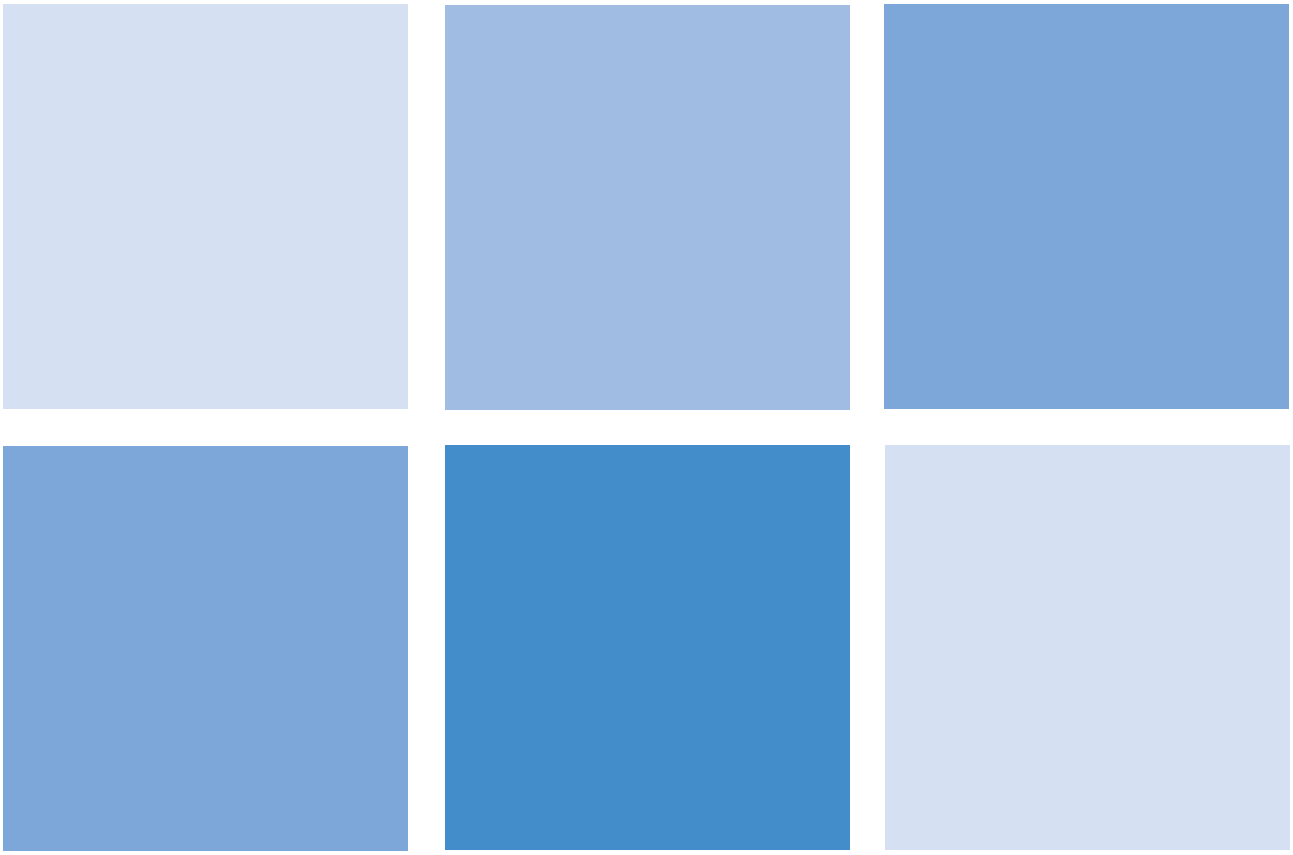
Lot 126 Caves Road, Burnside

Local Structure Plan



Lot 126 Caves Road, Burnside

Local Structure Plan

Prepared by:

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Client Manager: Joanne Cousins
Report Number: PR126662-3
Version/Date: Revision 6, 7 March 2018

Prepared for:

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IMPORTANT NOTE

We have prepared this report for the sole purposes of PGPM Pty Ltd ("**Client**") for the specific purpose of only for which it is supplied ("**Purpose**"). This report is strictly limited to the purpose and the facts and matters stated in it and do not apply directly or indirectly and will not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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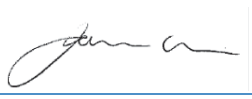
Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft A	Draft Structure Plan	C. Hearn	M. Hunt	21/2/16
Draft B	Draft Structure Plan	C. Hearn	D. Drown	24/2/16
Final	Structure Plan	C. Hearn	M. Hunt	20/04/16
Rev 1	Post advertising modifications for SAMR	M Hunt	R Sklarski	09/12/16
Rev 2	Post advertising modification for SAMR	M Hunt	D Drown	16/01/17
Rev 3	Post advertising modification for SAMR	M Hunt	M Young	16/05/17
Rev 4	Amendment to BMP	J Cousins	J Cousins	31/10/17
Rev 5	Amendment to BMP	J Cousins	J Cousins	24/01/18
Rev 6	Amendment to BMP	J Cousins	J Cousins	07/03/18

Approval for Issue

Name	Signature	Date
Joanne Cousins		07/03/18

This Structure Plan is prepared under the provisions of the Shire of Augusta Margaret River Local Planning Scheme No.1

CERTIFIED THAT THIS STRUCTURE PLAN WAS ADOPTED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

..... 9 March 2018 .....

Signed for and on behalf of the Western Australian Planning Commission

.....

an officer of the Commission duly authorised by the Commission pursuant to section 16 of the Planning and Development Act 2005 for that purpose, in the presence of:

..... Witness

..... 9 March 2018 ..... Date

..... 9 March 2028 ..... Expiry Date

Contents

Figures

Appendices

Executive Summary

RPS has been commissioned by the landowner of Lot 126 Caves Road, Burnside to prepare and lodge a structure plan submission for the subdivision and development of land within the Shire of Augusta Margaret River ('the Shire').

The proposed Structure Plan (refer **Appendix A**) establishes the future land use and development framework for the subject land and will be developed in a manner that responds to the topography and existing site features, and reflects the character of the surrounding locality.

The proposal has been informed by a comprehensive programme of technical investigations that addresses the key site constraints and is consistent with the land use framework prescribed in the Shire of Augusta-Margaret River Local Planning Scheme No. 1, Local Planning Strategy and other relevant State Policies such as the Leeuwin Naturaliste Ridge Statement of Planning Policy.

Details of the proposed Local Structure Plan are as follows:

Item	Data/ Supporting Comments
Total area covered by the Structure Plan	5.598ha
Area of each land use proposed: Rural Residential	 5.598ha
Estimated lot yield	2 Lots
Estimated number of dwellings	2 Dwellings
Estimated residential site density	1 dwelling per 3ha (approximately)
Estimated population	5 – 8
Number of high schools	Nil
Number of primary schools	Nil
Estimated commercial floor space (for activity centres if appropriate)	N/A
Estimated area and % of public open space: Regional open space District open space	 N/A N/A
Estimated area and number: Neighbourhood parks Local parks	 N/A N/A
Estimated number and area of natural area and biodiversity assets	Vegetation to be protected on site

PART ONE

IMPLEMENTATION

1.0 Structure Plan Area

1.1 Site Location and Physical Characteristics

Lot 126 Caves Road (the 'subject site') is located within the Shire of Augusta Margaret River. It has a total land area of 5.5982 ha, and is located approximately 5km north west of the Margaret River Townsite.

The majority of the subject site is covered by native vegetation, and forms part of a rural residential precinct adjacent to Caves Road and north of the Margaret River. The subject land slopes down towards the south west, with the highest point being the north east corner at approximately 65m above sea level (AHD) and the lowest point along a creek line section that sits at approximately 45m AHD.

2.0 Operation

This structure plan will come into effect on the date it is approved by the WAPC.

3.0 Staging

3.1 Provision of Infrastructure

A reticulated water supply is not currently available to the subject site. Dwellings that are proposed to be constructed on each lot will provide a potable water supply from a water tank with a minimum capacity of 135,000 Litres (135kL) as specified by the Shire of Augusta-Margaret River and shall be linked to a suitable roof catchment area of no less than 200 square metres.

A reticulated sewer system is not available or proposed to service the subject land. An alternative wastewater system will be implemented on each of the proposed lots at the dwelling construction stage.

The existing lot is connected to power at its Caves Road frontage. At the subdivision stage the power supply for the two new lots will be from the Western Power supply system to be installed as part of the Burnside Park subdivision to the north of the site.

3.2 Road Construction / Upgrades

No sealed road is currently available to the site. The subject land will be serviced via the implementation of the endorsed Development Guide Plan and subsequent conditional subdivision approval that exists over land located immediately to the north that forms the second stage of the Burnside Park rural residential estate. This development will deliver the extension of Burnside Road west and the construction of Cusmano Retreat south to the north-eastern corner of the subject property. This will provide access to Caves Road to the north. Road reserves for Burnside Road (west) and Cusmano Retreat are already established.

Alternate emergency access for the proposed lots within the Structure Plan is via a strategic fire break/emergency access route that has been established within a Crown Reserve running along the eastern side of the proposed lots. The access was constructed in 2009 during the development of the nearby Burnside Park estate and connects to Burnside Road near the intersection of Caves Road

Vehicle access to Caves Road is not proposed by the structure plan.

4.0 Subdivision and Development Requirements

4.1 Land Use Permissibility

Land uses within the Structure Plan area are prescribed through the implementation of the Shire of Augusta–Margaret River Local Planning Scheme No.1. For detailed explanation of planning framework refer Part 2, Section 1.3 of report.

4.2 Reports / Strategies and Other Considerations at Subdivision

At the time of subdivision (or imposed as a condition of approval), the following requirements and management plan(s) are to be considered and/or prepared, as applicable, to the satisfaction of the relevant authority:

- Bushfire Managment Plan - DFES an Shire of Augusta Margaret River. The BMP is to integrate relevant conservation objectives ascertained by the spring flora survey and fauna habitat in consultation with the Department of Parks and Wildlife.;
- Spring Flora Survey in accordance with EPA Guidance Statement 51 over the proposed disturbance areas, including potential and contingency building envelope locations, access ways, the busfire asset protection zone, and where fencing is proposed to assist with the assessment and management of potential impacts to the site's biodiversity values;
- Vegetation Impact Management Plan (VIMP) to be prepared and implemented to the satisfaction of the Department of Parks and Wildlife to manage the biodiversity values of the subject site when clearing of native vegetation is undertaken;
- No clearing of native vegetation is permitted outside the designated building envelope other than for essential bushfire protection requirements;
- Building envelopes to be 2000m^2;
- 60 metre setback to be provided from Caves Road;
- No vehicle access permitted from Caves Road;
- Retention of habitat trees as identified in the structure plan map;
- Cusmano Retreat to be constructed to the satisfaction of the Shire of Augusta-Margaret River; and
- Construction of the following access ways and roads prior to a subdivision application:
  - Cusmano Retreat;
  - Burnside Road;
  - the adjoining Emergency Access Way connecting between Cusmano Retreat and Caves Road via reserve 52718; and
  - The adjoining Emergency Access Way connecting Cusmano Retreat to Burnside Road.

PART TWO

EXPLANATORY SECTION AND TECHNICAL APPENDICES

1.0 Planning Background

1.1 Introduction and Purpose

The purpose of this structure plan is to facilitate the subdivision of Lot 126 Caves Road, Burnside River, as required by the Shire of Augusta Margaret River Local Planning Scheme No.1. This structure plan will provide a guide for the future development of the subject site for rural residential purposes.

1.2 Land Description

1.2.1 Site Location

The subject site is located approximately 5km north west of the Margaret River Townsite, on the eastern side of Caves Road, directly adjacent to its intersection with Kilcarnup Road. The site sits within a broader agricultural and rural residential landscape that ranges from cleared pasture to heavily vegetated land holdings.

Figure 1: Location Plan

1.2.2 Area and Land Use

The subject site has a total area of 5.5982 ha and is currently undeveloped and not utilised for any particular purpose. The majority of the subject site is covered by native vegetation comprising mainly an overstorey of Marri with Peppermints and Grass Trees and mixed Acacias in the understorey.

The Study Area slopes down towards the south west, with the highest point being the north east corner at approximately 65 m above sea level Australian Height Datum (AHD). The lowest area is the south west along a creek line section that sits at approximately 45m AHD.

Figure 2: Aerial Photograph

1.2.3 Surrounding Land Use

The subject site is bound by Caves Road to the west, vacant land to the north designated for future rural residential development and a large area of native bushland abutting the eastern boundary. This bushland is subject to a conservation covenant in favour of the Department of Parks and Wildlife. Land to the south is also covered with native vegetation.

1.2.4 Legal Description and Ownership

The land is described as Lot 126 on Deposited Plan 404521, Volume 2911 and Folio 985 and is currently owned by Mr Michael Bussell (refer **Appendix B**).

1.3 Planning Framework

1.3.1 Shire of Augusta-Margaret River Town Planning Scheme No. 1

The subject site is zoned "Rural Residential" under the Shire of Augusta-Margaret River Local Planning Scheme No. 1 (the Scheme) with a designation of "R-R 21" linking the subject land to Schedule 3 of the Scheme as follows:

Area No.	Site Description	
R-R21	Lot 9001 Caves Rd, Margaret River	1. The lot may be subdivided into 2 separate lots subject to the preparation of a Structure Plan endorsed by the local government and the Western Australian Planning Commission in accordance with Clause 6.2 of the Scheme.

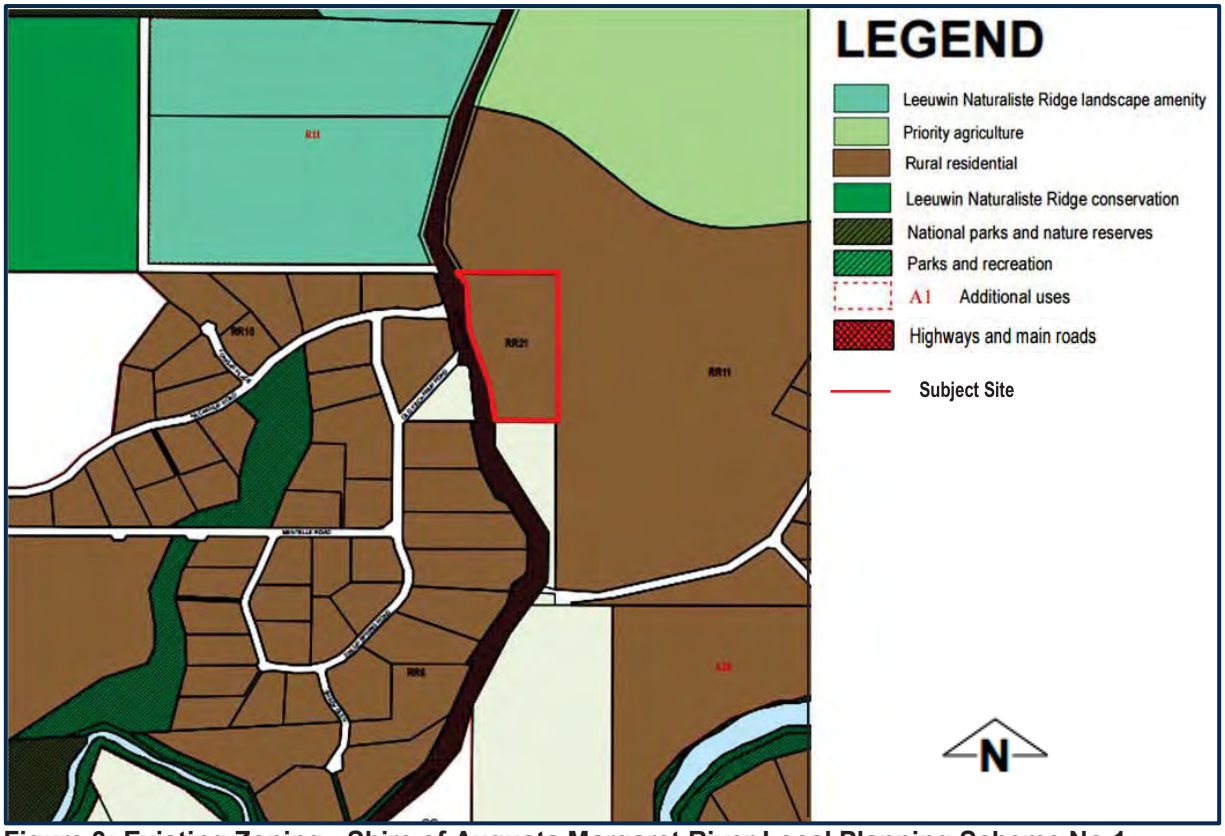


Figure 3: Existing Zoning - Shire of Augusta Margaret River Local Planning Scheme No.1

The Structure Plan and associated planning report has been prepared in accordance with the provisions of the Scheme and is cognisant of the relevant Local and State Government strategies and policies. The design approach responds appropriately to the various requirements / site constraints and is consistent with the land use intent envisaged for the site.

1.3.2 Shire of Augusta-Margaret River Local Planning Strategy (LPS)

The LPS seeks to provide a strategic guide for land use planning within the Margaret River region in to the short-medium term future. The subject site is designated as 'Rural Residential' under the LPS, which is consistent with the zoning under the Scheme. The proposed structure plan is consistent with the applicable *Rural Residential Policies* and additional provisions of the LPS.

Visual Management

The subject site is designated as *'Visual Management Area A'* under the LPS, which stipulates:

"Developments or changes in land use should result in no evident visual alteration to the landscape. Whilst changes may occur, the development or change of use should be of similar form, scale and pattern to the existing landscape."

The proposed building envelopes will be set back approximately 70 - 80m from the Caves Road corridor. Combined with the heavy vegetation on site, comprising a 15 – 20m high canopy of Marri trees with an understorey of Peppermints, Grass Trees and mixed Acacia species, the proposed dwellings will not be visible. Therefore, the two lots proposed will have no significant impact on the visual amenity of the locality or the view corridor along this section of Caves Road. Accordingly, the preparation of a Visual Impact Assessment is not warranted.

Environmental Corridor/ Remnant Vegetation

The subject site is located within an 'Environmental Corridor' as identified by the LPS. Therefore, the guiding landscape objective for the site is to balance the protection of the natural environment with the delivery of the rural residential land in a sustainable manner. As the majority of vegetation on site will be retained, the function of the subject site as part of a broader environmental corridor will not be significantly impacted by any part of development. A summary of the flora/ vegetation and fauna assessment undertaken over the site is detailed within Section 3.1.

Fire Risk

The preparation of a Fire Management Plan has been undertaken in support of the proposed structure plan (refer **Appendix C**). The purpose of this FMP is to detail the fire management methods and requirements that will be implemented within the proposed development. The FMP prepared was approved by the Department of Fire and Emergency Services in December 2015. The DFES approval is included in Appendix C. A summary of the report's findings and recommendations are as follows:

- The significant trees identified on site do not represent a fire hazard provided fuel loads beneath the canopy are maintained at a low level;
- A 27m Asset Protection Zone separation distance must be maintained between the wall of any future dwelling and the surrounding Open Forest vegetation type. The separation distance can include the significant trees (with low ground fuel) identified on site as these will not be removed;
- Both lots will have direct access to the public road system and an emergency access way providing two access routes;
- Existing firebreaks within the boundary of proposed lot 1 and lot 2 are to be maintained into the future;

- Any dwellings that are proposed to be constructed within the Site will be provided with a potable water supply from a water tank with a minimum capacity of 135,000 Litres (135kL) as specified by the Shire of Augusta-Margaret River and shall be linked to a suitable roof catchment area of no less than 200 square metres;

- All dwellings to be constructed shall be designed to conform with Shire specifications and requirements, and AS3959-2009.

1.3.3 State Planning Policy No. 6.1 Leeuwin-Naturaliste Ridge Policy

The WAPC's Leeuwin-Naturaliste Ridge Policy (SPP 6.1) Land Use Strategy Plan seeks to protect the landscape value of the Leeuwin-Naturaliste Ridge through a comprehensive range of objectives and policies. The site falls within the "Rural Residential" precinct.

SPP 6.1 has a general presumption against the provision of further Rural Residential land, however the subject site falls within an area designated for Rural Residential land use, and therefore complies with the objectives of the policy.

The relevant specific land use policies relating to Rural Residential land are as follow:

"*LUS 1.24 Rural Residential will be restricted to the areas shown in the Land Use Strategy Plan.*

LUS 1.25 Subdivision and development design that facilitates better use of land already committed for Rural Residential development will be encouraged. Assessment of proposals will address the following criteria:

- *provision for clustered settlement;*
- *provision of community-based activities and services;*
- *provision for walking, cycling and possible future public transport;*
- *opportunities for local enterprise development such as limited small-scale tourism development, including accommodation, attractions and cottage industries; and*
- *suitability for small-scale intensive agriculture.*

LUS 1.26 Consolidation and diversification of existing Rural Residential land to the west of Margaret River, will be compatible with Regional Environmental Corridor functions and landscape values.

This structure plan is consistent with the Rural Residential policies contained within SPP 6.1 in that the subject site is already within an area designated under the Land Use Strategy Plan

The subject site is also abuts a designated '*Travel Route Corridor'* under SPP 6.1 which defined as "*allowing people opportunities to access and experience adjoining areas and consist of a 600 metre wide corridor (300m on either side) along the Primary Transport Network. These corridors may or may not include areas where rural or natural significance have been identified".*

Policy Statement 3.3 of SPP 6.1 states that *"development will have due regard for the landscape integrity and value of Ridge backdrops when viewed from the coastline, bays or Travel Route Corridors".*

Apart from minor clearing within the nominated building envelopes, the majority of the vegetation on site will remain. Future dwellings are approximately 70 to 80 metres from Caves Road and will be screened by both high canopy trees combined with dense understorey mitigating any potential impact upon the amenity of the identified travel route corridor. The structure plan therefore complies with the relevant policies and objectives of SPP 6.1, and is appropriately located for Rural Residential land uses.

2.0 Proposed Local Structure Plan

The proposed Local Structure Plan (LSP) provides the foundation that will guide the subdivision of the land to follow with a focus on the key environmental considerations. The resultant LSP has been designed in response to detailed technical investigations across environmental, land capability and fire management disciplines. The key design elements are as follows:

2.1 Access and Movement

The proposed lots will be connected to the surrounding areas via the proposed Burnside Road extension and associated future construction of Cusmano Retreat as part of the implementation of the subdivision over land to the north.

An existing emergency access way running the length of the eastern boarder of the subject site will provide an alternative fire emergency route for existing and future residents in a southerly direction to Burnside Road.

No vehicle access will be obtained from Caves Road.

2.2 Lot Sizes and Lot Yield

The proposed local structure plan comprises a two (2) lot subdivision. The northern Lot 1 will be 2.854ha in area with southern Lot 2 being 2.598ha in area. Lot 2 will be serviced via a battle-axe leg connecting to Cusmano Retreat.

Both lots are regular in configuration and will facilitate the construction of a single dwelling and associated outbuildings on each lot in a manner that respects the environmental qualities of the site.

2.3 Building Envelopes

The location of the proposed building envelopes takes into consideration access, significant remnant vegetation and the recommendations of the fire management plan.

The building envelope for Lot 1 is located in the north east corner of the site, and the building envelope for Lot 2 is located along the eastern boundary adjacent to the emergency access way.

Both building envelopes are sized to ensure dwellings of an appropriate size can be constructed to maximise the site's qualities and satisfy future user requirements. Building envelopes are 2000m^2 in area to reflect the provisions of the scheme.

2.4 Protected Environmental Features

The site contains a number of key environmental features that have been recognised as a significant opportunity for the development to preserve and compliment the natural characteristics of the site through vegetation retention.

The vegetated bushland areas will be retained and enhanced for their long term protection. Vegetation linkages throughout the area will be maintained to the north, south and east across the boundary of the site. Vegetation retention adds to the creation of character, visual relief and a softening of the urban landscape.

A total of 12 "habitat" trees were identified in the vicinity of the preferred building areas during the significant flora/fauna survey undertaken by Ecosystems Solutions. To ensure the "habitat" trees are not affected, building envelopes have been set back a minimum 21m setback from such trees. While the fire management plan (Appendix C) requires a 27m Asset Protection Zone around dwellings, "habitat" trees can remain as free standing trees within the building protection area. Both fire management requirements and environmental considerations have therefore been accommodated through the placement of building envelopes.

3.0 Site Constraints and Technical Considerations

The proposed Structure Plan has been formulated with the assistance of sub-consultant investigations and supporting reports as follows:

Environment – Ecosystem Solutions Pty Ltd

- Significant Flora/ Vegetation and Fauna Assessment

Geotechnical – Civil/Structural Consulting Pty Ltd

- Geotechnical Investigation and Effluent Disposal Study

Fire Management – Ecosystem Solutions Pty Ltd

- Bushfire Hazard Assessment and Fire Management Plan

3.1 Flora/ Vegetation and Fauna Assessment

Ecosystem Solutions Pty Ltd was commissioned to undertake a Significant Flora/Vegetation & Fauna Assessment over the site (refer **Appendix D**). A summary of the findings and reports recommendations are as follows:

- No rare or priority flora was found on the site;
- The vegetation is mostly classified as “Very Good”, and is in the latter stages of regenerating naturally from a major bushfire event in 2011;
- No ecological communities of significance were found on the site;
- Twelve (12) trees have been identified as having suitable hollows for Black Cockatoos, although no signs of nesting, roosting, socialising or feeding were identified;
- A small population of Western Ringtail Possums utilise the subject land. The proposal is to subdivide the property into two rural residential lots will result in minimal disturbance to the vegetation and impact on the existing population; and
- A small population of Southern Brown Bandicoots utilise the site, however will not be significantly impacted by the proposed subdivision.

