PP160/2019-1

Road Reserve near Great Ocean Road
WYE RIVER

C/A: 1A, CA2111, CA2109, CA2110, CA2006

Use of utility installation & vegetation removal associated underground drainage

Colac Otway Shire Council

Officer – Bernadette McGovan

EXHIBITION FILE

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

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

Colac Otway SHIRE

Office Use Only

VicSmart? ◯ Yes ◯ No

Specify class of VicSmart application:

Application No.: Date Lodged: / /

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

Application for a **Planning Permit**

If you need help to complete this form, read MORE INFORMATION at the back 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 concerns, 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.

Clear Form

Application Type

Is this a VicSmart application?*

◉ No ◯ Yes

If yes, please specify which VicSmart class or classes:

⚠ If the application falls into one of the classes listed under Clause 92 or the schedule to Clause 94, it is a VicSmart application.

Pre-application Meeting

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

◯ No ◉ Yes

If 'Yes', with whom?: Bernadette McGovan?Doug McNeill

Date: Ongoing since November, 2018 day / month / year

The Land ⓘ

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

Street Address *

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

Suburb/Locality: 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.: ◯ Lodged Plan ◯ Title Plan ◯ Plan of Subdivision No.:

OR

B Crown Allotment No.: 2111, 2109, 2110, 2006 Section No.:

Parish/Township Name: Wye River

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? *

Planning Approval is sought for use of a Utility Installation in PCRZ and vegetation removal associated with the construction of underground drainage.

The proposal is to construct underground drainage, to reduce storm water runoff and erosion following the 2015 bushfires, as per the attached plan(Refer Cardno Plan V170115-CI-~~116013~~ 13000 Rev ~~2~~ 3).

The works will include excavation of drainage trenches and removal of vegetation and roots.

The Geotechnical Landslide Risk Assessment (Yttrup Pty Ltd) and the Biodiversity Assessment (Beacon Ecological) are attached.

☑ 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 $ 300,000

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

If the application is for land within **metropolitan Melbourne** (as defined in section 3 of the *Planning and Environment Act 1987*) and the estimated cost of the development exceeds $1 million (adjusted annually by CPI) the Metropolitan Planning Levy **must** be paid to the State Revenue Office and a current levy certific e **must** be submitted with the application. Visit www.sro.vic.gov.au for information.

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.

The land is within the rear of several private residential lots and within a transmission reserve and Reserve.

☑ 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: Kerim | Surname: Sijercic
Organisation (if applicable): Colac Otway Shire
Postal Address: | If it is a P.O. Box, enter the details here:
Unit No.: | St. No.: | St. Name:
Suburb/Locality: | State: | Postcode:

*Please provide at least one contact phone number **

Contact information for applicant OR contact person below
Business phone: | Email: kerim.sijercic@colacotway.vic.gov.au
Mobile phone: 0419 831 146 | Fax:

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

Contact person's details* | Same as applicant ☐
Name:
Title: | First Name: | Surname:
Organisation (if applicable):
Postal Address: | If it is a P.O. Box, enter the details here:
Unit No.: | St. No.: | St. Name:
Suburb/Locality: | State: | Postcode:

Owner *

The person or organisation who owns the land

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

Same as applicant ☐
Name:
Title: | First Name: | Surname:
Organisation (if applicable): Crown Land Manager DELWP
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

Information requirements

Contact Council's planning department to discuss the specific requirements for his application and obtain a planning permit checklist.

Is the required information provided?

◉ Yes ○ No

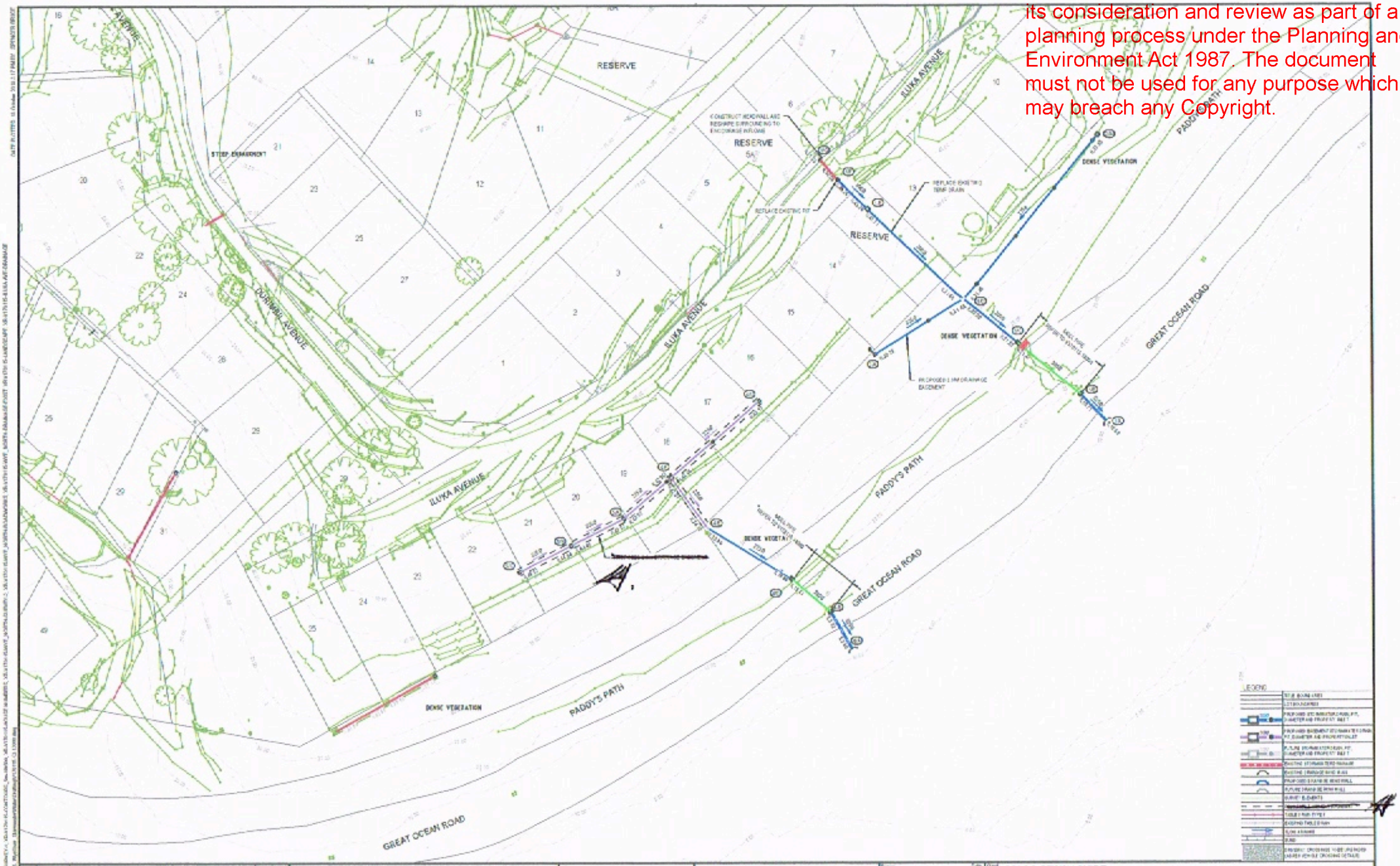
Declaration

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 cancellatio 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: 25.7.19 day / month / year



Colac Otway SHIRE

Cardno Shaping the Future

COLAC OTWAY SHIRE

WYE RIVER AND SEPARATION CREEK STORMWATER MANAGEMENT SYSTEM

DETAILED DESIGN

ILUKA AVE DRAINAGE UPGRADE

DETAILED LAYOUT PLAN

FOR TENDER ONLY

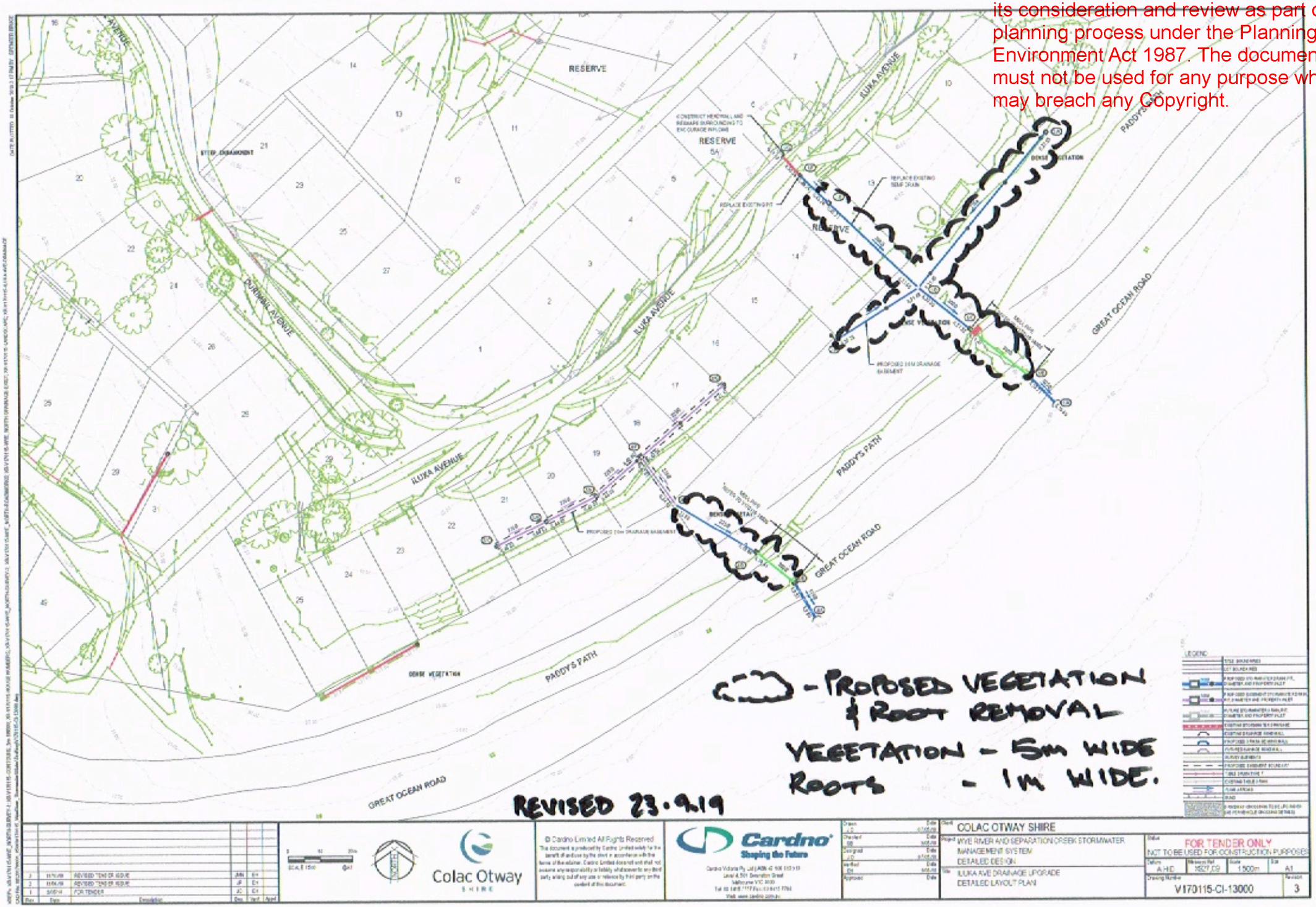
NOT TO BE USED FOR CONSTRUCTION PURPOSES

A1 HD

1:500 @ A1

V170115-CI-13000

3



3	07/11/19	REVISED TENDER ISSUE	MN	EH
2	01/11/19	REVISED TENDER ISSUE	JP	EH
1	30/09/19	FOR TENDER	AC	EH
Rev	Date	Description	Des	Vert

Cardno Shaping the Future

Client: COLAC OTWAY SHIRE

Project: WYE RIVER AND SEPARATION CREEK STORMWATER MANAGEMENT SYSTEM DETAILED DESIGN

Title: RUKA AVE DRAINAGE UPGRADE DETAILED LAYOUT PLAN

Status: FOR TENDER ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum: AHD | Reference Ref: 35577.03 | Scale: 1:500m | Size: A1

Drawing Number: V170115-CI-13000 | Revision: 3

Iluka Avenue, Wye River, Victoria.

Biodiversity Assessment: Detailed Assessment Pathway for Proposed Drainage Works

Report for Colac Otway Shire

September 2019

BeaconEcological

ACKNOWLEDGEMENTS

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

- **Neill Hocking** (Project Manager, Colac Otway Shire) for site and project information.

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Report Version: FINAL V2 September 9 2019
Field assessment: Luke Hynes
Report: Luke Hynes
Photography: Luke Hynes
Review: Mark Stockdale
Cover Photo: Vegetation within the study area

DISCLAIMER

The author advises 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

SUMMARY

Beacon Ecological was engaged by the Colac Otway Shire to undertake a Biodiversity Assessment for proposed drainage works at Iluka Avenue, Wye River, Victoria.

While the proposed development has been designed to best avoid native vegetation loss, the development will result in the removal, destruction and lopping of native vegetation and as such will require a permit under Victoria's *Planning and Environment Act 1987*.

This report provides permit application requirements as per the *Guidelines for the removal, destruction or lopping of native vegetation* (the Guidelines) (DELWP 2017) and the Significant Landscape Overlay (SLO 2 –Coastal Towns: Skenes Creek, Kennett River, Wye River and Separation creek).

METHODOLOGY

A field assessment was undertaken within the study area by qualified botanist, Luke Hynes (*Vegetation Quality Assessment Accreditation Number: 077*) on 21 June 2018. Dominant flora taxa and habitat types within the study area were noted and areas of native vegetation were mapped and assessed using the Vegetation Quality Assessment where appropriate.

RESULTS

The field visit revealed that the study area supports a mix of introduced vegetation and native vegetation with affinities to Shrubby Foothill Forest (EVC 45).

Previous and current records and habitat requirements for *Environmental Protection and Biodiversity Conservation Act* listed species from state and federal databases were reviewed. Given the paucity of previous local records, amount of survey effort and lack of suitable habitat, it is considered unlikely that the proposed works will have a significant impact on any matters of national environmental significance.

BIODIVERSITY ASSESSMENT

The application was determined to be of the detailed assessment pathway as native vegetation within Location 3 is proposed to be removed. Note that any native vegetation proposed to be impacted within small residential lots is considered exempt under clause 52.17-7 *Site area*.

Proposed Losses

A total of 0.031 hectares of non-exempt vegetation including one scattered large native trees is proposed to be disturbed. The Strategic Biodiversity Value is between 0.688 and 0.920.

Offset Requirements

- General Offset amount: 0.028 general units.
- Vicinity: Corangamite Catchment Management Authority or Colac Otway Shire Council
- Minimum strategic biodiversity value score: 0.698 (at least 80 per cent of the strategic biodiversity score of the native vegetation to be removed).

FURTHER REQUIREMENTS AND RECOMMENDATIONS

The following actions are required to satisfy requirements for the proposed development:

- **A permit to remove native vegetation from the Colac Otway Shire Council** is required. As per Clause 52.17 of the PE Act, the application has been classed as a *detailed assessment pathway*. In this instance DELWP is a recommending authority.

- To ensure *no net loss* to Victoria's biodiversity **0.028 general biodiversity units with a minimum strategic biodiversity value score of 0.698** within the Corangamite Catchment or Colac Otway Shire Council is required.

- As the proposed works south of Iluka Avenue are located on public land and protected flora species Tree Everlasting *Ozothamnus ferrugineus,* (Asteraceae family) and Prickly Moses *Acacia verticillata* (*Acacia* genera) are proposed to be removed, **a permit under the FFG Act is required from DELWP**.

Recommendations to further avoid and minimise impacts to ecological values during and after the proposed works are detailed in Section 6.2. Offsets will be purchased through an accredited third party offset broker.

1 INTRODUCTION

Beacon Ecological was engaged by the Colac Otway Shire to undertake a Biodiversity Assessment for proposed drainage works at Iluka Avenue, Wye River, Victoria.

While the proposed development has been designed to best avoid native vegetation loss, the development will result in the removal, destruction and lopping of native vegetation and as such will require a permit under Victoria's *Planning and Environment Act 1987*.

This report provides permit application requirements for the detailed assessment pathway as per the *Guidelines for the removal, destruction or lopping of native vegetation* (the Guidelines) (DELWP 2017) and the Significant Landscape Overlay (SLO 2 –Coastal Towns: Skenes Creek, Kennett River, Wye River and Separation creek).

1.1 SCOPE OF WORKS

The following tasks were completed during the vegetation assessment:

Background Literature Review: Relevant documentation pertaining to the study area was reviewed.

Vegetation Quality Assessment: A qualified and experienced botanist traversed the site to determine the extent of native vegetation and other ecological values.

Mapping: A site plan, using aerial photography detailing the location of the proposed works areas and vegetation proposed for removal and retention has been prepared for inclusion in the report. The mapping also includes, site location, boundaries, area of removal (in hectares), and ecological values using aerial photography and GPS (if required).

Report Production: A report was prepared to detail the:

- Results of the field assessment.
- Calculations of native vegetation losses and offsets if required.
- Recommendations to protect and conserve ecological values within the site during each construction phase.

1.2 STUDY AREA

The study area is located at Iluka Avenue, Wye River, Victoria (Figure 1) and includes the construction footprint of proposed drainage works (Figure 2a to 2e). The study area includes vegetation adjacent to Iluka Avenue and to the south through towards the ocean through private properties, road reserves and crown land. The study area is mapped as Location 1 on slopes and Location 3 closer to the coast under the Department of Environment, Land, Water and planning (DELWP) location risk mapping (DELWP 2018a).

The study area is located within Township Zone (TZ) adjacent to Iluka Avenue and Public Conservation and Resource Zone (PCRZ) to the south and covered by a Bushfire Management Overlay (BMO), Design and Development Overlay (DD04) and Erosion Management Overlay (EMO), (DELWP 2018d). A Significant Landscape Overlay (SLO 2 COASTAL TOWNS: SKENES CREEK, KENNETT RIVER, WYE RIVER AND SEPARATION CREEK) covers residential areas adjacent to liuka Avenue. The study area is located within the boundaries of the Colac Otway Shire, Corangamite Management Authority and Otway Ranges bioregion (DELWP 2018a).

2 METHODOLOGY

2.1 DATABASE REVIEW

The following databases were reviewed to obtain background information on the study area:

- **Nature Kit** for pre-1750 (pre - European settlement) and 2005 (extant) native vegetation modelling and significant flora and fauna species previously recorded within a five-kilometre radius of the study area (DELWP 2018a).
- **Victorian Biodiversity Atlas** for significant flora and fauna species previously recorded within a five-kilometre radius of the study area (DELWP 2018c).
- **Protected Matters Search Tool** for nationally significant ecological values that are predicted to occur within five kilometres of the study area (DEE 2018).
- **Planning Schemes Online** for information regarding planning provision overlays and zones pertaining to native vegetation and ecological values within the study area (DELWP 2018b).

2.2 MAPPING AND OTHER LITERATURE

Relevant literature, such as Bioregional Ecological Vegetation Class (EVC) Benchmarks and national/state/local policies and legislation were also reviewed as part of the investigation (DELWP 2018a, DELWP 2018b).

Other relevant documents were reviewed including design drawings *Wye River and Separation Creek Stormwater management System – Pits and Pipes. Colac Otway Shire* (Cardno 2017).

2.3 FIELD ASSESSMENT

A field assessment was undertaken within the study area by qualified botanist, Luke Hynes (*Vegetation Quality Assessment Accreditation Number: 077*) on 21 June 2018.

The entire study area of was traversed in order to:

- Note dominant flora taxa naturally occurring. Plant taxonomy follows the Victorian Biodiversity Atlas (VBA) (DELWP 2018c).
- Note any habitat types and distribution.
- Map the extent of native vegetation and habitat present.
- Undertake a Vegetation Quality Assessment (VQA) within areas of native vegetation that meet the assessment criteria thresholds. Note that a VQA was not undertaken in areas where the title is less than 0.4 hectares as these areas are exempt from requiring a permit to remove native vegetation under *Clause 52.17-7 Site area*.

- Map trees with a DBH greater than 0.5 metres as these require a permit for removal under the Significant Landscape Overlay (SLO 2 –Coastal Towns: Skenes Creek, Kennett River, Wye River and Separation creek).

2.4 BIODIVERSITY ASSESSMENT

The Guidelines (DELWP 2017) are incorporated into the Victoria Planning Provisions and all planning schemes in Victoria. The purpose of the Guidelines is to set out, and describe the application of Victoria's statewide policy in relation to assessing and compensating for the removal of native vegetation.

The three-step approach (avoid, minimise, offset native vegetation) is the key policy in relation to the removal of native vegetation to achieve no net loss to biodiversity. To determine extent of native vegetation, *remnant patch* or *scattered tree* are used as defined below:

Patch

A patch of native vegetation is:

- An area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native, or
- Any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or
- Any mapped wetland included in the Current wetlands map, available in DELWP systems and tools.

Scattered tree

A scattered tree is:

- A native canopy tree that does not form part of a patch.

Applications to remove native vegetation are categorised in to one of three assessment pathways with corresponding application requirements and decision guidelines.

- **Basic:** limited impacts on biodiversity.
- **Intermediate:** could impact on large trees, endangered EVCs, and sensitive wetlands and coastal areas.
- **Detailed:** could impact on large trees, endangered EVCs, sensitive wetlands and coastal areas, and could significantly impact on habitat for rare or threatened species

The assessment pathway is determined by considering the extent and location risk modelling of the native vegetation to be removed as per Table 1 below.

Table 1. Determining the assessment pathway.

Extent of native vegetation	Location 1	Location 2	Location 3
Less than 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
Less than 0.5 hectares and including one or more large trees	Intermediate	Intermediate	Detailed
0.5 hectares or more	Detailed	Detailed	Detailed

The current application is considered to be of the detailed assessment pathway as native vegetation is proposed to be cleared within location 3 (See Appendix 3 for the Native Vegetation Removal report).

2.5 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. The assessment was undertaken during autumn, generally not the optimal time to undertake flora surveys. As such, some species may be dormant or not displaying diagnostic characteristics at the time of survey.

A fauna survey (i.e. the identification of all fauna species present onsite) was not within the scope of works during the assessment.

However, the survey effort and review of existing relevant information is considered sufficient to provide adequate information to undertake a Biodiversity Assessment.

3 RESULTS

3.1 VEGETATION QUALITY ASSESSMENT

Vegetation Modelling

Pre-1750 (prior to European settlement) EVC modelling indicates that the study area is likely to have been dominated by Shrubby Foothill Forest (EVC 45) with Coastal Headland Scrub (EVC 161) along the coast. 2005 (extant) mapping indicates that the majority of the study area is devoid of native vegetation (DELWP 2016a).

The field visit revealed that the study area supports a mix of introduced vegetation and native vegetation with affinities to Shrubby Foothill Forest (EVC 45), (Figure 2).

Vegetation Quality Assessment

A Vegetation Quality Assessment (habitat hectare and scattered tree assessment) was undertaken within the proposed works areas where the land title is greater than 0.4 hectares. This included a patch of native vegetation southeast of Iluka Avenue (Figure 2). The habitat hectare scores are detailed in Table 1 and the description below.

Table 1. Vegetation Quality Assessment results

Habitat Zone			**SFF1**
Bioregion			Otway Ranges
EVC Name			Shrubby Foothill Forest
EVC Number			45
	Max Score		
Site Condition	**Large Trees**	10	0
	Canopy Cover	5	0
	Understorey	25	15
	Lack of Weeds	15	13
	Recruitment	10	10
	Organic Litter	5	5
	Logs	5	2
Landscape Context		25	18
Habitat Score		100	63
Habitat Score/100			0.63

Shrubby Foothill Forest **EVC Number:** 23

Shrubby Foothill Forest *occurs on ridges and exposed aspects on moderately fertile soils and at a range of elevations. The overstorey is a medium eucalypt forest to 25 metres tall over an understorey characterised by a distinctive middle stratum dominated by a diversity of narrow-leaved shrubs and a paucity of ferns, graminoids and herbs in the ground stratum* (DELWP 2018d).

Habitat Zone HRFF1

Habitat Zone HRFF1 is present to the southeast of Iluka Avenue (Figure 2c). This vegetation type is supports a scattered overstorey of Blue Gum *Eucalyptus globulus* over a dense shrub layer including Tree Everlasting *Ozothamnus ferrugineus,* Sweet Bursaria *Bursaria spinosa,* Prickly Moses *Acacia verticillata,* Hop Goodenia *Goodenia ovata* and Prickly Tea-tree *Leptospermum continentale* (Plate 1). The understorey is dominated by Bracken *Pteridium esculentum* in association with Kidney Weed *Dichondra repens*, Bidgee Widgee *Acaena novae-zelandiae*, Geranium *Geranium* spp., and Common Tussock –grass P*oa labillardierei.*

Introduced species cover is low and includes Cape Broom *Genista monspessulana,* Panic Veldt-grass *Ehrharta erecta* and Self-heal *Prunella vulgaris*

Plate 1. Habitat Zone SFF1 within the study area.

Vegetation within lots smaller than 0.4 hectares and introduced vegetation.

Vegetation within residential lots is variable including highly modified areas comprising maintained gardens (Plate 3).

Plate 3. Maintained gardens within the study area.

3.2 FAUNA HABITAT ASSESSMENT

A habitat assessment was undertaken which revealed the presence of two fauna habitats, modified forest, and maintained gardens within the study area.

Modified forest habitat provides a variety of habitat niches that are likely to be used by a range of arboreal mammals, native birds and reptiles for nesting, foraging and shelter. Insectivorous birds can forage underneath bark, on leaves and flowers, and in leaf litter on the ground. Mature trees provide potential perching and hunting sites for birds of prey, foraging for arboreal mammals, and dispersal habitat for many other fauna species. Larger birds may use the eucalypt canopy for nesting and perching.

Maintained gardens provides a variety of low quality habitat niches that are likely to be used by a range of arboreal mammals, native birds and reptiles for nesting, foraging and shelter. Common birds can forage underneath bark, on leaves and flowers, and in leaf litter on the ground.

3.3 NATIONALLY SIGNIFICANT FLORA SPECIES

Appendix 2 presents flora species listed on the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that have previously been recorded and/or are predicted to occur within a five-kilometre radius of the study area by the VBA or the Protected Matters Search tool (DELWP 2018c, DEE 2018).

No flora species of national significance listed under the EPBC Act have previously been recorded within a five-kilometre radius of the study area (DELWP 2018c).

Seven species listed under the EPBC Act are predicted to occur, or have habitat predicted to occur within a five-kilometre radius of the study area (DEE 2018), (Appendix 2). Given the paucity of previous local records, amount of survey effort and lack of suitable habitat, it is considered unlikely that the proposed works will impact on significant habitat for any additional flora species of national significance.

3.4 NATIONALLY SIGNIFICANT FAUNA SPECIES

Appendix 2 presents fauna species listed on the EPBC Act that have previously been recorded and/or are predicted to occur within a five kilometre radius of the study area by the VBA (DELWP 2018c) or the DEE Protected Matters Search tool (DEE 2018).

Six fauna species of national significance, listed under the EPBC Act, have previously been recorded within the five-kilometre VBA search area (DELWP 2018c, Appendix 3). The Protected Matters Search Tool identified an additional 26 species, listed under the EPBC Act, that may occur or for which habitat may occur in the offset site (DEE 2018, Appendix 3). The study area south of Iluka Avenue supports potential habitat albeit suboptimal for two species of national significance, Swamp Antechinus *Antechinus minimus maritimus,* and Long-nosed Potoroo *Potorous tridactylus tridactylus.* However the proposed works are considered unlikely to cause a significant impact to these species. Considering habitat requirements for some species are not represented and there is a lack of recent records for species with potential habitat it is unlikely that the study area provides significant habitat for any additional fauna species of national significance. Some species may flyover or forage within the study area on an occasional basis.

