

# 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: Lots 115 and 117 Mullewa-Wubin Road

Suburb: Wubin

State: W.A.

P/code: 6612

Local government area: Shire of Dalwallinu

Description of the planning proposal: Development of an Ammonium Nitrate Emulsion Plant

BMP Plan / Reference Number: 180091

Version: 1.0

Date of Issue:

Client / Business Name: Hanwha Mining Services

| 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)?  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| 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)? | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| <b>Is the proposal any of the following special development types (see SPP 3.7 for definitions)?</b>  |                                     |                                     |
| Unavoidable development (in BAL-40 or BAL-FZ)   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Strategic planning proposal (including rezoning applications)   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Minor development (in BAL-40 or BAL-FZ)   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| High risk land-use  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Vulnerable land-use   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |

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

|   |                                 |                                       |   |
|---|---------------------------------|---------------------------------------|---|
| <b>Name</b><br>Ian Macleod                | <b>Accreditation Level</b><br>1 | <b>Accreditation No.</b><br>BPAD39131 | <b>Accreditation Expiry</b><br>Nov 2018 |
| <b>Company</b><br>Bushfire Prone Planning |                                 | <b>Contact No.</b><br>6477 1144       |   |

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

14-3-18



# Bushfire Management Plan (Development Application)

---

Lot 115 on Plan 148784 and Lot 117 on Plan 150270  
Thomas Road & Mullewa-Wubin Road, Wubin

---

Shire of Dalwallinu

|                  |                  |
|------------------|------------------|
| Job Number:      | 180091           |
| Assessment Date: | 20 February 2018 |
| Report Date:     | 15 March 2018    |

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### **Disclaimer**

The measures contained in this Bushfire Management Plan are considered to be minimum standards and they do not guarantee that a building will not be damaged in a bushfire, persons injured, or fatalities occur either on the subject site or off the site while evacuating. This is substantially due to the unpredictable nature and behaviour of fire and extreme weather conditions. Additionally, the correct implementation of the required bushfire protection measures (and any associated response/evacuation plan if applicable) will depend, among other things, on the actions of the landowners or occupiers over which Bushfire Prone Planning has no control.

All surveys, forecasts, projections and recommendations made in this report associated with the project are made in good faith based on information available to Bushfire Prone Planning at the time.

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## Document Control

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|---------|------------------|----------------|
| 1.0     | Initial Document | 19-Mar-18      |
|         |                  | -              |
|         |                  | -              |

| Author | Accreditation | Signature |
|--------|---------------|-----------|
|--------|---------------|-----------|

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| Co-author |
|-----------|
|-----------|

| Reviewed/Approved |
|-------------------|
|-------------------|

Kathy Nastov

BPAD Level 3 - No. 27794



### Document Content Compliance Statement

*This Bushfire Management Plan (the Plan) provides the required information to address State Planning Policy No. 3.7: Planning in Bushfire Prone Areas - December 2015 (SPP 3.7), the associated Guidelines for Planning in Bushfire Prone Areas - WAPC 2017 v1.3 (Guidelines), and any additional information as directed by the WA Planning Commission (WA Department of Planning, Lands and Heritage). It is fit for accompanying a planning application.*

Complex DA BMP Template v1.0

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# 1 Executive Summary

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This BMP is to accompany a development application for the construction of an Ammonium Nitrate Emulsion Plant to service the mining industry in Western Australia. The proposed development site is currently farm land used for grazing.

An Environmental Management Plan has been produced for this development. The Plan states that the proposed development is not considered likely to have significant impact on the environment. The proposed site is predominantly cleared pasture and construction will not require the clearing of native vegetation, with the exception of the removal of vegetation in the Mullewa-Wubin road reserve for a driveway crossover.

It has been determined that the proposed development is a 'high-risk land use'. The proposed development is assessed to contain dangerous goods (Ammonium Nitrate, Calcium Nitrate, Diesel, Mineral Oil).

As the proposed development is considered a high risk land use Bushfire Prone Planning recommend a maximum radiant heat flux level of 10 kW/m<sup>2</sup> for the future buildings.

All buildings are required to be a minimum of 22.5 metres from the grassland vegetation. In some instances this will be achieved by the construction of hardstand areas around the proposed buildings. Where this is not applicable an Asset Protection Zone must extend into the existing Grassland and managed to comply with the requirements for Asset Protection Zones.

The proposed development consists of Class 8 buildings. These are not required to comply with AS3959-2009 and associated construction specifications. However, it is recommended that the proposed buildings be constructed to the specifications for a BAL-12.5 rating. This will provide protection against ember attack in the event of a bushfire.

## 2 The Proposal and Purpose of the Plan

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### 2.1 Details

---

Proponent: Hanwha Mining Services

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Site Address: Lot 115 on Plan 148784 and Lot 117 on Plan 150270  
Mullewa-Wubin Road, Wubin

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Local Government: Shire of Dalwallinu

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Lot Areas: Lot 115 – 103.98 ha  
Lot 117 – 40.272 ha

---

Planning Stage: Development application

---

Development Type: Construction of a Class 4 - Class 9 building

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#### Overview of the Proposal:

This BMP is to accompany a development application for the construction of an Ammonium Nitrate Emulsion Plant to service the mining industry. The proposed development site is currently farm land used for grazing.

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Bushfire Prone Planning  
Commissioned to Produce the Plan by: Hanwha Mining Services

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Purpose of the Plan: To Accompany a development application

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For Submission to: Shire of Dalwallinu

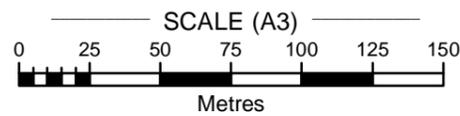
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Figure 1.1  
Proposed Development

Lot 117 on Plan 150270  
Thomas Road  
&  
Lot 115 on Plan 148784  
"no street address"  
WUBIN

**LEGEND**

-  Subject Area: Lots 115 & 117
-  Other Lots
-  Proposed Infrastructure



Aerial Imagery : Landgate/SLIP  
Image Date : Apr/Nov 2017

Coordinate System: GDA 1994 MGA Zone 50  
Projection: Universal Transverse Mercator Units: Metre  
Map compiled by: Russell Wornes  
Date map compiled/updated: 7/03/2018



Disclaimer and Limitation: This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.  
Document Path: G:\BushfireProne\Mapping\MXD's\180091\_Lots 115 & 117, Mulewa - Wubin Road, Wubin\_BMP( A3P)v18-3.mxd

Figure 1.2  
Proposed Development  
(SPATIAL CONTEXT)

Lot 117 on Plan 150270  
Thomas Road  
&  
Lot 115 on Plan 148784  
WUBIN

**LEGEND**

- Subject Area: Lots 115 & 117
- Other Lots
- Proposed Infrastructure

**Assessment Area**

- Vegetation - 150m

**Reserves & UCL**

- Unallocated Crown Land
- Reserve

**Roads**

|                       |                   |  |
|-----------------------|-------------------|--|
| National Highway      | Sealed            |  |
| State Highway/Freeway | Sealed - Unsealed |  |
| Main Road             | Sealed - Unsealed |  |
| Minor Road            | Sealed - Unsealed |  |

**SCALE (A3)**

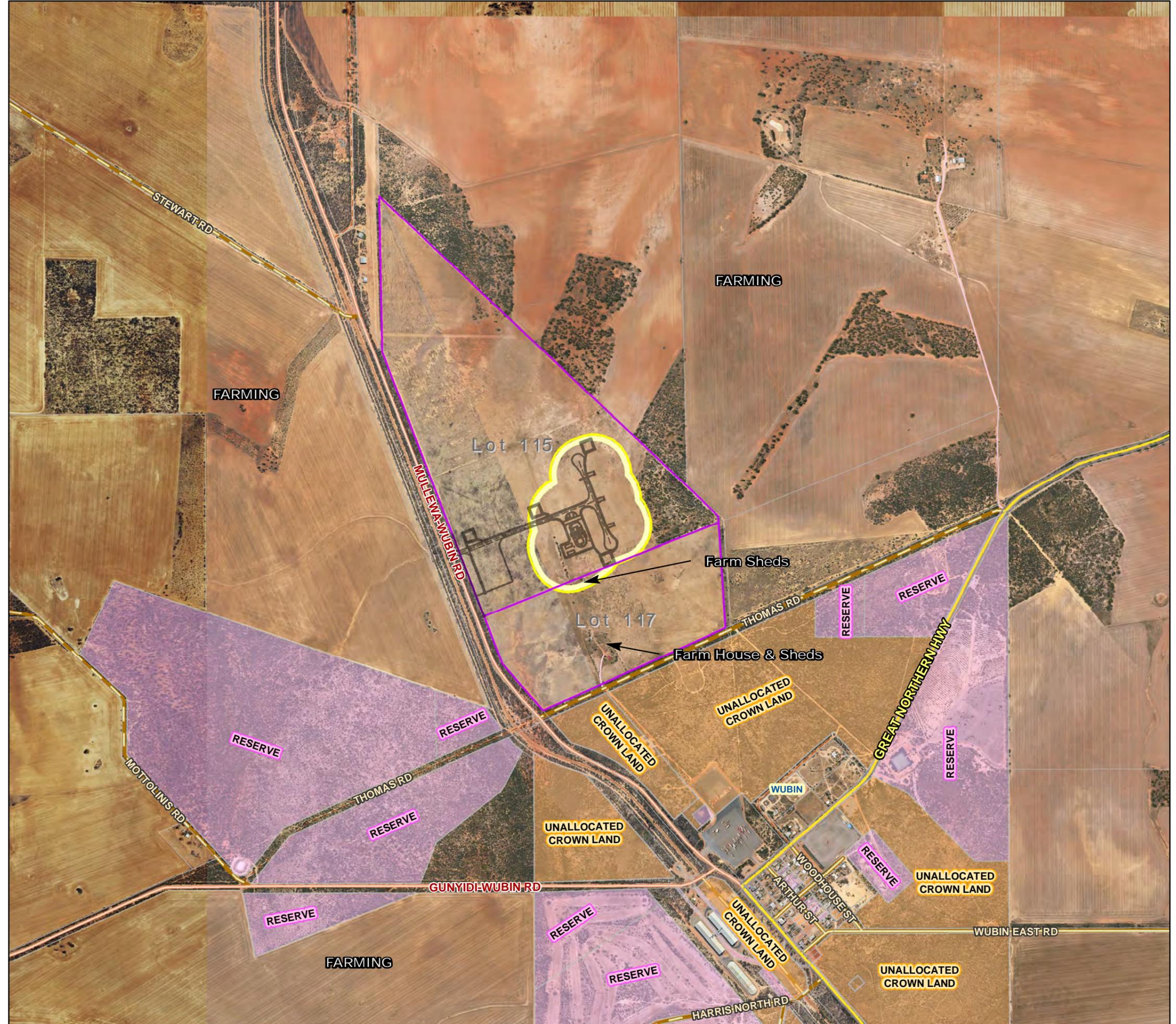
0 250 500 750 1,000  
Metres

**LOCALITY**

Aerial Imagery : Landgate/SLIP  
Image Date : Apr/Nov 2017  
Nov 2016

Coordinate System: GDA 1994 MGA Zone 50  
Projection: Universal Transverse Mercator Units: Metre

Map compiled by: Russell Wornes  
Date map compiled/updated: 2/03/2018



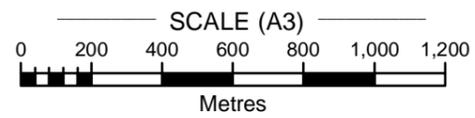
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Document Path: G:\BushfireProne\Mapping\MXD's\180091\_Lots 115 & 117, Mullewa - Wubin Road, Wubin\_BMP( A3P)v18-3.mxd

Figure 1.3  
Bushfire Prone Area

Lot 117 on Plan 150270  
Thomas Road  
&  
Lot 115 on Plan 148784  
"no street address"  
WUBIN

