Fire Management Plan

Ngarkat District

Incorporating Ngarkat, Carcuma and Kelvin Powrie Conservation Parks; Hardings Springs Conservation Reserve; included Crown Lands and participating Heritage Agreements

Department for Environment and Heritage

Australian Government

Government of South Australia

Department for Environment and Heritage

South Australian Murray-Darling Basin Natural Resources Management Board

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This plan has been produced by the South Australian Department for Environment and Heritage with the support of the Australian Government through the Natural Heritage Trust (NHT).

The Native Vegetation Council approved extension of this plan as a bushfire management plan until 31 December 2026 through the *Native Vegetation Regulations 2017*, Reg 9(1) Sch 1(17).

Please note that the Department for Environment and Heritage is now the Department for Environment and Water.

For further information please contact:
Department for Environment and Heritage
Phone Information Line (08) 8204 1910, or
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This Fire Management Plan is also available from:
https://www.environment.sa.gov.au/topics/fire-management/fire-science-and-planning/fire-management-plans/current-fire-management-plans

Front Cover: Ngarkat Conservation Park by Brett Stephens

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Government of South Australia
Department for Environment and Heritage

EXECUTIVE SUMMARY

Ngarkat Conservation Park (CP) is the largest protected area of remnant vegetation in settled South Australia. The reserve, along with Carcuma CP, Kelvin Powrie CP, Hardings Springs Conservation Reserve (CR), adjacent unalienated Crown land and Heritage Agreements, represents 300 000 hectares of heath habitat. It contains a diverse range of flora and fauna species, including some threatened species exclusively found within the region. The recognition that inappropriate fire regimes present a threat to biodiversity regardless of land tenure is important in such a fire-prone landscape. As such, the development of this plan has been funded by the South Australian Murray-Darling Basin (SAMDB) Natural Resources Management (NRM) Board.

This Draft Fire Management Plan for the Ngarkat district has been developed to provide direction for fire management activities, including bushfire suppression, in the region. The plan emphasises the protection of life and property as well as providing direction for land managers in the protection and enhancement of the natural and cultural heritage of Ngarkat and its surrounds. Implementation of the recommendations and works listed in this plan is subject to available resources as well as regional and statewide priorities. Some degree of flexibility will need to remain for fire suppression in those areas where there has only been partial implementation of works.

The Ngarkat district was identified as a priority for fire management planning within Department for Environment and Heritage (DEH) Murraylands Region to address the following issues:

- general protection of life, property and environmental values in the plan area
- protection of important habitat for many species and communities including those with conservation ratings
- the landscape protection of blocks and reserves, to reduce the likelihood of a whole reserve or large portion of a reserve burning in a single fire event.

These issues were addressed by:

- applying a risk assessment process to identify life, property and environmental values at risk from bushfires
- applying DEH Fire Management Zoning Principles to manage fuel in Asset and Buffer Zones
- identifying significant ecological assets and applying Ecological Fire Management Guidelines to determine appropriate burning in Conservation Zones
- auditing tracks within the DEH reserves using the Government Agencies Fire Liaison Committee's (GAFLC) "*South Australian Guidelines for State Government Agencies: Firebreaks and Fire Access Tracks*".

A number of recommendations as result of applying the above processes have been identified.

- Prescribed burning to:
    - reduce fuel in Asset and Buffer zones as outlined in the plan (other methods of fuel reduction will also be used, and in some cases is specifically mentioned)
    - reduce fuel in strategic areas within Conservation zones to provide landscape and habitat protection within the plan area and known threatened species populations
    - create mosaics of areas with a range of different fire ages.
- Track upgrades (in accordance with GAFLC guidelines).
- Identification of suppression considerations that may assist bushfire suppression operations to contribute to improved fire management.

The local community and South Australian Country Fire Service (CFS) volunteers have contributed extensive amounts of time, energy and resources to fire suppression in the Ngarkat district and they are to be commended for this contribution. The co-operation of stakeholders such as DEH, CFS, the apiary industry, Heritage Agreement owners, adjacent landholders and the local community will be critical to the success of the plan. The recognition that fire presents a genuine risk to a variety of land tenures within this plan area provides a unique opportunity to manage the landscape with respect to fire through combining the resources and experience of stakeholders.

The draft plan will be released for public comment for a period of four weeks. Comments will then be evaluated and incorporated according to the submission criteria. A major review of this plan will occur after ten years of implementation, or earlier if required. Recommended works will be reviewed on an annual basis.

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1 RATIONALE AND KEY OBJECTIVES

1.1 Background

The intention of this plan is to provide strategic direction and a framework for fire management activities in the Ngarkat district. The plan defines objectives for life and property protection and ecological fire management. More specifically, it lists recommendations and strategies to achieve these objectives. The pre-suppression works and activities will increase the level of preparedness for bushfires and guide management and suppression during bushfire incidents.

This plan is unique due to the inclusion of adjoining conservation lands such as Heritage Agreements and unalienated Crown land. This was completed with the knowledge that fire in this area is a landscape process, impacting on a variety of ecological communities regardless of land tenure. As the lead Agency for biodiversity management in South Australia, DEH, through the support of the SAMDB NRM Board, has developed this plan with the objective of producing better ecological fire management outcomes for the area. Fire prevention planning for land use outside of reserves is the responsibility of the relevant District Bushfire Prevention Committee, in accordance with the requirements of the *Fire and Emergency Services Act 2005*. DEH is represented on this committee, along with local government and local CFS brigades, in a collaborative approach to fire prevention planning and decision-making.

Fire has been a natural process within the Ngarkat district since well before European settlement; it is considered one of the most fire-prone regions of South Australia. The vegetation, predominantly heath with or without a mallee overstorey, has evolved with fire as a key ecological process. Despite alteration to fire regimes through fragmentation of the landscape for agricultural and pastoral burning practices, the contiguous nature of the remnant vegetation in the area still produces many large fire events. Previously, funding and works for fire management within the plan area have been largely restricted to track and break maintenance and attitudes have been largely reactionary rather than preventative and proactive.

"Fire prevention" is neither desirable nor achievable in this landscape; fires have and will continue to occur in this landscape as a natural process, regardless of any human intervention. However, the risk that fire poses to both biodiversity and built assets can be managed proactively within an adaptive framework that seeks to implement actions and learn from results. This plan is designed to provide direction for the mitigation of this threat through both pre-suppression and suppression activities.

Reducing Costs

Whilst the impacts of fire in the plan area are largely environmental given the low population density and infrastructure in the area, the economic and social costs of suppressing large fires have been an issue. Often the effort expended in suppressing large bushfires has been disproportionate to the success of suppression operations. It is hoped that the pre-suppression strategies prescribed in this document will serve to mitigate some of this cost and serve to reduce the time taken to suppress bushfires.

Identifying Assets and Assessing Risks

There are comparatively few built assets within or adjacent to the plan area. However, identifying the risk to these assets, along with quantifying risks to perceived ecological assets is a priority for effective fire management in and around Ngarkat (Seager, 2001). The identification of rare or significant populations or communities of flora are simpler given their sessile nature. Identifying corresponding fauna assets in a landscape of this size is rather more problematic given they are either rare, mobile, cryptic or a combination of all of the above. Along with known population or community locations and distributions, there is also the need to identify potential sites for habitation in the future if fire management is to be holistic in its approach. This is particularly the case in Ngarkat CP and Carcuma CP given the extensive areas that have been burnt recently. Actions prescribed will source ecological information provided on a range of threatened and significant species in the plan area to meet this objective.

Managing Fire Regimes

Much of the focus of fire management within Ngarkat CP, and indeed across Australia has centred on event-based management (Gill*, et al.*, 2002). Ecologically, improved management of fire regimes is required across this landscape to ensure the conservation of the ecological communities it supports. The current status quo of large fires at frequent intervals, often in combination with drought conditions, will not sustain the significant ecological assets in the area. Attempts to manipulate, in the first instance, the extent and location of bushfires within the plan area is pivotal in the sustainable management of not only significant or threatened species in the area, but all of the communities it supports.

The scale of this manipulation is dependent on the objectives. Initial strategies will seek to provide protection through prescribed burning across the landscape at a variety of scales. Whereas the major concern with fire events within the plan area centres on landscape level events (i.e. >10 000 ha), bushfires of much smaller magnitudes can be equally destructive at a local or habitat scale.

Increasing Knowledge

Improving our fire management knowledge in the plan area, with respect to fire suppression techniques, fire behaviour and fire ecology is a key goal. Ngarkat CP has been the focus of extensive ecological research over a long period. Research projects have been conducted in the area since the 1950's (Specht and Rayson, 1957; Specht*, et al.*, 1958) and are being continued today through the work of (amongst others) Dr. David Paton in conjunction with DEH. However, this base needs to be built on, particularly with respect to the interactions of significant species or communities and fire regime if the prescribed use of fire is to meet the ecological objectives set.

DEH has engaged Ensis (CSIRO Canberra) through the Bushfire Cooperative Research Centre (CRC) to increase knowledge of fire behaviour and fuel dynamics in heath and mallee-heath ecosystems. The inclusion of areas in Ngarkat within "Project FuSE" is an important step in developing greater understanding of fire behaviour in this environment.

Improving Response

Ngarkat CP is an extremely difficult environment in which to combat fire. The size of the area, lack of access and water, steep sandy terrain and often-rapid rate of fire-spread all contribute to a volatile fire environment. Ngarkat CP has been at the centre of considerable development into specific dry fire fighting machinery and techniques. The efforts of the Tatiara CFS Group in developing plant and equipment specifically for suppressing fires in Ngarkat CP have seen major improvements in suppression strategies and efficiencies. DEH, through the development of the Ngarkat Fire Operations Group, will continue to build this capacity through supporting and encouraging the exchange of ideas and the development of plant and equipment to improve fire management in the area.

1.2 Key Objectives

The following seven key objectives provide the focus for the plan. Specific management objectives for designated fire management zones and individual fire management blocks within the plan are dealt with in Section 9 of this plan.

- To protect life and property on all reserves and protected areas listed within the Plan.
- To contain (where operationally feasible) all bushfires within the boundaries of the planning area.
- To manage fires and fire regimes to meet the ecological requirements of species and communities that may be at risk from inappropriate fire regimes.
- Minimise the risk of bushfires greater than 10 000 hectares occurring.
- Promote patchiness using prescribed burns and bushfire suppression.
- Improve our understanding of the role of fire in mallee-heaths with a view to improving fire management practices within Ngarkat CP and its surrounds.
- Minimise the impacts of all fire management operations on the environment.

2 THE PLANNING FRAMEWORK

2.1 Legislation

2.1.1 State Legislation

Under the provisions of the *National Parks & Wildlife Act 1972,* DEH has responsibilities for fire management activities within reserves constituted under this Act.

The *Fire and Emergency Services Act 2005* outlines the responsibilities of DEH and other fire authorities in relation to fire management within proclaimed reserves. Under this Act, the Chief Officer (CFS) must take steps to have any relevant provisions of a management plan for a government reserve brought to the attention of members of CFS who might exercise powers under this section with respect to the reserve.

In prescribing any works or activities that involve clearance or the use of fire (which is also defined as 'clearance' under the *Native Vegetation Act 1991*), the plan must also meet any relevant provisions under the *Native Vegetation Act 1991*. All prescribed burns must be approved through the process delegated to DEH by the Native Vegetation Council (NVC).

Under the *Crown Lands Management Act 2009,* Crown land is described as either:

- dedicated Crown land (land that has been dedicated as a reserve for a specified purpose to a Minister, person or body (including local government or community groups))
- Crown leasehold land
- Crown land owned by, or under the control of the Minister for Environment and Conservation
- unalienated Crown land (land that has not been alienated from the Crown, not including those as defined above).

DEH has responsibilities for fire management on unalienated Crown land and any Crown land dedicated to, owned by or under the care and control of the Minister for Environment and Conservation. The Minister for Environment and Conservation is not responsible for fire management on Crown leasehold land or land dedicated to another government Minister, person or body.

2.1.2 Commonwealth Legislation

Overarching these three State Acts is the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The plan area contains nationally listed species including the Lowan Phebalium (*Phebalium lowanense*), Malleefowl (*Leipoa ocellata*), Red-lored Whistler (*Pachycephala rufogularis*), Mallee Emu-wren (*Stipiturus mallee*) and Western Whipbird (*Psophodes nigrogularis leucogaster*) that are afforded protection under this Act.

2.2 DEH Fire Management Policy

DEH has a Fire Management Policy (DEH, 2009) which outlines the agencies fire management responsibilities and provides a framework for bushfire suppression, prescribed burning and fuel

management on DEH managed land. Under this Policy, DEH is responsible for fire management on reserves dedicated under the *National Parks and Wildlife Act 1972* or *Wilderness Protection Act 1992* and any land under the *Crown Lands Management Act 2009* where the Minister for Environment and Conservation has fire management responsibilities (as defined within Section 2.1.1 of this plan).

The Policy contains a number of key principles:

- Fire is a natural component in Australian ecosystems
- Reserves play a crucial role in protecting biodiversity, particularly within a fragmented landscape, and are acknowledged as valuable ecological assets
- Land development has limited the extent, contiguity and biodiversity of these ecosystems whereby those remaining areas of natural vegetation now protected in reserves may become vulnerable to irreversible change if unprotected from recurrent fire
- Land development has led to the development of residential, agricultural and horticultural assets with increased potential for risk to life and property from uncontrolled fire
- The community has an expectation that their developed assets should be protected from the threat of unplanned fire
- Intervention to suppress unplanned fire is frequently necessary to limit damage to natural and developed assets.

Under this Policy direction, appropriate consideration is given in DEH fire management planning to achieve the dual aims of protecting the environment as well as protecting human life, property and assets. Property protection activities, where recognised as a priority, will be carried out in such a way as to reflect, wherever practicable, the importance of protecting the dynamics of natural ecosystems.

2.3 Zoning Policy

DEH has a Zoning Policy that outlines the zoning standard that is used for fire management planning on DEH managed lands (DEH, 2006a). Zoning is derived from:

- The level of perceived risk, using the *Policy and Procedure for Risk Assessment in DEH Fire Planning* (DEH, 2006b)
- The Overall Fuel Hazard, which is assessed using the *Overall Fuel Hazard Guide for South Australia* (DEH, 2006c)
- The activities considered appropriate to mitigate the threat that fire poses to life, property and environmental assets.

Three distinct zones exist: Asset zone (A-zone), Buffer zone (B-zone) and Conservation zone (C-zone). These are applied according to fire management objectives. A- and B-zones are determined by fuel management objectives whereas C-zones are designated to assist in the conservation of biodiversity through the application of appropriate fire regimes (DEH, 2006a). For more information on zoning, refer to Section 8 of this plan (Fire Management Zones) and the *Policy and Procedure for Fire Management Zoning in DEH Fire Planning* (DEH, 2006a).

2.4 Local and Regional Environmental Planning / Recovery Planning

The South Australian Murray-Darling Basin Biodiversity Plan (Kahrimanis, *et al.*, 2001) is one of several regional biodiversity plans developed by DEH. The Plan guides the conservation, management and rehabilitation of habitats at a regional level. In developing fire management planning objectives, strategies, works and activities in the Ngarkat District Fire Management Plan, careful consideration has been given to fire related issues, to ensure they are consistent with those in the Biodiversity Plan.

The Ngarkat District Fire Management Plan is directed by strategies and actions detailed in a number of recovery plans prepared for listed species found within the planning area. These plans recognise the significant threat that inadequate fire regimes pose to target species and list a number of management recommendations accordingly. The following plans have provided significant direction for the specific fire management requirements for a range of threatened flora and fauna:

- *Recovery Plan for the Mallee Emu-wren, Red-lored Whistler, Western Whipbird and Other Threatened Mallee Birds* (Baker-Gabb, 2004)
- *Regional Recovery Plan for the Mallee Emu-wren Stipiturus mallee, Striated Grasswren Amytornis striatus, Western Whipbird Psophodes nigrogularis leucogaster and Red-lored Whistler Pachycephala rufogularis in the South Australian Murray Darling Basin* (DEH, 2005b)
- *South Australian Murray Darling Basin Threatened Flora Recovery Plan* (Obst, 2005).

2.5 Reserve Management Planning

Reserve management plans are a statutory requirement under the *National Parks and Wildlife Act 1972* or the *Wilderness Protection Act 1992*. Reserve management plans provide the overarching strategy for all management activities in reserves.

In relation to fire, a reserve management plan will:

- provide an overview of any fire-related issues in the reserve in question
- state DEH responsibilities for managing fire in the reserve system in accordance with DEH Fire Management Policy (DEH, 2005c)
- identify the requirement for a Fire Management Plan based on the nature of any fire-related issues.

Fire Management Plans will be prepared for all fire-prone reserves, consistent with the objectives of the reserve management plan. In the absence of a reserve management plan, a Fire Management Plan for a reserve may still be prepared consistent with the objectives of the *National Parks and Wildlife Act 1972* and the *Wilderness Protection Act 1992* (if the reserve is a Wilderness Protection Area).

At this point, no reserve management plan exists for Carcuma and Kelvin Powrie Conservation Parks, or Hardings Springs CR. The overall management of Ngarkat CP is described in a reserve management plan (DEH, 2005a). With respect to fire, this document lists the following objectives and actions for fire management within Ngarkat CP.

Objectives

- Minimise the incidence of large high intensity fires within the reserve.
- Manage fire to ensure the protection of life and property, the maintenance of biodiversity and the protection of natural, cultural and built values.
- Minimise the negative environmental impacts of large fires and fire suppression activities within the reserve.

Actions

- Develop a Fire Management Plan for the reserve.
- Formally consult with CFS, the relevant District Bushfire Prevention Committees and other key stakeholders, conservation and reserve interest groups, neighbours and the wider community during the preparation of the Fire Management Plan.
- Review and update fire management planning to ensure the planning is current, accurate and adequately addresses all issues.
- Maintain a strategic network of fire access and fuel reduced areas.

The objectives and strategies in this Fire Management Plan are consistent with strategies listed in the Ngarkat CP reserve management plan. In the absence of reserve management plans for the other reserves and private land included in this plan, these objectives are prudent both ecologically and operationally for fire management in the plan area.

