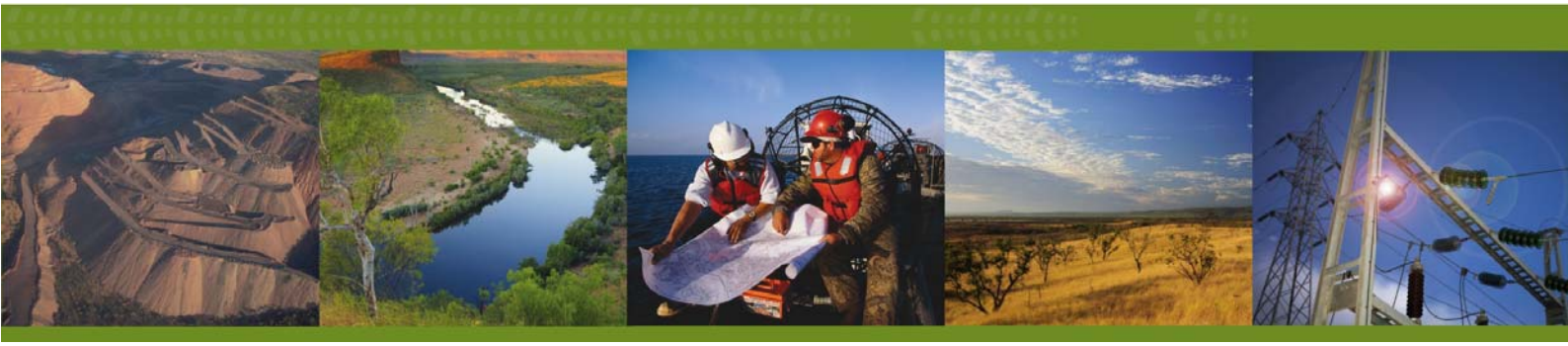
Appendix **Four** – Fire Management Plan



Fire Management Plan

Spires Estate Local Structure Plan

Prepared for
Spatial Property Group
by Strategen

March 2014

STRATEGEN
environmental consultants

Fire Management Plan

Spires Estate Local Structure Plan

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 2, 322 Hay Street Subiaco WA
ACN: 056 190 419

March 2014

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Strategen has not attempted to verify the accuracy or completeness of the information supplied by the Client.

Client: Spatial Property Group

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	Rev A	For review by client	Z Cockerill / T Bowra	Electronic	30/08/2013
Draft Report	Rev 0	For review by key stakeholders	Z Cockerill / R Banks	Electronic	2/09/2013
Draft Report	Rev 1	For review by key stakeholders	Z Cockerill / R Banks	Electronic	19/12/2013
Draft report	Rev 2	For consideration by CoR, DFES and DoP	Z Cockerill / R Banks	Electronic	12/02/2014
Draft report	Rev 3	To address final CoR and DoP comments	Z Cockerill	Electronic	24/02/2014
Final Report	Rev 4	Issued for use: to address Schedule of Modifications and for lodgement with final LSP	Z Cockerill	Electronic	26/03/2014

Filename: SPP13167_01 R001 Rev 4 - 26 March 2014

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1. Introduction

1.1 Background

Spatial Property Group (SPG) is proposing to implement the Spires Estate Local Structure Plan (LSP), which outlines proposed development of seven lots situated between Fifty Road and Baldivis Road in the City of Rockingham (the project area). The development is predominantly for residential purposes. Development Planning Strategies has prepared the LSP on behalf of SPG, as presented in Figure 1.

There is an inherent bush fire risk to proposed life and property assets of the development, particularly due to the extent of vegetation on adjoining properties. A bush fire hazard assessment was undertaken across the project area and surrounds by Bushfire Safety Consulting (2012), as outlined in Appendix 1. The assessment identified the project area and surrounding land as containing a range of bush fire hazard levels, some classified as 'Extreme'. Consequently, a Fire Management Plan (FMP) was recommended to be prepared for each future stage of subdivision application.

In response to the above recommendation, SPG has commissioned Strategen to prepare an FMP to support the Spires Estate LSP in accordance with *Planning for Bush Fire Protection Guidelines (Edition 2)* (PFBFP Guidelines) (WAPC et al. 2010). A completed FMP compliance checklist is contained in Appendix 2.

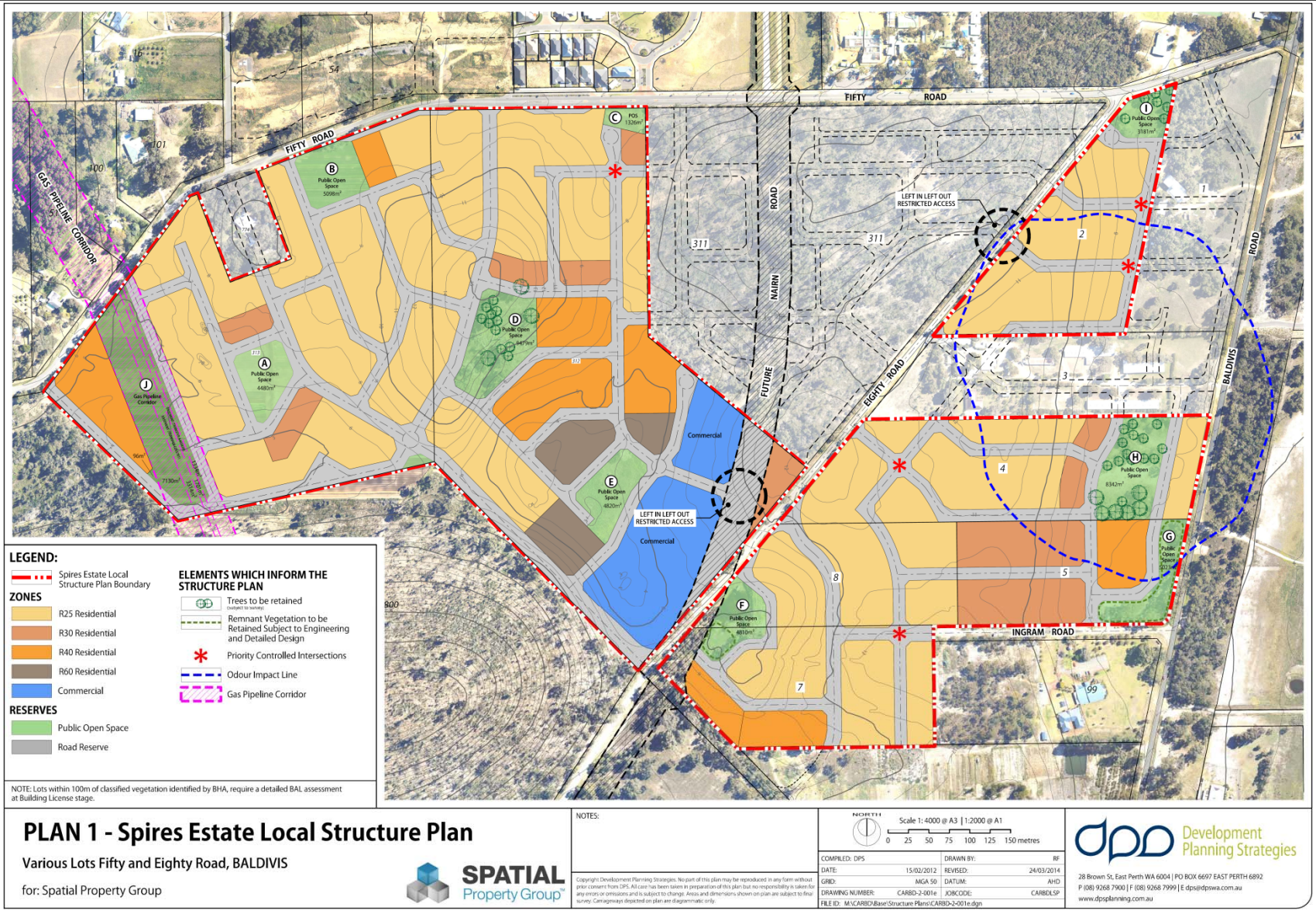
1.2 Purpose and application of the plan

The purpose of the FMP is to provide guidance on how to plan for and manage the bush fire risk to the project area through implementation of a range of bush fire risk mitigation measures in accordance with requirements of PFBFP Guidelines. The FMP outlines how future on-site assets can be protected during the summer months when the risk of bush fire is at its peak. This is particularly relevant when existing fire appliances in the area may be unable to offer an adequate emergency suppression response. Therefore, the developer should aim to ensure on-site assets are self-protecting from bush fire.

Implementation of the FMP is a shared responsibility between the developer, City of Rockingham (CoR) and prospective landowners to ensure bush fire risk treatment and mitigation measures are adopted and implemented on an ongoing basis to achieve bush fire management objectives.

1.3 Stakeholder consultation

Strategen has undertaken consultation with the developer, CoR, Department of Fire and Emergency Services (DFES) and Department of Planning (DoP) to ensure aims and objectives of the FMP are in accordance with stakeholder expectations and the FMP maintains compliance with PFBFP Guidelines.



Source: Development Planning Strategies 2014

2. Aim and objectives

2.1 Aim

The FMP aims to achieve a reduction in the occurrence of uncontrolled bush fires and minimise potential impacts on life and property of the proposed development. The following tasks have been undertaken to achieve this, as documented in this FMP:

- quantify the bush fire hazard and assess the bush fire risk to the project area
- document bush fire prevention requirements of the project area to provide ongoing protection to future residents, visitors and built assets of the subject land
- identify bush fire protection issues, appropriate strategies and those persons and/or organisations who have a responsibility to implement the FMP
- comply with PFBFP Guidelines and bush fire management on neighbouring subdivisions
- provide guidance for the developer, CoR and prospective landowners to protect the subject land and on-site assets in the event that fire appliances may not be available to offer a prompt bush fire suppression response.

2.2 Objectives

Key objectives of the FMP and the relevant section/s of this document in which they are addressed are outlined in Table 1.

Table 1 Key objectives of the FMP

Objective	Section
Define areas where values are located (i.e. location of assets)	Section 3.7
Define and rank fire hazard areas	Section 4.2
Nominate individuals and organisations responsible for fire management and associated works within the project area	Section 5.7
Propose fire management measures for the project area, with due regard for life, property and the environment	Section 5
Provide performance criteria and acceptable solutions for all fire management works in accordance with PFBFP Guidelines	Section 4.2.5

3. Description of the area

3.1 General overview

The project area is located approximately 40 km south of the Perth Central Business District, 6 km east of Rockingham City Centre and 2 km north of Baldivis District Centre (Figure 2). The project area is approximately 54.5 ha and comprises seven lots situated between Fifty Road and Baldivis Road in the City of Rockingham (Figure 3). Individual lot details are provided in Table 2.

The project area is bound by Fifty Road to the north and Baldivis Road to the east, and occurs on either side of Eighty Road and private vegetated Lot 311. Predominant land uses comprise a market garden, rural residential lifestyle properties and vacant landholdings.

Table 2 Lots contained within the project area

Lot number	Predominant land use	Area (ha)
Lot 312 Fifty Road	Vacant landholding	18.6
Lot 313 Fifty Road	Market garden	15.0
Lot 2 Eighty Road	Vacant landholding	4.0
Lot 4 Baldivis Road	Rural residential lifestyle property	5.8
Lot 5 Baldivis Road	Vacant landholding	3.4
Lot 7 Baldivis Road	Rural residential lifestyle property	4.3
Lot 8 Ingram Road	Rural residential lifestyle property	3.4
Total area		**54.5**

3.1.1 Overview of predominant areas of vegetation, bush fire hazard and risk

The majority of the project area consists of cleared land, with only small remnants of degraded or modified vegetation remaining in some areas. Furthermore, the proposed development will result in a predominantly cleared, built environment, with only minor retention of individual overstorey trees proposed throughout selected Public Open Space (POS) areas subject to annual management. Therefore, the long term bush fire risk on-site will be low due to the lack of predominant vegetation and bush fire hazards.

The predominant vegetation considered to pose a permanent bush fire risk to the project area occurs within the following adjacent properties, as illustrated in Figure 3:

- Rockingham Lakes Regional Park to the southwest (Bush Forever Site 356)
- Baldivis Nature Reserve to the northeast
- Tramway Reserve to the east
- rural-zoned land to the northwest.

The project area adjoins private vegetated properties subject to future urban development as indicated by the Metropolitan Region Scheme (MRS), City of Rockingham Town Planning Scheme No. 2 (TPS No. 2) and Baldivis North District Structure Plan (BNDSP). These properties include:

- private vegetated Lot 311 in the central-north
- private vegetated Lot 774 to the northwest
- private vegetated Lot 1 to the northeast.

These adjacent properties will pose a temporary bush fire risk to the project area until such time that the vegetation and bush fire hazards are removed through proposed urban development or by other means of fuel hazard reduction. Both the permanent and temporary bush fire risks posed by the abovementioned properties will need to be addressed as part of ongoing planning and design of the Spires Estate LSP.

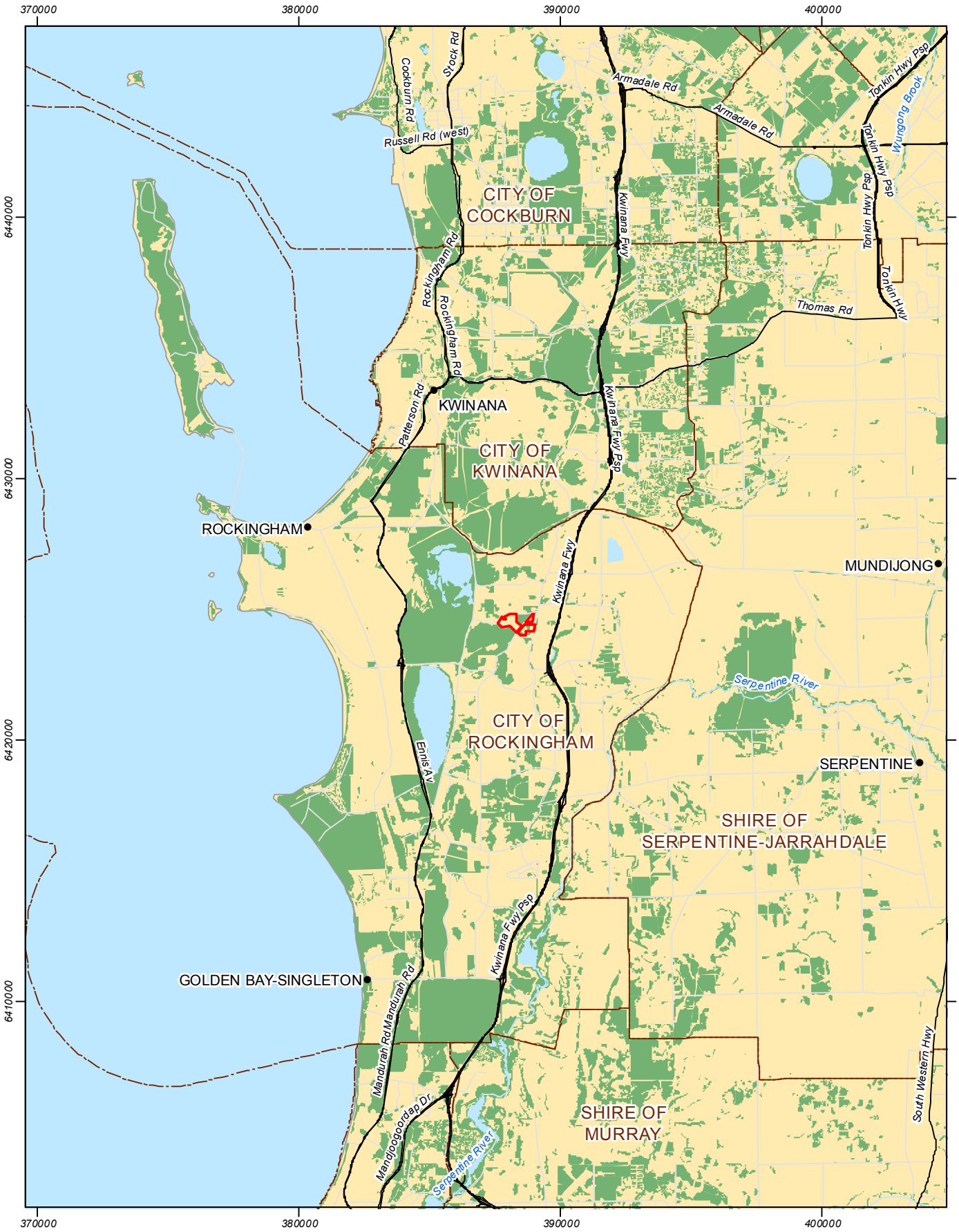


Figure 2 Regional location

Scale 1:200,000 at A4

0 1 2 3 4 5 km

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 28/08/2013
Author: JCrute
Source: Topography: Geoscience Australia 2011.

Legend

- Town
- Major road
- Minor road
- Major river
- Lakes
- Local government boundary
- Spires Estate LSP boundary
- Native vegetation

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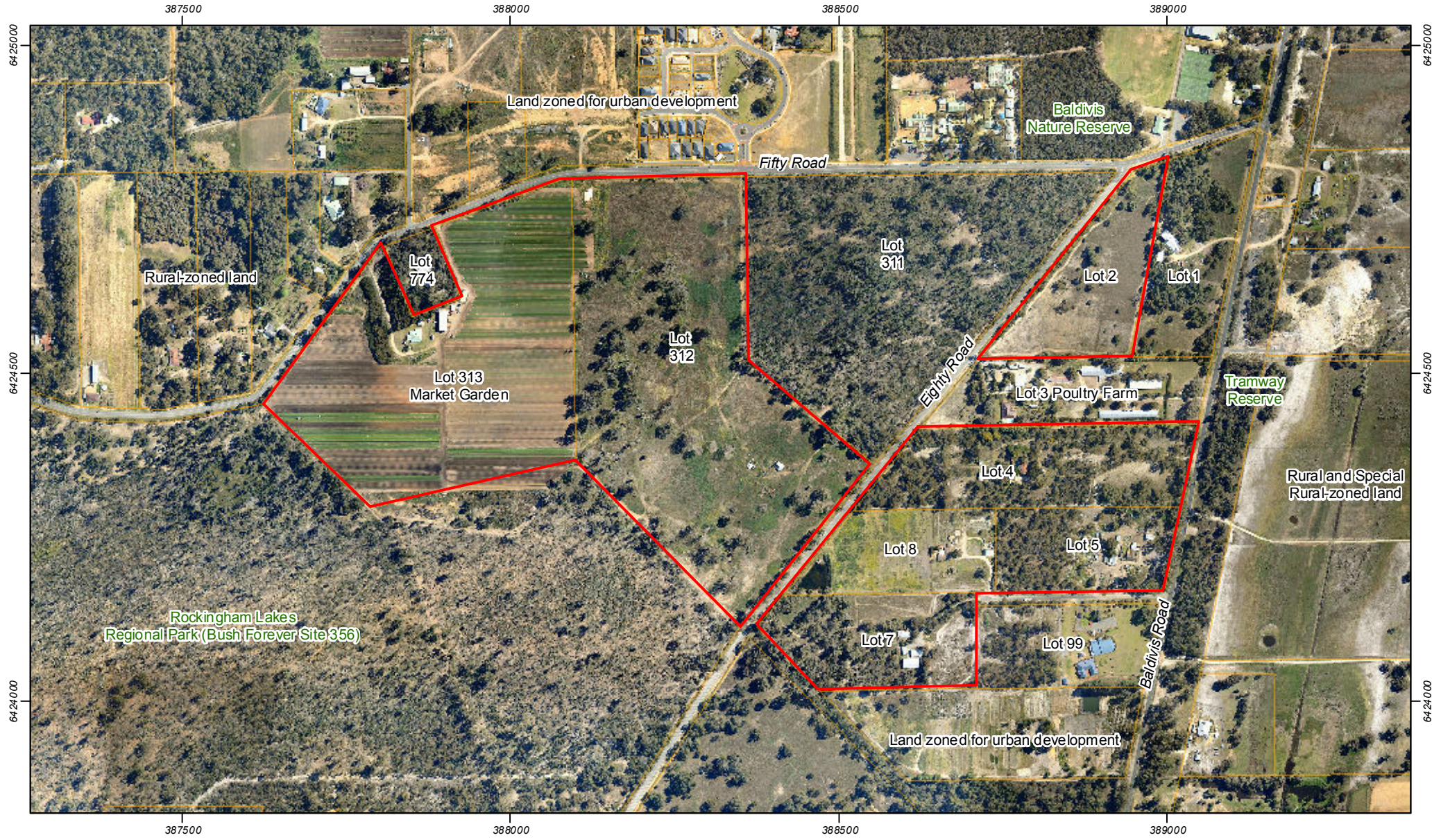

Figure 3 Site overview

Scale 1:8,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 28/08/2013

Author: JCrute
Source: Client 2013.

Legend

- Spires Estate LSP boundary
- Existing cadastral boundaries

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3.2 Local climate

The Baldivis locality experiences a Mediterranean-type climate characterised by mild, wet winters and warm to hot, dry summers. The Bureau of Meteorology (BoM) weather station at Medina Research Centre (Station No. 9194) provides mean monthly climate statistics for the Baldivis locality (Table 3). Mean annual rainfall since 1983 for Medina Research Centre is 765.6 mm (BoM 2012). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures are generally recorded from December to March, with mean monthly maximums ranging from 28°C in December to 31.4°C in February.

Table 3 Mean monthly climate statistics for Medina Research Centre

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	30.6	31.4	29.4	25.6	22.1	19.3	18.3	18.8	20.2	22.5	25.9	28.0	24.3
Mean minimum temperature (°C)	17.0	17.5	15.9	13.3	10.5	9.1	8.2	8.0	9.1	10.3	13.4	15.0	12.3
Mean rainfall (mm)	12.2	20.1	18.3	40.3	97.5	148.3	147.9	114.2	76.3	40.2	32.1	10.6	765.6

Source: BoM 2012

3.2.1 Fire weather

Southwest Western Australia generally experiences a cool to mild growing season in the months of August through to November of each year, followed by four months of summer drought conditions, which is when the potential for bush fire occurrence is at its peak. The worst fire weather conditions occur during this dry period when a low pressure trough forms off the west coast and strong winds develop from the north or northeast. These conditions are sometimes associated with 'Extreme' or 'Catastrophic' fire dangers, which are consistent with very high temperatures, low relative humidity and strong winds. On average, based on the predominant summer climatic conditions of the local area, these high fire risk fire weather conditions are considered to occur less than 5% of the time during the designated bush fire season, which equates to around 6 days between December and March.

Average 9:00 am and 3:00 pm January wind profiles for Medina Research Centre are contained in Appendix 3, which illustrate that the predominant winds during this high risk period are from the east and southeast in the morning averaging around 13 km/h; and from the southwest in the afternoon averaging around 20 km/h (BoM 2012). Mean 9:00 am and 3:00 pm relative humidity in January for Medina Research Centre is 53% and 42% respectively and the average maximum summer temperature in January for the area is 30.6°C. These predominant fire weather conditions correlate with an average fire danger index of 'High', as determined using the Commonwealth Science and Industrial Research Organisation (CSIRO) Fire Danger and Fire Spread Calculator (CSIRO 1999). These dominant fire weather conditions are considered to occur more than 95% of the time during the designated bush fire season.

3.3 Landform and topography

The project area is located on the Swan Coastal Plain, which is characterised by a low-lying coastal plain, mainly covered with woodlands. Banksia and Jarrah-banksia woodlands are the usual vegetation contained within the dune systems (McKenzie et al. 2003).

Site topography of the project area and adjacent properties is generally undulating due to the presence of dune systems, with slopes not exceeding 10 degrees (BSC 2012). The project area consists of several small rises and depressions, with on-site elevation ranging from 3 mAHD (Australian Height Datum) in the depressions, to 15 mAHD in the rises (Figure 4). On-site slope is not considered to be a significant factor of bush fire risk due to the lack of on-site vegetation under slope and proposed establishment of a built footprint across the site in association with managed POS areas. The surrounding vegetation extent is generally located on flat land or up-slope from the project area. This is particularly apparent in Rockingham Lakes Regional Park to the southwest and vegetated Lot 311 in the central-north (Figure 4).

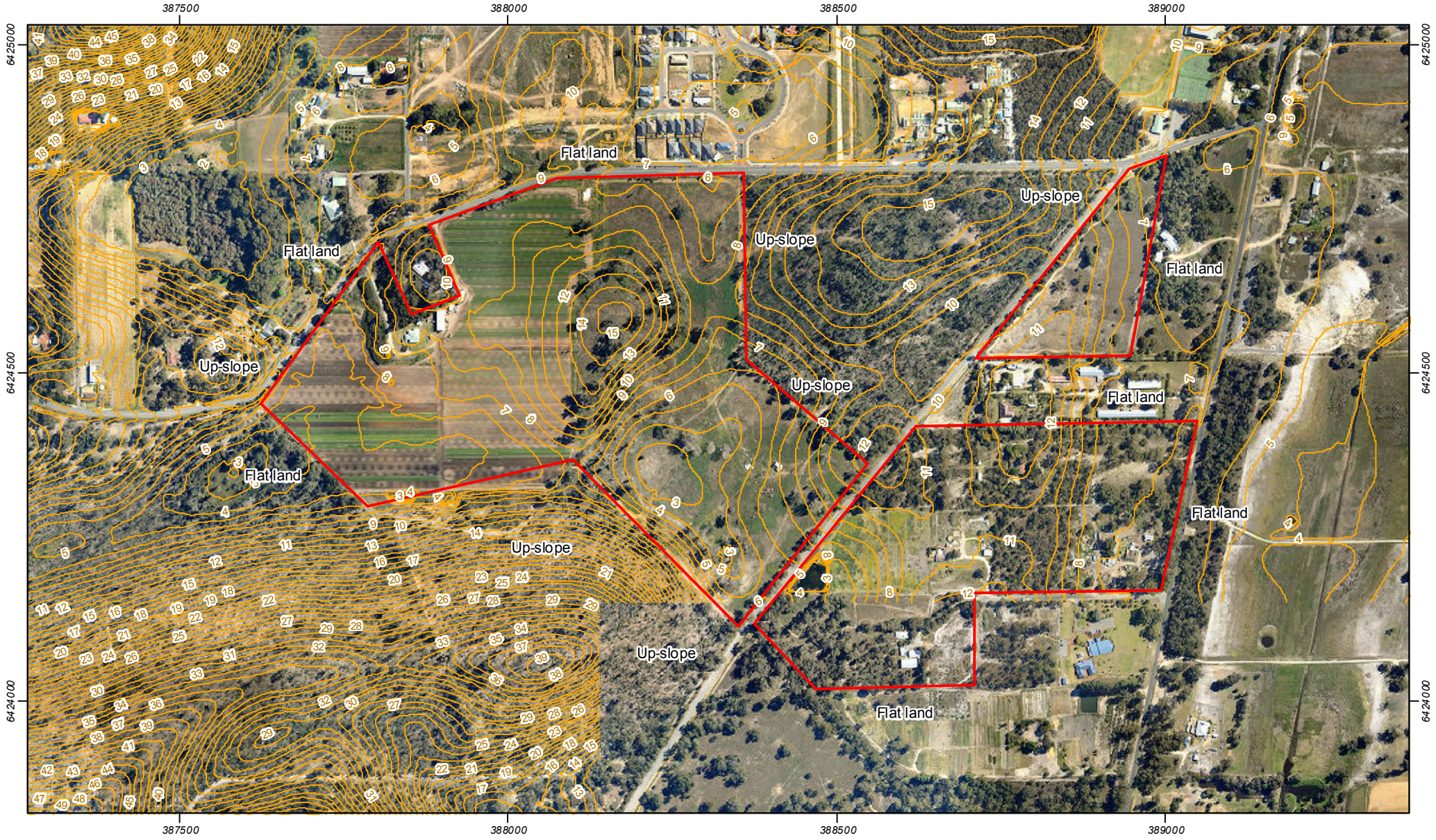

Figure 4 Site topography

Scale 1:8,000 at A4

0 50 100 150 200 250 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 18/12/2013

Author: JCrute
Source: Client 2013.

Legend

- Surface elevation (mAHD)
- Spires Estate LSP boundary

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3.4 Predominant soil types

The project area contains three natural soil types of the Spearwood and Tamala soil systems, as described in DPS (2013):

- Sand (S8): very light grey at the surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2 (clay), M4 (silt) and Mc2
- Sand (S7): pale yellowish brown, medium to coarse grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin
- Limestone (LS1): pale yellowish brown, fine to coarse grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.

3.5 Vegetation and flora

3.5.1 On-site vegetation extent

Current land use across the project area has resulted in a highly modified environment compared to the pre-clearing vegetation extent. Rural-residential pursuits have resulted in large portions of the project area being completely cleared of native vegetation, with only small pockets of degraded or modified vegetation remaining in some areas. Consequently, the on-site vegetation extent currently consists of:

1. A cleared grassland/pasture understorey with scattered individual *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) trees. This parkland landscape is particularly evident in the western portion of the site adjacent to the market garden.
2. A degraded woodland of eucalypts and scattered banksias, with limited mid and understorey species. This vegetation is particularly evident in the eastern portion of the site.
3. A small area of open eucalypt forest containing more intact over, mid and understorey stratums confined to the southeast portion of the site.
4. A small area of dense closed scrub vegetation abutting the market garden in the western portion of the site.

The proposed development will result in a predominantly cleared, built environment. This will remove the majority of on-site vegetation and bush fire hazard. There will be minor retention of overstorey trees in selected POS areas, as stated in Section 3.6.1.

Numerous flora and vegetation surveys were undertaken across the project area in 2011 and these confirmed that no Threatened Ecological Communities, Declared Rare Flora or any other significant flora or vegetation values were encountered within the site (DPS 2013). On-site vegetation condition ranged from ‘Completely Degraded’ to ‘Good’ (DPS 2013).

3.5.2 Adjacent vegetation extent

The predominant vegetation extent situated on properties adjoining the project area is representative of the Cottesloe (Central and South) and Karrakatta (Central and South) vegetation complexes (Figure 5), which are outlined in DPS (2013) as follows:

- Cottesloe Complex (Central and South): a mosaic of woodland of Tuart and open forest of Tuart-Jarrah-Marri with closed heath on the limestone outcrops
- Karrakatta Complex (Central and South): predominantly an open forest of Tuart-Jarrah-Marri and woodland of Jarrah-*Banksia spp*.

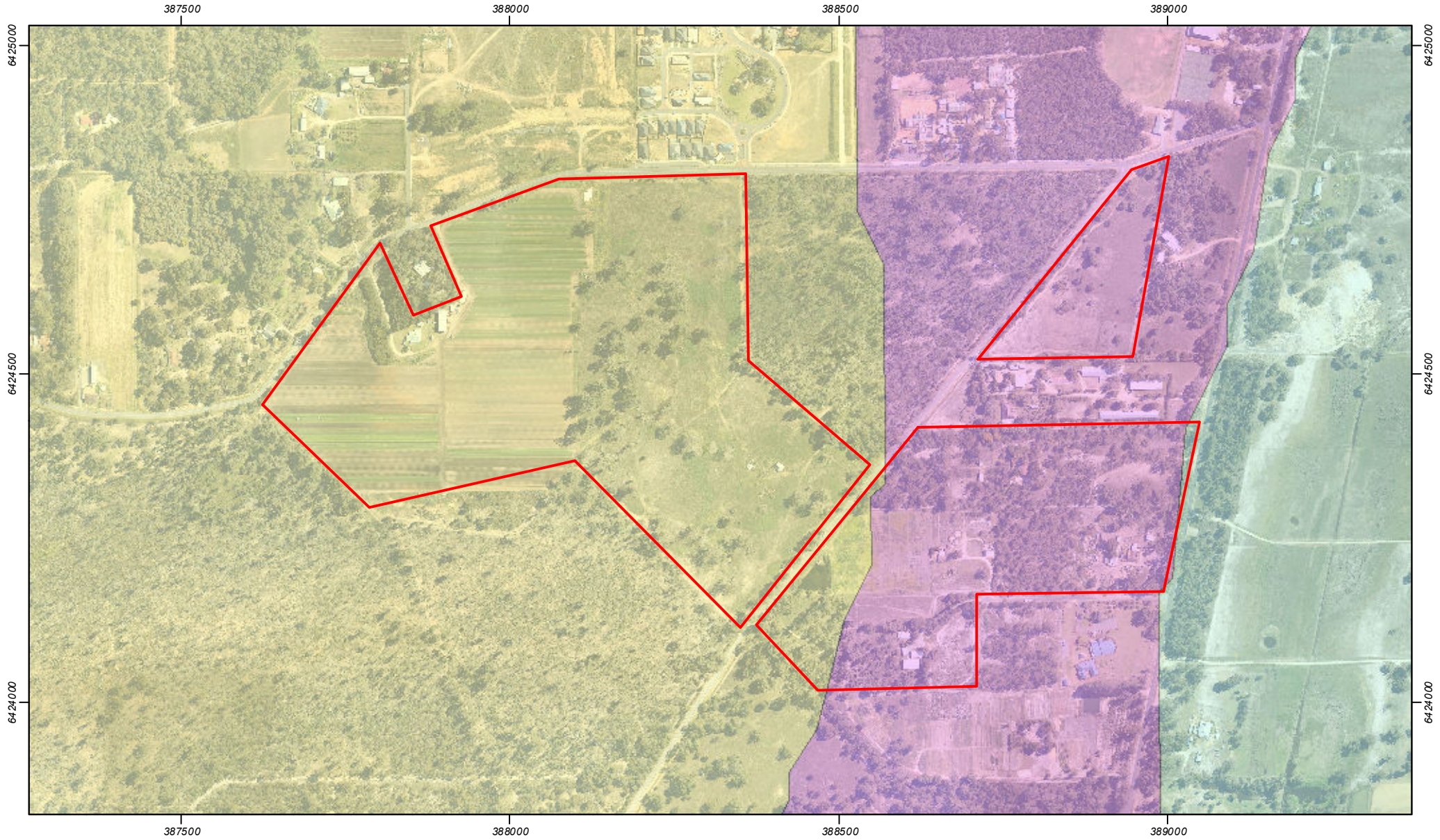

Figure 5 Vegetation complexes

Scale 1:8,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 28/08/2013

Author: JCrute
Source: Client 2013.