The report concludes that no other animals of significance were observed, either directly or by signs of their utilisation of the site. Given the nature of the site, it is highly unlikely that any of the other significant fauna within a 5 km radius of the site, would be utilising the site. Using the criteria outlined by the Commonwealth Government, the actions within this development do not constitute as having a significant impact on threatened species and as such, referral under the EPBC Act is not required.

3.2 Geotechnical and Land Capability

A Geotechnical Investigation and Effluent Disposal Study were undertaken by Civil/Structural Consulting Pty Ltd relating to the subject site (refer **Appendix E**). Matters considered in the assessment of the site included excavation of test pits, ground slopes and soil types, surface and sub-surface flows, and types of vegetation. A range of domestic effluent disposal systems were also considered to receive and process effluent on an ongoing basis.

The report has concluded that the full range of effluent disposal systems considered are appropriate for the subject site, including; standard concrete settling tanks, concrete settling tanks with pump, concrete settling tanks with semi or fully – inverted leach drains or alternative treatment systems which treat the effluent to a point acceptable for discharge.

In conclusion, it was determined that both of the sites assessed as a part of this study are suitable for construction of residential or light commercial structures using commonly accepted methods of construction.

3.3 Bushfire Hazard Assessment and Fire Management Plan

Ecosystem Solutions Pty Ltd has been engaged by the client to prepare a Fire Management Plan (FMP), which details the fire management methods and requirements that will be implemented with the proposed development. The FMP has been developed in accordance with the *Planning for Bushfire Guidelines (Edition 2)* and clause 6 of *State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7).*

The Bushfire Hazard Assessment identifies both building envelopes as falling within an area of 'Extreme Fire Risk'. However, the Fire Management Plan indicates that a BAL- 29 can be achieved over both building envelopes, requiring a 27m separation zone from surrounding vegetation, which exceeds the minimum setback requirement of 20m as identified in the Shire's Firebreak Notice. This separation distance can include the "habitat" trees identified on site as these do not represent a fire hazard provided ground fuels below the canopy are maintained to a low level. The proposed structure plan complies with all requirements of the FMP, and as such ensures that future subdivision and development of the site will achieve an acceptable level of risk. Further details can be viewed in the FMP attached as **Appendix C**. The Fire Management Plan (FMP) has been assessed and subsequently approved by DFES (Dec 2015) as it is considered to be consistent with the objectives and principles of the State's planning for bushfire protection legislation and guidelines.

Hazard Separation Zones in the development will need to extend to the lot boundaries, and will be maintained in a low fuel state of between 5 to 8 tonnes per hectare.

4.0 Conclusion

The proposed local structure plan is intended to facilitate the subdivision of Lot 126 Caves Road, Burnside, as prescribed by Schedule 3 of the Shire of Augusta Margaret River Local Planning Scheme No.1.

The proposal has been informed by a comprehensive programme of technical investigations that addresses the key site constraints and is consistent with the land use framework prescribed in the Shire of Augusta-Margaret River Local Planning Scheme No. 1, Local Planning Strategy and other relevant State Policies such as the Leeuwin Naturaliste Ridge Statement of Planning Policy.

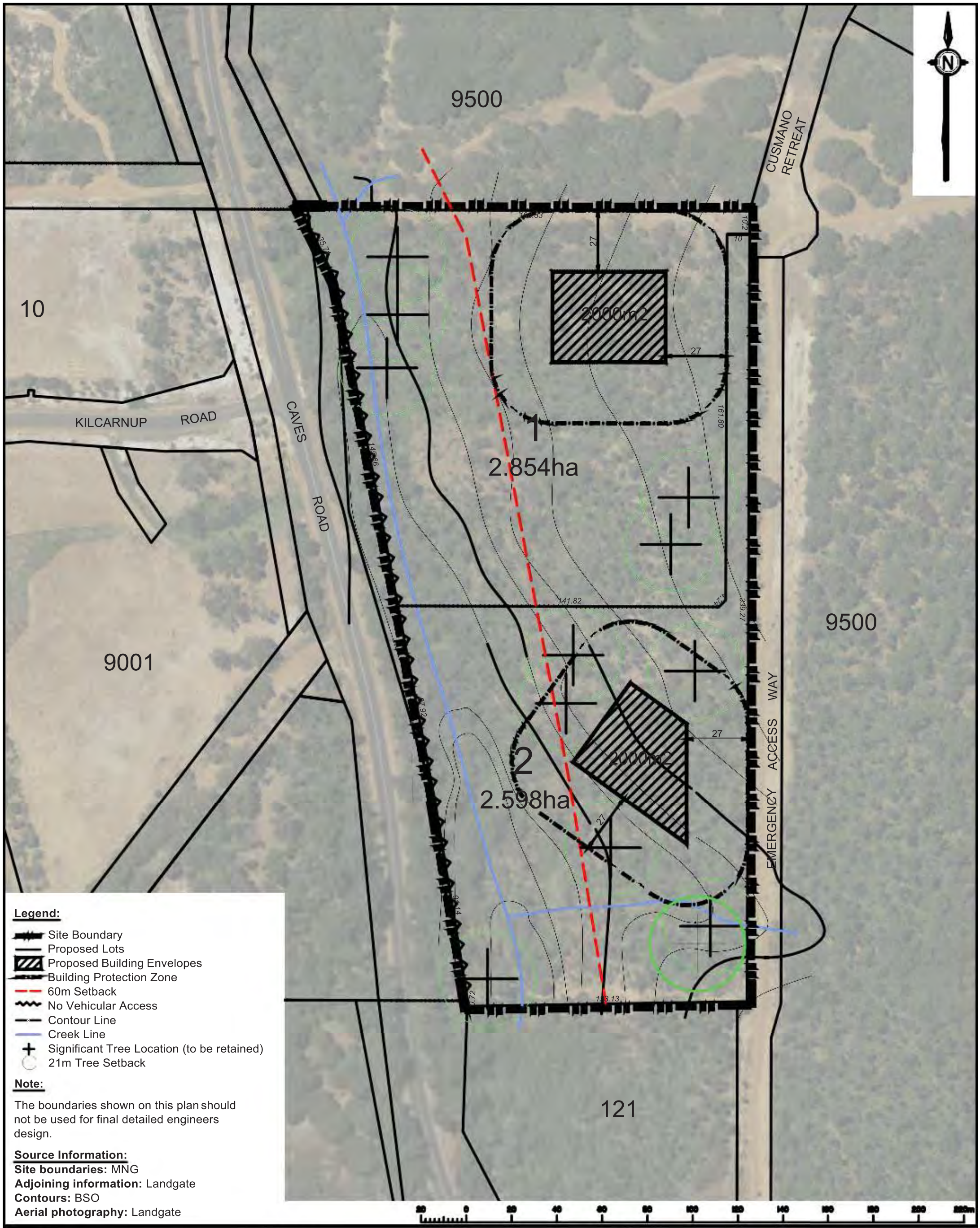
The layout has adopted a responsive design approach and is considered to provide for the most orderly and efficient use of the land in a manner that will create the desired character of the locality. It is therefore requested that the proposed Local Structure Plan be favourably considered.

APPENDIX A

Proposed Structure Plan

Lot 9001 (Plan Ref: 126662-2-001c)

Prepared by RPS



PROJECT
LOT 126 CAVES ROAD BURNSIDE

CLIENT
MR MIKE BUSSELL

LOCAL STRUCTURE PLAN
LOT 126 - CAVES ROAD

BURNSIDE

Job No: 126662	Date: 29 NOVEMBER 2016
Comp By: LCEV	DWG Name: 126662-2-001c.dwg
Checked By: RS	Locality: MARGARET RIVER
Local Authority: SHIRE OF AUGUSTA AND MARGARET RIVER	

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Scale	Sheet	Plan Ref	Rev
1 : 1500	A3	**126662-2-001**	**C**

APPENDIX B

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
126/DP404521	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF CERTIFICATE OF TITLE

VOLUME 2911 FOLIO 985

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 126 ON DEPOSITED PLAN 404521

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MICHAEL BUSSELL OF 13 BRENDON WAY, KARRINYUP
(AF N440450) REGISTERED 21 SEPTEMBER 2016

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *RESTRICTIVE COVENANT BENEFIT - SEE DEPOSITED PLAN 49046 AND INSTRUMENT J724653
2. *N440449 NOTIFICATION CONTAINS FACTORS AFFECTING THE WITHIN LAND. LODGED 21.9.2016.
3. *RESTRICTIVE COVENANT BENEFIT - SEE DEPOSITED PLAN 404521 AND INSTRUMENT N440448.
4. *RESTRICTIVE COVENANT BURDEN - SEE DEPOSITED PLAN 404521 AND INSTRUMENT N440448.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP404521.
PREVIOUS TITLE: 2649-327.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF AUGUSTA-MARGARET RIVER.

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING J293695

APPENDIX C

Fire Management Plan

Prepared by Ecosystem Solutions

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: Lot 126 Caves Road

Suburb: Burnside **State:** WA **P/code:** 6285

Local government area: Shire of Augusta Margaret River

Description of the planning proposal: Subdivision of existing lot into two lots

BMP Plan / Reference Number: 15187 **Version:** V10 **Date of Issue:** 14/2/2018

Client / Business Name: Mike Bussell C/- PGPM Pty Ltd Att: Peter Gleed

Reason for referral to DFES	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?	☐	☑
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the BPC elements)?	☐	☑
Is the proposal any of the following special development types (see SPP 3.7 for definitions)?		
Unavoidable development (in BAL-40 or BAL-FZ)	☐	☑
Strategic planning proposal (including rezoning applications)	☐	☑
Minor development (in BAL-40 or BAL-FZ)	☐	☑
High risk land-use	☐	☑
Vulnerable land-use	☐	☑

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Gary McMahon	Level 3	35078	Nov 2018
Company		**Contact No.**	
Ecosystem Solutions		08 9759 1960 / 0427 591 960	

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner  **Date** 14/2/2018

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Lot 126 Caves Road, Burnside

Bushfire Management Plan

14 February 2018

Prepared for:
Mike Bussell
C/- PGPM Pty Ltd
Att: Peter Gleed

Limitations Statement

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In undertaking this work the authors have made every effort to ensure the accuracy of the information used. Any conclusions drawn or recommendations made in the report are done in good faith and the consultants take no responsibility for how this information and the report are used subsequently by others.

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1 Introduction

This Bushfire Management Plan (BMP) has been prepared by Ecosystem Solutions Pty Ltd, as part of the process of the owners of Lot 126 Caves Road, Burnside (hereafter called the "Site") to subdivide the property into two rural residential lots.

The purpose of this BMP is to detail the fire management methods and requirements that will be implemented within the proposed development. The aim of the BMP is to reduce the threat to residents and fire fighters in the event of a fire within or near the Site.

2 Site Description.

2.1 Location

The Site is located within the Shire of Augusta-Margaret River approximately 5 kms west of the Margaret River town Site (Map 1).

The proposal is to subdivide the property into two rural residential lots, Proposed Lot One to the north (2.584 ha) and Proposed Lot Two in the south (2.598 ha) (Figure 1 & Map 2). There is a proposed 2000m^2 building envelope for each lot (Figure 1 & Map 2).

Main access to the lots will be via Cusmano Retreat, Burnside, which is to be constructed prior to the development.

2.2 Landscape Elements

The Site slopes down towards the south west, with the highest point being the north-east corner at approximately 65 m above sea level Australian Height Datum (AHD). The lowest area is the south west along a creek line section that sits at approximately 45m AHD.

The vegetation on the Site is mainly an overstorey of Marri (*Corymbia calophylla*) with Peppermints (*Agonis flexuosa*), Grass Trees (*Xanthorrhoea preissii)* and mixed Acacias in the understorey. This vegetation type covers 4.93 ha. The rest of the Site (0.58 ha) consists of scattered Marri trees over Peppermints and **Solanum nigrum* and **Rubus spp.*, with sedges, pasture grasses and climbers making up the remainder of the understorey. The Site sits within an agricultural landscape that is highly cleared of native vegetation, with areas of remnant bushland to the east and north-west.

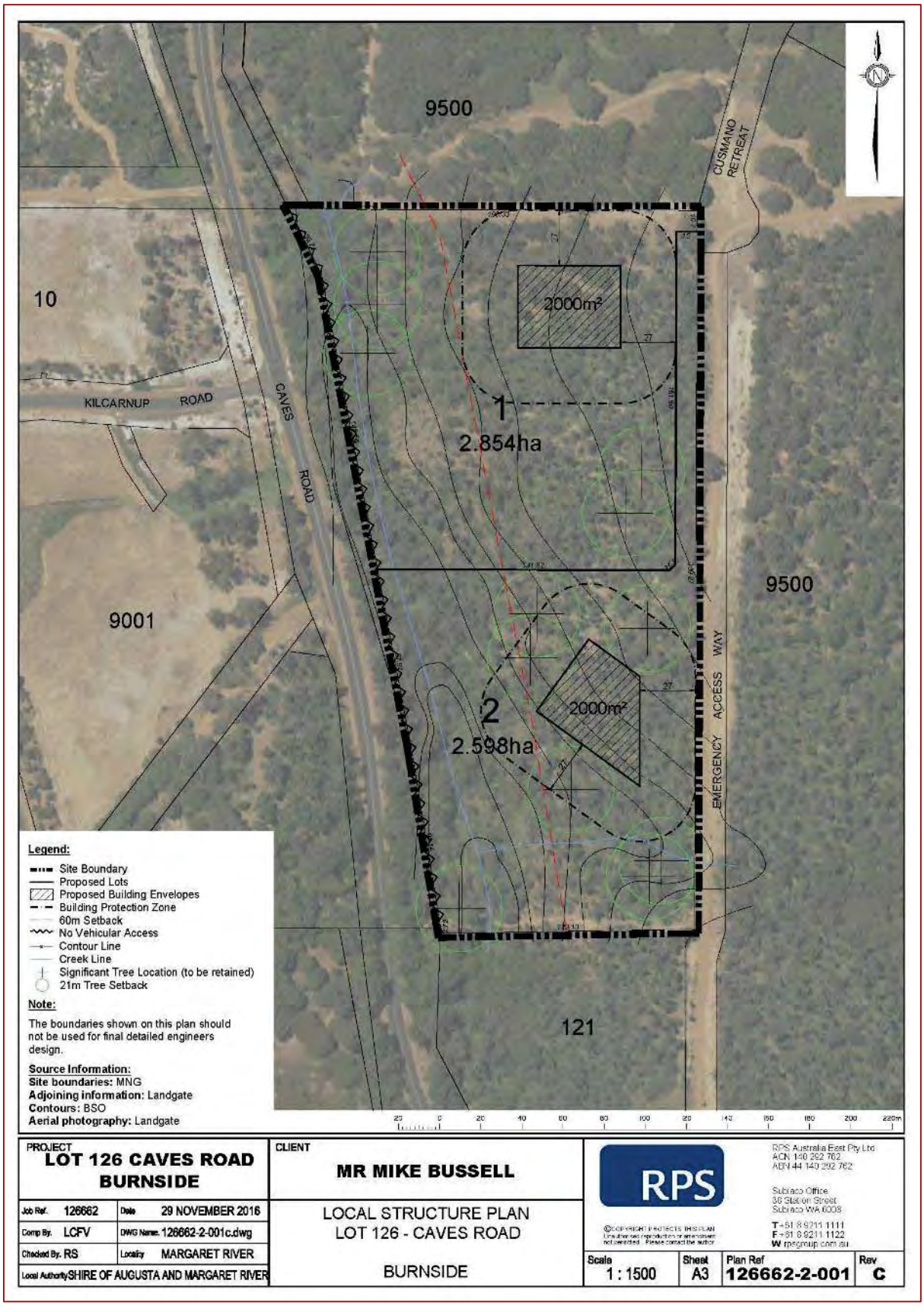


Figure 1: Proposed Structure Plan for Lot 126 Caves Road, Burnside.

Soil-Landscape systems are areas with recurring patterns of landforms, soils and vegetation and are used by the Department of Agriculture to maintain a consistent approach to land resource surveys.

The Study Area is within the Leeuwin Soil-Landscape Zone which is underlain by the Leeuwin Complex of granites and gneiss. Over this has formed the lateritic plateau of the Cowaramup Uplands system which has been dissected by a number of relatively shallow, undulating valleys collectively known as the Wilyabrup Valleys (Tille and Lantzke, 1990). There are four individual soil-landscape types within the Study Area, however they fall within two of the broader landscape systems defined by Tille and Lantzke (1990): The Cowaramup Upland System and the Willyabrup Valley System (Map 3). These are described as:

- *Cowaramup Upland System (216 Co) – Lateritic plateau in the Leeuwin Zone with sandy gravel, loamy gravel and grey sandy duplex soils. Principal vegetation is Jarrah-Marri forest.*
- *Wilyabrup Valleys System (216 Wv) – Granitic Valleys in the Leeuwin Zone with loamy gravel, sandy gravel and loamy earths. Jarrah-Marri forest dominate.*

3 Statutory Conditions

The Western Australian Planning Commission (WAPC) and the Fire and Emergency Services Authority of Western Australia (FESA) jointly developed *Planning for Bushfire Protection Guidelines* (Edition 2) in May 2010, in accordance with clause 6 of *State Planning Policy 3.4 Natural Hazards and Disasters (SPP 3.4).*

This Policy and Guidelines were superseded on 7th December 2015 by *State Planning Policy 3.7: Planning in Bushfire Prone Areas* and *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015), which was then updated in February 2017 (WAPC, 2017).

The objectives of this new policy are to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure;
- Reduce the vulnerability to bushfire through the identification and consideration of bushfire risks in decision making at all stages of the planning and development process;
- Ensure higher order strategic planning documents, strategic planning proposals, subdivision and development applications take bushfire protection requirements into account; and

- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and landscape amenity.

The policy determines those areas that are most vulnerable to bushfire and where development is appropriate and not appropriate. The provisions and requirements contained in the new *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015) are used in for this determination.

These guidelines form the foundation for fire risk management planning in WA at a community and land development level.

The Bushfires Act (1954) sets out provisions to reduce the dangers resulting from bushfires, prevent, control and extinguish bushfires and for other purposes. The Act addresses various matters such as prohibited burning times, and enables Local Government to require landowners/occupiers to maintain fire breaks, to control and extinguish bushfires and to establish and maintain Bushfire Brigades.

This Bushfire Management Plan (BMP) demonstrates that all fire protection requirements for issues including fire suppression response, development design, access, water supply, building locations and other relevant performance criteria contained in *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015) can be achieved to the satisfaction of the WAPC.

4 Fire Risk

Numerous elements affect building survival in a bushfire event. Some of these factors relate to the bushfire behaviour experienced at the Site, others relate to the design and the construction materials used in the building and the development's surrounding landscape. Infrastructure, utilities, climate and human behaviour also contribute to the overall risk.

Within this plan, the assessment of fire risk takes into account the layout of the development and the conditions that exist at the Site. These include:

- Vegetation Type and cover;
- Topography, with particular reference to ground slopes and accessibility;
- Climate; and
- Relationship to surrounding development.

4.1 Vegetation and Topography

The Site slopes down towards the south west, with the highest point being the north-east corner at approximately 65 m above sea level Australian Height Datum (AHD). The lowest area is the south west along a creek line section that sits at approximately 45m AHD.

The Site was inspected in July 2015 and the areas of vegetation were reviewed. The Site is made up of two vegetation communities (Map 4). The majority of the vegetation is a 15 - 20m high canopy of Marri trees with an understorey of Peppermints, Grass Trees and mixed Acacia species (Vegetation Type One). The remainder of the Site consists of scattered Marri trees 15 - 20m in height, over Peppermints and **Solanum nigrum* and **Rubus spp.*, with sedges, pasture grasses and climbers completing the understorey (Vegetation Type 2). The proposed building envelopes and the maximum Asset Protection Zone (See A2.1 below) have been excluded from classification under AS 3959-2009 Section 2.2.3.2 (f), as they will be established and maintained as low threat vegetation.

Figure 2: Vegetation Type One – Marri trees with an understorey of Peppermints, Grass Trees and mixed Acacia species.

Figure 3: Vegetation Type Two – Scattered Marri trees with an understorey of Peppermints, sedges, pasture grasses and climbers.

Based on AS 3959-2009, Vegetation Type One would be classified as Class A – Forest. Vegetation Type Two would be classified as Class B – Woodland.

4.2 Fire Climate

Bushfire behaviour is significantly affected by weather conditions. They will burn more aggressively when high temperatures combine with low humidity and strong winds. Generally, the greatest fire risk occurs from summer through to autumn, when the moisture levels in the soil and vegetation are low.

The Site is located within the southern area of south-west Western Australia which experiences hot dry summers and cool wet winters (commonly called a Mediterranean climate).

Data from the Bureau of Meteorology at Witchcliffe (approximately 12 kms to the south-east of the Site) confirms that the Site experiences hot dry summers with an average December to February temperature of 25-27^{0}C and 11 mm of rain per month over summer. Winters are cooler with a mean maximum temperature through June, July and August of 17^{0}C and an average July rainfall of 190mm (Figure 4 - BOM, accessed May 2015).

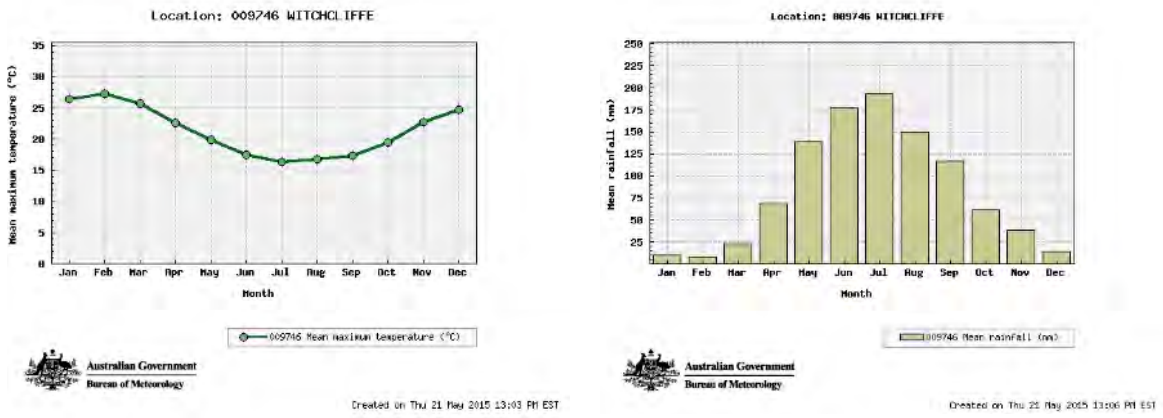


Figure 4: Mean Maximum recorded temperatures and Monthly rainfall for Witchcliffe.

The 3pm December wind rose for Witchcliffe shows that the afternoon sea breeze from the south and south-east dominates at 40 % of the time. This is similar for January, however south-easterly winds increase later in summer, occurring between 20-30 km/h approximately 10% of the time (Figure 5).

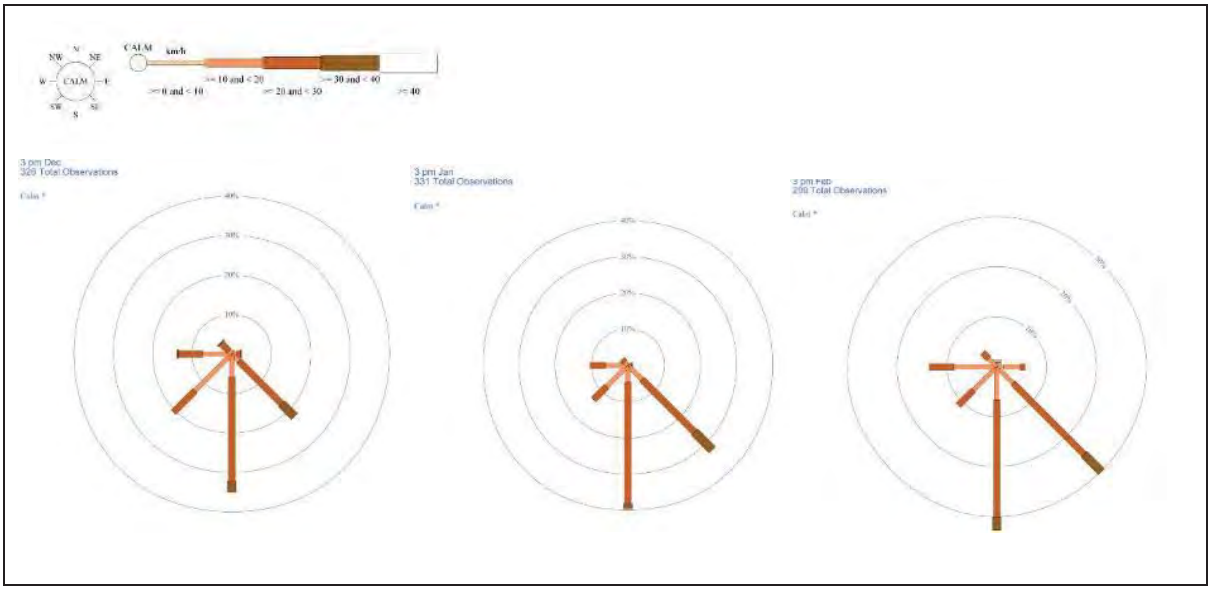


Figure 5: Wind Rose for Witchcliffe in km/h for December, January and February

The combination of hot dry summers, prevailing winds and dry vegetation poses a fire risk and bushfire prevention is considered essential for the protection of life and property and to ensure that frequent and uncontrolled burning does not degrade the vegetation and conservation values of the property.