**LEGEND**

-  Subject Area: Lots 115 & 117
-  Other Lots
-  Proposed Infrastructure
-  Bushfire Prone Areas (2017)

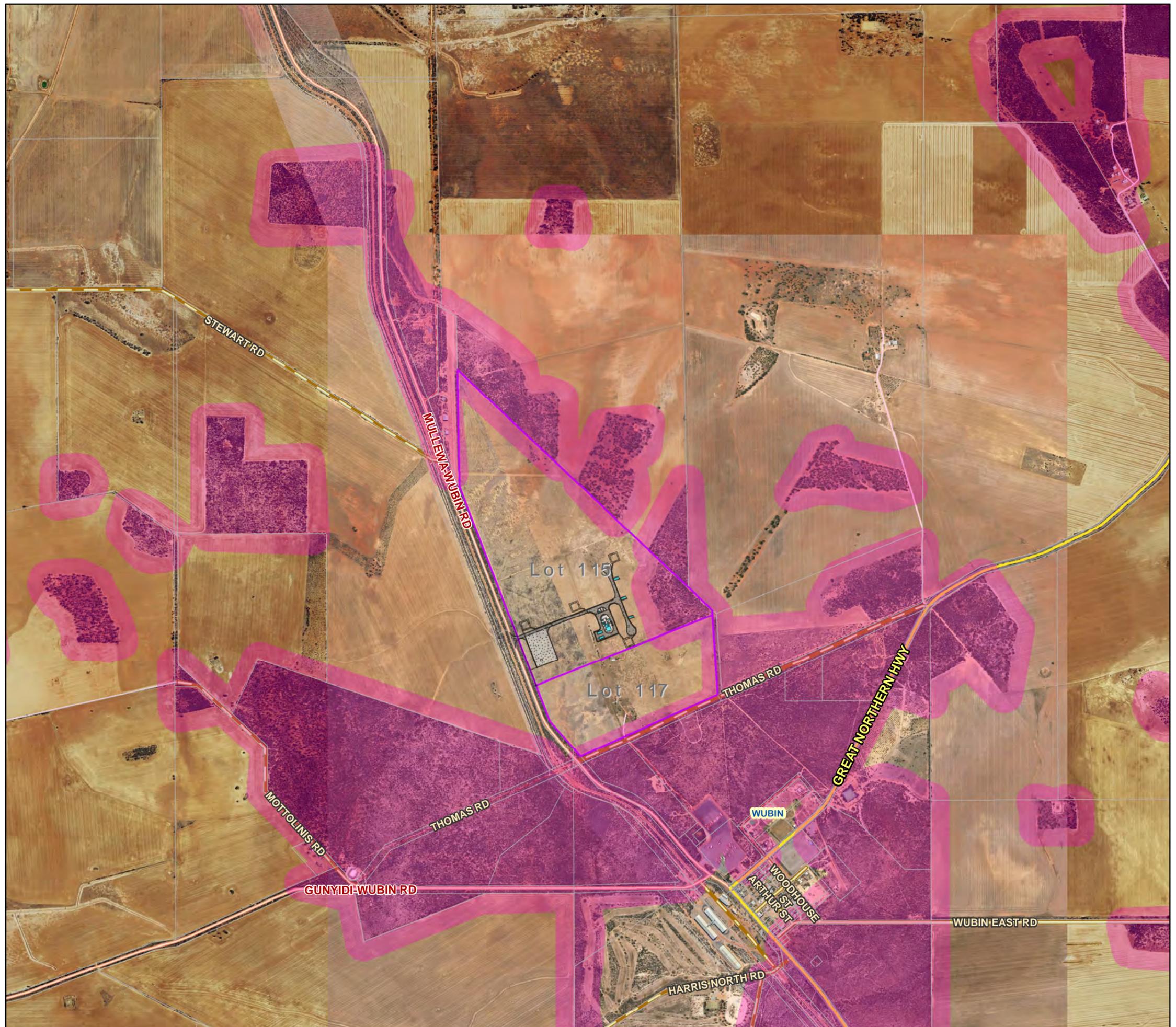


Aerial Imagery : Landgate/SLIP  
Image Date : Apr/Nov 2017  
& Nov 2016

Coordinate System: GDA 1994 MGA Zone 50  
Projection: Universal Transverse Mercator Units: Metre



Map compiled by: Russell Wornes  
Date map compiled/updated: 7/03/2018



## 2.2 Existing Documentation Relevant to the Construction of this Plan

This section acknowledges any known reports or plans that have been prepared for previous planning stages, that refer to the subject area and that may or will impact upon the assessment of bushfire risk and/or the implementation of bushfire protection measures and will be referenced in this Bushfire Management Plan.

| Relevant Documents              |                         |   |
|---------------------------------|-------------------------|---|
| Existing Document               | Copy Provided by Client | Title   |
| Proposal for Scheme Amendment   | Yes                     | Shire of Dalwallinu Town Planning Scheme No.2 Scheme Amendment No.2 |
| Environmental Report            | Yes                     | Ammonium Nitrate Emulsion Plant Environmental Management Plan       |
| Landscaping (Revegetation) Plan | No                      |   |
| Bushfire Risk Assessments       | No                      |   |

The Proposal for Scheme Amendment is now approved for the Additional Use for “Storage of Dangerous Goods and Associated Manufacturing” to Lots 115 and 117 on the corner of Mullewa-Wubin Road and Thomas Road.

The environmental report addresses the environmental acceptability of the proposal against relevant standards and policies.

## 2.3 High Risk Land Use

### Definition and Application

A 'high risk land use' is defined as "a land use which may lead to the potential ignition, prolonged duration and/or increased intensity of a bushfire. Such uses may also expose the community, firefighters and the surrounding environment to dangerous, uncontrolled substances during a bushfire event". The Guidelines provide examples of what constitutes a high-risk land use.

#### Required Additional Information – Flammable On-site Hazards

Development applications for a high-risk land use are to include a risk management plan that addresses the required bushfire risk management measures for any flammable onsite-hazards.

#### Required Additional Information - Inability to Comply with SPP 3.7

Proposed high risk land uses that cannot meet full compliance with SPP 3.7 and cannot fully comply with the bushfire protection criteria contained in the Guidelines, including if the proposed site is subject to BAL-40 or BAL-FZ, will generally not be supported unless:

1. Sufficient justification can be provided for support as 'unavoidable development' because the "development represents exceptional circumstances where full compliance with SPP 3.7 would be unreasonable as no alternative location exists and it can be proven that it is not contrary to the public interest", as determined by the decision maker.

*(Source: State Planning Policy No. 3.7: Planning in Bushfire Prone Areas - December 2015 (SPP 3.7) s7 and pm6.6 and Guidelines for Planning in Bushfire Prone Areas - WAPC 2017 v1.3 (Guidelines) s5.6.*

### Determination of High-Risk Land Use

It has been determined that the proposed development is a 'high-risk land use' as the proposed development is assessed to contain dangerous goods (Ammonium Nitrate, Calcium Nitrate, Diesel, Mineral Oil).

### Required Additional Information and its Location within this BMP

A risk management plan that addresses bushfire risk management measures for any flammable onsite-hazards to support the 'high-risk' land use.

✓

To be provided as bushfire specific content added to the proponents site specific management plans.

Create a responsibility for the landowner/occupier to inform persons on site of the existence and application of a Risk Management Plan containing bushfire risk management measures for any flammable onsite-hazards. Also to create a responsibility update the plan and continue to comply with the requirements

✓

Within Section 7

### 3 Environmental Considerations

#### 3.1 Native Vegetation – Modification and Clearing

**‘Guidelines’ s2.3:** “Many bushfire prone areas also have high biodiversity values. SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.”

Existing conservation areas that are potentially affected by the development proposal are required to be identified. This may result in vegetation removal/modification prohibition or limitations. These areas include National Parks, Nature Reserves, Wetlands and Bush Forever sites.

**Environmental Protection Act 1986:** “Clearing of native vegetation in Western Australia requires a clearing permit under Part V, Division 2 of the Act unless clearing is for an exempt purpose. Exemptions from requiring a clearing permit are contained in Schedule 6 of the Act or are prescribed in the Environmental Protection Regulations” (‘Guidelines’ s2.3).

**The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act):** This Act administered by the Australian Government Department of Environment, provides a national scheme of environment and heritage protection and biodiversity conservation. Nationally threatened species and ecological communities are a specific matter of significance. Areas of vegetation can be classified as a Threatened Ecological Community (TEC) under the EPBC Act and consequently have removal restrictions imposed.

#### Vegetation Modification and Clearing Assessment

|   |     |
|---|-----|
| Will on-site clearing of native vegetation be required?   | No  |
| Does this have the potential to trigger environmental impact/referral requirements under State and Federal environmental legislation?   | No  |
| Identified environmental legislation applicable to the Proposal site - No.1:  | N/A |
| Identified environmental legislation applicable to the Proposal site - No.2:  | N/A |
| For the proposed development site, have any areas of native vegetation been identified as species that might result in the classification of the area as a Threatened Ecological Community (TEC)? | No  |
| Potential TEC species identified:   | N/A |

An Environmental Management Plan has been produced for this development. The Plan states that the proposed development is not considered likely to have significant impact on the environment. The proposed site is predominantly cleared pasture and construction will not require the clearing of native vegetation, with the exception of the removal of vegetation in the Mullewa-Wubin road reserve for a driveway crossover.

## Impact on Adjoining Land

|  |            |
|--|------------|
| <p>Is this planning proposal able to implement the required bushfire measures within the boundaries of the land being developed so as not to impact on the bushfire and environmental management of neighbouring reserves, properties or conservation covenants?</p> | <p>Yes</p> |
|--|------------|

The proposed development can achieve Asset Protection Zone (APZ) requirements within the subject lot boundaries. Compliance is regulated via this Bushfire Management Plan for the site and the Shire of Dalwallinu annual Firebreak Order. Bushfire management measures external to the site are not required as part of this proposal.

### 3.2 Re-vegetation / Retained Vegetation / Landscape Plans

Riparian zones, wetland/foreshore buffers, road verges and public open space may have plans to re-vegetate or retain vegetation as part of the Proposal.

Vegetation corridors may join offsite vegetation and provide a route for fire to enter a development area.

When applicable, any such area will be identified in this Bushfire Management Plan and their impact on the assessment and future management accounted for.

|  |           |
|--|-----------|
| <p>Is re-vegetation of riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?</p>  | <p>No</p> |
| <p>Is the requirement for ongoing maintenance of existing vegetation in riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?</p> | <p>No</p> |

## 4 Potential Bushfire Impact Assessment

### 4.1 Assessment Input

#### 4.1.1 Fire Danger Index (FDI) Applied

AS 3959-2009 specifies the fire danger index values to apply for different regions as per Table 2.1. The values used in the model calculations are for the Forest Fire Danger Index (FFDI) and for which equivalent representative values of the Grassland Fire Danger Index (GFDI) are applied as per Appendix B. The values can be refined if appropriately justified.

Table 3.1: Applied FDI Value

| FDI Value            |                                 |                              |               |
|----------------------|---------------------------------|------------------------------|---------------|
| Vegetation Area      | As per AS 3959 - 2009 Table 2.1 | As per DFES for the Location | Value Applied |
| All vegetation areas | 80                              | N/A                          | 80            |

#### 4.1.2 Existing Vegetation Identification, Classification and Effective Slope

Vegetation identification and classification has been conducted in accordance with AS 3959-2009 s2.2.3 and the Visual Guide for Bushfire Risk Assessment in WA (DoP February 2016).

When more than one vegetation type is present, each type is identified separately with the worst-case scenario being applied as the classification. The predominant vegetation is not necessarily the worst-case scenario.

The vegetation structure has been assessed as it will be in its mature state (rather than what might be observed on the day). Areas of modified vegetation are assessed as they will be in their natural unmodified state (unless maintained in a permanently low threat, minimal fuel condition, satisfying AS 3959-2009 s2.2.3.2-f and asset protection zone standards). Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its revegetated mature state.