Legend

Spires Estate LSP boundary

Vegetation complex

Cottesloe complex - central and south

Karrakatta complex - central and south

Serpentine River complex

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3.6 Land use

Baldivis was historically a farming settlement, which has evolved over time into a semi-rural residential suburb of Perth. Land in the western portion of Baldivis was zoned for urban development in the 1990s under the MRS, and since has been progressively developed as residential land.

As is the case with many properties in the local vicinity, the project area is currently zoned 'Development' under the provisions of TPS No. 2 (DoP 2013). Predominant land uses currently comprise a market garden, rural residential lifestyle properties and vacant landholdings, as indicated in Table 2.

Eighty Road and future Nairn Road traverse the project area generally in a north-south direction, with Parmelia high pressure natural gas pipeline traversing Lot 313 in a northwest-southeast alignment in the western portion of the site.

3.6.1 Proposed land use

The proposed development, as depicted in Figure 1, will create large residential zones for medium and high density living, a commercial precinct and 10 POS areas (including a gas pipeline reserve). In addition, road, water, sewerage, power, gas and communications infrastructure will be provided throughout the project area to service the proposed development.

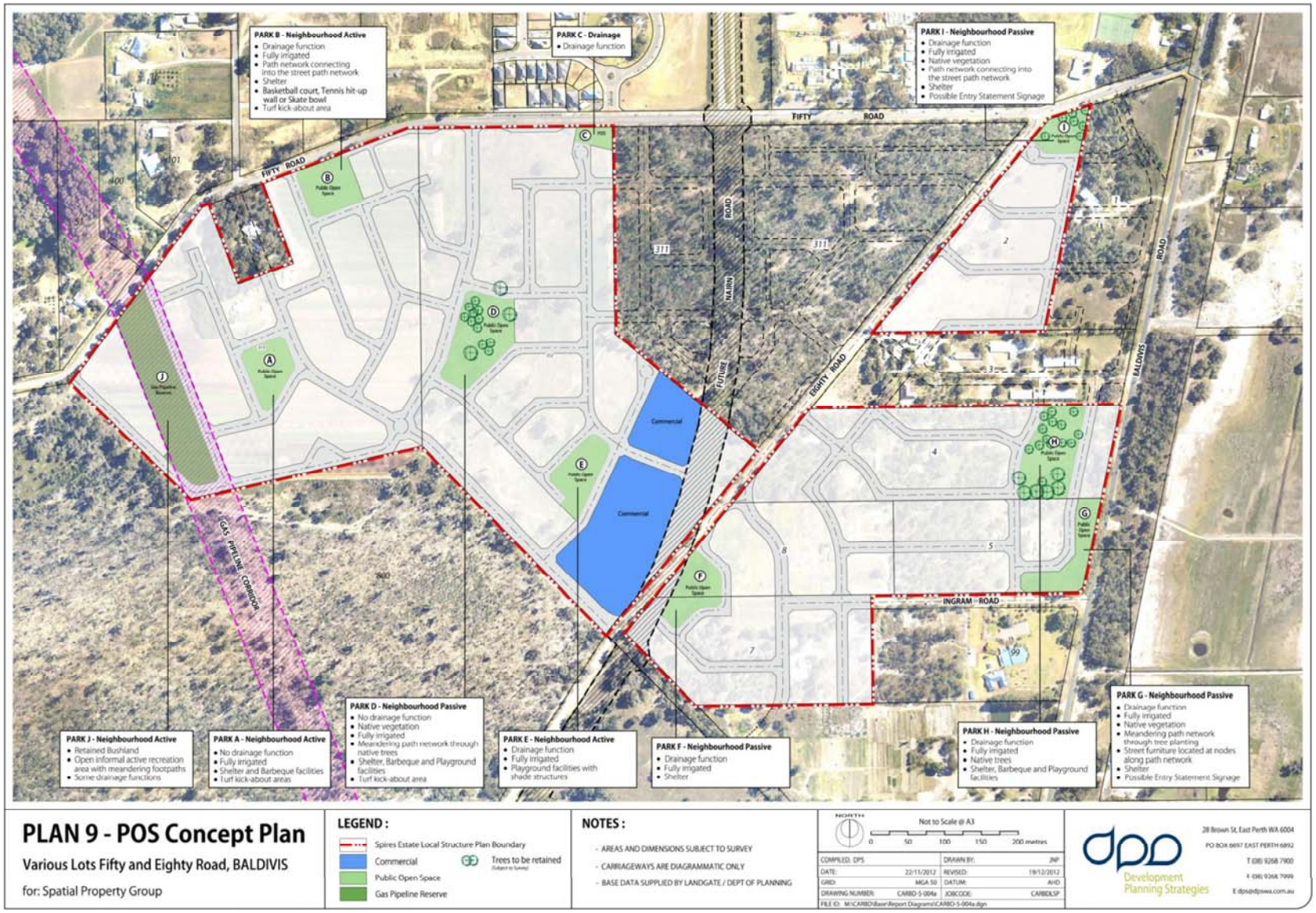
The POS concept is provided in Figure 6, which indicates that POS areas D, H and I will retain individual overstorey trees. All POS (including areas D, H and I) will have understoreys managed on an ongoing basis within 2 t/ha, so will not adversely contribute to the bush fire risk to life and property assets of the development.

3.6.2 Surrounding land use

Surrounding land uses comprise the following:

- market gardens and rural land to the northwest
- residential subdivision to the north (currently being developed)
- residential subdivision to the southeast (currently being developed)
- Baldivis Primary School and Baldivis Nature Reserve to the northeast
- private vegetated Lot 1 to the northeast, which contains a single dwelling and outbuilding
- private vegetated Lot 774 to the northwest, which contains a single dwelling and outbuilding
- private Lot 3 in the central-east, which is currently a poultry farm
- private vegetated Lot 311 in the central-north, which is undeveloped and fully vegetated
- Tramway Reserve to the far east, which is predominantly vegetated
- Rockingham Lakes Regional Park and Bush Forever Site 356 to the southwest, which is fully vegetated.

Much of the land surrounding the project area, in particular private lots 311, 1 and 774, is subject to future urban development in accordance with regional and local development planning directions under the MRS, TPS No. 2 and BNDSP.



Source: Development Planning Strategies 2013

STRATEGEN	Fire Management Plan: Spires Estate Local Structure Plan Public Open Space concept	Figure 6

3.7 Site assets

The project area does not currently contain an extensive range of on-site life, property or environmental assets. However, critical assets are still currently maintained throughout the project area through scattered dwellings/outbuildings and a small number of residents and visitors. Current life and property assets will be removed on development of the project area.

There project area contains limited on-site environmental assets due to the level of vegetation disturbance associated with current on-site land uses.

3.7.1 Proposed assets

Implementation of the Spires Estate LSP development will result in significant intensification of life and property assets. A dwelling yield projection outlined in DPS (2013) determined that approximately 950 dwellings should be achieved on implementation of the LSP, in addition to a commercial precinct and services. These will comprise the majority of future life and property assets within the project area, consisting of a combination of built assets, residents and visitors.

POS areas D, H and I will maintain environmental assets on implementation of the LSP through retention of individual overstorey trees. These POS areas will be managed to ensure the retained environmental assets do not adversely contribute to the bush fire risk.

3.8 Water supply

At present, there is no reticulated water supply to the site. This will be resolved through extension of the existing reticulated water supply from the development area to the southeast, which is currently under construction. In addition, the proposed water supply will be augmented through a link with the Tamworth Reservoir located immediately south of the site.

3.9 Power supply

Sufficient power supply exists in the vicinity of the project area in the form of a 22 KV aerial line, located along Baldivis Road, Fifty Road and Eighty Road. Existing aerial powerlines are proposed to be relocated underground on development of the project area.

3.10 Site access

Individual lots of the project area are currently accessed via driveways off Fifty Road, Eighty Road, Baldivis Road and Ingram Road.

A comprehensive internal public road network will be provided throughout the project area to service the proposed development, as outlined in Figure 1. The proposed road network provides numerous links to the surrounding public road network in Fifty Road, Eighty Road, future Nairn Road and Baldivis Road. The proposed road network also provides buffers to adjacent bushland areas and is sufficient for the provision of access for emergency fire service vehicles.

4. Fire problem

4.1 Bush fire history

The most recent bush fire in the vicinity of the project area occurred in 2012, which was a prescribed burn undertaken by CoR staff to reduce fuel loads within Baldivis Nature Reserve adjacent to Baldivis Primary School (Edwards H [CoR Chief Bush Fire Control Officer] 2013, pers. comm. 28 August).

Uncontrolled bush fires occur relatively frequently in the City of Rockingham during the bush fire season. The most recent of which (located near the project area) are outlined as follows (taken from BSC [2012]):

- 13 December 2010: a fire ignited at 1.12pm between Baldivis Road and Kwinana Freeway north of Safety Bay Road and burnt 20 ha of bushland. Fire crews saved four homes and several sheds. Part of the woodland vegetation in the Tramway Reserve was burnt.
- 12 April 2009: a fire ignited near Eighty and Fifty Road and DFES warned residents to close all doors and windows and turn off evaporative coolers. Fifty Road was closed between Baldivis Road and Safety Bay Road. This fire affected most of the project area and a total of 780 ha was burnt. The woodland vegetation to the west and southwest of the project area shows extensive evidence of this event.

In general, City of Rockingham is subject to a range of potential ignition sources, most notably suspected arson and accidental causes such as vehicle accidents, sparks from industrial work, pole-top fires, etc.

There are numerous emergency service resources in City of Rockingham that could provide a suppression response to the project area within 15 minutes, including local and career bush fire brigades at Baldivis, Rockingham, Secret Harbour and Singleton.

4.2 Bush fire hazards

A bush fire hazard assessment aims to classify the bush fire hazard at both the strategic and local level, which leads to an assessment of the Bushfire Attack Level (BAL). A preliminary bush fire hazard assessment was undertaken across the project area and adjacent land by Bushfire Safety Consulting (BSC 2012) in accordance with procedures outlined in PFBFP Guidelines (as outlined in Appendix 1). An additional, comprehensive bush fire hazard assessment, including assessment of the predominant vegetation types and available fuel loads, was undertaken by Strategen on 12 August 2013 across the full project area and adjoining properties. Results were compiled for both assessments, which are discussed in the following subsections.

4.2.1 On-site vegetation type, class and fuel hazards

On-site vegetation is restricted to isolated degraded remnants and individual scattered trees due to the level of vegetation clearance and disturbance associated with current on-site land uses. This has resulted in creation of large grassland and market garden areas, lesser areas of degraded eucalyptus woodland and small areas of open eucalypt forest and closed scrub.

Available fuel loads range from 0–2 t/ha (tonnes per hectare) in cleared grassland areas and market garden land; 2–5 t/ha in degraded eucalyptus woodland; and 5–8 t/ha in small areas of open eucalypt forest and closed scrub. The majority of these areas have been subject to various degrees of disturbance and fuel hazard reduction (e.g. clearing, rural use, prescribed burning and uncontrolled fire).

A summary of the on-site vegetation and fuel hazards is provided in Table 4, as well as a description of vegetation class and type in accordance with PFBFP Guidelines, supported by a series of photographs.

Table 4 On-site vegetation and fuel hazards

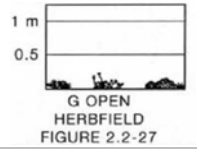
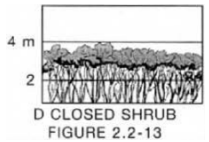
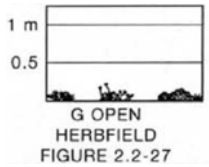
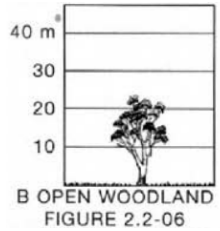
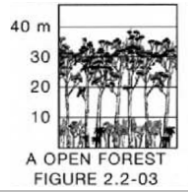
Lot number	Predominant vegetation and estimated available fuel load	Refer to plate number	Vegetation class	Vegetation type	Figure (as per PFBFP Guidelines)	Figure description
Lot 312	Grassland with scattered remnant Tuart trees (0–2 t/ha)	1	(G) Grassland	Open herbfield		All forms including situations with shrubs and trees if the overstorey foliage cover is less than 10%.
Lot 313	Market garden land (0–2 t/ha)	2	Not applicable for market garden land (unclassified vegetation type).			
	Small area of closed scrub (5–8 t/ha)	Not available	(D) Scrub	Closed scrub		Found in areas wet enough to support eucalypts trees; affected by poor soil fertility or shallow soils; greater than 30% foliage cover; dry heaths occur in rocky areas; shrubs 1–2 metres high; often coastal wetlands.
Lot 2	Grassland with scattered remnant Tuart trees (0–2 t/ha)	1	(G) Grassland	Open herbfield		All forms including situations with shrubs and trees if the overstorey foliage cover is less than 10%.
Lot 4	Eucalyptus woodland of Tuart, Jarrah and Marri with degraded mid and understoreys (2–5 t/ha)	3	(B) Woodland	Open woodland		Trees 10–30 m high; 10-30% foliage cover dominated by eucalypts; understorey low trees to tall shrubs typically dominated by Acacia, Callitris or Casuarina.
Lot 5	Eucalyptus woodland of Tuart, Jarrah and Marri with degraded mid and understoreys (2–5 t/ha)					
Lot 7	Eucalyptus woodland of Tuart, Jarrah and Marri with degraded mid and understoreys (2–5 t/ha)					
	Open eucalypt forest (5–8 t/ha)	4	(A) Forest	Open forest		Trees 10–30 m high; 30-70% foliage cover; (may include understorey of sclerophyllous low trees and tall scrubs or grass); typically dominated by eucalypts.
Lot 8	Market garden land (0–2 t/ha)	2	Not applicable for market garden land (unclassified vegetation type).			

Plate 1 Grassland adjacent to Fifty Road (0–2 t/ha)

Plate 2 Market garden land adjacent to Fifty Road (0–2 t/ha)

Plate 3 Eucalyptus woodland with degraded mid and understorey adjacent to Eighty Road (2–5 t/ha)

Plate 4 Open eucalypt forest adjacent to Eighty Road (5–8 t/ha)

4.2.2 Adjacent vegetation type, class and fuel hazards

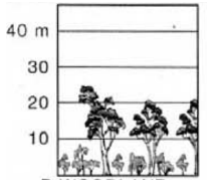
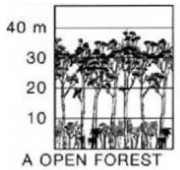
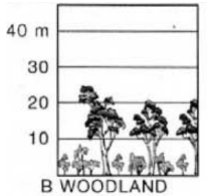
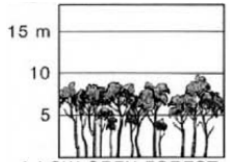
The vegetation extent situated adjacent to the project area consists of larger, more intact stands of woodland and forest vegetation. The adjacent vegetation extent has been allocated into two specific groups (refer to Section 3.1.1 for further information):

1. Vegetation considered to pose a permanent bush fire risk to the project area:
   (a) Rockingham Lakes Regional Park to the southwest (Bush Forever Site 356)
   (b) Baldivis Nature Reserve to the northeast
   (c) Tramway Reserve to the east
   (d) rural-zoned land to the northwest.
2. Vegetation considered to pose a temporary bush fire risk to the project area:
   (a) private vegetated Lot 311 in the central-north
   (b) private vegetated Lot 774 to the northwest
   (c) private vegetated Lot 1 to the northeast.

The abovementioned vegetated areas have been affected to varying degrees by three known bush fire events within the last five years, which have significantly reduced the available fuel loads.

A summary of the vegetation types and fuel hazards on land situated adjacent to the project area is provided in Table 5, as well as a description of vegetation class and type in accordance with PFBFP Guidelines, supported by a series of photographs.

Table 5 Adjacent vegetation and fuel hazards

Location of predominant vegetation	Predominant vegetation and estimated available fuel load	Refer to plate number	Vegetation class	Vegetation type	Figure (as per PFBFP Guidelines)	Figure description
Rockingham Lakes Regional Park (Bush Forever Site 356) to the southwest	Large area of eucalyptus woodland containing Tuart, Jarrah and Marri with intact midstorey of banksia and understorey shrubs and grasses (5–8 t/ha)	5 and 6	(B) Woodland	Woodland	 B WOODLAND FIGURE 2.2-05	Trees 10–30 m high; 10-30% foliage cover dominated by eucalypts; understorey low trees to tall shrubs typically dominated by Acacia, Callitris or Casuarina.
	Small area of open forest containing Tuart, Jarrah and Marri, with intact midstorey of banksia and understorey shrubs and grasses (5–8 t/ha)	Not available	(A) Forest	Open forest	 A OPEN FOREST FIGURE 2.2-03	Trees 10–30 m high; 30-70% foliage cover; (may include understorey of sclerophyllous low trees and tall scrubs or grass); typically dominated by eucalypts.
Vegetated private Lot 311 in the central-north	Large area of eucalyptus woodland containing Tuart, Jarrah and Marri with intact midstorey of banksia and understorey shrubs and grasses (5–8 t/ha)	7	(B) Woodland	Woodland	 B WOODLAND FIGURE 2.2-05	Trees 10–30 m high; 10-30% foliage cover dominated by eucalypts; understorey low trees to tall shrubs typically dominated by Acacia, Callitris or Casuarina.
Baldivis Nature Reserve to the north	Small area of low open eucalypt forest with a Jarrah-Marri overstorey, banksia midstorey and understorey of low shrubs (5 t/ha)	8	(A) Forest	Low open forest	 A LOW OPEN FOREST FIGURE 2.2-04	Trees 10–30 m high; 30-70% foliage cover; (may include understorey of sclerophyllous low trees and tall scrubs or grass); typically dominated by eucalypts.
Tramway Reserve to the east	Narrow strip of vegetation containing a combination of eucalyptus woodland and open forest vegetation (5–8 t/ha)	Not available	(B) Woodland and (A) Forest	Woodland and Open forest	As above	As above.

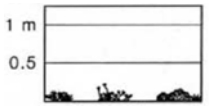
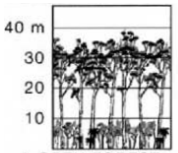
Location of predominant vegetation	Predominant vegetation and estimated available fuel load	Refer to plate number	Vegetation class	Vegetation type	Figure (as per PFBFP Guidelines)	Figure description
Rural land to the northwest and far east	Grassland with scattered remnant Tuart trees (0–2 t/ha)	Not available	(G) Grassland	Open herbfield	 G OPEN HERBFIELD FIGURE 2.2-27	All forms including situations with shrubs and trees if the overstorey foliage cover is less than 10%.
Vegetated private Lot 774 to the northwest	Small area of open forest containing Tuart, Jarrah and Marri, with intact midstorey of banksia and understorey shrubs and grasses (5–8 t/ha)	Not available	(A) Forest	Open forest	 A OPEN FOREST FIGURE 2.2-03	Trees 10–30 m high; 30-70% foliage cover; (may include understorey of sclerophyllous low trees and tall scrubs or grass); typically dominated by eucalypts.
Vegetated private Lot 1 to the northeast	Small area of vegetation containing a combination of eucalyptus open forest (5–8 t/ha) and grassland vegetation (0–2 t/ha)	Not available	(A) Forest and (G) Grassland	Open forest and Open herbfield	As above	As above.
Remaining cleared, undeveloped land to the north and southeast	Disturbed environment with weeds and sandy areas only (0–2 t/ha)	Not available	Not applicable for cleared land currently under development (unclassified vegetation type).			

Plate 5 Rockingham Lakes Regional Park (Bush Forever Site 356) to the southwest (5–8 t/ha)

Plate 6 Rockingham Lakes Regional Park (Bush Forever Site 356) to the southwest (5–8 t/ha)

Plate 7 Private vegetated Lot 311 in the central-north (5–8 t/ha)

Plate 8 Baldivis Nature Reserve to the northeast (5 t/ha)

4.2.3 Location of bush fire hazards

The location of existing bush fire hazard areas is outlined in the vegetation class map (Figure 7), as prepared by BSC (2012). This map has been created using the abovementioned vegetation class and type descriptions.

4.2.4 Bush fire hazard levels

Bush fire hazard levels of the predominant vegetation are displayed in the bush fire hazard assessment map (Figure 8), as prepared by BSC (2012). Classifying the bush fire hazard by assessing the predominant vegetation is a key to the initial determination of site suitability for development. This also leads to determination of the potential level of construction standard by the application of AS 3959–2009 *Construction of buildings in bushfire prone areas* (SA 2009) for any proposed development.

The project area and adjacent properties contain bush fire hazard levels ranging from 'Low' to 'Extreme':

- 'Low' bush fire hazards levels occur within market garden land, managed grasslands and areas currently subject to development
- 'Moderate' bush fire hazard levels occur in all areas of unmanaged grasslands, as well as managed or disturbed areas of open woodlands
- 'Extreme' bush fire hazard levels occur in all areas classified as woodland or forest.

According to PFBFP Guidelines, land with an assessed 'Moderate' to 'Extreme' bush fire hazard level is classified as bush fire prone land, which triggers implementation of AS 3959–2009 for any proposed development within 100 m.

Once developed, the project area will maintain a 'Low' bush fire hazard level. Therefore, the bush fire hazards on adjacent land will pose the predominant bush fire risk to the project area.

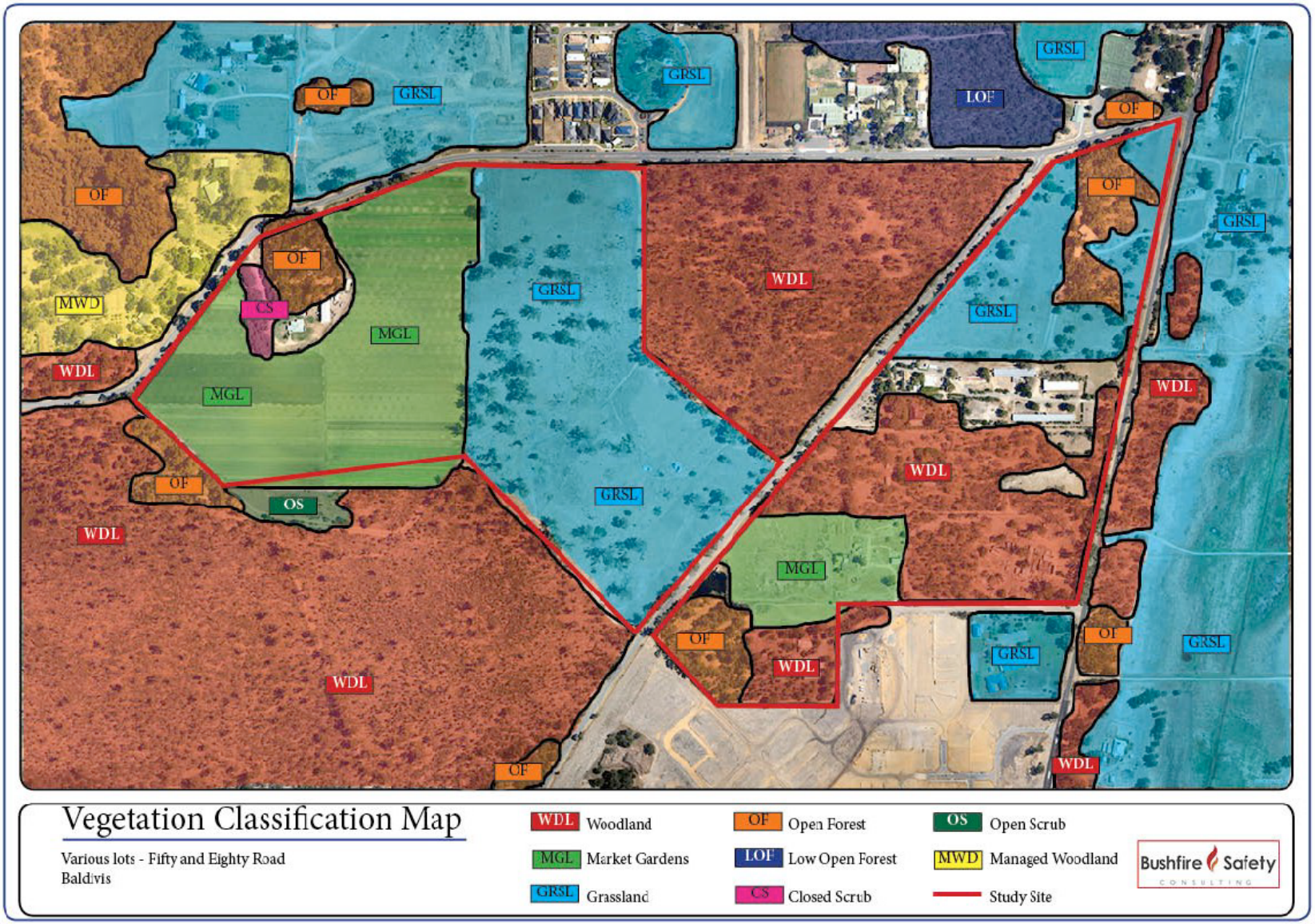
Permanent bush fire hazards are situated within the following areas:

- Rockingham Lakes Regional Park to the southwest ('Extreme')
- Baldivis Nature Reserve to the northeast ('Extreme')
- Tramway Reserve to the east (combination of 'Moderate' and 'Extreme')
- rural-zoned land to the northwest (combination of 'Moderate' and 'Extreme').

Temporary bush fire hazards are situated within the following areas:

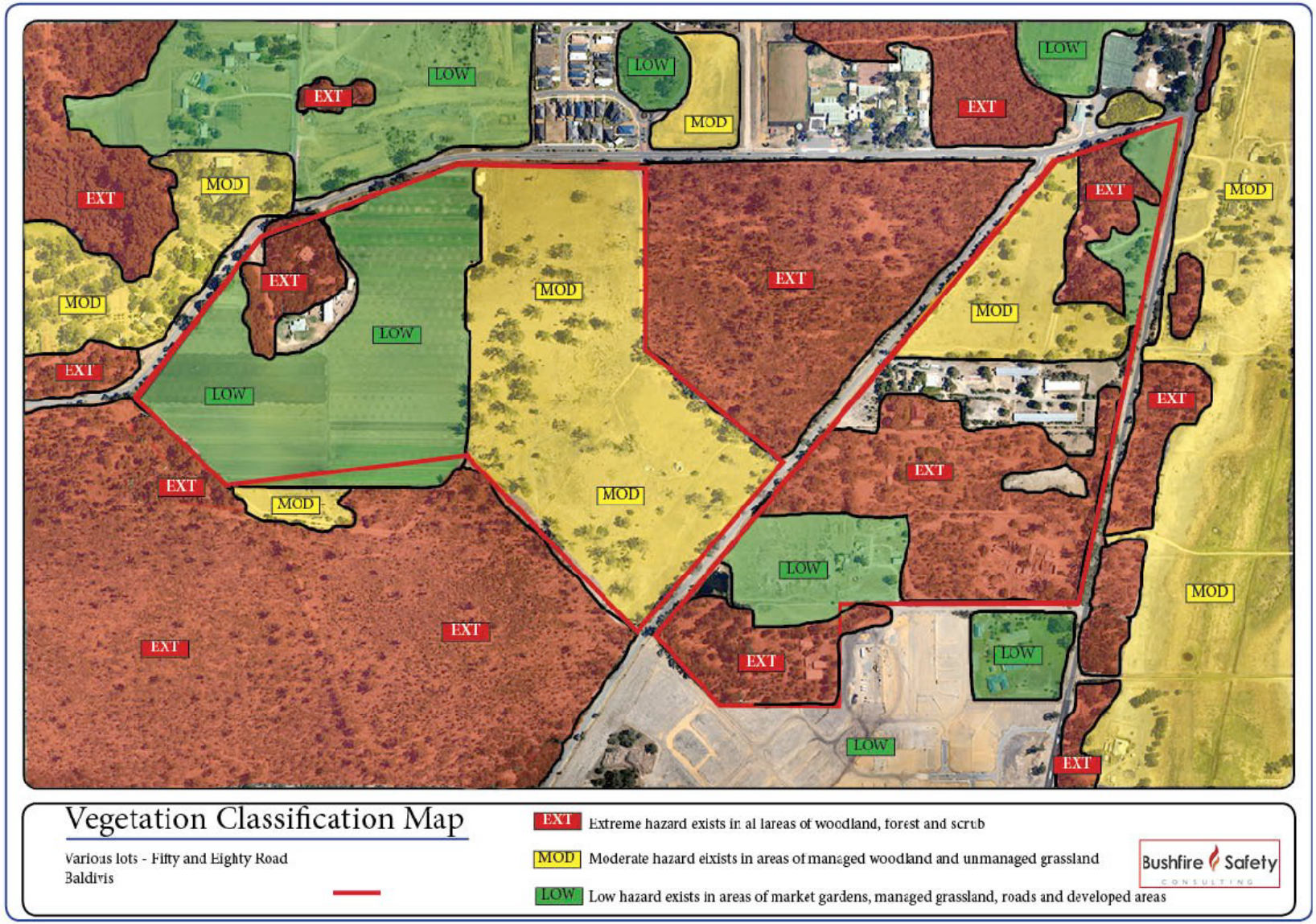
- private vegetated Lot 311 in the central-north ('Extreme')
- private vegetated Lot 774 to the northwest ('Extreme')
- private vegetated Lot 1 to the northeast (combination of 'Low' and 'Extreme').

The abovementioned permanent and temporary areas of adjacent 'Moderate' and 'Extreme' bush fire hazard will need to be managed through ongoing planning and design of the Spires Estate LSP.



Source: Bushfire Safety Consulting 2012

STRATEGEN	Fire Management Plan: Spires Estate Local Structure Plan Vegetation class map	Figure 7



Source: Bushfire Safety Consulting 2012

STRATEGEN	Fire Management Plan: Spires Estate Local Structure Plan Bush fire hazard assessment map	Figure 8

4.2.5 Bush fire hazard performance criteria

The relationship between various bush fire hazard levels and development performance criteria is set out in Table 6. The project area contains, and is situated adjacent to, areas with an 'Extreme' bush fire hazard level. In general, new developments are not permitted in areas with an 'Extreme' bush fire hazard level (WAPC et al. 2010). Therefore, a comprehensive suite of bush fire risk mitigation measures will need to be implemented to reduce and maintain the bush fire hazard to a 'Moderate' level or lower. This is expected to be achieved through implementation of numerous bush fire risk mitigation measures to compliment the extent of on-site vegetation clearance.

Compliance with performance criteria for a 'Moderate' bush fire hazard level will be achieved, focussing on the key areas of development location, vehicular access, water supply, siting of development and design of development. Performance criteria will be achieved through adoption of recommended acceptable solutions outlined in PFBFP Guidelines.

Table 6 Bush fire hazard levels and performance criteria

Bush fire hazard level	Bush fire protection performance criteria required
Low hazard	Development does not require special bush fire planning controls. Despite this, DFES strongly recommends that ember protection features be incorporated in design where practicable.
Moderate hazard	Performance criteria for: • location (Element 1) • vehicular access (Element 2) • water (Element 3) • siting of development (Element 4) • design of development (Element 5).
Extreme hazard	Development is to be avoided in areas with these hazard levels.

