PP304/2017-1

14 Mitchell Grove SEPARATION CREEK

Lot: 13 LP: 57713 V/F: 8430/385, Parish of Kaanglang

Construction of a dwelling and associated works

Ballarat Construction Management

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

D17/110975

Colac Otway SHIRE

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

Clear Form

Office Use Only

Application No.: Date Lodged: / /

Application for a **Planning Permit**

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

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

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

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

ⓘ Click for further information.

The Land ⓘ

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

Street Address *

Unit No.: | St. No.: 14 | St. Name: Mitchell Grove

Suburb/Locality: Separation Creek | Postcode: 3234

Formal Land Description *
Complete either A or B.

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

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

A Lot No.: 13 ◉ Lodged Plan ○ Title Plan ○ Plan of Subdivision No.: 57713

OR

B Crown Allotment No.: | Section No.:

Parish/Township Name:

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?** *

Construction of 2 level dwelling, using pre-existing crossovers and demolition of carport, previously dwelling destroyed by bush fire in December 2015

☑ 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 $ 800,000 ⚠ You may be required to verify this estimate. Insert '0' if no development is proposed.

Existing Conditions

Describe how the land is used and developed now *

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

Vacant land with a carport that will be demolished

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

Title Information

Encumbrances on title *

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

- ○ Yes (If 'yes' contact Council for advice on how to proceed before continuing with this application.)
- ◉ No
- ○ Not applicable (no such encumbrance applies).

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

Applicant and Owner Details

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

Applicant *

The person who wants the permit.

Name:
Title: Mr | First Name: David | Surname: Moyle
Organisation (if applicable): Ballarat Construction Management
Postal Address: | If it is a P.O. Box, enter the details here:
Unit No.: | St. No.: 900 | St. Name: Humffray Street South
Suburb/Locality: Mount Pleasant | State: VIC | Postcode: 3350

Please provide at least one contact phone number *

Contact information for applicant OR contact person below
Business phone: 03 53344882 | Email: david@ballaratcm.com.au
Mobile phone: 0417 160 078 | 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: Ms | First Name: Marcella | Surname: Moyle
Organisation (if applicable):
Postal Address: | If it is a P.O. Box, enter the details here:
Unit No.: | St. No.: 19B | St. Name: Hermitage Avenue
Suburb/Locality: Mount Clear | State: VIC | Postcode: 3350
Owner's Signature (Optional): | Date: 20/12/2017 day / month / year

Declaration

This form must be signed by the applicant *

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

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

Signature: David Moyle

Date: 20/12/2017 day / month / year

Need help with the Application?

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

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

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

○ No ◉ Yes If 'Yes', with whom?: Bernadette McGovan

Date: 28/11/2017 day / month / year

Checklist

Have you:

- ☑ Filled in the form completely?
- ☐ Paid or included the application fee? ⚠ Most applications require a fee to be paid. Contact Council to determine the appropriate fee.
- 📎 Provided all necessary supporting information and documents?
  - ☑ A full, current copy of title information for each individual parcel of land forming the subject site.
  - ☑ A plan of existing conditions.
  - ☑ Plans showing the layout and details of the proposal.
  - ☑ Any information required by the planning scheme, requested by council or outlined in a council planning permit checklist.
  - ☑ If required, a description of the likely effect of the proposal (for example, traffic, noise, environmental impacts).
- ☑ Completed the relevant council planning permit checklist?
- ☑ Signed the declaration above?

Lodgement

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

Colac Otway Shire
PO Box 283
Colac VIC 3250

2-6 Rae Street
Colac VIC 3250

Contact information

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

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

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

VOLUME 08430 FOLIO 385 Security no : 124069638367C
Produced 19/12/2017 03:34 pm

LAND DESCRIPTION

Lot 13 on Plan of Subdivision 057713.
PARENT TITLE Volume 08419 Folio 243
Created by instrument B518572 14/08/1963

REGISTERED PROPRIETOR

Estate Fee Simple
Sole Proprietor
MARCELLA MOYLE of 19B HERMITAGE AVENUE MOUNT CLEAR VIC 3350
AQ468417S 21/11/2017

ENCUMBRANCES, CAVEATS AND NOTICES

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

DIAGRAM LOCATION

SEE LP057713 FOR FURTHER DETAILS AND BOUNDARIES

ACTIVITY IN THE LAST 125 DAYS

NUMBER		STATUS	DATE
AQ374736X (E)	NOMINATION TO PAPER INST.	Completed	23/10/2017
AQ468416U	DISCHARGE OF MORTGAGE	Registered	21/11/2017
AQ468417S	TRANSFER	Registered	21/11/2017

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

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

Street Address: 14 MITCHELL GROVE SEPARATION CREEK VIC 3234

DOCUMENT END

FINAL SEARCH STATEMENT — Land Use Victoria

Security No : 124069638478F — Volume 8430 Folio 385
Produced 19/12/2017 03:37 PM

ACTIVITY IN THE LAST 125 DAYS

NUMBER		STATUS	DATE
AQ374736X (E)	NOMINATION TO PAPER INST.	Completed	23/10/2017
AQ468416U	DISCHARGE OF MORTGAGE	Registered	21/11/2017
AQ468417S	TRANSFER	Registered	21/11/2017

ADMINISTRATIVE NOTICES

NIL

STATEMENT END

D17110975

AQ468417S

Transfer of Land

Section 45 Transfer of Land Act 1958

Privacy Collection Statement
The information in this form is collected under statutory authority and used for the purpose of maintaining publicly searchable registers and indexes.

1. Land/s

Land Title

Volume 8430 Folio 385

2. Estate and Interest

FEE SIMPLE

3. Transferor/s

Transferor

Given Name/s IAN JOHN

Family Name HUGHES

4. Transferee/s

Transferee

Given Name/s MARCELLA

Family Name MOYLE

5. Manner of Holding

SOLE PROPRIETOR

6. Address/es of Transferee/s

Address of Transferee

Unit		Street No	19B
Street Name	HERMITAGE		
Street Type	AVENUE		
Locality	MOUNT CLEAR		
State	VIC	Postcode	3350

7. Consideration

$ 480,000

8. Signing

The transferor transfers to the transferee the estate and interest specified in the land described for the consideration expressed and subject to the encumbrances affecting the land including any created by dealings lodged for registration before the lodging of this transfer.

Transferor

Executed on behalf of IAN JOHN HUGHES

Signer Name IAN JOHN HUGHES

Signature

Execution Date 13-11-2017

Full Name of Witness ELLEN JUNE MONSON

Witness Signature

D17/110975

AQ468417S

Transfer of Land

Section 45 Transfer of Land Act 1958

Privacy Collection Statement
The information in this form is collected under statutory authority and used for the purpose of maintaining publicly searchable registers and indexes.

Transferee

Certifications

1.The Certifier has taken reasonable steps to verify the identity of the transferee.

2.The Certifier holds a properly completed Client Authorisation for the Conveyancing Transaction including this Registry Instrument or Document.

3.The Certifier has retained the evidence supporting this Registry Instrument or Document.

4.The Certifier has taken reasonable steps to ensure that this Registry Instrument or Document is correct and compliant with relevant legislation and any Prescribed Requirement.

Executed on behalf of	MARCELLA MOYLE
Signer Name	DONALD BRUCE ROBINSON
Signer Organisation	HARWOOD ANDREWS
Signer Role	AUSTRALIAN LEGAL PRACTITIONER
Signature	
Execution Date	13-11-2017

9. Lodging Party

Customer Code	699Y
Reference	1DBR:8SKB:21705714

Duty Use Only

4163851c

PLAN OF SUBDIVISION OF PART OF CROWN ALLOTMENT 29F

PARISH OF KAANGLANG

COUNTY OF POLWARTH

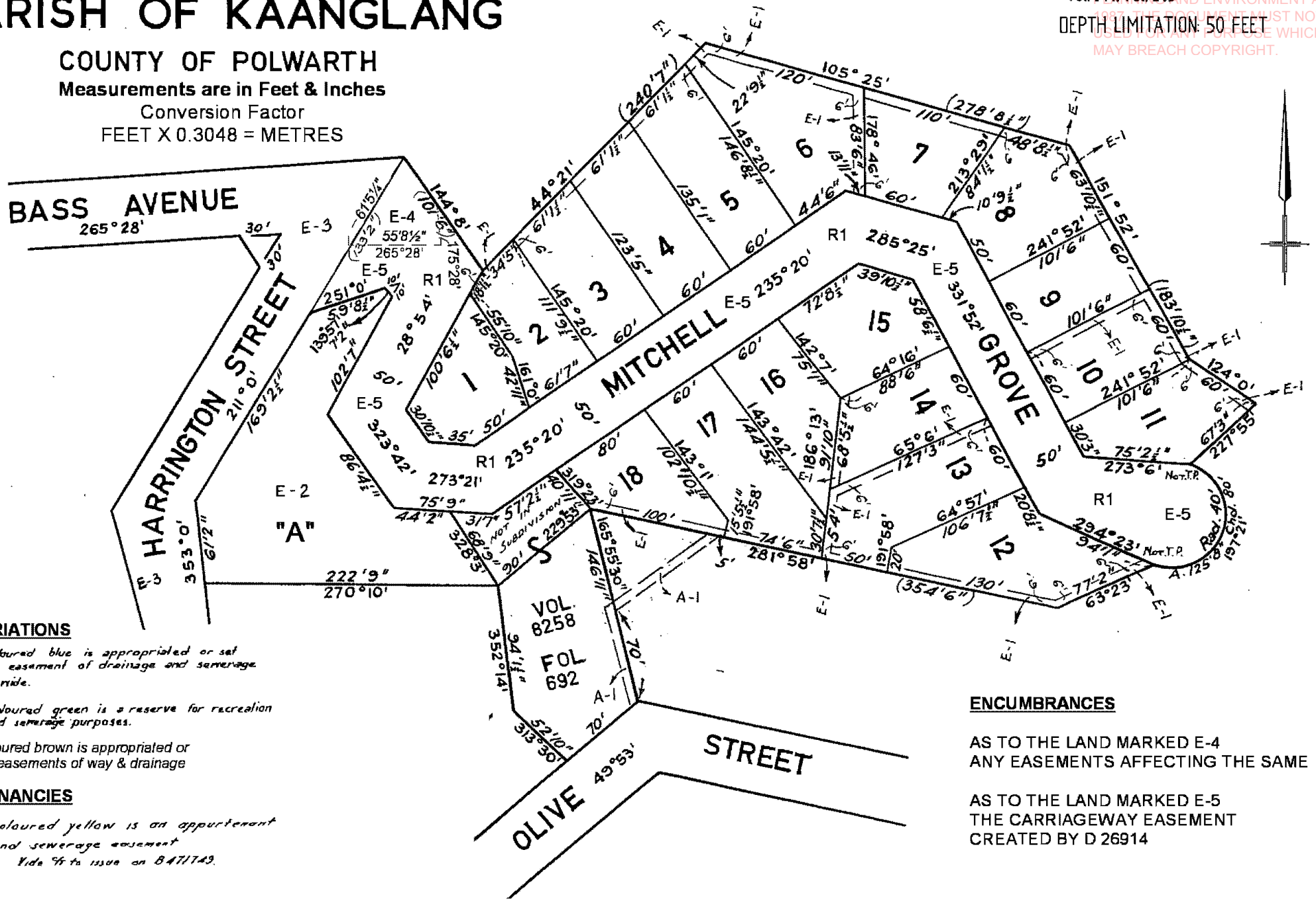
Measurements are in Feet & Inches

Conversion Factor

FEET X 0.3048 = METRES

COLOUR CONVERSION
B-1 = BLUE
B-2 = GREEN
B-3, E-4 & E-5 = BROWN
A-1 = YELLOW

LP57713
EDITION 3
PLAN MAY BE LODGED 14/6/63
Vol. 8419 Fol. 243
DEPTH LIMITATION: 50 FEET



APPROPRIATIONS

The land coloured blue is appropriated or set apart as an easement of drainage and sewerage and is 6'0" wide.

The land coloured green is a reserve for recreation drainage and sewerage purposes.

The land coloured brown is appropriated or set apart for easements of way & drainage

APPURTENANCIES

The land coloured yellow is an appurtenant drainage and sewerage easement Vide ‘ff’ to issue on B471749.

ENCUMBRANCES

AS TO THE LAND MARKED E-4
ANY EASEMENTS AFFECTING THE SAME

AS TO THE LAND MARKED E-5
THE CARRIAGEWAY EASEMENT
CREATED BY D 26914

MODIFICATION TABLE

RECORD OF ALL ADDITIONS OR CHANGES TO THE PLAN

PLAN NUMBER

LP 57713

WARNING: THE IMAGE OF THIS DOCUMENT OF THE REGISTER HAS BEEN DIGITALLY AMENDED. NO FURTHER AMENDMENTS ARE TO BE MADE TO THE ORIGINAL DOCUMENT OF THE REGISTER.

AFFECTED LAND/PARCEL	LAND/PARCEL IDENTIFIER CREATED	MODIFICATION	DEALING NUMBER	DATE	EDITION NUMBER	ASSISTANT REGISTRAR OF TITLES
ROAD R1 (PART)	E-4	EASEMENTS ENHANCED			2	AD
ROAD R1 (PART)	E-5	CREATION OF EASEMENT	D 26914		2	AD
"A"		REMOVAL OF RESERVE STATUS	AH854329Q		3	AF

MOYLE RESIDENCE
14 MITCHELL GROVE
SEPARATION CREEK

CLAUSE 54 RESPONSE

54 ONE DWELLING ON A LOT			
CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.01 NEIGHBOURHOOD AND SITE DISCRIPTION AND DESIGN RESPONSE			
54.01-01 Neighbourhood and site description		Refer to drawing TP 01 for details	Yes
54.01-02 Design response		Refer to drawing TP 01 for details	Yes

54.02 NEIGHBOURHOOD CHARACTER			
CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.02-1 Neighbourhood character objective	To ensure that the design respects the existing neighbourhood character or contributes to a preferred neighbourhood character. To ensure that development responds to the features of the site and the surrounding area.	Coastal design aesthetic employed Built form is designed to respond to site contours whilst minimising excavation. The plan has been generated to maximize views to the shore line	Yes
54.02-2 Integration with the street objective	To integrate the development with the street.	Site is located on low side of street and presents as a single storey dwelling	Yes

54.03 SITE LAYOUT AND BUILDING MASSING

CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.03-1 Street setback objective	To ensure that the setbacks of buildings from a street respect the existing or preferred neighbourhood character and make efficient use of the site.		
Standard A3 Modified Requirement	Walls of buildings should be setback at least 7m from the front street	7.5m	Yes
54.03-2 Building height objective	To ensure that the height of buildings respects the existing or preferred neighbourhood character.		
Standard A4 Modified Requirement	The maximum building height should not exceed 8 meters or two storeys, whichever is the lesser.	The effect of the slope of the site coupled with the side setback requirements make the building height objective difficult to comply with. The proposed building is well below 8m on the high side of the site, however exceeds 8m at the extreme end of the dwelling on the low side of the site. Despite this, the built form outcome appears balanced and not excessive in its height.	No
	Buildings are to be stepped to follow the contours of the site.	The dwelling has been designed to accommodate seniors and adopts 'Aging in Place' principals, as such steps have been minimised to increase safety precluding a stepped building form.	No

54.03-3 Site coverage objective Standard A5 Modified Requirement	To ensure that the site coverage respects the existing or preferred neighbourhood character and responds to the features of the site. The site area covered by buildings should not exceed the following amounts in the Precincts as shown on the Character Precincts Maps at Clause 21.04-13, Clause 21.04-14, Clause 21.04-15. • Separation Creek Precinct 1 – 25%	The site area of the dwelling is 195m2 = 23.5%	Yes
54.03-4 Permeability objectives	To reduce the impact of increased stormwater run-off on the drainage system. To facilitate on site stormwater infiltration.	The permeable site area is 569m2 = 69%	Yes
54.03-5 Energy efficiency objectives	To achieve and protect energy efficient dwellings To ensure the orientation and layout of development reduce fossil fuel energy use and make appropriate use of daylight and solar energy.	The dwelling has been designed with integrated sustainable features including; • Windows to allow North sun penetration • Excellent access to daylight to all rooms • Energy efficient glazing to all windows • Insulation proposed to external envelope • Water tanks for rain water harvesting • Louvres to the upper ground floor North Façade to minimise west sun heat load. • Skillion roof with louvered clerestory windows to allow night purging. • Low energy light fittings	Yes

54.03-6 Significant trees objectives	To encourage development that respects the landscape character of the neighbourhood. To encourage the retention of significant trees on the site	Proposed dwelling is mostly sited over the area of the previous dwelling, consequently existing vegetation is unaffected. No significant trees are proposed to be removed.	Yes

54.04 AMENITY IMPACTS

CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.04-1 Side and rear setbacks objective	To ensure that the height and setback of a building from a boundary respects the existing or preferred neighbourhood character and limits the impact on the amenity of existing dwellings.	Common pattern of development due to significant site slopes & width of the subject site precludes compliance	
Standard A10 Modified Requirement	A new building should be set back from both side boundaries a minimum of 3 meters	North side boundary setback = 2m South side boundary setback = 2.3m	No
	A new building should be setback a minimum of 5 meters from the rear boundary.	Exceeds 5.5m	Yes
	A new building should be setback from the side or rear boundary a minimum of 3 or 5 metres as required above, plus 0.3m for every metre height over 3.6m up to 6.9m, plus 1m for every metre height over 6.9m. Sunblinds, verandas, balconies, porches, eaves, fascia's, gutters, chimneys, flues, pipes, domestic fuel or water tanks, and heating or cooling equipment associated with a dwelling, may encroach into the setbacks of this standard.	North side boundary setback = 2m South side boundary setback = 2.3m	No

54.04-2 Walls on boundaries objectives	To ensure that the location, length and height of a wall on a boundary respects the existing or preferred neighbourhood character and limits the impact on the amenity of existing dwellings.	There are no walls proposed to be on the boundary.	Yes
54.04-3 Daylight to existing windows objective	To allow adequate daylight into existing habitable rooms windows.	The proposed dwelling is sited in excess of 10m from the adjoining property to the south consequently existing habitable room windows will not be impacted.	Yes
54.04-4 North-facing windows objective	To allow adequate solar access to existing north-facing habitable rooms windows.	There are no north-facing habitable room windows to the existing dwelling within 3m of the boundary.	Yes
54.04-5 Overshadowing open space objective	To ensure buildings do not unreasonably overshadow existing secluded private open space.	The proposed dwelling is sited in excess of 10m from the adjoining property to the south consequently existing private open space will not be unreasonably impacted	Yes
54.04-6 Overlooking objective	To limit views into existing secluded private open space and habitable room windows.	Existing private open space and habitable room windows exceed a horizontal distance of 9m	Yes

54.05 ON-SITE AMENITY AND FACILITIES			
CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.05-1 Daylight to new windows objective	To allow adequate daylight into new habitable room windows.	Habitable room windows will have excellent access to daylight	Yes
54.05-2 Private open space objective	To provide adequate private open space for the reasonable recreation and service needs of residents.	Private open space located on the Western Terrace is 43m2. The unbuilt areas of the site exceed 75% providing ample additional private open space.	Yes
54.05-3 Solar access to open space objective	To allow solar access into the secluded private open space of a new dwellings.	Private open space will have excellent solar access.	Yes

54.06 DETAILED DESIGN

CLAUSE	OBJECTIVE	RESPONSE	COMPLIES
54.06-1 Design detail objective	To encourage design detail that respects the existing or preferred neighbourhood character.	The building has been appropriately designed to reflect the coastal character of the region. The flat/skillion roof incorporates generous overhangs, and together with the cantilevered terrace creates strong surface articulation. The architecture is a confident and considered response to its context, deploying deeply cantilevered roofs and floors. The architecture projects a contemporary 2 storey silhouette against the landscape. The building is sited towards the front of the allotment to maintain easy access from the street. Side setbacks are sufficiently generous and creates a built form that is appropriately seated on the site without sitting uncomfortably with its neighbours, accordingly interstitial space appears generous. The outdoor terrace is co-located adjacent to the living zones and orientated to provide a generous outlook to the sea affording a high level of amenity for the occupants. The material palette is a thoughtful and appropriate selection of robust materials which are low maintenance and will be suitably resilient to weather and fire attack.	Yes
Standard A19 Modified Requirement	The design of the building's, including: • The number of storeys, • Verandahs, eaves and parapets, • Materials, colors and finishes, and • Building siting, including space around buildings Should respect the preferred neighbourhood character of the area. Garage and carport design should be visually unobtrusive and compatible with the development and the preferred neighbourhood character.		

54.06-2 Front fence objective Standard A20 Modified Requirement	To encourage front fence design that respects the existing or preferred neighbourhood character. The design of the front fence should complement the design of front fences on adjoining properties. A front fence within 3m of a street should not exceed a height of 1.2m and should be at least 50% transparent.	There is no new Front Fencing proposed.	Yes

LAND CAPABILITY ASSESSMENT REPORT

AT: **14 MITCHELL GROVE**
SEPARATION CREEK

PREPARED FOR: **DAVID MOYLE**
900 HUMFFRAY STREET SOUTH
MOUNT PLEASANT

REPORT NO.: **22854**

DECEMBER 2017

P.J. YTTRUP & ASSOCIATES PTY LTD | CONSULTING ENGINEERS

33 ROBERTS ROAD, BELMONT VIC 3216
P: 03 52433 388
E: admin@yttrup.com
W: yttrup.com

A.C.N. 005 909 919
A.B.N. 71 687 799 203

CONTENTS

EXECUTIVE SUMMARY

P.J. Yttrup & Associates Pty Ltd was commissioned to carry out a Land Capability Assessment at 14 Mitchell Grove, Separation Creek to assess the site's suitability for effluent disposal and to provide recommendations for the design of an on site waste water management system.

Based on our assessment of site and soil features, the site's capacity is subject to numerous constraints, including:

- Very high risk of landslide (Miner, 2007).
- Moderate slopes up to 15° in the Land Application Area (LAA) with straight sided slopes.
- Seepage occurs during wet winter months with rainfall exceeding potential evapotranspiration for 7 months of the year.
- Run on of storm water with excess water flowing downslope on the highly weathered rock interface.
- Strongly sodic, dispersive soils and Category 6c soil texture.

Recommendations to mitigate the above constraints include:

- Construct a terraced disposal field adopting subsurface irrigation beds and using imported Sandy LOAMs. Maintain a minimum 600 mm of Sandy LOAM between irrigation lines and underlying Medium to Heavy CLAY.
- Construction of retaining walls and management of surface and subsurface water in accordance with the Yttrup LRA (ref. LRA 22854, 20 December 2017).
- Adopt an advanced secondary treatment unit with 10/10/10 water quality.
- Re-vegetate with suitable, salt tolerant vegetation to maximise evapotranspiration.
- Treat the foundation soils (Category 6c) with Gypsum (0.5kg/m^2), during construction of the beds. Monitor soil sodicity over the life of the disposal field.
- Operation and management of the treatment and disposal system shall be in accordance with manufacturer's recommendations and the recommendations made in this report.

The proposed design mitigates the constraints and can reasonably be expected to perform to meet public health, environmental and amenity requirements.

LAND CAPABILITY ASSESSMENT REPORT AT 14 MITCHELL GROVE, SEPARATION CREEK REFERENCE NO: 22854

1.0 INTRODUCTION

P.J.Yttrup & Associates Pty Ltd (Yttrup) was commissioned to carry out a Land Capability Assessment (LCA) at the above property to assess the site's suitability for effluent disposal and to provide recommendations for the design of an on site waste water management system. This report provides information about the proposed development, site features, climatic conditions, soil profile and site constraints in accordance with:

- EPA Victoria's Code of Practice for Onsite Wastewater Management (EPA Publication 891.4, 2016).
- MAV - Victorian Land Capability Assessment Framework (2014).
- AS/NZS1547:2012 Onsite domestic wastewater management.
- AS1546:2008 Onsite domestic wastewater treatment units - Septic tanks.
- Colac Otway Shire (COS) Domestic Wastewater Management Plan (DWMP) - Whitehead and Associates, 2015

Coffey Geosciences completed a detailed land capability assessment for Wye River and Separation Creek (ref. Wye River and Separation Creek -Geotechnical, Land Capability and Wastewater Solutions, 5 April 2016).

1.1 Sensitivity Rating

Review of the COS DWMP and the Colac Otway Planning Maps indicates that the site has a high sensitivity for on-site disposal of domestic waste water.

2.0 PROPOSED DEVELOPMENT

Council Area:	Colac Otway Shire
Zoning:	Residential (TZ – Township Zone) (Refer to Planning Map, Appendix A).
Allotment Size:	Existing 828 m^2 (total site).
Existing dwelling	Vacant Site
Water Supply:	On-site roof catchment only, no reticulated supply.
Sewer	Non sewered area
Proposed Residence:	4 bedroom residence.
Occupancy:	The proposed residence will have a maximum nominal occupancy of five (5) people in accordance with EPA publication 891.4. Refer Section 6 for wastewater loading.
Overlays:	Bushfire Management Overlay (BMO) Design and Development Overlay (DDO) Erosion Management Overlay (EMO) Neighbourhood Character Overlay (NCO) Significant Landscape Overlay (SLO)

3.0 SITE FEATURES

Fieldwork was completed by a chartered geotechnical engineer of Yttrup on 27 October 2017.

The site is positioned on a concave slope with the southern property boundaries all containing stormwater easements, Photo 1. Key site features include:

- Concave slopes that decrease from 30° below the garage to 5° at the southern extent of the property, Figure 1. In the proposed Land Application Area (LAA) slopes decrease from 15 to 5°.
- Due to historical landslides in the north of Separation Creek, the site is positioned on a regionally convergent slopes. This feature has resulted in tunnel erosion in the past.
- The site is not within a designated catchment area.
- Recent bushfires destroyed the previous dwelling with footings still in place, Photo 2.
- The site is positioned in close proximity to a stormwater network with a series of pits within the drainage easements. At the time of the investigation the neighbouring property had connected their stormwater to the incorrect Legal Point of Discharge (LPOD) and consequently had excavated a trench across the property, Photo 1.

With regards to climatic conditions;

- The region has a temperate climate with dominant westerly winds and cool temperatures with moderate precipitation.
- The 70th percentile climate data (Whitehead and Associates, 2015) indicates rainfall in the order of 980 mm per year with Potential Evapotranspiration of approximately 900 mm per year. Note that rainfall exceeds evaporation during winter months.

The Yttrup Landslide Risk Assessment (LRA) presents several landslide risks related to effluent disposal (ref. LRA 22854, 20 December 2017).