3.5 SIGNIFICANT ECOLOGICAL COMMUNITIES

A review of information and databases maintained by DELWP and DEE identified the following ecological communities as occurring within the study area or within a five-kilometre radius of the study area.

Ramsar Wetlands (listed under the EPBC Act)

The Protected Matters Search Tool reported the study area is not near any Ramsar sites of international significance (DEE 2018).

Ecological Communities (listed under the EPBC Act)

The Protected Matters Search Tool reported one nationally significant ecological community may occur within five-kilometres of the study area (DEE 2018).

- *Subtropical and Temperate Coastal Saltmarsh*

This community was not noted within the study area.

Ecological Communities (listed under the FFG Act)

No ecological communities listed under the FFG Act were noted within the study area.

4 RELEVANT LEGISLATION AND POLICIES

The following policies and legislation were taken into consideration during the assessment.

4.1 NATIONAL

***Environment Protection and Biodiversity Conservation Act 2179* (EPBC Act)**

The Environment Protection and Biodiversity Conservation Act 2179 (the EPBC Act) is the central piece of national environmental legislation in Australia. The Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance (SEWPAC 2006).

Under the EPBC Act an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The *EPBC Act Significant Impact Guidelines* (SEWPAC 2006) provide information on whether an action (e.g. a project, a development, an undertaking, an activity or a series of activities) requires a referral.

Implications –

The proposed works are unlikely to pose a significant impact on any matters of national significance. A referral under the EPBC Act is not required.

4.2 STATE

***The Flora and Fauna Guarantee Act 1988* (FFG Act)**

The FFG Act is the key state legislation for the conservation of threatened species and communities and for the management of potentially threatening processes (PoV 2010b). The FFG Act provides for the listing of taxa (genera, species, subspecies, varieties) and communities of flora and fauna that are threatened (Threatened List); potentially threatening processes (Processes List); and flora that have legal protection (Protected Flora List) (PoV 2010b).

A permit is required from DELWP if an action on public land proposes to collect, kill, injure or disturb protected flora (PoV 2010b).

Implications -

As the proposed works south of Iluka Avenue are located on public land, a permit under the FFG Act is required from DELWP.

Species from the protected flora list that will be impacted include:

- Tree Everlasting *Ozothamnus ferrugineus,* (Asteraceae family likely between 20-30 plants) and
- Prickly Moses *Acacia verticillata* (*Acacia* genera – likely between 20-30 plants).

***Planning and Environment Act 1987* (PE Act)**

The Planning and Environment Act 1987 (PE Act) establishes a framework for planning the use, development and protection of land in Victoria. The PE Act provides for the Minister to prepare a set of standard provisions for municipal planning schemes called the Victoria Planning Provisions (VPP).

Under Clause 52.17 of the VPP a planning permit is required from the responsible authority (local council) to remove, destroy or lop native vegetation on land unless the action is exempt. Clause 52.17 also specifies that applications must also be classified as basic, intermediate or detailed assessment pathway as defined in the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017). Each assessment pathway has specific application requirements and decision guidelines that must be considered.

Under Clause 66 Referral and Notice Provisions of planning schemes, the following applications are referred to the Secretary to DELWP (DELWP 2017):

- To remove, destroy or lop native vegetation in the Detailed Assessment Pathway
- To remove, destroy or lop native vegetation if a PVP applies to the site
- To remove, destroy or lop native vegetation on Crown land which is occupied or managed by the responsible authority.

Implications –

A permit to remove native vegetation from the Colac Otway Shire Council is required. As per Clause 52.17 of the *Planning and Environment Act 1987* the application has been classed as a *detailed assessment pathway* as vegetation within location 3 is proposed to be disturbed. Application information requirements of this pathway are detailed in Section 5. In this instance DELWP is considered a recommending authority.

Note that native vegetation proposed to be impacted within small residential lots is considered exempt under clause 52.17-7 *Site area*:

> *Native vegetation that is to be removed, destroyed or lopped on land, together with all contiguous land in one ownership, which has an area of less than 0.4 hectares.*
>
> *This exemption does not apply to native vegetation on a roadside or rail reservation.*

4.3 LOCAL AND REGIONAL

Planning Scheme

Each municipality in Victoria is covered by a planning scheme, which sets out policies and provisions for the use, development and protection of land (zones and overlays). They are legal documents, sourced and constructed according to the VPP, prepared by the local council or Minister and approved by the Minister. Particular zones and overlays (such as Environmental Significance Overlays and Green Wedge Zones) in the planning scheme may stipulate additional conditions and requirements for applications proposing to remove native vegetation.

A **zone** is a planning provision that reflects the primary character of land (such as residential, industrial or rural) and indicates the type of use and development, which may be appropriate in that zone (DSE 2010d).

An **overlay** is also a planning provision, but one which is in addition to the zone. Overlays ensure that important aspects of the land are recognised (such as areas of significant vegetation). Overlays indicate the type of development and/or protection, which may be appropriate in that area (DSE 2010d).

Implications –

One overlay, Significant Landscape Overlay (SLO 2 –Coastal Towns: Skenes Creek, Kennett River, Wye River and Separation creek) pertains to the removal of trees with a diameter at breast height (DBH) of greater than 0.5 metres. No trees with a DBH greater than 0.5 metres are proposed to be impacted.

5 BIODIVERSITY ASSESSMENT

Table 2. Application requirements and responses for proposed vegetation clearance under the detailed assessment pathway.

#	Application Requirement	Response
1	Information about the native vegetation to be removed, including:	
	The assessment pathway and reason for the assessment pathway. This includes the location category of the native vegetation to be removed.	**Detailed Assessment Pathway** Native vegetation within location 3 is proposed to be disturbed,
	A description of the native vegetation to be removed that includes: • Whether it is a patch or a scattered tree (or both). • The extent (in hectares). • The number and circumference (in centimetres measured at 1.3 metres above ground level) of any large trees within a patch. • The number and circumference (in centimetres measured at 1.3 metres above ground level) of any scattered trees, and whether each tree is small or large. • The strategic biodiversity value score • The condition score. • If it includes endangered Ecological Vegetation Classes. • If it includes sensitive wetland or coastal areas.	• A total of 0.031 hectares of vegetation including is proposed to be disturbed. Note that the disturbance to native vegetation includes the total construction footprint. • Strategic Biodiversity Score: Between 0.688 and 0.920. • Condition Score: See Section 3.2 of this report. • The native vegetation to be removed does not include any endangered Ecological Vegetation Classes. • The native vegetation to be removed does not include any sensitive wetland or coastal areas.
	Maps showing the native vegetation and property in context and containing: • Scale, north point and property boundaries • Location of any patches of native vegetation and the number of large trees within the patch proposed to be removed • Location of scattered trees proposed to be removed, including their size	See Figure 2 for locations of patches of native vegetation.
	The offset requirement, determined in accordance with section 5 of the Guidelines, that will apply if the native vegetation is approved to be removed	• General Offset amount: 0.028 general habitat units. • Vicinity: Corangamite Catchment Management Authority or Colac Otway Shire Council

#	Application Requirement	Response
		• Minimum strategic biodiversity value score: 0.698 (at least 80 per cent of the strategic biodiversity score of the native vegetation to be removed).
2	Topographic and land information relating to the native vegetation to be removed, showing ridges, crests and hilltops, wetlands and waterways, slopes of more than 20 percent, drainage lines, low lying areas, saline discharge areas, and areas of existing erosion, as appropriate. This may be represented in a map or plan.	The native vegetation proposed to be removed is on sloping flat topography less than 20. There are no saline discharge or erosion areas.
3	Recent, dated photographs of the native vegetation to be removed.	See Section 3.2 of this report.
4	Details of any other native vegetation approved to be removed, or that was removed without the required approvals, on the same property or on contiguous land in the same ownership as the applicant, in the five year period before the application for a permit is lodged.	No other native vegetation has been approved to be removed, or was removed without the required approvals, on the same property or on contiguous land in the same ownership as the applicant, in the five year period before the application for a permit is lodged.
5	An avoid and minimise statement. The statement describes any efforts to avoid the removal of, and minimise the impacts on the biodiversity and other values of native vegetation, and how these efforts focussed on areas of native vegetation that have the most value. The statement should include a description of the following: • Strategic level planning – any regional or landscape scale strategic planning process that the site has been subject to that avoided and minimised impacts on native vegetation across a region or landscape • Site level planning – how the proposed use or development has been sited or designed to avoid and minimise impacts on native vegetation. • That no feasible opportunities exist to further avoid and minimise impacts on native	**Strategic level planning:** The study area has not been considered in any strategic level planning. **Site level planning**: The proposed works have been located to generally avoid native vegetation with only a small amount requiring to be offset. Additional ecological protection measures are detailed in Section 6.2.

#	Application Requirement	Response
	vegetation without undermining the key objectives of the proposal.	
6	A copy of any Property Vegetation Plan contained within an agreement made pursuant to section 69 of the Conservation, Forests and Lands Act 1987 that applies to the native vegetation to be removed.	No Property Vegetation Plan applies to the study area.
7	Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary. This statement must have regard to other available bushfire risk mitigation measures. This statement is not required when the creation of defendable space is in conjunction with an application under the Bushfire Management Overlay.	The removal of native vegetation is not to create defendable space
8	If the application is under Clause 52.16, a statement that explains how the proposal responds to the Native Vegetation Precinct Plan considerations at decision guideline 8.	The application is not under Clause 52.16.
9	An offset statement providing evidence that an offset that meets the offset requirements for the native vegetation to be removed has been identified, and can be secured in accordance with the Guidelines. A suitable statement includes evidence that the required offset: • Is available to purchase from a third party, or • Will be established as a new offset and has the agreement of the proposed offset provider, or • Can be met by a first party offset	As the offsets are for general habitat units only, these are easily available for purchase through an accredited offset broker.
10	A site assessment report of the native vegetation to be removed, including: • A habitat hectare assessment of any patches of native vegetation, including the condition, extent (in hectares), Ecological Vegetation Class and bioregional conservation status (BCS). • The location, number, circumference (in centimetres measured at 1.3 metres above	• See Section 3.2 of this report for details of the habitat hectare assessment. • 0.031 hectares of native vegetation is proposed to be impacted (Figure 2). • Ecological Vegetation Class: Shrubby Foothill Forest (EVC 45, BCS *Least Concern*). • No large trees are proposed to be impacted.

#	Application Requirement	Response
	ground level) and species of any large trees within patches. • The location, number, circumference (in centimetres measured at 1.3 metres above ground level) and species of any scattered trees, and whether each tree is small or large.	
11	Information about impacts on rare or threatened species habitat, including: • The relevant section of the Habitat importance map for each rare or threatened species requiring a species offset. • For each rare or threatened species that the native vegetation to be removed is habitat for, according to the Habitat importance maps: o The species' conservation status o The proportional impact of the removal of native vegetation on the total habitat for that species o Whether their habitats are highly localised habitats, dispersed habitats, or important areas of habitat within a dispersed species habitat.	There are no species offsets required. See Appendix 3 for details on rare or threatened species habitat that is being disturbed.

6 REQUIREMENTS AND RECOMMENDATIONS

6.1 REQUIREMENTS

The following actions are required as part of the proposed works:

- **A permit to remove native vegetation from the Colac Otway Shire Council** is required. As per Clause 52.17 of the PE Act, the application has been classed as a *detailed assessment pathway*. In this instance DELWP is a recommending authority.

- To ensure *no net loss* to Victoria's biodiversity **0.028 general biodiversity units with a minimum strategic score of 0.698** within the Corangamite Catchment or Colac Otway Shire Council is required.

- As the proposed works south of Iluka Avenue are located on public land and protected flora species Tree Everlasting *Ozothamnus ferrugineus,* (Asteraceae family) and Prickly Moses *Acacia verticillata* (*Acacia* genera) are proposed to be removed, **a permit under the FFG Act is required from DELWP**.

6.2 RECOMMENDATIONS

The following actions are highly recommended to further avoid and minimise impacts to ecological values during and after the proposed works.

Native Vegetation

- Avoid removal of and disturbance to native vegetation. Where possible, native vegetation should be trimmed rather than removed.

- Inform any contractors of areas of native vegetation within the study area. Ensure any contractors on-site are aware of, and educated about areas of native vegetation to be retained within the study area and enforce penalties for those who enter into or disturb these areas.

- Exclusion areas and 'no go' zones should be established and protected (i.e. use high visibility para-webbing to delineate areas of ecological value). Stockpiles, machinery and personnel rest areas should be placed in designated areas away from native vegetation.

- Ensure any proposed works remain within the permitted construction and defendable space footprint (i.e. do not disturb or remove areas of native vegetation outside this footprint).

- Any revegetation or landscaping within the lots will use locally indigenous species.

Sedimentation and Pollution

- Inform contractors that drainage lines are areas of ecological value or pathways to areas of ecological values (e.g. rivers, oceans and wetlands).

- Ensure best practice sedimentation and pollution control measures, to the satisfaction of the Environment Protection Authority (EPA 2171), are undertaken at all times to prevent off-site impacts.
- Ensure waste stockpiles, skips and personnel rest areas are located away from drainage areas to prevent accidental movement of rubbish and construction materials within waterways.

Weed and Biosecurity

- Any imported soil or gravel must be weed free to prevent importation of weed seed into the study area.
- Control the placement of any soil stockpiles and green waste outside areas of native vegetation.

FIGURES

Figure 1: Study area location

Proposed new drains

N

0 100 200 300m

Beacon Ecological

Lost tree with >50cm DBH & >10% DBH impacted

Offset loss

No offset loss

Shrubby Foothill Forest (EVC 45) SFF1

Removal area of drains

N

0 25 50m

Beacon Ecological

REFERENCES

Cardno 2017. *Wye River and Separation Creek Stormwater management System – Pits and Pipes. Colac Otway Shire*. Drawings dated 18/10/2017.

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DELWP 2018a. *Nature Kit.* Department of Environment, Land, Water and Planning website. www.delwp.vic.gov.au (Accessed November 2017).

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DSE 2004. *Vegetation Quality Assessment Manual: Guidelines for applying the habitat hectares scoring method*. Department of Sustainability and Environment, East Melbourne, Victoria.

EPA 2171 *Construction Techniques for Sediment Pollution Control.* Published by Environmental Protection Agency Victoria.

SEWPAC 2006 The *EPBC Act Significant Impact Guidelines.* Published by the Department of Sustainability, Environment, Water, Populations and Communities

APPENDICES

APPENDIX 1. EPBC ACT LISTED FLORA PREVIOUSLY RECORDED OR PREDICTED TO OCCUR WITHIN A FIVE KILOMETRE RADIUS OF THE STUDY AREA

LISTING:
***Environment Protection and Biodiversity Conservation Act* (EPBC Act):**

X	Extinct
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
Habitat	Habitat predicted to occur within 5 kilometre radius

Likelihood of occurring: Recorded, Potential Habitat, Unlikely, No Habitat.
Source: Victorian Biodiversity Atlas (DELWP 2018c) and (**H**) = Potential habitat predicted by the Protected Matters Search Tool (DOE 2018)

Scientific Name	Common Name	Total Records	EPBC Act	Likelihood of Occurrence
H *Amphibromus fluitans*	River Swamp Wallaby-grass	-	VU	No habitat
H *Prasophyllum cucullata*	Leafy-striped Greenhood	-	VU	No habitat
H *Pterostylis chlorogramma*	Green-striped Greenhood	-	VU	No habitat
H *Prasophyllum frenchii*	Maroon Leek-orchid	-	EN	No habitat
H *Glycine latrobeana*	Clover Glycine	-	VU	No habitat
H *Leiocarpa gatesii*	Wrinkled Buttons	-	VU	No habitat
H *Prasophyllum spicatum*	Dense Leek-orchid	-	EN	No habitat

APPENDIX 2. EPBC ACT LISTED FAUNA SPECIES PREVIOUSLY RECORDED OR WITH POTENTIAL HABITAT WITHIN A FIVE KILOMETRE RADIUS OF THE STUDY AREA (EPBC ACT MIGRATORY AND MARINE SPECIES ARE EXCLUDED)

LISTING:
***Environment Protection and Biodiversity Conservation Act* (EPBC Act):**

X	Extinct
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
Habitat	Habitat predicted to occur within 5 kilometre radius

Likelihood of occurring: Recorded, Potential Habitat, Unlikely, No Habitat.
Source: Victorian Biodiversity Atlas (DELWP 2018c) and (**H**) = Potential habitat predicted by the Protected Matters Search Tool (DOE 2018)

Scientific Name	Common Name	Total Records	EPBC Act	Likelihood of Occurrence
Prototroctes maraena	Australian Grayling	3	VU	No habitat
Thalassarche cauta	Shy Albatross	1	VU	No habitat
Thinornis rubricollis rubricollis	Hooded Plover	1	VU	No habitat
Antechinus minimus maritimus	Swamp Antechinus	3	VU	Unlikely
Dasyurus maculatus maculatus	Spot Tailed Quoll	1	EN	Unlikely
H *Potorous tridactylus tridactylus*	Long-nosed Potteroo	3	VU	Unlikely
H *Diomedea exulans*	Wandering Albatross	-	VU	No habitat
H *Macronectes giganteus*	Southern Giant-Petrel	-	EN	No habitat
H *Mastacomys fuscus mordicus*	Broad-toothed Rat	-	VU	No habitat
H *Calidris ferruginea*	Curlew Sandpiper	-	EN	No habitat
H *Anthochaera phrygia*	Regent Honeyeater	-	EN	No habitat
H *Rostratula benghalensis australis*	Australian Painted Snipe	-	VU	No habitat
H *Lathamus discolor*	Swift Parrot	-	EN	No habitat
H *Pteropus poliocephalus*	Grey-headed Flying-fox	-	VU	Unlikely
H *Botaurus poiciloptilus*	Australasian Bittern	-	EN	No habitat
H *Isoodon obesulus obesulus*	Southern Brown Bandicoot	-	EN	No habitat
H *Pseudomys fumeus*	Smoky Mouse	-	EN	Unlikely
H *Thalassarche melanophris melanophris*	Black-browed Albatross	-	VU	No habitat

Scientific Name	Common Name	Total Records	EPBC Act	Likelihood of Occurrence
H *Litoria raniformis*	Growling Grass Frog	-	EN	No habitat
H *Galaxiella pusilla*	Eastern Dwarf Galaxias	-	VU	No habitat
H *Miniopterus orianae bassanii*	Southern Bent-wing Bat	-	CR	No habitat
H *Calidris canutus*	Red Knot	-	EN	No habitat
H *Diomedea exulans*	Wandering Albatross	-	VU	No habitat
H *Diomedea epomophora epomophora*	Southern Royal Albatross	-	VU	No habitat
H *Diomedea epomophora sanfordi*	Northern Royal Albatross	-	EN	No habitat
H *Limosa lapponica menzbieri*	Northern Siberian Bar-tailed Godwit	-	CR	No habitat
H *Macronectes halli*	Northern Giant-Petrel	-	VU	No habitat
H *Neophema chrysogaster*	Orange-bellied Parrot	-	CR	No habitat
H *Phoebetria fusca*	Sooty Albatross	-	VU	No habitat
H *Thalassarche bulleri*	Buller's Albatross	-	VU	No habitat
H *Sternula nereis nereis*	Fairy Tern	-	VU	No habitat
H *Thalassarche chrysostoma*	Grey-headed Albatross	-	EN	No habitat
H *Thalassarche cauta steadi*	White-capped Albatross	-	VU	No habitat
H *Thalassarche melanophris impavida*	Campbell Albatross	-	VU	No habitat
H *Pterodroma mollis*	Soft Plumaged Petrel	-	VU	No habitat
H *Halobaena caerulea*	Blue Petrel	-	VU	No habitat
H *Numenius madagascariensis*	Eastern Curlew	-	CR	No habitat
H *Pachyptila turtur subantarctica*	Fairy Prion	-	VU	No habitat
H *Grantiella picta*	Painted Honeyeater	-	VU	

APPENDIX 3. NATIVE VEGETATION REMOVAL REPORT PROVIDED BY DELWP

Native vegetation removal report

This report provides information to support an application to remove, destroy or lop native vegetation in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation*. The report **is not an assessment by DELWP** of the proposed native vegetation removal. Native vegetation information and offset requirements have been determined using spatial data provided by the applicant or their consultant.

Date of issue: **05/09/2019**
Time of issue: **1:16 pm**

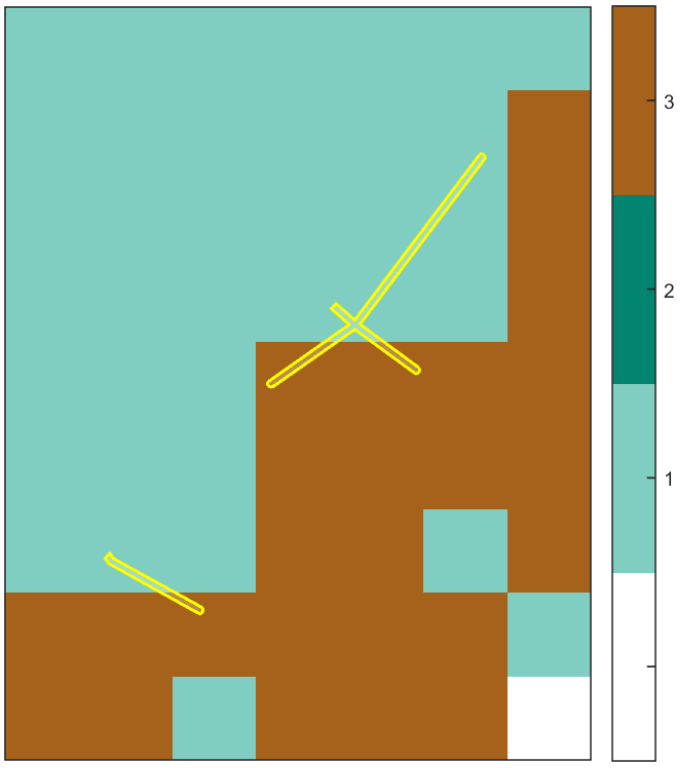
Report ID: BEC_2019_044

Project ID	WyeDrainsV4_2C__region

Assessment pathway

Assessment pathway	**Detailed Assessment Pathway**
Extent including past and proposed	0.031 ha
Extent of past removal	0.000 ha
Extent of proposed removal	0.031 ha
No. Large trees proposed to be removed	0
Location category of proposed removal	Location 3 The native vegetation is in an area where the removal of less than 0.5 hectares could have a significant impact on habitat for one or more rare or threatened species.

1. Location map



Offset requirements if a permit is granted

Any approval granted will include a condition to obtain an offset that meets the following requirements:

General offset amount[1]	0.028 general habitat units
Vicinity	Corangamite Catchment Management Authority (CMA) or Colac Otway Shire Council
Minimum strategic biodiversity value score[2]	0.698
Large trees	0 large trees

NB: values within tables in this document may not add to the totals shown above due to rounding

Appendix 1 includes information about the native vegetation to be removed

Appendix 2 includes information about the rare or threatened species mapped at the site.

Appendix 3 includes maps showing native vegetation to be removed and extracts of relevant species habitat importance maps

1 The general offset amount required is the sum of all general habitat units in Appendix 1.

2 Minimum strategic biodiversity score is 80 per cent of the weighted average score across habitat zones where a general offset is required

Next steps

Any proposal to remove native vegetation must meet the application requirements of the Detailed Assessment Pathway and it will be assessed under the Detailed Assessment Pathway.

If you wish to remove the mapped native vegetation you are required to apply for a permit from your local council. Council will refer your application to DELWP for assessment, as required. **This report is not a referral assessment by DELWP.**

This *Native vegetation removal report* must be submitted with your application for a permit to remove, destroy or lop native vegetation.

Refer to the *Guidelines for the removal, destruction or lopping of native* vegetation (the Guidelines) for a full list of application requirements This report provides information that meets the following application requirements:

- The assessment pathway and reason for the assessment pathway
- A description of the native vegetation to be removed (partly met)
- Maps showing the native vegetation and property (partly met)
- Information about the impacts on rare or threatened species.
- The offset requirements determined in accordance with section 5 of the Guidelines that apply if approval is granted to remove native vegetation.

Additional application requirements must be met including:

- Topographical and land information
- Recent dated photographs
- Details of past native vegetation removal
- An avoid and minimise statement
- A copy of any Property Vegetation Plan that applies
- A defendable space statement as applicable
- A statement about the Native Vegetation Precinct Plan as applicable
- A site assessment report including a habitat hectare assessment of any patches of native vegetation and details of trees
- An offset statement that explains that an offset has been identified and how it will be secured.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

For more information contact the DELWP Customer Service Centre 136 186

www.delwp.vic.gov.au

Appendix 1: Description of native vegetation to be removed

The species-general offset test was applied to your proposal. This test determines if the proposed removal of native vegetation has a proportional impact on any rare or threatened species habitats above the species offset threshold. The threshold is set at 0.005 per cent of the mapped habitat value for a species. When the proportional impact is above the species offset threshold a species offset is required. This test is done for all species mapped at the site. Multiple species offsets will be required if the species offset threshold is exceeded for multiple species.

Where a zone requires species offset(s), the species habitat units for each species in that zone is calculated by the following equation in accordance with the Guidelines:

Species habitat units = extent x condition x species landscape factor x 2, where the species landscape factor = 0.5 + (habitat importance score/2)

The species offset amount(s) required is the sum of all species habitat units per zone

Where a zone does not require a species offset, the general habitat units in that zone is calculated by the following equation in accordance with the Guidelines:

General habitat units = extent x condition x general landscape factor x 1.5, where the general landscape factor = 0.5 + (strategic biodiversity value score/2)

The general offset amount required is the sum of all general habitat units per zone.

Native vegetation to be removed

Information provided by or on behalf of the applicant in a GIS file							Information calculated by EnSym					
Zone	**Type**	**BioEVC**	**BioEVC conservation status**	**Large tree(s)**	**Partial removal**	**Condition score**	**Polygon Extent**	**Extent without overlap**	**SBV score**	**HI score**	**Habitat units**	**Offset type**
4-S1	Patch	otr_0045	Least Concern	0	no	0.630	0.025	0.025	0.920		0.022	General
5-S1	Patch	otr_0045	Least Concern	0	no	0.630	0.006	0.006	0.688		0.005	General

Appendix 2: Information about impacts to rare or threatened species' habitats on site

This table lists all rare or threatened species' habitats mapped at the site.