Source: WAPC et al. 2010

Compliance of the Spires Estate LSP development with bush fire protection performance criteria and associated acceptable solutions is documented in the compliance checklist (Appendix 2).

4.2.6 Classifying the Bushfire Attack Level (BAL)

This procedure, as outlined in PFBFP Guidelines and AS 3959–2009, uses a combination of the state-adopted Fire Danger Index rating of FDI 80, vegetation type, slope under classified vegetation and the distance maintained between proposed development areas and the classified vegetation to specify the Bushfire Attack Level (BAL). Based on the specified BAL, construction requirements for proposed buildings can then be assigned.

Once developed, the project area will maintain a 'Low' bush fire hazard level, with the full extent of surrounding classified vegetation located either up-slope or on flat land from proposed development areas.

On the basis of the above, Strategen considers that the predominant bush fire risk to the project area will be from adjacent 'Moderate' and 'Extreme' bush fire hazard areas. Some of these hazards are considered permanent (i.e. not currently subject to future urban development) and some are considered temporary (i.e. subject to future urban development), as outlined in Section 4.2.4.

Application of AS 3959–2009 to address permanent bush fire risk

All proposed lots situated within the 100 m Hazard Separation Zone (HSZ) to permanent 'Moderate' or 'Extreme' bush fire hazard areas (as depicted in Figure 9a) will require implementation of AS 3959–2009 and application of increased building construction standards and associated Building Protection Zones (BPZs), in accordance with the BALs and minimum separation distances highlighted in Table 7. The specified BALs and accompanying BPZs are illustrated in Figure 9a, which have been defined on the basis of the following parameters:

- FDI 80
- a combination of woodland and forest vegetation types
- no classified vegetation under slope located down-slope from proposed lots (i.e. the location of proposed lots is on flat land or down-slope from the adjacent vegetation)
- achievable separation distances provided by existing/proposed road reserves, footpaths, building setbacks, cleared areas and developed areas.

Table 7 Determination of Bushfire Attack Levels to address permanent bush fire hazards

Vegetation class	Bush fire attack level (BAL)				
	BAL FZ	BAL 40	BAL 29	BAL 19	BAL 12.5
	Distance (m) of the site from the predominant vegetation class				
	Vegetation is up-slope and flat land (0 degrees)				
(A) Forest	<16 (not appropriate)	16–<21 (not appropriate)	21–<31	31–<42	42–<100
(B) Woodland	<10 (not appropriate)	10–<14 (not appropriate)	14–<20	20–<29	29–<100

Application of AS 3959–2009 to address temporary bush fire risk

A 100 m wide HSZ and associated BALs and BPZs to adjacent temporary bush fire hazards is depicted in Figure 9b. This level of mitigation will be implemented should development within the 100 m wide buffer precede development of the adjoining vegetated private property (i.e. in Lot 311, Lot 774 and Lot 1). In this case, those areas within the 100 m wide buffer currently subject to BAL FZ and BAL 40 will remain undeveloped until such time as adjacent vegetation is cleared, consistent with the provisions of AS 3959–2009.

It should be noted that Figure 9b depicts preliminary BAL ratings for lots within the 100 m wide buffer of adjacent temporary bush fire risk. The preliminary BAL ratings may be updated by provision of more detailed BAL assessments.

In the event that the temporary bush fire risk is removed prior to development of the land within the 100 m wide buffer, then the above land use/development response will be redundant.

Measures will be incorporated to manage the temporary bush fire risk from on-site vegetation during internal staging, such as maintenance of a 100 m wide low fuel HSZ between stages undergoing development and future undeveloped stages that have a 'Moderate' to 'Extreme' bush fire hazard level (this is discussed further in Section 5.4.4).

4.2.7 Construction standards

A brief description of BAL 12.5, BAL 19 and BAL 29, associated heat flux exposure thresholds, predicted bush fire attack, levels of exposure and the relevant sections of AS 3959–2009 is provided in Table 8. Specific construction standards for BAL 12.5, BAL 19 and BAL 29 are fully explained in Appendix 4.

Table 8 Construction standards

Bush fire attack level (BAL)	Classified vegetation within 100m of the site and heat flux exposure thresholds	Description of predicted bush fire attack and levels of exposure	Section as per AS 3959–2009
BAL 12.5	≤12.5 kW/m^2	Ember attack	3 and 5
BAL 19	>12.5 kW/m^2 ≤19 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.	3 and 6
BAL 29	>19 kW/m^2 ≤29 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.	3 and 7

Source: SA 2009

4.3 Inherent bush fire risk

An inherent bush fire risk assessment has been undertaken for the project area, which quantifies the level of risk of loss or damage to current assets within the project area from uncontrolled bush fire, prior to the implementation of the Spires Estate LSP development and associated bush fire risk mitigation measures.

The risk assessment is derived from *Rural Urban Bush Fire Threat Analysis* (Smith 2003) and Australian Standard/New Zealand Standard *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines* (SA & SNZ 2009). Risks are evaluated through determining likelihood of ignition and consequence of bush fire occurrence, as well as a scoring system based on the parameters outlined in Table 9.

Results of the risk assessment are outlined in Table 9. The assessment revealed that the inherent risk of loss or damage to current site assets from uncontrolled bush fire is high on the basis of the following:

1. The project area contains or is in direct proximity to extreme bush fire hazard areas, derived mainly from the extent of eucalyptus woodland and forest located on adjoining properties.
2. The project area currently contains critical life and property assets.
3. The project area and surrounding vegetation has been subject to recent, frequent occurrences of uncontrolled bush fire.
4. The project area does not currently maintain a high level of bush fire management.

Table 9 Inherent bush fire risk assessment for the project area

Parameter	Risk to site assets
On-site fuel hazard rating (highest rating)	Extreme
Are assets located up-slope from vegetation?	No
Are assets located in the flame zone?	Yes
Resident/visitor presence (low, moderate, high)	Moderate
Values or assets (low, moderate, high)	High
Fire unit access risk (low, moderate, high)	Moderate
Fire suppression response time (minutes)	<15
Likelihood of ignition and bush fire occurrence (low, moderate, high)	High
Current level of bush fire management (low, moderate, high)	Low
Overall inherent ris	**High**

4.4 Summary of key bush fire issues

The following is a summary of key bush fire issues that should be considered as part of ongoing planning and design of the Spires Estate LSP and development of specified bush fire risk mitigation measures:

- the locality has had recent, frequent occurrences of uncontrolled bush fire
- the average response time in the event that the project area is threatened by bush fire is 15 minutes from local volunteer and career bush fire brigades
- the project area and surrounding land contains a range of vegetation types and available fuel loads, including grassland, woodland and forest fuels, the majority of which have been subject to various degrees of disturbance and fuel hazard reduction (e.g. clearing, rural use, prescribed burning and uncontrolled fire)
- a bush fire hazard assessment determined the project area and adjacent land to contain bush fire hazard levels of 'Low', 'Moderate' and 'Extreme'
- once developed, the project area will maintain a 'Low' bush fire hazard level; therefore, the bush fire hazards within adjoining properties will pose the predominant bush fire risk to the project area
- permanent bush fire hazards are situated within the following areas:
    - Rockingham Lakes Regional Park to the southwest ('Extreme')
    - Baldivis Nature Reserve to the northeast ('Extreme')
    - Tramway Reserve to the east (combination of 'Moderate' and 'Extreme')
    - rural-zoned land to the northwest (combination of 'Moderate' and 'Extreme')
- temporary bush fire hazards are situated within the following areas:
    - private vegetated Lot 311 in the central-north ('Extreme')
    - private vegetated Lot 774 to the northwest ('Extreme')
    - private vegetated Lot 1 to the northeast (combination of 'Low' and 'Extreme')
- permanent bush fire risks will be addressed through implementation of a combination of the following within a designated 100 m wide HSZ (refer to Figure 9a):
    - BAL 29 (with a minimum 21 m wide BPZ comprising a 14 m wide road reserve and 7 m building setback), BAL 19 and BAL 12.5 adjacent to forest
    - BAL 29 (with a minimum 14 m wide BPZ contained wholly within the adjacent road reserve), BAL 19 and BAL 12.5 adjacent to woodland
    - BAL 19 (with a minimum 20 m wide BPZ contained wholly within the adjacent road reserve) and BAL 12.5 adjacent to woodland
- temporary bush fire risk will be addressed through provision of a temporary 100 m wide HSZ, with BALs and BPZs (refer to Figure 9b) to be implemented should development within the 100 m wide HSZ precede development of the adjoining vegetated private property (i.e. in Lot 311, Lot 774 and Lot 1)
- those areas within the temporary 100 m wide buffer currently subject to BAL FZ and BAL 40 will remain undeveloped until such time as adjacent vegetation is cleared, consistent with the provisions of AS 3959–2009
- in the event that the temporary bush fire risk is removed prior to development of the land within the 100 m wide buffer, then the above land use/development response will be redundant
- measures will be incorporated to manage the temporary bush fire risk from on-site vegetation during internal staging, such as maintenance of a 100 m wide low fuel HSZ between stages undergoing development and future undeveloped stages that have a 'Moderate' to 'Extreme' bush fire hazard level
- performance criteria and acceptable solutions will be achieved for a moderate bush fire hazard level, focussing on the key areas of development location, vehicular access, water supply, siting of development and design of development
- the pre-development, inherent bush fire risk to the project area is high.

5. Bush fire risk mitigation

The following subsections outline how the proposed Spires Estate LSP development will mitigate the inherent bush fire risk to life, property and the environment and achieve a suitable and effective bush fire management outcome for the site. This will be achieved by meeting performance criteria and associated acceptable solutions in accordance with PFBFP Guidelines. Where applicable, these measures are illustrated on an aerial image of the project area to assist with implementation of the FMP, as depicted in Figure 9a (to address the permanent bush fire risk) and Figure 9b (to address the temporary bush fire risk).

5.1 Development location

Strategic location, layout and management of future development at the planning stage can reduce future fire threat and risk to critical life and property assets.

5.1.1 Proposed lots

Once developed, the project area will consist of a significant built footprint, with only minor retention of individual overstorey trees proposed throughout selected POS areas subject to annual management. This will result in creation of a 'Low' bush fire hazard area, which will incorporate all proposed lots.

5.1.2 Public Open Space

POS areas D, H and I will retain some individual overstorey trees. However, all POS areas will have managed understoreys, so will not adversely contribute to the bush fire risk to life and property assets of the development. Annual management of POS understoreys will achieve creation of a 'Low' bush fire hazard level across all POS areas, with available fuel loads maintained annually within 2 t/ha through mechanical slashing (i.e. mowing) of understorey grasses, trash and litter fuels prior to the onset of the designated bush fire season.

The above measures will ensure the development is not located on land subject to either an extreme bush fire hazard level or construction standards applicable to BAL 40 or BAL FZ. This meets performance criteria for development location (Element 1) by adopting acceptable solution A1.1.

5.2 Vehicular access

The Spires Estate LSP development will result in provision of a comprehensive internal road network. The proposed road network will provide up to 11 links to the surrounding public road network in Fifty Road, Eighty Road, future Nairn Road and Baldivis Road (Figure 9a). This measure adopts acceptable solution A2.1 by ensuring all residents and visitors of the development are provided with at least two vehicular access routes connecting to the surrounding public road network at all times.

All public roads, cul-de-sacs (including a small number of short, dead-end roads) and private driveways will be constructed to specifications in accordance with Main Roads WA and DFES requirements to align with acceptable solutions A2.2, A2.3 and A2.5.

Other acceptable solutions for vehicular access including emergency access ways, fire service access routes, gates, firebreaks and signage are not considered necessary as part of the development, due to the adequate level of vehicular access proposed and the lack of on-site bush fire hazards to warrant higher level access requirements. The external road network, which follows the LSP boundary, is sufficient to provide access for emergency fire service vehicles in the event that uncontrolled bush fire threatens the project area from adjoining bushland areas.

The above measures will ensure the development meets performance criteria for vehicular access (Element 2).

5.3 Water supply

A reticulated water supply will be provided for the proposed LSP development through extension of the existing reticulated water supply from the development area to the southeast, which is currently under construction. In addition, the proposed water supply will be augmented through a link with the Tamworth Reservoir located immediately south of the site.

A network of hydrants will also be provided along the internal road network at locations which meet relevant water supply authority and DFES requirements.

The above measures will ensure the development meets performance criteria for water supply (Element 3) by adopting acceptable solution A3.1.

5.4 Siting of development

When considering the overall bush fire management of the project area, protection should be provided to critical life and property assets (i.e. residents, visitors and built assets) as a minimum requirement. Low fuel buffers between fire hazard areas and critical assets, as well as application of AS 3959–2009 can be implemented to achieve this.

5.4.1 Hazard separation zones

The project area adjoins numerous properties designated as 'Moderate' or 'Extreme' bush fire hazard. These areas have been allocated as follows (refer to Section 3.1.1 for further information):

1. Permanent bush fire hazards are situated within:
   (a) Rockingham Lakes Regional Park to the southwest ('Extreme')
   (b) Baldivis Nature Reserve to the northeast ('Extreme')
   (c) Tramway Reserve to the east (combination of 'Moderate' and 'Extreme')
   (d) rural-zoned land to the northwest (combination of 'Moderate' and 'Extreme').
2. Temporary bush fire hazards are situated within:
   (a) private vegetated Lot 311 in the central-north ('Extreme')
   (b) private vegetated Lot 774 to the northwest ('Extreme')
   (c) private vegetated Lot 1 to the northeast (combination of 'Low' and 'Extreme').

100 m wide HSZs have been depicted around both permanent and temporary bush fire hazard areas rated as 'Moderate' or 'Extreme' to inform implementation of AS 3959–2009 and application of increased building construction standards and associated BPZs (see Figure 9a and Figure 9b respectively).

5.4.2 Application of AS 3959–2009 to address the permanent bush fire risk

All proposed lots situated within the permanent 100 m wide HSZ will be subject to Detailed Area Plan (DAP) requirements and require implementation of AS 3959–2009 and application of building construction standards applicable to either BAL 29, BAL 19 and BAL 12.5 (refer to Figure 9a for specified BAL ratings).

BAL 29 lots adjacent to forest vegetation, located along the southern boundary and west of POS area J, will be subject to a minimum BPZ of 21 m, which will impose building setbacks of 7 m on these lots since the proposed 14 m wide road reserve (which abuts POS area J) is not wide enough to accommodate the full 21 m wide BPZ.

BAL 29 lots adjacent to woodland vegetation will be subject to a minimum BPZ of 14 m, which is not expected to impose building setbacks since the full 14 m can be accommodated within the adjoining road reserve to the south.

BAL 19 lots adjacent to woodland vegetation will be subject to a minimum BPZ of 20 m, which is not expected to impose building setbacks since the full 20 m can be accommodated within the adjoining road reserves in Baldivis Road, Fifty Road and Eighty Road.

BAL 12.5 lots will not require individual BPZs since these lots are 'set back' further into the built footprint and have adequate hazard separation in accordance with AS 3959–2009 (refer to Table 7). The developer will provide an overlay of all BPZs on the subdivision layout to accompany subdivision. The BPZs will be maintained within 2 t/ha on an ongoing basis, consisting of existing/proposed road reserves, footpaths, building setbacks (where required), cleared areas and developed areas. Irrigated lawns, landscaped gardens and road-side verges can also be included within the BPZ, provided they are maintained annually within 2 t/ha.

5.4.3 Application of AS 3959–2009 to address temporary bush fire risk

All proposed lots within the temporary 100 m wide HSZ will potentially be subject to BAL and BPZ requirements, as depicted in Figure 9b. This level of mitigation will be implemented should development within the 100 m wide buffer precede development of the adjoining vegetated private property (i.e. in Lot 311, Lot 774 and Lot 1). In this case, land within the temporary 100 m HSZ currently subject to BAL FZ and BAL 40 (i.e. land directly adjoining the vegetated private property) will remain undeveloped as BPZs (either a 14 m wide BPZ if adjacent to woodland or a 21 m wide BPZ if adjacent to forest) until such time as the adjacent bush fire risk is removed, consistent with the provisions of AS 3959–2009. The developer will provide an overlay of all BPZs on the subdivision layout to accompany subdivision.

Figure 9b depicts preliminary BAL ratings for lots within the 100 m wide buffer of adjacent temporary bush fire risk. Should development of this land precede removal of the adjacent temporary bush fire risk, the preliminary BAL ratings may be updated by provision of more detailed BAL assessments.

In the event that the temporary bush fire risk is removed prior to development of the land within the 100 m wide buffer, then the above land use/development response will be redundant.

All lots within the 100 m HSZ will be subject to DAP requirements.

5.4.4 Development staging

Measures will be incorporated to manage the temporary bush fire risk from on-site vegetation during internal staging, such as maintenance of a 100 m wide low fuel Hazard Separation Zone (HSZ) between stages undergoing development and future undeveloped stages that have a 'Moderate' to 'Extreme' bush fire hazard level.

The range of measures outlined in Section 5.4 will ensure the development meets performance criteria for siting of development (Element 4) by adopting acceptable solution A4.1, A4.2, A4.3, A4.4 and A4.5. Strategen considers that these measures adequately address the permanent and temporary bush fire risk posed by on-site and adjoining vegetated land.

5.5 Design of development

Development design, as indicated in Figure 1, is expected to reduce the vulnerability of life and property from the affects of bush fire and greatly assist bush fire prevention and suppression operations. Given the proposed development is considered to comply with acceptable solutions A4.1, A4.2, A4.3, A4.4 and A4.5, there are no special design requirements.

5.6 Additional bush fire risk mitigation

The following measures will be considered in addition to those outlined previously to provide a more thorough level of bush fire protection to the project area:

1. Annual fuel inspections: inspections are undertaken by CoR staff and failure to comply with this FMP and the specified requirements of the current CoR fire control notice may result in the issuing of fines of up to $250 (refer to Appendix 5 for the current CoR fire control notice).
2. Landowner education and awareness: prospective landowners are required to be provided a copy of local government and DFES bush fire information booklets that are currently available. In addition, attendance by prospective landowners at annual DFES bush fire awareness briefings would be advantageous.

5.7 Summary of bush fire risk mitigation and works program

A summary of the bush fire risk mitigation measures described in Section 5 and a works program is provided in Table 10. These measures will be implemented to ensure ongoing protection of on-site assets is achieved. Additional optional techniques are also provided and can be adopted by residents to further mitigate their risk to life and property from uncontrolled bush fires. Responsibilities are also defined to assist with implementation of each management measure.

Table 10 Summary of bush fire risk mitigation measures and works program

Bush fire risk mitigation	Recommended works	Mandatory	Optional	Timing	Responsibility
Development location	Undertake clearing and development in accordance with the Spires Estate LSP to ensure the site maintains a 'Low' bush fire hazard level. Refer to FMP Section 5.1.1.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Manage all POS understoreys within 2 t/ha via mechanical slashing of understorey grasses, trash and litter fuels. Refer to FMP Section 5.1.2.	Yes	No	Annually prior to the onset of the designated bush fire season	Developer during development, CoR thereafter
Vehicular access	Construct an internal public road network in accordance with the Spires Estate LSP, which provides up to 11 links to the surrounding public road network. Refer to FMP Section 5.2.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Construct all public roads, cul-de-sacs (including a small number of short, dead-end roads) and private driveways in accordance with Main Roads WA and DFES requirements. Refer to FMP Section 5.2.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Provide an external perimeter road network sufficient for access by emergency fire service vehicles. Refer to FMP Section 5.2.	Yes	No	On implementation of Spires Estate LSP development	Developer
Water supply	Provide a reticulated water supply through extension of the existing reticulated water supply from the development area to the southeast. Refer to FMP Section 5.3.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Provide a network of hydrants along the internal road network at locations which meet relevant water supply authority and DFES requirements. Refer to FMP Section 5.3.	Yes	No	On implementation of Spires Estate LSP development	Developer
Siting of development	For those lots within the permanent 100 m wide HSZ, implement AS 3959–2009 and associated construction standards and BPZs in accordance with Figure 9a, based on the assessment outlined in Section 4.2.6 and summarised in Section 5.4.2.	Yes	No	On construction of individual buildings	Developer and prospective landowners
	Manage all BPZs within 2 t/ha on an ongoing basis, including irrigated lawns, landscaped gardens and road-side verges. Refer to FMP Section 5.4.2.	Yes	No	On implementation of Spires Estate LSP development	Developer during development, CoR and prospective landowners thereafter

Bush fire risk mitigation	Recommended works	Mandatory	Optional	Timing	Responsibility
	For those lots within the temporary 100 m wide HSZ, implement AS 3959–2009 and associated construction standards and BPZs in accordance with Figure 9b, should development within the temporary 100 m HSZ precede development of the adjoining vegetated private property (i.e. in Lot 311, Lot 774 and Lot 1). Refer to FMP Section 5.4.3.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Should the temporary bush fire risk remain, then land within the 100 m wide buffer currently subject to BAL FZ and BAL 40 will remain undeveloped as BPZs until such time as the adjacent bush fire risk is removed, consistent with the provisions of AS 3959–2009. Refer to FMP Section 5.4.3.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Maintain a 100 m wide low fuel HSZ between stages undergoing development and future undeveloped stages that have a 'Moderate' to 'Extreme' bush fire hazard level. Refer to FMP Section 0.	Yes	No	On implementation of Spires Estate LSP development	Developer
	Provide an overlay of all BPZs on the subdivision layout to accompany subdivision. Refer to FMP Sections 5.4.2 and 5.4.3.	Yes	No	On application of subdivision.	Developer
	Lots within the 100 m HSZ (permanent and temporary) are to be subject to DAP requirements. Refer to FMP Section 5.4.2.	Yes	No	Prior to subdivision of proposed lots	Developer
Design of development	Comply with all acceptable solutions A4.1, A4.2 and A4.3, A4.4 and A4.5. Refer to FMP Section 5.5.	Yes	No	On implementation of Spires Estate LSP development	Developer
Annual fuel inspections	Comply with the current CoR fire control notice. Refer to Appendix 5.	Yes	No	Annually prior to the onset of the designated bush fire season	Developer, CoR and prospective landowners
	Undertake an inspection of fuel hazards across individual lots to assess compliance with the FMP and annual fire control notice. Refer to FMP Section 5.6.	Yes	No	Annually prior to the onset of the designated bush fire season	CoR staff
	Issue work orders or fines where compliance with the *Bush Fires Act 1954*, the FMP or the annual fire control notice has been compromised. Refer to FMP Section 5.6.	Yes	No	Annually prior to the onset of the designated bush fire season	CoR staff
Landowner education and awareness	Distribution of bush fire information booklets. Refer to FMP Section 5.6.	Yes	No	Annually	CoR staff, DFES
	Attendance at annual DFES bush fire awareness briefings. Refer to FMP Section 5.6.	No	Yes	Annually	Prospective landowners
Optional building requirements	Restriction on the installation of evaporative air-conditioners, mesh screens and shutters. Installation of residential building sprinkler systems.	No	Yes	On construction of individual buildings	Prospective landowners
Restricted and prohibited burning times	Comply with the annual fire control notice and DFES/CoR-determined burning periods. Refer to Appendix 5.	Yes	No	As specified by DFES/CoR	CoR, prospective landowners

6. Implementation of the Fire Management Plan

6.1 Implementation of bush fire risk mitigation measures

The full range of bush fire risk mitigation measures and location of implementation as specified in this FMP is provided in Figure 9a (addressing the permanent bush fire risk) and Figure 9b (addressing the temporary bush fire risk), which are overlain on an aerial image of the project area to assist with implementation.

6.2 Residual bush fire risk

The residual bush fire risk is the level of risk remaining after the Spires Estate LSP development and associated bush fire risk mitigation measures have been implemented. A residual bush fire risk assessment for the project area is provided in Table 11.

The residual bush fire risk to life and property assets was assessed as 'Low', due to the increased level of bush fire management proposed across the site and the subsequent expected reduction in on-site fuel loads, access risk and likelihood of ignition and bush fire occurrence.

Table 11 Residual bush fire risk assessment for the project area

Parameter	Risk to site assets
On-site fuel hazard rating (highest rating)	Low
Are assets located up-slope from vegetation?	No
Are assets located in the flame zone?	No
Resident/visitor presence (low, moderate, high)	High
Values or assets (low, moderate, high)	High
Fire unit access risk (low, moderate, high)	Low
Fire suppression response time (minutes)	<15
Likelihood of ignition and bush fire occurrence (low, moderate, high)	Low
Level of bush fire management (low, moderate, high)	High
Overall residual ris	**Low**

Figure 9a Fire Management Plan (to address permanent bush fire risk): Spires Estate Local Structure Plan

Scale 1:5,500 at A3

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 12/02/2014
Author: JCrute
Source: Client 2013.

Legend

- Public vehicular access routes
- Proposed local roads
- 100 m HSZ to address permanent bush fire risk
- BAL 12.5
- BAL 19
- BAL 29
- 14 m wide BPZ
- 20 m wide BPZ
- 21 m wide BPZ
- Spires Estate LSP boundary
- Existing adjoining landholdings
- Proposed commercial areas
- Proposed POS areas (A-J)
- Proposed residential lots
- Proposed gas pipeline corridor
- Proposed Nairn Road alignment

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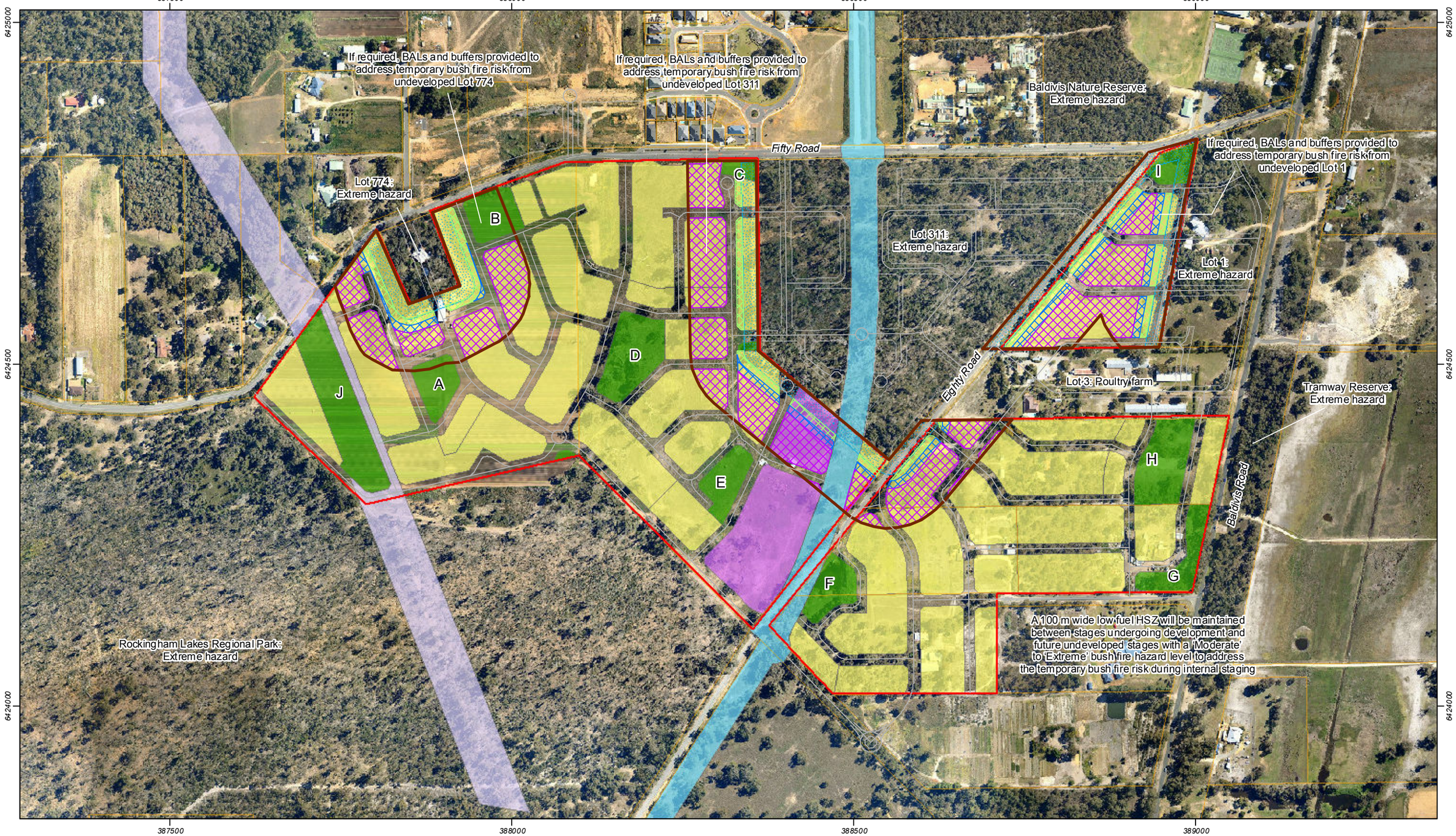

Figure 9b Fire Management Plan (to address temporary bush fire risk): Spires Estate Local Structure Plan

Scale 1:5,500 at A3

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 12/02/2014
Author: JCrute
Source: Client 2013.

Legend

- Proposed local roads
- 100 m wide HSZ to address temporary bush fire risk
- BAL FZ and BAL 40 (undevelopable buffer)
- BAL 12.5
- BAL 19
- BAL 29
- Spires Estate LSP boundary
- Existing cadastral boundaries
- Existing adjoining landholdings
- Proposed commercial areas
- Proposed POS areas (A-J)
- Proposed residential lots
- Proposed gas pipeline corridor
- Proposed Nairn Road alignment

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6.3 Legislative requirements, specifications and standards

The legislative requirements, specifications and standards applicable to implementation of this FMP are referenced in Section 7 and Appendix 6 and pertain to the following:

- *Bush Fires Act 1954*
- *Planning and Development Act 2005*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Environmental Protection Act 1986*
- *Wildlife Conservation Act 1950*
- Building Code of Australia
- Planning for Bush Fire Protection Guidelines (Edition 2)
- Australian Standard AS 3959–2009 Construction of Buildings in Bushfire Prone Areas
- City of Rockingham annual fire prevention notice 2013–2014.

7. References

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Western Australian Planning Commission, Department of Planning and Fire and Emergency Services Authority (WAPC et al.) 2010, *Planning for Bush Fire Protection Guidelines (Edition 2)*, Western Australian Planning Commission and Fire and Emergency Services Authority, Perth.

Appendix 1
Bushfire Hazard Assessment: Various Lots Fifty and Eighty Road, Baldivis (Bushfire Safety Consulting 2012)

Bushfire Safety
CONSULTING

Bushfire Hazard Assessment

Spatial Property Group

Local Structure Plan
Various Lots Fifty and Eighty Road,
Baldivis

City of Rockingham
June 2012

Local Structure Plan
Various Lots Fifty and Eighty Roads
Baldivis
CITY OF ROCKINGHAM

Report prepared by:

Rohan Carboon
Bushfire Safety Consulting Pty Ltd
P O Box 84
STONEVILLE WA 6081

Mobile: 0429 949 262
Email: enquiries@bushfiresafety.net
Website: www.bushfiresafety.net

Disclaimer

Table of Contents

Executive Summary

This Bushfire Hazard Assessment has been prepared following the survey of the site that is various Lots on Fifty and Eighty Road, Baldivis in the City of Rockingham.

The development site has been assessed for bushfire hazard levels. Bushfire attack level assessments have been undertaken to ensure the development will fall within the acceptable level of risk, i.e. dwellings exposed to BAL-29 and lower.

Currently, the site's bushfire hazard levels are rated as low, moderate and extreme but as the development progresses the hazard will be greatly reduced as the majority of the vegetation will be removed from within the site. Residual bushfire hazard will remain in some adjoining lots such as the Rockingham Lakes Regional Park.

Neighbouring sites to the north and east have been identified and zoned for future urban development, so bushfire hazards along these boundaries will be removed over time.

An assessment of the subdivision concept plan confirms that access and egress from all the proposed lots will adequately service residents and fire fighters within the development. The development design has several access options on to surrounding public roads.

Water will be adequate for residential needs and for a water supply during fire suppression operations.

This plan provides preliminary advice consistent with the fact that a Local Structure Plan is a guide only. Details in this report are consistent with the Planning for Bushfire Protection guidelines and will establish a framework for more detailed planning to occur at subdivision application stage.

This plan demonstrates the site is suitable for residential development. It outlines building siting criteria that establishes an acceptable solution is possible by installing a building protection zone to separate bushfire hazard from buildings. Predicted radiant heat flux exposure levels on buildings will be mitigated with implementation of bushfire construction standards consistent with AS3959-2009 Construction of buildings in bushfire-prone areas.

