



# **Planning and Strategy Committee of the Whole**

**11 October 2017**

**UNDER SEPARATE COVER  
ATTACHMENTS**

**ITEM 4.3**





Item 4.3	Mount Jerrabomberra Bushfire Management Plan	
	<i>Attachment 1</i>	<i>Mt Jerrabomberra Bushfire Management Plan 2017-2022 - Final Report Including all Maps and Photo's.....2</i>



# QUEANBEYAN-PALERANG REGIONAL COUNCIL

## Planning and Strategy Committee of the Whole Meeting Attachment

11 OCTOBER 2017

ITEM 4.3                    MOUNT JERRABOMBERRA BUSHFIRE MANAGEMENT PLAN

ATTACHMENT 1        MT JERRABOMBERRA BUSHFIRE MANAGEMENT PLAN 2017-  
2022 - FINAL REPORT INCLUDING ALL MAPS AND  
PHOTO'S

Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

Cover Photographs: G. Fleming.

## Document History

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Grant Fleming Environmental

ABN: 39 968 156 216

5 Rowland Road. MAGILL SA 5072

Phone 0448 600 767



# MOUNT JERRABOMBERRA BUSHLAND RESERVE BUSHFIRE MANAGEMENT PLAN 2017 - 2022



**QUEANBEYAN-  
PALERANG REGIONAL  
COUNCIL**

**FINAL REPORT**

**12 SEPTEMBER 2017**





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## EXECUTIVE SUMMARY

Grant Fleming Environmental (GFE) has been commissioned by Queanbeyan-Palerang Regional Council (QPRC) to update the 2007 Bushfire Management Plan (BMP) for Mount Jerrabomberra Bushland Reserve (Mt Jerrabomberra) at Jerrabomberra, NSW. The BMP for Mt Jerrabomberra endeavours to provide effective management measures to protect life, preserve environmental assets, minimise the likelihood of a significant portion of the Reserve burning in a single event and enhance biodiversity within Mt Jerrabomberra.

This plan has been developed in association with staff of QPRC and in consultation with stakeholders including the NSW Rural Fire Service (NSW RFS) and Fire and Rescue New South Wales (FRS). It is recommended that QPRC undertake public consultation to facilitate community involvement and to foster community ownership of the Mt Jerrabomberra BMP. Bushfire prevention and preparedness is a shared responsibility and engagement of a range of community stakeholders in bushfire management remains a key element for successful bushfire risk management within and surrounding Mt Jerrabomberra.

This BMP has been developed by a process of objective assessment of the bushfire threat to and posed by Mt Jerrabomberra. This assessment has included consideration of the ecological fire management guidelines for the vegetation associations that comprise Mt Jerrabomberra. Treatments or recommendations have been proposed to mitigate the bushfire threat. This plan is to be reviewed in five years, unless a fire event occurs within Mt Jerrabomberra prior to this time elapsing.

The methodology used in the preparation of this plan follows that of the NSW Rural Fire Service.

The BMP comprises three main stages:

- Recognising and assessing the bushfire risk – including mapping assets, undertaking fuel load assessments, fire track audits, stakeholder consultation and risk assessment;
- Treating the bushfire risk (recommendations) – assessing risk treatments, proposing risk treatment measures for each asset as applicable, prioritising risk treatments; and
- Monitoring, review and reporting. – including recommending that this plan be reviewed in 2022, QPRC monitor treatment works, undertake to map and retain the fire history of Mt Jerrabomberra and QPRC report updates regularly to the community.

Eight Management Zones, comprising four human settlement asset protection zones, three economic asset protection zones and one conservation land management zone were defined within and adjacent to Mt Jerrabomberra. An assessment of risk and consequence was undertaken for each and prioritised treatment measures presented for each of these zones. It is recognised that these zones are interdependent and risk treatment measures conducted in one zone can reduce the risk within other zones.



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### Key Recommendations

The following represents a prioritised summation of key recommendations made by this Mt Jerrabomberra BMP.

1. Create CAT 1 fire trails as recommended (APZ1 Fire Trail, APZ2 Fire Trail, APZ3 Fire Trail, APZ4 Fire Trails and Jerrabomberra Hill Road Fire Trail) to provide firefighting agencies with safe access to the interface of properties and Mt Jerrabomberra to facilitate firefighting. **Very High to Moderate Priority.**
2. Create asset protection zones as recommended (APZ1, APZ2, APZ3, APZ4) to increase the separation distance between houses and vegetation posing a hazard within Mt Jerrabomberra. **Very High Priority to Moderate Priority.**
  - a. An Inner Asset Protection Zone (IAPZ) of 10 m –co-located with the proposed fire trails where practicable.
  - b. An Outer Asset Protection Zone (OAPZ) of 10 m
3. Create asset protection zones as recommended (APZ5, APZ6, APZ7) to increase the separation distance between the economic assets (Lower and Upper Thornton Reservoirs and Telecommunication tower). **Very High Priority**
  - a. An Inner Asset Protection Zone (IAPZ) of 10 m
  - b. An Outer Asset Protection Zone (OAPZ) of 10 m
4. Submit this Mt Jerrabomberra BMP to the NSW RFS and FR NSW for endorsement. **Very High Priority.**
5. QPRC to work with NSW RFS & FRNSW to provide bushfire education information to residents within APZ1, APZ2, APZ3 and APZ4 to achieve an increase in the effective separation distance by removing fuel from the property between the house and the boundary with Mt Jerrabomberra. **Very High Priority.**
6. Create Conservation Land Management Zone CLMZ1 Dry Forest. **High Priority.**
7. Conduct a vegetation survey to map the vegetation communities (plant class types) within the Dry Forest Association throughout Mt Jerrabomberra. **High Priority**
8. Conduct a survey to locate populations of *Delma impar* (Striped Legless Lizard), listed as Vulnerable under the NSW TSC Act 1995 and under the EPBC Act. **High Priority**
9. Harvest and remove the remnant pine plantation (removal of timber from the Reserve). **High Priority.**
10. Conduct a prescribed burn in accordance with NSW RFS 2006, for ecological purposes in spring or autumn 2019 within the northern section of remnant pine plantation following removal of pines as recommended to initiate restoration of the former Dry Forest formation. **High Priority.**
11. Conduct a prescribed burn in accordance with NSW RFS 2006, for ecological purposes in spring or autumn 2021 within the southern section of remnant pine plantation following removal of pines as recommended to initiate restoration of the former Dry Forest formation. **High Priority.**





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

12. QPRC map the location of threatened flora and fauna within Mt Jerrabomberra to inform fire exclusion zones. **Moderate Priority.**
13. Conduct a prescribed burn in accordance with NSW RFS 2006, for ecological purposes in autumn 2018 within the Dry Forest formation as recommended. **High Priority.**
14. Conduct post prescribed fire spring vegetation assessments at six months, 18 months and 4.5 years following a prescribed fire. **High Priority**
15. Create a managed vegetation corridor (easement) under the power lines that supply the telecommunication tower in accordance with ISSC (2016) and ISSC (2012). **High Priority**



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## GLOSSARY OF TERMS AND ABBREVIATIONS

GLOSSARY OF TERMS AND ABBREVIATIONS	
ABC	Australian Broadcasting Corporation
ACT	Australian Capital Territory
ACT FRS	Australian Capital Territory Fire and Rescue Service
ACT RFS	Australian Capital Territory Rural Fire Service
AFAC	Australasian Fire and Emergency Service Authorities Council
APZ	Asset Protection Zone
Assets	In the context of this report, anything valued within Mt Jerrabomberra by stakeholders which may include fire-fighting infrastructure, threatened species, areas of cultural significance and the components of the environment that may be at risk from bush fire. The residences that adjoin Mt Jerrabomberra and associated infrastructure are also considered assets to be protected under this BMP.
BAL	Bushfire Attack Level. AS 3959 (2009) describes six levels of risk of bushfire attack including BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ and are based upon the potential exposure to heat flux thresholds, expressed as kW/m <sup>2</sup> .
Bushfire	A general term used to describe fire in vegetation, including grass fire and forest fire.
Bushfire Hazard	The potential severity of a bushfire, which is evaluated by fuel load, fuel arrangement and topography under a given climatic condition.
Bushfire Management	A systematic process that identifies and assesses assets and provides a range of treatments that contributes to the wellbeing of communities and the environment, which suffer the adverse effects of wildfire/bushfire.
BMP	Bushfire Management Plan
BOM	Bureau of Meteorology
BPA	Bushfire Prone Area
Bushfire Risk	The chance of a bushfire igniting, spreading and causing damage to the environment, community or the assets.
BRA	Bushfire Risk Assessment – the process of evaluating bushfire risk.
Bushfire Threat	Potential bushfire exposure of an asset due to the proximity and type of a hazard, and the slope on which the asset is situated.
CAFS	Compressed Air Foam System
CFU	Community Fire Unit, NSW Rural Fire Service
Clearance	The physical removal of vegetation. This may involve the removal of all vegetation from an area, for example on a fire track, through to trimming branches or the selective removal of species or a stratum of vegetation. With the exception of a fire track, generally clearance does not mean the removal of all vegetation.
Consequence	Outcome or impact of a bushfire event.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	DEM Digital Elevation Model
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EZ	Ember zone - Leased land that contains structures and assets that may be subject



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GLOSSARY OF TERMS AND ABBREVIATIONS	
	to impact by bushfires, principally through ember attack and potentially as a result of radiant heat and direct flame contact from bushfires (ESA 2014 <sup>1</sup> ).
FDI	Fire danger index
FDR	Fire danger rating
FFDI	Forest fire danger index
Fire Fighting Agencies	In NSW the two fire-fighting services are the NSW Fire and Rescue Service and NSW Rural Fire Service. ACT Emergency Services Agency is the overarching fire-fighting authority that administers the ACT Fire and Rescue Service and ACT Rural Fire Service that includes the TTCCS Brigade
FRNSW	Fire and Rescue Service of New South Wales
GFE	Grant Fleming Environmental
GIS	Geographic information system
IAPZ	Inner asset protection zone - land adjacent to assets with a low fuel hazard, reducing the level of ember attack, direct flame contact and radiant heat impact and providing a defensible space with increased safety under some conditions (ESA 2014 <sup>1</sup> ).
IBRA	Interim Biogeographic Region of Australia
ISSC	Electrical Industry Safety Steering Committee Guidelines
Lake George Zone BFMC	Lake George Zone Bushfire Management Committee
Lake George Zone BFRMP	Lake George Zone Bushfire Risk Management Plan
Likelihood	The chance of a bush fire igniting and spreading.
Major Bushfire	A bushfire which requires the attendance of multiple brigades, or causes damage to property or injury to one or more persons.
MNES	Matters of national environmental significance
Murrumbidgee CMA	Murrumbidgee Catchment Management Authority
NPWS	National Parks and Wildlife Service of New South Wales
NCC	National Construction Code
NSW RFS	New South Wales Rural Fire Service
NLALC	Ngunnawal Local Aboriginal Land Council
OAPZ	Outer asset protection zone - land adjacent to an inner asset protection zones, where fuel hazard is reduced to a lesser extent than within the IAPZ.
OEH	Office of Environment and Heritage, NSW
PBP	NSW RFS 2006 <sup>1</sup> . <i>Planning for Bushfire Protection: A guide for Councils, planners, fire authorities and developers.</i>
PVP	Property Vegetation Plan under the <i>Native Vegetation Act 2003</i>
QCC	Queanbeyan City Council
QPRC	Queanbeyan-Palerang Regional Council
Recovery Costs	The capacity of an asset to recover from the adverse impacts of a bushfire. This includes costs associated with the economy, time and resources.
RFMP	Regional Fire Management Program
RFS	Rural Fire Service of New South Wales



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

<b>GLOSSARY OF TERMS AND ABBREVIATIONS</b>	
Risk Acceptance	An informed decision to accept the consequences and the likelihood of a particular risk.
Risk Analysis	A systematic process to understand the nature of and to deduce the level of risk.
Risk Assessment	The overall process of risk identification, risk analysis and risk evaluation.
Risk Identification	The process of determining what, where, when, why, and how something could happen.
Risk Treatment	The process of selection and implementation of measures to modify risk.
TPC	Threshold of potential concern represents a limit of tolerance that a vegetation type has to a particular fire regime.
TSC Act	<i>NSW Threatened Species Conservation Act 1995</i>
TTCCS	Transport Canberra and City Services
Vulnerability	The susceptibility of an asset to the impacts of bushfire.
WoNS	Weed of national significance
YSLB	Years since last burn





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

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## APPENDICES

Appendix A: Mt Jerrabomberra Action Plan 2017 – 2022.

Appendix B: Mt Jerrabomberra – Fuel Hazard Assessment Field Data Sheets



GFE

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 1 INTRODUCTION

This Mount Jerrabomberra Bushland Reserve (Mt Jerrabomberra) Bushfire Management Plan (BMP) has been developed following review of the existing Mt Jerrabomberra BMP (Hansen 2007) by Grant Fleming Environmental (GFE) for Queanbeyan-Palerang Regional Council (QPRC).

Mt Jerrabomberra comprises the land that is listed in Table 1 within the suburbs of Jerrabomberra and Karabar, New South Wales. Mt Jerrabomberra collectively occupies approximately 142 hectares and is continuous with the extensive remnant bushland that occupies Lots 118 and 119 of Deposited Plan 823513 to the south east owned by the Ngunnawal Local Aboriginal Land Council (NLALC). The Edwin Land Parkway bisects the NLALC property forming a firebreak between the remnant bushland to the north that includes Mt Jerrabomberra and the remnant bushland to the south that includes Stringybark Reserve. The location of Mt Jerrabomberra is provided in Figure 1.

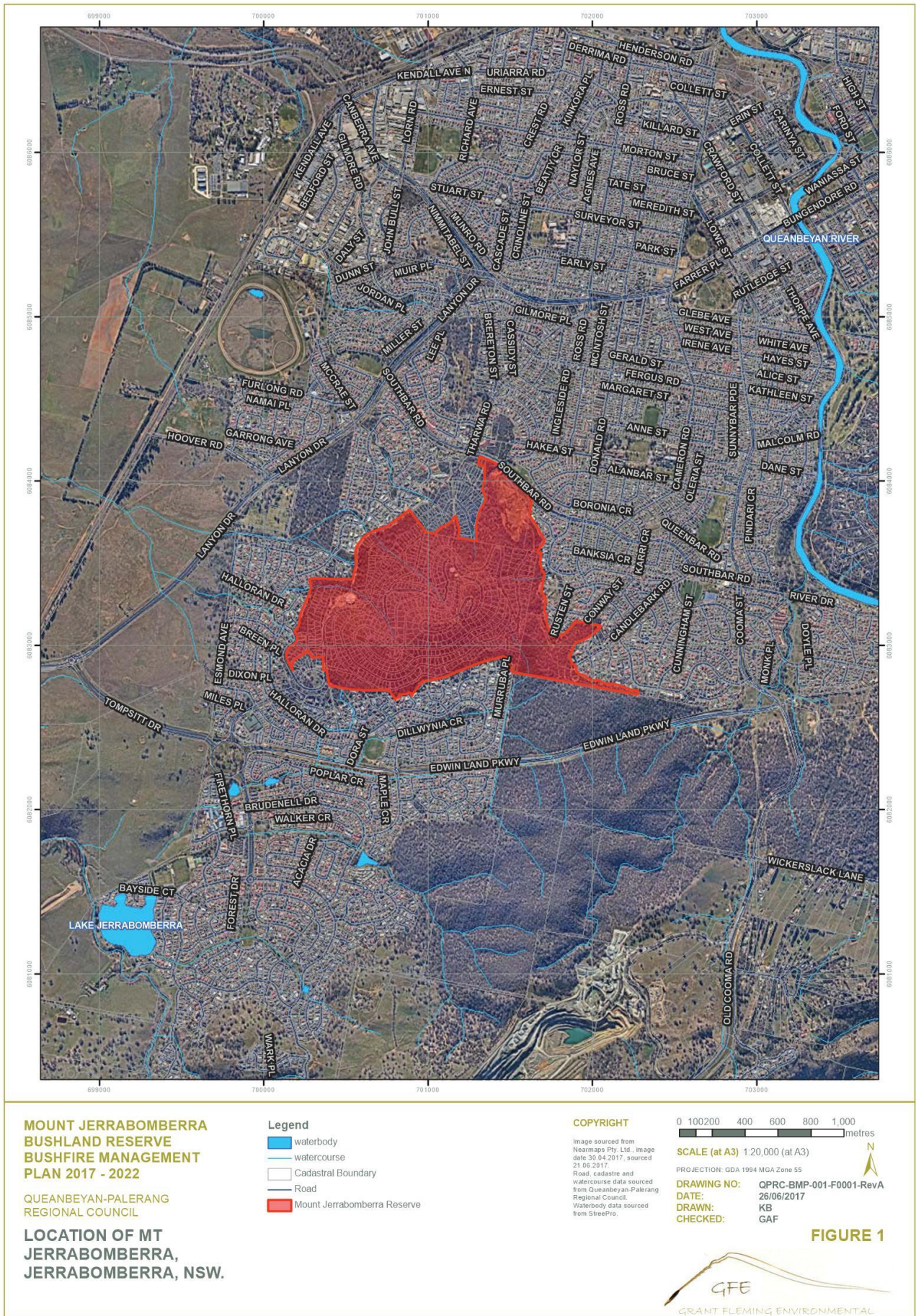
**Table 1: Land occupied by Mount Jerrabomberra Bushland Reserve (Greater Queanbeyan Council 2004).**

DEPOSITED PLAN NO.	LOTS
17204	104-119, 142-156, 177-190, 1354-1369, 1371-1374, 1472-1495, 1518-1543.
17205	1134-1146, 1165-1170, 1181-1202, 1210-1243, 1254-1267, 1269-1270, 1453-1471, 1496-1517, 1544-1562, 1602-1657, 1674-1688, 1690-1697, 1739-1751, 1758.
17206	1086-1133, 1147-1164, 1171-1180, 1427-1452, 1563-1601, 1658-1662, 1664-1673, 1678-1738, 1752-1753, 1755, 1757
595527	4
832788	177
811146	186
864750	357
740251	2
791259	1
8708	536
786344	77
588027	316
590742	235
606818	21
261045	255
617901	11
786344	76
816316	166, 167
746027	2

To the north, Mt Jerrabomberra extends to Southbar Road where it adjoins The Scar Recreation Reserve that includes areas established as a BMX track, off-leash dog park, shared mountain bike and walking tracks and is a rehabilitation area.









Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

The northeastern portion of Mt Jerrabomberra is loosely delineated by Woodridge Place, Kinsella Street and Rusten Street with residential properties located between these roads and Mt Jerrabomberra. The majority of the boundary of Mt Jerrabomberra is characterised by an interface with residential properties.

Along the southeastern boundary, a finger-like section of Mt Jerrabomberra extends into the adjoining Karabar residential area and is loosely bordered by Conway Street to the north, Beard Street to the east and Temora Place to the south, although residential properties occur between these roads and Mt Jerrabomberra. The eastern most point of Mt Jerrabomberra occurs at its junction with Candlebark Road.

The southeastern boundary of Mt Jerrabomberra is formed by Lot 118 of Deposited Plan 823513 owned by the NLALC. A formed track extends from Murruba Place through to Minda Place while the remainder of the southern boundary is loosely defined by residential properties located between Mt Jerrabomberra and Halloran Drive and then Carolyn Jackson Drive to the west.

The *Mount Jerrabomberra Plan of Management* (Planning for People et al. 2004) describes three vegetation types including: Dry Forest dominated by Red Stringybark (*Eucalyptus macrorhyncha*), Scribbly Gum (*Eucalyptus rossii*), Bundy (*Eucalyptus goniacalyx*) and the Red Anther Wallaby Grass (*Rytidosperma pallidum*) with Red Stringybark and Red Box (*Eucalyptus polyanthemus*) open forest woodland. There is Southern Tablelands Dry Shrub – Grass Forest with Broad-leaved Peppermint (*Eucalyptus dives*), Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark and Southern Tablelands Dry Shrub – Grass – Herb Forest with Broad-leaved Peppermint and Red Anther Wallaby Grass.

Mount Jerrabomberra is located within the NSW Rural Fire Service (NSW RFS) Region South, Lake George Bushfire Zone and Queanbeyan City RFS District (NSW RFS 2012). QPRC is located within the South East Local Land Service Region (LLSR) (NSW Government 2017).

Existing bushfire control strategies and actions are presented within the Mount Jerrabomberra Bush Fire Management Plan (Hansen 2007) and bushfire hazard reduction works have been conducted by QPRC in accordance with Bushfire Hazard Reduction Certificates issued under section 100G of the New South Wales *Rural Fires Act* 1997. This project is a comprehensive review of the existing BMP by Hansen (2007) including a bushfire risk assessment (BRA) and review of assets including communities, buildings, infrastructure, and culturally and environmentally significant locations within the area. This process allows an updated asset register to be established. The threat posed to these assets by bushfire can then be calculated and risk mitigation measures developed. This Mt Jerrabomberra BMP adopts the format of the *Stringybark Reserve Bushfire Management Plan 2015 – 2020* (GFE 2015) and in doing so provides a consistent approach to bushfire management between these environmentally significant areas within QPRC.

Mt Jerrabomberra is located in close proximity to the ACT and as a consequence some of the most relevant data used in this report is derived from the ACT. The response to a major bushfire is also likely to involve ACT firefighting services.

## 1.1 Objectives

The project objectives include the review and subsequent development of a BMP for Mt Jerrabomberra that meets QPRC's legal requirements under Section 63 of the *Rural Fires Act* 1997 to prevent the occurrence and spread of bushfires on their land.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

The objectives can be summarised as:

- Review the existing Mt Jerrabomberra BMP and develop a new Mt Jerrabomberra BMP for the period 2017 – 2021 including recommendations for monitoring and review.
- Conduct a Bushfire Risk Assessment (BRA) to identify assets within and surrounding Mt Jerrabomberra and establish the threat posed to these assets by bushfire.
- Consult with key stakeholders to inform the development of the new Mt Jerrabomberra BMP.
- Develop prioritised Bushfire Mitigation Strategies to protect assets, reduce the risk of bushfire occurring and spreading, and to protect life and property while maintaining the ecological integrity of Mt Jerrabomberra.
- Meet QPRC's legal requirements and responsibilities as a landowner, as they relate to bushfire management.

## 1.2 Legislative Context

Some of the key state and federal legislation that must be considered in the development of this Mt Jerrabomberra BMP includes the following:

- *New South Wales Threatened Species Conservation Act (TSC Act) 1995* [to be replaced by the Biodiversity Conservation Act 2016]
- *New South Wales Native Vegetation Act 2003* [to be replaced by the Biodiversity Conservation Act 2016]
- *New South Wales Noxious Weeds Act 1993* [to be replaced by the Biosecurity Act 2015]
- *New South Wales National Parks and Wildlife Act 1974*

### 1.2.1 Rural Fires Act 1997

Under Section 63 of the *Rural Fires Act 1997*, owners and land managers have a duty to prevent the occurrence and spread of bushfires on their land. This duty applies to QPRC as the owner of land forming Mt Jerrabomberra.

A Bush Fire Management Committee is required to be formed in each area of the state that is subject to bushfire risk. The Lake George Zone Bush Fire Management Committee (Lake George Zone BFMC) was constituted by the Bush Fire Coordinating Committee (BFCC) in accordance with the *Rural Fires Act 1997* and has developed a Bush Fire Risk Management Plan (BFRMP) (Lake George Zone BFMC 2010). The identification of fire prone land by the Lake George Zone BFRMP within the QPRC also triggers actions under the *New South Wales Environmental Planning and Assessment Act 1979* (EP&A Act) as discussed in the following section.

### 1.2.2 Environmental Planning and Assessment Act 1979

The EP&A Act is the primary legislation for establishment of controls on land use planning, establishing the framework for environmental planning and assessment in NSW.

As Mt Jerrabomberra and the adjoining residential development is categorised as bush fire prone land, in accordance with Section 79BA of the EP&A Act, development must conform to the specifications and requirements of Planning for Bushfire Protection guideline (PBP) (NSW Rural Fire Service 2006). The aims and objectives of the PBP apply to all developments regardless of the class of building being built.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

### 1.2.3 Environment Protection Biodiversity and Conservation Act 1999

Commonwealth legislation including the *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act) is applicable to the management of Mt Jerrabomberra due to the presence of Box-Gum Woodland on the lower slopes that is listed as an endangered ecological community under both the *NSW Threatened Species Conservation Act 1995* (TSC Act) and the (EPBC Act). *Leucochrysum albicans* subsp. *albicans* var. *tricolor* (Hoary Sunray) listed as endangered under the EPBC Act has been reported to occur in large populations within Mt Jerrabomberra (Ecological Australia 2010).

The presence of an EPBC Act listed community and plant species must be considered where bushfire or bushfire management measures may impact upon these matters of national environmental significance (MNES).

### 1.3 Mt Jerrabomberra Built Assets

Mt Jerrabomberra is dedicated to the conservation of the natural environment while facilitating passive recreational activities. Due to its height and geographic location, there is a small amount of built infrastructure with associated access roads within Mt Jerrabomberra. Numerous walking tracks are present although QPRC has attempted to restrict the proliferation of informal tracks throughout Mt Jerrabomberra. These tracks are utilised by motorbikes, mountain bikes and pedestrians. There are no formal fire breaks established within Mt Jerrabomberra, however there are a number of tracks around sections of the perimeter and Jerrabomberra Hill Road extends from Halloran Drive across the three peaks to Benalla Court and Southbar Road to the north and Kinsella Street to the east.

#### 1.3.1 Water reservoir tanks

A water reservoir tank has been built into the hill slope approximately 210 metres east from the end of Tully Place and 1.13 kilometres along Jerrabomberra Hill Road from Halloran Drive, Figure 2.



Figure 2. Location of water reservoir tanks on Mt Jerrabomberra.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

These tanks are fenced and there are no water standpipes or hydrants installed to facilitate re-filling by fire fighting vehicles and the gate has no signage present to indicate access to water is available. While there is a substantial laydown area within the compound, no formal asset protection zone (APZ) is established. Two additional reservoir water tanks are located on the crest of the northern-most ridge approximately 2.3 kilometres along Jerrabomberra Hill Road from Halloran Drive, Figure 3. These water reservoir tanks provide no opportunity for fire fighting vehicles to re-fill at this location and no formal APZ is present at this location.



Figure 3. Location of Upper Thornton reservoir tanks on Mt Jerrabomberra.

Pumping equipment located within each of two concrete rings, Figure 4 are located towards the southeast corner of Mt Jerrabomberra. This equipment is not labelled or signed and they present a hazard to fire fighting vehicles.



Figure 4. Evidence of a small fire at pumping infrastructure [E 701558 N 6083109].

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

Other water infrastructure within Mt Jerrabomberra includes the presence of a fire hydrant located adjacent the track that extends east from the Thornton Reservoir tanks and is marked by a yellow post and gatic cover with concrete surround, Figure 5. A standpipe is not present at this location and there is no provision for a fire fighting vehicle to pass another vehicle accessing the hydrant, with the track reduced to a width of 3 metres at this point.



Figure 5. Fire hydrant [E 701386 N 6083424].

The water reservoir tanks and pumping infrastructure are economic assets required to be protected from bushfire.

### 1.3.2 Telecommunication tower

A telecommunications tower and associated buildings are located at the crest of Mt Jerrabomberra an additional 500 metres along the road or 150 metres southeast of the water tanks, Figure 6. There is no formal APZ around the perimeter of the telecommunication tower compound and no fire-fighting infrastructure is present at this location.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.



Figure 6. Location of telecommunication tower on Mt Jerrabomberra.

## 1.4 Mt Jerrabomberra management

In accordance with the requirements of the *Local Government Act* 1993, Mt Jerrabomberra has been classified as bushland. Under section 36(5) of the LG Act, the core objectives for management of community land categorised as bushland are:

- To ensure the ongoing ecological viability of the land by protecting the ecological biodiversity and habitat values of the land, the flora and fauna (including invertebrates, fungi and micro-organisms) of the land and other ecological values of the land, and
- To protect the aesthetic, heritage, recreational, educational and scientific values of the land, and
- To promote the management of the land in a manner that protects and enhances the values and quality of the land and facilitates public enjoyment of the land, and to implement measures directed to minimising or mitigating any disturbance caused by human intrusion, and
- To restore degraded bushland, and
- To protect existing landforms such as natural drainage lines, watercourses and foreshores, and
- To retain bushland in parcels of a size and configuring that will enable the existing plant and animal communities to survive in the long term, and
- To protect bushland as a natural stabiliser of the soil surface.

QPRC strives to achieve these objectives by managing Mt Jerrabomberra in accordance with the following plans:

- Planning for People et al. (2004) *Mount Jerrabomberra Plan of Management*.
- QPRC (2016<sup>1</sup>) *Plan of Management Mount Jerrabomberra – Addendum 1*

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

- QCC (2010) *Plan of Management: Natural Areas*.
- QPRC (2016<sup>2</sup>) *Plan of Management: Natural Areas – Addendum 1*
- Hansen (2007) *Mount Jerrabomberra Bush Fire Management Plan*
- QCC (2011) *Weed Management Plan 2011-2021*.