**Effective Slope:** Is the ground slope under the classified vegetation and is determined for each area of classified vegetation. It is the measured or determined slope which will most significantly influence the bushfire behaviour in that vegetation as it approaches a building or site. Where there is a significant change in effective ground slope under an area of classified vegetation, that will cause a change in fire behaviour, separate vegetation areas will be identified, based on the change in effective slope, to enable the correct assessment.

Table 3.2: Vegetation identification and classification.

| <b>All Vegetation Within 150 metres of the Proposed Development</b> |   |                                     |   |             |
|---|---|-------------------------------------|---|-------------|
| Vegetation Area   | Identified Classification Types <sup>1</sup> or Description if 'Excluded' | Applied Classification <sup>2</sup> | Effective Slope Under Classified Vegetation |             |
|   |   |                                     | degrees                                     | description |
| 1   | Sparse Open Tussock G-24<br>Sparse Open Herbfield G-28                    | Class G Grassland                   | 2   | Undulating  |
| 2   | Open Scrub D-14   | Class D Scrub                       | 1.2   | Downslope   |

Representative photos of each vegetation area, descriptions and classification justification, are presented on the following pages. The areas of classified vegetation are defined, and the photo locations identified on the topography and classified vegetation map, Figure 3.1.

Note<sup>1</sup>: As per AS 3959-2009 Table 2.3 and Figures 2.3 and 2.4 a-g

Note<sup>2</sup>: As per AS 3959-2009 Table 2.3.

**Vegetation Area 1**

**Classification Applied:** Class G Grassland

**Classification Justification:** Well grazed open paddocks, sparse grass ground cover.



Photo ID: 1a



Photo ID: 1b

**Vegetation Area 1**

**Classification Applied:** Class G Grassland

**Classification Justification:** Well grazed open paddocks, sparse grass ground cover.



Photo ID: 1c



Photo ID: 1d

**Vegetation Area 1**

**Classification Applied:** Class G Grassland

**Classification Justification:** Well grazed open paddocks, sparse grass ground cover.



Photo ID: 1e



Photo ID: 1f

**Vegetation Area 1**

**Classification Applied:** Class G Grassland

**Classification Justification:** Well grazed open paddocks, sparse grass ground cover.



Photo ID: 1g



Photo ID: 1h

**Vegetation Area 2**

**Classification Applied:** Class D Scrub

**Classification Justification:** Scrub and shrubs, <30% foliage cover, grass understorey sparse in places.



Photo ID: 2a



Photo ID: 2b

**Vegetation Area 2**

**Classification Applied:** Class D Scrub

**Classification Justification:** Scrub and shrubs, <30% foliage cover, grass understorey sparse in places.



Photo ID: 2c



Photo ID: 2d

Figure 3.1  
Topography &  
Classified Vegetation

Lot 117 on Plan 150270  
Thomas Road  
&  
Lot 115 on Plan 148784  
"no street address"  
WUBIN

**LEGEND**

- Subject Area: Lots 115 & 117
- Other Lots
- Proposed Infrastructure
- Elevation contour (m)

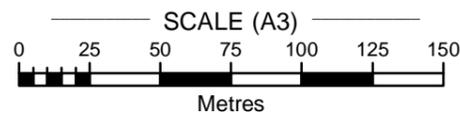
**Assessment Area**

- Vegetation - 150m

**Classified Vegetation**

- Class (D) Scrub
- Class (G) Grassland

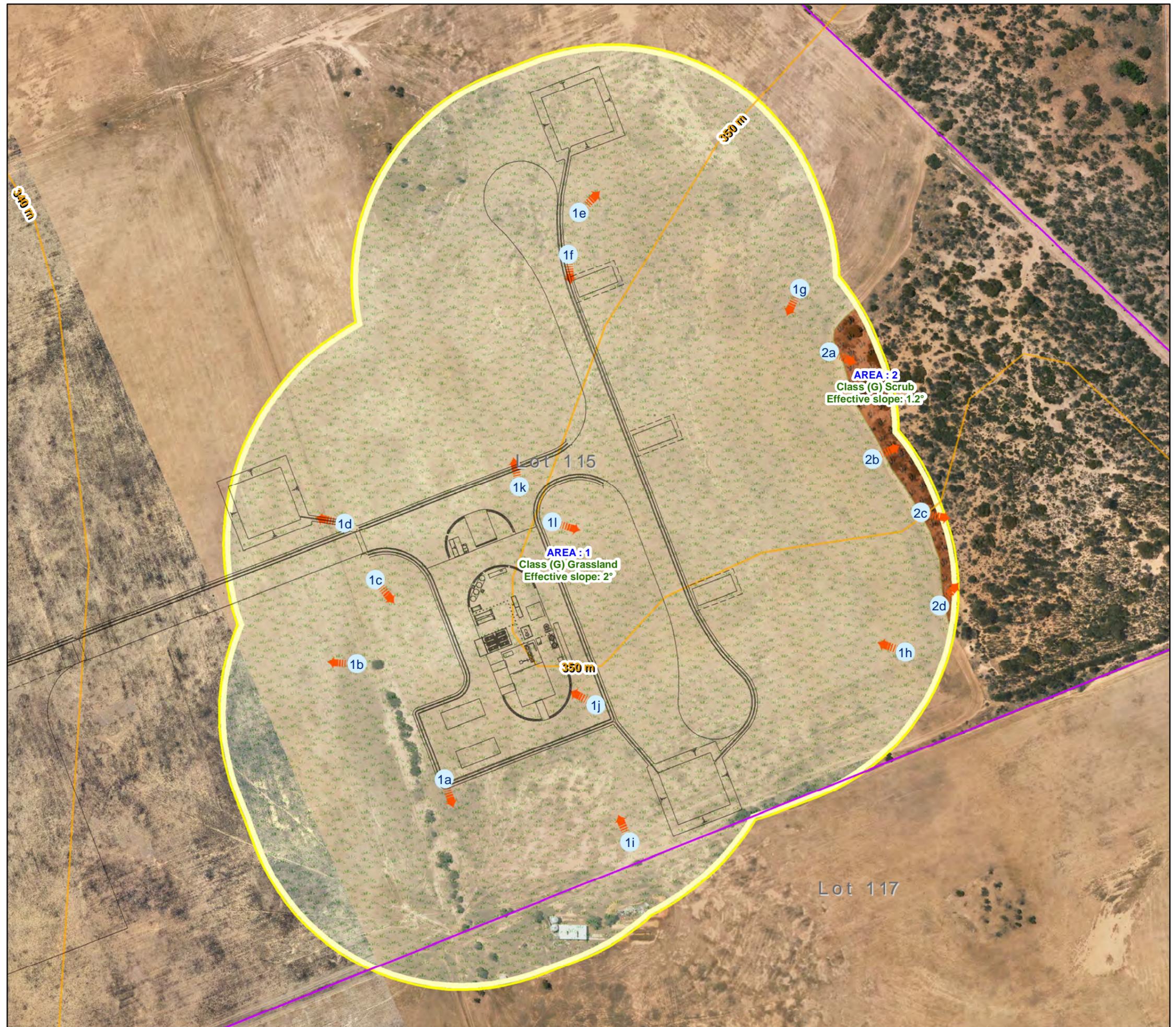
Photo no., location & direction



Aerial Imagery : Landgate/SLIP  
Image Date : Apr/Nov 2017

Coordinate System: GDA 1994 MGA Zone 50  
Projection: Universal Transverse Mercator Units: Metre

Map compiled by: Russell Wornes  
Date map compiled/updated: 7/03/2018



### 4.1.3 Vegetation Separation Distance

The vegetation separation distance is the horizontal distance from an existing building or planned building footprint to the start of an area of classified vegetation.

The separation distance can be:

- The actual distance – which will correspond to a single determined BAL rating. It can only be measured when the location of a building or building footprint is known; or
- A required distance or range of distances that correspond to a single BAL rating or varying BAL ratings. These calculated distances are used to indicate what BAL rating/s are achievable.

Required distances can be presented in this Plan in the following formats, dependant on the specific development proposal and the type of information most applicable:

- A distance that must be achieved to result in a stated BAL rating. This is presented as the Conditional BAL rating (conditional upon achieving the required separation distance);
- A table stating the separation distance range that, if achieved, would correspond to each BAL rating; or
- A map visually showing the separation distance range - from areas of classified vegetation that would remain post-development - that correspond to each BAL rating i.e. a BAL Contour Map.

Note:

Required (calculated) separation distances are presented in the 'Assessment Output' section as the BAL Contour Map and relevant tables to assist with its interpretation.

Required vegetation separation distances (calculated) to achieve stated BAL's are determined in this assessment and are presented in Section 3.2.



## 4.2 Assessment Output

### Understanding the Bushfire Assessment Results - Application of Bushfire Attack Levels (BAL)

The BAL rating has a different application in the building environment compared to the planning environment and the BAL assessment can result in a determined BAL or an indicative BAL which have different implications.

#### Building versus Planning Applications

In the building environment, a determined BAL rating is required (for the proposed construction) at the building application stage. This is to inform approval considerations and establish the construction standards that are to apply if approved. An indicative BAL rating is not acceptable for a building application.

In the planning environment, assessing the ability of a proposed development site to achieve BAL-29 or less is the objective (as one of the bushfire protection criteria being assessed). The 'development site' is defined by the LPS Amendment Regulations 2015 as "that part of a lot on which a building that is the subject of development stands or is to be constructed".

Therefore, being able to show that a BAL rating of BAL-29 or lower is achievable for a proposed development site (i.e. the building footprint) is an acceptable outcome for that criteria, as established by the bushfire provisions, SPP 3.7 and the associated Guidelines. For planning purposes, this BAL rating could be either indicative or determined.

#### Determined BAL Ratings

A determined BAL rating is to apply to an existing or proposed construction site (building) and not to a lot or envelope. Its purpose is to state the potential radiant heat flux to which the building will be exposed.

A determined BAL cannot be given for a future building whose location, elevation design and footprint (on a given lot) are unknown. It is not until these variables have been fixed that a BAL can be determined (typically at the development application or building application stage).

The one exception is when a building of **any dimension** can be **positioned anywhere** on a proposed lot or within defined limits within the lot (i.e. building setbacks or building envelope) and always remain subject to the same BAL rating. For this to be the case, there needs to be no classified vegetation either onsite or offsite that if retained could impact upon the determined BAL rating.

#### Indicative BAL Ratings

When this Plan presents a single indicative BAL rating for a proposed construction site (building), this will be because the construction is still subject to a location within the lot being confirmed and/or a vegetation separation distance being achieved. That is, it will be conditional upon some factor being confirmed at a later stage.

For planning applications associated with proposed lots, the building location, elevation design and footprint have typically not been established. Therefore, indicative rather than determined BAL rating/s will be presented for each lot (with the exception as noted above under 'Determined BAL Ratings').

When this Plan presents a single indicative BAL rating for a lot or building envelope (i.e. an 'area' that is not a located building footprint) it will represent the highest BAL rating affecting that 'area'. The BAL rating of a future building on that 'area' will be dependent on its eventual location.

Otherwise, this Plan will present all BAL ratings for each lot and for each BAL rating, the vegetation separation distances from each area of classified vegetation that are to apply. These distances will be presented as either figures in a table or as a BAL contour map.

From this indicative BAL information, it can be assessed if acceptable BAL ratings ( $\leq$  BAL-29) can be achieved for future buildings.

## 4.2.1 Indicative BAL Results Presented as a BAL Contour Map

### Interpretation of the Bushfire Attack Level (BAL) Contour Map

The contour map will present different coloured contour intervals constructed around the classified bushfire prone vegetation. These represent the different Bushfire Attack Levels that exist at varying distances away from the classified vegetation.

Each BAL represents a set range of radiant heat flux (as defined by AS 3959-2009) that can be generated by the bushfire in that vegetation at that location.