A Fire Management Plan is required at each future subdivision application stage.

1. Introduction

The site contains various lots on Fifty and Eighty Road, Baldivis in the City of Rockingham. It is bounded by Fifty Road in the west, and Baldivis Road in the east. It is a condition on the Local Structure Plan that a Bushfire Hazard Assessment (BHA) be prepared to examine the bushfire planning constraints on the proposed development. The BHA is to be prepared to the satisfaction of Local Government and the Fire and Emergency Services Authority (FESA).

The site is located 45 kms south of the Perth CBD and 10 kms east of Rockingham (Appendix A). The site currently contains some market gardens and rural residential lots. Most of the site is clear of remnant vegetation and areas remaining are mostly disturbed or modified. Surrounding lots contain substantial areas of woodland which is extreme bushfire hazard.

The site is held in multiple ownership by a number of different parties. It is zoned "Development" under the City of Rockingham's Town Planning Scheme No. 2.

This report provides broad advice consistent with the understanding that the Local Structure Plan is a guide. A detailed analysis of building siting is outlined to determine the correct setback distances that are required between bushfire hazard and dwellings. Vehicular access and water supply are discussed in broad terms. There are opportunities at subdivision application stage to revisit all bushfire hazard issues and provide specific mitigation strategies in greater detail in accordance with the key principles in this report.

1.1 The Proposal

The proposal includes the creation of large residential zones for medium and high density living, a commercial precinct and 11 Public Open Space (POS) areas.

At this early stage in planning a preliminary subdivision design is all that is available (Appendix B), it represents an indicative concept of what may occur once and if appropriate approvals are in place. The proposed development fits within a broader context of facilities, infrastructure and residential development in surrounding areas particularly north of Fifty Road (Appendix C).

1.2 Objectives

The purpose of this report is to:

- Assess the subject land and immediate surrounding area to determine the level of bushfire hazard.
- Assess the level of risk against the specific mitigation strategy siting of development.
- Assess the level of risk against broad mitigation strategies such as water supply and vehicular access consistent with the Planning for Bushfire Protection Guidelines (edition 2).
- Provide preliminary advice in relation to how bushfire hazards can be appropriately mitigated and managed as part of a local structure planning process.

This document demonstrates that the bushfire hazards are manageable in terms of intended land use change that includes residential development.

2. Statutory and Policy Framework

Relevant key legislation, policy and guidelines include the following:

2.1 Bush Fires Act

The Act sets out provision to diminish the dangers resulting from bushfires, prevent, control and extinguish bushfires and for other purposes. The Act addresses various matters including prohibited burning times, enabling Local Government to require land owners/occupiers to plough or clear firebreaks, to control and extinguish bushfires and establish and maintain Bush Fire Brigades.

The Act also applies to land throughout Western Australia that is managed by the Department of Environment and Conservation (DEC). Sections 39 and 45 provide authorised CALM Act officers with powers to suppress fires in and near forests and Crown Land. Other sections provide for authorised CALM Act officers to enforce the provisions of the Bush Fires Act. The Bush Fires Act does not affect the provisions of the CALM Act and the Bush Fires Act does not generally bind the DEC.

The provisions of the Bush Fires Act can be enforced in addition to this FMP.

2.2 State Planning Policy No. 3.4 Natural Hazards and Disasters

The objectives of this Policy are to:

- Include planning for natural disasters as a fundamental element when preparing all statutory and non-statutory planning documents, specifically town planning schemes and amendments, and local planning strategies, and
- Use these planning instruments to minimise the adverse effects of natural disasters on communities, the economy and the environment.

The Policy determines those areas that are most vulnerable to bushfire and where development is appropriate and not appropriate. The provisions and requirements contained in Planning for Bush Fire Protection Guidelines - Edition 2 (WAPC et al. 2010) were used in this determination.

2.3 Planning for Bush Fire Protection Guidelines (2010)

These Guidelines were prepared by FESA, the Western Australian Planning Commission (WAPC) and the Department of Planning. The document is the foundation for fire risk management planning on private land in Western Australia.

The document addresses important fire risk management and planning issues and sets out performance criteria and acceptable solutions to minimise the risk of bushfires in new subdivisions and developments. It addresses management issues including the location, design and siting of the development, vehicular access and water.

3. Bushfire Impacts

Reliable records began in 1900 and since then there have been 729 civilian fatalities from bushfires in Australia, of those 21 (or 3 per cent of the national total) have occurred in Western Australia. Bushfires have killed more people in Australia than any other natural disaster.

3.1 Building Survival

Buildings survive bushfires due to a number of factors; some relate to the way a bushfire behaves at a site, others relate to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leonard (2009) identified the following factors:

- Terrain (slope)
- Vegetation - overall fuel load, steady state litter load, bark fuels, etc.
- Weather (temperature, relative humidity and wind speed)
- Distance of building from unmanaged vegetation
- Individual elements surrounding the building that are either a shield or an additional fuel source
- Proximity to surrounding infrastructure
- Building design and maintenance
- Human behaviour - ability to be present and capacity to fight the fire
- Access to the building and how that influences human behaviour
- Water supply for active and/or passive defence, and
- Power supply.

It is likely that buildings are lost because of their vulnerability to the mechanisms of bushfire attack. Buildings constructed to Australian Standard (AS 3959) are more likely to survive a bushfire compared to buildings with no construction standards.

Buildings constructed to AS3959 standards do not guarantee their survival. Building survival depends on the way vegetation is managed, the unpredictable nature and behaviour of fire, and extreme weather conditions (Standards Australia 2009).

3.2 Human Fatalities

The final report from the Victorian Bushfires Royal Commission (VBRC) into the Black Saturday bushfires handed down on 31 July 2010 is the most comprehensive evidence ever assembled about the circumstances surrounding fatalities in an Australian bushfire.

Where people died on Black Saturday contrasts strikingly with studies from previous bushfire fatalities (VBRC 2010). Historically about 32 per cent of people have died in late evacuations (Risk Frontiers et al. 2008); however, on Black Saturday the majority of people (113 out of 173) died inside or close to structures. In a “Black Saturday” type of bushfire, safety can only be assured if people leave early, well before any fire arrives. When the Fire Danger rating is “Catastrophic” most buildings cannot be defended.

Most people die in bushfires from being exposed to radiant heat. Protection is provided by wearing long sleeved natural fibre clothing, having solid barriers and maintaining a long distance between people and the fire (i.e. source of radiant heat).

Bushfires also generate enormous amounts of smoke and wind, and when these factors are combined with the fire, they usually cause many trees to come down. If people evacuate late, then road conditions become extremely hazardous and emergency vehicles are also using the roads.

4. Description of the Area

Baldivis is a semi-rural residential suburb 45 kilometres south of the Perth CBD and 10 kms east of the centre of Rockingham. Development of the area dates from the 1920s, spurred by the Government's settlement scheme. Land was used mainly for farming. Significant development did not occur until the 1950s. Rapid growth took place from the mid 1990s, with the population more than trebling between 1996 and 2006, a result of new dwellings being added to the area. Growth has been mainly in the western section of Baldivis (http://www.rockingham.wa.gov.au/City-and-community/About-Rockingham/Profile-and-statistics.aspx).

Land parallel to the eastern side of Baldivis Road was set aside for a tramway between Jandakot in the north and Karnup to the south. Only part of the tramway was constructed but not in the Baldivis area. The Tramway Reserve is now retained for open space.

Land in the western portion of Baldivis was zoned for urban development in the 1990s, and the suburb has been progressively developed as residential land. Australian Bureau Statistics Census data from 2006 indicate that there were 5,952 people residing in Baldivis in 2128 dwellings. Of the 5,952 people, 877 (or 14 %) were aged over 55 years (see http://www.abs.gov.au/).

4.1 Description of the Subject Land

There are various lots that make up the site. Land use is currently a mixture of market gardens, pasture and lifestyle blocks.

This BHA focuses on the subject land and immediate surrounding area (Appendix B). In summary this land is:

- Used for a mixture of land uses including vegetable production and rural residential living.
- Generally undulating with slopes not exceeding 10 degrees
- Adjoining the Rockingham Regional Lakes Park that contains a woodland and small areas of open forest vegetation
- Intersected by Eighty Road with Fifty and Baldivis Roads as west and east perimeter roads respectively
- Adjacent to extreme bushfire hazard in the form of woodland vegetation in the Tramway Reserve, on Lot 311 and north of Fifty Road adjacent to the Baldivis Primary School.

4.2 Fire Climate

The behaviour of bushfires is significantly affected by weather conditions and they burn more aggressively when high temperatures combine with low humidity and strong winds.

In Perth and surrounding areas, the fire risk is greatest from summer through autumn, when the moisture content in vegetation is low. Summer and autumn days with high temperatures, low humidity and strong winds are particularly conducive to the spread of fire. This threat is enhanced if thunderstorms develop accompanied by lightning and little or no rain.

Research indicates that virtually all house losses occur during severe, extreme or catastrophic conditions (i.e when the Fire Danger Index is over 50) (Blanchi et al. 2010).

The Bureau of Meteorology website (www.bom.gov.au/weather/wa/sevwx/perth/bushfires.shtml) states that extreme fire weather conditions in the Perth region typically occur with strong easterlies or north easterly winds associated with a strong high to the south of the state and a trough offshore. Easterly winds represent about

60 per cent of extreme fire weather days (events) compared to less than 5 per cent associated with southerly winds. About 15 per cent of Perth events occurred in a westerly flow following the passage of a trough. Very dangerous fire weather conditions often follow a sequence of hot days and easterly winds that culminate when the trough deepens near the coast and moves inland. Winds can change from easterly to northerly and then to westerly during this sequence of climatic events.

Data from the Bureau of Meteorology research station at Medina (5 km north west of the study site) indicate the area experiences warm dry summers and cool wet winters (Figure 1), and is classified as a Mediterranean climate. Mean maximum temperatures vary from 31 degrees Celsius in February to 18 degrees Celsius in July.

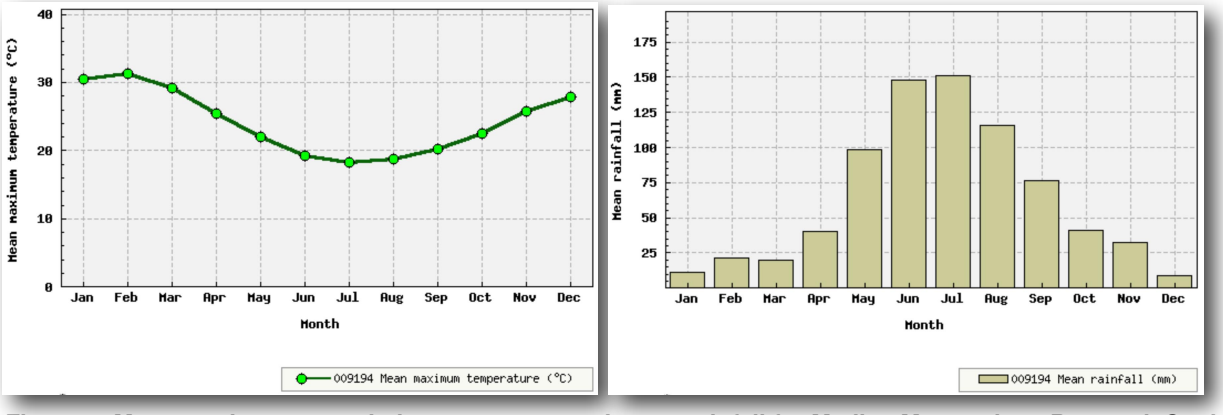

Figure 1: Mean maximum recorded temperatures and mean rainfall for Medina Meteorology Research Station between 1983 and 2010

The site is 7 km from the coast and is significantly influenced by land and sea breezes. These are created by the daily heating and cooling of the land surface next to the ocean. The sea breeze occurs when the air over the land heats up and becomes more buoyant and rises, denser moist air over the ocean then flows inland. Sea breezes can strengthen prevailing wind, reduce it or even reverse it, depending on the strength and direction of the two airstreams (Cheney and Sullivan 2008).

Data from the Bureau of Meteorology weather station at Medina indicate that the predominant winds in the summer months at 3 pm near the study site are south-westerlies (Figure 2). Wind strength, direction and frequency of the south-west wind is clearly dominant and occurs 40-60 per cent of the time. Winds from the west and south occur < 10 per cent of the time.

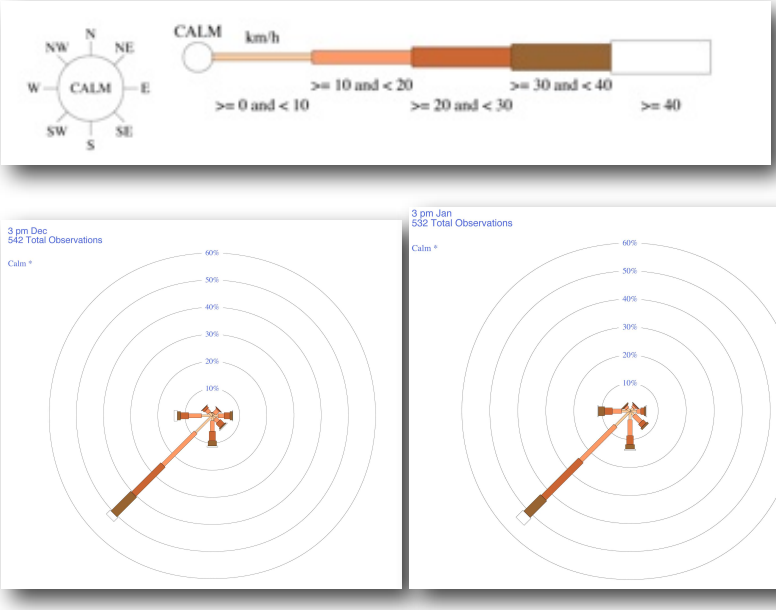

Figure 2: Rose of wind direction and wind speed in km/hr for December, January and February between 1983 and 2010 at the Medina Bureau of Meteorology Research Station

Interpreting Figure 2 - Wind speed Vs Direction Plot

Wind roses summarise the occurrence of winds at a location, showing their strength, direction and frequency. The percentage of calm conditions is represented by the size of the centre circle - the bigger the circle, the higher is the frequency of calm conditions. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Eight directions are used. The branches are divided into segments of different thickness and colour, which represent wind speed ranges in that direction. Speed ranges of 10 km/hr are used. The length of each segment within a branch is proportional to the frequency of winds blowing within corresponding range of speeds from that direction (BOM 2010).

5 Bushfire History

A recent study has concluded that bushfires may have been in the Australian Landscape for 50 million years longer than previously thought. The adaption of eucalypts that allows them to recover from bushfires has been traced back more than 60 million years (Crisp et al. 2011), indicating fire has been in the Australian landscape since that time.

Anthropological and historical evidence suggests that much of the Swan Coastal Plain was regularly burnt by the Aborigines until the middle of the nineteenth century (Hallam 1975, Abbott 2003).

Bushfires are common in the City of Rockingham. Recent bushfire history includes:

- 13 December 2010, a fire started at 1.12pm between Baldivis Road and Kwinana Freeway north of Safety Bay Road and burn't through 20 hectares of bush. Fire Crews saved four homes and several sheds. Part of the woodland vegetation in the Tramway Reserve was burnt.
- 12 April 2009, (Easter Sunday) a bushfire began near Eighty and Fifty Road and FESA warned residents to close all doors and windows and turn off evaporative coolers. Fifty Road was closed between Baldivis Road and Safety Bay Road. Thjsi fire impacted on most of the study site and 780 ha in total were burnt. The woodland vegetation shows extensive signs of this event.

Areas of native vegetation surrounded by residential estates are susceptible to frequent bushfires due to the high risk of arson and great potential for accidental ignitions (Walker 1981, Burrows and Abbott 2003).

6. Bushfire Hazard Assessment

Assessing bushfire hazards at a strategic level takes into account the predominant class of vegetation on the site and surrounding area for a minimum of 100 metres. The vegetation class map for the site and surrounding area for a minimum of 100 m is shown in Appendix D. Fuel layers in a typical forest environment can be broken down into 5 obvious segments (Figure 3). These defined fuel layers are used in the following descriptions regarding vegetation types, fuel structure and bushfire hazard levels.

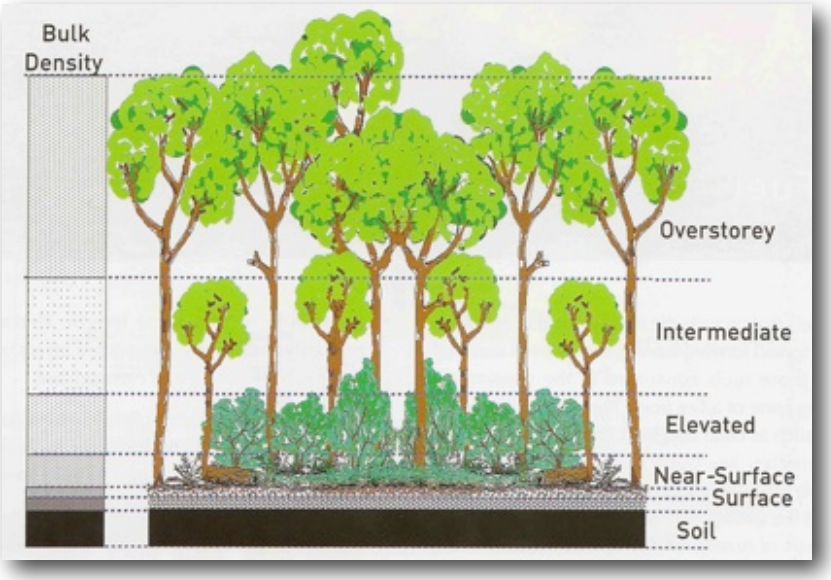

Figure 3 : The five obvious fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

6.1 Vegetation Type and Class

Native vegetation has been largely modified on the site particularly between Fifty and Eighty Road. In this area pasture grasses dominate over 60% of the site and the remaining is managed as a market garden. The pasture grasses appeared to be unmanaged and not currently grazed by livestock or horses. An open woodland of remnant Tuart trees (*Eucalyptus gomphocephala*) occur in the grassland but canopy foliage cover was assessed as being near and below 10% foliage cover overall. In tjis condition it is classified according to its understorey which is grassland.

Between Eighty and Baldivis Road, the site was vegetated in a mixture of uncultivated market garden land, Eucalypt woodland, grassland and three small areas of open forest. The Eucalypt woodland vegetation is dominant and contains a mixture of Tuart (*Eucalyptsu gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*). In some areas the woodland appeared relatively undisturbed, while in others there was significant modification of fuel layers including the absence of intermediate and elevated fuels. This left a canopy of woodland foliage and a near surface fuel layer of grasses only.

The more natural undisturbed areas of vegetation occur external to the site. South of site between Fifty and Eighty Road is the Rockingham Lakes Regional Park. This area experienced a large bushfire in April 2009 and a thick shrub layer has regenerated as has significant Eucalypt regrowth. The mature Tuart eucalypt trees have poor canopy health and reduced foliage cover. There is a grassy near surface fuel layer with seed heads up to 1 m in height. In some areas the overstorey canopy is below 10% foliage cover and would strictly mean the vegetation should be classified according to intermediate or elevated fuel layers. However, the site is assessed considering the overstorey foliage cover will increase as regeneration of tree species occurs. For this reason it is classified as Woodland vegetation.

The wedge of woodland vegetation north of the development site where Fifty and Eighty Roads intersect was also burnt in the April 2009 bushfire. It is similarly recovering and regenerating from this event and a thick elevated shrub layer has regenerated under the 20 metre high woodland canopy. Canopy foliage appears low with trees in poor condition.

North of Eighty Road on the eastern side of Baldivis Primary School, high fuel loads exist in the Low Open Forest. This vegetation type is characterised by banksia trees and some Jarrah and Marri overstorey trees. It appears to be relatively undisturbed and all fuel layers are present.

East of Baldivis Road, the Tramway Reserve contains woodland and open forest vegetation. A recent bushfire has also disturbed areas within this site. Elsewhere surrounding the site there are disturbed environments including other land being developed and residential areas.

The vegetation class map for the site and surrounding area for a minimum of 100 m is shown in Appendix D.

6.2 Slope

The landscape is undulating, the woodland vegetation south of the site has an effective upslope relative to the development site. The woodland area located south of Fifty Road between the two development areas is also predominantly positioned with an effective upslope however some downslope does exist.

6.3 The Bushfire Hazard Assessment Levels

The vegetation class map (Appendix D) outlines the dominant vegetation types on the study site and surrounding area for a minimum of 100 m. Descriptions of the vegetation class structure and dominant species are outlined in section 6.1 Vegetation Type and Class. The bushfire hazard assessment levels were determined using Appendix 1 of the Planning for Bushfire Protection Guidelines - Edition 2 (WAPC et al. 2010).

The study site has bushfire hazard ratings of low, moderate and extreme. Low bushfire hazards (Figures 4 and 5) occur in areas of market gardens, managed grasslands and areas undergoing development. Moderate bushfire hazards occur is all areas of unmanaged grasslands, and managed or disturbed woodland or open forest (Figures 6 and 7). Extreme bushfire hazards occur in all areas of undisturbed Woodland and Open Forest (Figures 8 and 9).

As the site develops and vegetation is removed, the bushfire hazard will reduce. Permanent hazard will remain around the perimeter of the site in the woodland and forest vegetation in the Rockingham Lakes Regional Reserve, the Tramway Reserve and in the wedge of vegetation south of Fifty Road.

The bushfire hazard rating map for the site and surrounding areas is shown in Appendix E. The following representative photos provide a picture of fuel quantity and structure on and surrounding the site. There is low (Figures 4 and 5) and

moderate (Figures 6 and 7) and extreme bushfire hazard rated vegetation (Figures 8 and 9).

Low bushfire hazard rating

Figures 4 and 5: Managed grassland (left) occurs on the site and a large market garden (right) occupies a large area on Fifty Road

Moderate bushfire hazard rating

Figures 6 and 7: Unmanaged grassland (left) covers significant areas, while some small areas of disturbed open forest without intermediate and elevated fuel exists (right)

Extreme bushfire hazard rating

Figures 8 and 9: Open forest occurs in the small areas where canopy health and foliage cover exceeds 30% (left), while woodland exists over many adjacent lots but it is still recovering from the 2009 bushfire (right)

7. Fire Mitigation Strategies

This report adopts a detailed acceptable solution approach for the bushfire management issue of building siting. The bushfire management issues of water and vehicular access are broadly analysed to ensure more specific mitigation strategies are dealt with and consistent during subdivision application stages. It is envisaged that a full Fire Management Plan (FMP) will be required at all future subdivision application stages. This is usually when more detailed assessment is completed.

All mitigation strategies are consistent with Appendix 2 in Planning for Bushfire Protection guidelines (WAPC et.al 2010).

7.1 Element: Siting of Development

Vegetation and bushfire hazard will be largely removed from within the site as development stages are completed. Some vegetation within POS areas may be retained and be a long term bushfire hazard for dwellings. However, the vast majority of bushfire hazard on the structure plan area will be from residual vegetation external to the site.

Based on this understanding, all dwellings within 100 metres of classified vegetation are exposed to predicted bushfire attack mechanisms that will warrant increased bushfire construction standards (Standards Australia 2009).

The mitigation strategy outlined in this report focusses on the provision of a low fuel Building Protection Zone (BPZ) which can include as roads, road reserves, irrigated lawns, landscaped gardens and setbacks on private lots. The key to the setback distance is that it must be sufficient to reduce the Bushfire Attack Level (BAL) to BAL-29 or lower. This will comply with the Planning for Bushfire Protection Guidelines (BPBG) and any exposed buildings will have construction standards aligned with AS3959-2009 Construction of buildings in bushfire prone areas.

Acceptable Solution: Building Protection Zone (BPZ)

One of the most important fire protection measures influencing the safety of people and property is to create a BPZ around buildings.

World first research into land management and house loss during the Black Saturday Victorian bushfires concluded that the action of private landholders, who managed fuel loads close to their houses, was the single most important factor to determine house survival when compared with other land management practices, such as broad scale fuel reduction burning remote from residential areas (Gibbons et al. 2012).

The creation of a BPZ around the perimeter of the built development between buildings and the residual bushfire hazard will ensure the predicted radiant heat flux exposure levels remain below Bushfire Attack Level BAL-29 or below predicted 29 kW/m^2. A minimum 20 metre BPZ must be achieved between all buildings and bushfire hazard. Some areas within the development boundary such as POS areas also could retain remnant native vegetation. Depending on the size, dimensions and location of these areas of internal remnant vegetation, they may also require provision of a BPZ to separate buildings from the hazard.

Creating and managing vegetation in the BPZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front, and
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front.

A permanent BPZ will be established surrounding the development between buildings and bushfire hazard.

The location and dimensions of the BPZ is outlined in the plan shown in Appendix F.

The BPZ must be established and maintained to the following standards:

- Width: 20 m surrounding the area of development containing structures and bushfire hazard as indicated in Appendix F
- Location: within the boundaries of the development lot or in adjoining road reserves
- Fuel load: reduced to and maintained at 2 tonnes per hectare
- All tree crowns are a minimum of 10 m apart
- All trees to have lower branches pruned to a height of 2 m
- All tall shrubs or trees are not to be located within 2 m of a building (including windows)
- No tree crowns or foliage is to be within 2 m of any building, this includes existing trees and shrubs and new plantings
- All fences and sheds are constructed with non-combustible materials (i.e. colorbond, brick or limestone)
- All shrubs to contain no dead material within the plant
- No tall shrubs are to be in clumps within 3 m of the building
- No trees are to contain dead material in the crown or on the bole.

A Hazard Separation Zone (HSZ) does provide additional protection to buildings and occupants by assisting to reduce fire intensity when a bushfire impacts on a building.

HSZ's can extend out to 100 metres from dwellings, however the size of a HSZ can be reduced or removed and the level of risk to dwellings mitigated by increasing building construction standards compliant with the Australian Standard (AS3959).

The Australian Standard (AS 3959-2009) will apply for all buildings within 100 metres of classified vegetation. The following Bushfire Attack Level (BAL) assessment examples demonstrate that the fuel managed BPZ zone results in a maximum Bushfire Attack Level of BAL-29. This achieves acceptable levels of risk for the development. Building construction standards will be increased to compensate for any reduction in size of the hazard separation zone. Further site specific assessments will need to be undertaken during each subdivision application stage in the form of a fire management plan.

The following Bushfire Attack Level (BAL) assessment demonstrates that the fuel management surrounding the development achieves acceptable levels of risk.

7.1.1 Building Siting and Predicted Bushfire Attack Levels

The AS 3959-2009 has six categories of Bushfire Attack Level, namely BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds.

The method for determining the BAL involves a site assessment of vegetation and local topography. The assumed Fire Danger Index (FDI) for Western Australia is 80. The BAL identifies the appropriate construction standard that applies as a minimum standard in Construction of buildings in bushfire-prone areas (AS 3959-2009).

Methodology and Assumptions

The following BAL examples were determined using the methodology in Appendix A of AS 3959-2009. This methodology is also outlined in the Planning for Bush Fire Protection Guidelines. Example BAL assessments were undertaken in eight different representative locations and chosen adjacent to the representative vegetation types, with sites located on each perimeter of the development (Appendix F). The results of these assessments are shown in Table 1.

The criteria to determine the BAL is outlined as follows:

Designated FDI : 80
Flame Temperature : 1090
Slope : Various (See Table 1)
Vegetation Class : Woodland and Forest
Setback distances : 20, 21 and 27 m (See Table 1)

BAL Assessment Number	Setback Distance	Classified Vegetation	Effective Slope (degrees)	BAL Rating
1	20 m minimum	Woodland	Upslope	BAL-19
2	27 m minimum	Open Forest	Downslope 1-2	BAL-29
3	20 m minimum	Woodland	Upslope	BAL-19
4	20 m minimum	Woodland	Upslope	BAL-19
5	20 m minimum	Woodland	Downslope 1-2	BAL-29
6	20 m woodland 21 m open forest	Woodland Open forest	Both upslope	BAL-29 BAL-19
7	20 m minimum	Woodland	Downslope 1-2	BAL-29 BAL-19
8	27 m minimum	Open Forest	Downslope 1-2	BAL-29

Table 1: Example "worse case" BAL scenarios on the perimeter of the development (See Appendix F for location)

A 20 m setback from woodland vegetation is sufficient to not exceed BAL-29 on effective downslope of 1-2 degrees. A 21 m setback is required to achieve BAL-29 for Open Forest with an effective upslope. A 27 metre setback achieves a BAL rating of BAL-29 adjacent to Open Forest with a downslope of 1-2 degrees (Table 1).

The proposed design of the development at structure plan stage will incorporate a minimum 20 metres low fuel zone around the perimeter of the site that is immediately adjacent to classified vegetation. As outlined in table 1, this setback distance needs to reflect the vegetation class adjoining the development and the effective slope under the vegetation. In some areas adjacent to open forest, 21 and 27 metres setback distance is required. On all sides of the development site this results in a predicted maximum BAL rating of BAL-29 which provides an acceptable solution under the PBPG (edition 2). Construction standards will be increased to mitigate the hazard on new dwellings.

7.1.2 Landscaping Considerations

Landscaping can both assist in the survival of the building and be a determining measure in its destruction. Landscaping can protect buildings by forming a barrier or deflector for windborne debris and radiant heat. It can also bring the fire directly to the building so a degree of care needs to be exercised when selecting and locating landscaping.

All plants will burn under the right conditions and plants do not achieve a “fire resistance level” to meet the Building Code of Australia (BCA). Placing plants too close to a building, under timber decks or next to windows will provide a direct threat to the building. Having a clearance around the building will achieve the desired effect of creating a break between the vegetation and the building. A pathway around the building may be one way to achieve this requirement. The landscaping can then be provided further out from the building.

Bark chips and combustible mulch near a building is not recommended and is a particular problem when the windows have low sill heights. The flames can have a direct connection with the glass which was identified as a major issue during the Canberra bushfires of 2003 where over 500 homes were destroyed. The recently released FESA document titled “Plant Guide within the Building Protection Zone” provides a useful list of species and spacing requirements to achieve compliance with vegetation within a building protection zone in the Swan Coastal Plain. It will provide some guidance for appropriate revegetation of POS areas.

7.2 Element: Vehicular Access

The intention is to ensure that the vehicular access serving a subdivision development is safe in the event of a bushfire occurring. This can be achieved where the layout, design, and construction of public and private vehicle access in the development allows emergency and other access vehicles to pass through it easily and safely at all times.

Vehicular access throughout the development is still at concept stage as outlined in Appendix B, however there are three main public roads that connect with the east and west perimeter. Eighty Road also dissects the study site. The preliminary subdivision design demonstrates a number of perimeter roads which are a good vehicular access feature. It is expected that many proposed internal roads will intersect with the existing public road system.

The residential development is unlikely to require emergency or fire access routes due to the intensity of development. Standards for public roads are outlined in the PBPG (edition 2).

Further details regarding vehicular access requirements and minimum standards will be outlined in a Fire Management Plan that will be required at future subdivision application stages.

7.3 Element: Water

The development will be provided with a reticulated water supply, together with fire hydrants, in accordance with the specifications of the Water Corporation and FESA. The type of development, land zoning and class of building proposed will ultimately determine the fire hydrant coverage required.

For building classes 2 - 9 in the Building Code of Australia, the process to determine hydrant coverage and compliance with Australian and FESA standards is outlined in FESA guideline No: GL-07 which can be downloaded at : http://www.fesa.wa.gov.au/regulationandcompliance/buildingplanassessment/Guidelines/GL-07-Submission_of_plans_for_assessment_against_the_Deemed-to-Satisfy_fire_requirements_of_the_BCA.pdf.

If the proposed structure/s are to be a Class 1a (residential dwelling) then the requirement is to have fire hydrants within (or every) 200 metres in residential zoned land. Fire services require ready access to an adequate water supply during fire emergencies. Further details will be provided when a Fire Management Plan is completed during each subdivision application stage.

7.4 Further Analysis Required at Subdivision Application Stage

Further bushfire management planning at each subdivision application stage is required to specifically assess building siting, water supply and vehicular access requirements on the development to enable life and property to be defended. It is envisaged that a full Fire Management Plan will be required at each future subdivision application stage. This is usually when more detailed assessment is completed.

8. Conclusion

This report outlines a detailed bushfire hazard assessment for the subject land. The site is predominantly cleared, with some remnant woodland and open forest. Some adjoining properties contain large areas of woodland vegetation. The landscape is rated low, moderate and extreme bushfire hazard depending on the vegetation type and structure.