The environmental issues that require management within Mt Jerrabomberra are typical of bushland reserves with an extensive urban interface. Encroachment by neighbouring residents, utilising reserve land for their own purposes and illegal dumping of waste and garden refuse are management issues that are monitored by QPRC. Other significant management issues within Mt Jerrabomberra are the creation of new bike riding tracks and jumps and illegal vehicular access that both contribute to the removal of vegetation and increase the potential for erosion and weed invasion of the disturbed areas. The invasion of weeds along drainage lines that extend into Mt Jerrabomberra from the neighbouring residential developments and plants spreading from adjoining gardens into Mt Jerrabomberra are management issues (Eco Logical Australia 2010). Other management issues include inappropriate fire regimes, that typically occur due to either a high frequency of low intensity fires (prescribed burns) to reduce fuel loads that exceeds the lower threshold of potential concern (TPC1) or through preventing an area from burning whereby the upper threshold of potential concern may be exceed (TPC2). Exceeding TPC1 may prevent; the recruitment of new individuals, the build-up of a seedbank sufficient in size to maintain the population through the next fire or result in a local extinction. Exceeding the TPC2 can result in the senescence of the plant community and an associated decline in species diversity and community health (National Parks and Wildlife Service (NPWS) 2004).



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 2 PROCESS & COMMUNICATION

### 2.1 Process

The process for recognising and assessing bushfire risk within Mt Jerrabomberra is based on that of the NSW Rural Fire Service, Bushfire Risk Management Planning Framework (NSW RFS 2008) and the Australian risk management standard AS/NZS ISO 31000:2009.

The NSW RFS Framework has been developed for risk management planning on a regional scale, however a modified approach remains applicable for the development of the Mt Jerrabomberra BMP. The general framework is provided below.



### 2.2 Communication & Consultation

#### 2.2.1 Communication

Communication of this Mt Jerrabomberra BMP to the local community is to be undertaken by QPRC.

The draft Mt Jerrabomberra BMP will be presented to QPRC to provide an opportunity for further input and clarification prior to GFE incorporating feedback and presenting the final Mt Jerrabomberra BMP.

Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 2.2.2 Consultation

The following individuals were consulted in the preparation of this BMP:

- Natasha Abbott, Manager, Environment & Health, Environment, Planning & Development, QPRC
- Jason Robinson, Supervisor Parks, Open Spaces and Bushland, QPRC
- Daryl Crapp, Mt Jerrabomberra Landcare
- Alison Roach, Mt Jerrabomberra Landcare
- Helen McIntyre, resident Candlebark Road, DeSalis, NSW
- Tim Carroll, District Manager, Lake George Zone, NSW Rural Fire Service
- Jeff Cutting, NSW Rural Fire Service (retired)
- Chris Quinn, Fire Behaviour Analyst, Community Planning, NSW Rural Fire Service
- Jason McWhirter, District Assistant, Lake George Zone, NSW Rural Fire Service
- Jason Murphy, Queanbeyan Station Commander, NSW Fire and Rescue
- Karen Groeneveld, Vice President, Canberra Orchid Society
- Zoe Groeneveld, Technical Assistant, ANU





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## 3 BUSHFIRE WEATHER

### 3.1 Fire Danger

Fire danger is the total of all factors that affect the initiation, spread, and difficulty of control of fires, and the damage they cause. Fire Danger is calculated separately for forest and grassland areas on a daily basis and is expressed as a numerical index on a scale from 0 – 100<sup>+</sup> and is known as either the:

- Forest Fire Danger Index (FFDI)
- Grass Fire Danger Index (GFDI)

Fire Danger Indices are used to set the fire danger on a regional scale. The following factors are used to calculate the FFDI:

- Seasonal dryness – this is indicated by a drought index, or a soil dryness index
- Temperature
- Relative humidity of the air
- Wind speed
- Rainfall (volume and duration)
- Fuel load.

To avoid confusion within the community, the reported Fire Danger Index (FDI) does not distinguish between these indices, although both are utilized operationally.

For planning purposes, the FDI for the Southern Ranges fire weather district, that includes Queanbeyan, has been set by the Australasian Fire and Emergency Service Authorities Council (AFAC) at the **FDI** value of **100**, as presented in Table 2.1 of AS 3959-2009 (Standards Australia 2009<sup>1</sup>).

A FDI value of 100 would therefore be used in all calculations of bushfire attack level under AS 3959 for the neighbouring residential areas (Standards Australia 2009<sup>1</sup>). It should be recognised that bushfires occur that exceed a prescribed FDI value of 100 and may be of such magnitude that preparations are likely to be inadequate. For example, the Horsham fire that was one of the Victorian Bushfires of 2009 that caused extensive loss of life and property, was calculated to have had a FDI of 312 (Parliament of Victoria 2010<sup>1</sup>).

A low fire danger rating indicates that the fire may not burn, be slow to spread and that it can be easily controlled. An index value of 100+ indicates that a fire would burn readily and so fast and hot that it would be unlikely that it could be controlled. The fire danger indices are therefore a measure of how destructive a fire can be and how difficult it may be to extinguish a fire.

The national fire danger rating system is presented in Table 2 and was developed in accordance with a recommendation of the Victorian Black Saturday Bushfire Royal Commission (Parliament of Victoria 2010<sup>2</sup>).

- Severe fire danger occurs when FFDI/GFDI is between 50 and 74;
- Extreme fire danger occurs when FFDI/GFDI is between 75 and 99; and
- Catastrophic (Code Red) fire danger occurs when FFDI/GFDI is 100 or above.



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Fire weather warnings issued by the Bureau of Meteorology (BOM) on a daily basis relate to Fire Danger Ratings of Severe, Extreme or Catastrophic (Code Red).

Table 2: Fire danger ratings and indices (NSW RFS 2009).

FIRE DANGER RATING	
CATEGORY	FIRE DANGER INDEX
CATASTROPHIC (Code Red)	100+
EXTREME	75 - 99
SEVERE	50 - 74
VERY HIGH	25 - 49
HIGH	12 - 24
LOW - MODERATE	0 - 11

### 3.2 Climate

#### 3.2.1 Rainfall

While the ACT has relatively uniform rainfall across winter and summer, there are significant annual variations that influence the timing and severity of the bushfire season (Lindesay et al 2007). The City of Queanbeyan, NSW and the majority of the ACT are within the BOM, Southern Tablelands Goulburn-Monaro weather district (Australian Government 2017<sup>1</sup>) and data obtained from the Canberra Airport Comparison weather station and the ACT more broadly can be used to describe climatic conditions at the site.

The average annual rainfall recorded at the Queanbeyan Bowling Club weather station (site number 070072) from 1870-2015 was 594.3 millimetres with rainfall spread comparatively evenly across the months, Table 3 (Australian Government 2017<sup>1</sup>).

The lowest mean rainfall occurs in the month of July (39.4 mm), with the highest mean rainfall recorded for November (58.9 millimetres) that may act to increase the growth of vegetation pushing the period of major fire risk later into January and February, although these months also had high rainfall (Australian Government 2017<sup>1</sup>). Annual variations in the weather pattern or El Nino Southern Oscillation events that are associated with rainfall deficits are more likely to be associated with severe bushfire events (ESA 2009<sup>1</sup>).

Table 3: Mean rainfall – Queanbeyan Bowling Club, 1870-2015, BOM, Australian Government (2017<sup>1</sup>).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Mean Rainfall (mm)	55.6	51.5	51.3	43.6	43.3	44.4	39.4	43.8	48	59.2	58.9	55.7	594
Median Rainfall (mm)	49.4	42.7	33.0	35.1	29.7	35.2	33.8	40.8	43.1	52.9	52.9	47.0	571

Bushfire season – shaded grey, is from 1 October to 31 March

#### 3.2.2 Temperature

The highest mean maximum temperature recorded at the BOM Queanbeyan Bowling Club weather station was 29.0°C in January with the next highest mean temperatures being recorded





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in February (28.5°C) and 27.6°C in December, Table 4 (Australian Government 2017<sup>1</sup>). During December there are on average 0.9 days over 35°C, 2.8 days in January and 1.2 days in February and 0.2 days in March over 35°C (Australian Government 2017<sup>2</sup>). Warm weather can start in mid-October and extend through to and include April depending upon weather patterns. The mean number of days of high temperature across a potential bushfire season is presented in Table 5 (Australian Government 2017<sup>2</sup>). Lindesay *et al* (2007) report that during the period 1951-2004 (53 years) from data recorded at Canberra airport that there were 105 days ≥FFDI 50 and 0.1 per cent of days that had a FFDI >70, that is 19 days in 53 years, Table 6.

**Table 4: Mean monthly temperature – Queanbeyan Bowling Club, 1870-2015, BOM (Australian Government 2017<sup>1</sup>).**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Mean Max. Temp. (°C)	29.0	28.5	25.6	20.6	15.9	12.5	11.8	13.7	17.3	20.7	24.4	27.6	20.6
Mean Min. Temp. (°C)	12.7	12.9	10.7	6.6	3.3	0.9	-0.2	0.9	3.3	6.0	8.9	11.4	6.4

Bushfire season – shaded grey, is from 1 October to 31 March. Red - highest value, Blue – lowest value

**Table 5: Mean number of days of high temperature - Canberra airport comparison, 1939-2010, BOM (Australian Government 2017<sup>2</sup>).**

Mean Number of Days	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Annual
≥30 °C	0.3	2.5	6.9	11.1	7.8	3.0	0.1	31.7
≥35 °C	0	0.3	0.9	2.8	1.2	0.2	0	5.4
≥40 °C	0	0	0	0.1	0	0	0	0.1

**Table 6: Frequency of extreme days - Canberra airport comparison, 1951-2004, BOM (Lindesay *et al* 2007).**

Number of occurrences (Days)	FFDI				
	50-59	60-69	70-79	80-89	90-100
	61	25	9	4	6

ESA (2014<sup>1</sup>) utilised long term BOM data to produce the average monthly FFDI and maximum FFDI shown in Figure 7 that demonstrates the extreme bushfire conditions that can occur within the ACT and the City of Queanbeyan.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

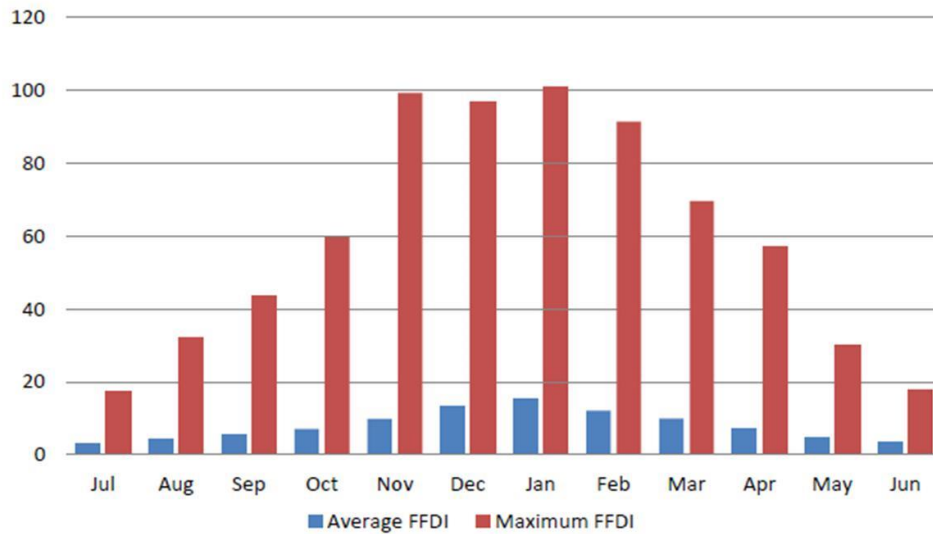


Figure 7. Average monthly FFDI (average maximum DF) and maximum FFDI (maximum monthly DF), Canberra airport synoptic data [Source: Fig 3.4 ESA 2014<sup>1</sup>].

### 3.2.3 Wind

Wind data is derived from observations made at the BOM Canberra Airport Comparison weather station, as it is the closest weather station to the site with suitable records. Wind from the northwest is a dominant feature across the entire year (Australian Government 2017<sup>3</sup>).

During the summer months, the components of wind from the northwest and west remain a feature of the wind roses, Figure 8 and Figure 9 (Australian Government 2017<sup>3</sup>). There is a strong wind (>40 kilometres per hour) component associated with winds from both the northwest and west during the summer months (Australian Government 2017<sup>3</sup>). In December, 3.32 per cent of wind from the northwest and west is >40 kilometres per hour and 53.8 per cent of winds during December come from the west or northwest with a further 12.4 per cent of winds from a northerly direction, based upon total observations from 1939 to 2010 at 3 pm, Figure 8 (Australian Government 2017<sup>3</sup>). Only 9 per cent of wind in January is from the east (Australian Government 2017<sup>3</sup>). In February, the combined strong wind component from the west and northwest has declined to 1.18 per cent and 41.4 per cent of winds during February come from the west or northwest, a reduction of 12.4 per cent from December, Figure 9 (Australian Government 2017<sup>3</sup>). A further 10.7 per cent of winds come from a northerly direction, a reduction of 1.7 per cent since December based upon total observations from 1939 to 2010 at 3 pm (Australian Government 2015<sup>3</sup>). The easterly components of the wind roses for February are stronger, with 15.2 per cent of wind from the east in February compared to 9 per cent in December (Australian Government 2017<sup>3</sup>). The easterly wind component appears to be most prominent in the March wind rose (Australian Government 2017<sup>3</sup>). A bushfire is therefore most likely to approach the site from the north to northwest while a fire ignited within Mt Jerrabomberra during bushfire season is most likely to spread towards the southeast.

Severe fire weather is typically associated with a north-westerly air flow due to the presence of high pressure systems over the Tasman Sea and the Great Australian Bight with a trough of low pressure separating these systems (ESA 2009<sup>1</sup>).

With an approaching cold front that causes a sudden change in wind direction, from the southwest, the direction of the fire can shift abruptly and increase the size of the fire front.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

The plot of the top 500 highest FFDI days, Figure 10, demonstrates the association of high FFDI days with winds from the northwest although high FFDI days do occur with winds from the southwest through to the north (ESA 2014<sup>1</sup>). The potential for fires to occur associated with winds from other directions should not be discounted and other interactions between winds and the landscape, for example Foehn winds, thermal belts or winds being channeled between gullies can have localized effects upon bushfires.

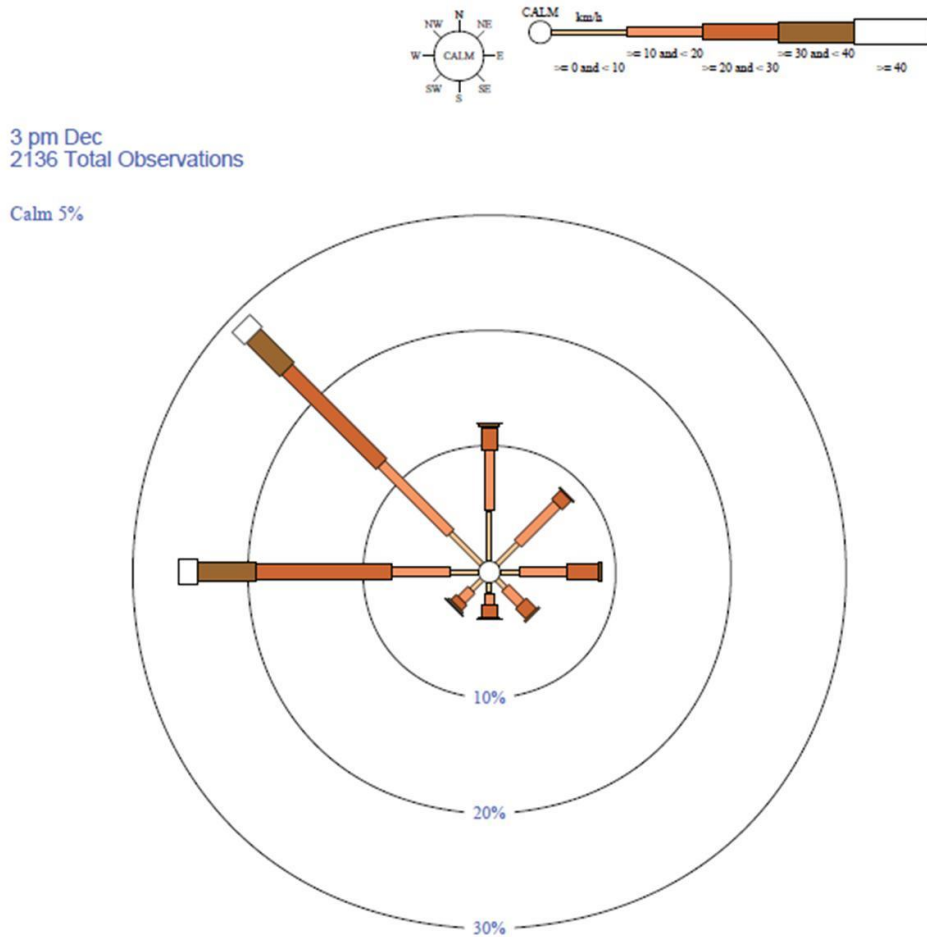


Figure 8. December 1939-2010 total observations - rose of wind direction versus wind speed in km/hr (Australian Government 2017<sup>3</sup>).

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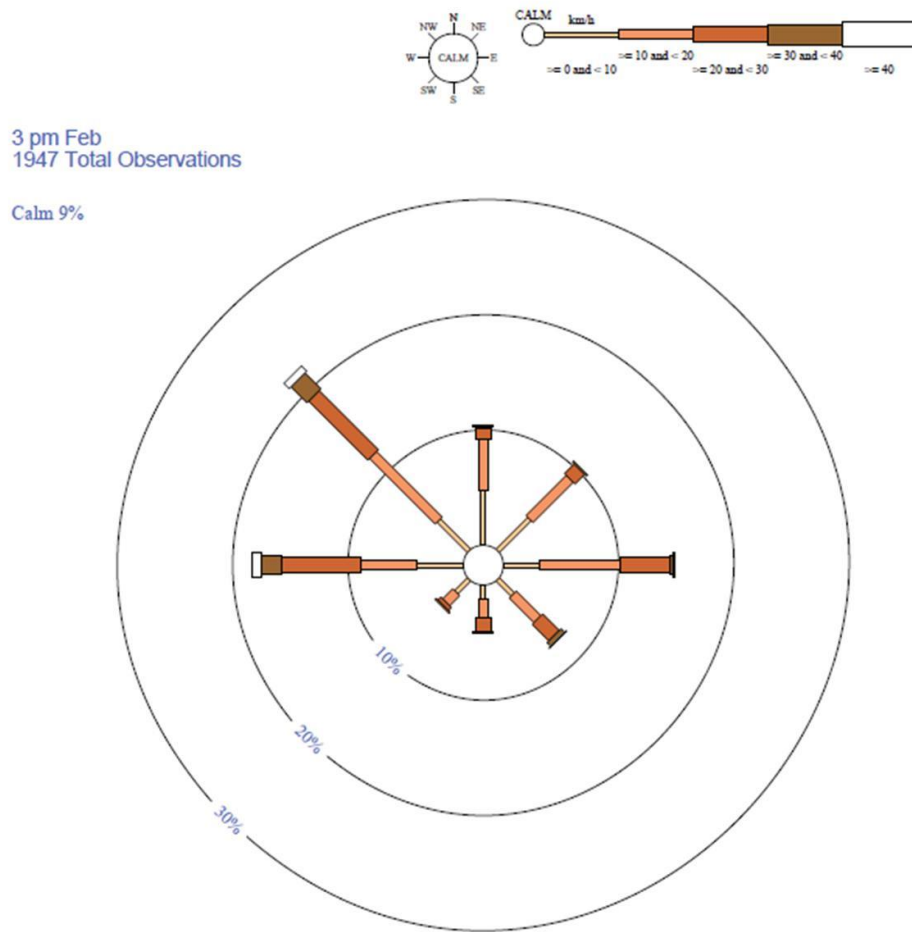


Figure 9. February 1939-2010 total observations - rose of wind direction versus wind speed in km/hr (Australian Government 2017<sup>3</sup>).

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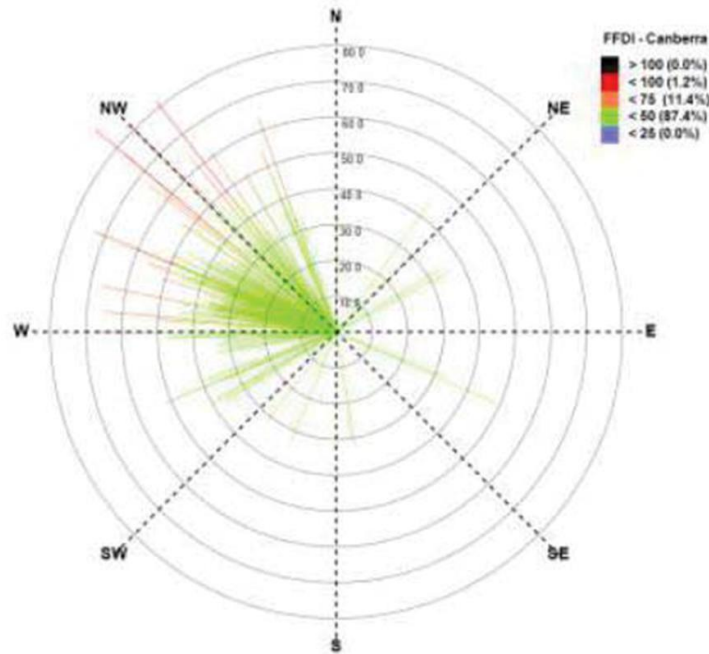


Figure 10. Canberra airport wind ray. Top 500 FFDI days at 3 pm –synoptic data with BOM derived DF. [Source: Fig 3.5 ESA 2014<sup>1</sup>].

### 3.2.4 Humidity

Low humidity, that is, hot dry air is associated with days of severe to catastrophic fire danger. These conditions typically occur during summer and are associated with winds from the north and north-west that have blown across the inland, heating and drying as they do so. The associated low relative humidity (less than 20 per cent) dries out fuel (timber and grass) increasing flammability. Table 7 shows that Queanbeyan experiences comparatively high relative humidity across the year and therefore annual variations in the weather pattern or El Nino Southern Oscillation events that are associated with lower humidity conditions are more likely to be associated with severe bushfire events.

Table 7: Mean monthly (9 am) humidity – Queanbeyan Bowling Club, 1870-2015, BOM (Australian Government 2017<sup>1</sup>).

Month	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean Relative Humidity (per cent)	64	68	70	74	79	81	81	76	72	65	62	61	71
Bushfire season – shaded grey, is from 1 October to 31 March. Red – highest value, Blue – lowest value													

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

### 3.3 Bushfire Season

The declared bushfire season for the Lake George Bushfire Zone is typically from 1<sup>st</sup> October to 31<sup>st</sup> March although the season may vary from year to year subject to prevailing weather conditions and fuels loads (Lake George Zone BFMC 2010). The bushfire season may commence in September and can extend into April (Lake George Zone BFMC 2010).





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## 4 BUSHFIRE HAZARD ASSESSMENT

### 4.1 Bushfire Ignition Assessment

Fires that are lit deliberately for the purpose of fuel reduction or land management purposes are referred to as prescribed fires. Bushfires are therefore unplanned fires in vegetation, and the term is used to refer to both grass fires and forest fires. Prescribed fires have been conducted within Mt Jerrabomberra [J. Robinson, QCC pers. comm. 19 May 2015].

The Lake George Bushfire Zone has approximately 80 bushfires per year with approximately six on average considered to be major bushfires (Lake George Zone BFMC 2010). The leading causes of bushfire ignition reported by Lake George Zone BFMC (2010) are:

- Illegal burn offs
- Legal burn offs
- Lightning
- Incendiaries
- Camp fires
- Accidental (includes power lines)

The history of bushfires in the ACT is well documented (ESA 2009<sup>1</sup>). In 2003 fires in the ACT burnt nearly 70 percent of the land (164,000 hectares) within the ACT and resulted in four deaths (ESA 2009<sup>1</sup>). These fires burnt into NSW south of Queanbeyan; although, Mt Jerrabomberra was not directly impacted by these fires. ESA (2009<sup>1</sup>) notes that from the 2003-2004 to the 2006-2007 bushfire seasons, the vast majority of bushfires (97-100 per cent) in the ACT were ≤5 hectares, Table 8.

**Table 8: Number of unplanned fires in ACT, 2003-04 to 2006-07 [Source: Table 1 ESA 2009<sup>1</sup>].**

Bushfire Season	Total Fires	Fires ≤5 ha		Fires >5 ha		
		Number	Per cent	Number	Total area burnt (ha)	Maximum area (ha) burnt in single fire
2003/04	92	89	97	3	240	220
2004/05	196	196	100	0	0	0
2005/06	296	292	99	4	110	80
2006/07	588	583	99	5	59	20
<b>Total</b>	<b>1172</b>	<b>1160</b>		<b>12</b>	<b>409</b>	<b>-</b>

#### 4.1.1 Power lines

Historically, numerous bushfires have been associated with power line faults, unfortunately these records have been included under the category of accidental ignition causes by ESA (2009<sup>1</sup>) and would be more appropriately identified as a stand-alone ignition cause due to their importance.

Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

Power lines and associated equipment are a recognised cause of bushfire ignition. Energy Safe Victoria (2009) report that, while power lines are thought to start only between 1 and 4 percent of bushfires, a disproportionately high number of the catastrophic bushfires have been caused by power lines. In Victoria alone, power lines are thought to have started:

- Nine of the 16 major fires on 12 February 1977
- Four of the eight major fires on Ash Wednesday (16 February 1983)
- Five of the 15 major fires on Black Saturday (7 February 2009) that were considered by the Royal Commission (Energy Safe Victoria 2009).

During the site visit on 13 June 2017, it was noted that vegetation was growing within close proximity to power lines near the telecommunication tower presenting a potential ignition hazard, Figure 11. Vegetation growing beneath and around these power lines and poles must be managed in accordance with the Electrical Industry Safety Steering Committee Guidelines [ISSC] (2012) and ISSC (2016) so as to reduce the potential of a flashover ignition.



**Figure 11. Golden wattles growing in close proximity to power lines near telecommunication tower.**

A related issue was observed at the telecommunications tower with a tree branch having grown into the facility presenting a potential ignition hazard and also providing an access route across the razor wire fence surrounding the facility, Figure 12. The telecommunication tower lacks an established APZ and, while some vegetation has been cleared, vegetation remains in very close proximity to the facility, Figure 12.

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.



Figure 12. Vegetation encroaching into the telecommunication tower facility.

#### 4.1.2 Arson and human activity

The majority of bushfires within the ACT are caused by human activity, including arson. ESA (2009<sup>1</sup>) reports that arson was responsible for 80 percent of bushfires since 1960, where the cause of ignition was known. Other types of human activity known to cause bushfires includes escaped campfires or barbeques, illegal burn-offs, vehicle accidents, sparks from machinery, fires associated with utilities such as power lines and escaped prescribed burns (ESA 2009<sup>1</sup>). Evidence of small camp fires was located at two locations, including an area above the Scar Recreation Reserve, Figure 13 and adjacent pipeline infrastructure in the southeastern corner of Mt Jerrabomberra, Figure 4.



Figure 13. Evidence of a camp fire above The Scar Recreation Reserve [E 701551 N 6083689].

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The concrete rings covered by a locked steel mesh cover house pumping equipment, however, rubbish has been allowed to accumulate within these structures and presents a fire risk to the infrastructure and surrounds. This infrastructure is located in the middle of a track with no warning to vehicles or bollards installed presenting a hazard for fire fighting vehicles in particular given conditions of reduced visibility associated with bushfires.

Prior to vehicle access to Mt Jerrabomberra being restricted by perimeter fencing and locked gates “there were numerous small fires started by torched cars” although mapping of these fires has been patchy [C. Quinn, NSW RFS pers. comm. 24 May 2017]. Two mobile property fires are mapped as having occurred within Mt Jerrabomberra in the last 10 years [J. Murphy, NSW FR pers. comm. 8 June 2017]. One fire was within the Scar Recreation Reserve and the other was adjacent this Reserve near the end of Woodridge Place.

### 4.1.3 Lightning

Since 1960 lightning has accounted for approximately 11 per cent of fires within the ACT (ESA 2009<sup>1</sup>). Lightning strikes have tended to result in larger areas of land burnt (ESA 2009<sup>1</sup>), as lightning strikes are more likely to occur on the mountain ranges that are typically less accessible and more remote areas. Dry thunderstorms are a particular issue within the Lake George Bushfire Zone during December to February, in particular within the southern ranges where access to the area is difficult due to the rough terrain (Lake George Zone BFMC 2010).

The average annual lightning ground flash density (Ng) map shows that Queanbeyan and the Mt Jerrabomberra experiences 2 - 3 ground lightning strikes per km<sup>2</sup> per year (Australian Government 2012). This indicates that Mt Jerrabomberra, occupying an area of 142 ha, is likely to receive between 2 and 5 lightning strikes each year. Mt Jerrabomberra is not remote and there is generally good access to the reserve perimeter and interior to respond to a fire started by a lightning strike. Lightning strike is likely to be a significant cause of fire ignition within Mt Jerrabomberra, although lightning may often be associated with rainfall events that may assist in extinguishing a bushfire. There are several examples of trees that have been shattered due to lightning strike within Mt Jerrabomberra [A. Roach pers. comm. 12 June 2017].

An electrical storm started three bushfires within the space of 40 minutes on 30 January 1994 with one of these fires located between the suburbs of Jerrabomberra and Hume burning an area of 90 hectares prior to being controlled by fire fighters (Corby 1994). This example serves to highlight the potential for lightning strikes to ignite multiple fires within a short space of time that can place a high demand on fire-fighting resources. Rainfall associated with the storm was insufficient to assist fire-fighters, although it was reported that a drop in wind speed did assist fire – fighters (Corby 1994) demonstrating the destructive potential of dry thunderstorms. As Mt Jerrabomberra includes three peaks at 775 metres, 779 metres and 745 metres that are the most prominent features of the landscape, Mt Jerrabomberra may be a focal point of lightning strikes, in particular due to the presence of the telecommunications tower.