4.3 Surrounding Landscape & History

The property adjoins agricultural land, with areas to the west and north-east mainly cleared paddock areas with scattered trees. These areas pose a low bushfire risk due to lack of remaining vegetation. To the east and north-west of the property lie greater areas of remnant native vegetation, posing a higher bushfire risk.

The fire risk to people and property within the Site is considered extreme due to the areas of vegetation to be retained within the proposed lots and the vegetation remaining in the land to the north-west and east of the property. By complying with the requirements of this BMP, this risk can be appropriately managed.

5 Bushfire Management Plan

The aim of the Bushfire Management Plan is to reduce the impacts to residents and fire fighters in the event of bushfire within or near the Site.

The Site will need to be developed to incorporate fire management measures outlined within this plan. This includes the following bushfire protection elements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015):

- Location;
- Siting and Design of Development:
- Vehicular Access;
- Water sources and storage; and
- Dwelling Construction Standards.

Maps 5-8 shows the elements of the Bushfire Management Plan as mentioned below.

5.1 Element 1: Location

Intent

To ensure that the development is located in an area with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

Performance Principle

The intent of this element may be achieved where the development is located in an area where the bushfire hazard assessment is or will on completion, be moderate or low, or a BAL-29 or below and the risk can be managed.

Acceptable Solutions

To achieve compliance with this element using an acceptable solution approach, acceptable solutions A 1.1 must be met:

A1.1 – Development Location

The development is located in an area that is, or will be on completion, be subject to either a moderate or low bushfire hazard level or BAL-29 or lower.

Background

Australian Standard (AS) 3959-2009 requires that properties exposed to a potential bushfire risk, be assessed to determine a "Bushfire Attack Level" (BAL). The standard defines BAL as:

> *A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire. (Standards Australia, AS 3959-2009).*

Once assigned, a BAL will determine the appropriate construction requirements for a block or property.

AS 3959-2009 specifies 6 Bushfire Attack Levels (BAL), ranging from Low to Extreme. There are increasing construction requirements ranging from ember protection to direct flame contact protection as the BAL level increases. A BAL assessment determines the appropriate construction requirements for the property. The determination of a property's BAL in accordance with AS 3959 for bushfire prone areas, is a site-specific assessment that

considers a number of factors including the slope of the land, the types of surrounding vegetation and its proximity to other building or structures on the Site. A BAL-LOW rating is considered to be a low bushfire hazard land classification. BAL- 12.5, BAL-19 and BAL-29 ratings are considered to be areas with a moderate bushfire hazard and BAL-40 and BAL-FZ are rated as areas with extreme bushfire hazard levels and these are not normally approved as suitable building sites by the decision-making authorities.

Acceptable Solutions

Assessing bushfire hazards in the landscape requires classification of lots within a minimum of 100m from a bushfire risk. Both lots within the Site have proposed building envelopes which are surrounded by Class A – Forest vegetation. For Proposed Lot 1, the topography is sloping at 4-5° down to the west, therefore the vegetation in this aspect poses the highest risk. For a residential dwelling to achieve a BAL of 29, the setback required from this vegetation needs to be at least 27 m. If clearing of the vegetation with the building envelopes on Proposed Lot 1 is carried out to maintain the required setback, it will be given an indicative rating of BAL-29.

The proposed building envelope of Lot 2 is also surrounded by Class A - Forest vegetation. Due to the slope of 4° down to the south-west, the vegetation in this aspect poses the highest risk. For a residential dwelling to achieve a BAL of 29, the setback required from this vegetation needs to be at least 27 m. If clearing of the vegetation with the building envelopes on Proposed Lot 2 is carried out to maintain the required setback, it will also be given an indicative rating of BAL-29.

It is recommended that the Asset Protection Zone area of any dwelling (as specified in A2.1 below) of each lot be located within the proposed building envelope and ideally, the entire separation distance of 27m be maintained with the building envelope. If this cannot occur, prudent vegetation modification may be required outside of the building envelope to enable sufficient separation. The maximum necessary Asset Protection Zone is illustrated in Map 9. It is recommended, however, that this be minimised wherever possible, ideally by the location of any dwelling in the middle area of the Building Envelope. If modification of vegetation is required, identified hollow bearing trees, as shown on Figure 1, will not be removed. It is possible for these trees to remain within an APZ and still retain the necessary defendable space around a dwelling.

The below tables outline the setbacks required from each vegetation type based on topography:

For Class A - Forest vegetation upslope or flat, the separation distances and BALs are shown in Table 1.

Table 1: BAL Separation Distances Forest Vegetation: Upslope or Flat land.

Veg Class	BAL – FZ (m from veg)	BAL-40 (m from veg)	BAL-29 (m from veg)	BAL-19 (m from veg)	BAL-12.5 (m from veg)
Class A Forest	<16m	16 - <21m	21 - <31m	31 - <42m	42-100m

These separation distances are shown in Map 5.

For Class A - Forest vegetation downslope >0 to 5 degrees, the separation distances and BALs are shown in Table 2.

Table 2: BAL Separation Distances Forest Vegetation: Downslope >0 to 5 degrees.

Veg Class	BAL – FZ (m from veg)	BAL-40 (m from veg)	BAL-29 (m from veg)	BAL-19 (m from veg)	BAL-12.5 (m from veg)
Class A Forest	<20m	20 - <27m	27 - <37m	37 - <50m	50-100m

These separation distances are shown in Map 6.

For Class B -Woodland downslope >0 to 5 degrees, the separation distances and BALs are shown in Table 3.

Table 3: BAL Separation Distances Woodland Vegetation: Downslope >0 to 5 degrees.

Veg Class	BAL – FZ (m from veg)	BAL-40 (m from veg)	BAL-29 (m from veg)	BAL-19 (m from veg)	BAL-12.5 (m from veg)
Class B Woodland	<13m	13 - <17m	17 - <25m	25 - <35m	35-<100m

These separation distances are shown in Map 7.

The areas of the site with a rating of greater than BAL-29 are illustrated in Map 8.

5.2 Element 2: Siting & Design of Development

Intent

To ensure that the siting and design of development minimizes the level of bushfire impact.

Performance Principle

The intent of this element may be achieved where the siting and design of the development, including roads, paths and landscaping, is appropriate to the level of bushfire threat that applies to the site. That it minimizes the bushfire risk to people, property and infrastructure, including compliance with AS 3959 if appropriate.

Acceptable Solutions

To achieve compliance with this element acceptable solution A2.2 must be met to the extent that it satisfies Element 1 - Location.

A2.1 – Asset Protection Zone

Background

The WAPC (2015) states that the Asset Protection Zone (APZ) is a low fuel area immediately surrounding a habitable or specified building, and is designed to minimise the likelihood of flame contact with buildings. All of the requirements prescribed in A2.1 are essential and must be achieved to ensure compliance.

Non-flammable features such as driveways, lawns, landscaped gardens and vegetable patches can form part of the APZs. Isolated trees and shrubs may be retained within APZs.

All APZs should be accommodated within the boundaries of the subject lot, except in situations where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity. The presence of a wall between the bushfire hazard and the site does not alone preclude the need for an Asset Protection Zone (WAPC, 2015).

The size of the APZ from each external wall, supporting post or column of a dwelling needs to be sufficient to provide adequate protection to ensure the potential radiant heat impact of a fire does not exceed 29kW/m^2. The size of the zone is dependent on the adjacent vegetation type and topography, with the distance increasing as the slope increases (WAPC, 2017). Within this site, the APZ will need to be 27 metres from any Class A – Forest which is downslope at >0 to 5 degrees from a dwelling and 21 metres from any Class A – Forest which is upslope or flat in relation to a dwelling. The maximum APZs are illustrated in Map 9. By

placing any dwellings within the centre of the building envelope, the level of vegetation modification outside of the building envelope will be minimize.

Acceptable Solutions

Every building will be surrounded by an APZ, depicted on submitted plans, which meets the following requirements:

a. Width: measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a bushfire does not exceed 29kW/m^2 (BAL-29) in all circumstances;

b. Location: the APZ should be contained solely within the boundaries of the lot on which the building is situated, expect in situations where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, into perpetuity;

c. Fences: within the APZ are constructed from non-combustible materials (eg. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.

d. Objects: within 10 metres of a building combustible object must not be located close to vulnerable parts of the building i.e. windows and doors.

e. Fine Fuel load: combustible dead vegetation matter less then 6mm in thickness reduced to and maintained at an average of two tonnes per hectare.

f. Trees (>5m in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and/or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.

g. Shrubs (0.5m – 5m in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m^2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated at trees.

h. Ground covers (<0.5 m in height): can be planted under trees but must be property maintained to remove dead plant material and any parts within 2 meters of a structure,

but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 100 millimetres in height are to be treated as shrubs.

i. Grass: should be managed to maintain a height of 100 millimetres or less.

Within this development, Asset Protection Zones will meet the acceptable solutions requirements of A2.1.

5.3 Element 3: Vehicular Access

Intent

To ensure that the vehicular access serving a development is available and safe during a bushfire event.

Performance Principle

The intent of this element may be achieved where the internal layout, design and construction of public and private vehicular access and egress in the subdivision/development allow emergency and other vehicles to move through it easily and safely at all times.

Acceptable Solutions

To achieve the intent, all applicable 'acceptable solutions' must be addressed.

A3.1 – Two Access Routes

There is a proposed subdivision that will occur to the north of this site (lot 9500). This will allow primary access through the public road system via Burnside Road and Cusmano Retreat. This will provide access to Caves Road to the north. The proposed lots in lot 126 (the site) will therefore have emergency access in both north and south directions.

Note that there is provision within the approved structure plan, that subdivision of this site cannot occur until these public roads are constructed.

Alternate emergency access for the lots is via an emergency access route running along the east of the lots, which has been constructed during a previous development. This provides wide and clear access to Burnside Road to the north, which is a public road (to be built by the subdivision to the north) and joins Caves Road. To the south, the "old" Burnside Road gravel section between Horseford Road and Caves Rd will eventually be closed to public access however, will remain as an EAW as confirmed by the Shire of Augusta Margaret River. The Shire has also stated that due to this proposed closure, they will not allow the EAW

along the eastern boundary of the site that links Cusmano Retreat to the current Caves Road / Burnside intersection, to be converted into a Public Road

There is also an EAW (within an easement in favour of the Shire) proposed for the subdivision to the north of the site (WAPC ref 150249 lot 9500) that will provide a link between the southern portion of Cusmano Retreat and the "new" Burnside Road exiting via a battleaxe lot's sealed access leg. Under the approved Structure Plan, the subdivision of Lot 126 cannot occur until Cusmano Retreat, the "new" Burnside Road and the EAW are constructed. Map 9 shows a broader landscape overview of the proposed Site and the EAWs within the landscape. An extract from the Bushfire Management Plan relating to the subdivision to the north (lot 9500) is shown as Map 10 which illustrates the additional EAW to the north as well as the location of a water supply tank to be established as part of that subdivision at the intersection of Burnside Road and Horseford Road.

The EAW link in the subdivision to the north between Cusmano Retreat and the "new" Burnside Road has been endorsed and approved by the Department of Biodiversity, Conservation and Attractions which is currently preparing a Conservation Covenant over the bushland immediately north of lot 126 and west of Cusmano Retreat as part of the conditions of the subdivision approval for lot 9500 – the land to the north. The Department has required the EAW to not impact on bushland. The initially contemplated alternative of an EAW alongside the northern boundary of lot 126 (the site) that then heads north alongside Caves Road to the "new" Burnside Road / Caves Road intersection, is also not supported by the DBCA as it would require bushland clearing to the detriment of conservation values. Furthermore, the alignment alongside Caves Road north to the "new" Burnside Road / Caves Road intersection is a winter creek. Construction of an EAW along that alignment would severely compromise environmental values. This also supports Section 6.9 of SPP 3.7 with regards for balancing biodiversity conservation priorities while making bushfire planning decisions. The proposed EAW provides adequate alternative access/egress while not impacting on the conservation values.

It is however a requirement of the subdivision to the north (lot 9500) to establish standard mineral earth boundary firebreaks alongside the northern boundary of lot 126 (the site) and alongside Caves Road north to the "new" Burnside Road and Caves Road intersection when ground conditions permit and before the statutory date for mineral earth firebreak installation.

A3.2 – Public Roads

Public road will be constructed through Cusmano Retreat and the subdivision to the north of the site. Note that part of the approved structure plan for this site, prevents the subdivision of this site until the public roads are constructed. These Public Roads will meet the following requirements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 1:

- Minimum trafficable surface: 6 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres

Caves Road, Burnside Road and all roads to be constructed (Cusmano Retreat) as part of this development are or will be built to public road standards and allow easy access for both vehicles and emergency appliances.

A3.3 – Cul-de-sac

Cusmano Retreat will be constructed as part of this development. While this cul de sac will be 270 m in length, which exceeds the recommended maximum by 70 m, there will be an Emergency Access Way constructed along the southern boundary of the proposed development to the north (WAPC ref: 150249) (shown in Maps 9 and 10). This EAW will be constructed to the standards of the current version of the guidelines and, as the SP states, with passing bays every 200m. There is also an EAW, from the end of Cusmano Retreat that currently exists (Note that this EAW cannot be re-classified as a public road as mentioned above). This EAW meets the current standards and is greater than 10 metres wide, with ample passing width for the full length. Cusmano Retreat does not service more than eight lots and with two EAWs providing multiple safe access and egress opportunities in a bushfire, compliance with A 3.3 can be achieved given the length is shorter than 600m.This cul-de-sac will meet the following requirements as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 2:

- Minimum trafficable surface: 6 metres
- Horizontal clearance: 6 metres

- Vertical clearance: N/A
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres
- The turnaround area requirements include a minimum of 17.5 metre diameter turning head.

A3.4 – Battle-axe

There is a battle-axe driveway allowing access to Proposed Lot 2. While battle axe accessed lots are not preferred in bushfire prone areas, the design is unavoidable given the existing EAW that runs along the eastern boundary of the site. The battle-axe driveway will be constructed to the standards as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 3:

- Trafficable surface: 4 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres;
- Maximum length: 600 metres; and
- Minimum width: six metres.

A 3.5 – Private Driveway Longer Than 50 m

The location of the proposed building envelopes could result in a residential building being more than 50m from a public road. The resulting private driveways will be required to meet

the standards as outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015) Table 4, Column 3:

- required where house site is more than 50 metres from a public road
- Minimum trafficable surface: 4 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 metres
- Maximum grade over <50 metres: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres;
- The driveway must be all weather surface (i.e. compacted gravel, limestone or sealed):
- Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes.
- Passing bays constructed every 200m with a minimum length of 20 m and a minimum width of 2 m (resulting in a combined width of the passing bay and constructed private driveway to be a minimum of 6 metres). An indicative turnaround bay is illustrated in Map 8.

A3.6 – Emergency access ways

There is an existing Emergency Access Way that has been constructed as part of a neighbouring development (Map 8) between the existing Burnside Road and Caves Road intersection and Cusmano Retreat. There is also an additional EAW that will be constructed as part of the development to the north (refer Maps 9 and 10). The development of Lot 126 cannot occur until these roads/accessways are constructed in the subdivision to the north (lot 9500). While the current EAW is marginally above the maximum length stated in the guidelines, it is built to a high standard (all weather gravel surface and in a Crown Reserve greater than 10 m in width). Combined with the other alternative access/egress routes, the development meets the intent and performance principle of this element. These alternative access/egress routes will provide an alternative link to public roads during emergencies and will meet the following requirements as specified in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015):

- Provided as right of way or public access easement in gross to ensure accessibility and fire services during an emergency
- Minimum trafficable surface: 6 metres
- Horizontal clearance: 6 metres
- Vertical clearance: 4.5 meters
- Maximum grades: 1 in 10
- Minimum weight capacity: 15 tonnes
- Maximum crossfall: 1 in 33
- Curves minimum inner radius: 8.5 metres
- Any gates must not be locked, and;
- Must be signposted

A3.8 - Firebreaks

Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three metres or to the level as prescribed in the local firebreak notice issued by the Shire of Augusta-Margaret River.

The 2016/17 Bushfire Order time periods are:

Prohibited Burning Period – 22nd December – 13th March inclusive;

Restricted Burning Period – 9th November – 21st December inclusive & 14th March – 12th May inclusive[1].

The compliance period for the completion of the firebreaks and other fire requirements on Rural lots in the Augusta-Margaret River region is the 1st of December each year and the break must be maintained until the 12th of May. These dates can change due to seasonal fire conditions. If this does occur, changes will be published in the local newspapers. It is the responsibility of the individual property owner to maintain in good order and condition, their firebreaks, gates and property fences.

The Shire of Augusta-Margaret River in their 2016-2017 Fuel Hazard Reduction and Fire Break Notice define a firebreak as:

[1] These dates may be changed due to weather conditions. The Shire of Augusta-Margaret River (9780 5255) or the Bushfire Control Officer (0419 758 452) can provide updated information regarding any changes.

"A strip of land that has been cleared of all trees, bushes, grasses and any other object or thing which may be flammable, leaving a bare mineral earth two (2) metre wide firebreak with a four (4) metre high vertical clearance."

The lot is zoned rural residential. The requirements of this category as per the Shire of Augusta-Margaret 2016-2017 Fuel Hazard Reduction and Fire Break Notice are:

- Asset Protection Zone:
  - Width: 20 metres measured from the external perimeter of the building or as stated in your approved BAL assessment.
  - Location: Within the boundaries of the lot on which the building is situated.
  - Fine Fuel Loads: Reduced and maintained to two (2) tonnes per hectare of fuel loading.
  - Trees: No tall trees are to be within two (2) metres of a building and branches are not to overhang a building within four (4) metres.
  - Shrubs: No tall shrubs or trees are to be located within two (2) metres of a building
- Hazard Separation Zone:[2]
  - Width: a minimum of 80 metres measured from the outer edge of the APZ.
  - Within the boundaries of the lot on which a building is situated.
  - Fine Fuel Load: Reduced and maintained to no more than 8 tonnes per hectare of fuel loading in Jarrah/Marri forest and woodlands and no more than 15 tonnes per hectare of fuel loading in Coastal Heath or Karri Forest.
- Mineral Earth Firebreaks: A minimum 2-metre-wide trafficable firebreak within 100 metres of a boundary abutting a road reserve or as stated in your approved Fire Management Plan and/or approved variation.
- Un-grazed pastureland: Where pastureland is not maintained to 10cm or less, a two (2) metre wide firebreak is required immediately inside all boundaries of the paddock which is not actively grazed.
- Garden refuse, ground fuel and/or wood stacks: A 2 metre fire break is required around all piles of garden refuse and/or wood.

[2] Note as of 20th February 2017, HSZs have been removed as a requirement under SPP 3.7. The ongoing validity of this element should be confirmed with the local government once their planning policies have been updated to reflect the State amendments.

- Fuel and fodder storage areas: A 2 metre firebreak immediately around fuel storage tanks or gas cylinders. 2 metre firebreak no closer than 6 metres around fodder.

During the field visit in July 2015, firebreaks had been maintained around the internal perimeter of the existing lot, apart from the western boundary.

Element 4: Water Sources and Storage.

Intent

To ensure that water is available to the development to enable people, property and infrastructure to be defended from bushfire.

Performance Principle

The development is provided with a permanent and secure water supply that is sufficient for firefighting purposes.

Background

Landowners within this development will be required to supply their own domestic water for potable use and emergency structural firefighting purposes.

Acceptable Solutions

A4.3 Individual lots within non-reticulated areas

The Kilcarnup subdivision area is serviced by two firefighting water supply tanks located on Mentelle Road. The first of these tanks was installed by the developers of the "Burnside at Kilcarnup Estate" in the late 1990's. Subsequently, Mr Mike Bussell, the developer of the Kilcarnup Parklands Estate and proponent of the proposed structure plan installed a further 20,000 gallon (90,000 litre) tank adjacent to the existing tank and upgraded the supply pipe between the pump in the nearby creekline and the tanks.

The two tanks are under the control of the Shire of Augusta – Margaret River and maintained by the Wallcliffe Bushfire Brigade. The tanks and associated infrastructure complies with requirement A 3.2 of Planning for Bushfire protection and are approximately 1km from the site. There are also two other tanks within 1km to 2km from the site respectively being a tank in Horseford Road and a further tank in Freshwater Drive. In addition, reticulated scheme water supplied hydrants are available south of the site in the McHenry Vineyard estate west of Caves road which is also approximately 1km south of the site. The subdivision to the north will also establish an additional water tank for the area at the intersection of Burnside Road and Horseford Road (refer Map 10).

Under the Guidelines of Planning in Bushfire Prone Areas (WAPC, 2015), Acceptable Solutions A4.3 will apply in that a single individual lot over 500 square metres is created and as such each lot will require a dedicated static water supply that has an effective capacity of 10,000 litres for firefighting purposes. Indicative locations are shown in Map 9. A hardstand and turn around area with sufficient area will be installed at the tanks to allow a 3.4 fire appliance to manoeuvre.

The fire suppression requirements for any built asset/dwelling will be documented within the Building Licence application.

5.4 Dwelling Construction

Any dwelling that is to be constructed or additions planned to existing dwellings shall be designed and built to conform with:

- The Shire of Augusta-Margaret River's specifications and requirements;
- Australian Standards AS3959-2009 (Recommendations)- with a BAL-29 rating, construction sections 3 & 7 of AS 3959-2009 apply; with a BAL-19 rating construction sections 3 & 6 of AS 3959-2009 apply; with a BAL 12.5 rating construction sections 3 & 5 apply; and
- The *Homeowners Bushfire Survival Manual* (FESA, 2007) & *Prepare, Act, Survive (*FESA, 2011*)* guidelines.

The owners should note that a low-pitched roof, with closed eaves, metal mesh flyscreens and vent covers will provide optimum safety protection in bushfire prone area.

5.5 Fire-Fighting Facilities

The property is serviced by the Wallcliffe Fire Brigade, which is located in Wallcliffe Road approximately 3 km to the south of the Site. The Wallcliffe Fire Brigade operate a 2.4 appliance, and three Light Tankers for firefighting operations. This is a volunteer brigade and turn out times cannot be assured. The current Fire Control Officer[3] for the area is located Margaret River. The owners should make themselves aware of any changes to this by contacting the Shire of Augusta - Margaret River prior to each fire season or noting changes listed in the Shire of Augusta - Margaret River's Annual Bushfire Notice, which is published and distributed to landowners annually.

[3] As at January 2015, the Chief Fire Control Officer for the location is Rob Bootsma – 0419 525 843, The Deputy Fire Control Officer is David Holland, 0419 628 465). This information should be updated by the owners annually. DoFES Emergency Information Line is 1300 657 209.

It is recommended that representatives from the Wallcliffe Fire Brigade are invited to the property before the start of the fire season so that they are familiar with the internal access areas and firefighting resources (including water supplies), whenever prescribed burning or fire-fighting is conducted in the vicinity of the development.

6 Conclusion.

This plan provides acceptable solutions and responses to the performance criteria outlined in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

The Site contains vegetation within the proposed lots, some areas of which will need to be cleared to provide acceptable separation distance to minimise BAL ratings. Other areas will need to be appropriately managed as per this BMP to reduce risk. The areas of surrounding land include areas of remnant vegetation that pose an extreme fire risk due to a well-developed understorey and high levels of canopy cover over substantial areas. Other surrounding areas have been cleared for agriculture and pose only a low bushfire hazard.

Bushfire safety is a shared responsibility between governments, fire agencies, communities and landowners. The planning and building controls outlined in the plan will reduce the risk of bushfire to people and property. It will not remove all risk however. People interpret risk differently. The way they prepare and maintain their properties, buildings and assets and the actions they take (e.g. evacuate early or stay and defend) greatly influence their personal safety. Should any guests eventuate within the proposed Site, they need to maintain self-reliance and not wait or expect warnings or assistance from emergency services.

7 Summary

7.1 Overall Fire Threat

The design of the proposed expansion and the facilities to be established at the time of development are such that, with the implementation of this Bushfire Management Plan, fire threat to people and property within this development is significantly reduced.