Acceptable solutions are outlined that comply with the performance criteria in Planning for Bush Fire Protection (WAPC et. al. 2010) for building siting. Adjacent to Woodland vegetation, a minimum 20 m perimeter BPZ between all buildings and bushfire hazard will drop predicted radiant heat flux exposure levels to below 29kW/m^2 (or BAL-29 or lower). For Open Forest, a setback of 27 m is required when the effective slope is 0-5 degrees downslope. Construction standards will be increased to mitigate any reduced setback distances consistent with the Australian Standard AS3959.

Vehicular access will be designed to minimum standards outlined in PBPG (edition 2). A reticulated water supply will be provided to all lots with hydrants provided to FESA, Water Corporation Standards and City of Rockingham standards.

A full Fire Management Plan is required to be developed at each subdivision application stage which will provide more specific bushfire planning requirements.

9. References

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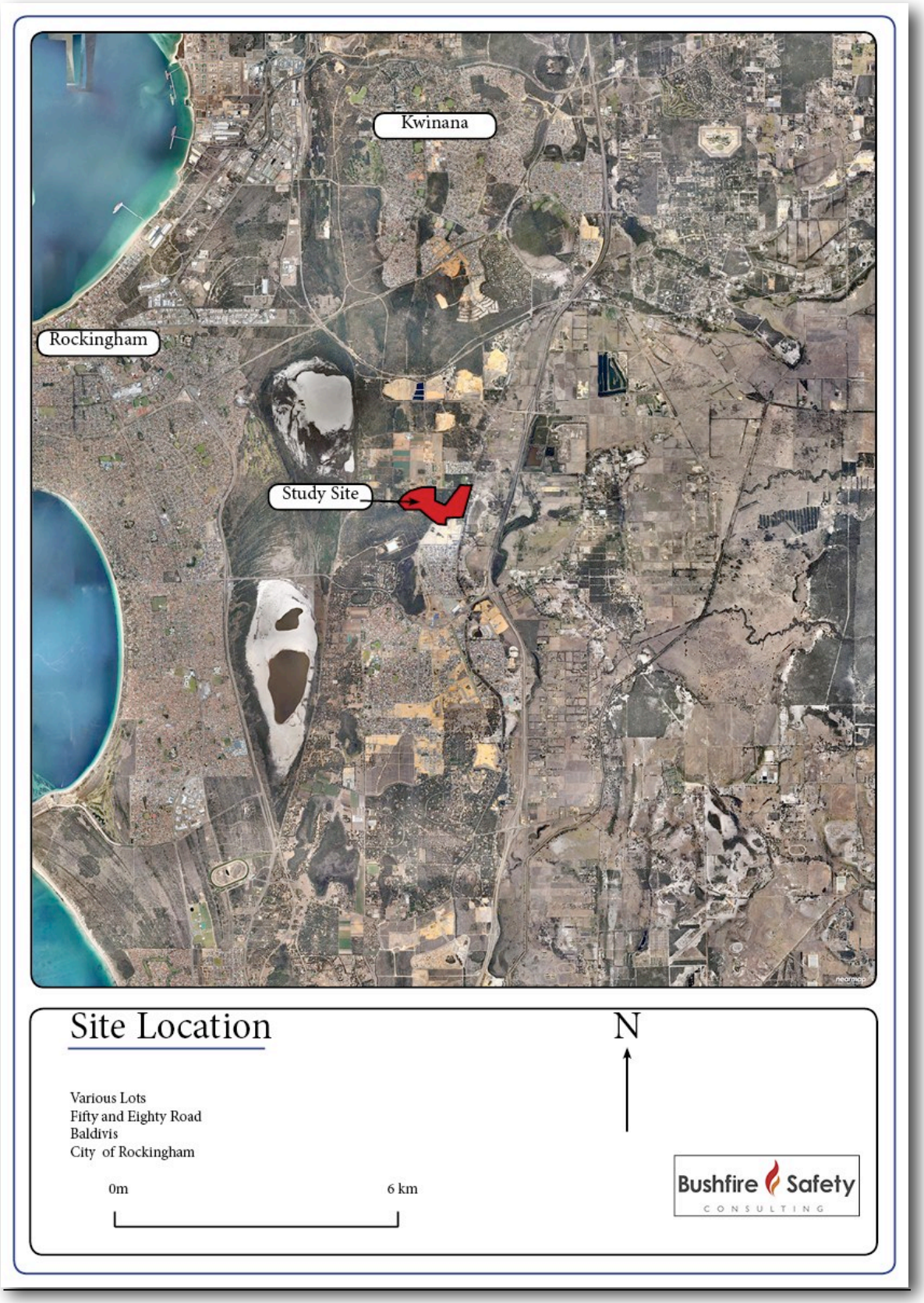
10. Appendices

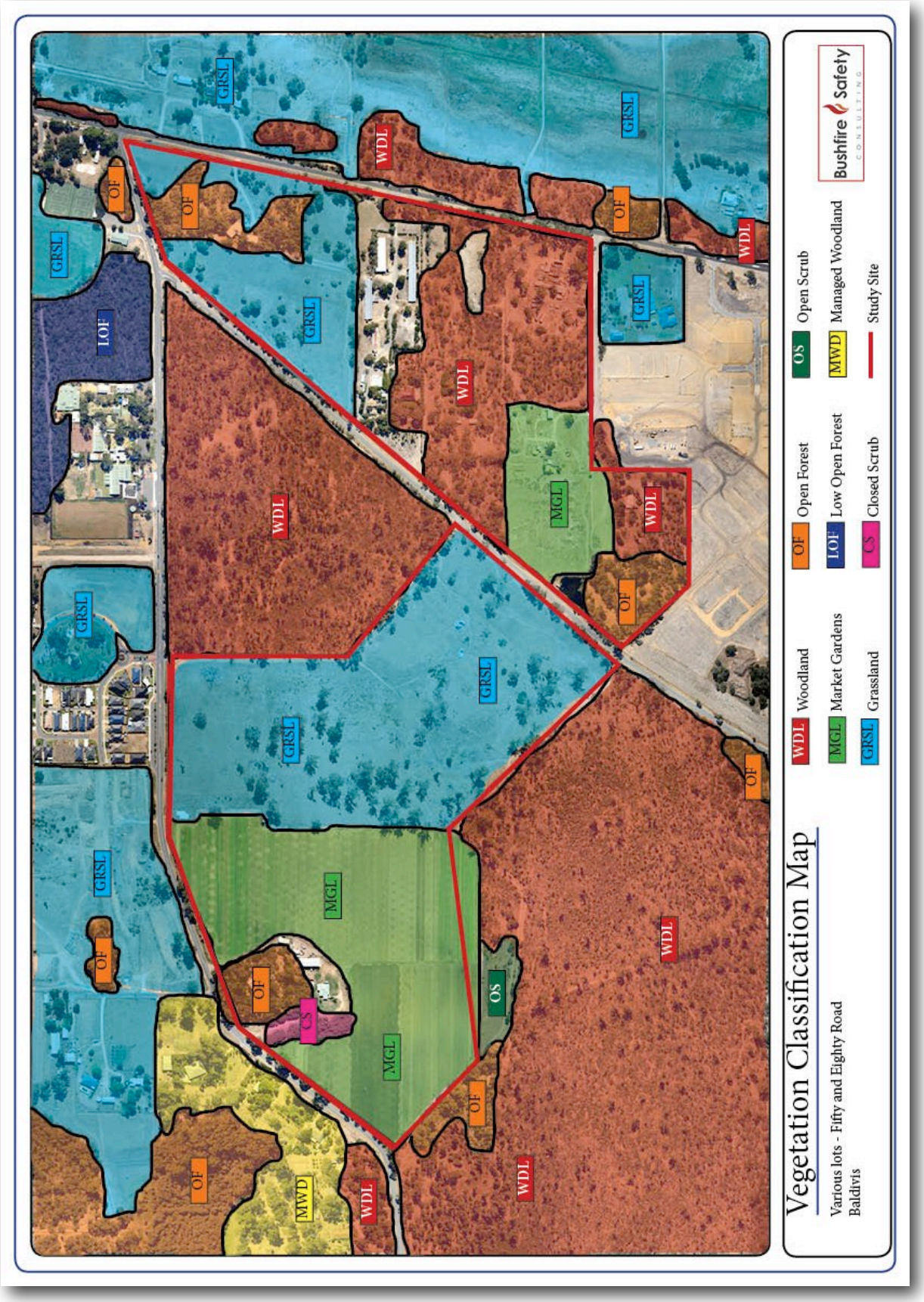
Appendix A: Site Location



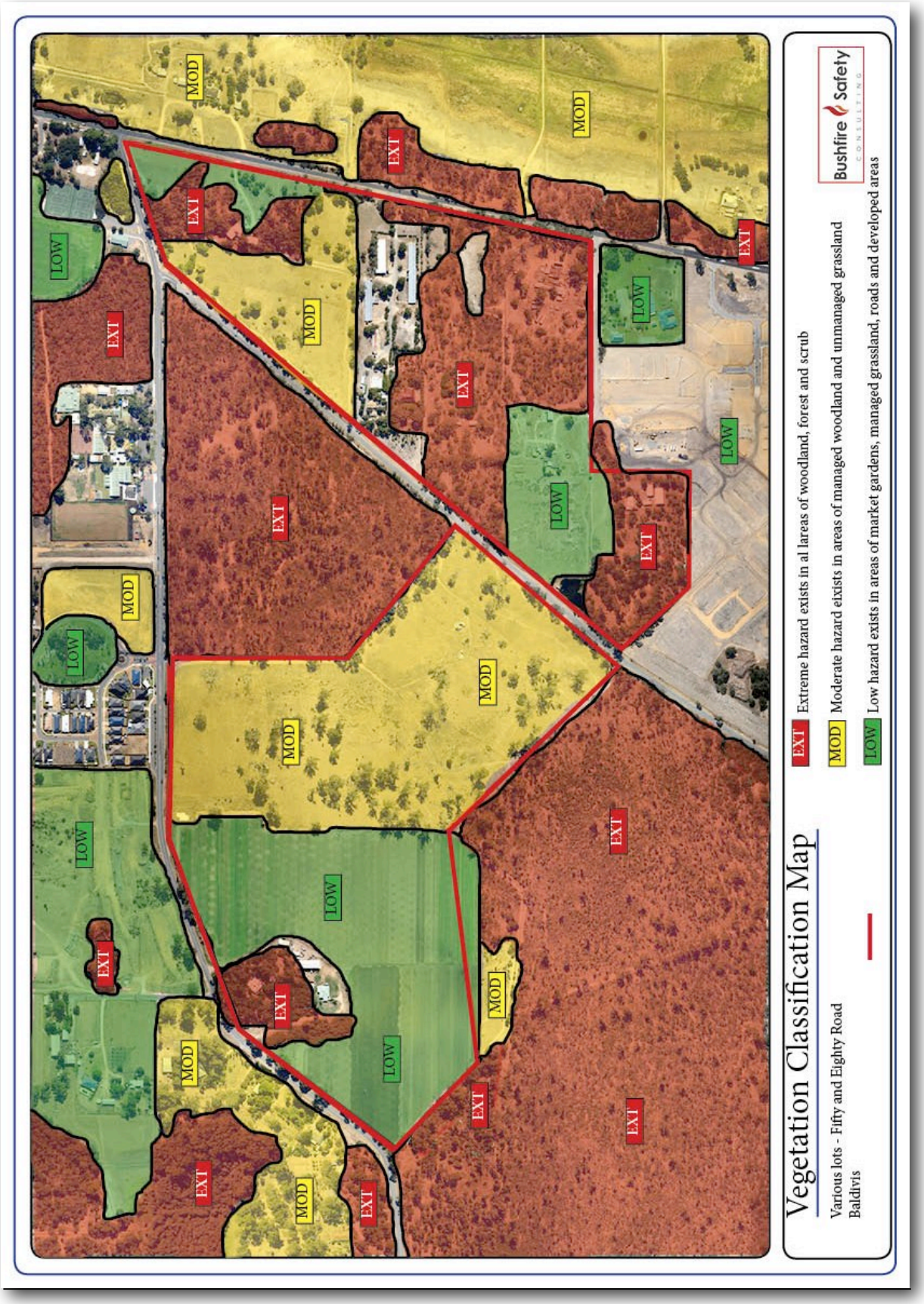
Appendix B: Subdivision Plan

Appendix C: Structure Plan Context

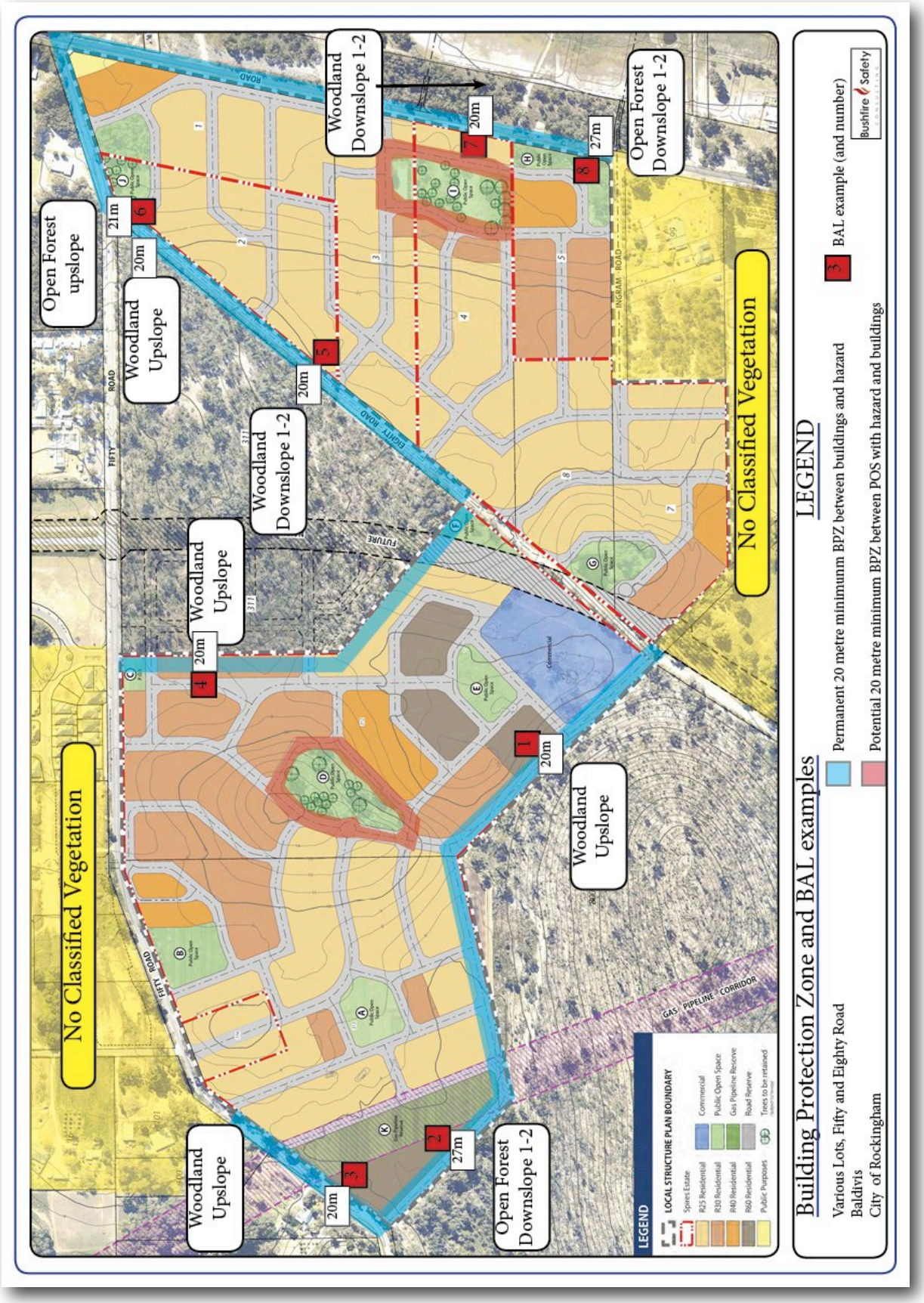
Appendix D: Vegetation Class Map



Appendix E: Bushfire Hazard Rating Map



Appendix F: Building Protection Zone and BAL examples



Appendix 2
Fire Management Plan compliance checklist

Compliance checklist for performance criteria and acceptable solutions

Element	Acceptable solution	Compliance	Yes/No	Explanation (if no)
1. Location	A1.1 Development location	Does the proposal comply with performance criteria P1 by applying acceptable solution A1.1?	Yes	
2. Vehicular access	A2.1 Two access routes	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.1?	Yes	
	A2.2 Public roads	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.2?	Yes	
	A2.3 Cul-de-sacs	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.3?	Yes	
	A2.4 Battle axes	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.4?	N/A	
	A2.5 Private driveways	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.5?	Yes	
	A2.6 Emergency access ways	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.6?	N/A	
	A2.7 Fire service access routes	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.7?	N/A	
	A2.8 Gates	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.8?	N/A	
	A2.9 Firebreak widths	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.9?	N/A	
	A2.10 Signs	Does the proposal comply with performance criteria P2 by applying acceptable solution A2.10?	N/A	
3. Water	A3.1 Reticulated areas	Does the proposal comply with performance criteria P3 by applying acceptable solution A3.1?	Yes	
	A3.2 Non-reticulated areas (a)	Does the proposal comply with performance criteria P3 by applying acceptable solution A3.2?	N/A	
	A3.3 Non-reticulated areas (b)	Does the proposal comply with performance criteria P3 by applying acceptable solution A3.3?	N/A	
4. Siting of development	A4.1 Hazard separation – moderate to extreme bush fire hazard level	Does the proposal comply with performance criteria P4 by applying acceptable solution A4.1?	Yes	
	A4.2 Hazard separation – low bush fire hazard level	Does the proposal comply with performance criteria P4 by applying acceptable solution A4.2?	Yes	
	A4.3 Building protection zone	Does the proposal comply with performance criteria P4 by applying acceptable solution A4.3?	Yes	
	A4.4 Hazard separation zone	Does the proposal comply with performance criteria P4 by applying acceptable solution A4.4?	Yes	
	A4.5 Reduction in bush fire attack level due to shielding	Does the proposal comply with performance criteria P4 by applying acceptable solution A4.5?	Yes	
5. Design of development	A5.1 Compliant development	Does the proposal comply with performance criteria P5 by applying acceptable solution A5.1?	Yes	
	A5.2 Non-compliant development	Does the proposal comply with performance criteria P5 by applying acceptable solution A5.2?	N/A	

Note: Performance criteria and acceptable solutions are in accordance with *Planning for Bush Fire Protection Guidelines (Edition 2)* (WAPC et al. 2010).

Applicant Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Full name: Roger Banks

Applicant signature: 

Date: 26/03/2014

Appendix 3

January wind profiles for Medina Research Centre

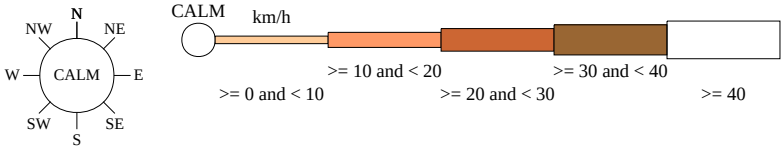
Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 30 Sep 2010)

Custom times selected, refer to attached note for details

MEDINA RESEARCH CENTRE

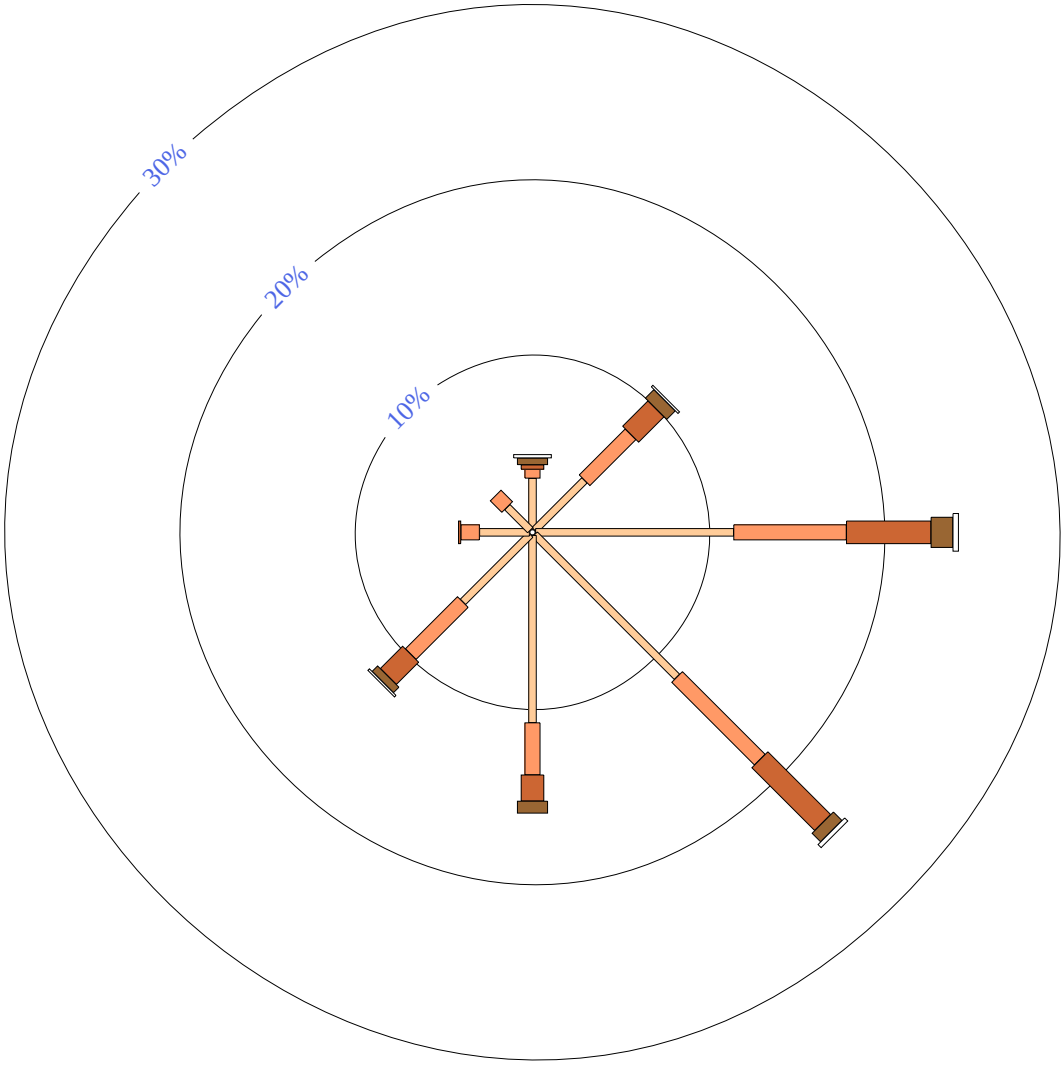
Site No: 009194 • Opened Apr 1983 • Still Open • Latitude: -32.2208° • Longitude: 115.8075° • Elevation 14m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Jan
796 Total Observations

Calm 1%



Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 30 Sep 2010)

Custom times selected, refer to attached note for details

MEDINA RESEARCH CENTRE

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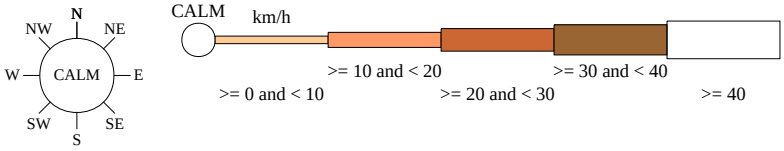
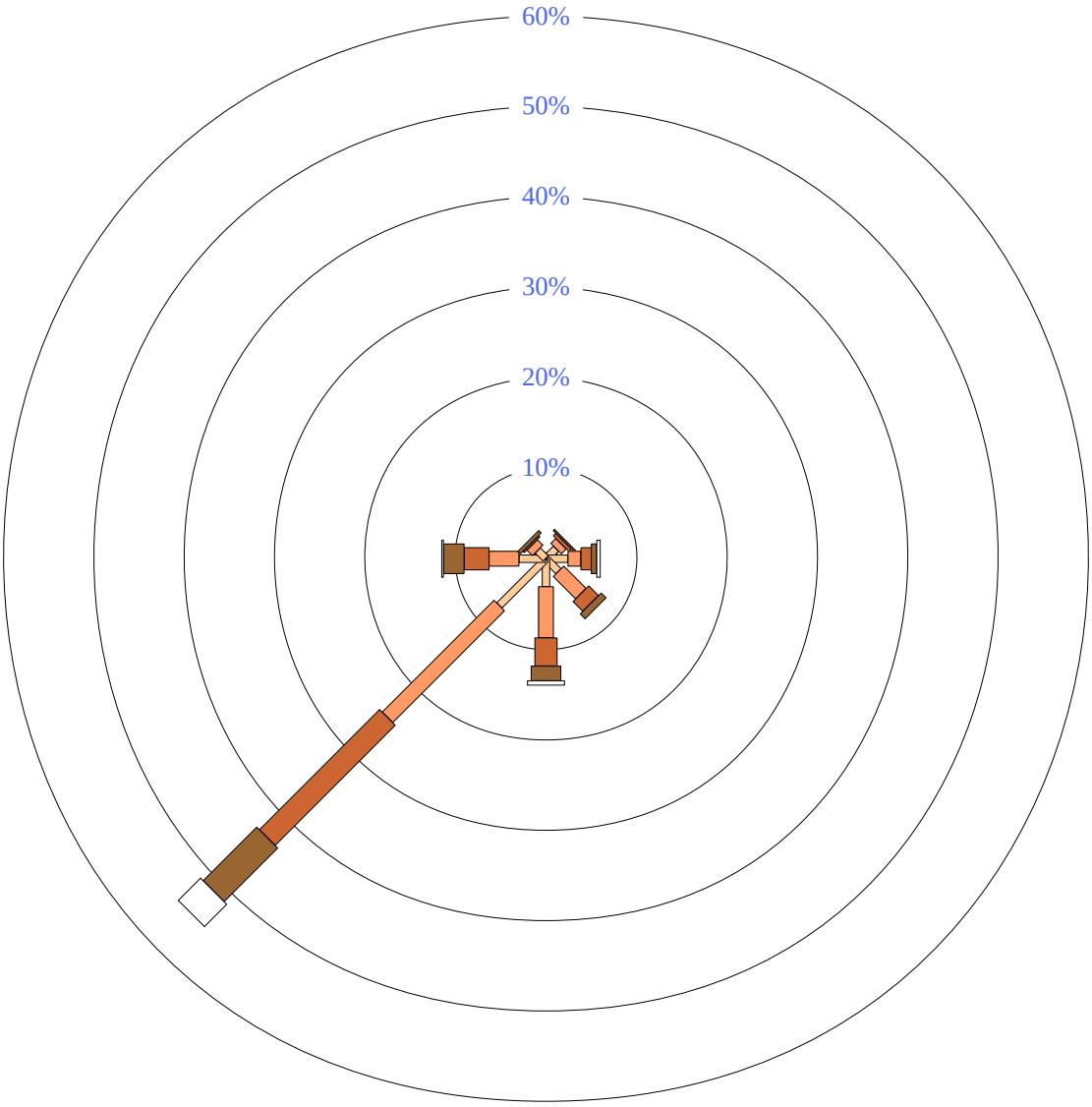


3 pm Jan
532 Total Observations

Calm *



Appendix 4
Construction standards for BAL 12.5, BAL 19 and BAL 29 as per AS 3959–2009

SECTION 5 CONSTRUCTION FOR BUSHFIRE ATTACK LEVEL 12.5 (BAL — 12.5)

5.1 GENERAL

A building assessed in Section 2 as being BAL—12.5 shall comply with Section 3 and Clauses 5.2 to 5.8.

NOTE: There are a number of Standards that specify requirements for construction; however, where this Standard does not provide construction requirements for a particular element, the other Standards apply.

Any element of construction or system that satisfies the test criteria of AS 1530.8.1 may be used in lieu of the applicable requirements contained in Clauses 5.2 to 5.8 (see Clause 3.8).

NOTE: BAL—12.5 is primarily concerned with protection from ember attack and radiant heat up to and including 12.5 kW/m^2 where the site is less than 100 m from the source of bushfire attack.

5.2 SUBFLOOR SUPPORTS

This Standard does not provide construction requirements for subfloor support posts, columns, stumps, piers and poles.

NOTE: The exclusion of requirements for subfloor supports applies to the principal building only and not to verandas, decks, steps, ramps and landings (see Clause 5.7).

C5.2 *Ideally, storage of combustible materials beneath a floor at this BAL would not occur and on this assumption, there is no requirement to enclose the subfloor space or to protect flooring materials from bushfire attack. However, should combustible materials be stored, it is recommended the area be protected as materials stored in the subfloor space may be ignited by embers and cause an impact to the building.*

5.3 FLOORS

5.3.1 Concrete slabs on ground

This Standard does not provide construction requirements for concrete slabs on the ground.

5.3.2 Elevated floors

This Standard does not provide construction requirements for elevated floors, including bearers, joists and flooring.

5.4 EXTERNAL WALLS

5.4.1 Walls

That part of an external wall surface that is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less

than 18 degrees to the horizontal and extending more than 110 mm in width from the wall (see Figure D3, Appendix D) shall be of—

(a) non-combustible material; or

(b) fibre-cement external cladding, a minimum of 6 mm in thickness; or

(c) bushfire-resisting timber (see Appendix F); or

(d) a timber species as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(e) a combination of any of Items (a), (b), (c) or (d) above.

There are no requirements for external wall surfaces 400 mm or more from the ground or for external wall surfaces 400 mm or more above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the wall (see Figure D3, Appendix D).

5.4.2 Joints

All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed to prevent gaps greater than 3 mm.

Alternatively, sarking-type material may be applied over the outer face of the frame prior to fixing any external cladding.

5.4.3 Vents and weepholes

Vents and weepholes in external walls shall be screened with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium, except where the vents and weepholes are less than 3 mm (see Clause 3.6), or are located in an external wall of a subfloor space.

5.5 EXTERNAL GLAZED ELEMENTS AND ASSEMBLIES AND EXTERNAL DOORS

5.5.1 Bushfire shutters

Where fitted, bushfire shutters shall comply with Clause 3.7 and be made from—

(a) non-combustible material; or

(b) a timber species as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(c) bushfire-resisting timber (see Appendix F); or

(d) a combination of any of Items (a), (b) or (c) above.

5.5.2 Windows

Window assemblies shall comply with one of the following:

(a) They shall be completely protected by a bushfire shutter that complies with Clause 5.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) For window assemblies less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame (see Figure D3, Appendix D), window frames and window joinery shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) A timber species specified in Paragraph E2 and listed in Table E2, Appendix E.

or

(C) Metal.

Or

(D) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel and the frame and sash shall satisfy the design load, performance and structural strength of the member.

(ii) Externally fitted hardware that supports the sash in its functions of opening and closing shall be metal.

(iii) Where glazing is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame (see Figure D3, Appendix D), the glazing shall be Grade A safety glass minimum 4 mm, or glass blocks with no restriction on glazing methods.

NOTE: Where double glazed units are used the above requirements apply to the external face of the window assembly only.

(iv) Where glazing is other than that specified in Item (iii) above, annealed glass may be used.

(v) The openable portions of windows shall be screened with mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

5.5.3 Doors—Side-hung external doors (including French doors, panel fold and bi-fold doors)

Side-hung external doors, including French doors, panel fold and bi-fold doors, shall comply with one of the following:

(a) They shall be protected by a bushfire shutter that complies with Clause 5.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) Doors shall be—

(A) non-combustible; or

(B) a solid timber door, having a minimum thickness of 35 mm for the first 400 mm above the threshold; or

(C) a door, including a hollow core door, with a non-combustible kickplate on the outside for the first 400 mm above the threshold; or

(D) a fully framed glazed door, where the framing is made from materials required for bushfire shutters (see Clause 5.5.1), or from a timber species specified in Paragraph E2 and listed in Table E2, Appendix E.

(ii) Where doors incorporate glazing, the glazing shall comply with the glazing requirements for windows.

(iii) Doors shall be tight-fitting to the doorframe and to an abutting door, if applicable.

(iv) Where any part of the door assembly is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the door (see Figure D3, Appendix D), that part of the door assembly shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) A timber species specified in Paragraph E2 and listed in Table E2, Appendix E.

or

(C) Metal.

or

(D) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel and the door assembly shall satisfy the design load, performance and structural strength of the member.

(v) Weather strips, draught excluders or draught seals shall be installed at the base of side-hung external doors.