## 4.2 Bushfire History

### 4.2.1 Mt Jerrabomberra – bushfire records

There have not been any major bushfires within Mt Jerrabomberra within the last 10 years [T. Carroll, NSW RFS pers. comm. 18 May 2015]. Lake George Zone BFMC (2010) mapped the historical occurrence of bushfires within the Lake George Zone in 2007 and this mapping indicates an absence of bushfires from Mt Jerrabomberra and the surrounding landscape. It has been established by GFE that this mapping is incomplete and does not accurately portray the incidence of bushfire within and surrounding Mt Jerrabomberra.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

A bushfire in March 1888 started in the cemetery and spread up the slopes of Jerrabomberra Hill and presented “*literally the aspect of a burning mountain*” (Anon 1888), while Figure 29 indicates an earlier fire in 1881 occurred in the area.

### 1952

Based upon the mapping provided within ESA (2009<sup>1</sup>), it is considered that Mt Jerrabomberra was impacted by the major bushfire of 25 January 1952, as shown in Figure 14.



Figure 14. Area burnt (orange) by major bushfires in the 1951-1952 bushfire season (ESA 2009<sup>1</sup>).

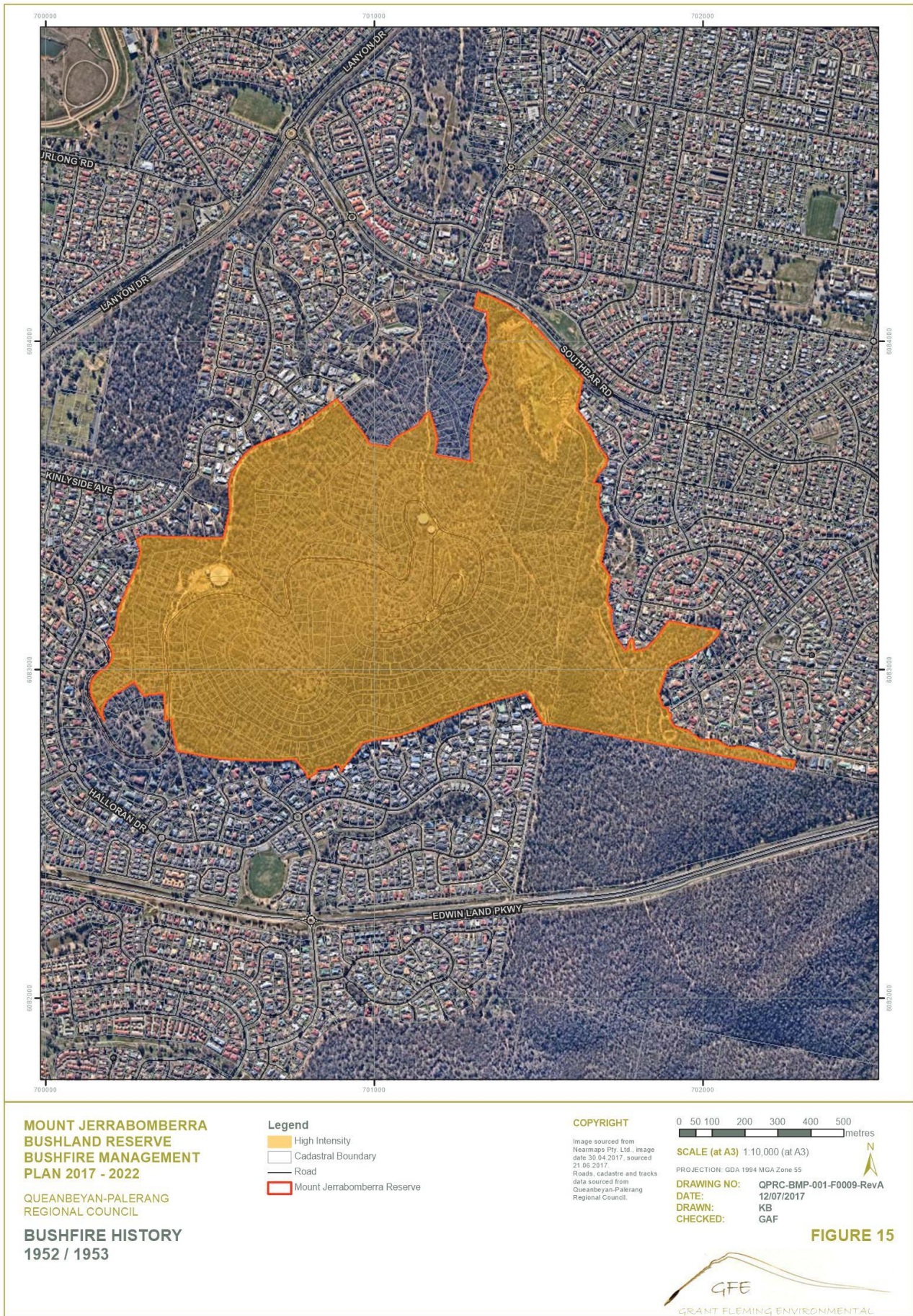
In the absence of evidence to the contrary, it is assumed that Mt Jerrabomberra was burnt in its entirety, Figure 15 in the 1952 bushfire and therefore it can be assumed that the vegetation communities present are no more than 65 years old at the time of preparing this BMP. This age approximates with twice the upper TPC for Dry Forest, unless areas have been burnt by a more recent bushfire.

### 1977

A bushfire burnt at Jerrabomberra Hill in November 1977 “*mostly the lower eastern and southern slopes under a light east-northeasterly and was contained by a long back-burn along the Goongong Dam pipeline firebreak, linking with the Cooma Road for a distance of approximately 500 – 700 metres*”, Figure 16 and Figure 17 [J. Cutting pers. comm. 20 June 2017].









Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.



Figure 16. Back burning along the Googong pipeline firebreak, light wind from the northeast [Photo supplied by Jeff Cutting].



Figure 17. Mt Jerrabomberra bushfire burning strongly near the Googong pipeline firebreak [Photo supplied by Jeff Cutting].

Cutting also indicates that “volunteer fire-fighters were engaged in containment halfway up the summit track”, Figure 19 and considers that the fire severity within the scrubland was moderate and burnt an area of 10 - 20 hectares. Figure 19 shows the fire burning tussock grass that was 90 percent cured under the influence of a light northerly wind [J. Cutting pers. comm. 26 June 2017].

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Figure 19. Volunteer fire fighters staging approximately halfway up Mt Jerrabomberra Drive [Photo supplied by Jeff Cutting].

### 1985

On Monday 4<sup>th</sup> March 1985, bushfires threatened Queanbeyan, including a bushfire that spread under the influence of a west-northwesterly wind from Jerrabomberra Hill (Anon 1985). Jeff Cutting [pers. comm. 20 June 2017] indicates that the Jerrabomberra Hill fire started in grass on the roadside of Lanyon Drive about 500 metres northeast of the roundabout at the intersection with Tompsitt Drive. The fire “*fire spread rapidly across grassland onto steep timbered slopes where it intensified and scattered spot fires eastwards over the southern Queanbeyan suburbs and the Queanbeyan River*” [J. Cutting pers. comm. 20 June 2017]. The blackened foreground in Figure 20 is due to the Sundown Drive-In bushfire [J. Cutting pers. comm. 20 June 2017], while the dense smoke plumes were formed as the bushfire moved across the southern and eastern aspects of Mt Jerrabomberra [J. Cutting pers. comm. 20 June 2017].



Figure 20. View of the Mt Jerrabomberra fire from the Monaro Highway (near Gaoi). [Photo supplied by Jeff Cutting].

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An indication of the path of the Mt Jerrabomberra fire from Lanyon Drive into the southern and eastern slopes of Mt Jerrabomberra is provided by Figure 21. Spot fires were ignited by embers from the Mt Jerrabomberra bushfire including at Doyles Reserve, Barracks Flat, Figure 22 [J. Cutting pers. comm. 20 June 2017].



Figure 21. Dense smoke plume, Mt Jerrabomberra as viewed from Lanyon Drive. [Photo supplied by Jeff Cutting].

“The newer residences were largely surrounded by bare ground and thus were saved from property losses” [J. Cutting pers. comm. 20 June 2017]. This bushfire occurred prior to the residential development on the southern side of Mt Jerrabomberra and it burnt through to Candlebark Road [H. McIntyre pers. comm. 12 June 2017].



Figure 22. Spot fire at Barracks Flat amongst new residences. [Photo supplied by Jeff Cutting].

The Mt Jerrabomberra bushfire “linked up with the Burra and Mugga Lane fires and burnt through to Captains Flat Road past Widgiewa” [Jeff Cutting pers comm. 27 May 2015]. The distribution of these bushfires is shown in Figure 23 and an indication of the area burnt on Mt Jerrabomberra is provided in Figure 18.

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Castle (1985) reports that the fires were thought to have been started by an arsonist. These fires resulted in the death of one man at a property near Googong and the collective destruction of approximately 30,000 hectares (Castle 1985).

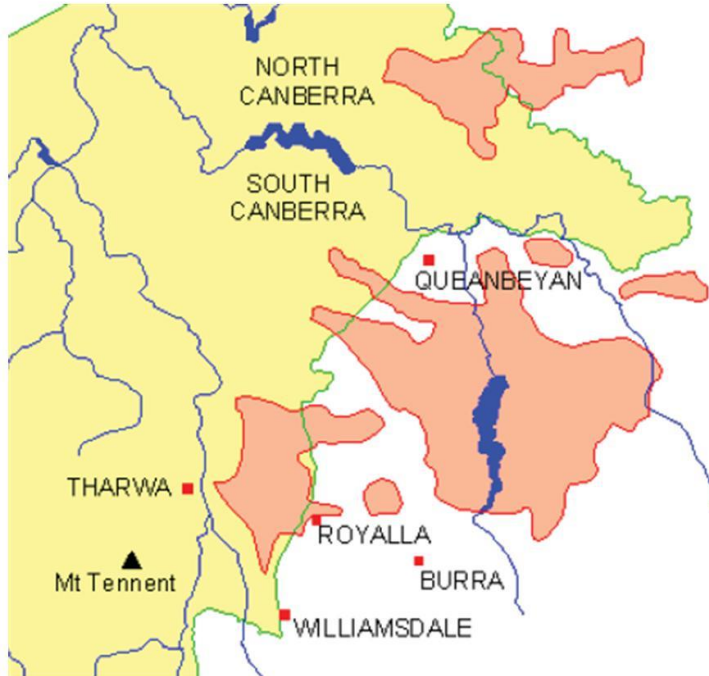


Figure 23. Area burnt (orange) by major bushfires in the 1984-1985 bushfire season (ESA 2009<sup>1</sup>).

### 2013

Arson poses an ongoing threat to Mt Jerrabomberra. Johnston (2013<sup>1</sup>) reported that several arson attacks resulted in fires at Mt Jerrabomberra, Bicentennial Park and Nugent Close, Jerrabomberra on 30 September 2013. Arson was also responsible for fires in bush land adjacent Southbar Road (Mt Jerrabomberra) and in Bicentennial Park on 31 October 2013 with an additional two fires lit within Bicentennial Park the following day (Johnston 2013<sup>2</sup>).

### 2007 – 2017

A map of fires within Mt Jerrabomberra attended by NSWFR (Queanbeyan Fire Station) was provided by J. Murphy [pers. comm. 8 June 2017] and shows several fires along Mt Jerrabomberra Drive near the summit in addition to the vehicle fires near The Scar Recreation Reserve discussed in Section 4.1.2. Individuals that use the bush walking paths and mountain bike trails are credited with providing early notice of fires facilitating a quick response by NSWFR [J. Murphy pers. comm. 8 June 2017].

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

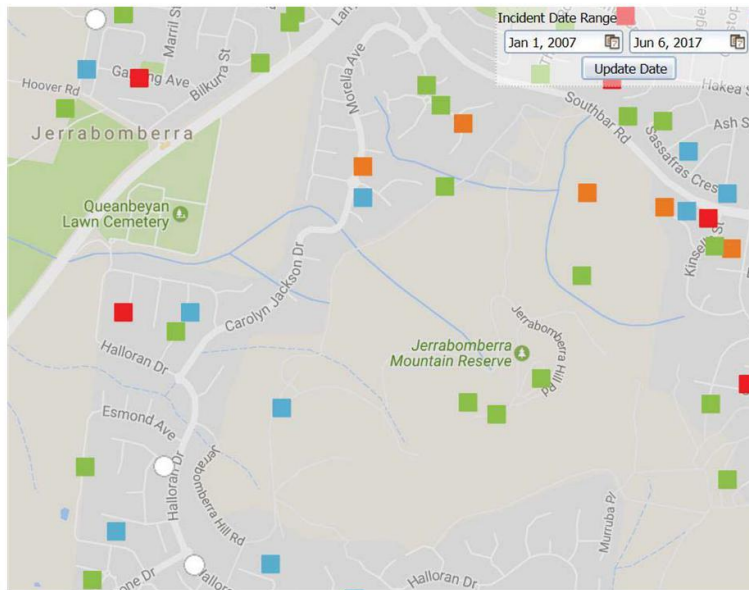


Figure 24. Fires attended by Queanbeyan FRNSW in the vicinity of Mt Jerrabomberra since 2007 [J. Murphy pers. comm. 8 June 2017] Red- residential/structural fires, Orange – Mobile/property fires, Green – Bush/grass fires and Blue – Rubbish fires.

#### 4.2.2 Mt Jerrabomberra – bushfire evidence

Evidence of the presence of major bushfires within Mt Jerrabomberra was obtained during the site walkover conducted in the presence of D. Crapp and A. Roach of Mt Jerrabomberra Landcare 12 June 2017. Additional evidence of historic fire damage confirming that one or more major fires had occurred within Mt Jerrabomberra was obtained during the fuel load assessments conducted on 12 and 13 June 2017.

There was evidence of either a low or high intensity bushfire or both at each of the 12 locations where fuel load was assessed, Table 12. Evidence remained of the prescribed burns conducted in 2009, 2010 and 2011. Evidence of low intensity fires was also located outside of the prescribed burn areas and, as no other prescribed burns have been conducted within Mt Jerrabomberra, these areas are either associated with arson or misuse of fire associated with children (under the age of 16) or are potentially associated with lightning strikes.

The evidence of intense fire activity along the southern slopes is associated with the 1985 bushfire. Many examples of lee bole scarring were located and several examples of trees killed by bushfire were observed, Figure 25. The red stringybark shown in Figure 26 has charring on the lee side bole indicating that the tree has been burnt twice, which could be consistent with the tree having burnt in both the 1977 and 1985 bushfire.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.



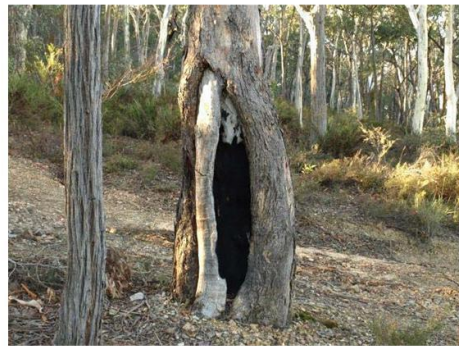
Charring on base of red stringybark (eastern slope).



Evidence of an intense fire on scribbly gum (southern slope).



Fire damaged tree on summit.



Burnt hollow from a major fire (southwestern slope).



Lee side bole scarring from a major fire and charring from a prescribed burn.



Evidence of intense fire with damage the entire height of the tree (southern slope).

Figure 25. Evidence of low and high intensity bushfire, Mt Jerrabomberra.

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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.



Figure 26. Red stringybark with evidence of two fires.

The large scribbly gum specimen shown in Figure 27 is considered to demonstrate fire damage from an earlier bushfire although it has not been possible to determine the number of years of regrowth since the fire event. Several of these larger and older trees remained along this drainage line located between the southern-most ridges. Evidence of a low intensity fire was also located nearby.



Figure 27. Large scribbly gum with significant fire damage.

The available bushfire history information and evidence obtained during the site visit has been utilised to produce Figure 28 that shows the years since last burn across Mt Jerrabomberra.







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### 4.2.3 Surrounding area

Historically, bushfires have occurred throughout the area surrounding Mt Jerrabomberra. This has included the major bushfires of the 1951 – 1952 and the 1984 – 1985 bushfire seasons, Figure 29. The areas mapped, Figure 29 are indicative of the areas burnt and do not represent all bushfires nor is the mapping to be taken as definitive as acknowledged by Queanbeyan City Rural Fire Brigade (2015).

A bushfire on 10 December 1977 burnt approximately 220 hectares of bushland and the Kowen pine plantation approximately six kilometres northeast of Mt Jerrabomberra while another fire burnt approximately 50 hectares near the Queanbeyan Golf Course approximately three kilometres to the northeast of Mt Jerrabomberra (The Canberra Times 1977). The potential exists for embers to reach Mt Jerrabomberra from these regions.

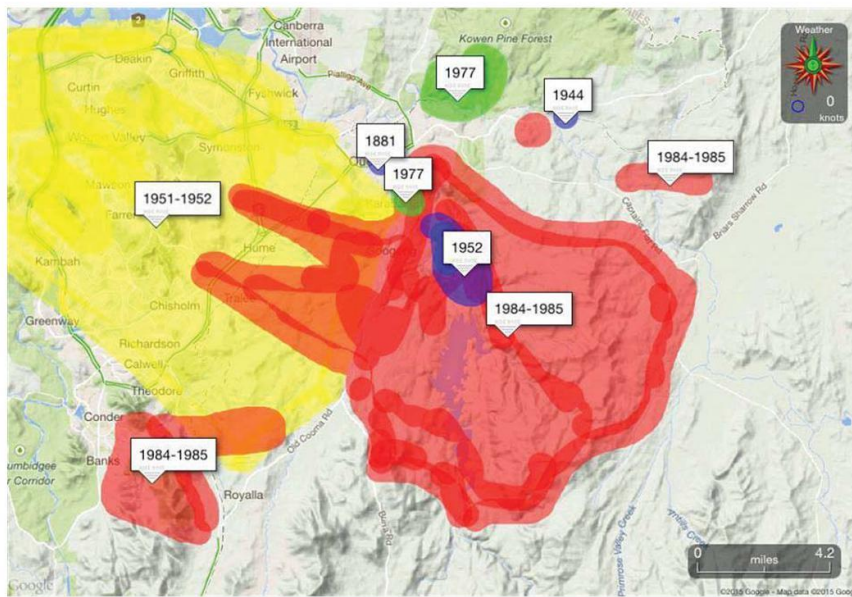


Figure 29. Area burnt by major bushfires near Queanbeyan, NSW (Queanbeyan City Rural Fire Brigade 2015).

A bushfire on Friday 16<sup>th</sup> February 1979, described as occurring on the southern slopes of Mount Jerrabomberra near Barracks Creek, west of the Cooma Road and north of the then Readymix quarry, burnt approximately 100 ha (The Canberra Times 1979). The description of the location of this fire and the size of the area burnt suggests that this bushfire may have burnt at least part of what is presently known as Stringybark Reserve rather than Mt Jerrabomberra.

A bushfire on Tuesday 18 November 1980 destroyed approximately 40 hectares near Mt Jerrabomberra (The Canberra Times 1980), although the precise location of this fire is unknown.

Mt Jerrabomberra is separated from Stringybark Reserve to the south by the Edwin Land Parkway. GFE (2015) presented evidence of a major bushfire throughout Stringybark Reserve suggesting that the entire Reserve had burnt at least once and this was thought to be the 1985 bushfire event. This fire event appears to have been a major fire sufficiently intense to kill large Eucalypt trees, with many burnt stumps, dead standing trees and windfall trees observed.





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A bushfire burnt an 8 hectare area within Stringybark Reserve at Jerrabomberra on 7<sup>th</sup> January 2014, and re-ignited the following day with 10 fire units attending, (Westcott 2014, Westcott & Raggatt 2014). The cause of the fire was reported to be suspicious (ABC 2014).

A bushfire on 14 November 2014 at Tamarind Place, Jerrabomberra, burnt less than a hectare immediately adjacent to Stringybark Reserve [J. Murphy pers. comm. 28 May 2015].

A history of bushfires in the surrounding region is described in GFE (2015).

### 4.3 Prescribed Fires

The Mt Jerrabomberra fire regime is determined by the frequency, intensity and season in which fire occurs and includes both bushfires and prescribed fires. Understanding the spatial and temporal distribution of fire across Mt Jerrabomberra is essential to facilitating effective management of both fire and biota within the landscape. Prescribed fire is a management tool that can be employed to achieve favourable ecological outcomes for certain plants and animals or it may be employed to achieve a reduction in standing fuel load within a defined area for a limited period of time. The impacts of fire within an ecosystem are complex and need to be considered if prescribed fires are to be used as a management tool. The location of prescribed fires has been incorporated into the mapping of the number of years since last burn as presented in Figure 28.

Prescribed fires have been conducted within Mt Jerrabomberra during May 2009, April 2010 and May 2011. The eastern perimeter of Mt Jerrabomberra was burnt by a series of five prescribed fires in May 2009 that burnt an area of 11.8 hectares. Of the four prescribed fires that were conducted in April 2010, the two northern most fires were conducted within land adjoining the Scar Recreational Reserve outside of Mt Jerrabomberra although portions of these fires burnt into Mt Jerrabomberra, Figure 30. The remaining two prescribed fires were conducted along the western perimeter of Mt Jerrabomberra, burning a total of 14.1 hectares. Two prescribed fires were conducted within Mt Jerrabomberra during May 2011, the first occurred between the reservoir tank and Carolyn Jackson Drive and burnt 1 hectare. The second burnt approximately 6.1 hectares in the southwestern corner of the Reserve including land beyond the Reserve. These prescribed fires, shown in Figure 30 were initiated by the then Queanbeyan City Council (QCC) and were conducted by the NSWRFSS [J. McWhirter pers. comm. 1 June 2017].

Prescribed fires must be conducted in accordance with the following guidelines and standards:

- National Parks and Wildlife Service (2004) *Guidelines for Ecologically Sustainable Fire Management*
- NSWRFSS (2006<sup>2</sup>) *Bushfire Environmental Assessment Code for New South Wales*
- NSWRFSS (n.d.) *Standards for Low Intensity Bushfire Hazard Reduction Burning (for private landholders)*.

It is also essential that the areas actually burnt by prescribed fires are mapped, as this may differ from the area proposed to be burnt, for example, in instances where a fire has jumped containment lines or the fire has self-extinguished and failed to burn the entire proposed area. Similar mapping must be conducted for all bushfires within Mt Jerrabomberra regardless of size. Research into the ecological outcomes of the prescribed fire must be conducted so as to obtain knowledge as to the effectiveness of the prescribed fire in achieving the management objectives and the ecological impacts so as to inform future management actions. Fire management must therefore be adaptive and this requires inputs of reliable ecological information. Post fire



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ecological and fire management outcome research is a key recommendation within this Mt Jerrabomberra FMP.

Concerns regarding the timing and location of prescribed fires with respect to their impact upon plants and orchids in particular were raised by Ms Karen Groeneveld, Vice President, Canberra Orchid Society and reported by Allen (2014). While the concerns raised in the article are addressed within the guiding documentation, some valid questions remain regarding the fire management objectives and effectiveness of the prescribed burns conducted within Mt Jerrabomberra in particular with regard to ecological outcomes. These questions are addressed within this report.



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## 4.4 Fire Fighting Agencies

There are two fire-fighting agencies, the Fire and Rescue Service of NSW (FRNSW) that is staffed by fulltime fire fighters and is generally responsible for fighting fires within built up areas, and the NSW Rural Fire Service (RFS) that is largely staffed by volunteers and responds to fires outside of built up areas.

Mt Jerrabomberra is located in the suburb of Jerrabomberra within the jurisdiction of the FRNSW, with the Queanbeyan NSW FRS station the first responders to a fire in this area. The NSW RFS appliances are better suited for firefighting in bush land and are likely to attend a bushfire within Mt Jerrabomberra.

The closest NSW fire-fighting services to Mt Jerrabomberra include:

- Queanbeyan Fire Station, 41 Campbell Street, Queanbeyan, NSW 2620
- Queanbeyan City Rural Fire Brigade, Ellerton Drive, Queanbeyan, NSW 2620
- Ridgeway Rural Fire Brigade, 2 Highland Close, The Ridgeway, NSW 2620

Additional fire-fighting support could be provided by the ACT Fire and Rescue Service (ACT FRS) and ACT Rural Fire Service (ACT RFS). The first response arrangements to all bushfires and grassfires by ACT Services are by the nearest available most appropriate resource, irrespective of jurisdiction or Service and irrespective of the land tenure (ACT 2012). Of the ACT based FRS and RFS stations located throughout the ACT, those most likely to respond to a fire within Mt Jerrabomberra include but is not limited to the following:

- Chisholm Fire Station - ACT FRS
- Fyshwick Fire Station - ACT FRS
- Jerrabomberra Brigade - ACT RFS
- Kambah Fire Station - ACT FRS
- Phillip Fire Station - ACT FRS
- South Tuggeranong Fire Station - ACT FRS

The likelihood of a multiagency response was demonstrated by the 7<sup>th</sup> January 2014 bushfire within Stringybark Reserve that was fought by units from both ACT and NSW RFS, and FRS services (Westcott 2014).

Aerial support from fire-fighting helicopters is available from the ACT RFS depot at Hume. An Erickson Air Crane may be present subject to seasonal requirements and the NSW government had been trialing the use of American air tankers that were used to suppress the 17 February 2017 Carwoola bushfire that, subject to a review of their use, may also be available along with other aerial fire-fighting aircraft based in NSW.

The first attack fire-fighting capability and capacity to provide backup support in the event of a bushfire within Mt Jerrabomberra is considered by GFE to be excellent, largely due to the location of the Reserve at the urban interface, so close to Canberra and the ACT RFS depot at Hume.

There is a FRNSW Community Fire Unit (CFU), as shown in Figure 31, located adjacent to Mt Jerrabomberra at Tully, Place, Jerrabomberra [J. Murphy pers. comm. 8 June 2017].

CFUs are utilised by volunteers and, while not involved with direct fire-fighting, these units are involved in the preparation of properties to be bushfire ready and, in the event of a bushfire,



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members are able to undertake 'mopping up' activities in the area that releases front line fire fighters to continue to their direct attack on the fire front.



Figure 31. Example of a FRNSW community fire unit.

## 4.5 Access

The housing development that surrounds Mt Jerrabomberra does not comply with NSW Rural Fire Service (2006<sup>1</sup>) 'Planning for Bushfire Protection: A guide for Councils, planners, fire authorities and developers' (PBP) with regard to access and egress. Of principal concern is the lack of an external road separating residences from Mt Jerrabomberra that would provide a fire break and an alternate means of escape for residents. Many residential properties at the edge of the development back directly onto bushfire prone land, Figure 32.



Figure 32. Example of residential properties backing onto Mt Jerrabomberra.

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This development predates the requirements within NSW RFS (2006<sup>1</sup>) PBP.

QPRC has numerous locations in which to access Mt Jerrabomberra, with the main access via Halloran Drive along Jerrabomberra Hill Road, Figure 33.



Figure 33. QPRC access to Mt Jerrabomberra, located off Halloran Drive.

These locations comprise either of locked swing boom gates, Figure 33 or narrow pedestrian access walkways, Figure 34, designed to prevent motorcycle access.



Figure 34. Pedestrian access to Mt Jerrabomberra, located off Conway Street.

While signage is present on some of these gates, Figure 33, it does not provide any indication as to the nature of the access, traffic ability or destination of the access; information that should be provided to fire fighters. These access points while potentially useful for fire-fighting, would need to be accessed by fire-fighting services with caution as they do not provide access to



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formed fire tracks or fire breaks, including a lack of through access, overtaking lanes or turning areas. In this regard Mt Jerrabomberra lacks a developed network of fire access tracks and fire breaks.

Vehicular access to Mt Jerrabomberra has been restricted by QPRC through the use of perimeter steel rail fencing, Figure 35, use of large rocks and gabion walls, Figure 33, although access by motorbikes continues to be an issue [N. Abbott QPRC pers. comm. 29 May 2017]. Access to Mt Jerrabomberra is also possible at several locations through perimeter parcels of land that have yet to be developed.



Figure 35. Steel rail fence separating Mt Jerrabomberra and NLALC.

Fire-fighting agencies have been supplied with keys by QPRC and are able to enter through the appropriate gates [C. Quinn NSWRFSS pers. comm. 11 June 2015].

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## 4.6 Water Supply

NSWFERS can access the existing network of fire hydrants along the road network adjacent Mt Jerrabomberra and therefore access to water for bushfire fire-fighting purposes is considered to be adequate. While six water hydrants are mapped as occurring on Mt Jerrabomberra, only the fire hydrant shown in Figure 5 was located during the two days spent walking across Mt Jerrabomberra. The failure to locate the mapped fire hydrants raises the concern that they are difficult to locate and would be harder to locate under bushfire conditions. In any event, the fire hydrant that was located did not have a standpipe to allow for rapid filling of fire-fighting appliances. While Mt Jerrabomberra has two reservoirs present, i.e. the upper and lower Thornton Reservoirs, no hydrant was obvious at either location and no standpipe was observed. No signage was present at the gates of the reservoirs to indicate that fire-fighting appliances were able to fill at these locations. There are no water standpipes located within or immediately adjacent to Mt Jerrabomberra. There are no static water supplies within Mt Jerrabomberra other than the water supply reservoirs on Jerrabomberra Hill Road.