3.1 Site Constraints

A summary of site constraints requiring mitigation measures is provided in Table 1. Refer to the full Site Risk Assessment matrix in Appendix C for details.

4.0 SOIL ASSESSMENT

Geological maps indicate the site is within the Eumeralla Formation (Edwards, 1996). This is consistent with the profile encountered on site, with residual soils overlying bedrock at depth, Photo 3. Reference to the Corangamite soil group mapping (DPI, 2003) indicates that the site is underlain by *"brown, yellow, grey and black gradational soils on cretaceous sediments"*. Typical characteristics include;

- Gradual increase in clay with depth,
- Variable surface soil depth
- Pale mottled lower subsoils

Two boreholes were drilled on site and left open to assess groundwater. Borehole logs are provided in Appendix B.

Seepage was not observed. However, seepage often occurs during prolonged periods of rainfall and low evaporation (winter months).

A soil texture category of massive medium to heavy CLAY (Cat 6c), Photo 3, is considered appropriate for this soil. This is supported by texture ribbons in excess of 100 mm and 97 % SILT/CLAY fraction. The Particle Size Distribution is provided in Appendix B. The soils have the following properties:

- High plasticity CLAY with a liquid limit of 75%
- Soil Electrical conductivity, EC_e measurements typically between 0.06 dS/m to 0.74 dS/m indicating non saline soils in context of soil texture. In borehole BH4 an ECe reading of 1.87 was recorded in the vicinity of the old effluent field, however this is non-saline in the context of soil texture (medium to heavy CLAY).
- Soil pH was measured at 7.1 to 7.5 indicating neutral conditions.
- Coffey completed 19 ESP tests in Wye River/Separation Creek with 2.9 to 22% and an average of 12% ESP. Site specific testing was completed with and ESP of 14% indicating strongly sodic conditions.
- Emerson Aggregate Class of 1 to 2 indicating potentially dispersive soils. This is in agreement with the sodicity results.

The underlying Medium Clay will control the application rate. Due to the size of the property there will be insufficient area available to use the site won soils.

4.1 Soil Constraint

A summary of soil constraints requiring mitigation measures is provided in Table 1. Refer to the full Site Risk Assessment matrix in Appendix C for details.

5.0 ASSESSMENT RESULTS

Based on the assessment of site and soil features, the site's capacity is subject to several significant site and soil constraints. The remedial works in Table 1 are expected to present an acceptable solution that address the constraints and reduce risk to acceptable levels, however, there are a number of risks that will need to be closely monitored.

Careful planning, construction and maintenance of the disposal system will be required to be implemented to reduce the associated risks.

Disposal is recommended to be a terraced subsurface irrigation bed area, sized in accordance with EPA891.4. The area will need to be benched and terraced to provide suitable zone application. The disposal field will be required to be distributed across the full width of the block (less the required setbacks) to limit concentration of moisture in one location. Furthermore, imported FILL will be required to improve the application rates. Additional slope stabilisation will be required (ref. LRA 22854, 20 December 2017) in order to reduce the potential landslide risks, most likely in the form of subsurface and surface water cut off drains and engineered retaining walls (as required). Refer to Figure 2 for a concept design of the proposed terraced beds.

N.B. The COS EMO allows for terraces to be supported by landscaped retaining walls when the retained height is less than 1m. Adopting this methodology can result in a significant increase in the number of terraces required. Where retaining walls are proposed to be underneath suspended floors of the dwelling, these shall be engineer designed due to the difficulty in regaining access for maintenance and the proximity to footings of the dwelling.

TABLE 1: SUMMARY OF RISK ASSESSMENT RESULTS & MITIGATION MEASURES

ELEMENT	CONSTRAINTS		MITIGATION MEASURES
	MODERATE	MAJOR	
SITE	• 200 to 250 slope aspect • Seepage occurs during wet winter months • Excess water flows downslope on the weathered rock interface • Straight slopes with convergence towards southern extent. • Run on of stormwater • 5° to 15° slopes. • Poorly draining soils with bull rushes/reeds present. • Little variety in vegetation. • Tunnel erosion on adjacent properties however not observed during the investigation. • Recent earthworks from neighbour has left a thin layer of FILL across the LAA.	• Rainfall exceeds potential evapotranspiration for 7 months of the year. • Very high risk of landslide (Miner, 2007). • Insufficient area for LAA	1. Construct a terraced disposal field adopting subsurface irrigation beds and using IMPORTED SANDY LOAM. Back slopes to be no greater than 10%. 2. Minimum 600 mm of Sandy LOAM between irrigation lines and underlying Medium Clays. 3. Construction of retaining walls and management of surface and subsurface water in accordance with the Yttrup LRA (ref. LRA 22854, 20 December 2017). 4. Re-vegetate with suitable, salt tolerant vegetation to maximise evapotranspiration. 5. Design using a water balance spreadsheet. 6. Provide a cut off and subsurface drain between the dwelling and the LAA, Figure 2. 7. Adopt a 10/10/10 water quality black water system
SOIL	• Mottling increasing with depth	• Category 6c soils (massive) • Emerson Class 1 to 2 • Strongly sodic soils	As per measures 1 to 7 above and; 8. Treat the foundation soils (Category 6c) with Gypsum (0.5kg/m^2), prior to construction of the beds. Monitor soil sodicity over the life of the disposal field.

6.0 WASTEWATER DESIGN

6.1 On Site Treatment

The onsite treatment system is to be in accordance with the EPA Septic Tanks Code of Practice (EPA891.4), and AS/NZS1547:2012 On-site domestic-wastewater management. The system is to be constructed and operated in a manner that:

- Is consistent with the State Environmental Protection Policy (Water of Victoria).
- Incorporates an EPA approved waste water treatment plant.
- Allows ready operation and maintenance in accordance with the EPA's Septic Tanks Code of Practice.

The proposed black water treatment system is to be an EPA approved proprietary aerated wastewater treatment system (AWTS), with adequate daily flow and tank capacity for effective detention period. An AWTS is a tank-based system that typically employ the following processes: settling of solids and flotation of scum; oxidation and consumption of organic matter; clarification and disinfection. Good maintenance is essential to ensure a consistently high level of performance. By law, an AWTS is required to be serviced quarterly by an approved maintenance contractor.

The water quality of secondary standard effluent in Victoria is;

- Less than 20 g/m^3 BOD_5
- Less than 30 g/m^3 TSS,
- E.Coli < 10cfu/100mg

The water quality of advanced secondary standard effluent in Victoria is;

- Less than 10 g/m^3 BOD_5
- Less than 10 g/m^3 TSS,
- E.Coli < 10cfu/100mg

Treatment recommendations are as follows:

1. Yttrup recommends that an advanced black water system is adopted due to placement of some of the LAA under suspended floors, Figure 1.
2. The selected black water system must have proven nutrient reduction capabilities with a post-treatment Nitrogen concentration of 25 mg/L or less. Refer to Section 6.4 for details.

Refer to the EPA website (http://www.epa.vic.gov.au/your-environment/water/onsite-wastewater/wastewater-secondary-domestic-treatment-systems) for a list of suitable AWTS systems that could be adopted. It is the owners' responsibility to ensure that the system is EPA approved and is serviceable in Victoria.

6.2 Hydraulic Loading

As the proposed development relies on on-site water collection it will be necessary to exercise sensible water minimisation practices in order to both conserve rainwater storages and reduce the level of wastewater discharge.

To assist in conserving water and to maintain a sensible hydraulic loading to the wastewater system, the development will need to operate in a manner that shall include practices such as:

- Consider adopting greywater recycling for re-use in toilets.
- Using water-saving devices, including aerated shower heads and water conserving automatic washing machines and appliances.
- Installing maximum 4.5/3L dual flush water closets, with reduced reservoir volume and flow.
- Installing a flow-meter at the inlet of the AWTS to observe and monitor the usage and wastewater flow rates, and to allow the owner to modify their water conservation techniques accordingly.
- Encouraging the use of water conservation techniques, including shorter showers, partially filled baths, using washing appliances with full loads, and through vigilant repair of leaking plumbing fixtures.
- The appropriate use of detergents and disinfectants that affect the bacterial action of the treatment and disposal system biomass, and minimises excess sodium loading on the disposal area should also be employed, in accordance with the EPA's recommendations and manufacturer's guidelines.
- Management of the sodium loading in the wastewater is critical to ensure adequate performance of the disposal system.

Design water loadings are summarised in Table 2 for a four bedroom house and a population equivalent of 5 people.

TABLE 2: DESIGN WATER LOADINGS

TREATMENT	WATER QUALITY[1]	POPULATION EQUIVALENT (p)	WATER LOADING /PERSON (L/p/day)	DESIGN WATER LOADING (L/day)
AWTS	10/10/10	5	150	750

Note 1. Refer to Section 6.1 for water quality definition

6.3 Buffer Distances

The following buffer distances have been adopted in accordance with Table 5 of EPA891.4 and Table R1 of AS 1547:2012 for secondary sewage and greywater effluent;

- LAQ up slope of a stormwater pit – 3m
- LAA up slope of building – 3 m
- LAA up slope of adjacent lot – 1 m (advanced) to 3 m (Secondary)
- LAA down slope of building 1.5 m
- LAA down slope of adjacent lot – 0.5 m (advanced secondary) to 1.5 m (secondary)
- Waterways – 30 m for secondary treated effluent.

6.4 On Site Disposal

The effluent disposal field is proposed to incorporate terraced sub-surface irrigation beds. A soil permeability category 2 has been adopted for imported Sandy LOAM. Note that the Sandy LOAM should have a minimum of 60% SAND and less than 20% CLAY.

For imported Sandy LOAM, the design irrigation rate (DIR) has been adopted at 5 mm/day.

A water balance spreadsheet has been used to size the LAA. The 70th percentile rainfall data has been used from Kennett River. The following assumptions have been made;

- Crop coefficient of 0.8
- Rainfall runoff factor of 0.7

The results of the water balance assessment indicate;

- Irrigation using site won soils and an AWTS is not feasible (>1000 m^2 required and 290m^2 available)
- Irrigation using imported soils is achievable for an AWTS (250 m^2 required and 290m^2 available). Nitrogen balance controls the LAA size.

TABLE 3: ON SITE DISPOSAL

OPTION	TREATMENT	WATER QUALITY	AREA REQUIREMENT(m^2)		
			WATER BALANCE	NITROGEN	DESIGN
SANDY LOAM IMPORT	AWTS	10/10/10	220	250	250

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The option provided in Table 3 presents a sustainable option for on-site disposal. The proposed wastewater dispersion method is through a 250 m^2 irrigation field subdivided into at least three separate fields that can be watered alternately. An automatic indexing valve (generically known as a "roto-valve") can be used to allow alternation between the areas with each pump cycle.

It is recommended that the owner consult an irrigation expert familiar with wastewater disposal, to help select, design and install the system.

Slope stabilisation works will be required at the location of the proposed beds, in order to reduce the landslide potential. Refer to the LRA by this office (Ref. LRA 22854, 20 December 2017) for the construction of engineer designed retaining walls (as required) and sub-surface and surface cut off drains.

Note that the COS EMO allows for terraces to be supported by landscaped retaining walls when the retained height is less than 1m. Adopting this methodology can result in a significant increase in the amount of terraces required.

The positioning of the effluent disposal field is to be located potentially above and below the house, within the site boundary, and includes setbacks as required in Table 5 of the EPA 891.4.

Note that reduced evaporation and higher rainfall patterns are expected in winter months. A holding tank storage system may be provided to collect, store and recycle treated effluent during peak flows or in low-evaporation wet seasons. The storage system may allow effluent recycling back through the disposal system or require periodic pump-outs in winter months.

All effluent disposal beds are to be planted with appropriate vegetation that will grow well in the climatic conditions and maximise evapo-transpiration.

6.5 Maintenance and Operation

Maintenance and operation of the wastewater management system shall be in accordance with the recommendations outlined in the EPA891.4, AS/NZS 1547:2012, and the manufacturer's specification for the relevant treatment system. Regular inspection and assessment of the systems are essential to ensure minimisation of any potential failures of the treatment and disposal systems.

7.0 STORMWATER AND SUBSURFACE WATER MANAGEMENT

The effluent disposal area will be located above and below the proposed dwelling. Diversion and subsurface drains shall be constructed and maintained on the upslope side of the disposal field to divert any stormwater run-on and sub-surface water from above the disposal field. Furthermore, these drains will be required between the effluent field and the house where the field is positioned above the house.

The ground adjacent to the house is recommended to be graded away from the building in accordance with AS2870-2011 and BCA requirements.

All tank overflows and surface drainage shall be appropriately collected and drained to the legal point of discharge, in accordance with council's requirements.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The site is subject to a number of site and soil constraints including insufficient area available for disposal, storm water run-on and steep slopes. Risks are able to be managed to ensure a sustainable effluent disposal system can be provided to the proposed development.

Recommendations to mitigate the above constraints include:

- Construct a terraced disposal field adopting subsurface irrigation beds and using imported Sandy LOAMs. Maintain a minimum 600 mm of Sandy LOAM between irrigation lines and underlying Medium to Heavy Clays.
- Construction of retaining walls and management of surface and subsurface water in accordance with the Yttrup LRA (ref. LRA 22854, 20 December 2017).
- Re-vegetate with suitable, salt tolerant vegetation to maximise evapotranspiration.
- Adopt an advanced secondary treatment unit with 10/10/10 water quality. .
- Treat the foundation soils (Category 6c) with Gypsum (0.5kg/m^2), during construction of the beds. Monitor soil sodicity over the life of the disposal field.
- Operation and management of the treatment and disposal system shall be in accordance with manufacturer's recommendations and the recommendations made in this report

The proposed design mitigates the constraints and can reasonably be expected to perform to meet public health, environmental and amenity requirements.

Dane Pope
Chartered Professional Engineer
Geotechnical Engineer

Jeffrey Andrews
Chartered Professional Engineer

P.J YTTRUP & ASSOCIATES PTY LTD

20 December 2017

9.0 REFERENCES

1. Coffey Geosciences (2016). Wye River and Separation Creek- Geotechnical, Land Capability and Wastewater Solutions – Land Capability Assessment.
2. DPI (2003) A land resource assessment of the Corangamite Region. Primary Industries Research Victoria. Bendigo.
3. Edwards, J., Tickell, S.J., Willocks, A.J., Eaton, A.R., Cramer, M.L., King, R.L., Bourton, S.M. (1996). 1: 250,000 Colac geological map. Melbourne: Geological Survey of Victoria.
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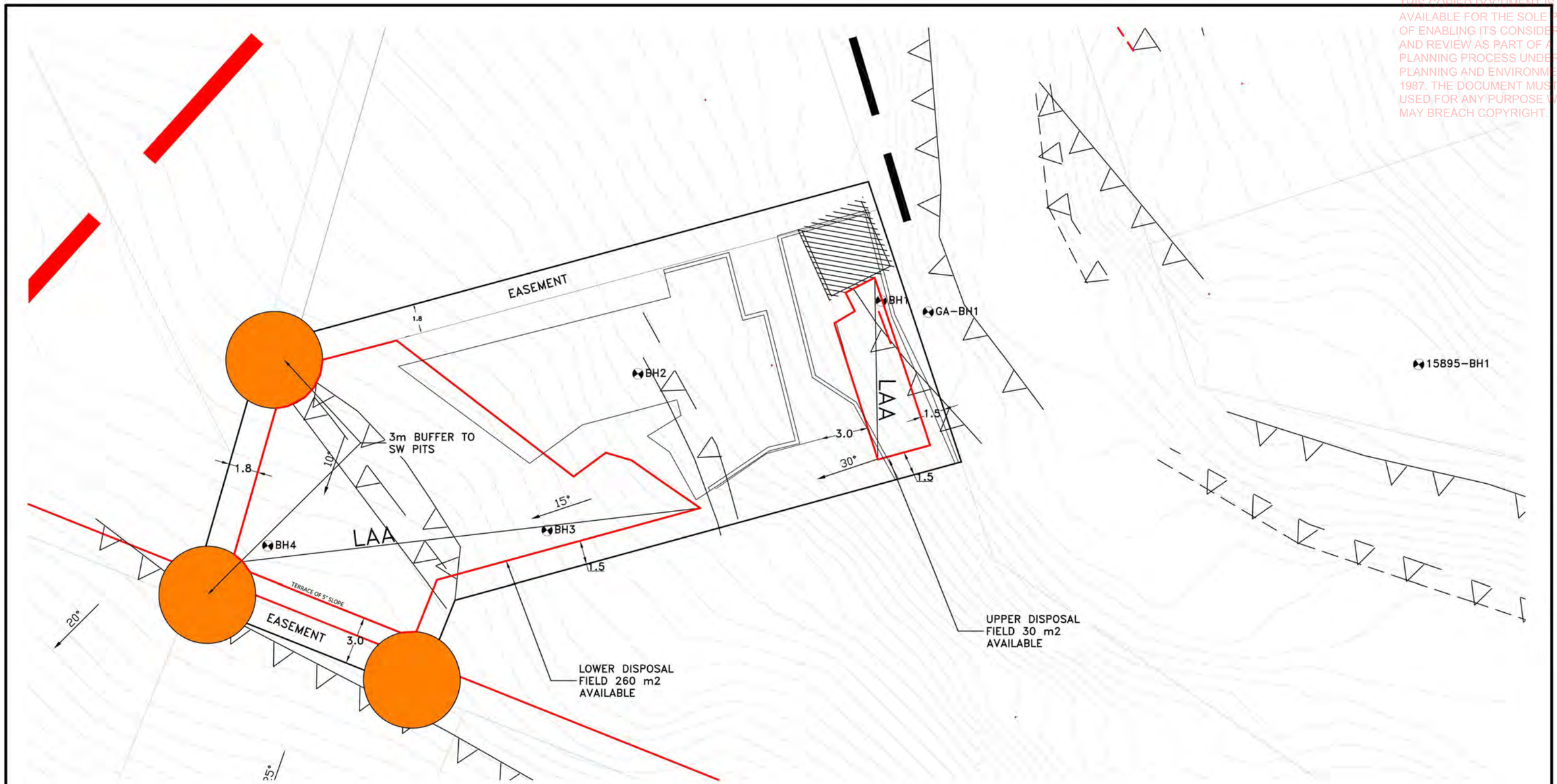
FIGURES

D17/110975



LEGEND

HUMMOCKY GROUND

26.5° SLOPE

SCARP

15 CLIFF (HEIGHT SHOWN)

1 BEDDING – APPROX. DIP

CONVEX SLOPE

CONCAVE SLOPE

BH1 BOREHOLE

SEEPAGE OR OVERLAND FLOW

0.5 to 1 m CONTOUR

ISSUE					
DATE	ISSUED TO	NO	DATE	ISSUED TO	NO

DATE	REVISION	BY

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CONSULTING ENGINEERS
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PH: (03) 5243 3388 FAX: (03) 5244 3023

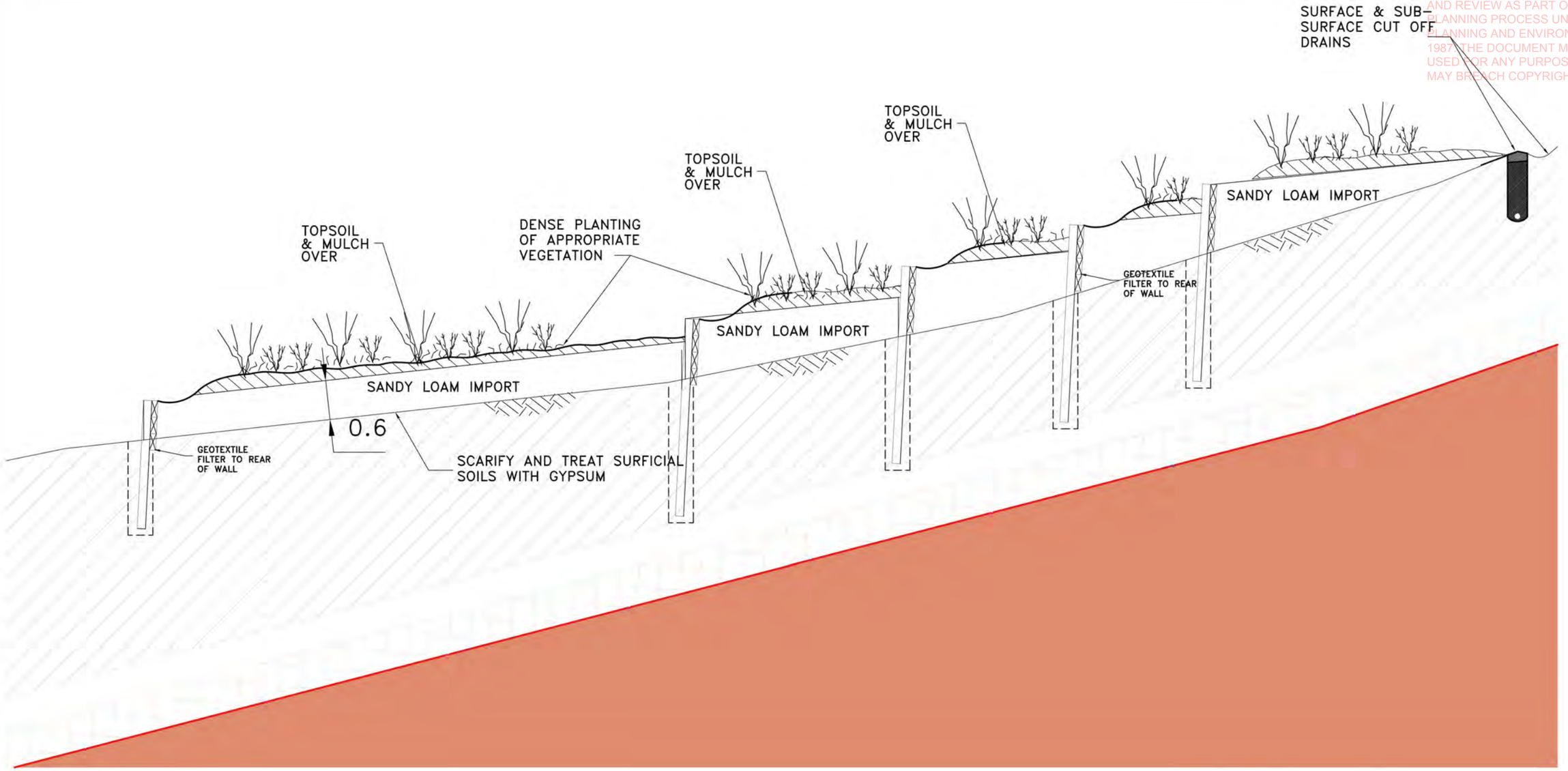
CLIENT: DAVID MOYLE

PROJECT: 14 MITCHELL GROVE
SEPARATION CREEK

DRAWING: SITE PLAN
LAA SETOUT

ENGINEER	DRAWN	JOB No.
	DP	22854
CHECKED	FIGURE	
	1	
SCALE	DATE	REV No.
–	13.12.17	A3

D17/110975



ISSUE					
DATE	ISSUED TO	NO	DATE	ISSUED TO	NO

DATE	REVISION	BY

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CONSULTING ENGINEERS
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CLIENT
DAVID MOYLE

PROJECT
14 MITCHELL GROVE
SEPARATION CREEK

DRAWING
SECTION
TERRACED DISPOSAL FIELD

ENGINEER	DRAWN	JOB No.
	DP	22854
CHECKED	FIGURE	
	2	
SCALE	DATE	REV No.
–	13.12.17	A3

PHOTOS

Photo 1 Disposal field looking south west with uncontrolled FILL and incorrect storm water drain construction at the time of inspection. .

Photo 2 Disposal field looking west showing moderate slopes at the bottom of the property.

Photo 3 Typical sub-surface conditions at borehole BH3 with Sandy Clay LOAM overlying mottled Medium CLAY at depth.

APPENDIX A

Planning Property Report

Site Location Plan

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Department of Environment, Land, Water and Planning

Planning Property Report

from www.planning.vic.gov.au on 07 December 2017 03:13 PM

Address: 14 MITCHELL GROVE SEPARATION CREEK 3234
Lot and Plan Number: Lot 13 LP57713
Local Government (Council): COLAC OTWAY **Council Property Number:** 19713
Directory Reference: VicRoads 519 T4

Planning Zone

TOWNSHIP ZONE (TZ)
SCHEDULE TO THE TOWNSHIP ZONE (TZ)

Note: labels for zones may appear outside the actual zone - please compare the labels with the legend.

