the application dry ground gypsum without ripping. Gypsum should be applied to the base of the trenches or irrigation channels prior to line installation and lightly watered in to dissolve the gypsum and encourage infiltration into the soil profile.

Long term soil amelioration may take several years and as such we recommend the application of liquid gypsum as an ongoing maintenance process. Liquid gypsum can be added to the pump well of the irrigation system and mixed with treated waste water ready for direct application to the subsurface soil profile. We propose that the application of **2L** of concentrated liquid gypsum added to the pump well of the irrigation system on a **biannually** basis should provide adequate ongoing sodic soil amelioration. Gypsum requirement computations are provided in Appendix VI.

The overall capability of the soil to sustainably manage effluent onsite is considered satisfactory providing recommended mitigation measures discussed above and in Table 2 are implemented.

3.5. OVERALL LAND CAPABILITY RATING

Based on the results of the site and soil assessment tabled above, the overall land capability of the proposed effluent management area is **moderately constrained**. Subject to implementation of the mitigation measures recommended in Tables 1 and 2, it is possible to dispose treated wastewater on site.

It is therefore our recommendation that considering the site's physiographic constraints and soil characteristics, 'All Waste' effluent should be secondary treated and disposed on-site either via pressure compensating sub-surface drip irrigation (Option 1) or by primary treated absorption trenches (Option 2).

4. WASTEWATER MANAGEMENT SYSTEM

The following sections provide an overview of a suitable on-site wastewater management system, with sizing and design considerations and justification for its selection. Detailed design for the system should be undertaken at the time of the building application and submitted to Council.

4.1. EFFLUENT DISPOSAL SYSTEM

A range of possible land application systems have been considered for part on-site disposal, such as absorption trenches, evapotranspiration/absorption (ETA) beds, wick trench and bed systems, subsurface irrigation and mounds.

The preferred system (Option 1) is **pressure compensated sub surface irrigation**. Subsurface irrigation will provide even and widespread dispersal of the treated effluent within the root-zone of plants, does not require a reserve area and can be installed on slopes up to 30% (17°) before requiring terracing or a specialised irrigation design. This system will provide beneficial reuse of effluent, which is desirable given that the site is not serviced by town water. It will also ensure that the risk of effluent being transported off-site will be negligible and is the most accepted method of onsite waste disposal for minimising the risk of slope instability.

Due to the site already being serviced by a recently installed **absorption trench** wastewater system, utilisation and extension of the existing system has been considered in this report and is accounted for in Option 2. Trenches are a cost-effective system for wastewater removal due to their primary treatment quality and gravity fed distribution, however they do require an equally sized reserve area in the event that the trenches fail. As such, they are generally applicable for sites with large amounts of available land. They require horizontal installation that follows the contours of the land. When installing on slopes the height of the trench at the lowest point of the slope needs to comply with Australian Standards relating to On-site domestic wastewater management (AS/NZS 1547:2012). In order to accommodate the large number of trenches required for this site, it has been necessary to split LAA into two effluent fields, which will require the installation of a pump to distribute the effluent across the two fields.

4.2. DESCRIPTION OF THE DISPOSAL SYSTEM

A detailed irrigation system design is beyond the scope of this report, however a general description of subsurface irrigation and absorption trenches is provided here for the information of the client and Council.

Subsurface irrigation comprises a network of drip-irrigation lines that is specially designed for use with wastewater. The pipe contains pressure compensating emitters (drippers) that employ a biocide to prevent build-up of slimes and inhibit root penetration.

The lateral pipes are usually 1-1.5m apart for a LIGHT CLAY, installed parallel along the contour. Installation depth is a minimum of 100mm into at least 150mm of good quality topsoil in accordance with AS/NZS 1547:2012. It is critical that the irrigation pump be sized properly to ensure adequate pressure and delivery rate to the irrigation network.

A filter is installed in the main line to remove fine particulates that could block the emitters. This must be cleaned regularly (typically monthly) following manufacturer's instructions. Vacuum breakers should be installed at the high point/s in the system to prevent air and soil being sucked back into the drippers when the pump shuts off. Flushing valves are an important component and allow periodic flushing of the lines, which should be done at six monthly intervals. Flush water should be returned to the treatment system via a return line.

All trenching used to install the pipes must be backfilled properly to prevent preferential subsurface flows along trench lines. Irrigation areas must not be subject to high foot traffic movement, and vehicles and livestock must not have access to the area otherwise compaction around emitters can lead to premature system failure.

Absorption trenches may be a conventional piped trench or a self-supporting arch trench. They utilise a series of lines 600mm wide, installed to a depth up to 400-380mm parallel to the contours of the land. The total length of trench is usually divided into equal proportions with each line of trench containing a distribution box to ensure even flow to each trench. Trenches can be gravity loaded using a distribution pipe, or pressure does loaded using perforated pipe or LPED lines. Where discharge control is required, does loading is the only option.

Once installation of pipework is finalised, the trenches are filled with 20-40mm aggregate around the arch or a minimum of 75mm above the distribution pipe in a conventional trench. A filter cloth placed above the distribution aggregate or over the arch to prevent soil incursion, then the trench is backfilled with topsoil that is less permeable than the surrounding natural soil.

4.3. SIZING THE DISPOSAL SYSTEM

To determine the necessary size of the irrigation area water balance modelling has been considered based on the water balance method outlined in AS1547:2012 and Victorian Land Capability Assessment Framework (2014). Final sizing of the irrigation system has been undertaken adopting a justifiable deep seepage rate based on the measured saturated hydraulic conductivity (Ksat) and comparing the minimum area for zero storage with the maximum allowable application rate or DIR from Table 9 of the EPA (2016). The Tennessee Valley Authority (2004) in their peer reviewed guidelines for drip irrigation recommends that the seepage or percolation rate used in water balance modelling may be 10-14% of measured Kast and that the final application rate (DIR) should be less than 10% of measured Ksat.

The water balance presenting in this assessment adopts a trial land application area methodology to find the most suitably sized effluent field according to the justifiable deep seepage rate and the maximum allowable application rate.

The retained rainfall factor used in the water balance has been derived using a formula to calculate a weighted run off coefficient based on published run off coefficients for different land uses and surfaces and total catchment size. Professional judgement has been used where selected coefficients vary from published coefficients in the calculations and justification for the variation is provided with the computations attached to this report.

Crop factors used in the water balance may vary depending on the type of vegetation or degree of shading expected in the proposed effluent disposal area. Crop Nitrogen uptake rates used in the mass balance calculation may also vary and are selected with reference to either the type of vegetation growing on the subject area, or a particular vegetation type proposed for use in the effluent area. Published crop Nitrogen uptake rates are sourced from EPA Publication 168 (1991).

4.3.1 Water Balance

The water balance can be expressed by the following equation:

Precipitation + Effluent Applied = Evapotranspiration + Percolation

Data used in the water balance includes:

- Mean monthly rainfall and mean monthly pan evaporation;

- Design daily flow rate for a 4 bedroom dwelling – 750L/day (from Table 4 of the Code and Table H2 of the Standard);
- Deep seepage Rate – 6.5mm/day[1]; (based on measured Ksat of 0.49m/day)
- Crop factor – 0.4-0.7; and
- Retained rainfall – 70% as per the VLCAF (2016) for 20° slope.

The results of the water balance are compared against the basic irrigation formula **A = Q/DIR** to ensure the final application rate for the disposal field (DIR) approximates that for the appropriate soil category in the EPA Code of Practice (2016) and AS1547:2012.

The water balance method is used to calculate the minimum area required to balance all inputs and outputs to the water balance. As a result of these calculations at least **174m^2** is required for on-site wastewater disposal, using subsurface drip irrigation, based on hydraulic loading.

Minimum required buffers and offsets are not included in this figure.

This yields an application rate of **4.3mm/day** which is above the maximum 3.0mm/day from the EPA Code of Practice (2016) for application to a strongly structures light clay and only 0.9% of measured Ksat[2]. The application rate is inconsistent with that for Category 5 soils with measured Ksat being at the high end of the indicative permeability.

Water balance calculations have also been conducted for an absorption trench option.

Data used in the trench water balance includes:

- Mean monthly rainfall and mean monthly pan evaporation;
- Design daily flow rate for a 4 bedroom dwelling – 750L/day (from Table 4 of the Code and Table H2 of the Standard);
- Deep seepage Rate – 11mm/day[3]; (based on measured Ksat of 0.49m/day)
- Crop factor – evapotranspiration considered negligible
- Retained rainfall – 70% as per the VLCAF (2016) for 20° slope.

As a result of these calculations at least **93m^2** of basal trench is required for on-site wastewater disposal, which equates to 155m of lineal trench using assuming a trench width of 0.6m.

Minimum required buffers and offsets are not included in this figure.

This yields an application rate of **8.1mm/day** which is greater than the maximum 5mm/day from the EPA Code of Practice (2016) for application to moderately structured light clay. This application rate is consistent with Category 4 clay loam soils with an indicative permeability similar to measured ksat.

A full water balance is provided as Appendix V.

[1] This rate is significantly less than the recommended permeability rate of 10-14% of measured Ksat (TVA, 2004) and has been selected considering reccomended rate reducitons for sloping sites in accordance with AS1547:2012.
[2] The reccomended application rate is <10% of measured Ksat (TVA, 2004).
[3] Higher seepage rate for trenches to account for lateral sidewall seepage as well as vertical seepage.

4.3.2 Nutrient Balance

A nutrient balance is considered to check that the Land Application Area is of sufficient size to ensure nutrients are assimilated by the soils and vegetation. It is acknowledged that a proportion of nitrogen will be retained in the soil through processes such as mineralisation and volatilisation. Typically, only sensitive sites with limiting site or soil constraints require nutrient considerations.

NOTE: Soil has a high PRI (phosphorus retention index) in clayey soils. Phosphorus is readily removed under these circumstances from wastewater fixation in clayey soil by the action of adsorption. Phosphate in dispersed effluent is lost within a few centimetres of the soil.

This leaves nitrogen (N) as the limiting factor in this proposed development.

The nutrient balance can be expressed by the following Mass Balance equation:

$$\textbf{Land Application Area } (m^2) = (C \times Q)/L_x$$

Data used in the nutrient balance includes:

- C = Concentration of nutrient - 25mg/L (from EPA Publication 464.2);
- Q = Design daily flow rate – 750L (from Table 4 of the Code and Table H2 of the Standard);
- L_x = Critical loading rate of nutrients – 60.27 mg/m^2/day (from EPA Publication 464.2).
- Nutrient loss to soil processes – 20% (Geary & Gardner 1996)
- Crop N uptake rate – 220 kg/ha/yr

As a result of the Mass Balance calculations, the minimum **Land Application Area** required for complete nutrient (nitrogen) uptake is **249m^2** for on-site disposal.

A Full nutrient balance is provided in Appendix V.

4.3.3 Minimum Disposal Field and Land Application Area

Subsurface Drip Irrigation – Option 1 (preferred)

The nutrient loading is the most limiting factor here and as such nutrient loading and the mass balance would normally be used to nominate the minimum area required to balance both nutrient and hydraulic loading including all inputs and outputs.

Although water balance indicates that approximately 174m^2 is required as the minimum effluent disposal area required to achieve zero storage and complete nutrient uptake, this does not make any allowance for the hydraulic gradient of the site. As a result, effluent would need to be applied to the land via raised terraces (over the entire effluent area) so as to provide near horizontal application areas.

The construction of raised terracing can be a very costly addition to a waste water project and given the concern around slope stability on this site, it is our preference to avoid adding additional loading to the steep, susceptible slopes. In order to eliminate the need for raised terracing, the application rate based on hydraulic loading should be reduced by at least 50%. This is effectively achieved by increasing the disposal area to **350m^2**.

Dispersing waste water over **350m^2** will reduce the maximum application rate by 50% and in doing so, satisfies the area required for nitrogen export, which required 249m^2.

Extension of the Existing Absorption Trench System – Option 2

In this instance, the water balance indicates that approximately 93m^2 (or 155 lineal metres) is required as the minimum effluent disposal area required to achieve zero storage and complete nutrient uptake, however this does not take into account the ability of absorption trenches to store water.

A spacing of 3m between the trenches more than covers the 249m^2 of area required for nitrogen export.

4.4. SITING AND CONFIGURATION OF THE DISPOSAL SYSTEM

The preferred area for siting the disposal system is to the south-west of the proposed dwelling. The Test Site and LAA Location Plans display the envelopes of land that is suitable for effluent management, (Appendix III).

Final placement and configuration of the disposal system will be determined by the client and/or system installer, provided it complies with the mandatory setback and buffers. The minimum area required according to the water balance is shown to scale (Appendix III). The recommended location for the effluent disposal shown in Appendix III has been selected on the basis that the available area with the greatest lateral width will encourage lateral hydraulic flow and minimise surface run off.

It is important that appropriate buffer distances to neighbouring properties, buildings and the drainage easement be maintained. It is also important to note that buffers are measured as the overland flow path for run-off water from the effluent irrigation area.

The Test Site and LAA Location Plan indicate site contours and flow path directions on the property (Appendix III).

It is highly recommended that the owner consult an irrigation expert familiar with effluent irrigation equipment and steeply sloping sites to design the system, and an appropriately registered plumbing/drainage practitioner to install the system. The irrigation plan must ensure even application of effluent throughout the entire irrigation area and that final configuration ensures an application rate or dosage to the irrigation field no greater the rates described in Section 4.3.3.

4.5. BUFFER DISTANCES

Setback buffer distances from effluent land application areas and treatment systems are required to help prevent human contact, maintain public amenity and protect sensitive environments. The relevant buffer distances for this site, taken from Table 5 of the Code (2016) are:

- 20 metres upslope from potable or non-potable groundwater bores;
- 100 metres upslope from watercourses in a potable water supply catchment.
- 30 metres upslope from surface waters and waterways (non-potable) for secondary treated effluent and 60 metres if primary treated.
- 3 metres if area upslope and 1.5 metres if area downslope of property boundaries, swimming pools and buildings.
- For primary treatment: 6 metres if application area upslope and 3 metres if area downslope of property boundaries and buildings.
- 15 metres upslope from escarpments or cuttings.

All required buffer distances are achievable on this site.

The appended site plan shows the location of the proposed wastewater management system components, recommended setback distances and other relevant features such as the recommended location of cut off drains (Appendix III).

4.6. INSTALLATION OF AN IRRIGATION SYSTEM

Installation of the irrigation system must be carried out by a suitably qualified, licensed plumber or drainer experienced with effluent irrigation systems.

To ensure even distribution of effluent, it is essential that the pump capacity is adequate for the size and configuration of the irrigation system, taking into account head and friction losses due to changes in elevation, pipes, valves, fittings etc. To achieve even coverage, irrigation areas should be dosed alternately using an automatic indexing or sequencing valve and line spacing's should be progressively increased down slope.

The irrigation area and surrounding areas must be vegetated or revegetated immediately following installation of the system, preferably with turf or dense ground covering shrubs and grasses with high transpiration rates. The area should be fenced or otherwise isolated (such as by landscaping), to prevent vehicle and stock access; and signs should be erected to inform householders and visitors of the extent of the effluent irrigation area and to limit their access and impact on the area.

Stormwater run-on is expected to pose a moderate amount of concern for the proposed disposal areas. Upslope diversion berms and surface drainage should be constructed during installation of the disposal system and connected to the site drainage system and diverted to the legal point of discharge. Stormwater from roofs and other impervious surfaces must not be disposed of into the wastewater treatment system or onto the effluent management system.

Due to the sloping nature of the terrain on site the irrigation system should be designed by an irrigation specialist experienced with steeply sloping terrain to ensure an even distribution of effluent over the irrigation field.

4.7. TREATMENT SYSTEM

The minimum secondary effluent quality required is:

- BOD < 20 mg/L
- TSS < 30 mg/L
- E.Coli < 10 cfu/100mg

Unlike secondary effluent quality, primary treated wastewater does not have specific quality requirements.

Refer to the EPA website for the list of approved options that are available[4]. Many of the secondary or advanced secondary treatment system options are capable of achieving the desired level of performance. The property owner has the responsibility for the final selection of the secondary treatment system and will include the details of it in the Septic Tank Permit to Install application form for Council approval.

As a guide, the two types of treatment methods which are able to produce high quality waste water are Membrane Bioreactor or MBR systems and Trickling Filters. MBR's combine treatment technologies such as aerated water treatment systems (AWTS) and membrane filtration. They typically use a pre-treatment settling tank, followed by aerobic bioreactor (AWTS) and finally a filter membrane followed by disinfection with UV for higher quality waste water. Trickling Filters such as generic sand filters use aerobic biological processes and mechanical filtration to treat effluent. They incorporate a settling or septic tank (which may be generic or alternative such as a worm farm) for primary treatment after which effluent is applied to the filter and then may be disinfected with either by chlorine or UV. Other methods of secondary treatment system such as Aerated Wastewater Treatment System's (AWTS) are also acceptable utilising disinfection to achieve advanced secondary standard.

If the proposed dwelling is to be used intermittently for short stay and holiday rental, consideration should be given to passive systems which are less reliant on power and regular maintenance. In this situation we recommend the application of Trickling Filters with disinfection so long as the system can achieve 20/30/10 standard effluent for greywater recycling.

Further consideration should be given to selecting a system that includes a suitably sized storage or balancing tank to moderate flow into the wastewater treatment system or a system that integrally uses multiple chambers where intermittent or periodic surge flows are expected. Where an AWTS is to be considered in this situation, selection of a system which includes recirculation or some other technology to accommodate intermittent flow is recommended.

Alternative methods of waste management to provide a reduction in daily flow rates may include the use of dry compositing or incinerating toilets. Dry composting or incinerating toilets would effectively remove a portion of the daily water loading for the fixture from the water balance, thus reducing the required effluent disposal footprint. Recycling of advanced secondary treated greywater in house to toilets will also provide a similar outcome.

[4] http://www.epa.vic.gov.au/en/your-environment/water/onsite-wastewater

5. MONITORING, OPERATION AND MAINTENANCE

Maintenance is to be carried out in accordance with the EPA Certificate of Approval of the selected secondary treatment system and Council's permit conditions. The treatment system will only function adequately if appropriately and regularly maintained. We highly recommend the client enters into an ongoing service agreement with a service contractor approved by the treatment system manufacture.

To ensure the **treatment** system functions adequately, residents must:

- Have a suitably qualified maintenance contractor service the secondary or advanced secondary treatment system at the frequency required by Council under the permit to use;
- Use household cleaning products that are suitable for septic tanks;
- Keep as much fat and oil out of the system as possible; and
- Conserve water (3 star or better rating fixtures and appliances are recommended).

To ensure the **land application** system functions adequately, residents must:

- Regularly harvest (mow) vegetation within the LAA and remove this to maximise uptake of water and nutrients;
- Monitor and maintain the subsurface irrigation system following the manufacturer's recommendations, including flushing the irrigation lines;
- Regularly clean any in-line filters;
- Not erect any structures and paths over the LAA;
- Avoid vehicle and livestock access to the LAA, to prevent compaction and damage;
- Ensure that the LAA is kept level by filling any depressions with good quality topsoil (not clay);
- Apply dry ground gypsum into irrigation channels or to the base of absorption trenches during installation of the effluent system;
- Add 2L of concentrated liquid gypsum to the site via the irrigation system pump well upon commissioning of the irrigation system and thereafter at least biannually. The regular addition of liquid gypsum will provide an ongoing soil remediation measure designed to improve soil structure and permeability, and mitigate dispersion and erosion properties from developing;

6. CONCLUSIONS

As a result of our investigations we conclude that sustainable onsite wastewater management is feasible for the 4 bedroom development at 571 Wild Dog Road, Apollo Bay with the implementation of appropriate mitigation measures as outlined.

Specifically, we recommend the following:

Option 1 – Sub-surface Drip Irrigation (preferred)

- Secondary treatment of 'All Waste' by an EPA-accredited treatment system to a 20/30/10 standard.
- Application of treated effluent to a **350m²** (minimum) area via pressure compensating subsurface drip irrigation
- Specialist design of the irrigation system by an irrigation expert experienced with steeply sloping terrain based on the maximum available space for effluent disposal as depicted in Appendix III;
- Direct application of dripper lines installed along the natural contour over a minimum area of **350m²** as indicated in Appendix III applied at a maximum rate of **2.1mm/day (750L/day)**.
- Detailed documentation of the as built irrigation design, including the filter, manifold, irrigation line location and diameter, number and length of dripper lines, number and location of vacuum breaker(s), sequencing valve(s), location of flush valve(s) and the location of the return line returning flush water back to the treatment system.
- Installation of 3 star or better water saving fixtures and appliances in the residence to conserve water and reduce the effluent load;
- Use of low phosphorus and low sodium (liquid) detergents to improve effluent quality and maintain soil properties for growing plants; and
- Operation and management of the treatment and disposal system in accordance with manufacturer's recommendations, the EPA Certificate of Approval, the EPA Code of Practice (2016) and the recommendations made in this report.

Option 2 – Extension of Existing Absorption Trenches

- Primary treatment of 'All Waste' by an EPA-accredited septic tank.
- Application of treated effluent to **93m² basal area or 155 lineal metres** (minimum) via below ground absorption trenches. This equals a total of 5 x 31m trenches, or 4 additional trenches.
- Specialist design of the trench system by drainage expert experienced with steeply sloping terrain based on the maximum available space for effluent disposal as depicted in Appendix III;
- Installed along the natural contour over a minimum area of **93m²** as indicated in Appendix III applied at a maximum rate of **8.1mm/day (750L/day)**.
- Spacing of 3m between trenches to allow for a reserve field should the trenches fail.

- Detailed documentation of the as built trench system design, including any, manifolds, trench line location and pipe diameter, number and length of trenches, any sequencing valve(s), and pumping setups.

- Installation of 3 star or better water saving fixtures and appliances in the residence to conserve water and reduce the effluent load;

- Use of low phosphorus and low sodium (liquid) detergents to improve effluent quality and maintain soil properties for growing plants; and

- Operation and management of the treatment and disposal system in accordance with manufacturer's recommendations, the EPA Certificate of Approval, the EPA Code of Practice (2016) and the recommendations made in this report.