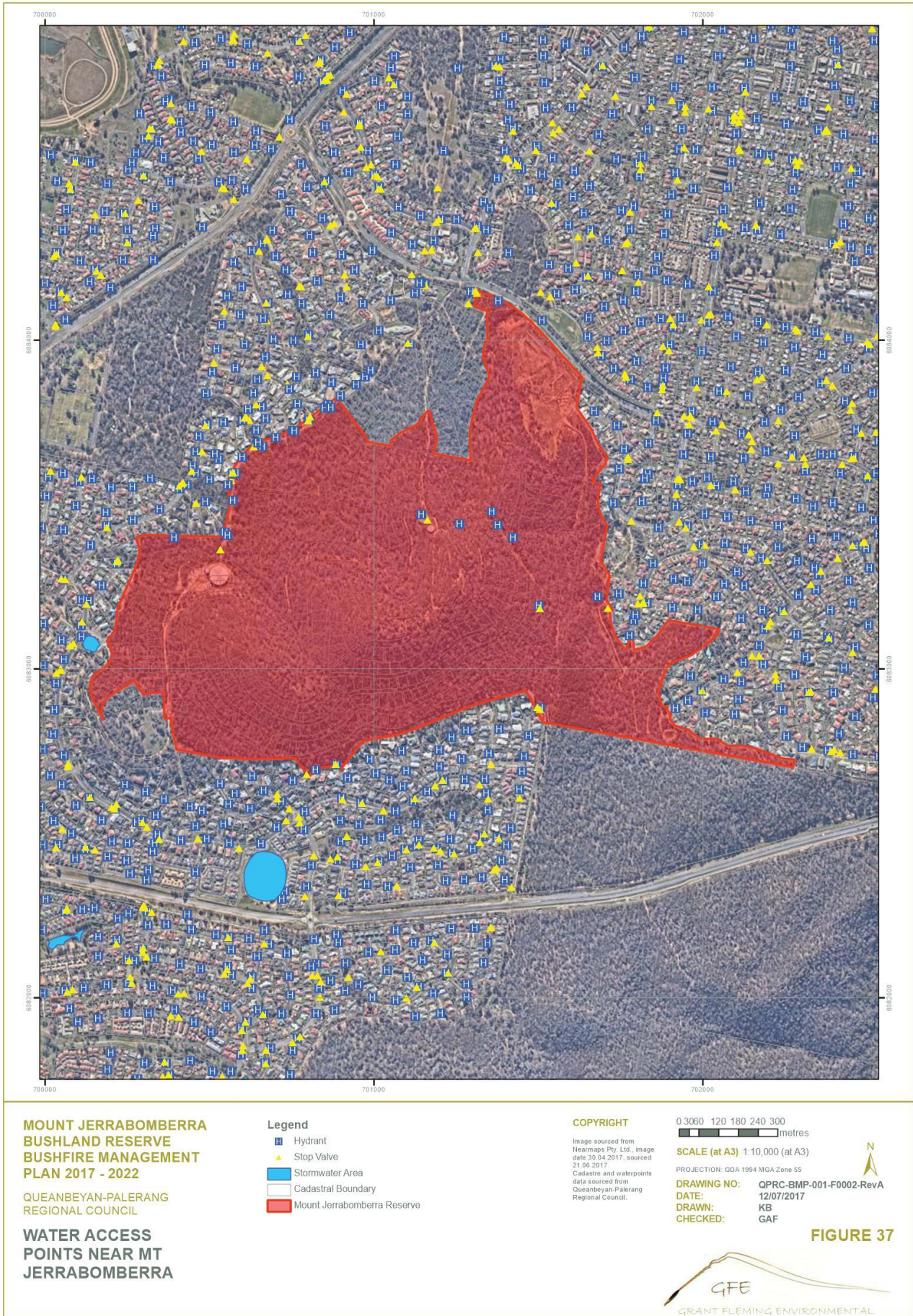
The closest locations that could be utilised by Dolphin fire-fighting helicopters and Erickson Air Crane that are able to fill from standing water bodies that are clear of obstructions are Lake Jerrabomberra and the dam adjacent the intersection of Acacia Drive and Brudenell Drive, Jerrabomberra.

The water carrying capacity of fire fighting vehicles that are likely to attend a bushfire within Mt Jerrabomberra includes:

- Category 1 heavy tanker (3000-4000 L)
- Category 2 medium tanker (1600-3000 L)
- Compressed Air Foam System (CAFS) tanker (8000 L)
- CAFS tanker (2000 L)
- Category 7 light tanker (800-1600 L)
- Category 10 light pumper (<1600 L)
- Light unit (400 L)









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## 4.7 Bushfire Prone Land

Bushfire prone land is defined as land that is either capable of supporting a bushfire or is subject to bushfire attack, including ember attack (NSW RFS 2014). Bushfire prone land is classified in accordance with the type of vegetation present:

- Vegetation **category 1** is land that supports; forests, woodlands, heathlands (tall and short), pine plantations or forested wetlands. Remnant and Short Fire Run vegetation within 30 metres of each other where the combined area is greater than 2.5 hectares is classified as category 1 vegetation. Where land is classified as vegetation category 1, a 100 metre **buffer** is applied (NSW RFS 2014).
- Vegetation **category 2** is land that supports; grasslands, freshwater wetlands, semi-arid woodlands, arid shrublands or rainforests. Remnant vegetation and short fire runs greater than 100 metre lateral separation from category 1 vegetation and 30 metres from other category 2 vegetation is classified as category 2. Where land is classified as vegetation category 2, a 30 metre **buffer** is applied (NSW RFS 2014).

Bushfire prone land is declared and mapped by the QPRC, is endorsed by the NSW RFS and includes all land mapped as category 1, category 2 or buffer. The map of bushfire prone land in relation to Mt Jerrabomberra (QCC 2012) is provided in Figure 38.

Land classified as BPA within Mt Jerrabomberra corresponds with the distribution of Dry Forest and Box Gum Woodland.

Development within the BPA requires an assessment under the Australian Standards AS 3959 – ‘Construction of buildings in bushfire prone areas’ (Standards Australia 2009) to determine the mandatory construction standards. Development must also comply with the NSW RFS (2006) ‘Planning for Bushfire Prevention Guidelines’.





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Figure 38. QCC bushfire prone land, vegetation category 1 (orange), vegetation category 2 (yellow), vegetation buffer (red) modified from QCC (2012).

## 4.8 Vegetation Communities

The vegetation communities present have been mapped within Mt Jerrabomberra, although potential fire runs beyond the Reserve were considered. The type of vegetation present is a determinant of the maximum fire size that an asset may be exposed to due to the fuel characteristics of each vegetation type. Fuel comprises material that can be ignited and sustain a fire, and can include grass, leaf litter and live vegetation. Fuel is categorised according to the layer in which it occurs, including the surface, near surface, elevated (e.g. shrubs and understorey), bark and canopy.



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Open Forest comprises trees with the tallest stratum 10-30 metres in height with a mid-dense, 30 – 70 per cent foliage cover compared to Tall Open Forest that is the same height but with a dense foliage cover of 70 – 100 per cent (Specht 1970).

Ecological (2010) indicates that Mt Jerrabomberra is dominated by Western Tablelands Dry Forest with several severely disturbed areas and an area of pine plantation, and does not support Box Gum Woodland, although it occurs on the lower slopes and in the general vicinity of Mt Jerrabomberra. Ecological (2010) state “the vegetation within the study area comprises part of the Southern Tableland Dry Sclerophyll Forests vegetation community and Dry Sclerophyll Forests (Shrubby subformation) vegetation formation of Keith (2006).”

The vegetation mapping supplied by QPRC indicates that native grassland occurs along the narrow projection of Mt Jerrabomberra adjacent the NLALC land in the far southeast corner of the Reserve and at either end of The Scar Recreation Reserve, and in a narrow band between two of the three peaks, Figure 42, although Ecological (2010) report that native grasslands were not present within the study area.

The area of remnant pine plantation in the southeast corner of the Reserve occupies approximately 2.4 hectares and contains scattered native regrowth. The pine plantation lacks the understorey stratum being comprised almost entirely of a canopy layer and surface layer of vegetation.



Figure 39. Remnant pine plantation.

#### 4.8.1 Dry sclerophyll shrub forest

The Dry Sclerophyll Shrub Forest vegetation association is dominated by *Eucalyptus rossii* (Scribbly Gum), Figure 40, with *Eucalyptus polyanthemos* (Red Box), *Eucalyptus macrorhyncha* (Red Stringybark), *Eucalyptus goniocalyx* (Bundy) and *Eucalyptus nortonii* (Mealy Bundy). The plant class community types have not been mapped across Mt Jerrabomberra and, while Dry Forest plant associations can accumulate fuel rapidly (NPWS 2004), evidence obtained from the site inspection indicates that the presence of *Kunzea ericoides* (Burgan) or other shrubs with a similar structure can have a significant impact upon the fuel hazard rating, Figure 41. It is therefore recommended that detailed mapping of plant community types be conducted across Mt Jerrabomberra so that a more accurate picture can be obtained of the fuel hazard that exists.





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Burgan is considered a highly flammable plant (Fogarty 2001) that forms dense monospecific stands increasing the fuel load and increasing the probability of high fire intensity across the area in which it occurs (Simmons, Adams and Stoner 2006). Spread of Burgan within Mt Jerrabomberra in response to fire, in particular in response to prescribed fire must be monitored, as an increase in distribution increases the likelihood of a high intensity bushfire.



Figure 40. Dry Forest with a canopy of *Eucalyptus rossii* (scribbly gum).



Figure 41. Dry Forest with a canopy of Scribbly Gum and Red Stringybark with Burgan.

The Dry Sclerophyll Shrub Forest vegetation association includes a diverse orchid assemblage, Table 9, that can be susceptible to inappropriate fire regimes.









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Table 9: Records of orchid species within Mt Jerrabomberra (K. Groeneveld pers. comm. 5 June 2015).

Mount Jerrabomberra Bushland Reserve			
Species	Common name	Conservation Status	Flowering season
<i>Caladenia caerulea</i>	Blue Fingers	Not listed	Spring: Mid Sep-early Oct
<i>Caladenia fuscata</i>	Dusky Fingers	Not listed	Spring: Oct
<i>Caladenia moschata</i>	Musky Caps	Not listed	Spring: Oct
<i>Caladenia phaeoclavia</i>	Brown-clubbed Spider Orchid	Not listed	Spring: Late Oct-early Nov
<i>Caladenia tentaculata</i>	Fringed Spider Orchid	Not listed	Spring: Mid Sep-early Oct
<i>Caladenia ustulata</i>	Brown Caps	Not listed	Spring: Oct
<i>Caleana major</i>	Flying Duck Orchid	Not listed	Spring: Late Oct-early Nov
<i>Corunastylis clivicola</i>	Rufous Midge Orchid	Not listed	Autumn: Late Mar
<i>Corunastylis cornuta</i>	Horned Midge Orchid	Not listed	Autumn: March
<i>Diplodium revolutum</i>	Autumn Greenhood	Not listed	Autumn: March
<i>Diuris semilunulata</i>	Late Leopard Orchid	Not listed	Spring: Oct
<i>Diuris sulphurea</i>	Hornet or Tiger Orchid	Not listed	Spring: Mid Oct-early Nov
<i>Eriochilus cucullatus</i>	White Autumn Orchid	Not listed	Autumn: March
<i>Glossodia major</i>	Waxlip Orchid	Not listed	Spring: Late Sep-mid Oct
<i>Hymenochilus cyanocephalus</i>	Swan Greenhood	Not listed	Spring: Late Sep-early Oct
<i>Hymenochilus muticus</i>	Midget Greenhood	Not listed	Spring: Late Sep-early Oct
<i>Microtis parviflora</i>	Slender Onion Orchid	Not listed	Spring: Nov
<i>Specularantha rubescens</i>	Blushing Tiny Greenhood	Not listed	Autumn: March
<i>Thelymitra junceifolia</i>	Large Spotted Sun Orchid	Not listed	Spring: Late Oct-early Nov
<i>Thelymitra pauciflora</i>	Slender Sun Orchid	Not listed	Spring: Late Oct-early Nov



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### 4.8.2 Threatened species

A search within the Atlas of Living Australia database, Table 10 for occurrence records of threatened plant species within Mt Jerrabomberra located five records of *Glycine clandestina* (Twining Glycine) and a single record of *Rutidosia leptorrhynchoides* (Button Wrinklewort) (ALA 2017). Ecological (2010) reported locating a single specimen of *Glycine clandestina* (Twining Glycine) within Mt Jerrabomberra. The indicative location of this population can be obtained from Ecological (2010) and, while a targeted search was conducted for *Rutidosia leptorrhynchoides* (Button Wrinklewort), no specimens were located.

Table 10: Records of threatened plant species within Mt Jerrabomberra (ALA 2017).

FAMILY	SPECIES	COMMON NAME	NSW STATUS	COMMONWEALTH STATUS
Asteraceae	<i>Rutidosia leptorrhynchoides</i>	Button Wrinklewort	Endangered	Endangered
Fabaceae	<i>Glycine clandestina</i>	Twining Glycine	Endangered	Not listed

Ecological (2010) reported locating five sites that supported a population of 200 – 300 *Leucochrysum albicans* (Hoary Sunray), Figure 43, that, while recognized as being locally common, is listed as endangered under the EPBC Act.



Figure 43. *Leucochrysum albicans* var. *tricolor* (Hoary Sunray).

Hoary Sunray relies on the presence of bare ground for germination and establishment (Sinclair 2011). While periodic disturbances such as fire create the required bare ground, fire may not be required in the high altitude grasslands where there is a greater inter-tussock space suitable for germination offsetting the requirement for periodic disturbance (Sinclair 2011). Hoary Sunray has been known to colonise roadside areas following disturbance (Sinclair 2011). Destruction of stands of Hoary Sunray should be avoided wherever possible, although it may be possible to recolonize an area following disturbance either by seed collection and subsequent replanting with tube stock or by sowing seed directly. Any prescribed burns should seek to avoid burning stands of Hoary Sunray although a burn may create conditions suitable for germination of this species provided that a seed source remains intact.

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### 4.8.3 Fire thresholds

Fire plays an important role in maintaining biodiversity within a plant association or community. The response to fire of key species within each plant association needs to be understood so that this information can be applied to fire management practices. Knowledge of key species responses can be used to establish fire regime (fire interval, intensity, season and type) thresholds. A threshold of potential concern (TPC) refers to the specific fire regime where species significantly increase or decline. That is, a particular fire regime is required to maintain the ecological community and plant association. The lower threshold of potential concern (TPC1) for fire interval for the Dry Forest is 7 years (NPWS 2004). More frequent fires would cause the vegetation association to become dominated by the early successional species such as Acacias and may kill juvenile trees recruited following the initial fire event. The upper threshold of potential concern (TPC2) for these vegetation associations is 30 years (NPWS 2004). Fire intervals longer than this period may lead to a decline in those plants that are obligatory seeders. The ecological fire management guidelines for these major vegetation subgroups within Mt Jerrabomberra are presented in Table 11.

Occasional fire intervals of greater than 25 years may be desirable (NPWS 2004). While fuel loads accumulate quite rapidly in this vegetation formation, with NPWS (2004) indicating that 10 tonnes per hectare may be reached within 2-5 years of a low intensity fire, strategic planning of controlled burns will be necessary to manage overall fuel loads whilst maintaining the ecological integrity of the vegetation formation.

Table 11: Ecological fire management guidelines.

Keith (2002) Vegetation Formation of NSW		E2: Dry Sclerophyll Shrub Forest
OEH (2011) <i>Plant Communities of the South Eastern Highlands within the Murrumbidgee CMA</i>		p4: Red Stringybark – Scribbly Gum
Interval (NPWS 2004)	TPC1: Lower Threshold in years	7
	TPC2: Upper Threshold in years	30
Spatial Criteria	Inter-fire intervals with TPC1 and TPC2 across more than x per cent of the extent of this MVS within the planning area 1.	60
	per cent >TPC2	20
Frequency	Avoid more than two fires within a period of x years.	15
	Avoid more than two successive fires of low intensity (within the same location).	Yes
Intensity	Some medium to high intensity fire needed to regenerate some species.	Yes
Season	Avoid two or more successive fires in season.	Spring or following drought

The schedule in Table 11 refers to controlled burns and the incidence of bushfire or arson, and requires a flexible approach to planning controlled burns. It is apparent from the recommended fire thresholds that fire should remain a comparatively infrequent event within these vegetation associations, with no more than two fires recommended within a period of 15 years for the Dry Sclerophyll Forest with a shrub layer. Occasional fire intervals of greater than 25 years in the Dry Sclerophyll Forest are desirable (NPWS 2004).



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## 4.9 Fuel Load

Fuel comprises material that can be ignited and sustain a fire; this can include grass, leaf litter and live vegetation. Fuel is categorised according to the layer in which it occurs, including the surface, near surface, elevated (shrubs and understorey), bark and canopy, Figure 44. The assessment of fuel load is used to evaluate the threat posed to assets within and adjacent to Mt Jerrabomberra.

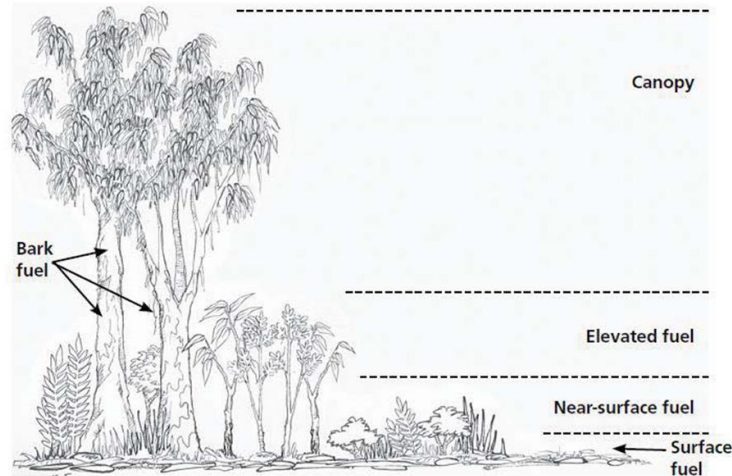


Figure 44. Fuel layers (Fig. 2.1 from Hines et al. 2010).

- **Canopy Fuel** – This is the crown of the Scribbly Gum, Red Stringybark, Red Box and other trees that make up the tallest layer. The Hines *et al* (2010) fuel assessment procedure does not measure the canopy fuel as part of the overall fuel hazard, however, this does not detract from the importance of tree canopy as a fuel nor the influence canopy has on the dynamics of a bushfire, in particular spotting and crown fires.
- **Bark Fuel** – The flammable bark on tree trunks and upper branches. Eucalypts with thick fibrous bark or bark that hangs from branches in long strips can significantly increase the fuel available to a fire. Bark affects fire behaviour by providing a source of embers that can produce spot fires. Strips of bark hanging from trunks and branches can act as wicks and fire brands. The presence of *Eucalyptus macrorhyncha* (Red Stringybark), Figure 45, or *Eucalyptus rubida* (Candlebark) within an area significantly increases the potential fuel load.
- **Elevated Fuel** – Refers to the shrub layer and juvenile canopy layer plants, typically growing to a height of 2-3 metres. This includes *Kunzea ericoides* (Burgan), Figure 45, and *Acacia pycnantha* (Golden Wattle). Typically this layer has a vertical structure as is the case for Golden Wattle, however, plants with dense foliage, spreading bushy form that extend to the ground, increase the fuel load, as the branch and leaf structure allows for a high mix of fuel (organic matter) and oxygen. The structural form of the vegetation is a determinant of fire intensity.
- **Near-surface Fuel** – Includes the tussock grasses, Figure 46, low shrubs and weed species. This layer varies in structure and continuity with tussock grasses more commonly found on slopes with a southerly aspect. Drier slopes of Mt Jerrabomberra typically possessed a sparse layer of low shrubs and herbs, as shown in Figure 40 where clumps of *Stypandra glauca* (Nodding Blue Lily) were the dominant understorey species under a canopy of scribbly gum.





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Figure 45. Example of very high bark fuel – *Eucalyptus macrorhyncha* (Red Stringybark) and low bark fuel hazard - *E. rossii* (Scribbly Gum).



Figure 46. Example of near surface fuel load – *Poa sieberiana* (Snow Grass) tussock grasses.

- **Surface Fuel (or litter)** – Includes the twigs, branches, bark and leaves, Figure 47. This layer typically contributes the greatest amount to fuel quantity, as it includes the partially decomposed fine organic matter.



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Figure 47. Dry forest surface fuel load – leaf litter, bark and small branches.

The fuel load within Mt Jerrabomberra was assessed between 12 -13 June 2017 at 12 locations using the Hines *et al* (2010) methodology. The results are presented in Table 12 and Figure 48, and clearly demonstrate the greatest fuel load assessed occurs within plant communities with Red Stringybark and Burgan. Variation amongst the overall fuel hazard ratings attained for the fuel load assessment locations within the Dry Forest vegetation formation was largely due to the density of *Eucalyptus macrorhyncha* (Red Stringybark) present or other dominant tree species that shed bark in ribbons. The density of the shrub layer also showed considerable variation between fuel load assessment sites.

The indicative fuel load within the Dry Forest ranged from 5 – 34<sup>+</sup> tonnes per hectare across the fuel load assessment sites indicating that the fuel load can vary significantly within the Dry Sclerophyll Forest vegetation association. The overall fuel hazard rating is considered to be 'high' with this value increasing in patches where Red Stringybark and/or Burgan occur. As discussed in Section 4.8.1, mapping of the vegetation community types across Mt Jerrabomberra is essential to delineate these localized areas of very high or extreme fuel hazard. The mapping of fire history across Mt Jerrabomberra is equally important given the known response of Burgan to fire, that is, fuel load may be increased following a fire due to the proliferation of Burgan. This effect was evident at fuel load assessment points 1 and 12 that had been burnt in 2009 and 2010 respectively, and recorded fuel hazards of extreme and very high correspondingly due to the dominance of Burgan and Golden Wattle in the elevated fuel layer.

The post fire response of vegetation must be considered in planning prescribed burning programs, as, while a prescribed fire produces a reduced fuel load hazard in the short term, the mid to long term effect may be to increase the fuel load hazard to a level greater than the pre-fire level by creating conditions that promote flammable species that then dominate the community.

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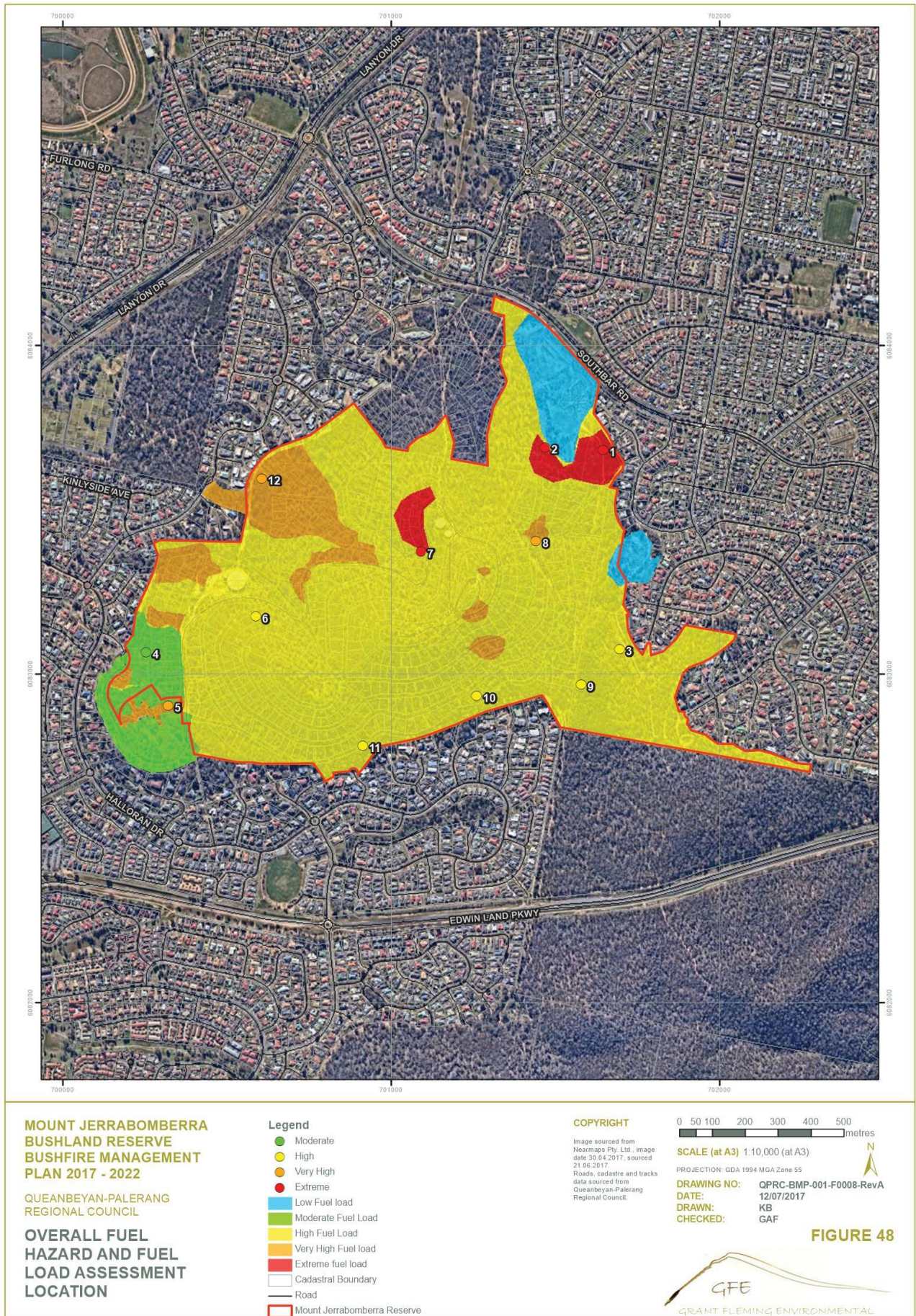
Table 12: Mt Jerrabomberra – indicative fuel loads.

Vegetation Formation	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest	Dry Forest
Location No.	1	2	3	4	5	6	7	8	9	10	11	12	
Previous low intensity fire.	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	Yes	
Previous high intensity fire.	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	
Bark Hazard	VH	VH	L	L	M	L	VH	H	H	M	M	M	
Elevated Fuel Hazard	VH	VH	M	L	VH	L	L	H	L	M	L	H	
Near Surface Fuel Hazard	VH	VH	M	L	VH	M	E	M	L	H	H	VH	
Surface Fine Fuel Hazard	E	M	VH	M	E	VH	E	E	H	H	VH	VH	
Surface Fine Fuel Hazard (mm)	56.8	20.2	32.2	22.2	48.0	35.0	41.8	56.6	22.2	31.2	28.4	33.8	
Combined Surface & Near Surface	E	VH	VH	M	E	VH	E	E	H	VH	E	E	
Overall Fuel Hazard Rating	E	E	H	M	VH	H	E	VH	H	H	H	VH	
Indicative Fuel Load (t/ha)	23-36+	11 - 26	15 - 25	5 - 13	23 – 32+	14 - 24	22 – 34+	20 – 28+	9 - 19	12 - 21	15 - 26	18 - 30	

L= low, M=moderate, H=high, VH=very high, E=extreme









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## 4.10 Fire Behaviour Assessment

### 4.10.1 Topography

The local topography including slope and aspect are determinants of the part of the fire (head, flank, back) that an asset may be exposed to.

Mt Jerrabomberra is located within the Interim Biogeographic Region of Australia (IBRA) South Eastern Highlands Bioregion and the Monaro subregion within the upper Murrumbidgee catchment (OEH 2011<sup>1</sup>). The Monaro subregion is characterised as a sloping plateau rising in elevation from 600 m to 1300 m north to south, with structural ridges and stepped basalt plains with intervening low areas of granite, or sedimentary rocks (OEH 2011<sup>1</sup>). The area is in a rain shadow with rainfall across the Monaro Bioregion ranging from 450 mm - 750 mm. The soils present vary from harsh yellow texture soils in general, to red brown soils and black stony loams that have developed in the presence of underlying basalt (OEH 2011<sup>1</sup>).

Mt Jerrabomberra comprises three adjacent northwest to southeast aligned ridges that sit along a northeast to southwest axis. The peaks are of 754 metres, 785 metres and 777 metres. The drainage lines present are ephemeral first and second order streams that either drain towards Jerrabomberra Creek to the west or towards Barracks Creek and the Queanbeyan River to the east. Generally these drainage lines exit Mt Jerrabomberra through drainage reserves that extend through the surrounding housing estates. The lower slopes of Mt Jerrabomberra have almost entirely been developed as residential housing.

An escarpment that extends from the northwest to the southeast separates the Scar Recreation Reserve from the remainder of Mt Jerrabomberra.

### 4.10.2 Slope

Slope can affect bushfire behaviour with fires burning faster up slope than down slope, in particular when aligned with the prevailing wind direction. A fire burning up a 10 degree slope will generally spread at double the rate of a fire on level ground (Bushfire CRC 2009). Likewise a fire burning up a 20 degree slope will generally spread at a rate that is four times the rate of spread across level ground (Bushfire CRC 2009).

Slopes within Mt Jerrabomberra and the surrounding area have been calculated using 2 m contour intervals within ArcView Spatial Analyst to produce a digital elevation model (DEM) that enabled the slope to be calculated in degrees. Slope was classified into five categories, Table 13.