2.6 Fire Management in Heritage Agreements

The inclusion of private land tenure under Heritage Agreement within this plan is unique, but logical when placed in the context of the landscape. Prior to European settlement and the associated land clearance, Ngarkat CP formed part of what was once a much larger area of mallee-heath. The ecosystem is strongly adapted to the impacts of fire; with many species of fire obligate plants found in the area. As such, the development of a more landscape approach when managing these remnants for fire is necessary in order to manage biodiversity within the landscape.

Prescribed burning within Heritage Agreements included within this plan may be carried out for the following purposes:

- Fuel reduction around or adjacent built assets.
- To provide landscape protection for populations and/or communities of threatened or significant flora and fauna.
- Achieving specific ecological objectives such as weed management, threatened species population management or habitat restoration.

To facilitate a consistent approach across the plan area and to ensure that the objective of any prescribed action is aligned with the objectives stated within this plan, any fire management actions prescribed and implemented on Heritage Agreements are undertaken by individual landholders within the following constraints:

- Any prescribed action undertaken on private land will comply with the guidelines stated within this plan and the relevant Policies and Acts listed.

- All prescribed burning planned for Heritage Agreement areas will be prepared in accordance with the DEH *Policy and Procedures for Prescribed Burning* (DEH, 2006f) and the GAFLC *South Australian Prescribed Burning Code of Practice* (GAFLC, 2004).
- All prescribed burning conducted within Heritage Agreement areas will be completed only in conjunction with an adequate monitoring program (refer to Section 10).
- The final decision to implement any prescribed action listed within the plan for a specific Heritage Agreement is the landowners.
- DEH, through the relevant Bush Management Advisor or other relevant NRM funded staff, will provide technical support and expertise in the preparation of prescribed burn plans, environmental assessment tables and pre- and post-fire monitoring. Funding for monitoring programs can be sought through the Native Vegetation Council grants scheme.
- DEH will not contribute toward the implementation (either through resources or financially) of any prescribed action on private land unless it is demonstrated that there is a benefit or shared risk to public land.

Recommendation

Heritage Agreements

1. To assist in the implementation of prescribed burning and other pre-suppression works within Heritage Agreements it is recommended that funding be sought through the SAMDB and South East NRM Boards to assist in fire management on private land. These funds should be managed through the Conservation Programs Unit (Murraylands Region).

2.7 Fire Management and the Apiary Industry

There is a long history (stretching back prior to the dedication of the reserve) associating the apiary industry with the Ngarkat area. Ngarkat CP is a major over-wintering area in South Australia for commercially managed honeybees (DEH, 2004b) and there are currently 205 licensed bee sites within the reserve. Management of these sites within Ngarkat CP and other conservation reserves in South Australia is directed by the *Bee Site Policy for National Parks and Wildlife Act 1972 and Crown Lands Act 1931 Conservation Reserves* (DEH, 1997). Issues addressed within the policy include site numbers, site management and fees. The impacts of fire on the management of sites are addressed within these sections. The policy recognises the importance of the apiary industry to South Australia and encourages collaboration with the apiary industry, as such, representatives of the apiary industry have been engaged during the development of this plan.

The impacts of fire, particularly large events, on commercial apiary are considerable. These impacts often parallel the ecological impacts of large fires. The destruction of hives, bees and associated infrastructure are potential short-term impacts on apiarist productivity. However, it is the long-term impacts associated with reduced nectar availability that are far more important. Given that one of the honeybee's principal source of nectar, the Desert Banksia (*Banksia ornata*), does not flower abundantly until six to eight years post-fire, large

fires can render significant numbers of sites unusable for up to a decade. The severity of these impacts is further compounded by successive large fires, or poor post-fire conditions, which can significantly reduce post-fire recruitment and survival of species such as Desert Banksia. This can result in either localised extinction of the species, or an indefinite reduction in local populations, thereby further reducing the value of sites.

Given the impacts of large fires on the apiary industry within Ngarkat CP, there are a number of benefits to the apiary industry that will be gained from prescribed burning:

- Greater protection from large fires destroying large numbers of current sites.
- Greater protection for sites not currently being utilised due to recent fires.
- A greater diversity (in time) of vegetation age classes, structure and floristic productivity for bees to utilise.
- Greater protection for leaseholders during bushfire suppression operations.
- Increased probability of successful suppression during bushfires.

Whilst prescribed burning will not be conducted within the plan area with the specific objective of mitigating risk to existing bee sites, it will provide greater protection at a landscape level to apiary operations within Ngarkat CP. In the event that a planned prescribed burn impacts upon an existing site, DEH will notify the leaseholder and negotiate an alternative arrangement where possible, in accordance with Sections 3.6.6, 3.6.10 and 3.7.2 of the Bee Site Policy (DEH, 1997).

DEH recognises the important resource apiarists provide during bushfires as a fire fighting resource, and their broad local knowledge and experience of both fire behaviour and suitable access points within Ngarkat CP. This knowledge will continue to be accessed through the Ngarkat Fire Operations Group, on which local apiarists are represented. DEH will also engage the apiary industry to pursue research opportunities relevant to the impacts of fire and prescribed burning on bee sites and associated impacts on native biota in accordance with Principle 2.4 of the Bee Site Policy (DEH, 1997).

2.8 The Role of the Country Fire Service

The Country Fire Service has overall responsibility for fire suppression activities. Responding to a fire on DEH managed land is undertaken jointly by CFS and DEH. Within Heritage Agreements the responsibility lies with the CFS, with DEH participation subject to the discretion of the DEH Regional Duty Officer. Over the last three decades, DEH has formed a close working relationship with the three CFS Groups (Tatiara, Mallee and Coorong) and two CFS Regions (3 and 5) that have response zones within the Ngarkat district. The co-operation, support and understanding between CFS, DEH and the local community have been critical to successful fire suppression both on and off reserve in the past, and will be critical to the success of this plan.

The role of the CFS in prescribed burning at this point is informal and based on a case-by-case agreement between the CFS and DEH. It is hoped that this plan will serve to foster a partnership between land managers, both public and private, and the CFS toward the common goal of reducing fire impacts within the area. The value of including the CFS in

prescribed burning operations within the Ngarkat district can be measured in a number of ways:

- Inter-agency operations promote a better understanding of the policies and approaches used to manage fire at a landscape level.
- Such activities provide excellent training opportunities for both DEH and CFS staff on a joint platform. Improved knowledge of fire behaviour, fire ecology, operational procedures and local resource capacity are benefits directly attributed to such exercises.

3 BUSHFIRE ENVIRONMENT

The basic components of any landscape contributing to the bushfire potential include terrain, slope and aspect, climate and weather, vegetation and land use. The plan area has an extremely high seasonal potential for bushfires, supporting 300 000 hectares of highly flammable mallee-heath.

3.1 Location

The Ngarkat district is located 200 kilometres southeast of Adelaide, to the south of the Mallee Highway through Lameroo and north of the Dukes Highway through Keith (refer to Map 1). The plan area incorporates Ngarkat, Carcuma and Kelvin Powrie Conservation Parks as well as Hardings Springs Conservation Reserve, adjacent unalienated Crown land and Heritage Agreements (subject to owner consent). It forms the basis for the largest area of protected land in settled South Australia. The reserve's eastern boundary is the Victorian border, where it adjoins Big Desert Wilderness, forming a combined area of 885 000 hectares of protected land: the largest such remnant in south-eastern Australia.

3.2 Terrain

Terrain in the planning area is dominated by rolling Aeolian sand dunes, intermittent with sand plain and outcropping limestone ridges (in the south-west of the plan area). Dunes are often very large (in excess of 100 metres high) and steep on their leeward (predominantly eastern aspect) side. As such, the terrain, in combination with the flammability of the vegetation, creates an extremely difficult environment to suppress bushfires. Terrain is presented in Map 1.

3.3 Climate, Wind and Weather

The plan area has a Mediterranean climate predominated by hot, dry summers and cool, wet winters characterised by frontal systems. Average rainfall is 389.6 mm per annum in Lameroo (BOM, 2005a) ranging up to 470.6 mm in Keith (BOM, 2005b) whilst rainfall has been recorded in the reserve at a number of sites records have not been taken for a long enough period to be meaningful.

Summer temperatures reach an average maximum of 30.7°C in Lameroo and 29.7°C in Keith with an average minimum of 13.1°C (Lameroo) and 12.9°C (Keith) in January. Daily maximum temperatures in excess of 40°C are common in the summer. Maximum winter temperatures reach an average of 14.9°C (both Lameroo and Keith) in July, with an average daily minimum of 4.3°C (Lameroo) and 5.5°C (Keith). Overnight winter temperatures can drop to as low as –4.3°C. Winter conditions occasionally produce extensive frosts, often associated with this is widespread frost damage and if severe enough, mortality in vegetation communities.

Wind speed and direction varies seasonably across the plan area. In the presence of a high-pressure system ahead of a cold front or thundery low-pressure system, winds are frequently from the north before swinging to the southwest. These conditions are the most conducive to bushfires, as they are often strong both before and after the frontal system arrives.

3.4 Fuel

Fuel hazard assessment methodology is based on the Overall Fuel Hazard Guide for South Australia (NRE, 1999), which is ultimately an assessment of four fuel layers (components). These are surface fuel (litter), near surface fuel, elevated fuel and bark fuel (Figure 1). The Overall Fuel Hazard is used to determine the level of risk posed by bushfire to life, property and environmental assets in the risk assessment.

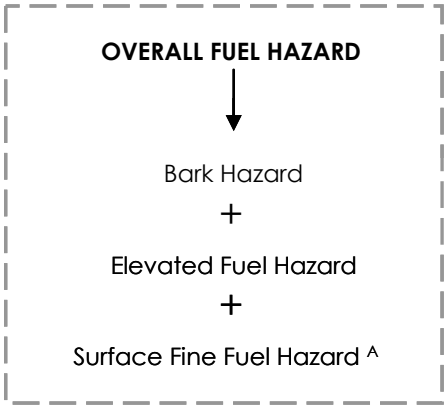

FIGURE 1: OVERALL FUEL HAZARD

Each fuel layer contributes to different aspects of fire behaviour: flame depth and height, surface fire combustion and rate of spread, spotting and crown fire (DEH, 2006c). Each layer, as well as the Overall Fuel Hazard can be assessed as: *Low, Moderate, High, Very High* or *Extreme*.

Research completed by McCarthy and Tolhurst (2004) investigated the effectiveness of fuel reduction burning in Victoria. It was concluded that maintaining Overall Fuel Hazard levels at *High* or less aids in slowing the rate of spread of a subsequent bushfire. It was determined that to achieve long-term fuel reduction effects the focus should be on the reduction of bark and elevated fuels as these fuel layers are likely to contribute to the overall fuel hazard.

The likely maximum Overall Fuel Hazard levels for the vegetation communities occurring within the plan area are shown in Table 1. These communities are shown on Map 2 (Vegetation Communities). The recorded Overall Fuel Hazard across the planning area at time of assessment is explained in more detail in Section 9 (Block Prescriptions). For more information on fuel hazard assessment methodology and evaluation refer to the *Overall Fuel Hazard Guide for South Australia* (DEH, 2006c). The process used to derive Major Vegetation Sub-groups (MVS) is described in Section 6.2 and the extent of each MVS within the plan area is shown on Map 2 (Vegetation Communities).

TABLE 1: LIKELY MAXIMUM OVERALL FUEL HAZARD FOR MVS

MVS No	MVS Description	Dominant Species Layers	Likely Maximum Overall Fuel Hazard	Significant Fuel Layers
8	Eucalyptus woodlands with a shrubby understorey	*Eucalyptus leucoxylon ssp*. low woodland over *Xanthorrhoea caespitosa* (mixed) shrubs and *Lepidosperma concavum* (mixed) shrubs *Eucalyptus arenacea* low woodland over *Babingtonia behrii* (mixed) shrubs and *Astroloma conostephioides* (mixed) shrubs	Extreme	Surface, Elevated and Bark*
19	Eucalyptus low open woodlands with tussock grass	*Eucalyptus leucoxylon ssp*. low open woodland over *Danthonia sp.* (mixed) tussock grasses	High	Surface
27	Mallee with hummock grass	*Eucalyptus leptophylla* mid mallee woodland over *Melaleuca lanceolata* shrubs and *Triodia irritans* (mixed) hummock grasses	Extreme	Near-surface, Elevated and Bark*
29	Mallee heath and shrublands	*Eucalyptus incrassata* mid mallee woodland over *Leptospermum coriaceum* (mixed) shrubs and *Hibbertia australis* (mixed) shrubs *Eucalyptus diversifolia ssp.* diversifolia mid open mallee forest over *Xanthorrhoea caespitosa* (mixed) shrubs and *Hibbertia australis* (mixed) shrubs *Eucalyptus rugosa* mid mallee woodland over *Melaleuca lanceolata* shrubs and *Dianella revoluta var.* (mixed) tussock grasses *Eucalyptus calycogona ssp.* mid open mallee woodland over *Melaleuca acuminata ssp. acuminata* shrubs and *Austrostipa sp.* (mixed) tussock grasses *Eucalyptus gracilis* mid open mallee woodland over *Melaleuca lanceolata* shrubs and *Sclerolaena diacantha/uniflora* (mixed) shrubs *Eucalyptus dumosa* mid open mallee forest over *Danthonia sp.* (mixed) tussock grasses	Extreme	Near-surface, Elevated and Bark*
30	Heath	Emergent *Eucalyptus incrassata* mallee trees over *Banksia ornata* (mixed) mid shrubland and *Astroloma conostephioides* (mixed) shrubs and *Lepidosperma carphoides* (mixed) sedges	Extreme	Elevated
31	Chenopod shrublands	*Enchylaena tomentosa var. tomentosa* low open shrubland	Low	-

MVS No	MVS Description	Dominant Species Layers	Likely Maximum Overall Fuel Hazard	Significant Fuel Layers
32	Other shrublands	*Callitris verrucosa* shrubland over *Leptospermum coriaceum* and *Hibbertia australis* shrubs. Emergent *Eucalyptus leucoxylon ssp.* mallee trees over *Xanthorrhoea caespitosa* (mixed) low sparse shrubland and *Kunzea pomifera* (mixed) shrubs	High	-
47	Eucalyptus open woodlands with a shrubby understorey	*Eucalyptus fasciculosa* mid open woodland over *Banksia marginata* (mixed) shrubs and *Kunzea pomifera* (mixed) shrubs	Extreme	Surface, Elevated and Bark*

*Denotes Extreme if stringybark is present.

3.5 Fire Behaviour in Mallee-Heath Ecosystems

Australian heaths, including those in the plan area, are renowned for their flammability. Factors contributing to the fire-prone nature of heath include aerated fine fuels, the persistence of dead foliage, the influence of wind on exposed fuels and a variety of terpenes, waxes and oils contained in vegetative matter (Keith, *et al.*, 2002). These features, in conjunction with the potential of heath to carry fire at very short intervals following substantial rain, result in heaths being flammable for much of the year. Bushfires have been recorded in the plan area from September to early May.

3.5.1 Conditions for Large Fire Events

For many areas of South Australia, there has been little collation, analysis and interpretation of fire events and their associated fuel and weather conditions. The frequency of large, prolonged fire events within the plan area has allowed for some analysis and interpretation of the conditions during such bushfires. Historical evidence of the conditions conducive to large bushfires in the area is as follows:

- Bushfires in Ngarkat CP are predominantly started by lightning strikes produced by thunderstorms (often dry). These storms prevail from mid-October to late January.
- These thunderstorms often break ahead of cool changes on the back of periods of hot, dry, weather with often strong north-to-north westerly winds.
- Within a period of 6-24 hours after these initial storms, wind will swing to the south-west associated with an approaching cold front. Wind strength and direction following the change is often variable for several days depending on the strength of the change before reverting back to the north under the influence of an approaching high pressure system.
- Rates of spread (between 6-8 km/hr) have been observed to be greatest in heathland (MVS No. 30). In this community, fuel is continuous at a number of levels, fire behaviour is strongly influenced by wind due to the absence of any real canopy and fuel is

susceptible to drying and rapid preheating. In this MVS, it is common for fires to grow in excess of 30 000 hectares in one day.

- The resulting patterns of fire spread are classically represented by the fire heading south-east following the strike before a wind change to the south west converts the eastern flank of the fire to a head fire which then travels on a north easterly trajectory producing a "tick" shaped fire. Fire history reflects this pattern (Refer to Map 3).

4 FIRE HISTORY AND FIRE REGIMES

4.1 Fire Regimes in Mallee and Heath Communities

Fire regimes in Australian heaths exhibit considerable variability, driven amongst other things, by climate, topography and land tenure. These features and the aspects of fire behaviour (listed in 3.5) distinctive to heath (Keith*, et al.*, 2002) produce a diversity of fire regimes that is unparalleled . The minimum inter-fire interval varies considerably between different types of heath. Mallee-heath found in Ngarkat CP and Big Desert Wilderness typically will not carry a fire for at least seven years (Grant and Wouters, 1993), however areas within Ngarkat CP have reburnt in as little as two years.

Fire regimes in heath have shaped what are extremely diverse vegetation communities. There are over 200 recorded plant species in the planning area. Within these communities, a variety of plant response mechanisms have evolved to cope with the disturbance of fire and indeed in many instances to flourish following it. Gaining an understanding of these components and their contribution to fire regimes at a variety of scales is pivotal if one is to effectively manage fire regimes in heath.

4.2 Prior to European Settlement

Unfortunately, little is known of what fire regimes, if any, were applied by Aboriginal occupants (the Ngarkat people) in the region. Any observations regarding the role that traditional owners have played in altering fire regimes in mallee are largely speculative (Harris, 1989). Observations would suggest that some localised patches of vegetation may have been burnt either purposely or inadvertently by traditional owners; suffice to say that the practices employed were nowhere near the scale, intensity and frequency of those groups in northern Australia and as such have not shaped the landscape to the same extent. The most pronounced evidence of aboriginal firing of vegetation is present around soakage areas such as Jimmy's Well, Rabbit Island, Pine Hut soak and Scorpion Springs where little understorey remains with the exception of the disturbance promoted Muntries (*Kunzea pomifera*).