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C.E.T. ACCREDITED

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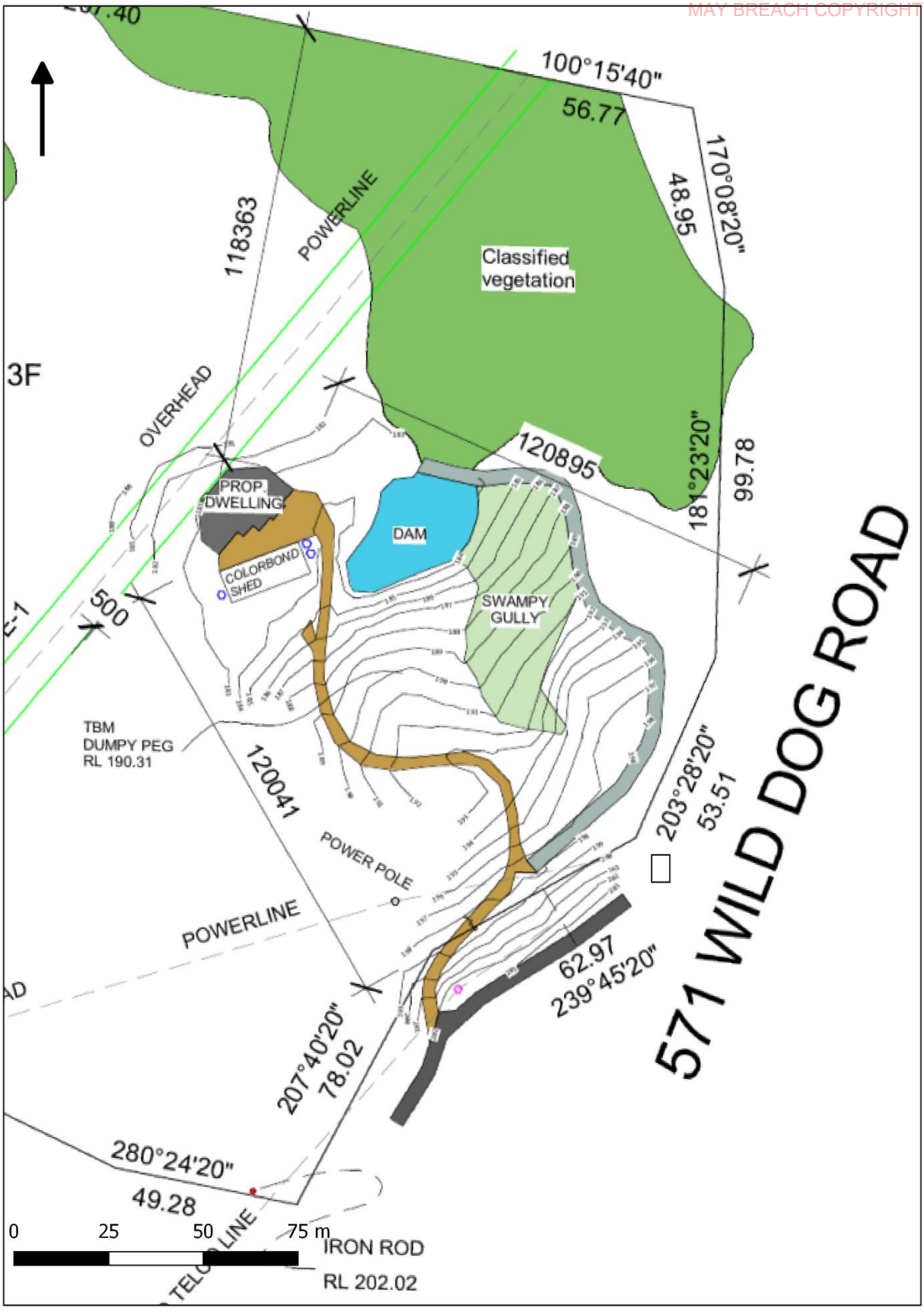
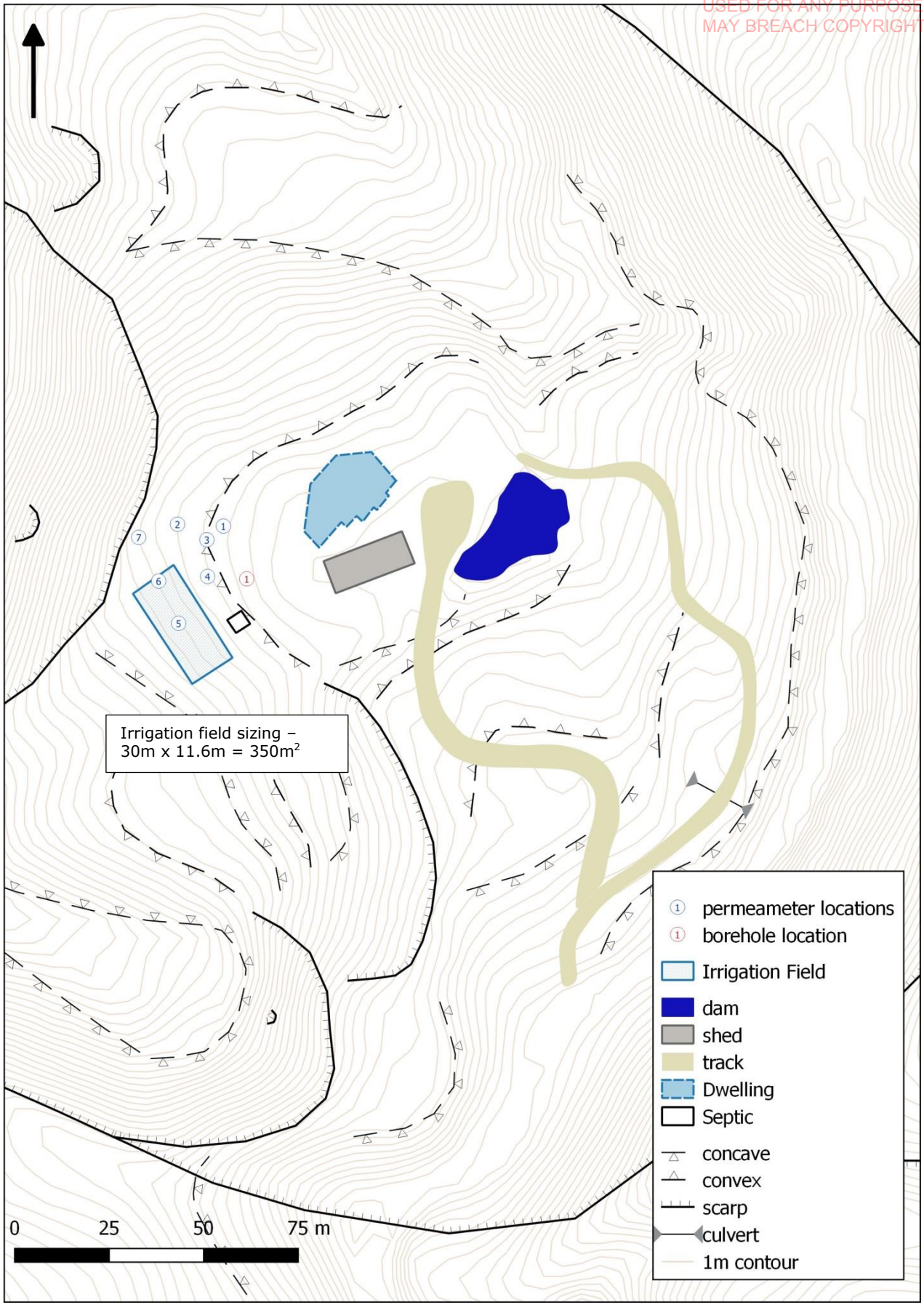
Appendix I:Aerial Photo

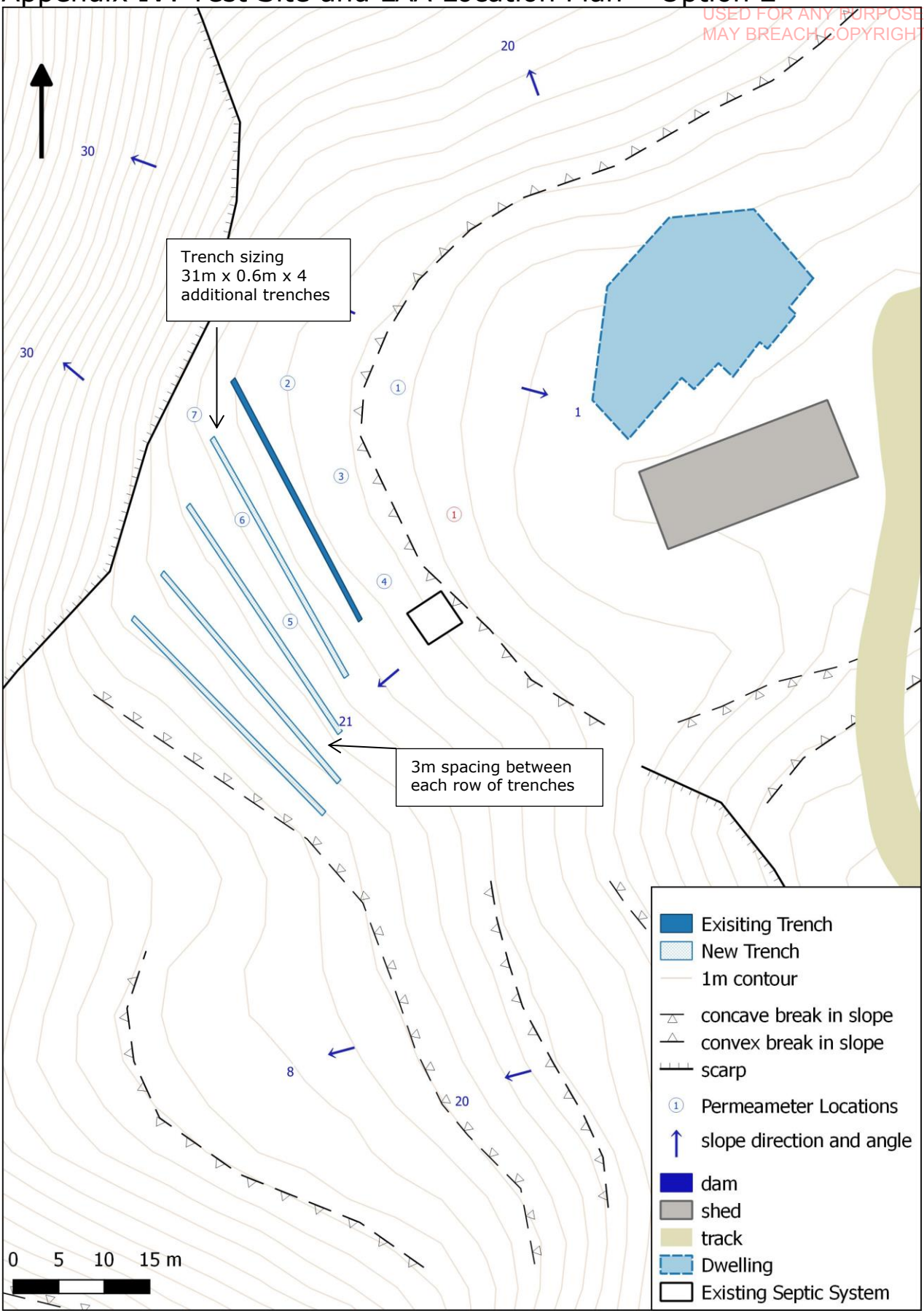
Appendix II:Site Plan



Appendix III Test Site and LAA Location Plan – Option 1



Appendix IV: Test Site and LAA Location Plan – Option 2



Appendix V: Borehole Descriptions

AGR GeoSciences

Client:	18H296LCA	Bore Hole	No. 1
Project Address:	571 Wild Dog Rd Apollo Bay	Field work Completed By:	David Horwood
Reference No:		Field Work Date:	2/6/2019

Depth	Excavatoin Method	Graphic Log	Horizon	Material Description	Texture	Structure	Shade	Colour	Mottles	Moisture	Coarse Fragments	Boundary Type	Sample
100	Hand Auger		A1	Clayey Silt	CL	Wk	Dk	Gy / Br		D	nil		
200				Category 4 Clay loams								Abrupt	1
300			B2	Silty Clay	SiC	Md	Lt	Or / Br		D	<10%		
400				With Sand									2
500				Category 5 Light clays		St							
600													
700										SM			
800													
900													
1000				Grading Sandy				Yl / Br	Gy <5%	SM	<10%	Diffuse	
1100													
1200													
1300													
1400													
1500													
1600													
1700													
1800													
1900													
2000													
2100													
2200													
2300													
2400													
2500													

Comment:

Texture:					
S	Sand	ZL	Silty Loam	SiC	Silty Clay
LS	Loamy Sand	SCL	Sandy Clay Loam	LC	Light Clay
CS	Clayey Sand	CL	Clay Loam	LMC	light Med Clay
SL	Sandy Loam	ZCL	Silty Clay Loam	MC	Medium Clay
FSL	Fine Sandy Loam	FSCL	Fine Sandy Clay Loam	HC	Heavy Clay
L	Loam	SC	Sandy Clay		

Moisture:	
D	Dry
SM	Slightly Moist
M	Moist
VM	Very Moist
W	Wet

Structure:	
Gr	(Single) Grained
Mas	Massive
Wk	Weakly Structured
Md	Mod Structured
St	Strongly Structured

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

Groundwater ▼	**Boundary Type:**	Sharp <5mm	Abrut 5-20mm	Clear 20-50mm
Sample: 1		Gradual 50-100mm	Diffues >100mm	

Appendix VI: Ksat, Water and Nutrient Balance Computation

Project: 571 Wild Dog Road
Apollo Bay

Client: Holman Designs
Subject: Soil Permeability Calculations

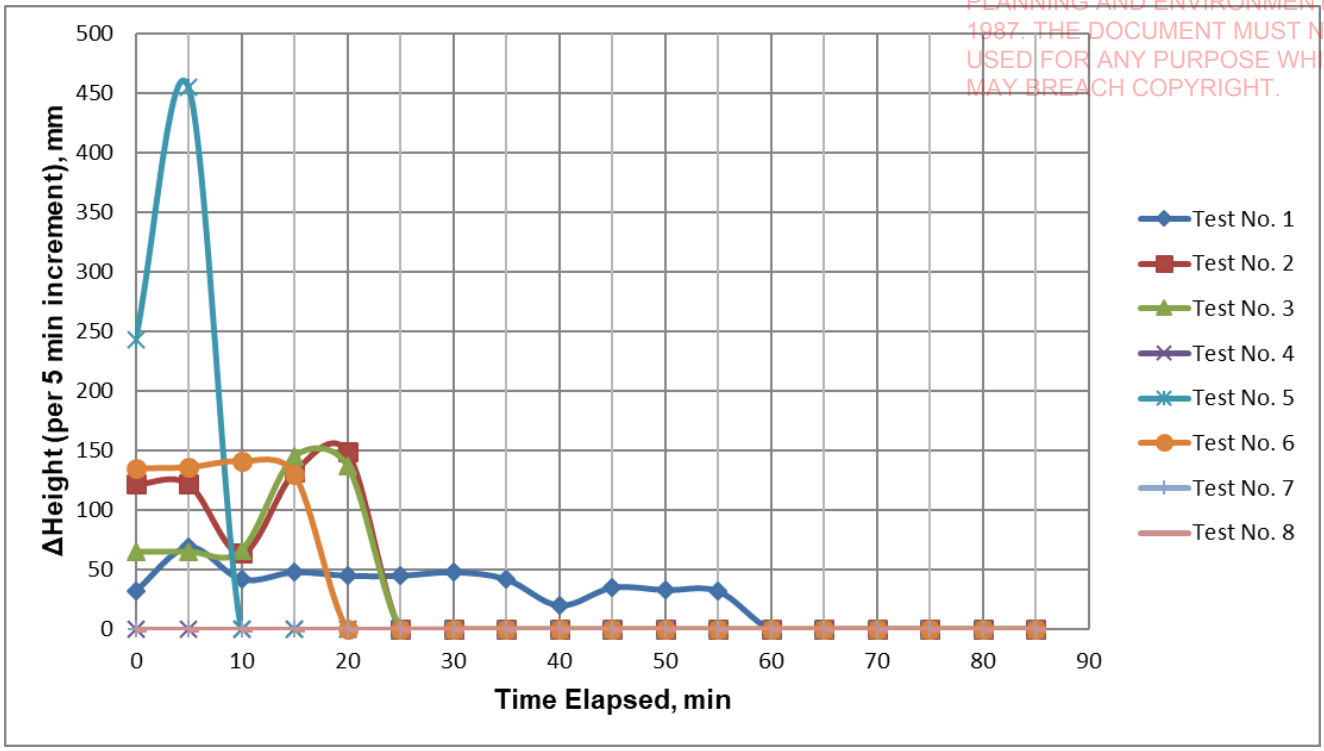
Job No.: 18H296LCA
Comp: 18/02/2019
Date: 6/02/2019
Attendee: NH
Review: 0

AGR ASSESSING GEOLOGICAL RISK

SOIL PERMEABILITY CALCULATIONS

Refer Site Investigation Plan for locations of test sites
Refer Borehole Profiles for soil types and depths encountered

Test Number:		1	2	3	4	5	6	7	8
Time Step (min):		5	5	5	5	5	5	5	
Hole Depth(mm):		450	450	450	500	450	450	450	
Hole Dia. (mm)		75	75	75	75	75	75	75	75
Tube Inside Dia. (mm):		40	40	40	40	40	40	40	40/50
Lim. Layer Depth(mm):		300	300	250	300	300	300	300	
Lim. Layer Material:		SC	SC	SC	SC	SC	SC	SC	
Tube Insert. Depth:		300	300	300	350	300	300	300	
Tube Number:		1	2	3	4	5	6	7	
Test Liquid:		Tap Water	Tap Water	Tap Water	Tap Water	Tap Water	Tap Water	Tap Water	Tap Water
Soil Moisture:		D	D	D	D	D	D	D	
	Time								
Time	0	109	78	139		102	155		
Reading:	5	141	200	204		345	290		
Drop:		32	122	65		243	135		
Reading:	10	210	322	269		800	426		
Drop:		69	122	65		455	136		
Reading:	15	252	386	335			567		
Drop:		42	64	66			141		
Reading:	20	300	518	480			697		
Drop:		48	132	145			130		
Reading:	25	345	667	617					
Drop:		45	149	137					
Reading:	30	390							
Drop:		45							
Reading:	35	438							
Drop:		48							
Reading:	40	480							
Drop:		42							
Reading:	45	500							
Drop:		20							
Reading:	50	535							
Drop:		35							
Reading:	55	568							
Drop:		33							
Reading:	60	600							
Drop:		32							
Reading:	65								
Drop:									
Reading:	70								
Drop:									
Reading:	75								
Drop:									
Reading:	80								
Drop:									
Reading:	85								
Drop:									
Reading:	90								
Drop:									



	1	2	3	4	5	6	7	8
Starts uniform drop	15	10	20			5		
Stops uniform drop	60	25	25			20		
Time elapsed(min)	45	15	5			15		
Total Drop (cm)	34.8	34.5	13.7			40.7		
z	2.0	2.0	2.0			2.0		
Flow, Q (cm^3/min)	9.7	28.9	34.4			34.1		
K_{sat} (cm/min)	0.0125	0.0371	0.0442			0.0438		
K_{sat} (m/day)	0.180	0.535	0.637			0.631		
					Average K_{sat} (m/day)			**0.4956**

Project: 571 Wild Dog Road
Apollo Bay

Client: Holman Designs

Subject: Land Application Area Sizing Using Water Balance - Standard Irrigation

Job No.: 18H296LCA
Comp: 18/02/2019
Date: 6/02/2019
Attendee: NH
Review: DH

AGR ASSESSING GEOLOGICAL RISK

INPUT DATA

Design Wastewater Flow	Q	750	L/day
Design Seepage Rate	DSR	6.5	mm/day
Trial Land Application Area	LAA	350	m^2
Crop Factor	C	Pasture	unitless
Rainfall Runoff Factor	RF	0.70	untiless
Effective Void Ratio	N	0.3	unitless
Minimum Freeboard Topsoil Layer	F	100	mm
Mean Monthly Pan Evaporation Data		Apollo Bay (090001)	
Mean Monthly Rainfall Data		Apollo Bay (090001)	

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Evaporation	E		mm/month	180.0	150.0	135.0	80.0	50.0	40.0	35.0	60.0	80.0	100.0	150.0	170.0	1230
Rainfall	R		mm/month	51.9	50	67.9	82	98.8	109.1	117.4	127.9	109.8	98.2	79.9	63.9	1056.8
Crop Factor	C		unitless	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
OUTPUTS																
Evapotranspiration	ET	E x C	mm/month	126.0	105.0	94.5	48.0	25.0	18.0	14.0	27.0	44.0	65.0	105.0	119.0	**791**
Seepage	S	DSR x D	mm/month	201.5	182.0	201.5	195.0	201.5	195.0	201.5	201.5	195.0	201.5	195.0	201.5	**2372.5**
Total Outputs		ET+S	mm/month	327.5	287.0	296.0	243.0	226.5	213.0	215.5	228.5	239.0	266.5	300.0	320.5	**3163.0**
INPUTS																
Retained Rainfall	RR	R x RF	mm/month	36.3	35.0	47.5	57.4	69.2	76.4	82.2	89.5	76.9	68.7	55.9	44.7	**739.8**
Applied Effluent	W	QxD	L/month	23250	21000	23250	22500	23250	22500	23250	23250	22500	23250	22500	23250	**273750**
Total Inputs		RR+W	mm/month	59.6	56.0	70.8	79.9	92.4	98.9	105.4	112.8	99.4	92.0	78.4	68.0	**1013.5**
DISPOSAL RATE																
Disposal Rate	DR	(ET+S)-RR	mm/month	291.2	252.0	248.5	185.6	157.3	136.6	133.3	139.0	162.1	197.8	244.1	275.8	
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	80	83	94	121	148	165	174	167	139	118	92	84	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 174 m^2
ADOPTED LAND APPLICATION AREA: 350 m^2
DESIGN APPLICATION RATE: 2.1 mm/day

STORAGE CALCULATION

Application Rate	AR	Q/LAA	mm/month	66.4	60.0	66.4	64.3	66.4	64.3	66.4	66.4	64.3	66.4	64.3	66.4	
Storage For The Month	ST	AR-DR	mm/month	-224.7	-192.0	-182.0	-121.3	-90.9	-72.3	-66.9	-72.5	-97.9	-131.3	-179.8	-209.3	
Increase In Depth Of Stored Effluent	ΔH	ST/N	mm/month	-749.1	-640.0	-606.8	-404.4	-303.0	-241.1	-223.0	-241.8	-326.2	-437.8	-599.3	-697.8	
Storage Remaining From Previous Month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Cumulative Storage At End Of Month	CS		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Cumulative Storage From Previous Year	CS		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage Depth for Nominated Area	MS			0 mm												

DESIGN DIMENSIONS SUMMARY

Land Application Area	LAA	174	m^2
Maximum Storage Height	MS	0	mm
Minimum Freeboard Topsoil Layer	F	100	mm
Min Depth Of Land Application System	Z		mm