7.2 Landowners' Responsibilities

The landowners' in succession will be responsible for:

- Being aware of the bushfire risk potentially affecting their property, with an understanding that bushfire threat can never be fully removed;
- Reading, understanding and complying with this Bushfire Management Plan;
- Ensuring the ongoing implementation of this Bushfire Management Plan, including providing successive landowners with a copy of this Bushfire Management Plan, and making them aware of the responsibilities outlined in this Bushfire Management Plan;
- Ensure Access ways are maintained as outlined;
- Maintain APZ in a low fuel state in accordance with Appendix 4, Element 2, Schedule 1 of the Guidelines (as summarised in Section 5.2 above);
- Preparing and implementing contingency measures in the event a bushfire should occur onsite;
- The provision of a dedicated static water supply with an effective capacity of 10,000 litres in a location acceptable to the local government, within each of the two lots;
- Responding to and complying with fire protection or hazard management notices issued by the local government;
- Maintaining, in good order and condition, all access gates and property fencing, ensuring that the fence does not encroach over the firebreak; and
- Ensuring that all dwellings are designed and constructed in full compliance with Australian Standards AS3959-2009 (Recommendations) and the requirements of the Shire of Augusta-Margaret River.

7.3 Developer's Responsibilities

The developer shall be required to carry out works that include the points listed below.

- Install all access ways as described.
- Install Asset Protection Zones as described.
- Prepare right of way or easement in gross for Emergency Access Way for all landowners in development.
- Lodging a section 70A Notification on each Certificate of Title proposed by the subdivision. The notification shall alert purchasers of land and successors in Title of the responsibilities of this Bushfire Management Plan.
- Maintaining the existing fire breaks to the required standard until individual lots are sold (when they become the individual lot owner's responsibilities).
- Supply a copy of this Bushfire Management Plan and the Bushfire Survival Manual to each property owner on sale of the allotment. A copy of the approved Bushfire Management Plan must be attached to all Contracts of Sale for the Lot.

7.4 Shire of Augusta-Margaret River's Responsibilities

The responsibility for compliance with the law rests with individual property owner and occupiers and the following conditions are not intended to necessarily transfer some to the responsibilities to the Shire of Augusta-Margaret River.

The Shire of Augusta-Margaret River shall be responsible for:

- Monitoring bush fuel loads in road reserve, public reserves, POS areas and other areas of bushfire risk and maintaining fuel loads at safe levels;
- Maintain public roads to appropriate standards ensuring compliance with standards.
- Developing and maintaining District Fire-Fighting Facilities.
- Maintaining, in good order, the condition of the district water tanks and fire hydrants and the apparatus for firefighting purposes.
- Enforcement of the Annual Firebreak Notice.
- Provision of fire prevention and preparedness advice to landowners upon request.

8 Compliance Checklist

The following comprises the completed checklist for performance criteria and acceptable solutions as stipulated in Guidance Statement B2 of *Planning for Bushfire Protection*.

Element			
1: Location	**Yes**	**No**	**Comment**
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	✓		
2: Siting and design of development	**Yes**	**No**	**Comment**
Does the proposal comply with the performance criteria by applying acceptable solution A2.1	✓		
3: Vehicular access	**Yes**	**No**	**Comment**
Does the proposal comply with the performance criteria by applying acceptable solution A3.1	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.2	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.3	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.4	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.5	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.6	✓		
Does the proposal comply with the performance criteria by applying acceptable solution A3.7			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.8	✓		
4: Water sources and storage	**Yes**	**No**	**Comment**
Does the proposal comply with the performance criteria by applying acceptable solution A4.1			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A4.2			N/A
Does the proposal comply with the performance criteria by applying acceptable solution A4.3	✓		

Applicant Declaration

This Bushfire Management Plan meets the requirements of SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015).

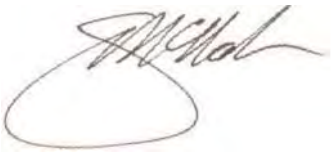
I declare that the information proposed within this plan is true and correct to the best of my knowledge.

Gary McMahon (B.Sc. M. Env Mgmt PG Dip Bushfire Protection)

for Ecosystem Solutions Pty Ltd.

BPAD Level 3. No. 35078

19th January 2018



BPAD
Bushfire
Planning & Design
Accredited Practitioner
Level 3

9 References

DFES (2015). *Map of Bush Fire Prone Areas.* Department of Fire and Emergency Services. [available at www.dfes.wa.gov.au/bushfireproneareas].

FESA, WAPC & Dept of Planning (2010). *Planning for Bushfire Protection*. Edition 2. May, Government of Western Australia, Perth. WA.

FESA (2012). *Visual Fuel Load Guide for Scrub Vegetation of the Swan Coastal Plain and Darling Scarp, including Geraldton Sandplains & Leeuwin Ridge Regions of Western Australia*. Bushfire and Environmental Protection Branch, Fire and Emergency Services Authority of Western Australia.

WAPC (2015). *Guidelines for Planning in Bushfire Prone Areas. Version 1.0 December 2015.* Western Australian Planning Commission, Perth. WA.

WAPC (2015a). *State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7)*. Western Australian Planning Commission, Perth. WA.

WAPC (2015). *Guidelines for Planning in Bushfire Prone Areas. Version 1.1 Updated February 2017.* Western Australian Planning Commission, Perth. WA.

10 Glossary

AS 3959: Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas.

Asset Protection Zone (APZ): A low fuel area immediately surrounding a building.

BAL: Bushfire Attack Level (BAL) as set out in the Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959), as referenced in the Building Code of Australia (as amended).

BAL Assessment: An assessment prepared in a manner and form set out in AS 3959 to determine a BAL. It is strongly recommended that BAL assessments are prepared by accredited Level 1 BAL Assessors, unless otherwise exempted in these Guidelines.

BAL Contour Map: A BAL Contour Map is a scale map of the subject lot/s illustrating the potential radiant heat impact and associated indicative BAL ratings in reference to any classified vegetation remaining within 100 metres of the assessment area after the development is complete. The intent of the BAL contour map is to identify land suitable for development based on the indicative BAL rating. It is strongly recommended that BAL Contour Maps are prepared by an accredited Bushfire Planning Practitioner.

Bushfire: An unplanned fire burning in vegetation. A generic term which includes grass fires, forest fires and scrub fires not with and without a suppression objective.

Bushfire hazard: The potential or existing flammability of vegetation that, in association with topography and slope, when ignited may cause harm to people and/or damage property and/or infrastructure.

Bushfire Hazard Level (BHL) assessment: A BHL assessment provides a measure of the likely intensity of a bushfire and the likely level of a bushfire attack on a site determined by categorising and mapping land as having a low, moderate or extreme Bushfire Hazard Level in accordance with the methodology set out in the Guidelines. It is strongly recommended that Bushfire Hazard Level assessments are prepared by an accredited Bushfire Planning Practitioner.

Bushfire Management Plan (BMP): A document that sets out short, medium and long term risk management strategies for the life of the development. It is strongly recommended that Bushfire Management Plans are prepared by accredited Bushfire Planning Practitioners in accordance with

the requirements set out in the Guidelines on behalf of the landowner/proponent with the assistance of the responsible authority for emergency services where required.

Bushfire Planning Practitioner: A person who holds Level Two or Level Three accreditation under the Western Australian Bushfire Association Framework.

Bushfire prone area: An area that has been designated by the Fire and Emergency Services Commissioner under s. 18P of the Fire and Emergency Services Act 1998 as an area that is subject, or likely to be subject, to bushfires. Such areas are identified on the Map of Bush Fire Prone Areas and can be found on the Department of Fire and Emergency Services website.

Bushfire Protection Criteria: A performance based system of assessing bushfire risk management measures contained in the Guidelines and applied to all strategic planning proposals, subdivisions and development applications.

Bushfire risk: The chance of a bushfire igniting, spreading and causing damage to people, property and infrastructure.

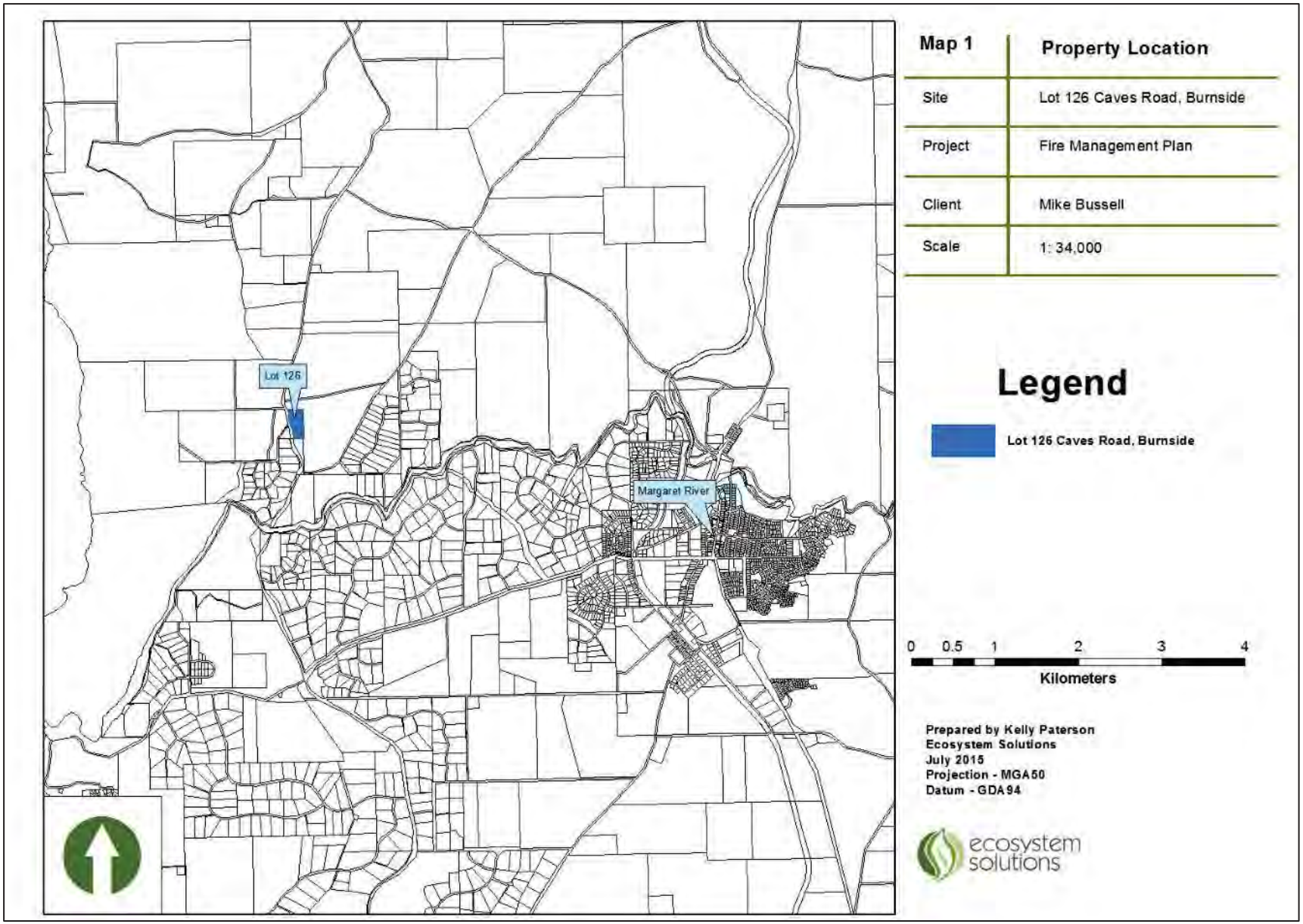
Bushfire risk management: Means the application of the bushfire protection criteria contained in the Guidelines.

Development application: An application for approval to carry out development or change a land use under either a local planning scheme or region planning scheme. This includes local development plans but excludes application for single houses and ancillary dwellings on a lot or lots less than 1,100m^2.

Guidelines: Refers to the Guidelines for Planning in Bushfire Prone Areas (WAPC 2015), as amended.

WAPC: Western Australian Planning Commission.

11 Maps


Lot 126
Margaret River
Map 1
Property Location
Site
Lot 126 Caves Road, Burnside
Project
Fire Management Plan
Client
Mike Bussell
Scale
1: 34,000
Legend
Lot 126 Caves Road, Burnside
0 0.5 1 2 3 4
Kilometers
Prepared by Kelly Paterson
Ecosystem Solutions
July 2015
Projection - MGA50
Datum - GDA94
ecosystem solutions


Cusmano Retreat
Lot 1
Lot 2
Caves Road
Map 2
Site Layout
Site
Lot 126 Caves Road, Burnside
Project
Fire Management Plan
Client
Mike Bussell
Scale
1: 1,560
Legend
Proposed Lot Boundaries
Proposed 200m2 Building Envelopes (Indicative)
0 20 40 80 120 160
Metres
Prepared by Kelly Paterson
Ecosystem Solutions
Updated April 2017
Projection - MGA50
Datum - GDA94
The details on this map have not been surveyed and are indicative only.
This map is for planning/discussion purposes only.
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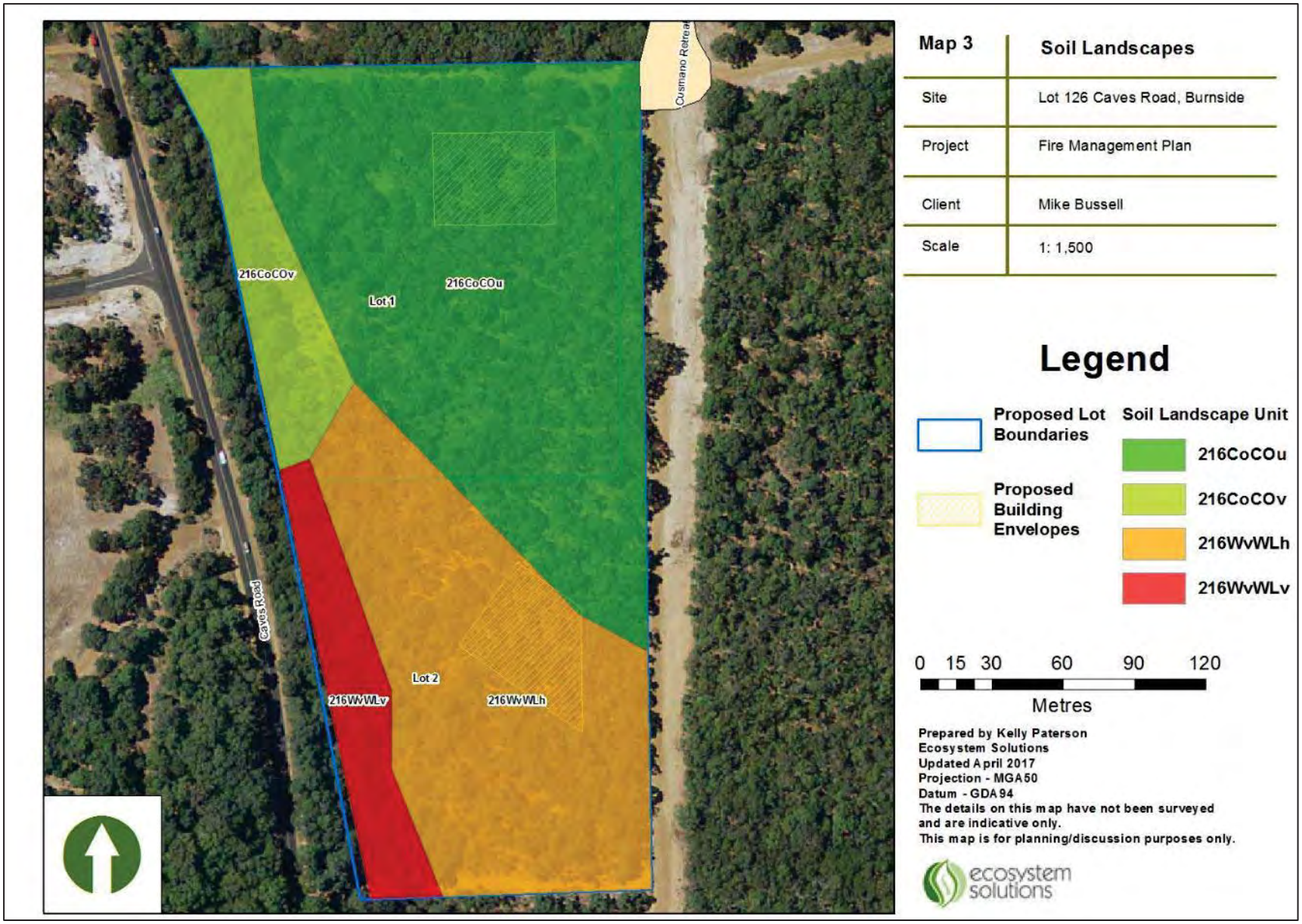
Cusmano Retreat
216CoCOv
216CoCOu
Lot 1
Caves Road
Lot 2
216WvWLv
216WvWLh
Map 3
Soil Landscapes
Site
Lot 126 Caves Road, Burnside
Project
Fire Management Plan
Client
Mike Bussell
Scale
1: 1,500
Legend
Proposed Lot Boundaries
Proposed Building Envelopes
Soil Landscape Unit
216CoCOu
216CoCOv
216WvWLh
216WvWLv
0 15 30 60 90 120
Metres
Prepared by Kelly Paterson
Ecosystem Solutions
Updated April 2017
Projection - MGA50
Datum - GDA94
The details on this map have not been surveyed and are indicative only.
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Map 4
Vegetation Classification
Site
Lot 126 Caves Road, Burnside
Project
Fire Management Plan
Client
Mike Bussell
Scale
1: 1,455
Legend
Proposed Lot Boundaries
Vegetation Classification
Elevation (m) AHD
Class A - Forest
Proposed Building Envelopes
Class B - Woodland
Excluded
0 15 30 60 90 120
Metres
Prepared by Kelly Paterson
Ecosystem Solutions
Updated April 2017
Projection - MGA50
Datum - GDA94
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ecosystem solutions
Lot 1
Lot 2
Caves Road

Map 5	Forest Upslope/ Flat BAL Contour
Site	Lot 126 Caves Road, Burnside
Project	Fire Management Plan
Client	Mike Bussell
Scale	1: 1,455

Legend

- Proposed Lot Boundaries
- Elevation (m) AHD
- Proposed Building Envelopes

Forest Upslope/ Flat BAL Contour

- 0-<16m: BAL-FZ
- 16-<21m: BAL-40
- 21-<31m: BAL-29
- 31-<42m: BAL-19
- 42-<100m: BAL-12.5

Prepared by Gary McMahon
Ecosystem Solutions
Updated Jan 2018
Projection - MGA50
Datum - GDA94
The details on this map have not been surveyed and are indicative only.
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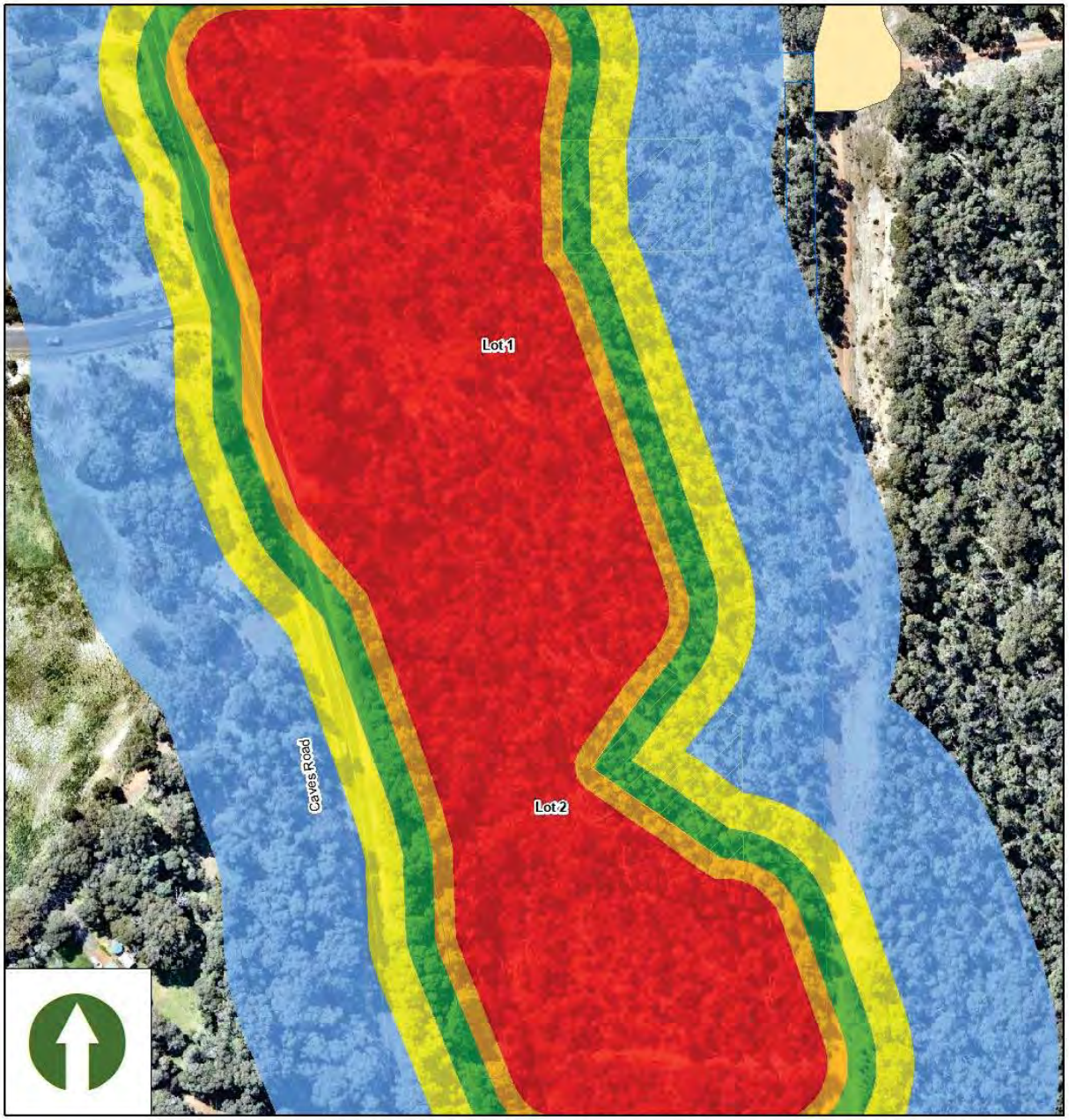
0 15 30 60 90 120

Metres

ecosystem solutions



Map 6	Forest Downslope 0 to 5 degrees BAL Contour
Site	Lot 126 Caves Road, Burnside
Project	Fire Management Plan
Client	Mike Bussell
Scale	1: 1,455

Legend

Proposed Lot Boundaries

Elevation (m) AHD

Proposed Building Envelopes

Forest Downslope >0 to 5 degrees BAL Contour

- 0-<20m: BAL-FZ
- 20-<27m: BAL-40
- 27-<37m: BAL-29
- 37-<50m: BAL-19
- 50-<100m: BAL-12.5

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Ecosystem Solutions
Updated Jan 2018
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0 15 30 60 90 120

Metres

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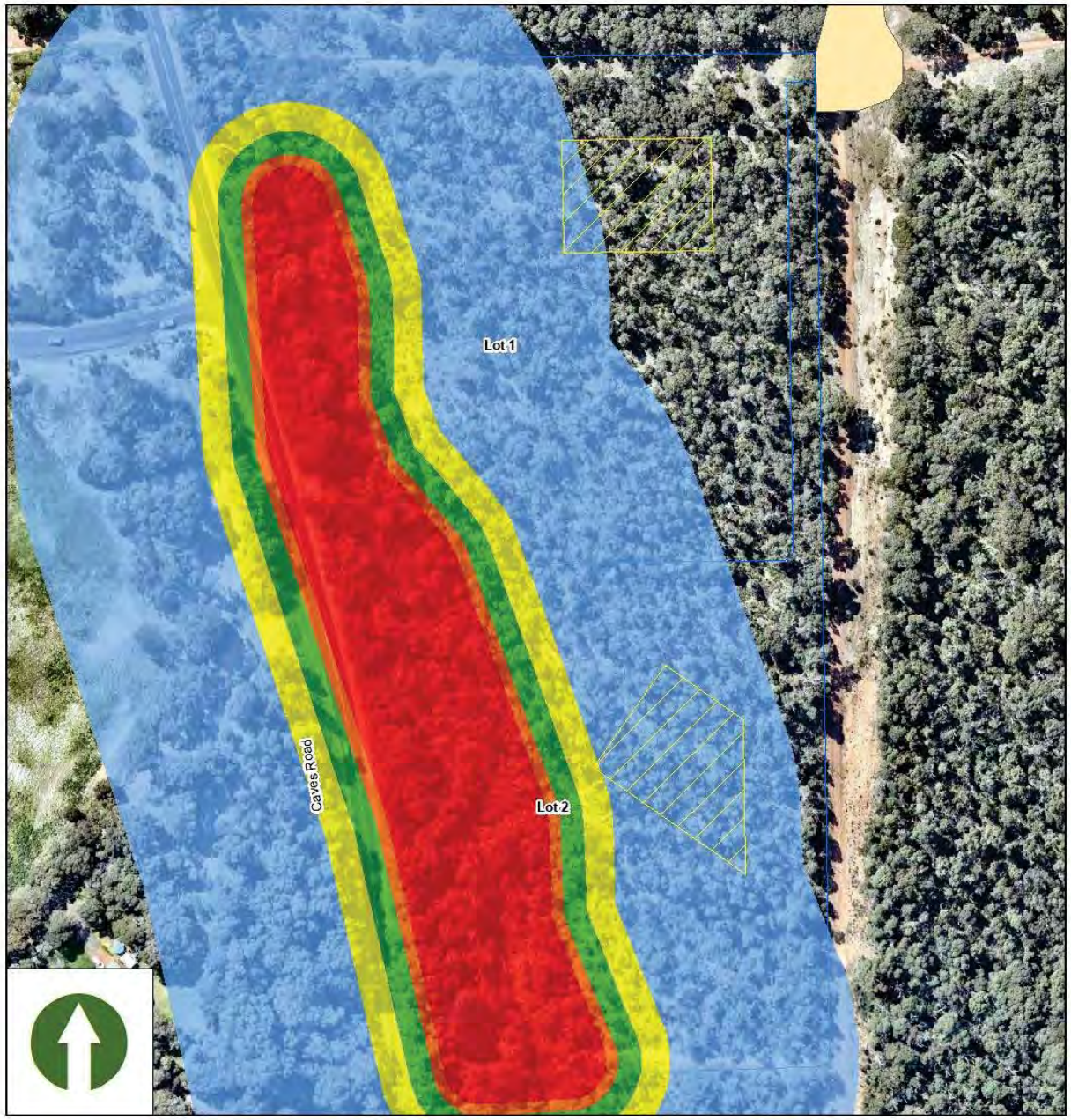