Table 13: Slope categories.

Description	Slope Category
Flat	Flat – 5 degrees
Gentle	6 – 10 degrees
Moderate	11 – 15 degrees
Steep	16 – 20 degrees
Very Steep	20 – 30+ degrees

Mt Jerrabomberra is characterised by steep to very steep slopes across much of the landscape, Figure 49, and very steep slopes extend in a broad arc from the southwest, eastwards to the northeast and escarpment. On the western side of the mountain, the slopes, while steep to very steep, are more broadly rounded and are noticeably bisected by the two main drainage lines



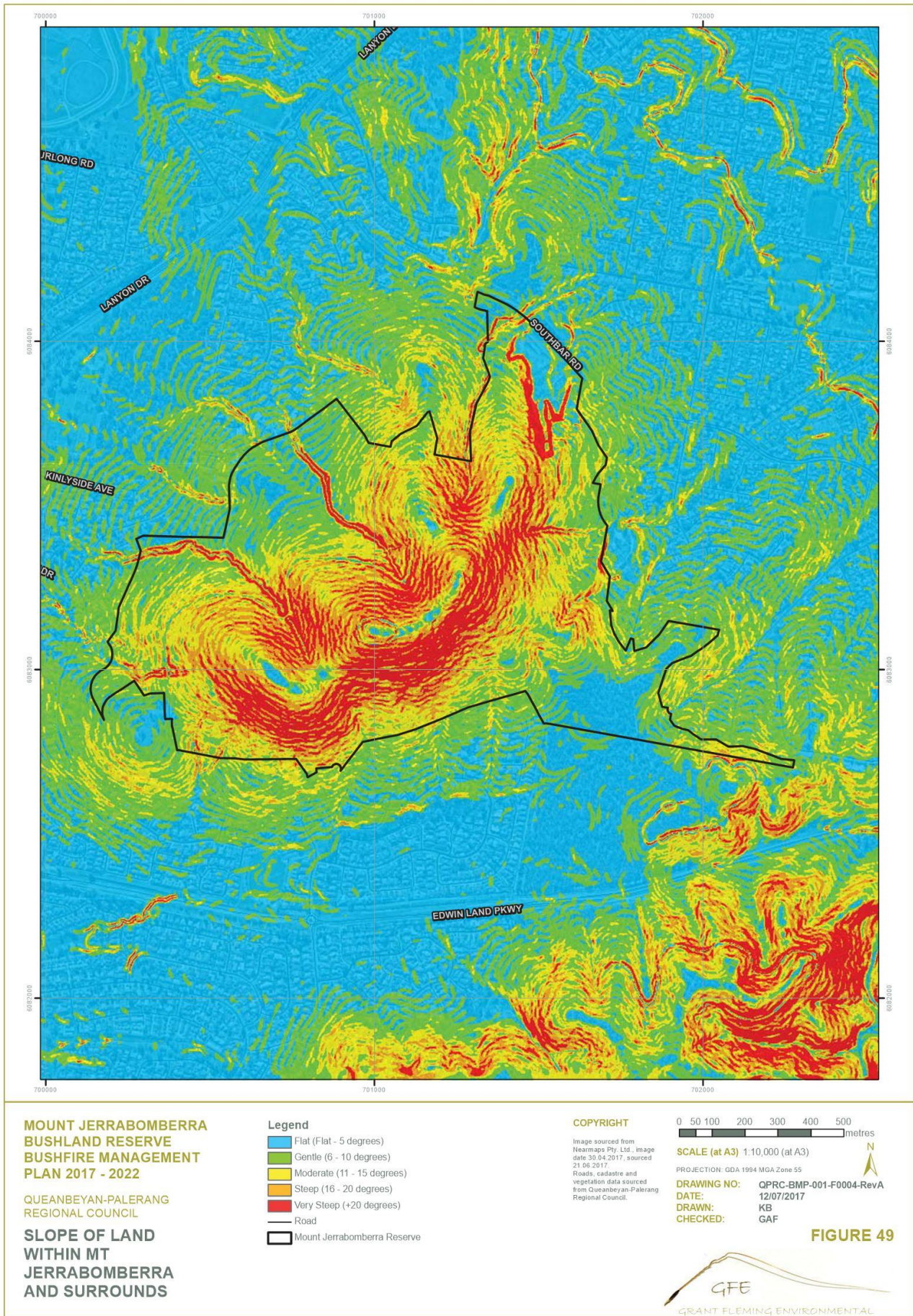
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that separate the three ridges giving this side of the mountain a convex curvature in plan view. The peaks are typically flat.

Steep and very steep slopes that are equal to or greater than  $16^{\circ}$  are associated with the rising ground of watercourses that bisect Mt Jerrabomberra. Comparatively small areas of flat to gentle sloping land is located around the perimeter of the Reserve, due to the development of the surrounding housing estates, although, where this has not occurred in the southeast corner, a broader area of flat land exists that coincides with the location of the pine plantation.









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### 4.10.3 Aspect

Aspect is another topographical factor affecting bushfire behaviour. North facing slopes receive more solar radiation that dries surface fuel faster than on south facing slopes (Bushfire CRC 2009). Later in summer and during drought, fuels may become uniformly dry across slopes with different aspects, at which stage slope orientation to the prevailing wind becomes a more important factor (Bushfire CRC 2009). As shown in Figure 10, the greatest percentage of high FFDI days involves a northwesterly wind direction.

Mt Jerrabomberra is aligned along a northeast to southwest axis with each ridge aligned 90 degrees to this axis. As discussed, the southeastern side of these ridges gently curves and is not strongly bisected by streams. As a result, the aspect is a broad band of southeast and southerly aspect slopes that are very steeply sided.

On the northwestern side of Mt Jerrabomberra, the three ridges are strongly bisected by the streams giving rise to southwest-westerly slopes on one side of the stream gully and northeasterly aspect slopes on the opposite side. The strongly convex contours give rise to rounded head slopes that have a northwesterly-northerly aspect. The extent of slopes with northerly or northwesterly aspects is, however greatly reduced and they are confined to the head slopes due to the bisected nature of the landform. The presence of the ephemeral streams within gullies that are aligned in a northwest to southeast direction presents the possibility of bushfire being funneled up these steep to very steep gullies towards the crests. Bushfire can be expected to move rapidly upslope along the entire northwestern side of Mt Jerrabomberra and more rapidly along the gully slopes with a northwesterly to northeasterly aspect as these slopes will be inherently drier earlier in the bushfire season.

The escarpment above The Scar Recreation Reserve may act to hinder the advance of bushfire upslope, however once fire moves beyond the escarpment, it is also expected to move rapidly upslope due to the very steep northeasterly and northwesterly aspect slopes to the crest under the influence of a northeasterly wind.

In producing the calculation of bushfire hazard, weightings were applied to the slope categories to produce a weighted slope dataset. Weightings were applied on the basis of the potential impact of aspect upon the fire hazard due to the alignment with prevailing wind direction on days of high FFDI and fuel condition. The weightings follow those utilised by EarthTech (2006), as shown in Table 14. Aspect could have the following possible effects upon a fire:

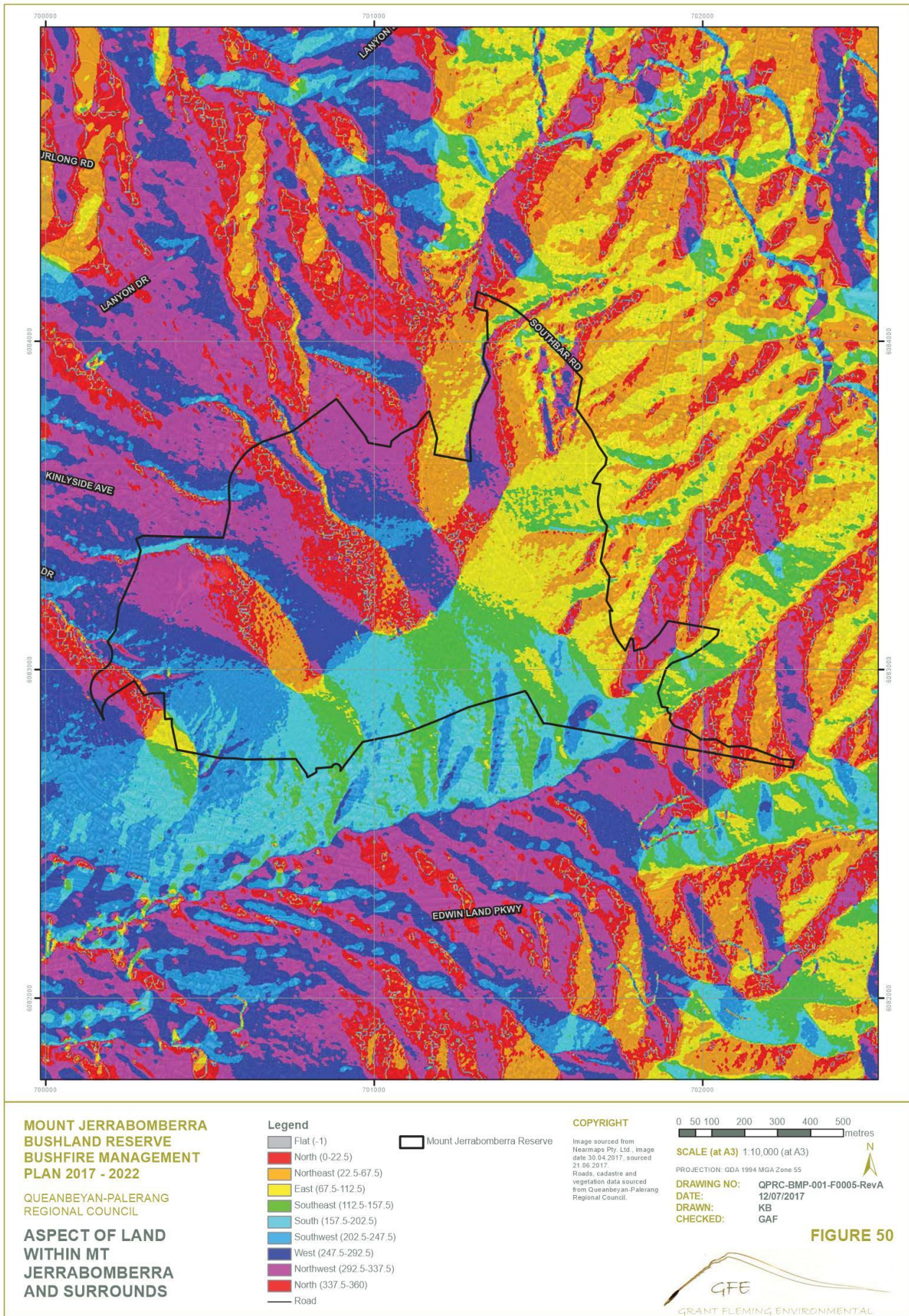
- Increase the effect of slope upon one or more fire characteristics
- Reverse the effect of slope upon one or more fire characteristics
- No impact on the effect of slope upon one or more fire characteristics.

**Table 14: Aspect weightings to be applied to create weighted slope classification (From EarthTech 2006 & Shamir 2003).**

Aspect (degrees)	Weighting	Aspect (degrees)	Weighting
Flat (0°)	1.0	S (157.5° -202.5°)	-0.5
N (0-22.5°, 337.5° -360°)	0.5	SW (202.5° -247.5°)	0.0
NE (22.5° -67.5°)	0.0	W (247.5° -292.5°)	0.5
E (67.5° -112.5°)	-0.5	NW (292.5° -337.5°)	1.0
SE (112.5° -157.5°)	-1.0		









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#### 4.10.4 Fire run

The consideration of fire run is based upon the fastest moving part of the fire called the head fire that spreads generally in the direction of the wind. Where land that would support a bushfire interfaces with Mt Jerrabomberra, the maximum length fire run that intersects the interface has been calculated. Fire runs from the northwest are prioritized as they align with the dominant wind directions associated with extreme/catastrophic fire danger occurrences, as identified shown in Figure 10. Secondary priorities are given equally to fire runs from the north, west, east-southeast and southwest. These fire run calculations consider the potential for a fire to enter Mt Jerrabomberra.

A bushfire could originate from any adjoining residential property, as there is often no effective separation between the Reserve and the property, however this has not been mapped as there is no effective fire run. Fire runs exist where native vegetation has been retained between houses in the form of a drainage reserve or access. Three fire runs into Mt Jerrabomberra of 58 metres, 115 metres and 138 metres exist along Carolyn Jackson Drive.

The most significant threat to Mt Jerrabomberra is considered to be associated with the fire runs that exist between the undeveloped property to the northeast of Mt Jerrabomberra that extends south from Southbar Road and east from both Benalla Court and Ormond Court. In the vicinity of Benalla Court, fire runs exist into Mt Jerrabomberra under the influence of a northerly wind (242 metres), northwesterly (362 metres) and westerly (372 metres). A fire run also exists under the influence of a northerly wind through this same property from Southbar Road into Mt Jerrabomberra, a distance of 507 metres. The native vegetation present on this land is contiguous with Mt Jerrabomberra that is, there is no discernable boundary present. The position of this property to the northwest of Mt Jerrabomberra aligns with the prevailing wind direction most likely to be associated with days of extreme or catastrophic fire danger making these fire runs the most significant threat from a bushfire ignition external to Mt Jerrabomberra.

The most substantial interface with bushland occurs in the southeast corner of the Reserve. Fire runs from along the Edwin Land Parkway exist through the NLALC land under the influence of a southerly or southeasterly wind. These fire runs may be up to 435 metres long, with fire runs shortening as the point of ignition is moved eastwards along the Edwin Land Parkway.

Consideration is also given to the potential fire run of a bushfire igniting at the interface with Mt Jerrabomberra and travelling away from the interface. Mt Jerrabomberra is surrounded by residential properties that effectively eliminate all fire runs with the exception of the undeveloped land in the northwest corner and the NLALC lands that adjoin the southeast corner of the Reserve. Under the influence of a northwesterly wind, the greatest potential for fire to emerge from Mt Jerrabomberra into bushland occurs in the southeastern corner at the junction with the NLALC lands. These fire runs are the reverse of these described that threaten Mt Jerrabomberra along the NLALC boundary with the Edwin Land Parkway.

In accordance with ESA (2014<sup>2</sup>), the length of fire run is classified into three distance categories for the purpose of the asset interface classification (AIC). The fire run distance categories are:

- <100 m
- 100-350 m
- >350 m

The classification of fire run that exists on land that interfaces with Mt Jerrabomberra and could potentially support a bushfire is presented in Figure 51.

A fire within Bicentennial Park has the potential to spot into Mt Jerrabomberra directly or spread into the Reserve if it is able to jump both Tharwa Road and Southbar Road. A similar potential exists for a bushfire to either spot directly into Mt Jerrabomberra from the natural bushland located to the west. This bushland extends between the Queanbeyan Lawn Cemetery and the residential properties west of Brennan Court and Freestone Crescent, and extends north to Lanyon Drive and is only separated from Mt Jerrabomberra by Carolyn Jackson Drive. A





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bushfire within this bushland therefore has the potential to spread into Mt Jerrabomberra under the influence of a north-westerly wind if it jumps the width of Carolyn Jackson Drive. While the potential fire runs that exist within the landscape surrounding Mt Jerrabomberra present a more direct threat, the potential exists for spot fires to ignite within Mt Jerrabomberra from bushfires with an active front up to 20 km away, subject to weather conditions on the day.

Historically bushfires on Mt Jerrabomberra have caused spot fires in the adjoining residential areas of DeSalis and Karabar through to Barracks Flat and the eastern side of the Queanbeyan River, and this threat remains.

Long internal fire runs threaten adjoining residential areas in every direction subject to the prevailing winds.

### Scenarios

- A bushfire ignited (most likely due to arson) on the western slopes would move rapidly under the influence of a westerly, north-westerly or northerly wind up the head slopes and potentially even faster up the gullies to the crest of one or more ridges subject to the location of the ignition point. While the steep to very steep slopes on the south-eastern side of Mt Jerrabomberra would slow the fire front, spotting ahead of the fire front would be a significant problem. Residential properties on the south-eastern side would come under direct threat and indirect threat from ember attack.
- Under extreme FFDI conditions, a major bushfire on Mount Jerrabomberra could spot under the influence of a north westerly wind into the surrounding residential areas, NLALC lands and Stringybark Reserve.
- A bushfire ignited (most likely due to arson) along the southwestern corner of Mt Jerrabomberra has the potential to sweep across the south-western to south-eastern slopes of Mt Jerrabomberra in a broad arc towards Rusten Street and Kinsella Street under the influence of westerly to south-westerly wind, along a similar path of the 1977 and 1985 bushfires.
- A bushfire ignited (most likely due to arson) on the flanks of The Scar Recreation Reserve would move rapidly up the slope to the crest of Mt Jerrabomberra under the influence of a northerly or north-easterly wind.
- A bushfire could be ignited, most likely through carelessness from an adjoining residential property as a result of an outdoor fire.









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## 4.11 Bushfire Hazard Calculations

Bushfire hazard is greatest on steep to very steeply sloping land with a north, north westerly or westerly aspect that has a very high to extreme overall fuel hazard.

These areas have been mapped by utilising aspect to produce a weighted measure of slope and modelling this parameter against overall fuel load across Mt Jerrabomberra that was determined by field assessments. The bushfire hazard was calculated utilising the matrix shown in Table 15 to produce a four-class hazard rating that is consistent with NSW RFS (2008) of Low, Moderate, High or Very High. This approach has been adapted from that employed by EarthTech (2006).

The fire ignition potential, while better understood as a result of the investigation conducted for this BMP, is not sufficiently detailed to be applied at the scale of Mt Jerrabomberra. Future records of fire ignition events and mapping of areas burnt may enable fire ignition probability to be utilised to enhance modelling of bushfire hazard within Mt Jerrabomberra. Probable fire ignition has therefore been assigned as a constant across Mt Jerrabomberra for the basis of modelling bushfire hazard.

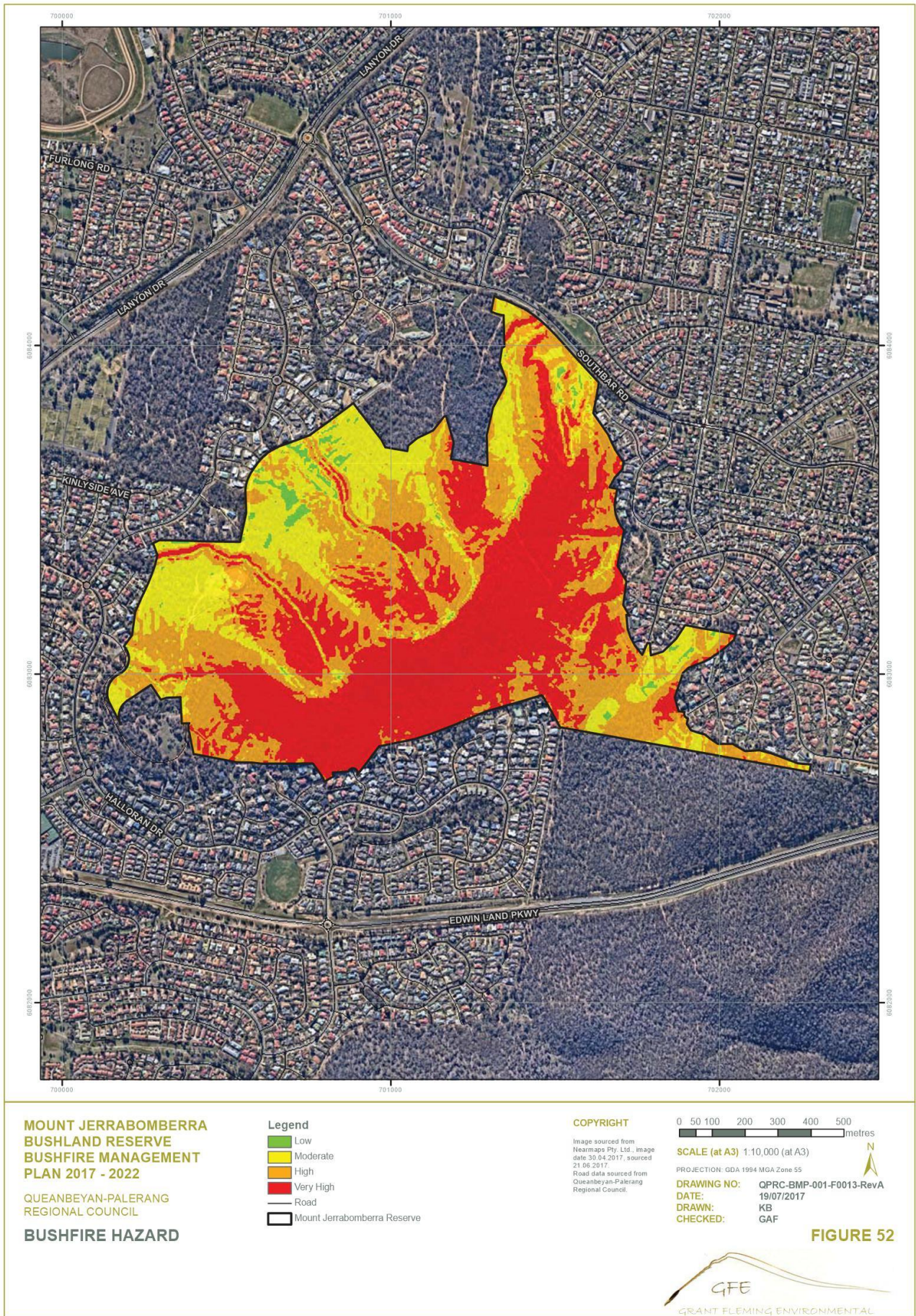
Table 15: Bushfire hazard categories.

		Weighted Slope				
		Flat	Gentle	Moderate	Steep	Very Steep
Fuel Load	Low	Low	Low	Low	Moderate	Moderate
	Moderate	Low	Moderate	Moderate	High	High
	High	Low	Moderate	High	High	Very high
	Very High	Moderate	High	High	Very high	Very high
	Extreme	Moderate	High	Very high	Very high	Very high

The resultant map of bushfire hazard across Mt Jerrabomberra is shown in Figure 52.









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## 5 BUSHFIRE RISK ASSESSMENT

### 5.1 Risk Assessment Process

The process of calculating the bushfire risk differs for each type of asset (Human Settlement, Economic or Environmental Assets), as shown in Figure 53. In general terms:

$$\text{Consequence} \times \text{Likelihood} = \text{RISK}$$

The process of determining the *likelihood* of a bushfire igniting and spreading within Mt Jerrabomberra involves consideration of how often fires occur, the cause of fires (arson or as the result of other human activities) and consideration of accessibility by fire crews to suppress fires. Consideration is also given to the potential for a fire to run and information that is known or can be predicted regarding the path that fires will take. The calculation of likelihood is consistent for each asset type.

While the risk assessment approach is explained in more detail within the following sections, the different methods of calculating consequence are outlined in this section.

#### 5.1.1 Human settlement assets

The calculation of *consequence* for Human Settlement Assets involves the determination of the *threat* and the vulnerability. That is:

$$\text{Threat} \times \text{Vulnerability} = \text{CONSEQUENCE}$$

The level of threat posed to an asset by bushfire is determined by the vegetation association that poses the threat, for example, Dry Forest Shrub formation and the inherent fuel load. Slope and aspect influence fire behaviour and therefore are also utilised to determine the level of threat. The distance that separates the hazard and the asset is also used to determine threat.

Vulnerability is a measure of how prepared the property is to resist attack by fire and how prepared and informed residents are. A list of some of the factors taken into consideration is presented in Table 23 (Section 5.3.3).

#### 5.1.2 Economic assets

The calculation of *consequence* for Economic Assets differs in that it involves the determination of the *level of impact* and the *recovery costs*. That is:

$$\text{Level of impact} \times \text{Recovery costs} = \text{CONSEQUENCE}$$

The level of impact refers to whether the costs associated with the loss of the asset would impact upon the local economy, have a regional impact or impact on the state or national economy. Recovery cost is associated with the level of financial support required to redevelop the asset following the fire. The Victorian Black Saturday bushfires would be an example of a high recovery cost, as support is required over a broad geographic area for an extended period of time (years) to recover.



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### 5.1.3 Environmental assets

The calculation of *consequence* for Environmental Assets requires a unique approach and involves the determination of the *vulnerability* of the environmental asset to bushfire and the *potential impact* that a bushfire may have upon the ecological community or composite species.

That is:

$$\text{Potential impact} \times \text{Vulnerability} = \text{CONSEQUENCE}$$

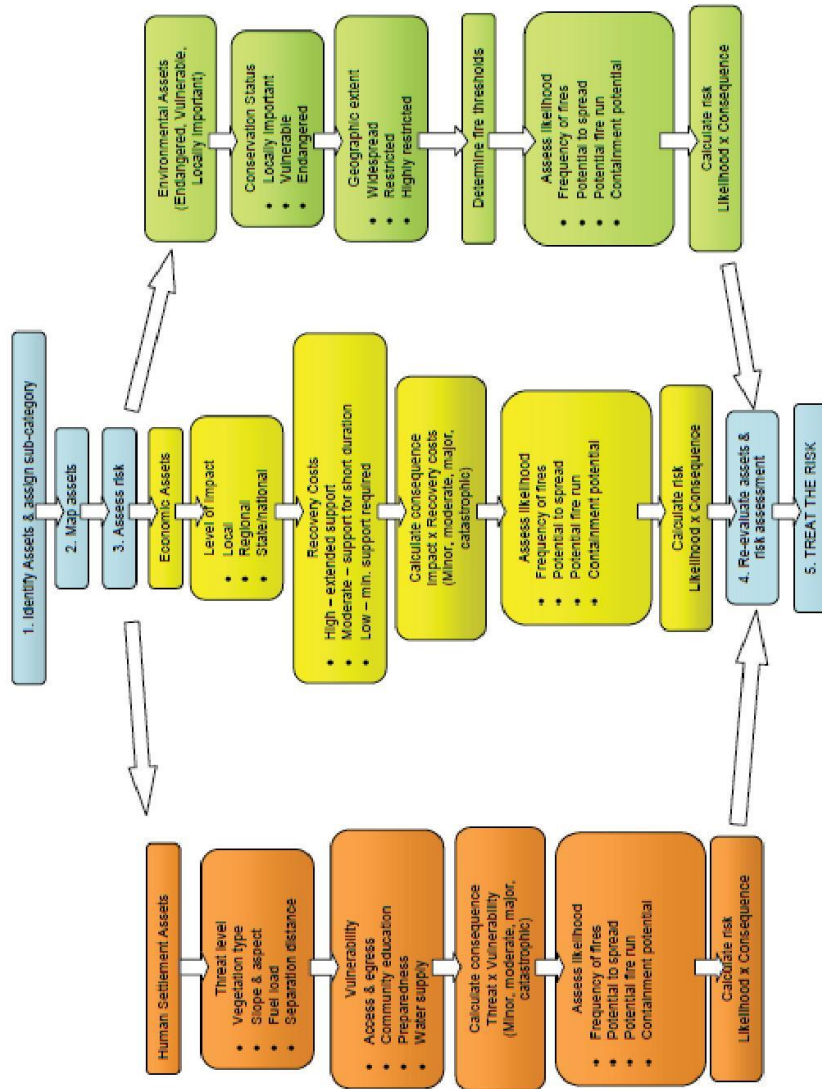
Vulnerability is determined by establishing the *conservation value* of the flora and fauna present and consideration of the *geographic distribution* of these species. *Potential impact* refers to the individual susceptibility of the composite species to bushfire. The timing of a bushfire may affect susceptibility, for example a bushfire in spring may impact upon bird species nesting at that time. Some plant species may have no fire tolerance while others may require fire to reproduce. Potential impact of bushfire upon an ecosystem is therefore a complex consideration. Fire thresholds must be considered when determining the potential impact of a fire.





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Figure 53. Bushfire risk management procedure (adapted from NSW RFS 2008).



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## 5.2 Assets

### 5.2.1 Human settlement

There are no residences located within Mt Jerrabomberra; however, this BMP takes into consideration the residences that abut the Reserve, Figure 54. These residences principally occur within the suburbs of Jerrabomberra along the western boundary of Mt Jerrabomberra and DeSalis on the eastern side. Hulston (2014) indicates that “85 per cent of houses are lost in the first 100 m from bushland” and that ember attack is a significant factor. In consideration of the potential for ember attack arising from a fire within Mt Jerrabomberra and taking into account the layout of residential areas, the asset zones extend 50 m from the boundary of Mt Jerrabomberra.

Human settlement assets have been classified according to their geographic location and are treated as four separate zones, Table 16.

Table 16: Human settlement assets adjacent Mt Jerrabomberra

Asset Number	Asset Type	Asset Sub-type	Asset Name	Description
APZ1	Human Settlement	Residential	Carolyn Jackson Drive	Extends from the Glenora Court access to the main entrance of Jerrabomberra Hill Road.
APZ2	Human Settlement	Residential	Halloran Drive	Extends from the main entrance of Jerrabomberra Hill Road to the entrance at Minda Place.
APZ3	Human Settlement	Residential	Marruba Place	Extends from the entrance at Minda Place through to the entrance at Marruba Place.
APZ4	Human Settlement	Residential	Southbar Road	Extends from number 84 Candlebark Road along the eastern edge of Mt Jerrabomberra to Southbar Road.









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### 5.2.2 Economic

The economic and social assets present within Mt Jerrabomberra are restricted to the Lower, and Upper Thornton Reservoirs, Figure 2 and Figure 3 and the telecommunication tower, Figure 6 located on Jerrabomberra Hill Road within the Reserve, Table 17.