The width of each shaded contour (i.e. the distance interval) will vary and is determined by consideration of variables including vegetation type, fuel structure, ground slope, climatic conditions. They are unique to a site and can vary across a site. The width of each contour is a diagrammatic expression of the separation distances from the classified vegetation that apply for each BAL rating, for that site.

A building (or 'area') located within any given BAL contour will be subject to that BAL rating and potentially multiple BAL ratings of which the highest rating will be applied.

### Separation Distances Calculated to Construct the BAL Contours

As the proposed development is considered a high risk land use Bushfire Prone Planning recommend a maximum radiant heat flux level of 10 kW/m<sup>2</sup> for the proposed buildings. The calculated vegetation separation distances required to achieve this rating are shown in Table 3.3 below.

Table 3.3: Vegetation separation distances applied to construct the BAL contours.

| Calculated Vegetation Separation Distances |                           |                 |            |  |  |        |        |        |          |                      |
|--|---------------------------|-----------------|------------|--|--|--------|--------|--------|----------|----------------------|
| Vegetation Area                            | Vegetation Classification | Effective Slope | Site Slope | BAL Assessment Method Applied <sup>1</sup> | BAL Rating and Corresponding Separation Distance <sup>2</sup> (metres) |        |        |        |          |                      |
|  |                           | Degrees         |            |  | BAL-FZ   | BAL-40 | BAL-29 | BAL-19 | BAL-12.5 | 10 kW/m <sup>2</sup> |
|  |                           |                 |            |  |  |        |        |        |          |                      |
| 1  | Class G Grassland         | 2               | 0          | Method 1                                   | <7   | 7-<9   | 9-<14  | 14-<20 | 20-<22.5 | 22.5-<50             |
| 2  | Class D Scrub             | 1.2             | 0          | Method 1                                   | <11  | 11-<15 | 15-<22 | 22-<31 | 31-<33.9 | 33.9-<100            |

<sup>1</sup> Method 1 as per AS 3959-2009 Table 2.4.3 and Method 2 as per AS 3959-2009 Appendix B. The input variables applied, other than the calculation model defaults, are presented in Section 3.1 of this Plan.

<sup>2</sup> Copies of the summaries of Method 2 calculation inputs and outputs are presented in Appendix 4

Figure 3.2  
BAL Contour Map

Lot 117 on Plan 150270  
Thomas Road  
&  
Lot 115 on Plan 148784  
"no street address"  
WUBIN

**LEGEND**

- Subject Area: Lots 115 & 117
- Other Lots
- Proposed Infrastructure
- Asset Protection Zone (BAL 10)

**Assessment Area**

- Vegetation - 150m
- BAL Contour - 100m

**Bushfire Attack Levels**

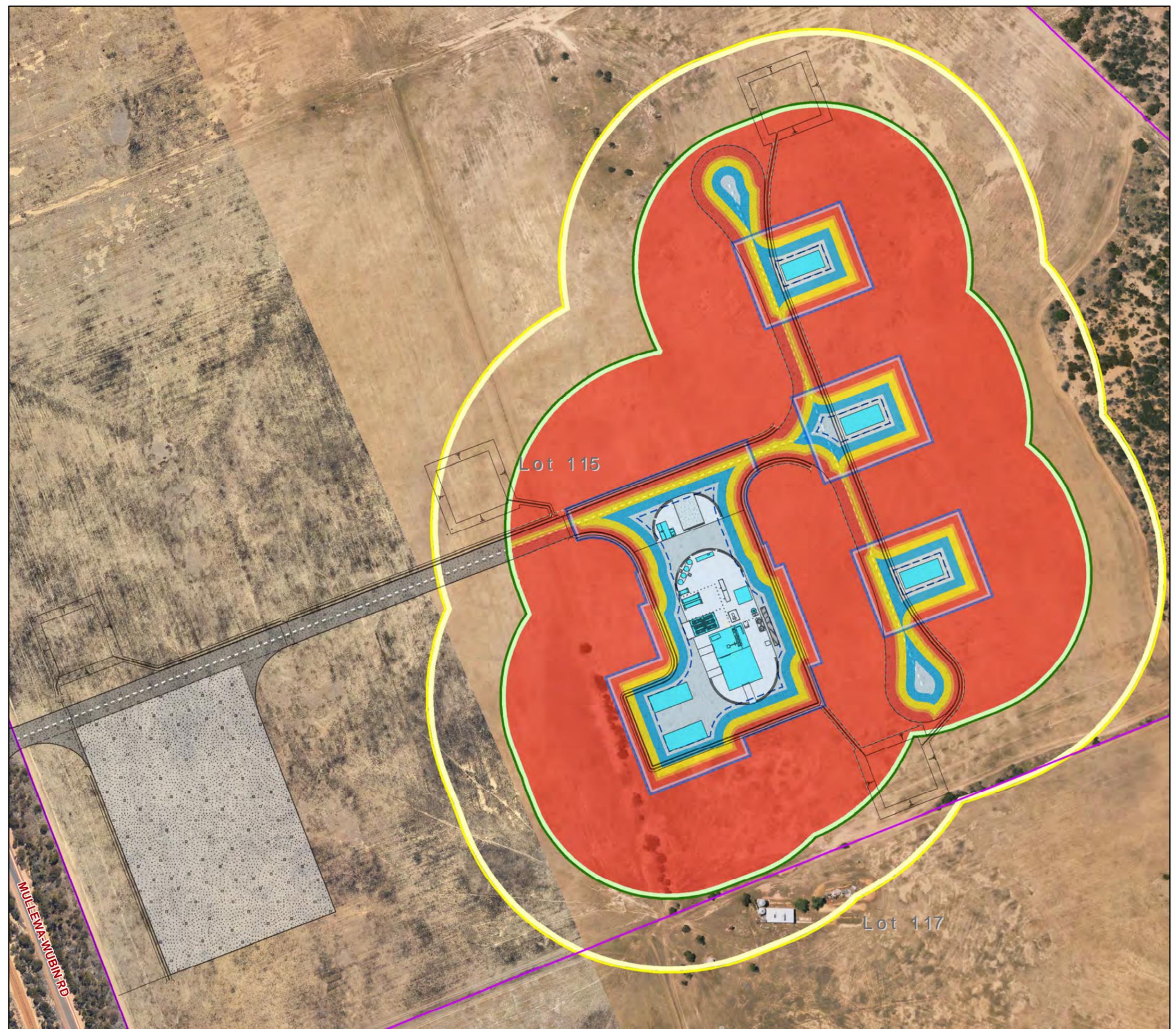
- Vegetation edge (Indicative only)
- BAL FZ (Indicative only)
- BAL 40 (Indicative only)
- BAL 29 (Indicative only)
- BAL 19 (Indicative only)
- BAL 12.5 (Indicative only)
- BAL 10 (indicative only)
- BAL LOW (Indicative only)



Aerial Imagery : Landgate/SLIP  
Image Date : Apr/Nov 2017

Coordinate System: GDA 1994 MGA Zone 50  
Projection: Universal Transverse Mercator Units: Metre

Map compiled by: Russell Wormes  
Date map compiled/updated: 8/03/2018



**Disclaimer and Limitation:** This map has been prepared for bushfire management planning purposes only. All depicted areas, contours and any dimensions shown are subject to survey. Bushfire Prone Planning does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.  
Document Path: G:\BushfireProne\Mapping\MXD's\180091\_Lots 115 & 117, Mullewa - Wubin Road, Wubin\_BMP(A3P)v18-3.mxd

## 4.2.2 Bushfire Attack Levels (BAL) Derived from The Contour Map

### **Deriving a BAL Rating for a Future Construction Site (Building) from the BAL Contour Map Data (Capacity to Issue a BAL Certificate)**

**Key Assumptions:** The actual location of a building within a lot or envelope (an 'area') has not been determined at this stage of planning; and the BAL ratings represent the BAL of an 'area' not a building.

#### **The BAL Rating is Assessed as Indicative**

If the assessed BAL for the 'area' is stated as being 'indicative', it is because that 'area' is impacted by more than one BAL contour interval and/or classifiable vegetation remains on the lot, or on adjacent lots, that can influence a future building's BAL rating (and this vegetation may have been omitted from being contoured for planning purposes e.g. Grassland or when the assumption is made that all onsite vegetation can be removed and/or modified).

In this report the indicative BAL is presented as either the highest BAL impacting the site or as a range of achievable BAL's within the site – whichever is the most appropriate.

The BAL rating that will apply to any future building within that 'area' will be dependent on:

1. vegetation management onsite; and/or
2. vegetation remaining on adjacent lots; and/or
3. the actual location of the future building within that 'area'.

A BAL Certificate cannot be provided for future buildings, within a lot or envelope with an indicative BAL, until the building location and in some instances building design (elevation), have been established and any required and approved vegetation modification/removal has been confirmed. Once this has occurred a report confirming the building location and BAL rating will be required to submit with the BAL certificate.

The required confirmation of the BAL rating must be done by a bushfire practitioner with the same level of accreditation as has been required to compile this Bushfire Management Plan. This is dependent on the type of calculations utilised (e.g. if performance based solutions have been used in the Plan BPAD Level 3 accreditation is required)

#### **The BAL Rating is Assessed as Determined**

If the assessed BAL for the lot or envelope is stated as being 'determined' it is because that lot or envelope is impacted by a single BAL contour interval. This BAL has been determined by the existence (or non-existence) of classified vegetation outside the lot or envelope, and no classifiable vegetation currently exists on the lot or envelope (i.e. it has been cleared to a minimal fuel, low bushfire threat state). In the situation where the BAL Contour Map has been constructed around multiple lots, there also needs to be no classifiable vegetation on an adjacent lot if this vegetation has not already been incorporated into the creation of the BAL Contour Map.

As a result, a determined BAL can be provided in this limited situation because:

1. No classified vegetation is required to be removed or modified to achieve the determined BAL, either within the lot/envelope or on adjacent lots (or if vegetation is excluded from classification, it is reasonable to assume it will be maintained in this state into the future); and
2. A future building can be located anywhere within the 'site' and be subject to the determined BAL rating; and
3. The degree of certainty is more than sufficient to allow for any small discrepancy that might occur in the mapping of the BAL contours.

For a determined BAL rating for a lot/envelope, A BAL Certificate (referring to this BMP) can be provided for a future building, if the BMP remains current.

Table 3.4: Indicative bushfire attack levels for the proposed development.

| <b>Indicative Bushfire Attack Levels for Future Buildings on Subject Lots</b><br>(with required BAL-10 building setback stated) |   |   |
|---|---|---|
| Relevant Fire Danger Index (AS 3959-2009 Table 2.1)   |   | 80  |
| Highest Indicative BAL Impacting the Proposed Buildings   | BAL Determination Method Applied (AS 3959-2009)   | 10 kW/m <sup>2</sup><br>Building Setback (metres) |
| BAL-10 (10 kW/m <sup>2</sup> )  | Method 1 as per AS 3959-2009 s2.2.6 and Table 2.4.3. and Method 2 as per AS 3959-2009 Appendix B. | 22.5  |

All buildings are required to be a minimum of 22.5 metres from Vegetation Area 1. In some instances this will be achieved by the construction of hardstand areas around the proposed buildings. Where this is not applicable the Asset Protection Zone must extend into the existing Grassland and be managed to comply with the requirements for Asset Protection Zones (See Appendix 1).

See Section 3.2.1 Figure 3.2 for indicative representation of the required Asset Protection Zones.

## 5 Identification of Bushfire Hazard Issues

---

With the exception of a relatively small area of scrub (7ha), which is greater than 100 metres from the proposed development, the whole of the subject lots are undulating grassland pasture ranging from 0-5 degrees in slope. This is considered a moderate bushfire hazard level.