Map 7	Woodland Downslope 0 to 5 degrees BAL Contour
Site	Lot 126 Caves Road, Burnside
Project	Fire Management Plan
Client	Mike Bussell
Scale	1: 1,455

Legend

Elevation (m) AHD

Proposed Building Envelopes

Proposed Lot Boundaries

Woodland Downslope >0 to 5 degrees BAL Contour

- 0-<13m: BAL-FZ
- 13-<17m: BAL-40
- 17-<25m: BAL-29
- 25-<35m: BAL-19
- 35-<100m: BAL-12.5

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Ecosystem Solutions
Updated Jan 2018
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Datum - GDA94
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0 15 30 60 90 120

Metres

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Map 8	Bushfire Management Plan Elements
Site	Lot 126 Caves Road, Burnside
Project	Fire Management Plan
Client	Mike Bussell
Scale	1: 2,500

Legend

- Watertank (indicative)
- EAW
- Proposed
- Current
- Roadways
- Proposed Lot Boundaries
- Proposed Building Envelopes
- Elevation (m) AHD
- Driveway Access
- Maximum Asset Protection Zone
- Area greater than BAL29
- Turn Around Bay (Indicative)

Prepared by Gary McMahon
Ecosystem Solutions
Updated Feb2018
Projection - MGA50
Datum - GDA94
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0 25 50 100 150 200
Metres

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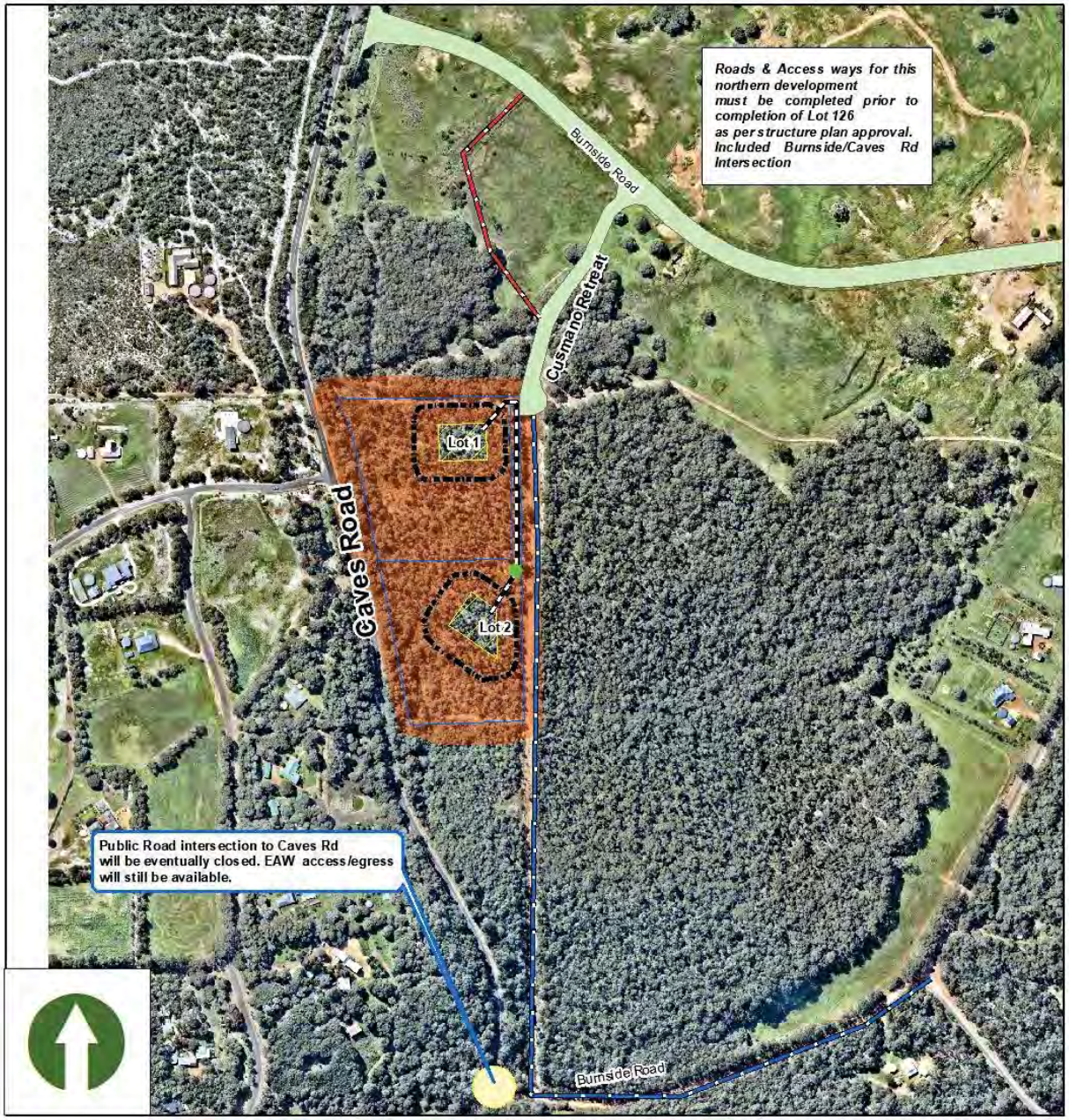

Map 9	Access Ways (Landscape)
Site	Lot 126 Caves Road, Burnside
Project	Fire Management Plan
Client	Mike Bussell
Scale	1: 4,000

Roadways
Proposed Lot Boundaries
Proposed Building Envelopes
Elevation (m) AHD
Driveway Access
Maximum Asset Protection Zone
Area greater than BAL29
Turn Around Bay (Indicative)
EAW
Proposed
Current

Prepared by Gary McMahon
Ecosystem Solutions
Updated Feb2018
Projection - MGA50
Datum - GDA94
The details on this map have not been surveyed and are indicative only.
This map is for planning/discussion purposes only.

0 40 80 160 240 320
Metres

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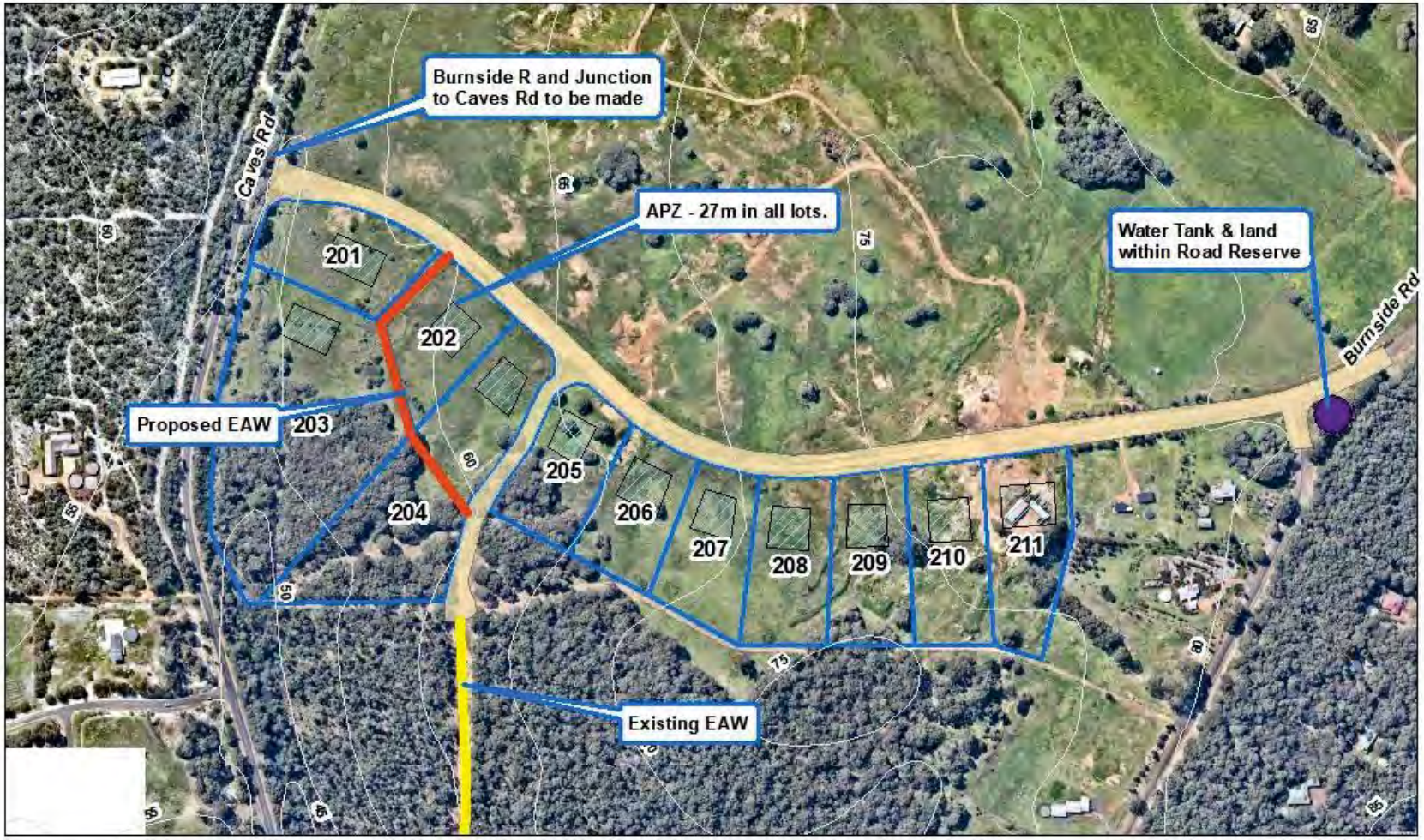

Map 10: Bushfire Plan Elements Project Address: Lot 9501 Burnside Rd Margaret River

Projection - MGA50
Datum - GDA94
November 2017
Prepared by G McMahon
17434

N

Scale: 1:6,000

0 20 40 80 120 160 Meters

Proposed Lots
Roadways
Elevation (m)

Access
Proposed EAW
Existing EAW
Strategic Water Supply

ecosystem solutions
www.ecosystemsolutions.com.au
(08) 9759 1960

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APPENDIX D

Significant Flora/Vegetation & Fauna Assessment

Prepared by Ecosystems Solutions

Report

Lot 126 Caves Road Burnside

Significant Flora/Vegetation & Fauna Assessment

Prepared by

ECOSYSTEM SOLUTIONS PTY LTD

A.B.N. 19115287593

For

Glenn Yeatman

Principal Scientist/Team Leader

RPS Australia Asia Pacific

13th April 2015

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No express or implied warranties are made by Ecosystem Solutions Pty Ltd regarding the findings and data contained in this report. No new research or field studies were conducted other than those specifically outlined in this report. All of the information details included in this report are based upon the research provided and obtained at the time Ecosystem Solutions Pty Ltd conducted its analysis.

In undertaking this work the authors have made every effort to ensure the accuracy of the information used. Any conclusions drawn or recommendations made in the report are done in good faith and the consultants take no responsibility for how this information and the report are used subsequently by others.

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Contents

1. Introduction

The owner of Lot 126 Caves Road, Burnside, in the Shire of Augusta Margaret River (hereafter referred to as the Study Area), is looking at opportunities to develop the site into two rural residential lots.

As part of the identification of any constraints on the property, Ecosystem Solutions were contracted to investigate and report on the presence of any significant flora, fauna, communities and vegetation within the proposed areas.

This report provides the results of these assessments and provides advice regarding the potential impacts on the fauna, flora and vegetation from the proposed development.

The objectives for these assessments were to:

- Conduct a desktop review of the fauna, flora and vegetation of conservation significance likely to occur in the study area:
- Conduct a field survey to determine the presence of any significant fauna within the survey area;
- Conduct a field survey to determine the floristic composition of the survey area, including the occurrence of any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs), Environmentally Sensitive Areas (ESAs) or other vegetation of conservation significance;
- Describe and map the vegetation communities present and their condition;
- Map the occurrence of any fauna, flora or communities of conservation significance; and
- Produce a report integrating the findings from the desktop review and field surveys and consider if any impacts from the development may necessitate a referral under the *Environmental Protection and Biodiversity Conservation Act* (EPBC Act). A significant impact on any of the matters of National Environmental Significance would require a referral to the Department of Environment (DoE).

This report outlines the methodology and results of these surveys and summarises the findings of each of these parameters.

2. Site Details

The Site is located with the Shire of Augusta-Margaret River, approximately 5kms west of the Margaret River town site (Map 1). It is situated to the east of Caves Road and is accessible off Burnside Road, via an Emergency Access Way that runs along the eastern edge of the location. The Study Area is a 5.5 ha area of native vegetation within an agricultural landscape that is highly cleared of vegetation (Map 1). The Study Area slopes down towards the south west, with the highest point being the north east corner at approximately 65 m above sea level Australian Height Datum (AHD). The lowest area is the south west along a creek line section that sits at approximately 45m AHD.

3. Flora and Vegetation.

3.1. Landscape, Soils & Vegetation

Soil-Landscape systems are areas with recurring patterns of landforms, soils and vegetation and are used by the Department of Agriculture to maintain a consistent approach to land resource surveys.

The Study Area is within the Leeuwin Soil-Landscape Zone which is underlain by the Leeuwin Complex of granites and gneiss. Over this has formed the lateritic plateau of the Cowaramup Uplands system which has been dissected by a number or relatively shallow, undulating valleys collectively known as the Wilyabrup Valleys (Tille and Lantzke, 1990). There are four individual soil-landscape types within the Study Area, however they fall within two of the broader landscape systems defined by Tille and Lantzke (1990): The Cowaramup Upland System and the Willyabrup Valley System (Map 2). These are described as:

- *Cowaramup Upland System (216 Co) – Lateritic plateau in the Leeuwin Zone with sandy gravel, loamy gravel and grey sandy duplex soils. Principal vegetation is Jarrah-Marri forest.*
- *Wilyabrup Valleys System (216 Wv) – Granitic Valleys in the Leeuwin Zone with loamy gravel, sandy gravel and loamy earths. Jarrah-Marri forest dominate.*

The mapping of Havel and Matiske (2000) categorises four vegetation complexes within the Study Area, (Map 3):

- Cowaramup (Cd) -Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia ilicifolia* on sandy rises and low woodland of *Melaleuca preissiana* on lower slopes in the hyperhumid to humid zones. This is the only vegetation type in the lots west of Caves Road.
- Cowaramup (C1) - Open to tall Open Forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in the hyperhumid zone.
- Wilyabrup (W1) - Tall Open Forest of *Eucalyptus diversicolor-Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in the hyperhumid zone.
- Wilyabrup (Ww1) - Tall Open Forest of *Eucalyptus diversicolor-Agonis flexuosa-Callistachys lanceolata* with some *Corymbia calophylla* on flats and valleys in the hyperhumid zone.

Comparing the current extent to the pre-European extent of each of these complexes, the following percentages remain (WALGA, 2007):

- Cowaramup (Cd) – 64% remaining;
- Cowaramup (C1) – 37% remaining;
- Wilyabrup (W1) – 60% remaining; and
- Wilyabrup (Ww1) – 59% remaining.

4. Flora, Vegetation and Community Survey

4.1. Objectives

To assess the flora and vegetation of the site with regard to its conservation value and report on these.

4.2. Methods

An extract from the Department of Parks and Wildlife (DPAW) Nature Base Database was obtained to determine if records of any rare or threatened flora are known within the boundary or vicinity of the site. A preliminary reconnaissance survey of the results of the desktop study was conducted, consistent with a Level 1 Flora and Vegetation Survey (EPA, 2004).

The Study Area was surveyed on 21st and 24th April 2015 by Gary McMahon (B.Sc. M.

Env Mgmt) and Kelly Paterson (B.Sc. (Hons)) from Ecosystem Solutions. The site was walked in a systematic manner to cover all of the area. Zones with consistent vegetation structure and composition were noted and the main species in each of the strata were identified and recorded using a revele style survey. The vegetation condition of the vegetation based on Keighery (1994) was also recorded using Global Positioning System (GPS). Vegetation communities and condition maps were prepared.

The Study Area was also inspected for flora species of significance and Threatened Ecological Communities, based on the DPaW database records.

The vegetation was assessed using the releve method whereby the following information was collected at unmarked survey sites;

- GPS coordinates,
- Dominant or important plant species within approximately 10 m radius of the observer,
- Notes on vegetation structure using the method of Muir (1977),
- Vegetation condition score (Keighery, 1994),
- Surface soil texture and colour.

4.3. Declared Rare and Priority Flora

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. DPAW recognizes these threats of extinction and consequently applies regulations towards population and species protection. Declared Rare Flora species are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act (1950) and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Wildlife Conservation Act (1950-1980) defines "to take" as "… to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means" (Government of Western Australia, 2010).

Priority List Flora are under consideration for declaration as "rare flora", but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the Wildlife Conservation Act (1950) (Department of Environment and Conservation, 2010a).

Table 1 : Rare and Priority Flora Categories

CONSERVATION CODE	CATEGORY
R	"Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.'
P1	"Taxa which are known from one or a few (generally <5) populationswhich are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P3	"Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey."
P4	"Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

4.4. Results and Discussion

4.4.1. Native Flora

Seven rare or priority flora species are listed as being within 5 kilometres of the Study Area (Table 2).

Table 2: Rare and Priority Flora within 5 km of the site.

SPECIES	STATUS	LIFE FORM	HABITAT
Caladenia excelsa	DRF	Herb	White, grey or brown sands, sandy loams
Caladenia lodgeana	DRF	Herb	Black Loamy soils
Gastrolobium formosum	P3	Shrub	Clay loams, along river banks or in swamps
Pultenaea pinifolia	P3	Shrub	Loams or clary, floodplains, swampy areas.
Acacia tayloriana	P4	Prostrate shrub	Grey, yellow/orange sandy soils, winter wet areas.
Bossiaea disticha	P4	Shrub	Sandy soils over limestones
Gahnia scleroides	P4	Sedge	Sandy soils, creeklines and winter wet areas.

None of these species were identified during the field surveys within the Study Area, While a spring flora survey was not conducted as part of this survey, which means that *Caladenia* species would not be observable, the known nearby populations are on

road reserve areas and there are no plans with this development to disturb the vegetation along Caves Road side of the Study Area. This also includes fire breaks along the proposed western edge of the development as the Shire of Augusta Margaret River have approved a variation from their Firebreaks requirements due to the high potential for erosion should the vegetation be removed along this boundary. The full details of this exemption are included in the approved Fire Management Plan for the site and the adjoining areas west of Caves Road (Ecosystem Solutions, 2015).

4.4.2. Vegetation Communities

Finer scale mapping of the broad communities revealed two main vegetation types within the Study Area (Map 4). Dominant species at each stratum were identified to determine the different vegetation communities.

Note that the vegetation within the Study Area was significantly impacted by the November 2011 bushfires that occurred in the Margaret River/Kilcarnup area. The tree species all had scorch marks up over 5m in their trunks (Figure 1) and the understory areas were dominated by dense areas of primary coloniser species such as *Acacia pulchella* and *A. divergens*. This made differentiating the communities difficult, however the indicative break in the communities is shown in Map 4.

The vegetation types are described below using the structural classification of Muir (1977).

- Vegetation Community 1 (4.93 ha) (Figure 2) –Open Woodland of *Corymbia calophylla*, over Low Woodland of *C. calophylla*, over Tall Shrubland of *C. calophylla* and *Agonis flexuosa*, over Open Heath of *Xanthorrhoea preissii*, *Acacia pulchella* and *A. divergens*, over Low Shrubland of *Hovea chorizemifolia, Hibbertia hypericoides, A. flexuosa and Kennedia spp* over Very Open Grassland of annual pasture grasses and *Briza* spp.
- Vegetation Community 2 (0.58 ha) (Figure 3) – Scattered Trees of *Corymbia calophylla*, over Low Open Forest of *C. calophylla* and *Agonis flexuosa*, over Tall Shrubland of *Callistachys lanceolata* and *A. flexuosa*, over Open Shrubland of **Solanum nigrum* and **Rubus spp*., over Low Open Woodland of **Rubus spp*, over Sedgeland of *Lepidosperma gladiatum* and *Juncus spp*, over grassland of annual pasture grasses, with scattered climbers of *Hardenbergia comptoniana*.

Utilising the scale of condition developed by Keighery (1994, Table 3), most of the areas with native vegetation would be considered as Very Good, despite the impact of the recent fire event. This classification is reached due to the presence of good structural diversity, albeit dominated by primary colonisers. There is a small section on the southern edge of the creekline vegetation that would be classified as Degraded due to the abundance of weed species such as blackberry and nightshade. While a number of trees appear to have been killed from the fire, most are regenerating with strong epicormic growth throughout the Study Area. Vegetation conditions is shown in Map 5.

Table 3: Keighery Condition Scale.

Category	Description
Pristine	Pristine or nearly so, no obvious signs of destruction.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. For example damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle track.
Very Good	Vegetation structure altered, No obvious signs of disturbance. For example disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate to it. For example disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration, but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation in no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora composing weed or crop species with isolated native trees or shrubs.

(Keighery. 1994).

5. Fauna

5.1. Objectives

The objective of this survey was to identify significant fauna or signs of significant fauna, including Western Ringtail Possum and Black Cockatoo species, within the Study Area.

5.2. Methodology

A desktop study and analysis of the records of DPAW and the WA Museum (Nature Map) were made to determine the presence or likely presence of fauna or faunal assemblages at the property. The analysis primarily targeted threatened vertebrate species listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the Western Australian Wildlife Conservation Act (WA) 1950 (WC Act).

With these species in mind, a field study of the site was conducted. The approach adopted for this survey follows.

- A LandSat Satellite Image of the property was acquired from Landgate (previously Department of Land Information).
- A day time visual inspection of the property and adjoining vegetation for any signs of fauna (e.g. scats, diggings, dreys, nests, burrows, feeding signs) was conducted. Note that this occurred over two days due to the density of the vegetation.
- Hollow bearing trees or trees suitable for black cockatoos were marked with an aluminium id tag and details recorded.
- Direct observations of fauna and signs of fauna were recorded using a Trimble GPS and Arcpad © (Version 9 ESRI, 2013).
- Two non-consecutive night time spotlight surveys were conducted to determine fauna activity. A 40 w LightForce hand-held spotlight was used with white light. Observations were recorded using GPS and ArcPad ©.
- A two pre-dawn and sunset surveys was conducted to determine Black Cockatoo activity.
- Field observations were analysed and mapped with ArcGis (ArcMap V10.3©).

This type of survey has minimal impact on the fauna within the property and provides sufficient data on the presence and relative abundance and distribution of taxa. During the field surveys, the habitat at the site was assessed to determine its potential

suitability to host any of the anticipated threatened or rare species. This approach is consistent with a Level 1 survey under the EPA's Guideline No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004) which specifies a minimum requirement of a background research or desktop study to gather information on the subject site and a reconnaissance survey to verify the accuracy of the background study and delineate fauna and faunal assemblages.

The survey's protocol is also consistent with the requirements outlined in the Development Planning Guidelines for Western Ringtail Possums (CALM 2003).

Guidelines for the three black cockatoo species (Department of Sustainability, Environment, Water, Populations and Communities, 2011) outline requirements for appropriate level of surveys for these species. This survey's intensity and design comply with these guidelines.

5.3. Fauna

5.3.1. Conservation Significant Fauna

The conservation status of fauna within Western Australia is determined by criteria outlined within two acts of legislation: the Environmental Protections and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the State-based Western Australian Wildlife Conservation Act (WA) 1950 (WC Act).

Under Section 179 of the EPBC Act, fauna may be listed in one of the following categories (in decreasing degree of threat of extinction):

- Extinct;
- Extinct in the wild;
- Critically Endangered;
- Endangered;
- Vulnerable; and
- Conservation Dependant.