5.5.4 Doors—Sliding doors

Sliding doors shall comply with one of the following:

(a) They shall be protected by a bushfire shutter that complies with Clause 5.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) Any glazing incorporated in sliding doors shall be Grade A safety glass complying with AS 1288.

(ii) There is no requirement to screen the openable part of the sliding door. However, if screened, the screens shall be a mesh or perforated sheet made of corrosion-resistant steel, bronze or aluminium.

NOTE: The construction of manufactured sliding doors should prevent the entry of embers when the door is closed. There is no requirement to provide screens to the openable part of these doors as it is assumed that a sliding door will be closed if occupants are not present or during a bushfire event. Screens of materials other than those specified may not resist ember attack.

(iii) Sliding doors shall be tight-fitting in the frames.

5.5.5 Doors—Vehicle access doors (garage doors)

The following apply to vehicle access doors:

(a) The lower portion of a vehicle access door that is within 400 mm of the ground when the door is closed (see Figure D4, Appendix D) shall be made from—

(i) non-combustible material; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) fibre-cement sheet, a minimum of 6 mm in thickness; or

(iv) a timber species specified in Paragraph E1 and listed in Table E1, Appendix E; or

(v) a combination of any of Items (i), (ii), (iii) or (iv) above.

(b) Panel lift, tilt doors or side-hung doors shall be fitted with suitable weather strips, draught excluders, draught seals or guide tracks, as appropriate to the door type, with a maximum gap no greater than 3 mm.

(c) Roller doors shall have guide tracks with a maximum gap no greater than 3 mm and shall be fitted with a nylon brush that is in contact with the door (see Figure D4, Appendix D).

(d) Vehicle access doors shall not include ventilation slots.

5.6 ROOFS (INCLUDING VERANDA AND ATTACHED CARPORT ROOFS, PENETRATIONS, EAVES, FASCIAS, GABLES, GUTTERS AND DOWNPIPES)

5.6.1 General

The following apply to all types of roofs and roofing systems:

(a) Roof tiles, roof sheets and roof-covering accessories shall be non-combustible.

(b) The roof/wall junction shall be sealed, to prevent openings greater than 3 mm, either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.

(c) Roof ventilation openings, such as gable and roof vents, shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

5.6.2 Tiled roofs

Tiled roofs shall be fully sarked. The sarking shall—

(a) have a flammability index of not more than 5;

(b) be located directly below the roof battens;

(c) cover the entire roof area including the ridge; and

(d) be installed so that there are no gaps that would allow the entry of embers where the sarking meets fascias, gutters, valleys and the like.

5.6.3 Sheet roofs

Sheet roofs shall—

(a) be fully sarked in accordance with Clause 5.6.2, except that foil-backed insulation blankets may be installed over the battens;

or

(b) have any gaps greater than 3 mm, under corrugations or ribs of sheet roofing and between roof components, sealed at the fascia or wall line and at valleys, hips and ridges by—

(i) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(ii) mineral wool; or

(iii) other non-combustible material; or

(iv) a combination of any of Items (i), (ii) or (iii) above.

5.6.4 Veranda, carport and awning roofs

The following apply to veranda, carport and awning roofs:

(a) A veranda, carport or awning roof forming part of the main roof space [see Figure D1(a), Appendix D] shall meet all the requirements for the main roof, as specified in Clauses 5.6.1, 5.6.2, 5.6.3, 5.6.5 and 5.6.6.

(b) A veranda, carport or awning roof separated from the main roof space by an external wall [see Figures D1(b) and D1(c), Appendix D] complying with Clause 5.4 shall have a non-combustible roof covering.

NOTE: There is no requirement to line the underside of a veranda, carport or awning roof that is separated from the main roof space.

5.6.5 Roof penetrations

The following apply to roof penetrations:

(a) Roof penetrations, including roof lights, roof ventilators, roof-mounted evaporative cooling units, aerials, vent pipes and supports for solar collectors, shall be adequately sealed at the roof to prevent gaps greater than 3 mm. The material used to seal the penetration shall be non-combustible.

(b) Openings in vented roof lights, roof ventilators or vent pipes shall be fitted with ember guards made from a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(c) All overhead glazing shall be Grade A laminated safety glass complying with AS 1288.

(d) Glazed elements in roof lights and skylights may be of polymer provided a Grade A safety glass diffuser, complying with AS 1288, is installed under the glazing. Where glazing is an insulating glazing unit (IGU), Grade A toughened safety glass, minimum 4 mm, shall be used in the outer pane of the IGU.

(e) Flashing elements of tubular skylights may be of a fire-retardant material, provided the roof integrity is maintained by an under-flashing of a material having a flammability index no greater than 5.

(f) Evaporative cooling units shall be fitted with butterfly closers at or near the ceiling level or, the unit shall be fitted with non-combustible covers with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(g) Vent pipes made from PVC are permitted.

5.6.6 Eaves linings, fascias and gables

The following apply to eaves linings, fascias and gables:

(a) Gables shall comply with Clause 5.4.

(b) Eaves penetrations shall be protected the same as for roof penetrations, as specified in Clause 5.6.5.

(c) Eaves ventilation openings greater than 3 mm shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

Joints in eaves linings, fascias and gables may be sealed with plastic joining strips or timber storm moulds.

This Standard does not provide construction requirements for fascias, bargeboards and eaves linings.

5.6.7 Gutters and downpipes

This Standard does not provide material requirements for—

(a) gutters, with the exception of box gutters; and

(b) downpipes.

If installed, gutter and valley leaf guards shall be non-combustible.

Box gutters shall be non-combustible and flashed at the junction with the roof with non-combustible material.

5.7 VERANDAS, DECKS, STEPS, RAMPS AND LANDINGS

5.7.1 General

Decking shall be either spaced or continuous (i.e., without spacing).

There is no requirement to enclose the subfloor spaces of verandas, decks, steps, ramps or landings.

C5.7.1 *Spaced decking is nominally spaced at 3 mm (in accordance with standard industry practice); however, due to the nature of timber decking with seasonal changes in moisture content, that spacing may range from 0–5 mm during service. The preferred dimension for gaps is 3 mm (which is in line with other 'permissible gaps') in other parts of this Standard. It should be noted that recent research studies have shown that gaps at 5 mm spacing afford opportunity for embers to become lodged in between timbers, which may contribute to a fire. Larger gap spacings of 10 mm may preclude this from happening but such a spacing regime may not be practical for a timber deck.*

5.7.2 Enclosed subfloor spaces of verandas, decks, steps, ramps and landings

5.7.2.1 *Materials to enclose a subfloor space*

This Standard does not provide construction requirements for the materials used to enclose a subfloor space except where those materials are less than 400 mm from the ground.

Where the materials used to enclose a subfloor space are less than 400 mm from the ground, they shall comply with Clause 5.4.

5.7.2.2 *Supports*

This Standard does not provide construction requirements for support posts, columns, stumps, stringers, piers and poles.

5.7.2.3 *Framing*

This Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).

5.7.2.4 *Decking*

This Standard does not provide construction requirements for decking that is more than 300 mm from a glazed element.

Decking less than 300 mm (measured horizontally at deck level) from glazed elements that are less than 400 mm (measured vertically) from the surface of the deck (see Figure D2, Appendix D) shall be made from—

(a) non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a timber species, as specified in Paragraph E1 and listed in Table E1 of Appendix E;

(d) PVC-U; or

(e) a combination of any of Items (a), (b), (c) or (d) above.

5.7.3 Unenclosed subfloor spaces of verandas, decks, steps, ramps and landings

5.7.3.1 *Supports*

This Standard does not provide construction requirements for support posts, columns, stumps, stringers, piers and poles.

5.7.3.2 *Framing*

This Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).

5.7.3.3 *Decking*

This Standard does not provide construction requirements for decking unless it is less than 300 mm from a glazed element.

Decking less than 300 mm (measured horizontally at deck level) from glazed elements that are less than 400 mm (measured vertically) from the surface of the deck (see Figure D2, Appendix D) shall be made from—

(a) non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(d) a combination of any of Items (a), (b) or (c) above.

5.7.4 Balustrades, handrails or other barriers

This Standard does not provide construction requirements for balustrades, handrails and other barriers.

5.8 WATER AND GAS SUPPLY PIPES

Above-ground, exposed water and gas supply pipes shall be metal.

SECTION 6 CONSTRUCTION FOR BUSHFIRE ATTACK LEVEL 19 (BAL — 19)

6.1 GENERAL

A building assessed in Section 2 as being BAL—19 shall comply with Section 3 and Clauses 6.2 to 6.8.

NOTE: There are a number of Standards that specify requirements for construction; however, where this Standard does not provide construction requirements for a particular element, the other Standards apply.

Any element of construction or system that satisfies the test criteria of AS 1530.8.1 may be used in lieu of the applicable requirements contained in Clauses 6.2 to 6.8 (see Clause 3.8).

NOTE: BAL—19 is primarily concerned with protection from ember attack and radiant heat greater than 12.5 kW/m2 up to and including 19 kW/m2.

6.2 SUBFLOOR SUPPORTS

This Standard does not provide construction requirements for subfloor support posts, columns, stumps, piers and poles.

NOTE: The exclusion of requirements for subfloor supports applies to the principal building only and not to verandas, decks, steps, ramps and landings (see Clause 6.7).

C6.2 Ideally, storage of combustible materials beneath a floor at this BAL would not occur and on this assumption, there is no requirement to enclose the subfloor space or to protect flooring materials from bushfire attack. However, should combustible materials be stored, it is recommended the area be protected as materials stored in the subfloor space may be ignited by embers and cause an impact to the building.

6.3 FLOORS

6.3.1 Concrete slabs on the ground

This Standard does not provide construction requirements for concrete slabs on ground.

6.3.2 Elevated floors

This Standard does not provide construction requirements for elevated floors, including bearers, joists and flooring.

6.4 EXTERNAL WALLS

6.4.1 Walls

That part of an external wall surface that is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18

degrees to the horizontal and extending more than 110 mm in width from the wall (see Figure D3, Appendix D) shall be made from—

(a) non-combustible material; or

(b) fibre-cement external cladding, a minimum of 6 mm in thickness; or

(c) bushfire-resisting timber (see Appendix F); or

(d) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(e) a combination of any of Items (a), (b), (c) or (d) above.

This Standard does not provide construction requirements for external wall surfaces 400 mm or more from the ground or for external wall surfaces 400 mm or more above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the wall (see Figure D3, Appendix D).

6.4.2 Joints

All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed to prevent gaps greater than 3 mm.

Alternatively, sarking-type material may be applied over the outer face of the frame prior to fixing any external cladding.

6.4.3 Vents and weepholes

Vents and weepholes in external walls shall be screened with mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium, except where they are less than 3 mm (see Clause 3.6), or are located in an external wall of a subfloor space.

6.5 EXTERNAL GLAZED ELEMENTS AND ASSEMBLIES AND EXTERNAL DOORS

6.5.1 Bushfire shutters

Where fitted, bushfire shutters shall comply with Clause 3.7 and be made from—

(a) non-combustible material; or

(b) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(c) bushfire-resisting timber (see Appendix F); or

(d) a combination of any of Items (a), (b), or (c) above.

6.5.2 Windows

Window assemblies shall comply with one of the following:

(a) They shall be completely protected by a bushfire shutter that complies with Clause 6.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) For window assemblies less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings, having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame (see Figure D3, Appendix D), window frames and window joinery, shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) A timber species, as specified in Paragraph E2 and listed in Table E2, Appendix E.

or

(C) Metal.

or

(D) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel and the frame and the sash shall satisfy the design load, performance and structural strength of the member.

(ii) Externally fitted hardware that supports the sash in its functions of opening and closing, shall be metal.

(iii) Where glazing is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings, having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame (see Figure D3, Appendix D), the glazing shall be toughened glass, minimum 5 mm, or glass blocks with no restriction on glazing methods.

NOTE: Where double-glazed units are used, the above requirements apply to the external face of the window assembly only.

(iv) Where glazing is other than that specified in Item (iii) above, annealed glass may be used. Where annealed glass is used, the fixed and openable portions of windows shall be screened externally with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(v) Where toughened glass is used, the openable portions of windows shall be screened internally or externally with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(vi) Glazed elements that are designed to take internal screens shall use toughened glass and the openable portion shall be screened in such a way to have no gaps greater than 3 mm in diameter. Screening material shall be a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

6.5.3 Doors—Side-hung external doors (including French doors, panel fold and bi-fold doors)

Side-hung external doors, including French doors, panel fold and bi-fold doors, shall comply with one of the following:

(a) They shall be protected by a bushfire shutter that complies with Clause 6.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) Doors shall be—

(A) non-combustible; or

(B) a solid timber door, having a minimum thickness of 35 mm for the first 400 mm above the threshold; or

(C) a door, including a hollow core door, with a non-combustible kickplate on the outside for the first 400 mm above the threshold; or

(D) a fully-framed glazed door, where the framing is made from materials specified for bushfire shutters (see Clause 6.5.1).

(ii) Where doors incorporate glazing, the glazing shall be toughened glass minimum 5 mm.

(iii) Doors shall be tight-fitting to the doorframe and to an abutting door, if applicable.

(iv) Where the doorframe is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the door (see Figure D3, Appendix D) the doorframe shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) A timber species, as specified in Paragraph E2 and listed in Table E2, Appendix E.

or

(C) Metal.

or

(D) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel and the door assembly shall satisfy the design load, performance and structural strength of the member.

(v) Weather strips, draught excluders or draught seals shall be installed at the base of side-hung external doors.

6.5.4 Doors—Sliding doors

Sliding doors shall comply with one of the following:

(a) They shall be completely protected by a bushfire shutter that complies with Clause 6.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) Any glazing incorporated in sliding doors shall be toughened glass, minimum 5 mm.

(ii) There is no requirement to screen the openable part of the sliding door. However, if screened, the screens shall be mesh or perforated sheet made of corrosion-resistant steel, bronze or aluminium.

NOTE: The construction of manufactured sliding doors should prevent the entry of embers when the door is closed. There is no requirement to provide screens to the openable part of these doors as it is assumed that a sliding door will be closed if occupants are not present or during a bushfire event. Screens of materials other than those specified may not resist ember attack.

(iii) Sliding doors shall be tight-fitting in the frames.

6.5.5 Doors—Vehicle access doors (garage doors)

The following apply to vehicle access doors:

(a) The lower portion of a vehicle access door that is within 400 mm of the ground when the door is closed (see Figure D4, Appendix D) shall be made from—

(i) non-combustible material; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) fibre-cement sheet, a minimum of 6 mm in thickness; or

(iv) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(v) a combination of any of Items (i), (ii), (iii) or (iv) above.

(b) Panel lift, tilt doors or side-hung doors shall be fitted with suitable weather strips, draught excluders, draught seals or guide tracks, as appropriate to the door type, with a maximum gap no greater than 3 mm.

(c) Roller doors shall have guide tracks with a maximum gap no greater than 3 mm and shall be fitted with a nylon brush that is in contact with the door (see Figure D4, Appendix D).

(d) Vehicle access doors shall not include ventilation slots.

6.6 ROOFS (INCLUDING VERANDA AND ATTACHED CARPORT ROOFS, PENETRATIONS, EAVES, FASCIAS, GABLES, GUTTERS AND DOWNPIPES)

6.6.1 General

The following apply to all types of roofs and roofing systems:

(a) Roof tiles, roof sheets and roof-covering accessories shall be non-combustible.

(b) The roof/wall junction shall be sealed, to prevent openings greater than 3 mm, either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.

(c) Roof ventilation openings, such as gable and roof vents, shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

6.6.2 Tiled roofs

Tiled roofs shall be fully sarked. The sarking shall—

(a) have a flammability index of not more than 5, when tested to AS 1530.2;

(b) be located directly below the roof battens;

(c) cover the entire roof area including the ridge; and

(d) be installed so that there are no gaps that would allow the entry of embers where the sarking meets fascias, gutters, valleys and the like.

6.6.3 Sheet roofs

Sheet roofs shall—

(a) be fully sarked in accordance with Clause 6.6.2, except that foil-backed insulation blankets may be installed over the battens;

or

(b) have any gaps greater than 3 mm under corrugations or ribs of sheet roofing and between roof components sealed at the fascia or wall line and at valleys, hips and ridges by—

(i) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(ii) mineral wool; or

(iii) other non-combustible material; or

(iv) a combination of any of Items (i), (ii), or (iii) above.

6.6.4 Veranda, carport and awning roofs

The following apply to veranda, carport and awning roofs:

(a) A veranda, carport or awning roof forming part of the main roof space [see Figure D1(a), Appendix D] shall meet all the requirements for the main roof, as specified in Clauses 6.6.1, 6.6.2, 6.6.3, 6.6.5 and 6.6.6.

(b) A veranda, carport or awning roof separated from the main roof space by an external wall [see Figures D1(b) and D1(c), Appendix D] complying with Clause 6.4 shall have a non-combustible roof covering.

NOTE: There is no requirement to line the underside of a veranda, carport or awning roof that is separate from the main roof space.

6.6.5 Roof penetrations

The following apply to roof penetrations:

(a) Roof penetrations, including roof lights, roof ventilators, roof-mounted evaporative cooling units, aerials, vent pipes and supports for solar collectors shall be adequately sealed at the roof to prevent gaps greater than 3 mm. The material used to seal the penetration shall be non-combustible.

(b) Openings in vented roof lights, roof ventilators or vent pipes shall be fitted with ember guards made from a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(c) All overhead glazing shall be Grade A laminated safety glass complying with AS 1288.

(d) Glazed elements in roof lights and skylights may be of polymer provided a Grade A safety glass diffuser, complying with AS 1288, is installed under the glazing. Where glazing is an insulating glazing unit (IGU), Grade A toughened safety glass of minimum 4 mm shall be used in the outer pane of the IGU.

(e) Flashing elements of tubular skylights may be of a fire-retardant material, provided the roof integrity is maintained by an under-flashing of a material having a flammability index no greater than 5.

(f) Evaporative cooling units shall be fitted with butterfly closers at or near the ceiling level, or the unit shall be fitted with non-combustible covers with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

6.6.6 Eaves linings, fascias and gables

The following apply to eaves linings, fascias and gables:

(a) Gables shall comply with Clause 6.4.

(b) Eaves penetrations shall be protected the same as for roof penetrations, as specified in Clause 6.6.5.

(c) Eaves ventilation openings greater than 3 mm shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

Joints in eaves linings, fascias and gables may be sealed with plastic joining strips or timber storm moulds.

This Standard does not provide construction requirements for fascias, bargeboards and eaves linings.

6.6.7 Gutters and downpipes

This Standard does not provide material requirements for—

(a) gutters, with the exception of box gutters; and

(b) downpipes.

If installed, gutter and valley leaf guards shall be non-combustible.

Box gutters shall be non-combustible and flashed at the junction with the roof with non-combustible material.

6.7 VERANDAS, DECKS, STEPS, RAMPS AND LANDINGS

6.7.1 General

Decking shall be either spaced or continuous (i.e., without spacings).

There is no requirement to enclose the subfloor spaces of verandas, decks, steps, ramps or landings.

C6.7.1 Spaced decking is nominally spaced at 3 mm (in accordance with standard industry practice); however, due to the nature of timber decking with seasonal changes in moisture content, that spacing may range from 0–5 mm during service. The preferred dimension for gaps is 3 mm (which is in line with other ‘permissible gaps’) in other parts of this Standard. It should be noted that recent research studies have shown that gaps at 5 mm spacing afford opportunity for embers to become lodged in between timbers, which may contribute to a fire. Larger gap spacings of 10 mm may preclude this from happening but such a spacing regime may not be practical for a timber deck.

6.7.2 Enclosed subfloor spaces of verandas, decks, steps, ramps and landings

6.7.2.1 *Materials to enclose a subfloor space*

This Standard does not provide construction requirements for the materials used to enclose a subfloor space except where those materials are less than 400 mm from the ground.

Where the materials used to enclose a subfloor space are less than 400 mm from the ground, they shall comply with Clause 6.4.

6.7.2.2 *Subfloor supports*

This Standard does not provide construction requirements for subfloor support posts, columns, stumps, stringers, piers and poles.

6.7.2.3 *Framing*

This Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).

6.7.2.4 *Decking*

This Standard does not provide construction requirements for decking that is more than 300 mm from a glazed element.

Decking less than 300 mm (measured horizontally at deck level) from glazed elements that are less than 400 mm (measured vertically) from the surface of the deck (see Figure D2, Appendix D) shall be made from—

(a) non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(d) a combination of any of Items (a), (b), or (c) above.

6.7.3 Unenclosed subfloor spaces of verandas, decks, steps, ramps and landings

6.7.3.1 *Supports*

This Standard does not provide construction requirements for support posts, columns, stumps, stringers, piers and poles.

6.7.3.2 *Framing*

This Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).

6.7.3.3 *Decking*

This Standard does not provide construction requirements for decking that is more than 300 mm from a glazed element.

Decking less than 300 mm (measured horizontally at deck level) from glazed elements that are less than 400 mm (measured vertically) from the surface of the deck (see Figure D2, Appendix D) shall be made from—

(a) non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a timber species, as specified in Paragraph E1 and listed in Table E1, Appendix E; or

(d) a combination of any of Items (a), (b), or (c) above.

6.7.4 Balustrades, handrails or other barriers

This Standard does not provide construction requirements for balustrades, handrails and other barriers.

6.8 WATER AND GAS SUPPLY PIPES

Above-ground, exposed water and gas supply pipes shall be metal.

SECTION 7 CONSTRUCTION FOR BUSHFIRE ATTACK LEVEL 29 (BAL — 29)

7.1 GENERAL

A building assessed in Section 2 as being BAL—29 shall comply with Section 3 and Clauses 7.2 to 7.8.

NOTE: There are a number of Standards that specify requirements for construction; however, where this Standard does not provide construction requirements for a particular element, the other Standards apply.

Any element of construction or system that satisfies the test criteria of AS 1530.8.1 may be used in lieu of the applicable requirements contained in Clauses 7.2 to 7.8 (see Clause 3.8).

NOTE: BAL—29 is primarily concerned with protection from ember attack and radiant heat greater than 19 kW/m2 up to and including 29 kW/m2.

7.2 SUBFLOOR SUPPORTS

This Standard does not provide construction requirements for subfloor supports where the subfloor space is enclosed with—

(a) a wall that complies with Clause 7.4; or

(b) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(c) a combination of Items (a) and (b) above.

Where the subfloor space is unenclosed, the support posts, columns, stumps, piers and poles shall be—

(i) of non-combustible material; or

(ii) of bushfire-resisting timber (see Appendix F); or

(iii) a combination of Items (i) and (ii) above.

NOTE: This requirement applies to the principal building only and not to verandas, decks, steps, ramps and landings (see Clause 7.7).

C7.2 Combustible materials stored in the subfloor space may be ignited by embers and cause an impact to the building.

7.3 FLOORS

7.3.1 Concrete slabs on ground

This Standard does not provide construction requirements for concrete slabs on ground.

7.3.2 Elevated floors

7.3.2.1 *Enclosed subfloor space*

This Standard does not provide construction requirements for elevated floors, including bearers, joists and flooring, where the subfloor space is enclosed with—

(a) a wall that complies with Clause 7.4; or

(b) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(c) a combination of Items (a) and (b) above.

7.3.2.2 *Unenclosed subfloor space*

Where the subfloor space is unenclosed, flooring material, including bearers, joists and flooring less than 400 mm above finished ground level, shall be—

(a) non-combustible (e.g., concrete, steel); or

(b) of bushfire-resisting timber (see Appendix F); or

(c) particleboard or plywood flooring where the underside is lined with sarking-type material or mineral wool insulation; or

(d) a system complying with AS 1530.8.1; or

(e) a combination of any of Items (a), (b), (c) or (d) above.

This Standard does not provide construction requirements for elements of elevated floors, including bearers, joists and flooring, if the underside of the element is 400 mm or more above finished ground level.

7.4 EXTERNAL WALLS

7.4.1 Walls

Walls shall be one of the following:

(a) Made of non-combustible material (e.g., full masonry, brick veneer, mud brick, concrete, aerated concrete).

or

(b) Made of timber-framed or steel-framed walls that are sarked on the outside of the frame and clad with—

(i) fibre-cement external cladding, a minimum of 6 mm in thickness; or

(ii) steel sheet; or

(iii) bushfire-resisting timber (see Appendix F); or

(iv) a combination of any of Items (i), (ii) or (iii) above.

or

(c) A combination of Items (a) and (b) above.

7.4.2 Joints

All joints in the external surface material of walls shall be covered, sealed, overlapped, backed or butt-jointed to prevent gaps greater than 3 mm.

Alternatively, sarking-type material can be applied over the frame prior to fixing any external cladding.

7.4.3 Vents and weepholes

Vents and weepholes in external walls shall be screened with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium, except where they are less than 3 mm (see Clause 3.6).

7.5 EXTERNAL GLAZED ELEMENTS AND ASSEMBLIES AND EXTERNAL DOORS

7.5.1 Bushfire shutters

Where fitted, bushfire shutters shall comply with Clause 3.7 and be made from—

(a) non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (a) and (b) above.

7.5.2 Windows

Windows shall comply with one of the following:

(a) They shall be completely protected by a bushfire shutter that complies with Clause 7.5.1.

or

(b) They shall comply with the following:

(i) Window frames and window joinery and shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) Metal.

or

(C) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel, and the frame and the sash shall satisfy the design load, performance and structural strength of the member.

(ii) Externally fitted hardware that supports the sash in its functions of opening and closing shall be metal.

(iii) Glazing shall be toughened glass minimum 5 mm.

(iv) Where glazing is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the window frame (see Figure D3, Appendix D) that portion shall be screened with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(v) The openable portions of windows shall be screened with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

7.5.3 Doors—Side-hung external doors (including French doors, panel fold and bi-fold doors)

Side-hung external doors, including French doors, panel fold and bi-fold doors, shall comply with one of the following:

(a) They shall be protected by a bushfire shutter that complies with Clause 7.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium

or

(c) They shall comply with the following:

(i) Doors shall be—

(A) non-combustible; or

(B) a solid timber door, having a minimum thickness of 35 mm for the first 400 mm above the threshold; or

(C) a door, including a hollow core door, protected on the outside by a screen door or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(D) a fully framed glazed door, where the framing is made from non-combustible materials or from bushfire-resisting timber (see Appendix F).

(ii) Externally fitted hardware that supports the panel in its functions of opening and closing shall be metal.

(iii) Where doors incorporate glazing, the glazing shall be toughened glass, minimum 5 mm.

(iv) Where glazing is less than 400 mm from the ground or less than 400 mm above decks, carport roofs, awnings and similar elements or fittings having an angle less than 18 degrees to the horizontal and extending more than 110 mm in width from the door (see Figure D3, Appendix D), that portion shall be screened with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(v) Doorframes shall be made from one of the following:

(A) Bushfire-resisting timber (see Appendix F).

or

(B) Metal.

or

(C) Metal-reinforced PVC-U. The reinforcing members shall be made from aluminium, stainless steel, or corrosion-resistant steel and the door assembly shall satisfy the design load, performance and structural strength of the member.

(vi) Doors shall be tight-fitting to the doorframe and to an abutting door, if applicable.

(vii) Weather strips, draught excluders or draught seals shall be installed at the base of side-hung external doors.

7.5.4 Doors—Sliding doors

Sliding doors shall comply with one of the following:

(a) They shall be protected by a bushfire shutter that complies with Clause 7.5.1.

or

(b) They shall be completely protected externally by screens with a mesh with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

or

(c) They shall comply with the following:

(i) Doorframes shall be of bushfire-resisting timber (see Appendix F) or aluminium or steel.

(ii) Externally fitted hardware that supports the panel in its functions of opening and closing shall be metal.

(iii) Where sliding doors incorporate glazing, the glazed assembly shall be toughened glass minimum 6 mm except where both the fixed and openable portions of doors are screened by a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(iv) Sliding doors shall be tight-fitting in the frames.

7.5.5 Doors—Vehicle access doors (garage doors)

The following apply to vehicle access doors:

(a) Vehicle access doors shall be made from—

(i) non-combustible material; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) fibre-cement sheet, a minimum of 6 mm in thickness; or

(iv) a combination of any of Items (i), (ii) or (iii) above.

(b) Panel lift, tilt doors or side-hung doors shall be fitted with suitable weather strips, draught excluders, draught seals or guide tracks, as appropriate to the door type, with a maximum gap no greater than 3 mm.

(c) Roller doors shall have guide tracks with a maximum gap no greater than 3 mm and shall be fitted with a nylon brush that is in contact with the door (see Figure D4, Appendix D).

(d) Vehicle access doors shall not include ventilation slots.

7.6 ROOFS (INCLUDING VERANDA AND ATTACHED CARPORT ROOFS, PENETRATIONS, EAVES, FASCIAS, GABLES, GUTTERS AND DOWNPIPES)

7.6.1 General

The following apply to all types of roofs and roofing systems:

(a) Roof tiles, roof sheets and roof-covering accessories shall be non-combustible.

(b) The roof/wall junction shall be sealed, to prevent openings greater than 3 mm, either by the use of fascia and eaves linings or by sealing between the top of the wall and the underside of the roof and between the rafters at the line of the wall.

(c) Roof ventilation openings, such as gable and roof vents, shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(d) A pipe or conduit that penetrates the roof covering shall be non-combustible.

7.6.2 Tiled roofs

Tiled roofs shall be fully sarked. The sarking shall—

(a) have a flammability index of not more than 5, when tested to AS 1530.2;

(b) be located directly below the roof battens;

(c) cover the entire roof area including the ridge; and

(d) extend into gutters and valleys.

7.6.3 Sheet roofs

Sheet roofs shall—

(a) be fully sarked in accordance with Clause 7.6.2, except that foil-backed insulation blankets may be installed over the battens;

or

(b) have any gaps greater than 3 mm under corrugations or ribs of sheet roofing and between roof components sealed at the fascia or wall line and at valleys, hips and ridges by—

(i) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(ii) mineral wool; or

(iii) other non-combustible material; or

(iv) a combination of any of Items (i), (ii) or (iii) above.

7.6.4 Veranda, carport and awning roofs

The following apply to veranda, carport and awning roofs:

(a) A veranda, carport or awning roof forming part of the main roof space [see Figure D1(a), Appendix D] shall meet all the requirements for the main roof, as specified in Clauses 7.6.1, 7.6.2, 7.6.3, 7.6.5 and 7.6.6.

(b) A veranda, carport or awning roof separated from the main roof space by an external wall [see Figures D1(b) and D1(c), Appendix D] complying with Clause 7.4 shall have a non-combustible roof covering and the support structure shall be—

(i) of non-combustible material; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) timber rafters lined on the underside with fibre-cement sheeting a minimum of 6 mm in thickness, or with material complying with AS 1530.8.1; or

(iv) a combination of any of Items (i), (ii) or (iii) above.

7.6.5 Roof penetrations

The following apply to roof penetrations:

(a) Roof penetrations, including roof lights, roof ventilators, roof-mounted evaporative cooling units, aerials, vent pipes and supports for solar collectors, shall be adequately sealed at the roof to prevent gaps greater than 3 mm. The material used to flash the penetration shall be non-combustible.

(b) Openings in vented roof lights, roof ventilators or vent pipes shall be fitted with ember guards made from a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(c) All overhead glazing shall be Grade A laminated safety glass complying with AS 1288.

(d) Glazed elements in roof lights and skylights may be of polymer provided a Grade A safety glass diffuser, complying with AS 1288, is installed under the glazing. Where glazing is an insulating glazing unit (IGU), Grade A toughened safety glass, minimum 4 mm, shall be used in the outer pane of the IGU.

(e) Where roof lights are installed in roofs having a pitch of less than 18 degrees to the horizontal, the glazing shall be protected with ember guards made from a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

(f) Evaporative cooling units shall be fitted with butterfly closers at or near the ceiling level, or the unit shall be fitted with non-combustible covers with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

7.6.6 Eaves linings, fascias and gables

The following apply to eaves linings, fascias and gables:

(a) Joints in eaves linings, fascias and gables may be sealed with plastic joining strips or timber storm moulds.

(b) Gables shall comply with Clause 7.4.

(c) Fascias and bargeboards shall—

(i) where timber is used, be made from bushfire-resisting timber (see Appendix F); or

(ii) where made from metal, be fixed at 450 mm centres; or

(iii) be a combination of Items (i) and (ii) above.

(d) Eaves linings shall be—

(i) fibre-cement sheet, a minimum 4.5 mm in thickness; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) a combination of Items (i) and (ii) above.

(e) Eaves penetrations shall be protected the same as for roof penetrations (see Clause 7.6.5).