These assets do not have established APZs, although the Lower Thornton Reservoir has a laydown area on the southwestern side of the tank that measures approximately 66 metres wide and 66 metres long that acts as an APZ for a fire approaching from this direction. This reservoir is built into the hillside and a cutting is present on the southern and eastern sides of the tank.

Each of the upper Thornton Reservoir tanks are surrounded by an access track, approximately 3 metres wide and are located within a fenced compound.

The telecommunication tower and base station equipment is located within a small compound approximately 6 metres wide and 22 metres long. The compound has been levelled by constructing a retaining wall of wooden sleepers on the western and southern sides and filling the structure. The compound comprises a metal mesh screen topped with an overhang of razor wire and there is a narrow space between the perimeter compound fence and the infrastructure housed within the compound.

Table 17: Economic assets within Mt Jerrabomberra.

Asset Number	Asset Type	Asset Sub-type	Asset Name	Description
APZ5	Economic	Infrastructure	Lower Thornton Water Supply Reservoir – Mt Jerrabomberra Hill Road	This water supply reservoir and associated infrastructure is located within Mt Jerrabomberra along Jerrabomberra Hill Road. It comprises a single large tank (60 metre diameter) and a smaller tank (12.5 metre diameter) and is built into the hill mid-slope.
APZ6	Economic	Infrastructure	Upper Thornton Water Supply Reservoir – Mt Jerrabomberra Hill Road	This water supply reservoir and associated infrastructure is located within Mt Jerrabomberra along Jerrabomberra Hill Road and comprises two tanks (32 metre and 20 metre diameter). The tanks are located on an upper slope but are not built into the hill.
APZ7	Economic	Infrastructure	Telecommunication tower and infrastructure	The telecommunication tower is located on the northern most crest within Mt Jerrabomberra and is supplied by power from an overhead powerline.





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### 5.2.3 Environmental

Mt Jerrabomberra is itself a major environmental asset. Environmental assets are subdivided into three categories based upon the presence of species listed as significant at either the regional, state or national level (NSW RFS 2008). There are significant plants present within the Reserve at these levels of significance, as described within Section 4.8.

Suitable habitat for *Delma impar* (Striped Legless Lizard), listed as Vulnerable under the NSW TSC Act 1995 and under the EPBC Act, was noted within Mt Jerrabomberra. This species prefers tussock grasslands or grassy woodlands with appropriate cover (generally over 50 per cent tussock cover), cracks in the soil, lightly embedded rocks and sites with 1-10 per cent rock cover (Department of the Environment 2015<sup>2</sup>).

A search within the Atlas of Living Australia database for occurrence records of threatened species within Mt Jerrabomberra located a record of *Calyptorhynchus lathami* (Glossy Black Cockatoo), listed as vulnerable within NSW from within the Dry Forest vegetation formation (ALA 2017).

Mt Jerrabomberra is therefore likely to support fauna species of both state and national significance. Three threatened bird species *Callocephalon fimbriatum* (Gang-gang Cockatoo), *Petroica boodang* (Scarlet Robin), *Daphoenositta chrysoptera* (Varied Sittella) and four threatened bat species *Miniopterus (schreibersii) oriana* (Eastern Bentwing Bat), *Falsistrellus tasmaniensis* (Eastern Falsistrelle), *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail Bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat), all listed as vulnerable under the TSC Act, were recorded by Ecological Australia (2010) within Mt Jerrabomberra.

Mt Jerrabomberra is considered a significant environmental asset by QPRC. The CLMZ has been assessed on the basis of the major vegetation formation and assets that are present, Table 18.

Table 18: Environmental assets within Mt Jerrabomberra.

Asset Number	Asset Type	Asset Sub-type	Asset Name	Description
CLMZ1	Environmental	Endangered (species)	Dry Forest	This vegetation association is the dominant vegetation type across the Reserve and includes EPBC Act listed plant species.

### 5.2.4 Cultural

Mt Jerrabomberra may have cultural value to the Ngambri / Ngunnawal traditional owners of the land. Cultural assets were not assessed as part of this BMP, however it is a recommendation of this BMP that a cultural heritage assessment of Mt Jerrabomberra be conducted and the outcomes incorporated into revisions of this BMP.

## 5.3 Level of Risk

The level of bushfire risk is evaluated using a combination of likelihood and consequence.

### 5.3.1 Likelihood

The likelihood of a bushfire igniting and spreading is used to evaluate the bushfire risk associated with assets. The fire history of Mt Jerrabomberra, Section 4.2, and evaluation of fire run, Section 4.10.4, and frequency of a fire within Mt Jerrabomberra are utilised to evaluate likelihood of bushfire. The fire ignition history for the area, Section 4.1, is also useful in evaluating the likelihood of bushfire and the location and



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mechanism of ignition. The likelihood of a bushfire occurring is also reduced by routine fire prevention actions such as weed control, fire track and break maintenance, public education and fuel reduction activities.

The likelihood categories utilised in this BMP, Table 19, are adapted from Table 4.2 of NSW RFS (2008).

Major fire has been an infrequent occurrence across Mt Jerrabomberra, although with increased residential development within the suburb of Jerrabomberra, the number of small fires would appear to have increased in frequency. Overall it is considered that fires occur infrequently but retain the potential to spread across Mt Jerrabomberra and reach assets. The limited separation distance between residential areas and vegetation that presents a hazard, increases the likelihood that a bushfire would be able to reach those assets. The likelihood rating for Mt Jerrabomberra is therefore assessed to be 'Likely'.

Table 19: Likelihood ratings for bushfire.

Fire Frequency	Fire Run	
	Fires are expected to spread and reach assets	Fires are not expected to spread and reach assets
Fires occur frequently	Almost Certain	Possible
Fires occur infrequently	Likely	Unlikely

### 5.3.2 Consequence

The consequence rating refers to the effect that a bushfire has upon an asset. There are three types of assets identified for Mt Jerrabomberra and adjacent properties, Section 5.2. A consequence rating is calculated in a different manner for each asset type. Within each of the four categories of consequence; Minor, Moderate, Major and Catastrophic, there are specific descriptors that apply to each type of asset being considered, Table 20. This approach follows NSW RFS (2008), which has been modified to account for the reduction in scale from a regional approach to a local scale applied to Mt Jerrabomberra and the immediate surrounding residential areas.





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Table 20: Description of consequence ratings (Adapted from Table 4.1 NSW RFS 2008).

CONSEQUENCE RATING	DESCRIPTION
<b>CATASTROPHIC</b>	<ul style="list-style-type: none"> <li>● Significant fatalities;</li> <li>● Large number of severe injuries;</li> <li>● Extended and large numbers requiring hospitalisation;</li> <li>● General and widespread displacement of people for an extended duration;</li> <li>● Extensive damage to assets;</li> <li>● Extensive resources required for personal support;</li> <li>● Economic impact for an extended period of time with financial assistance required;</li> <li>● Permanent damage to the environment;</li> <li>● Local extinction of native species in Mt Jerrabomberra.</li> </ul>
<b>MAJOR</b>	<ul style="list-style-type: none"> <li>● Possible fatalities;</li> <li>● Extensive injuries, significant hospitalisation;</li> <li>● Large number of people displaced for more than 24 hours;</li> <li>● Significant damage to assets, requires external resources;</li> <li>● Loss of community services associated with Mt Jerrabomberra;</li> <li>● Significant resources required for personal support;</li> <li>● Local economy impacted for a significant period of time with significant financial assistance required;</li> <li>● Significant damage to the environment asset which requires major rehabilitation or recovery works;</li> <li>● Localised extinction of native species (this may range from loss of a single population to loss of all of the species within Mt Jerrabomberra).</li> </ul>
<b>MODERATE</b>	<ul style="list-style-type: none"> <li>● No fatalities, some medical treatment required;</li> <li>● Hospitalisation may be required;</li> <li>● Individuals are displaced, return in 24 hours;</li> <li>● Localised damage to assets, rectified by routine arrangements;</li> <li>● Some disruption to community, normal function maintained;</li> <li>● Personal support via local arrangements;</li> <li>● Local economic impact, financial support required; and</li> <li>● Lower ecological fire threshold exceeded.</li> </ul>



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CONSEQUENCE RATING	DESCRIPTION
<b>MINOR</b>	<ul style="list-style-type: none"> <li>● No fatalities;</li> <li>● First aid may be required;</li> <li>● Individuals are not displaced;</li> <li>● Inconsequential or no damage to asset;</li> <li>● Minimal or no disruption to community;</li> <li>● Minimal or no personal support required (physical, mental or emotional);</li> <li>● Minimal or no financial loss; and</li> <li>● Fire within lower and upper ecological thresholds.</li> </ul>

### 5.3.3 Consequence - human settlement assets

The consequence of a bushfire to a human settlement asset such as a residence is evaluated by the calculation of threat to the asset and the vulnerability of the asset, Table 21.

Threat is evaluated by establishing the vegetation type that poses the highest hazard, associated fuel load, the slope and aspect of the topography and the distance separating the asset from the hazard.

Table 21: Consequence rating classes for human settlements (Adapted from Table 5.2 NSW RFS2008).

Vulnerability	Threat			
	Low	Moderate	High	Very High
High Vulnerability	Moderate	Major	Catastrophic	Catastrophic
Moderate Vulnerability	Minor	Moderate	Major	Catastrophic
Low Vulnerability	Minor	Minor	Moderate	Major





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### Separation Distance

The average separation distance to the perimeter of residential properties was evaluated for each Human Settlement Asset, Table 22. The distance between the hazard taken to be the boundary of vegetation within Mt Jerrabomberra likely to carry a bushfire and house (closest house wall) was evaluated.

Table 22: Separation distance to human settlement assets.

Asset	Asset Type	Asset Subtype	Mean Separation Distance (metres)	Description
APZ1	Human Settlement	Residential	15 (n=20)	A formed track does not extend the entire length of this APZ. Numerous homes have native vegetation within their boundary that greatly reduces the separation distance.
APZ2	Human Settlement	Residential	28 (n=18)	Mt Jerrabomberra Hill Road extends approximately halfway along the interface of the residences and Mt Jerrabomberra increasing the separation distance. The remaining interface does not have a formed track present.
APZ3	Human Settlement	Residential	26 (n=11)	A formed track separates the residences and the vegetation within Mt Jerrabomberra.
APZ4	Human Settlement	Residential	26 (n=20)	The majority of this APZ lacks a formed track. The separation distance is often determined by the house position on the block.

The separation distance from the closest wall of the homes to the closest vegetation within Mt Jerrabomberra likely to carry a bushfire within APZ1 ranged from 0 metres (overhanging vegetation) to 35 metres. The mean separation distance for each asset (APZ1-4) is presented in Table 22. An example of limited separation is provided in Figure 55, where a portion of APZ1 does not have a formed track located along the interface between Mt Jerrabomberra and the residences that abut the Reserve. Vegetation along this interface has not been cleared and no effective APZ exists between properties and the vegetation that presents the hazard. All properties back immediately onto Mt Jerrabomberra within APZ1. A formed track extends 400 metres from level with the Glenora Court pedestrian access southwest to the drainage reserve off of Carolyn Jackson Drive, and serves to increase the separation distance between the residences and the vegetation with the Reserve. The separation distance is improved where residences have created a break in the vegetation, however some residences have no effective separation distance as vegetation extends to the building or overhangs the building, Figure 55. The effectiveness of the separation distance is to a large extent subject to the landscaping and general maintenance of the residential property, and may be reduced due to the presence of outbuildings. The location of the house on the residential block is a significant factor determining the separation distance, as homes positioned close to the property boundary that interfaces with Mt Jerrabomberra reduce the separation distance. The residential development within APZ1 would not comply with the current planning requirements for a perimeter road around a residential subdivision (NSW RFS 2006<sup>1</sup>).



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Figure 55. Properties with limited separation distance to bushfire hazard (APZ1).

The average separation distance between houses and hazardous vegetation within APZ2 was 28 metres, with a range of 0 - 76 metres. Jerrabomberra Hill Road is located approximately 30 metres from the rear fence line of residential properties that abut Mt Jerrabomberra from the entrance off Halloran Drive through to the Nyora Place pedestrian access effectively increasing the separation distance. The remaining section of this APZ through to Minda Place has no formed track present, Figure 56, and properties appear poorly prepared, greatly reducing the separation distance and increasing the threat posed by a bushfire.



Figure 56. Poor separation (APZ2) to bushfire hazard.





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A formed track extends the length of APZ3 from Minda Place to Marruba Place, although typically the land between the rear of the property and the formed track retains vegetation reducing the effective separation distance. The mean separation distance within APZ3 is 26 metres.

The mean separation distance within APZ4 remains the same as for APZ3 at 26 metres. A short length of formed track abuts the residences along Woodridge Place, Figure 57. A short section of Kinsella Street opposite Amaroo Place has not been developed for housing allowing the road to form the perimeter, although the effectiveness of the gap is reduced due to native vegetation that extends to the road.



Figure 57. Separation distance within APZ4 varies greatly.

Separation distance ranged from 0 m to 142 m, again highlighting that some residences are immediately adjacent vegetation considered capable of carrying a bushfire. Caution is therefore required when conducting the risk assessment in that it is a process of generalization and the actual risk posed by bushfire to individual homes may vary considerably.

Separation distance has been divided into three categories in accordance with NSW RFS (2008):

- <20 metres
- 20-60 metres
- >60 metres.

### Vulnerability

Residential premises that are well prepared are less susceptible to the adverse effects of bushfire than those residences that are poorly prepared. Vulnerability of human settlement assets is evaluated in accordance with NSW RFS (2008) methodology, Table 23, and the results are presented in Table 24.



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Table 23: Human settlement asset vulnerability [adapted from table 5.1 NSW RFS (2008)].

Vulnerability Category	Description
Low	<ul style="list-style-type: none"> <li>Area has had targeted community education programs;</li> <li>Properties are prepared;</li> <li>Adequate access and egress;</li> <li>Residents/owners likely to be able to defend their own property;</li> <li>Adequate water supply; and</li> <li>Majority of homes meet current construction standards for building in bushfire prone areas.</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>Area has had targeted community education programs;</li> <li>Properties are not prepared;</li> <li>Adequate access and egress;</li> <li>Residents/owners likely to be able to defend their own property; and</li> <li>Adequate water supply.</li> </ul>
High	<ul style="list-style-type: none"> <li>No recent or targeted community education programs or programs have been ineffective;</li> <li>Properties are not prepared;</li> <li>Inadequate access and egress;</li> <li>Residents/owners unlikely to be able to defend their own property; and</li> <li>Inadequate water supply.</li> </ul>

The properties adjoining Mt Jerrabomberra are considered to have Moderate Vulnerability due to the use of flammable fencing materials, a general lack of bushfire preparedness in particular with respect to vegetation management on the property and the lack of effective access to the rear of properties that adjoin Mt Jerrabomberra. QPRC has conducted targeted bushfire community education programs and the water supply is considered adequate for a residential development. Building construction standards amongst homes within the human settlement APZs have not been audited as part of this BMP and this may present a limitation of this methodology, however appropriate building compliance can reasonably be expected to have been enforced by QPRC in meeting its legislative requirements under the National Construction Code.

Table 24: Human settlement assets – vulnerability.

Asset	Asset Type	Asset Subtype	Vulnerability
APZ1	Human Settlement	Residential	Moderate
APZ2	Human Settlement	Residential	Moderate
APZ3	Human Settlement	Residential	Moderate
APZ4	Human Settlement	Residential	Moderate

The consequence level associated with the human settlement assets is evaluated by comparing threat and the level of vulnerability that exists for each asset.

### Threat

As mentioned, threat has been evaluated in consideration of vegetation type present and the associated fuel load, slope and aspect and the separation distance between the vegetation that poses the hazard and the houses. Bushfire hazard within Mt Jerrabomberra has been mapped, Figure 52. The predominant hazard category that adjoins the asset interface (i.e. low, moderate, high or very high hazard class) is then modified to take the separation distance into account, to produce an overall level of threat.





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Separation distance has been divided into three categories in accordance with NSW RFS (2008) and a correction factor attached to each category.

- <20 metres (+1 hazard class);
- 20-60 metres (no change to hazard class)
- >60 metres (-1 hazard class).

Example: APZ 1 has a slope of 6-10° (Gentle) and a weighted slope of 7-11° due to the predominantly NW aspect (NW aspect + 1) and an assessed fuel load that ranges from High – Very High (designated as Very High). The hazard score from Table 15 is 'High'. Houses in this area have an average separation distance of 15 m (i.e. <20 m). The overall threat is therefore determined by increasing the hazard class score from 'High' to 'Very High' (i.e. +1 hazard class) due to the poor separation distance.

Threat scores for the human settlement asset zones are shown in Table 26. APZ1 has an elevated fuel load, in part due to the Dry Forest vegetation formation present with Burgan and Red Stringybark, and the poor separation of houses from the vegetation deemed to pose a hazard. At the interface between the residential properties and Mt Jerrabomberra, the slopes are generally gentle and the southerly and easterly aspects that apply do not increase the slope weighted slope categories, and as the separation distances for APZ2 – 4 are between 26-28 metres, there is no change to the hazard class determined on the basis of weighted slope and fuel load present. While APZ4 has an area with an extreme fuel load and other areas with a low fuel load, the dominant fuel load across APZ4 remains high.

### Consequence

Consequence for human settlement assets is determined using Table 25 and the results are presented in Table 26. There are four categories of consequence in accordance with those outlined in Table 20.

**Table 25: Calculating consequence of bushfire for human settlement assets.**

VULNERABILITY	THREAT			
	Low	Moderate	High	Very High
High	Moderate	Major	Catastrophic	Catastrophic
Moderate	Minor	Moderate	Major	Catastrophic
Low	Minor	Minor	Moderate	Major

**Table 26: Human Settlement Consequence Ratings for Mt Jerrabomberra Assets.**

Asset	Vulnerability	Threat	Consequence
APZ1	Moderate	Very High	Catastrophic
APZ2	Moderate	Moderate	Moderate
APZ3	Moderate	Moderate	Moderate
APZ4	Moderate	Moderate	Moderate

### 5.3.4 Consequence - economic asset

The consequence of the effect of a fire upon an economic asset is evaluated by the cost to restore the asset and consideration of the extent of financial costs in terms of replacement and losses. Consequence is measured at three levels; Local, Regional and National (or State), Table 27.



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The lower Thornton Water Supply Reservoir (APZ5) is partially shielded from radiant heat on the southern side by being built into the hillside. The structural integrity of the reservoir tanks is another factor that may reduce the impact of bushfire upon this asset. Damage to this asset by a bushfire is likely to be restricted to a local level of economic impact, as the water supply reservoir has a localised function. It is considered probable that the asset is unlikely to be destroyed by a bushfire and therefore recovery may be associated with repair rather than replacement of the entire asset. Recovery costs incurred, while dependent upon the extent of damage, are likely to be Low - Moderate when considered at the local level. The asset can be expected to be recovered with minimal financial support or with additional financial support for a short period of time. The consequence of a bushfire upon APZ5 is therefore considered to be Moderate, Table 28.

Table 27: Consequence rating for economic assets [Adapted from Table 6.4 NSW RFS 2008].

Recovery Costs	Level of Economic Impact		
	Local	Regional	National/State
High Recovery Costs	Major	Major	Catastrophic
Moderate Recovery Costs	Moderate	Major	Major
Low Recovery Costs	Minor	Moderate	Moderate

The upper Thornton Water Supply Reservoir (APZ6) comprises two tanks that are exposed to a fire front moving up slope from the northwest, as the tanks are not built into the hill but rather sit on top of the ridge line. The level of impact and proposed recovery costs are similar for those described for the lower Thornton Water Supply Reservoir (APZ5). The consequence of a bushfire upon APZ6 is therefore also considered to be Moderate, Table 28.

The telecommunication tower (APZ7) and base station infrastructure is vulnerable to bushfire and is likely to be destroyed requiring complete replacement. The impact of the destruction of the telecommunication facility is considered to be local while recovery costs are considered to be comparatively high, Table 28.

Table 28: Consequence Ratings for Mt Jerrabomberra Economic Assets.

Asset	Recovery Cost	Level of Impact	Consequence
APZ5	Moderate	Local	Moderate
APZ6	Moderate	Local	Moderate
APZ7	High	Local	Major

### 5.3.5 Consequence - environmental assets

The evaluation of consequence for environmental assets involves consideration of the geographical extent of the environmental asset, the vulnerability of composite species, their conservation status and the evaluation of the effects of a bushfire or particular fire regime (NSW RFS 2008).

#### Geographic Extent

Geographic extent is categorised as *Widespread*, *Restricted* or *Highly Restricted*. With regard to this BMP, consideration of geographic extent has been considered across Mt Jerrabomberra and at a Regional, State and National Level. That is, a species that is confined in distribution solely to Mt Jerrabomberra is more vulnerable than a species that is represented by populations across the Southeast Highlands Bioregion, New South Wales or interstate, in addition to occurring within Mt Jerrabomberra.





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The Dry Forest vegetation association that comprises Mt Jerrabomberra is widespread within New South Wales. While *Leucochrysum albicans* (Hoary Sunray), Figure 43, is listed as endangered under the EPBC Act, it is recognized as being locally common and, while Mt Jerrabomberra supports a diverse orchid flora, these species are not restricted to Mt Jerrabomberra.

### Vulnerability

The vulnerability rating for the environmental assets is a measure of the susceptibility of an asset to the adverse effects of a bushfire. The determination of vulnerability utilises Table 29 to produce the ratings presented in Table 30. The presence of a species listed under the EPBC Act as endangered on Mt Jerrabomberra and state listed species increases the vulnerability rating to Moderate, Table 30.

Table 29: Calculating the vulnerability rating for environmental assets (adapted from BFCC 2008).

Geographic Extent	Conservation Status		
	Locally Important	Vulnerable	Endangered
Highly Restricted	Moderate	High	Very High
Restricted	Low	Moderate	High
Widespread	Low	Low	Moderate

Table 30: Vulnerability rating for environmental assets.

Environmental Asset	Environmental Asset Name	Vulnerability Rating
CLMZ1	Dry Forest	Moderate

### Potential Impact of Bushfire

The potential impact of bushfire upon the Dry Forest vegetation association, the composite species and the fauna that occur in the area can be complex, and for the purposes of this BMP is considered within the framework of a worst case scenario. The three categories of potential impact are:

- Exclude Bushfire – fire within the area would have a negative impact. This restriction could be total exclusion, such as the prohibition of a prescribed fire within 100 m of creeks, or conditional such as no burning in spring or a particular month, Table 11.
- Restrict Bushfire – fire within an area may be permitted within certain periods of time or between ecological thresholds for a vegetation association, or restrictions may apply to an individual species, for example, to avoid the nesting period.
- No Conditions – There are no conditions regarding the use of prescribed fire and a bushfire is unlikely to have a serious or long lasting negative impact. This category may also apply whereby the remnant vegetation is of low biodiversity value and in poor condition.

'Restrict Bushfire' is the most applicable category for the environmental assets within Mt Jerrabomberra, as fire remains an important factor in the reproduction of many species and the maintenance of the existing vegetation communities. Prescribed burning within Mt Jerrabomberra should not be undertaken within 5 m of first and second order streams, and not within 10 m of third order streams (NSW RFS 2006<sup>2</sup>). Where practicable, this buffer should be increased to maintain an effective buffer area between drainage lines (first order, second order and third order streams) and any area burnt to avoid impacts upon the watercourses. Consideration of the erosion potential of the substrate should be made prior to the prescribed burn and the buffer area increased accordingly.



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As mentioned, the evaluation of consequence in relation to environmental assets involves the comparison of Vulnerability and the potential impact of a bushfire.

The evaluation of consequence utilises Table 31 to produce the ratings presented in Table 32.

Table 31: Calculating consequence ratings for environmental assets (adapted from NSW RFS 2008).

Potential Impact of Bushfire	Vulnerability			
	Low	Moderate	High	Very High
Exclude Bushfire	Moderate	Major	Major	Catastrophic
Restrict Bushfire	Minor	Moderate	Moderate	Major
No Conditions	Minor	Minor	Minor	Moderate

Table 32: Consequence ratings for environmental assets.

Environmental Asset	Environmental Asset Name	Consequence Rating
CLMZ1	Dry Forest	Moderate

## 5.4 Bushfire Risk Level

There are five bushfire risk levels: Low, Medium, High, Very High and Extreme, Table 33. The bushfire risk level is assessed for each asset or grouped assets and is provided as a register. The bushfire risk level for assets located at Mt Jerrabomberra is presented in Table 34 and is mapped in Figure 58.

Table 33: Bushfire risk level (Table 4.3 NSW RFS 2008).

LIKELIHOOD	CONSEQUENCE			
	Minor	Moderate	Major	Catastrophic
Almost Certain	High	Very High	Extreme	Extreme
Likely	Medium	High	Very High	Extreme
Possible	Low	Medium	High	Very High
Unlikely	Low	Low	Medium	High

The 'extreme' level of risk associated with APZ1 is due to the majority of the area having a very high fuel load and generally poor separation between houses and the vegetation that poses the hazard. A mitigating factor is that the assets (residences) are downslope from the hazard, that is, the prevailing wind direction on most days of extreme fire danger will be from the northwest and followed by a change in direction to being from the southwest. In these eventualities, a fire would run up hill and away from the residences within this APZ. In the event of a fire approaching from the east, it would have to burn downhill to the houses which would slow the fire's progress, although it would still be likely to spot ahead into residential areas. Management measures are required to be implemented to reduce this associated risk for APZ1.

The Lake George Zone Bushfire Management Committee (2010) has assessed an asset identified as Asset 45 'Mt Jerrabomberra North' as being 'Likely' to experience bushfire with a 'Moderate' consequence resulting in a risk rating of 'High'. Asset 45 includes the majority of the residential





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development within the area while APZ1 is more geographically restricted as the APZ is limited to 50 metres from the interface of the residences with Mt Jerrabomberra and as a result these outcomes are not directly comparable.

APZ2 and APZ3 have the same assigned bushfire risk level of 'High', derived from a bushfire likelihood of 'Likely' and a consequence value of 'Moderate'. Lake George Zone Bushfire Management Committee (2010) asset number 46 'Mount Jerrabomberra South' includes APZ2 and APZ3 from this report and is assessed as being 'Likely' to experience bushfire with a 'Moderate' consequence resulting in a risk rating of 'High' that coincides with the bushfire risk determined in this report. It must be remembered that the bushfire risk associated with each individual residence may vary from that determined for APZ2 and APZ3 overall.

APZ4 extends along the eastern side of Mt Jerrabomberra and has an assigned bushfire risk of 'High'. Lake George Zone Bushfire Management Committee (2010) asset number 44 'Karabar' includes much of the suburbs of DeSalis and Karabar and is classified as 'High' bushfire risk.

Lake George Zone Bushfire Management Committee (2010) did not identify the water supply reservoirs or telecommunication tower on Mt Jerrabomberra as assets. The bushfire risk associated with the water supply reservoirs (APZ5 and APZ6) is 'High' while the bushfire risk associated with the telecommunication tower (APZ7) is 'Very High' as the likely consequence of a bushfire striking the telecommunications tower is considered to be major.

The bushfire risk associated with CLMZ1 the Dry Forest vegetation association across Mt Jerrabomberra is 'High' due to the presence of plant species listed under the EPBC Act and at the state level.



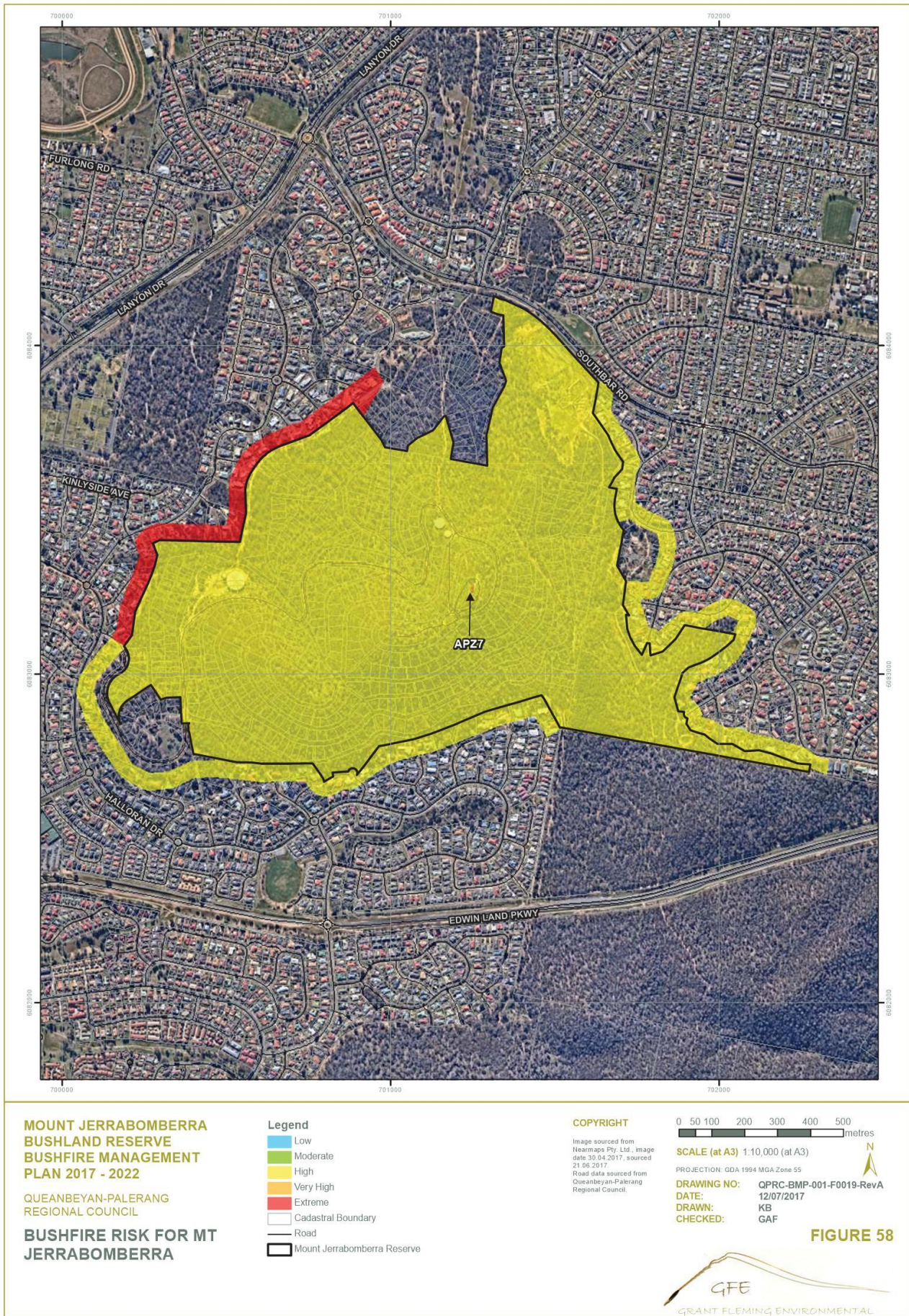
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Table 34: Asset risk register – Mt Jerrabomberra.