These categories are consistent with the International Union for Conservation of Nature (IUCN) classifications and therefore link into a global ranking system for taxa at risk of extinction.

The WC Act also uses these categories, but uses a set of schedules to define extinction risk (Table 4).

Table 4: Conservation Categories in the Wildlife Conservation Act (WA) 1950.

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct.
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

The Department of Parks and Wildlife also produce a supplementary list of possible threatened species that do not meet the criteria for listing in the above categories. These species are not considered threatened under the WC Act, but due to a lack of knowledge or where species are poorly represented in conservation reserves, some concern for their long term survival exists. Table 5 shows the priority classifications.

Table 5: Priority Classifications used in WA.

Category	Code	Description
Priority 1	P1	Taxa with a few, poorly known populations on lands not managed for conservation (e.g. agricultural lands, urban areas etc.).
Priority 2	P2	Taxa with few, poorly known populations on conservation lands (e.g. national parks, nature reserves etc.).
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands, but where known threats could affect them.
Priority 4	P4	Rare, near threatened and other species in need of monitoring.
Priority 5	P5	Conservation Dependant species: species that are not threatened, but are subject to a specific conservation project that if stopped, would result in the species becoming extinct within 5 years.

The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

The conservation status of all vertebrate species listed as occurring within, near or likely to occur within the property, were assessed using the most recent lists of the relevant legislation and DPAW priority lists (current as at 3/12/2014).

5.3.2. Expected Fauna

A list of fauna expected to occur within a 5 km radius of the property was compiled from searches conducted on the WA Museum database and DPAW fauna database (Nature Maps), the Department of Environment (DoE) websites, Commonwealth EPBC database and the Birds Australia Atlas project database.

The results of the native fauna database search for species likely to still be within or utilise the Study Area include:

- *Calyptorhynchus baudinii* (Baudin's White Tailed Black Cockatoo - Vulnerable (Cwth) & Schedule 1 (WA);
- *Calyptorhynchus latirostris* (Carnaby's White Tailed Black Cockatoo - Endangered (Cwth) & Schedule 1 (WA);
- *Pseudocheirus occidentalis* (Western Ringtail Possum) (Endangered-Cwth) & Schedule 1 (WA);
- *Phascogale tapoatafa* subsp. *tapoatafa* (Southern Brush-tailed Phascogale, Wambenger) (P3-WA);
- *Macropus irma* (Western Brush Wallaby) (P4-WA);
- *Isoodon obesulus* subsp. *fusciventer* (Southern Brown Bandicoot, Quenda) (P5-WA).

Other species listed that, due to the quality of the remaining habitat, are unlikely to utilise the site are:

- *Dasyurus geroffroii* (Chuditch) - Vulnerable (Cwth) & Schedule 1 (WA);
- *Myrmecobius fasiatus (*Numbat) - Vulnerable (Cwth) & Schedule 1 (WA);
- *Setonix brachyurus* (Quokka) – (Vulnerable – Cwth);

One bird species, protected under international agreements, have been historically found within the 5 km radius of the Study Area (Marine Bird species, such as Albatross and Petrels have been excluded as the Study Area does not have habitat for these species):

- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)

5.3.3. Limitations

Field surveys were confined to a two day surveys with two pre-dawn and two dusk surveys for black cockatoos and a two non-consecutive night surveys for other fauna. No seasonal survey work was conducted. The night surveys were conducted with two experienced operators on foot, utilising a head torch and a hand-held spotlight, therefore it is likely that not all animals potentially present were observed.

The site was traversed by foot in a systematic way, however it was not possible to examine every tree for evidence of fauna, and therefore the listing of foraging evidence found will only present a subset of the actual evidence that is present for the site.

All large trees of suitable size were examined from the ground for the presence of hollows. It should be noted however, that all of the prerequisites that determine the suitability of a hollow for use by cockatoos are difficult to assess. In addition to entrance size, the depth, floor and orientation of the hollow are important factors. The presence of suitable hollows, even in breeding areas, does not make them available for breeding as hollows must be spatial, structurally and temporally correct (Johnstone and Johnston, 2004). The listing of potential nesting hollows is therefore likely to be an over estimation of those actually suitable.

5.4. Results

The Study Area was surveyed on 21st and 24th April 2015 by Gary McMahon (B.Sc. M. Env Mgmt) and Kelly Paterson (B.Sc. (Hons)) from Ecosystem Solutions. The site was traversed on foot, in a systematic fashion to cover all the areas suitable for habitat.

Two areas of bandicoot diggings were observed during the two day field survey events (Map 6). No signs of Black Cockatoo feeding or roosting were observed, however the density of the *Acacia* regrowth in the lower canopy made detailed survey for food sign difficult.

All trees with large hollows were inspected for any signs of use by cockatoos. These include wear around the hollow, chewing, scarring and scratch marks on the trunks

or branches. All hollow assessments were conducted from ground level, with the suitability for use by black cockatoos based on the size of the hollows entrance. Hollows that appeared large enough to allow the entry of a cockatoo were recorded as a potential nest site. Hollows with an entrance of less than about 12 cm in diameter were considered unsuitable for cockatoos.

Old or recent evidence of cockatoo's feeding or roosting sites (feathers, droppings etc.) were also searched for.

Twelve trees were found that had a diameter in excess of 550 mm and had potential hollows that meet the criteria. These are listed in Table 6 and an example shown in Figure 4. Height was determined using a Sunto Clinometer and the Diameter at Breast Height (DBH) and other elements were directly was measured and recorded. Their location is shown in Map 6.

Table 6: Potential Hollow Bearing Trees on the site (Map 6).

No	Species	Height (m)	DBH (mm)	Status	COMMENTS
1	Marri	18	960	Healthy	Potential hollow
2	Marri	9	970	Dead	Chimney hollow
3	Marri	8	790	Dead	Chimney hollow
4	Marri	15	765	Healthy	Potential hollow
5	Marri	12	870	Poor	Chimney hollow
6	Marri	14	1,050	Poor	Chimney hollow
7	Marri	15	885	Poor	Potential hollow
8	Jarrah	12	760	Poor	Potential hollow
9	Marri	13	1,090	Dead	Chimney hollow
10	Marri	11	865	Healthy	Potential hollow - North
11	Marri	10	1,200	Healthy	Multiple hollows
12	Jarrah	12	620	Healthy	Potential hollow

** note poor condition is likely due to the impacts of fire, these trees are likely to increase in vigour over time.*

The first nocturnal survey was conducted on 24th April 2015 from 5.35 pm to 10.45pm. This included a pre-dusk and dusk survey for any sign of black cockatoos. Official

sunset time was 6.34 pm with dusk (last light) at 6.56 pm. The night was fine and clear, with a temperature of approximately 17.3^{0}C during the survey and a Relative Humidity (RH) of 62 % and a slight SE breeze of less than 2 km/h.

The site was traversed by foot, by two observers, in a systematic plan to cover the area thoroughly.

Three Brushtail Possums (*Trichosurus vulpecula*) were seen during the surveys. Their location is shown in Map 6. No black cockatoos were seen or heard during the dusk observations and no animals of significance were observed during the spotlighting survey.

The initial pre-dawn survey for Black Cockatoo activity occurred on 24th April 2015 from 5.20am am til 7.45 am. The temperature was 14^{0}C, the wind was slight from the SW and the RH was 54 %. Dawn (first light) was at 6.30 am and Sunrise was at 6.51 am.

No black cockatoos were seen or heard on or near the property.

The second nocturnal survey was conducted 11th May 2015 from 5.10 pm to 11.10 pm. The night was fine and clear. The temperature was 20^{0}C at the beginning of the survey and dropped to 16^{0}C by the completion. The RH was 65%, with a slight south easterly breeze less than 1 km/h. The official sunset time was 6.27 pm with dusk at 6.50 pm.

The site was traversed in a systematic fashion by two operators to ensure all habitat areas were inspected during these surveys.

No Black Cockatoo species were observed or heard during this survey. A single Western Ringtail Possum was observed and two Brushtail Possums were seen during the survey. Their locations are shown in Map 6.

The second pre-dawn survey for Black Cockatoo activity occurred on 11th April 2015 from 5.35 am til 8.00 am. The temperature was 11^{0}C, the wind was slight from the SE and the RH was 67 %. Dawn (first light) was at 6.32 am and Sunrise was at 6.54 am.

No black cockatoos were seen or heard on or near the property.

5.5. Discussion

The vegetation of the Study Area consist primarily of *Corymbia calophylla* trees with the occasional *Eucalyptus marginata*, over *Agonis flexuosa* woodland with regenerating low and mid strata. The creekline vegetation has similar vegetation overstorey, but a sedge/rush understory. The quality of the habitat is good and is increasing in value as the vegetation recovers from the fire event in 2011.

Twelve trees had girths large enough to potentially develop hollows or obvious hollows were identified and measured during the survey (Map 6).

No black cockatoos were seen or heard during any of the surveys. There were no signs of feeding or feathers within the Study Area. This is probably due to impact of the fire on the Study Area and Black Cockatoos finding better quality food and roosting sites in other areas of their range. The Study Area does not appear to contain any nesting or used roosting site for black cockatoos.

One single Western Ringtail Possum was observed during the survey effort, no dreys or other signs were found, which would indicate there is a very small population of the species that utilise the Study Area. Two small area of Southern Brown Bandicoot diggings were observed on the eastern edge of the Study Area which indicate that there is at least two small populations of the species present. It is likely that the creekline area has more of these species as the habitat is highly suitable, however the regeneration and density of ground species made observation of signs difficult. None of the other significant species were found. The lack of this data should not be taken directly as an indication that the species is absent from the site. No trapping or seasonal sampling was conducted. Table 7 summarises the likely presence based on habitat availability and the potential impact of the development on potential significant species within the subject site.

Table 7: Other Significant Fauna Likelihood and Impact

Species	Potential impact in site
Baudin's White Tailed Black Cockatoo	No nest hollows are being used and minimal foraging habitat is present in the site. No impact is anticipated.
Carnaby's White Tailed Black Cockatoo	No nest hollows are being used and minimal foraging habitat is present in the site. No impact is anticipated.
Western Ringtail Possum	A small population was found within the Study Area. The development is unlikely to cause significant disturbance to the bulk of the habitat area. Any disturbance planned in the area where WRP were found will be managed to ensure no animals are impacted.
Chuditch	Given large home range required and minimal vegetation on site. It is unlikely that the species frequents the site. No impact is anticipated.
Quenda	Small number of diggings found, although habitat is suitable. Best areas would be the creekline system which is not proposed to be impacted by the development. Given lack of proposed development in the project, the impact on this species would be minimal.
Brush Tail Phascogale	No signs of the species found. Habitat is suitable, though likely to a few years before its ideal as the area regenerates from the fire impact. The proposal is unlikely to impact on any populations of this species due to the minimal proposed disturbance.
Western Brush Wallaby	This species was not observed in the Study Area. Given large home range required and the lack of observation on the site, It is highly unlikely that the species frequents the site. No impact is anticipated.

The bird species protected under international agreements was not seen during the surveys. The nature of the site would result in the area within it as unsuitable habitat for breeding for these species and it is highly unlikely that they would be occasional opportunistic visitors to the site.

6. Significance

Under the EPBC Act, an action that has, will have, or is likely to have, a significant impact on a matter of national environmental significance, requires approval from the Minister. A significant impact is defined as an impact which is important or of consequence, having regard for its context or intensity (Commonwealth of Australia, 2009).

Matters of environmental significance are:

- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Ramsar wetlands of international importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Great Barrier Reef Marine Park, and
- Nuclear actions.

For this development, there is a potential for impact on threatened species. Significant Impact Guidelines 1.1 (Commonwealth of Australia, 2009) lists significant impact criteria for the assessment for activities which may impact on threatened species. Table 8 describes these criteria as it relates to the subject site and the vulnerable species that may potentially be impacted in the subject site.

Table 8: Significant Impact Criteria for Vulnerable Listed Species.

Significant Impact Criterion	Discussion		Meets Criterion
	Black Cockatoo Species	Western Ringtail Possum	
Lead to a long-term decrease in the size of an important population[1] of a species	None of the trees are utilised by the regional population of Black Cockatoos.	A small extant population of WRP are believed to be present within the Study Area. The proposal intends minimal impact on the habitat and the overall impact on the population will minimal, if at all.	No
Reduce the area of occupancy of an important population	Will not impact on the area of occupancy of the current population.	Will not reduce the area of occupancy.	No
Fragment an existing important population into two or more populations	Will not fragment current population.	Will not fragment population.	No
Adversely affect habitat critical to the survival of a species	None of the trees are presently being utilised by Black Cockatoos. Will not affect critical habitat	Will not affect critical habitat.	No
Disrupt the breeding cycle of an important population	No breeding sites identified on site.	Small population within the site, any disturbance in the vegetation for building purposes will be conducted with fauna management protocols and will not impact on the population	No
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No. No significant trees are planned to be removed from the development site.	Potential disturbance or removal of building envelope requirements may reduce some of the available habitat, however this is unlikely to cause a decline in the species within the site.	No

[1] *An 'important population' is a population that is necessary for a species' long-term survival and recovery.*

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Any introductions highly unlikely to have any impact on species.	Potential of the introduction of invasive species likely to impact the species are minimal to very low	No
Introduce disease that may cause the species to decline,	Highly unlikely to occur.	Highly unlikely to occur.	No
Interfere substantially with the recovery of the species.	Development will not impact on the recovery of the species.	Development will not impact on the recovery of the species.	No

Using these criteria, the proposed development will not significantly impact on any significant species to a point where a referral is required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Referral guidelines for three threatened black cockatoos species (Commonwealth of Australia. 2011) uses a decision tree and a set of criteria to determine whether actions significantly impact on black cockatoos. These are set out below based on the details of the development and the data obtained from the surveys. Notes on the flow chart follow.

Question	Answer	High Risk of Significance – Referral Recommended
1. Could the impacts of your action occur within the modelled distribution of the black cockatoos?	Yes – Action occurs within the distribution area of all three species.	• Clearing of any known nesting tree • Clearing of any part or degradation of breeding habitat • Clearing more than 1ha of quality foraging habitat • Creating a gap of greater than 4 km between patches of habitat • Clearing or degradation of known roosting site.
2. Could the impacts of your action affect any black cockatoo habitat or individuals?	Unlikely. No signs of animal utilisation of the site was found.	**Uncertainty – Referral Recommended or contact Department**
3. Have you surveyed for black cockatoos using the recommended methods?	Yes	• Degradation of more than 1 ha of foraging habitat. • Clearing or disturbance in areas surrounding habitat that has the potential to degrade through introduction of threats. • Actions that do not directly affect species but have potential to introduce indirect impacts. • Actions with potential to introduce known plant diseases.
4. Could your actions have an impact on black cockatoos or their habitats?	No. No signs of animal activity was found within the site.	**Low risk of significant impacts – referral may not be required.**
5. Is your impact mitigation best practice so that it may reduce the significance of your impacts on black cockatoos?	No significant impact is anticipated due to lack of evidence of activity on site.	• Actions that do not affect black cockatoo habitat or individuals • Actions whose impact occurs outside modelled distribution.
6. Could your action require a referral to the federal environmental Minister for significant impact on black cockatoos?	No as there are no signs of any of the three species present within or adjoining the Study Area. It is unlikely that the species is dependent on the site.	

The summary of these responses are:

1- The development is within the area of modelled distribution of black cockatoo species.
2- The proposed actions will not impact black cockatoo individuals or habitat.
3- The site has been surveyed using the recommended methods from the guideline.
4- It is unlikely that any actions will impact on any animals or habitat as no evidence of use or visitation by the species were found on site.
5- No evidence on site of utilisation and the unlikely presence of any of the three species of black cockatoos would mean that no mitigation measures are required.
6- Using the flow chart and criteria it is determined that there is a low risk of actions resulting in an impact upon black cockatoos within the subject site.

It is recommended that a referral pursuant to the EPBC Act is not required for the components of the development within the subject site, as actions involved do not constitute a significant impact on any of the threatened species present.

7. Summary and Recommendations

Based on the results of the analysis of site, the following conclusions and recommendations are made.

- No rare or priority flora was found on the site.
- The vegetation communities within the Study Area are of the type that is still relatively abundance from pre European extent (Less than 30% remaining is considered a critical threshold below which vegetation communities may be considered at risk).
- The vegetation is mostly classified as Very Good, and is in the latter stages of regenerating naturally from a major bushfire event in 2011.
- No Ecological Communities of significance were found within the Study Area.
- Twelve trees with a DBH over 550mm with potential hollows, suitable for black cockatoos were found, however no signs of nesting, roosting, socialising or feeding were found.
- Black cockatoo species are highly mobile and may utilise the site opportunistically as a feeding site within their range although their preferred food source is not dominant in the remaining vegetation. The species would not presently be relying on the site for habitat.
- A small extant population of Western Ringtail Possums utilise the Study Area, however the proposal is to subdivide the property into two Rural Residential lots and consequently there will be minimal disturbance required on the site. Any disturbance in the area where WRP were observed, should be conducted with the presence of a fauna observer to minimise potential impact on the species.
- A small population of Southern Brown Bandicoots utilise the site. As with the above comment, there should be no major impact on this population within the proposed development.
- No other animals of significance were observed, either directly or by signs of their utilisation of the site. Given the nature of the site, it is highly unlikely that any of the other significant fauna within a 5 km radius of the site, would be utilising the site.
- Using the criteria outlined by the Commonwealth Government, the actions within this development do not constitute as having a significant impact on threatened species and as such, referral under the EPBC Act is not required.

8. Figures

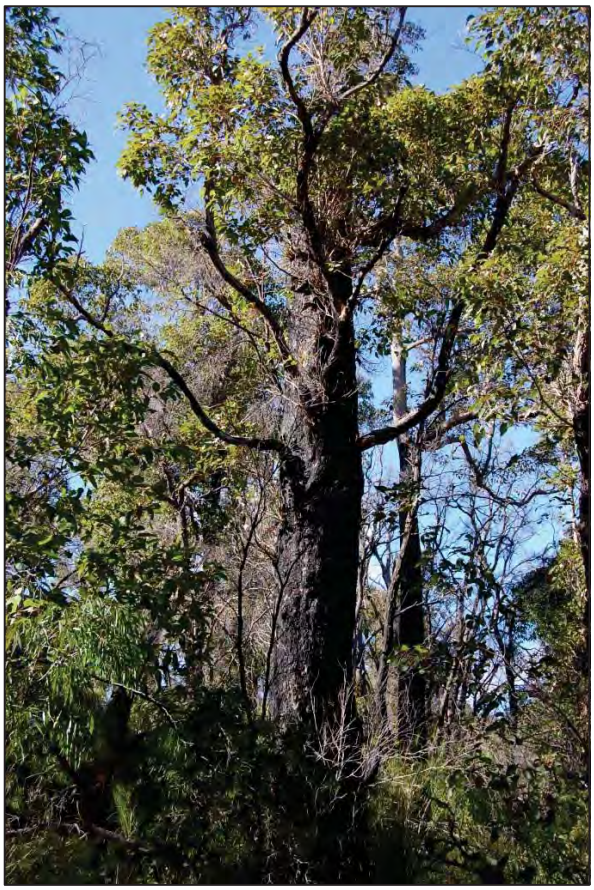


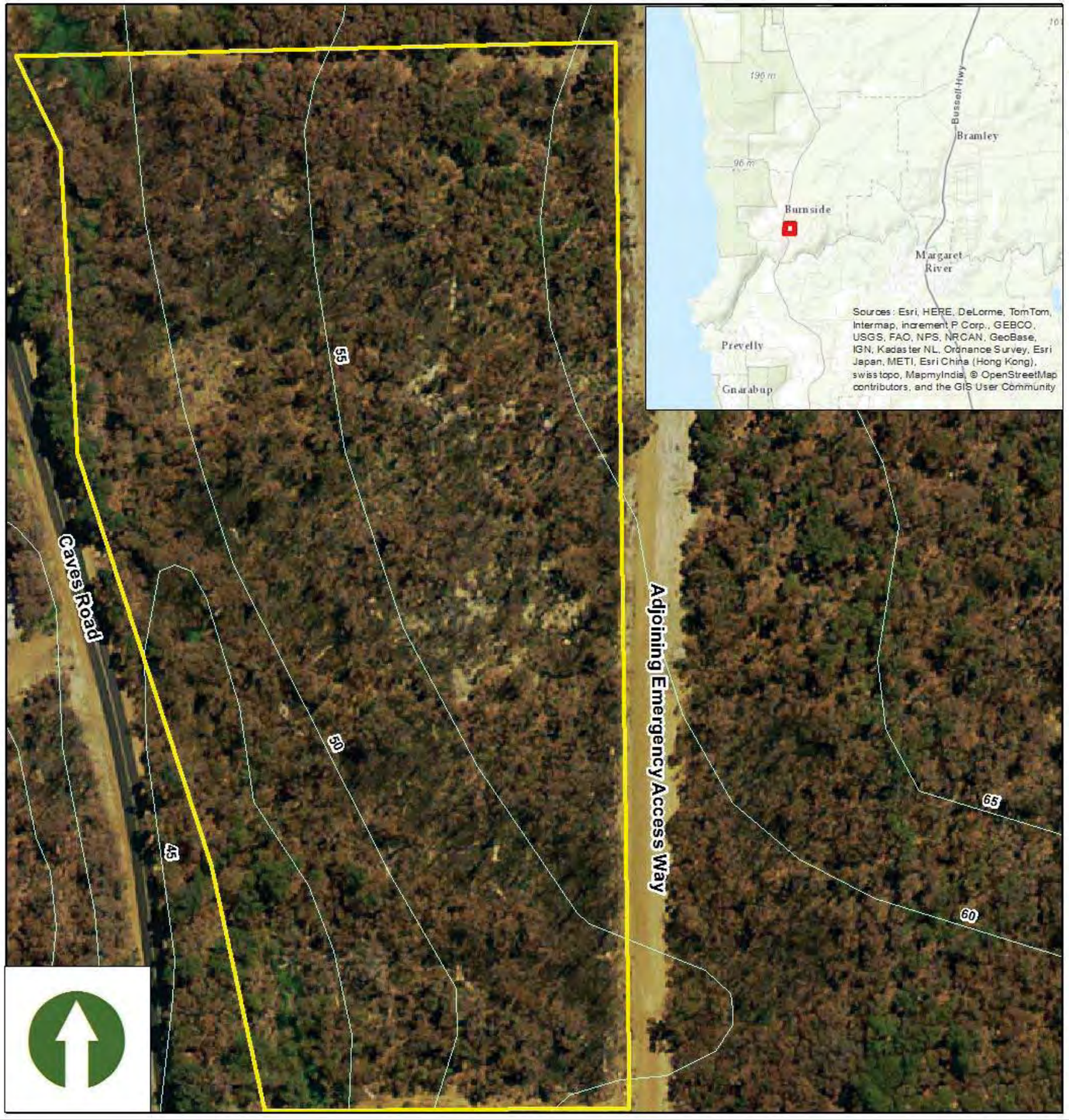
Figure 1: Chimney Hollow in a Marri with full scorch marks up in excess of 7m.

Figure 2: Vegetation Type 1.

Figure 3: Vegetation Type 2.