(f) Eaves ventilation openings greater than 3 mm shall be fitted with ember guards made of non-combustible material or a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

7.6.7 Gutters and downpipes

This Standard does not provide construction-specific material requirements for downpipes.

If installed, gutter and valley leaf guards shall be non-combustible.

With the exception of box gutters, gutters shall be metal or PVC-U.

Box gutters shall be non-combustible and flashed at the junction with the roof, with non-combustible materials.

7.7 VERANDAS, DECKS, STEPS, RAMPS AND LANDINGS

7.7.1 General

Decking shall be either spaced or continuous (i.e., without spacing).

There is no requirement to enclose the subfloor spaces of verandas, decks, steps, ramps or landings.

C7.7.1 Spaced decking is nominally spaced at 3 mm (in accordance with standard industry practice); however, due to the nature of timber decking with seasonal changes in moisture content, that spacing may range from 0–5 mm during service. The preferred dimension for gaps is 3 mm (which is in line with other ‘permissible gaps’) in other parts of this Standard. It should be noted that recent research studies have shown that gaps at 5 mm spacing afford opportunity for embers to become lodged in between timbers, which may contribute to a fire. Larger gap spacings of 10 mm may preclude this from happening but such a spacing regime may not be practical for a timber deck.

7.7.2 Enclosed subfloor spaces of verandas, decks, steps, ramps and landings

7.7.2.1 *Materials to enclose a subfloor space*

The subfloor spaces of verandas, decks, steps, ramps and landings are considered to be ‘enclosed’ when—

(a) the material used to enclose the subfloor space is—

(i) non-combustible; or

(ii) bushfire-resisting timber (see Appendix F); or

(iii) a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium; or

(iv) a combination of any of Items (i), (ii) or (iii) above; and

(b) all openings greater than 3 mm are screened with a mesh or perforated sheet with a maximum aperture of 2 mm, made of corrosion-resistant steel, bronze or aluminium.

7.7.2.2 *Supports*

This Standard does not provide construction requirements for support posts, columns, stumps, stringers, piers and poles.

7.7.2.3 *Framing*

This Standard does not provide construction requirements for the framing of verandas, decks, ramps or landings (i.e., bearers and joists).

7.7.2.4 *Decking*

Decking shall be—

(a) of non-combustible material; or

(b) of bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (a) and (b) above.

7.7.3 Unenclosed subfloor spaces of verandas, decks, steps, ramps and landings

7.7.3.1 *Supports*

Support posts, columns, stumps, stringers, piers and poles shall be—

(a) of non-combustible material; or

(b) of bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (a) and (b) above.

7.7.3.2 *Framing*

Framing of verandas, decks, ramps or landings (i.e., bearers and joists) shall be—

(a) of non-combustible material; or

(b) of bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (a) and (b) above.

7.7.3.3 *Decking*

Decking shall be—

(a) of non-combustible material; or

(b) of bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (a) and (b) above.

7.7.4 Balustrades, handrails or other barriers

Those parts of the handrails and balustrades less than 125 mm from any glazing or any combustible wall shall be—

(a) of non-combustible material; or

(b) bushfire-resisting timber (see Appendix F); or

(c) a combination of Items (i) and (ii) above.

Those parts of the handrails and balustrades that are 125 mm or more from the building have no requirements.

7.8 WATER AND GAS SUPPLY PIPES

Above-ground, exposed water and gas supply pipes shall be metal.

Appendix 5
City of Rockingham fire control notice 2014–2014

Fire Control Notice

First and Final Notice (Under Section 33 of the *Bushfires Act 1954*)

NOTICE TO OWNERS AND/OR OCCUPIERS OF LAND IN THE CITY OF ROCKINGHAM

As a landowner or occupier you have a legal requirement under Section 33 of the *Bush Fires Act 1954* to carry out fire prevention work on your property in accordance with the provisions of this Fire Control Notice. Inspection of all properties will be carried out in all areas for compliance with this notice after 30 November. Persons who fail to comply with the requirements of this order will be issued with an infringement notice ($250).

It is the property owners' not the contractors who are responsible for the standard and quality of the fire prevention work undertaken and maintained as per this notice.

***BUSHFIRES ACT 1954* (as amended)**
Pursuant to the powers contained in Section 33 of the *Bushfires Act 1954* (as amended) you are hereby required, on or before 30 November 2013, to remove from land owned or occupied by you all flammable material or to clear firebreaks to mineral earth in accordance with the following and thereafter to maintain the land or the firebreaks clear of all flammable material up to and including 31 May 2014.


Correct Rural Firebreak


Incorrect Rural Firebreak

1. Rural Land
On or before 30 November 2013 and thereafter up until and including 31 May 2014.

1.1 Have FIREBREAKS not less than three (3) metres wide immediately inside and along all boundaries of land and including the land abutting road, rail and drain reserves and all public open space reserves, with all overhanging tree branches, tree limbs etc. to be trimmed back clear of the firebreak area to a height of four metres.

1.2 Have FIREBREAKS not less than three metres wide so far as to surround all buildings, sheds and haystacks, with all overhanging branches, trees, limbs etc. to be trimmed back clear of the firebreak area to a height of four metres.

2. Urban Areas (Vacant Land)
On or before 30 November 2013 and maintained until and including 31 May 2014.

2.1 Have the entire vacant land clear of all flammable material where the area of land is less than 2,000m^2 by SLASHING, MOWING or other means to a height no greater than 50mm.

2.2 Where the area of land exceeds 2,000m^2 have FIREBREAKS not less than three metres wide immediately inside and along all boundaries of the vacant land with all overhanging tree branches, trees, limbs etc. to be trimmed back clear of the firebreak area to a height of four metres.

3. Alternative Situations
Variation applications must be lodged in writing to the City of Rockingham by the third week in October each year.

An Application to Vary Location and Type of Firebreaks can be downloaded from the City's website or is available from the Emergency Services Administration Officer on 9527 0732.

4. Fire Management Plans
All properties within subdivisions/developments within the City of Rockingham shall comply with the Fire Management Plans for their estates to the satisfaction of Council or its duly authorised Officer.

5. Penalty
If you do not meet your responsibilities specified in this Notice you will be fined a minimum of $250 and be required to meet the cost of the City's efforts to make your property comply with the Fire Control Notice.

Fire Control Enquiries
8.30am – 4.30pm Monday to Friday
Phone: 9527 0732
Email: firecontrol@rockingham.wa.gov.au

www.rockingham.wa.gov.au

city of Rockingham
where the coast comes to life

Appendix 6

AFAC bush fire glossary

afac
Australasian Fire and Emergency Service Authorities Council

BUSHFIRE GLOSSARY

Prepared by Rural and Land Management Group for AFAC Agencies

January 2012

Disclaimer
While all possible care has been taken to ensure a comprehensive and accurate publication, the Australasian Fire Authorities Council and its servants or agents shall not be liable for technical or editorial errors contained herein or omissions there from; nor for incidental or consequential liability in any way resulting from the information or advice that is contained in this publication or use of that material.

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AFAC Limited (ABN 52 060 049 327)
Level 5, 340 Albert Street
East Melbourne Victoria 3002
Telephone: 03 9419 2388
Facsimile: 03 9419 2389

Email: afac@afac.com.au
Internet: http://www.afac.com.au
http://knowledgeweb.afac.com.au/

Preface

The AFAC Bushfire Glossary has been developed to promote an exchange of information between member agencies on terminology used specifically in bushfires.

The Glossary has been developed based on a set of agreed business rules. It includes the bushfire technical terms, their definition or description as adopted and applied by the AFAC member agencies. It does include some fire terms that are of a general industry wide nature for completeness. It excludes terms for which an agreed definition could not be reached by the member agencies.

This document is not designed to be a text book or to provide a discussion of a term beyond the definition/description of that term. Nor is it an attempt to modify or redefine terms defined in codes, standards or legislation. Terms that have been adopted for use by the fire management industry from another discipline will maintain the meaning ascribed to them in their originating discipline.

It is proposed that this Glossary will be reviewed regularly to ensure that it continues to be relevant and meets the needs of AFAC member agencies. This is the fifth review. It is the current 2012 version.

AFAC acknowledges the significant contribution of the Rural and Land Management Glossary Working Group lead by Greg Esnouf and Country Fire Authority staff, Matthew Fraser and Jo Richards, who contributed generously of their time and expertise in the establishment of this document and the work of the Genesis Institute to provide a framework for refining the glossary.

Previous versions of the Glossary were titled Wildfire Glossary. The term wildfire has been replaced with the term bushfire in line with a trend towards using language more accepted by the general public.

The terms appear in alphabetical order excluding spaces. In this way it is possible to find a compound word without knowing if it is one or two words.

Aim

The purpose of this Glossary is to seek to facilitate a greater understanding by using common language between bushfire and land management agencies and support organisations during the prevention of, preparedness for, response to and recovery from bushfires.

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Term	Definition
Accelerant	Any substance (such as oil, gasoline, etc) that is applied to a fuel-bed to expedite the burning process.
Adaptor	A fitting used to couple different sized hoses, hoses of the same size with different threads, or different types of couplings, or to connect the male to male, or female to female parts of the same type of coupling.
Adsorption	The taking in of water vapour from the air by dead plant material.
Advance burn	A prescribed fire that reduces fuel through a forest area before felling operations. It is intended to improve the safety of timber harvesting operations and as a silvicultural tool to protect lignotubers and standing trees.
Advancing fire	That portion of the fire with rapid fire spread and higher intensity which is normally burning with the wind and/or up slope.
Aerial detection	The discovering, locating and reporting of fires from aircraft.
Aerial fuel	See: Elevated fuel
Aerial ignition	Ignition of fuels by dropping incendiary devices or materials from aircraft.
Aerial ignition device (AID)	Inclusive term applied to equipment designed to ignite wildland fuels from an aircraft.
Aerial Observer	See: Air Observer
Aerial reconnaissance	Use of aircraft for detection of fires and observing fire behaviour, values-at-risk, suppression activity, and other critical factors to facilitate command decisions on strategy and tactics needed for fire suppression.
Aerosol	Airborne solid or liquid particles dispersed or suspended in a gas stream.
After action review (AAR)	A discussion, focused on performance standards, of an event that enables those involved to discover what happened, why it happened, and how to sustain strengths and improve on weaknesses. An After action review is a tool incident command personnel and units can use to get maximum benefit from every incident. It provides a review of the incident upon its completion to identify and discuss effective and non-effective performance and lessons learned and how to apply them in the future. (adapted from NWCG)
AIIMS structure	The combination of facilities, equipment, personnel, procedures, and communications operating within a common organisational structure with responsibility for the management of allocated resources to effectively accomplish stated objectives relating to an incident (AIIMS).
Air attack	The direct use of aircraft in the suppression of bushfires.
Air attack Supervisor	Primarily responsible for the safety and efficient tactical coordination of aircraft operations when fixed and/or rotary firebombing aircraft are operating at a fire (Air Attack Supervisor Training Manual).
Air base Manager	An experienced, trained person who is appointed to manage all the functions and personnel on an air base or helicopter base.
Air mass	A meteorological term referring to an extensive body of air within which the conditions of temperature and moisture in a horizontal plane are essentially uniform.
Air Observer	The primary role of the air observer is to aerially obtain intelligence to assist the planning of fire suppression operations (NSWRFS).
Air operations	The use of aircraft in support of an incident for the purposes of suppression, transportation of personnel, equipment or supplies, or for aerial reconnaissance.

Term	Definition
Air operations Manager	The air operations manager position is responsible for overall coordination of air operations and air support activities in support of an incident.
Aircraft Officer	The aircraft officer is responsible for ground operations and overall provision of support, enabling a safe and efficient air operation to be conducted.
Airside	The parts of an airport not normally open to unauthorised people. It comprises the apron, taxiways, runways and the areas containing them.
Allocated resources	Resources working at an incident (AIIMS).
Anchor point	An advantageous location, usually a barrier to fire spread, from which to start constructing a fireline. The anchor point is used to minimize the chance of being flanked by the fire while the line is being constructed (NWCG).
Aqueous film forming-foam (AFFF)	A synthetic amber coloured liquid concentrate mixed with water to form an agent that is capable of forming water-solution films on the surface of flammable liquids that prevent the escape of fuel vapours, excludes oxygen and maintain the surface when disturbed (self healing).
Area ignition	Ignition of several individual fires throughout an area, either simultaneously or in rapid succession, and so spaced that they add to and influence the main body of the fire to produce a hot, fast-spreading fire condition. Also called simultaneous ignition.
Area of origin	General location where the fire started.
Arson	The deliberate setting of a fire where the intent of the person responsible was to cause harm or destruction to life or property.
Aspect	The direction towards which a slope faces.
Asphyxiants	Substances which interfere with the respiratory process.
Assembly area	See Staging area.
Assessment	The process of determining if an individual has the prescribed skills, knowledge and experience needed to acquire a specific capability.
Assets	Anything valued by people which includes houses, crops, forests and, in many cases, the environment.
Assisting agency	An agency directly contributing suppression, support or service resources to another agency.
Atmospheric stability	The degree to which the atmosphere resists turbulence and vertical motion.
Attack time	See Elapsed time
Australasian Inter-service Incident Management System (AIIMS)	A nationally adopted structure to formalise a coordinated approach to emergency incident management.
Automatic dispatch	See Pre-planned dispatch.
Automatic weather station (AWS)	The Bureau's standard AWSs use sensors to monitor temperature, humidity, wind speed and direction, pressure and rainfall. Various advanced sensors are available for specialised applications. These sensors can monitor cloud height (ceilometer), visibility, present weather, thunderstorms, soil temperature (at a range of depths) and terrestrial temperature. (Developed from the BOM)
Available fuel	The portion of the total fuel that would actually burn under various environmental conditions.
Available resources	The resources at an incident and available for allocation at short notice. (AIIMS)

Term	Definition
Backburn	1. A fire started intentionally along the inner edge of a fireline during indirect attack operations to consume fuel in the path of a bushfire (Australia). 2. A counterfire commenced from within continuous fuel for the purpose of fighting a fire (New Zealand).
Back fire	See: Backburn (Preferred term).
Backing fire	The part of a fire which is burning back against the wind or down slope, where the flame height and rate of spread are reduced.
Bark fuel	The flammable bark on tree trunks and upper branches.
Bark heaps	Accumulations of bark and branch material resulting from timber harvesting operations. Soil may be mixed with bark heaps, but generally the heap is formed by a machine dropping fresh bark on the top of the heap.
Basal accumulation	Bark fallen from a tree and forming a relatively high and localized accumulation of fine fuel.
Base camp	A location where personnel are accommodated and fed for a period of time. A base camp usually contains catering, ablution and accommodation facilities, a water supply and a lighting system, and may include other facilities such as car parking maintenance and servicing. (AIIMS)
Bay(s)	A marked indentation (s) in the fire perimeter usually located between two fingers.
Beaufort wind scale	A system for estimating wind speeds based on observation of visible wind effects. A series of descriptions of visible wind effects upon land objects or sea surfaces is matched with a corresponding series of wind speed ranges, each being allocated a *Beaufort number.*
Blacking out	The process of extinguishing or removing burning material along or near the fire control line, felling stags, trenching logs to prevent rolling and the like, in order to make the fire safe.
Blackspot	An area where two-way radio coverage does not exist.
Blank cap	The metal cap used on delivery outlets and on the suction inlet of the pump to prevent discharge of water.
Blow down	See: Wind throw.
Blow up	Sudden increase in fireline intensity or rate of spread of a fire sufficient to preclude direct control or to upset existing suppression plans. Often accompanied by violent convection and may have other characteristics of a fire storm. (NWCG)
Bole	The trunk of a tree.
Bole damage	The damage to the trunk of a living tree by fire, mechanical equipment or disease.
Bracken	Bracken fern varies significantly in height and density. If Bracken is generally upright (either alive or dead) with the majority of its biomass in the top half of the plant and only the stems in touch with the ground, then it is considered to be part of the elevated fuel. If however, it has collapsed and most of its biomass is in touch with the ground, then it is considered to be Near-surface fuel.
Branch	A tapered pipe, fitted to the end of a hose line, which increases the velocity (converting pressure energy to kinetic energy) of the water or foam solution travelling through the hose, and forms an effective firefighting jet or spray.
Breakaway	The points at which a fire, after it has been contained, escapes into unburnt areas across a fireline or fire edge.

Term	Definition
Breeching	A device to divide one hose line into two or collect two hose lines into one.
Briefing	A general overview of an operation.
Broad area hazard reduction	Large scale removal of selected fuel before the onset of a bushfire danger period.
Broadcast burning	See: Prescribed burning (Preferred term)
Buffer	A strip or block of land on which the fuels are reduced to provide protection to surrounding lands.
Bulk water carrier	A large tanker used for replenishing water to firefighting tankers.
Burn back	See: Reburn (Preferred term).
Burning brands	Lofted burning material such as bark, usually flaming.
Burning conditions	The state of the combined components of the fire environment that influence fire behaviour and fire impact in a given fuel type. Usually specified in terms of such factors as fire weather elements, fire danger indices, fuel load and slope.
Burning off	Generally setting fire - with more or less regard to areas carrying unwanted vegetation such as rough grass, slash and other fuels.
Burning out	To intentionally light fires to consume islands of unburned fuel inside the fire perimeter.
Burning program	A program of prescribed burns scheduled these for a designated area over a nominated time, normally looking ahead over one fire season (for the coming spring to the following autumn), but can also look ahead five years or more.
Burning rotation	The period between burning of a prescribed area for management purposes.
Burning unit	A specified land area for which prescribed burning is planned.
Burn out	1. A fire set to consume islands of unburnt fuel inside the fire perimeter and between the fire edge and fireline (Australia). 2. A counterfire commenced from a natural or previously constructed firebreak for the purpose of fighting a fire (New Zealand).
Burn over	A section of fire that overruns personnel and/or equipment.
Burn plan	The plan which is approved for the conduct of prescribed burning. It contains a map identifying the area to be burnt and incorporates the specifications and conditions under which the operation is to be conducted.
Bushfire	Un planned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective.
Bushfire danger period	A period of the year either established by legislation or declared by the relevant agency, when restrictions are placed on the use of fire due to dry vegetation and the existence of conditions conducive to the spread of fire.
Bushfire management	All those activities directed to prevention, detection, damage mitigation, and suppression of bushfires. Includes bushfire legislation, policy, administration, law enforcement, community education, training of fire fighters, planning, communications systems, equipment, research, and the multitude of field operations undertaken by land managers and emergency services personnel relating to bushfire control.
Byram-Keetch Drought index (BKDI)	See: Keetch-Byram Drought Index
Cache	A predetermined complement of supplies stored in a designated location. (CIMS).
Campaign fire	A fire normally of a size and/or complexity that requires substantial firefighting resources, and possibly several days or weeks to suppress.

Term	Definition
Candle (Candling)	A tree (or small clump of trees) is said to candle when its foliage ignites and flares up, usually from the bottom to top.
Candlebark	Long streamers of bark that have peeled from some eucalypt species that form fire brands conducive to very long distance spotting.
Canopy	The crowns of the tallest plants in a forest – the overstorey cover.
Canopy cover	Canopy cover refers to 2 dimensions (ie plan view, area coverage)
Canopy density	Canopy density refers to 3 dimensions (ie mass/volume)
Catastrophic fire danger	The highest fire danger rating as determined by fire agencies and generally with a Forest fire danger index greater than 100 or a Grassland fire danger index greater than 150.
Central ignition	A method of prescribed burning in which fires are set in the centre of an area to create a strong convective column. Additional fires are then set progressively closer to the outer control lines causing indraft winds to build up. This has the effect of drawing the fires towards the centre.
Chaining	The process of flattening vegetation (usually mallee or scrub) by dragging a heavy chain or cable between two large tractors or bulldozers.
Charged line	A line of fire hose filled with water under pressure and ready to use.
CIMS	Coordinated Incident Management System used in New Zealand.
Class A foam	See: Foam
Class labels	Class labels identify the type of hazardous material being stored or transported. These are grouped under broad classifications according to the predominant type of risk involved.
Climate	The atmospheric conditions of a place over an extended period of time.
Clinometer	An instrument used to measure the angle of a slope.
Cloud cover	The amount of sky covered or obscured by cloud, expressed in eighths. Eight eighths is complete cloud cover.
Coarse fuels	Dead woody material, greater than 25mm in diameter, in contact with the soil surface (fallen trees and branches). Some researchers categorise forest fuels as: fine <6 mm diameter; twigs 6-25 mm diameter; coarse >25 mm diameter.
Code of Practice	Document giving methods developed to assist compliance with acts and regulations in the performance of work.
Cold front	A cold front is the delineation between cold polar air moving towards the equator and undercutting warm tropical air moving poleward. The temperature differences across a cold front can be extreme and associated with strong winds. The warm tropical air is forced to rise and become unstable with the development of large cumuliform clouds. Severe weather such as thunderstorms, squall lines and severe turbulence may accompany these cold fronts. (BOM)
Cold trailing	A method of determining whether or not a fire is still burning, involving careful inspection and feeling with the hand, or by use of a hand-held infrared scanner, to detect any heat source.
Collecting head	A collecting head is used to collect (usually from two to four) lines into the suction inlet of a pump.
Combat agency/authority	See: Control authority
Combustion	Rapid oxidation of fuels producing heat, and often light.

Term	Definition
Command	The direction of members and resources of an agency in the performance of the agency's role and tasks. Authority to command is established in legislation or by agreement within an agency. Command relates to agencies and operates vertically within an agency.
Communications plan	Details the methods and systems for people to communicate with each other, the incident management structure, including the actual radio channels/mobile phone numbers. (AIIMS)
Compartment	(1) Forestry Definition – A basic administrative unit of a managed forest. (2) Building Definition - An enclosed space with floor, walls and ceiling.
Competency	Skills and knowledge and their application within an occupation to the standard of performance required in the workplace. (Vic report)
Conduction	The transfer of thermal energy between regions of matter due to temperature gradient.
Contained	The status of a wildfire suppression action signifying that a control line has been completed around the fire, and any associated spot fires, which can reasonably be expected to stop the fire's spread. (NWCG)
Contour lines	Contour lines connect points of equal elevation on a topographical map.
Control	The overall direction of response activities in an emergency situation. Authority for control is established in legislation or in an emergency response plan, and carries with it the responsibility for tasking and coordinating other agencies in accordance with the needs of the situation. Control relates to situations and operates horizontally across agencies.
Control authority	The agency, service, organization or authority with legislative responsibility for control of the incident. (Also referred to as the responsible authority or agency.) (AFAC)
Controlled	The stage during fire suppression activities at which the complete perimeter of a fire is secured and no breakaway is expected.
Controlled burning	See: Prescribed burning.
Control line	See: Fireline
Convection	1. As applied in meteorology, atmospheric motions that are predominantly vertical, resulting in vertical transport and mixing of atmospheric properties; distinguished from advection. 2. As applied in thermodynamics is a mechanism of heat transfer occurring because of the bulk movement of fluids.
Convection burn	See: Central ignition
Convection column	The rising column of smoke, ash, burning embers and other particle matter generated by a fire.
Convective activity	General term for manifestations of convection in the atmosphere, alluding particularly to the development of convective clouds and resulting weather phenomena, such as showers, thunderstorms, squalls, hail, and tornadoes. (NWCG)
Convergence zone	1. See: Junction zone. 2. In fire weather, that area where two winds come together from opposite directions and are forced upwards often creating clouds and precipitation. (NWCG)
Convoy	Two or more vehicles driving together under the control of a single Convoy Leader.

Term	Definition
Coordination	The bringing together of agencies and elements to ensure effective response to an incident or emergency. It is primarily concerned with the systematic acquisition and application of resources in accordance with the requirements imposed by the emergency or emergencies. Coordination relates primarily to resources and operates: • vertically, within an agency, as a function of the authority to command; • horizontally, across agencies, as a function of the authority to control.
Cordon	A cordon is the means to maintain an area and is used to restrict movement into and out of an area.
Coupe	A defined forest area in which timber harvesting takes place.
Crew	See: Fire crew.
Crew leader	Person responsible for the supervision and management of crews
Critical burnout time	Total time a fuel can burn and continue to feed energy to the base of a forward-travelling convection column.
Critical incident stress	Unusually strong emotional reactions which have the potential to interfere with the ability of personnel to function, either at the incident scene or later, arising from any situation faced during operations.
Critical incident stress debriefing	The process in which teams of professional and peer counsellors provide emotional and psychological support to incident personnel who are or have been involved in a critical (highly stressful) incident.
Cross bearings	Intersecting lines of sight from two or more points on the same object; used to determine the location of bushfire from lookouts.
Crown fire	A fire that advances from top to top of trees or shrubs.
Crown scorch	Browning of the needles or leaves in the crown of a tree or shrub caused by heat from a fire.
Crowning	A fire ascending into the crowns of trees and spreading from crown to crown.
Crowning potential	A probability that a crown fire may start, calculated from inputs of foliage moisture content and height of the lowest part of the tree crowns above the surface. (NWCG)
Curing	Drying and browning of herbaceous vegetation due to mortality or senescence.
Dead fuel	Fuels with no living tissue in which moisture content is governed almost entirely by absorption or evaporation of atmospheric moisture (relative humidity and precipitation). (NWCG)
Debrief	To gather information from the participants in an action so as to gauge the success or otherwise of the action at the end of the task, shift, tour or incident.
Deep-seated fire	A fire burning far below the surface in duff, mulch, peat, or other combustibles as contrasted with a surface fire.
Defensive strategy	A firefighting strategy used where the protection of life and assets is a priority when a fire is: (i) located in inaccessible or remote location OR (ii) too intense to be safely or effectively attacked directly.
Dehydration	Excessive loss of water from the body's tissues. Dehydration may follow any condition in which there is a rapid depletion of body fluids.
Delayed aerial ignition devices (DAID)	An incendiary device that will ignite after a predetermined time.

Term	Definition
Deliberate fire	A fire resulting from a person placing burning material to cause ignition. The intent of the person may have been to cause harm or destruction to life or property (arson-criminal offence) or to modify fuels and/or vegetation for land management purposes (summary offence). See also Arson.
Delivery hose	Hose used to transport water under pressure.
Delivery valve	On a pump, the valved outlet through which water is discharged.
Demobilisation	The orderly release of resources no longer required at an incident.
Depth of burn	The reduction in forest floor litter thickness (cm) due to consumption by fire. Most commonly used in connection with prescribed burning.
Desiccant	A chemical that, when applied to a living plant causes or accelerates the drying out of its aerial parts.
Desorption	The loss of moisture to the atmosphere from dead plant material.
Detection	The discovery of a fire. Individuals, fire towers, reconnaissance aircraft and automatic devices may be used, either alone or in combination.
Dew	The moisture which collects in small droplets on the surface of substances and vegetation by atmospheric condensation, chiefly at night.
Dew point temperature	This is a measure of the moisture content of the air and is the temperature to which air must be cooled in order for dew to form. The dew-point is generally derived theoretically from dry and wet-bulb temperatures, with a correction for the site's elevation. (BOM)
Dieback	The progressive dying, from the top downward, of twigs, branches or tree crowns.
Diffused pattern	A spray pattern (as opposed to straight stream) of water or foam.
Direct attack	A method of fire attack where wet or dry firefighting techniques are used. It involves suppression action right on the fire edge which then becomes the fireline.
Dispatch	The act of ordering attack crews and/or support units to respond to a fire, or from one place to another.
Division	A portion of the incident comprising of two or more sectors. The number of sectors grouped in a Division should be such as to ensure effective direction and control of operations. Divisions are generally identified by a local geographic name.
Dominant height	Mean height of the largest trees in a stand. A specified number per unit area are generally selected.
Downwind	Away from the wind direction. In the direction opposite to the direction from which the wind is blowing. The direction that smoke will travel.
Dozer	A crawler tractor fitted with a blade which can be transported to a fire on a tray truck or trailer. Dozer is a shortened form of "Bulldozer"
Dozer line	Fireline constructed by the front blade of a dozer.
Drain time	The time (minutes) it takes for foam solution to drop out from the foam mass; for a specified percent of the total solution contained in the foam to revert to liquid and drain out of the bubble structure.
Drift	The effect of wind on smoke or on a water drop.
Drip torch	A canister of flammable fuel fitted with a wand, a burner head and a fuel flow control device. It is used for lighting fires for prescribed burning, backburning and burning out.

Term	Definition
Drop pass	Indicates that the firefighting aircraft has the target in sight and will make a drop of fire control agent on this run over the target.
Drop pattern	The distribution of an aerially delivered fire control agent drop on the target area in terms of its length, width, and momentum (velocity x mass) as it approaches the ground. The latter determines the relative coverage level of the fire control agent on fuels within the pattern.
Drop zone (DZ)	Target area for firefighting aircraft, or cargo dropping.
Drought	Prolonged absence or marked deficiency of precipitation (rain). (BOM)
Drought index	A numerical value reflecting the dryness of soils, deep forest litter, logs and living vegetation.
Dry bulb temperature	Technically, the temperature registered by the dry-bulb thermometer of a psychrometer. However, it is identical to the temperature of the air. (Degrees Celsius). (NZ)
Dry firefighting	The suppression of a fire without the use of water. This is normally achieved by removing the fuel by the use of hand tools, burning or machinery.
Duff	The layer of decomposing vegetative matter on the forest floor below the litter layer, the original structure still being recognisable.
Ecological burning	A form of prescribed burning. Treatment with fire of vegetation in nominated areas to achieve specified ecological objectives.
Edge burning	A term used to describe perimeter burning of an area in mild conditions prior to large scale prescribed burning. This practice is used to strengthen buffers and to reduce mop-up operations.
Elevated fuel	The standing and supported combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, bark and creepers.
Embers	Glowing particles cast from the fire (as 'showers' or 'storms'). (Vic report)
Emergency centre	A facility where the coordination of the response and support to the incident is provided.
En route resources	Resources despatched to an incident that have not yet checked in. (AIIMS)
Entrapment	A situation in which individuals are exposed to life threatening or potentially life threatening conditions from which they cannot safely remove themselves.
Equilibrium moisture content (EMC)	The moisture content that a fuel element would attain if exposed for an infinite period in an environment of specified constant dry-bulb temperature and relative humidity. When a fuel element has reached its EMC, it neither gains nor loses moisture as long as conditions remain constant.
Equipment	All material supplied to an incident excluding personnel and vehicles.
Escape route	A planned route away from danger areas at a fire.
Evacuation	The temporary relocation of persons from dangerous or potentially dangerous areas to safe areas.

Term	Definition
Exposures	Parts of the same structure or other structures or property not directly involved in the fire but at risk of being burnt or damaged if the fire is not controlled. In the bushfire context: 1. Property that may be endangered by a fire burning in another structure or by a bushfire. In general, property within 12 metres of a fire may be considered to involve an exposure hazard, although in very large fires the danger may exist at much greater distances. 2. Direction in which a slope faces, usually with respect to cardinal directions (N, S, E, W). 3. The general surroundings of a site, with special reference to its openness to winds and sunshine.
Extinguishing agent	A substance used to put out a fire by cooling the burning material or blocking the supply of oxygen, or chemically inhibiting combustion or combinations of these mechanisms.
Extreme fire behaviour	A level of bushfire behaviour characteristics that ordinarily precludes methods of direct suppression action. One or more of the following is usually involved: • high rates of spread • prolific crowning and/or spotting • presence of fire whirls • a strong convective column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.
Extreme fire danger	The second highest fire danger rating as determined by fire agencies and generally with a Forest fire danger index between 75 and 99 or a Grassland fire danger index greater between 100 and 149.
Facilities	Permanent and temporary facilities where personnel sleep, cook, maintain and repair equipment. (AIIMS)
Fall back fire control line	Any fire control line which is at a distance from the fire perimeter, and is the second control line at which the fire perimeter may be stopped should it cross the first fire control line. Also known as 'fallback line'.
Fine fuel	Fuel such as grass, leaves, bark and twigs less than 6mm in diameter that ignite readily and are burnt rapidly when dry.
Fingers	Long and narrow slivers of fire which extend beyond the head or flanks. (AFAC)
Fire	The chemical reaction between fuel, oxygen and heat. Heat is necessary to start the reaction and once ignited, fire produces its own heat and becomes self-supporting.
Fire access track	A track constructed and/or maintained expressly for fire management purposes.
Fire behaviour	The manner in which a fire reacts to the variables of fuel, weather and topography.
Fire Behaviour Analyst	Person responsible for developing fire behaviour predictions based on fire history, fuel, weather, and topography. (NWCG)amended
Fire behaviour model	A set of mathematical equations that can be used to predict certain aspects of fire behaviour.
Fire behaviour prediction	Prediction of probable fire behaviour usually prepared by a fire behaviour analyst in support of fire suppression or prescribed burning operations. (NWCG)
Fire behaviour prediction system	A system that uses a set of mathematical equations to predict certain aspects of fire behaviour in wildland fuels when provided with data on fuel and environmental conditions.