The greater portion of land surrounding the subject lots is utilised for farming either stock or crops. Some local natural bush areas abut the subject lot boundaries. Areas of native vegetation exist in Crown Reserves and Unallocated Crown Land to the south of the subject lots but are over 500 metres from the proposed development.

## 6 Assessment Against the Bushfire Protection Criteria (BPC)

### 6.1 Bushfire Protection Criteria - Assessment Summary

| Summarised Outcome of the Assessment Against the Bushfire Protection Criteria (BPC) |   |   |  |  |
|---|---|---|--|--|
| Element   | Basis for the Assessment of Achieving the Intent of the Element           |   |  |  |
|   | Achieves compliance with the Element through meeting Acceptable Solutions |   | Achieves compliance with the Element by application of a Performance Based Solution  | Minor or Unavoidable Development                               |
|   | Meets all relevant acceptable solutions                                   | One or more relevant Acceptable Solutions are not <u>fully</u> met. A <u>variation</u> of the solution is provided and justified. | One or more applicable Acceptable Solutions are not met. A solution is developed with the summary presented in this Plan in Section 5.5. The supporting document presenting Bushfire Prone Planning's detailed methodology is submitted separately to the decision makers. | The required supporting statements are presented in this Plan. |
| Location  | ✓   |   |  | N/A  |
| Siting and Design of Development  | ✓   |   |  |  |
| Vehicular Access  | ✓   |   |  |  |
| Water   | ✓   |   |  |  |

The subject Proposal has been assessed against:

1. The requirements established in Appendix 4 of the Guidelines for Planning in Bushfire Prone Areas, WAPC 2017 v1.3 (the 'Guidelines'). The detail, including technical construction requirements, are found at <https://www.planning.wa.gov.au/8194.aspx>. A summary of relevant information is provided in the appendices of this Plan; and
2. Any endorsed variations to the Guideline's acceptable solutions and associated technical requirements that have been established by the relevant local government. If known and applicable these have been stated in Section 5.2 of this Plan with the detail included as an appendix if required by the relevant local government.

## 6.2 Local Government Variations to Apply

Local governments may add to or modify the acceptable solutions of the Bushfire Protection Criteria (BPC) and/or apply technical requirements that vary from those specified in the Guidelines for Planning in Bushfire Prone Areas (WAPC). In such instances, this Proposal will be assessed against these variations and/or any specific local government technical requirements for emergency access and water. Refer to Appendices 2 and 3 for relevant technical requirements.

|  |    |
|--|----|
| Will local or regional variations to the acceptable solutions (endorsed by WAPC / DFES) and/or the technical requirements contained in the Guidelines, apply to this Proposal. | No |
|--|----|

## 6.3 Bushfire Protection Criteria – Acceptable Solutions Assessment Detail

### 6.3.1 Element 1: Location

| <b>Bushfire Protection Criteria Element 1: Location</b><br>Assessment Statements and Bushfire Protection Measures to be Applied   |                            |  |  |
|---|----------------------------|--|--|
| <b>Intent:</b> To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure. |                            |  |  |
| Acceptable Solution:  | A1.1: Development Location | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution will be fully met. |

The proposed development achieves compliance by:

- Being located in an area where the bushfire hazard level assessment within 100m of the external boundary of the subject site is or will on completion, be moderate or low; and
- Managing the remaining bushfire risk to an acceptable level by the existence/implementation and ongoing maintenance of all required bushfire protection measures, as identified within this Plan. These measures include the requirements for vegetation management, vehicular access and firefighting water supply.

The proposed development is located within undulating grassland pasture of less than 10 degrees slope. The bushfire hazard level within 100 metres of the development site is assessed as moderate.

## 6.3.2 Element 2: Siting and Design of Development

### Bushfire Protection Criteria Element 2: Siting and Design of Development

Assessment Statements and Bushfire Protection Measures to be Applied

**Intent:** To ensure that the siting and design of development (note: not building/construction design) minimises the level of bushfire impact.

|                      |                             |  |  |
|----------------------|-----------------------------|--|--|
| Acceptable Solution: | A2.1: Asset Protection Zone | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution will be fully met. |
|----------------------|-----------------------------|--|--|

The proposed development achieves compliance by:

- Ensuring future building work on the lots can have established around it an APZ of the required dimensions - to ensure that the potential radiant heat from a bushfire to impact future buildings, does not exceed 29 kW/m<sup>2</sup> (i.e. a BAL rating of BAL-29 or less will apply to determine building construction standards);
- The APZs can be established fully within the lot boundaries; and
- The landowner/s having the responsibility of continuing to manage the required APZ as low threat vegetation in a minimal fuel state, by maintaining the APZ to the required dimensions and standard, including compliance with the local government's annual firebreak notice.

The required APZ dimensions are set out in Section 3.2.2 Table 3.4. The APZ technical requirements (Standards) are detailed in Appendix 1.

As the proposed development is considered high risk land use and this development is additionally not required to comply with the construction standards of AS3959-2009, a maximum BAL rating of BAL-10 (10 kW/m<sup>2</sup>) is recommended for the buildings. This will reduce the radiant heat impact on the buildings and provide greater separation from ember attack.

### 6.3.3 Element 3: Vehicular Access

#### Bushfire Protection Criteria Element 3: Vehicular Access Assessment Statements and Bushfire Protection Measures to be Applied

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

|                      |                            |  |                                       |
|----------------------|----------------------------|--|---------------------------------------|
| Acceptable Solution: | A3.1:<br>Two access routes | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution is fully met. |
|----------------------|----------------------------|--|---------------------------------------|

The Mullewa-Wubin Road provides safe access and egress to two different destinations. As a sealed public road, it is available to all residents and the public at all times and under all weather conditions.

|                      |                     |  |                                       |
|----------------------|---------------------|--|---------------------------------------|
| Acceptable Solution: | A3.2<br>Public Road | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution is fully met. |
|----------------------|---------------------|--|---------------------------------------|

No new public roads are to be constructed for this development. The existing Mullewa-Wubin Road complies with the technical requirements.

|                      |   |  |  |
|----------------------|---|--|--|
| Acceptable Solution: | A3.3<br>Cul-de-sacs (including a dead-end road) | Method of achieving Element compliance and/or the Intent of the Element: | N/A  |
| Acceptable Solution: | A3.4: Battle-axe                                | Method of achieving Element compliance and/or the Intent of the Element: | N/A  |
| Acceptable Solution: | A3.5: Private Driveways                         | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution will be fully met. |

The construction technical requirements established by the Guidelines and/or the local government will and will be complied with. These requirements are set out in Appendix 2.

|                      |                                    |  |  |
|----------------------|------------------------------------|--|--|
| Acceptable Solution: | A3.6<br>Emergency Access Way       | Method of achieving Element compliance and/or the Intent of the Element: | N/A  |
| Acceptable Solution: | A3.7<br>Fire Service Access Routes | Method of achieving Element compliance and/or the Intent of the Element: | N/A  |
| Acceptable Solution: | A3.8<br>Firebreak Width            | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution will be fully met. |

The proposed lots will comply with the requirements of the local government annual firebreak notice issued under s33 of the Bush Fires Act 1954. Firebreaks to be installed prior to development clearance.

## 6.3.4 Element 4: Water

### Bushfire Protection Criteria Element 4: Water Assessment Statements and Bushfire Protection Measures to be Applied

**Intent:** To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

|                      |                        |  |     |
|----------------------|------------------------|--|-----|
| Acceptable Solution: | A4.1 Reticulated Areas | Method of achieving Element compliance and/or the Intent of the Element: | N/A |
|----------------------|------------------------|--|-----|

A reticulated water supply is not currently available to the site. The closest hydrant is located approximately 2.5 kilometres south of the proposed development on Glowrey Street in the Wubin townsite.

|                      |  |  |  |
|----------------------|--|--|--|
| Acceptable Solution: | A4.2 Non-Reticulated Areas                   | Method of achieving Element compliance and/or the Intent of the Element: | N/A  |
| Acceptable Solution: | A4.3 Non-reticulated Areas (Individual Lots) | Method of achieving Element compliance and/or the Intent of the Element: | The acceptable solution will be fully met in the future. |

The proposed development will have installed a minimum of 50,000 litres of stored water for firefighting purposes, by the developer, prior to occupancy.

The construction technical requirements established by the Guidelines and/or the local government can and will be complied with. These requirements are set out in Appendix 3.

## 6.4 Additional Information for Required Bushfire Protection Measures

The purpose of this section of the Plan is:

- As necessary, to provide additional detail (to that provided in the tables of Section 5.3) regarding the implementation of the acceptable solutions for those persons who will have the responsibility to apply the stated requirements;
- As necessary, to detail specific onsite vegetation management requirements such as the APZ dimensions, management of Public Open Space or application of landscaping plans for onsite vegetation;
- To discuss how staged development will be handled, if applicable; and
- As relevant, for future planning stages, consider and discuss the requirements that may apply to future planning applications and the content of the associated BMP. In particular:
  - Any potential Vulnerable or High-Risk Land Uses.
  - Any additional content that will be required in the future BMP.

### 6.4.1 Vegetation Management

#### **Asset Protection Zone (APZ) Dimensions that are to Apply**

The required dimensions of the APZ will vary dependent upon the purpose for which the APZ has been defined. There are effectively three APZ dimensions that can apply:

1. An application for planning approval will be required to show that an APZ can be created which is of sufficient size to ensure the potential radiant heat impact of a fire does not exceed  $29\text{kW/m}^2$  (BAL-29); and
2. If the assessment has determined a BAL rating for an existing or future building is less than BAL-29, the APZ must be of sufficient size to ensure the potential radiant heat impact of a fire does not exceed the  $\text{kW/m}^2$  corresponding to the lower assessed BAL rating; or
3. Complying with the relevant local government's annual firebreak notice may require an APZ of greater size than that defined by the two previous parameters.

The dimensions (vegetation separation distances) that are to apply to the APZ for this Proposal are presented in the tables below.

| <b>The 'Determined BAL-10' APZ</b>                 |                                   |   |                                   |   |                                      |
|--|-----------------------------------|---|-----------------------------------|---|--------------------------------------|
| Required Minimum Dimensions for the Subject Site   |                                   |   |                                   |   |                                      |
| Relevant Fire Danger Index (AS3959-2009 Table 2.1) |                                   |   |                                   |   | 80                                   |
| BAL Determination Method                           |                                   | Method 2 (as per AS 3959-2009 Appendix B) |                                   |   |                                      |
| Vegetation Area                                    | Applied Vegetation Classification | Effective Slope (degrees)                 | Determined Bushfire Attack Level  | Minimum Separation Distance Required (metres) | Current Separation Distance (metres) |
| 1  | Class G Grassland                 | 2   | BAL-10<br>(10 kW/m <sup>2</sup> ) | 22.5  | 0                                    |
| 2  | Class D Scrub                     | 1.2                                       |                                   | 33.9  | 131                                  |

| <b>'Local Government Firebreak Notice APZ'</b>  |  |
|---|--|
| Required Minimum Dimensions for the Subject Site  |  |
| Requirement Set By:   | Shire of Dalwallinu  |
| Minimum Dimensions:   | See Shire of Dalwallinu Bush Fire Information notice.  |
| Other Conditions:   | If Asset Protection Zone technical requirements are defined in the Notice, the standards and dimensions may differ from the Guideline's APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with. Refer to Appendix 1. |
| This requirement has been established through the stated local government's annual fire break notice issued under the Bushfires Act 1954 s33. |  |

See Section 3.2.1 Figure 3.2 for indicative representation of the required Asset Protection Zones.

## 6.5 Recommended Bushfire Protection Measures

These recommendations are for measures that are not directly considered by SPP 3.7 and the associated Guidelines, including the bushfire protection criteria.

These measures are recommended by the bushfire consultant to improve the safety of property occupants and the resilience of buildings in the event of a bushfire impacting the property.

The proposed development consists of Class 8 buildings. These are not required to comply with AS3959-2009 and the associated construction specifications. However, it is recommended that the proposed buildings be constructed to the specifications for a BAL-12.5 rating. This will provide protection against ember attack in the event of a bushfire.