Figure 4: Hollow in burnt Marri

9. Maps



Map 1	Site Location
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

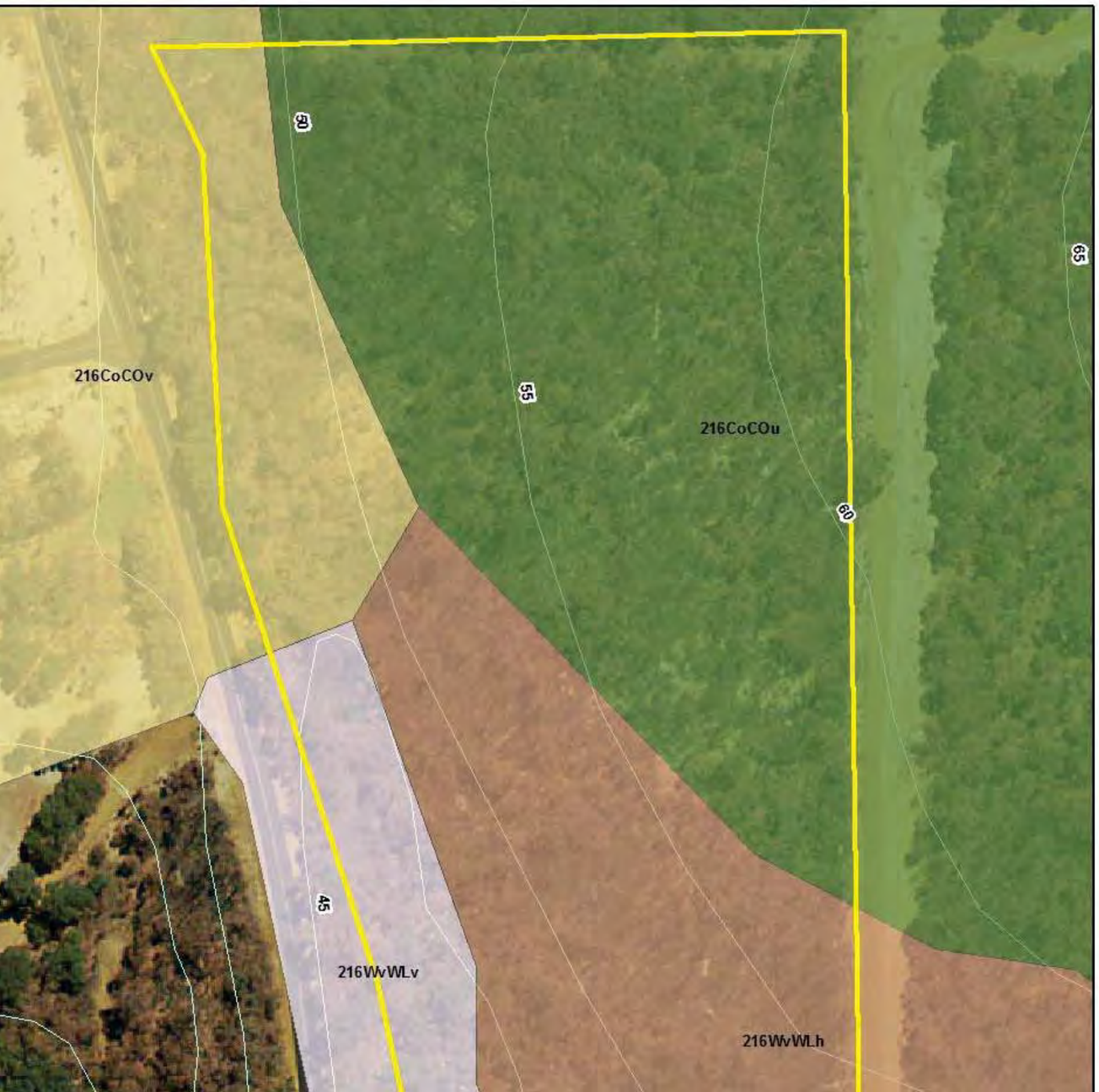
Lot 126 Boundary

Contours m (AHD)

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015
Projection - MGA50
Datum - GDA94
The details on this map have not been surveyed.
This map is for planning/discussion purposes only.



Map 2	Soil Landscapes
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

Lot 126 Boundary

Soil Landscape Units

- 216CoCOu
- 216CoCOv
- 216WvWLh
- 216WvWLv

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015

Map 3	Vegetation Complexes (RFA)
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

Lot 126 Boundary

RFA Veg Complexes

- C1
- Cd
- W1
- Ww1

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015

Map 4	Mapped Vegetation
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

Lot 126 Boundary

Mapped Veg Communities

1

2

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015

Map 5	Vegetation Condition
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

- Lot 126 Boundary

Condition

- Very Good
- Good
- Degraded

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015

Map 6	Fauna Survey
Site	L126 Caves Road Burnside
Project	Significance Survey
Client	RPS Australia Asia Pacific
Scale	1: 1,250

Legend

- Lot 126 Boundary
- Trees

Animal & Survey

- Bandicoot Digging Day
- Brushtail Possum Night 1
- Brushtail Possum Night 2
- Ringtail Possum Night 2

0 15 30 60 90

Metres

Prepared by Gary McMahon
Ecosystem Solutions
May 2015

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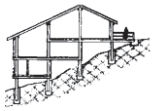
APPENDIX E

Geotechnical Investigation Report

Prepared by Civil, Structural & Environmental Engineers and Project Managers

Civil/Structural Consulting Pty Ltd



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REPORT TO GEOTECHNICAL INVESTIGATION

and EFFLUENT DISPOSAL STUDY FOR

LOT 126 CAVES ROAD, BURNSIDE (MARGARET RIVER)

REPORT FOR: Mr. Peter Gleed

OF: PGPM Pty Ltd

CLIENT: Mr Michael Bussell

REPORT BY: T Moore

OF: Civil/Structural Consulting Pty Ltd

DATE: July 2015

Civil/Structural Consulting Pty Ltd

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GEOTECHNICAL and EFFLUENT CAPACITY REPORT FOR PROPOSED DEVELOPMENT AT LOT 126 CAVES ROAD, BURNSIDE (MARGARET RIVER)

July 2015

1.0 BACKGROUND

On 29th June 2015 this office was commissioned by Mr Peter Gleed of PGPM Pty Ltd, on behalf of the owner Mr Michael Bussell to carry out a geotechnical investigation and effluent capacity investigation of relevant areas for proposed subdivision and residential construction, at the site Lot 126 Caves Road Burnside, in the Margaret River region, and provide a report thereof.

1.1 THE SITE

See Appendix A for site plan.

The subject site is situated approximated 5km north west of Margaret River town centre, 2.5km east from the coast. Bordered by Caves Road to the west, emergency fire break and Lot 9500 to the north and east, and Lot 121 bushland to the south. Total area of the subject site is 5.452ha. The proposed development consists of a subdivision of 2 lots, the northern lot 1 area totals 2.854ha and the southern lot 2 2.598ha

The site is fairly densely vegetated, dominated by young Marri and Jarrah trees up to 500mm diameter. Scattered Peppys, Grasstrees and medium dense undergrowth is prevalent throughout. The southern (Lot 2) has a slightly thicker undergrowth. Generally, the land falls predominantly to the west, and to a lesser degree to the south-west, toward a seasonal creekline with the slope being approximately 200mmm in 10m.

There were no signs of a high water table in any of the Test Pits. High rainfall had occurred in the days prior to fieldwork.. Soil layers were damp due to the passage of water through the higher permeable upper layers of the soil profiles.

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2.0 GEOTECHNICAL INVESTIGATIONS

Lot 126 Caves Road Burnside, was visited and assessed for geotechnical considerations, including: excavation of test pits; ground slopes; ground types; soil types (including sampling and soil tests by NATA registered soils laboratory); surface and sub-surface water flows and type and proximity of vegetation.

The results of the investigation are presented in report form for each of the areas. See Appendix B for copies of the reports and Appendix C for laboratory test results of the clay fractions of the soils.

2.1 SUMMARY OF FIELDWORK AND SITE CLASSIFICATIONS (GEOTECHNICAL)

NOTE

- Full Geotechnical Investigation Reports are provided in Appendix B.
- Test Hole locations are shown in Appendix A.
- Laboratory Soil Test Results (Clays) are provided in Appendix C.

LOT	CLASSIFICATION
1	M
2	M

Refer to CSIRO Information Sheet (Appendix F) for further details on general definitions of Site Classifications.

3.0 EFFLUENT DISPOSAL

The areas proposed for development were visited and assessed for all factors affecting effluent disposal, including: ground types; presence of catchments; falls to the land; landforms; ability of the various areas to accept effluent; permeability of the soils in the various areas; and water movement - both surface and sub-surface.

Copies of the Effluent Site and Soil Evaluation Report, which contain soil profiles to the relevant depths and evaluation of the relevant areas, can be found in Appendix D.

The soil profiles for geotechnical purposes have been logged up to depths of 1.7m and are also useful as a part of effluent disposal assessment. They are contained in Appendix B.

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3.1 TYPES OF EFFLUENT DISPOSAL SYSTEMS

Generally speaking there are four main types of domestic effluent disposal systems considered in this report. The choice as to which is the most suitable is determined by the capacity of the discharge area to receive and process the nutrients and biochemical oxygen demand (b.o.d.) on an ongoing basis. The possibility of excessive effluent flows or concentration which may exceed the capacity of the receiving system to process on an ongoing basis is to be avoided.

The capacity of various systems to receive and process effluent on an ongoing basis varies, for example a healthy stand of dense natural vegetation founded in loamy, gravely soils will have a higher capacity than a warm, low flow stream system (see also Section 5.1 below).

The domestic effluent disposal systems considered in this report are:

TYPE ONE
Standard concrete settling tanks with in-ground leach drains fed by gravity.
TYPE TWO
The above standard system combined with a pump tank which allows the in-ground leach drains to be placed at any suitable location and not requiring fall to an area lower than the settling tanks.
TYPE THREE
Standard concrete settling tanks with semi-inverted or fully-inverted leach drains located with fall from the settling tanks.
TYPE FOUR
Alternative treatment systems which treat the effluent to a point acceptable for discharge onto purpose designed receival areas.

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3.1 TYPES OF EFFLUENT DISPOSAL SYSTEMS (Cont)

General principles to be followed when disposing of effluent are:

- Maintain a reasonable distance from stream flows and catchments to stream flows (this distance would depend on the "barriers" to effluent flow between the disposal area and the stream/catchment such as: belts of vegetation; ground water flows; surface water flows and permeability of the soil);
- Maintain a reasonable distance from water supplies such as bores and dams (the above considerations apply here also); and
- Be aware of the "robustness" of the system with regard to processing effluent on an ongoing basis.

Mitigating structures may be included in an effluent disposal system, such as subsoil drains uphill of the disposal area if sub-surface water flow is likely to be a problem; surface cut-off drains to re-direct surface runoff should there be a catchment contributing to the disposal area; below ground barriers if it is desirable to reduce downhill migration of effluent.

3.2 SUMMARY OF FIELDWORK AND CALCULATIONS (EFFLUENT)

NOTE

- Full Site and Soil Evaluation Reports are provided in Appendix D.
- Test Pit locations are shown in Appendix A.
- Phosphorous Retention Index Laboratory test results are shown in Appendix E.

EFFLUENT TEST PIT	SOIL CATEGORY	DESIGN LOAD RATE (mm/d)	PRI	DESIGN IRRIGATION RATE (mm/day)	DEPTH TO "IMPERMEABLE" LAYER (mm)
1	2 (to 4)	25	-	5.0	800
2	2 (to 4)	20	8.8	5.0	700
3	2 (to 4)	20		4.0	700
4	2 (to 4)	25	16	5.0	1100

(NOTE: Soil category, DLR, DIR and PRI are values at the anticipated depth of effluent disposal.

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4.0 CONCLUSIONS AND RECOMMENDATIONS - GEOTECHNICAL

All of the sites assessed as a part of this study are suitable for construction of residential or light commercial structures using commonly accepted methods of construction.

Matters to consider during design, earthworks and construction include: falls of the ground; overland and sub-surface water flows; rock; presence and reactivity of clays in the foundations and proximity and types of vegetation.

Whilst a fairly rigorous investigation of the various areas has been carried out, the reports contained in Appendix B should be considered preliminary only. Further investigation necessary for classification of the sites under AS2870, for design and construction purposes of any proposed structures, should be carried out at the appropriate time.

5.0 CONCLUSIONS AND RECOMMENDATIONS - EFFLUENT

Design and construction of the effluent disposal systems is to comply with AS1547-2012, Health Department of WA and Local Authority requirements.

There is no likelihood of “deep sewer” servicing this area in the foreseeable future (certainly not within ten years).

Having regard for those considerations in Section 5.1 below, any of the disposal systems detailed in Section 3.1 above are suitable on the subject site.

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5.1 EFFLUENT DISPOSAL CONSIDERATIONS

Factors affecting "safe" effluent absorption and assimilation into the environment which are relevant to this subject site are:

- Moderate permeability of the soil profiles.
- Proximity of the disposal area to catchments to the creeklines, effluent disposal should not occur within 30m of these area.
- Surface water flow.
- Sub-surface water flow.
- Steepness of the terrain, particularly toward the western portion of the site.
- Robustness of the receiving environment, in particular moderate phosphate retention/assimilation capacity and density and health of vegetation.

5.1.1 HIGH WATER TABLE

No watertable, nor signs of a water table were observed in any of the geotechnical test holes or effluent test pits.

The site will drain well, after heavy rainfall, due to the moderate permeability of the upper soil profiles and falls toward the west.

5.1.2 PHOSPHOROUS RETENTION CAPACITY

Phosphorous is present in domestic effluent (most commonly as phosphates). It can cause problems under certain circumstances if it accumulates in water bodies.

The capacity of soils to absorb and assimilate phosphorus varies. "Poor" sandy soils have a very low capacity to deal with phosphorous, which tends to wash out and can accumulate in nearby water bodies, with likely resulting environmental problems.

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5.1.2 PHOSPHOROUS RETENTION CAPACITY (Cont)

Phosphorous Retention Index (PRI) provides us with a measure of the capacity of a soil to retain phosphorous, thus allowing it to be assimilated into the environment. A reading below 5 would indicate a poor phosphate retention capacity. From 10 to 50 would indicate a moderate to poor PRI and above 50 would indicate a good PRI..

All of the soils from the subject area are loamy gravels underlain with clay, the upper layers would have a moderate capacity to assimilate phosphates. The assimilation capacity would be expected to increase with depth. It is accepted that the robustness of a soil is improved by the planting of high nutrient absorbing vegetation, and this is recommended to be carried out.

See Section 3 above, and Appendices D and E for further details.

END REPORT

Civil/Structural Consulting Pty Ltd

Civil, Structural & Environmental
Engineers & Project Managers

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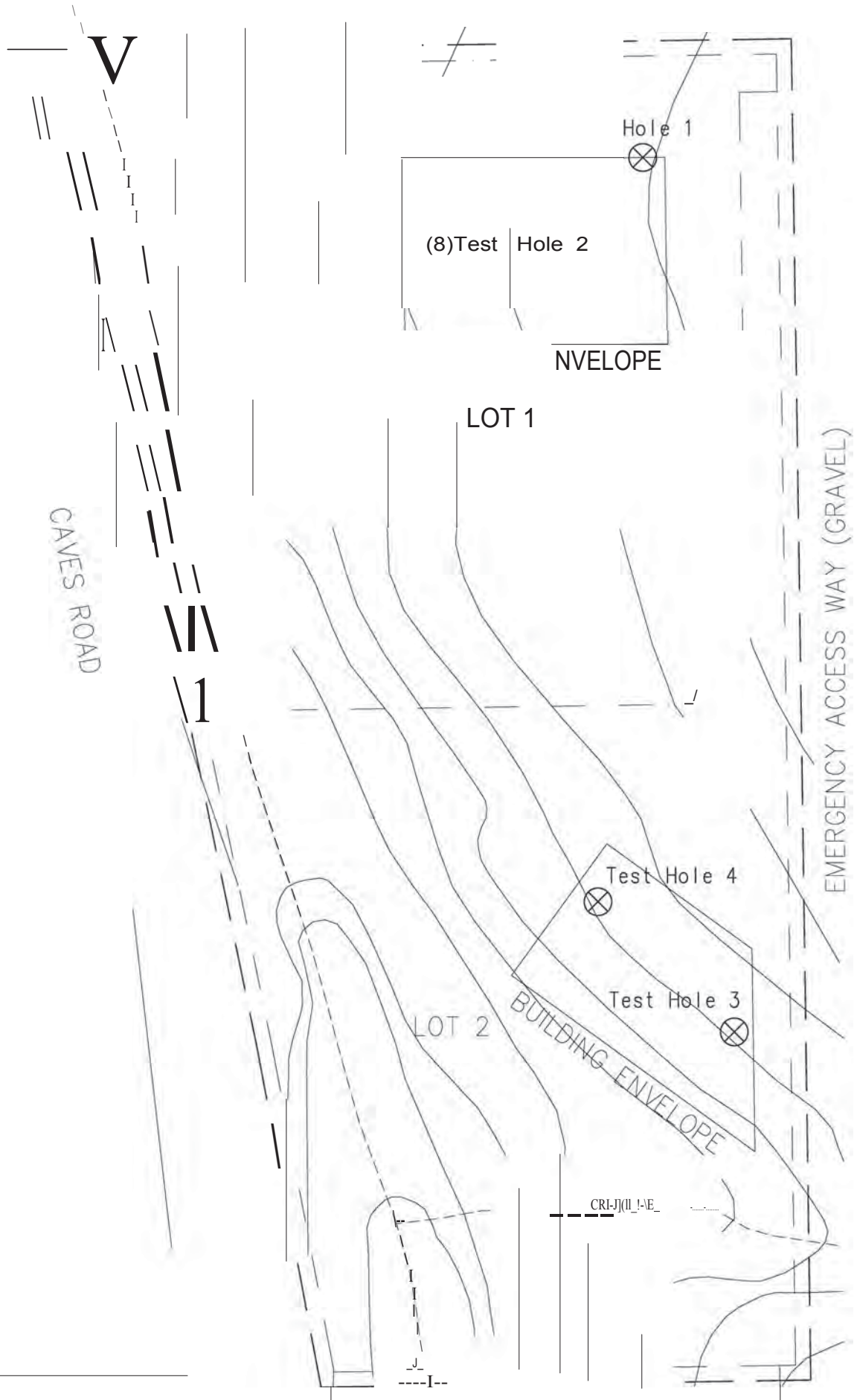
APPENDIX A

PLAN WITH LOCATIONS OF GEOTECHNICAL TEST HOLES AND EFFLUENT TEST PITS

LOT 126 CAVES ROAD, BURNSIDE (MARGARET RIVER)

9500



LEGEND

(8) Test Ho l e Location

Subject Site

Lot Boundaries

Creek l ine

121

APPROVED : Tim **Moore**

CLIENT: M Bussell	DRAWING NO: Appendix A				DATUM: -	SCALE: 1 : 1500 A3 1/1
	DESIGN: T. Moore				**CIVIL/STRUCTURAL CONSULTING PtyLtd**	
PROJECT: Proposed Subdivision, Lot 126 Caves Road, Burnside (Margaret River)	The designs contained in this drawing remain the property of Civil/Structural Consulting. They may not be reproduced or distributed without the express permission of Civil/Structural Consulting.				Civil, Structural and Environmental Engineers and Project Managers	
TITLE: Site Plan & Test Pit Locations		30/7/15	IM/DF	Released for Information	41 Townview Tee (P O Box 852) MARGARET RIVER WA 6285	E-mail: tim.csc@iligpond.com.au TEL: (08) 97572488 Mobile: 0419969010
		REVISION	DRAWN	DESCRIPTION		

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APPENDIX B

GEOTECHNICAL INVESTIGATION REPORTS

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GEOTECHNICAL TEST PIT RESULTS

NOTE: TEST HOLE LOCATIONS ARE SHOWN IN APPENDIX A

SITE Lot No.: 126 Street: Caves Road

Location: Burnside (Margaret River)

CLASSIFICATION OF SITES by soil profile identification in accordance with AS2870-2011.

The site classifications are "M" for all sites investigated

THE FOLLOWING COMMENTS APPLY TO THE SITES ASSESSED WITH REGARD TO GEOTECHNICAL INVESTIGATIONS

COMMENTS

1) Having regard for geotechnical conditions, all sites, as detailed on plans, are suitable for construction of residential or light commercial structures using commonly accepted methods of construction.
2) Representative testing has been carried out by a NATA Registered Soil Laboratory to the clay fractions of the soil profiles, see Appendix C for test results.
3) No water table, nor signs of any water table were observed in any test holes. There are no signs of subsurface water, however it is probable there would be surface flow and subsurface flow in heavy rains and this would require appropriate management.
4) Removal of any large trees or rocks required for construction of buildings, roads etc will necessitate grubbing of roots greater than 50mm diameter. Resultant holes will require battering 1 vertical to 3 horizontal and proper placement of suitable backfill, then suitable compaction will be required, layer thickness will depend on method of compaction (For sand - 1 tonne plate compactor maximum 300mm, 10 tonne vibrating drum roller maximum 600mm).
5) Classification of individual sites depends primarily on the presence or absence of reactive clay in the soil profile, the depth to the clay and the anticipated variation in moisture content. Reactive clay was present in all the test holes relatively high in the soil profile, because of this all sites inspected will be class "M".
6) Classification of sites is preliminary only. Sites are to be fully assessed on an individual basis at time of construction of any proposed structures.

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COMMENTS (Cont)

7) Where classification is shown as being between categories, the final classification will be dependant upon the depth of stable overburden to the reactive clay that is retained during construction of earthworks AND the degree to which the moisture content is stabilised during the proposed development. No removal of overburden will result in the classification closer to the lower category. Removal of all overburden will result in classification closer to the higher category.
8) Classifications given assume a suitable density to proposed buildings is provided. Where necessary pre-compaction of sites is to be carried out prior to any construction occurring.
9) Rock may be encountered in some areas if earthworks deeper than 1m are anticipated, particularly to the south-west portion of the subject site.
10) All profile measurements are from existing Natural Ground Level.
11) CSIRO Information Sheet is enclosed (Appendix E).
12) All sites are located within 2.5km of coast. Wind classification N2 ground floor and N2 second storey.
13) Where relevant Standard Perth Sand Penetrometer testing was carried out in accordance with AS1289.6.3.3. This provides an indication of the insitu relative density of the sands in the soil profile, the first reading gives the blowcount from 150 to 450mm below NGL, the second reading gives blowcount from 450 to 750mm below NGL and the third reading gives blowcount from 750 to 1050mm below NGL. As a general guide the expected minimum blowcounts required for construction of residential and light construction would be 7/9/12.

SOIL PROFILES, TEST RESULTS and PRELIMINARY CLASSIFICATIONS

TEST HOLE 1

0 to 150	-	Dark brown topsoil, roots and organic matter.
150 to 500	-	Orange/light brown gritty sandy clay, slightly damp, minor roots.
500 to 800	-	Grey gritty clay, damp.
800 to 1600	-	Mottled red/grey clay, increasing plasticity with depth (Sample One from 1500).

TEST RESULTS

Linear Shrinkage = 11% LL = 61%
Plasticity Index = 38% PL = 23%
Passing 75μm sieve = 41%

Site Classification "**M**"

TEST HOLE 2

0 to 150	-	Dark brown topsoil, roots and organic matter.
150 to 500	-	Grey/brown gritty, sandy clay.
500 to 700	-	Grey/orange gritty clay.
700 to 1400	-	Mottled red/grey clay.

Site Classification "**M**"

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SOIL PROFILES, TEST RESULTS and PRELIMINARY CLASSIFICATIONS (Cont)

TEST HOLE 3

0 to 150	-	Dark brown topsoil, roots and organic matter.
150 to 400	-	Grey/brown gritty sandy clay, minor roots.
400 to 700	-	Grey gritty sandy clay, moist.
700 to 1400	-	Mottled red/grey/orange clay.

Site Classification "**M**"

TEST HOLE 4

0 to 150	-	Dark brown topsoil, roots and organic matter.
150 to 400	-	Orange/brown gritty sandy clay.
400 to 1100	-	Mottled red/grey gritty clay, minor laterite.
1100 to 1700	-	Mottled red/grey clay, increasing red colour with depth (Sample Two from 1600).

TEST RESULTS

Linear Shrinkage = 12% LL = 55%
Plasticity Index = 32% PL = 23%
Passing 75μm sieve = 22%

Site Classification "**M**"

Signed:..... Date: 7/7/15

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APPENDIX C

LABORATORY SOIL TEST RESULTS (CLAYS)

Cardno Geotech
T/ As Geotech Material Testin g Services
ABN 48 137 480 034
72 McComb e Road, Halifax WA 6230, Au strali a
PO BO X 5004, Sunbury DC, WA 6230, Austr ali a
Phone: +61 8 9726 2187 Fax: +61 8 97212348
www .cardn o.com.au

Sunbury Base l ab
72 McComb e Ro ad, Hali fax WA 6230
(08) 9726 2187
paul.k e nt @cardno.c om.au

TEST CERTIFICATE
TESTS FOR CONSISTENCE LIMITS & ABBREVIATED PARTICLE SIZE DISTRIBUTION (0.425 &0.075mm SIEVES}
AS 1289 3.1.2, 3.2.1, 3.3.1, 3.4.1 & 3.6.1

Client:	Civil Structural Consulting	**Sample No:**	S/5488
Project:	Lot 126 Caves Road	**Date Tested:**	10-Jul - 15
Location:	Margaret River	**Tested By:**	H.Dellaca
Sample Details/ BH #:	TH 1		
Depth (m):			
Material Description:	Grey Red CLAY with some rocks		

TEST No:	1
Liquid Limit (%) (AS 1289 3.1.2)	61
Plastic Limit (%) (AS 1289 3.2.1)	23
Plasticity Index (%) (AS 1289 3.3.1)	38
Linear Shrinkage (%) (AS 1289 3.4.1)	11 .0
Material Passing 0.425 Sieve (%)	57
Material Passing 0.075 Sieve (%)	41

NOTE:
1. Sample supplied by client.
2. Consistence Limits tests - oven dried and dry sieving sample preparati on.
3. Particle Size Distribution test - deviation from standard method, 0.425 and 0.075 sieves only used in fine sieving.