Zones Legend

- ACZ - Activity Centre
- B1Z - Commercial 1
- B2Z - Commercial 1
- B3Z - Commercial 2
- B4Z - Commercial 2
- B5Z - Commercial 1
- C1Z - Commercial 1
- C2Z - Commercial 2
- CA - Commonwealth Land
- CCZ - Capital City
- CDZ - Comprehensive Development
- DZ - Dockland
- ERZ - Environmental Rural
- FZ - Farming
- GRZ - General Residential
- GWAZ - Green Wedge A
- GWZ - Green Wedge
- IN1Z - Industrial 1
- IN2Z - Industrial 2
- IN3Z - Industrial 3
- LDRZ - Low Density Residential
- MUZ - Mixed Use
- NRZ - Neighbourhood Residential
- PCRZ - Public Conservation & Resource
- PDZ - Priority Development
- PPRZ - Public Park & Recreation
- PUZ1 - Public Use - Service & Utility
- PUZ2 - Public Use - Education
- PUZ3 - Public Use - Health Community
- PUZ4 - Public Use - Transport
- PUZ5 - Public Use - Cemetery/Crematorium
- PUZ6 - Public Use - Local Government
- PUZ7 - Public Use - Other Public Use
- PZ - Port
- R1Z - General Residential
- R2Z - General Residential
- R3Z - General Residential
- RAZ - Rural Activity
- RCZ - Rural Conservation
- RDZ1 - Road - Category 1
- RDZ2 - Road - Category 2
- RGZ - Residential Growth
- RLZ - Rural Living
- RUZ - Rural
- SUZ - Special Use
- TZ - Township
- UFZ - Urban Floodway
- UGZ - Urban Growth
- Urban Growth Boundary

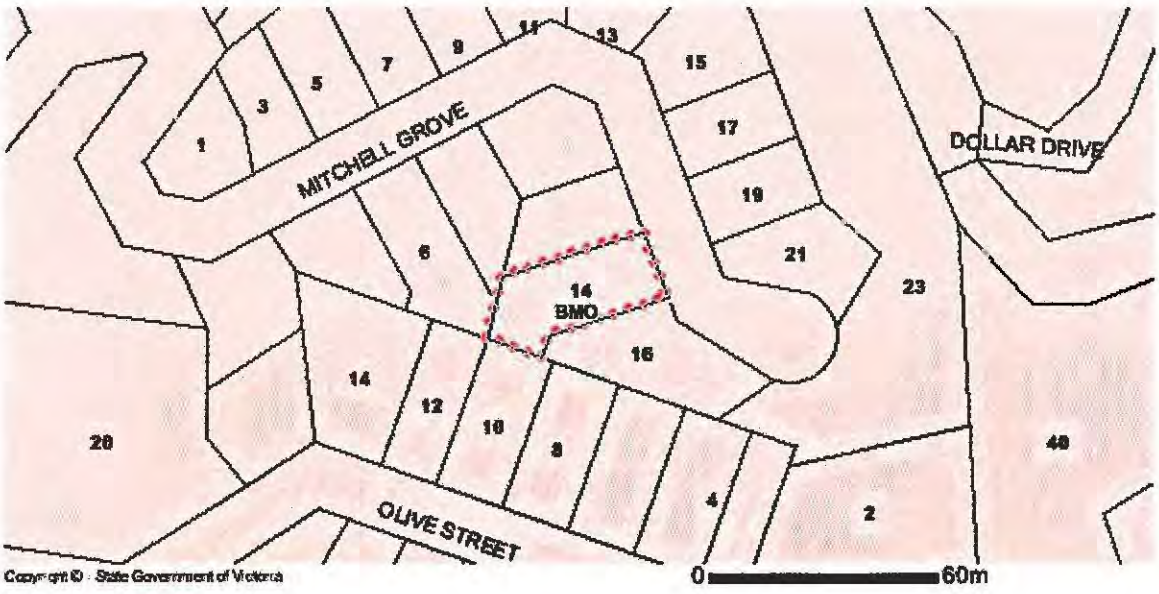
Railway | Tram | River, stream | Lake, waterbody

VICTORIA State Government | Environment, Land, Water and Planning

Department of Environment, Land, Water and Planning

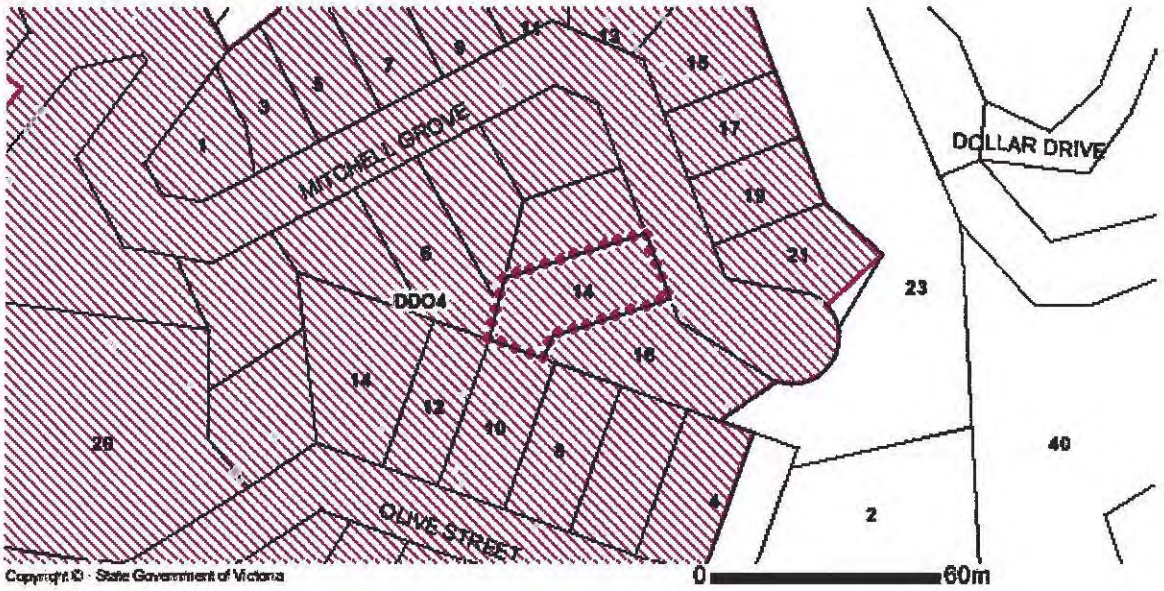
Planning Overlays

BUSHFIRE MANAGEMENT OVERLAY (BMO)



DESIGN AND DEVELOPMENT OVERLAY (DDO)

DESIGN AND DEVELOPMENT OVERLAY - SCHEDULE 4 (DDO4)



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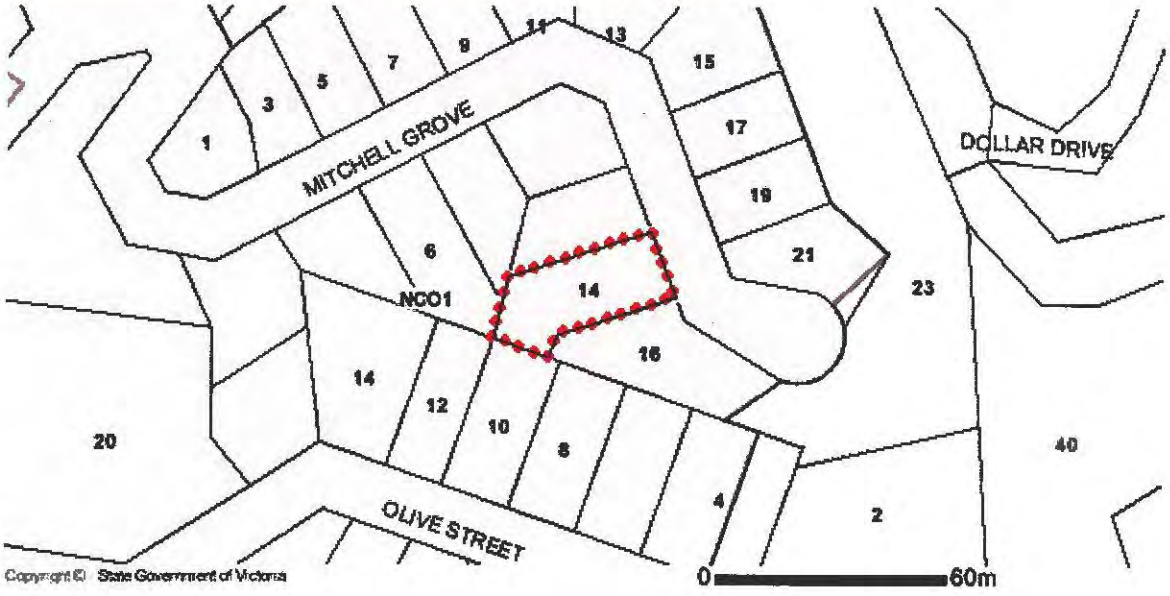
Planning Overlays

EROSION MANAGEMENT OVERLAY (EMO)

EROSION MANAGEMENT OVERLAY - SCHEDULE 1 (EMO1)

NEIGHBOURHOOD CHARACTER OVERLAY (NCO)

NEIGHBOURHOOD CHARACTER OVERLAY - SCHEDULE 1 (NCO1)



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Planning Overlays

SIGNIFICANT LANDSCAPE OVERLAY (SLO)

SIGNIFICANT LANDSCAPE OVERLAY - SCHEDULE 2 (SLO2)

Overlays Legend

- AEO - Airport Environs
- BMO - Bushfire Management
- CLPO - City Link Project
- DCPO - Development Contributions Plan
- DDO - Design & Development
- DDOPT - Design & Development Part
- DPO - Development Plan
- EAO - Environmental Audit
- EMO - Erosion Management
- ESO - Environmental Significance
- FO - Floodway
- HO - Heritage
- ICPO - Infrastructure Contributions Plan
- IPO - Incorporated Plan
- LSIO - Land Subject to Inundation
- MAEO1 - Melbourne Airport Environs 1
- MAEO2 - Melbourne Airport Environs 2
- NCO - Neighbourhood Character
- PO - Parking
- PAO - Public Acquisition
- RO - Restructure
- RCO - Road Closure
- SBO - Special Building
- SLO - Significant Landscape
- SMO - Salinity Management
- SRO - State Recource
- VPO - Vegetation Protection

Railway | Tram | River, stream | Lake, waterbody

Note: due to overlaps some colours on the maps may not match those in the legend.

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Department of Environment, Land, Water and Planning

Further Planning Information

Planning scheme data last updated on 4 December 2017.

A **planning scheme** sets out policies and requirements for the use, development and protection of land. This report provides information about the zone and overlay provisions that apply to the selected land. Information about the State, local, particular and general provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council or by visiting Planning Schemes Online

This report is NOT a **Planning Certificate** issued pursuant to Section 199 of the Planning & Environment Act 1987. It does not include information about exhibited planning scheme amendments, or zonings that may abut the land. To obtain a Planning Certificate go to Titles and Property Certificates

For details of surrounding properties, use this service to get the Reports for properties of interest

To view planning zones, overlay and heritage information in an interactive format visit Planning Maps Online

For other information about planning in Victoria visit www.planning.vic.gov.au

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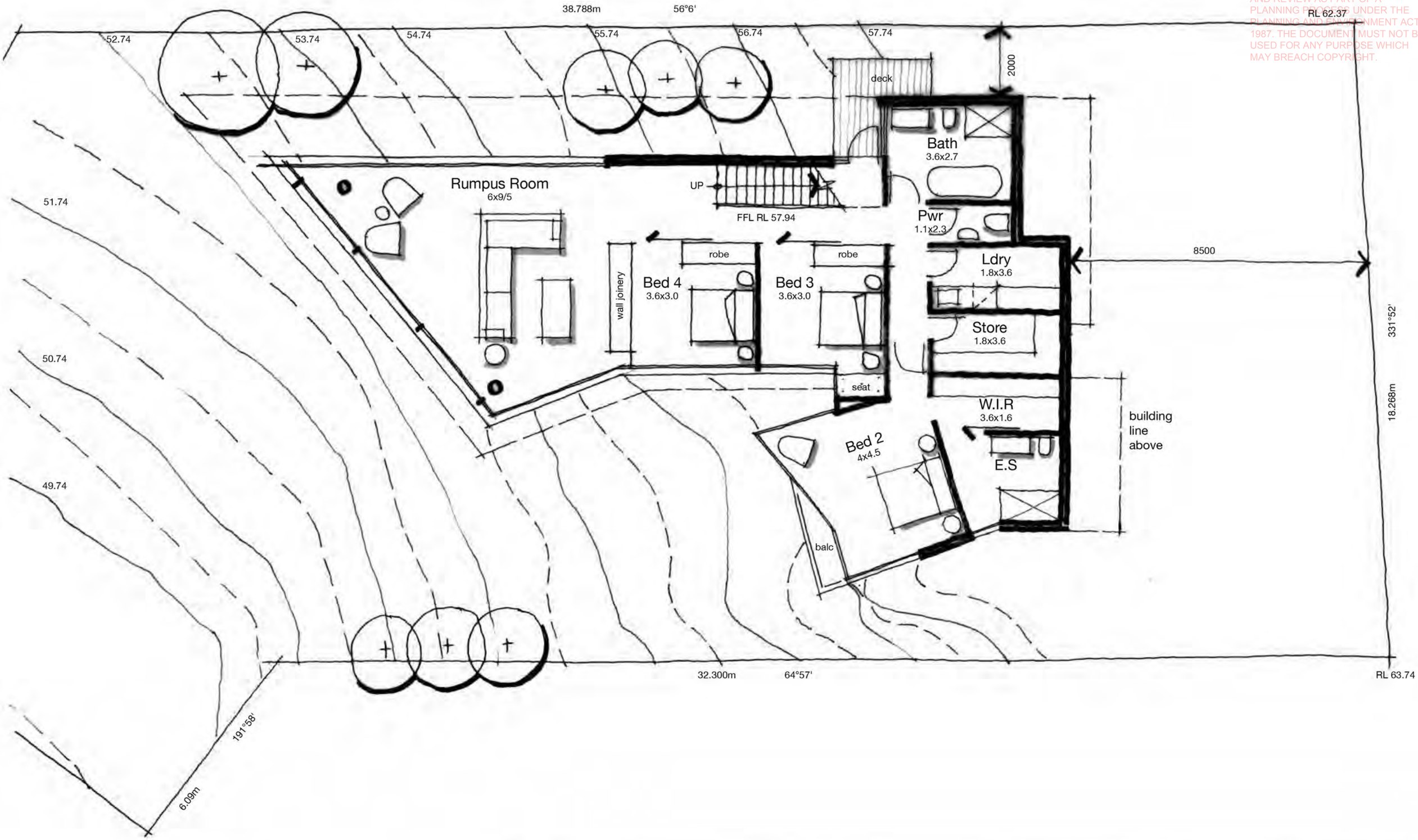

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Lower Floor Plan

SCALE @ A3
1:100

DRAWN
SdB

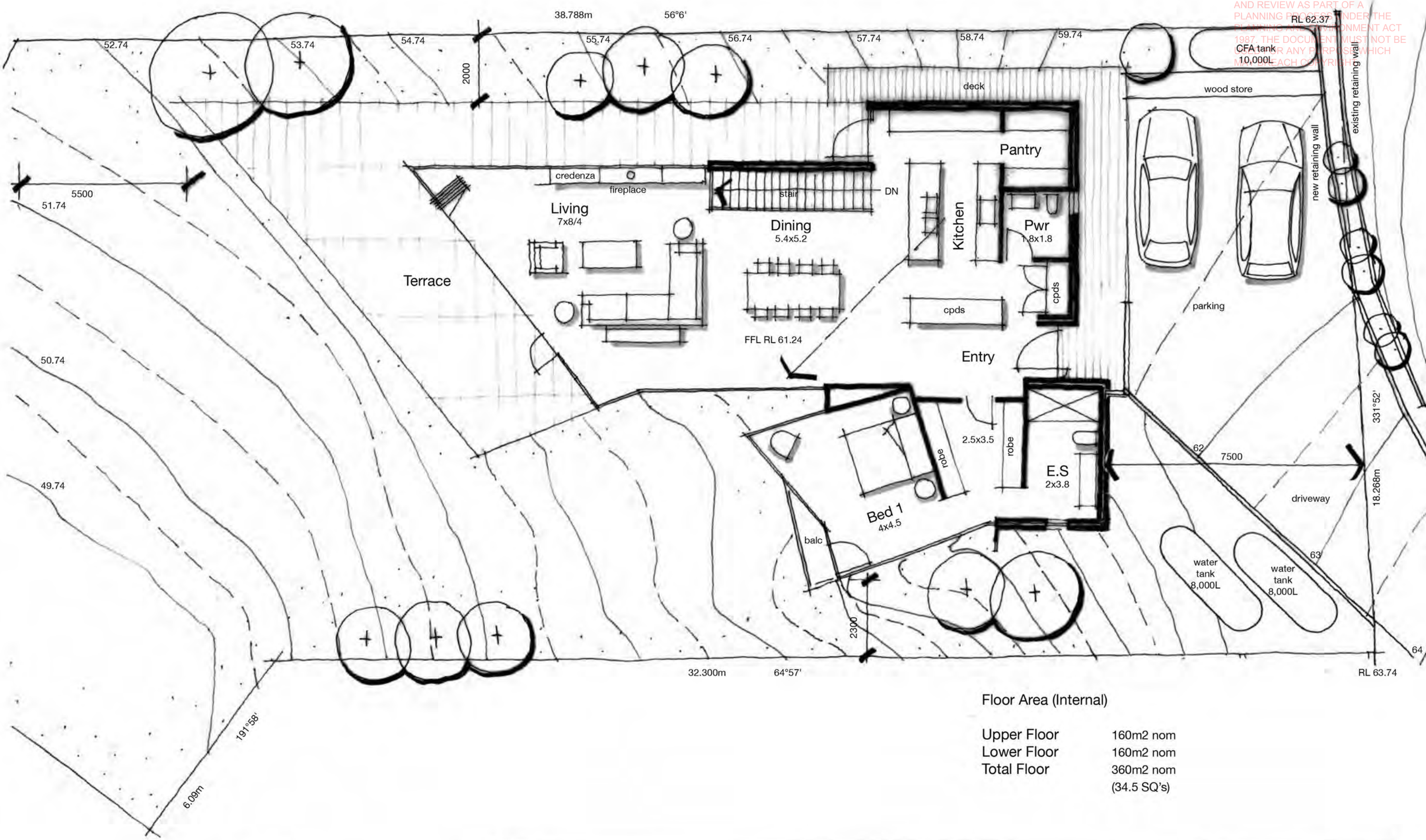
PROJECT No:
17.121

DRAWING No:
20171214-SK02

DATE
14/12/2017

REV:
A

D17/110975



Floor Area (Internal)

Upper Floor	160m2 nom
Lower Floor	160m2 nom
Total Floor	360m2 nom (34.5 SQ's)

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Upper Floor Plan

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	20171214-SK01
DATE	REV.
14/12/2017	A

D17/110975

SITE ANALYSIS

SITE AREA	825m²
LOWER GROUND	
PROPOSED FLOOR AREA	176.00 m²
DECK/BALCONY	8.00 m²
UPPER FLOOR	
PROPOSED FLOOR AREA	165.00 m²
DECK/BALCONY	75.00 m²
PROPOSED SITE COVERAGE (APPROX.) = 240m2	29%

12 MITCHELL GROVE
(VACANT)

14 MITCHELL GROVE

16 MITCHELL GROVE
DOUBLE STOREY
WEATHERBOARD HOUSE

MITCHELL GROVE

TOP RL - 63.84
TOE RL - 62.24

CFA WATER TANK
10000 L

TOP RL - 63.84
TOE RL - 62.24
PROPOSED RETAINING WALL

TOP RL - 63.84
TOE RL - 62.24
EXISTING RETAINING WALL

TOP RL - 64.24
TOE RL - 62.64

TOP RL - 64.24
TOE RL - 62.84

TOP RL - 64.24
TOE RL - 63.04

TOP RL - 64.24
TOE RL - 63.34

FALL

BENCH RL - 57.64

PROPOSED RETAINING WALL

AREA OF CUT

WATER TANK
8000 L

WATER TANK
8000 L

EASEMENT

FLOOR LINE ABOVE

BOUNDARY LOCATION

LINE OF EXISTING GRAVEL DRIVEWAY

LINE UNDERGROUND EFFLUENT FIELD

EASEMENT

BOUNDARY LOCATION

LINE OF UNDERGROUND EFFLUENT FIELD

EASEMENT

BOUNDARY LOCATION

BOUNDARY LOCATION

1
TP07

1 OVERALL SITE PLAN
1 : 100

N

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MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
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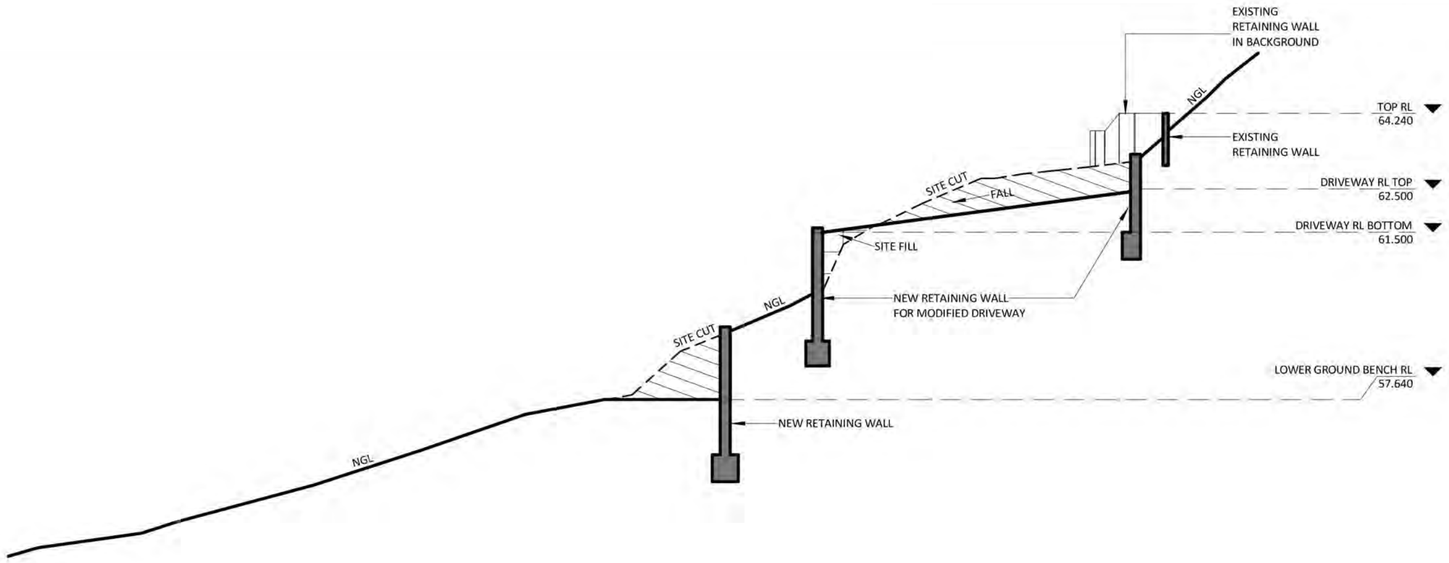
D17/110975



1 Section 1
1 : 100

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MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
1 : 100	VD	SDB		B	TP07

P:\Residential\M\Moyle Separation Creek\2.0 Design & Doc\2.4 Arch Dwgs\17.121 Moyle_Site_R18.rvt

EAST ELEVATION

NORTH ELEVATION

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	20171214-TP04
DATE	REV.
19/12/2017	A

WEST ELEVATION

SOUTH ELEVATION

LEGEND

F1	OFF FORM CONCRETE
F2	PAINTED METAL FASCIA
F3	CORTEN STEEL
F4	METAL DECK ROOF
F5	GLASS WINDOWS
F6	CLASS BALUSTRADE
F7	PERFORATED CORTEN STEEL LOUVRES
F8	PAINTED STEEL HOOD
F9	STEEL GUTTER
F10	TIMBER LINING BOARDS

Crosier Scott
Architects
585 Burwood Road
Hawthorn Victoria 3122
T 03 8862 7900
www.croscott.com.au

PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3
1:100

DRAWN
SdB

PROJECT No.
17.121

DRAWING No.
20171214-TP05

DATE
19/12/2017

REV.
A

APPENDIX B
Borehole Logs
Laboratory Test Results

D17/110975

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

Hole ID: **BH3**

CLIENT	: David Moyle	POSITION	: REFER TO SITE PLAN
CONTRACTOR	:	EASTING	:
PROJECT	: LCA	NORTHING	:
LOCATION	: 14 Mitchell Gorve, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5 t excavator
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

Depth (m)	Water	Graphic Log	Description	Soil Category	Moisture Condition	Sample or Field Test	LABORATORY TESTING: Moisture Content (%)	Emerson Class	pH	ESP (%)	Electrical Conductivity EC 1:5 dS/m	Electrical Conductivity ECe dS/m	STRUCTURE AND ADDITIONAL OBSERVATIONS
0			Sandy Clay LOAM, slightly plastic, brown, moderate structure, rootlets throughout			0.00-0.10 m		2	7.4		0.007	0.06	
				4a	D	0.10-0.20 m		2	7.1		0.015	0.13	
0.2			Medium to Heavy CLAY, highly plastic, pale grey with orange brown mottles, massive			0.30-0.80 m							
0.4													
0.6							23			14	0.098	0.74	
0.8				6c	M								
1.0													
1.2			Hole Terminated at 1.20 m Target depth										
1.4													

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

P.J. YTTRUP

& ASSOCIATES PTY. LTD.
Consulting Engineers

Hole ID **BH4**

CLIENT	: David Moyle
CONTRACTOR	:
PROJECT	: LCA
LOCATION	: 14 Mitchell Gorve, Seperation Creek
PROJECT No.	: 22854
POSITION	: REFER TO SITE PLAN
EASTING	:
NORTHING	:
COORD. SYS.	: MGA94 Zone 55
GROUND RL	:

Drill Rig: 5.5 t excavator
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

Depth (m)	Water	Graphic Log	Description	Soil Category	Moisture Condition	Sample or Field Test	Moisture Content (%)	Emerson Class	pH	ESP (%)	Electrical Conductivity EC 1:5 dS/m	Electrical Conductivity ECe dS/m	STRUCTURE AND ADDITIONAL OBSERVATIONS
0.00–0.10			Clay LOAM, moderately plastic, brown, moderate structure, rootlets throughout	4a	D	DS 0.00-0.10 m		6	7.1		0.069	0.59	
0.10–1.20			Medium to Heavy CLAY, highly plastic (liquid limit of 75%), pale grey with orange brown mottles, massive	6c	M	DS 0.10-0.30 m		1	7.5		0.057	0.43	
						DS 0.50-0.80 m 97% fines wl = 75 wp = 21		2	7.2		0.249	1.87	
1.20			Hole Terminated at 1.20 m Target depth										

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

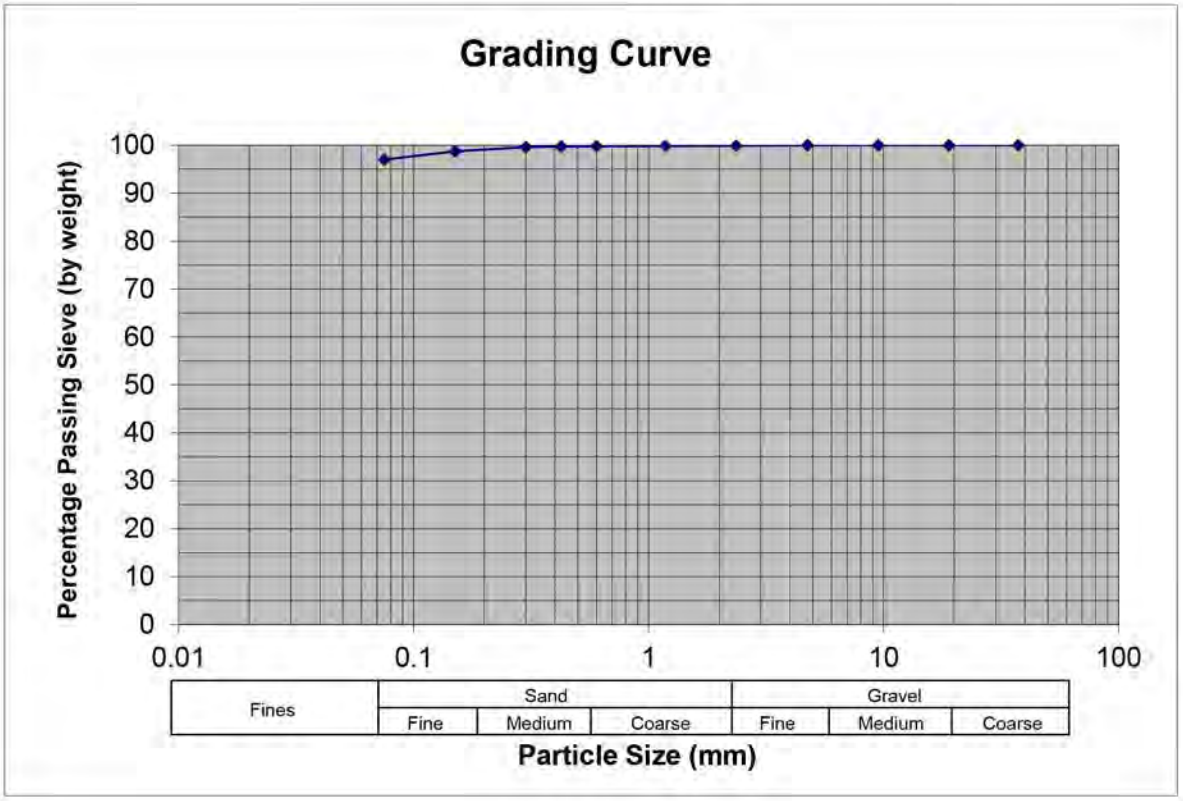
Washed Sieve Analysis

Date	15/11/2017
Job No.	22854
Client	Ballarat Construction Management
Site	14 Mitchell Gve Separation Ck
Pit No.	4
Depth	0.5-0.8m