## 7 Responsibilities for Implementation and Management of the Bushfire Protection Measures

Table 6.1: BMP Implementation responsibilities prior to lot sale, occupancy or building for the Landowner (Developer).

| <b>LANDOWNER (DEVELOPER) - PRIOR TO LOT SALE, OCCUPANCY OR BUILDING</b> |   |
|---|---|
| No.   | Implementation Actions  |
| 1   | <p>The local government may condition a development application approval with a requirement for the landowner/proponent to register a notification onto the certificate of title (it may also need to be included on the deposited plan).</p> <p>This will be done pursuant to Section 70A Transfer of Land Act 1893 as amended ('Factors affecting use and enjoyment of land, notification on title:'). This is to give notice of the bushfire hazard and any restrictions and/or protective measures required to be maintained at the owner's cost.</p> <p>This condition ensures that:</p> <ol style="list-style-type: none"> <li>1. Landowners/proponents are aware their lot is in a designated bushfire prone area and of their obligations to apply the stated bushfire risk management measures; and</li> <li>2. Potential purchasers are alerted to the Bushfire Management Plan so that future landowners/proponents can continue to apply the bushfire risk management measures that have been established in the Plan.</li> </ol> |
| 2   | <p>Prior to occupancy and post planning approval, the entity responsible for having the BMP prepared should ensure that anyone listed as having responsibility under the Plan has endorsed it and is provided with a copy for their information and informed that it contains their responsibilities. This includes the landowners/proponents (including future landowners where the Plan was prepared as part of a subdivision approval), local government and any other authorities or referral agencies ('Guidelines' s4.6.3).</p>   |
| 3   | <p>Prior to occupancy of the proposed development the subject lot it is to be compliant with the relevant local government's annual firebreak notice issued under s33 of the Bushfires Act 1954.</p>  |
| 4   | <p>Prior to occupancy, establish the Asset Protection Zone (APZ) around the development and on the lot to the dimensions and standard stated in the BMP. This is the responsibility of the developer.</p>   |
| 5   | <p>Prior to occupancy, install the required emergency static water supply (50,000 litre tank within the lot) and associated vehicle access, to the standards stated in the BMP.</p>   |
| 6   | <p>Prior to occupancy, install the private driveways to the standards stated in the BMP.</p>  |
| 7   | <p>Prior to use of the buildings, there is an outstanding obligation created by this Bushfire Management Plan to develop and have approved, the required risk management plan that addresses bushfire risk management measures for onsite flammable hazards, as directed in Section 1.3.</p>  |
| 8   | <p>Prior to any building work, inform the builder of the existence of this Bushfire Management Plan and the responsibilities it contains, regarding the required construction standards. This will be:</p>  |

- The standard corresponding to the determined BAL rating, as per the bushfire provisions of the Building Code of Australia (BCA); and/or
- A higher standard as a result of the BMP establishing that construction is required at a standard corresponding to a higher BAL rating.

Table 6.2: Ongoing management responsibilities for the Landowner/Occupier.

| <b>LANDOWNER/OCCUPIER - ONGOING</b> |  |
|-------------------------------------|--|
| No.                                 | Ongoing Management Actions   |
| 1                                   | Maintain the Asset Protection Zone (APZ) to the dimensions and standard stated in the BMP.   |
| 2                                   | Comply with the Shire of Dalwallinu Bush Fire Information notice issued under s33 of the Bush Fires Act 1954.  |
| 3                                   | Maintain vehicular access routes within the lot to the required surface condition and clearances as stated in the BMP.   |
| 4                                   | Maintain the emergency water supply tank and its associated fittings and vehicular access in good working condition.   |
| 5                                   | Ensure that any builders (of future structures on the lot) are aware of the existence of this Bushfire Management Plan and the responsibilities it contains regarding the application of construction standards corresponding to a determined BAL rating.  |
| 6                                   | Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with: <ol style="list-style-type: none"> <li>1. the requirements of the WA Building Act 2011 and the bushfire provisions of the Building Code of Australia (BCA); and</li> <li>2. with any identified additional requirements established by this BMP or the relevant local government.</li> </ol> |
| 7                                   | To consider, implement and maintain, as relevant and able, any bushfire protection measures that have been <u>recommended</u> by the bushfire consultant (refer to Section 5.5), in addition to the measures that are <u>required</u> to be implemented and maintained.  |
| 8                                   | The Risk Management Plan containing bushfire risk management measures for flammable onsite hazards must be reviewed each year and relevant information updated. All required measures must continue to be complied with.   |

Table 6.3: Ongoing management responsibilities for the Local Government.

| <b>LOCAL GOVERNMENT - ONGOING</b> |   |
|-----------------------------------|---|
| No.                               | Ongoing Management Actions  |
| 1                                 | Monitor landowner compliance with the Bushfire Management Plan and the annual Bush Fire Information notice. |

## Appendix 1 - Onsite Vegetation Management Technical Requirements

It is the responsibility of the landowner to maintain the established bushfire protection measures on their property. Not complying with these responsibilities can result in buildings being subject to a greater potential impact from bushfire than that determined by the assessed BAL rating presented in this Bushfire Management Plan.

For the management of vegetation within a lot (i.e. onsite) the following technical requirements exist:

1. **The APZ:** Installing and maintaining an asset protection zone (APZ) of the required dimensions to the standard established by the Guidelines for Planning in Bushfire Prone Areas (WA Planning Commission, as amended). When, due to the planning stage of the proposal to which this Bushfire Management Plan applies, defined APZ dimensions are known and are to be applied to existing or future buildings – then these dimensions are stated in Section 5.4.1 of this Plan.
2. **The Firebreak/Fuel Load Notice:** Complying with the requirements established by the relevant local government's annual firebreak notice issued under s33 of the Bushfires Act 1954. Note: If an APZ requirement is included in the Notice, the standards and dimensions may differ from the Guideline's APZ Standard – the larger dimension must be complied with.
3. **Changes to Vegetated/Non-Vegetated Areas:**
  - a. If applicable to this Plan, the minimum separation distance from any classified vegetation, that corresponds to the determined BAL for a proposed building, must be maintained as either a non-vegetated area or as low threat vegetation managed to a minimal fuel condition as per AS 3959-2009 s2.2.3.2 (e) and (f). Refer to Part 4 of this Appendix 1.
  - b. Must not alter the composition of onsite areas of classified vegetation (as assessed and presented in Section 3.1.2) to the extent that would require their classification to be changed to a higher bushfire threat classification (as per AS 3959-2009); and
  - c. Must not allow areas within a lot (i.e. onsite) that have been:
    - i. excluded from classification by being low threat vegetation or non-vegetated; and
    - ii. form part of the assessed separation distance that is determining a BAL rating -  
...to become vegetated to the extent they no longer represent a low threat (refer to Part 4 of Appendix 1). Note: The vegetation classification exclusion specifications as established by AS 3959-2009 s2.2.3.2, are included at A1.4 below for reference.

## 1. Requirements Established by the Guidelines – the Asset Protection Zone (APZ) Standards

(Source: Guidelines for Planning in Bushfire Prone Areas - WAPC 2017 v1.3 Appendix 4, Element 2, Schedule 1 and Explanatory Note E2.1)

### Defining the Asset Protection Zone (APZ)

**Description:** An APZ is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level (by reducing fuel loads). The width of the required APZ varies with slope and vegetation. For planning applications, the minimum sized acceptable APZ is that which is of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m<sup>2</sup> (BAL-29). It will be site specific.

The APZ may include public roads, waterways, footpaths, buildings, rocky outcrops, golf courses, maintained parkland as well as cultivated gardens in an urban context, but does not include grassland or vegetation on a neighbouring rural lot, farmland, wetland reserves and unmanaged public reserves.

For subdivision planning, design elements and excluded/low threat vegetation adjacent to the lot can be utilised to achieve the required vegetation separation distances and therefore reduce the required dimensions of the APZ within the lot.

**Defendable Space:** The APZ includes a defendable space which is an area adjoining the asset within which firefighting operations can be undertaken to defend the structure. Vegetation within the defendable space should be kept at an absolute minimum and the area should be free from combustible items and obstructions. The width of the defendable space is dependent on the space which is available on the property, but as a minimum should be 3 metres.

**Establishment:** The APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity.

*Note: Regardless of whether an Asset Protection Zone exists in accordance with the acceptable solutions and is appropriately maintained, fire fighters are not obliged to protect an asset if they think the separation distance between the dwelling and vegetation that can be involved in a bushfire, is unsafe.*

### Schedule 1: Standards for APZ

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

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

**Fine Fuel Load:** combustible dead vegetation matter less than 6 mm in thickness reduced to and maintained at an average of two tonnes per hectare (example below).

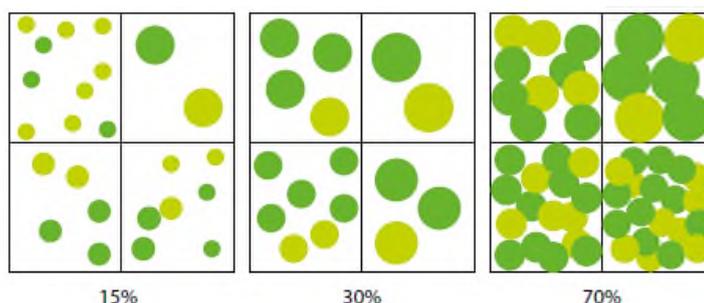
*Example Fine Fuel Load of Two Tonnes per Hectare*



(Image source: Shire of Augusta Margaret River’s Firebreak and Fuel Reduction Hazard Notice)

**Trees (> 5 metres 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. Diagram below represents tree canopy cover at maturity.

*Tree canopy cover – ranging from 15 to 70 per cent at maturity*



(Source: Guidelines for Planning in Bushfire Prone Areas 2017, Appendix 4)

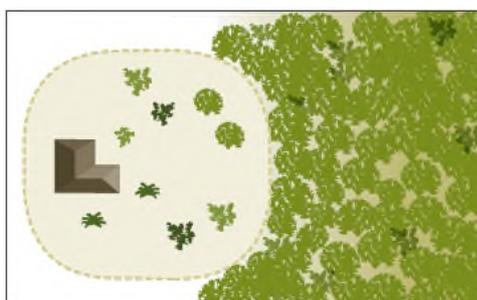
**Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m<sup>2</sup> in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater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

**Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 mm in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.

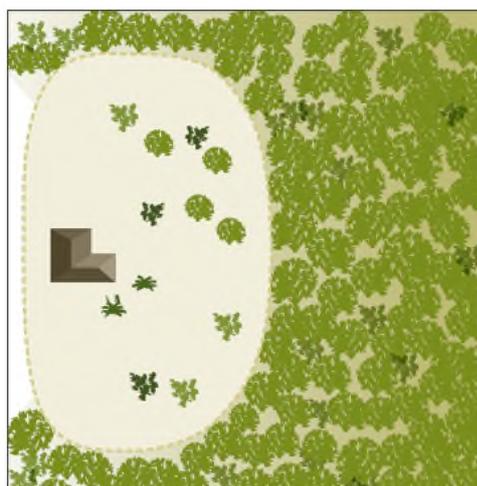
**Grass:** should be managed to maintain a height of 100 mm or less.

The following example diagrams illustrate how the required dimensions of the APZ will be determined by the type and location of the vegetation.

Hazard on one side  
 APZ



Hazard on three sides  
 APZ



## 2. Requirements Established by the Local Government – the Firebreak Notice

These requirements are established by the relevant local government’s Firebreak Notice created under s33 of the Bushfires Act 1954 and issued annually (potentially with revisions). The Notice may include additional components directed at managing fuel loads, accessibility and general property management with respect to limiting potential bushfire impact.

The relevant local government’s current Firebreak Notice is available on their website, at their offices and is distributed as ratepayer’s information. It must be complied with.