Species common name	Species scientific name	Species number	Conservation status	Group	Habitat impacted	% habitat value affected
Peninsula Daisy-bush	*Olearia sp. 2*	502348	Rare	Highly Localised Habitat	Habitat importance map	0.0008
Coast Correa	*Correa backhouseana var. backhouseana*	504369	Vulnerable	Dispersed	Habitat importance map	0.0006
Otway Grey-gum	*Eucalyptus litoralis*	504557	Vulnerable	Dispersed	Habitat importance map	0.0000
Coast Twin-leaf	*Zygophyllum billardierei*	503615	Rare	Dispersed	Habitat importance map	0.0000
Broad-leaf Prickly Moses	*Acacia verticillata subsp. ruscifolia*	504211	Rare	Dispersed	Habitat importance map	0.0000
Coast Ballart	*Exocarpos syrticola*	501354	Rare	Dispersed	Habitat importance map	0.0000
Dune Poa	*Poa poiformis var. ramifer*	504826	Rare	Dispersed	Habitat importance map	0.0000
Sea Bindweed	*Calystegia soldanella*	500606	Vulnerable	Dispersed	Habitat importance map	0.0000
Leafy Greenhood	*Pterostylis cucullata subsp. cucullata*	505911	Endangered	Dispersed	Habitat importance map	0.0000
Southern Bent-wing Bat	*Miniopterus schreibersii bassanii*	61343	Critically endangered	Dispersed	Habitat importance map	0.0000
Southern Xanthosia	*Xanthosia tasmanica*	504088	Rare	Dispersed	Habitat importance map	0.0000
Swamp Skink	*Lissolepis coventryi*	12407	Vulnerable	Dispersed	Habitat importance map	0.0000
Hoary Rapier-sedge	*Lepidosperma canescens*	501915	Rare	Dispersed	Habitat importance map	0.0000
Slender Pink-fingers	*Caladenia vulgaris*	504449	Rare	Dispersed	Habitat importance map	0.0000
Common Bent-wing Bat (eastern ssp.)	*Miniopterus schreibersii oceanensis*	61342	Vulnerable	Dispersed	Habitat importance map	0.0000
Forest Bitter-cress	*Cardamine papillata*	505034	Vulnerable	Dispersed	Habitat importance map	0.0000
Currant-wood	*Monotoca glauca*	503859	Rare	Dispersed	Habitat importance map	0.0000
Bog Gum	*Eucalyptus kitsoniana*	501290	Rare	Dispersed	Habitat importance map	0.0000

Leafy Twig-sedge	*Cladium procerum*	500786	Rare	Dispersed	Habitat importance map	0.0000
Hooded Plover	*Thinornis rubricollis rubricollis*	10138	Vulnerable	Dispersed	Habitat importance map	0.0000
Parsley Xanthosia	*Xanthosia leiophylla*	504562	Rare	Dispersed	Habitat importance map	0.0000
Tufted Club-sedge	*Isolepis wakefieldiana*	501789	Rare	Dispersed	Habitat importance map	0.0000
Grey Goshawk	*Accipiter novaehollandiae novaehollandiae*	10220	Vulnerable	Dispersed	Habitat importance map	0.0000
Wrinkled Buttons	*Leiocarpa gatesii*	501942	Vulnerable	Dispersed	Habitat importance map	0.0000
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	11008	Endangered	Dispersed	Habitat importance map	0.0000
Elegant Parrot	*Neophema elegans*	10307	Vulnerable	Dispersed	Habitat importance map	0.0000
Lewin's Rail	*Lewinia pectoralis pectoralis*	10045	Vulnerable	Dispersed	Habitat importance map	0.0000
Tremont Bundy	*Eucalyptus aff. goniocalyx (Dandenong Ranges)*	507008	Vulnerable	Dispersed	Habitat importance map	0.0000
Chestnut-rumped Heathwren	*Calamanthus pyrrhopygius*	10498	Vulnerable	Dispersed	Habitat importance map	0.0000
White-throated Needletail	*Hirundapus caudacutus*	10334	Vulnerable	Dispersed	Habitat importance map	0.0000
Dwarf Silver Wattle	*Acacia nano-dealbata*	500064	Rare	Dispersed	Habitat importance map	0.0000
Black Falcon	*Falco subniger*	10238	Vulnerable	Dispersed	Habitat importance map	0.0000

Habitat group

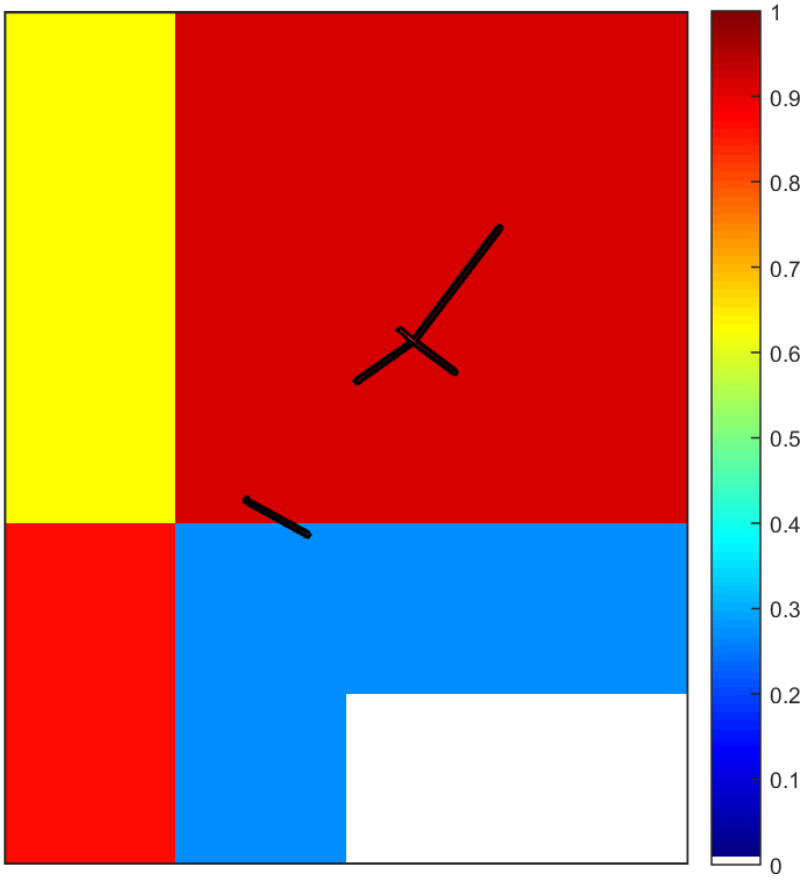
- Highly localised habitat means there is 2000 hectares or less mapped habitat for the species
- Dispersed habitat means there is more than 2000 hectares of mapped habitat for the species

Habitat impacted

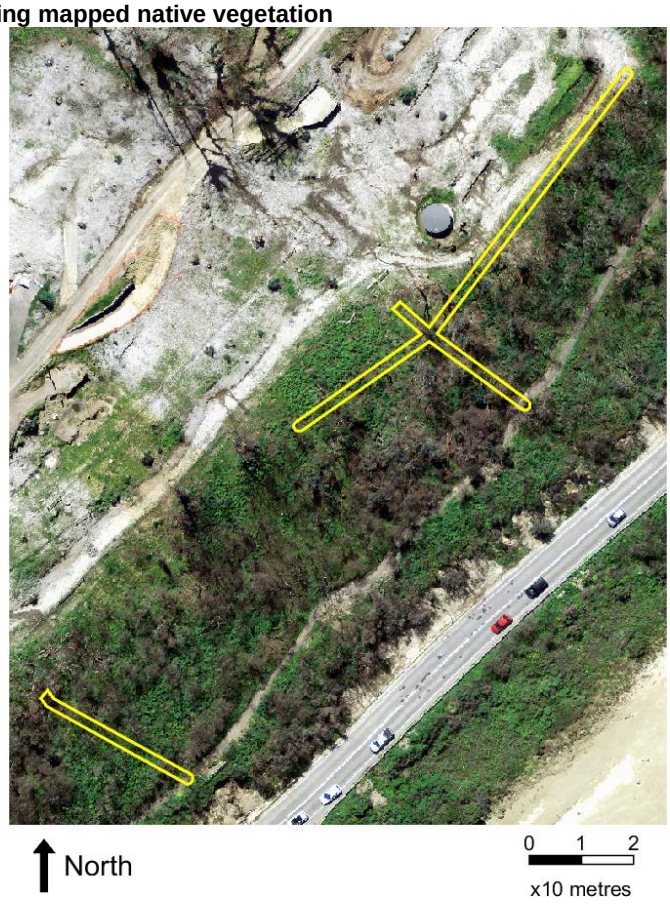
- Habitat importance maps are the maps defined in the Guidelines that include all the mapped habitat for a rare or threatened species
- Top ranking maps are the maps defined in the Guidelines that depict the important areas of a dispersed species habitat, developed from the highest habitat importance scores in dispersed species habitat maps and selected VBA records
- Selected VBA record is an area in Victoria that represents a large population, roosting or breeding site etc.

Appendix 3 – Images of mapped native vegetation

2. Strategic biodiversity values map



3. Aerial photograph showing mapped native vegetation



4. Map of the property in context

Yellow boundaries denote areas of proposed native vegetation removal.

YTTRUP

LANDSLIDE RISK ASSESSMENT REPORT

AT: **STORMWATER NETWORK**
ILUKA AVENUE
WYE RIVER

PREPARED FOR: **COLAC OTWAY SHIRE**
C/- KERIM SIJERCIC

REPORT NO.: **23170B**

FEBRUARY 2019

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LANDSLIDE RISK ASSESSMENT REPORT AT: ILUKA AVENUE, WYE RIVER REFERENCE NO: 23170B

1.0 INTRODUCTION

P.J. Yttrup & Associates Pty Ltd were commissioned by Colac Otway Shire (COS) to carry out a landslide risk assessment (LRA) at the above address in accordance with the requirements of the Australian Geomechanics Society (AGS) Guidelines on Landslip Risk Assessment (AGS, 2007) and the Colac Otway Shire (COS) Erosion Management Overlay (EMO).

The report details findings of the current and previous site inspections and investigations carried out on this site, and makes comments and recommendations in regards to slope stability, footings and earthworks at the site.

1.1 Landslide Susceptibility

The COS EMO indicates that a Landslide Risk Assessment (LRA) must be included in the planning permit application should a geotechnical assessment indicate that natural slopes are steeper than 14 degrees.

The Corangamite Catchment Management Authority (CCMA) has undertaken assessment and strategies as part of its Soil Health Strategy, including Landslide Susceptibility Mapping (Miner, 2007).

Reference to the 1:25,000 Wye River, Colac-Otway Shire Landslide Susceptibility Map indicates that the site is categorised with the Very High Landslip Susceptibility (Miner, AS (2007), in consideration of the knowledge of former landslides and the steep natural slopes within the area.

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2.0 PREVIOUS ASSESSMENTS

This site and adjacent properties have been subject to a number of previous investigations by this office and others:

- Coastal Community Revitalisation Project Report. Kennett River, Separation Creek and Wye River. April 2003.
- Coffey Report: Wye River and Separation Creek – Geotechnical, Land Capability and Wastewater Solutions – Geotechnical Assessment. 31 March 2016.
- AS MINER Report 922. Proposed Retaining Structures for Sites with a Significant Risk to Public Safety Wye River North – Version 3 09.08.16
- Golder Associates Reports for 17 Iluka Avenue, the "Iluka Track" and the legacy landslide risk assessment.
- Yttrup Report "15299 Land Stability Report" for 17 Iluka Avenue, Wye River. September 2003 and 2017.
- Yttrup Report "15406 Land Stability Report" for 23 Iluka Avenue, Wye River. August 2003. .
- Yttrup Report "13625 Landslide Review at Durimbil Avenue, Wye River. 2001.
- Yttrup Report "22478 Land Risk Assessment Report" at 3 Iluka Avenue, Wye River. December 2016.
- Yttrup Report "22317 Land Risk Assessment Report" at 24 Iluka Avenue, Wye River. April 2017. This includes bored pier inspections.
- AGR reports for 14 and 15 Iluka Avenue. 2016 to 2017.

The observations, comments, geotechnical investigations and recommendations of the above reports have been considered when preparing this report.

3.0 PROPOSED DEVELOPMENT

A stormwater network is proposed to be constructed in three locations on Iluka Avenue, Figure 1. It is understood that excavations in the order of 0.4 to 1.8 m are required for a 300 mm diameter stormwater drain that commence at Iluka Avenue and connect to outfall locations on the Great Ocean Road. Flexible above grade pipework is proposed in areas of known instability.i.e. The northern batter of the Great Ocean Road.

The proposed section from 25 Iluka Avenue will connect to a new drain on Wallace Avenue and may be up to 2.3 m deep. A design has been prepared by Cardno, Appendix A

4.0 GEOTECHNICAL INVESTIGATION

A Senior Geotechnical Engineer of Yttrup completed a site walkover in February 2019. Furthermore, that engineer completed mapping of geomorphology and several slopes between Iluka and Durimbil Avenue from May 2016 to August 2018.

The methods of investigation are highlighted on individual borehole logs and has included use of a 6 to 16 tonne excavators with rock augers, Gemco HS7 trailer mounted auger rig, Seismic refraction surveys, hand augers and Dynamic Cone Penetration testing.

Borehole and slope log reports relevant to the proposed alignment are attached in Appendix B.

5.0 SITE CONDITIONS

5.1 Geological Setting

Reference to the Geological Survey of Victoria Colac Mapsheet (Edwards et al, 1996) indicates the site lies within deposits of the Cretaceous Otway Group (Eumerella Formation). The formation is composed mainly of fine to medium grained sandstone and siltstone interbedded with thinner and less frequent mudstone. The quartz content is relatively low and the deposits weather rapidly to silts and clays.

Edwards et al (1996) outline the broad physiography of the Otway ranges as follows;

- The ranges are comprised of uplifted and eroded Cretaceous Eumeralla Formation.
- Miocene compression activity has produced northeast trending anticlinoria.
- The south eastern limb of these folds often forms dipslopes in proximity to the coastline.
- Numerous folds are offset by east trending faults. Typically streams run sub-parallel to these fault systems.

Dahlhaus et al (2003) report bedding typically dipping at 10 to 40 degrees to the southeast with variation in dips inferred to occur due to close proximity to faults and folds. In close proximity to Iluka Avenue the bedding varies from 20 to 25 degrees to the southeast. Iluka Avenue effectively runs along strike of bedding and therefore the property is positioned on a dipslope. This was confirmed by detailed mapping of beds by others and this office.

The dipslope can be considered as a structural domain, bounded by the ridge lines to the north and south, Figure 1.

There are several typical modes of failure found on dipslopes which are discussed in section 5.2.

5.2 Geomorphology

Dahlhaus et al, (2003) have described the significant geomorphological processes that affect Wye River in detail. Dahlhaus et al, (2003) state that;

- Coastal flanks of the Otway Ranges comprise rugged topography of ridges and spurs separated by deeply dissected and steep valleys.
- Erosion processes are driven by –
  - Significant uplift of the Otway ranges.
  - Relatively recent fluctuations of the sea level and warmer and wetter climates.
- Coastal erosion rates have been estimated at up to 50 to 100 m over the past 6000 years for sandstone and mudstone respectively.
- Inference that the majority of coastal landslides have occurred in the past 5000 years.
- Due to the current erosion processes and the significant number of landslides in the region, colluvium and landslide debris is often encountered.

For the purpose of this report the size of landslides are described by surface area in agreement with Dahlhaus et al, (2003). Where quantitative assessments are made, the estimates of potential volume of landslide material are calculated.

5.2.1 Documented & Observed Landslides & Instability

The proposed development site is immediately southeast of a known landslide zone (Miner, AS (2007), Figure 1.

Yttrup have previously documented the Durimbil Avenue historical landslide (Ref. 13625, 2001). That report inferred that

"The formation of the amphitheatre would have occurred within the past 6000 years, since the Otway Coast has receded 50 to 100 metres during that time (Bird, 2000). As the Holocene maximum sea level occurred 5000 to 6000 years before present, and sea levels have dropped approximately two metres in the past 3000 years, it may be assumed that the present day coastal landscapes may be up to 3000 years old. However, continued tectonic uplift of the Otway Ranges during that time has accelerated coastal erosion, and the morphology of features such as the amphitheatre may have developed over the past millennium.

The majority of the larger feature, interpreted as the initial slump, is considered stabilised as there is no evidence of recent major movement and the presence of rock outcrop indicates that the majority of the slumped debris material has been eroded. However, the steep northeastern slopes show signs of active creep and episodic colluvium failures."

This landslide is close to the proposed development however it poses no significant risk due to;

- 50 m offset to be documented scarp.
- Significantly different slope aspect. i.e. the landslide is on the opposing side of the ridge, Figure 1.
- No evidence of major and recent movement of the mass. Yttrup (ref. 13625, 2001) discuss the progressive nature of this failure where the backscarp is steep:

> *"Small (50 to 1000 m^2) to medium (1000 to 10000 m^2) landslide debris flows have been noted on Lot 187 and Lot 186 and possibly on Lot 182. These debris flows are derived from the over steep areas of the headscarp and are estimated to be of the order of 1000 years old at a maximum. As such, the likelihood of further occurrences must be classified as Possible in accordance with the AGS Guidelines."*

A summary of observed landslides and instability in Wye River that are relevant to the proposed development is provided in Table 1

TABLE 1
SUMMARY OF OBSERVED LANDSLIDES AND INSTABILITY

LOCATION	MODE OF FAILURE	STRATIGRAPHY	SLOPE CONTROL	COMMENTS
COASTAL PLATFORM BELOW ILUKA AVENUE	Planar Slide	Sandstone Colluvium	Wave action undercutting sandstone beds on the rock platform	Failure of the overlying soils, Photo 1 and in some cases, slab failures of slightly weathered rock, Photo 2. Presence of colluvium overlying rock indicates that this process has been occurring for a significant amount of time.
	Creep	Colluvium	wave action groundwater fault zones	Eroded fault zones are present on the rock platform and the risk of further erosion has historically been addressed by block retaining walls. Observed tilt to one of the retaining walls would support that it is affected by passive slope movements (creep of colluvial materials).
PADDY'S PATH 24 to 25 ILUKA AVE	Translational slide and debris flow	Residual soils and extremely weathered rock	over-excavation at the toe prolonged heavy rainfall coastal erosion lack of stormwater controls	May 2016 - post failure slope of a small (~600 m^2) sized and shallow translational slide was observed immediately above the Great Ocean Road and below 24 Iluka Avenue, Photo 3. The backscarp was approximately 1.5 m above the translated mass. Bedding planes were observed at the base of the failure and measureable seepage was observed on the shoulder of the Great Ocean Road. Rotated trees were obvious. September 2016 - after a period of heavy rainfall this failure regressed further upslope and close to the property boundary of 24 to 25 Iluka Avenue, Photo 4. It is possible that the Great Ocean Road was built on this colluvial material. Alternatively the road construction may have undercut fabric of weathered rock and led to instability immediately north of the road. Vicroads have since designed and constructed a slope remediation system to mitigate the effects of this landslide.

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LOCATION	MODE OF FAILURE	STRATIGRAPHY	SLOPE CONTROL	COMMENTS
PADDY'S PATH BELOW 17 ILUKA AVE	Translational slide and debris flow	Residual soils and extremely weathered rock	over-excavation at the toe, prolonged heavy rainfall reduced vegetation cover lack of stormwater controls	July 2016 - small translational failure occurred in the Great Ocean Road cutting, Photo 5.
PADDY'S PATH, 1ILUKA AVENUE	Creep	Surficial, residual soils and extremely weathered rock	Poor stromwater control Over-steep fill batters Non-engineered retaining walls	Common in the Wye River and Separation Creek area. Accumulation of colluvium at the toe of the dipslope may be a product of ongoing slab failures and creep. Non-engineered retaining walls (landscape walls) with obvious tilt
23 ILUKA AVENUE	Planar Slide	Highly weathered Sandstone	Bedding defect strength	May 2016 - man-made cut slopes showed evidence of movement on bedding, Photos 6 and 7. Planar slide is occurring on Clay seams and smooth bedding partings with the remaining shotcrete walls restricting movement.
2 ILUKA AVENUE 4 ILUKA AVENUE	Circular	FILL, Surficial, residual soils and extremely weathered rock	Cut slopes unprotected from surface water and no sub-surface water control. Heavy rainfall	Circular slumps where the slope angle approaches or exceeds 50 degrees, Photo 8. Where burnt out retaining walls are in cut and/or have been backfilled, the platforms are no longer supported and are unstable. Highest risk during construction.
TYPICAL OF ALL FIRE AFFECTED SLOPES IN WYE RIVER	Erosion	Surficial, Residual	Reduction in vegetation cover. Removal of topsoil. No stormwater control.	Increased susceptibility to erosion. Removal of residual soils which may increase the rehabilitation effort required. During winter surface water was observed to be transporting residual soils to stormwater (i.e to gullies, creeks, ocean). Piping observed above Paddy's path where existing drain from 14 Iluka intersects path (February 2019)

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5.2.2 Site slope detail

The proposed stormwater network is positioned on a dipslope, Figure 1. Key slope features include;

- Significant retaining walls are present on site. The retaining walls are cantilevered and comprise steel and concrete post and plank, Photos 9 to 10.
- Moderate to steep slopes (AGS, 2007), Figure 1, typically in the order of 15 to 35 degrees, Photos 11 to 12.
- The Great Ocean Road batter is typically in the order of 45 to 50 degrees. A major stabilising program is underway with soil nail, inclined drains and mesh, Photo 13 and retaining walls, Photo 14.
- VICROADs have constructed a cantilevered retaining wall at the southern property boundary of No. 25 Iluka Avenue, Photos 15 to 16.
- The site is positioned at the crest of a convex slope. i.e. the slope gets steeper approaching the toe. Over steepening may be due to:
  - Local folds and faults
  - Post slab failure geometry
  - Flexure of beds due to the height of the dip slope (approximately 60 m).

5.2.3 Surface water

Drainage across the project area is fair with ponding water common in wet season. During the inspection slopes were dry with no seepage observed.

5.3 Subsurface conditions

5.3.1 Lithology

The conditions encountered in the boreholes and mapping indicated subsurface conditions generally consistent with those described on the geological map and by others (Dahlhaus et al, 2003).

The following geotechnical units have been identified in the batters and boreholes:

- **SURFICIAL (1A)** Typically Sandy SILT, low plasticity, dark grey, fine grained sand, typically dry, firm to stiff.
- **COLLUVIUM (1B)** Combinations of Units 1A, 2 & 3B/4B with variable strength and moisture.
- **FILL (IC)** Combinations of Units 1A, 2 & 3B/4B with variable strength and moisture.
- **RESIDUAL (2)** Where SILSTONEs are at depth - typically a Silty CLAY, medium to high plasticity, pale grey and orange brown, typically stiff to very stiff, moist.

  Where SANDSTONEs are at depth – Sandy CLAY or Silty SAND, medium plasticity/fine to medium grained, brown, orange brown and pale grey, typically firm CLAY and medium dense SAND increasing in strength with depth, dry to moist.

  Note that the residual soils grade to extremely weathered SILTSTONE/SANDSTONE at depth.
- **SANDSTONE (3B)** SANDSTONE, fine to medium, brown, very low to low strength becomes medium strength towards the base of the unit, highly weathered.
- **SANDSTONE (3A)** SANDSTONE, fine to medium, grey and brown, medium to high strength, moderately to slightly weathered
- **SILTSTONE (4B)** SILTSTONE, fine, pale grey brown, laminated, extremely to very low strength, highly weathered.

The depths at which the above geotechnical units were encountered are summarised in Table 2.

TABLE 2
SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED

BOREHOLE/ EXPOSURE	DEPTH TO TOP OF UNIT (m)						TOTAL HEIGHT/ DEPTH (m)
	1A	1B	1C	2	3B	4B	
25-BH5	0.0	-	-	0.2	1.4	-	1.4
25-SLOPE 1	0.0	0.2	-	-	1.5	-	1.5
15406-BH1	-	-	-	0.0	1.5	-	1.7
17-BH3	-	-	0.0		1.35	0.8	1.35
17-BH4	-	-	0.0		0.7	0.6	1.35
17-SLOPE 1	0.0	-	-	0.2	2.5	1.0	2.8
GA-BH1	-	-	0.0	1.0	4.2	1.8	4.2
15299-BH1	-	-	0.0	0.7	1.9	1.4	1.9
AGR-BH1	0.0	-	-	0.4	1.0	-	1.2
AGR-BH2	0.0	-	-	0.1	1.1	-	1.1
AGR-BH3	1.5	-	0.0	1.8	2.3	-	7.0
AGR-BH4	0.0	-	-	0.4	-	1.6	3.4

5.3.2 Structural Model

Histograms of the field mapping data were produced to assess the general characteristics of structure relevant to the proposed development, Appendix B. This data has been combined with other recent mapping to confirm the validity of any assumed domains.

Stereoplots were produced to identify any structural sets within the field data. A magnetic declination correction of +11.4 degrees was used (Geoscience Australia, 2015).

5.3.2.1 Folds

The site is located on a fold limb with no evidence of significant variation in dip. There is evidence of change in strike of beds, in close proximity to faults.

5.3.2.2 Bedding

A total of 35 bedding planes have been mapped on the Iluka Avenue dipslope. Bedding planes generally had a dip varying from 5 to 30 degrees towards 080 to 185. The pole for the data set was 20/145. This is in good agreement with the trend of the exposed beds on the rock platform.

5.3.2.3 Joints

Joints are inferred to have formed during the sedimentation period as well under compression (folding) events. In folded sedimentary rocks, Fookes (2000) indicates that longitudinal, transverse joints and cross cutting joints will commonly be observed.

A total of 84 joints have been mapped between May to September 2016 with the histograms provided in Appendix B. Two to three sub-vertical joint sets are present in the cuttings and rock platform. A summary of these joints and their general characteristics is provided in Table 3.

TABLE 3
TYPICAL WYE RIVER DISCONTINUITY SETS

SET 1	SET 2	SET 3	SET 4
Bedding	Joint Orthogonal to bedding	Joint Cross cutting bedding	Joint Parallel to bedding
ORIENTATION (TRUE NORTH) DIP/DIP DIRECTION			
5 to 30/95 to 200 (20/145)	45 to 90/10 to 75 (75/050) 65 to 85/205 to 240 (80/225)	45 to 90/245 to 310 (70/280)	45 to 90/180 to 195 (70/190) 55 to 90/340 to 010 (75/355)
EFFECTIVE LENGTH (m)			
Dip slope indicates 100's of metres	Horizontal 10-20m observed on rock platform Vertical generally <5m (limited by height of cuts and beds)		
EFFECTIVE SPACING (m)			
<0.25 to 0.75m	Typically 0.25 to 1 m up to a max. of 5m. Terminate at beds.	Typically 0.25 to 1 m, up to 5 m.	
CONDITION			
Planar. Slightly rough to rough. Iron stained with clay veneers and seams common in Unit 3B Bedding parallel shears are rare (5%)	Highly weathered - typically Planar, Slightly rough, iron stained with some clay seams and smooth surfaces. Moderately weathered or better - typically Planar, Rough, iron stained.		

5.3.2.4 Faults and Shears

A total of three fault/shear zones were observed on the rock platform. These fault/shear zones run sub-parallel to Sets 2 and 3. Throws were not observed however significant disturbance from shearing was evident.

5.3.3 Groundwater

Permanent groundwater was not observed in the cut slopes or in the boreholes, however perched and ponding water has been noted as follows:

- Along the interface of units 2 & 3B/4B in most cuts during wet weather.
- In bored pier excavations to 4.5 m BGL on 21 to 24 Iluka Avenue.

Considering the proposed position of the development and slope of the site, it is unlikely that permanent groundwater would be encountered on this site at depths relevant to the development. However, groundwater may flow through the soil and fractured rock during periods of wet weather and the wet season. Rainfall infiltrates the surficial soils (Units 1A to 1C, 2) with the mass of Unit 4B/3B restricting flows to along defects (bedding/joints).

6.0 IMPACTS OF PROPOSED DEVELOPMENT

6.1 Tree Removal

Removal of vegetation is proposed to construct the stormwater drain. Trees provide a “root binding” effect in the upper soil structure, and an uptake of moisture which increases soil suction and improves the stability of slopes.

Existing vegetation should be maintained where practical, and any stripped areas should be re-vegetated with suitable, managed vegetation.

Exposed residual soils with no topsoil cover are present on site and they are at risk of erosion due to the loss of vegetation on site. Furthermore, there is an increased risk of shallow translational failures in the surficial and residual soils. This risk will be at its greatest during winter and during periods of construction where engineering controls have yet to be installed. Yttrup has considered the bushfire impacts in the risk assessment for alignment as follows;

- Increased ‘likelihood’ of some failure modes from likely to almost certain where historical engineering controls have been destroyed GROCON and VICROADS have largely implemented the engineering controls required to stabilise the site for the construction period. Furthermore temporary large diameter plastic stormwater drains are in place.
- Increased ‘likelihood’ of translational failures due to the lack of storm water control (loss of roof catchments, storage, and discharge points).
- Once the stormwater system is implemented the likelihood of the above failures will reduce significantly, especially when dwellings are connected to the LPOD.