Tray No.	18
Colour	
Soil Type	Silty CLAY
Weight tray & Wet Soil	1103.8
Weight tray & Dry Soil	898.63
Weight Dry Soil	

Initial Soil Weight	603.63
Soil Weight Post Wash	17.47
Weight Fines Lost	586.16
% Fines	97

Sieve Size (mm)	Sieve Weight (g)	Seive & Soil Wt (g)	Wt of soil Retained (g)	Cumulative Weight (g)	Percentage Retained (%)	Cum % Retained	Percentage Passing (%)
37.5	515.13	515.13	0	0	0	0.0	100.0
19.0	485.31	485.31	0	0	0.0	0.0	100.0
9.5	452.34	452.34	0	0	0.0	0.0	100.0
4.75	491.51	491.51	0	0	0.0	0.0	100.0
2.36	426.28	426.8	0.52	0.52	0.1	0.1	99.9
1.18	398.54	398.87	0.33	0.85	0.1	0.1	99.9
0.600	362.69	363.15	0.46	1.31	0.1	0.2	99.8
0.425	337.85	338.07	0.22	1.53	0.0	0.3	99.7
0.300	332.02	332.97	0.95	2.48	0.2	0.4	99.6
0.150	313.29	318.53	5.24	7.72	0.9	1.3	98.7
0.075	288.24	298.69	10.45	18.17	1.7	3.0	97.0
Pan	284.77	285.03	586.42	604.59	97.0	100.0	0.0
TOTAL		4706.4	604.59				



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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

P. J. Yttrup & Associates Pty Ltd
33 Roberts Rd
Belmont
VIC 3216

Attention: **Dane Pope**

Report **570644-S**
Project name 14 MITCHELL GROVE SEPARATION CREEK
Project ID 22854
Received Date Nov 02, 2017

Client Sample ID			**BH03-0.3-0.8**
Sample Matrix			**Soil**
Eurofins | mgt Sample No.			**M17-No02241**
Date Sampled			**Oct 27, 2017**
Test/Reference	LOR	Unit	
Conductivity (1:5 aqueous extract at 25°C)	10	uS/cm	98
Exchangeable Sodium Percentage (ESP)	0.1	%	14
Magnesium (exchangeable)	0.1	meq/100g	19
Potassium (exchangeable)	0.1	meq/100g	1.7
Sodium (exchangeable)	0.1	meq/100g	3.5
% Moisture	1	%	23
Cation Exchange Capacity			
Calcium (exchangeable)	0.1	meq/100g	0.9
Cation Exchange Capacity	0.05	meq/100g	25

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25°C)	Melbourne	Nov 03, 2017	7 Day
- Method: LTM-INO-4030			
Magnesium (exchangeable)	Melbourne	Nov 06, 2017	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Potassium (exchangeable)	Melbourne	Nov 06, 2017	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Sodium (exchangeable)	Melbourne	Nov 06, 2017	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity and ESP			
Cation Exchange Capacity	Melbourne	Nov 06, 2017	180 Days
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
Exchangeable Sodium Percentage (ESP)	Melbourne	Nov 06, 2017	28 Day
- Method: LTM-MET-3060 - Cation Exchange Capacity (CEC) & Exchangeable Sodium Percentage (ESP)			
% Moisture	Melbourne	Nov 02, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

Sydney
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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Melbourne
2-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1254 14271
Site# 1254

ABN– 50 005 085 521
e.mail : EnviroSales@eurofins.com
web : www.eurofins.com.au

Company Name:	P J Yttrup & Associates	**Order No.:**	22854
Address:	33 Roberts Rd Belmont VIC 3216	**Report #:**	570644
		Phone:	03 5243 3388
		Fax:	03 5244 3023
Project Name:	14 MITCHELL GROVE SEPARATION CREEK		
Project ID:	22854		

Received:	Nov 2, 2017 9:17 AM
Due:	Nov 10, 2017
Priority:	5 Day
Contact Name:	Dane Pope

Eurofins | mgt Analytical Services Manager : Mary Makarios

Sample Detail						Eurofins | mgt Suite B20	Moisture Set
elbourne Laboratory - NATA Site # 1254 & 14271						X	X
ydney Laboratory - NATA Site # 18217							
risbane Laboratory - NATA Site # 20794							
erth Laboratory - NATA Site # 23736							
xternal Laboratory							
o	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID		
	BH03-0.3-0.8	Oct 27, 2017		Soil	M17-No02241	X	X
est Counts						1	1

Eurofins | mgt 2-5 Kingston Town Close, Oakleigh, Victoria, Australia, 3166
ABN : 50 005 085 521 Telephone: +61 3 8564 5000

Date Reported:Nov 09, 2017

mgt

eurofins

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE**: pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

ug/L: micrograms per litre

ppb: Parts per billion

org/100mL: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Conductivity (1:5 aqueous extract at 25°C)	uS/cm	< 10			10	Pass	
Magnesium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Potassium (exchangeable)	meq/100g	< 0.1			0.1	Pass	
Method Blank							
Cation Exchange Capacity							
Calcium (exchangeable)	meq/100g	< 0.1			0.1	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C)	M17-No02229	NCP	uS/cm	960	990	2.0	30%	Pass	
Exchangeable Sodium Percentage (ESP)	S17-No04879	NCP	%	0.9	0.8	13	30%	Pass	
Magnesium (exchangeable)	S17-No04879	NCP	meq/100g	5.2	5.1	2.0	30%	Pass	
Potassium (exchangeable)	S17-No04879	NCP	meq/100g	0.4	0.4	3.0	30%	Pass	
Sodium (exchangeable)	S17-No04879	NCP	meq/100g	0.4	0.3	20	30%	Pass	
% Moisture	M17-No02203	NCP	%	22	23	2.0	30%	Pass	
Duplicate									
Cation Exchange Capacity				Result 1	Result 2	RPD			
Calcium (exchangeable)	S17-No04879	NCP	meq/100g	36	34	7.0	30%	Pass	
Cation Exchange Capacity	S17-No04879	NCP	meq/100g	42	40	7.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Comments

Authorised By

Mary Makarios	Analytical Services Manager
Alex Petridis	Senior Analyst-Metal (VIC)
Huong Le	Senior Analyst-Inorganic (VIC)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

APPENDIX C

Land Capability Assessment Matrix

P.J. YTTRUP & ASSOCIATES PTY LTD | CONSULTING ENGINEERS

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P. J. YTTRUP & ASSOCIATES PTY LTD

Consulting Engineers

SITE CONSTRAINTS - RISK ASSESSMENT TABLE

Client: DAVID MOYLE
Project: 14 MITCHELL GROVE
SEPARATION CREEK
Job No.: 22854

Date: 19/12/2017
Tested: DRP

Characteristic	Level of Constraint			Observed Features	Assessed Level of Constraint for Site	Mitigation Measures
	Nil or Minor	Moderate	Major			
Aspect (affects solar radiation received)	North / North-East / North-West	East / West / South-East / South-West	South	Aspect of 200 to 250 (west to south west)	Moderate	Provide planting to maximise evapotranspiration
Climate (difference between annual rainfall and pan evaporation)	Excess of evaporation over rainfall in the wettest months	Rainfall approximates to evaporation	Excess of rainfall over evaporation in the wettest months	rainfall exceeds evaporation in winter	Major	Provide planting to maximise evapotranspiration Design using a water balance spreadsheet.
Erosion [1] (or potential for erosion)	Nil or Minor	Moderate	Severe	Tunnel erosion reported on adjacent properties	Moderate	Provide surface and sub-surface cutoff drain around disposal areas.
Exposure to sun and wind	Full sun and/or high wind or minimal shading	Dappled light	Limited patches of light and little wind to heavily shaded all day	Faces dominant wind direction. No signficant trees on propoerty	Minor	
Fill [2] (imported)	No fill or minimal fill, or fill is good quality topsoil	Moderate coverage and fill is good quality	Extensive poor quality fill and variable quality fill	Earthworks for drains has left thin veneer of FILL on site	Moderate	Medium CLAY to be replaced as part of other control measures.
Flood frequency (ARI)[3]	Less than 1 in 100 years	Between 100 and 20 years	More than 1 in 20 years	Not Relevant	Minor	
Groundwater bores [4]	No bores onsite or on neighbouring properties	Setback distance from bore complies with requirements in EPA Code of Practice 891.4 (as amended)	Setback distance from bore does not comply with requirements in EPA Code of Practice 8914 (as amended)	Nil	Minor	
Land area available for LAA	Exceeds LAA and duplicate LAA and buffer distance requirements	Meets LAA and duplicate LAA and buffer distance requirements	Insufficient area for LAA	Insufficient area for in-situ soil	Major	Use of terraced sub-surface irrigation system. Terrace back slope to be less than or equal to 10% Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines

P. J. YTTRUP & ASSOCIATES PTY LTD

Consulting Engineers

SITE CONSTRAINTS - RISK ASSESSMENT TABLE

Client: DAVID MOYLE
Project: 14 MITCHELL GROVE SEPARATION CREEK
Job No.: 22854
Date: 19/12/2017
Tested: DRP

Characteristic	Level of Constraint			Observed Features	Assessed Level of Constraint for Site	Mitigation Measures
	Nil or Minor	Moderate	Major			
Landslip (or landslip potential) [5]	Nil	Minor to moderate	High or Severe	Very high risk (Miner 2007))	Major	Use of terraced sub-surface irrigation system. Terrace back slope to be less than or equal to 10% Provide surface and sub-surface cutoff drain around disposal areas.
Rock outcrops (% of surface)	<10%	10-20%	>20%	Nil	Minor	
Slope Form (affects water shedding ability)	Convex or divergent side-slopes	Straight side-slopes	Concave or convergent side-slopes	Straight side slopes, convergent towards the lower section	Moderate	Use of terraced sub-surface irrigation system. Provide surface and sub-surface cutoff drain around disposal areas.
Slope gradient [6] (%)						
(c) for subsurface irrigation	<10%	10-30%	>30%	15 degrees (27%) with flat terrace in lower 10m of property	Moderate	Use of terraced sub-surface irrigation system. Terrace back slope to be less than or equal to 10%
Soil Drainage [7] (qualitative)	No visible signs or likelihood of dampness, even in wet season	Some signs or likelihood of dampness	Wet soil, moisture-loving plants, standing water in pit; water ponding on surface, soil pit fills with water	Bull rushes indicative of poorly draining materials	Moderate	Provide surface and sub-surface cutoff drain around disposal areas.
Stormwater run-on	Low likelihood of stormwater run-on		High likelihood of inundation by stormwater run-on	Protection in the form of benched slopes and engineered drainage measures	Moderate	Provide surface and sub-surface cutoff drain around disposal areas.
Surface waters- setback distance (m) [9]	Setback distance complies with requirements in EPA Code of Practice 8914 (as amended)		Setback distance does not comply with requirements in EPA Code of Practice 8914 (as amended)	> 100 m to ocean/gully	Minor	
Vegetation coverage over the site	Plentiful vegetation with healthy growth and good potential for nutrient uptake	Limited variety of vegetation	Sparse vegetation or no vegetation	Grasses and reeds. No major trees.	Moderate	Provide planting to maximise evapotranspiration

P. J. YTTRUP & ASSOCIATES PTY LTD

Consulting Engineers

SITE CONSTRAINTS - RISK ASSESSMENT TABLE

Client: DAVID MOYLE
Project: 14 MITCHELL GROVE
SEPARATION CREEK
Job No.: 22854

Date: 19/12/2017
Tested: DRP

Characteristic	Level of Constraint			Observed Features	Assessed Level of Constraint for Site	Mitigation Measures
	Nil or Minor	Moderate	Major			
Soil Drainage [8] (Field Handbook definitions)	Rapidly drained. Water removed from soil rapidly in relation to supply, excess water flows downward rapidly. No horizon remains wet for more than a few hours after addition.	Well drained. Water removed from the soil readily, excess flows downward. Some horizons may remain wet for several days after addition	Moderately well drained. Water removed somewhat slowly in relation to supply, some horizons may remain wet for a week or more after addition Poorly/Very poorly drained. Water remains at or near the surface for most of the year, strong gleying. All horizons wet for several months	Excess water flows downslope on interface with residual clays or highly weathered rock.	Moderate	Provide planting to maximise evapotranspiration Design using a water balance spreadsheet. Use of terraced sub-surface irrigation system. Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines Provide surface and sub-surface cutoff drain around disposal areas.

Legend:
Nil or Minor: If all constraints are minor, conventional/standard designs are generally satisfactory.
Moderate: For each moderate constraint an appropriate design modification over and above that of a standard design, should be outlined.
Major: Any major constraint might prove an impediment to successful on-site wastewater management, or alternatively will reqauire in depth investigation and incorporation of sophisticated mitigation measures in the design to permit compliant onsite waterwater management.

Provide the following informaion in the LCA report:

1 Provide basis for erosion rating
2 Describe the nature of the fill and compaction
3 Annual Return Interval (in years)
4 Refer to setback buffers for groundwater bores in Table 5 of the EPA Code of Practice (2013)
5 May require assessment by a geotechnical expert. Consider the potential for the additional water from the treatment system to impact the stability of the soil by reducing the friction forces within the soil or increasing the mass of the block of soil.
6 Gentler slopes are required for higher loading rates. Steeper slopes have the potential for landslip and soil erosion.
7 Provide date and weather conditions.
8 Use local anecdotal information.
9 Refer to setback buffers for specific waterways types in Table 5 of the EPA Code of Practice (2013)

P. J. YTTRUP & ASSOCIATES PTY LTD

Consulting Engineers

SOIL CONSTRAINTS - RISK ASSESSMENT TABLE

Client: DAVID MOYLE
Project: 14 MITCHELL GROVE
SEPARATION CREEK
Job No.: 22854

Date: 19/12/2017
Tested: DRP

Characteristic	Level of Constraint			Observed Features	Assessed Level of Constraint for Site	Mitigation Measures
	Nil or Minor	Moderate	Major			
Electrical Conductivity (ECe) dS/m) as a measure of soil salinity [1]	<0.8	0.8 - 2	>2	Less than 0.8 except at 0.5 m BH4 = 1.87. Non saline in context of texture.	Minor	
Emerson Aggregate Class (consider in context of sodicity)	4, 5, 6, 8	7	1, 2, 3	Typically 1 to 2	Major	Use of terraced sub-surface irrigation system. Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines Treat subsurface soils with gypsum at 0.5kg/m2.
Gleying [2] **(see Munsell Soil Colour Chart)**	Nil	Some evidence of greenish grey / black or bluish grey / black soil colours	Predominant greenish grey / black, bluish grey / black colours	Nil		
Mottling (see Munsell Soil Colour Chart)	Very well to well-drained soils generally have uniform brownish or reddish colour	Moderately well to imperfectly drained soils have grey and/or yellow brown mottles and the mottled areas occur higher in the profile the less well-drained the soil.	Poorly drained soils have predominant grey colours with yellow brown or reddish brown mottles located along root channels, large pores and cracks	Orange brown mottling of Medium to Heavy CLAY	Moderate	Use of terraced sub-surface irrigation system. Terrace back slope to be less than or equal to 10% Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines
pH [3] **(favoured range for plants)**	5.5 - 8 is the optimum range for a wide range of plants; 4.5 - 5.5 suitable for many acid-loving plants		<4.5, >8	7.1-7.5 Optimum range	Minor	
Rock Fragments (size & volume %)	0 - 10%	10 - 20%	>20%	No rock fragments to 1.2 m	Minor	
Sodicity [4] **(ESP %)**	<6%	6 - 8%	>8%	14% Strongly sodic (See Emerson Results)	Major	Treat subsurface soils with gypsum at 0.5kg/m2. Use of terraced sub-surface irrigation system. Terrace back slope to be less than or equal to 10% Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines
Soil Depth to Rock or other impermeable layer (m) [5]	>1.5 m	1.5 - 1 m	<1 m	>1.5 m to rock	Minor	
Soil Structure (pedality)	Highly or Moderately structured	Weakly-structured	Structureless, Massive or hardpan	Massive Cat6c	Major	Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines

Characteristic	Level of Constraint			Observed Features	Assessed Level of Constraint for Site	Mitigation Measures
	Nil or Minor	Moderate	Major			
Soil Texture,[6] Indicative Permeability	Cat. 2b, 3a, 3b, 4a	Cat. 4b, 4c, 5a	Cat. 1, 2a, 5b, 5c, 6	Massive Cat6c	Major	Use of terraced sub-surface irrigation system. Terraces are to be level Import Sandy LOAM (Category 2 texture). Minimum 600mm of Sandy LOAM below irrigation lines
Water Depth (m) below the base of the LAA	>2m	2 - 1.5 m	<1.5 m	>2m	Minor	

Legend:

Nil or Minor: If all constraints are minor, conventional/standard designs are generally satisfactory.
Moderate: For each moderate constraint an appropriate desing modification over and above that of a standard design, should be outlined.
Major: Any major constraint might prove an impediment to successful on-site wastewater management, or alternatively will require in-depth investigation and incorporation of sophisticated mitigation measures in the design to permit compliant onsite wastewater management.

Footnotes

1 Refer to Stevens et al. (2008).
2 Greenish grey/black, bluish and grey / black colours are typical of prolonged periods of intermittent or continuous saturation and reducing conditions. Poorly drained soils will undergo long periods during which the soil's pores are filled with water indicating an inability of the water to leave the site. Anaerobic conditions slow down the decomposition of organic wastewater contaminants but may increase denitrification of nitrate. Anaerobic soils often have a foul smell from rotting organic matter.
3 pH <4.5 may lead to aluminium or manganese toxicity; pH >8 may reduce availability of trace elements and phosphorate and make gypsum ineffective as an amendment to lower sodicity.
4 A value of ESP = 6% is taken as the threshold between a sodic and non-sodic soil but it depends on thetype of clay material in the soil. Soilswith elevated ESP are often very dispersive and have low permeability.
5 Shallow soil depth or a high seasonal water table may result in inadequate depth of aerobic soil to adequately treat and dissipate the wastewater.
6 Refer to Soil Classification in the latest version of AS/NZS1547 and the Design Loading Rates and Design Irrigation Rates in Table 9 of the EPA Code of Practice. Indicative permeability ranges have been allotted to each texture and structure combination, but these may be need to be varied due to other soil factors such as sodicity and dispersibility. Soil permeability can be measured directly using the constant head permeability method outlined in AS/NZS 1547:2012.

APPENDIX D

Water Balance Spreadsheets

D17/110975

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

LAA sizing using Nominated Area Water Balance for Zero Storage - Existing Soils

Site Address:	**14 Mitchell Grove, Separation Creek**		
Date:	November. 2017	**Assessor:**	Dane Pope

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2016)
Design Irrigation Rate	DIR	2.0	mm/day	Based on MC to HC and derived from Table 9 in the EPA Code of Practice (2016)
Nominated Land Application Area	L	290	m^2	[1]
Crop Coefficient	C	0.8	unitless	Estimates evapotranspiration as a fraction of potential evapotranspiration; varies with season and crop type[2]
Rainfall Runoff Factor	RF	0.7	untiless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data	Kennett River 70th Percentile			BoM Station and number
Mean Monthly Pan Evaporation Data	Kennett River ET0			BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	47	49	62	78	93	100	107	120	102	92	71	59	**980**
Potential Evapotranspiration	ET0		mm/month	129	106	90	58	39	28	32	44	61	87	102	121	**897**
Crop Coefficient	kc		unitless	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ET0xkc	mm/month	103	85	72	46	31	22	26	35	49	70	82	97	**717.6**
Percolation	B	DIRxD	mm/month	62.0	56	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	**730.0**
Outputs		ET+B	mm/month	165.2	140.8	134.0	106.4	93.2	82.4	87.6	97.2	108.8	131.6	141.6	158.8	**1447.6**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	32.9	34.3	43.4	54.6	65.1	70	74.9	84	71.4	64.4	49.7	41.3	**686**
Applied Effluent	W	(QxD)/L	mm/month	80.2	72.4	80.2	77.6	80.2	77.6	80.2	80.2	77.6	80.2	77.6	80.2	**944.0**
Inputs		RR+W	mm/month	113.1	106.7	123.6	132.2	145.3	147.6	155.1	164.2	149.0	144.6	127.3	121.5	**1630.0**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	25.8	77.9	143.0	210.5	277.5	317.7	330.6	316.3	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-52.1	-34.1	-10.4	25.8	52.1	65.2	67.5	67.0	40.2	13.0	-14.3	-37.3	
Cumulative Storage	M		mm	0.0	0.0	0.0	25.8	77.9	143.0	210.5	277.5	317.7	330.6	316.3	279.0	
Maximum Storage for Nominated Area	N		mm	330.65												
	V	NxL	L	95888												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	176	197	257	434	827	1815	1831	1761	602	346	245	198	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 1831.0 m^2

CELLS

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

NOTES

[1] This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

[2] Values selected are suitable for pasture grass in Victoria

D17/110975

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

LAA sizing using Nominated Area Water Balance for Zero Storage - Existing Soils

Site Address:	**14 Mitchell Grove, Separation Creek**		
Date:	November. 2017	**Assessor:**	Dane Pope

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2016)
Design Irrigation Rate	DIR	5.0	mm/day	Based on SANDY LOAM IMPORT and derived from Table 9 in the EPA Code of Practice (2016)
Nominated Land Application Area	L	290	m^2	[1]
Crop Coefficient	C	0.8	unitless	Estimates evapotranspiration as a fraction of potential evapotranspiration; varies with season and crop type [2]
Rainfall Runoff Factor	RF	0.7	untiless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data	Kennett River 70th Percentile			BoM Station and number
Mean Monthly Pan Evaporation Data	Kennett River ET0			BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	47	49	62	78	93	100	107	120	102	92	71	59	**980**
Potential Evapotranspiration	ET0		mm/month	129	106	90	58	39	28	32	44	61	87	102	121	**897**
Crop Coefficient	kc		unitless	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ET0xkc	mm/month	103	85	72	46	31	22	26	35	49	70	82	97	**717.6**
Percolation	B	DIRxD	mm/month	155.0	140	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	**1825.0**
Outputs		ET+B	mm/month	258.2	224.8	227.0	196.4	186.2	172.4	180.6	190.2	198.8	224.6	231.6	251.8	**2542.6**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	32.9	34.3	43.4	54.6	65.1	70	74.9	84	71.4	64.4	49.7	41.3	**686**
Applied Effluent	W	(QxD)/L	mm/month	80.2	72.4	80.2	77.6	80.2	77.6	80.2	80.2	77.6	80.2	77.6	80.2	**944.0**
Inputs		RR+W	mm/month	113.1	106.7	123.6	132.2	145.3	147.6	155.1	164.2	149.0	144.6	127.3	121.5	**1630.0**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-145.1	-118.1	-103.4	-64.2	-40.9	-24.8	-25.5	-26.0	-49.8	-80.0	-104.3	-130.3	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	103	110	127	159	192	220	220	219	177	145	124	110	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 220.0 m^2

CELLS

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

NOTES

[1] This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

[2] Values selected are suitable for pasture grass in Victoria

Victorian Land Capability Assessment Framework

Please read the attached notes before using this spreadsheet

Nitrogen Balance

Site Address: 14 Mitchell Grove, Separation Creek

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

INPUT DATA[1]

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

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

NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer		
Nitrogen	249	m^2

Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)		
Nominated LAA Size	290	m^2
Predicted N Export from LAA	-0.91	kg/year
Minimum Buffer Required for excess nutrient	0	m^2

CELLS

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

NOTES

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

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

LANDSLIDE RISK ASSESSMENT REPORT

AT: 14 MITCHELL GROVE
SEPARATION CREEK

PREPARED FOR: DAVID MOYLE
900 Humffray Street South
Mount Pleasant

REPORT NO.: 22854

DECEMBER 2017

P.J. YTTRUP & ASSOCIATES PTY LTD | CONSULTING ENGINEERS

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LANDSLIDE RISK ASSESSMENT REPORT AT 14 MITCHELL GROVE, SEPARATION CREEK REFERENCE NO: 22854

1.0 INTRODUCTION

P.J. Yttrup & Associates Pty Ltd (Yttrup) were commissioned 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 Landslide Risk Management (AGS, 2007) and the Colac Otway Shire (COS) Erosion Management Overlay (EMO).

The report details findings of the investigation 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 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 assessments 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 Landslide Susceptibility (Miner, AS (2007), in consideration of the knowledge of former landslides and the steep natural slopes within the area.

2.0 PREVIOUS ASSESSMENTS

This site and adjacent properties have been subject to a number of previous investigations:

- 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.
- Golder Associates Technical Memorandum for slope remediation at 14 Mitchell Grove (ref. 1653161-065-TM-Rev0 14 Mitchell, 18 August 2016).
- Yttrup Report 13402b regarding tunnel erosion and geotechnical investigation at 12 to 14 Olive Street.
- Yttrup Report 15895 regarding slope creep and geotechnical investigation at 21 Mitchell Grove.

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

3.0 PROPOSED DEVELOPMENT

The location and layout of the proposed development is shown in plan on Figures 1 to 2 and section, Figure 3. Further detail is provided on the architectural drawings, Appendix A.