4.3 Twentieth Century Fires

4.3.1 Mapping Fire Occurrences

Maps displaying fire history have been compiled from DEH and CFS records of fire incidents (Table 2 and Map 3). Thematic fire history maps are presented in four frames:

- Last Fire frame: shows the last fire (i.e. the most recent fire event for any given location within the planning area up to the completion of the 2006/7 Fire Season)
- Fire Frequency frame: shows the fire frequency (i.e. the number of times an area has burnt since records have been kept (1945) up to the completion of the 2006/7 Fire Season)
- Last Fire by interval frame: shows last fire in 10 year intervals (i.e. fire history categorised into fire ages of 0-10 years, 11-20, 21-30, 31-40, 41-50 and 51-60 and 61-78 (no records)

- Fire Management frame: Displays Proposed Conservation Zone Burns (hatched areas) within the context of fuels less than 10 years of age across the planning area. This map includes prescribed burns that DEH has already undertaken: either as Buffer Zone burning or Landscape/Habitat Protection burning.

The quality of the fire scar mapping varies, depending on the methods of capture, which range from digitising enlarged aerial photographs to interpretation of hand drawn maps. Present fire history in Ngarkat CP dates back to 1945, fire records prior to this are anecdotal and as such not presented. The frequent nature of fires within the area over the last 50 years has lead to a comprehensive database of fire history. Where fire scars were visible on historic aerial photography (largely at 1:40 000 scale) they have been digitised for mapping and future analysis in a Geographic Information System (GIS). It is important to note that only visible fire scars were mapped. As such, the mapped fires should be regarded as a minimum estimate of fire occurrences.

TABLE 2: LARGE FIRES (>10 000 HA) IN NGARKAT CONSERVATION PARK SINCE 1945

**Note that data reliability decreases in older records.*

Fire Date	Season	Ignition Source	Fire Area (ha)	% of Ngarkat CP Burnt
1954	54/55	Lightning	90 269	33.4
1958	58/59	Lightning	82 844	30.7
1958	58/59	Lightning	15 732	6.0
1961	60/61	Lightning	106 579	39.5
1973	73/74	Lightning	10 195	3.7
1973	73/74	Lightning	15 294	5.7
1978	78/79	Unknown - started off reserve	78 560	29.1
1986	86/87	Lightning	39 332	14.6
1988	88/89	Lightning	10 350	3.8
1990	90/91	Lightning	58 069	21.5
1999	98/99	Lightning	72 727	26.9
2002	02/03	Lightning	25 902	9.6
2005	04/05	Lightning	24 765	9.1
2006	05/06	Lightning	62 737	23.2

4.3.2 Lightning and Fires / Anthropogenic Fires

Historically pastoral activities produced frequent fires through the late 19th Century and early to mid 20th Century to promote the growth of pasture fodder (Harris, 1989). It is impossible to quantify what impact or influence this would have had on existing fire regimes, as there are no detailed records of burning practices and associated fire history prior to 1945.

Lightning has always been, and will continue to be, the principal ignition source for fires in the plan area. Dry thunderstorms are a common occurrence in the region from September through to March. Ignitions are most common at the head of a cool change late in the afternoon or early evening as the wind is shifting from the north to the west. These

thunderstorms frequently produce multiple strikes and ignitions across the area as they move through.

Given the relative isolation of Ngarkat CP, and the strict controls on access to all reserves that make up the area, the prevalence of anthropogenic fires is minimal.

4.3.3 Fire Frequency and Impact

Ngarkat CP has a long history of very large and frequent fire events; it is amongst the most naturally fire-prone areas of South Australia (Table 2, Map 3). Since records have been kept, 812 000 hectares (three times the total area of Ngarkat CP, or twelve times the size of metropolitan Adelaide) has been burnt in the plan area. There have been 14 fires greater than 10 000 hectares during this period, five of which have been in the last 15 years. The largest event recorded was in 1961, totalling 106 000 hectares.

In contrast, adjacent Heritage Agreement areas and other lands contained within the planning area are subject to infrequent and smaller fire events. This pattern is almost certainly a function of landscape fragmentation in the case of the smaller parcels of land and Heritage Agreements in the plan area (i.e. smaller patches of native vegetation have a lower probability of being struck by lightning). Map 3 displays both the current fire frequencies over the plan area since records have been kept and the last fire.

Some areas within Ngarkat CP have been burnt seven times in the last 50 years (Gillam, 2004a), many others have been burnt four or five times- a frequency that is unsustainable for many species of both flora and fauna. These areas are located in the centre of the reserve and dominated by low *Banksia* and *Allocasuarina* communities. In conditions of moderate to high winds and low humidity, fire can travel through such vegetation at a rate of spread over 6km/hr.

4.4 Present and Future Fire Regimes

4.4.1 Impact of Land Use and Operational Capacity on Fire Regimes

Land use changes have increased the economic, political and community pressure on CFS and DEH to suppress bushfires when they occur. Concurrently, the operational capacity to suppress fires has increased through several mechanisms including improved access, well-equipped and trained firefighters, aerial suppression support and improved management of incidents. The suppression strategies and tactics adopted, such as backburning, can also maximise fire suppression capability, but may result in a different pattern of burning, patchiness and extent than what may have occurred naturally in the past.

The combination of pressure to suppress all fires, along with our capacity to control fires of low to moderate intensity, means that such fires are extinguished sooner than would happen naturally. This in turn means the natural fire regime is altered, as are the fuel and flammability patterns across the landscape. Given the vast size of Ngarkat CP, the scarce settlement within the region and the comparatively low operational suppression capacity, the influence of European settlement on fire regimes within the plan area is not as pronounced as it has been in other areas of the state. As such, large fires are still frequent in the plan area; however, it is logical to assume that prior to settlement these fires would have burnt unchecked over enormous areas for extended periods during the summer months. In saying

this, pastoralism is likely to have introduced a different fire regime to the plan area through the activity of prescribed burning through the early 1900's. The frequent, cyclical burning of certain leases would have significantly altered the fire regime at a local scale.

Conversely, other protected areas within the plan area have had their fire regimes significantly altered by fragmentation of the landscape. Logically, smaller areas have less chance of being struck by lightning, have better access from all sides and therefore offer a better suppression advantage to firefighters. As such, these areas experience fire less frequently and when they do, they are rarely exposed to large events.

4.4.2 Influences on Current Fire Regimes

Whilst there are differences between current fire regimes and historical ones, these differences are not easily recognised. Current fire patterns on the landscape are a result of factors including climatic and vegetation changes, Aboriginal presence and absence, European settlement, accompanying vegetation clearance and associated fires, fire exclusion, changing land use and fire suppression. Pastoralism in the region has had the most pronounced impact on fire regimes since settlement. Large areas of bushland surrounding the plan area have been cleared for cropping and grazing, and grazing pressure has altered fuel levels and fuel types markedly (Harris, 1989). The resultant fragmented landscape will certainly continue to shape the size and frequency of bushfires.

4.4.3 Future Fire Regimes

The fire prone nature of the Ngarkat area would suggest that fires of varying seasonality, intensity, duration and spatial extent would continue to shape the landscape and the communities it supports. The proactive management strategy prescribed in this plan will serve to shape in some part the extent, intensity and duration of bushfires. However, they are by no means designed to prevent fire from occurring in a landscape that has evolved with it. One challenge facing land managers in this area with respect to fire is to manage fire regimes at a variety of scales for a range of communities and species.

5 DAMAGE POTENTIAL TO BUILT ASSETS

5.1 Land Use

The major use for land adjoining the plan area is agriculture. Cropping, grazing and some broad-acre horticultural farming (centre-pivot irrigated potato crops) are the most frequent uses. Scattered throughout this farmland are areas of native scrub, many of which are protected under Heritage Agreement. To the east Ngarkat CP is adjoined by the Big Desert Wilderness in Victoria, which combined forms an area of 885 000 hectares of mallee-heath. Refer to Map 1 for an overview of land use.

5.2 Built Assets and Property Protection

Whilst a very large percentage of the plan area is sparsely populated, there are a number of built assets both within and adjacent the plan area requiring protection from fire. These include homes, outbuildings such as shearing sheds, implement sheds, vineyards, orchards, reserve visitor facilities, and information bays.

DEH will undertake fire management works and activities to minimise impact on built assets, for both public and private buildings and agricultural areas. The difficulty is in striking a balance between property protection and conservation management objectives. More detail is provided on Map 4 (Fire Management and Access) and in Section 9 (Fire Management Block Prescriptions).

All landholders are obliged to comply with the *Fire and Emergency Services Act 2005,* which outlines responsibilities for fire preparedness. DEH will implement works for fire management on DEH managed lands within the plan area in order to minimise risks, however adjoining landholders are also required to implement works on their own property to minimise the threat of fire.

5.3 Tourism

Ngarkat CP is a popular tourist destination, particularly for bird lovers and four-wheel-drive enthusiasts. The potential impacts of fire on tourism in the area mirror those impacts on the ecology of the area as essentially tourism within the region is ecologically driven. The sandy nature of much of the reserve means tracks in areas denuded by fire are at times impacted upon significantly by sand drift, which in turn impacts upon 4wd visitation if these tracks are closed. The Border Track (a partial one-way track) is located on the South Australian – Victorian border where Ngarkat CP abuts Big Desert Wilderness, is closed each fire season to protect reserve visitors from bushfire.

5.4 Cultural Heritage

"Although the Ninety Mile Desert may appear attractive and interesting to the naturalist or casual visitor, it is worth noting that the difficult terrain, infertile soils and paucity of surface water have combined to make the area relatively inhospitable to man. Indeed, its inhospitable nature is the reason for its protection: a more favoured area would long ago have been developed for agriculture or pastoralism" (Harris, 1982). Harris provides an account of both Aboriginal and European history of the area that is briefly summarised in the following section.

5.4.1 Aboriginal Heritage

Aboriginal history in Ngarkat CP is not extensively documented, however the name Ngarkat CP refers to the first peoples to inhabit the area. Harris (1989) states that the Ngarkat people traditionally inhabited these lands, utilising the scarce soak areas in an area otherwise devoid of water. Evidence of their inhabitation is still present today in these areas, often typified by clearings in areas of low relief with an overstorey of SA Blue Gum and large tracts of Muntries. Sites are typified also by the presence of hearthstones, chippings and skeletal remains. Water supplies at these soaks were reliable in all but the driest years when the neighbouring Ngaiawang and the Nganguruku groups allowed the Ngarkat people to move into areas adjacent to the River Murray for water.

The Ngarkat people's use of fire in the area is not well known, however Harris (1989) speculates that regular systematic firing of vegetation would have been commonplace: particularly in areas adjacent to soaks. There is some evidence of this in these areas, which are frequently dominated by extensive populations of Muntries and *Xanthorrhoea caespitosa*: both species respond positively to disturbance, including frequent fire.

Within the planning area, there are three reported archaeological sites in Scorpion Springs Block, one reported site in Ashby's and Box Flat Block's respectively. While Mt Rescue Block has one registered archaeological site and two reported archaeological sites on the Department of Aboriginal Affairs and Reconciliation (DAARE) Heritage Sites Database. These sites will be zoned as Conservation or (C-zones) within the plan, however the management of known cultural heritage sites will be interpreted on a case by case basis in consultation with relevant Aboriginal groups due to the potential impacts of fuel reduction on the integrity of the site. Specific guidelines for the management of these sites are listed in Section 8.5 (Conservation Zones).

5.4.2 European Heritage

The Ngarkat area has experienced periodic pastoral settlement dating back to its initial occupation in 1871, up until the reserve's dedication in 1979 (Harris, 1989). Whereas much of the land to the north, west and south of Ngarkat CP has been successfully cleared for both grazing and cereal cropping, pastoral success in the plan area was poor due to a paucity of soil nutrients, the quick recovery of largely unpalatable vegetation, minimal water, feral animals and limited access.. Within the reserve, there are still some relics from the pastoral leases of the past, the most prominent being the ruins at Buck's Camp Station in Mt. Rescue Block and in Box Flat Block. Mills and bores at Pocock's Mill, Pertendi Hut and Comet Bore are now used as firewater sources.

6 BIODIVERSITY

6.1 Fire and Mallee-Heath Ecosystems

Heath ecosystems across Australia have evolved with fire as a key ecological process (Keith*, et al.*, 2002). Whilst adaptations to fire are most evident in vegetation, there is considerable evidence to suggest that the majority of heath fauna: invertebrates, reptiles, birds and mammals have also developed mechanisms to not only persist but thrive in the post-fire environment. These adaptations may be behavioural, physiological, anatomical or biological. Indeed, such is the reliance on fire in heaths that many species would cease to exist in its absence. Conversely, given the dramatic changes to the landscape associated with European settlement, there is an equal threat posed by too frequent fire, even in remnant areas as large as the Ngarkat – Big Desert heath complex. As such, the management of fire and more importantly fire regimes is essential to ensure the long-term conservation of these communities.

6.2 Vegetation

Heath vegetation communities are amongst the most diverse and species rich terrestrial ecosystems in Australia (Specht, 1979; 1981). The heaths of south-western Western Australia are home to over 3 000 species of plant, whilst species numbers in the Ngarkat-Big Desert area number over 200. This species richness is reflective of the environmental conditions under which these communities have evolved. Nutrient poor soils (particularly nitrogen and phosphorus), a Mediterranean climate and the influence of fire have combined to produce an incredibly diverse suite of species (Groves, 1979).

Nearly all heath plants have evolved strategies to deal with fire and indeed many are reliant on it for their continued survival. As long distance dispersal into burnt areas is rare in heath species (<10%), adaptations are largely geared toward *in situ* persistence of populations following disturbance (Keith*, et al.*, 2002). These strategies are diverse, utilising a range of different adaptations to survive or repropogate following bushfire (Gill, 1981; Keith*, et al.*, 2002). A number of species use a combination of these strategies, both sexual and asexual, to survive and reproduce following fire. The vegetation communities in the plan area contain many species that utilise one or all of these strategies.

6.2.1 Vegetation Mapping

The vegetation of the Ngarkat area has been mapped in 2000 as part of the *Biological Survey of the Murray Mallee, South Australia* by DEH (Foulkes and Gillen, 2000). The area was mapped using aerial photography interpretation in conjunction with site-based sampling in representative areas; the data was digitised and stored in a GIS.

Floristic mapping for this plan uses a compilation of regional vegetation mapping data that has been reclassified to comply with the National Vegetation Information System (NVIS) classification for Australia. The MVS level of the NVIS classification emphasises the structural and floristic composition of the dominant stratum but with additional types identified according to typical shrub or ground layers occurring with a dominant tree or shrub stratum. There are eight MVS within the plan area (Map 2). Ecological Fire Management Guidelines for these MVS are outlined in Table 3.

The MVS represented in the planning area are:

- MVS No. 8 Eucalyptus woodlands with a shrubby understorey
- MVS No. 19 Eucalyptus low open woodlands with tussock grass
- MVS No. 27 Mallee with hummock grass
- MVS No. 29 Mallee heath and shrublands
- MVS No. 30 Heath
- MVS No. 31 Chenopod shrublands
- MVS No. 32 Other shrublands
- MVS No. 47 Eucalyptus open woodlands with a shrubby understorey

6.3 Fauna

As with the majority of fire-based ecological research, our understanding of faunal response mechanisms and strategies is inferior to that of flora. This is a function of the simplicity in studying the respective groups. Plants are sessile organisms with easily tracked responses to environmental change, whereas fauna are often highly mobile and frequently experience mortality during or immediately following a bushfire. Consequently, responses are far more cryptic and as such difficult to study and interpret.

The role of fire regimes will strongly shape the success of a given species post-fire recovery. Favourable post-fire weather conditions will promote better regeneration and recruitment opportunities for vegetation communities, and in doing so, aid the recovery of fauna. Favourable seasons in existing habitat will also enable source populations to recruit, disperse and recolonise regenerating habitat- often when that habitat may be sub-optimal. Similarly, suitable inter-fire periods will also allow for both flora and fauna populations to replenish numbers and disperse and cope with the impacts of the next disturbance.

6.3.1 Avifauna

Inadequate fire regimes have been identified as a key threatening process for a range of threatened mallee birds (DEH 2005). However, it is not fire itself that is the threat, it is threat of inadequate fire regimes, predominantly created by landscape fragmentation that pose a problem to threatened mallee birds. Even in large landscapes, land clearance has left species with a reduced number of viable refugia in the event of large-scale bushfires, hence the need to proactively manage this.

When compared with other mallee-heath fauna there is a better understanding of the fire ecology of avifauna through work on specific threatened species (Baker-Gabb, 2004; Clarke, 2005; DEH, 2005b; Paton, 2000; Ward and Paton, 2004). This knowledge, in conjunction with information provided by the Threatened Mallee Birds Recovery Plans and the DEH Murraylands Conservation Programs Unit will drive the decision making process for fire management in or adjacent to areas that contain or have historically contained these species.

The majority of bird species in the plan area prefer vegetation communities between six and 40 years of age (Appendix 2a). There are some exceptions, such as the Malleefowl *(Leipoa*

ocellata) (40 + years of age), however in Ngarkat CP, which is approaching the southern extent of the bird's range, they have been recorded in areas as early as six years post-fire and have been reported breeding in areas only 15 years after disturbance. As such, maintaining large areas between the ages of 15 and 30 years, with intermittent patches-particularly of mallee of an older age, would benefit the majority of bird species in the plan area including rated species.

It is also clear that large fires do not benefit any bird species, and indeed, in recent times they have been detrimental to the long-term survival of species such as the Mallee Emu-wren and the Western Whipbird. Successive large fire events in areas supporting both remnant populations and potential habitat have reduced numbers of these birds to critically low levels. Therefore, the importance of strategies tailored toward reducing the probability and impacts of large fire events is critical to the management of these species.

6.3.2 Mammals and Reptiles

Comparatively little work has been done on post fire response dynamics of mammals and reptiles in mallee-heath environments. Our knowledge is restricted to few studies at minimal sites (Keith*, et al.*, 2002). The monitoring data gathered over the last 15 years by Dr. David Paton (Appendix 2b) provides some insight into the post-fire response and habitat preferences of a range of small mallee-heath mammals and reptiles. This data indicates some obvious synergies between reptiles, mammals and birds.

Few species appear to prefer very early post-fire habitat conditions. This may be for a number of reasons including lack of shelter, lack of suitable food resources or an increased risk of predation. In this there is little doubt that the strategies and adaptations observed in these animals are similar to those employed by birds. Species will certainly exploit improved resource availability and transiently occupy these areas to feed as their productivity increases. The Silky Mouse (*Pseudomys apodemoides*) and Western Pygmy Possum (*Cercatetus concinnus*) (Appendix 2b, Paton 2006 unpubl. data) are a testament to this. Both species require the proximity of older heath to recently burnt areas in order to benefit-hence the need for fire management strategies aimed reducing bushfire size and increasing the patchiness of bushfire events.