Asset	Asset Type	Asset Subtype	Asset Location	Bushfire Likelihood	Bushfire Consequence	Bushfire Risk
APZ1	Human Settlement	Residential	Extends from the Glenora Court access to the main entrance of Jerrabomberra Hill Road	Likely	Catastrophic	Extreme
APZ2	Human Settlement	Residential	Extends from the main entrance of Jerrabomberra Hill Road to the entrance at Minda Place.	Likely	Moderate	High
APZ3	Human Settlement	Residential	Extends from the entrance at Minda Place through to the entrance at Marruba Place.	Likely	Moderate	High
APZ4	Human Settlement	Residential	Extends from number 84 Candlebark Road along the eastern edge of Mt Jerrabomberra to Southbar Road.	Likely	Moderate	High
APZ5	Economic	Infrastructure	Lower Thornton Water Supply Reservoir – Jerrabomberra Hill Road	Likely	Moderate	High
APZ6	Economic	Infrastructure	Upper Thornton Water Supply Reservoir – Jerrabomberra Hill Road	Likely	Moderate	High
APZ7	Economic	Infrastructure	Telecommunication tower and base station – Jerrabomberra Hill Road	Likely	Major	Very High
CLMZ1	Environmental	Endangered	Dry Forest – Mt Jerrabomberra	Likely	Moderate	High
APZ – Asset Protection Zone. CLMZ – Conservation Land Management Zone						









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## 6 BUSHFIRE RISK MANAGEMENT

Bushfire risk management is divided into managing the physical bush fire hazards (i.e. Hazard Management) and the behaviours that contribute to bushfires and the safety of personnel (i.e. Risk Management).

The purpose of treating the risks is to reduce either the likelihood of fire occurring and spreading or to reduce the damaging consequences of a bushfire or to achieve both. Treatments can be targeted towards the:

- Community – e.g. such as through the use of bushfire education programs;
- Hazard - e.g. through modification of the hazard, such as slashing grass; and
- Environment – e.g. implementation of a weed control program or prescribed burn.

Some treatment measures may be specific for an area or a particular asset while others can be applied across Mt Jerrabomberra to reduce risk.

The likelihood and consequence values utilised to evaluate the level of risk for each asset are also used to evaluate the priority for treatment measures. Areas of 'Extreme' risk have the highest priority, then 'Very High', 'High', 'Medium' and 'Low' risk areas (NSW RFS 2008). It is important to note that current treatments must be considered and also the interplay between treatments. For example, bushfire treatment measures within the CLMZ1 that comprises Mt Jerrabomberra will indirectly reduce the risk to all other APZs.

Resources should be allocated by QPRC to the highest priority bushfire risk areas in the first instance. The treatment priority listed from highest to lowest, as provided in the risk register, Table 34 for Mt Jerrabomberra is provided in Table 35.

Table 35: Asset risk register – Mt Jerrabomberra.

Treatment Priority	Asset	Risk Rating
1	APZ1	Extreme
2	APZ7	Very High
3	APZ2, APZ3, APZ4, APZ5, APZ6	High

Resources should therefore be directed in the first instance to reduce the risk to premises located within APZ1 that abut Mt Jerrabomberra where bushfire risk is categorised as 'Extreme'. The recommended treatments that apply to APZ1 therefore have the highest priority and would include the establishment and maintenance of an APZ.

There are no low priority treatment measures with measures broadly prioritised as either:

- Very High Priority
- High Priority
- Moderate Priority.





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The prioritisation of treatments within Mt Jerrabomberra is undertaken at a broad level in the knowledge that QPRC is best placed to prioritise specific works. The suggested time frames, and priorities are provided in the Action Plan, APPENDIX A.

## 6.1 Fire Trails

### 6.1.1 General treatment measures

The following treatments are applicable to fire trails (new) within Mt Jerrabomberra.

1. Fire trails are to comply with The Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard.
  - a. Vehicle carrying capacity must be clearly identified on maps and roadside signage
  - b. Fire trail must be maintained free of obstructions
  - c. Permanent fire trail signage must be installed at both ends of the Jerrabomberra Hill Road fire trail. An example of appropriate signage is shown in Figure 59.
2. The fire trail access gate is to be painted white with red markings in accordance with AS1744 (Standard alphabets for road signs), AS1743 (Road sign specifications) (high reflectivity for low light conditions).
3. Annual inspections of fire trails (August) is to be undertaken and appropriate maintenance undertaken to rectify identified issues.

### 6.1.2 New fire trails

Access to Mt Jerrabomberra to fight fires is restricted due to the lack of a complete perimeter formed fire trail separating residences and Mt Jerrabomberra. The typical separation distance between buildings and vegetation that presents a hazard is poor (Mean distance = 15 m) at the interface of APZ1 and Mt Jerrabomberra. The following recommendations are made to improve access for firefighting. Consultation is recommended with NSW RFS and NSW FR to determine the cost benefit in construction of Cat 1 versus Cat 7 fire trails. The recommendation to construct Cat 1 fire trails facilitates the use of these fire trails by all fire fighting vehicles including FR NSW heavy tankers.

Where possible and practicable recommended fire trails have been located within the recommended IAPZs or located to take advantage of existing tracks.

4. Construct APZ1 Fire Trail as indicated on Figure 60, between Glenora Court and Jerrabomberra Hill Road off of Halloran Drive with an additional access from Carolyn Jackson Drive as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.
5. Construct APZ2 Fire Trail – Jerrabomberra Hill Road to Minda Place as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.
6. Construct APZ3 Fire Trail – Minda Place to Marruba Place Fire Trail as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.



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7. Construct APZ3-APZ4 Fire Trail – Marruba Place Fire Trail to Temora Place as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Important'.
8. Construct APZ4 Fire Trail – Candlebark Road to Temora Place as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Important'.
9. Construct APZ4 Fire Trail – Temora Place to Beard Close as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Important'.
10. Construct APZ4 Fire Trail – Rusten Street to join the Jerrabomberra Hill Road Fire Trail to exit at Kinsella Street as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.
11. Construct APZ4 Fire Trail – Kinsella Street to Southbar Road via the Scar Recreation Reserve carpark as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.
12. Upgrade Jerrabomberra Hill Road to a CAT 1 Fire Trail with through access to Kinsella Street including a loop access to the telecommunication tower and entrance to the Lower Thornton Water Supply Reservoir as indicated on Figure 60. This fire trail is considered to be 'Essential'.





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Figure 59: Proposed fire trail sign design.



GFE







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## 6.2 Asset Protection Zones

An asset protection zone (APZ) is a type of fire management zone defined by NSW Rural Fire Service (2005) as “a fuel reduced area surrounding a built asset or structure.” The reduction of fuel within the APZ aims to prevent the bushfire travelling either along the ground or through a canopy to the asset. An APZ can comprise of a combination of perimeter roads, fire trails or managed lands so that a fire path is not created between the hazard and the asset.

An APZ provides:

- a buffer zone between a bush fire hazard and an asset;
- an area of reduced bush fire fuel that allows suppression of fire;
- an area from which back burning may be conducted; and
- a relatively safe area for firefighters to operate in area and allows emergency services access (NSW RFS 2005).

Where dry forest interfaces with the asset, the APZ can be made up of an Inner Asset Protection Zone (IAPZ) and an Outer Asset Protection Zone (OAPZ). The IAPZ is located adjacent to the asset with a low fuel hazard, reducing the level of ember attack, direct flame contact and radiant heat impact and provides a defensible space with increased safety under some conditions (ESA 2014<sup>1</sup>). The OAPZ is a fuel reduced area that is designed to reduce the potential flame length by slowing the rate of spread, filtering embers and suppressing crown fires.

The precise location of fire management zones and the type of zones employed within the vicinity of an asset is identified through the Lake George Zone Bush Fire Risk Management Plan, (BFRMP) therefore the location and nature of the fire management zones recommended in this BMP should be considered indicative until the NSW RFS has endorsed the Mt Jerrabomberra BMP as a sub-plan of the Lake George Zone BFRMP.

The determination of the width of the IAPZ and OAPZ applied to land that would support a bushfire within Mt Jerrabomberra is specified by NSW RFS (2006<sup>1</sup> and 2006<sup>2</sup>). There are however two complicating factors to be taken into consideration in determining the positioning of the APZs. Firstly the residential developments that abut Mt Jerrabomberra were developed prior to the PBP guide (NSW RFS 2006<sup>1</sup>) and, as a consequence, there is no formed road or access between the Reserve and the residences that would otherwise have formed the APZ. Secondly, Mt Jerrabomberra Bushland Reserve is of high environmental and social value to the Queanbeyan community and it is therefore necessary to minimize adverse impacts upon the Reserve.

### 6.2.1 APZ standard construction & maintenance

The asset protection zones are recommended to establish a greater separation distance between homes and the vegetation hazard within Mt Jerrabomberra. This is a historic issue that under current subdivision requirements would not occur (NSW RFS 2006<sup>1</sup>). To correct for the lack of a perimeter road, an IAPZ is recommended to be created at the property boundary within Mt Jerrabomberra. The creation of the recommended IAPZs establishes an area in which fire fighter safety is enhanced and the heat flux that houses are exposed to is reduced.

The IAPZ will take advantage of existing roadways or cleared areas wherever they exist so as to minimise environmental disturbance. The typical layout of the IAPZ and OAPZ is shown in Figure 61. Where they have been recommended, fire trails should be located within the IAPZ where possible as they will account



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for 60 per cent of the IAPZ taking into account the shoulder area of the fire trail. The remainder of the IAPZ should be maintained so that fuel loads are low, while providing protection from erosion.

Prescribed fire is not recommended within the APZ and fuel should be removed through mechanical means in accordance with NSW RFS (2005) and NSW RFS (2006<sup>2</sup>).

The OAPZ recommended involves the reduction of the fuel load for a distance of 10 m from the boundary of the IAPZ. Fuel load reduction can be achieved by 'skirting' trees, whereby branches lower than 2 m from the surface are removed and selective branch removal practiced to create canopy coverage of approximately 30 per cent. More importantly the ground and near ground fuel layers are reduced by weed removal, slashing, pruning and selective shrub removal and thinning.

ESA (2014<sup>3</sup>) specifies the default fuel treatment standards to be achieved for both IAPZ and OAPZ based upon the type of vegetation association present at the asset interface, Table 36. These standards developed for the ACT have been adopted for the Mt Jerrabomberra BMP.

Table 36: Asset protection zone –fuel management standards [Source Table 4, ESA 2014<sup>3</sup>].

Asset Protection Zone	Treatment Standard	
	Vegetation Type	Fuel management standards
<b>Inner Asset Protection Zone</b>		
Default standards to be applied across at least 80 per cent of the zones as mapped. Where default standards cannot be achieved, QPRC may identify alternative treatments to meet the overall objectives for the zone. Any significant variation on the default standards shall be approved by the NSW RFS.	Dry Forest and Woodland	Maintained at an overall fuel hazard <low. 3-5 m canopy separation or fuel gap to crown, >3 m maintained.
	Grassland and Open Woodland	Grassland maintained at <200 mm height when grassland curing >70 per cent
<b>Outer Asset Protection Zone</b>		
Default standards to be applied across at least 70 per cent of the zones as mapped. Where default standards cannot be achieved, QPRC may identify alternative treatments to meet the overall objectives for the zone. Any significant variation on the default standards shall be approved by the NSW RFS.	Dry Forest and woodland	Overall fuel hazard <moderate
	Grassland and Open Woodland	Grassland fire hazard <35 when grassland curing >70 per cent

### 6.2.2 Fire treatment measures (APZ1, APZ2, APZ3, and APZ4)

13. Construct APZ1 10 metres IAPZ and a 10 metres OAPZ, as indicated on Figure 60, between Glenora Court and Jerrabomberra Hill Road entrance. The IAPZ may be positioned over sections of existing perimeter roads to minimise environmental impact.
14. Construct APZ2 10 metres IAPZ and a 10 metres OAPZ, as indicated on Figure 60, between Jerrabomberra Hill Road entrance and Minda Place. The recommended fire trail is to modify as required the existing Jerrabomberra Hill Road.
15. Construct APZ3 10 metres IAPZ and a 10 metres OAPZ, as indicated on Figure 60, from Minda Place to Marruba Place.





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16. Construct APZ4 10 metres IAPZ and a 10 metres OAPZ, as indicated on Figure 60, from Candlebark Road to Southbar Road.
17. Council develop a Plan Amendment Report (PAR) to prohibit the use of flammable materials, such as brush or timber as fencing materials for those properties that share a rear boundary with Mt Jerrabomberra (APZ1, APZ2, APZ3, APZ4). This should apply to the erection of new fences or the replacement of existing fences as required.
18. Council should advise residents that share a boundary with Mt Jerrabomberra of the appropriate materials to be utilised when constructing fencing in a declared bushfire risk area (fire prone land).
19. QPRC take action as deemed necessary to prevent encroachment into Mt Jerrabomberra.
20. New homes or home additions proposed for properties that share a rear property boundary with Mt Jerrabomberra are to comply with AS3959 – 2009.
21. Council to work with NSW RFS & FR NSW to provide bushfire education information to residents within APZ1, APZ2, APZ3 and APZ4.
  - a. Distribution of NSW RFS materials
  - b. Council/NSW RFS mail out of prepared materials
  - c. Council/ NSW RFS street meetings and community meetings
  - d. Council to coordinate activities with NSW RFS Community Educators
  - e. A priority of community education is to achieve an increase in the effective separation distance between the hazard and the house on the residents' property, i.e. remove fuel from the property between the house and the boundary.

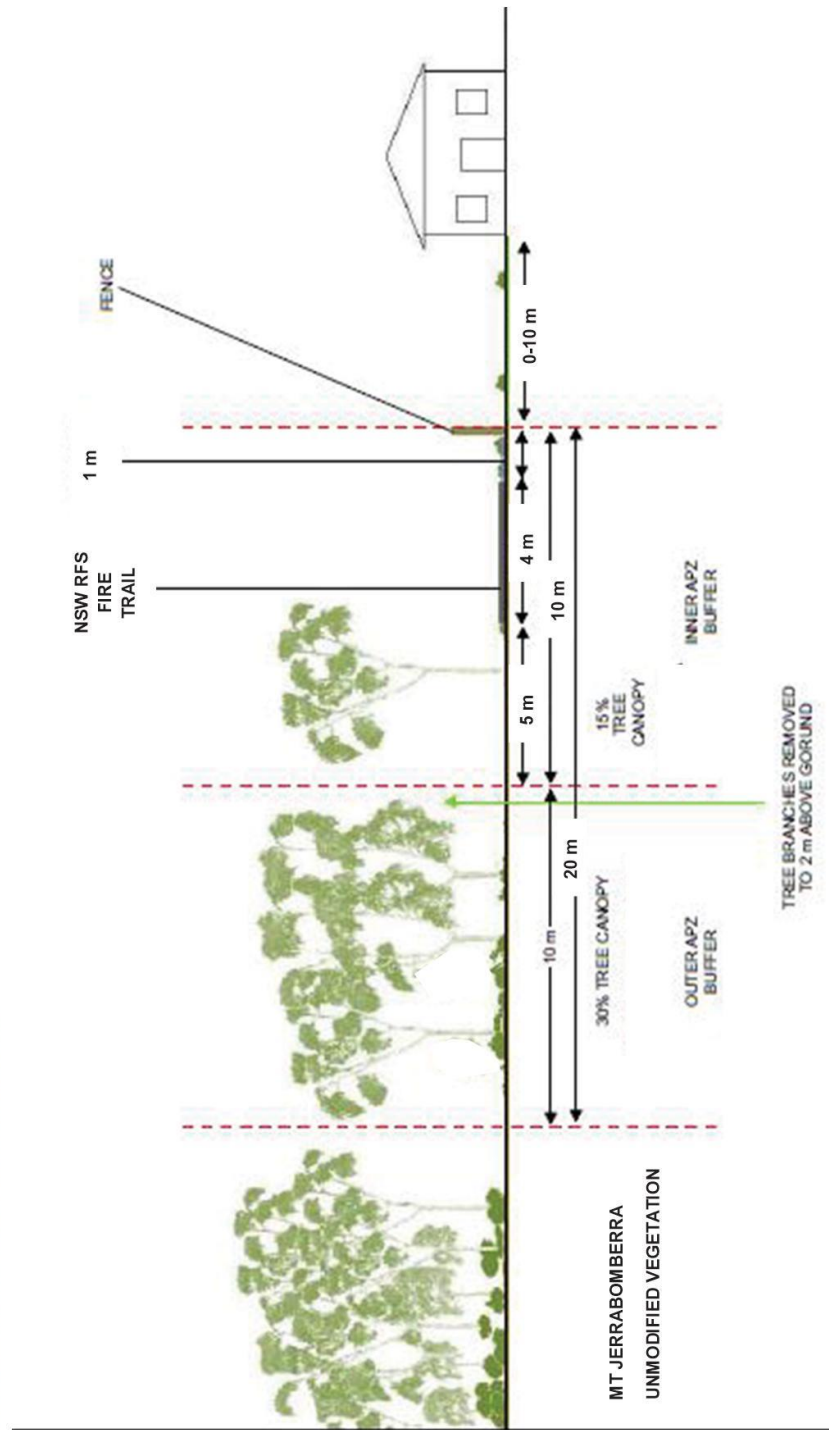
### 6.2.3 Fire treatment measures (APZ5, APZ6 and APZ7)

22. Construct APZ5 and APZ6 10 m IAPZ and a 10 m OAPZ, as indicated on Figure 60, around the water supply reservoirs, with the IAPZ starting from against the wall of the reservoir tank. The rock face cutting, road and laydown areas are incorporated into the IAPZ and OAPZ.
23. Construct APZ7 10 m IAPZ and a 10 m OAPZ, as indicated on Figure 60, around the perimeter fence of the telecommunication tower and base station, ensuring all overhanging vegetation is removed.
24. Clear vegetation from the vicinity of the powerline and poles to create and maintain an easement corridor in accordance with industry standards ISSC (2016) and ISSC (2012).



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Figure 61: Proposed APZ construction details.





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## 6.3 Conservation Land Management Zone

### 6.3.1 General treatment measures CLMZ1.

25. Council establish Conservation Land Management Zones as indicated in Figure 54.
26. Council conduct a vegetation survey of across Mt Jerrabomberra to identify and map the vegetation communities present within the Dry Forest vegetation association.
27. Council conduct a survey to locate populations of *Delma impar* (Striped Legless Lizard), listed as Vulnerable under the NSW TSC Act 1995 and under the EPBC Act.
28. Establish an updated map (GIS layer) of the location of threatened species within Mt Jerrabomberra.
29. Undertake weed management throughout Mt Jerrabomberra in accordance with Eco Logical (2010) and as required to maintain the ecological integrity of the Reserve and to control the fire risk presented by weeds within the Reserve. *Acacia baileyana* (Cootamundra Wattle) and *Eragrostis curvula* (African Lovegrass) are priority species to be eradicated.
30. Inspect Mt Jerrabomberra during the fire ban season for activity that presents a fire risk and implement corrective actions where possible (police, public education, expiation notice/ fine).
31. Close Mt Jerrabomberra on days of Catastrophic fire danger. Install signage at all entrances.
32. Exclude waterways from prescribed fire, in accordance with NSW RFS (2006<sup>2</sup>). Establish a 10 m buffer as a minimum for 1<sup>st</sup> and 2<sup>nd</sup> order streams.
33. An unplanned fire within Mt Jerrabomberra will trigger a review of the prescribed burning plan and expert advice should be sought prior to proceeding with any prescribed burn following a bushfire.
34. Initiate a program of works to remove the remnant pine plantation from the southeast corner of the Reserve. Prescribed fires are planned to be conducted in these areas following the complete removal of pines to promote recovery of the Dry Forest vegetation association.

### 6.3.2 Fire treatment measures (CLMZ1)

35. Conduct a prescribed fire in accordance with NSW RFS 2006, for ecological purposes in late autumn 2018 subject to appropriate weather conditions in the area marked on Figure 62 to initiate heterogeneity (mosaic pattern) within the Dry Forest formation. This area is considered not to have burnt for at least 65 years and is beyond the upper threshold of potential concern (TPC2) of 30 years for Dry Forest (NPWS 2004).
  - a. Protect 1<sup>st</sup> and 2<sup>nd</sup> order streams with buffer zones (unburnt areas) of 10 m.
  - b. Identify locations of threatened plants within the proposed prescribed burn footprint and take measures to prevent these locations from being burnt.
  - c. Establish a permanent monitoring location within the prescribed burn area and conduct a vegetation assessment to obtain a pre-fire baseline condition.
  - d. Burn no more than 70per cent of the designated area for the prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through.



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- e. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore conduct a low intensity fire in accordance with the principles of NSW RFS (n.d.).
36. Following the mechanical harvesting and removal of pine trees (remnant pine plantation), conduct a prescribed fire in either spring or autumn 2019 subject to appropriate weather conditions in the area marked on Figure 62 to initiate restoration of the former Dry Forest formation.
- a. Establish a permanent monitoring location within the prescribed burn area and conduct a vegetation assessment to obtain a pre-fire baseline condition.
  - b. Burn no more than 70 per cent of the designated area for the prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through.
  - c. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore conduct a low intensity fire in accordance with the principles of NSW RFS (n.d.).
37. Following the mechanical harvesting and removal of pine trees (remnant pine plantation), conduct a prescribed fire in either spring or autumn 2021 subject to appropriate weather conditions in the area marked on Figure 62 to initiate restoration of the former Dry Forest formation.
- a. Establish a permanent monitoring location within the prescribed burn area and conduct a vegetation assessment to obtain a pre-fire baseline condition.
  - b. Burn no more than 70 per cent of the designated area for the prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through.
  - c. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore conduct a low intensity fire in accordance with the principles of NSW RFS (n.d.).
38. Allocate resources to control weeds following each prescribed burn (extended program of weed control as required).
39. Council is to request NSW RFS to conduct the prescribed burns.
40. NSW RFS are to evaluate the methodology appropriate for the conditions and geographic location for each prescribed burn and document this in a fire plan submitted to Council. This may include slashing boundaries, using wet barriers.
41. Monitor the vegetation response within each prescribed burn area to:
- a. Identify appropriate weed control measures.
  - b. Conduct post fire vegetation assessments to provide feedback regarding the recovery of vegetation species within each fire scar area. Vegetation assessments are to be conducted:
    - i. Spring survey (6 months post fire)
    - ii. Spring (18 months post fire)
    - iii. Spring (4.5 years post fire).
42. Council is to accurately map the fire scars (GIS) from the prescribed burn program, including areas within the prescribed burn that remained unburnt.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

43. Council is to advise the community well in advance of the prescribed burning being undertaken in accordance with NSW RFS protocols.
44. Council is to allocate resources to control weeds following each prescribed burn (extended program of weed control as required).



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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 7 WATER SUPPLY

There are several water hydrants indicated as occurring within Mt Jerrabomberra, however during the site walkover only one hydrant that was marked as a fire hydrant was located.

45. QPRC is to review the fire hydrant data set to ensure that hydrants indicated as occurring within Mt Jerrabomberra are present and visible 'on the ground' within Mt Jerrabomberra.
  - a. Fire hydrants within Mt Jerrabomberra must be clearly marked and be visible and accessible.
46. Fire agencies are to inspect any existing hydrants located at the Lower or Upper Thornton Water Supply Reservoirs to assess accessibility and compatibility with NSW FR & NSW RFS fire fighting vehicles. If the existing hydrants are not suitable, a water supply standpipe is to be installed with Storz fittings compatible with NSW FR & NSW RFS fire fighting vehicles to enable safe rapid refilling.
47. Signage is to be installed on fire trails to indicate the presence of fire hydrants.
48. Accumulated rubbish is to be removed from the concrete rings housing equipment and consideration should be given to reducing the mesh size of the cover to prevent rubbish accumulation.
49. Hazard signs are to be installed at either end of the concrete rings to improve visibility and fire crew awareness that these hazards are located in the middle of this track.

## 8 MONITORING AND REVIEW

### 8.1 Monitoring

QPRC should confirm BMP management recommendations have been effectively implemented and should regularly monitor the performance of bushfire management practices.

It has been recommended that QPRC accurately map the footprint of all fires within Mt Jerrabomberra so as to build an accurate fire history map that does not currently exist for this Reserve. Mapping of prescribed fire footprints and bushfires should include the perimeter and areas within the footprint that remain unburnt so as to be able to determine the percentage cover of burnt and unburnt areas. The unburnt areas within the footprint of a fire provide refuge for animals and seed source for recolonization by some plant species, food source for animals and are therefore vitally important. It is never the intent of a prescribed fire to raze an area.

Opportunities are created through the introduction of prescribed fire into the landscape to learn more about the local response to bushfire and to integrate this information into the management of Mt Jerrabomberra. Monitoring of the vegetation response following fire over a 5 year period and beyond provides valuable information that can be utilised to inform future bushfire management planning within QPRC and specifically Mt Jerrabomberra.

Monitoring of both the fauna and vegetation of Mt Jerrabomberra, in particular species of significance enables this information to inform future management decisions.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 8.2 Review

A review of the BMP is to be conducted if significant changes in legislation occur that manifestly affect the management recommendations of the BMP.

GFE recommends that the BMP be presented to the NSW RFS and FRS for endorsement and certain recommendations relating to the provision and location of asset protection zones requires the endorsement of these agencies.

An unplanned fire within the immediate vicinity of Mt Jerrabomberra should trigger a review of the BMP.

A significant change in the bushfire risk should trigger a review of the BMP, e.g. an extended period of extreme weather, when arson activity is reported in the area, a new subdivision or medium to high housing density is proposed.

The complete BMP should be reviewed in preparation for the 2022 – 2023 bushfire season.



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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 9 LIMITATIONS

This BMP has been completed based upon the information provided to GFE and the agreed scope of works between GFE and QPRC.

Extensive consultation with stakeholders was outside of the scope of works for this BMP, although limited input was sought from key stakeholders where it was considered vital to the risk assessment process and for integrated management.

Bushfire risk assessment and management is not a precise science and a significant number of factors may influence how bushfire risks are assessed and managed at any particular location. These factors include the landscape hazards, weather conditions, vulnerability of assets, community preparedness, and implementation of management programs, practicality and cost. It must be acknowledged that the level of bushfire risk in any given situation and the potential for mitigation remains a complex balance of these and other factors, most of which are outside of the control of GFE. It is not possible to guarantee that a bushfire will not occur as a result of mitigation measures proposed or that the associated consequences can be removed. It must be acknowledged that under catastrophic bushfire conditions bushfires may occur that cannot be controlled by fire-fighting services and bushfire mitigation measures may not be effective in preventing loss of property or life.

GFE has prepared this BMP in accordance with the usual care and thoroughness of the consulting profession, by reference to applicable industry standards, guidelines and assessment criteria in existence at the date of issue of this Report and based upon the information and advice provided to GFE. For the reasons outlined, no warranty or guarantee, whether expressed or implied, is made as to the data, observations and recommendations expressed in this BMP.

Any reliance of this BMP by a third party shall be entirely at such party's own risk. GFE provides no warranty or guarantee to any third party, express or implied, as to the information and or professional advice indicated in this BMP, and accept no liability whatsoever for or in any respect of any use or reliance upon this BMP by a third party.



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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## 10 CLOSURE

The Mt Jerrabomberra BMP is designed to assist QPRC meet their obligations under the *Rural Fires Act 1997* and additional applicable legislation. In practice this necessitates a cooperative approach between QPRC and NSW FR Brigade and RFS NSW City Brigade to ensure risk management actions outlined in this report are undertaken.

The BMP provides an approach to managing the bushfire risk within Mt Jerrabomberra and based upon available information and the approach utilised by the RFS NSW. It must be recognised that given adverse weather conditions, all areas within Mt Jerrabomberra could be subject to bushfire and the greatest likelihood of a fire igniting within Mt Jerrabomberra comes from an arson attack or the reckless act of an individual.