It is proposed to construct a four bedroom residence on the site. Current drawings indicate that the proposed construction will include:

- Reinforced concrete design with suspended floors and V shaped columns
- Minor Steel cladding

The proposed effluent disposal field may be located above and below the house, Figure 1. Refer to the Yttrup Land Capability Assessment (LCA) (ref. LCA 22854, 20 December 2017).

4.0 GEOTECHNICAL INVESTIGATION

Fieldwork was completed on 27 October 2017. Fieldwork comprised investigation by 600 diameter piling auger attached to a 5.5 tonne excavator, hand methods and geomorphological mapping. A Chartered Geotechnical Engineer of this office completed all fieldwork. Borehole log reports and explanatory notes are provided in Appendix B.

A desktop study was completed to review geotechnical information from adjacent properties including;

- 12-14 Olive Street – two geotechnical boreholes and seismic refraction surveys.
- 21 Mitchell Grove-six geotechnical boreholes.
- 13 Mitchell Grove- two seismic refraction surveys
- 14 Mitchell Grove – one borehole from the Golder Associates Investigation.

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.

In addition to the above typical stratigraphy, Coffey (2016) infer that there is a layer of old colluvium south of Mitchell Grove extending down to the coastline.

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.

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.

5.2.1 Documented & Observed Landslides & Instability

The proposed development site is within the bounds of a known ancient landslide zone (Miner, AS (2007), Figure 1 which is bounded by the steep ridge lines which surround the northern extent of Separation Creek. Two smaller landslide polygons are located in close proximity to the property, Figure 1.

A discussion and summary of documented and observed landslides and instability in Separation Creek 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
12 to 14 Olive Street	Tunnel Erosion	Thick residual/colluvial CLAYs overlying extremely weathered SILTSTONE	Surface water. Dispersive residual soils.	Documented and investigated by Yttrup in 2000. Generally a lack of stormwater controls above dwellings resulted in significant tunnel erosion. These two properties are located where west and south east dipping slopes meet as a result of ancient slope movement.
Stanway Drive and Cassidy's track	Translational	Colluvium, Residual and Extremely to Highly Weathered rock	Pre-existing failure materials. Residual strengths. Lack of Storm water Control	Several slopes below the Dunoon Road ridge line have hummocky terraces with boulder debris. Immediately above and below Stanway Drive are translational slides. These slides have developed due to the presence of poor quality SILTSTONE beds, rock structure and a tendency for deeper weathering profiles to develop over this rock type.
Mitchell Grove	Wedge Failure (Ancient). Translational Slide Creep (recent)	Thick residual/colluvial CLAYs overlying extremely weathered SILTSTONE	West dipping shears and tightly spaced joints intersecting bedding shears Poor rock mass quality of SILSTONE High rainfall Aggressive erosion environment	Slope failure may have been progressive and is likely to have occurred during a period of significant rainfall in the past 3000 to 5000 years. Interglacial maximums are spaced at approximately 100,000 years (UNSW, 2014) therefore repeating conditions are considered rare. In the upper steep slopes of the back scarp, translational slides are still possible where poor slope practices are adopted. In the upper and lower slopes, creep is likely and possibly exacerbated by tunnel erosion. Note that on an adjacent site Yttrup observed and documented building damage to an older building due to shallow footings and the impact of slow moving slopes. Furthermore, at the same site, the failure of a landscaped retaining wall was noted in a difficult position to service (behind the house).
TYPICAL OF ALL FIRE AFFECTED SLOPES IN WYE RIVER	Erosion	Surficial, Residual	Reduction in vegetation cover. Removal of topsoil. No storm water 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 storm water (i.e to gullies, creeks, ocean). Most properties are showing signs of vegetation recovery nearly two years post bush fire.

5.2.2 Site Slope Detail

Key slope features include;

- Adjacent property owner has incorrectly installed a stormwater drain across the property and left a veneer of FILL across the site, Photo 1.
- Slopes are concave with slope angles decreasing as elevation decreases.
- Convergent slopes are noted to the south west where a significant gully system dissects several properties. The plunge of this gully is typically in the order of 16 to 17° towards the south south west, Figure 1.
- Steep decreasing to moderate slopes (AGS LR2, 2007) with:
  - Typically 30° to 35° slopes above the GROCON retaining wall, Figure 2 and Photo 2.
  - 30° slopes immediately below the garage Photo 3.
  - Decreasing to 10 to 15° below the existing footings of the dwelling, Photo 4.
  - There is a moderate to gentle terrace at the southern end of the block, Photo 5, where the old disposal field is inferred to have been positioned.
- A convex break of slope is located to the south of the property, Figure 1, where slopes increase to 20° to 25° towards the south south west.

5.2.3 Surface Water

Run-off is expected from above the site, however there is limited catchment above the property as Mitchell Grove has cross fall back to the v drain on the northern side of the road. Drainage on the block is currently good with minor trafficability issues due to the wet surficial and residual silts and clays typically of these materials in winter and or the wet season.

5.3 Subsurface Conditions

5.3.1 Lithology

The conditions encountered in the boreholes indicated subsurface conditions generally consistent with those described on the geological map. The following geotechnical units have been identified in the batters and boreholes:

- **SURFICIAL (1A)** — Clayey Sandy SILT, low plasticity, brown, fine grained sand, typically dry,stiff.
- **FILL (IB)** — Sandy GRAVEL, 40 mm nominal sub-angular BASALT, dark grey, loose, dry (Crushed rock).

  Sandy CLAY, medium plasticity, orange brown, firm, moist.

  On adjacent properties it is observed as mixtures of Units 1A, 2 and 3C with significant variations in moisture and strength depending on site conditions.
- **OLD COLLUVIUM (1C)** — Although inferred to be present (Coffey, 2016) it is not readily distinguished from RESIDUAL Clay as described in Unit 2. It is possible that it is present in borehole BH4 as the Atterberg limits of Liquid limit of 75% and a Plastic limit of 21% are at odds with ten other tests completed across Wye River/Separation Creek over the past two years. For simplicity this layer is combined with residual materials as both are of poor quality when considered in the context of retaining wall and foundation design.
- **RESIDUAL (2)** — Typically a Silty CLAY, medium to high plasticity, pale grey and orange brown, typically stiff to very stiff, moist.

  Note that the CLAY grades to extremely weathered SILTSTONE at depth which is observed as a Clayey GRAVEL or a Clayey SILT/Silty CLAY with SILTSTONE rock fragments in the auger cuttings.
- **SILTSTONE (3C)** — SILTSTONE, fine, yellow brown, laminated, extremely to very low strength, highly weathered
- **SILTSTONE (3B)** — SILTSTONE, fine, yellow brown, laminated, very low to low strength, highly weathered.
- **SILTSTONE (3A)** — SILTSTONE, fine, grey brown, laminated, low to medium strength, moderately weathered.

The depths at which the above geotechnical units were encountered are presented on the geological cross section, Figure 3. A summary is provided in Table 2. With regards to the geotechnical units observed on and adjacent to site;

- SILTSTONE beds are the dominant bedrock material. No SANDSTONE was encountered in a strip of hillside at least 50 m wide.
- Generally the depth to Highly Weathered SILTSTONE (Unit 3C) increases as you travel down slope which is consistent with typical weathering of hillsides with seasonal fluctuations and concentrations of groundwater at the bottom of the slope.
- FILL was limited to immediately above and below the driveway due to cut/fill earthworks.
- Bedrock suited to domestic building foundations or very low to low strength SILTSTONE (Unit 3B) is anticipated to be least 1.5 to 2.5 m below ground level depending on the amount of existing or proposed cut with low to medium strength rock (UNIT 3A) below 4.2 to 4.9 m.

TABLE 2
SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED IN BOREHOLES AND SEISMIC SURVEYS

BOREHOLE/ EXPOSURE	DEPTH TO TOP OF UNIT (m)						TOTAL HEIGHT/ DEPTH (m)
	1A	1B	2	4C	4B	4A	
BH1	-	0.0	0.5	1.0	1.5	-	1.8
BH2	-	-	0.0	2.0	2.5	-	2.6
BH3	0.0	-	0.3	-	-	-	1.2
BH4	0.0	-	0.1	-	-	-	1.2
GA-BH1	-	0.0	0.05	1.5	2.5	-	4.1
BP1	-	-	0.0	4.3	4.5	4.9	5.0
15895-BH1	-	0.0	1.1	3.6	4.0	-	4.0
13402-BH1	0.8	0.0	1.3	-	2.45	-	2.45
13402-SEISMIC 1	-	-	0.0	-	-	4.2	9.0
13402-BH2	0.3	0.0	0.5	2.3	3.4	-	3.4
13402 SEISMIC 2	-	-	0.0	3.2	-	-	5.0

5.3.2 Structural Model

As part of the Wye River/Separation Creek re-build Yttrup has completed mapping at over 20 sites across Wye River including the rock platforms, rivers/gullies and individual properties to determine if there are obvious structural domains in the area. Mapping completed for this investigation has been combined with data from other recent investigations (May 2016 to current) to confirm if there are significant variations in structural trends.

A total of 92 bedding planes have been mapped in the Wye River/Separation Creek area between the coastal platform and 22 Karingal Drive. Bedding planes generally had a dip varying from 5 to 35 degrees towards 080 to 200 (excludes some cross bedding). The pole for the data set is 20/150.

Mapping completed in Separation Creek on Bass Avenue, Stanway drive and Harrington Street indicates a pole of bedding of 20/160 which is generally consistent with that observed elsewhere in Wye River/Separation Creek. Cross bedding was observed in the gully immediately west of the property with bedding dips towards the south.

In general, the bedding indicates that the site is positioned on a south east dipping fold limb of an anticline.

In the rockmass the following bedding characteristics can be expected;

- The persistence of beds is in the order of 100s of metres. Bedding partings in SANDSTONE do not necessarily persist for this distance, and have only been observed to persist across small cuts (less than 10 m in dimension). Bedding partings and bedding parallel shears in SILTSTONE may persist for 10s to 100s of metres as observed on the platform between Wye River and Separation Creek.
- SILTSTONE beds are considered to be a plane of weakness when interbedded with massive SANDSTONE. i.e. the strain incompatibility between the two materials will result in significant movement along SILTSTONE beds before the SANDSTONE will dilate.
- The spacing of bedding partings varies from 0.25m to 0.75m in SANDSTONE however can be less than 100 mm in SILTSTONE.
- Approximately 5% of bedding defects in SANDSTONE show evidence of shearing (bedding parallel shears). This would be significantly greater in SILTSTONE beds with smooth surfaces common.

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 150 joints have been mapped between during the Wye River re-build (2016/2017), 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.

Numerous fault/shear zones have been mapped across Wye River/Separation Creek. Examples include;

- On the rock platform.
- In the rock cutting above 2 Koonya Avenue (Yttrup report 22496) including bedding parallel and sub-vertical shears.
- Within Wye River near Cassidy track.
- Stanway drive quarry.
- Within tributary gullies that lead to Wye River (Riverside drive)

Broad structural controls of Wye River/Separation Creek slopes are inferred to include the interaction of bedding parallel shears and the sub-vertical joint/shear sets.

Based on the observed structure in Separation Creek the key mode of failure is wedge failure due to intersection of west dipping shears and joints with south east dipping bedding. The line of intersection of these two features is generally 10 to 20 degrees towards the south south west (parallel to the plunge of local gullies). Stereonets are presented in Appendix B.

TABLE 3
TYPICAL WYE RIVER/SEPARATION CREEK DISCONTINUITY SETS

SET 1	SET 2	SET 3	SET 4
Bedding	Joint Strike Orthogonal to bedding	Joint Cross cutting bedding	Joint Strike Parallel to bedding
ORIENTATION (TRUE NORTH) DIP/DIP DIRECTION			
5 to 30/95 to 200 (20/150)	60 to 90/030 to 075 (75/055) 65 to 90/205 to 270 (80/235)	60 to 90/335 to 015 (85/355) 65 to 85/180 to 195 (85/185)	60 to 85/275 to 325 (70/300)
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. Smooth. Iron stained with clay veneers and seams common in Highly Weathered rocks Bedding parallel shears common in fine grained beds.	Highly weathered SILTSTONE - typically Planar, Smooth to Slightly rough, with some clay seams. Moderately weathered or better - typically Planar, Smooth to Slightly rough, iron stained and clay infills.		

5.3.3 Groundwater

Permanent groundwater was not observed in the cut slopes or in the boreholes. Signs of past water flow is evident as iron staining on the surfaces of faults, joints and bedding planes.

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. Groundwater may flow through the soil and fractured rock as noted above. Rainfall infiltrates the surficial soils with the mass of Unit 3C restricting flows to along defects (bedding/joints).

6.0 SITE CLASSIFICATION

This site must be classified as Class "P" – Problem Site, due to landslide risks, in accordance with Clause 1.3.3 of AS 2870-2011.

In the absence of landslide risk, a classification of "M" – Moderately Reactive would be appropriate for the site. Where suspended slabs close to ground level are proposed at the location of the cut for the proposed dwelling the designer should consider;

- A natural characteristic ground surface movement value, y_s, in the order of 35 mm is appropriate for this site
- The proposed building will be constructed on a cut platform. The expected additional ground movement is about 25 mm at the cut side. This additional movement reduces to zero by the natural ground level.
- The existing trees at or near to the site, can cause ground movement at the site of the proposed construction.
    - Removal of a tree(s) will cause additional ground heave at the tree and can be assumed to reduce linearly to zero at a distance of 1.5 times the current height of the tree. Potential ground heave is estimated as follows;
        - For the 4 to 6 m trees, approximately 25 mm of heave
- Trees left in place will continue to grow and the additional ground movements at the building site will be a function of the existing height and the expected mature height of the tree(s).

The footing system for the proposed construction must be designed using engineering principles. The very low to low strength SILTSTONE (Unit 3B and Unit 3A) is considered to be a competent foundation material to support the proposed dwelling with slabs designed as suspended, in order to reduce the effects of foundation movements due to potential creep, and ground movements to AS 2870-2011.

Refer to Section 9.2 of the Landslide Risk Treatment Plan for recommendations for design of foundations.

7.0 IMPACTS OF PROPOSED DEVELOPMENT

7.1 Bush Fire Impacts and Tree Removal

Yttrup has considered the bushfire impacts in the risk assessment for this property as follows;

- Increased likelihood of translational and circular failures due to the lack of storm water control (loss of roof catchments, storage, and discharge points).
- Increased likelihood of creep of the shallow layer of residual soils due to the removal of mature trees.

The risk assessment and assumptions is detailed in Section 8 with recommendations to mitigate the elevated risks during the bushfire recovery period detailed in Section 9.0.

7.2 Excavation

Excavation is proposed for:

- Ground floor of the building with retaining walls in the order of 2.6 m in height
- Driveway and carpark with retaining walls in the order of 1.5 m in height
- Footings for the dwelling and disposal field.
- Level foundations for tanks.

Any proposed excavation has the potential to cause slope instability; both during construction and in the long-term. Failures may be either localised translational or wedge failures of surficial and residual soils. 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 8), 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.

With regards to existing footings of the Grocon constructed retaining wall, the owner/designer shall obtain confirmation from COS or their designers of acceptance of the proposed excavation adjacent to the existing retaining wall.

7.3 Effluent and Stormwater Management

Poor management of stormwater and wastewater has the potential to cause localised concentration of moisture on the slope, increasing the risk of a landslide. In particular, increased moisture in the surficial/residual soils and weathered rock will increase the likelihood of creep and shallow translational failures developing. The LCA has been completed by Yttrup (ref. LCA 22854, 20 December 2017).

The installation of appropriate surface and sub-surface cut off drains across the site should divert water around the building, and effluent field and slope. Water shall be collected and discharged via suitable stormwater outlets.

8.0 LANDSLIDE RISKS

8.1 Introduction

A LRA is required to be undertaken, in accordance with the requirements of the AGS Guidelines 2007 and the COS EMO. Risk to life and property shall be considered for all credible potential modes of failure at the site.

As outlined in the COS EMO Schedule, a "Tolerable Risk" defined by AGS Guidelines 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 less weathered SILTSTONE (UNIT 3A), unaffected by the upper development may be considered an 'existing' slope.
- Slopes within the footprint of the proposed building are considered to be 'new' slopes. This includes slopes;
  - Cut for retaining wall construction/tank foundations
  - Cut for temporary access
  - Subject to possible increase in building loads.
  - Subject to waste water disposal.

8.2 Modes of Failure

Based on the results of the fieldwork, four failure modes have been identified. These are presented in Section, Figure 2 and discussed in Table 5.

TABLE 5
SUMMARY OF LANDSLIDE RISKS

CASE	MODE OF FAILURE	GEOTECH. UNITS	TRIGGERS	DISCUSSION	ESTIMATED P(H)
1	Creep	ALL 1, 2	• Over-steep cuts • Poor management of surface and sub-surface water • Low strength Residual materials • Above average rainfall • Removal of vegetation and topsoil and; • Strain incompatibility with underlying bedrock	Creep is almost certain to occur over the life of the development without engineering controls. Increase in probability and consequence where slope angles increase above 25° and where vegetation and topsoil has been removed. Two variations of this failure mode have been identified; • Mode 1A: Upper slope above the building • Mode 1B: Lower slope below and including the disposal field	• For 30° slopes 1/5 year above average rainfall (0.2 or "Almost Certain") • For 10 to 15° slopes would require 1/100 year rainfall event or negligent slope practices. (0.01 or likely)
2	Translational	ALL 1,2	• As per Case 1 and; • Unsupported cut slopes. • Prolonged heavy rainfall. • Major plumbing failure	Observed in 2017 (Stanway Drive) in a similar structural domain however with much steeper cut slopes. Kinematic analysis indicates low probability of wedge failure and therefore this failure mode is more likely to occur in surficial soils. Three variations of this failure mode have been identified; • Mode 2A: At the driveway platform impacting the dwelling • Mode 2B: Below the dwelling • Mode 2C: At the disposal field with regression to the dwelling Failure above the driveway is considered to be a rare event due to the construction of a significant cantilevered retaining wall. **N.B. Failures from properties to the south on Olive Street have been considered however they are unlikely to impact elements on the property. Mode 2C is representative of a failure developing from these adjacent properties.**	• For steep slopes - Possible over longer term ($1x10^{-3}$) • For moderate slopes less than 15° it is unlikely to occur. • With engineered controls in place (eg proposed retaining wall and engineered footing system) failure is unlikely ($1x10^{-4}$) to rare ($1x10^{-5}$).
3	Passive/Active Wedge	All 1, 2, 3C	• As per Case 2. • Surcharged FILL platforms (Active wedge) and relatively weak passive wedge	The current development proposal includes a series of closely spaced retaining walls with retained heights in the order of 2.6 m, Appendix A. The car park retaining wall is less than 1 m from the Grocon built cantilevered retaining wall. An engineered retaining system will be required to reduce risk to life and property to acceptable levels and the serviceability of the walls shall be adequate to mitigate the risk of building damage over the 50 year design life. It is likely that the main retaining wall will need a permanent anchor system to control deflections.	• With engineered controls in place failure is unlikely ($1x10^{-4}$) to rare ($1x10^{-5}$).
4	Wedge failure	ALL UNITS	• As per Case 2 and; • West/North West dipping shears intersecting bedding parallel defects • Major earthworks with no engineering controls	The existing Separation Creek landslide is inferred to be controlled by the intersection of bedding with shears/joints of west north west dip. i.e. it is a large version of this mode of failure. The plunge of intersection is approximately to the south south west. Given the slope aspect of 250, slopes at or less than 30°, the stable nature of the old landslide mass in the lower slopes (typically effective friction angles exceed the slope angles), movement of a similar wedge is considered rare.	• Failure would require large cuts in excess of 3 m and no engineering controls. • Rare over the life of the development provided Good Hillside Practice is adopted ($1x10^{-5}$).

8.3 Risk to Property

The modes of failure and qualitative risk appraisal for the various modes that could impact on the dwelling are outlined in Appendix D.

8.4 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.

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/property/road in which occupants may be situated.

This analysis has estimated landslide volumes and measured reach angles from surveyed geometry. Our assumptions are based on Mostyn et al (2002) and Walker (2002) and are summarised 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)
- Pedestrians/Car on driveway or Mitchell Grove – 0.25 hours per day (1/96)
- The house is occupied 80% of the time
    - If the house is destroyed in an event $P_{(T:S)} = 0.8$
    - If the house is damaged in an event, $P_{(T:S)}) = 0.5 \times 0.8 = 0.4$ (representing use of the bedroom for half of the day).

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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 passengers in vehicles have a high vulnerability (1.0) in large slides, but reduced vulnerability in small scale slides where they are not buried (0.3).
- 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).

8.5 Results of Assessment

The results of the assessment are provided in Appendix D. The risk appraisal suggests a "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 9 for further details of the risk mitigation works.

9.0 RISK TREATMENT PLAN

If the above 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.

9.1 Building Structure

Lightweight, flexible construction is recommended in order to comply with AGS Good Hillside Practice (2007). The owner shall consider a flexible solution as this may reduce serviceability issues and potentially decrease foundation construction costs.

Yttrup understands that the proposed dwelling comprises reinforced concrete with suspended floors and steel clad frame construction which does not satisfy this requirement. Note that this type of construction is technically feasible and requires robust engineered retaining and footing systems.

Note that an increase in landslide risk is expected if i) inappropriate, brittle construction materials such as unreinforced brick or blockwork is used, ii) excessive earthworks are undertaken or iii) site maintenance is neglected. Refer also to "Good Hillside Practice" notes in Appendix E for further information and guidance.

9.2 Footing System

Due to the modes of failure identified on site, bored piles would be the preferred foundation system to satisfactorily mitigate the risks of slope failure, building damage and reduce the risk to life.

It is recommended that the top of socket is adopted as the very low to low strength SILTSTONE (UNIT 3B) which is typically between 1.5 to 2.5 m BGL. Furthermore, due to the nature of construction (reinforced concrete with suspended floors) the designer shall confirm that the rock socket is suitable for serviceability and ultimate limit states. It is likely that settlement and lateral deflections of the footings may control the design.

Where anchors are required to control footing deflections, rock bolts may be designed using the parameters provided in Tables 6 and 7. All rock bolts shall be subjected to acceptance testing including proof loading.

Due to the variability in depth to Unit 3B it is recommended that a geotechnical engineer supervise the initial stages of footing works.

The footings may extend into Moderately Weathered SILTSTONE (Unit 3A) of low to medium strength. This material results in high resistance to small piling rigs (5 tonne excavators). Yttrup recommends that an experienced piling contractor familiar with the rock conditions is engaged to install the footings and that their equipment is capable of penetrating rock with a UCS in the order of 10 to 20 MPa.

The footings shall be designed to resist lateral pressures caused by creep of the upper surficial and residual soils (Units 1 to 2) that vary from 1 to 2 m thick (site cut dependent) at the location of the proposed dwelling. Socket lengths will depend on deflection tolerances of the bored piles. Bored piles can be designed using the parameters provided in Table 7 and using a geotechnical strength reduction factor of 0.4 in accordance with AS2159 (2009).

9.3 Permanent and Temporary Batters

Excavation should be minimised where possible. Temporary access into the site for the construction period will need to consider the requirements for construction of access tracks and temporary stability of the site, including excavations. Temporary batter slopes for slopes less than 2.5 m in height are provided in Table 8, 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.

Should permanent batters exceed the recommendations provided in Table 8, engineer designed retaining walls shall be adopted.

9.4 Retaining Walls

Where possible, excavation and construction of retaining walls should be minimised. Where retaining walls are required they shall be engineer designed. Where retained heights exceed 2.5 m (e.g. the retaining wall immediately behind the proposed dwelling) then a top down construction method with "hit and miss" sequencing should be adopted.

Lateral resistance within Units 1 and 2 should not be relied upon. Lateral earth pressures due to hillside creep can be estimated using the parameters provided in Table 6. Resistance shall be within highly (or less weathered) SILTSTONE (Unit 3C). Please note that the depth to Highly Weathered SILTSTONE (Unit 3C) varies across the site. Confirmation of suitable founding material for retaining walls should be conducted by a Geotechnical Engineer.

The designer shall consider the slope angle at the location of proposed retaining walls. The earth pressure coefficients may be calculated using the effective friction angles provided in Table 6.

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.

Adequate drainage shall be provided for any retaining walls to limit hydrostatic forces on the wall. Drainage shall be connected into the stormwater outfall.

With regards to existing footings of the Grocon constructed retaining wall, the owner/designer shall obtain confirmation from COS or their designers of acceptance of the proposed excavation adjacent to the existing retaining wall.

TABLE 6 ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS

INFERRED UNIT	BULK UNIT WEIGHT (kN/m^3)	EFFECTIVE STRENGTH PARAMETERS	
		c' (kPa)	ϕ' (deg)
UNIT 1	17	2	26
UNIT 2 -CLAY	19	3	27
UNIT 2 – GRAVEL	19	0	30
UNIT 3C	22	15	30
UNIT 3B/3A	23	30	30
BEDDING PLANE SHEAR	20	0	20

TABLE 7 ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS FOR PILES & ANCHORS

INFERRED UNIT	RQD (%)	UCS (MPA)	ULTIMATE GROUT/ROCK BOND STRESS (KPA)	ALLOWABLE GROUT/ROCK BOND STRESS (KPA)	ULTIMATE END BEARING (MPa)	SERVICEABILITY END BEARING PRESSURE (MPA)	ULTIMATE SHAFT ADHESION (KPA)	YOUNG'S MODULUS, E (MPA)
UNIT 3C	25 to 40	0.6	60	30	Not Recommended	Not Recommended	75	50
UNIT 3B/3A	50	1	100	50	4.5	0.5	125	100

TABLE 8: BATTER SLOPE ANGLES

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

Note 1: SILTSTONE rocks of the Eumeralla Formation typically slake and brake down to soil.

9.5 Site Drainage

Surface and sub-surface cut off drains shall be installed between the driveway and the dwelling and between the dwelling and the proposed effluent disposal field, Figure 3, to collect all runoff and intercept seepage. Water shall be discharged in an appropriate manner to the legal point of discharge.

Site drainage shall be constructed and maintained in accordance with AS 2870-2011 and good hillside construction practice (refer to notes in Appendix E).

No ponding of surface water shall occur across the site or at levelled areas. Levelled areas shall have fall of at least 1 in 50 towards a drainage point.

9.6 Wastewater Disposal

The land capability assessment was completed by Yttrup (ref. LCA 22854, 20 December 2017). Based on the results of the LRA, the design of the disposal field would need to consider the modes of failure that may affect the system. As a terraced disposal area has been proposed, the designer may adopt engineered retaining walls to support the terracing of the slope with footings designed as per Sections 9.2 and 9.3. The effluent disposal system shall be designed by a qualified professional.