6.3.3 Species of Conservation Significance: Flora and Fauna

The Environmental Database of South Australia contains records from several data sources including the Threatened Plant Population Database, the Biological Survey of South Australia and opportunistic sightings of significant flora and fauna.

In this plan '*of conservation significance*' is used to describe ecologically important or rated communities, populations or species of flora and fauna. Species may be:

- Australian rated, that is, listed as threatened (with a rating of Extinct, Critically Endangered, Endangered, Vulnerable or Conservation Dependent) under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999.*
- South Australian rated, listed as Threatened (with a rating of Endangered, Vulnerable or Rare) under the *National Parks and Wildlife Act 1972, Revised Schedules 7, 8 and 9.*

- Of significant value within an ecosystem based on its ecological importance, either as food resource, habitat or dominant/keystone species/community regardless of its conservation status.

Rated species reflects that given species or community are in danger of extinction at two levels:

- **State** - species will be extinct from South Australia.
- **Australia** – species will be extinct, not occurring anywhere across the continent.

Refer to Appendix 3 for a key of EPBC Act and South Australian Conservation Status Codes.

A number of flora and fauna species of conservation significance occur in the plan area. It should be noted that many of these species distributions are poorly defined because the database only contains point locations from site visits or observations. Importantly, distributions for key threatened species such as the Mallee Emu-wren and Malleefowl are better mapped due to more intensive surveying. The Murray Mallee Biological Survey records are now 16 years old and will require current verification before any management actions are based on them. Extensive monitoring throughout Ngarkat CP by Dr. David Paton and The University of Adelaide over the past 17 years, and more recently by Threatened Species Project Officers has resulted in better knowledge of species distributions in these areas.

Tabulated in Appendices 1 and 2 is a list of all threatened and significant species and ecological communities found within the plan area. Included within these tables are the status of these species under both the *National Parks and Wildlife Act 1972* and the Commonwealth *EPBC Act 1999*, information on the fire ecology of the species (if any) and the information source. The information presented in these tables summarises threatened and significant species/community responses to fire and as such demonstrates justifications for the management prescriptions and guidelines listed within the plan. The information gathered through monitoring programs and research projects will build on this baseline over time to make more informed fire management decisions for threatened species.

6.4 Ecological Fire Management

The management of fire to maintain biodiversity is discussed in more detail in the Draft DEH *Guidelines for Ecological Fire Management* (DEH, 2006g). This approach is being used as a sound basis for the management of fire for biodiversity across Australia (Andersen*, et al.*, 2003; FEWG, 2004; Hopkins and Saunders, 1987; Whelan*, et al.*, 2002). It is based on accumulating knowledge of species, populations and communities and their response to fire regimes, and then applying this knowledge to fire management practices to maximise biodiversity outcomes. Ecological Fire Management Guidelines are used to assist in achieving management objectives in C-zones within all DEH Fire Management Plans. For more information on C-zones, refer to Section 8.5 of this Fire Management Plan.

6.4.1 Fire Regimes for Biodiversity Conservation

Fire regime is described as the history of fire in a particular vegetation type or area including the fire frequency, interval, intensity, extent and seasonality of burning (Brooks*, et al.*, 2004). It is therefore assumed that avoiding adverse fire regimes across the majority of the habitat for any given species should minimise the risk of adverse impacts or local extinction. That is, an

adverse fire regime confined to a minor proportion of the habitat of any particular species may influence local distribution, but will have little effect on the persistence of that species across the landscape. A range of different fire intensities, frequencies, seasons and scales of burning need to be incorporated into ecologically based regimes if they are to result in the conservation of biodiversity.

6.4.2 Methodology

Ecological Fire Management Guidelines have been developed from the research and analysis of available data relating to the *Key Fire Response Species* within the plan area. The approach used by DEH to define the Ecological Fire Management Guidelines involves the identification of fire regime thresholds using flora and the assessment of the potential impacts of these thresholds against known faunal requirements, particularly the requirements of species of conservation significance. The steps taken in the development of the Ecological Fire Management Guidelines are as follows:

- Vital attributes data of plant and animal species, and ecological communities are gathered and assessed.
- This knowledge is used to identify the *Thresholds of Potential Concern* (TPC) of fire regime (fire interval, intensity, season and type) where species significantly decrease.
- Ecological Fire Management Guidelines are formed from these thresholds and are then used to guide the fire management practices to ensure that adequate habitat is available to maintain biodiversity (i.e. species, populations and communities).

6.4.3 Interpreting Ecological Fire Management Guidelines

Ecological Fire Management Guidelines have been defined for MVS, enabling strategic fire management across the plan area in a way that will ensure maintenance of biodiversity (Table 3). Guidelines for five aspects of fire regime (interval, frequency, spatial, intensity and season) have been determined for all MVS within the planning area (where data is available). The upper and lower limits of fire interval for a particular MVS have been proposed, as well as recommendations on the management of fire frequency. Fire intensity requirements for species regeneration and undesired seasonal burning patterns have also been identified. Ecological Fire Management Guidelines **should not be used as prescriptions**; instead, they define a window of "acceptable" fire regime to promote the conservation of existing species.

TABLE 3: ECOLOGICAL FIRE MANAGEMENT GUIDELINES FOR MVS IN THE PLAN AREA

		FIRE REGIME						
		Interval		Spatial Criteria	Frequency		Intensity	Season
MVS No	MVS NAME	**TPC1**: Lower threshold in years	**TPC2**: Upper threshold in years	Inter-fire intervals within **TPC1** & **TPC2** across more than *X*% of the extent of this MVS within the planning area [1]	Avoid 2 or more fires within a period of X years	Avoid more than 2 successive fires of low intensity	Some medium to high intensity fire needed to regenerate some species	Avoid 2 or more successive fires in season
8	*Eucalyptus* woodlands with a shrubby understorey	10	35	50%	35	Y	Y	Spring
19	Eucalyptus low open woodlands with tussock grass	7	50	50%	40	Y	Y	Spring
27	Mallee with hummock grass	20	50	50%	40	Y	Y	Dry years
29	Mallee heath and shrublands	10	50	50%	40	Y	Y	Spring
30	Heath	7	30	50%	25	Y	Y	Spring
31	Chenopod shrublands	#	#	#	#	#	#	Spring
32	Other shrublands	7	40	50%	35	Y	Y	Spring
47	Eucalyptus open woodlands with shrubby understorey	10	35	50%	35	Y	Y	Spring

\# *Denotes that fire response is unknown or ambiguous for this MVS thus the required data is not available to propose Ecological Fire Management Guidelines. When data becomes available, this table will be updated.*

6.4.4 Thresholds of Potential Concern

The *Threshold of Potential Concern* (TPC) for a vegetation type or community is the level of fire regime element (i.e. fire interval, frequency, intensity or season) where *Key Fire Response Species* are likely to significantly decline if exceeded. Fire regimes beyond that level are likely to lead to local extinction of significant biodiversity.

- TPC1 demonstrates the recommended lower limit for fire interval for a particular MVS. That is, vegetation within this MVS will be represented predominantly by early successional species if the inter-fire interval is less than the time specified, and those species that require longer to flower and set seed can disappear from a community.
- TPC2 demonstrates the recommended upper limit for fire interval for a particular MVS. That is, populations of some species (e.g. obligate seeders) are likely to reduce within this MVS if fire is absent for more than the time specified.

6.5 Other Threats to Biodiversity

6.5.1 Pest Plants

It is well known that fires can provide the opportunity for some weed species to establish and proliferate, with many weed species out-competing native species in regenerating post-fire. While this is not likely to be a problem in the larger blocks where the edge effect is low and the areas are relatively weed-free, it may cause a problem in areas adjacent farmland or in modified vegetation.

Principal species of concern within the plan area include Horehound (*Marrubium vulgare*), Salvation Jane (*Echium plantagineum*), Bridal Creeper (*Asparagus asparagoides*), Perennial Veldt grass (*Erhrata calycina*) and Evening Primrose (*Oenethera stricta*) (DEH, 2004b). Any monitoring program should ensure that vulnerable areas are evaluated pre and post-fire; to determine what post-fire weed control is required. Within the plan area weed invasion is relatively localised and as such not seen as being a large issue post-fire due to the paucity of available soil nitrogen and phosphorus (Pelton & Conran, unpub. data). However, monitoring will incorporate the recording of any new species within an area (native or otherwise). Eradication programs can be based on the extent and nature of the species recorded.

6.5.2 Pest Animals

As with weeds, feral animals can flourish in the conditions existing after a fire. The primary feral species in the plan area are Goat *(Capra hircus)*, Fallow Deer *(Dama dama)*, Red Deer *(Cervus elaphus),* European Rabbit *(Oryctolagus cuniculus)*, Cat *(Felis catus)*, Fox *(Vulpes vulpes)*, Wild Dog *(Canis lupus familiaris, Canis lupus dingo* and hybrids) and Brown Hare *(Lepis capensis)*. All species can benefit from the regrowth readily available post-fire or the increased access a fire provides. Native species, such as kangaroos may also thrive and concentrate in the regenerating areas, finding suitable food. The degree of impact that these species have post-fire depends on a number of factors, including pre-fire numbers, size, shape and location of fire etc. Whilst post-fire grazing isn't presently viewed as an issue in Ngarkat, areas containing threatened plants, in particular the Lowan Phebalium (*Phebalium lowanense*) will require closer post-fire monitoring to quantify the impacts of post-fire grazing on population recovery given the perceived threat grazing poses to the survival of the species (Barrie, 2005; Carter, 2005; Obst, 2005).

6.5.3 Plant Pathogens/Diseases

Generally, plant pathogens have not been an issue within the Ngarkat area. The risk of *Phytophthora cinnamomi* infection is low given the average rainfall and deep, sandy soils however, precautions should be taken with appliances and machinery sourced from known regions of the state where Phytophthora is prevalent.

Mundulla Yellows is another plant disease found locally that poses a genuine threat to species of *Eucalyptus* within the plan area. Whilst the cause of the disease is still unknown, the correlation between the distribution of infected trees and roads (both sealed and unsealed) is a cause for concern, as roads appear to be acting as a vector for the disease. As with Phytophthora, large numbers of vehicles or plant and equipment accessing the plan area for suppression operations may increase the risk of the disease spreading.

7 BUSHFIRE SUPPRESSION

7.1 Legislation

Section 97 of the *Fire and Emergency Services Act 2005* explains the importance of this Fire Management Plan and the role of the CFS during a fire incident on DEH land. The legislation states that under fire or threat of a fire a member of the CFS must consult with the person in charge (if that person is in the presence of, or may be immediately contacted by, the member of the CFS of that reserve) and if the prescribed action would affect a government reserve, they must take into account any relevant provisions of a management plan for the reserve that have been brought to the attention of the member.

7.2 Policies and Procedures

The following Policies and Procedures are to be used in conjunction with this Fire Management Plan:

- DEH Fire Management Policy.
- DEH Fire Policy and Procedure Manual (covering various aspects of fire management).
- CFS Chief Officer Standing Orders (COSOs).
- CFS Standard Operating Procedures (SOPs).
- CFS Operations Management Guidelines (OMGs).

Strategies implemented during an incident will be determined by the Incident Management Team (IMT), taking this plan into consideration.

7.3 Fire Emergency Procedures and Response Planning

DEH has developed a *Response Plan for the Mallee District* and a detailed *Bushfire Response Plan for the Ngarkat District,* as it was identified that fire response issues within Ngarkat CP need addressing within a separate document. These plans are reviewed annually and updated as required to ensure currency. The response plan provides reserve-specific information in relation to initial attack including water point locations, levels of equipment, access points, levels of preparedness and communications.

It is recognised that the risk fire poses within the Ngarkat District requires a distinct arrangement. DEH, through the Ngarkat Fire Operations Group has engaged partners and stakeholders such as the CFS, the South Australian Farmers Federation (SAFF) and the apiary industry to discuss all fire operations issues in the area.

Justification: The nature of bushfires in the planning area often requires response to more than one fire simultaneously. To provide better coordination and therefore more efficient management to an incident integrated response arrangements are a necessity, particularly early in an incident.

Recommendations

Fire Emergency Procedures and Response Planning

2. Maintain and expand as necessary the Ngarkat Fire Operations Group to:
    - review and endorse the DEH annual works program as developed considering the objectives of this plan
    - contribute to the review of this plan after 10 yeas of implementation
    - identify operational issues and corrective actions specific to the Ngarkat District
    - identify knowledge and resource deficiencies specific to fire management and make recommendations on how these deficiencies might be addressed
    - report to CFS Regional Operations Planning Officers and Centre for Lessons Learnt of relevant recommendations and outcomes of actions
    - review and implement any recommendations or an action arising out of agency or interagency debriefs.

7.4 General Objectives for Fire Suppression

- To provide for the protection of human life during fire suppression activities.
- To provide for the protection of built assets and neighbouring properties from bushfires.
- To ensure that sound conservation and land management principles are applied to fire suppression and fire management activities.
- To provide for the strategic containment of bushfires.

7.5 Strategies and Actions to Achieve Objectives

- Control lines will be established for use during bushfire incidents. These are fire access tracks that have been upgraded to GAFLC guidelines and will be subject to ongoing maintenance.
- New access tracks on DEH managed land will only be constructed for suppression purposes, where provided for in planning, or where approved by the Incident Controller in liaison with DEH staff.
- When bushfires occur, unless otherwise stated, only recognised control lines will be utilised for vehicle-based suppression activities.
- Previous fire scars (bushfires or prescribed burns), changes in vegetation type and topography and the resultant variations in fuel patterns will be used to assist suppression activities.
- The use of heavy machinery to construct control lines within blocks for fire suppression will be used in accordance with DEH Policy and Procedures following authorisation from the Incident Controller in liaison with a DEH representative or (in the case of private land) the landowner involved. Refer to Section 7.6 for further detail.
- The use of retardant should be restricted to the protection of human life, built reserve and private assets, or to contain hotspots where ground crew access is hindered by terrain and vegetation and it is possible that a fire will build before these areas can be

blacked out. Approval must be given by the Incident Controller in liaison with a DEH representative or (in the case of private land) the landowner involved.

7.5.1 Justification for Suppression Strategies

All land management organisations have an obligation to maximise safety for fire suppression activities. For this plan, standards for control lines are in line with the GAFLC Standard. Where the combination of vegetation, fuel loads and terrain is likely to reduce the effectiveness of these control lines, they may be widened or perimeter burns undertaken in the immediate vicinity of control lines to minimise the likelihood of bushfires crossing control lines.

By utilising control lines, and through the strategic use of previous fire scars and fuel patterns, the need to undertake other high impact suppression measures such as mineral earth breaks during a running fire will be reduced.

7.5.2 Aerial Observation

The vastness of the plan area and lack of adequate lookouts necessitates the deployment of aircraft to accurately locate a fire. The weather conditions that are conducive to fires in the area will often result in multiple strikes and ignitions over a wide area. Locating these lightning strikes from the ground is both time consuming and potentially dangerous given the distances involved and the lack of vantage points.

Recommendation

Aerial Observation

3. It is strongly recommended that Incident Management Teams request aerial observation as early as possible in the incident. An aerial platform should be deployed when smoke is first sighted or in the event of an electrical storm passing through the area during the months September through to March.

7.5.3 Aerial Suppression in the Ngarkat District

Aerial suppression is recommended throughout the plan area under certain circumstances:

- Aerial suppression is a costly exercise and requires considerable ground support. Bombers are not present in the Murraylands and as such, they need to be requested from either the South East or Adelaide. Primary aerial response zones will be given priority.
- If adequate ground based support is available to complement bomber work. Aerial suppression is ineffective in halting a running fire unless it is used in conjunction with ground crews and established control lines.
- The proximity of the airstrip to the fire, expected turnarounds times for filling and dropping and the capacity of the strip to handle multiple trips under load. The ideal drop radius is 20 km, this may be extended to greater distances, however, in doing this the effectiveness of aerial suppression will drop as the time between dropping loads on the edge of the fire is increased. Presently large portions of the plan area are further

than 20 km from a CFS approved airstrip, reducing the effectiveness of air operations. Established strips are at Tintinara, Lameroo, and Alcheringa (Map 4). As such, the majority of the reserve is well covered with the exception of Mount Shaugh.

- In the event of two or more fires, or fires burning on wide fronts, priority should be given first to protecting any life or built assets in harms way, following this designated habitat areas will receive priority (based on an assessment from the IMT in consultation with DEH) over other areas.

Recommendation

Aerial Suppression

4. It is recommended that a CFS approved airstrip be constructed and maintained at Kirra Station for fire emergencies to provide improved aerial suppression capabilities in Mount Shaugh, Ngarkat, Pertendi and McCallum Blocks as well as in western Victoria.

7.5.4 Backburning Operations in the Ngarkat District

DEH supports the use of backburning as a bushfire suppression tool under appropriate conditions with adequate safety precautions. Used correctly within the plan area it can be a highly effective tool in containing bushfires. However, some tradeoffs require consideration before works are implemented. An IMT should consider three critical aspects:

A > When should backburning be conducted?

Backburning should only be conducted when authorised by the IMT under favourable weather conditions. Weather conditions should maximise the probability of managing the backburn, but they should also ensure an adequate level of fire behaviour is produced to provide an effective break against an approaching bushfire. As such, backburning in the early hours of the morning when fire behaviour is often low may not produce an adequate result.

B > Where should backburning be conducted?

Backburning is most effective when it augments existing low fuel areas (either changes in vegetation type or age). Operations should be sited from existing designated control lines that may be widened by the use of heavy machinery. The width of these burns should be determined by the IMT based on the weather conditions and the observed and predicted fire behaviour of the fuels in the area concerned. Existing buffers may be reburnt if in the view of the IMT that a fire will carry through them under the current conditions.

C > How should backburning be conducted?

A backburn is essentially a prescribed burn, excepting that it is implemented under emergency conditions with a fraction of the preplanning that occurs with similar landscape protection or fuel reduction burns. For this reason there must be consultation with DEH when planning to backburn areas.