Bushfire risk management and bushfire prevention is a shared responsibility that requires individual landholders to take responsibility for their own assets, and make sure that their properties and they as individuals are prepared for the eventuality of a fire.

The BMP endeavours to establish a balance between the protection of human settlements, community assets, preserving life and preserving and enhancing the environmental assets that comprise Mt Jerrabomberra. This Reserve remains a valuable environmental asset that is available to the Council community and others to experience and enjoy.

The BMP is designed to be a dynamic document, through the recommended processes of monitoring, review and reporting.



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## SIGNATURE PAGE

**GRANT FLEMING ENVIRONMENTAL**



Grant Fleming BSc(Hons), BAppSc, MAppSc  
Principal Environmental Scientist



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Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## APPENDIX A

# MT JERRABOMBERRA ACTION PLAN 2017 - 2022



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN				
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT
<b>FIRE TRAILS</b>				
<b>GENERAL FIRE TRAIL MEASURES</b>				
	All proposed fire trails are to comply with The Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard			
1	a. Vehicle carrying capacity must be clearly identified on maps and roadside signage b. Fire trail must be maintained free of obstructions c. Permanent fire trail signage must be installed at both ends of the fire trails. An example of appropriate signage is shown in Figure 59.	Moderate	Oct-19	
2	Paint Fire trail access gates white with red markings in accordance with AS1744 (Standard alphabets for road signs), AS1743 (Road sign specifications) (high reflectivity for low light conditions).	Moderate	Oct-19	
3	Conduct annual inspections of fire trails (August) and appropriate maintenance undertaken to rectify identified issues.	Moderate	Aug-annually	
<b>NEW FIRE TRAILS</b>				
4	Construct APZ1 Fire Trail as indicated on Figure 60, between Glenora Court and Jerrabomberra Hill Road off of Halloran Drive with an additional access from Carolyn Jackson Drive as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails CAT 1 standard. This fire trail is considered to be 'Essential'.	Very High	Oct-19	
5	Construct APZ2 Fire Trail – Jerrabomberra Hill Road to Minda Place as indicated on Figure 60. This fire trail is to be built as a CAT1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.	High	Oct-20	
6	Construct APZ3 Fire Trail – Minda Place to Marruba Place Fire Trail as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails CAT 1 standard. This fire trail is considered to be 'Essential'.	High	Oct-20	





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN					
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT	
7	Construct APZ3-APZ4 Fire Trail – Marruba Place Fire Trail to Temora Place as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails CAT 1 standard. This fire trail is considered to be 'Important'.	High	Oct-20		
8	Construct APZ4 Fire Trail – Candlebark Road to Temora Place as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Important'.	High	Oct-20		
9	Construct APZ4 Fire Trail – Temora Place to Beard Close as indicated on Figure 60. This fire trail is to be built as a CAT1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails CAT 1 standard. This fire trail is considered to be 'Important'.	High	Oct-20		
10	Construct APZ4 Fire Trail – Rusten Street to join the Jerrabomberra Hill Road Fire Trail to exit at Kinsella Street as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails CAT 1 standard. This fire trail is considered to be 'Important'.	High	Oct-20		
11	Construct APZ4 Fire Trail – Kinsella Street to Southbar Road via the Scar Recreation Reserve carpark as indicated on Figure 60. This fire trail is to be built as a CAT 1 Fire Trail in accordance with Bush Fire Coordinating Committee Policy No. 2/2007 – Fire Trails Cat 1 standard. This fire trail is considered to be 'Essential'.	High	Oct-20		
12	Upgrade Jerrabomberra Hill Road to a CAT 1 Fire Trail with through access to Kinsella Street including a loop access to the telecommunication tower and entrance to the Lower Thornton Water Supply Reservoir as indicated on Figure 60. This fire trail is considered to be 'Essential'.	Very High	Oct-19		
<b>ASSET PROTECTION ZONES - RESIDENTIAL &amp; ECONOMIC</b>					
<b>GENERAL FIRE TREATMENTS ASSET PROTECTION ZONES</b>					
13	Construct APZ1 10 metre IAPZ and a 10 metre OAPZ, as indicated on Figure 60, between Glenora Court and Jerrabomberra Hill Road entrance. The IAPZ may be positioned over sections of existing perimeter roads to	Very High	Oct-18		



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN				
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT
	minimise environmental impact.			
14	Construct APZ2 10 metre IAPZ and a 10 metre OAPZ, as indicated on Figure 60, between Jerrabomberra Hill Road entrance and Minda Place. The recommended fire trail is to modify as required the existing Jerrabomberra Hill Road.	High	Oct-18	
15	Construct APZ3 10 metre IAPZ and a 10 metre OAPZ, as indicated on Figure 60, from Minda Place to Marruba Place.	High	Oct-18	
16	Construct APZ4 10 metre IAPZ and a 10 metre OAPZ, as indicated on Figure 60, from Candlebark Road to Southbar Road.	High	Oct-18	
17	Council develop a Plan Amendment Report (PAR) to prohibit the use of flammable materials, such as brush or timber as fencing materials for those properties that share a rear boundary with Mt Jerrabomberra (APZ1, APZ2, APZ3, APZ4). This should apply to the erection of new fences or the replacement of existing fences as required.	Moderate	Oct-18	
18	Council should advise residents that share a boundary with Mt Jerrabomberra of the appropriate materials to be utilised when constructing fencing in a declared bushfire risk area (fire prone land).	Moderate	Oct-17	
19	QPRC take action as deemed necessary to prevent encroachment into Mt Jerrabomberra.	High	Aug-annually	Ongoing occasional QPRC action required. Annual inspection in August
20	New homes or home additions proposed for properties that share a rear property boundary with Mt Jerrabomberra are to comply with AS3959 – 2009.	Very High	Oct-18	This is a legislated requirement with no additional action required by QPRC.
21	Council work with NSW RFS & FRNSW to provide bushfire education information to residents within APZ1, APZ2, APZ3 and APZ4. a. Distribute NSW RFS materials b. Council/NSW RFS mail out of prepared materials c. Council/NSW RFS street meetings and community meetings d. Council to coordinate activities with NSW RFS Community Educators e. A priority of community education is to achieve an increase in the effective separation distance between the hazard and the house on the	High	Sep 17 - Annually	Annual community education programs are required to be implemented with information sessions held and information distributed prior to the commencement of the bushfire season.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN					
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT	
	residents' property, i.e. remove fuel from the property between the house and the boundary.				
22	Construct APZ5 and APZ6 10 metres IAPZ and a 10 metres OAPZ, as indicated on Figure 60, around the water supply reservoirs, with the IAPZ starting from against the wall of the reservoir tank. The rock face cutting, road and laydown areas are incorporated into the IAPZ and OAPZ.	Medium	Oct-19		
23	Construct APZ7 10 m IAPZ and a 10 m OAPZ, as indicated on Figure 60, around the perimeter fence of the telecommunication tower and base station, ensuring all overhanging vegetation is removed.	Very High	May-18	Work is to be conducted as soon as is practicable and may be conducted in stages with removal of overhanging vegetation an immediate priority.	
24	Clear vegetation from the vicinity of the powerline and poles to create and maintain an easement corridor in accordance with industry standards ISSC (2016) and ISSC (2012).	Very High	May-18	Clearance of vegetation growing into the hazard zone of the poles (2 metres) and powerlines is an immediate priority.	
CONSERVATION LAND MANAGEMENT ZONES					
GENERAL FIRE TREATMENTS CONSERVATION LAND MANAGEMENT ZONES					
25	Council establish Conservation Land Management Zones as indicated in Figure 54.	Very High	Oct-17		
26	Council conduct a vegetation survey of across Mt Jerrabomberra to identify and map the vegetation communities present within the Dry Forest vegetation association.	High	Dec-18		
27	Council conduct a survey to locate populations of <i>Delma impar</i> (Striped Legless Lizard), listed as Vulnerable under the NSW TSC Act 1995 and under the EPBC Act.	High	Dec-18	Survey is to be completed before the end of summer 2018 and is to focus upon areas of tussock grassland/woodland.	
28	Council establish an updated map (GIS layer) of the location of threatened species within Mt Jerrabomberra.	Moderate	Mar-18		



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN				
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT
29	Undertake weed management throughout Mt Jerrabomberra in accordance with Eco Logical (2010) and as required to maintain the ecological integrity of the Reserve and to control the fire risk presented by weeds within the Reserve. <i>Acacia baileyana</i> (Cootamundra Wattle) and <i>Eragrostis curvula</i> (Love grass) are priority species to be eradicated.	High	Ongoing	
30	Inspect Mt Jerrabomberra during the fire ban season for activity that presents a fire risk and implement corrective actions where possible (Police, public education, expiation notice/ fine).	High	Oct-Mar Annually	Inspections conducted regularly across each declared bushfire season.
31	Close Mt Jerrabomberra on days of Catastrophic fire danger. Signage to be installed at all entrances.	Very High	Oct-Mar Annually	As required during the bushfire season each year. Signage should be in ready for use Oct 2017.
32	Exclude waterways from prescribed fire, in accordance with NSW RFS (2006 <sup>2</sup> ). A 10 m buffer is to be established as a minimum for 1 <sup>st</sup> and 2 <sup>nd</sup> order streams.	High	As required	The first prescribed fire is scheduled for late autumn 2018 and the remaining prescribed fires in 2019 and 2021.
33	Review the prescribed burning plan following an unplanned fire within Mt Jerrabomberra with expert advice sought prior to proceeding with any prescribed burn following a bushfire.	High	As required	Expert advice should be sought, as to whether a prescribed fire should proceed.
34	Initiate a program of works to remove the remnant pine plantation from the southeast corner of the Reserve. Prescribed fires are planned to be conducted in these areas following the complete removal of pines to promote recovery of the Dry Forest vegetation association.	Moderate	Nov-2018	The northern section of pine plantation is to be cleared prior to Nov 2018. The southern section of pine plantation is to be cleared prior to Nov 2020. Harvested pines are to be removed from the Reserve. Remnant native vegetation should be retained in this area, that is pines should be removed selectively to preserve native trees.
<b>SPECIFIC FIRE TREATMENT CLMZ1</b>				
35	Conduct a prescribed fire in accordance with NSW RFS 2006, for ecological purposes in late autumn 2018 subject to appropriate weather conditions in the area marked on Figure 62 in order to initiate heterogeneity (mosaic pattern) within the Dry Forest formation. This area is considered not to have burnt for at least 65 years and is beyond the upper threshold of potential concern (TPC2) of 30 years for Dry Forest (NPWS 2004).	High	Apr-18	NSW RFS is to be consulted and provided with advance notice of the intent to burn.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN				
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT
	<p>a. Protect 1<sup>st</sup> &amp; 2<sup>nd</sup> order streams by 10 m buffer zones (unburnt areas).</p> <p>b. Identify locations of threatened plants within the proposed prescribed burn footprint and measures taken to prevent these locations from being burnt.</p> <p>c. Establish a permanent monitoring location within the prescribed burn area and a vegetation assessment conducted to obtain a pre-fire baseline condition.</p> <p>d. Burn no more than 70 per cent of the designated area for the prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through.</p> <p>e. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore a low intensity fire is to be conducted in accordance with the principles of NSW RFS (n.d.).</p>			
36	<p>Conduct a prescribed fire in either spring or autumn 2019 subject to appropriate weather conditions in the area marked on Figure 62 to initiate restoration of the former Dry Forest formation following the mechanical harvesting and removal of pine trees (remnant pine plantation).</p> <p>a. Establish a permanent monitoring location within the prescribed burn area and a vegetation assessment conducted to obtain a pre-fire baseline condition.</p> <p>b. Burn no more than 70 per cent of the designated area for the prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through.</p> <p>c. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore a low-moderate intensity fire is to be conducted in accordance with the principles of NSW RFS (n.d.).</p>	High	Spring or autumn 2019	The timing of the prescribed fire is flexible to take into account the time required to remove the pine plantation. It is recommended that pines are harvested and removed from the Reserve.
37	<p>Conduct a prescribed fire in either spring or autumn 2021 subject to appropriate weather conditions in the area marked on Figure 62 to initiate restoration of the former Dry Forest formation following the mechanical harvesting and removal of pine trees (remnant pine plantation).</p> <p>a. Establish a permanent monitoring location within the prescribed burn area and a vegetation assessment conducted to obtain a pre-fire baseline condition.</p> <p>b. Burn no more than 70 per cent of the designated area for the</p>	High	Spring or autumn 2021	The former pine plantation areas are to be burnt on separate occasions to promote heterogeneity in the area. Monitoring of the outcome of the prescribed fire in the northern section can be utilised to inform the 2021 prescribed fire planned for the southern section.



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN				
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT
	prescribed burn to create a mosaic of burnt and unburnt areas within the area that the fire travelled through. c. NSW RFS (2006) prohibits high intensity fire within Dry Forest communities therefore a low-moderate intensity fire is to be conducted in accordance with the principles of NSW RFS (n.d.).			
38	Allocate resources to control weeds following each prescribed burn (extended program of weed control as required).	High	May-18 Ongoing	Budget item - funds to be allocated.
39	Council request NSW RFS to conduct the prescribed burns.	High	Feb-18	NSW RFS is to be consulted and provided with advance notice of the intent to burn. Staff experienced in the application of fire for ecological purposes should be utilised to conduct the prescribed burn.
40	The NSW RFS are to evaluate the methodology appropriate for the conditions and geographic location for each prescribed burn and this is to be documented in a fire plan submitted to Council. This may include slashing boundaries, using wet barriers.	Very High	Mar-18	NSW RFS are the responsible agency.
41	Monitor the vegetation response within each prescribed burn area to: a. Identify appropriate weed control measures. b. Conduct post fire vegetation assessments to provide feedback regarding the recovery of vegetation species within each fire scar area. Vegetation assessments are to be conducted: Spring survey (6 months post fire) Spring (18 months post fire) Spring (4.5 years post fire)	High	Sep/Oct 2018 Ongoing	The exact timing of the vegetation assessments is subject to the timing of the prescribed fire, however assessments should be conducted in Spring.
42	Accurately map the fire scars (GIS) from the prescribed burn program, including areas within the prescribed burn that remained unburnt.	High	Apr-18 ongoing	The perimeter of the fire is to be mapped and unburnt areas within the perimeter are also to be recorded to determine the percentage of the area burnt.
43	Advise the community well in advance of the prescribed burning being undertaken in accordance with NSW RFS protocols.	High	Mar-18	This is to be conducted in accordance with existing protocols.





Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

MOUNT JERRABOMBERRA PROPOSED ACTION PLAN					
REC.	ACTION REQUIRED	PRIORITY RATING	TIMING	COMMENT	
44	Council is to allocate resources to control weeds following each prescribed burn (extended program of weed control as required).	High	Mar-18	Requires additional budget allocation for post 2018, 2019 and 2021 prescribed fires.	
<b>WATER SUPPLY</b>					
45	QPRC review the fire hydrant data set to ensure that hydrants indicated as occurring within Mt Jerrabomberra are present and visible 'on the ground' within Mt Jerrabomberra. Fire hydrants within Mt Jerrabomberra must be clearly marked, visible and accessible.	High	Mar-18	The review should be conducted as soon as practicable with an onsite inspection to confirm the status of hydrants within Mt Jerrabomberra.	
46	Fire agencies inspect any existing hydrants located at the Lower or Upper Thornton Water Supply Reservoirs to assess accessibility and compatibility with NSW FR & NSW RFS firefighting vehicles. If the existing hydrants are not suitable, a water supply standpipe is to be installed with Storz fittings compatible with NSW FR & NSW RFS fire fighting vehicles to enable safe rapid refilling.	High	Mar-18	The preference is to establish free standing stand pipes at each water supply reservoir compound at a location that is readily accessible to fire fighting vehicles.	
47	Install signage on fire trails to indicate the presence of fire hydrants.	Moderate	Oct 18	This action needs to be undertaken following the review of hydrants within Mt Jerrabomberra.	
48	Remove accumulated rubbish from the concrete rings housing equipment and consideration should be given to reducing the mesh size of the cover to prevent rubbish accumulation.	Moderate	Oct 17	Regular maintenance could remove rubbish however a long term solution would be to alter the screen size to prevent rubbish being pushed through the grid.	
49	Install hazard signs at either end of the concrete rings to improve visibility and fire crew awareness that these hazards are located in the middle of this track.	Moderate	Oct 18	While the track is not a recognised fire trail it may be utilised by fire fighting or other vehicles and no warning exists of the hazard.	



Bushfire Management Plan – Mount Jerrabomberra, Jerrabomberra, NSW.

## APPENDIX B

# MT JERRABOMBERRA – FUEL HAZARD ASSESSMENT FIELD DATA SHEETS



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## Appendix 2. Sample fuel assessment field work form v3

Date Assessed: 12 JUNE 17	Assessors: GF
Sampling Location: MT. JERRABOMBERRA	Veg Type: DRY FOREST

Plot Information			
Plot No.	1. 2009 Burn Area	2. slope above Scar	3. 2009 Burn area
Zone:	SB M061	NO Burn. M.062	M72
Easting (GDA94 MGA UTM):	701645	701468	701695
Northing (GDA94 MGA UTM):	6083680	6083688	6083074

Canopy height (Assess over a 20m radius)			
Average Height to Top of Canopy:	10 m	10 m	10 m
Average Height to Base of Canopy:	5 m	5 m	3 m

Bark fuel (Assess over a 20m radius)															
Stringybark Fuel Hazard:	NP	M	H	VH	E	NP	M	H	VH	E	NP	M	H	VH	E
Ribbon Bark Fuel Hazard:	NP	M	H	VH	E	NP	M	H	VH	E	NP	M	H	VH	E
Other Bark Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark AND it has the highest rating. Otherwise use the bark with next highest rating.)

Bark Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E
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Elevated fuel layer (Assess over a 10m radius)															
Elevated % Cover:	80 %	80 %	15 %												
Elevated % Dead:	10 %	10 %	5 %												
Elevated Fuel Ave Height (m):	2 m	3 m	1.0 m												
Elevated Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Near-surface fuel layer (Assess over a 10m radius)															
Near-surface % Cover:	80 %	10% - 80 %	10 %												
Near-surface % Dead:	15 %	10 %	50 %												
NS Average Height (cm):	40 cm	30 cm	20 cm												
NS Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Surface fuel layer (Assess over a 10m radius)															
Surface Litter % Cover:	56.8mm 95 %	25.2mm 70 %	32.2 90 %												
Average Litter Depth (mm):	4150 70 53 70 mm	16 26 34 21 4 mm	33 32 18 36 42 mm												
Surface Fuel Hazard:	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Combined Surface and Near-surface Fine Fuel Hazard calculation (refer Section 7)															
Combined Hazard	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Overall Fuel Hazard calculation (refer Section 8)															
Overall Fuel Hazard	L	M	H	VH	E	L	M	H	VH	E	L	M	H	VH	E

Are the plots representative of the average fuels across the sampling location? Yes  No

If no, explain any significant difference between plots. For example, wet gully runs through the sampling area, no plots were located in this gully.

p26, 15, 24 60 61 62



## Appendix 2. Sample fuel assessment field work form v3

Date Assessed: <u>TUES. 13/6.</u>	Assessors: <u>LF.</u>
Sampling Location: <u>MT JERRABOMBERRA</u>	Veg Type: <u>E. Rosii</u>

Plot Information			
Plot No.	<u>4. near center</u>	<u>#5. W back</u>	<u>#6. E. Rosii</u>
Zone:	<u>55</u>	<u>loops. M83</u>	<u>above tanks #1</u>
Easting (GDA94 MGA UTM):	<u>700253</u>	<u>700320</u>	<u>700587</u>
Northing (GDA94 MGA UTM):	<u>6083064</u>	<u>6082902</u>	<u>6083173</u>

M 88

Canopy height (Assess over a 20m radius)			
Average Height to Top of Canopy:	<u>12 m</u>	<u>10 m</u>	<u>14 m</u>
Average Height to Base of Canopy:	<u>8 m</u>	<u>3 m</u>	<u>8 m</u>

Bark fuel (Assess over a 20m radius)			
Stringybark Fuel Hazard:	(NP) M H VH E	(NP) M H VH E	(NP) M H VH E
Ribbon Bark Fuel Hazard:	(NP) M H VH	(NP) M H VH	(NP) M H VH
Other Bark Fuel Hazard:	(L) M H	(L) (M) H	(L) M H

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark AND it has the highest rating. Otherwise use the bark with next highest rating.)

Bark Fuel Hazard:	(L) M H VH E	L (M) H VH E	(L) M H VH E
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Elevated fuel layer (Assess over a 10m radius)			
Elevated % Cover:	<u>10 %</u>	<u>60 %</u>	<u>2 %</u>
Elevated % Dead:	<u>2 %</u>	<u>2 %</u>	<u>100 %</u>
Elevated Fuel Ave Height (m):	<u>1 m</u>	<u>3 m</u>	<u>2 m</u>
Elevated Fuel Hazard:	(L) M H VH E	L M H (VH) E	(L) M H VH E

Near-surface fuel layer (Assess over a 10m radius)			
Near-surface % Cover:	<u>10 %</u>	<u>5%</u>	<u>65 %</u>
Near-surface % Dead:	<u>1 %</u>	<u>2 %</u>	<u>5 %</u>
NS Average Height (cm):	<u>30 cm</u>	<u>40 cm</u>	<u>40 cm</u>
NS Fuel Hazard:	(L) M H VH E	L M H (VH) E	L (M) H VH E

Surface fuel layer (Assess over a 10m radius)			
Surface Litter % Cover:	<u>22.2</u>	<u>70 %</u>	<u>48mm 100. %</u>
Average Litter Depth (mm):	<u>16 21 16 27 31</u>	<u>mm</u>	<u>14 30 58 54 54 mm</u>
Surface Fuel Hazard:	L (M) H VH E	L M H VH (E)	L M H (VH) E

Combined Surface and Near-surface Fine Fuel Hazard calculation (refer Section 7)			
Combined Hazard	L (M) H VH E	L M H VH (E)	L M H (VH) E

Overall Fuel Hazard calculation (refer Section 8)			
Overall Fuel Hazard	L (M) H VH E	L M H (VH) E	L M (H) VH E

Are the plots representative of the average fuels across the sampling location? Yes No

If no, explain any significant difference between plots. For example, wet gully runs through the sampling area, no plots were located in this gully.

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## Appendix 2. Sample fuel assessment field work form v3

Date Assessed: <u>TUES. 13/6</u>	Assessors: <u>GF</u>
Sampling Location: <u>MT JERRABOMBERRA</u>	Veg Type: <u>DRY FOREST</u>

Plot Information			
Plot No.	<u>#7 near 2<sup>nd</sup> tank</u>	<u>#8 track from</u>	<u>#9 Pines</u>
Zone:	<u>M93</u>	<u>tanks 1/5 M107</u>	<u>M104</u>
Easting (GDA94 MGA UTM):	<u>701091</u>	<u>701440</u>	<u>701578</u>
Northing (GDA94 MGA UTM):	<u>6083370</u>	<u>6083403</u>	<u>6082966</u>

Canopy height (Assess over a 20m radius)			
Average Height to Top of Canopy:	<u>18</u> m	<u>M</u>	<u>14</u> m
Average Height to Base of Canopy:	<u>8</u> m		<u>5</u> m

Bark fuel (Assess over a 20m radius)			
Stringybark Fuel Hazard:	NP M H <u>VH</u> E	NP M <u>H</u> VH E	NP M H VH E
Ribbon Bark Fuel Hazard:	<u>NP</u> M H VH	<u>NP</u> M H VH	<u>NP</u> M H VH
Other Bark Fuel Hazard:	<u>L</u> M H	<u>L</u> <u>M</u> H	<u>L</u> M <u>H</u>

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark **AND** it has the highest rating. Otherwise use the bark with next highest rating.)

Bark Fuel Hazard:	L M H <u>VH</u> E	L M <u>H</u> VH E	L M <u>H</u> VH E
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Elevated fuel layer (Assess over a 10m radius)			
Elevated % Cover:	<u>5</u> %	<u>20</u> %	<u>5</u> %
Elevated % Dead:	<u>0</u> %	<u>5</u> %	<u>1</u> %
Elevated Fuel Ave Height (m):	<u>1</u> m	<u>2</u> m	<u>1.5</u> m
Elevated Fuel Hazard:	<u>L</u> M H VH E	L M <u>H</u> VH E	<u>L</u> M H VH E

Near-surface fuel layer (Assess over a 10m radius)			
Near-surface % Cover:	<u>80</u> %	<u>30</u> %	<u>25</u> %
Near-surface % Dead:	<u>40</u> %	<u>15</u> %	<u>6</u> %
NS Average Height (cm):	<u>50</u> cm	<u>20</u> cm	<u>10</u> cm
NS Fuel Hazard:	L M H VH <u>E</u>	L <u>M</u> H VH E	<u>L</u> M H VH E

Surface fuel layer (Assess over a 10m radius)			
Surface Litter % Cover:	<u>41.8</u> 100. %	<u>56.6mm</u> 80. %	<u>22.2</u> 100%
Average Litter Depth (mm):	<u>27 36 66 28 52</u> mm	<u>66 76 31 61 49</u> mm	<u>16 19 34 26 16</u> mm
Surface Fuel Hazard:	L M H VH <u>E</u>	L M H <u>VH</u> E	L M <u>H</u> VH E

Combined Surface and Near-surface Fine Fuel Hazard calculation (refer Section 7)			
Combined Hazard	L M H VH <u>E</u>	L M H VH <u>E</u>	L M <u>H</u> VH E

Overall Fuel Hazard calculation (refer Section 8)			
Overall Fuel Hazard	L M H VH <u>E</u>	L M H <u>VH</u> E	L M <u>H</u> VH E

Are the plots representative of the average fuels across the sampling location? Yes  No

If no, explain any significant difference between plots. For example, wet gully runs through the sampling area, no plots were located in this gully.

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## Appendix 2. Sample fuel assessment field work form v3

Date Assessed: <u>TUES. 13/6.</u>	Assessors: <u>EF</u>
Sampling Location: <u>MT JERRABOMBERRA.</u>	Veg Type: <u>DRY FOREST</u>

Plot Information			
Plot No.	<u>10.</u>	<u>11</u>	<u>12 Mill</u>
Zone:	<u>8th Permits. 4106</u>	<u>8th Per. M10.</u>	<u>Cardyn Judson</u>
Easting (GDA94 MGA UTM):	<u>701260</u>	<u>700914</u>	<u>700604</u>
Northing (GDA94 MGA UTM):	<u>6082931</u>	<u>6082779</u>	<u>6083593</u>

Canopy height (Assess over a 20m radius)			
Average Height to Top of Canopy:	<u>12 m</u>	<u>17 m</u>	<u>10 m</u>
Average Height to Base of Canopy:	<u>5 m</u>	<u>8 m</u>	<u>6 m</u>

Bark fuel (Assess over a 20m radius)															
Stringybark Fuel Hazard:	NP	(M)	H	VH	E	NP	(M)	H	VH	E	NP	(M)	H	VH	E
Ribbon Bark Fuel Hazard:	(NP)	M	H	VH		(NP)	M	H	VH		(NP)	M	H	VH	
Other Bark Fuel Hazard:	(L)	M	H			(L)	(M)	H			(L)	M	H		

Select the Bark Hazard rating from above that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark **AND** it has the highest rating. Otherwise use the bark with next highest rating.)

Bark Fuel Hazard:	L	(M)	H	VH	E	L	(M)	H	VH	E	L	(M)	H	VH	E
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Elevated fuel layer (Assess over a 10m radius)															
Elevated % Cover:	<u>20 %</u>	<u>15 %</u>	<u>70 %</u>												
Elevated % Dead	<u>2 %</u>	<u>2 %</u>	<u>5 %</u>												
Elevated Fuel Ave Height (m)	<u>1.5 m</u>	<u>1.5 m</u>	<u>2 m</u>												
Elevated Fuel Hazard:	L	(M)	H	VH	E	(L)	M	H	VH	E	L	M	(H)	VH	E

Near-surface fuel layer (Assess over a 10m radius)															
Near-surface % Cover:	<u>50 %</u>	<u>30 %</u>	<u>60 %</u>												
Near-surface % Dead	<u>10 %</u>	<u>5 %</u>	<u>10 %</u>												
NS Average Height (cm):	<u>30 cm</u>	<u>35 cm</u>	<u>40 cm</u>												
NS Fuel Hazard:	L	M	(H)	VH	E	L	M	(H)	VH	E	L	M	H	(VH)	E

Surface fuel layer (Assess over a 10m radius)															
Surface Litter % Cover:	<u>31.2</u>	<u>90 %</u>	<u>28.4mm 100. %</u>	<u>33.8mm</u>	<u>70 %</u>										
Average Litter Depth (mm):	<u>26 28 47 73 22 mm</u>	<u>26 32 26 21 37 mm</u>	<u>22 31 32 46 38 mm</u>												
Surface Fuel Hazard	L	M	(H)	VH	E	L	M	H	(VH)	E	L	M	H	(VH)	E

Combined Surface and Near-surface Fine Fuel Hazard calculation (refer Section 7)															
Combined Hazard	L	M	H	(VH)	E	L	M	H	VH	(E)	L	M	H	(VH)	(E)

Overall Fuel Hazard calculation (refer Section 8)															
Overall Fuel Hazard	L	M	(H)	VH	E	L	M	(H)	VH	E	L	M	H	(VH)	E

Are the plots representative of the average fuels across the sampling location? Yes    No

If no, explain any significant difference between plots. For example, wet gully runs through the sampling area, no plots were located in this gully.

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