The risk assessment and assumptions are detailed in Section 7 with recommendations to mitigate the elevated risks detailed in Section 8.0.

6.2 Excavation

Excavation is proposed for:

- Stormwater manholes
- Stormwater trenches
- Access to the alignment

Any proposed excavation has the potential to cause slope instability; both during construction and in the long-term. Failures may be either localised translational failures or slumping of Units 1 and 2. Access excavations should be minimised where possible, however this can be difficult when considering the site slope.

For support of permanent cuts, which are steeper than recommended batter angles (Table 7), engineer designed retaining walls are required and shall consider the likely construction methods and timeframe. Suitable lateral support should be maintained during construction.

Bulk excavations for temporary works shall not be left open for extended periods (greater than one month) or undertaken during wet periods. Staging of works shall consider appropriate timeframes and sequencing of earthworks to minimise the amount of disturbed slopes at any time.

6.3 Stormwater Management

Poor management of stormwater has the potential to cause localised concentration of moisture on the slope, increasing the risk of a landslide. In particular, increased moisture in the residual soils and weathered rock will increase the likelihood of creep and shallow slab failures developing.

During construction appropriate surface cut off drains/bunds across the site should divert water around the trenches. Construction during periods of wet weather should be avoided where possible.

7.0 LANDSLIDE RISKS

A LRA is required to be undertaken, in accordance with the requirements of the AGS (2007) and the COS EMO. Risk to life and property have been considered for credible modes of failure at the site.

As outlined in the COS EMO Schedule, a "Tolerable Risk" as defined by AGS (2007) is required to allow development to proceed, Table 4.

TABLE 4
TOLERABLE RISK

RISK TYPE FOR LOW RISE RESIDENTIAL DEVELOPMENT	TOLERABLE RISK LEVEL (AS PER AGS 2007 C AND D)
Risk to Property and infrastructure (Qualitative Assessment)	MODERATE
Risk to Life for existing slopes and development (Quantitative Assessment)	1×10^{-4}
Risk to Life for new slopes and new development (Quantitative Assessment)	1×10^{-5}

With regards to slopes of the proposed development;

- Site slopes above and below the proposed development, within well vegetated areas, and that are to be unmodified are considered to be 'existing' slopes.
- Deep seated failures within underlying Moderately or Slightly Weathered SANDSTONE, unaffected by the upper development may be considered an 'existing' slope.
- Slopes within the footprint of the proposed drains are considered to be 'new' slopes. This includes slopes;
    - Composed of FILL
    - Cut for temporary access
    - Excavations for manholes

Based on the results of the fieldwork, seven failure modes have been identified. These are presented in Sections, Figures 4 to 5 and Plan, Figure 6.

TABLE 5
SUMMARY OF LANDSLIDE RISKS – DIPSLOPE DOMAIN

CASE	MODE OF FAILURE	GEOTECH. UNITS	TRIGGERS	DESCRIPTION	ESTIMATED P(H)
1	Trench Collapse	1, 2	• Over steep unsupported batters. • Removal of vegetation and topsoil • Wet weather & seepage	Trench collapse is possible without engineering controls. Increase in risk where trenches run parallel to slope. Increase in risk due to vegetation and topsoil removal.	• With engineering controls unlikely to occur.
2	Piping	1,2	• Steep trench grades • Seepage • Dispersive CLAY	Piping is almost certain to occur over the life of the development without engineering controls. Increase in risk where pipeline travels directly down the slopes.	• Almost certain without controls, reducing to unlikely with good quality back fill materials.
3/6	Translational	1,2	• Over steep slopes. • Prolonged heavy rainfall • Poor management of surface and sub-surface water • Poor management of Great Ocean Road (GOR) shoulders. • Loss of vegetation and stripping of topsoil materials • Large pore pressure gradient at the toe of the slope	Observed in 2016 (Paddy's Path) in the same structural domain. The majority of these failures have been shallow (less than 2 m thick). Five variations of this failure mode have been identified; • Mode 3A: Impacting VicRoads retaining wall at 25 Iluka Avenue • Mode 3B: Impacting Iluka Track Retaining wall and adjacent disposal fields and footings for dwellings. • Mode 3C: Impacting the stormwater network with potential regression into adjacent properties. • Mode 6A to 6C: regression of Great Ocean Road instability affecting the network. The evidence of slab failures is present at the rock platform and immediately above the Great Ocean Road. Failures that develop at the toe would progress up the slope with time. The likelihood of heavy rainfall causing slab failures in the upper slopes is considered rare to barely credible as no scarps of this nature were observed, nor have they been reported on this dipslope. In completing the assessment the following is assumed: • Site won CLAY not suitable for re-use (see piping risk). • GOR instability may damage pipework and therefore the flexible above ground option is recommended. • Given the existing grid of soil nails above ground is one of few practical options to deliver stormwater to the outlet. • Where the network follows contour it is close to existing retaining walls. The designer shall consider proximity to adjacent footings.	• Given the recommendation for high quality back fill and the major stabilisation works completed by VICROADS, it is unlikely that the source of failure would be from the drain itself.
4	Creep	1, 2	• Over steep slopes. • Strain incompatibility with underlying bedrock • Seepage • Removal of vegetation and topsoil	Creep is possible to occur over the life of the stormwater network without engineering controls. Drains along contour will be susceptible to creep and will require routine inspection to check for leaks and flexible fittings.	• Possible without controls, reducing to unlikely with good quality back fill materials and flexible fittings.
5	Erosion Head	1, 2	• Unstable batters of Great Ocean Road	Unstable road batters may result in damage to network, leaks and progressive slope failure. However, major stabilisation works in the area will have improved stability of the site.	• With VicRoads routine slope inspections, stabilisation works and above grade flexible construction considered unlikely to occur. • Decrease in probability with high quality back fill materials.
7	Planar	ALL UNITS	• Buckling due to excessive heights of dip slopes. • Undercutting of beds on the rock platform or other major earthworks. • Smooth bedding partings	This typically affects finer grained beds such as siltstone and mudstone. These are encountered in the highly weathered rock mass however they are not encountered at depth. Based on mapping completed at several locations along Iluka Avenue, the Great Ocean Road and the rock platform, the likelihood of a weak siltstone or mudstone bed at 3 to 6 m depth is considered rare to barely credible.	• Based on erosion rates and mapped bed thicknesses. • The calculated probability equates well with 'rare' (3 x 10^{-5})

7.1 Risk to Property

The modes of failure that could impact on the network are outlined in Table 5. The qualitative risk appraisal for the various modes that could impact on the network and adjacent dwellings are outlined in Appendix D.

7.2 Risk to Life

The risk of loss of life can be estimated using the AGS quantitative risk assessment, expressed with the following equation:

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

Refer to the Risk Assessment Matrix and commentary in Appendix D.

Annual Probability of Occurrence, $P_{(H)}$:

Values for the annual probability of occurrence are calculated where information is available or they are taken directly from the AGS guidelines which recommends values for the probability of occurrence and their qualitative descriptor equivalent.

For coastal erosion rates;

- A 2m thick SANDSTONE bed dipping at 20 degrees will take approximately 650 years to erode. It will take 1400 years for 4 m of SANDSTONE beds to erode and trigger a large slab failure.
- This is the assumed trigger for a shallow slab failure. However, significantly greater erosion would be required to pose a risk to properties on Iluka Avenue as the Great Ocean Road is a bench i.e. the road would have to be undermined to expose beds which control stability of the dipslope Based on our geological model we have estimated that between 5 to 10 m of erosion would be required to trigger instability of the entire dipslope.
- Note we have not included mudstone/siltstone rates as these units have not been mapped in a zone relevant to the development. The immediate toe of the cliff line on the rock platform contains SANDSTONE beds.

With regards to bedding plane defects we have assumed;

- Bedding plane defects are persistent from Iluka Avenue to the rock platform. Note that 14% of Sandstone defects on the rock platform were noted to be smooth.
- 60% of the bedding planes in weathered rock had a clay infill or veneer.

These factors have been multiplied by the erosion rates to produce an annual probability of occurrence for Mode 7, in existing slopes. These erosion rates

result in indicative annual probabilities in the order of 1 x 10^{-4} to 1 x 10^{-5} which is in general agreement with Unlikely to Rare likelihoods.

Probability of Spatial impact , $P_{(S:H)}$:

Spatial impacts have been estimated as a probability of the given failure mode physically imposing on the dwelling or asset in which occupants may be situated.

This analysis has estimated landslide volumes and measured reach angles to the elements at risk from surveyed geometry. Our assumptions regarding the reach of landslide are based on Mostyn et al (2002) and Walker (2002). Our assumptions regarding the location of back scarps and possible regression are based on the structural model and inferred defect strengths.

For details please refer to the risk assessment in Appendix D.

Temporal Spatial Probability $P_{(T:S)}$:

Temporal spatial probability describes the likelihood of a person being at the site (or in the house) at the time of occurrence.

We have conservatively assumed the following;

- Pedestrians on upper or lower slopes (maintenance) 0.5 hours per day (1/48)
- The houses on each property are occupied 80% of the time (conservative given the typical holiday usage).

Vulnerability, $V_{(D:T)}$

Example vulnerability values are provided in Appendix F of AGS 2007. The basic approach adopted by Yttrup is presented in (Finlay, Mostyn, & Fell, 1999) and discussed as follows;

- Pedestrians and workers have a high vulnerability (1.0) in large slides, but reduced vulnerability in small scale slides where they are not buried (0.1).
- Occupants in houses on top of a slide have a low vulnerability (0.1) as the dwelling is not likely to collapse but rather move down slope as a “rigid body” translation. Occupants in houses are less vulnerable in small slides that strike the dwelling only (0.05), but have high vulnerability in large slides (1.0) where burial or collapse may occur.
- A person/vehicle subject to slow landslide creep effects on slopes (less than 1.0 m/year) is highly unlikely to be impacted. I.e. there is a negligible vulnerability (0.001).

7.3 Results of Assessment

The results of the assessment are provided in Appendix D. The risk appraisal suggests a “High to Very High” risk exists on the current site, which reduces to “Low to Moderate” risk when additional controls are implemented.

Risk Mitigation Works are required to be implemented to reduce the risk to property and life to tolerable levels. Refer to Section 8 further details of the risk mitigation works. These apply to temporary access and construction.

8.0 RISK TREATMENT PLAN

If the risk to property and loss of life are to be reduced, the following works shall be carried out. This is critical to reducing and maintaining risks at this site.

8.1 Bulk Earthworks Conditions and Constraints

It is understood that open trenching is the preferred method of construction.

Based on the geotechnical investigation and proposed invert levels up to 2.3 m BGL, excavation may include FILL Colluvium, Residual Soils and Weathered Siltstone and Sandstone. Excavation in these units should be achievable using conventional earth moving equipment (e.g. excavators).

Where possible, the depth of excavation for proposed pipework shall be minimised.

Where trenching is adopted, the designer shall consider:

- **GEOHAZARD:** Significant landslide features are present along the alignment. In areas parallel to slope where no retaining walls are present (25 Iluka to Wallace) squeezing conditions and trench collapse is possible. Furthermore, seepage is to be expected. Appropriate dewatering, trench batters and staging will be required. High quality back fill options shall be considered.
- Hill side creep may impact drains running along slope contour. It is less likely to occur adjacent to the GROCON retaining walls however between 25 Iluka Avenue and the connection to Wallace Avenue expansion joints and swivels may be considered. Alternatively acceptance of higher frequency of inspection and maintenance of that length of pipeline could be adopted.
- Hit and miss sequencing of earthworks may be required to avoid destabilising slopes.
- The CLAYs are dispersive and prone to piping related failures. The designer shall consider methods of controlling piping such as:
    - Use of non-dispersive material as back fill (e.g. crushed rock or cement stabilised sand/rock).
    - Non-permeable capping.

8.2 Footings for Manholes

The development drawings indicate manholes may be installed. Allowable bearing capacities for units expected to be encountered at footing level are provided in Table 6.

TABLE 6 ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS FOR MANHOLES

INFERRED UNIT	SERVICEABILITY END BEARING PRESSURE (KPA)
UNIT 2, stiff	100
UNIT 3B	500
UNIT 4B	300

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8.3 Permanent and Temporary Batters

Temporary batter slopes for slopes less than 2.5 m in height are provided in Table 3, subject to the following conditions;

1. The batters shall be protected from erosion.
2. Temporary batters should not be left unsupported for more than one month without further advice.
3. An inspection by a geotechnical engineer should be undertaken following significant rain events.
4. Where loads are imposed or retaining walls/structures/services are located within one batter height of the crest of the batter, further advice, including stability assessments, should be sought. This may apply to numerous retaining walls along the easement.

Should permanent batters exceed the recommendations provided in Table 7, engineer designed shoring walls shall be adopted.

TABLE 7: BATTER SLOPE ANGLES

MATERIAL	TEMPORARY	PERMANENT
UNITS 1 to 2, FILL PLATFORMS	1H:1V	3H:1V
UNITS 4B		2H:1V[1]
UNITS 3B	1H:2V	

Note 1: SILTSTONE rocks of the Eumeralla Formation typically slake and brake down to soil. This can happen over a period of days.

8.4 Shoring Walls

The designer shall consider the slope angle at the location of proposed shoring walls. The earth pressure coefficients may be calculated using the effective friction angles provided in Table 8. Earth pressure coefficients may be calculated as follows:

Active Earth Pressure, Ka

$$K_a = \frac{\cos\beta - \sqrt{(\cos^2\beta - \cos^2\emptyset)}}{\cos\beta + \sqrt{(\cos^2\beta - \cos^2\emptyset)}}$$

Passive Earth Pressure, Kp

$$K_p = \frac{\cos\beta + \sqrt{(\cos^2\beta - \cos^2\emptyset)}}{\cos\beta - \sqrt{(\cos^2\beta - \cos^2\emptyset)}}$$

Where: β is slope surface angle from the horizontal and $\emptyset$ is the effective friction angle of the soil/weathered rock layer.

TABLE 8 ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS – SHORING WALLS

INFERRED UNIT	BULK UNIT WEIGHT (kN/m^3)	EFFECTIVE STRENGTH PARAMETERS	
		EFFECTIVE COHESION *c'* (kPa)	EFFECTIVE FRICTION ANGLE $\emptyset$' (deg)
UNIT 1	18	2	26
UNIT 2	19	5	27
UNIT 3B	23	25	35
UNIT 4B	22	15	30
BEDDING PLANE SHEAR	20	0	20

8.5 Material Re-Use and Fill Placement

Re-use of site won materials presents several constraints:

- The CLAYs are dispersive and prone to piping related failures.
- The weathered rock when ripped or subjected to breakers typically returns an oversized product. This will not be suited for use in back fill without sorting and potential crushing.

All fill should be placed in accordance with the guidelines in AS3798-2007, “Guidelines on Earthworks for Commercial and Residential Development”.

It is considered appropriate that the earthworks to the site would be undertaken with supervision to the requirements of AS3798-2007 and COS.

The designer shall consider the use of non-dispersive back fill.

8.6 Site Drainage

Surface water control measures shall be designed to collect all runoff upslope of the excavation. Water shall be discharged in an appropriate manner to the legal point of discharge.

Note that at these depths, groundwater may be encountered during the wet season. The designer shall consider groundwater control measures during construction. In trench drainage measures may be adopted to permanently drain the base of the trench. Ponding of water in the base of trenches has the potential to cause instability in adjacent FILL batters and should be avoided.

8.7 Revegetation

The removal of vegetation has the potential to increase the risk of instability. It is recommended that existing vegetation be maintained where practical, and that any stripped areas are re-vegetated with suitable managed vegetation, as soon as possible. Realignment of stormwater trenches are recommended where possible to avoid removal of vegetation. E.g. along the existing Grocon access tracks that run along slope contour.

8.8 Earthworks Supervision

A geotechnical inspection is recommended during initial construction to assess any proposed access tracks into the site for construction, and the temporary stability of the site.

8.9 Ongoing Site Maintenance

Ongoing site maintenance and development shall be in accordance with the attached notes for Good Practices for Hillside Development, Appendix E.

Even with best practice construction, above average maintenance of trench back fill and cleaning of drains should be factored into the operation of the network.

9.0 CONCLUSION

The LRA has found that the site can be made suitable with appropriate controls, and that the proposed development can meet the "tolerable" risk criteria outlined by AGS (2007). This will include:

- Minimise excavation depth where possible.
- Relocate pipework to adjacent tracks where practical to avoid vegetation removal.
- Provide engineer designed shoring systems to excavations, as required. Strict limitations apply to unsupported excavations.
- High quality back fill options with limitations on re-use of site won materials.
- An allowance for above average maintenance and inspection of the network due to risk of hillside creep damaging concrete pipes.
- Consideration of expansion joints and swivels where creep is difficult to control.
- Drainage, re-vegetation and maintenance in accordance with attached Good Practices for Hillside Development.

We consider that the LRA has shown that the proposed stormwater network can meet the 'tolerable risk' criteria, provided that the recommendations given in Section 8 are adopted.

Dane Pope
Chartered Professional Engineer
Geotechnical Engineer

Nathan McLaren
Chartered Professional Engineer
Director

P.J. YTTRUP & ASSOCIATES PTY. LTD.
27 February 2019

10.0 REFERENCES

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FIGURES

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DURIMBIL AVE
HISTORICAL
LANDSLIDE FEATURES

ILUKA AVENUE

PADDYS PATH

GREAT OCEAN ROAD

ZONE OF
CREEP,COLLUVIAL
FANS

DIPSLOPE

DIPSLOPE

MULTIPLE FAILURES IN ROAD
BATTER AUG. TO SEPT. 2016

UNIT 2 AT
SURFACE (EWR)

UNIT 3B AT
BASE OF CUT

SEPT. 2016
FAILURE

PIPING/EROSION
OBSERVED

EXISTING TRACK
AND GROCON
RW

GULLY

SILTSTONE BEDS

SILTSTONE BEDS

TOR 0.4m

TOR 1.5m

TOR 2.3

TOR 1.1

TOR 1.2

TOR 1.8

TOR 1.0

TOR 1.2 m

TOR 1.2 m

AGR-BH3

AGR-BH2

AGR-BH1

AGR-4

22478-BH4

22478-BH5

GA BH1

17-DCP1

15299-BH

17-DCP3

17-DCP2

BH4

17-SLOPE1

17-BH2

17-BH3

17-BH1

15375-BH1

15375-BH1

15406-BH1

24-SLOP

25-BH1

24-BH2

24-BH1

23-SLOPE 1

25-SLOPE 1

25-BH2

25-BH3

25-BH4

25-BH5

25-SLOPE1

10

13

14

15

21

1/F

2/A

1/D

3/A

4/G

4/F

5/A

5/C

4/E

8/D

8/B

7
FIG4

8
FIG 5

P5/155

20/150

25/155

LEGEND

- PROPOSED STORM WATER DRAIN
- HUMMOCKY GROUND
- HISTORICAL SEISMIC LINE
- ANTICLINE HINGE
- SYNCLINE HINGE
- BEDDING – APPROX. DIP
- SLOPE
- SCARP
- CLIFF (HEIGHT M)
- CONVEX SLOPE
- CONCAVE SLOPE
- BH1 BOREHOLE
- TOR 1.5 DEPTH TO TOP OF ROCK (m)
- SEEPAGE OR OVERLAND FLOW
- 0.5 to 1 m CONTOUR

ISSUE

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DATE	REVISION	BY

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CLIENT: COS

PROJECT: ILUKA AVENUE
WYE RIVER

DRAWING: SITE PLAN

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CHECKED	FIGURE: 1	
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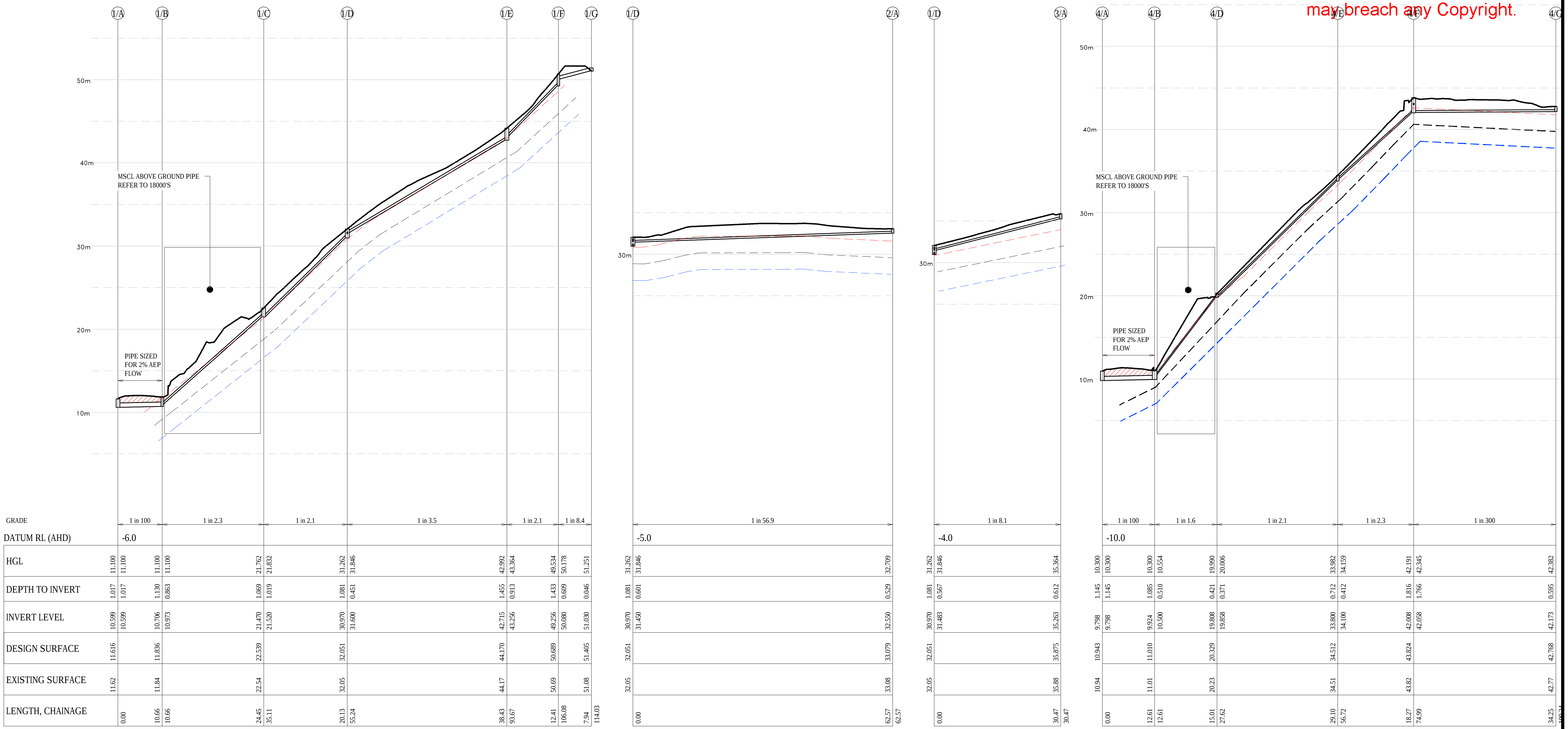

LEGEND

TOP OF ROCK (TOR)

TOP OF LOW TO MEDIUM STRENGTH ROCK

TOP OF SW TO FRESH ROCK

ISSUE					
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PROJECT: ILUKA AVENUE WYE RIVER

DRAWING: SECTIONS 1A TO 1G, 1D TO 2A, 1D TO 3A, 4A TO 4G

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CHECKED	FIGURE	
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SCALE	DATE	REV No.
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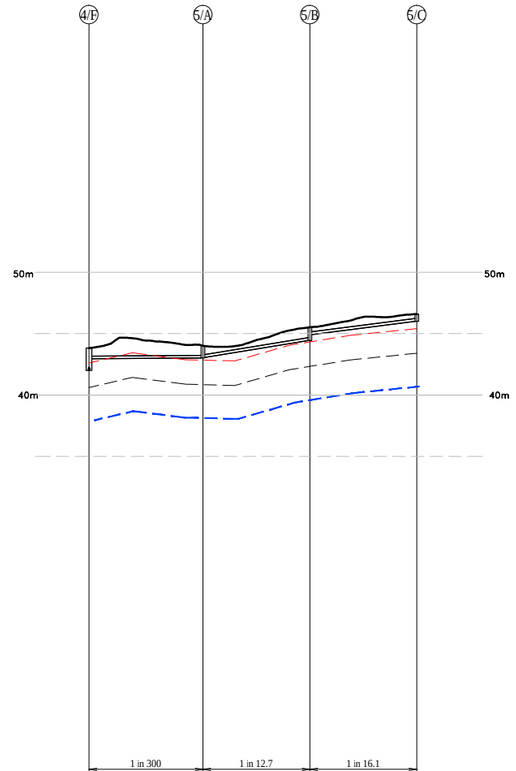
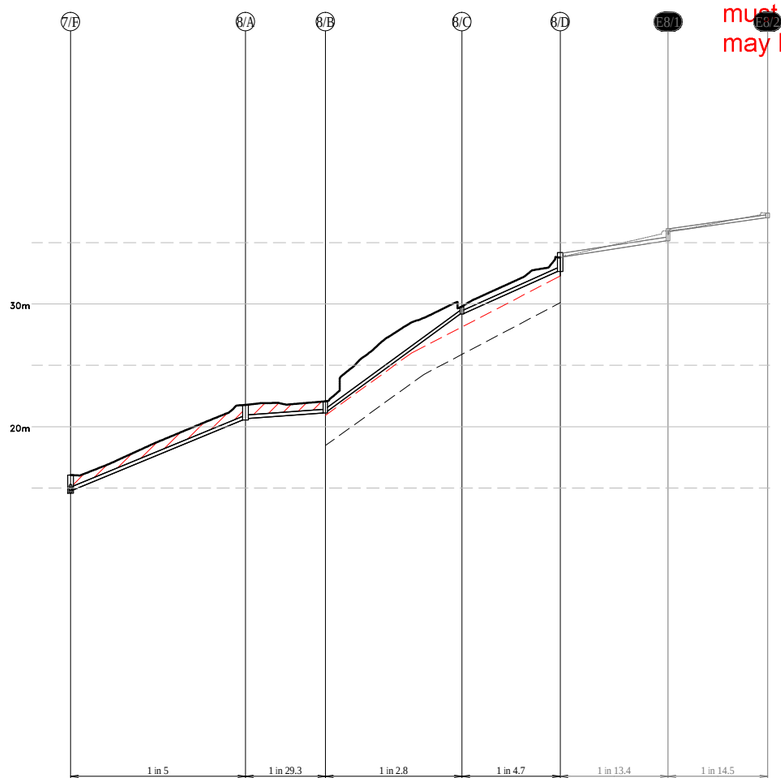


GRADE		1 in 300		1 in 12.7		1 in 16.1	
DATUM RL (AHD)		7.0					
HGL	42.191	43.103	43.214	43.269	44.549	44.979	46.089
DEPTH TO INVERT	1.816	0.861	0.999	0.949	1.084	0.595	0.595
INVERT LEVEL	42.008	42.963	43.025	43.075	44.450	44.939	46.018
DESIGN SURFACE	43.824		44.023		45.534		46.613
EXISTING SURFACE	43.82		44.02		45.53		46.61
LENGTH, CHAINAGE	0.00	18.58	18.58	17.45	36.04	17.41	53.44