N.B. Where the retained height are less than 1 m the COS EMO allows for non-engineered retaining walls however the designer shall consider:

- The impact of difficult access on retaining wall maintenance over the design life of the dwelling when selecting the type of retaining wall for the effluent field.
- The back slope of the retaining wall.
- The proximity to adjacent footings.

9.7 Revegetation

The removal of vegetation during bushfire remediation has the potential to increase the risk of instability and erosion. It is recommended that existing vegetation be maintained where practical, and that any stripped areas are re-vegetated with suitable vegetation, as soon as possible.

9.8 Construction Supervision

Validation of design assumptions is required during construction. Amendments to the design may be necessary if conditions encountered on site are different to the current design assumptions. This includes:

- The depth of the potential creep zone and imposed forces on the footings.
- The strength and quality of Unit 3 at depth.

It is envisaged that supervision of piling works would provide this information and HOLD points would have to be adopted should unfavourable ground conditions be encountered. Geotechnical supervision is required during the initial period of construction of the foundations including:

- Appropriate founding depth and material for bored piers, as designed.
- Assessment of any proposed access tracks into the site for construction, and the temporary stability of the site.

Note that footings shall be inspected by a suitably qualified geotechnical engineer.

With regards to anchors, proof testing to 125% of working loads is recommended. Should excessive extensions or creep be noted during the testing of each anchor/bolt, then redesign would be required. This would be an effective HOLD POINT with no further construction permitted until the failed bolt(s) had been rectified, reinstalled and satisfactorily stressed.

9.9 Ongoing Site Maintenance

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

10.0 CONCLUSION

The landslide risk appraisal has found that the site can be made suitable with risk mitigation measures, and that the proposed development can meet the "tolerable" risk criteria outlined by AGS Guidelines (2007). This will include:

- Provide engineer designed retaining walls to any excavations, as required. Strict limitations apply to unsupported excavations.
- Footings constructed as bored piers. Bored piers founded into underlying very low to low strength SILTSTONE (Unit 3B/3A) and designed to resist potential creep forces in the upper Surficial soil, residual soil and extremely weathered rock (Units 1 to 2).
- Drainage, re-vegetation and maintenance in accordance with attached Good Practices for Hillside Development and recommendations enclosed in this report.
- Construction supervision to confirm the depth to Unit 3B and appropriate socket is achieved.

We consider that the risk analysis has shown that a new development can achieve an 'tolerable risk management' criteria, provided that the recommendations given in Section 9 are adopted. These recommendations form an integral part of the Landslide Risk Management Process.

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20 December 2017

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FIGURES

D17/110975

DOCUMENTED LANDSLIDE FROM AERIAL PHOTO INTERPRETATION

DOCUMENTED LANDSLIDE FROM AERIAL PHOTO INTERPRETATION

24°

FIG3

55°

13402–BH2/SEISMIC

BH2

BH4

15°

BH3

30°

10°

20°

25°

13402–SEISMIC/1

13402–BH1

17° PLUNGE TOWARDS 190 TO 200

BH4A–BH1

15895–BH1

DOCUMENTED LANDSLIDE FROM AERIAL PHOTO INTERPRETATION

LEGEND

HUMMOCKY GROUND

26.5° SLOPE

SCARP

15 CLIFF (HEIGHT SHOWN)

1 BEDDING – APPROX. DIP

CONVEX SLOPE

CONCAVE SLOPE

BH1 BOREHOLE

SEEPAGE OR OVERLAND FLOW

0.5 to 1 m CONTOUR

ISSUE					
DATE	ISSUED TO	NO	DATE	ISSUED TO	NO

DATE	REVISION	BY

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CLIENT
DAVID MOYLE

PROJECT
14 MITCHELL GROVE
SEPARATION CREEK

DRAWING
SITE PLAN
Significant Geomorphology & Structure

ENGINEER	DRAWN	JOB No.
	DP	22854
CHECKED	FIGURE	
	1	
SCALE	DATE	REV No.
–	13.12.17	A3

DOCUMENTED LANDSLIDE FROM AERIAL PHOTO INTERPRETATION

LOCAL PLUNGE OF SEPARATION CREEK CONVERGENT SLOPE

NEW GROCON RETAINING WALL

SUSPENDED FLOORS ABOVE LAA (REDUCED RAINFALL)

BP1

24°

FIG3

55°

BH1

GA-BH1

BH2

15895-BH1

13402-BH2/SEISMIC 2

10°

15°

30°

BH4

BH3

20°

UPPER DISPOSAL FIELD 30 m2 AVAILABLE

LOWER DISPOSAL FIELD 260 m2 AVAILABLE

HISTORICAL DRAINAGE ISSUES

17° PLUNGE TOWARDS 190 TO 200

25°

13402-SEISMIC 1

13402-BH1

LEGEND

HUMMOCKY GROUND

26.5° SLOPE

SCARP

15 CLIFF (HEIGHT SHOWN)

1 BEDDING – APPROX. DIP

CONVEX SLOPE

CONCAVE SLOPE

BH1 BOREHOLE

SEEPAGE OR OVERLAND FLOW

0.5 to 1 m CONTOUR

ISSUE					
DATE	ISSUED TO	NO	DATE	ISSUED TO	NO

DATE	REVISION	BY

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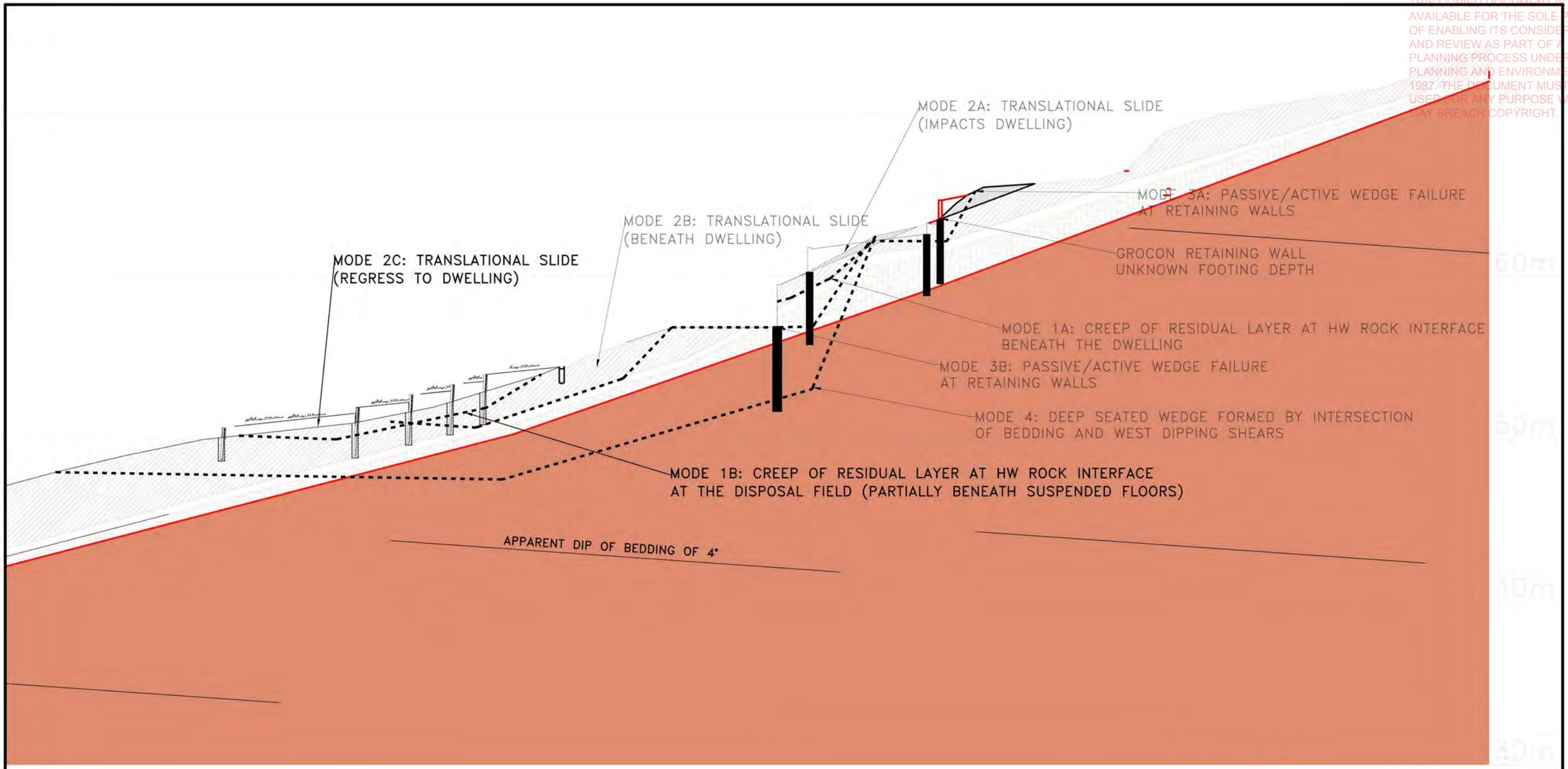
CLIENT: DAVID MOYLE

PROJECT: 14 MITCHELL GROVE
SEPARATION CREEK

DRAWING: SITE PLAN
DETAIL

ENGINEER	DRAWN	JOB No.
	DP	22854
CHECKED	FIGURE	
	2	
SCALE	DATE	REV No.
–	13.12.17	A3



LEGEND

- UNIT 2 – RESIDUAL
- UNIT 4C– SILSTONE, ELS–VLS,HW
- UNIT 4B– SILSTONE, VLS–LS,HW
- UNIT 4A – SILTSTONE, LS–MS,MW
- UNIT 1B – FILL

ISSUE					
DATE	ISSUED TO	NO	DATE	ISSUED TO	NO

DATE	REVISION	BY

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CLIENT: DAVID MOYLE

PROJECT: 14 MITCHELL GROVE
SEPARATION CREEK

DRAWING: SECTION 1
GEOLOGICAL MODEL
LITHOLOGY

ENGINEER	DRAWN	JOB No.
	DP	22854
CHECKED	FIGURE	
	3	
SCALE	DATE	REV No.
1:250	13.12.17	A3

APPENDIX A
Architectural Drawings
Site Survey

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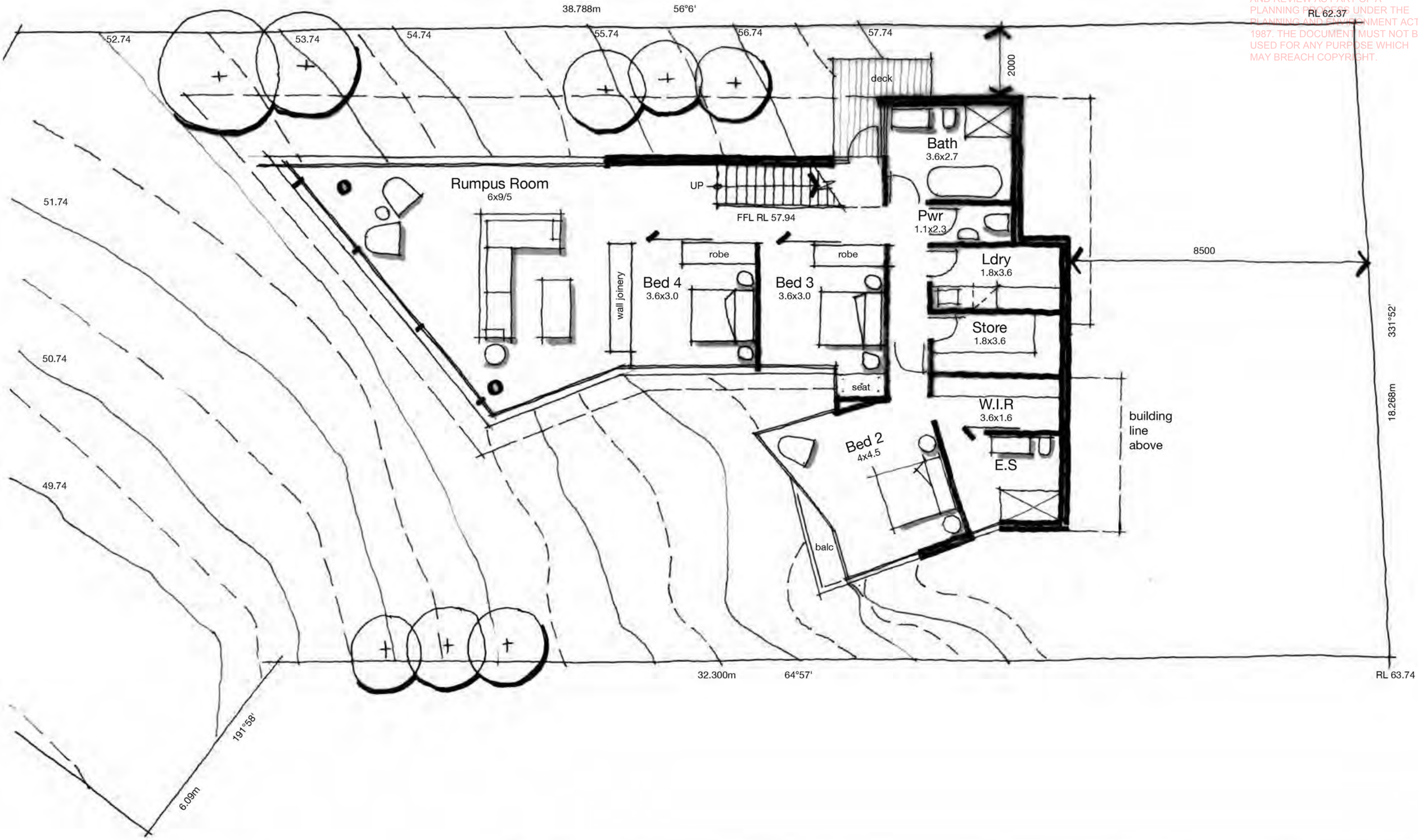

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Lower Floor Plan

SCALE @ A3
1:100

DRAWN
SdB

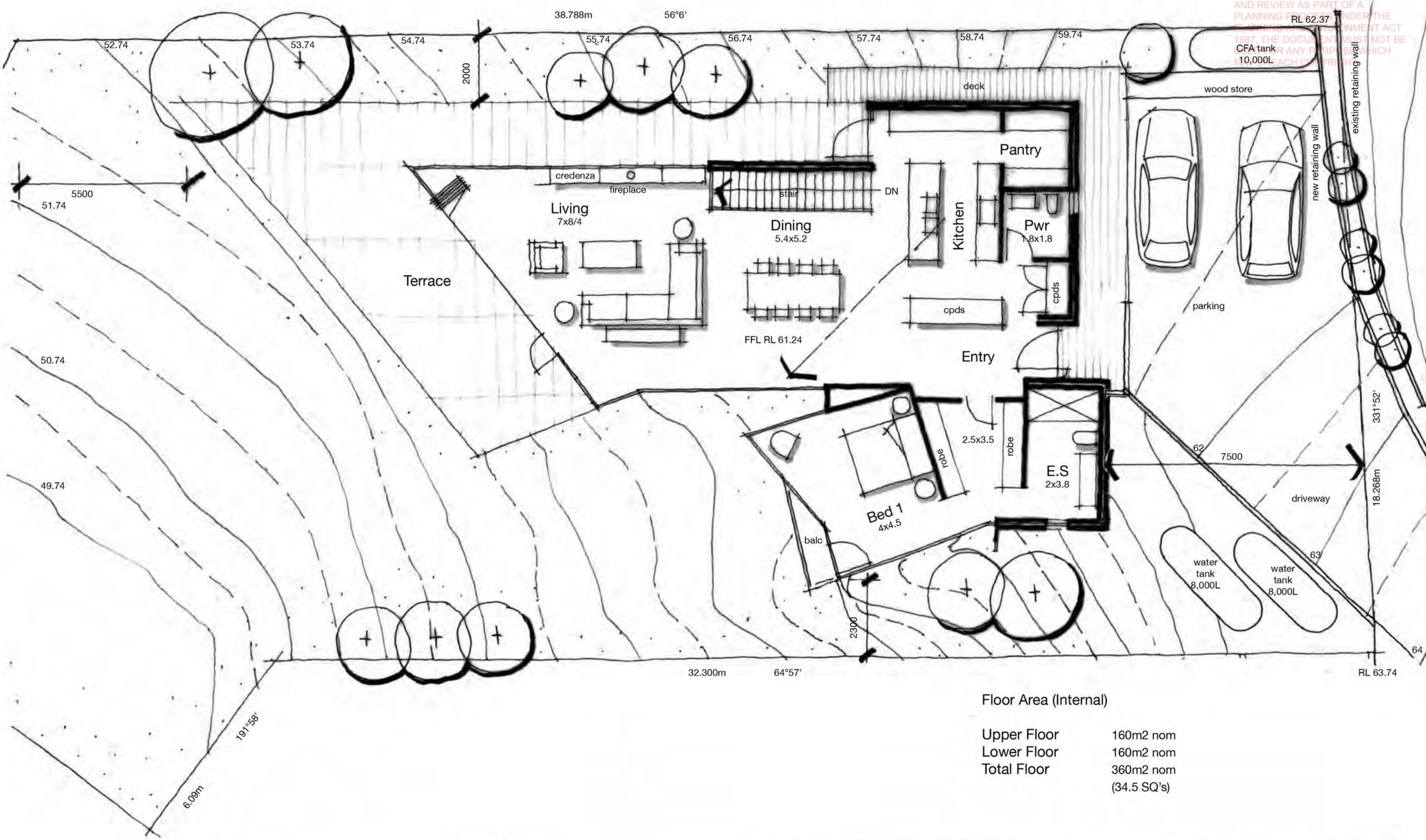
PROJECT No:
17.121

DRAWING No:
20171214-SK02

DATE
14/12/2017

REV:
A

D17/110975



Floor Area (Internal)

Upper Floor	160m2 nom
Lower Floor	160m2 nom
Total Floor	360m2 nom (34.5 SQ's)

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Upper Floor Plan

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	20171214-SK01
DATE	REV.
14/12/2017	A

D17/110975

SITE ANALYSIS

SITE AREA	825m²
LOWER GROUND	
PROPOSED FLOOR AREA	176.00 m²
DECK/BALCONY	8.00 m²
UPPER FLOOR	
PROPOSED FLOOR AREA	165.00 m²
DECK/BALCONY	75.00 m²
PROPOSED SITE COVERAGE (APPROX.) = 240m2	29%

12 MITCHELL GROVE
(VACANT)

14 MITCHELL GROVE

16 MITCHELL GROVE
DOUBLE STOREY
WEATHERBOARD HOUSE

MITCHELL GROVE

TOP RL - 63.84
TOE RL - 62.24

CFA WATER TANK
10000 L

TOP RL - 63.84
TOE RL - 62.24
PROPOSED RETAINING WALL

TOP RL - 63.84
TOE RL - 62.24
EXISTING RETAINING WALL

TOP RL - 64.24
TOE RL - 62.64

TOP RL - 64.24
TOE RL - 62.84

TOP RL - 64.24
TOE RL - 63.04

TOP RL - 64.24
TOE RL - 63.34

FALL

BENCH RL - 57.64

PROPOSED RETAINING WALL

AREA OF CUT

WATER TANK
8000 L

WATER TANK
8000 L

EASEMENT

FLOOR LINE ABOVE

BOUNDARY LOCATION

LINE OF EXISTING GRAVEL DRIVEWAY

LINE UNDERGROUND EFFLUENT FIELD

EASEMENT

BOUNDARY LOCATION

LINE OF UNDERGROUND EFFLUENT FIELD

EASEMENT

BOUNDARY LOCATION

BOUNDARY LOCATION

1
TP07

1 OVERALL SITE PLAN
1 : 100

N

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MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
1 : 100	VD	SDB		B	TP06

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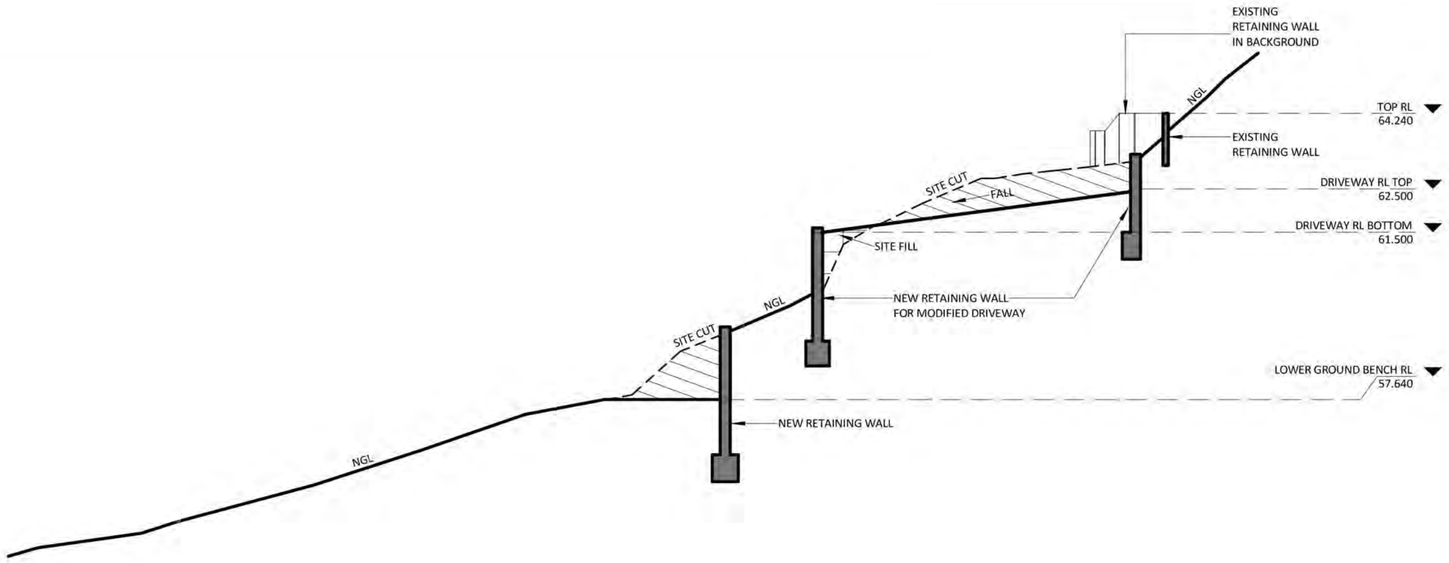
D17/110975



1 Section 1
1 : 100

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MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
1 : 100	VD	SDB		B	TP07

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EAST ELEVATION

NORTH ELEVATION

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	20171214-TP04
DATE	REV.
19/12/2017	A

WEST ELEVATION

SOUTH ELEVATION

LEGEND

F1	OFF FORM CONCRETE
F2	PAINTED METAL FASCIA
F3	CORTEN STEEL
F4	METAL DECK ROOF
F5	GLASS WINDOWS
F6	CLASS BALUSTRADE
F7	PERFORATED CORTEN STEEL LOUVRES
F8	PAINTED STEEL HOOD
F9	STEEL GUTTER
F10	TIMBER LINING BOARDS

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PROJECT
Moyle Residence
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3
1:100

DRAWN
SdB

PROJECT No.
17.121

DRAWING No.
20171214-TP05

DATE
19/12/2017

REV.
A

APPENDIX B
Geotechnical Borehole Logs
Stereonets

D17/110975

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Hole ID: **BH1**

CLIENT	: David Moyle	POSITION	: Refer to Site Plan
CONTRACTOR	:	EASTING	:
PROJECT	: LRA	NORTHING	:
LOCATION	: 14 Mitchell Grove, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5t 600 Auger
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

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 5 10 15 20 25)
			FILL: Sandy GRAVEL, 40mm nominal, sub-angular basalt, dark grey		D	L								
			FILL: Sandy CLAY, medium plasticity, orange/brown, medium sand with some coarse sub-angular gravel	DS 0.20-0.50 m	M	F		25	40					
0.5			Clayey GRAVEL, fine to medium sub-angular, SILTSTONE gravel, orange/brown, medium plasticity fines, with some 60 to 100 mm cobbles, inferred extremely weathered SILTSTONE	DS 0.50-0.80 m	D	MD		16	30					
1.0			SILTSTONE, fine, yellow/brown with traces of orange brown, very low strength, highly weathered	DS 1.00-1.50 m				11	0					
1.5			Becoming: very low to low strength, highly weathered	DS 1.50-1.70 m				8	10					
			Hole Terminated at 1.80 m Target depth											
2.0														
2.5														

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

File: 22854 BH1 1 OF 1

D17/110975

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

Hole ID: **BH2**

CLIENT	: David Moyle	POSITION	: Refer to Site Plan
CONTRACTOR	:	EASTING	:
PROJECT	: LRA	NORTHING	:
LOCATION	: 14 Mitchell Grove, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5t 600 Auger
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

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
			Silty CLAY, medium plasticity, brown and orange brown	DS 0.20-0.50 m FV s_u>140 kPa	D to M	VSt	>140	22	0					
0.5			Becoming: medium to high plasticity, pale grey and orange/brown	DS 0.40-0.80 m				31	20					
1.0				DS 1.00-1.50 m	M	St								
1.5				DS 1.50-1.70 m				22	0					
			Clayey SILT/ Silty CLAY, medium plasticity, pale grey yellow brown and orange brown, with some very low strength SILTSTONE layers to 100 mm thick	DS 1.80-2.00 m	M	VSt		24	70					
2.0			SILTSTONE, fine, yellow brown, orange brown staining, very low strength, highly weathered, with clay seams 50 to 100 mm thick	DS 2.00-2.30 m				9	20					
			Becoming; very low to low strength, some clay seams 50 to 100 mm thick	DS 2.30-2.50 m				10	20					
2.5			very low strength to low strength, trace clay seams, increase in auger resistance to high											
			Hole Terminated at 2.60 m Target depth											

Remarks/Testing DCP Blows/100 mm: 0 5 10 15 20 25

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

D17/110975

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Hole ID: **BH3**

CLIENT	: David Moyle	POSITION	: Refer to Site Plan
CONTRACTOR	:	EASTING	:
PROJECT	: LRA	NORTHING	:
LOCATION	: 14 Mitchell Grove, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5t 600 Auger
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

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 5 10 15 20 25)
0			Clayey Sandy SILT, low plasticity, brown, fine sand	DS 0.10-0.30 m	D									
			Silt CLAY, medium to high plasticity, pale grey and orange/brown	0.30-0.80 m	M	St								
0.5														
1.0														
			Hole Terminated at 1.20 m Target depth											
1.5														
2.0														
2.5														