7.6 Fire Access Tracks and Firebreaks

The planning area is dissected by a range of access tracks (refer to Map 4), all varying in quality, width and level of maintenance. For the purposes of this plan, tracks are categorised in accordance with GAFLC (2005) guidelines (see below). Within Ngarkat CP, designated fire access tracks and firebreaks are presently treated on a four-year cyclic basis. Tracks are placed into one of four categories:

- **Vehicle or Service Tracks**: Includes vehicular access tracks of no fixed width for reserve management staff, apiarists or private access to heritage agreement areas.
- **Minor Fire Tracks:** Trafficable in one direction, maintained at a width of four metres both at ground and canopy level.
- **Standard Fire Tracks**: As above, trafficable in a two-way direction through the provision of passing bays at intervals of 400 metres.
- **Major Fire Tracks:** Maintained at a minimum width of seven metres at both ground and canopy level to provide safe two-way access.

Refer to Map 4 for information on existing fire access tracks.

- **Firebreaks:** A 20 metre wide rolled firebreak with a major fire track located on the outer edge surrounds all of Ngarkat CP (note that boundary firebreaks are not represented spatially).

7.6.1 Guidelines for Establishment and Maintenance of Fire Access Tracks

GAFLC has drafted *Guidelines for Firebreaks & Fire Access Tracks* (2005). This document specifically details parameters for fire management access tracks and control lines, including adjacent fuel management, siting and maintenance, mapping, signage and safety.

All existing tracks within plan area are deemed essential for fire management operations and are to be maintained at the minimum standard detailed in the GAFLC guidelines unless otherwise stated within this plan. This excludes tracks maintained by apiarists for bee site access.

A > Firebreak / Fire Access Signage

Presently, adequate signage displaying information on the type of access, the name of the track or break, physical location, dead ends or steep terrain as defined in the GAFLC (2005) guidelines is not present in the planning area. As such, signage should be implemented across the planning area on public lands and adjacent heritage agreements. Money for this project should be sought through the Bushfire Mitigation fund through joint applications via DEH, the CFS and the relevant District Bushfire Prevention Committee.

Justification: Given the size of the area, the extensive network of tracks that fire fighters have to negotiate, often with little local knowledge and at night, presents a considerable safety issue.

B > Fire Access Track Standards (Private Land)

For those areas of the plan that are not managed by DEH, it is recommended that the GAFLC (2005) guidelines are adopted by all landowners in the plan area to maintain consistency in

the standard of fire access tracks and control lines. Specifically, for those sections under Heritage Agreement abutting Ngarkat CP it is recommended (subject to agreement from the relevant landholder) that a perimeter firebreak be developed and maintained to a width of 20 metres. Similarly, for Heritage Agreement areas surrounding Carcuma CP it is recommended that perimeter major fire access track be developed and maintained to a width of seven metres.

Justification: A consistent minimum standard, regardless of tenure or terrain, will provide Incident Management Teams with greater confidence when planning strategies to suppress fires. Fire crew can access areas and execute these strategies with the confidence that access tracks are at a suitable standard.

C > *Firebreak Maintenance (Unalienated Crown Land)*

Areas of unalienated Crown land adjacent to the existing boundary of Ngarkat CP shall be included within the rolling firebreak program and rolled to a width of 20 metres until they are gazetted as part of the Conservation Park.

Recommendations	
Fire Access Tracks	5. Implement signage across the planning area on public lands and adjacent heritage agreements.
	6. Encourage adjacent landowners to adopt that the GAFLC (2005) guidelines.
	7. Encourage owners of Heritage Agreements abutting Ngarkat CP to implement and maintain a 20 metre perimeter firebreak on their land.
	8. Encourage owners of Heritage Agreements abutting Carcuma CP to implement and maintain a Major Track (seven metre width) on their land.
	9. Include areas of unalienated Crown land adjacent to the existing boundary of Ngarkat CP within the rolling firebreak program. These areas shall be rolled to a width of 20 metres until they are gazetted as part of the Conservation Park.

7.6.2 Usage of Control Lines during Fire Incidents

The usage of control lines should be determined by the IMT, based on fire severity and weather conditions giving due consideration to safety and strategic advantage. If control lines are not up to the recognised standard, they may be fuel reduced to the desired standard during a bushfire or prescribed burn using any means deemed appropriate by the IMT under the following provisos:

- All mechanically treated edges (i.e. A-framed, rolled or scrub-raked), either existing or new, are rehabilitated during prescribed burns and bushfires (wherever it is practically safe and feasible to do so) to encourage vegetation recovery.
- New control lines implemented to control fire edges should avoid dune crests and where possible run in as close as possible to a straight line to minimise the chance of rekindles escaping and maximise the chance of crews suppressing fire flanks. In areas where this line is away from the fire edge, fuel should be burnt wherever possible.

7.6.3 Heavy Machinery Usage in the Ngarkat District

Bushfires within the plan area have always involved the use of heavy machinery. Historically, the most commonly used method of implementing control lines or securing fire edges has been a bulldozer towing a cross-ribbed roller. More recently, the development of the 'A-frame' has proven to be very effective for implementing control lines in bushfires. These options have been favoured over mineral earth or ploughed breaks because they can access difficult terrain and provide an area of modified fuel with minimal long-term impact on vegetation community composition (Pelton and Conran, 2002; Pelton unpub. data). The decision to deploy heavy machinery for direct attack should be made by the IMT at the earliest possible point in time given:

- The time it takes to deploy heavy machinery is anywhere between two and 12 hours depending on the location of the machine, the state of the access roads, the mode of transportation and the location of the fire.
- The quicker the response time, the earlier in the incident work can commence, thereby increasing the probability that control lines will be successful and decreasing the overall area cleared in the establishment of these lines.
- The fire weather and associated fire behaviour conditions under which plant will be operating.

All actions involving heavy machinery are to be authorised by the IMT following liaison with DEH or the relevant landowner. Heavy machinery is only to be used when the IMT has determined that:

- There is a significant threat to life and/or property.
- The sensitivity of vegetation and habitat define a critical need to stop the fire entering an adjacent area (i.e. known threatened species habitat).
- There is unlikely to be irreversible or an unacceptable level of impact on cultural heritage sites (Aboriginal or European), significant ecological communities, species or habitats.
- The topography is suitable and/or safe for heavy machinery and the line will be trafficable by 14's (small fire appliances) to support implementation and mop-up.
- No heavy machinery is to operate without a support appliance with firefighting capability or adequate communication capabilities.

7.7 Fire Management Utilities and Facilities

Existing water sources and facilities are illustrated on Map 4. Access to water sources for firefighting purposes should be negotiated directly with neighbours, through the CFS Group or the District Bushfire Prevention Committee. A Response Plan, dealing with DEH response to bushfire, will be updated as required, to reflect alterations and additions to utilities and facilities (DEH, 2006e).

7.7.1 Water Supply

Whilst there is a significant reliance on dry fire fighting techniques such as heavy machinery usage in the plan area, water supply is critical to both firefighter safety and effective

mopping up operations in both bushfires and indeed prescribed burning. The lack of adequate water supplies is problematic within the plan area during large campaign fires, as turn around times for refilling tanks are often over two hours. The recommended designated firewater tank sites are listed in the block prescriptions (refer to Section 9).

Recommendations

Fire Water

10. All tanks (Pertendi Hut, Comet Bore and Pocock's Mill) within Ngarkat CP must be at carrying capacity at the start of each fire season.
11. Tanks at Pertendi Hut, Comet Bore and Pocock's Mill within Ngarkat CP are protected by Asset Protection zones (A-zones). All tank sites are to have minor access tracks to allow for safe access and egress.
12. Water sources adjacent the planning area are identified, the landholder is consulted and arrangement negotiated for access to the water. This can also involve the provision of tanks and fittings on private property if there is a strategic benefit in having water at that location. Funding for such works will be negotiated between members of the Ngarkat Operations Group and the landholder concerned.

8 FIRE MANAGEMENT ZONES

8.1 Zoning Background

Fire management zones as detailed in the *Policy and Procedures for Fire Management Zoning in DEH Fire Planning* (DEH, 2006a) have been introduced into DEH fire management planning to:

- ensure that appropriate management actions are implemented to meet the requirements for asset protection and ecological management on DEH managed land
- clarify the areas where different fire management activities will be undertaken on DEH managed land and reserves
- ensure a standard approach to the application of fire management zones on DEH managed lands and reserves in South Australia
- assist in the development of Fire Management Plans and programs for DEH managed land.

Fire management zones are categorised according to the primary objective for fire management; Asset Zone (A-zone), Buffer Zone (B-zone) or Conservation Zone (C-zone). These zones were determined, giving consideration to the level of risk and the protection and management of built assets, natural and cultural values (DEH, 2006a). The zones allocated to sections of blocks are described in the relevant Block Prescriptions and are displayed on Map 4 (Fire Management and Access).

8.2 Risk Assessment

A risk assessment was conducted in line with the *Policy and Procedures for Risk Assessment in DEH Fire Planning* (DEH, 2006b), as a requirement of the compilation of this Fire Management Plan. The risk assessment is a tool used to gauge the risks arising from bushfire to life, property and environmental values, within and adjacent to the planning area. The risk assessment considered visitor use, assets (built, heritage and environmental) and neighbouring properties across the planning area. The likelihood of a risk occurring was scored on a scale from Rare to Almost Certain (*Rare, Unlikely, Possible, Likely* and *Almost Certain*). The consequence of that risk was scored on a scale from Insignificant to Critical (*Insignificant, Minor, Moderate, Major* and *Critical*). The Likelihood score and the Consequence score where then used in conjunction with a Risk Matrix to determine the Overall Risk for each scenario, ranked from *Low* to *Extreme (Low, Moderate, High, Extreme)*. The Overall Risk rating was then used to determine Fire Management Zones.

The following sections briefly describe each of the zoning categories, and describe the objectives and strategies for each category.

8.3 Asset (A) Zone

These are small zones containing built or significant cultural assets archaeological or heritage listed sites, homes, outbuildings, visitor centres, tanks and interpretative signage. They are the most visited areas of the reserves. They could possibly be sources of human-caused ignitions but, to date, the statistics suggest this is unlikely. However, they are areas that need to

provide safe zones for visitors during significant fire incidents. Current fire protection standards around assets within the plan area are acceptable given the risk fire poses, if these standards are adhered to annually then no further work will be required to improve asset safety. The overall fuel hazard in A-zones should not exceed *Moderate*.

Note: All built assets within the plan area are by default A-zones; fuel levels in these areas may be modified by any means deemed appropriate by reserve management in accordance with DEH policy.

8.3.1 Management Objectives for A-zones

- To protect visitors, firefighters and firefighting equipment from bushfires.
- To protect cultural heritage sites from the impacts of bushfire and bushfire suppression.
- To minimise bushfire damage to infrastructure.
- To lower the risk of anthropogenic ignitions.

8.3.2 Detailed Strategies in A-zones

A > Establishing Low Fuel Buffers

Provide an area of low fuel to a radius of at least 40 metres to act as a buffer during a bushfire (where required) and to provide suppression advantage should a fire start in the zone. Options for achieving this include mulching, slashing, rolling, manual removal of standing fuels, or small prescribed fires on the perimeter of the zone. Prioritising the order and means in which these zones are to be maintained is the responsibility of the Regional Fire Management Officer and the District Ranger, Mallee based on the relative risk to the site in question, the resources available and the priority of protecting the site when compared to other landscape or habitat protection works prescribed in other zones.

Justification: As many of the areas are also assembly points during emergencies it is critical they offer protection from bushfire. This is achieved to some degree by the existence of cleared areas for vehicle parking but further works around or close to parts of the perimeter, or around water supplies, are required provided it is consistent with the values of the area.

B > Managing and Educating Visitors

The management of ignition risks associated with visitor use and at reserve facilities and the education of visitors with respect to the aims of this plan is essential.

Visitors to the plan area during the fire danger season (approximately November to April) will continue to be provided with information detailing pre-suppression measures (including prescribed burning) and emergency procedures in the event of a bushfire.

Justification: Anthropogenic ignitions cause a very small percentage of fires in Ngarkat CP. There is considerable benefit gained from presenting overarching philosophies and objectives of the plan to the public. Explanations surrounding fire access signage, the presence of C-zone burning, B-zones, A-zones and monitoring sites will provide a strong message that land managers in the area are proactive regarding fire management as opposed to reactive.

Recommendation

Managing Visitors

13. Interpretive signage, describing evacuation procedures and the aims and strategies of the Ngarkat District Fire Management Plan, should be implemented at relevant Visitor Centres and the DEH Regional and District Offices for each of the Reserves concerned.

8.4 Buffer (B) Zone

These are areas where the protection of buildings, farms, horticultural or ecological assets is of critical importance. Within this plan, B-zones are restricted to DEH reserves only and are strategically located to protect built assets (e.g. Kirra Station), or are located against major fire access points (e.g. Bordertown to Pinnaroo Road with the aim of providing greater protection and suppression opportunities to fire fighters and assisting in halting the easterly spread of a bushfire). Areas designated as B-zones will be retreated cyclically to manage fuel levels. The overall fuel hazard in B-zones should not exceed *High*.

Note: This does not mean that the blocks that contain these zones do not include areas of conservation significance or that conservation objectives should be disregarded in these areas.

8.4.1 Management Objectives for B-zones

- To minimise the risk of property and ecological asset losses due to bushfire.
- To minimise the likelihood of fires entering blocks from adjacent areas.
- To define a level of prescribed fire that is both effective in halting the spread of bushfires and ecologically sustainable for the communities impacted on.
- To promote patchiness in fires, prescribed or otherwise.
- To provide greater protection and an increased suppression advantage for firefighters and greater protection for the public on major public roads traversing the plan area.

8.4.2 Detailed Strategies in B-zones

A > Establishing Strategic Areas of Low Fuel Using Prescribed Fire

Prescribed burning within these zones consists of linear strips. Strips approximately 500 metres wide shall be implemented at strategic points across the landscape adjacent to fire access tracks.

In areas with conservation land situated either side of the fire access track the alternate side of the fire access track will be burnt to the same width once the fuel level reaches *High*. This will effectively produce a minimum 1 000 metre wide buffer of reduced fuel designed to aid in halting the spread of smaller, less intense fires, and slowing the progression of larger, more intense events.

In areas where B-zones are situated against private land, the zone will be retreated again once the fuel hazard reaches *High*. In these areas, DEH will negotiate with the relevant adjacent landholder and District Bushfire Prevention Officer to ensure that adequate complementary or reciprocal fire management work is carried out on the boundary of the adjacent property in question.

Alterations to the width or continuity of a designated B-zone are permitted under the following circumstances:

- Operational restrictions and risks associated with implementing a prescribed burn in steep and/or sandy terrain.
- Variation in fuel hazard levels across the pre-designated area of the zone.
- An identified, viable and significant population of a listed species of flora or fauna is located within the zone area.

Note: any decision to alter the extent or continuity of a prescribed burn in this instance needs to be negotiated between the Regional Fire Management Officer, the Mallee District Ranger and the Murraylands Conservation Programs Unit.

B-zones are not to be retreated if the fuel hazard is estimated at less than *High* except in the following circumstance:

- Backburning operations in the event of a bushfire. Designated B-zones should be retreated first in the event of a bushfire, thereby limiting the impacts to an area already altered by management prescriptions.

All B-zones should be implemented against a major fire access track. If a second, parallel scrub break is employed to secure the fire during the treatment of the zone, this break will be burnt, rehabilitated and closed once prescribed burning operations are completed to promote regeneration of vegetation.

Justification: Areas of modified or reduced fuel strategically located across the plan area will provide a safer operating environment for firefighters, greater protection for assets within and adjacent to the planning area, increase the patchiness of bushfires and restrict their extent and as such minimise the impacts upon ecological communities.

8.5 Conservation (C) Zone

Conservation zones are defined as those areas where the primary objective of fire management is the conservation of ecological communities and species, or biodiversity. Given the minimal numbers of built assets the greater percentage of the plan area is a designated C- zone.

8.5.1 Management Objectives for C-zones

- To manage fires and fire regimes to meet the ecological fire requirements of species and communities that may be at risk from inappropriate fire regimes.
- To minimise the risk of any large block (>10 000 ha), or multiple blocks burning in a single high intensity bushfire event.

- To provide refuge areas for fauna species during a large bushfire, either within large blocks or in adjacent blocks.
- To promote patchiness in fires, prescribed or otherwise.
- To minimise the negative impacts of fire management and suppression activities on conservation values and provide a suppression advantage for bushfire operations wherever possible.

8.5.2 Detailed Strategies in C-zones

A > Guidelines for the Prescribed Use of Fire

Prescribed burning in C-zones will be used for one of three purposes, with strategies in the short to medium term (i.e. during the review period of this plan) geared toward using fire in the landscape to protect landscapes (*Landscape Protection Burning*) or specific habitat from being burnt (*Habitat Protection Burning*) in single large-scale fire events. The controlled use of fire for ecological purposes (*Ecological Burning*) is something that is necessary in the long term to manage biodiversity in the plan area.

All prescribed burning (regardless of the objective or tenure) within C-zones will adhere to the process detailed in Figure 2 and will utilise the Ecological Fire Management Guidelines discussed in Section 6.4 (Table 3).