GRADE		1 in 5		1 in 29.3		1 in 2.8		1 in 4.7		1 in 13.4		1 in 14.5	
DATUM RL (AHD)		-11.0											
HGL	14.997	15.206	20.702	20.760	21.257	21.317	29.316	29.319	32.785	33.913	35.292	35.949	37.101
DEPTH TO INVERT	1.492	1.199	1.234	1.097	0.947	0.794	0.622	0.572	1.138	-0.059	0.795	0.035	0.369
INVERT LEVEL	14.568	14.860	20.535	20.672	21.117	21.269	29.175	29.225	32.643	33.840	35.150	35.910	37.030
DESIGN SURFACE	16.060		21.769		22.063		29.797		34.200		36.145		37.399
EXISTING SURFACE	16.06		21.77		22.06		29.80		33.78		35.95		37.40
LENGTH, CHAINAGE	0.00	28.54	28.54	13.05	41.58	22.26	63.84	16.02	79.86	17.59	97.46	16.24	113.70

LEGEND

TOP OF ROCK (TOR)

TOP OF LOW TO MEDIUM STRENGTH ROCK

TOP OF SW TO FRESH ROCK

ISSUE

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PROJECT: ILUKA AVENUE WYE RIVER

DRAWING: SECTIONS 4F TO 5C 7F TO 8D

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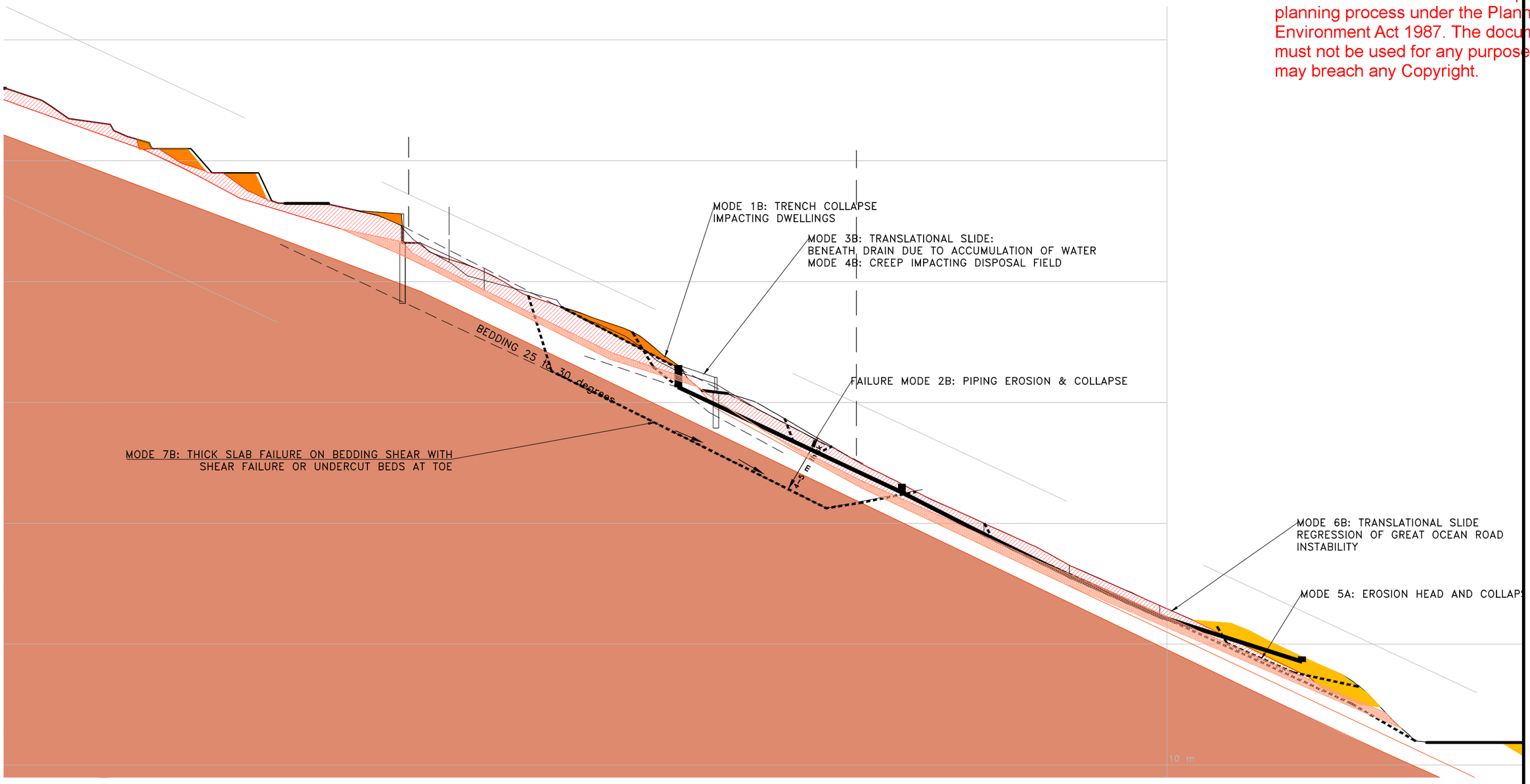

LEGEND

UNIT 1A – SURFICIAL

UNIT 1B – COLLUVIUM

UNIT 1C – FILL

UNIT 2 – RESIDUAL

UNIT 3B – SANDSTONE, VLS–LS,HW

UNIT 3A – SANDSTONE, M–H, MW–SW

UNIT 4B – SILTSTONE ELS–VLS, HW

UNIT 4A – SILTSTONE VLS–LS, MW

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PROJECT: ILUKA AVENUE
WYE RIVER

DRAWING: SECTION 7
17 ILUKA
MODE OF FAILURE

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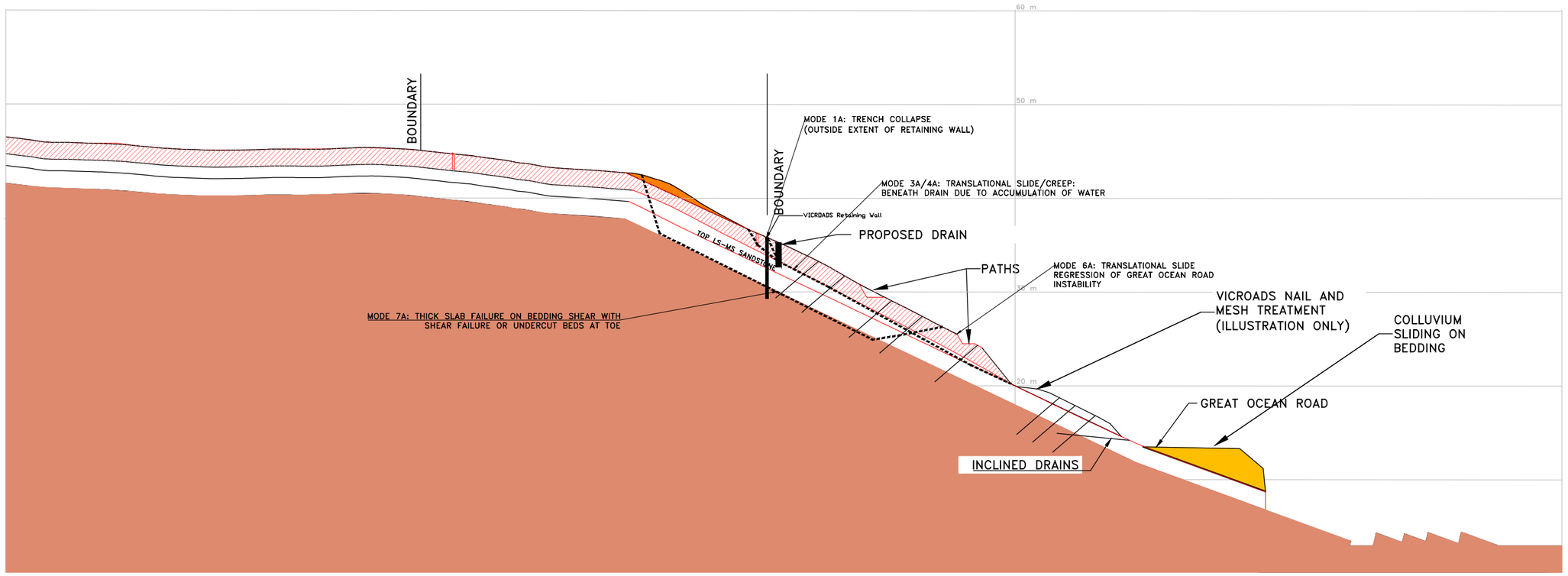

LEGEND

UNIT 1A – SURFICIAL		UNIT 3B – SANDSTONE, VLS–LS,HW	
UNIT 1B – COLLUVIUM		UNIT 3A – SANDSTONE, M–H, MW–SW	
UNIT 1C – FILL		UNIT 4B – SILTSTONE ELS–VLS, HW	
UNIT 2 – RESIDUAL		UNIT 4A – SILTSTONE VLS–LS, MW	

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PROJECT: ILUKA AVENUE
WYE RIVER

DRAWING: SECTION 8
25 ILUKA AVE

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DURIMBIL AVE
HISTORICAL
LANDSLIDE FEATURES

ILUKA AVENUE

10
13
14
15
21

MODE 2C:
PIPING
EROSION AND
COLLAPSE

MODE
3C/4C:
TRANSLATIONAL
SLIDE/CREEP

MODE 1C:
TRENCH
COLLAPSE

MODE 5B:
EROSION HEAD
& COLLAPSE

MODE 6C/7C:
LARGE DEBRIS
FLOWS OR
SLAB
FAILURES

MODE 1B:
TRENCH
COLLAPSE

MODE 2B:
PIPING
EROSION
AND
COLLAPSE

MODE 5A:
EROSION HEAD
& COLLAPSE

MODE 3B/4B:
TRANSLATIONAL
SLIDE/CREEP

MODE 6B/7B:
LARGE DEBRIS
FLOWS OR
SLAB
FAILURES

MODE 2A:
PIPING
EROSION AND
COLLAPSE

MODE
1A:
TRENCH
COLLAPSE

MODE 3A/4A:
TRANSLATIONAL
SLIDE/CREEP

MODE 6A/7A:
LARGE DEBRIS
FLOWS OR
SLAB
FAILURES

P5/155
P20/160

1/F
2/A
3/A
4/G
4/F
5/A
5/C
4/E
8/D
8/B
1/A

7
FIG4

8
FIG5

LEGEND

- PROPOSED STORM WATER DRAIN
- HUMMOCKY GROUND
- HISTORICAL SEISMIC LINE
- ANTICLINE HINGE
- SYNCLINE HINGE
- BEDDING – APPROX. DIP
- SLOPE
- SCARP
- CLIFF (HEIGHT M)
- CONVEX SLOPE
- CONCAVE SLOPE
- BOREHOLE
- DEPTH TO TOP OF ROCK (m)
- SEEPAGE OR OVERLAND FLOW
- 0.5 to 1 m CONTOUR

ISSUE

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CLIENT
COS

PROJECT
ILUKA AVENUE
WYE RIVER

DRAWING
SITE PLAN
MODE OF FAILURE

ENGINEER	DRAWN	JOB No.
	DP	23170
CHECKED	FIGURE	
	6	
SCALE	DATE	REV No.
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APPENDIX A

Drawings

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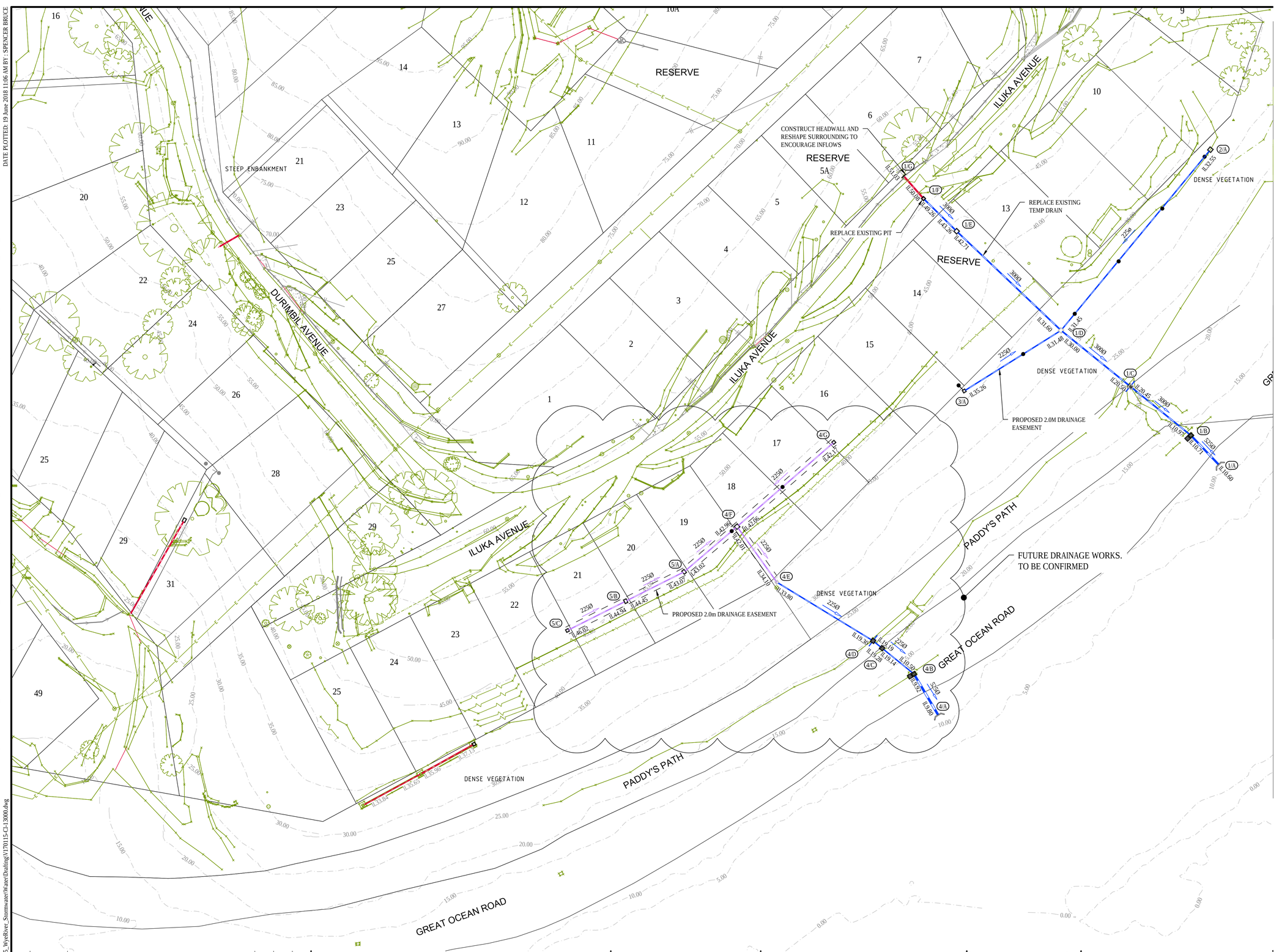

Rev.	Date	Description	Des.	Verif.	Appd.
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1	9/05/18	FOR TENDER	JO	EH	

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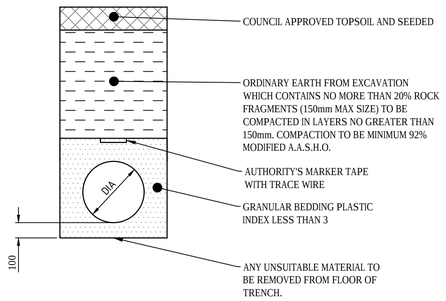
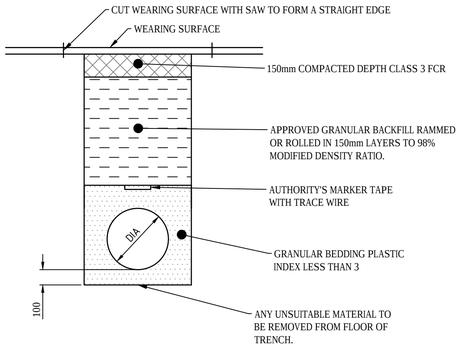
Drawn	J.O	Date 07/05/18
Checked	SB	Date 9/05/18
Designed	J.O	Date 07/05/18
Verified	EH	Date 9/05/18
Approved		Date

Client: COLAC OTWAY SHIRE
Project: WYE RIVER AND SEPARATION CREEK STORMW MANAGEMENT SYSTEM DETAILED DESIGN
Title: ILUKA AVE DRAINAGE UPGRADE DETAILED LAYOUT PLAN

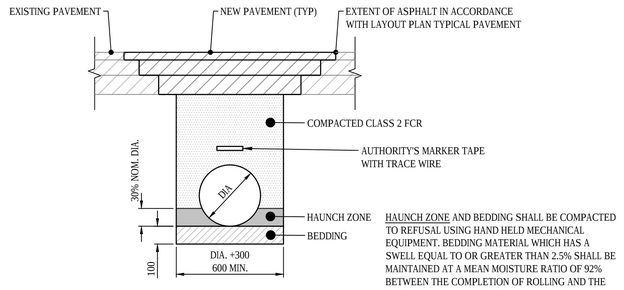
DATE PLOTTED: 19 June 2018 11:06 AM BY : SPENCER BRUCE



TRENCHES UNDER LANDSCAPE AREAS

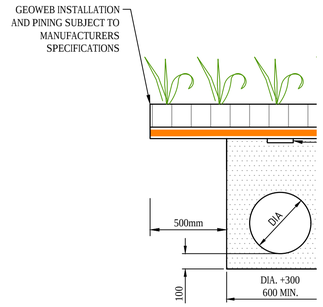


TRENCHES UNDER FOOTPATHS



HAUNCH ZONE AND BEDDING SHALL BE COMPACTED TO REFUSAL USING HAND HELD MECHANICAL EQUIPMENT. BEDDING MATERIAL WHICH HAS A SWELL EQUAL TO OR GREATER THAN 2.5% SHALL BE MAINTAINED AT A MEAN MOISTURE RATIO OF 92% BETWEEN THE COMPLETION OF ROLLING AND THE PLACEMENT OF THE OVERLAYING LAYER

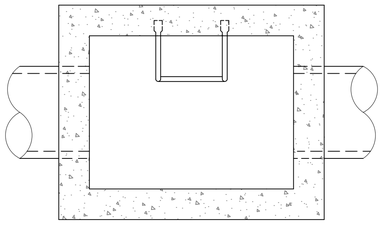
TRENCHES UNDER ROADS



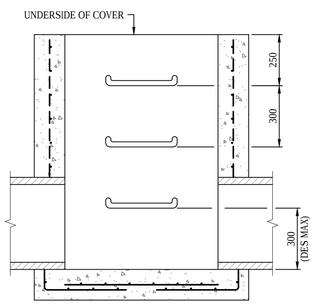
TRENCHES FOR PIP
EMBANKMENT SLO
STEEPER THAN 1

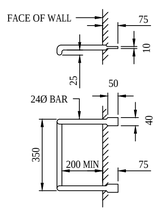
PIPE TRENCH DETAILS

NOT TO SCALE



PLAN



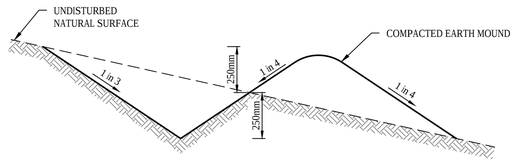


NOTES:
1. PITS DEEPER THAN 1000mm SHALL BE FITTED WITH STEP IRONS.
2. STEP IRONS SHALL BE LOCATED:
   - DIRECTLY BELOW THE OPENING IN THE COVER
   - DESIRABLY ON A WALL WITHOUT PIPE OPENINGS
   - DESIRABLY ON ONE OF THE LONG SIDES OF THE PIT
3. MATERIAL FOR STEP IRONS SHALL BE STRUCTURAL GRADE 250 TO AS 1204.
4. STEP IRONS SHALL HAVE SHARP EDGES ROUNDED AND HOT DIP GALVANIZED AFTER FABRICATION.
5. PROPRIETY STEPS SUCH AS THE GATIC PS2-PF POLYPROPYLENE STEPS (OR APPROVED ALTERNATIVE) MAY BE USED. THESE SHALL BE INSTALLED ACCORDING TO THE MAUFACTUREERS INSTRUCTIONS.

STEP IRON DETAIL

NOT TO SCALE

PLANT SCHEDULE FOR SLOPES STEEPER THAN 1 IN 2			
BOTANICAL NAME	COMMON NAME	PLANT DENSITY	NOTES
GOODENIA OVATA	HOP GOODENIA	1 -2 PLANTS PER 50m2	DISPERSED PLANTING AND PLANT AT TOP OF BANKS/TRANSITION BETWEEN ROAD AND PIPE TRENCH
CORREA ALBA	WHITE CORREA	1 -2 PLANTS PER 50m2	DISPERSED PLANTING AND IMMEDIATELY UPSTREAM OF PITS
POA POAFORMIS	COAST TUSSOCK-GRASS	5 PLANTS PER 5m2	PLANT IN CLUMPS OF 5
LOMANDRA LONGFOLIA	MAT RUSH	1 -2 PLANTS PER 50m2	DISPERSED PLANTING
ENCHYLAENA TOMENTOSA	RUBY SALTBUSH	1 -2 PLANTS PER 50m2	DISPERSED PLANTING
MICROLAENA STIPOIDES	WEEPING GRASS	10g/m2	BEGIN WITH A WEED FREE SEED BED. SOW SEED 10-15mm BELOW THE SOIL SURFACE



TYPICAL MOUNDED CATCH DRAIN(TYPE-F)

NOT TO SCALE

NOTE: DRAINS TO BE GRADED TO NOMINATED OUTLETS. FINISH WITH 100mm TOPSOIL

Rev.	Date	Description	Des.	Verif.	Appd.
2	19/06/18	REVISED TENDER ISSUE	JP	EH	
1	9/05/18	FOR TENDER	JO	EH	

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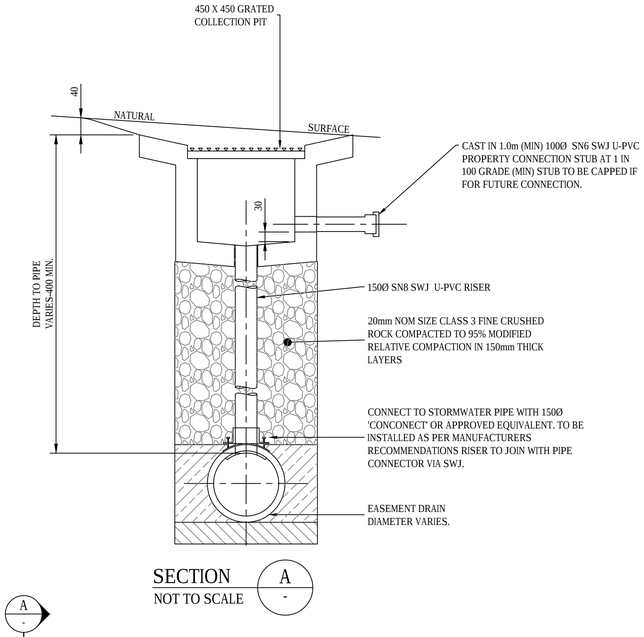
		Date
Drawn	J.O	07/05/18
Checked	SB	9/05/18
Designed	J.O	07/05/18
Verified	EH	9/05/18
Approved		Date

Client: COLAC OTWAY SHIRE

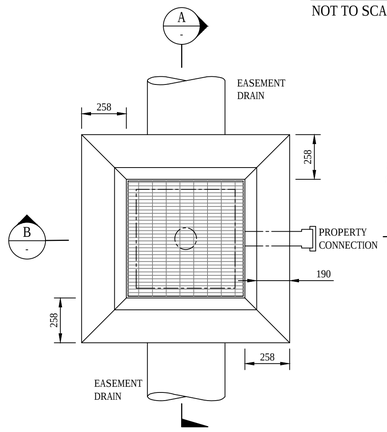
Project: WYE RIVER AND SEPARATION CREEK STORMW
MANAGEMENT SYSTEM
DETAILED DESIGN

Title: ILUKA AVE DRAINAGE UPGRADE
DRAINAGE TYPICALS
SHEET 1 OF 2

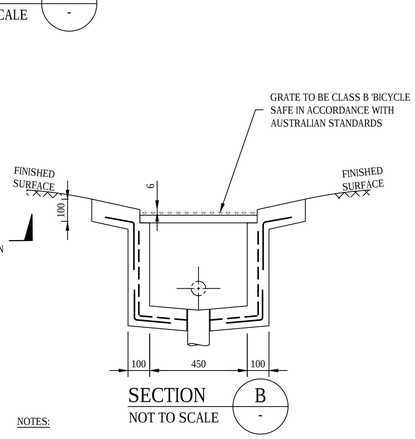
XREFs: XR-V170115-DRAINAGE_TYPICALS
CAD File: W:\2017\0001_0500\V170115_WyeRiver_StormwaterWaterDrafting\V170115-CJ-13100-13101.dwg



SECTION A
NOT TO SCALE



COLLECTION PIT - PLAN
NOT TO SCALE



SECTION B
NOT TO SCALE

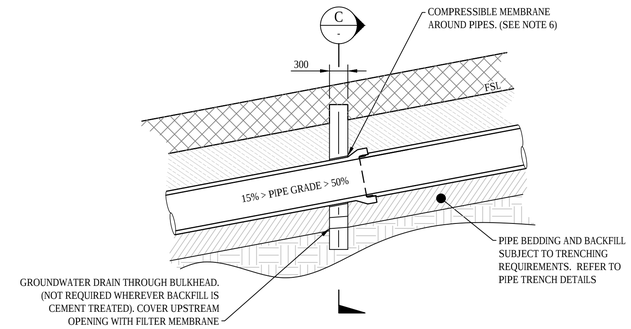
NOTES:

1. EDGE CONCRETE AROUND PERIMETER OF GRATE
2. TOP OF GRATE 40mm (min) BELOW FINISHED SURFACE.
3. DO NOT BOND GRATE TO CONCRETE TO ALLOW EASY ACCESS TO PIT.
4. CONCRETE TO BE SMOOTH TROWELLED FINISH.
5. GRATE FRAME TO BE OILED IF INSTALLED IN WET CONCRETE.
6. CONCRETE STRENGTH F'C = 25MPa. (MIN) AT 28 DAYS
7. SEAL UP AND MAKE GOOD PIPE CONNECTION / INSERTION TO PIT.
8. PROPERTY CONNECTION MIN 100Ø PIPE AS PER CLAUSE 16.10.2 (PIPE DIAMETERS).