Certificate Approved By: J.Fischer **Date:** 17-Jul-15

Cardno Geatech
T/As Geotech Material Testing Services
ABN 48 137 480 034
72 McCombe Road, Halifax WA 6230, Australia
PO BOX 5004, Bunbury DC, WA 6230, Australia
Phone: +61 8 9726 2187 Fax: +61 8 9721 2348
www.cardno.com.au

Bunbury Base Lab
72 McCombe Road, Halifax WA 6230
(08) 9726 2187
paul.kent@cardno.com.au

TEST CERTIFICATE
TESTS FOR CONSISTENCE LIMITS & ABBREVIATED PARTICLE SIZE DISTRIBUTION (0.425 & 0.075mm SIEVES)
AS 1289 3.1.2, 3.2.1, 3.3.1, 3.4.1 & 3.6.1

Client:	Civil Structural Consulting	**Sample No:**	S/5489
Project:	Lot 126 Caves Road	**Date Tested:**	10-Jul-15
Location:	Margaret River	**Tested By:**	H.Dellaca
Sample Details/ BH#:	TH 4		
Depth (m):			
Material Description:	Red Brown/Cream Rocky CLAY (Coffee Rock)		

TEST No:	1
Liquid Limit (%) (AS 1289 3.1.2)	55
Plastic Limit (%) (AS 1289 3.2.1)	23
Plasticity Index (%) (AS 1289 3.3.1)	32
Linear Shrinkage (%) (AS 1289 3.4.1)	12.0
Material Passing 0.425 Sieve (%)	33
Material Passing 0.075 Sieve(%)	22

NOTE:
1. Sample supplied by client .
2. Consistence Limits tests - oven dried and dry sieving sample preparation.
3. Particle Size Distribution test - deviation from standard method, 0.425 and 0.075 sieves only used in fine sievin g.

Certificate Approved By: J.Fischer **Date:** 17-Jul-15

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APPENDIX D

EFFLUENT SITE AND SOIL EVALUATION

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EFFLUENT SITE AND SOIL EVALUATION

NOTE: TEST PIT LOCATIONS ARE SHOWN IN APPENDIX A

SITE Lot No.: 126 Street: Caves Road

Location: Burnside (Margaret River)

ALL SITES

SOIL CATEGORY – Upper Layers 1 to 3, Lower Layers 4 to 6

DESIGN LOAD RATE (Trenches & Beds) = 20mm/day

DESIGN IRRIGATION RATE (LPED) = 4.5mm/day

IN ACCORDANCE WITH AS/NZ1547:2012

CONCLUSIONS

All sites are suitable for onsite effluent disposal.

System of disposal and design of the system(s) is to have regard for:

- The large lot sizes.
- The moderate phosphate retention capacity of all the sites.
- The moderate permeability of the soil profiles, underlain by low permeability clays.
- The likelihood of surface and sub-surface water flows throughout the wet season, particularly after prolonged heavy rains.
- The proximity of the three creeklines.

COMMENTS

1) This report is based predominantly on the fieldwork carried out on 7/7/15 and on the requirements of AS/NZS1547:2012.
2) There are two lots proposed - 28,540m^2 and 25,980m^2 in area.
3) This investigation was carried out at the wettest time of the year. Heavy rainfall occurred in the days prior to the fieldwork. There was no sign of a water table, it is reasonable to assume that absence of ground water observed at the depth of field test holes is indicative that a high water table will not be an issue.
4) These reports are to be read in conjunction with the geotechnical test pits (see Appendix B) which were dug to varying depths up to 1.7m.
5) There are no signs of subsurface water, however it is probable there would be surface flow and subsurface flow in heavy rains and this would require appropriate management.

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COMMENTS (Cont)

6) The subject site, is situated approximated 5km north west of Margaret River town centre, 2.5km inland from the coast. The subject site contains fairly dense vegetation, dominated by young Marri and Jarrah trees up to 500mm diameter. Scattered Peppys, Grasstrees and medium-dense undergrowth is prevalent throughout. The southern Lot 2 has a slightly thicker undergrowth. Generally, the land falls in a westerly and south westerly direction towards a seasonal creekline with the slope being approximately 200mm in 10m.
7) The closest water source is a seasonal creek line running north-south in the western portion of the site ranging from approximately 10-25m east of the Caves Road reserve property boundary. A tributary travels east-west in the south of the site through a culvert under the Emergency Access Way on the western boundary.
8) Upper layers of soil profile (to about 500mm below GL) may be considered moderately permeable (Soil Category 1 to 2). Below this (generally approximately 800mm below natural GL) permeability may be considered low to moderate permeability (Soil Category 3 to 4). Once we enter the clay layer proper (below about 800mm below GL) permeability can be expected to be low to very low (Soil Category 5 to 6). Permeability results are for the anticipated zone of disposal and are based on Tables L1 and M1 (Refer also to AS/NZS1547:2012 Table 5.1 for Soil Categories and permeability).
9) Upper soil profile has a moderate capacity for phosphate retention. PRI can be expected to increase to a higher capacity with depth. (See Appendix E for Phosphorous Retention Index test results).
10) Low health risk, low environmental risk. The Design Loading Rate (DLR) for this area and soil profile is 20mm/day. (Refer to ASNZS1547:2012 Table L1), this is for a standard settling tanks and leach drain system. Design Irrigation Rate (DIR) is 4.5mm/day (refer to AS/NZS1547-2012 Table M1), this is for Low Pressure Effluent Distribution (LPED) systems.
11) Design of effluent disposal system is to be in accordance with this report and the requirements of the Local Health Authority and Department of Health WA. Improvement of nutrient uptake is recommended by planting of the effluent disposal area with nutrient absorbing plants (such as Kikuyu grass).

SOIL PROFILES and TEST RESULTS

TEST HOLE 1 (Soil Category in brackets)

0 to 150	-	Dark brown topsoil, roots and organic matter. (1)
150 to 500	-	Orange/light brown gritty sandy clay, slightly damp, minor roots. (2)
500 to 800	-	Grey gritty clay, damp. (3 to 4)

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SOIL PROFILES and TEST RESULTS (Cont)

TEST HOLE 2

0 to 150	-	Dark brown topsoil, roots and organic Matter. (1)
150 to 500	-	Grey/brown gritty, sandy clay. (2)
500 to 700	-	Grey/orange gritty clay (PRI Sample from 500). (3 to 4)

Phosphorous Retention Index - 8.8

INFILTRATION RESULTS

Reading 1 - 2m 20s
Reading 2 - 4m 4s
Reading 3 - 5m 30s
Reading 4 - 5m 30s

Permeability = 2m/d

TEST HOLE 3

0 to 150	-	Dark brown topsoil, roots and organic matter. (1)
150 to 400	-	Grey/brown gritty sandy clay, minor roots. (2)
400 to 700	-	Grey gritty sandy clay, moist. (3 to 4)

TEST HOLE 4

0 to 150	-	Dark brown topsoil, roots and organic matter. (1)
150 to 400	-	Orange/brown gritty sandy clay. (2)
400 to 1100	-	Mottled red/grey gritty clay, minor Laterite (PRI Sample from 500). (3 to 4)

Phosphorous Retention Index - 16

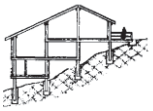
INFILTRATION RESULTS

Reading 1 - 1m 45s
Reading 2 - 2m 40s
Reading 3 - 2m 40s

Permeability = 2m/d

Signed:..... Date: 7/7/15

Civil/Structural Consulting Pty Ltd



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APPENDIX E

LABORATORY TEST RESULTS

(PHOSPHOROUS RETENTION INDICIES)

VINTESSENTIAL LABORATORIES

www.vintessential.com.au
ABN: 60 068 057 045

VIC (Site A)
13/143 Point Nepean Road, Dromana VIC, 3936
PO Box 2244, Dromana VIC, 3936
T: 03 5987 2242 F: 03 5987 3303
E: info@vintessential.com.au

WA (Site B)
4/222 Naturaliste Tce, Dunsborough WA, 6281
PO Box 843, Dunsborough WA, 6281
T: 08 9755 3622 F: 08 9756 8074
E: lab-wa@vintessential.com.au

QLD (Site C)
22 Caves Road, Stanthorpe QLD, 4380
PO Box 161, Stanthorpe QLD, 4380
T: 07 4681 1522 F: 07 4681 1544
E: lab-qld@vintessential.com.au

LABORATORY REPORT NUMBER: B1507037

Civil/Structural Consulting
PO Box 852
Margaret River WA 6285
Phone 08 97572488

Purchase Order
Sample(s) Received 9/07/2015
Report Type Final
Issue Preferences x2 tim.csc@bigpond.com; cc_fritch78@hotma

Sample Number	Sample Details	
B1507037/01	PRI 1	Lot 126 Caves Road, Margaret River

Test	Result	Unit
Phosphorous Retention Index (S06)	8.8	

Sample Number	Sample Details	
B1507037/02	PRI 2	Lot 126 Caves Road, Margaret River

Test	Result	Unit
Phosphorous Retention Index (S06)	16	

Phoebe Norman
Approved Signatory
Vintessential Laboratories

Date Report Issued
14/07/2015

The above results relate only to the samples as received.

***Indicates determination by NATA accredited method.**

Accreditation No. 11587
Site No. 11580 (Vic) 14527 (WA)
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025

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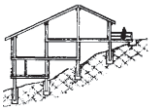

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APPENDIX F

CSIRO INFORMATION SHEET – GUIDE TO HOMEOWNERS ON FOUNDATION MAINTENANCE AND FOOTING PERFORMANCE

DIVISION OF BUILDING, CONSTRUCTION AND ENGINEERING
information service
Sheet No. 10-91
Revised November 1988

Note: This is a revision of CSIRO Division of Building Research Information Sheet No. 10·91. (The Division of Building Research is now incorporated as part of the Division of Building, Construction and Engineering.)

GUIDE TO HOME O\VNERS ON FOUNDATION MAINTENANCE AND FOOTING PERFORMANCE (updated for AS 2870-1988)

1. INTRODUCTION

This guide was prepared by Dr P.F. Walsh of CSIRO, with advice from !he Standards Auslralia Committee on Residential Slabs and Footings, to provide guidance to home owners on their responsibilities for the care of a clay foundation, and to discuss !he performance that can be expected from a footing system. (The ground that supports a house is called a foundation, and the concrete structure that transfers !he load to this foundation is the footing system).

The best infonnation about the design and construction of footing systems is contained in the Australian Standard 'AS 2870 - Residential Slabs and Footings'. That Standard gives a system of site classification, prescribed footing and slab designs and construction methods that provides an excellent footing system for Australian houses. However, a warning is given that the chance of a footing failure is higher if extreme site conditions, such as the following, are permitted to occur.

(a) planting of trees too close to a footing;
(b) excessive watering of gardens adjacent to the house;
(c) lack of maintenance of site drainag and
(d) failure to repair plumbing leaks.

The Standard further states that compliance with this guide is a way to avoid extreme site conditions,

Clay foundations are the cause of major problems for houses. Clays are very fine-grained soils that are plastic and sticky when wet, and hard and strong when dry. All clays swell or shrink to some degree as they become wet or dry out. 'Reactive' clays swell or shrink to such an extent that foundation movements can damage houses.

All house sites are classified. Reactive-clay sites are classified as M, H, or E, in order of increasing reactivily. Proper maintenance of such clay sites requires that the moisture content of the clay should be kepl reasonably constant.

Some minor cracking of masonry walls is almost inevitable despite proper design, construction and maintenance. Very slight crncks up to l mm wide could be expected in most houses. Larger cracks, up to 5 mm. may occur in some houses with properly designed and constructed footings, if reactive clay sites have been suhjecl to large changes of moisture. Cracks larger than 5 mm are regarded as significant damage.

F_urther information on these topics is given in the following sections. The guide has been updated to he consistent with the revised edition of AS 2870 which was published in 1989.

2. SITE CLASSIFICATION

AS 2870 requires all sites to be classified by an engineer or the builder. 'Ille emphasis has been placed on reactive clays that swell and shrink with changes of moisture content because these are the most common cause of problems. The classification system is fairly complicated but, as a general guide, the following may be helpful in understanding the system for clay sites.

S Clays that have not given trouble in the past.

M Moderately reactive clays that may cause minor damage to brick houses on old-style light strip footings. Moderately reactive clays are common and occur, for example, in eastern Melbourne and western Sydney.

H Highly reactive clays that often damage houses, patl1s and fences. Examples occur in northern and western Melbourne and in parts of Adelaide.

E Extremely reactive clays that frequently damage houses even with strong footings. No examples occur in major cities except Adelaide. Otkr occurrences include outback NSW, Darling f)wns and Horsham.

Since the precautions necessary depend on tl1 , ti· ,:-.· of the site, the owner should check the classi: .• tior is shown on the house plans.

The maintenance of the building and the site is the responsibility of tl1e owner, and so the owner should be familiar with the requirements of this guide.

3. CARE OF CLAY FOUNDATIONS

All clays move with changes of moisture content, so tl1e aim is lO minimise such changes in the clay by

- draining the site;
  keeping gardens and trees away from the house;
  adequate but modernte garden watering; and
- repairing plumbing leaks.

On a reactive-clay site tl1cre arc some restrictions on the way tlie owner can develop the garden around tl1c house. 111ese restrictions apply mainly to brick houses. In most cases, only minimal precautions arc justified for fnuncd houses clad with timber or sheeting.

The site must be well drained. Under no cin.:ums1m1ccs should water be allowed to lie against the house or even near the house. The ground immediately nexl 10 the

CSIRO Division of Building, Construction and Engineering, P.O . Box 56, Highett, Victoria 3190, Australia

Telephone: (03) 252 6000 Facsimile: (03) 252 6244 ISSN 0314-5956

house should be graded away with a slope of about 50 mm over the first metre. Suitable surracc drains should he provided to take the surface wutt:r away frvm the house. Where topsoil is brought in, it hould not inrerfere witb tbe site drainage. nor should it rai,e the ground level enough to block the weepholes in the brick walls *Cit* au;- subfloor vents.

Large garden beds are best not iocated near tbe house. This will avoid the possibility of introducing too mu<:h moisture to I.be foundation clay by over watering. 1lle zone near tJ1e house should be planned for paLl:!s or covered with 1uavel and ola.stic sheeting. Small shrubs may be plantedat reasonable spacings. -

Gardens and lawns should he watered adequately but not excessively. Uniform, consistent watering can he important to prevent damage to I.he foundation during dry spells such as droughts or dry summers.

Trees and large shrubs require substantial amounts of water, and if the soil near the tree drie our, the root. wm extend in search of soil moismre. Tree watering *is* important in late summer and in drought. The use of siow drip watering syslems may be appropriate. ft has also peen found useful to drill holes near trees and fill them with gravel to allow water betti.:r access to the tree root.s. Olherwi e. days will shrink as they dry. and a house may seUk as bown below.

Removal of large trees creates me opposite problem. As soil moisture is gradually restored, clays swell and may lift shallow footings.

Many factors determine I.he extent of clay drying by trees, and the more import.anl indude the soil type, the size and number of trees. and their species. Trees obtain moisture from roots that spread sideways and the drying zone is influenced by lhe e;;tent of these root.,. for single trees.. lhe drying wne is usually one-half ro twiee the tree height, but the zone may be larger for gmups or ruws of trees. Although it is known that the spedes can influence the extent and severity of the drying zone, little definite information is available. Some Australian trees are particularly efficient in extracting waler from vl!'f)' dry soils and can *be* more dangerous than non-Australia.'1 species !hat use large amounts of water in uormal conditions. The effect of tree drying on the amount of movement is also related 10 the. reactivity of the clay, To minimise the ri of damage, tre<!s (especially groups of trees) should not he planted near the hou.,c on a reactive clay site, and Illle following limi<sare re.::ommended.

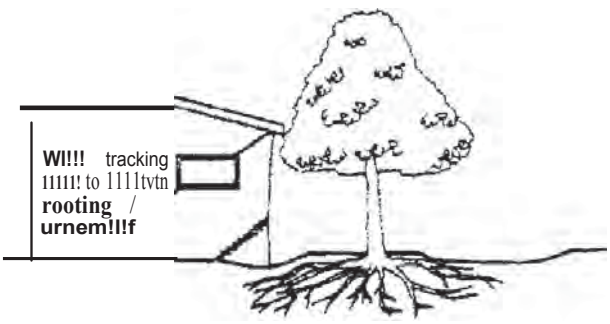
d • 1 1/2 h for Class E sites
d "" I h for Class H sites
d"' 3/4 h for Class M sites

wllere <i is the clistam.:e of I.he tree from the house, and h is the eventual mature height of I.be tree. These values should be increased by 50% if tbe trees are in a dense group. These rule& mean that on the average suburban block, trees that grow higher lhan 8 to 9 m are often impractical unless the owner accepts the risk of some dam.age to the house. If large trees are desire<l, it may **be** practicai to adopt a s iaHy designed footing system, e.g..apiled footing system,

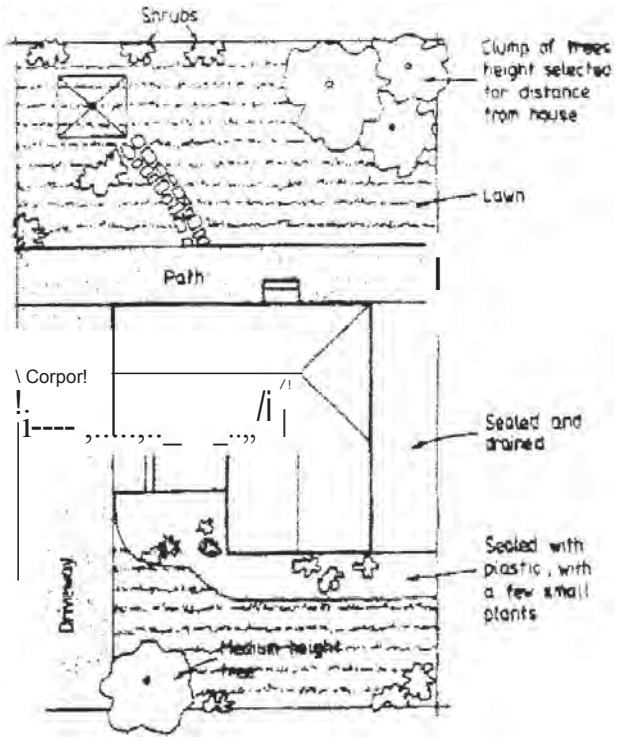
A leak in the plumbing can cause tile footings of a house on a reactive day to move. The water seeps into !he clay causing it to swell and push the footing system upwards. .....ny obvious leak. in. stormwater, drainage or SC\'"1erage pipes should be investigated. Leaking water pipes can he detected by turning off all the caps and checking if the water meter re.::ords any flow.

The abo\'e restrictions may seem onerous for new home ow'f!er:,, hut la...k of site n1aintenance on a ri.:active clav can cause damage to t:he house. still. the w bole issue shou111 be kept in some perspective. The damage to houses caused by reai:tive clays is mostly unsightly i..Tdckb in th..: brickwork. In the typical Au tralian brick· veneer house. the brickwork does not support the si1\Jct11re. It is !he timber frdillc that carries the walls and roof loads, so bride cracks do not affect the structural safety of !he house.

If owners choose *w* disregard some of the above restrictions and, say, plant large trees *all* around the house, 1.hcy ,hould nOi blame tlk: builder, !he engineer, or the Council if the house suffer, some cracking.



TREES CArnf!SHRL'\'KAGE AND DAMAGE



GARDEi",/S FOR REACTIVE *SITF.S*

4. PERFORMANCE OF FOOTING SYSTEMS

All building materials move. Concrete and timber shrink, bricks grow, and so on. Many building practices have been evolved to reduce the damage that such movements cause, and the minor difficulties that arise are usually repaired without significant problems.

The footing of a house is more likely to move on reactive clays. Some house walls may be more sensitive than usual, and may crack even though the footing system has performed its design task. Such cracking must be expected occasionally and this is expressed in the perfonnance requirements of AS 2870 (see Appendix A).

The performance requirement of AS 2870 suggests that Category O to I damage may be expected for houses on a reactive-clay site, but that the damage is of little consequence. Category 2 is clearly not satisfactory (isolated cracks up to 5 mm wide), but it still does not constitute significant failure and could be expected to occur under adverse conditions for the occasional house.

For these categories of damage, it is the intention of AS 2870 that consequent repairs are part of the normal house maimenance and are therefore the responsibility of the owner.

Nonetheless, to ensure that the damage does not proceed to a more serious state, the owner should take some action.

(a) Check that the recommendations on sire treatment, drainage, garden arrangement, trees etc., have **been** observed.

(b) Keep a record of the crack width against the time of the year. If the damage is as high as Calegory 2 and seems to be increasing, the owner should consult the builder who may be able to offer more specific advice. **If** this docs not prove satisfactory, the owner should engage a consulting engineer who specialises in house footings.

(c) Engage a plumber to check for leaks if this is suspected to be the cause.

(d) Replace soil moisture in dry spells by watering. Such watering can be more effective if holes or trenches are dug into the clay. The holes or trenches should be filled with compacted crushed **rock or** gravel and moderately watered. Some trees may need to be removed orkept pruned.

Complete stability is difficult to achieve, so repairs to damaged walls should include methods that will disguise further movements. Extra joints should be included in exremal masonry walls and further cracking in internal walls can be concealed by flexible paints, wall paper, or panelling. Repairing of cracks with brittle fillers should be avoided unless the cracks have stabilised.

For the more serious categories of damage, the steps to be taken are similar, except that there should be little delay in seeking advice. Remedial action for significant failure may still only include attention to stabilising moisture conditions as described above, but could also involve constructing a concrete wall in the ground to stop drying of the foundation clay. Underpinning is usually **not** satisfactory in reactive clays.

Experience indicates that lack of maintenance is responsible for many failures. Even with proper design and site maintenance the occasional failure may still occur because footing behaviour is so complex.

5. SHRINKAGE OF CONCRETE FLOORS

Concrere needs water. Firstly to allow the fresh concrete to flow and, secondly, to develop Slrength during its first few weeks. As a slab starts to dry, it shrinks and tries to contract. Some of this movement is restrained or resisted by friction on tbe bottom of the slab and by the beams in the ground. This restraint causes tension or stretching forces in the slab and these forces are ofren large enough to crack the slab.

Shrinkage cracking is almost inevitable and does not represent failure. Most owners never notice the cracks because they ofren do not occur until after the carpets are laid. Cracks under brittle or sensitive **floor** coverings are of concern but the risk of damage can be reduced by using flexible mortars 7Ullr glues for fixing slate and tiles, etc. Also it helps to delay installing the floor covering until after the shrinkage has occurred. The length of delay should be at least three months afrer the slab has started to dry (i.e. from the time the slab is last wet from rain or during construction.

6. ADHESIVE-FIXED FLOOR COVERINGS

A concrete slab takes a long time to dry. For example, under remperate conditions a slab will take about three months to dry. Moisture in the concrete can interfere with the bond or break down the adhesive used to attach floor coverings. However, a range of adhesives is available for various floor coverings and these should perform quite well on slabs that have been allowed to dry sufficiently.

7. CONCLUSION

This guide has been prepared to advise owners on how to care for the foundation of their houses and what to expect from a well-<lesigned footing system. The main concern with foundation mainrenance is to prevent the foundation soil becoming too wet or too dry, and a variety of recommendations are given to achieve this.

Additional information may be found in the following reports which are available from their publishers.

CSIRO (1985). 'House Cracking in Drought Periods', CSIRO Australia Information Sheet No. 10-88. Division of Building Research.

Cameron, D.A. and Earl, I. (1982). Trees and Houses: A Question of Function. Cement and Concrele **Association,** Melbourne.

Martin, K.G., Lewis, R.K., Palmer, R.E. and Walsh, P.F. (1983). Floor Coverings on Concrete Slab-on-ground. CSIRO Australia Division of Building Research Report.

Cameron. D.A. and Walsh, P.F. (1984). Damage to Buildings on Clay Soils. National Trust Technical Bullelin'5.l.

APPENDIX A

(This Appendix rorms an integral part or AS 2870-1988)

TABLE Al
CLASSIFICATION OF DAMAGE WITH REEERENCE TOW ALLS

Description of typical damage and required repair	Approximate crack width limit (see Note I)	Category and damage degree (see Note 2)
Hairline cracks.	<0.1 mm	0 Negligible
Fine cracks which do not need repair.	<Imm	1 Very slight
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5mm	2 Slight
Cracks can **be** repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	*5* to 15 mm (or a number number of cracks 3 to *5* mm in one group)	3 Moderate
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably (see Note 3), some loss of bearing in beains. Service pipes disrupted.	15 to 25 mm but also depends on number of cracks	4 Severe

TABLEA2
CLASSIFICATION OF DAMAGE WITH REFERENCE TO CONCRETE FLOORS

Description of typical damage	Approximate crack width limit in floor	Change in offset from a 3 m straight edge centred over defect (see Note 5)	Category and degree of damage
Hairline cracks, insignificant movement of slab from level.	<0.3mm	<8mm	0 Negligible
Fine but noticeable cracks. Slab reasonably level.	<l.0mm	< 10mm	I Very slight
Distinct cracks. Slab noticeably curved or changed in level.	<2.0mm	< 15mm	2 Slight
Wide cracks. Obvious curvature or change in level.	2to4rnm	15 to 25 mm	3 Moderate
Gaps in slab. Disturbing curvature or change in level.	4to 10mm	>25mm	4 Severe

NOTES:

L Crack width is the main factor, which may be supplemented by others, in assessing category of damage.

2. In assessing the degree of damage, account shall be taken of the location in the building or structure where it occurs, and also of the function of the building or structure.
3. Local deviation of slope, trom the horizontal or vertical, of more than 1/100 will normally be clearly visible. Overall deviations in excess of 1/150 are undesirable.
4. Account should be taken of the past history of damage in order to assess whether it is stable or likely to increase.
5. The straight edge is centred over the defect, usually a crack, and supported at its ends by equal height spacers. The change in offset is then measured relative to this straight edge.