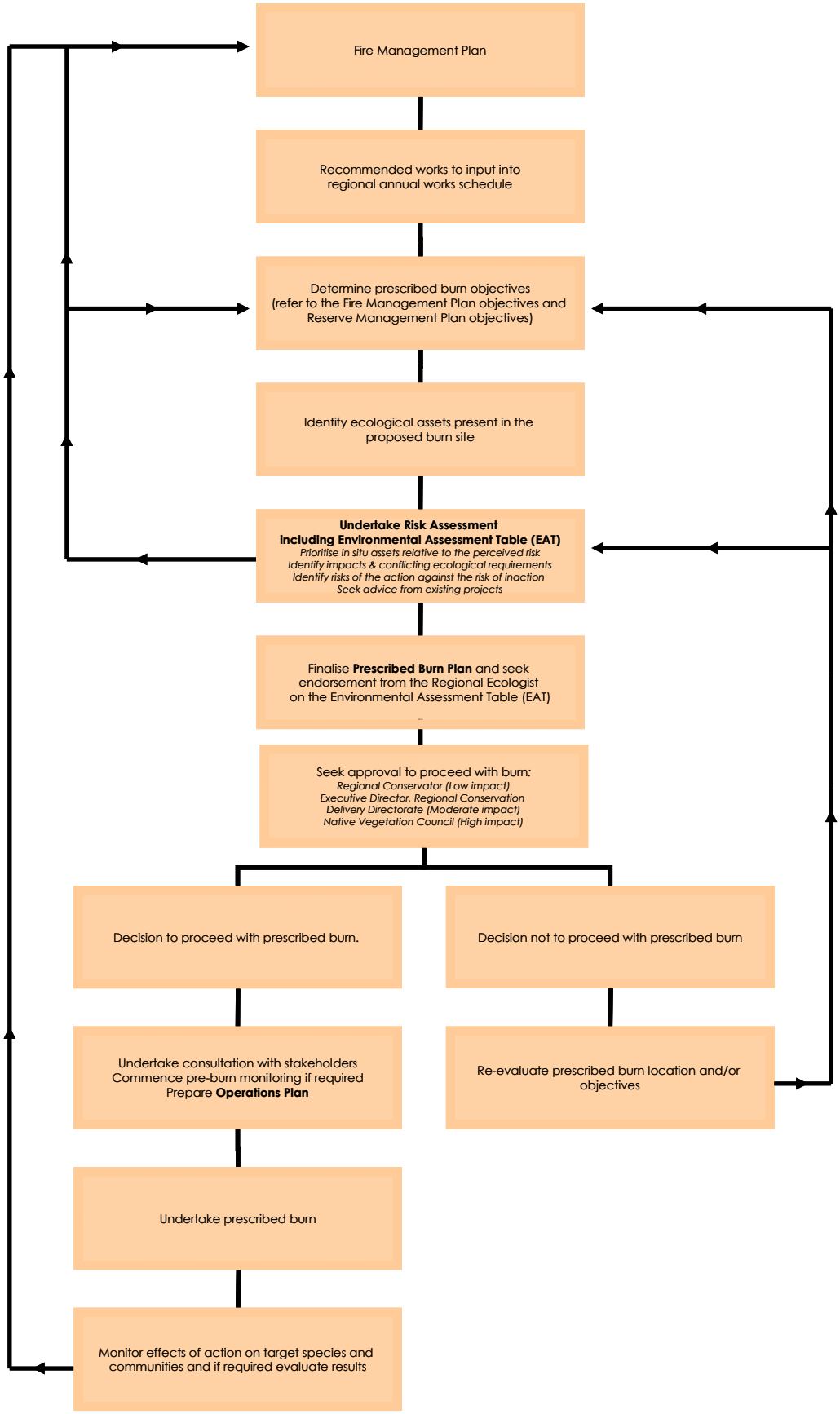

FIGURE 2: THE BURN PLANNING PROCESS

Landscape Protection Burning

Landscape Protection Burning will be conducted in conservation zones with the aim of providing landscape scale protection to adjacent ecological communities or private lands, and, where relevant, to provide a suppression advantage for crews in the event of a bushfire. Proposed Landscape Protection burns are displayed on Map 3 and 4.

Note: proposed burn areas are subject to alteration due to fire history, regime, weather, funding and resource availability.

Habitat Protection Burning

Habitat Protection Burning will be conducted with the specific ecological objective of providing smaller scale *in situ* protection to known populations or communities of threatened or significant species. Particular focus for this program in the first instance will be identified habitat for the Mallee Emu-wren. As knowledge of other threatened species distributions is developed, this will be built into the program on a priority basis.

Note: proposed burn areas are subject to alteration due to fire history, regime, weather, funding and resource availability.

Ecological Burning

Ecological Burning **may** be conducted with the following objectives:

- To promote suitable conditions for the conservation/propagation of a known population or community of a threatened or significant species.
- Increasing specific knowledge on the fire ecology of a particular species or community.
- Development of knowledge on fire behaviour, fire suppression techniques or the efficacy of pre-suppression measures.
- Increasing understanding of the processes shaping fire regimes.

Note: proposed burn areas are subject to alteration due to fire history, regime, weather, funding and resource availability.

Justification: These guidelines will ensure the responsible use of prescribed fire by not allowing large areas to be burnt at any one time or over a short period. Ideally, bushfires should be managed to restrict the burnt area to within a single block or less than 10 000 hectares to reduce the ecological, economic and social impacts of the fire on the district. At the same time, the strategy employed will firstly limit the impact upon optimal habitat for species in these areas and reduce the costs of suppression associated with large bushfires whilst seeking to increase and enhance our knowledge of the ecological role of fire in heath and mallee-heath systems.

B > Define a Method of Establishing Landscape Protection/Habitat Protection Burns

This will be achieved through prescribed burning to provide an area of low fuel to act as a buffer during a bushfire. All prescribed burns conducted within C-zones will be implemented with adequate control lines surrounding them. Control lines may be implemented using heavy machinery (preferably rolled or A-framed), or alternatively the use of existing fire scars wherever possible is preferred to reduce the impact on the environment.

Pre-burning the perimeter of such burns is permissible during the winter months to a width of 30 metres (including the firebreak). Landscape protection burns are to be burnt to a width of approximately 500 metres wide (terrain, built and ecological asset proximity permitting), with a preference given to late spring or early autumn for burning. Note that in areas supporting breeding populations of threatened species, consultation is required with the Murraylands Conservation Programs Unit when designating a date for prescribed burning.

The primary objective for these burns is landscape/habitat protection on a temporary basis. Sites will be selected based on existing fire regime, proximity to control lines and access points for suppression operation in the event of a bushfire, and the location of threatened and/or significant populations/communities.

Justification: It is unacceptable to allow large high intensity bushfires to burn out large blocks of native vegetation, due to the risk of local extinction to both flora and fauna.

Given the restrictions placed on fire management activities by the terrain, size of the area, resources available and the threat of impinging upon threatened species, the options for minimising the size of fire within a block are limited. The option chosen is to use prescribed fires to provide buffer areas on existing block boundaries or control lines in areas that do not require repeated treatment, or alternatively in areas that are identified as requiring protection from large bushfire events due to the presence of populations of significant or threatened species. These resulting lower fuel loads will aid in impeding the spread and intensity of a bushfire and promote patchiness to increase available refuge areas for fauna.

C > Exclude Bushfire from Regenerating Areas, Areas of Significant Biodiversity Value or Cultural Heritage Sites

Consecutive bushfires in any conservation zone in the plan area should be no less than the Threshold of Potential Concern (Refer to Table 3) for the MVS in question. This will be achieved by implementing prescribed burning to assist in excluding bushfire (and promoting patchiness in the event of bushfire).

Justification: Under extreme conditions, heath vegetation can re-burn from as early as two years post-fire (Keith, et al., 2002). It is important to allow time without fire for adequate regeneration, to ensure post-fire maturity and reproduction of most perennial components and obligate seed regenerators across as large an area as possible. Beyond this, information suggests that many species of heath and mallee-heath fauna (including the Malleefowl and Mallee Emu-wren) will not inhabit these areas with any regularity until at least 15 years post fire. There is currently no evidence to suggest that the exclusion of bushfire from an area over such a time frame will be detrimental in the long term to any species of flora or fauna.

For known cultural heritage sites, mechanical disturbance shall not occur any closer than 100 metres from these areas in either pre-suppression or suppression operations, nor should they be used as staging or safe areas for persons or equipment unless in an emergency situation. The preferred method for reducing fuels (if warranted as many are naturally low in fuel) in these areas is prescribed burning. Protecting culturally significant sites such as archaeological sites or previous settlements from the impacts of bushfire suppression activities helps to preserve the heritage value of the area. Management of all sites should be consisted with the *DEH Aboriginal Heritage Handbook and Strategy* (DEH, 2006d) and the *Aboriginal Heritage Act 1988.*

9 FIRE MANAGEMENT BLOCKS

There are general fire management objectives that apply to all zones and blocks in relation to suppression and firefighter safety. There are also fire management objectives that are zone specific, applying to all blocks in a particular zone. Finally, there are objectives that may only apply to a specific block. Within the plan area, a block may have two designated zones based on the management objectives. For example, Pertendi Block is designated as C-zone, but Pertendi Hut is zoned an A-zone. One of the objectives in a C-zone is to manage fires to meet the ecological fire requirements of species and communities that may be at risk of long-term damage from inappropriate fire regimes. To facilitate this, bushfire should be excluded from a recently burnt area for the period described in Table 3 (Ecological Fire Management Guidelines for MVS). This will allow sufficient time for plants to regenerate and fauna to move back into that block. An action of fire exclusion may be required in a recently burnt block and this may involve actions such as intensifying suppression effort or implementing strategic preventative measures to protect it.

9.1 Block Prescriptions

Information specific for each block has been included and this is supplemented by Map 4. A summary of vegetation and fire history is presented for each block. The number of flora and fauna of conservation significance that have been recorded for each block has been summarised. Objectives and actions that apply to a specific block are included in the block's prescription.

Note: The information on species that are mobile, such as birds, may not give an accurate picture of species' distribution. Also, the absence of records for a species in a block does not mean that the particular species does not occur in it, because the data represents one point collection in space and time (Foulkes and Gillen, 2000), rather than any extended ecological studies. As such, any inference one draws about flora and fauna species distributions should not be considered holistic.

CARCUMA BLOCK

Tenure, Land Use

Carcuma CP, Department for Environment and Heritage; Heritage Agreements: Section 13 and Allotment 301 of the Hundred of Lewis, Sections 18, 20, 22, 25 and 36 of the Hundred of Carcuma.

Size 7 525 ha (2 940 ha Carcuma CP, 4 585 ha Heritage Agreements)

Vegetation

MVS No. 8, 19, 27, 29, 30 and 32.

Carcuma Block is dominated by alternating patches of Banksia heathland (MVS No. 30) and Mallee-heath (MVS No. 29).

Fire History

Dates: 7/10/2004, 5/01/2005, 21/10/2006.

There have recently been three recorded fires (in October 2004, January 2005 and October 2006) in Carcuma CP and adjacent areas totalling 1 717 hectares since records have been commenced. The most significant of these was the October 2006 fire – which burnt the remaining unburnt areas of Carcuma CP and the majority of the adjacent Heritage Agreement areas and private scrub. Prior to these fire events, the majority of this block had not been exposed to fire for over 40 years.

Natural Values

There are records of six species of threatened bird and three species of threatened plant in Carcuma Block. The Mallee Bitter-pea (*Daviesia benthamii ssp. humilis*), Narrow-leaf Wax-flower (*Eriostemon angustifolius ssp. angustifolius*) and the Scented Sundew (*Drosera whittakeri ssp. aberrans*) have all been found in Carcuma or the surrounding bushland. Foraging visitors of note include the Red and Yellow-tailed Black Cockatoos (*Calyptorhynchus banksii graptogyne* and *Calyptorhynchus funereus*), although the Red-tailed Black Cockatoo record is 20 years old. Mallee Emu-wrens have also been recorded within the block.

Built Assets

There are no built assets within the block. However there are a number of farmhouses and outbuildings in the vicinity, including Nulungery and Southrose Homesteads. Areas surrounding both holdings are cleared farmland.

Fire Access Refer to Map 4.

Access to the area is principally from the Tintinara Geranium Road from both North and South. There is currently no continuous GAFLC rated access around Carcuma Block. The status of any tracks used for suppression operations should be confirmed with the relevant landowner or DEH.

Fire Risk

Fire risk in Carcuma Block is currently low given the recent fire events.

Fire Water

Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Carcuma Block

1. To minimise the risk of Carcuma CP or any Heritage Agreement component of Carcuma Block being burnt out in a single fire event.
2. To contain bushfires within block boundaries and protect adjacent assets.
3. To reduce the impacts of further fire events in the block for the next 10 years to promote community recovery following the recent fires.
4. Protect the remnant unburnt vegetation in Heritage Agreements within the block from burning in a single fire event.

Recommended Works

Pre-Suppression

- A major fire access track is to be developed and maintained on the Carcuma CP boundary to a width of seven metres.
- All other Heritage Agreement components should have minor fire access tracks (four metres) maintained on their perimeter.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Carcuma Block. Police should be notified of any threat to public traffic on the Tintinara-Geranium Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to act on any threats to properties adjacent to Carcuma Block before focusing on protecting known populations of significant or threatened species in the unburnt areas in the north and west of the block. Impacts associated with backburning and heavy machinery are to be minimised in these areas.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Knowledge regarding service track standards should be sought from local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

ASHBY'S BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage; Heritage Agreements: Sections 4 and 10 and Allotments 51 and 52 of the Hundred of Lewis.

Size 21 893 ha (15 954 ha Ngarkat CP, 5 939 ha Heritage Agreements)

Vegetation

MVS No. 8, 27, 29 and 30.

Ashby's Block is diverse, supporting seven different recognised mallee-heath communities. The majority of the block is dominated by Banksia heath (MVS No. 30) on sand plains and an overstorey of Desert Stringybark (*Eucalyptus arenacea*) on dune ridges. Leeward slopes and easterly facing dune bases will frequently support stands of SA Blue Gum and Spinifex *(Triodia irritans)*. Swale areas are frequently scattered with various mallee overstorey communities including Narrow-leafed Red Mallee *(Eucalyptus leptophylla)* and Ridge-fruited Mallee *(Eucalyptus incrassata)*.

Fire History

Dates: 1954, 1958, 1959, 1961, 1966, 1978, 1982, 1984, 1986, 1988, 1990, 1990, 1991, 1997, 27/11/1999, 7/10/2004 (x2), 24/05/2005, 20/01/2006 and 21/11/2006.

Fire history in Ashby's Block is diverse, with 20 fires burning an area in excess of 64 240 hectares (mean area: 3 831 hectares). Prior to 2006, the largest events occurred in 1958 and 1984, with 12 500 and 8 500 hectares burnt respectively (the majority within the Ngarkat CP boundary). The January 2006 bushfire burnt 17 664 hectares or 81% of the block's total area.

Natural Values

Prior to the 2006 fire populations of the Mallee Emu-wren were known to occur within the block. The current status of these populations is presently unknown, although given that the majority of the block was burnt out during this event, it is highly unlikely that they are still present. Although no formal records of Malleefowl have been made in the block, there have been numerous sightings within Heritage Agreements included in the block: some of these areas still remain following the January 2006 bushfire. Cleland's Beard-heath (*Leucopogon clelandii*) has been recorded within Ngarkat CP; its status following the 2006 bushfire is unknown.

Built Assets

There are no built assets within the block. However, there are a number of adjacent farm properties that are at varying risk from bushfire under winds from an easterly, southerly or westerly influence. These are Ashfield Park, Southern Cross, Southrose, Carcory, Mount Timothy, Pfeiffer's and Jasper Downs Stations.

Fire Access Refer to Map 4

The block is best accessed from the Tintinara-Geranium Road and Southern Cross Road to the west and from the Box Flat Track or Garra South Road to the north. The block is traversed by a large number of apiary service tracks of variable quality and is bounded by standard fire tracks to the east (Box Flat–Jimmy's Well Track) and south (Emu Springs Track). Northern and western reserve boundaries have 20 metre wide firebreaks.

Fire Risk

Fire risk in Ashby's Block is variable given the diversity of post-fire ages. The short-term risk of fire impacting on the majority of block or adjacent farmland was significantly reduced following the fires in January and November 2006. However, as fuel levels rise, the risk of fire escaping the northern boundary of the block will increase, as will the risk to properties adjacent the western boundary of the block.

Fire Water

Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Ashby's Block

1. To prevent fire from escaping any component of the block into adjacent private lands.
2. To minimise the risk of any component of the block being burnt out in a single fire event- in particular the Heritage Agreement components of the block that remain unburnt following the January 2006 bushfire.
3. To reduce the impacts of further fire events in the block for the next 10 years to promote vegetation community and alternative Mallee Emu-wren habitat recovery following the 2004 and 2006 fires.
4. To promote patchiness within future bushfires and prescribed burns to ensure a greater diversity of post-fire vegetation states within the block.

Recommended Works

Pre-Suppression

- The Box Flat-Jimmy's Well Block Boundary Track is to be maintained to seven metres.
- All other Heritage Agreement components should have (as a minimum) minor fire access tracks (four metres) maintained on their perimeter.
- The western and northern boundaries of the Ngarkat CP that are part of the block are to be maintained to a width of 20 metres using cross-ribbed rolling on a four-year cycle.
- Landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C-zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect remnant vegetation or identified habitat areas for targeted threatened species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Ashby's Block. Police should be notified of any threat to any private asset as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to act on any threats to properties adjacent to Ashby's Block. All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and back burning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH and local apiarists where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

BOX FLAT BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage; Heritage Agreements: Section 52 and 1494 O.O.H. Pinnaroo, Sections 33, 34, 35 and 42 of the Hundred of Allenby.

Size 16 041 ha (13 703 ha Ngarkat CP, 2 338 ha Heritage Agreements)

Vegetation

MVS No. 8, 27, 29 and 30.

Box Flat Block is diverse, supporting six different recognised mallee-heath communities. The majority of the block is dominated by Banksia heath (MVS No. 30) on sand plains and an overstorey of Desert Stringybark on dune ridges. Leeward slopes and easterly facing dune bases will frequently support stands of SA Blue Gum and Spinifex. Swale areas are frequently scattered with various mallee overstorey communities including Narrow-leafed Red Mallee and Ridge-fruited Mallee.

Fire History

Dates: 1954, 1958, 1959, 1961, 1966, 1973, 1978, 1982, 1986, 1988, 1990, 1991, 1997, 29/10/2002, 24/05/2005, 20/01/2006

Box Flat Block has recorded 16 fires burning a total area of 46 441 hectares (mean area: 2 902 hectares). The largest events have occurred in 1973, 1978 and 2006, with 5 500, 8 600 and 12 570 hectares burnt respectively. All bushfires were started by lightning strikes, except the 1978 fire, which is believed to have started on an adjacent farm property.

Natural Values

Box Flat Block has historically supported populations of Mallee Emu-wren, Malleefowl and Slender-billed Thornbill. The Yellow-tailed Black-Cockatoo is a seasonal foraging visitor. The current status of these populations is presently unknown, although given that the majority of the block was burnt out during the 2006 fire it is highly unlikely that they are still present. Although no formal records of Malleefowl have been made in the block, there have been some sightings in Heritage Agreements included in the block: some of these areas still remain following the January 2006 bushfire. The Eastern Apple-berry (*Billardiera scandens var. scandens*), Whittaker's Drosera (*Drosera whittakeri ssp. aberrans*) and Cleland's Beard-heath have been recorded within Ngarkat CP. Note that Aboriginal heritage sites are recorded in this block.