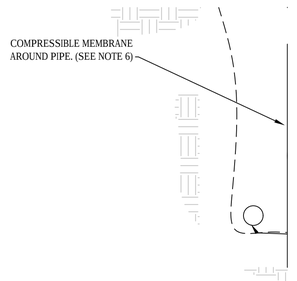
EASEMENT DRAIN CONNECTION - PITS
NOT TO SCALE

BULKHEAD NOTES:

1. BULKHEADS ARE REQUIRED FOR PIPES 300mm DIAMETER OR GREATER
2. BULKHEAD TO BE LOCATED DIRECTLY BEHIND DOWNSTREAM OF COLLAR SO AS NOT TO ENCASE THE JOINT
3. LOCATE BULKHEAD AT A RETAINING WALL UNDER THE WALL.
4. KEY CONCRETE BULKHEADS INTO SIDES AND BOTTOM OF TRENCH AGAINST A BEARING SURFACE OF UNDISTURBED SOIL
5. CONCRETE TO BE CLASS N25
6. DO NOT DEFORM PIPES DURING PLACEMENT OF CONCRETE
7. PROVIDE CONTINUOUS DRAINAGE PATH THROUGH BULKHEADS
8. COMPRESSIBLE MEMBRANE AROUND PIPE TO BE 3 THICK RUBBER FOR BULKHEADS ON SLOPES
9. GROUNDWATER DRAIN THROUGH BULKHEAD IS NOT REQUIRED WHEREVER BACKFILL IS CEMENT TREATED
10. GROUNDWATER DRAINS THROUGH BULKHEADS SHALL BE FILLED WITH FIBREGLASS WOOL OR OTHER APPROVED FILTER MATERIAL
11. BULKHEADS SHALL BE CONSTRUCTED AT EVERY SECOND JOINT WHERE PIPE GRADES EXCEED 15% (1 in 6.7) AND CEMENT TREATED BACKFILL IS NOT SPECIFIED. REFER TYPICAL DETAIL



CONCRETE BULKHEAD FOR RCP DETAIL
NOT TO SCALE



SECTION
NOT TO SCALE

Rev.	Date	Description	Des.	Verif.	Appd.
2	19/06/18	REVISED TENDER ISSUE	JP	EH	
1	9/05/18	FOR TENDER	JO	EH	

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Drawn	J.O	Date 07/05/18
Checked	SB	Date 9/05/18
Designed	J.O	Date 07/05/18
Verified	EH	Date 9/05/18
Approved		Date

Client: COLAC OTWAY SHIRE
Project: WYE RIVER AND SEPARATION CREEK STORMW MANAGEMENT SYSTEM DETAILED DESIGN
Title: ILUKA AVE DRAINAGE UPGRADE DRAINAGE TYPICALS SHEET 2 OF 2

XREFs: XR-V170115-DRAINAGE_TYPICALS
CAD File: M:\2017\0001_0500\V170115_WyeRiver_Stormwater\Water\Drafting\V170115-C-13100-13101.dwg

XREFs: XR-V170115-WYE_NORTH-ROADWORKS; XR-V170115-WYE_NORTH-SURVEY-1; XR-V170115-CONTOURS_5m-1IN500; XR-V170115-HOUSE NUMBERS; XR-V170115-WYE_NORTH-SURVEY-2; XR-V170115-EARLY_WORKS-DRAINAGE; XR-V170115-WYE_NORTH-DRAINAGE-EXIST; XR-V170115-LANDSCAPE; XR-V170115-WYE_NORTH-DRAINAGE; XR-V170115-WALLACE ST-DRAINAGE
DATE PLOTTED: 19 June 2018 1:50 PM BY: SPENCER BRUCE
CAD File: W:\2017\0001_0500\V170115_WyeRiver_StormwaterWaterDrafting\V170115-CI-12000.dwg

LEGEND

- FUTURE BOUNDARIES
- KERB & CHANNEL
- PROPOSED STORMWATER DRAIN, PIT, DIAMETER AND PROPERTY INLET
- EXISTING STORMWATER DRAINAGE
- FUTURE STORMWATER DRAINAGE TO BE CONSTRUCTED BY OTHER CONTRACTOR
- EXISTING DRAINAGE WING WALL
- PROPOSED DRAINAGE WING WALL
- SURVEY ELEMENTS
- EASEMENT BOUNDARY
- EXISTING AND FUTURE TABLE DRAIN
- FLOW ARROWS
- EASEMENT BUND
- DRIVEWAY CROSSINGS TO BE UPGRADED (AS PER VEHICLE CROSSING DETAILS)

PROVIDE BUNDING WITH TABLE DRAIN CONSTRUCTED WITH NON DESTRUCTIVE DIGGING UPSLOPE OF BUND

REPLACE EXISTING PIT

EPHEMERAL WATERWAY MAINTAIN EXISTING NATIVE VEGETATION WHERE POSSIBLE. REFER TO LANDSCAPE PLAN

HOUSE UNDERSIDE RL 20·03

MATCH EXISTING CHANNEL INVERT AT EDGE OF HOUSE UNDERSIDE.

CUSTOM ANGLED GRILLED PIT. REFER TO PIT DETAIL FOR INFORMATION.

MAINTAIN EXISTING TABLE DRAIN AND DRIVEWAY CULVERTS

CONNECT EXISTING DRAINAGE OUTLET TO PROPOSED PIT VIA 90° PVC ELBOW AND LENGTH OF 300Ø PVC

USIL 22.41
DSIL 22.04

CUSTOM ANGLED GRILLED PIT. REFER TO PIT DETAIL FOR INFORMATION.

RECTIFICATION WORKS REQUIRED FOR GUARD RAIL IF IMPACTED DURING CONSTRUCTION

JUNCTION PIT TO HAVE ASPHALT INFILL COVER

CONTRACTOR TO REMOVE EXISTING CULVERT AND REINSTATE EXISTING DRIVEWAY

REPLACE EXISTING PIT

SECTION OF DRAIN EXTREMELY STEEP. REFER TO STEEP TRENCHING DETAIL FOR BACKFILLING INFORMATION. INSTALL HDPE PIPES WITH JOINTS IN REVERSE TO FLOW DIRECTION TO PROTECT EDGE OF INNER PIPE LINER FROM HIGH FLOW VELOCITY

PIT (NOT ACCESSIBLE)

STEEP ENBANKMENT

DENSE VEGETATION

RESERVE

WALLACE AVENUE

DURIMBIL AVENUE

ILUKA AVENUE

McLELLAN COURT

PADDY'S PATH

GREAT OCEAN ROAD

Rev.	Date	Description	Des.	Verif.	Appd.
2	19/06/18	REVISED TENDER ISSUE	JP	EH	
1	9/05/18	FOR TENDER	JO	EH	

0 10 20m
SCALE 1:500 @A1

NORTH

Colac Otway SHIRE

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		Date
Drawn	J.O	07/05/18
Checked	SB	9/05/18
Designed	J.O	07/05/18
Verified	EH	9/05/18
Approved		Date

Client: COLAC OTWAY SHIRE

Project: WYE RIVER AND SEPARATION CREEK STORMWATER MANAGEMENT SYSTEM
DETAILED DESIGN

Title: WALLACE AVE DRAINAGE UPGRADE
DETAILED LAYOUT PLAN

Status: FOR TENDER ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	Melways Ref.	Scale	Size
A.H.D	X927,C9	1:500m	A1

Drawing Number: V170115-CI-12000
Revision: 2

APPENDIX B

Geotechnical borehole logs
Mapping Histograms

33 Roberts Road, Belmont, 3216
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P.J. YTTRUP
& ASSOCIATES PTY. LTD.
Consulting Engineers

Hole ID: 25—BH5

CLIENT	: COS	POSITION	: REFER TO SITE PLAN	Drill Rig:
CONTRACTOR	:	EASTING	:	Date: 26/08/2016
PROJECT	:	NORTHING	:	Logged By: SB
LOCATION	: 25 Iluka Avenue, Wye River	COORD. SYS.	: MGA94 Zone 55	Reviewed By:DP
PROJECT No.	: 23170	GROUND RL	:	

Depth (m)	Water	Graphic Log	Description	Sample or Field Test	Moisture Condition	Estimated Strength	Shear Vane (kPa)	LABORATORY TESTING: Moisture Content (%)	Free Swell (%)	Shrink Swell Index (%)	Total Suction (pF)	Electrical Conductivity EC 1:5 dS/m	Electrical Conductivity ECe dS/m	Remarks/Testing DCP Blows/100 mm
0	Not Observed		Sandy SILT: low plasticity, dark brown, fine grain sand		M	F								0 5 10 15 20 25
0.2			Silty SAND: fine to medium, brown, orange brown, low plasticity silt, trace coarse angular sandstone gravel											
			0.3m Emerson Classification 2. pH = 7.5	DS 0.30 m		MD						0.021	0.157	
0.4														
0.6			Clayey SAND: fine to medium, orange brown, low plasticity clay	DS 0.60 m								0.019	0.142	
			0.6m Emerson Classification 1. pH = 7.4											
0.8			Silty CLAY: low to medium plasticity, grey brown, orange brown			St								
			0.9m Emerson Classification 1. pH = 7.5	DS 0.90 m								0.087	0.652	
1.0			Silty CLAY: medium to high plasticity, pale grey brown, orange brown			VSt								
1.2			Silty SAND: fine to medium, orange brown, low plasticity silt, some weakly cemented medium sub angular sandstone gravel	DS 1.20 m		MD						0.049	0.367	
1.4			Hole Terminated at 1.40 m Refusal on Highly Weathered Sandstone at 1.4m											
1.6														
1.8														

See Explanatory Notes for details of abbreviations & basis of descriptions.

P.J.Yttrup & Associates Pty.Ltd. Consulting Engineers

BORE LOG

Client: COS
Project: 23 Iluka Avenue
Wye River
Job No.: 23170
Date: 1/08/2003

Borehole No.: 15406-BH1
Logged By : MSD
Drill Method: HS7 Drill Rig

Depth m	Soil Description	Graphic Log	Sample Type	Moisture Condition	Consistency	Relative Density	Dynamic Cone / 100 mm	Shear Vane kPa	Moisture Content %	Free Swell %	Swell / Shrink Index %	Unconfined Comp. kPa	Depth m
	Field Observations								Laboratory Results				
0.5	sandy SILT, some gravel, brown												0.5
0.6													
1.0	Silty SAND, fine to medium, pale brown, inferred extremely weathered SANDSTONE												1.0
1.5													1.5
1.7	SANDSTONE, fine to medium, very low to low strength, highly weathered												
2.0	Refusal on SANDSTONE @ 1.7m												2.0
2.5													2.5
3.0													3.0

Moisture Condition
D - Dry
SM - Slightly Moist
M - Moist
W - Wet

Consistency
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

Relative Density
VL - Very Loose
L - Loose
M - Medium
D - Dense
VD - Very Dense

Sample Type
D - Disturbed
U50 - 50 mm Core

Water Level ▽

P.J.Yttrup & Associates Pty.Ltd. Consulting Engineers **BORE LOG**

Client: COS
Project: 17 Illuka Avenue
Wye River
Job No.: 15299
Date: 17/09/2003

Borehole No.: 17–1
Logged By : MSD
Drill Method: HS7 Drill Rig

Depth m	Soil Description	Graphic Log	Sample Type	Moisture Condition	Consistency	Relative Density	Dynamic Cone / 100 mm	Shear Vane kPa	Moisture Content %	Free Swell %	Swell / Shrink Index %	Unconfined Comp. kPa	Depth m
	Field Observations								**Laboratory Results**				
0.5	FILL clayey SILT, grey/brown			M	F-St								0.5
0.7													
1.0	Silty CLAY(CI), orange/brown			M	St								1.0
1.4	becoming extremely weathered												
1.5	SANDSTONE, fine to medium, orange brown, very low strength, highly weathered												1.5
1.7	low to medium strength												
1.9													
2.0	END OF BOREHOLE @ 1.9m Rock bit refusal in sandstone												2.0
2.5													2.5
3.0													3.0

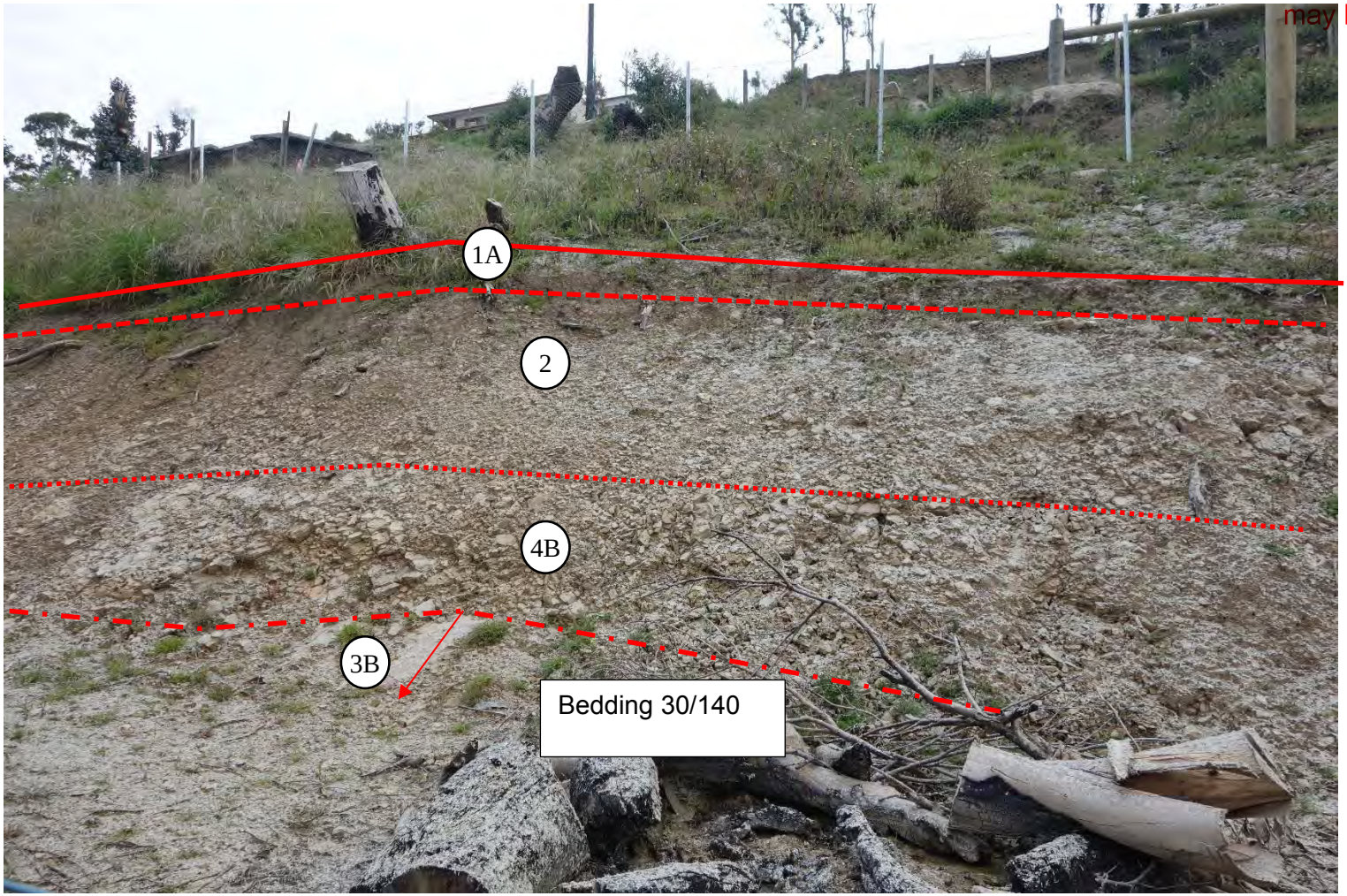
Moisture Condition
D - Dry
SM - Slightly Moist
M - Moist
W - Wet

Consistency
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

Relative Density
VL - Very Loose
L - Loose
M - Medium
D - Dense
VD - Very Dense

Sample Type
D - Disturbed
U50 - 50 mm Core

Water Level ▽



Depth below surface level
0 to 0.2 m

0.2m to 1.0 m

1.0 m to 2.5m

2.5 m to 2.8 m

17-SLOPE 1.

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P.J. YTTRUP
& ASSOCIATES PTY. LTD.
Consulting Engineers

Hole ID: BH3

CLIENT :		POSITION : Refer to Site Plan	Drill Rig: 6 tonne excavator
CONTRACTOR :		EASTING :	Date: 7/11/2016
PROJECT :		NORTHING :	Logged By: DP
LOCATION :	17 Iluka Avenue, Wye River	COORD. SYS. : MGA94 Zone 55	Reviewed By:DP
PROJECT No. :		GROUND RL :	

Depth (m)	Drilling Resistance	Graphic Log	Description	Sample or Field Test	Moisture Condition	Estimated Strength	Shear Vane (kPa)	LABORATORY TESTING: Moisture Content (%)	Free Swell (%)	Shrink Swell Index (%)	Total Suction (pF)	Electrical Conductivity EC 1:5 dS/m	Electrical Conductivity ECe dS/m	Remarks/Testing DCP Blows/100 mm
0			Sandy SILT, low plasticity, dark grey brown, trace 100mm cobbles			VSt								0 5 10 15 20 25
0.5			Silty CLAY, medium plasticity, grey brown with orange brown		D to M	VSt to H								
1.0			Interbedded SANDSTONE/SILTSTONE, fine, orange brown, very low to low strength, highly weathered, highly fractured											
1.5			SANDSTONE, fine to medium, brown with orange brown staining of defects, low to medium strength, moderately weathered											
2.0			Hole Terminated at 1.35 m											
2.5														

See Explanatory Notes for details of abbreviations & basis of descriptions.

File: 22580 BH3 1 OF 1

P.J. YTTRUP
& ASSOCIATES PTY. LTD.
Consulting Engineers

Hole ID: BH4

CLIENT :		POSITION : Refer to Site Plan	Drill Rig: 6 tonne excavator
CONTRACTOR :		EASTING :	Date: 7/11/2016
PROJECT :		NORTHING :	Logged By: DP
LOCATION :		COORD. SYS. : MGA94 Zone 55	Reviewed By:DP
PROJECT No. :		GROUND RL :	

Depth (m)	Drilling Resistance	Graphic Log	Description	Sample or Field Test	Moisture Condition	Estimated Strength	Shear Vane (kPa)	LABORATORY TESTING: Moisture Content (%)	Free Swell (%)	Shrink Swell Index (%)	Total Suction (pF)	Electrical Conductivity EC 1:5 dS/m	Electrical Conductivity ECe dS/m	Remarks/Testing DCP Blows/100 mm
0			Sandy SILT, low plasticity, dark grey brown, fine sand, trace 100mm cobbles		D	VSt								0 5 10 15 20 25
			Silty CLAY, medium plasticity, grey brown and orange brown		M	St								
0.5			Interbedded SILTSTONE/SANDSTONE, fine, orange brown, very low to low strength, highly weathered, highly fractured											
			SANDSTONE, fine to medium, brown with orange brown staining of defects, very low to low strength, highly weathered											
1.0			becoming; low to medium strength, moderately weathered											
			Hole Terminated at 1.35 m											
1.5														
2.0														
2.5														

See Explanatory Notes for details of abbreviations & basis of descriptions.

P.J. YTTRUP & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS
A.C.N. 005 909 919
A.B.N. 71 687 799 203

METHOD OF SOIL DESCRIPTION

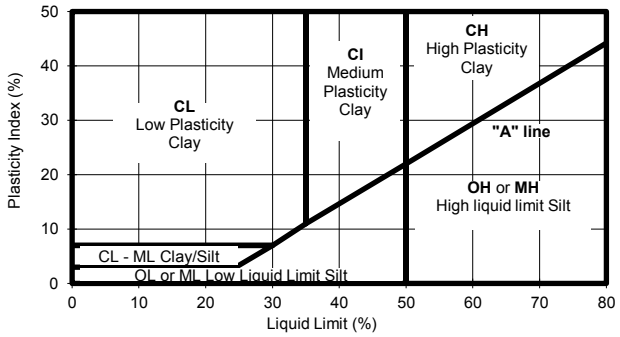
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and rock is classifed and described using the method outlined in AS1726-1993 (Amdt1-1994 and Amdt2-1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.0075 mm
CLAY		<0.002 mm

Plasticity Properties



MOISTURE CONDITION

Reference: AS1726-1993 Section A2.5(a)

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and Silts may be brittle or friable
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY[1]

Reference: AS1726-1993 Section A2.5(b)

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index (%)	SPT "N" Value[2]
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

Notes:
1. In the absence of test results, consistency and density may be assesed from correlations with the observed behaviour of the material.
2. SPT correlations are not stated in AS1726 (1996), refer Terzaghi et al (1996). N values may be subjected to corrections for overburden pressure and equipment type.

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TERMS USED ON LOGS

DRILLING/EXCAVATION METHOD

AD/	Auger Drilling	RD	Rotary blade or Drag bit	NQ	Diamond Core - 47 mm
*V	V-Bit	RT	Rotary Tri-cone bit	NMLC	Diamond Core - 52 mm
*T	TC-Bit	RA	Rotary Air	HQ	Diamond Core - 63 mm
HA	Hand Auger			HMLC	Diamond Core - 63 mm
ADH	Hollow Auger			BH	Tractor mounted Backhoe
HA	Hand Auger			EX	Tracked hydraulic excavator

PENETRATION RESISTANCE

Symbol	Term	Description
L	Low	Rapid penetration with little effort.
M	Medium	Acceptable penetration rate requiring a moderate effort.
H	High	Slow penetration with significant applied effort.
R	Refusal	No further progress without risk of damage to equipment.

The excavatability is dependent on both the operator and plant used. This assessment is dependent on numerous factors including the equipment type (power, weight, size), experience of the operator and condition of the equipment.

WATER


Water level at date shown


Partial loss of water circulation


Water inflow


Full loss of water circulation

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
6,7,12 N = 19	6,7,12 denotes blows per 150 mm. The N value denotes blows per 300 mm penetration following 150 mm seating
30/150 mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed Sample
BDS	Bulk Disturbed Sample
FV	Field vane shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PP	Pocket penetrometer test expressed as instrument reading in kPa
U50	Thin walled tube sample - number indicates nominal sample diameter in millimetres
DCP	Dynamic cone penetration test

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TERMS FOR ROCK STRENGTH, WEATHERING AND DEFECTS

STRENGTH

Symbol	Term	Point Load Index, Is(50) (MPa)	Field Guide
EL	Extremely Low	<0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3 cm thick can be broken by finger pressure
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 50 mm diameter may be broken by hand.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

ROCK STRENGTH TEST RESULTS

○ Point Load Strength Index, Is(50), Diametral Test (MPa)
● Point Load Strength Index, Is(50), Axial Test (MPa)
UCS Uniaxial Compressive Strength

The relationship between Is(50) and UCS varies with rock type and strength and should be determined on a site-specific basis.

ROCK MATERIAL WEATHERING

Term	Symbol	Description
Fresh	FR	Rock Substance unaffected by weathering
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance
Moderately Weathered	MW	Rock substance affected by weathering to the extent staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are evident. Porosity and strength may be increased/decreased when compared to the fresh rock substance, usually as the result of the leaching or decomposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties. i.e. it can be remoulded and can be classified according to the Unified Soil Classification System. The texture of the original rock is evident.

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TERMS FOR ROCK STRENGTH, WEATHERING AND DEFECTS

ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

Defect Type

CL	Clay Seam	BG	Bedding parting	CV	Cleavage	DK	Dyke
FL	Fault	BSH	Bedding plane shear	FO	Foliation	DZ	Decomposed Zone
SR	Shear	JN	Joint	CZ	Crushed Zone	FZ	Fractured Zone
SH	Sheared Zone	CN	Contact	VN	Vein	SC	Schistosity

Shape

Term	Symbol	Desciption
Planar	PL	Forms a continuous plane withouth variation in orientation
Curved	CU	Has a gradual change in orientation
Undulating	UN	Has a wavy surface
Stepped	ST	Has one or more well defined steps
Irregular	IR	Many changes of orientation

Roughness

Term	Symbol	Desciption
Slickensided or polished	Sl	Very smooth, reflects light
Smooth	Sm	Roughness not detected with finger.
Slightly Rough	SRo	Sandpaper feel (fine to medium sandpaper)
Rough	Ro	Sandpaper feel (medium to coarse sandpaper)
Very Rough	VRo	Very well defined ridges and/or steps

Coating or infill

Cn	Clean
Sn	Stain less than 1 mm thick
Vr	Veneer coating less than 1 mm thick

If infill thickness is greater than 1 mm, the actual thickness is recorded in millimeters

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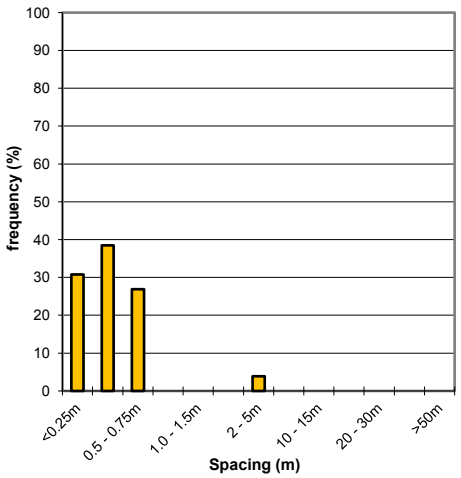
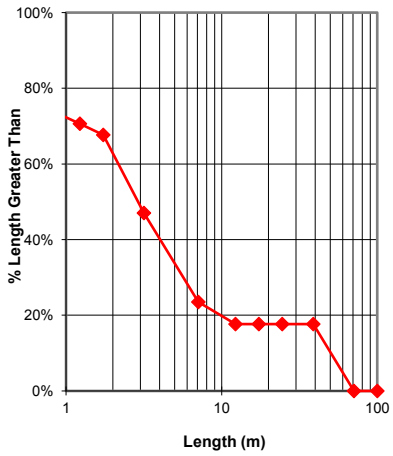
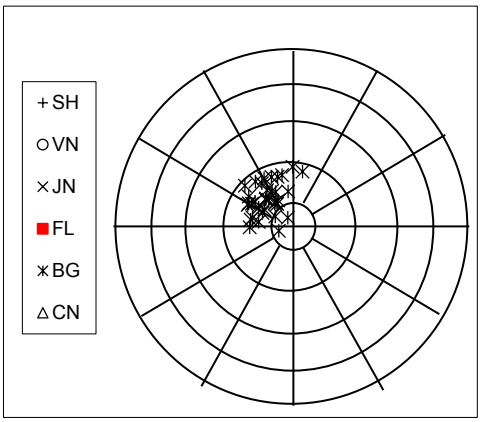
Geotechnical Field Mapping
Data Histograms

project: Landslide Risk Assessment
location: 17 Iluka Avenue, Wye River
datum: Magnetic North
date: 2-Feb-17

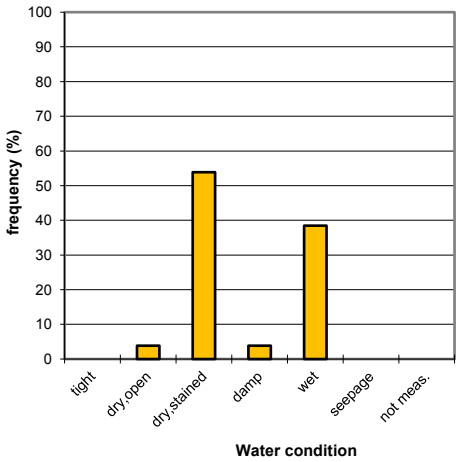
Data records 35 **Lithology:** All **Traverse:** All **Type Defect:** BG
Location Iluka Avenue dipslope