WATER BALANCE COMPUTATION SHEET

Project: 571 Wild Dog Road
Apollo Bay

Client: Holman Designs

Subject: Land Application Area Sizing Using Water Balance - Trench Basal Area

Job No.: 18H296LCA
Comp: DH
Date: 4/03/2019
Attendee: NH
Review: DH

AGR ASSESSING GEOLOGICAL RISK

INPUT DATA

Design Wastewater Flow	Q	750	L/day
Design Seepage Rate	DSR	11.0	mm/day
Trial Land Application Area	LAA	93	m^2
Crop Factor	C	Pasture	unitless
Rainfall Runoff Factor	RF	0.70	untiless
Effective Void Ratio	N	0.45	unitless
Minimum Freeboard Topsoil Layer	F	100	mm
Mean Monthly Pan Evaporation Data	Apollo Bay (090001)		
Mean Monthly Rainfall Data	Apollo Bay (090001)		BoM Station

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Evaporation	E		mm/month	180	150	135	80	50	40	35	60	80	100	150	170	1230.0
Rainfall	R		mm/month	51.9	50	67.9	82	98.8	109.1	117.4	127.9	109.8	98.2	79.9	63.9	1056.8
Crop Factor	C		unitless	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
OUTPUTS																
Evapotranspiration	ET	E x C	mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0**
Seepage	S	DIR x D	mm/month	341.0	308.0	341.0	330.0	341.0	330.0	341.0	341.0	330.0	341.0	330.0	341.0	**4015.0**
Total Outputs		ET+S	mm/month	341.0	308.0	341.0	330.0	341.0	330.0	341.0	341.0	330.0	341.0	330.0	341.0	**4015.0**
INPUTS																
Retained Rainfall	RR	R x RF	mm/month	36.3	35.0	47.5	57.4	69.2	76.4	82.2	89.5	76.9	68.7	55.9	44.7	**739.8**
Applied Effluent	W	QxD	L/month	23250	21000	23250	22500	23250	22500	23250	23250	22500	23250	22500	23250	**273750**
Total Inputs		RR+W	mm/month	59.6	56.0	70.8	79.9	92.4	98.9	105.4	112.8	99.4	92.0	78.4	68.0	**1013.5**
DISPOSAL RATE																
Disposal Rate	DR	(ET+S)-RR	mm/month	304.7	273.0	293.5	272.6	271.8	253.6	258.8	251.5	253.1	272.3	274.1	296.3	
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	76	77	79	83	86	89	90	92	89	85	82	78	

MINIMUM AREA REQUIRED FOR ZERO STORAGE:	93	m^2	or	155.0	lineal metres of trenching
ADOPTED LAND APPLICATION AREA:	93	m^2	or	155.0	lineal metres of trenching
DESIGN APPLICATION RATE:	8.1	mm/day			

STORAGE CALCULATION

Application Rate	AR	Q/LAA	mm/month	250.0	225.8	250.0	241.9	250.0	241.9	250.0	250.0	241.9	250.0	241.9	250.0	
Storage For The Month	ST	AR-DR	mm/month	-54.7	-47.2	-43.5	-30.7	-21.8	-11.7	-8.8	-1.5	-11.2	-22.3	-32.1	-46.3	
Increase In Depth Of Stored Effluent	ΔH	ST/N	mm/month	-121.5	-104.9	-96.6	-68.1	-48.5	-26.0	-19.6	-3.3	-24.9	-49.5	-71.4	-102.8	
Storage Remaining From Previous Month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Cumulative Storage At End Of Month	CS		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Cumulative Storage From Previous Year	CS		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage Depth for Nominated Area	MS			0	mm											

DESIGN DIMENSIONS SUMMARY

Land Application Area	LAA	93	m^2
Maximum Storage Height	MS	0	mm
Minimum Freeboard Topsoil Layer	F	100	mm
Min Depth Of Land Application System	Z		mm

Nitrogen Balance

Site Address:	571 Wild Dog Road Apollo Bay

SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE	249	m^2

INPUT DATA[1]

Wastewater Loading			
Hydraulic Load		750	L/day
Effluent N Concentration		25	mg/L
% N Lost to Soil Processes (Geary & Gardner 1996)		0.2	Decimal
Total N Loss to Soil		3750	mg/day
Remaining N Load after soil loss		15000	mg/day

Nutrient Crop Uptake					
Crop N Uptake	220	kg/ha/yr	which equals	60.27	$mg/m^2/day$

NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer		
Nitrogen	249	m^2

Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nominated LAA Size	350	m^2
Predicted N Export from LAA	-2.225	kg/year
Minimum Buffer Required for excess nutrient	0	m^2

CELLS

	Please enter data in blue cells
XX	Red cells are automatically populated by the spreadsheet
XX	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

NOTES

[1] Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as:

- *EPA Guidelines for Effluent Irrigation*
- *Appropriate Peer Reviewed Papers*
- *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households*
- *USEPA Onsite Systems Manual*

Appendix VII: Gypsum Requirement

GYPSUM REQUIREMENT COMPUTATION SHEET

Project: 571 Wild Dog Road
Apollo Bay

Client: Holman Designs
Subject: Gypsum Requirement

Job No.: 18H296LCA
Comp: 18/02/2019
Date: 6/02/2019
Attendee: NH
Review: 0

AGR ASSESSING GEOLOGICAL RISK

Calculation CEC x 1.6 x (ESP - ESP_D)

	meq/100g	%	Sample 1
Exchangeable Calcium	3.7	61.7	
Exchangeable Magnesium	1.7	28.3	
Exchangeable Potassium	0.4	6.7	
Exchangeable Sodium	0.2	3.3	
Exchangeable Hydrogen		0.0	
Sample Depth (mm)			200
Depth of soil (mm)			200
Gypsum factor (tons)[1]			1.6
t/ha to kg/m^2 conversion			0.1

Cation Exchange Capacity (CEC)	MEQ%	6.1
Excangable Sodium Percentage (ESP)	%	3.7
Desirable Exchangable Sodium Percentage (ESP_D)	%	6.0
Calcium Replacement (ESP - ESP_D)	%	0.0

Gypsum Requirement	t/ha	0.00
	kg/m^2	0.00

[1]US Department of Agriculture (1954) Agrigulture Handbook No. 60; Davis *et al* (2012)

GYPSUM REQUIREMENT COMPUTATION SHEET

Project: 571 Wild Dog Road
Apollo Bay

Client: Holman Designs
Subject: Gypsum Requirement

Job No.: 18H296LCA
Comp: 18/02/2019
Date: 6/02/2019
Attendee: NH
Review: 0

AGR ASSESSING GEOLOGICAL RISK

Calculation $CEC \times 1.6 \times (ESP - ESP_D)$

Sample 2

	meq/100g	%
Exchangeable Calcium	3.5	46.7
Exchangeable Magnesium	3.6	48.0
Exchangeable Potassium	0.2	2.7
Exchangeable Sodium	0.2	2.7
Exchangeable Hydrogen		0.0

Sample Depth (mm)	400
Depth of soil (mm)	800
Gypsum factor (tons)[1]	1.6
t/ha to kg/m^2 conversion	0.1

Cation Exchange Capacity (CEC)	MEQ%	7.5
Excangable Sodium Percentage (ESP)	%	2.8
Desirable Exchangable Sodium Percentage (ESP_D)	%	6.0
Calcium Replacement ($ESP - ESP_D$)	%	0.0

Gypsum Requirement	t/ha	0.00
	kg/m^2	0.00

[1]US Department of Agriculture (1954) Agrigulture Handbook No. 60; Davis *et al* (2012)

Appendix VIII: Runoff Coefficient Computation

Standard values used due to site size

MGA 94
ZONE 54

1
PS412913F
NO. 571
9.939ha

E-1

POWERLINE

OVERHEAD

LINE OF POSTS

EMBANKMENT

PROPOSED HOUSE BUILDING AREA

WATER TANKS

COLORBOND SHED
FL183.51
GUTTER RL186.53
RIDGE RL187.42

WATER TANK

DRIVEWAY

GRAVEL

DAM

TRACK

SWAMPY GULLY

TBM
DUMPY PEG
RL 190.31

POWER POLE

TELCO POLE

WIRE FENCE

GATE

239°45'20"
62.97

207°40'20"
78.02

203°28'20"
53.51

49.28
280°24'20"

POST

IRON ROD
RL 202.02

ORM (PIPE)
(PS412913F

ROAD

DOG

WILD

CONCRETE CULVERT

EDGE OF GRAVEL ROAD

LEGEND

	GENERAL		TOP OF BANK
	WATTLE		TOE OF BANK
	FERN		CHG OF GRADE
	EUCALYPT		TREES
	BLACKWOOD		SHRUBS
	STUMP		OH ELEC
	FRUIT		UG ELEC
	CYPRESS		OH TELCO
	PINE		UG TELCO
			FENCE
	GRATED PIT		
S	SEWER PIT	OP	OLD PEG
WM	WATER MAIN	NP	NEW PEG
FH	FIRE HYDRANT	WS	WINDOW SILL
		FL	FLOOR LEVEL
		IL	INVERT LEVEL

DATE			
21/12/2018	CREATED	01	AJ
		V	CH

DRAWING HISTORY & AMENDMENTS

NOTATIONS

LAND SUBJECT TO EASEMENT: E-1 POWERLINE 12m WIDE VIDE PS412913F
DATUM FOR LEVELS IS A TBM DUMPY PEG WITH AN AHD LEVEL VALUE OF 190.31
AHD LEVELS VALUE OBTAINED BY GPS CONNECTION TO THE VIC 09 GEOID
BOUNDARIES ARE NOT FENCED UNLESS OTHERWISE SHOWN
BOUNDARY POSITION IS NOT THE RESULT OF THIS SURVEY
CONTOUR INTERVAL IS 0.20 METRES

DISCLAIMER

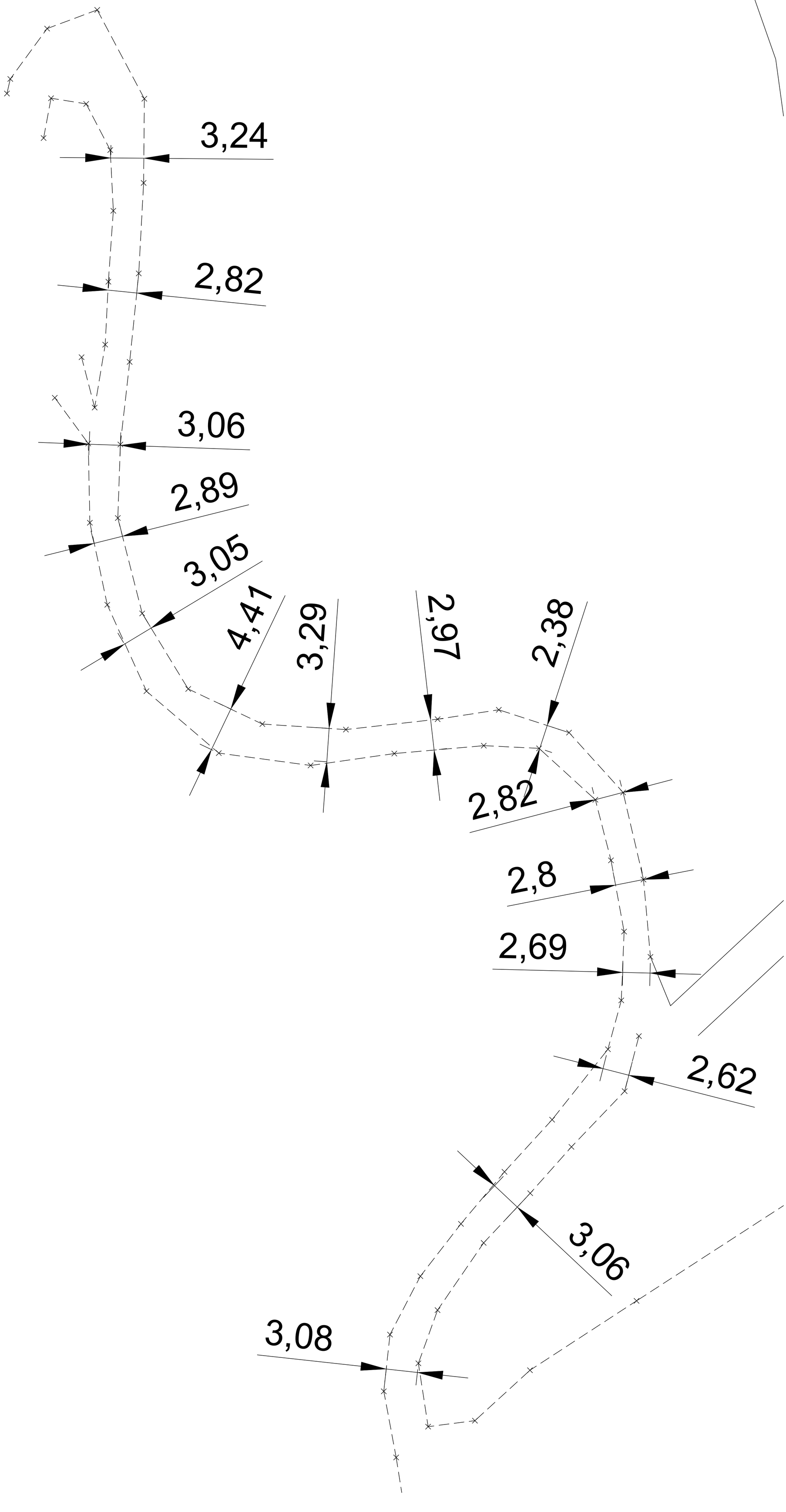
SURVEYOR	AHJ	PLAN REFERENCE
SURVEY DATE	19/12/2018	1224FSV01-1

AH & LJ JEAVONS
LAND SURVEYORS
South West Survey Group
m: 0430 401 954 t: 5261 2971
14 Ocean Boulevard, Jan Juc, VIC 3228
tonyjeavons@swsg.com.au www.swsg.com.au

PLAN OF FEATURE & LEVEL SURVEY

COUNTY: POLWARTH
PARISH: KRAMBRUK
SECTION: 1
CROWN ALLOTMENT: 20F (PART)
ADDRESS: 571 WILD DOG ROAD
APOLLO BAY, VIC. 3233

SCALE	ORIGINAL		SURVEYORS REFERENCE
2 0 2 4 6 8	SCALE	SHEET SIZE	1224FSV01
LENGTHS ARE IN METRES	1: 200	A0	SHEET 1 OF 1



25 March 2019

Planning Department

Colac Otway Shire Council

PO Box 283

COLAC VIC

Via Email to: inq@colacotway.vic.gov.au

Dear Planning Department

SUBJECT SITE: **571 Wild Dog Road, Apollo Bay**

APPLICATION: **PP263/2018 - Use and Development of a Dwelling**

We refer to Council's Further Information request dated 29th November and the subsequent extensions of time granted up to 30th April 2019.

The proposal has been reviewed in relation to the issues raised by Council and we note the following:

1. There is no retrospective approval required as secondary consent (PP347/2004) SCON31/2011-1 was granted to reduce the size and alter layout of dwellings, cottages and shed; and re-siting of the dwelling, cottage and shed on 25th October 2011. Please see attached. In addition, the shed has a building permit (BSU1166/201200170/0 Issued 06/02/2012) see attached.
2. The proposed colours had already been approved as above and are as existing.
3. See attached revised LRA.
4. See attached revised LRA with Form A.
5. See attached revised LRA and cross-reference with Development Plans (Holman Designs)
6. See attached revised LCA.
7. See attached proposed LMP by Beacon Ecological.

We trust this information assists Council to now proceed to public notification.

On a secondary issue, I will be over seas from 23rd April to 22nd May so can Guy Holman of Holman Designs please be your point of contact for any information during this time.

Many thanks

Shelly Fanning

Coastal Planning

Attachments:

1. **Revised Development Plan by Holman Designs dated 21.03.2019**
2. **Revised Land Risk Assessment dated 21 March 2019 by AGR GeoScience**
3. **Land Capability Assessment dated 4 March 2019 by AGR GeoScience**
4. **Land Management Plan dated March 2019 by Beacon Ecological**
5. **Bushfire Management Statement dated February 2019 by Terramatrix**
6. **Feature Level and Survey by Tony Jeavons dated 19 December 2019**
7. **Endorsed plans of existing shed**
8. **Stamped planning permit shed**
9. **Building Permit and Secondary Consent Planning Permit for shed**
10. **Driveway plan**

Toni Brain

From: Shelly Fanning <shelly@coastalplanning.com.au>
Sent: Monday, 25 March 2019 4:09 PM
To: INQ
Cc: Helen Evans
Subject: Email 1 of 2 - FI Response PP263/2018
Attachments: FI Response to 25.03.2019.pdf; 25.03.2019 driveway.pdf; 25.03.2019 FL&S.pdf; 25.03.2019 LCA.pdf; 25.03.2019 LRA.pdf; 25.03.2019 LMP.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Planning

FURTHER INFORMATION RESPONSE PP263/2018.

Please see attached cover letter by Coastal Planning and attachments including:

1. **Revised Development Plan by Holman Designs dated 21.03.2019**
2. **Revised Land Risk Assessment dated 21 March 2019 by AGR GeoScience**
3. **Land Capability Assessment dated 4 March 2019 by AGR GeoScience**
4. **Land Management Plan dated March 2019 by Beacon Ecological**
5. **Bushfire Management Statement dated February 2019 by Terramatrix**
6. **Feature Level and Survey by Tony Jeavons dated 19 December 2019**
7. **Endorsed plans of existing shed**
8. **Stamped planning permit shed**
9. **Building Permit and Secondary Consent Planning Permit for shed**
10. **Driveway plan**

We look forward to this application proceeding to Public Notification ASAP.

Many thanks

Shelly Fanning | Planning Consultant

coastal planning

m: 0408 734 169

e: shelly@coastalplanning.com.au | **w:** www.coastalplanning.com.au

Proposed Residence

571 Wild Dog Road APOLLO BAY

Cornelis & Mieke Versteeg

HOLMAN DESIGNS

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:42 PM	G. Holman		General	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION
DP/AD 36250
P: 0402 257 152

1 SITE

1 : 2000

Site Area : 99,390sqm - 9.939H
Building works: 357sqm
Site Coverage: 0.35%

HOLMAN DESIGNS

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:45 PM	G. Holman	1 : 2000	Site Plan	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION
DP/AD 36250
P: 0402 257 152

1 SITE -500

1 : 500

NORTH

CLASSIFIED VEGETATION

PROPOSED HOUSE
RL: 182.40

PROP. PARKING AREA

COURTYARD

COLORBOND SHED

GUTTER RL186.53

RIDGE RL187.42

FL183.51

GUTTER RL186.53

WATER TANK

WATER TANKS

4263

20,000L CFA water tank

DAM
10,000L STATIC WATER SUPPLY FOR CFA

EXISTING CRUSHED ROCK DRIVEWAY

POWERLINE

OVERHEAD

E-1

500

2x 20,000L water tanks

Existing Septic

New Trenches for septic system
3m spacings
as per recomendations by AGR Geoscience
Report 18H296LCA

TBM
DUMPY PEG
RL 190.31

Driveway widening for CFA access required
4m minimum, Gravel finish with 15 tonne capacity

SWAMPY GULLY

120895

TRACK

TRACK

TRACK

LINE OF POSTS

203°28'20"

53.51

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:47 PM	G. Holman	1 : 500	Site Plan 2	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

HOLMAN DESIGNS

REGISTRATION DP/AD 36250
P: 0402 257 152

1 DEFENDABLE SPACE

1 : 2000

Construction standards
The dwelling must be designed and constructed to a minimum Bushfire Attack Level of **BAL-40** (BAL-40)

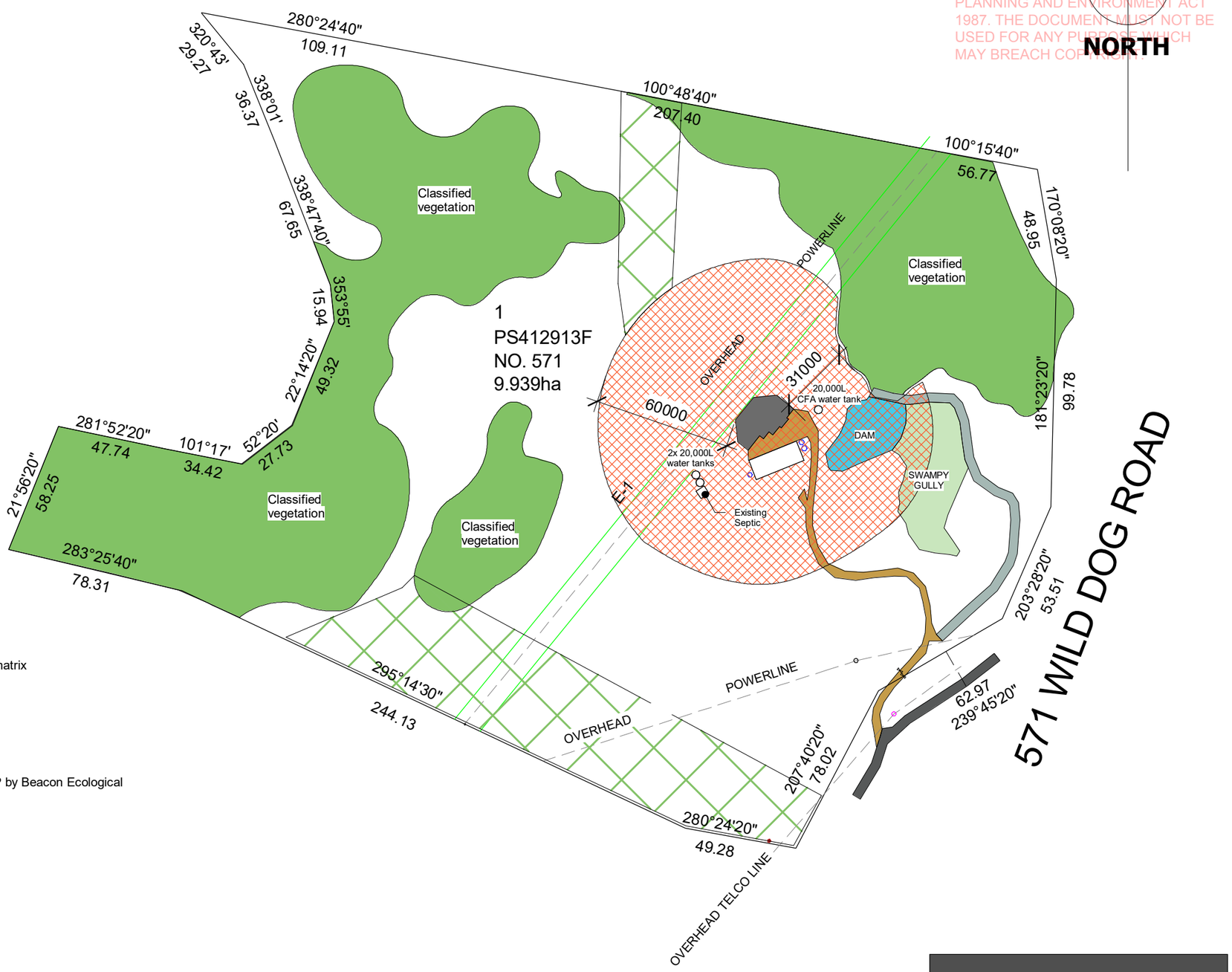
Vegetation management requirements:
Defendable space to the **distances shown** will be provided and maintained in accordance with the following requirements:
- Grass must be short cropped and maintained during the declared fire danger period.
- All leaves and vegetation debris must be removed at regular 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 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.