Built Assets

Box Flat Campground and ruins (minimal infrastructure). There are also a number of adjacent farm properties that are at varying risk from bushfire under winds from an easterly or southerly influence. These include Mount Timothy, Baan View and Pfeiffer homesteads.

Fire Access Refer to Map 4.

The block is best accessed from the Baan Hill, Garra South or Parrakie South Roads from the north. The block is traversed by a large number of apiary service tracks of variable quality and is bounded by standard fire tracks to the west (Box Flat-Jimmy's Well Track) and north (McCallum-Ngarkat Boundary Track). It can also be accessed from the south (Emu Springs Track) and east (Baan Hill Track). Northern and western reserve boundaries have 20 metre wide firebreaks. Information on access to Heritage Agreement components of the block is available through the relevant landowner.

Fire Risk

Fire risk in Box Flat Block is variable depending on fuel type and age. The short-term risk of fire impacting on the majority of block or adjacent farmland was significantly reduced following the fire in January of 2006. However, as fuel levels rise, the risk of fire escaping the northern boundary of the block will increase, as will the risk to properties adjacent to the western boundary of the block.

Fire Water

Water is available from Rohrlach's property near Baan Hill Reserve and Pocock's Mill. Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Box Flat Block

1. To prevent fire from escaping any component of the block into adjacent private lands.
2. To minimise the risk of any component of the block being burnt out in a single fire event- in particular the Heritage Agreement components of the block that remain unburnt following the January 2006 bushfire.
3. To reduce the impacts of further fire events in the block for the next 10 years to promote vegetation community and alternative Mallee Emu-wren habitat recovery following the 2005 and 2006 fires.
4. To promote patchiness within future bushfires to ensure a greater diversity of post-fire vegetation states within the block.

Recommended Works

Pre-Suppression

- The Box Flat-Jimmy's Well Track is to be maintained at a width of seven metres.
- The western and northern boundaries of Ngarkat CP that are part of the block are to be maintained to a width of 20 metres.
- All other Heritage Agreement components should have (as a minimum) minor fire access tracks (four metres) maintained on their perimeter.
- Landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect remnant vegetation or identified habitat areas for targeted threatened species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict fires to the block. Police should be notified of any threat to private assets as soon as possible to facilitate patrols and road closures.

Note: Box Flat Campground should be checked for visitors at the earliest possible point in an incident.

Suppression efforts should seek to act on any threats to properties adjacent to Box Flat Block. All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and backburning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH and local apiarists where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

JIMMY'S WELL BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage.

Size 27 407 ha

Vegetation

MVS No. 8, 27, 29 and 30.

Jimmy's Well Block supports a diverse array of vegetation communities due to increased rainfall and varying soil types: Aeolian sands, lacustrine clays and marine limestone. Sand plains are dominated by Banksia heaths (MVS No. 30) with some Mallee overstorey communities (MVS No. 29) in the south-eastern corner.

Fire History

Dates: 1954, 1956, 1961, 1976, 1979, 1980, 1981, 1/11/1988, 21/11/1988, 31/12/1988, 27/12/1990, 31/12/1991, 29/10/2002, 2/11/2002, 30/11/2003, 26/01/2005 and 20/01/2006.

Fire history in Jimmy's Well Block is extensive, with 17 fires burning an area in excess of 65 505 hectares (mean area: 3 853 hectares). Until 2005 a large portion of the block had not been burnt since 1958, however the fires in January 2005 and January 2006 burnt a combined total of 16 600 hectares of the block, as such the majority of the block is recently burnt.

Natural Values

Jimmy's Well and Mount Rescue Blocks were the last known sites containing the Western Whipbird within the plan area prior to the 2005 and 2006 fires. The status of these populations within the block is now unknown. The Malleefowl, Painted Button-quail (*Turnix varia*), Red-lored Whistler, Slender-billed Thornbill have all been recorded within the block, whilst the Yellow-tailed Black-Cockatoo is a frequent foraging visitor. As with the Western Whipbird, it is unlikely that the block supports Malleefowl following the recent bushfires.

Built Assets

There are no built assets within the block, however there are a number of adjacent properties to the west of the block including Emu Springs, Ketring and Sinclair homesteads.

Fire Access Refer to Map 4

The block is best accessed from the Emu Springs Road from the west and from the Baan Hill Track to the east. The block is traversed by Box Flat-Jimmy's Well Track, and bounded by the Mt. Rescue-Jimmy's Well and Jimmy's Well-Ashby's Block boundary tracks and the Baan Hill Track (all are standard fire access tracks). The block contains a number of apiary service tracks of variable quality and the western reserve boundary has a 20 metre wide firebreak.

Fire Risk

Fire risk in Jimmy's Well Block is currently low given recent bushfires. This risk will increase as fuel levels recover; much of the block is covered in steep dunes, making suppression operations difficult. There is a moderate risk of fire escaping the western boundary of the block.

Fire Water

Pocock's Mill in Box Flat Block. Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Jimmy's Well Block

1. To prevent fire from escaping the block into adjacent private lands and threatening life and property.
2. To minimise the risk of any component of the block being burnt in a single fire event.
3. To reduce the impacts of further fire events in the block for the next 10 years to promote community and alternative Mallee Emu-wren habitat recovery following the 2005 and 2006 fires.
4. To promote patchiness in bushfires and a diversity of different aged vegetation communities within the block to facilitate community and habitat recovery following the 2005 and 2006 bushfires.
5. To monitor the effects of prescribed burning on the ecological assets within the block with respect to potential displacement of threatened species.

Recommended Works

Pre-Suppression

- The Box Flat-Jimmy's Well Track, the Mt. Rescue-Jimmy's Well and Jimmy's Well-Ashby's Block Boundary Tracks and the Baan Hill Track are to be maintained at a width of seven metres.
- The western boundary of the block/reserve is to be maintained to a width of 20 metres.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect threatened species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Jimmy's Well Block.

All suppression activities should seek to use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and backburning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH and local apiarists where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

MOUNT RESCUE BLOCK

Tenure, Land Use

Ngarkat and Kelvin Powrie CPs, Department for Environment and Heritage; Section 11 of the Hundred of Archibald; Section 1 of the Hundred of Makin; Heritage Agreements.

Size 24 798 ha (21 351 Ngarkat and Kelvin Powrie CP, 3 447 Heritage Agreements and unalienated Crown land)

Vegetation

MVS No. 8, 27, 29, 30 and 47.

Mt Rescue Block supports a diverse array of vegetation communities due to increased rainfall and varying soil types: Aeolian sands, lacustrine clays and marine limestone. Sand plains are dominated by Banksia heath (MVS No. 30) with some Mallee overstorey communities (MVS No. 29) in the south-eastern corner.

Fire History

Dates: 1954, 1956, 1958, 1961, 1976, 1979, 1980, 1981, 1/11/1988, 21/11/1988, 31/12/1988, 27/12/1990, 31/12/1991, 29/10/2002, 2/11/2002, 30/11/2003, 26/01/2005, 20/01/2006, 21/10/2006, 26/11/2006 and 30/12/2006.

Fire history in Mt Rescue Block is extensive, with 22 fires recorded. Until 2005 a large portion of the block had not been burnt since 1958; however the fires in January 2005, January 2006, October 2006, November 2006 and December 2006 have burnt the majority of the block.

Natural Values

Mt Rescue Block and Jimmy's Well Block were the last known sites containing the Western Whipbird within the plan area prior to the 2005 and 2006 fires. The status of these populations within the block is now unknown. The Malleefowl Painted Button-quail, Red-lored Whistler, Slender-billed Thornbill have all been recorded within the block, whilst the Yellow-tailed Black-Cockatoo is a frequent foraging visitor. As with the Western Whipbird, it is unlikely that the reserve components of the block support Malleefowl following the recent bushfires. The Mallee Wattle (*Acacia montana*), Whittaker's Drosera, Cleland's Beard-heath, Annual Fern (*Anogramma leptophylla*), Limestone Phebalium (*Leionema brachyphyllum*), Spreading Pennywort (*Hydrocotyle crassiuscula*), Pink Zieria (*Zieria veronicea*), Kangaroo Island Logania (*Logania insularis*) and Splendid Bush-pea (*Pultenaea villifera var. glabrescens*) have all been recorded in Mount Rescue Block. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

Buck's Camp and Rabbit Island Campgrounds, Botany Hut (Gosse Hill). Adjacent properties include Tamboore, Bropea Downs, Gambak Park and Benbullen homesteads.

Fire Access Refer to Map 4

The block is best accessed from Snoswell's, Raphael, Sugarloaf or Darke Island Well Roads to the south, from the north via the Emu Springs Road and from the Baan Hill Track to the east. The block is traversed by number of standard fire access tracks and apiary service tracks of variable quality and is bounded by standard fire tracks to north (Mount Rescue Track) and east (Baan Hill Track). Southern and western reserve boundaries have 20 metre wide firebreaks.

Fire Risk

Fire risk in Mt Rescue Block is increasing as fuel levels recover; much of the block is covered in steep dunes, making suppression operations difficult. There is a moderate risk of fire escaping the southern or western boundary of the reserve and the adjacent Crown lands or Heritage Agreements under prevailing wind conditions. Of the adjacent properties, Tamboore is at highest risk from escaping bushfire. Fire risk to Kelvin Powrie CP is considered minimal; however consideration should be given to closing the Dukes Highway in the event of a bushfire for safety reasons.

Fire Water

Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Mount Rescue Block

1. To prevent fire from escaping any component of the block into adjacent private lands and threatening life and property.
2. To minimise the risk of any component of the block being burnt out in a single fire event.
3. To reduce the impacts of further fire events in the southern section of the block (Section 11, Hundred of Archibald and Section 1, Hundred of Makin) for the next 10 years to promote community and alternative Mallee Emu-wren and possibly Western Whipbird habitat recovery following the 2005 and 2006 fires.
4. To monitor the effects of prescribed burning on the ecological assets within the block with respect to potential displacement of threatened species.

Recommended Works

Pre-Suppression

- The Gosse Hill, Bucks Camp, Mt Rescue-Jimmy's Well Block Boundary and the Baan Hill Tracks are to be maintained at a width of seven metres.
- The southern, eastern and western boundaries of the block/reserve are to be maintained to a width of 20 metres.
- The boundary of Section 11, Hundred of Archibald and Section 1, Hundred of Makin should be maintained as a firebreak to a width of 20 metres given their impending gazettal as part of Ngarkat CP.
- Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (minor fire access track) to ensure adequate access for appliances during incidents.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect identified habitat areas for the Mallee Emu-wren. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible. Priority should be given to breaking up Section 11, Hundred of Archibald to ensure it is not consumed in one fire event.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Mt Rescue Block. Police should be notified of any threat to public traffic on the Dukes Highway as soon as possible to facilitate patrols and road closures.

***Note that Buck's Camp and Rabbit Island campsites should be checked for visitors at the earliest possible point in an incident.**

Suppression efforts should seek to act on any threats to properties adjacent to Mt Rescue Block before focusing on protecting known populations of the Mallee Emu-wren in the unburnt areas in the south of the block. Impacts associated with back-burning and heavy machinery are to be minimised in these areas.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and back burning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH and local apiarists where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

MCCALLUM BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage.

Size 23 029 ha

Vegetation

MVS No. 29 and 30.

McCallum Block is dominated by Banksia heaths (MVS No. 30) with some Mallee overstorey communities (MVS No. 29) in the south-eastern corner.

Fire History

Dates: 1954, 1958, 1959, 1961, 1966, 1973, 1980, 1981, 1982, 1984, 1986, 1988, 1988, 1990, 1993, 1999, 2/12/2001, 2/11/2002, 3/05/2004*(prescribed burn), 26/01/2005, 21/11/2006.

Fire history in McCallum Block is the most diverse in the plan area with 21 fires burning an area in excess of 68 000 hectares (mean area: 3 238 hectares). The prevalence of Banksia heath in this block has contributed to its fire prone nature, despite this there are still significant area in the north and south of this block that support fuel loading capable of carrying a fire.

Natural Values

McCallum Block supports the majority of the remaining Mallee Emu-wrens (in Ngarkat CP; the protection of this sub-population is a priority. The Yellow-tailed Black-Cockatoo and the Australian Bustard (*Ardeotis australis*) are both foraging visitors to the area; the Australian Bustard is often seen scavenging burnt reptiles and insects following fire. There are two species of threatened plant; Cleland's Beard-heath and the Pink Zieria have both been recorded in the block. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

There are no built assets within the block, although the block is bounded to the south and east by a number of farming properties.

Fire Access Refer to Map 4

The block is best accessed from the Bordertown–Pinnaroo Road to the south and east and from the Baan Hill Track to the west. The block is traversed by a number of standard fire access tracks and apiary service tracks of variable quality and is bounded by standard fire tracks to the west (Baan Hill Track) and north (McCallum-Ngarkat Block Boundary Track). Southern and eastern reserve boundaries have 20 metre wide firebreaks.

Fire Risk

Fire risk in McCallum Block is variable given the diversity of post-fire ages. Key risks involve the potential loss of Mallee Emu-wren habitat in the north of the block, and fire escaping the block boundary onto private land in older stands of mallee-heath on the southern boundary.

Fire Water

Water is available at Bunn's Bore, Comet Bore and Pertendi Hut. Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for McCallum Block

1. To prevent fire from escaping any component of the block into adjacent private lands.
2. To minimise the risk of any component of the block being burnt in a single fire event.
3. To reduce the impacts of further fire events in the southern section of the block for the next 10 years to promote community and alternative Mallee Emu-wren recovery following the 2001 and 2002 fires.
4. Minimise the impacts of fire and promote patchiness within the northern areas of the block to maintain as much Mallee Emu-wren habitat as possible.
5. To monitor the effects of prescribed burning on the ecological assets within the block with respect to potential displacement of threatened species.

Recommended Works

Pre-Suppression

- The McCallum-Ngarkat Block Boundary Track, Emu-wren Track, the Pines Track and the Baan Hill Track are to be maintained at a width of seven metres.
- The southern and eastern boundaries of the block/reserve are to be maintained to a width of 20 metres.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect identified habitat areas for the Mallee Emu-wren. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within McCallum Block. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to act on any threats to properties adjacent to McCallum Block before focusing on:

- Protecting where possible known populations of significant or threatened species (in particular the remaining Mallee Emu-wren sub-population) and apiary sites in the unburnt areas in the north of the block. Impacts associated with backburning and heavy machinery are to be minimised in these areas.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and back burning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH and local apiarists where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

NGARKAT BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage.

Size 55 700 ha

Vegetation

MVS No. 27, 29 and 30.

Ngarkat Block is dominated by Banksia heaths (MVS No. 30) with extensive areas of Mallee overstorey communities (MVS No. 29) to the east and north. An area of Parilla clay and limestone in the northwest of the block near the Baan Hill Track is dominated by a stand of Narrow-leafed Red Mallee (MVS No. 27).

Fire History

Dates: 1954, 1958, 1959, 1961, 1973, 1978, 1980, 1981, 1984, 1986, 1988, 1990, 1997, 31/12/1998, 27/01/1999, 29/10/2002, 2/11/2002, 3/05/2004 and 20/01/2006.

Ngarkat Block is the most fire prone block in the planning area; there have been 19 fires burning an area in excess of 221 245 hectares (mean area: 11 644 hectares per fire). Some areas have been burnt as many as seven times in the last 60 years, whilst only 50 hectares of the block has been unburnt since 1945. Ngarkat Block has frequently experienced some very large events: bushfires in 1954, 58, 61, 86, 90, 99 and 2002 all burnt in excess of 20 000 hectares of the block.

Natural Values

Ngarkat Block currently supports populations of Mallee Emu-wrens in the far south of the block. The protection of these areas is a priority for this block. There have been six species of threatened flora and ten species of threatened fauna recorded in Ngarkat Block. Plants recorded include Pink Zieria, Cleland's Beard-heath, and the Lowan Phebalium. Recognised populations of the Lowan Phebalium are a priority for management within this block. The Malleefowl, Red-lored Whistler, Striated Grasswren (*Amytornis striatus*) and Western Whipbird have all been historically recorded within Ngarkat Block, however recent fire events make their presence is unlikely. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

No built assets are present within the block.

Fire Access Refer to Map 4

The block is best accessed from the Bordertown-Pinnaroo Road and the Piggery Track to the south and east and from the Baan Hill Track to the west. There are few internal service tracks and the block is bounded by standard fire tracks to the west (Baan Hill Track), north (Piggery Track) and south (McCallum-Ngarkat Block Boundary Track). There is no access to the interior of the block.

Fire Risk

Fire risk in Ngarkat Block is currently low due to recent fire events in 1999, 2002 and 2006. However, the risk of large fires occurring within this block will increase as these areas recover due to the Banksia heath fuels and slow response times for suppression crews. Whilst the immediate risk to life and property is low, Ngarkat Block has historically been an area

responsible for rapid growth in bushfires as they move east- hence there is an inferred risk on neighbouring blocks that needs to be mitigated.

Fire Water

Water is located at Pocock's Mill in Day Block, Pertendi Hut and Baan Hill Reserve. Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Ngarkat Block

1. To prevent fire from escaping any component of the block into adjacent private lands.
2. To minimise the risk of the block being burnt out in a single fire event.
3. To contain all east heading bushfires at the Bordertown-Pinnaroo Road.
4. To protect the remaining unburnt areas of the block from bushfire, promote patchiness in bushfires and manage fire regimes to benefit the communities present.
5. Minimise the impacts of fire and promote patchiness within the southern areas of the block to maintain as much Mallee Emu-wren habitat as possible.
6. To maintain and if possible expand existing populations of the Lowan Phebalium within the block through managing suitable fire regimes.
7. To promote patchiness in bushfires and manage fire regimes to benefit other listed significant species and communities within the block.