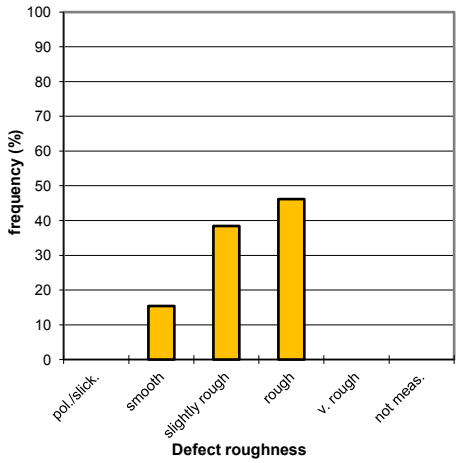


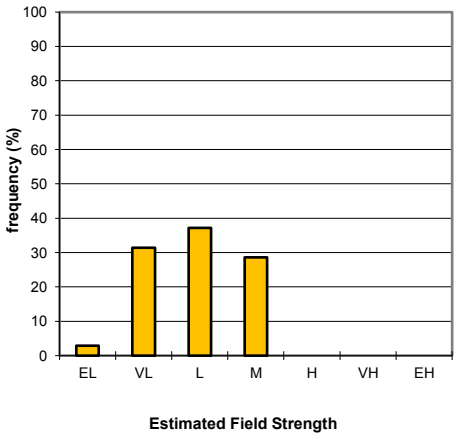


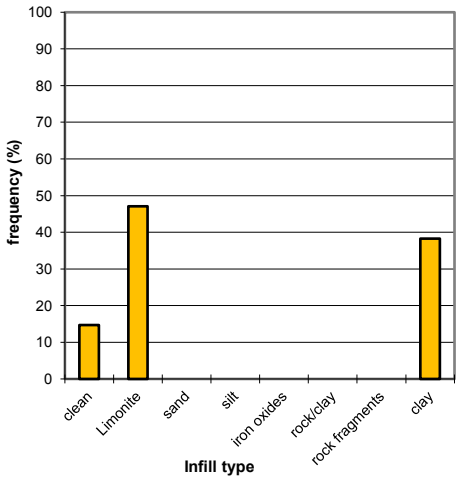


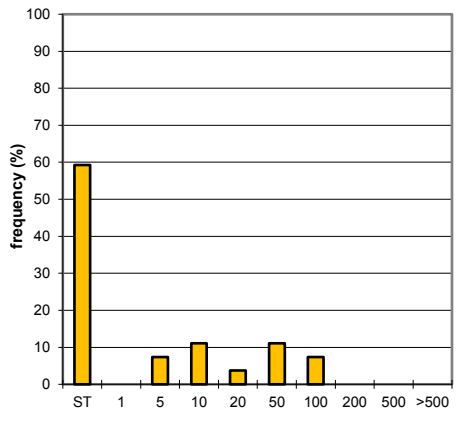
EQUAL AREA STEREO-NET

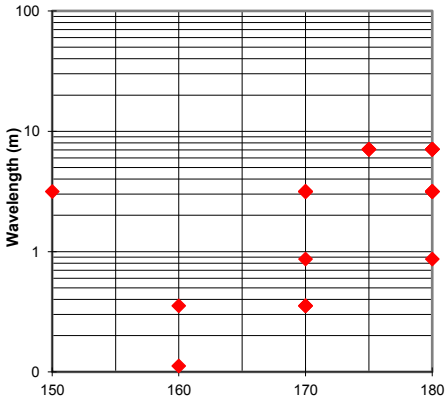












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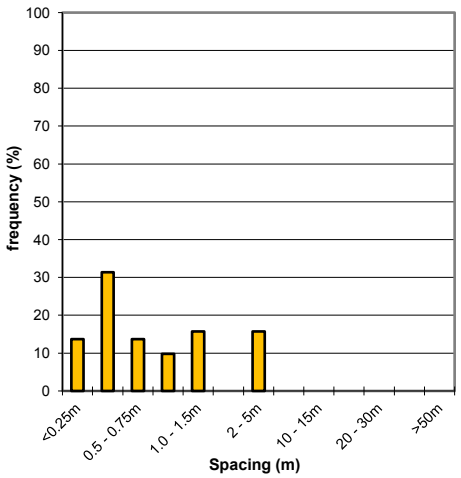
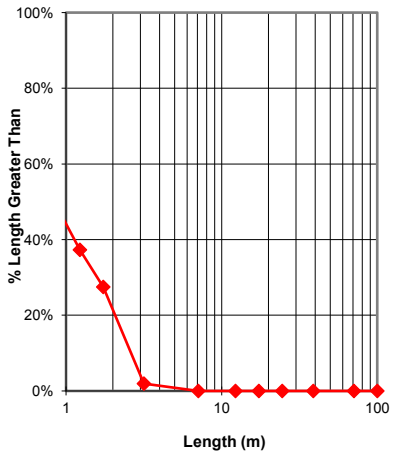
Geotechnical Field Mapping
Data Histograms

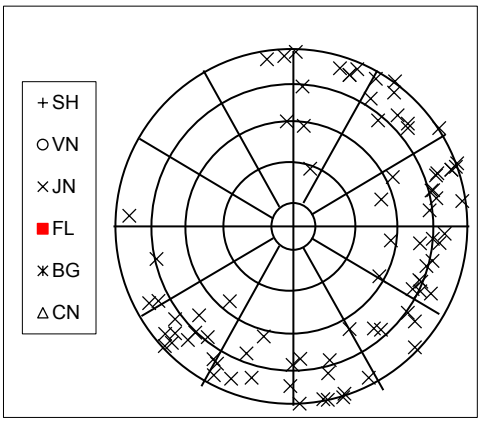
project: Landslide Risk Assessment
location: 17 Iluka Avenue, Wye River

datum: Magnetic North
date: 2-Feb-17

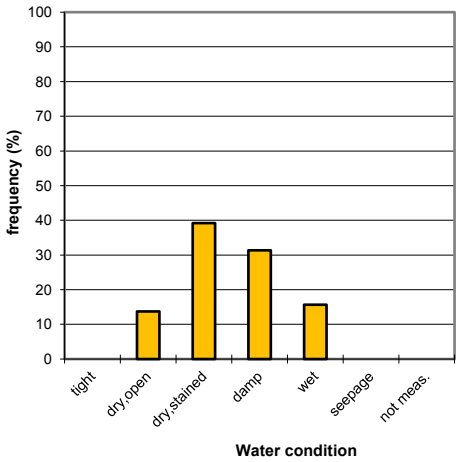
Data records 84 **Lithology:** All **Traverse:** All **Type Defect:** JN
Location ALL WYE RIVER

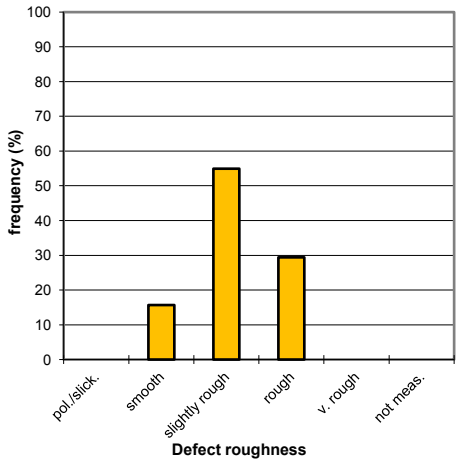


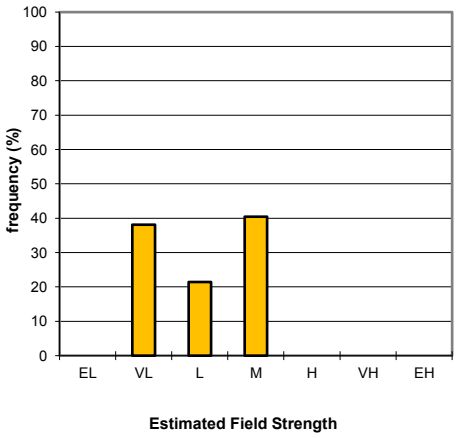


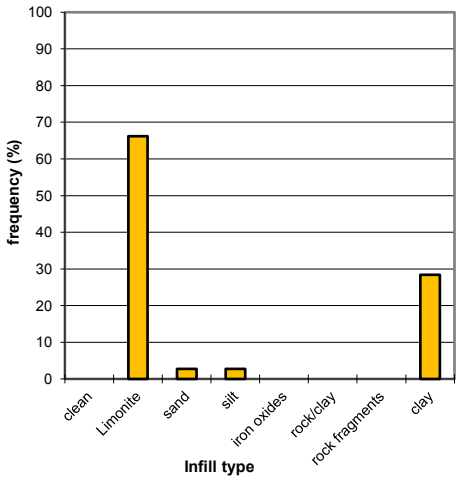


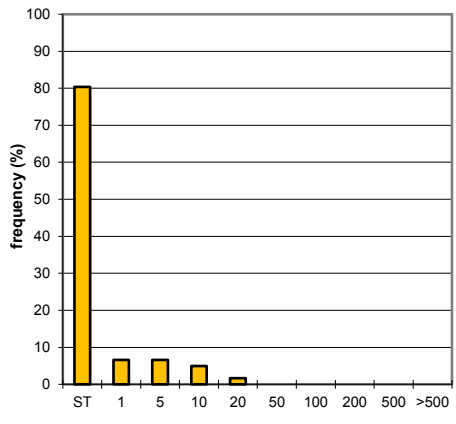
EQUAL AREA STEREO-NET

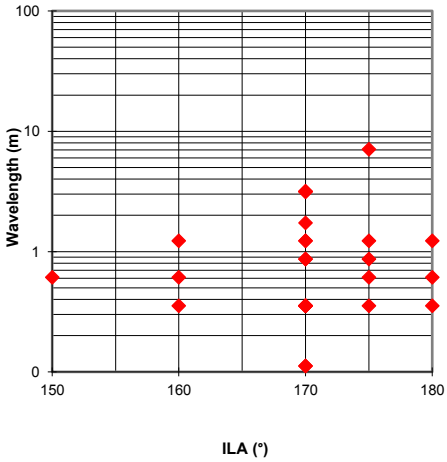












APPENDIX C

Photos

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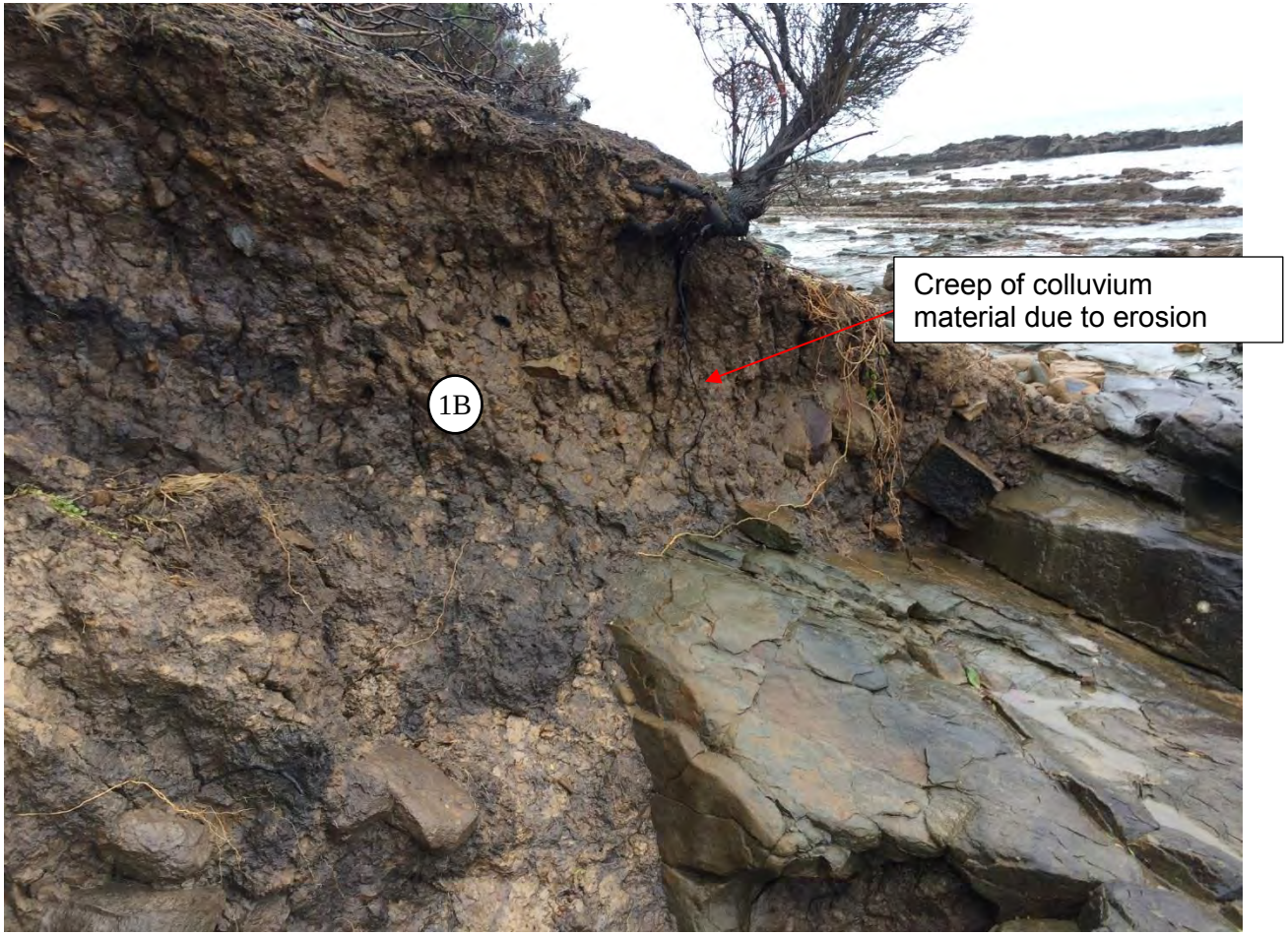

Photo 1 Creep of Colluvium on the rock platform.

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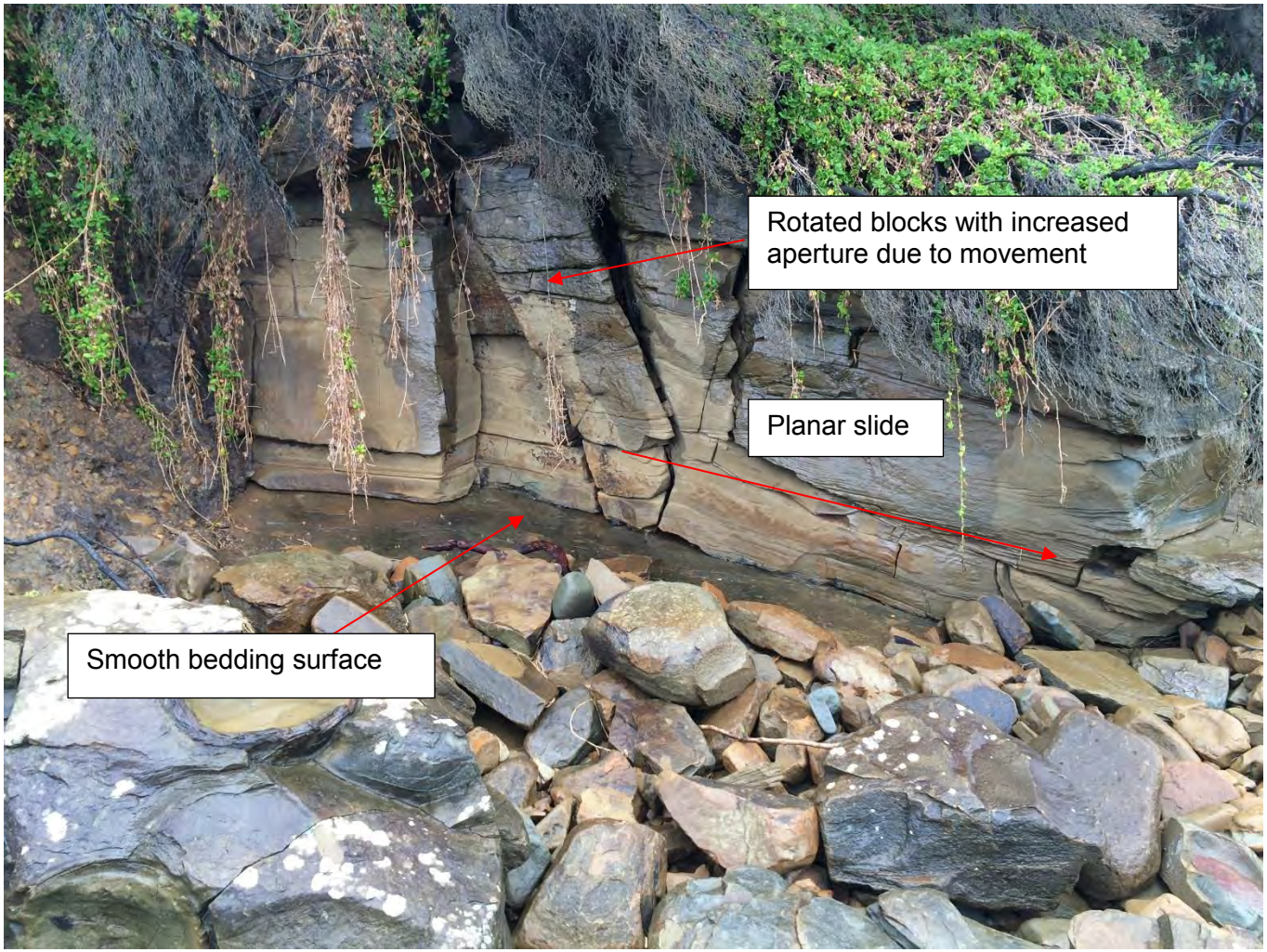

Photo 2 Planar slide of Moderately to Slightly Weathered SANDSTONE on smooth bedding plane

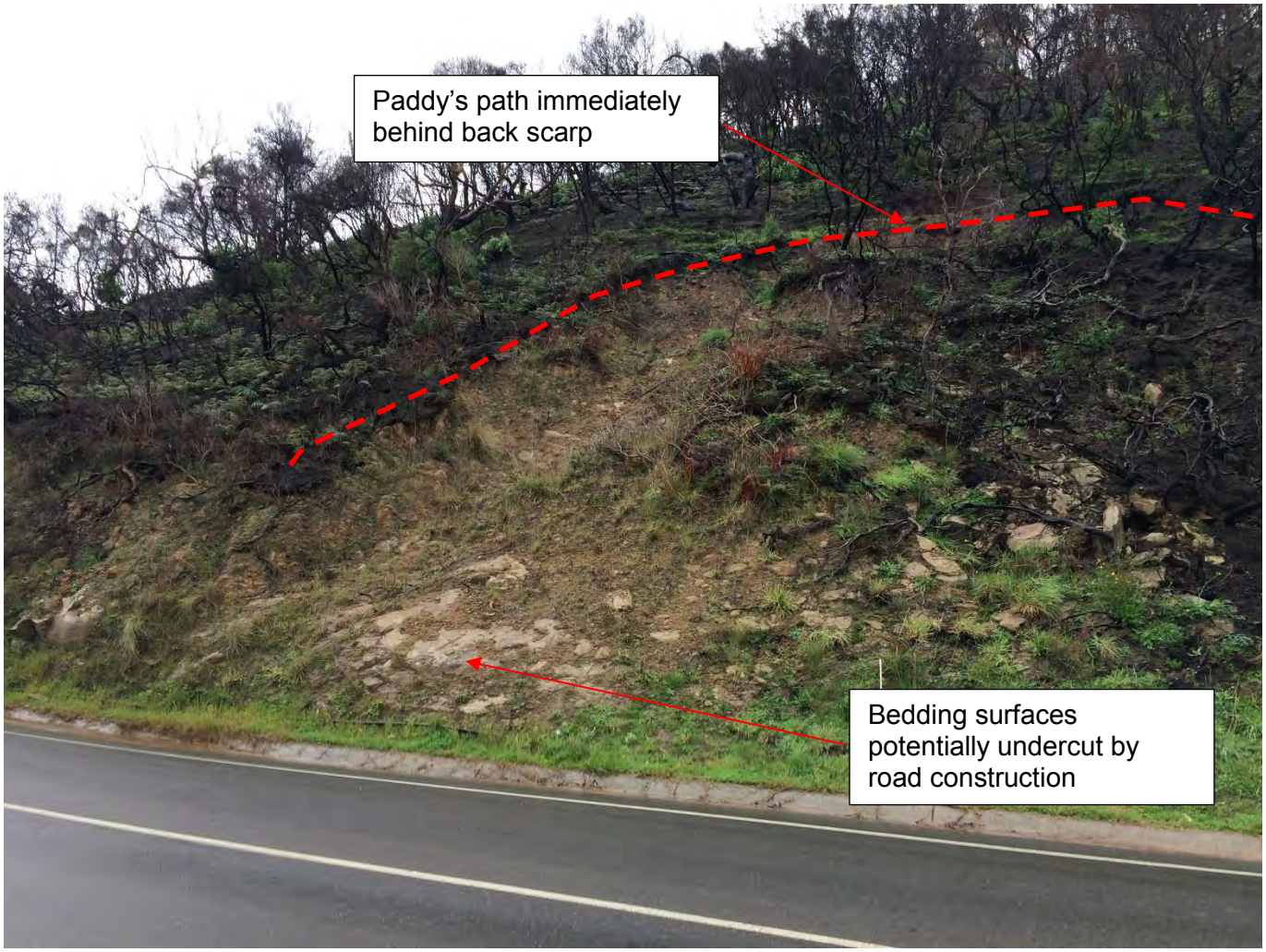

Photo 3 Small translational failure above the Great Ocean Road, looking north west.

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Photo 4 Regression of Paddy's Path failure following heavy rainfall in September 2016.

Photo 5 Small translational failure above the Great Ocean Road, looking north with highly weathered Sandstone bedding observed near the toe. Bedding does not appear to be undercut and sliding is occurring at the interface of colluvium/residual and the underlying more competent rock mass.

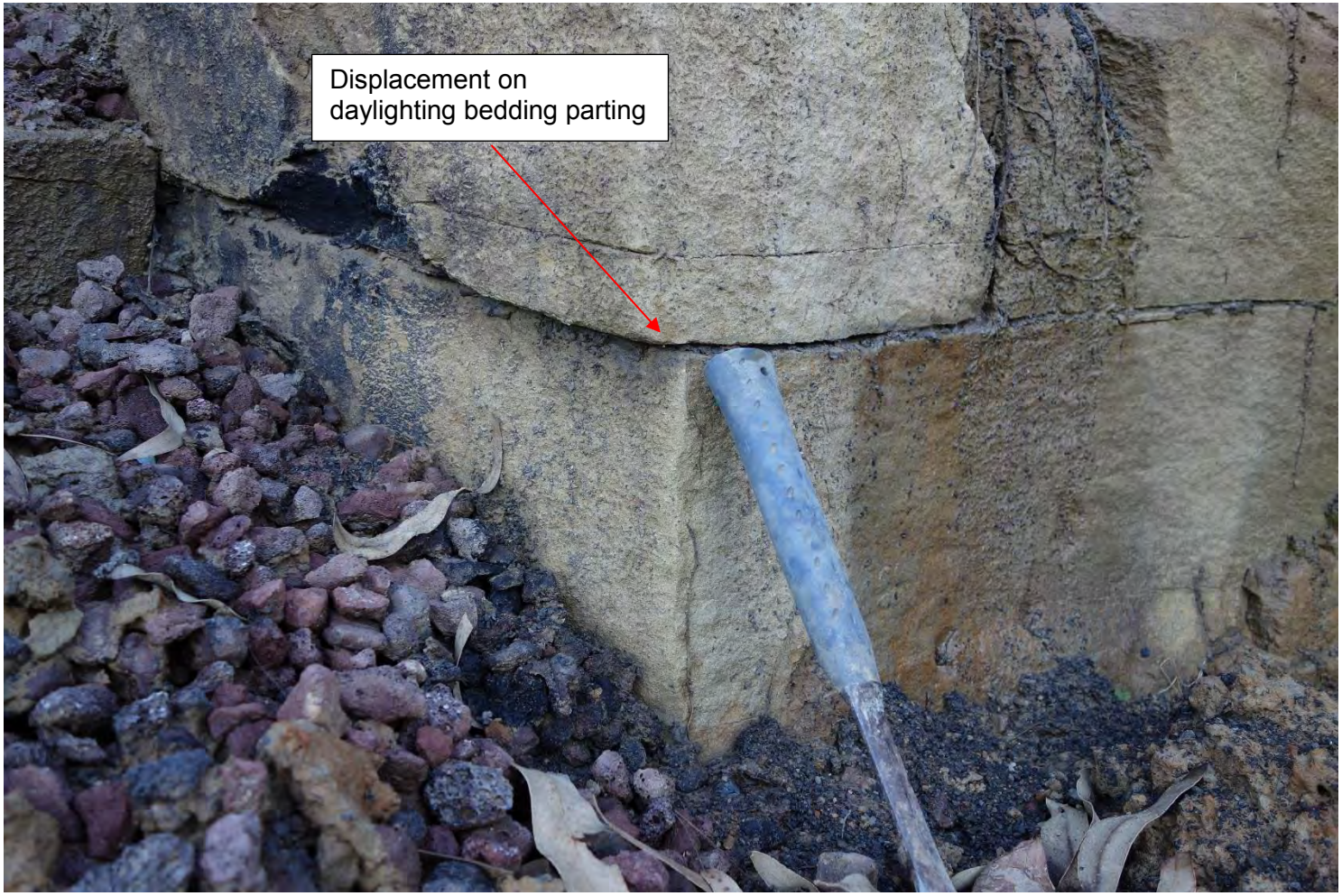

Photo 6 Burnt out retaining wall at 23 Iluka Ave - Displacement on bedding surfaces in Unit 3A.

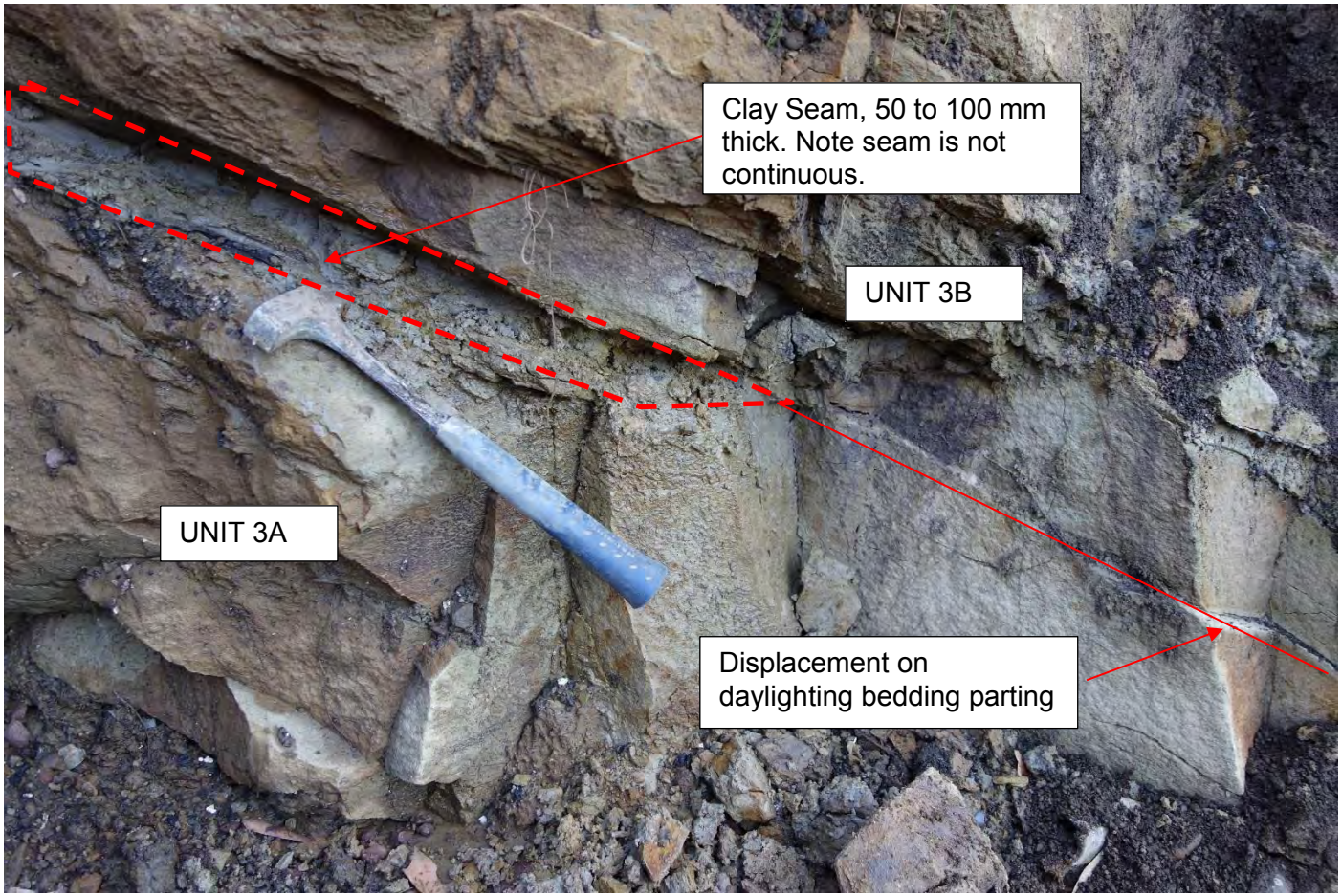

Photo 7 Burnt out retaining wall at 23 Iluka Ave - Displacement on bedding surfaces in Unit 3A with clay seam highlighted at the base of Unit 3B. Note that the clay seam is not continuous.