Term	Definition
Fire bombing	A technique of suppressing a bushfire by dropping water, foam or retardants on it from an aircraft.
Fire brand	A piece of flaming or smouldering material capable of acting as an ignition source. eg eucalypt bark.
Fire climate	The composite pattern or integration over time of the fire weather elements that affect fire occurrence and fire behaviour in a given area.
Fire control	See Fire suppression.
Fire control agent	A substance that acts as an Extinguishing agent, and or a Fire retardant and or a Fire suppressant.
Fire control line	See: Fireline.
Fire crew	A general term for two or more firefighters organised to work as a unit. (NWCG)
Fire danger	Sum of constant danger and variable danger factors affecting the inception, spread, and resistance to control, and subsequent fire damage; often expressed as an index. (NWCG)
Fire danger class	A segment of a fire danger index scale identified by a descriptive term and or a colour code. The classification system may be based on more than one fire danger index and an assessment of risk exposure.
Fire danger index (FDI)	A relative number denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed.
Fire danger rating	A relative class denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed, indicating the relative evaluation of fire danger.
Fire ecology	The study of the relationships between fire, the physical environment and living organisms.
Fire edge	Any part of the boundary of a going fire at a given time. *NOTE*: The entire boundary is termed the 'fire perimeter'.
Fire effects	The physical, biological and ecological impact of fire on the environment. (NWCG)
Fire environment	The surrounding conditions, influences, and modifying forces of topography, fuel, and weather that determine fire behaviour. (NWCG)
Firefighter	Any employee, volunteer or agent of any fire agency who occupies, or is designated, to undertake a role for the purpose of fire suppression.
Firefighting operations	Any work or activity directly associated with control of fire.
Fire frequency	A general term referring to the recurrence of fire in a given area over time (NWCG). Also see: Fire regime
Fire front	The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smouldering combustion. (NWCG)
Fireground	The area in the vicinity of a fire suppression operations, and the area immediately threatened by the fire. It includes burning and burnt areas; constructed and proposed fire lines; the area where firefighters, vehicles, machinery and equipment are located when deployed; roads and access points under traffic management control; tracks and facilities in the area surrounding the actual fire; and may extend to adjoining area directly threatened by the fire.

Term	Definition
Fire hazard	A fuel complex, defined by volume, type condition, arrangement, and location, that determines the degree of ease of ignition and of resistance to control.
Fire intensity	See: Fireline intensity.
Fireline	A natural or constructed barrier, or treated fire edge, used in fire suppression and prescribed burning to limit the spread of fire.
Fireline intensity	The rate of energy release per unit length of fire front usually expressed in kilowatts per metre (Kw/m). The rate of energy release per unit length of fire front, defined by the equation I=Hwr, where I = fireline intensity (kW/m) H = heat yield of fuel (kJ/kg)-16,000 kJ/kg w = dry weight of fuel consumed (kg/m2) (mean total less mean unburnt) r = forward rate of spread (m/s) The equation can be simplified to I = w r/2 where I = fireline intensity (kW/m) w = dry weight of fuel consumed (tonnes/ha) r = forward rate of spread (m/hr)
Fire lookout	A structure strategically located and manned to detect the occurrence and the location of fires. It may be a tower or a structure on a high point
Fire management	All activities associated with the management of fire prone land, including the use of fire to meet land management goals and objectives.
Fire potential	The chance of a fire or number of fires occurring of such size, complexity or impact that requires resources (both a pre-emptive management and suppression capability) from beyond the area of the fire origin. (BCRC)
Fire preparedness	All activities undertaken in advance of bushfire occurrence to decrease its extent and severity and to ensure more effective fire suppression.
Fire prevention	All activities concerned with minimising the incidence of bushfire particularly those of human origin.
Fire regime	The history of fire in a particular vegetation type or area including the frequency, intensity and season of burning. It may also include proposals for the use of fire in a given area. (AFAC)
Fire report	An official record of a fire, generally including information on cause, location, action taken, damage, costs, etc., from start of the fire until completion of suppression action. These reports vary in form and detail from agency to agency (NWCG). Also see Report of Fire
Fire retardant	A chemical generally mixed with water, designed to retard combustion by a chemical reaction. It is applied as slurry from the ground or air to fuels ahead of the fire.
Fire risk	Processes, occurrences or actions that increase the likelihood of fires occurring.
Fire run	A rapid advance of a fire front. It is characterised by a marked transition in intensity and rate of spread.
Fire scar	1) A healing or healed-over injury caused or aggravated by fire on a woody plant. 2) A mark left on a landscape by fire.
Fire season	The period during which bushfires are likely to occur, spread and do sufficient damage to warrant organised fire control.
Fire simulator	A device that imposes simulated fire and smoke on a projected landscape scene, for the purpose of informing fire suppression personnel of potential fire situations either for an actual fire or hypothetical fire(s).
Fire spread	Development and travel of fire across surfaces.

Term	Definition
Fire storm	Violent convection caused by a large continuous area of intense bushfire often characterised by destructively violent surface indrafts, a towering convection column, long distance spotting, and sometimes by tornado-like whirlwinds. (AFAC)
Fire suppressant	An additive designed to reduce the surface tension of water and/or to hold water in suspension thus increasing water's efficiency as a fire extinguishing agent. Suppressants are applied directly to the burning fuels.
Fire suppression	The activities connected with restricting the spread of a fire following its detection and before making it safe.
Fire suppression organisation	1. The personnel and equipment collectively assigned to the suppression of a specific fire or group of fires. 2. The personnel responsible for fire suppression within a specified area. 3. The management structure, usually shown in the form of an organization chart of the persons and groups having specific responsibilities in fire suppression. (NWCG)
Fire suppression plan	See Incident action plan (IAP).
Fire tetrahedron	An instructional aid in which the sides of the tetrahedron (comprising 4 triangular shaped figures) are used to represent the 4 components of combustion and flame production process-fuel, heat, oxygen and the chemical chain reaction.
Fire threat	The impact a fire will have on a community.
Fire tower	Tower strategically located and manned to detect and report the occurrence and location of fires. A type of Fire lookout
Fire training simulator	A training device that imposes simulated fire and smoke on a projected landscape scene, for the purpose of instructing fire suppression personnel in fire situations and fire suppression techniques.
Fire triangle	Diagrammatic expression of the three elements that are necessary for a fire to occur. FUEL – HEAT – OXYGEN. The removal of any one of these will extinguish a fire.
Fire weather	Weather conditions which influence fire ignition, behaviour, and suppression. (NWCG)
Fire weather forecast	A weather prediction specially prepared for use in wildland fire operations and prescribed fire. (NWCG)
Fire whirl	Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than one foot to over 500 feet in diameter. Large fire whirls have the intensity of a small tornado. (NWCG)
Fire wind	The inflow of air close to a fire caused by the action of convection. It is not to be confused with a prevailing wind.
First attack	See: Initial attack
Fixed wing aircraft	A heavier than air aircraft which obtains lift for flight by forward motion of wings through the air.
Flame angle	The angle of the flame in relation to the ground, caused by wind direction or the effect of a slope.
Flame depth	The depth of the zone within which continuous flaming occurs behind the fire edge.

Term	Definition
Flame height	The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope. (NWCG)
Flame length	The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity. (NWCG)
Flame Zone	The highest level of bushfire attack as a consequence of direct exposure to flames from the fire front in addition to heat flux and ember attack. (AS 3959 - 2009)
Flame zone	The area around fuels where the combustion of gases occurs to form flames.
Flaming zone	See: Flame zone.
Flammability	The ease with which a substance is set on fire.
Flammable	Capable of being ignited and of burning with a flame.
Flank attack	Obtaining control of a fire by attacking its side/s (flank).
Flanks of a fire	Those parts of a fire's perimeter that are roughly parallel to the main direction of spread. (NWCG)
Flare up	Any sudden acceleration of fire spread, or intensification of fire, or a part of the fire. A flare up is of relatively short duration and does not radically change existing control plans. (NWCG)
Flash fire	A fast moving fire consuming most of the fine fuels available.
Foam	Foam is a mass of bubbles formed by mixing air with water and a foam concentrate in specific proportions. It is used as a firefighting agent to form a smothering, cooling and/or ignition preventing layer of the surface over a fuel.
Foam blanket	A layer of foam which forms an insulating and reflective barrier to heat and is used for fuel protection, suppression, and mop-up. (NWCG)
Foam Class A	A mixture of foam concentrate & water specifically formulated for extinguishing bushfires. The foam is biodegradable, non toxic and is used at very low concentrates. It may be delivered aspirated or non-aspirated. (See also Foam solution).
Foam Class B	A foam formulated for application on Class B fires
Foam concentrate	The concentrated foaming agent as received from the manufacturer which, when added to water, creates a foam solution.
Foam inductor	Equipment consisting of an inlet connection, ejector pump and a discharge assembly, for the induction of foam concentrate.
Foam solution	The mixture of water and foam concentrate.
Forest	An area, incorporating all living and non-living components, that is dominated by trees having usually a single stem and a mature or potentially mature stand height exceeding 2 metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20 per cent. This definition includes Australia's diverse native forests, woodlands and plantations, regardless of age.
Forest fire	A fire burning mainly in forest and/or woodland.
Forest type	A category for describing a forest commonly based on the predominant tree species, tree form and structure.

Term	Definition
Forward looking infrared (FLIR)	Hand held or aircraft mounted device designed to detect heat differentials and display them. FLIRs have thermal resolution similar to IR line scanners, but their spatial resolution is substantially less; commonly used to detect hot spots and flare ups obscured by smoke, evaluate the effectiveness of firing operations, or detect areas needing mop-up. (NWCG)
Forward rate of spread (FROS)	The speed with which a head fire moves in a horizontal direction across the landscape.
Frontal fire intensity	See: Fireline Intensity
Front end loader	Earthmoving equipment designed to move loose earth and/or loads into vehicles. A multi-purpose bucket is fitted to articulated arms at the front of the vehicle. May be either wheeled or tracked.
Fuel	Any material such as grass, leaf litter and live vegetation which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare. Related Terms: Available fuel, Coarse fuel, Dead fuel, Elevated dead fuel, Fine fuel Ladder fuels, Surface fuels, and Total fine fuel.
Fuel age	The period of time lapsed since the fuel was last burnt.
Fuel arrangement	A general term referring to the spatial distribution and orientation of fuel particles or pieces. (NWCG)
Fuel array	The totality of fuels displayed in a location: fine and coarse, live and dead. (Vic report)
Fuel assessment	The estimation or calculation of total and available fuel present in a given area.
Fuel bed depth	Average height of surface fuels contained in the combustion zone of a spreading fire front. (NWCG)
Fuelbreak	A natural or manmade change in fuel characteristics which affects fire behaviour so that fires burning into them can be more readily controlled.
Fuelbreak system	A series of modified strips or blocks tied together to form continuous strategically located fuel breaks around land units.
Fuel continuity	The degree or extent of continuous or uninterrupted distribution of fuel particles in a fuel bed thus affecting a fire's ability to sustain combustion and spread. This applies to aerial fuels as well as surface fuels.
Fuel depth	The average distance from the bottom of the litter layer to the top of the layer of fuel, usually the surface fuel.
Fuel load	The oven dry weight of fuel per unit area. Commonly expressed as tonnes per hectare. (AFAC). (Also known as fuel loading)
Fuel management	Modification of fuels by prescribed burning, or other means. (AFAC)
Fuel map	A map showing areas of varying fuel quantities and types and usually indicates past fire history.
Fuel model	Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified. (NWCG)
Fuel modification	Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).(NWCG)
Fuel moisture content	The water content of a fuel expressed as a percent of the oven dry weight of the fuel particle. (%ODW)

Term	Definition
Fuel moisture differential	A term used to describe the situation where the difference in the moisture content between fuels on adjacent areas results in noticeably different fire behaviour on each area.
Fuel profile	The vertical cross section of a fuel bed down to mineral earth.
Fuel quantity	See: Fuel load.
Fuel reduction	Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.
Fuel reduction burning	The planned application of fire to reduce hazardous fuel quantities; undertaken in prescribed environmental conditions within defined boundaries.
Fuel separation	The action of separating fuel for the purpose of providing a mineral earth firebreak. Also means the actual gap between fuel layers or particles eg gap between individual hummock grasses or gap between surface and canopy fuels
Fuel type	An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause predictable rate of spread or difficulty of control under specified weather conditions. (AFAC)
Fuel weight	See Fuel load.
General origin area	The larger area where the fire started that is readily identifiable based on macro scale indicators and witness statements. (NWCG)
Going fire	Any bushfire which is expanding and suppression actions have not yet contained the fire.
Grass fire	Any fire in which the predominant fuel is grass or grass like. (NWCG)
Grassland curing	The proportion of dead material in grasslands – usually increases over summer as tillers die off and dry out, increasing the risk of grassland fire.
Grid ignition	A method of lighting prescribed fires where ignition points are set individually at a predetermined spacing through an area.
Ground crew	See: Hand crew.
Ground fire	Fire that consumes the organic material beneath the surface litter ground, such as a peat fire. (NWCG)
Ground fuel	All combustible materials below the surface litter, including duff, roots, peat and saw dust dumps that normally support a glowing or smouldering combustion without flame.
Habitat	The local environment of conditions in which an animal or plant lives.
Hand crew	A fire suppression crew trained and equipped to fight fire with hand tools.
Hand line	A fireline constructed with hand tools. (NWCG) (Wildfire context)
Hand trail	See Hand line.
Hang up	A situation in which a tree is lodged in another and prevents it from falling to the ground.
Hazard	A source of potential harm or a situation with potential to cause loss.
Hazard reduction	See: Fuel Management
Head	See: Head Fire
Head attack	Directly knocking down the head of a fire. Recommended only for low intensity fires where firefighters can be sure that the fire will not flare up unexpectedly.
Head fire	The part of a fire where the rate of spread, flame height and intensity are greatest, usually when burning downwind or upslope.

Term	Definition
Heat exhaustion	A form of shock, due to depletion of body fluids resulting from overexposure to a hot environment.
Heat stress	Illness caused by the body overheating.
Heat stroke	A life-threatening condition that develops when the body's temperature-regulating and cooling mechanisms are overwhelmed and body systems begin to fail.
Heat transfer	The transfer of thermal energy from one physical system to another by conduction, convection or thermal radiation.
Heavy fuels	See: Coarse fuels.
Heel	See: Rear (Preferred term).
Heel fire	See: Backing Fire.
Helibase (HB)	A location for parking, refuelling and maintenance of helicopters operating in support of an incident.
Helicopter	A form of heavier-than-air, rotor-wing aircraft whose lift is produced by engine-driven rotors which behave as if they were both propellers and wings.
Helipad (HP)	A designated location which meets specific requirements for a helicopter to take off and land.
Helitack crew	An initial attack crew specially trained in the tactical and logistical use of helicopters for fire suppression.
Heli-torch	An aerial ignition device hung from or mounted on a helicopter to disperse ignited lumps of gelled gasoline. Used for backburns, burnouts, or prescribed burns. (NWCG)
High fire danger	The second lowest fire danger rating as determined by fire agencies and generally with a Forest fire danger index between 25 and 49 or a Grassland fire danger index between 25 and 49.
High intensity fire	Fires with an average intensity greater than 3000 $kW.m^{-1}$ and flame heights greater than 3 m, causing complete crown scorch or possibly crown fires in forests. Uncontrollable by direct attack. The term is also applied to stationary fires burning in very high fuel loads (such as logging slash).
Hold over fire	See: Sleeper
Hop over	See: Breakaway.
Hose bandage	A means of affecting a temporary repair to a canvas or synthetic hose.
Hose strangler	A crimping device for stopping the flow of water in a hose.
Hot Refueller	A trained person responsible for the operation of the equipment for the 'hot' refuelling of helicopters.
Hot spot	1. A particularly active part of a fire. 2. An area of smouldering fuels requiring to be extinguished during patrol operations.
Humus	Layer of decomposed organic matter on the forest floor beneath the fermentation layer and directly above the soil. It is that part of the duff in which decomposition has rendered vegetation unrecognizable and mixing of soil and organic matter is underway. See Also: Duff & Litter
Hygrometer	An Instrument which measures the humidity in the air.
Ignition	The beginning of flame production or smouldering combustion; the starting of a fire.

Term	Definition
Ignition pattern	The manner in which a prescribed burn, backburn, or burnout is set, determined by weather, fuel, ignition system, topographic and other factors having an influence on fire behaviour and the objective of the burn.
Ignition source	A source of energy sufficient to initiate combustion.
Incendiary	A burning compound or metal used to produce intense heat or flame, like a bomb.
Incendiary device	Device designed and used to start a fire.
Incident	Any unplanned event requiring emergency intervention. (AIIMS)
Incident Action Plan (IAP)	The plan used to describe the incident objectives, strategies, resources and other information relevant to the control of an incident. (AIIMS)
Incident control	See: Incident management
Incident Control Centre (ICC)	The location where the Incident Controller and various members of the Incident Management Team provide overall direction of response activities. (See also Incident Control Point)
Incident Controller	The individual responsible for the management of all incident control activities across a whole incident (AIIMS)
Incident Control Point (ICP)	The location where the Incident Controller and, where established, members of the Incident Management Team provide overall direction of response activities in an emergency situation. (See also Incident Control Centre)
Incident control system (ICS)	A command structure to systematically and logically manage suppression of emergency incidents including bushfires, from small, simple incidents to large, difficult or multiple situations. It is designed to develop in modular fashion from the top (Incident Controller) downwards. Refer NIMS, AIIMS, CIMS
Incident management	The process of controlling the incident and coordinating resources. (EMA)
Incident Management Team (IMT)	The group of incident management personnel comprising the Incident Controller, and the personnel he or she appoints to be responsible for the functions of Operations, Planning and Logistics. (AIIMS)
Incident objective	An incident objective is a goal statement indicating the desired outcome of the incident. Incident objectives guide the development of the Incident Action Plan and must reflect the policies and needs of the control authority and supporting agencies. All factors affecting the incident and its potential impact must be considered before determining the objective. (AIIMS)
Incident strategies	The incident strategies will be developed from the incident objectives and will describe how the Incident Management Team plans to resolve the incident. There is a requirement for strategies to be developed throughout the incident and they should be reviewed for each operational period. (AIIMS)
Indirect attack	A method of suppression in which the control line is located some considerable distance away from the fire's active edge. Generally done in the case of a fast-spreading or high-intensity fire and to utilize natural or constructed firebreaks or fuelbreaks and favourable breaks in the topography. The intervening fuel is usually backburnt; but occasionally the main fire is allowed to burn to the line, depending on conditions.(NWCG)
Induced wind	See: Fire wind.
Infrared scanning	Use of an optical-electronic system for identifying or obtaining imagery of thermal infrared radiation to detect non-smoking fires or fire perimeters through smoke.
Initial attack	The first suppression work on a fire.

Term	Definition
Instability	The tendency for air parcels to accelerate when they are displaced from their original position; especially, the tendency to accelerate upward after being lifted. Instability is a prerequisite for severe weather - the greater the instability, the greater the potential for severe thunderstorms. (Weather Zone)
Interface	See: Urban Rural interface.
Inversion	A layer of the atmosphere in which temperature increases with increasing elevation. A condition of strong atmospheric stability.
Island	An unburnt area within a fire perimeter.
Isobar	Lines on weather maps joining places which have the same air pressure.(BOM)
I zone	See: Urban Rural interface.
Jump fire	See: Spot fire
Jump over	See: Breakaway
Junction zone	An area of greatly increased fire intensity caused by two fire fronts (or flanks) burning towards one another.
Keetch-Byram Drought Index (KBDI)	A numerical value reflecting the dryness of soils, deep forest litter, logs and living vegetation, and expressed as a scale from 0 - 200 where the number represents the amounts of rainfall (mm) to return the soil to saturation.
Knock down	To reduce the flame or heat on the more vigorously burning parts of a fire edge. (NWCG)
Ladder fuels	Fuels that provide vertical continuity between strata. Fire is able to carry surface fuels into the crowns of trees with relative ease.
Lag time	The time delay in fuel moisture content responding to changing environmental conditions (for example, relative humidity). Technically, it is the time necessary for a fuel particle to lose approximately 63% of the difference between its initial moisture content and its equilibrium moisture content.
Lead agency	The organisation with the legislative or agreed authority for control of an incident.
Lee (leeward)	Away from the wind, on the sheltered side of something that the wind is blowing on.
Legislation	A set of rules made by a State, Territory or Federal Government; includes acts and regulation.
Light fuel	An assessment of fuel quantity indicating a low weight.
Lighting pattern	See: Ignition pattern.
Lightning	The flash of light accompanying a sudden electrical discharge which takes place from or inside a cloud, or less often from high structures or the ground or from mountains. A large electrical spark. Caused when the negative charge in the lower part of the cloud and the positive charge in the upper part of the cloud become so great that they can overcome the natural resistance of the air and discharge between negative and positive takes place. (BOM)
Lightning fire	A fire caused by lightning.
Lightning formation	See: Lightning.
Light patrol unit	See: Tanker.
Line ignition	See: Strip burning.

Term	Definition
Litter	The top layer of the forest floor composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves and needles, little altered in structure by decomposition. (The litter layer of the forest floor). (NWCG)
Litter bed fuel	Dead fine fuel, including surface fuel and fuel lower in the fuel profile.
Litter fall	The addition of litter that falls from vegetation to the forest floor.
Living fuels	Fuels made up of living vegetation.
Living shrub fuel	Living understorey fine fuel less than 2 metres above ground level.
Local winds	Winds which are generated over a comparatively small area by local terrain and weather. They differ from those which would be appropriate to the general pressure pattern. (NWCG)
Log	Documentation of information and actions arising during an incident
Logistics	The provision of facilities, services and materials in support of an incident.
Lookout	1. A person designated to detect and report fires from a fixed vantage point. 2. A member of a fire crew designated to observe the fire and warn the crew when there is danger. 3. For structure see: Fire lookout
Lookout tower	See: Fire tower.
Low intensity fire	A fire which travels slowly and only burns lower storey vegetation, like grass and lower tree branches, with an average intensity of less than 500 $kW.m^{-1}$ and flame height less than 1.5m. Usually causes little or no crown scorch and is easily controlled.
Low-moderate fire danger	The lowest fire danger rating as determined by fire agencies and generally with a Forest fire danger index less than 12 or a Grassland fire danger index less than 12.
Medium fuels	See Course fuels.
Mineral earth	When used in the context of fire control refers to a non-flammable surface (either natural or prepared) which provides a break in understorey, litter and humus fuels and hence a barrier (of varied effectiveness depending, amongst other things, on its width and the intensity of the approaching fire) to fire travelling on or near the ground surface.
Mobilisation	The processes and procedures for organisations to activate, assemble, and transport the requested resources to an incident.
Moisture content	See Fuel moisture content.
Mopping up	See Blacking out
Mosaic	Used in reference to the spatial arrangement of burnt and unburnt fuels at either a local or a landscape scale.
Move up method	See: Step-up method
Multi-agency response	The response to an incident where one or more agencies assist the jurisdictional control agency or agencies.
Multiple fire situation	A circumstance of high fire incidence over short periods of time in any administrative unit, usually overtaxing the normal initial attack capability of the unit.
Natural barrier	Any area where lack of flammable material obstructs the spread of vegetation fires.

Term	Definition
Near surface fuel	Live and dead fuel, including suspended leaves, bark or twigs, effectively in touch with the ground but not lying on it, with a mixture of vertical and horizontal orientation.
Needle bed	A fuel bed consisting mainly of pine needles.
Nozzle	A fitting that is used with a branch to control the size, pattern and/or velocity of water or extinguishing medium being discharged.
One lick method	A progressive system of building a fireline on a wildfire without changing relative positions in the line. Each worker does one to several "licks", or strokes removing a set proportion of the fuel on the line, with a given tool and then moves forward a specified distance to make room for the worker behind. (NWCG)
Operations	The direction, supervision and implementation of tactics in accordance with the Incident Action Plan.
Operations point	The location from which the overall field operations are commanded by the Operations Officer. (AIIMS)
Parallel attack	Method of fire suppression in which fireline is constructed approximately parallel to, and just far enough from the fire edge to enable workers and equipment to work effectively, though the fireline may be shortened by cutting across unburned bays. The intervening strip of unburned fuel is normally burned out as the control line proceeds but may be allowed to burn out unassisted where this occurs without undue delay or threat to the fireline. (NWCG)
Parallel fire suppression	See: Parallel attack.
Parallel method	See: Parallel attack.
Parts of a Fire	See: Bay(s), Fingers, Flanks of a fire, Head.
Patch burning	Burning in patches to prepare sites for group planting or sowing or to form a barrier to subsequent fires. (NWCG)
Patrol	1. To travel over a given route to prevent, detect, and suppress fires. Includes interaction with the public for wildland fire prevention and educational purposes. 2. To go back and forth vigilantly over a length of control line during and/or after construction to prevent breakaways, suppress spot fires, and extinguish overlooked hot spots. 3. A person or group of persons who carry out patrol actions. (NWCG)
Peat	An amorphous organic material formed by anaerobic decomposition which usually means that the area is seasonally or permanently inundated with water. Peat fires burn by smouldering combustion and generate very high amounts of energy per unit area.
Perimeter	See: Fire perimeter.
Peri urban interface	See: Urban rural interface.
Permit burn	A burn carried out under permit from a Fire Authority.
Personal protection equipment (PPE)	The equipment and clothing designed to mitigate the risk of injury from the chemical, physical and thermal hazards that may be encountered at an incident.
Personal protective clothing (PPC)	The clothing designed to mitigate the risk of injury from the chemical, physical and thermal hazards that may be encountered at an incident.
Plan of attack	See: Incident Action Plan (Preferred term)
Planned burning	See: Prescribed burning.
Pocket	See: Island.

Term	Definition
Point of attack	The part of the fire on which work is started when suppression forces arrive.
Point of origin	The specific location where the fire started.
Portable dam	A temporary water storage used in conjunction with power pumps and hose lines.
Predicted rate of spread	The rate of spread predicted by the application of fire spread models utilising appropriate inputs of fuel conditions, topography and weather. Also see Rate of Spread.
Pre-incident plan	Advanced planning and preparation for an emergency situation.
Pre-suppression plan	See Pre-Incident Plan
Prepared community	A community that has developed effective emergency management arrangements at the local level, resulting in: • An alert, informed and active community that supports its voluntary organizations • An active and involved local government • Agreed and coordinated arrangements from prevention, preparedness, response and recovery.
Preparedness	All activities undertaken in advance of the occurrence of an incident to decrease the impact, extent and severity of the incident and to ensure more effective response activities.
Pre-planned dispatch	The pre-planned dispatch of designated suppression forces to fires in predetermined zones. It is usually dependent on the location of the fire, and the forecast fire danger.
Prescribed burn	A fire utilised for Prescribed burning.
Prescribed burn plan	See: Burn plan.
Prescribed burning	The controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives.
Prescribed fire	Any fire ignited by management actions to meet specific objectives. A written, approved burn plan must exist, and approving agency requirements (where applicable) must be met, prior to ignition.
Prescription	A written statement defining the objectives to be attained during prescribed burning.
Prevention	All activities concerned with minimising the occurrence of incidents, particularly those of human origin.
Profile litter moisture content	The moisture content, expressed as a percentage of oven-dry weight, of the entire leaf litter bed above the mineral soil surface.
Profile moisture content	See Fuel moisture content.
Psychrometer	The general name for instruments designed for determining the relative humidity of the air. A psychrometer consists of wet and dry bulb thermometers, generally with the aid of psychrometric tables or a psychrometric slide rule. (BOM)
Pulaski tool	A combination chopping and trenching tool widely used in fireline construction, which combines a single-bitted axe blade with a narrow adze-like trenching blade fitted to a straight handle. (NWCG)
Pumper	A firefighting vehicle equipped with a large capacity pump, water tank and hose. Generally intended to be operated when stationary, from reticulated or static water supplies.

Term	Definition
Quick-fill pump	A high volume water pump used for filling tankers.
Rain gauge	The general name for instruments designed to measure the amount of rain that has fallen.
Rakehoe (McLeod tool)	A hand tool used for bushfire fighting, consisting of a combination of a heavy rake and hoe.
Rate of spread (ROS)	The speed with which a fire moves in a horizontal direction across the landscape at a specified part of the fire perimeter. See also Forward rate of spread.
Reaction time	The time taken between the report of a fire or incident, and the departure of the crew. See also Response time.
Rear	1. That portion of a fire spreading directly into the wind or down slope. 2. That portion of a fire edge opposite the head. 3. Slowest spreading portion of a fire edge. Also called heel of a fire. (NWCG)
Reburn	Repeat burning of an area over which a fire has previously passed, but left fuel that later ignites when burning conditions are more favourable. (NWCG)
Reconnaissance	To examine a fire area to obtain information about current and probable fire behaviour and other related fire suppression information. (NWCG)
Recovery	The coordinated process of supporting emergency affected communities in reconstruction of the physical infrastructure and restoration of emotional, social, economic and physical wellbeing.
Red Flag Warning	A process for passing critical safety information to incident suppression resources and support resources on which they can base decisions regarding strategy, tactics and deployment.
Regeneration burn	A burn lit under prescribed conditions for the purpose of achieving regeneration of a particular vegetation type.
Re-ignition	The action of a material that ignites again after it has been extinguished.
Relative humidity (RH)	The amount of water vapour in a given volume of air, expressed as a percentage of the maximum amount of water vapour the air can hold at that temperature.
Relay pumping	Using a series of pumps positioned at intervals along a line or lines of hose to share the workload of pumping water over a long distance.
Relief	The replacement of personnel whose period of time at the incident has concluded.
Report of fire	The notification of the detection of a fire to the fire service. (AFAC)
Residence time	The time required for the flaming zone of a fire to pass a stationary point; the width of the flaming zone divided by the rate of spread of the fire.
Resources	All personnel and equipment available, or potentially available, for incident tasks.
Response	Actions taken in anticipation of, during, and immediately after an incident to ensure that its effects are minimised, and that people affected are given immediate relief and support.
Response time	The time taken between the report of a fire or incident, and arrival at the scene. It includes both reaction time and travel time.
Responsible authority	See: Control authority.
Retardant	See: Fire retardant.

Term	Definition
Risk	The exposure to the possibility of such things as economic or financial loss or gain, physical damage, injury or delay, as a consequence of pursuing a particular course of action. The concept of risk has two elements, i.e. the likelihood of something happening and the consequences if it happens. (AS4360)
Risk analysis	A systematic use of available information to determine how often specific events may occur and the magnitude of their likely consequences.
Road Management Point	A strategic position from which traffic can be observed and controlled. (See also Traffic Management Point and Vehicle Control Point)
Rural	Any area wherein residences and other developments are scattered and intermingled with forest, range, or farm land and native vegetation or cultivated crops.
Rural urban interface (RUI)	See Urban rural interface
Safe	The stage of bushfire suppression or prescribed burning when it is considered that no further suppression action or patrols are necessary.
Safety zone	An area cleared of flammable materials used for escape if the line is outflanked or in case a spot fire outside the control line renders the line unsafe. In fire operations, crews progress so as to maintain a safety zone close at hand, allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks. They are greatly enlarged areas which can be used with relative safety by fire fighters and their equipment in the event of a blow up in the vicinity. (Vic report)
Scorch height	1. The height above ground level up to which foliage has been browned by a fire. 2. A measurement for determining the acceptable height of flame during prescribed burning.
Scout	A person who checks and reports on conditions in the fire area.
Scrub	Refers to vegetation such as heath, wiregrass and shrubs, which grows either as an understorey or by itself in the absence of a tree canopy.
Scrub fire	Fires burning in scrub.
Secondary fire control line	See: Fall back fire control line.
Sector	A specific area of an incident which is under the control of a Sector Commander who is supervising a number of crews.
Seen area	The ground, or vegetation, that is directly visible from an established or proposed lookout point, or aerial detection flight route.
Severe fire danger	The third highest fire danger rating as determined by fire agencies and generally with a Forest fire danger index between 50 and 74 or a Grassland fire danger index between 50 and 74.
Shift	The period resources are allocated during an operation at the incident or on the fireground.
Shift change	Replacement of allocated crews and or equipment during operations.
Situation report **(Sitrep)**	A report on the progress of the fire and the efforts to control it. It confirms the location of the fire, its status and potential and the number, nature and effectiveness of resources deployed. Situation reports are normally provided at regular times until the fire is declared safe.
Size up	The evaluation of a fire to determine a course of action for suppression.
Slash	Accumulated fuel resulting from such natural events as wind, fire, snow breakage, or from such human activities as logging, cutting or road construction.