Unless specified in a schedule or otherwise agreed to in writing to the satisfaction of the relevant fire authority.

Access provisions
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 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 per cent) (8.1°) with a maximum grade of no more than1 in 5 (20 per cent)(11.3°) for no more than 50 metres.
- Dips must have no more than a 1 in 8 (12.5 per cent) (7.1°) entry and exit angle.

A turning area for fire fighting vehicles must be provided close to the building by one of the following:
- A turning circle with a minimum radius of 8 metres.
- A driveway encircling the dwelling.
- The provision of other vehicle turning heads - a T or Y head - which meet the specifications of Austroad Design for an 8.8 metre Service Vehicle.

Water supply
A **10,000L** water tank that is dedicated solely for fire fighting purposes must be provided and must meet the following requirements:
Unless otherwise agreed in writing by the relevant fire authority, the water supply must:
- Be stored in an above ground water tank constructed of concrete or metal.
- Have all fixed above-ground water pipes and fittings required for fire fighting purposes made of corrosive resistant metal.
- Include a separate outlet for occupant use.
- Be readily identifiable from the building or appropriate identification signage to the satisfaction of the relevant fire authority.
- Be located within 60m of the outer edge of the approved building.
- The outlet/s of the water tank must be within 4 metres of the accessway and be unobstructed.
- Incorporate a separate ball or gate valve (British Standard Pipe (BSP 65 millimetre) and coupling (64mm and coupling (64 millimetre CFA 3 thread per inch male fitting).
- Any pipework and fittings must be a minimum of 65 millimetres (excluding the CFA coupling).



Defendable space area
As per BMO report by Terrmatrix

New Vegetation as per LMP by Beacon Ecological

HOLMAN DESIGNS

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:50 PM	G. Holman	1 : 2000	Defendable space	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION DP/AD 36250
P: 0402 257 152

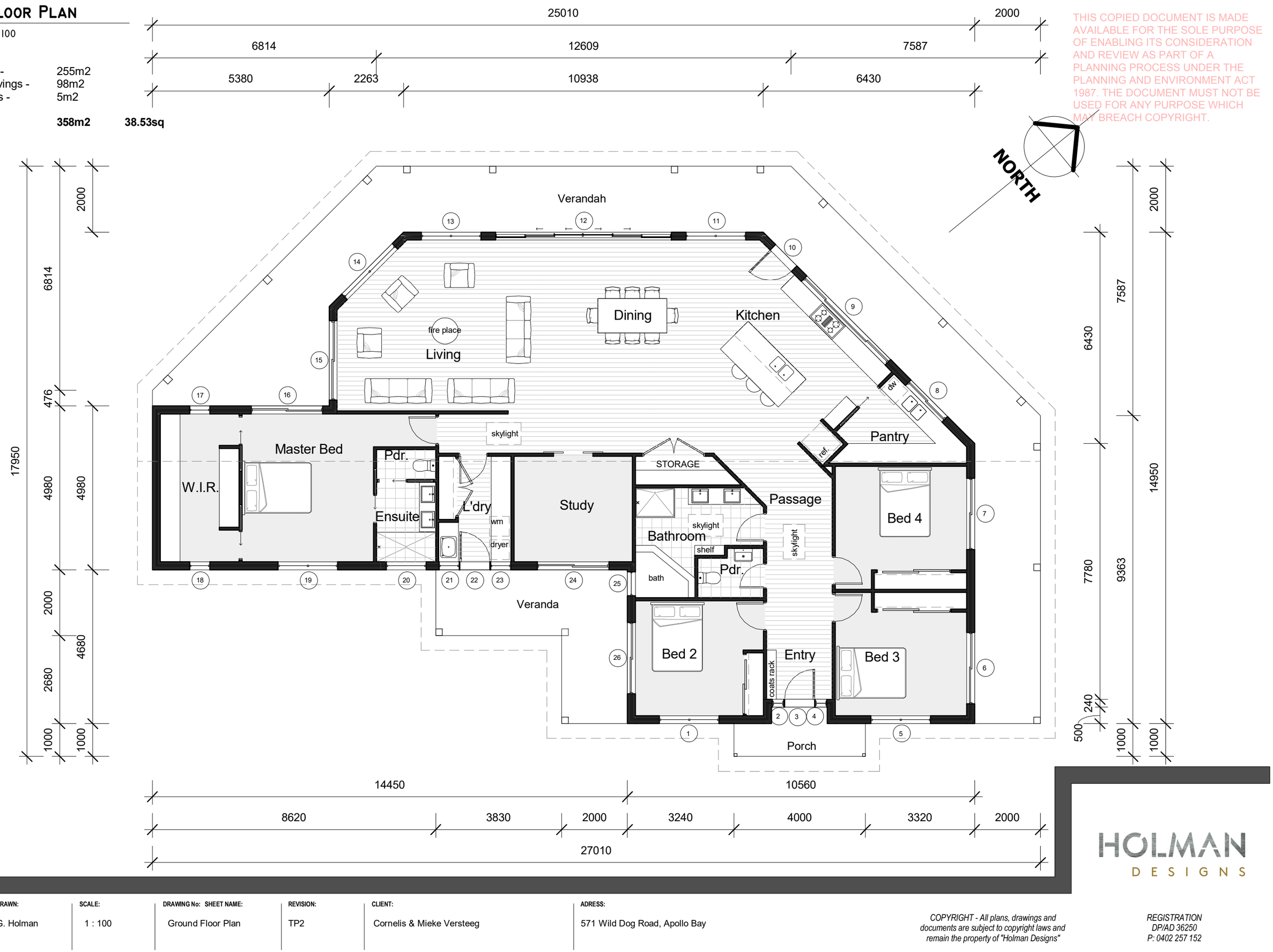
1 FLOOR PLAN

1 : 100

AREAS

Ground Floor -	255m2
Verandah Pavings -	98m2
Porch Pavings -	5m2
TOTAL:	**358m2**

38.53sq



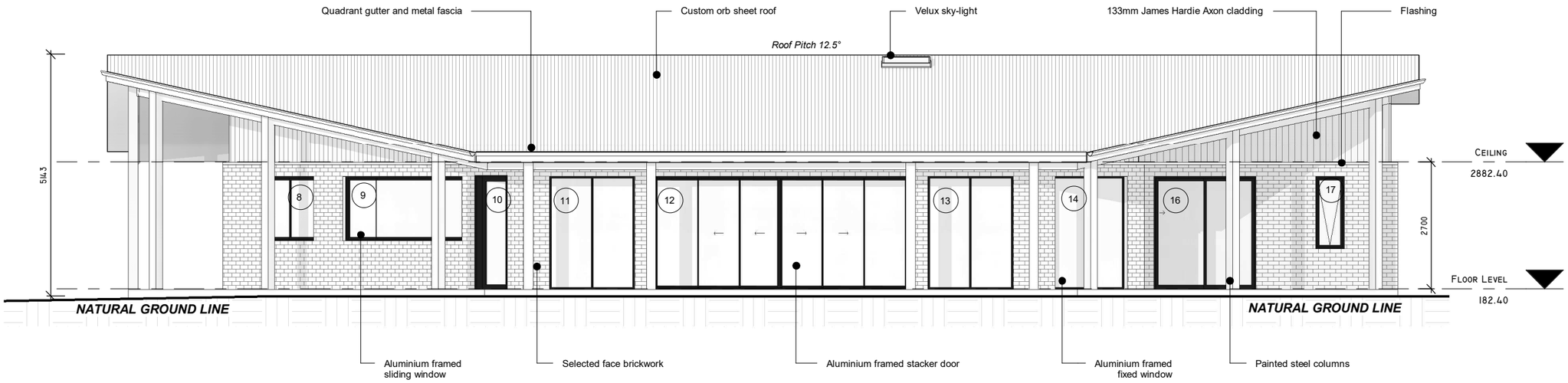
HOLMAN DESIGNS

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:51 PM	G. Holman	1 : 100	Ground Floor Plan	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION
DP/AD 36250
P: 0402 257 152

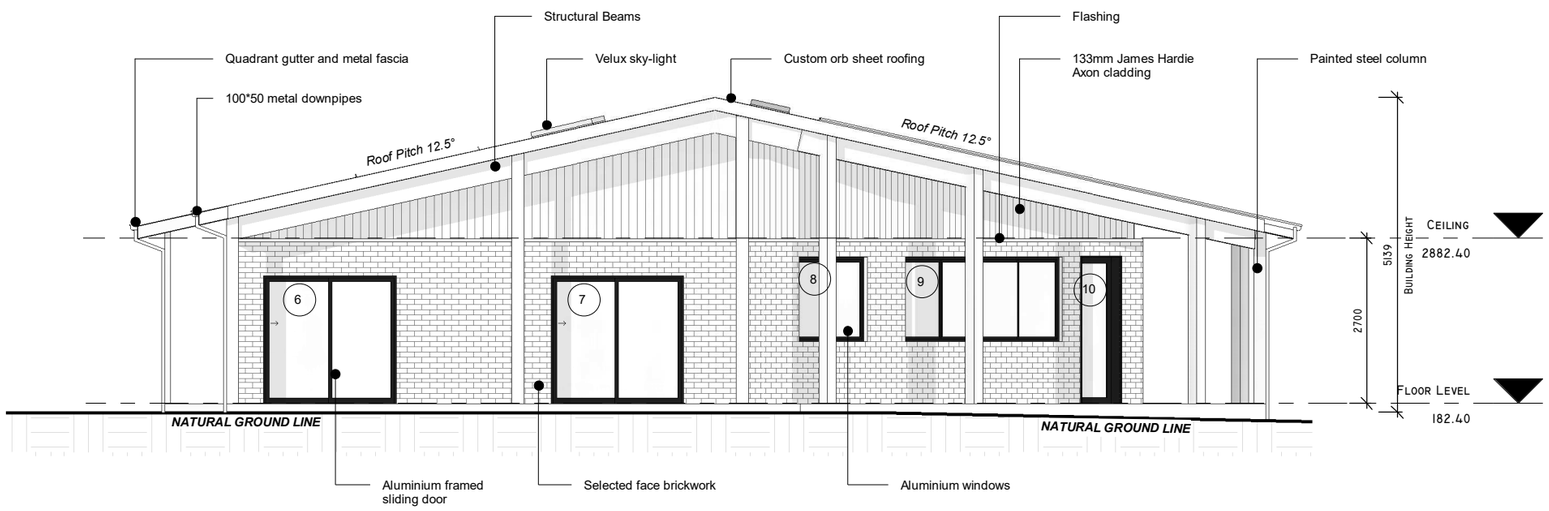
1 North Elevation

1 : 100



2 East Elevation

1 : 100



Materials:

Brick - *Austral 'San Selmo Ember' or, Adbri Sandhurst Stone 'Oatmeal'*

Cladding - *Innex Express or Scyon Axon woodgrain or Colorbond*

Roofing - *Colorbond custom orb "Monument"*

Windows gutters and flashings to match

Fascia - *LOSP Fascia board Colour "Dune"*

HOLMAN DESIGNS

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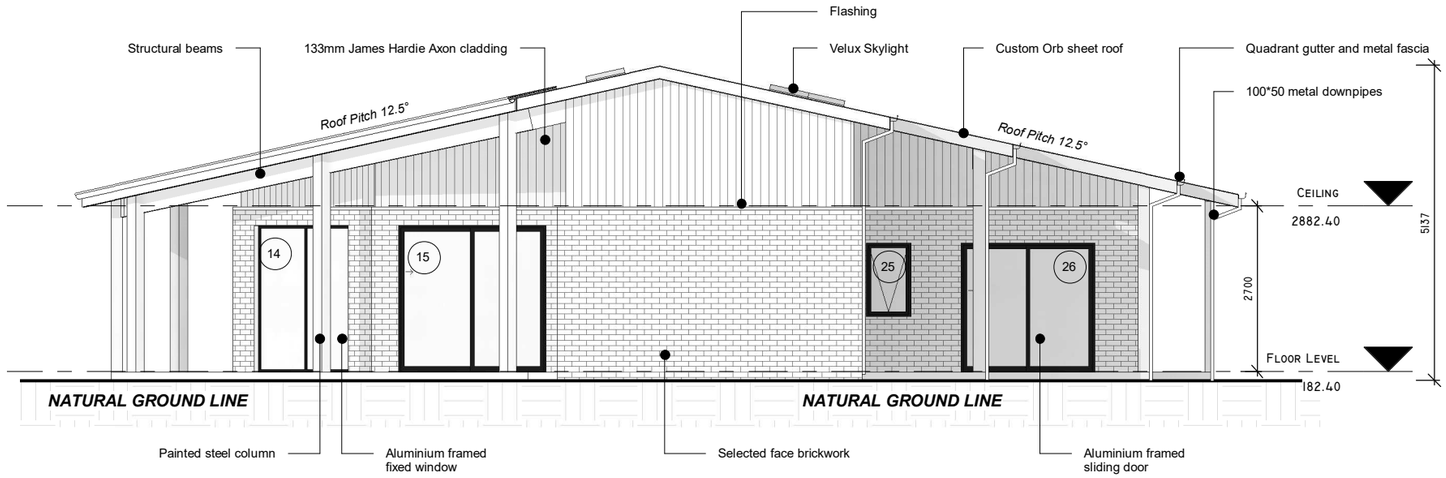
21/03/2019 12:47:53 PM	G. Holman	1 : 100	Elevations	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION DP/AD 36250 P: 0402 257 152

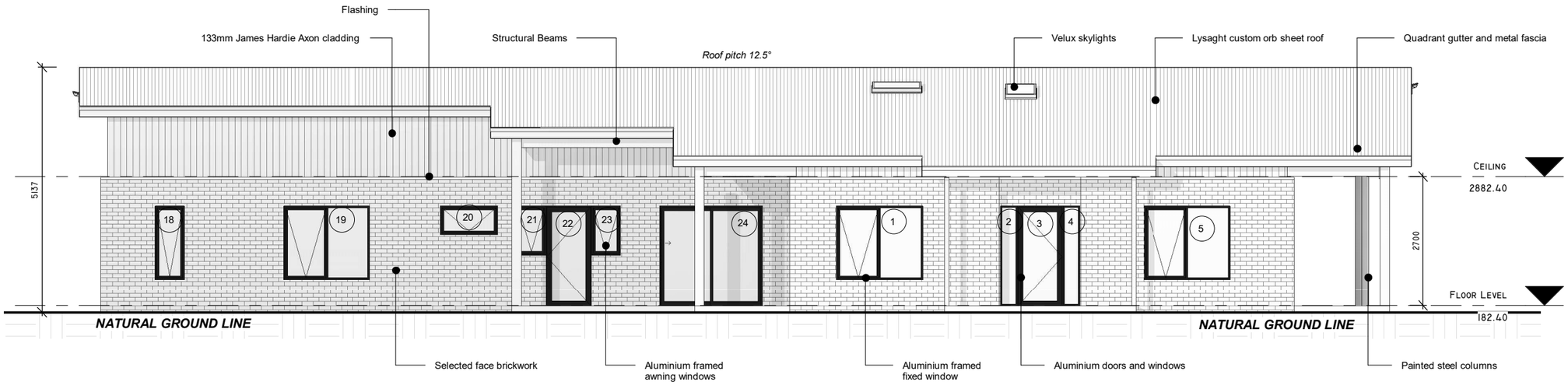
3 West Elevation

1 : 100



4 South Elevation

1 : 100



Materials:

Brick - *Austral 'San Selmo Ember' or, Adbri Sandhurst Stone 'Oatmeal'*

Cladding - *Innex Express or Scyon Axon woodgrain or Colorbond*

Roofing - *Colorbond custom orb "Monument"*

Windows gutters and flashings to match

Fascia - *LOSP Fascia board Colour "Dune"*

HOLMAN DESIGNS

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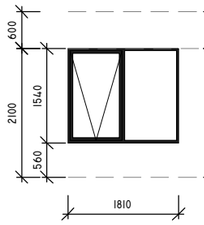
21/03/2019 12:47:54 PM	G.Holman	1 : 100	Elevations 2	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION DP/AD 36250
P: 0402 257 152

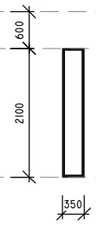
WINDOW SCHEDULE

1 : 100

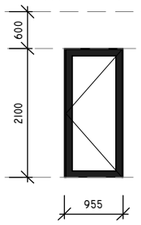
No: 1
Type: Awning
Room: Bed 2
Glass: Double Glazed



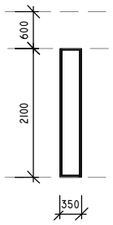
No: 2
Type: Fixed
Room: Entry
Glass: Double Glazed



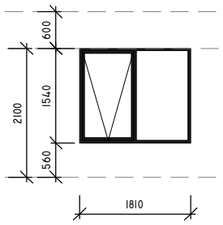
No: 3
Type: Door
Room: Entry
Glass: Double Glazed



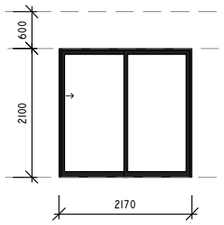
No: 4
Type: Fixed
Room: Entry
Glass: Double Glazed



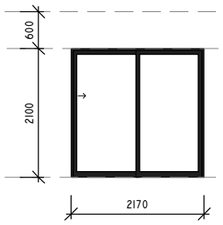
No: 5
Type: Awning
Room: Bed 3
Glass: Double Glazed



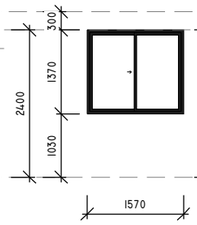
No: 6
Type: Sliding Door
Room: Bed 3
Glass: Double Glazed



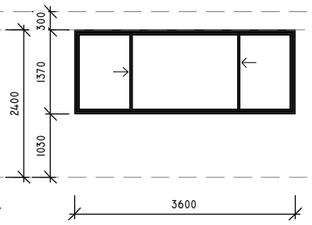
No: 7
Type: Sliding Door
Room: Bed 4
Glass: Double Glazed



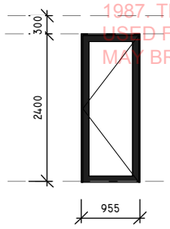
No: 8
Type: Sliding
Room: Pantry
Glass: Double Glazed



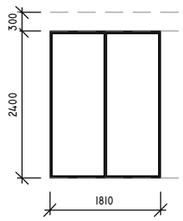
No: 9
Type: Sliding
Room: Kitchen
Glass: Double Glazed



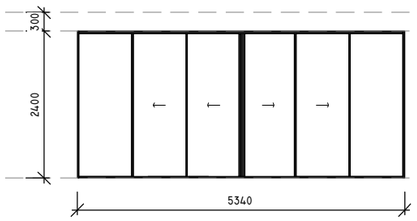
No: 10
Type: Door
Room: Kitchen
Glass: Double Glazed



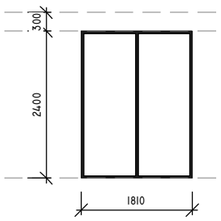
No: 11
Type: Fixed
Room: Dining
Glass: Double Glazed



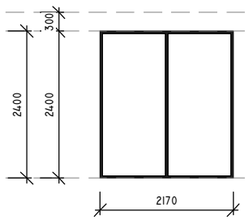
No: 12
Type: Stacking door
Room: Dining
Glass: Double Glazed



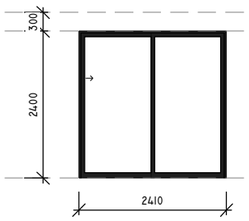
No: 13
Type: Fixed
Room: Living
Glass: Double Glazed



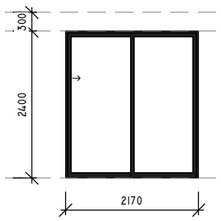
No: 14
Type: Fixed
Room: Living
Glass: Double Glazed



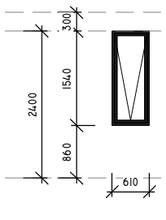
No: 15
Type: Sliding Door
Room: Living
Glass: Double Glazed



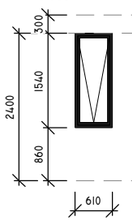
No: 16
Type: Sliding Door
Room: Master Suite
Glass: Double Glazed



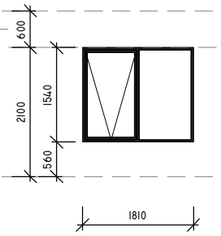
No: 17
Type: Awning
Room: W.I.R.
Glass: Double Glazed



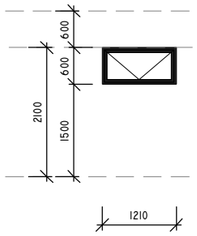
No: 18
Type: Awning
Room: W.I.R.
Glass: Double Glazed



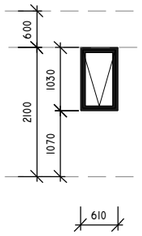
No: 19
Type: Awning
Room: Master Suite
Glass: Double Glazed



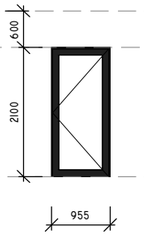
No: 20
Type: Awning
Room: Ensuite
Glass: Double Glazed



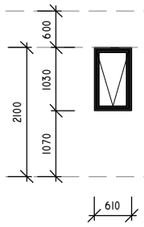
No: 21
Type: Awning
Room: Laundry
Glass: Double Glazed



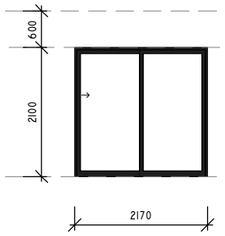
No: 22
Type: Door
Room: Laundry
Glass: Double Glazed



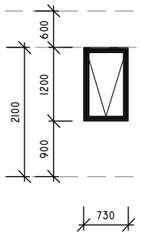
No: 23
Type: Awning
Room: Laundry
Glass: Double Glazed



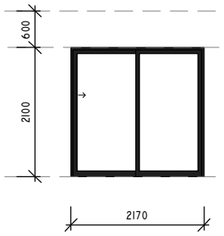
No: 24
Type: Sliding Door
Room: Study
Glass: Double Glazed



No: 25
Type: Awning
Room: Bathroom
Glass: Double Glazed



No: 26
Type: Sliding Door
Room: Bed 2
Glass: Double Glazed



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DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:55 PM	G. Holman	1 : 100	Windows	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION
DP/AD 36250
P: 0402 257 152

BAL - 40 Notes

BAL—40 is primarily concerned with protection of your building from ember attack and burning debris ignited by wind borne embers and exposure to a high level of radiant heat radiant heat up to and including 40 kW/m2. There is some likelihood of direct exposure to flames from the fire front.