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

D17/110975

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Hole ID: **BH4**

CLIENT	: David Moyle	POSITION	: Refer to Site Plan
CONTRACTOR	:	EASTING	:
PROJECT	: LRA	NORTHING	:
LOCATION	: 14 Mitchell Grove, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5t 600 Auger
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

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 5 10 15 20 25)
0			Clayey SILT, medium plasticity, brown	DS 0.00-0.10 m	D									
			Silty CLAY, high plasticity, pale grey and brown and orange/brown	0.10-0.30 m										
0.5				DS 0.50-0.80 m 97% fines wl = 75% wp = 21%	M	St		34						
1.0														
1.5			Hole Terminated at 1.20 m Target depth											
2.0														
2.5														

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

D17/110975

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Hole ID: **BP1**

CLIENT	: David Moyle	POSITION	: Refer to Site Plan
CONTRACTOR	:	EASTING	:
PROJECT	: LRA	NORTHING	:
LOCATION	: 14 Mitchell Grove, Seperation Creek	COORD. SYS.	: MGA94 Zone 55
PROJECT No.	: 22854	GROUND RL	:

Drill Rig: 5.5t 600 Auger
Date: 27/10/2017
Logged By: DP
Reviewed By:DP

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 5 10 15 20 25)
0.0			Silty CLAY, medium to high plasticity, brown and grey with orange brown. Collapsed slope cut in the order of 3 m high abover 450 diamter bored pier.		D to M	F								
3.0			inferred residual		M	St								
4.3			SILTSTONE, fine, yellow brown, extremely to very low strength, highly weathered											
4.5			becoming; very low to low strength											
5.0			becoming; low to medium strength, moderately weathered. High resistance to augers											
			Hole Terminated at 5.00 m Target depth											

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

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METHOD OF SOIL DESCRIPTION

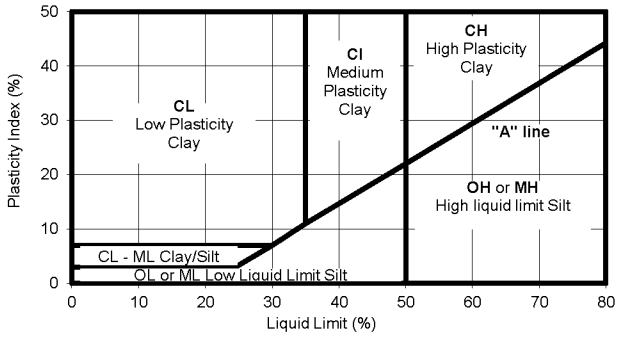
CLASSIFICATION AND INFERRED STRATIGRAPHY

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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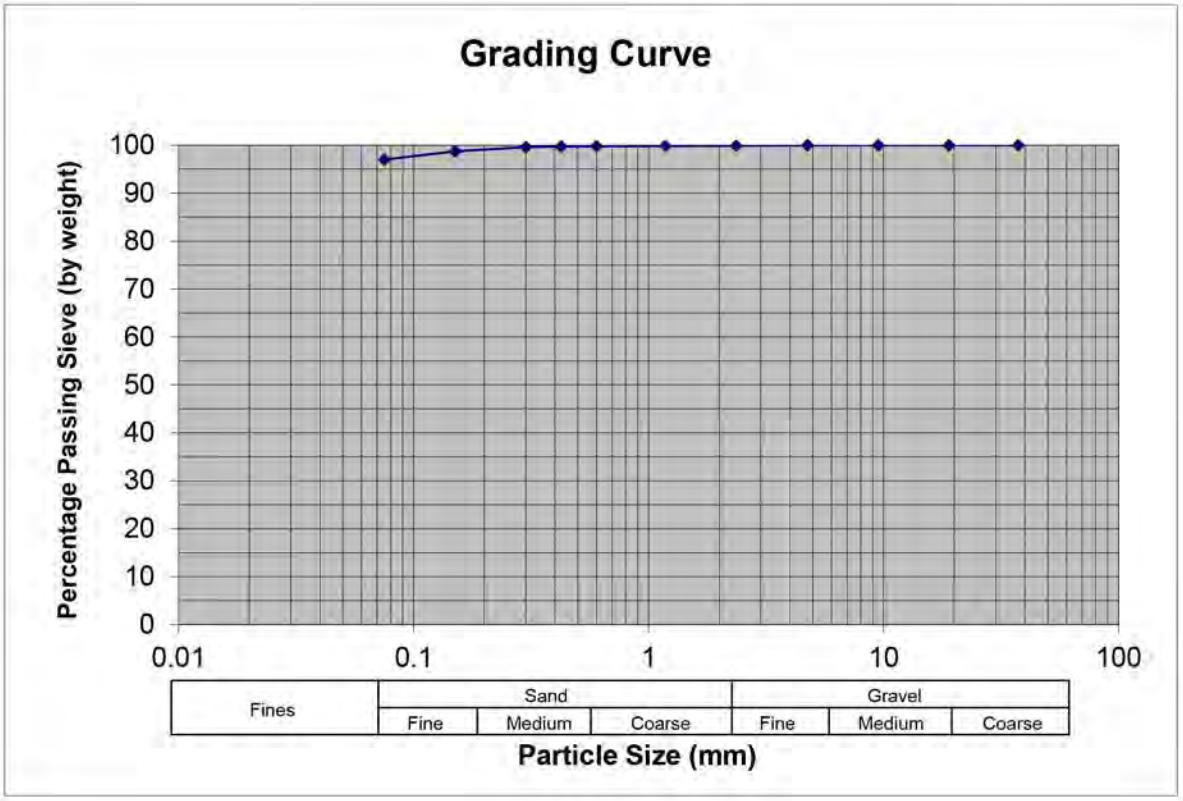
Washed Sieve Analysis

Date	15/11/2017
Job No.	22854
Client	Ballarat Construction Management
Site	14 Mitchell Gve Separation Ck
Pit No.	4
Depth	0.5-0.8m

Tray No.	18
Colour	
Soil Type	Silty CLAY
Weight tray & Wet Soil	1103.8
Weight tray & Dry Soil	898.63
Weight Dry Soil	

Initial Soil Weight	603.63
Soil Weight Post Wash	17.47
Weight Fines Lost	586.16
% Fines	97

Sieve Size (mm)	Sieve Weight (g)	Seive & Soil Wt (g)	Wt of soil Retained (g)	Cumulative Weight (g)	Percentage Retained (%)	Cum % Retained	Percentage Passing (%)
37.5	515.13	515.13	0	0	0	0.0	100.0
19.0	485.31	485.31	0	0	0.0	0.0	100.0
9.5	452.34	452.34	0	0	0.0	0.0	100.0
4.75	491.51	491.51	0	0	0.0	0.0	100.0
2.36	426.28	426.8	0.52	0.52	0.1	0.1	99.9
1.18	398.54	398.87	0.33	0.85	0.1	0.1	99.9
0.600	362.69	363.15	0.46	1.31	0.1	0.2	99.8
0.425	337.85	338.07	0.22	1.53	0.0	0.3	99.7
0.300	332.02	332.97	0.95	2.48	0.2	0.4	99.6
0.150	313.29	318.53	5.24	7.72	0.9	1.3	98.7
0.075	288.24	298.69	10.45	18.17	1.7	3.0	97.0
Pan	284.77	285.03	586.42	604.59	97.0	100.0	0.0
TOTAL		4706.4	604.59				



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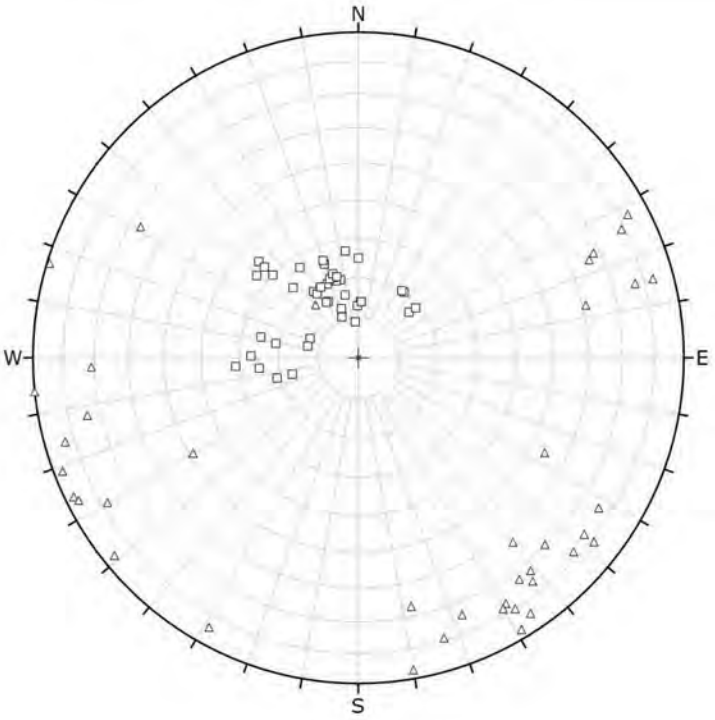
Stereo Plot

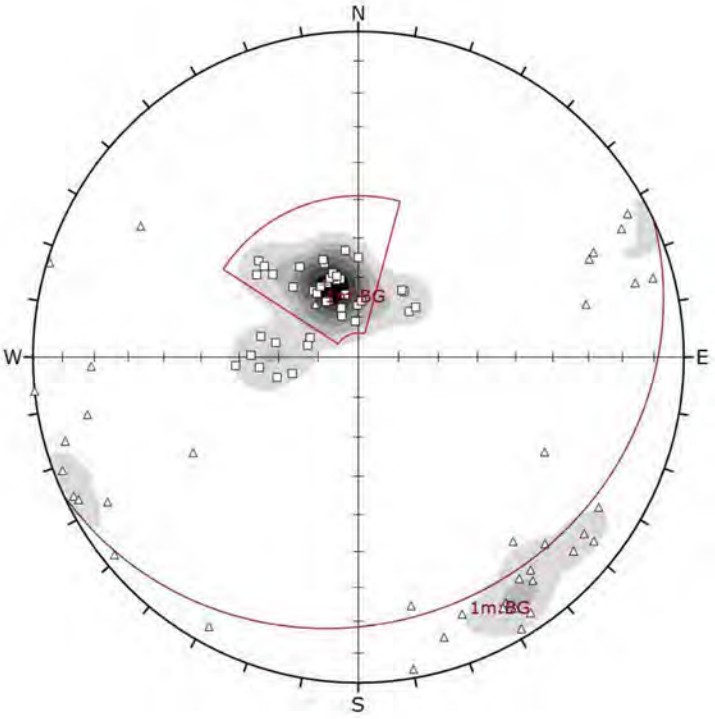
LINE MAPPING DATA

Project:	14 Mitchell Grove	**North datum:**	True	**Processed by:**	DP
Job no:	**22854**	**Location:**	Various	**Date:**	7-Dec-17
Domain:	Separation Creek	**Traverse:**	Various	**Defect type:**	BG & JN Sets
Lithology:	Various	**Slope:**	All data		



Symbol	DEFECT	Quantity
□	BG	42
△	JN	40

Plot Mode	Pole Vectors
Vector Count	82 (82 Entries)
Hemisphere	Lower
Projection	Equal Area



Symbol	DEFECT	Quantity
□	BG	42
△	JN	40

Color	Density Concentrations
	0.00 - 3.30
	3.30 - 6.60
	6.60 - 9.90
	9.90 - 13.20
	13.20 - 16.50
	16.50 - 19.80
	19.80 - 23.10

Contour Data	Pole Vectors
Maximum Density	22.47%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
Mean Set Planes				
1m		20	155	BG

Plot Mode	Pole Vectors
Vector Count	82 (82 Entries)
Hemisphere	Lower
Projection	Equal Area

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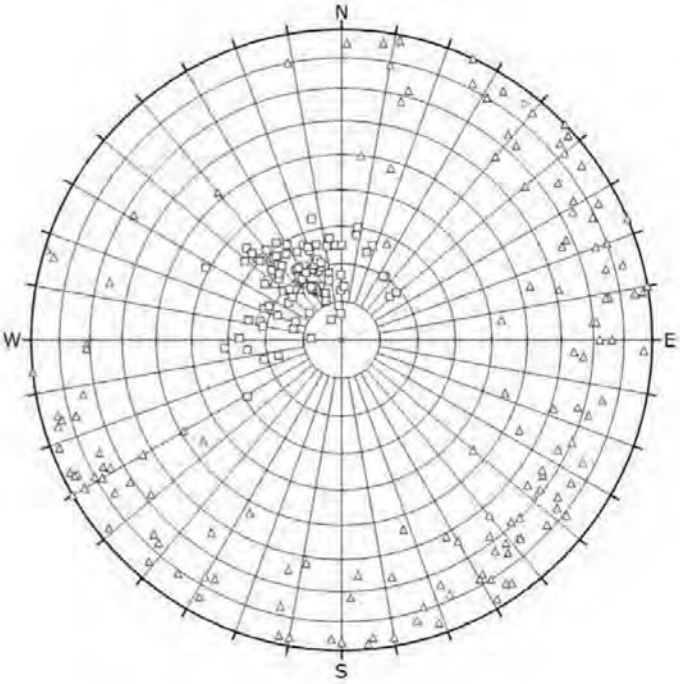
Stereo Plot

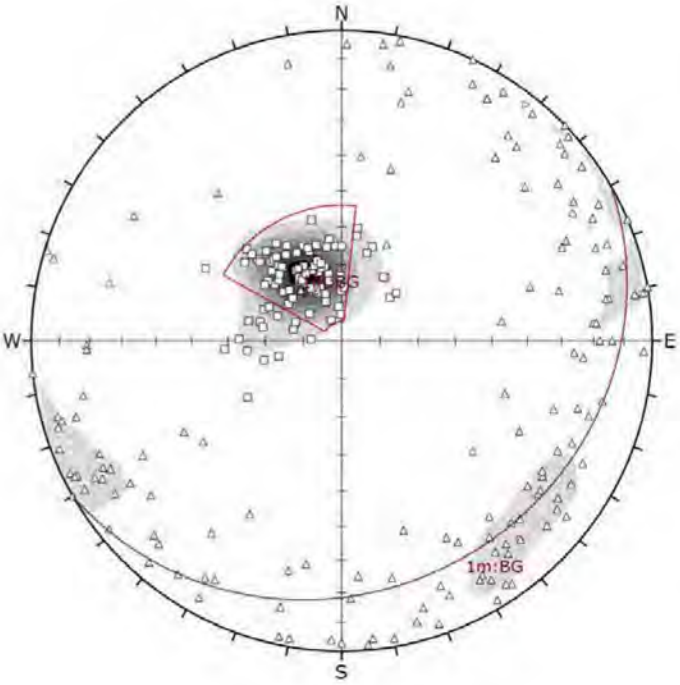
LINE MAPPING DATA

Project:	14 Mitchell Grove	**North datum:**	True	**Processed by:**	DP
Job no:	**22854**	**Location:**	Various	**Date:**	7-Dec-17
Domain:	Karingal East	**Traverse:**	Various	**Defect type:**	ALL
Lithology:	Various	**Slope:**	All data		



Symbol	DEFECT	Quantity
	BG	94
	FL	1
	JN	150
	SH	2

Plot Mode	Pole Vectors
Vector Count	247 (247 Entries)
Hemisphere	Lower
Projection	Equal Area



Symbol	DEFECT	Quantity
	BG	94
	FL	1
	JN	150
	SH	2

Color	Density Concentrations
	0.00 - 2.30
	2.30 - 4.60
	4.60 - 6.90
	6.90 - 9.20
	9.20 - 11.50
	11.50 - 13.80
	13.80 - 16.10

Contour Data	Pole Vectors
Maximum Density	15.25%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
Mean Set Planes				
1m		21	150	BG

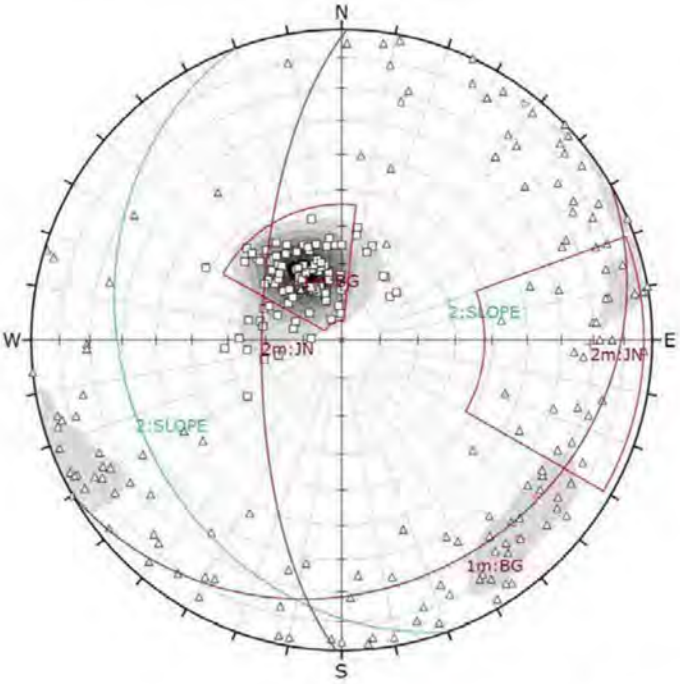
Plot Mode	Pole Vectors
Vector Count	247 (247 Entries)
Hemisphere	Lower
Projection	Equal Area

P.J.YTTRUP & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS

Stereo Plot

KINEMATICS

Project:	14 Mitchell Grove	**North datum:**	True	**Processed by:**	DP
Job no:	**22854**	**Location:**	Various	**Date:**	15-Dec-17
Domain:	Karingal East	**Traverse:**	Various	**Defect type:**	BG & JN Sets
Lithology:	Various	**Slope:**	Various		



Symbol	DEFECT	Quantity
□	BG	94
+	RL	1
△	JN	150
▷	SH	2

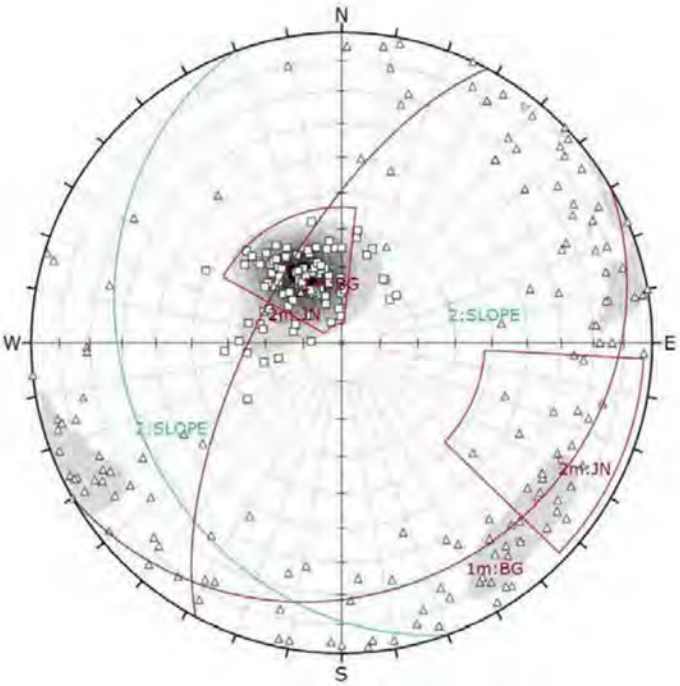
Color	Density Concentrations
	0.00 - 2.30
	2.30 - 4.60
	4.60 - 6.90
	6.90 - 9.20
	9.20 - 11.50
	11.50 - 13.80
	13.80 - 16.10

Contour Data	Pole Vectors
Maximum Density	15.25%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
2		30	250	SLOPE
Mean Set Planes				
1m		21	150	BG
2m		89	271	JN

Plot Mode	Pole Vectors
Vector Count	247 (247 Entries)
Hemisphere	Lower
Projection	Equal Area

Separation Creek Kinematics



Symbol	DEFECT	Quantity
□	BG	94
+	RL	1
△	JN	150
▷	SH	2

Color	Density Concentrations
	0.00 - 2.30
	2.30 - 4.60
	4.60 - 6.90
	6.90 - 9.20
	9.20 - 11.50
	11.50 - 13.80
	13.80 - 16.10

Contour Data	Pole Vectors
Maximum Density	15.25%
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
2		30	250	SLOPE
Mean Set Planes				
1m		21	150	BG
2m		68	298	JN

Plot Mode	Pole Vectors
Vector Count	247 (247 Entries)
Hemisphere	Lower
Projection	Equal Area

14 Mtichell Grove Kinematics

APPENDIX C

Photos

P.J. YTTRUP & ASSOCIATES PTY. LTD.
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Photo 1 General overview looking south west with FILL and drainage works in lower half of property.

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Photo 2 Typical slopes on the northern property boundary looking north west

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Photo 3 Typical small benches at the location of the previous dwelling looking north east. Note the recovering vegetation.

33 Roberts Road, Belmont, 3216
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Photo 4 Concave slopes below the previous dwelling looking north.

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Photo 5 Moderate slopes in the area of the disposal field looking west. Note recovering vegetation.

APPENDIX D
Risk Assessment & AGS Matrix

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

QUALITATIVE RISK ASSESSMENT - PROPERTY

Job Number: 22854
Site Address: 14 Mitchell Grove

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	Creep in surficial and residual soils	Rear of House	ALMOST CERTAIN	MAJOR	VERY HIGH	Foundations socketed into Very Low to Low Strength SILTSTONE Engineered retaining walls designed for landslide forces Revegetation Surface and sub-surface cut off drains Management of slopes in accordance with good hillside practice	UNLIKELY	MEDIUM	LOW
1B	Creep in surficial and residual soils	Front of House	POSSIBLE	MAJOR	HIGH	Foundations socketed into Very Low to Low Strength SILTSTONE Engineered retaining walls designed for landslide forces Revegetation Management of slopes in accordance with good hillside practice Surface and sub-surface cut off drains	UNLIKELY	MEDIUM	LOW
2A	Translational/rotational failure of the upper slope above the building	Rear of House	POSSIBLE	MAJOR	HIGH	Engineered retaining walls Foundations socketed into Very Low to Low Strength SILTSTONE	UNLIKELY	MEDIUM	LOW
2B	Translational/rotational failure of the lower slope below the building, triggered by poor drainage/application of effluent.	Disposal Field Front of House	POSSIBLE POSSIBLE	MEDIUM MAJOR	MODERATE HIGH	Foundations socketed into Very Low to Low Strength SILTSTONE Management of slopes in accordance with good hillside practice Surface and sub-surface cut off drains Revegetation	UNLIKELY UNLIKELY	MINOR MEDIUM	LOW LOW
2C	Translational failure of the lower slope below the building, triggered by poor drainage/ application of effluent with regression to the dwelling	Disposal Field Front of House	UNLIKELY UNLIKELY	MEDIUM MAJOR	LOW MODERATE				
3A	Active/Passive wedge failure above driveway	Vehicles on Driveway Rear of House	UNLIKELY UNLIKELY	MAJOR MAJOR	MODERATE MODERATE	Engineered retaining walls Approval from COS or their designer to construct a retaining wall in close proximity to the existing retaining wall.	UNLIKELY UNLIKELY	MAJOR MAJOR	MODERATE MODERATE
3B	Active/Passive wedge failure between driveway and dwelling	Vehicles on Driveway Rear of House	POSSIBLE POSSIBLE	MAJOR CATASTROPHIC	HIGH VERY HIGH	Engineered retaining walls designed for landslide forces Surface and sub-surface cut off drains Foundations socketed into Very Low to Low Strength SILTSTONE	UNLIKELY UNLIKELY	MEDIUM MAJOR	LOW MODERATE
4	Wedge Failure	Entire House	RARE	CATASTROPHIC	MODERATE				

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A.B.N. 71 687 799 203

QUANTITATIVE RISK ASSESSMENT - LIFE

Job Number: 22854
Site Address: 14 Mitchell Grove

FAILURE MODE	DESCRIPTION	SLOPE TYPE	VOLUME ESTIMATE (m^3)	REACH ANGLE (^{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	Creep in surficial and residual soils	Proposed	100	30	Occupant in damaged house	1E-02	0.4	0.40	0.001	1.7E-06	YES							
				30	Pedestrian on property	1E-02	0.4	0.02	0.001	8.9E-08	YES							
1B	Creep in surficial and residual soils	Proposed	300	90	Pedestrian on property	1E-03	1.0	0.02	0.001	2.1E-08	YES							
		Proposed		90	Occupant in damaged house	1E-03	1.0	0.40	0.001	4.0E-07	YES							
2A	Translational/rotational failure of the upper slope above the building.	Proposed	100	30	Pedestrian on property	1E-03	0.4	0.02	1	8.9E-06	YES	Engineered retaining walls	1E-04	0.4	0.02	0.1	8.9E-08	YES
				30	Occupant in damaged house	1E-03	0.4	0.40	1	1.7E-04	NO	Foundations socketed into Very Low to Low Strength SILTSTONE	1E-04	0.4	0.40	0.2	3.4E-06	YES
												Surface and sub-surface cut off drains						
												Management of slopes in accordance with good hillside practice						
2B	Translational/rotational failure of the lower slope below the building, triggered by poor drainage/application of effluent	Proposed	300	90	Occupant in damaged house	1E-03	1.0	0.40	0.2	8.0E-05	NO	Foundations socketed into Very Low to Low Strength SILTSTONE	1E-04	1.0	0.40	0.2	8.0E-06	YES
				90	Pedestrian on property	1E-03	1.0	0.02	0.1	2.1E-06	YES	Management of slopes in accordance with good hillside practice	1E-04	1.0	0.02	0.1	2.1E-07	YES
												Surface and sub-surface cut off drains						
												Revegetation						
2C	Translational failure of the lower slope below the building, triggered by poor drainage/ application of effluent with regression to the dwelling	Proposed	300	90	Pedestrian on property	1E-04	1.0	0.02	0.1	2.1E-07	YES							
				90	Occupant in damaged house	1E-04	1.0	0.40	0.2	8.0E-06	YES							
3A	Active/Passive wedge failure above driveway	Proposed	50	30	Pedestrian on property	1E-04	0.3	0.02	1	7.2E-07	YES							
				25	Occupant in damaged house	1E-04	0.1	0.40	0.2	1.1E-06	YES							
				90	Vehicles on Road	1E-04	1.0	0.01	0.1	1.0E-07	YES							
3B	Active/Passive wedge failure between driveway and dwelling	Proposed	200	90	Pedestrian on property	1E-03	1.0	0.02	1	2.1E-05	NO	Engineered retaining walls designed for landslide forces	1E-04	1.00	0.02	0.1	2.1E-07	YES
				50	Occupant in damaged house	1E-03	1.0	0.40	1	4.0E-04	NO	Surface and sub-surface cut off drains	1E-04	1.00	0.40	0.2	8.0E-06	YES
												Foundations socketed into Very Low to Low Strength SILTSTONE						
4	Wedge Failure	Existing	2000	30	Pedestrian on property	1E-05	0.8	0.02	1	1.7E-07	YES							
				30	Occupant in damaged house	1E-05	0.8	0.40	1	3.2E-06	YES							