If Asset Protection Zone technical requirements are defined in the Notice, the standards and dimensions may differ from the Guideline’s APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with.

When, due to the planning stage of the proposal to which this Bushfire Management Plan applies, defined APZ dimensions are known and are to be applied to existing or future buildings – then these dimensions are stated in Section 5.4.1 of this Plan.

## 3. Requirements Recommended by DFES – Property Protection Checklists

Further guidance regarding ongoing/lasting property protection (from potential bushfire impact) is presented in the publication ‘DFES – Fire Chat – Your Bushfire Protection Toolkit’. It is available from the Department of Fire and Emergency Services (DFES) website.

#### 4. Requirements Established by AS 3959-2009 - Maintaining Areas within your Lot as 'Low Threat'

This information is provided for reference purposes. This knowledge will assist the landowner to comply with Management Requirement No. 3 set out in the Guidance Panel at the start of this Appendix. It identifies what is required for an area of land to be excluded from classification as a potential bushfire threat.

*"Australian Standard - AS 3959-2009 Section 2.2.3.2: Exclusions - Low threat vegetation and non-vegetated areas:*

*The Bushfire Attack Level shall be classified BAL-LOW where the vegetation is one or a combination of the following:*

- a) Vegetation of any type that is more than 100m from the site.*
- b) Single areas of vegetation less than 1ha in area and not within 100m of other areas of vegetation being classified.*
- c) Multiple area of vegetation less than 0.25ha in area and not within 20m of the site or each other.*
- d) Strips of vegetation less than 20m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20m of the site or each other, or other areas of vegetation being classified.*
- e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.*
- f) Low threat vegetation, including grassland managed in a **minimal fuel condition** (i.e. insufficient fuel available to significantly increase the severity of a bushfire attack – recognisable as short cropped grass to a nominal height of 100mm for example), maintained lawns, golf courses, maintained public reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks."*

## Appendix 2 - Vehicular Access Technical Requirements

Each local government may have their own standard technical requirements for emergency vehicular access and they may vary from those stated in the Guidelines.

Contact the relevant local government for the requirements that are to apply in addition to the requirements set out as an acceptable solution in the Guidelines. If the relevant local government requires that these are included in the Bushfire Management Plan, they will be included in this appendix and referenced.

### Requirements Established by the Guidelines – The Acceptable Solutions

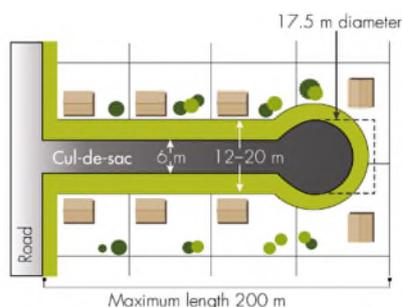
(Source: *Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4*)

#### Vehicular Access Technical Requirements - Part 1

##### Acceptable Solution 3.3: Cul-de-sacs (including a dead-end road)

Their use in bushfire prone areas should be avoided. Where no alternative exists then the following requirements are to be achieved:

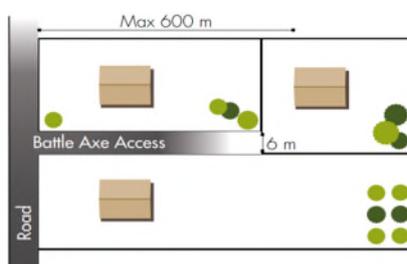
- Maximum length is 200m. If public emergency access is provided between cul-de-sac heads (as a right of way or public access easement in gross), the maximum length can be increased to 600m provided no more than 8 lots are serviced and the emergency access way is less than 600m in length;
- Turnaround area requirements, including a minimum 17.5m diameter head to allow type 3.4 fire appliances to turn around safely;
- The cul-de-sac connects to a public road that allows for travel in two directions; and
- Meet the additional design requirements set out in Part 2 of this appendix.



##### Acceptable Solution 3.4: Battle-axe

Their use in bushfire prone areas should be avoided. Where no alternative exists then the following requirements are to be achieved:

- Maximum length 600m and minimum width 6m; and
- Comply with minimum standards for private driveways.



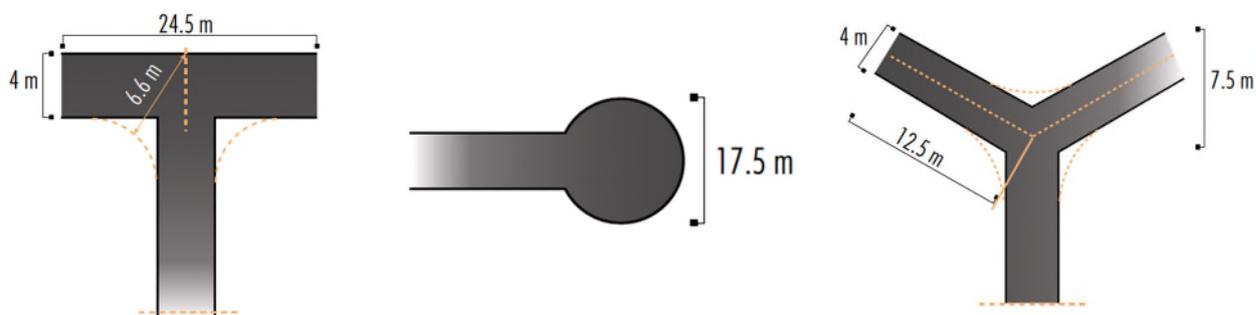
### Acceptable Solution 3.5: Private Driveways

The following requirements are to be achieved:

- The design requirements set out in Part 2 of this appendix; and

Where the house site is more than 50 metres from a public road:

- Passing bays every 200 metres with a minimum length of 20 metres and a minimum width of two metres (ie combined width of the passing bay and constructed private driveway to be a minimum six metres);
- Turn-around areas every 500 metres and within 50 metres of a house, designed to accommodate type 3.4 fire appliances to turn around safely (ie kerb to kerb 17.5 metres);
- Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes; and
- All weather surface (i.e. compacted gravel, limestone or sealed).

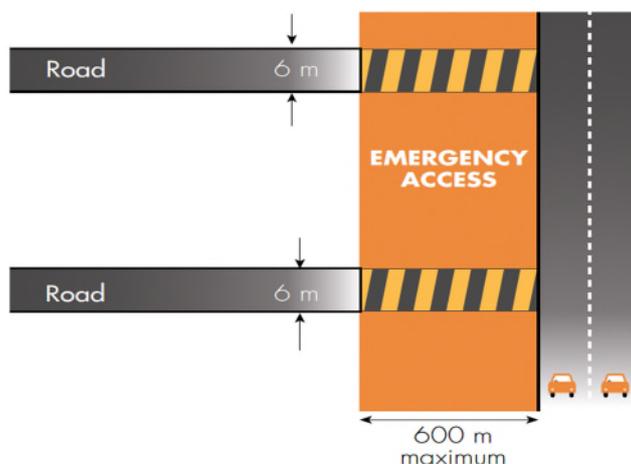


### Acceptable Solution 3.6: Emergency Access Way

An access way that does not provide through access to a public road is to be avoided bushfire prone areas.

Where no alternative exists, an emergency access way is to be provided as an alternative link to a public road during emergencies. The following requirements are to be achieved:

- No further than 600 metres from a public road;
- Must be signposted including where they ajoin public roads;
- Provided as a right of way or public access easement in gross;
- Where gates are used they must not be locked and they must be a minimum width of 3.6 metres with design and construction approved by local government (refer to the example in this appendix); and
- Meet the additional design requirements set out in Part 2 of this appendix.



### Acceptable Solution 3.7: Fire Service Access Routes (Perimeter Roads)

Are to be established to provide access within and around the edge of subdivision and related development and to provide direct access to bushfire prone areas for firefighters and link between public road networks for firefighting purposes. Fire service access is used during bushfire suppression activities but can also be used for fire prevention work. The following requirements are to be achieved:

- No further than 600 metres from a public road (driveways may be used as part of the designated fire service access;
- Dead end roads not permitted;
- Allow for two-way traffic (i.e. two 3.4 fire appliances);
- Provide turn-around areas designed to accommodate 3.4 fire appliances and to enable them to turn around safely every 500m (i.e. kerb to kerb 17.5 metres);
- All weather surface (i.e. compacted gravel, limestone or sealed) and have erosion control measures in place;
- Must be adequately sign posted;
- Where gates are used they must be a minimum width of 3.6 metres with design and construction approved by local government (refer to the example in this appendix) and may be locked (use a common key system);
- Meet the additional design requirements set out in Part 2 of this appendix;
- Provided as right of ways or public access easements in gross; and
- Management and access arrangements to be documented and in place.

### Acceptable Solution 3.8: Firebreak Width

Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three meters or to the level as prescribed in the local firebreak notice issued by the local government.

#### Vehicular Access Technical Requirements - Part 2

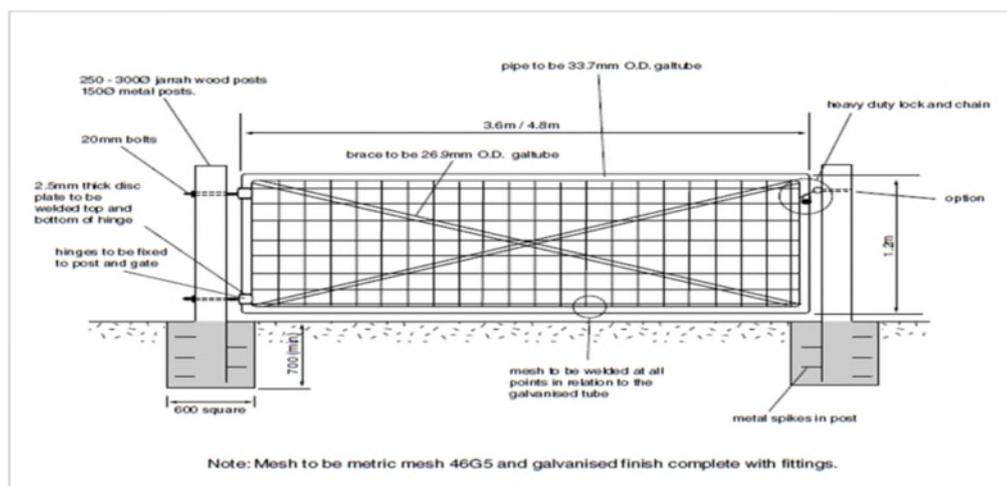
| Technical Component             | Vehicular Access Types |             |                   |                       |                            |
|---------------------------------|------------------------|-------------|-------------------|-----------------------|----------------------------|
|                                 | Public Roads           | Cul-de-sacs | Private Driveways | Emergency Access Ways | Fire Service Access Routes |
| Minimum trafficable surface (m) | 6*                     | 6           | 4                 | 6*                    | 6*                         |
| Horizontal clearance (m)        | 6                      | 6           | 6                 | 6                     | 6                          |
| Vertical clearance (m)          | 4.5                    | 4.5         | 4.5               | 4.5                   | 4.5                        |
| Maximum grade <50 metres        | 1 in 10                | 1 in 10     | 1 in 10           | 1 in 10               | 1 in 10                    |
| Minimum weight capacity (t)     | 15                     | 15          | 15                | 15                    | 15                         |
| Maximum cross-fall              | 1 in 33                | 1 in 33     | 1 in 33           | 1 in 33               | 1 in 33                    |
| Curves minimum inner radius (m) | 8.5                    | 8.5         | 8.5               | 8.5                   | 8.5                        |

\* A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metres of paving and one metre of constructed road shoulders. In special circumstances, where 8 lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of ninety metres may be provided subject to the approval of both the local government and DFES.