To comply with the Building Code of Australia, your construction or complying development certificate plans must include details of the building construction relevant to the level of bushfire.
Those parts of this document that relate to your development must be included on the construction certificate plans or in the construction specification.
The construction requirements for the next lower BAL may be used for an elevation of a dwelling that is not exposed to the source of a bushfire. An elevation is not exposed if the entire elevation is completely screened from the source of a bushfire by another part of the building.
Any element of construction or system that satisfies the test criteria of AS 1530.8.1 may be used in lieu of the applicable requirements below (see Clause 3.8 of the Standard).

SARKING
Sarking, where used for bushfire protection shall be:
a. Non-combustible; or
b. Breather-type sarking complying with AS/NZS4200.1 and with a flammability index of not more than 5 and sarked on the outside of the frame; or
c. An insulation material conforming to the appropriate Australian Standard for that material.
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Edition August 2014

SUBFLOOR SUPPORTS
This Standard does not provide construction requirements for subfloor supports where the subfloor space is enclosed with a wall that complies with the requirements for an external wall below except that sarking is not required to be installed where specified.
Where the subfloor space is unenclosed, the support posts, columns, stumps, piers and poles shall be—
(1) of non-combustible material; or
(2) a system that has been tested and complies with AS 1530.8.1; or
(3) a combination of Items (i) and (ii) above.
NOTE: This requirement applies to the principal building only. See requirements below for verandas, decks, steps, ramps and landings.

FLOORS
1) Elevated floors
a) Enclosed subfloor space
The Standard does not provide construction requirements for elevated floors, including bearers, joists and flooring, where the subfloor space is enclosed with a wall that complies with the standards for an external wall below except that sarking is not required to be installed where specified for a wall.
b) Unenclosed subfloor space
Where the subfloor space is unenclosed, the bearers, joists and flooring, shall—
(a) be non-combustible; or
(b) have the underside of the combustible elements of the floor system protected with a non-combustible material (e.g., fibre-cement sheet or metal sheet); or
(c) a system that has been tested and complies with AS 1530.8.1; or
(d) be a combination of any of Items (a), (b) or (c) above.

EXTERNAL WALLS
1) Walls
The exposed components of an external wall shall be:
(a) Non-combustible material such as cavity brick, masonry veneer walls with an outer leaf of clay, concrete, calcium silicate or natural stone, precast or in situ walls of concrete or aerated concrete or earth walling including mud brick; or
(b) Cladding that is fixed externally to a timber-framed or a steel-framed wall and is—
(i) Fibre-cement a minimum of 9 mm in thickness; or
Summary of BAL 40 Standards Page 3
Edition August 2014
(iii) Steel sheeting; or
(iv) A combination of any of Items (i) and (ii) above; or
(c) a system that has been tested and complies with AS 1530.8.1
(d) A combination of any of Items (a), (b) or (c) above.
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 3 mm.
3) Vents and weepholes
Vents and weepholes in external walls shall be screened with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium, except where the vents and weepholes have an aperture less than 3 mm.

EXTERNAL WINDOWS and DOORS
1) Windows
Window assemblies shall comply with one of the following:
(a) They shall be completely protected by a bushfire shutter that complies with Note 1 below; or

(b) They shall comply with the following:
(i) Window frames and hardware shall be metal.
(ii) Externally fitted hardware that supports the sash in its functions of opening and closing shall be metal.
(iii) Glazing shall be a minimum of 6 mm toughened glass.

NOTE: Where double-glazed units are used, the above requirements apply to the external face of the window assembly only.
(iv)Both the openable and fixed portions of windows shall be screened externally with screens complying with Note 2 below.
(v) Seals to stiles, head and sills or thresholds shall be manufactured from materials having a flammability index no greater than 5 or from silicone.

2) Doors—Side-hung external doors (including French doors, panel fold and bi-fold doors)
Side-hung external doors, including French doors, panel fold and bi-fold doors, shall comply with one of the following:
(a) Doors and door frames shall be protected by bushfire shutters that comply with Note 1; or
(b) Doors and door frames shall comply with the following:
(i) Doors shall be—
(A) non-combustible; or

(B) a solid timber door, having a minimum thickness of 35 mm for the first 400 mm above the threshold and protected on the outside by a metal framed screen door with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze; or
(C) a fully framed glazed door, where the framing is made from noncombustible materials.
(ii) Externally fitted hardware that supports the panel in its function of opening and closing shall be metal.
(ii) Where doors incorporate glazing, the glazing shall be toughened glass with a minimum thickness of 6mm.
(iii) Doors shall be tight-fitting to the door frame and to an abutting door, if applicable.
(iv) Where glazing is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings, having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame, that portion shall be screened externally with a screen that complies with Note 2 below.
(v) Seals to stiles, head and sills or thresholds shall be manufactured from materials having a flammability index no greater than 5 or from silicone.
(vi) Door frames shall be metal.
(vii) Weather strips, draught excluders or draught seals shall be installed at the base of side-hung external doors.
Sliding doors
Sliding doors shall comply with one of the following:
(a) They shall be completely protected by a bushfire shutter that complies with Note 1; or
(b) They shall comply with the following:
(i) Any glazing incorporated in sliding doors shall be toughened glass with a minimum thickness of 6mm and both the fixed and openable portions of the door must be screened externally with screens complying with Note 2 below.
(ii) The door frame supporting the sliding door, the framing surrounding any glazing and any externally fitted hardware that supports the functioning of the door shall be metal.
(iii) Seals to stiles, head and sills or thresholds shall be manufactured from materials having a flammability index no greater than 5 or from silicone.
(iv) Doors shall be tight-fitting to the door frame and to an abutting door, if applicable.

Note 1: Where fitted, bushfire shutters shall be made from non-combustible material and:
(a) be fixed to the building and be non-removable;
(b) when in the closed position, have no gap greater than 3 mm between the shutter and the wall, the sill or the head;
(c) be readily manually operable from either inside or outside;
(d) protect the entire window assembly or door assembly;
(f) where perforated, have—
(i) uniformly distributed perforations with a maximum aperture of 3 mm when the shutter is providing radiant heat protection or 2 mm when the shutter is also providing ember protection (such as where the openable portion of the window is not screened in accordance with the requirements of the respective BAL); and
(ii) a perforated area no greater than 20% of the shutter. If bushfire shutters are fitted to all external doors then at least one of those shutters shall be operable from the inside to facilitate safe egress from the building.

Note 2: Where fitted, screens for windows and doors shall have a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze. Gaps between the perimeter of the screen assembly and the building element to which it is fitted shall not exceed 3 mm.
The frame supporting the mesh or perforated sheet shall be made from metal.
Note 3: Where double glazed units are used the above requirements apply to the external face of the window assembly only.

ROOFS (INCLUDING VERANDA AND ATTACHED CARPORT ROOFS, PENETRATIONS, EAVES, FASCIAS, GABLES, GUTTERS AND DOWNPIPES)
1. General
The following apply to all types of roofs and roofing systems:
(a) roof tiles, roof sheets and roof-covering accessories are to be non-combustible.
b) the roof/wall junction is to be sealed to prevent openings greater than 3 mm, either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.
(c) roof ventilation openings, such as gable and roof vents, are to be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze.
(d) a pipe or conduit that penetrates the roof covering shall be non-combustible.
(e) Roof mounted evaporative coolers are not permitted in BAL-40.

4. Verandah, carport and awning roofs
The following apply to veranda, carport and awning roofs:
(a) A veranda, carport or awning roof forming part of the main roof space shall meet all the requirements for the main roof.
(b) A veranda, carport or awning roof separated from the main roof space by a wall that complies with the specification above for an external wall shall have a non-combustible roof covering and the support structure shall be—
(i) of non-combustible material; or
(ii) timber rafters lined on the underside with fibre-cement sheeting a minimum of 6 mm in thickness, or with material complying with AS 1530.8.1; or
(iii) a system that has been tested and complies with AS 1530.8.1; or
(iv) a combination of any of Items (i), (ii) or (iii) above.
Summary of BAL 40 Standards Page 7
Edition August 2014

5. Roof penetrations
The following apply to roof penetrations:
(a) Roof penetrations, including roof lights, roof ventilators, aerials, vent pipes and supports for solar collectors, shall be adequately sealed at the roof to prevent gaps greater than 3 mm. The material used to seal the penetration shall be non-combustible.
(b) Glazed elements in roof lights and skylights are to have minimum fire resistance level (FRL) of -/30/-.
(c) External single plane glazed elements of roof lights and skylights, where the pitch of the glazed element is 18 degrees or less to the horizontal, shall be protected with ember guards made from a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze.

6. Eaves linings, fascias and gables
The following apply to eaves linings, fascias and gables:
(a) Gables shall comply with the requirements for an external wall.
(b) Fascias and bargeboards shall be a system that has been tested and complies with AS 1530.8.1. At this time there have been a minimal number of tests on fascias and bargeboards. The Rural Fire Service (RFS) recommends that compliance with the requirements for External Walls is appropriate for fascias and bargeboards.
(c) Eaves linings shall be—
(i) fibre-cement sheet, a minimum 6 mm in thickness; or
(ii) calcium silicate sheet, a minimum 6 mm in thickness; or
(iii) a combination of Items (i) and (ii) above.
(d) Eaves penetrations shall be protected the same as for roof penetrations.
(e) Eaves ventilation openings greater than 3 mm shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze.
(f) Joints in eaves linings, fascias and gables may be sealed with plastic joining strips or timber moulds.
7. Gutters and downpipes
The Standard does not provide material requirements for downpipes.
If installed, gutter and valley leaf guards shall be non-combustible.
Gutters shall be non-combustible.
Box gutters shall be flashed at the junction with the roof with non-combustible material.
Summary of BAL 40 Standards Page 8
Edition August 2014

VERANDAHS, DECKS, STEPS, RAMPS AND LANDINGS
1) General
Decking may not be spaced.
There is no requirement to enclose the subfloor spaces of verandas, decks, steps, ramps or landings.

2) Enclosed subfloor spaces of verandas, decks, steps, ramps and landings
a) Materials to enclose a subfloor space
The subfloor spaces of verandas, decks, steps, ramps and landings are considered to be 'enclosed' when —
i) the material used to enclose the subfloor space complies with the standards for external walls above except that sarking is not required to be installed where specified; and
ii) all openings greater than 3 mm are screened with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel or bronze.
b) Supports
The Standard does not provide construction requirements for support posts, columns, stumps, stringers, piers and poles.
c) Framing
The Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).
d) Decking, stair treads and the trafficable surfaces of ramps and landings shall be—
i) of non-combustible material; or
ii) a system that has been tested and complies with AS 1530.8.1; or
iii) a combination of Items (i) and (ii) above.

3) Unenclosed subfloor spaces of verandas, decks, steps, ramps and landings
a) Supports
Support posts, columns, stumps, stringers, piers and poles shall be—
i) of non-combustible material; or
ii) a system that has been tested and complies with AS 1530.8.1; or
iii) a combination of Items (i) and (ii) above.
b) Framing
Framing of verandas, decks, ramps or landings (i.e., bearers and joists) shall be—
i) of non-combustible material; or
ii) a system that has been tested and complies with AS 1530.8.1; or
iii) a combination of Items (i) and (ii) above.
c) Decking, stair treads and the trafficable surfaces of ramps and landings
Decking, stair treads and the trafficable surfaces of ramps and landings shall be—
i) of non-combustible material; or
ii) a system that has been tested and complies with AS 1530.8.1; or
iii) a combination of Items (i) and (ii) above.

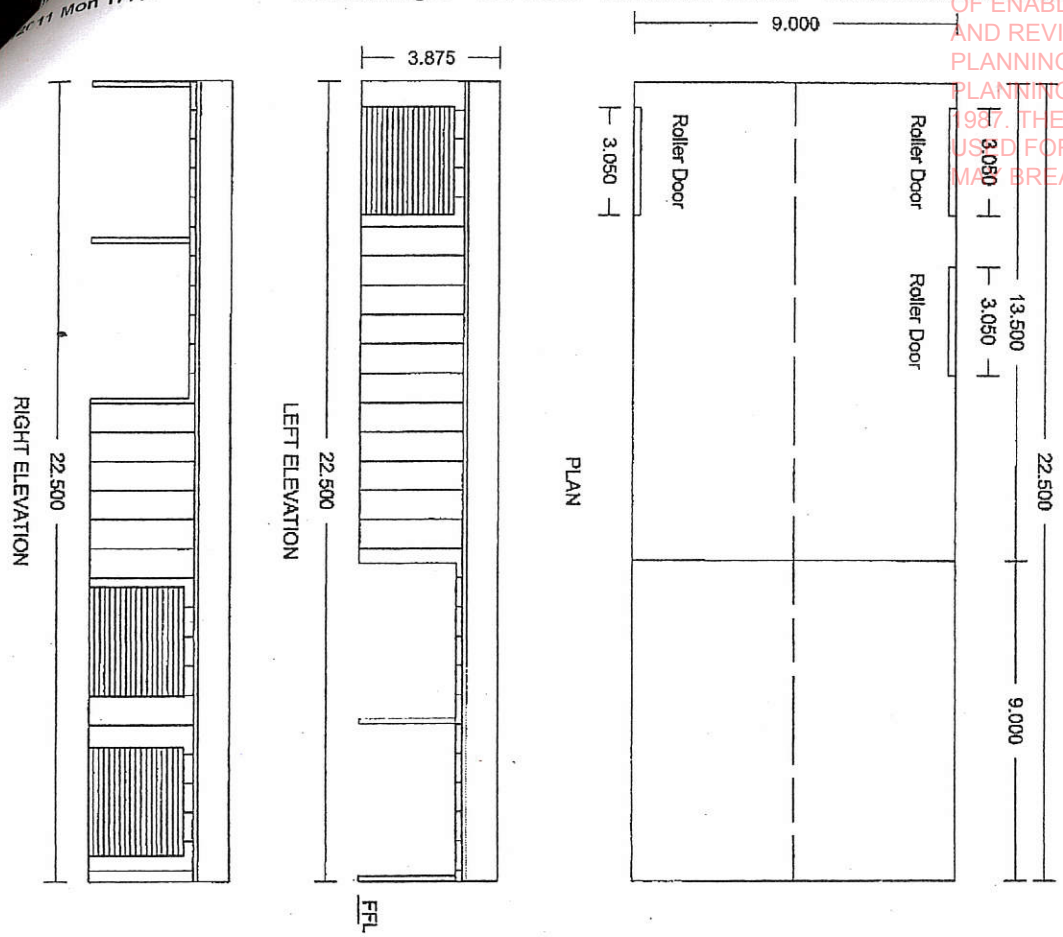
4) Balustrades, handrails or other barriers
Those parts of the handrails and balustrades less than 125 mm from any glazing or any combustible wall shall be of non-combustible material.
Those parts of the handrails and balustrades that are 125 mm or more from the building have no requirements.

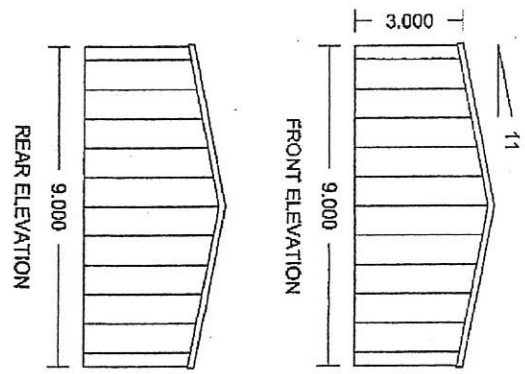
WATER AND GAS SUPPLY PIPES
Above-ground, exposed water and gas supply pipes are to be metal.

HOLMAN DESIGNS

DATE:	DRAWN:	SCALE:	DRAWING No: SHEET NAME:	REVISION:	CLIENT:	ADRESS:
21/03/2019 12:47:56 PM	G. Holman		BAL - 40 Notes	TP2	Cornelis & Mieke Versteeg	571 Wild Dog Road, Apollo Bay

REGISTRATION
DP/AD 36250
P: 0402 257 152



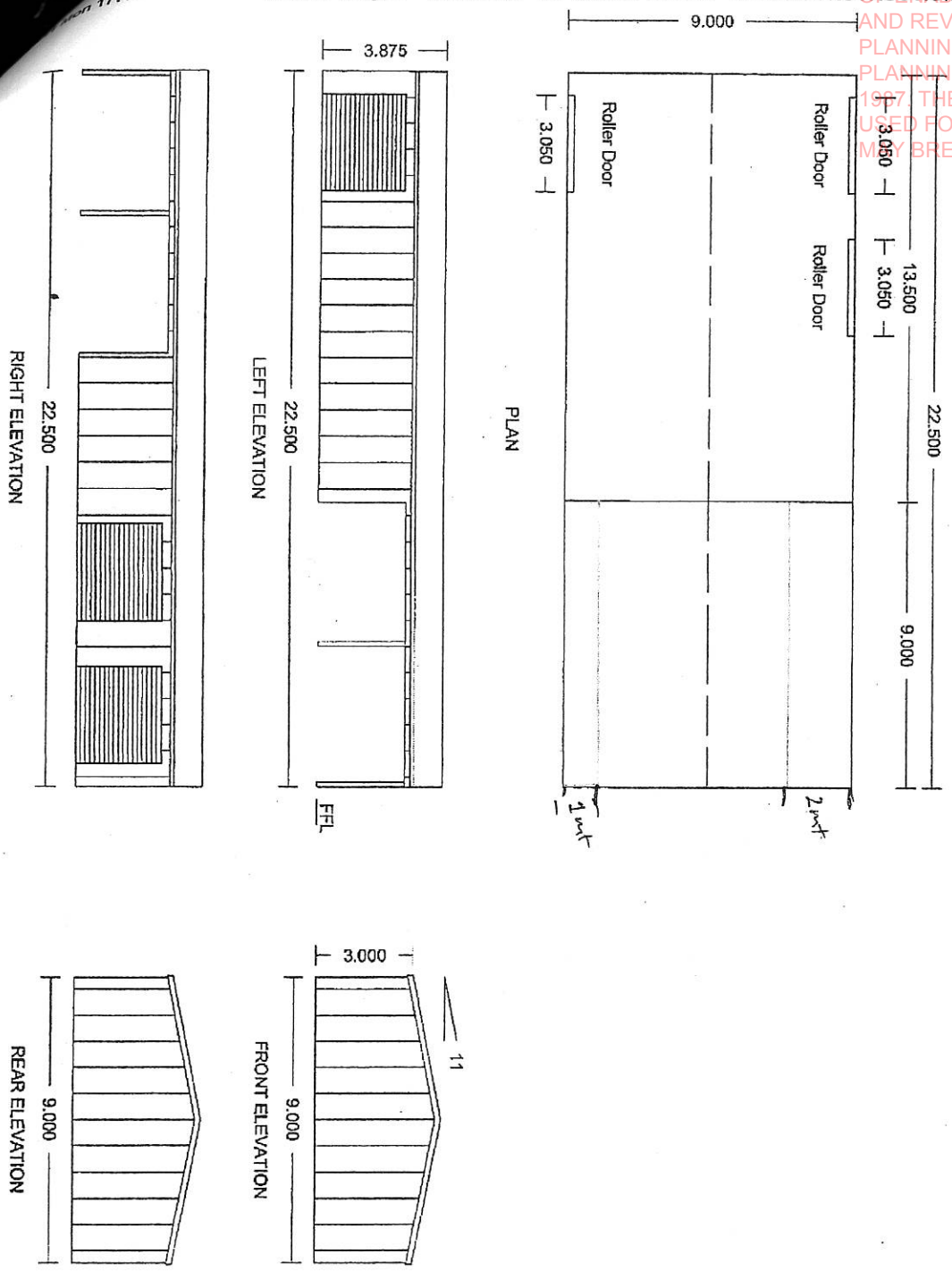


JRMA BUILDING SERVICES P/L
APPROVED
IN ACCORDANCE WITH THE BUILDING ACT
AND BUILDING REGULATIONS 2006
BUILDING SURVEYOR BSU1156
DATE 6/2/12 PERMIT No. 0017/0
Wind cat 2.