Photo 89 Slumping of cut slope in residual material (Unit 2) on 4 Iluka Avenue with strong seepage from broken stormwater in the foreground.

Photo 9 New Retaining walls below 17 Iluka Avenue looking south west with moderate back slope (for ~1.5 m width) immediately behind the wall.

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Photo 10 New Retaining walls below 10 Iluka Avenue with existing access track immediately below.

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Photo 11 Typical slopes below 18 Iluka Avenue in the area of the proposed stormwater drain.

Photo 12 Typical Slopes in drainage easement between 13 and 14 Iluka Avenue.

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Photo 13 VicRoads remedial works of Great Ocean Road.

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Photo 14 VicRoads remedial works at proposed outlet from 18 Iluka Avenue. Soil Nail and Mesh with drainage immediately downslope of hand rail.

Photo 15 VicRoads retaining wall works – Slope 1 at 25 Iluka Avenue. Soil Profile of Colluvium overlying Highly Weathered SANDSTONE (at base of cut).

Photo 16 VicRoads retaining wall works at 25 Iluka Avenue – February 2019.

APPENDIX D

Risk Assessment to AGS 2007

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QUALITATIVE RISK ASSESSMENT - PROPERTY

Job Number: 23170
Site Address: ILUKA AVENUE

FAILURE MODE	DESCRIPTION	ELEMENT AT RISK	CURRENT RISK TO PROPERTY			CONTROL MEASURES	RESIDUAL RISK TO PROPERTY		
			LIKELIHOOD OF FAILURE	CONSEQUENCE OF FAILURE	RISK		LIKELIHOOD OF FAILURE	CONSEQUENCE OF FAILURE	RISK
1A	Trench collapse during construction	Retaining wall	POSSIBLE	MAJOR	HIGH	Appropriate batters or shoring systems	UNLIKELY	MINOR	LOW
						Protection from storm water run-on			
						Work in dry weather			
						Management of slopes in accordance with good hillside practice			
1B	Trench collapse during construction	Rear of House	POSSIBLE	MAJOR	HIGH	Appropriate batters or shoring systems	UNLIKELY	MINOR	LOW
						Protection from storm water run-on			
						Hit and miss excvavation sequencing			
						Work in dry weather			
		Retaining wall	POSSIBLE	MAJOR	HIGH	Management of slopes in accordance with good hillside practice			
1C	Trench collapse during construction	Stormwater Asset	POSSIBLE	MINOR	MODERATE				
2A	Piping collapse post construction	Stormwater asset	ALMOST CERTAIN	MAJOR	VERY HIGH	Cement stabilised back fill	UNLIKELY	MINOR	LOW
						In trench drainage measures			
2B	Piping collapse post construction	Disposal Field	POSSIBLE	MEDIUM	MODERATE	Cement stabilised back fill			
		Stormwater asset	ALMOST CERTAIN	MINOR	HIGH	In trench drainage measures	UNLIKELY	MINOR	LOW
						Management of slopes in accordance with good hillside practice			
2C	Piping collapse post construction	Stormwater asset	ALMOST CERTAIN	MINOR	HIGH	Cement stabilised back fill			
						In trench drainage measures	UNLIKELY	MINOR	LOW
						Management of slopes in accordance with good hillside practice			
3A	Translational slide	RETAINING WALL	POSSIBLE	MEDIUM	MODERATE	Cement stabilised back fill	UNLIKELY	MINOR	LOW
		Stormwater asset	POSSIBLE	MAJOR		In trench drainage measures			
3B	Translational slide	Disposal Field	POSSIBLE	MAJOR	HIGH	Crushed rock back fill			
		Stormwater asset	POSSIBLE	major	HIGH	In trench drainage measures	UNLIKELY	MINOR	LOW
		RETAINING WALL	POSSIBLE	MEDIUM	MODERATE	Management of slopes in accordance with good hillside practice			
		Rear of House	POSSIBLE	major	HIGH				
3C	Translational slide	Disposal Field	POSSIBLE	MAJOR	MODERATE	Crushed rock back fill			
		Stormwater asset	POSSIBLE	major	HIGH	In trench drainage measures	UNLIKELY	MINOR	LOW
		RETAINING WALL	POSSIBLE	MEDIUM	HIGH	Management of slopes in accordance with good hillside practice			

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QUALITATIVE RISK ASSESSMENT - PROPERTY

Job Number: 23170
Site Address: ILUKA AVENUE

FAILURE MODE	DESCRIPTION	ELEMENT AT RISK	CURRENT RISK TO PROPERTY			CONTROL MEASURES	RESIDUAL RISK TO PROPERTY		
			LIKELIHOOD OF FAILURE	CONSEQUENCE OF FAILURE	RISK		LIKELIHOOD OF FAILURE	CONSEQUENCE OF FAILURE	RISK
4A	Shallow creep	RETAINING WALL	UNLIKELY	MEDIUM	**LOW**	Cement stabilised back fill	UNLIKELY	MINOR	**LOW**
		Stormwater asset	POSSIBLE	MAJOR	**HIGH**	In trench drainage measures			
4B	Shallow creep	Disposal Field	UNLIKELY	MAJOR	**MODERATE**				
		Stormwater asset	UNLIKELY	major	**MODERATE**				
		RETAINING WALL	UNLIKELY	MEDIUM	**LOW**				
		Rear of House	UNLIKELY	major	**MODERATE**				
4C	Shallow creep	Disposal Field	UNLIKELY	MAJOR	**MODERATE**	Crushed rock back fill			
		Stormwater asset	POSSIBLE	major	**HIGH**	In trench drainage measures	UNLIKELY	MINOR	**LOW**
		RETAINING WALL	UNLIKELY	MINOR	**LOW**	Management of slopes in accordance with good hillside practice			
5A	Erosion Head	Stormwater asset	UNLIKELY	MAJOR	**MODERATE**	Flexible above ground construction			
						Protection from storm water run-on			
						Management of slopes in accordance with good hillside practice			
						VICROADS remediation including retaining walls and soil nails			
5B	Erosion Head	Stormwater asset	UNLIKELY	MAJOR	**MODERATE**	Flexible above ground construction Protection from storm water run-on Management of slopes in accordance with good hillside practice VICROADS remediation including retaining walls and soil nails			
6A	Progressive failure of road batters	Stormwater asset	UNLIKELY	MAJOR	**MODERATE**	Flexible above ground construction			
						Protection from storm water run-on Management of slopes in accordance with good hillside practice VICROADS remediation including retaining walls and soil nails			
6B	Progressive failure of road batters	Stormwater asset	UNLIKELY	MAJOR	**MODERATE**	Flexible above ground construction			
						Protection from storm water run-on Management of slopes in accordance with good hillside practice VICROADS remediation including retaining walls and soil nails			
7	Thick slab failure in SW Sandstone 4 to 6 m thick	RETAINING WALL Stormwater asset Disposal Field Entire House	RARE	CATASTROPHIC	**MODERATE**				

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QUANTITATIVE RISK ASSESSMENT - LIFE

Job Number: 23170
Site Address: ILUKA AVENUE

FAILURE MODE	DESCRIPTION	SLOPE TYPE	VOLUME ESTIMATE (m^3)	POSITION OF ELEMENT[1] (^{0})	ELEMENT AT RISK	CURRENT RISK TO LIFE						CONTROL MEASURES	RESIDUAL RISK TO LIFE					
						$P_{(H)}$	$P_{(SH)}$	$P_{(Ts)}$	$V_{(DT)}$	$P_{(DI)}$	TOLERABLE RISK		$P_{(H)}$	$P_{(SH)}$	$P_{(Ts)}$	$V_{(DT)}$	$P_{(DI)}$	TOLERABLE RISK
1A	Trench collapse during construction	Proposed	10	90	Pedestrian on property	1E-03	1.0	0.33	1	3.30E-04	NO	Appropriate batters or shoring systems	1E-04	1.0	0.33	0.1	3.3E-06	YES
												Protection from storm water run-on						
												Work in dry weather						
												Management of slopes in accordance with good hillside practice						
1B	Trench collapse during construction	Proposed	10	90	Pedestrian on property	1.0E-03	1.0	0.33	1	3.30E-04	NO	Appropriate batters or shoring systems	1E-04	1.0	0.33	0.1	3.3E-06	YES
				Outside easement	Occupant in damaged house	1.0E-03	0.1	0.40	0.1	4.00E-06	YES	Protection from storm water run-on						
												Work in dry weather						
												Management of slopes in accordance with good hillside practice						
1C	Trench collapse during construction	Proposed	10	90	Pedestrian on property	1.0E-03	1.0	0.33	1	3.30E-04	NO	Appropriate batters or shoring systems	1E-04	1.0	0.33	0.1	3.3E-06	YES
												Protection from storm water run-on						
												Work in dry weather						
												Management of slopes in accordance with good hillside practice						
2A	Piping collapse post construction	Proposed	10	90	Pedestrian on property	1.0E-02	1.0	0.02	0.1	2.08E-05	NO	Cement stabilised back fill	1E-04	1.0	0.02	0.1	2.1E-07	YES
												In trench drainage measures						
2B	Piping collapse post construction	Proposed	10	90	Pedestrian on property	1.0E-02	1.0	0.02	0.1	2.08E-05	NO	Cement stabilised back fill	1E-04	1.0	0.02	0.1	2.1E-07	YES
												In trench drainage measures						
												Management of slopes in accordance with good hillside practice						
2C	Piping collapse post construction	Proposed	10	90	Pedestrian on property	1E-02	1.0	0.02	0.1	2.08E-05	NO	Cement stabilised back fill	1E-04	1.0	0.02	0.1	2.1E-07	YES
												In trench drainage measures						
												Management of slopes in accordance with good hillside practice						
3A	Translational slide	Proposed	100	90	Pedestrian on property	1.0E-03	1.0	0.02	0.1	2.08E-06	YES							
3B	Translational slide	Proposed	100	90	Pedestrian on property	1.0E-03	1.0	0.02	0.1	2.08E-06	YES							
					Occupant in damaged house	1.0E-03	0.1	0.40	0.1	4.00E-06	YES							
3C	Translational slide	Proposed	100	90	Pedestrian on property	1E-03	1.0	0.02	0.1	2.08E-06	YES							
4A	Shallow creep	Proposed	100	90	Pedestrian on property	1.0E-03	1.0	0.02	0.01	2.08E-07	YES							
4B	Shallow creep	Proposed	100	90	Pedestrian on property	1.0E-04	1.0	0.02	0.01	2.08E-08	YES							
4C	Shallow creep	Proposed	100	90	Pedestrian on property	1E-04	1.0	0.02	0.01	2.08E-08	YES							
5A	Erosion Head	Proposed	200	90	Pedestrian on property	1.0E-04	1.0	0.02	0.1	2.08E-07	YES							
5B	Erosion Head	Proposed	200	90	Pedestrian on property	1.0E-04	1.0	0.02	0.1	2.08E-07	YES							
6A	Progressive failure of road batters	Proposed	200	90	Pedestrian on property	1E-04	1.0	0.02	0.1	2.08E-07	YES							
6B	Progressive failure of road batters	Proposed	200	90	Pedestrian on property	1E-04	1.0	0.02	0.1	2.08E-07	YES							
7	Thick slab failure in SW Sandstone 4 to 6 m thick	Existing	5000	On failure	Occupant in destroyed house	3E-05	1.0	0.80	1	2.40E-05	YES							
				On failure	Pedestrian on property	3E-05	1.0	0.02	1	6.25E-07	YES							
				30	Vehicles on Great Ocean Road	3E-05	0.5	0.17	1	2.50E-06	YES							

LEGEND

$P_{(H)}$ Annual probability of occurrence **$P_{(Ts)}$ Temporal Probability** **$P_{(DI)}$ Risk for Loss of Life of an Individual**

$P_{(SH)}$ Spatial impact by hazard **$V_{(DT)}$ Vulnerability**

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

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

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

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.

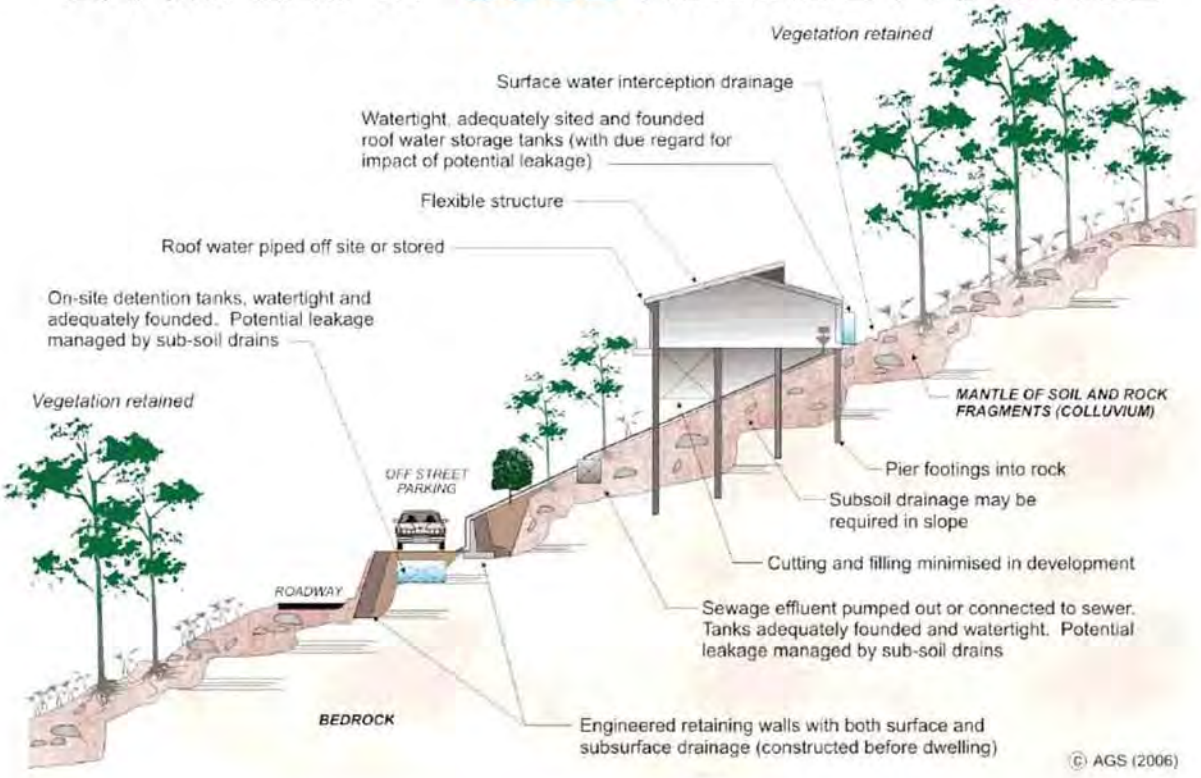
Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX E

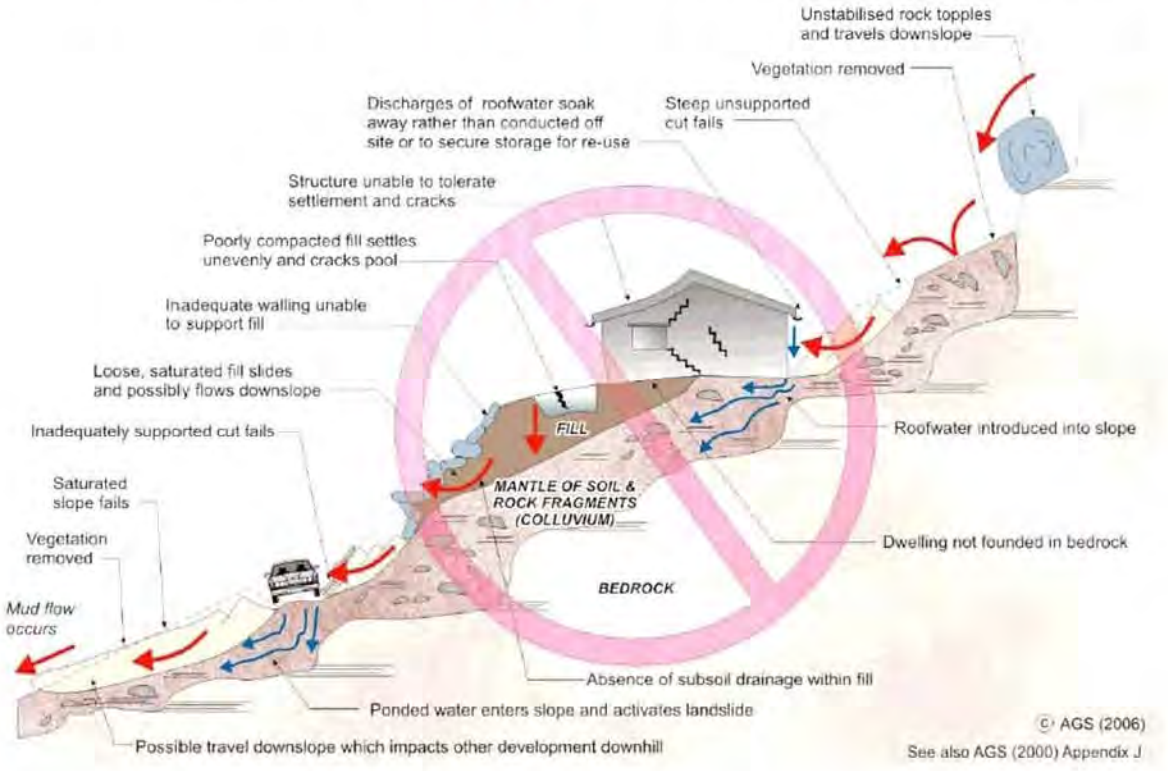
Good Practice for Hillside Construction

33 Roberts Road, Belmont, 3216
Telephone: 03 5243 3388 Facsimile: 03 5244 3023
admin@yttrup.com www.yttrup.com

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

APPENDIX F

Form A - Geotechnical Declaration

33 Roberts Road, Belmont, 3216
Telephone: 03 5243 3388 Facsimile: 03 5244 3023
admin@yttrup.com www.yttrup.com

FORM	A	**Geotechnical Declaration and Verification Development Application**
Office Use Only		Colac Otway SHIRE

To be submitted with planning application. It must accompany the Geotechnical Assessment and/or Landslip Risk Assessment. This form is essential to verify that the Geotechnical Assessment and/or Landslip Risk Assessment has been prepared in accordance with Cl 44.01 of the Colac Otway Planning Scheme and that the author of the Assessment/s is a geotechnical engineer or engineering geologist as defined by this clause.

Section 1	**Related Application**
Planning Application Number (if known)	
Site Address	Iluka Avenue, Wye River
Applicant	Colac Otway Shire

Section 2	**Geotechnical Assessment and /or Landslip Risk Assessment**	
Details	*Report Title:* LANDSLIDE RISK ASSESSMENT REPORT	
	Author's Company/ Organisation Name: P.J. YTTRUP & ASSOC.	*Report Reference No:* 180227 LRA ILUKA AVE 23170B
	Author: DANE POPE	*Dated:* 27 02 2018

Section 3		**Checklist**
Geotechnical Requirements (Tick as appropriate either Yes or No)		**The following checklist covers the minimum requirements to be addressed in a Geotechnical Assessment and/or Landslip Risk Assessment. The report must also cover any additional matters required by Clause 44.01. This checklist must accompany each report. Each item is to be cross-referenced to the section or page of the Geotechnical Assessment and/or Landslip Risk Assessment which addresses that item.**
☑ Yes	☐ No	A review of readily available history of slope instability in the site or related land as per < 23170B Section 5.2.1 >
☑ Yes	☐ No	An assessment of the risk posed by all reasonably identifiable geotechnical hazards as per < 23170B Section 7 >
☑ Yes	☐ No	Plans and sections of the site and related land as per < 23170B Figures >
☑ Yes	☐ No	Presentation of a geological model as per < 23170B Figures >
☑ Yes	☐ No	Photographs and/or drawings of the site as per < 23170B App. C >
☑ Yes	☐ No	A conclusion as to whether the site is suitable for the development proposed to be carried out either conditionally or unconditionally as per < 23170B Section 9 >
☐ Yes	☐ No	If any items above are ticked No, an explanation is to be included in the report to justify why < >
		Is the approval subject to recommendations and conditions relevant to:
☑ Yes	☐ No	Selection and construction of footing systems.
☑ Yes	☐ No	Earthworks.
☑ Yes	☐ No	Surface and sub surface drainage.
☑ Yes	☐ No	Recommendations for the selection of structural systems consistent with the geotechnical assessment of the risk.
☑ Yes	☐ No	Any conditions that may be required for the ongoing mitigation and maintenance of the site and the proposal from a geotechnical viewpoint.
☑ Yes	☐ No	Highlighting and detailing the inspection regime to provide the <PCA> and builder with adequate notification for all necessary inspections.
50 Years		State the Design Life of the Structure adopted in the Geotechnical Assessment and/or the Landslip Risk Assessment.
☑ Yes	☐ No	Are the risk mitigation measures as recommended in the Geotechnical Assessment and/or the Landslip Risk Assessment suitable for the design life of the structure?
NOTE:		**<Add Reference> - Add in the relevant section or page number of the listed Geotechnical Assessment and/or Landslip Risk Assessment which addresses each item**

FORM	A	**Geotechnical Declaration and Verification Development Application**

Section 4 — **List of Drawings referenced in Geotechnical Assessment and/or Landslip Risk Assessment**

Design Documents	Description	Plan or Document No.	Revision or Version No.	Date	Author
	Cardno - Iluka Ave Drainage Upgrade	V170115-CI-13000-2	2 tender	9/05/18	JO
	1:25,000 Landslide Susceptibility Map			18/03/07	CCMA
	1:25,000 Landslide Inventory Map			19/03/07	AM
	Survey - Coastal Lidar 0.5m contour				
	Cardno - Wallace Ave Drainage Upgrade (25 Iluka to Wallace only)	V170115-CI-12000-2	2 tender	19/06/18	JO

Section 5 — **Declaration**

Declaration (Tick all that apply)		
☑ Yes	☐ No	I am a geotechnical engineer or engineering geologist as defined by the Colac Otway Planning Scheme and on behalf of the company below:
☑ Yes	☐ No	I am aware that the Geotechnical Assessment and/or Landslip Risk Assessment I have either prepared or am technically verifying (referenced above) is to be submitted in support of a planning application for the proposed development site (referenced above) and its findings will be relied upon by the Colac Otway Shire Council in determining the planning application
☑ Yes	☐ N/A	I prepared the Geotechnical Assessment and/or Landslip Risk Assessment referenced above in accordance with the Colac Otway Planning Scheme and the AGS Guidelines 2007 as defined in the planning scheme.
☑ Yes	☐ N/A	I technically verify that the Geotechnical Assessment and/or Landslip Risk Assessment referenced above has been prepared in accordance with the Colac Otway Planning Scheme and the AGS Guidelines 2007 as appropriate.
☐ Yes	☑ No	I technically verify that the Geotechnical Assessment prepared for the planning application for the site confirms the land can meet the acceptable risk criteria specified in the schedule to Clause 44.01 of the Colac Otway Planning Scheme taking into account the total development and site disturbance proposed.
☑ Yes	☐ No ☐ N/A	I technically verify that the Landslip Risk Assessment prepared for the planning application for the site confirms the land can meet the tolerable risk criteria specified in the schedule to Clause 44.01 of the Colac Otway Planning Scheme taking into account the total development and site disturbance proposed.

Section 6 — **Geotechnical Engineer or Engineering Geologist Details**

Company/ Organisation Name	P.J. YTTRUP & ASSOCIATES	
Name (Company Representative)	Surname: POPE	Dr / Mr / Mrs / Ms / Miss
	Given Name(s)	DANE
	Chartered Professional Status CPENG	Registration Number 3435860
Signature		Dated: 27 / 02 / 2019

Reference: AGS Guidelines 2007c *"Practice Note Guidelines for Landslide Risk Management"*, Australian Geomechanics Society, Australian Geomechanics. V42. N1 March 2007.

Note: N/A = Not Applicable

Department of Environment, Land, Water & Planning

Department of Environment, Land, Water & Planning
Cnr Fenwick & Little Malop Street,
Geelong, Victoria 3220
Ph: 5226 4667
www.delwp.vic.gov.au

Our Ref: SP467501

24 May 2019

Mr Neil Hocking
Project Manager
Colac Otway Shire
2-6 Rae Street
Colac VIC 3250

Email: neil.hocking@colacotwayshire.vic.gov.au

Dear Mr Hocking,

CONSENT FOR USE AND DEVELOPMENT OF COASTAL CROWN LAND - WYE RIVER – SEPARATION CREEK DRAINAGE WORKS

Thank you for your correspondence of 10 March 2019 for consent to use or develop coastal Crown land pursuant to *Section 68* of the *Marine and Coastal Act 2018*.

The application is for the construction of stormwater drainage in Wye River and Separation Creek.

Pursuant to *Section 70* of the *Marine and Coastal Act 2018* and as delegated by the Minister, I consent to the proposed use and development subject to the conditions in the attached consent notice.

Please note that you will need to liaise with and seek permission for your works from VicRoads who have been undertaking extensive land stability works near Paddy's Path.

Note that the *Aboriginal Heritage Act 2006* requires that the discovery of Aboriginal cultural heritage places or objects on any public land in Victoria be reported to the Office of Aboriginal Victoria.

If you would like to discuss any further queries relating to this matter please contact Fraser Clatworthy, Environmental Planner, at the Anglesea Office on (03) 5220 2020

Yours sincerely,

Colleen White
Regional Director
Barwon South West

VICTORIA State Government

Department of Environment Land Water and Planning

DELWP Ref: SP467501

CONSENT FOR USE AND DEVELOPMENT OF COASTAL CROWN LAND

CLAUSE 70 *MARINE AND COASTAL ACT 2018*

Crown Description: Crown Allotment 27 E, Crown Allotment 2006, Crown Allotment 2109, Parish of Kaanlang

Local Name: Wye River

Street Address: Wye River, 3221

CONSENT FOR: **WYE RIVER – SEPARATION CREEK DRAINAGE WORKS**

Pursuant to *Part 7 Division 2* of the *Marine and Coastal Act 2018* and as delegated by the Minister, I consent to the proposed use and development subject to the following conditions:

1. Works are to be completed to the satisfaction of the Program Manager, Land and Built Environment, Department of Environment, Land, Water and Planning (the Manager).
2. All works are to be consistent with the application dated 10 March 2019.
3. Any proposed amendments to the works including changes to the design or siting must be referred to the Manager and written approval of the Department of Environment, Land, Water and Planning Delegate is required.
4. The work site is to be maintained to a safe standard to avoid public risk, and where practical public use is to be excluded from the works area using signs and appropriate barriers.
5. Prior to works commencing a Construction Environmental Management Plan (CEMP) is to be prepared and submitted to the Manager for approval. The plan must include measures to ensure that the works do not impact on the coastal environment and outline any cultural heritage protection measures.
6. Signage with contact details to answer any questions and concerns are to be displayed on site for two weeks before and after works and during construction.
7. All works are to be constructed to Australian Standards and to be certified for public use prior to public use.
8. The site is to be left in a clean and tidy condition at the completion of works.
9. All future maintenance is the responsibility of Colac Otway Shire
10. The consent will expire if the works are not completed within 2 years of the date of issue unless an extension of time is applied for and approval granted by the Delegate.
11. The works are subject to all other approvals.

Colleen White
Regional Director, Barwon South West
(as delegate for the Minister for Environment and Climate Change)

24/05/2019

VICTORIA State Government | Environment, Land, Water and Planning