LEGEND

$P_{(H)}$ **Annual probability of occurrence**
$P_{(SH)}$ **Spatial impact by hazard**
$P_{(Ts)}$ **Temporal Probability**
$V_{(DT)}$ **Vulnerability**
$P_{(DI)}$ **Risk for Loss of Life of an Individual**

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}	[illegible]	[illegible]	[illegible]	H	M or L (5)
B – LIKELY	10^{-2}	[illegible]	[illegible]	H	M	L
C – POSSIBLE	10^{-3}	[illegible]	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

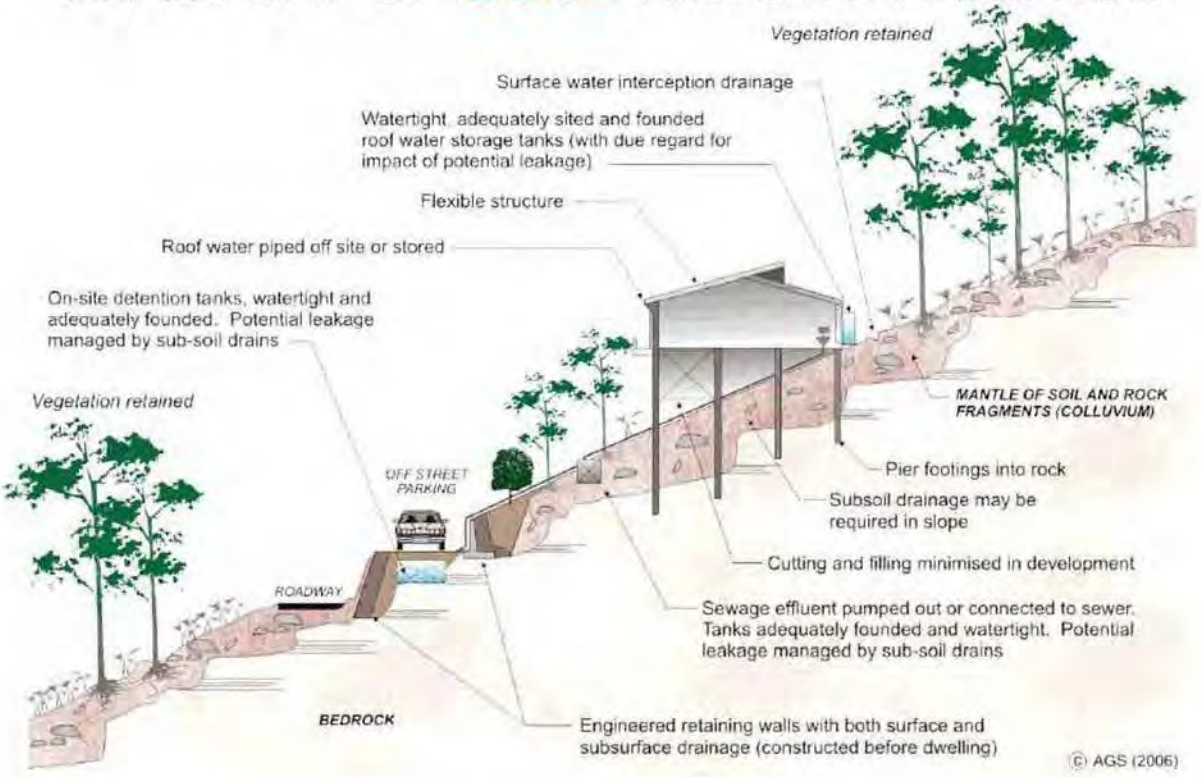
Risk Level		Example Implications (7)
[illegible]	[illegible]	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of 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.

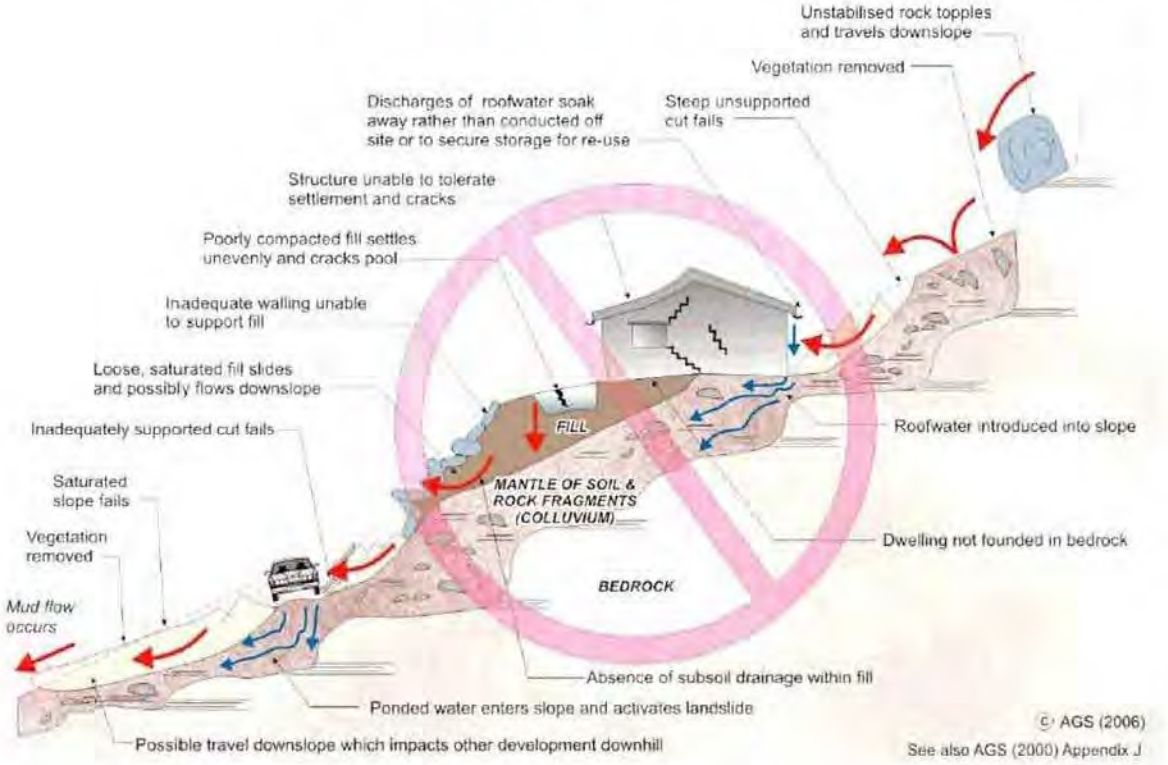
APPENDIX E

Good Practice for Hillside Construction

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

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	14 MITCHELL GROVE, Separation Creek
Applicant	DAVID MOYLE

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:* 171220 LRA 22854
	Author: DANE POPE	*Dated:* 20 / 12 / 2017

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 < 22854 Section 5.2.1 >
☑ Yes	☐ No	An assessment of the risk posed by all reasonably identifiable geotechnical hazards as per < 22854 Section 8.0 >
☑ Yes	☐ No	Plans and sections of the site and related land as per < 22854 Figures >
☑ Yes	☐ No	Presentation of a geological model as per < 22854 Fig. 3 >
☑ Yes	☐ No	Photographs and/or drawings of the site as per < 22854 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 < 22854 Section 10.0 >
☐ 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
	Moyle Residence Separation Creek	17.121	A	14/12/2017	SdB
	1:25,000 Landslide Susceptibility Map			18/03/07	CCMA
	1:25,000 Landslide Inventory Map			19/03/07	AM
	FEATURE SURVEY - c/- Crosier Architects				unknown

Section 5 — **Declaration**

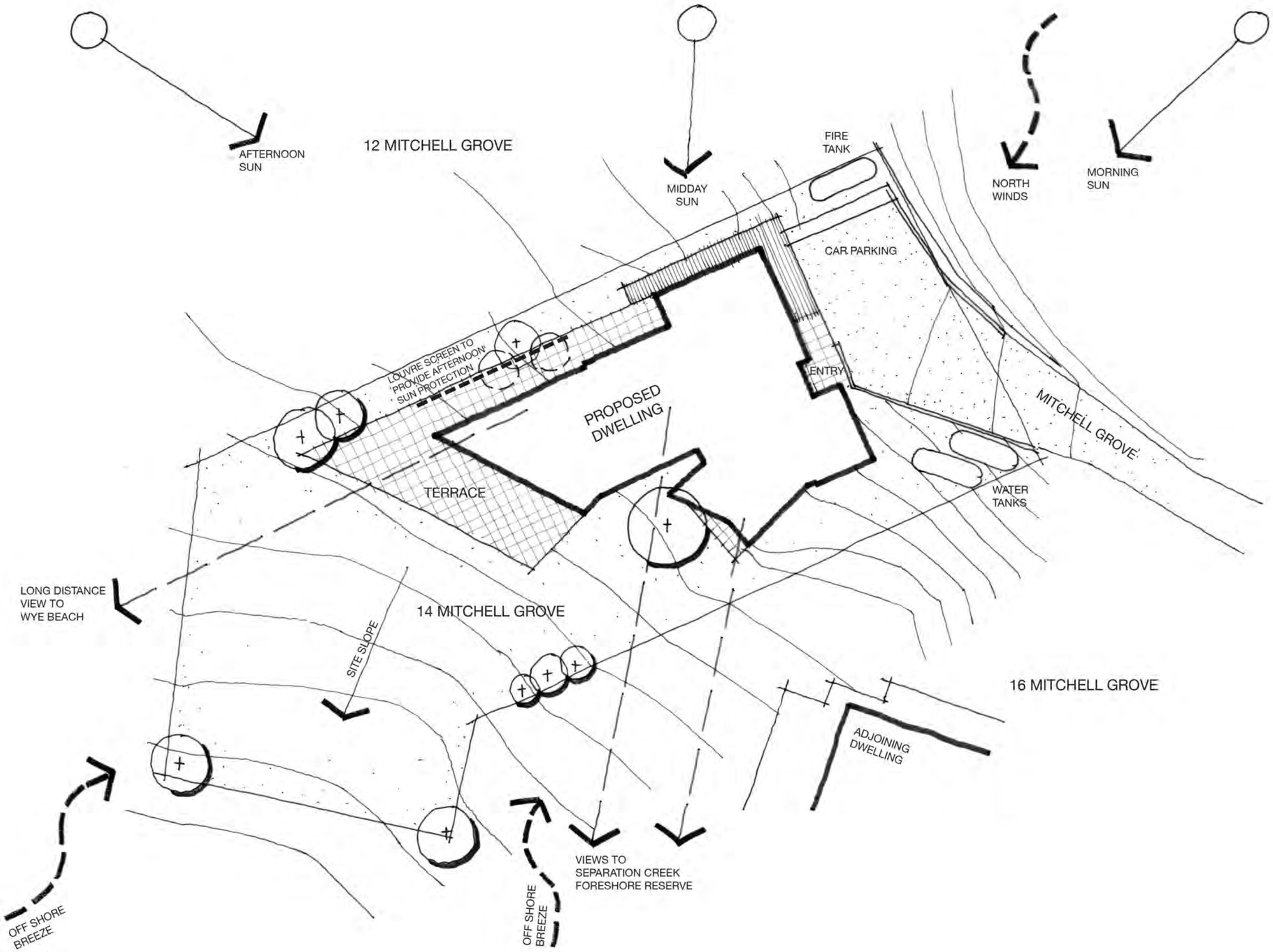
Declaration (Tick all that apply)		
☑ Yes	☐ No	I am a geotechnical engineer or engineering geologist as defined by the Colac Otway Planning Scheme and on behalf of the company below:
☑ Yes	☐ No	I am aware that the Geotechnical Assessment and/or Landslip Risk Assessment I have either prepared or am technically 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: 20 / 12 / 2017

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



Crosier Scott
Architects
585 Burwood Road
Hawthorn Victoria 3122
T 03 8862 7900
www.croscott.com.au

PROJECT
Moyle Residence
14 Mitchell Grove
Seperation Creek

CLIENT
David Moyle

TITLE
Site Context and
Design Response Plan

SCALE @ A3
1:200

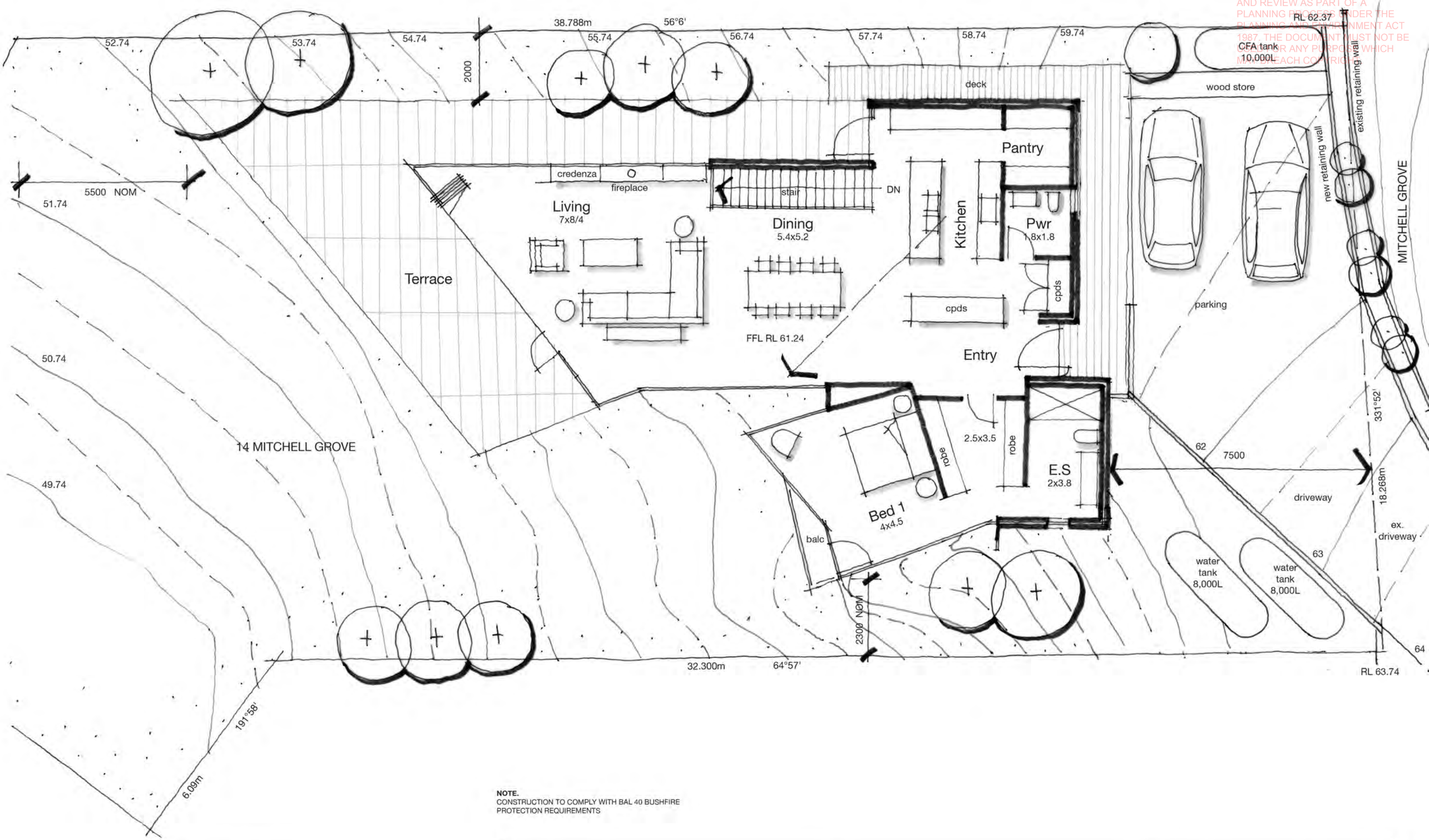
DRAWN
SdB

PROJECT No.
17.121

DRAWING No.
TP01

DATE
20/12/2017

REV.



NOTE.
CONSTRUCTION TO COMPLY WITH BAL 40 BUSHFIRE PROTECTION REQUIREMENTS

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PROJECT
Moyle Residence
14 Mitchell Grove
Seperation Creek

CLIENT
David Moyle

TITLE
Upper Floor Plan

SCALE @ A3
1:100

DRAWN
SdB

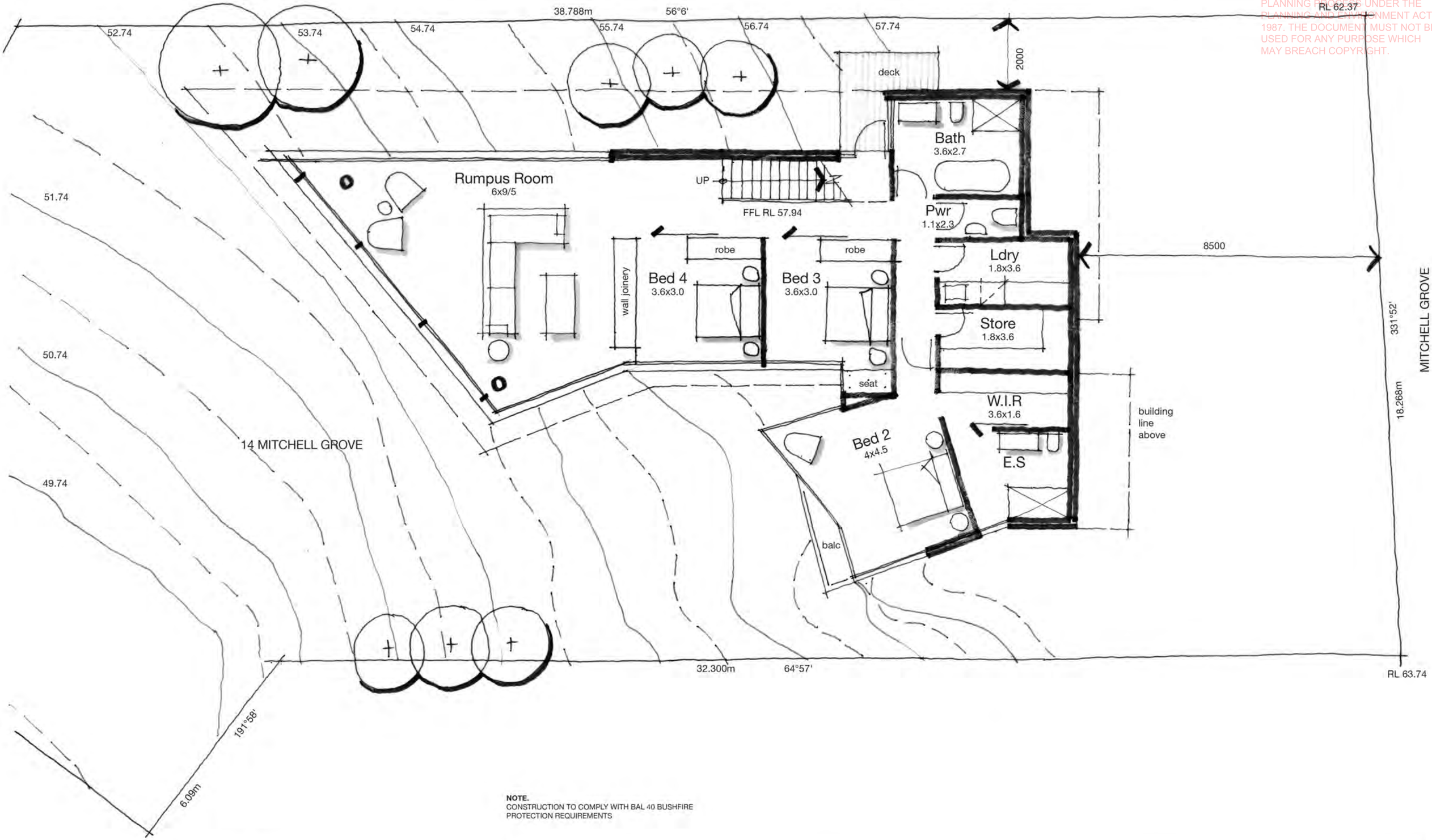
PROJECT No.
17.121

DRAWING No.
TP02

DATE
20/12/2017

REV.

D17/110975



NOTE.
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PROJECT
Moyle Residence
14 Mitchell Grove
Seperation Creek

CLIENT
David Moyle

TITLE
Lower Floor Plan

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	TP03
DATE	REV.
20/12/2017	

EAST ELEVATION

NORTH ELEVATION

NOTE.
CONSTRUCTION TO COMPLY WITH BAL 40 BUSHFIRE PROTECTION REQUIREMENTS

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PROJECT
Moyle Residence
14 Mitchell Grove
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3	DRAWN
1:100	SdB
PROJECT No.	DRAWING No.
17.121	TP04
DATE	REV.
20/12/2017	

WEST ELEVATION

SOUTH ELEVATION

NOTE.
CONSTRUCTION TO COMPLY WITH BAL 40 BUSHFIRE PROTECTION REQUIREMENTS

LEGEND

F1	OFF FORM CONCRETE
F2	PAINTED METAL FASCIA
F3	CORTEN STEEL
F4	METAL DECK ROOF
F5	GLASS WINDOWS
F6	GLASS BALUSTRADE
F7	PERFORATED CORTEN STEEL LOUVRES
F8	PAINTED STEEL HOOD
F9	STEEL GUTTER
F10	TIMBER LINING BOARDS

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PROJECT
Moyle Residence
14 Mitchell Grove
Seperation Creek

CLIENT
David Moyle

TITLE
Elevations

SCALE @ A3
1:100

DRAWN
SdB

PROJECT No.
17.121

DRAWING No.
TP05

DATE
20/12/2017

REV.

D17/110975

SITE ANALYSIS

SITE AREA	825m²
LOWER GROUND	
PROPOSED FLOOR AREA	176.00 m²
DECK/BALCONY	8.00 m²
UPPER FLOOR	
PROPOSED FLOOR AREA	165.00 m²
DECK/BALCONY	75.00 m²

12 MITCHELL GROVE
(VACANT)

14 MITCHELL GROVE

16 MITCHELL GROVE
DOUBLE STOREY
WEATHERBOARD HOUSE

MITCHELL GROVE

TOP RL - 63.84
TOE RL - 62.24

CFA WATER TANK
10000 L

PROPOSED RETAINING WALL

TOP RL - 63.84
TOE RL - 62.24
EXISTING RETAINING WALL

TOP RL - 64.24
TOE RL - 62.64

TOP RL - 64.24
TOE RL - 62.84

TOP RL - 64.24
TOE RL - 63.04

TOP RL - 64.24
TOE RL - 63.34

FALL

BENCH RL - 57.64

AREA OF CUT

WATER TANK
8000 L

WATER TANK
8000 L

BOUNDARY LOCATION

EASEMENT

FLOOR LINE ABOVE

LINE OF EXISTING GRAVEL DRIVEWAY

LINE UNDERGROUND EFFLUENT FIELD

1
TP07

63.0 64.0 65.0 61.5 61.74 60.74 59.74 58.74 61.25 57.74 56.74 55.74 54.74 53.74 52.74 51.74 50.74 49.74 48.74 47.74 62.74

1 OVERALL SITE PLAN
1 : 100

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N

MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
1 : 100	VD	SDB		C	TP06

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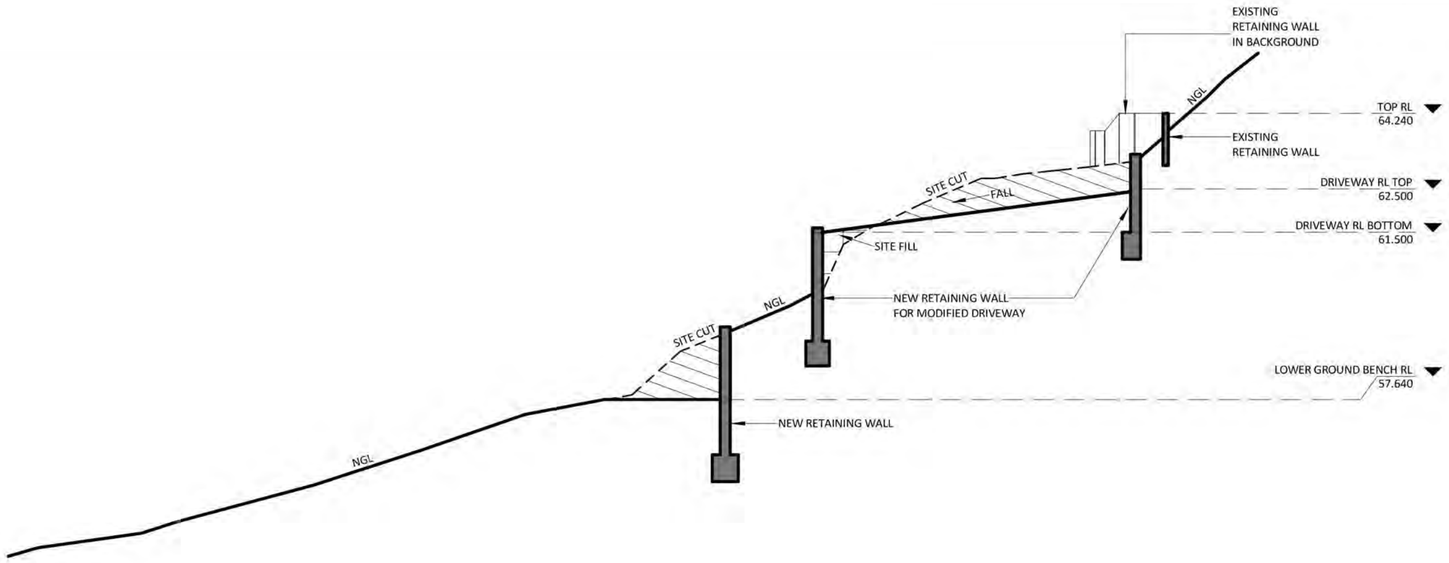
D17/110975



1 Section 1
1 : 100

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MOYLE RESIDENCE - 14 MITCHELL GROVE

SCALE @ A2	DRAWN	APP.	PROJECT No.	REV.	DWG No.
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