PROPOSED Shed 9.000x22.500x3.000		
At 575 Wild dog Rd Apollo Bay		
For Roger Hardley		
Wall Colour - Monolith	Roof colour - Armour Grey	
Barge Colour - Monolith	Roller Door Colour - Monolith	
Job No	Quote No	Scale 1:200
All Work To Be In Accordance With Accompanying Engineers Details		

Eureka Garages & Sheds
24-26 Lt Boundary Rd Laverton Nth Vic 3026

NOT FOR CONSTRUCTION



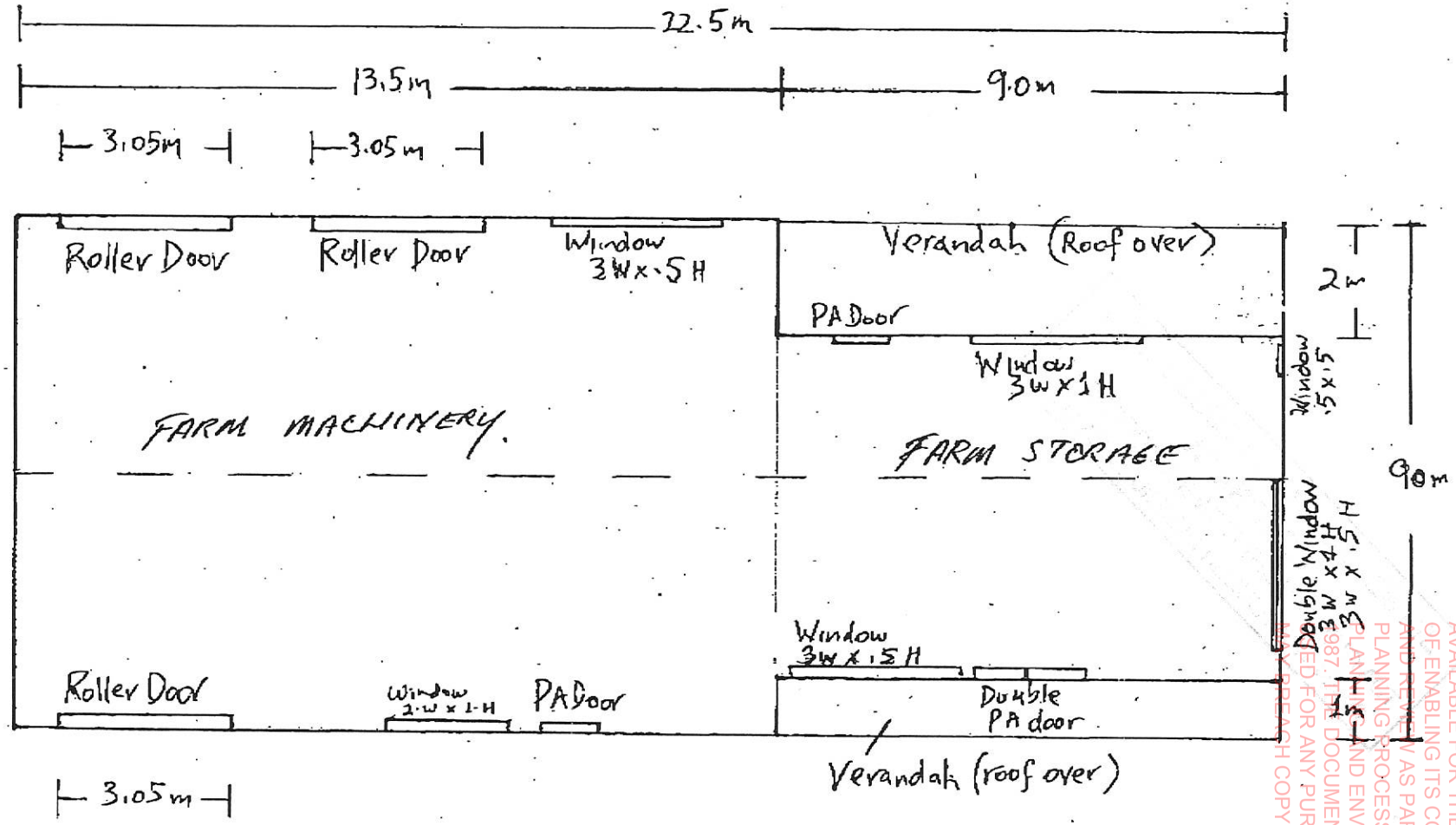
PROPOSED Shed 9.000x22.500x3.000		
At 575 Wild dog Rd Apollo Bay		
For Roger Hardley		
Wall Colour - Monolith	Roof colour - Armour Grey	
Barge Colour - Monolith	Roller Door Colour - Monolith	
Job No	Quote No	Scale 1:200
All Work To Be In Accordance With Accompanying Engineers Details		

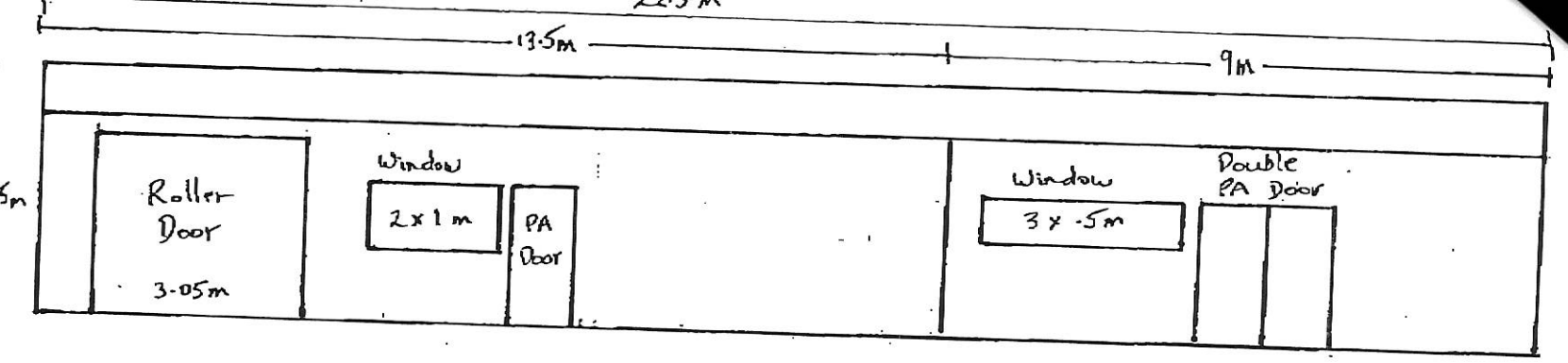
Eureka Garages & Sheds
24-26 Lt Boundary Rd Laverton Nth Vic 3026

NOT FOR CONSTRUCTION

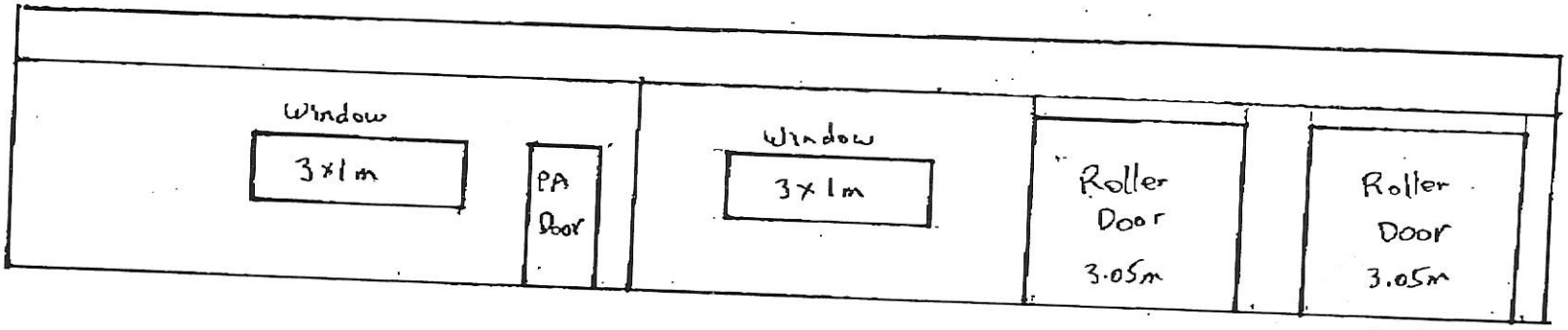
PG1.

PROPOSED SHED FOR HARDLEY 575 WILD DOG ROAD : 9.0m x 22.5m x 3m
FLOORPLAN including windows + doors.

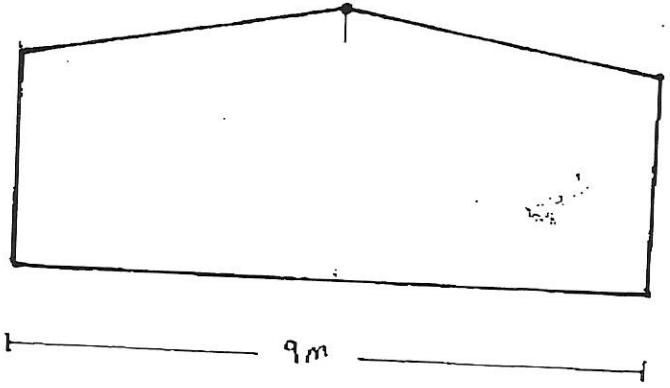




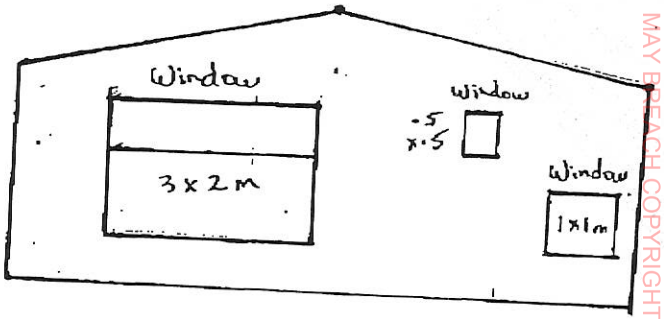
NORTH ELEVATION



SOUTH ELEVATION



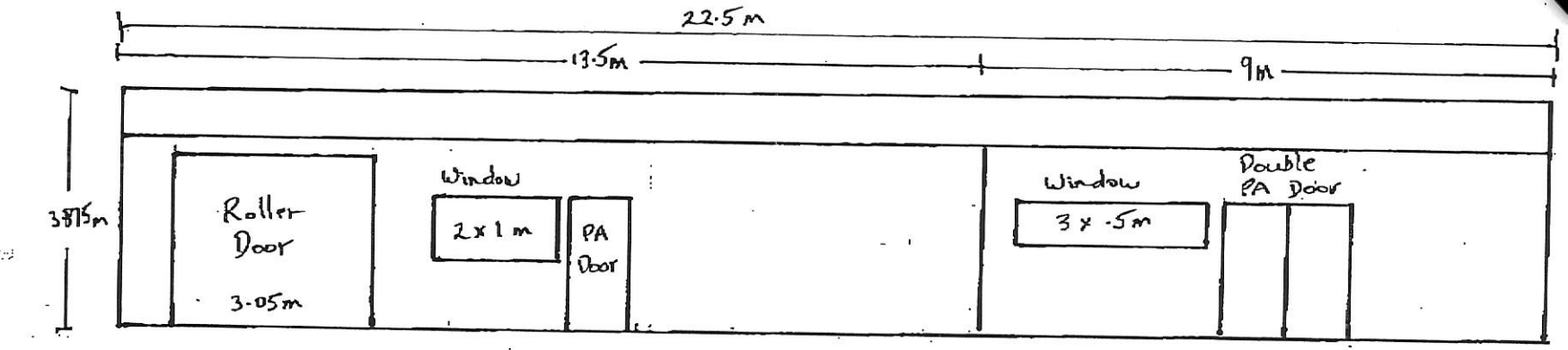
EAST ELEVATION



WEST ELEVATION

Apollo Bay LPO

PG 2. HARDLEY
APOLLO BAY.



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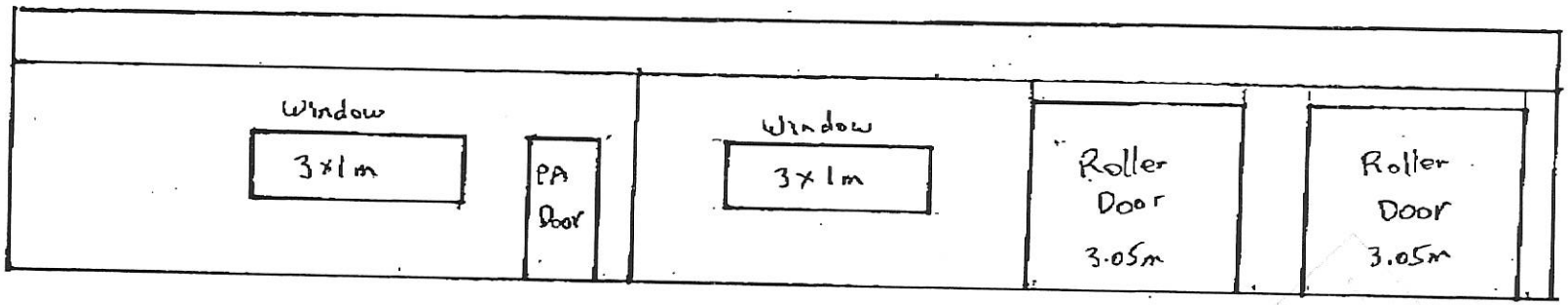

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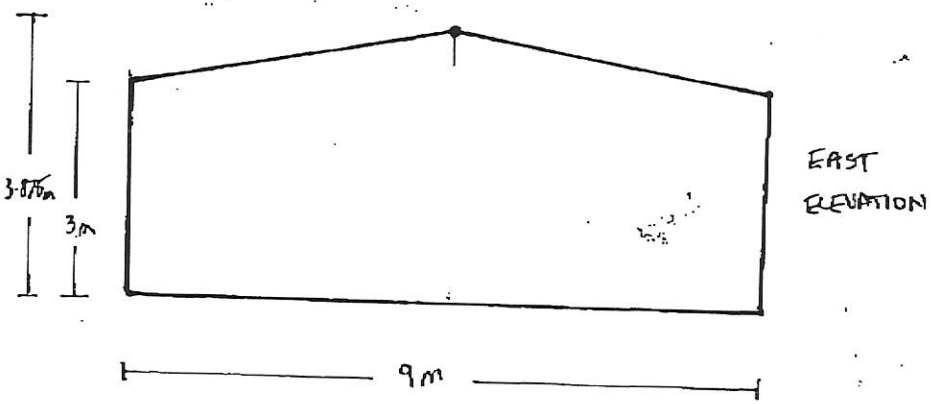
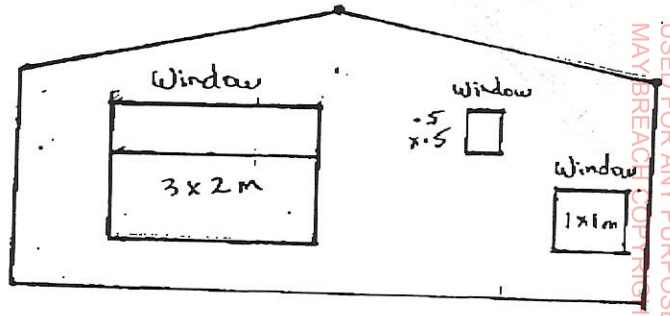


EAST ELEVATION



WEST ELEVATION

Apollo Bay LPO

61 3 52377242 # 2/ 2

Builder's copy

JRMA BUILDING SERVICES PTY LTD.
(P.O. Box 118)
SUITE 9, 22-26 PRINCES WAY DROUIN 3818
ph 03 56251522 fax 03 5625 4848

Recd 13/2/12

FORM 2
Building Act 1993 Building Regulations 2006 Regulation 313

BUILDING PERMIT No. BSU1166/20120017/0
ISSUED 06/02/2012

Issued to
Owner/Agent of owner **G. Hardley**
Postal address **485 Wild Dog Rd APOLLO BAY 3233**
Telephone **0447 937 770**

SHED

Ownership Details (only if agent of owner listed above)
Owner **G. Hardley**
Postal address **485 Wild Dog Rd, APOLLO BAY 3233**
Telephone **5237 6272**

Property details (include Title details as and if applicable)
Number **485** Street/road **Wild Dog Rd** City/suburb/town **APOLLO BAY** Postcode **3233**
Lot/s **1** LP/PS **412913P** Volume **10518** Folio **342**

Municipal District **Colac-Otway Shire Council** Unique Property Identifier

Builder
Name **G. Hardley** Telephone **0447 937 770**
Address **485 Wild Dog Rd APOLLO BAY VIC 3233**
Telephone **5237 6272**

Details of building practitioners and architects
who were engaged to prepare documents forming part of the application for this permit [2]
Civil Engineer EC1039 R. Proud

Details of relevant planning permit
Planning permit no. **EXT34/2010-1** Date of grant of planning permit. **28/03/2011**

Nature of building work
Construction of farm outbuilding

Stage of building work permitted **All**
Cost of building work **$24,000** Total floor area of new building work **0m2**

Building classification
Part of building **10a** **New Building**

Occupation or Use of building: A Certificate of Final Inspection is required prior to the occupation or use of this building

Commencement and completion:
This building work must commence by: **06/02/2013**
This building work must be completed by: **06/02/2014**

Inspection requirements
The mandatory notification stages are:
Inspection of footings
Inspection of steel for slab
Completion of Steel frame
Inspection for Final Certificate

Relevant building surveyor
Name: JOHN M AUSTIN Registration No. BSU1166

Signature: _____

JRMA BUILDING SERVICES PTY LTD.

(P.O. Box 118)
SUITE 9, 22-26 PRINCES WAY DROUIN 3818
ph 03 56251522 fax 03 5625 4848

Building Act 1993
Building Regulations 2006
Regulation 1006
Form 7

CERTIFICATE OF FINAL INSPECTION

For Building Permit: BSU1166/20120017/0

Issued to (owner)
G. Hardley
485 Wild Dog Rd
APOLLO BAY VIC 3233

Builder

Site
Lot Number: 1 **Street** 485 Wild Dog Rd
Suburb APOLLO BAY **Postcode** 3233

Municipality Colac-Otway Shire Council

Description of Building Work:

10a	Garage, carport, shed or storage facility	New Building

Directions
Any directions under Part 4 of the Building Act 1993 have been complied with.

Certificate number: **20120017** Certificate date: **27 June 2013**

Inspection approval dates for mandatory inspections that have been carried out with regard to building work carried out under Building Permit No. **BSU1166/20120017/0**, issued on 06/02/2012 are as follows;

Inspection Type	Approved Date
Inspection of footings	06/02/2012
Inspection of steel for slab	06/02/2012
Completion of Steel frame	18/03/2012
Inspection for Final Certificate	18/03/2012

Issued By: JOHN M AUSTIN Registration No.: BSU1166
Postal Address: PO Box 118 DROUIN VIC 3818
Signature:

ON31/
rl Menz
531

Dog Road APOLLO BAY

Colac Otway SHIRE

25 October 2011

G R HARDLEY
WILD DOG COTTAGES
485 Wild Dog Rd
APOLLO BAY VIC 3233

Dear Sir/Madam,

PLANNING APPLICATION: PP347/2004
SECONARY CONSENT: SCON31/2011-1
SUBJECT LAND: 485 Wild Dog Road APOLLO BAY
PROPOSAL: Secondary Consent - PP347/2004-1

I refer to the above application to amend the endorsed plans for the above Planning Permit.

It is considered the application can be allowed under the secondary consent provisions for Condition 1.

The changes hereby approved are:

- Reduce the size and alter layout of dwelling, cottages and shed.
- Re-siting of the dwelling, cottages and shed.

Please find enclosed the endorsed plans which now supersede the previous endorsed plans.

If you have any queries about your application, I can be contacted on 5232 9561.

Yours faithfully

Carl Menze
Statutory Planner

SCON31/ Dog Road APOLLO BAY

Carl Menz
20531

Colac Otway SHIRE

25 October 2011

G R HARDLEY
WILD DOG COTTAGES
485 Wild Dog Rd
APOLLO BAY VIC 3233

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Yours faithfully

Carl Menze
Statutory Planner

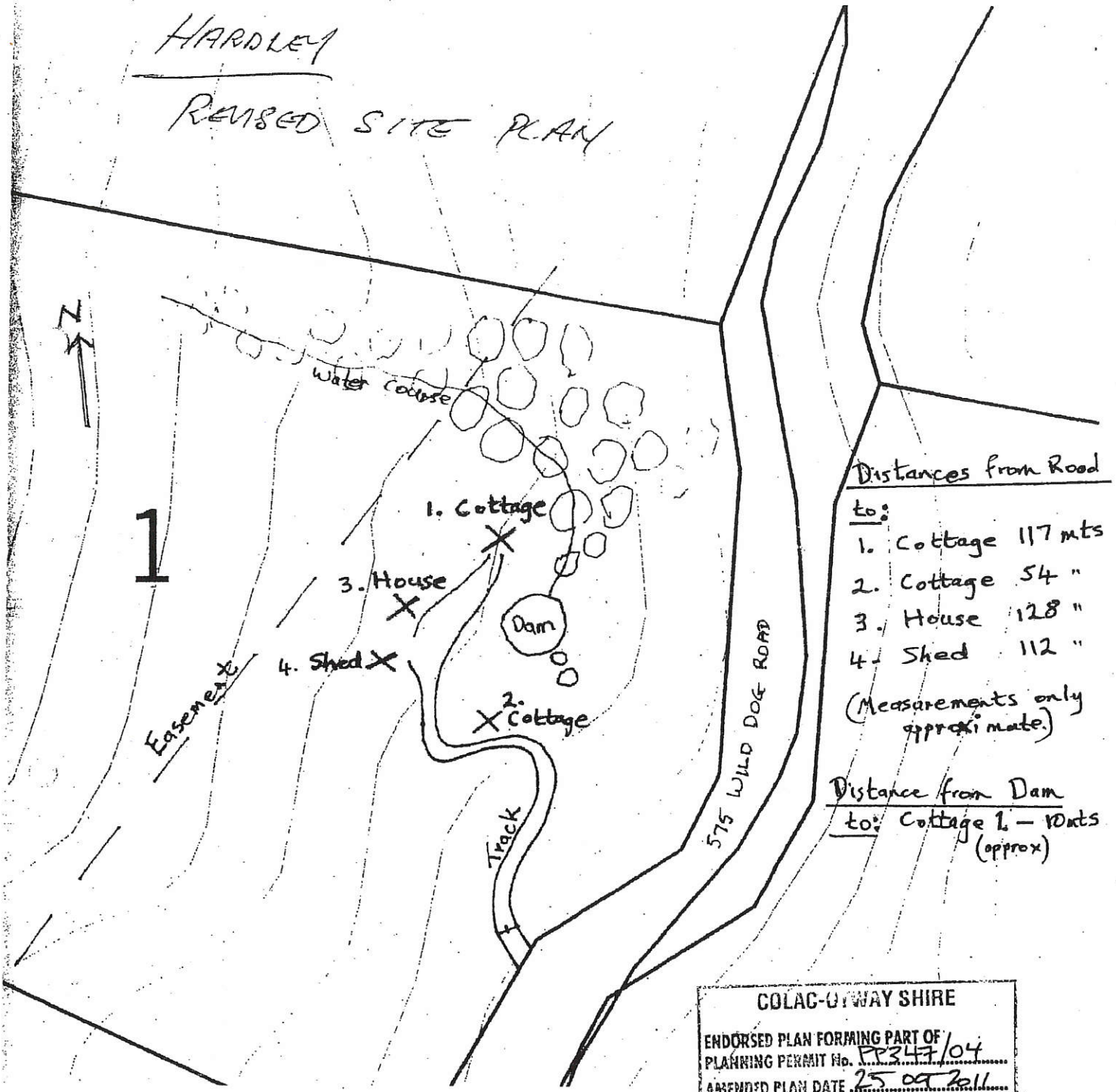
Colac Otway Shire
PO Box 283
Colac Victoria 3250
www.colacotway.vic.gov.au
inq@colacotway.vic.gov.au

Colac Service Centre
2-6 Rae Street
Colac Victoria 3250
Ph: (03) 5232 9400
Fax: (03) 5232 1046

Apollo Bay Service Centre
69-71 Nelson Street
Apollo Bay Victoria 3233
Ph: (03) 5237 6504
Fax: (03) 5237 6734

HARDLEY

REVISED SITE PLAN



Distances from Road

to:

1.	Cottage	117 mts
2.	Cottage	54 "
3.	House	128 "
4.	Shed	112 "

(Measurements only approximate)

Distance from Dam

to: Cottage 1. – 10mts (approx)

COLAC-OTWAY SHIRE

ENDORSED PLAN FORMING PART OF PLANNING PERMIT No. PP347/04

AMENDED PLAN DATE 25 OCT 2011

ORIGINAL ISSUED DATE 29 AUG 2006

1 of 9

PLANNING OFFICER

Carl Menze

From: Wild Dogs [wilddogs2@bigpond.com]
Sent: Monday, 24 October 2011 4:08 PM
To: Carl Menze
Subject: HARDLEY Secondary Consent Ref # SCON31/2011-1

Hello Carl,

We omitted to indicate colour for the Colourbond on the shed.
Apparently you (ie. the Shire) needs to sign-off on the colour(s) under the terms of the Permit.