## Vehicular Access Technical Requirements – Gates and Signs Examples

### Gates

- **Design and construction to be approved by relevant local government.**
- Minimum width 3.6m
- Emergency access way gates must not be locked.
- Fire service access route gates may be locked but only with a common key that is available to local fire service personnel.
- Bollards will be to the relevant local government specifications



### Signs

- **Design and construction to be approved by the relevant local government.**
- Minimum height above ground of 0.9m.
- Lettering height to be 100mm.
- To display the words (as appropriate) "Emergency Access Only" or "Fire Service Access – No Public Access".
- Size 600mm x 400mm.
- Sign colour red, base (white) area is reflective background.
- Rounded corners, radius 20mm.
- White key-line 3mm wide, 3mm from outside edge.
- Suggested mounting hole six 6mm diameter.



## Appendix 3 - Water Technical Requirements

### Requirements Established by the Guidelines - Acceptable Solution A4.1: Reticulated Areas

(Source: *Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4, Element 4*)

The requirement is to supply a reticulated water supply and fire hydrants, in accordance with the technical requirements of the relevant water supply authority and DFES.

The Water Corporation's 'No 63 Water Reticulation Standard' is deemed to be the baseline criteria for developments and should be applied unless local water supply authority's conditions apply.

Key specifications in the most recent version/revision of the design standard include:

- **Residential Standard** – hydrants are to be located so that the maximum distance between the hydrants shall be no more than 200 metres.
- **Commercial Standard** – hydrants are to be located with a maximum of 100 metre spacing in Industrial and Commercial areas.
- **Rural Residential Standard** – where minimum site areas per dwelling is 10,000 m<sup>2</sup> (1ha), hydrants are to be located with a maximum 400m spacing. If the area is further subdivided to land parcels less than 1ha, then the residential standard (200m) is to be applied.

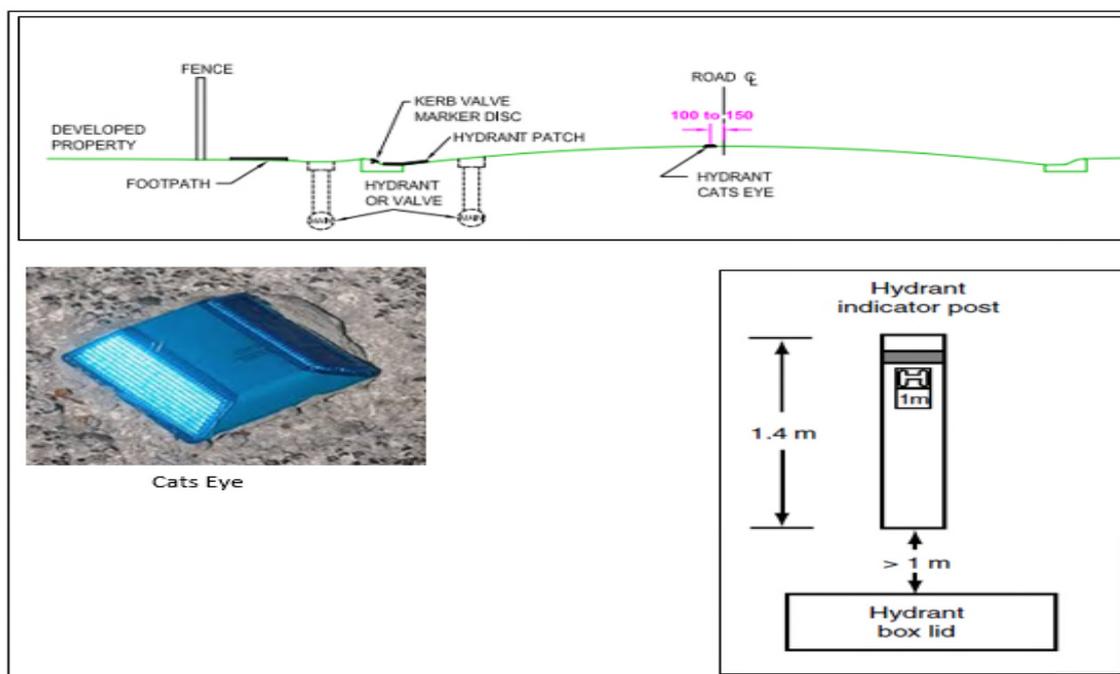


Figure A4.1: Hydrant Location and Identification Specifications

Contact the relevant water supply authority to confirm the technical requirements that are to be applied. They may differ from the minimum requirements of the 'baseline' Water Corporation's No. 63 Water Reticulation Standard.

## Requirements Established by the Guidelines - Acceptable Solution A4.2: Non-Reticulated Areas

Each local government may have their own standard technical requirements for firefighting water supplies and they may vary from those stated in the Guidelines.

Contact the relevant local government for the requirements that are to apply in addition to the requirements set out as an acceptable solution in the Guidelines. If the relevant local government requires that these are included in the Bushfire Management Plan, they will be included in this appendix and referenced.

**Table A4.1:** The acceptable solution as contained in the Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4, Element 4 – with example construction / coupling requirements from various sources including FESA (DFES) Operational Circular 07/2011 and Planning for Bushfire Protection Guidelines WAPC 2010.

### Technical Requirements for Static Water Supply (example only – check with local government)

|                               |   |
|-------------------------------|---|
| Volume:                       | 50,000 litres per tank  |
| Ratio of tanks to lots:       | 1 tank per 25 lots (or part thereof)  |
| Location:                     | No more than two kilometres to the furthest house site within the residential development to allow a 2.4 fire appliance to achieve a 20-minute turnaround time at legal road speeds.              |
| Tank Construction:            | Above ground tanks constructed using concrete or metal. Stands of raised tanks are constructed using non-combustible materials and heat shielding where applicable (required for metal stands).   |
| Pipe Construction:            | Galvanised or copper (PVC if buried at least 300mm below ground).   |
| Access:                       | Hardstand and turnaround areas suitable for a 3.4 appliance (i.e. kerb to kerb 17.5metres) are provided within three metres of each tank.   |
| Couplings:                    | Hydrant or standpipe to be provided. Tanks can be fitted with a full flow valve gate (not ball valve) and a 100mm cam-lock coupling of metal/alloy construction (examples below).                 |
| Ownership and Responsibility: | Water tanks and associated facilities are vested in the relevant local government. A procedure must be in place to ensure that water tanks are maintained at or above designated capacity always. |



## Requirements Established by the Guidelines - Acceptable Solution A4.3: Non-Reticulated Areas – Single Lot

Each local government may have their own standard technical requirements for firefighting water supplies and they may vary from those stated in the Guidelines.

Contact the relevant local government for the requirements that are to apply in addition to the requirements set out as an acceptable solution in the Guidelines. If the relevant local government requires that these are included in the Bushfire Management Plan, they will be included in this appendix and referenced.

**Table A4.1:** The acceptable solution as contained in the Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4, Element 4 – with example construction / coupling requirements from various sources including FESA (DFES) Operational Circular 07/2011 and Planning for Bushfire Protection Guidelines WAPC 2010.

### Technical Requirements for Static Water Supply (example only – check with local government)

|                    |  |
|--------------------|--|
| Application:       | Single lots above 500 m <sup>2</sup> need a dedicated static water supply on the lot. This solution is only for use if creating one additional lot and cannot be applied cumulatively. |
| Volume:            | Minimum 10,000 litres per tank dedicated to firefighting purposes. The storage tank must not facilitate sharing the water for domestic use due to the danger of contamination.         |
| Tank Construction: | Above ground tanks constructed using concrete or metal.  |
| Pipe Construction: | Galvanised or copper (PVC if buried at least 300mm below ground).  |
| Vehicle Access:    | Hardstand and turnaround area suitable for a 3.4 appliance (i.e. kerb to kerb 17.5metres) is provided at the tank.   |
| Couplings:         | Tanks are to be fitted with a full flow gate valve (not ball valve) and a 50mm or 100mm cam-lock coupling of metal/alloy construction (example below).                                 |
| Responsibility:    | A procedure must be in place to ensure that water tanks are maintained at or above designated capacity always.   |



## Appendix 4 – Method 2 Calculations

### Minimum Distance Calculation for Vegetation Area 1 Grassland



Calculated February 22, 2018, 7:19 pm (MDC v.4.7)

#### Wubin Emulsifier Plant

| Minimum Distance Calculator - AS3959-2009 (Method 2) |              |  |   |
|--|--------------|--|---|
| Inputs   |              | Outputs                                      |   |
| Grassland Fire Danger Index                          | 110          | Rate of spread                               | 16.41 km/h                                      |
| Vegetation classification                            | Grassland    | Flame length                                 | 7.36 m  |
| Surface fuel load                                    | 4.5 t/ha     | Flame angle                                  | 54 °, 64 °, 73 °, 78 °, 80 ° & 85 °             |
| Overall fuel load                                    | 4.5 t/ha     | Elevation of receiver                        | 2.97 m, 3.3 m, 3.52 m, 3.6 m, 3.62 m & 3.66 m   |
| Vegetation height                                    | n/a          | Fire intensity                               | 38,167 kW/m                                     |
| Effective slope                                      | 2 °          | Transmissivity                               | 0.886, 0.875, 0.858, 0.837, 0.825 & 0.752       |
| Site slope   | 0 °          | Viewfactor                                   | 0.5842, 0.4326, 0.2907, 0.1956, 0.1588 & 0.0435 |
| Flame width  | 100 m        | Minimum distance to < 40 kW/m <sup>2</sup>   | 6.3 m   |
| Windspeed  | n/a          | Minimum distance to < 29 kW/m <sup>2</sup>   | 8.5 m   |
| Heat of combustion                                   | 18,600 kJ/kg | Minimum distance to < 19 kW/m <sup>2</sup>   | 12.6 m  |
| Flame temperature                                    | 1,090 K      | Minimum distance to < 12.5 kW/m <sup>2</sup> | 18.5 m  |
|  |              | Minimum distance to < 10 kW/m <sup>2</sup>   | 22.5 m  |
|  |              | Minimum distance to < 2.5 kW/m <sup>2</sup>  | 62.6 m  |

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

## Minimum Distance Calculation for Vegetation Area 2 Scrub



Calculated March 6, 2018, 5:58 pm (MDc v.4.7)

### Wubin Emulsifier Plant

| Minimum Distance Calculator - AS3959-2009 (Method 2) |              |  |  |
|--|--------------|--|--|
| Inputs   |              | Outputs                                      |  |
| Fire Danger Index                                    | 80           | Rate of spread                               | 4.52 km/h                                      |
| Vegetation classification                            | Scrub        | Flame length                                 | 12.07 m  |
| Surface fuel load                                    | 25 t/ha      | Flame angle                                  | 53 °, 63 °, 71 °, 76 °, 78 ° & 83 °            |
| Overall fuel load                                    | 25 t/ha      | Elevation of receiver                        | 4.82 m, 5.38 m, 5.71 m, 5.86 m, 5.9 m & 5.99 m |
| Vegetation height                                    | m            | Fire intensity                               | 58,461 kW/m                                    |
| Effective slope                                      | 1.2 °        | Transmissivity                               | 0.877, 0.86, 0.837, 0.812, 0.798 & 0.733       |
| Site slope   | 0 °          | Viewfactor                                   | 0.5973, 0.442, 0.298, 0.202, 0.1642 & 0.0447   |
| Flame width  | 100 m        | Minimum distance to < 40 kW/m <sup>2</sup>   | 10.1 m   |
| Windspeed  | 45 km/h      | Minimum distance to < 29 kW/m <sup>2</sup>   | 13.6 m   |
| Heat of combustion                                   | 18,600 kJ/kg | Minimum distance to < 19 kW/m <sup>2</sup>   | 19.9 m   |
| Flame temperature                                    | 1,090 K      | Minimum distance to < 12.5 kW/m <sup>2</sup> | 28.4 m   |
|  |              | Minimum distance to < 10 kW/m <sup>2</sup>   | 33.9 m   |
|  |              | Minimum distance to < 2.5 kW/m <sup>2</sup>  | 84.1 m   |

Rate of Spread - Catchpole et al. 1998

Flame length - Byram, 1959

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005