We have chosen : WALLS "Monument"
and :ROOF "Windspray"

As you probably know you can check-out the colours by going to Bluescopesteel.com.au

Select ; Colourbond
" ; Colour Centre
" ;Standard Range

We intend to use the same colours on the Cottages and House.

Trust you find that all satisfactory.

Kind regards,
Roger

COLAC-OTWAY SHIRE
ENDORSED PLAN FORMING PART OF PLANNING PERMIT No. PP347/04
AMENDED PLAN DATE 25 OCT 2011
ORIGINAL ISSUED DATE 29 AUG 2006
9 of 9
PLANNING OFFICER

Colac Otway SHIRE

Our Ref: 8.2011.612.1 25487
Contact: Building Department

19 December 2011

G R Hardley
Wild Dog Cottages
485 Wild Dog Road
Apollo Bay VIC 3233

Dear Sir/Madam

Report & Consent at 571 Wild Dog Road Apollo Bay

I write in relation to the application for Report & Consent made for the construction of a shed on vacant land at the above property.

Council's Planning Department have advised the construction of the shed on vacant land was taken into consideration when issuing the Planning Permit.

As such, Report & Consent is not required under Building Regulation 422(1) and your application has been cancelled.

If you have any queries in relation to this matter, please contact Council on 03 5232 9443.

Yours sincerely,

David Kors
Municipal Building Surveyor
BS-U 24780

Note: Councils Surveyor is available Wednesdays, administration staff are available Monday to Friday

Colac Otway Shire
PO Box 283
Colac Victoria 3250
www.colacotway.vic.gov.au
inq@colacotway.vic.gov.au

Colac Service Centre
2-6 Rae Street
Colac Victoria 3250
Ph: (03) 5232 9400
Fax: (03) 5232 1046

Apollo Bay Service Centre
69-71 Nelson Street
Apollo Bay Victoria 3233
Ph: (03) 5237 6504
Fax: (03) 5237 6734

terramatrix

Bushfire Management Statement

for the proposed construction of a dwelling
at 571 Wild Dog Road, Apollo Bay

Report prepared for
Cornelis Versteeg

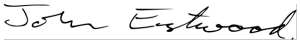
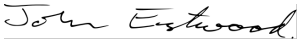
February 2019

WWW.TERRAMATRIX.COM.AU

Terramatrix project: Versteeg-2018-01 BMO-Apollo Bay
Cover image: View of site from Wild Dog Road

Terramatrix Pty. Ltd.
ACN 129 163 373
ABN 44 129 163 373
PO Box 1391, Collingwood VIC 3066
P: 03 9417 2626
www.terramatrix.com.au

Approvals

Accountability	Name	Signature
Bushfire analysis	John Eastwood, Analyst	
Report compilation	John Eastwood, Analyst	
Peer review and approval for release	Jon Boura, Managing Director	

Version Control

Version	Date completed	Comments	Undertaken by / Distribution
0.1	11 October 2018	Analysis, maps and report writing	JE
0.1	11 October 2018	Peer review and approval for release	JB
1.0	12 October 2018	Bushfire Management Statement	to Client
1.1	02 February 2019	Updated site plan and update to VC132/VC140	to Client
1.2	03 March 2019	Minor updates	to Client

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TABLE OF CONTENTS

1 Introduction

This Bushfire Management Statement (BMS) has been prepared on behalf of Cornelis Versteeg, to show how the development of 571 Wild Dog Road, Apollo Bay can comply with the Victorian planning and building controls that relate to bushfire; specifically, the requirements of the Bushfire Prone Area (BPA), Clause 53.02 *Bushfire Planning*, Clause 44.06 *Bushfire Management Overlay* (BMO) and Clause 13.02 *Bushfire* (Colac Otway Planning Scheme, 2018a, b and c).

The site is currently used for grazing sheep, storage of materials and maintenance using the existing shed with farm workshop and amenities and associated water tanks, dam and fencing. The development proposal is for the construction of a dwelling adjacent to the existing shed, and the property will continue to be used intermittently as a home for around six months of the year.

The development is in the Rural Conservation Zone and the Schedule applies (RCZ). Accordingly, this report follows the BMO 'Pathway 2' to demonstrate how the development responds to the relevant objectives of Clause 53.02-4 *Planning for Bushfire*.

In accordance with the application requirements of Clause 44.06, this report includes:

- A *bushfire hazard site assessment*, including a plan that describes the bushfire hazard within 150m of the proposed development;
- A *bushfire hazard landscape assessment,* including a plan that describes the bushfire hazard of the general locality more than 150m from the site; and
- A *BMO compliance* section, detailing how the development responds to the bushfire risk and the requirements and objectives of Clauses 44.06 and 53.02 in the Colac Otway Planning Scheme.

This report also includes a Bushfire Management Plan (BMP) consistent with the CFA's standard permit conditions and BMP guidance (CFA, 2017).

This report has been prepared consistent with guidance provided in *Planning Applications Bushfire Management Overlay, Technical Guide* (DELWP, 2017).

1.1 Property details

Address:	571 Wild Dog Road, Apollo Bay
Property size:	9.9ha
Local Government Area:	Colac Otway Shire Council
Zone/s	Rural Conservation Zone and Schedule (RCZ)
Overlay/s	Bushfire Management Overlay (BMO) Erosion Management Overlay and Schedule 1 (EMO1) Significant Landscape Overlay and Schedule 3 (SLO3)
Directory reference:	VicRoads 101 C5
Site assessment date:	19 June 2018
Assessed by:	John Eastwood

2 Bushfire hazard site assessment

2.1 Vegetation

Vegetation within the 150m assessment zone around the dwelling has been classified in accordance with the BMO/AS 3959-2018 methodology. Classified vegetation is vegetation that is deemed hazardous with regard to bushfire.

The classification system is not directly analogous to Ecological Vegetation Classes (EVCs) but uses a generalised description of vegetation based on the AUSLIG (Australian Natural Resources Atlas: No. 7 - Native Vegetation) classification system. The classification is based on the mature state of the vegetation and the likely fire behaviour that it will generate.

Vegetation to the west of the proposed dwelling, on a steep slope down to Wild Dog Creek, comprises a mix of established trees, patches of shrubs, low bushes and regrowth (see Figure 3). This area has been classified as Forest as a precautionary measure.

2.1.1 Forest

Treed vegetation to the north and west of the proposed dwelling best accords with the Forest group of AS 3959-2018. Forest vegetation comprises areas with trees 30m high at maturity, typically dominated by eucalypts, with 30–70% foliage cover (may include understorey ranging from rainforest species and tree ferns to sclerophyllous low trees or shrubs). Includes pine and eucalypt plantations (Standards Australia, 2018).

2.1.2 Grassland

Vegetation on and around the site matches the AS 3959-2018 classification of Grassland, which is defined as all forms of vegetation (except Tussock Moorlands) including situations with shrubs and trees, if overstorey foliage cover is less than 10%. Includes pasture and cropland.

Grassland vegetation is considered hazardous and therefore classifiable, when it is not managed in a minimal fuel condition. Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (e.g. short-cropped grass, to a nominal height of 100 mm) (Standards Australia, 2018). In the BMO, Grassland areas are assumed to be unmanaged and classifiable unless there is ‘reasonable assurance’ that they will be managed in perpetuity, in a low threat state, no more than 100mm high.

2.1.3 Excluded vegetation and non-vegetated areas

Areas of low threat vegetation and non-vegetated areas within 150m of the site can be excluded from classification in accordance with Section 2.2.3.2 of AS 3959-2018, if they comprise one or more of the following:

i. *'Vegetation of any type that is more than 100m[1] from the site.*
ii. *Single areas of vegetation less than 1 ha in area and not within 100m of other areas of vegetation being classified vegetation.*
iii. *Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other, or of other areas of vegetation being classified vegetation.*
iv. *Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.*
v. *Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.*
vi. *Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition[2], mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks'* (Standards Australia, 2018).

Low-threat areas excluded from classification include the managed areas around the existing building within the site. Non-vegetated areas include the roads, driveways and structures within the 150m site assessment zone (see Map 1).

2.2 Topography

The BMO/AS 3959-2018 methodology requires that the 'effective slope' be identified to determine the BAL and applicable defendable space or vegetation setback distances. This is the slope of land under the classified vegetation that will most significantly influence the bushfire attack on a building. Two broad types apply:

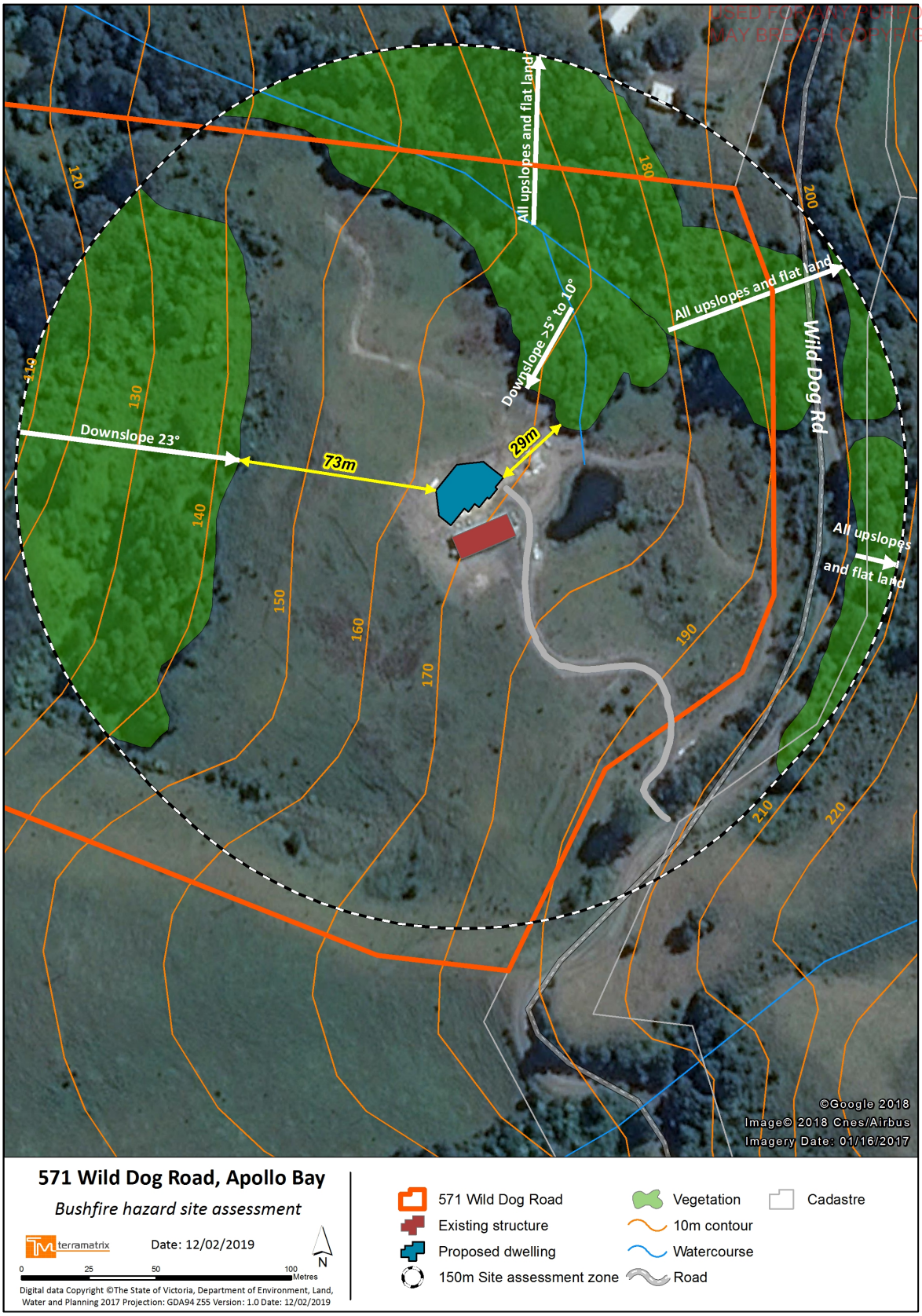
- Flat and/or Upslope - land that is flat or on which a bushfire will be burning downhill in relation to the development. Fires burning downhill (i.e. on an upslope) will generally be moving more slowly with a reduced intensity.
- Downslope - land under the classified vegetation on which a bushfire will be burning uphill in relation to the development. As the rate of spread of a bushfire burning on a downslope (i.e. burning uphill towards a development) is significantly influenced by increases in slope, downslopes are grouped into five classes in 5˚ increments from 0˚ up to 20˚.

The topography on and around the site within the 150m assessment zone is complex, with significant changes in elevation that would exacerbate the bushfire attack (see Map 1).

[1] This distance extends to 150m in BMO areas.
[2] Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack, recognisable as short-cropped grass for example, to a nominal height of 100mm (Standards Australia, 2018).

To the west of the proposed dwelling, the land drops steeply down to Wild Dog Creek creating an average effective slope under the Forest in that direction of 23˚.

To the north, an arm of the Forest follows a gully rising toward Wild Dog Road past the site of the proposed dwelling. The rise of the gully in this direction is steep, but oblique or cross-slope in relation to the site of the proposed dwelling (see Map 1). The rise toward the proposed dwelling up the side of the gully is steep in places but very short (generally less than 5m). As a precautionary measure, this slope has been assessed as being in the 'Downslope >5°-10°' slope category in relation to the proposed dwelling.



Map 1 - Bushfire hazard site assessment plan.

Figure 1 - Looking west from Wild Dog Road, showing existing shed and surrounding area.

Figure 2 - Looking west from area of proposed dwelling, showing the hill dropping away and Forest below.

Figure 3 - Forest on steep slope to west of proposed dwelling.

Figure 4 - Looking east toward Wild Dog Road.

Figure 5 - Looking north at existing shed, showing orientation of proposed dwelling site in relation to the Forest to the west and north.

Figure 6 – Forest in the gully immediately to the north of the proposed dwelling.

3 Bushfire hazard landscape assessment

3.1 Location description

The Regional Bushfire Planning Assessment (RBPA) for the Barwon South-west Region (DPCD, 2012) identifies the Wild Dog Creek area as the '*Presence of curvilinear single access roads servicing lots in the area including Busty Road. Single access roads meander through vegetated areas*' (DPCD, 2012).

571 Wild Dog Road is located in a valley that runs inland from the coast toward the forested areas of the Otway Range, including the Great Otway National Park. The landscape to the east, southeast and northeast of the site is predominately agricultural, comprising extensive areas of pasture over complex topography. The Wild Dog Creek valley forms the interface between the more pastoral land to the east and the forested areas to the north. In much of the valley, the land is too steep for agriculture and is a mix of forested areas and scrub to the floor of the valley. Wild Dog Road winds along the floor and sides of the valley with some residences (farms and rural living) set in a mosaic of pasture, trees and scrub.

To the west of the site, on the far side of the valley and beyond, the landscape is dominated by large areas of forest on complex and often steep topography. Access to Apollo Bay, the nearest large town, is via the narrow and winding Wild Dog Road, which joins the Great Ocean Road to the south.

3.2 Fire History

The general area around Apollo Bay was affected by bushfire in both 1939 and 1967 (see Map 2).

3.3 Landscape risk

Clause 13.02 of the Planning Policy Framework prioritises the protection of human life over all other policy considerations. It stipulates that developments must properly assess bushfire risk, including consideration of the hazard (and the resultant risk) beyond the site level (Colac Otway Planning Scheme, 2018).

An assessment of risk beyond the site level is required, and to assist in defining the risk, four 'broader landscape types', representing different risk levels, are described in the DELWP technical guide *Planning Applications Bushfire Management Overlay* (DELWP, 2017). These are intended to streamline decision-making and support more consistent decisions based on the landscape risk.

The four types range from low risk landscapes, where there is little hazardous vegetation beyond 150m of the site and extreme bushfire behaviour is not credible, to extreme risk landscapes with limited or no evacuation options.

The development site and surrounding landscape accords with Broader Landscape Types 3 and 4 (see Table 1).

Table 1 - Landscape risk typologies (from DELWP, 2017a).

Broader Landscape Type 1	Broader Landscape Type 2	Broader Landscape Type 3	Broader Landscape Type 4
• *There is little vegetation beyond 150 metres of the site (except grasslands and low-threat vegetation).* • *Extreme bushfire behaviour is not possible.* • *The type and extent of vegetation is unlikely to result in neighbourhood-scale destruction of property.* • *Immediate access is available to a place that provides shelter from bushfire.*	• *The type and extent of vegetation located more than 150 metres from the site may result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to a site.* • *Bushfire can only approach from one aspect and the site is located in a suburban, township or urban area managed in a minimum fuel condition.* • *Access is readily available to a place that provides shelter from bushfire. This will often be the surrounding developed area.*	• *The type and extent of vegetation located more than 150 metres from the site may result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to a site.* • *Bushfire can approach from more than one aspect.* • *The site is located in an area that is not managed in a minimum fuel condition.* • *Access to an appropriate place that provides shelter from bushfire is not certain.*	• *The broader landscape presents an extreme risk.* • *Fires have hours or days to grow and develop before impacting* • *Evacuation options are limited or not available.*
I N C R E A S I N G R I S K →			

3.4 Fire scenarios

In Victoria, the most likely bushfire scenarios for a large landscape fire are an approach from those directions typically associated with the direction of the wind on severe or higher, fire danger days i.e. approach of bushfire from the north, northwest, west or southwest (Long, 2006).

571 Wild Dog Road has the potential to be approached by bushfire from any direction, with potentially long runs of fire from the north, northwest, west and southwest. Although the immediately surrounding forest is partially fragmented, arms of forest extend close to the site, along gullies and waterways.

The topography is complex and often steep, with the possibility of extreme fire behaviour. Proximity to the coast raises the possibility of unpredictable wind behaviour. Fire behaviour in this broader landscape may be beyond the default assumptions in the BMO, with the possibility of severe fire winds and extreme fire behaviour associated with convective plumes. This type of fire behaviour was documented for the 1983 'Ash Wednesday' fire that impacted the Great Ocean Road townships of Lorne, Aireys Inlet and Anglesea further to the northwest (Billing, 1983).

Map 2 - Bushfire hazard landscape assessment plan.

4 BMO compliance

This section identifies how the proposed development responds to the bushfire risk and the requirements of Clause 44.06 and associated Clause 53.02 of the Colac Otway Planning Scheme.

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'*

Compliance with these objectives at Clause 53.02-4.1 is proposed via the following approved measures.

4.1.1 Approved measure 2.1 Landscape

'The bushfire risk to the development from the landscape beyond the site can be mitigated to an acceptable level'.

As identified in Section 2, the landscape is one of extreme bushfire risk. Bushfire behaviour may exceed BMO expectations and design parameters. The topography is complex and often steep, and the fuel hazard is likely to accord with that presumed in the BMO/AS 3959-2018 model for Forest

However, it is proposed that the risk can be mitigated to an acceptable level by implementing approved bushfire protection measures in compliance with the BMO requirements, including BAL construction standard, commensurate defendable space (taking advantage of the large cleared area around the existing shed), provision of a water supply for firefighting, and ensuring access and egress is available for occupants and emergency services.

4.1.2 Approved measure 2.2 Siting

'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'.*

The siting and layout maximises the setback from the hazard (i.e. unmanaged vegetation) as far as practicable, takes advantage of the existing cleared and level areas on the site and achieves compliance with the BMO setback requirements for defendable space (see Map 3). The siting is constrained by a transmission easement on the western side.

The proposed development is close to the road, and access and egress can comply with the requirements for emergency vehicles and occupants.

4.1.3 Approved measure 2.3 Design

'A building is designed to be responsive to the landscape risk and reduce the impact of bushfire on the building'.

The building has been designed with a simple roofline and a minimum of re-entrant corners. It is noted that all BAL standards above BAL-Low are deemed to satisfy the building code requirement that buildings be designed and constructed to reduce the risk of ignition from a bushfire, appropriate to the:

(a) *'potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire; and*

(b) *intensity of the bushfire attack on the building'* (ABCB, 2016).

4.2 Defendable space and construction objective

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

This objective will be met via alternative measure 3.4. The vegetation management standard to be applied within the defendable space will meet the requirements of Table 6 to Clause 53.02 as detailed in Appendix 1.

4.2.1 Alternative measure 3.4

'Defendable space and the bushfire attack level is determined using Method 2 of AS 3959:2009 Construction of buildings in bushfire prone areas (Standards Australia) subject to any guidance published by the relevant fire authority.'

The defendable space and construction standard for the proposed dwelling have been determined using Method 2 of AS 3959-2018. The potential fire behaviour for credible bushfire scenarios was modelled using a combination of 'site-specific' local inputs (topography) and 'generic' (fuel load and weather) inputs from the BMO and AS 3959-2018 methodology.

These inputs were combined to determine potential fire behaviour in terms of forward rate of spread, fireline intensity, flame length and radiant heat flux. The modelling results were then used to determine the recommended defendable space distances.

The effective slope has been modelled at an average of 23˚, with a site slope of 20˚. Unless otherwise stated, all other inputs are as per the AS 3959-2018 defaults including the overall Forest fuel load of 35 tonnes/hectare.

Table 2 - Summary of 'Method 2' defendable space and construction standard determination.

Attribute	Value
Inputs	
Vegetation	Forest
FFDI/GFDI	100
Flame temp (K)	1090
Flame emissivity	0.95
Flame width (m)	100
Heat of combustion (kJ/kg)	18,600
Vegetation height (m)	12.0
Surface fuel load (t/ha)	25
Overall fuel load (t/ha)	35
Effective slope (°)	23
Site slope (°)	20
Outputs	
Rate of spread (km/h)	14.7
Calculated elevation of receiver (m)	14.2
Flame length (m)	99.5
View factor	0.4716
Flame angle (˚)	55
Radiant heat	
Distance to reach 12.5 kW/m^2 (m)	110.9
Distance to reach 19 kW/m^2 (m)	89.1

Distance to reach 29 kW/m^2 (m)	71.5
Distance to reach 40 kW/m^2 (m)	59.6
Radiant heat at asset (kW/m^2)	39.5

The proposed dwelling is located 73m from the Forest to the west, providing sufficient setback to allow for a BAL-40 construction standard. Part of the land between the proposed dwelling and the Forest is steep, although vegetation management is practical as evidenced by previous clearing and current condition as Grassland.

A BAL-40 construction standard is proposed for all elevations of the dwelling, with defendable space extending for 60m in all directions, with the exception of to the north. In this direction, the proposed dwelling is setback 29m from the currently existing Forest on a Downslope in the >5˚ to 10˚ slope category, which requires 31m of defendable space for a BAL-40 construction standard. The defendable space shown on Map 3 largely reflects the existing tree line to the north of the proposed dwelling, with only minor vegetation removal required to meet the required defendable space conditions.

Defendable space will be maintained in accordance with the vegetation management requirements detailed vegetation management requirements stipulated in Table 6 at Clause 53.02-5, as detailed in Appendix A of this report. This is detailed in the Bushfire Management Plan provided as Map 3.

4.3 Water supply and access objectives

'A static water supply is provided to assist in protecting the property.
Vehicle access is designed and constructed to enhance safety in the event of a bushfire.'

These objectives can be achieved via approved measure 4.1.

4.3.1 Approved measure 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:

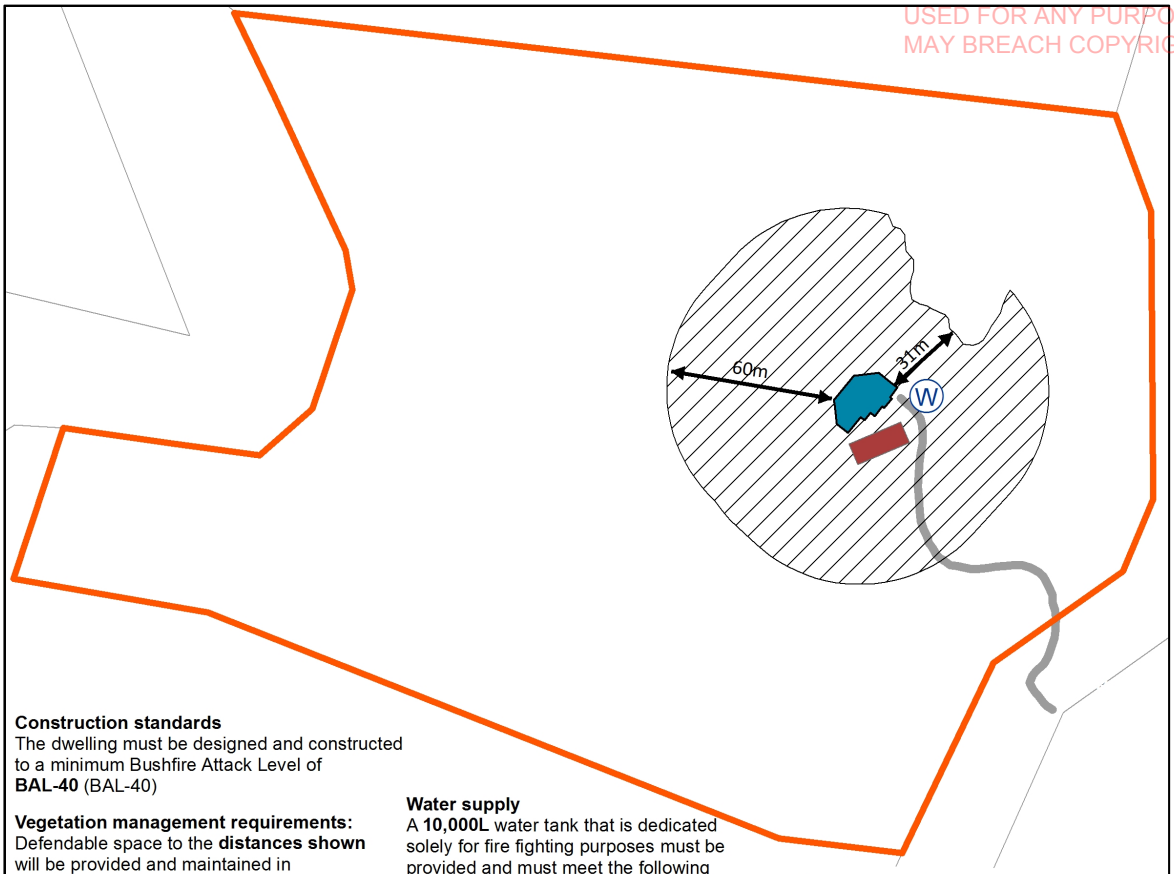
- *A static water supply for firefighting and property protection purposes specified in Table 4 to Clause 53.02-5.*
- *Vehicle access that is designed and constructed as specified in Table 5 to Clause 53.02-5.*

The water supply may be in the same tank as other water supplies provided that a separate outlet is reserved for firefighting water supplies.'

As the property is greater than 1,000m^2 in area, the proposed dwelling will be provided with a static water supply of 10,000L for firefighting purposes only. Access to the water by the CFA will be provided in accordance with Table 5 to Clause 53.02-5 (detailed in Appendix B).

Note: The siting of the static water supply on Map 3 is indicative only. The tank can be relocated from the position shown, provided that the alternative location complies with the fire authority requirements of Tables 4 and 5 to Clause 53.02, as detailed in Appendix B and C.

A driveway will be provided that will be approximately 175m in length. It will comply with all requirements of Table 5 to Clause 53.02-5 regarding construction, curves, grade, passing bays, width and clearance as detailed in Appendix C.



Construction standards
The dwelling must be designed and constructed to a minimum Bushfire Attack Level of **BAL-40** (BAL-40)

Vegetation management requirements:
Defendable space to the **distances shown** will be provided and maintained in accordance with the following requirements:
- 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 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.

Unless specified in a schedule or otherwise agreed to in writing to the satisfaction of the relevant fire authority.

Water supply
A **10,000L** water tank that is dedicated solely for fire fighting purposes must be provided and must meet the following requirements:
Unless otherwise agreed in writing by the relevant fire authority, the water supply must:
- Be stored in an above ground water tank constructed of concrete or metal.
- Have all fixed above-ground water pipes and fittings required for fire fighting purposes made of corrosive resistant metal.
- Include a separate outlet for occupant use.
- Be readily identifiable from the building or appropriate identification signage to the satisfaction of the relevant fire authority.
- Be located within 60m of the outer edge of the approved building.
- The outlet/s of the water tank must be within 4 metres of the accessway and be unobstructed.
- Incorporate a separate ball or gate valve (British Standard Pipe (BSP 65 millimetre) and coupling (64mm and coupling (64 millimetre CFA 3 thread per inch male fitting).
- Any pipework and fittings must be a minimum of 65 millimetres (excluding the CFA coupling).

Access provisions
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 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 per cent) (8.1°) with a maximum grade of no more than1 in 5 (20 per cent)(11.3°) for no more than 50 metres.
- Dips must have no more than a 1 in 8 (12.5 per cent) (7.1°) entry and exit angle.

A turning area for fire fighting vehicles must be provided close to the building by one of the following:
- A turning circle with a minimum radius of 8 metres.
- A driveway encircling the dwelling.
- The provision of other vehicle turning heads - a T or Y head - which meet the specifications of Austroad Design for an 8.8 metre Service Vehicle.

571 Wild Dog Road, Apollo Bay

Bushfire management plan

terramatrix Date: 12/02/2019

0 35 70 140 Metres

N

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571 Wild Dog Road
Proposed dwelling
Existing structure
60m Defendable space
Driveway
10,000L static water supply indicative location
Cadastre

Map 3 – Bushfire management plan.

5 Conclusion

The proposed dwelling at 571 Wild Dog Road, Apollo Bay was assessed using the BMO site assessment methodology for compliance with Clause 13.02, Clause 44.06 and Clause 53.02 of the Colac Otway Planning Scheme.

The development proposal uses the Clause 53.02-4 application pathway. All applicable BMO objectives are met by complying with approved measures 2.1, 2.2, 2.3, 3.1, alternative measure 3.4, and approved measure 4.1.

Classified Forest and Grassland pose a bushfire hazard in all directions, and the topography under the classified vegetation (and the site itself) is steep and contributes significantly to the bushfire risk. In response to the 23˚ slope to the west of the site, the defendable space and applicable construction standard have been determined using Method 2 of AS 3959-2018 as provided for in alternative measure 3.4.

The results demonstrate that 60m of defendable space to the west allows for a BAL-40 construction standard. The default tabulated values of Clause 53.02 allow for a BAL-40 construction standard and 31m of defendable space in response to the Forest in the gully to the north. Consequently, the defendable space extends for 60 in all directions with the exception of to the north, where it largely follows the existing tree line 29m (at the closest point) from the proposed dwelling. Minor vegetation removal at this point will allow for the provision of the full 31m of defendable space.

Water supply and access and egress requirements can comply with BMO specifications.

The development is in an extreme risk landscape, however, appropriate bushfire protection measures can be provided in compliance with BMO requirements.

Please Note: The bushfire protection measures proposed in this document do not guarantee survival of the building or the occupants in the event of a bushfire. The client is strongly encouraged to develop and practice a bushfire survival plan including determining triggers for leaving early on days of severe or higher, fire danger. Information and assistance including a template for a Bushfire Survival Plan is provided on the CFA website at <http://www.cfa.vic.gov.au/plan-prepare/>.

6 Appendices

6.1 Appendix A: Vegetation management requirements

As per Table 6 to Clause 53.02-5:

'Defendable space is provided and is managed in accordance with the following requirements:

- *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 3m 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 sq. 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*

Unless specified in a schedule or otherwise agreed in writing to the satisfaction of the relevant fire authority' (Colac Otway Planning Scheme, 2018a).

6.2 Appendix B: Water supply requirements

Table 4 from Clause 53.02-5 - Capacity, fittings and access (Colac Otway Planning Scheme, 2018a)

Capacity, fittings and access

Lot sizes (square meters)	Hydrant available	Capacity (litres)	Fire authority fittings and access required
Less than 500	Not applicable	2,500	No
500-1,000	Yes	5,000	No
500-1,000	No	10,000	Yes
1,001 and above	Not applicable	10,000	Yes

Note 1: A hydrant is available if it is located within 120 metres of the rear of the building

Fire Authority Requirements

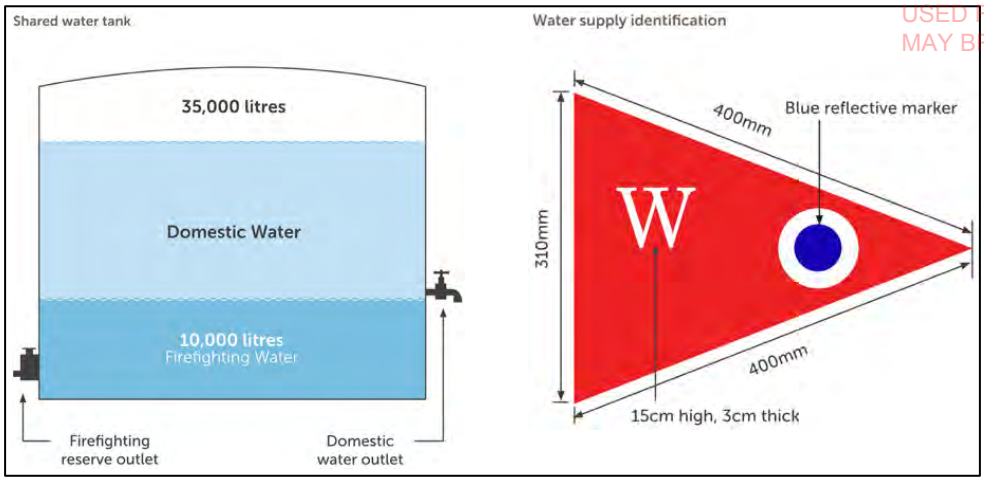
'Unless otherwise agreed in writing by the relevant fire authority, the water supply must:

- *Be stored in an above ground water tank constructed of concrete or metal.*
- *Have all fixed above ground water pipes and fittings required for firefighting purposes made of corrosive resistant metal.*
- *Include a separate outlet for occupant use.*

Where a 10,000 litre water supply is required, fire authority fittings and access must be provided as follows:

- *Be readily identifiable from the building or appropriate identification signage to the satisfaction of the relevant fire authority.*
- *Be located within 60 metres of the outer edge of the approved building.*
- *The outlet/s of the water tank must be within 4 metres of the accessway and unobstructed.*
- *Incorporate a separate ball or gate valve (British Standard Pipe (BSP 65 millimetre) and coupling (64 millimetre CFA 3 thread per inch male fitting).*
- *Any pipework and fittings must be a minimum of 65 millimetres (excluding the CFA coupling)'* (Colac Otway Planning Scheme, 2018a).

The water supply may be provided in the same water tank as other water supplies provided they are separated with different outlets. See figure below illustrating signage and an example of outlets where fire fighting water will be in the same tank as water for other use.



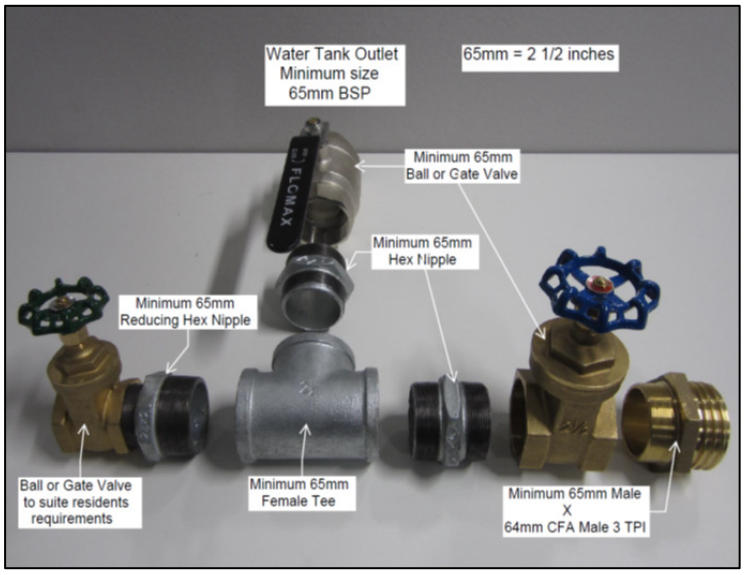
(DELWP, 2017)

CFA Fittings (CFA, 2014)

'If specified within Table 4 to Clause 53.02-5 (if fire brigade access to your water supply is required), CFA's standard BMO permit conditions require the pipe work, fittings and tank outlet to be a minimum size of 64 mm.

65 mm BSP (British Standard Pipe) is the most common size available. A 65 mm fitting is equivalent to the old 21/2 inch. A 65 mm BSP (21/2 inch) fitting exceeds CFA's requirements and will therefore comply with CFA's standard permit conditions for the BMO.

The diagram below shows some common tank fittings available at most plumbing suppliers which meet the connection requirements. It includes a 65 mm tank outlet, two 65 mm ball or gate valves with a 65 mm male to 64 mm CFA 3 threads per inch male coupling. This is a special fitting which allows the CFA fire truck to connect to the water supply. An additional ball or gate valve will provide access to the water supply for the resident of the dwelling'.

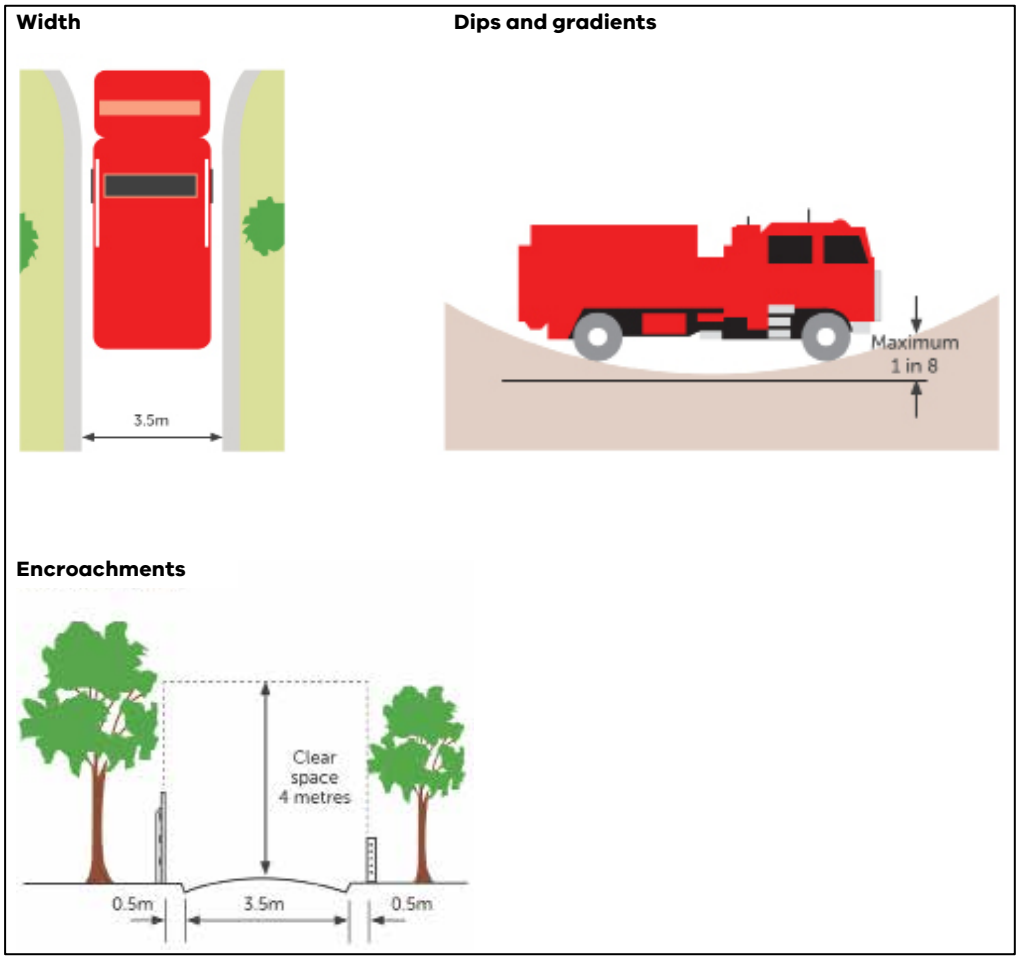


6.3 Appendix C: Access requirements

Access between 30m and 100m in length

Where the length of access is greater than 30 metres the following design and construction requirements apply (*the length of access should be measured from a public road to either the building or the water supply outlet, whichever is longer* (Colac Otway Planning Scheme, 2018a)):

- 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 of no more than 1 in 5 (20%) (11.3°) for no more than 50 metres.
- Dips must have no more than a 1 in 8 (12.5%) (7.1°) entry and exit angle.
- A load limit of at least 15 tonnes and be of all-weather construction.
- 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.
- A cleared area of 0.5 metres is required to allow for the opening of vehicle doors along driveways.
- Dips must have no more than a 1 in 8 (12.5 per cent) (7.1 degrees) entry and exit angle.

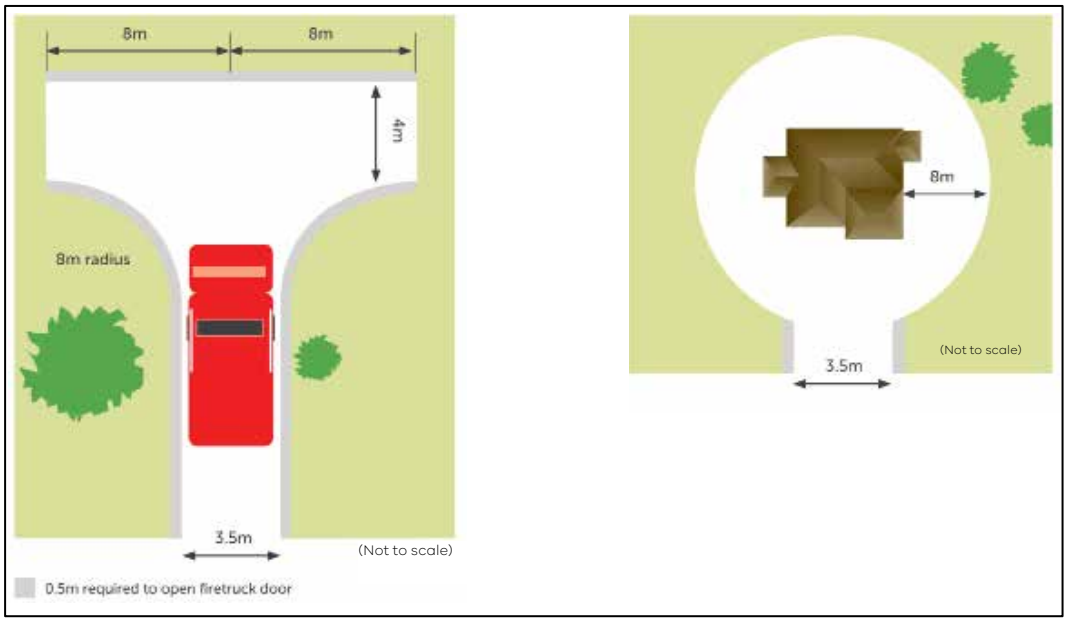


(DELWP, 2017)

Access between 100m and 200m in length

In addition to the 30m-100m requirements above, a turning area for fire fighting vehicles must be provided close to the building by one of the following:

- a turning circle with a minimum radius of 8 metres
- a driveway encircling the dwelling
- other vehicle turning heads such as a T or Y head which meet the specification of Austroad Design for an 8.8 metre service vehicle.

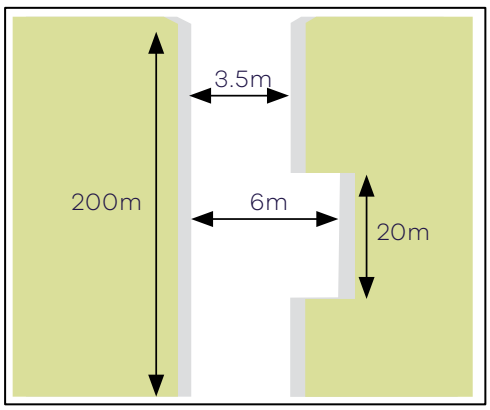


(DELWP, 2017)

Access greater than 200m in length

In addition to the requirements above, passing bays are required at least every 200 metres that are:

- a minimum of 20 metres long
- with a minimum trafficable width of 6 metres.



(DELWP, 2017)

7 References

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Colac Otway Planning Scheme (2018c) Clause 13.02 *Bushfire.* Available at <http://planningschemes.dpcd.vic.gov.au/schemes/vpps>.

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From: Shelly Fanning <shelly@coastalplanning.com.au>
Sent: Monday, 25 March 2019 4:11 PM
To: INQ
Cc: Helen Evans
Subject: Email 2 of 2 - FI Response PP263/2018
Attachments: 25.03.2019 BMS.pdf; 25.03.2019 Building & Planning Permit Shed.pdf; 25.03.2019 Endorsed Plans Existing Shed.pdf; 25.03.2019 Versteeg TP2 - Dev. Plans.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Email 2 of 2

We look forward to this application proceeding to Public Notification ASAP.

Many thanks

Shelly Fanning | Planning Consultant

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m: 0408 734 169

e: shelly@coastalplanning.com.au | **w:** www.coastalplanning.com.au

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