Recommended Works

Pre-Suppression

- The Piggery Track and the Baan Hill Track are to be maintained at a width of seven metres.
- A B-zone approximately 500 metres wide is to be maintained to the west of the Bordertown-Pinnaroo Road. The alternate side (Pertendi and Mt Shaugh Blocks) will also be maintained to a width of 500 metres- treated alternately as fuel levels require.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C-zones) for detail on the process to be followed. Areas adjacent to the Baan Hill Track, the Piggery Track should be given priority for these works.
- Unbounded landscape protection burns less than 2 500 hectares (5% of the block area) may be implemented using aerial ignition through the centre of the block to promote patchiness in fire regimes and aid in preventing bushfires growing rapidly in inaccessible areas of the block. These buffers are to be predominantly linear and run in a north-south direction on flat terrain. Refer to Section 8.5 (C-zones) for detail on the process to be followed.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect identified habitat areas for threatened species. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.
- Ecological burning is permitted (as outlined in Section 8.5) to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Ngarkat Block. Given the lack of internal access, undulating terrain and the fuel types present, fires have the potential

to grow very quickly. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to:

- Protecting known populations of significant or threatened species (in particular the remaining Mallee Emu-wren sub-populations) in the unburnt areas in the south of the block. Impacts associated with back-burning and heavy machinery are to be minimised in these areas.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and back burning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH staff or local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

DAY BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage; Section 2 and 47, Allotment 13 and Parcel 11 of the Hundred of Day; Heritage Agreements: Sections 2, 5, 25, 27, 28, 31 and 34 of the Hundred of Day.

Size 41 682 ha (34 476 ha Ngarkat CP, 7 206 ha Heritage Agreements)

Vegetation

MVS No. 8, 29, 30, 31 and 32.

Day block is dominated by Banksia heath (MVS No. 30) in the south-west with extensive areas of Mallee overstorey communities (MVS No. 29) to the east and north.

Fire History

Dates: 1954, 1958, 1961, 1966, 1973, 1978, 1984, 1986, 1990, 1997, 1998, 27/01/1999, 19/03/2001, 15/02/2002, 2/11/2002 and 20/01/2006.

Fire history in Day Block is diverse, with 16 bushfires burning an area in excess of 94 600 hectares (mean area: 5 913 hectares per fire). Only 5 000 hectares, much of it unalienated Crown land or Heritage Agreement, has been unburnt since 1945. Day Block has experienced some very large events: the recent fire in January 2006 burnt 14 700 hectares of the block.

Natural Values

Day Block historically has supported populations of Mallee Emu-wrens, although the recent fire in January 2006 has significantly reduced areas of suitable habitat in the south-west of the block. The Malleefowl is another resident species, but again due to recent fire events it is likely that this species distribution will be restricted to the eastern section of the block in 28-year-old mallee-heath. The Yellow-tailed Black-Cockatoo and the Australian Bustard are both foraging visitors to the area; the Australian Bustard is often seen scavenging burnt reptiles and insects following fire. One species of threatened plant, the climbing Eastern Apple-berry (*Billardiera scandens*) has been recorded in the block. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

Pocock's Mill, University of Adelaide Research Hut (Paton's Hut).

Fire Access Refer to Map 4.

The block is best accessed from the Bordertown–Pinnaroo Road and the Piggery Track to the south and east, the Lameroo South and Duckhole Roads from the north and from the Baan Hill Track to the west. There are few internal service tracks and the block is bounded by standard fire tracks to the west (Baan Hill Track) and south (Day-Ngarkat Block Boundary Track). The northern reserve boundary has a 20 metre wide firebreak.

Fire Risk

Fire risk in Day Block is variable given the diversity of post-fire ages. Key risks involve the potential movement of bushfire into private land into the north of the block and into Scorpion Springs or Pertendi Blocks to the north and east.

Fire Water

Water is located at Pocock's Mill, Pertendi Hut and Rohrlach's property near Baan Hill Reserve. Adjacent private properties will have supplies subject to negotiation with the landowner.

Specific Management Objectives for Day Block

1. To prevent fire from escaping any component of the block into adjacent private lands.
2. To minimise the risk of any component of the block being burnt out in a single fire event.
3. To contain all east heading bushfires at the Bordertown-Pinnaroo Road.
4. To protect the remaining unburnt areas of the block from bushfire, promote patchiness in bushfires and manage fire regimes to benefit the communities present.
5. To monitor the effects of prescribed burning on the ecological assets within the block with respect to potential displacement of threatened species.

Recommended Works

Pre-Suppression

- The Piggery Track and the Baan Hill Track are to be maintained at a width of seven metres.
- The northern boundary of the block, including the unalienated Crown land adjoining the reserve's northern boundary are to be maintained to a width of 20 metres. Discussions should be held with adjacent Heritage Agreement owners regarding the feasibility (where possible) of extending this firebreak along the boundary of abutting Heritage Agreements.
- An A-zone is to be maintained to a width of 40 metres around the windmill, tanks and standpipe at Pocock's Mill and at Paton's Hut.
- A B-zone approximately 500 metres wide is to be maintained to the west of the Bordertown-Pinnaroo Road. The alternate side (Pertendi Block) will also be maintained to a width of 500 metres- treated alternately as fuel levels require.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed. Areas adjacent to the Baan Hill Track, the Piggery Track and Heritage Agreements on the northern boundary of Ngarkat CP should be given priority for these works.
- Habitat protection burns (as outlined in Section 8.5) may be implemented to protect identified habitat areas for threatened species. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Day Block. Given the lack of internal access, undulating terrain and the fuel types present, fires have the potential to grow very quickly. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to act on any threats to properties adjacent to Day Block before focusing on:

- Protecting known populations of significant or threatened species in the unburnt areas in the north of the block. Impacts associated with back-burning and heavy machinery are to be minimised in these areas.

- Halting the easterly progress of any bushfire at the Bordertown–Pinnaroo Road.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and back burning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH staff or local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

SCORPION SPRINGS BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage; Heritage Agreements: Section 4 of the Hundred of Quirke.

Size 32 914 ha (31 890 ha Ngarkat CP, 1 024 ha Heritage Agreements)

Vegetation

MVS No. 8, 29, 30 and 32.

The majority of vegetation in the north of the block is dominated by old stands of varying mallee (MVS No. 29) and Mallee Cypress-pine (MVS No. 32). The south of the block supports similar communities however the 1999 bushfire has altered community structure and composition.

Fire History

Dates: 1945, 1958, 1966, 1976, 1978, 1988, 1989, 27/01/1999, 19/03/2001 and 17/12/2002.

Scorpion Springs Block has experienced 10 fires since records have been kept. In total 49 767 hectares (average fire area of 4 976 hectares) have been burnt in the block since 1945. The block has the largest unburnt remnant in Ngarkat CP, with nearly 9 000 hectares having fire history, although anecdotal records indicate a large event in 1929 that may have burnt some of these areas. These long unburnt patches are characterised by an open vegetation community dominated by very large Mallee Cypress-pine. Scorpion Springs Block is the only area of Ngarkat CP that supports this community.

Natural Values

The block historically supported four species of listed flora and five species of listed fauna. There are historical records of Chestnut Quail-thrush (*Cinclosoma castanotus*), Red-lored Whistler, Striated Grasswren, Striped Honeyeater (*Plectorhyncha lanceolata*) and Malleefowl within the block. The present status of these species is unknown, however it is unlikely that the majority of the south of the block is suitable habitat given the 1999 bushfire. Scaly Haeckeria (*Haeckeria pholidota*), Narrow-leaf Wax-flower (*Eriostemon angustifolius ssp. angustifolius*), Lowan Phebalium and Fringed Heath-myrtle (*Micromyrtus ciliata*) are all found within Scorpion Springs Block. The nationally listed Lowan Phebalium is a priority for management. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

Pine Hut Soak. There are a number of adjacent homesteads to the west and north of the block, including Alcheringa (which supports a CFS approved airstrip used during bushfire), Pine Springs, Yappara Downs and Mallee View.

Fire Access Refer to Map 4

Scorpion Springs Block is best accessed from the west via the Bordertown-Pinnaroo Road. Access from the north is via Rosey Pine Road that extends into the reserve as the Centre Track (maintained a standard fire access track). The Border Track is maintained as a standard fire access track south of the Pertendi Hut turnoff and a service track north of the Pertendi Hut turnoff. This northern section is closed to public traffic during the fire danger season, at all other times only one way access from the north is available.

Fire Water

Water is available at Comet Bore and Pertendi Hut in Pertendi Block. Adjacent private properties will have supplies subject to negotiation with the landowner. Alcheringa has water available for batching aircraft.

Fire Risk

The risk of fire either starting or moving into Scorpion Springs Block is high in the north of the block where fuel levels are high. As such, there is a risk that fire can escape the block to either the north or east under prevailing wind conditions. Risk to life and property in these areas is low given the paucity of built assets- Pine Hut Soak is the only built asset on the block and that is situated in an area of low fuel.

Specific Management Objectives for Scorpion Springs Block

1. To minimise the risk of the block being burnt out in a single fire event.
2. To contain bushfire within the block boundaries and protect adjacent assets.
3. To prevent bushfires entering the block from the west on a large front.
4. To manage the risk of bushfire entering the adjacent Big Desert Wilderness Area.
5. To maintain and if possible expand existing populations of the Lowan Phebalium within the block through managing suitable fire regimes.
6. To promote patchiness in bushfires and manage fire regimes to benefit other listed significant species and communities within the block.
7. To protect identified stands of old-growth Mallee Cypress-pine and provide a diversity of different ages in recovering stands to ensure the species persistence within the block.

Recommended Works

Pre-Suppression

- The Centre Track is to be maintained as a standard fire access track (rolled to a width of seven metres).
- Reserve boundary firebreaks are maintained to a width of 20 metres.
- Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (minor fire access track) to ensure adequate access for appliances during incidents.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C-zones) for detail on the process to be followed. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the block's northern boundary, extending south to the Pertendi Block boundary as fuel levels in the 1999 fire scar build to levels that will again carry a fire. Similarly, areas on the western boundary of the block adjacent to Heritage Agreement scrub will increase in fire risk as fuel levels build.
- Ecological burning is permitted (as outlined in Section 8.5) to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Scorpion Springs Block. Incident managers are to notify the Victorian Government Department of Sustainability and Environment (DSE) and Victorian Country Fire Authority (CFA) of any fire within the block and

provide information on the likelihood of the fire moving into the Big Desert Wilderness. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures. Firefighters should note that the section of the Border Track to the Pertendi Hut turnoff is one way from the north and closed to public access during the fire danger season.

Note: Pine Hut Soak, Cox's windmill, the Pines and The Gums campsites should be checked for visitors at the earliest possible point in an incident.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and backburning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH staff or local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

PERTENDI BLOCK

Tenure, Land Use

Ngarkat CP, Department for Environment and Heritage.

Size 29 264 ha

Vegetation

MVS No. 8, 29, 30 and 32.

Vegetation is dominated by young (1999) stands of Mallee-heath (MVS No. 29) intermittent with areas of Banksia heath (MVS No. 30) and dense stands of Mallee cypress-pine (MVS No. 32). Common species of mallee canopy through out the block include Ridge-fruited Mallee and Narrow-leaved Mallee.

Fire History

Dates: 1954, 1958, 1976, 1978, 1986, 1991, 31/12/1998, 27/01/1999, 6/11/2000 and 17/12/2002.

Pertendi Block has experienced 10 fires since records have been kept. In total 49 838 hectares (average fire area of 4 983 hectares) have been burnt in the block since 1945 and 2 693 hectares have no reported fire history. The 1999 fire burnt 14 569 hectares or 50% of the block, whilst 40% of the block was burnt in 1978 and 70% in 1958. Such large areas burning in single events are symptomatic of fires building rapidly to very large sizes in the adjacent Ngarkat Block before crossing the Bordertown-Pinnaroo Road on large fronts.

Natural Values

The block historically supported two species of listed flora and two species of listed fauna. There are historical records of Mallee Emu-wren and Malleefowl within the block. The present status of these species is unknown, however it is unlikely that the majority of the area is suitable habitat given the 1999 bushfire. Lowan Phebalium and Fringed Heath-myrtle are both found within Pertendi Block. The nationally listed Lowan Phebalium is a priority for management. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

Kirra Station (adjacent). Pertendi Hut and Comet Bore campgrounds and tanks (on-reserve).

Fire Access Refer to Map 4

Pertendi Block is best accessed via the Bordertown-Pinnaroo Road. The Centre Track bounds the block to the east and is maintained as a standard fire access track. The Border Track is maintained as a standard fire access track and is closed to public traffic during the summer.

Fire Water

Water is available at Bunn's Bore, Kirra Station, Comet Bore and Pertendi Hut. Adjacent private properties will have supplies subject to negotiation with the landowner.

Fire Risk

The risk of fire either starting or moving into Pertendi will increase during the next five years as fuel levels recover from the 1999 fire (in Ngarkat CP). Large areas in the north (pre 1929) and south-east of the block are covered in old fuels; as such mitigating the risk to Kirra Station (a pastoral lease to the south of the block surrounded by DEH land) is a priority.

Specific Management Objectives for Pertendi Block

1. To minimise the risk of the block being burnt in a single fire event.
2. To contain bushfire within the block boundaries and protect adjacent assets.
3. To protect Kirra Station, Pertendi Hut and Comet Bore from bushfires.
4. To prevent bushfires entering the block from the west on a large front.
5. To manage the risk of bushfire entering the adjacent Big Desert Wilderness Area.
6. To maintain and if possible expand existing populations of the Lowan Phebalium within the block through managing suitable fire regimes.
7. To promote patchiness in bushfires and manage fire regimes to benefit other listed significant species and communities within the block.

Recommended Works

Pre-Suppression

- The Centre and Border Tracks are to be maintained as a standard fire access track.
- Reserve boundary firebreaks are maintained to a width of 20 metres.
- A 40 metre A-zone is designated around the firewater tanks and toilet facilities at Pertendi Hut and Comet Bore Campgrounds.
- A B-zone is designated on the northern boundary of Kirra Station. The zone will be a strip approximately 500 metres wide.
- A B-zone is designated either side of the Bordertown-Pinnaroo Road from the northern boundary of the block through to the southern boundary with Mount Shaugh Block. The zone will be a strip approximately 500 metres wide burnt on alternate sides of the road.
- Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C-zones) for detail on the process to be followed. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the northern Kirra Station boundary, extending north as fuel levels in the 1999 fire scar build to levels that will again carry a fire.
- Ecological burning to manage populations of Lowan Phebalium (in accordance with recommendations in both the Regional and National Recovery Plan for the species).

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Pertendi. Incident managers are to notify DSE and CFA of any fire within the block and provide information on the likelihood of the fire moving into the Big Desert Wilderness. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should focus on threats to Kirra Station, Pertendi Hut and Comet Bore Campgrounds. Firefighters should note that the section of the Border Track to the Pertendi Hut turnoff is one way from the north and closed to public access during the fire danger season. **Comet Bore and Pertendi Hut campsites should be checked for visitors at the earliest possible point in an incident.**

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and backburning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH staff or local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

MOUNT SHAUGH BLOCK

Tenure, Land Use

Ngarkat CP and Hardings Springs CR, Department for Environment and Heritage; Heritage Agreements: Section 3, 8, 12, 13 and Allotment 22 of the Hundred of Shaugh.

Size 21 326 ha (14830 ha Ngarkat CP and Hardings Springs CR, 6 496 ha Heritage Agreements)

Vegetation

MVS No. 29 and 30.

Vegetation is dominated by older stands of Mallee-heath (MVS No. 29) in the east of block, whilst younger stands are found in the west. Large areas of the Heritage Agreement: Section 3, Hundred of Shaugh supports Banksia heath (MVS No. 30).

Fire History

Dates: 1958, 1986, 1988, 1989, 1990, 1991, 1998, 27/01/1999, 6/12/1999, 10/01/2002 and 14/01/2002.

Mount Shaugh Block is currently less impacted by fire than other blocks in the plan area and only 11 fires have been recorded. In total 22 495 hectares (average fire area of 1 668 hectares) have been burnt in the block since 1945 and 4 195 hectares have no fire history recorded.

Natural Values

Mount Shaugh Block historically supported six species of listed flora and four species of listed fauna. There are historical records of Chestnut Quail-thrush, Mallee Emu-wren, Red-lored Whistler and Slender-billed Thornbill within the block. The present status of Red-lored Whistler and Mallee Emu-wren in the block is unknown, however it is unlikely that the majority of the area is suitable habitat. Cleland's Beard-heath, Pink Zieria, Eastern Apple-berry, Wilson's Honey-myrtle, Lowan Phebalium and Fringed Heath-myrtle. Of these species the Nationally listed Lowan Phebalium, is a priority for management. Refer to Appendix 1, 2a and 2b for fire management guidelines for these species.

Built Assets

Kirra Station, Comet Bore Campground and tanks.

Fire Access Refer to Map 4.

Mount Shaugh Block is best accessed via the Bordertown-Pinnaroo Road (including Hardings Springs CR). The reserve boundary and Kirra Station are bounded by a 20 metre wide firebreak, and the Kirra Access Road is maintained as a major fire access track to a width of seven metres. The Border Track is maintained as a standard fire access track and is closed to public traffic during the summer.

Fire Water

Water is available at Bunn's Bore, Kirra Station, Comet Bore and Pertendi Hut. Adjacent private properties will have supplies subject to negotiation with the landowner.

Fire Risk

The risk of fire either starting or moving into Mount Shaugh Block will increase during the next five years as fuel levels recover from the 1999 fire (in Ngarkat CP) and 2002 (Section 3,

Allotment 22, Hundred of Shaugh). Large areas in the eastern section of the block support old (1954) fuels and as such will support an intense fire; as such mitigating the risk to Kirra Station (a pastoral lease in the north of the block surrounded by conservation land) is a priority. Fire risk to Hardings Springs CR is considered minimal.

Specific Management Objectives for Mount Shaugh Block

1. To contain bushfire within the block boundaries and protect adjacent assets.
2. To protect Kirra Station from bushfire.
3. To prevent any component (DEH reserve or otherwise) of the block being burnt out completely in a single bushfire.
4. To manage the risk of bushfire entering the adjacent Big Desert Wilderness Area.
5. To reduce the risk of fire leaving public land and entering adjacent Heritage Agreement components of the block.
6. To maintain and if possible expand existing populations of the Lowan Phebalium within the block through managing suitable fire regimes.
7. To promote patchiness in bushfires and manage fire regimes to benefit other listed significant species and communities within the block.

Recommended Works

Pre-Suppression

- The Kirra Access Road is to be maintained to a major track standard (Tatiara District Council are responsible for the maintenance of this road).
- The southern boundary of the block/reserve is to be maintained to a width of 20 metres.
- Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (minor fire access track) to ensure adequate access for appliances during incidents.
- An emergency airstrip should be constructed in Kirra Station (subject to the landowner's approval) for use in aerial observation, suppression, or ignition operations during bushfires or prescribed burning. This resource would also be available for DSE aircraft in the event of a bushfire approaching or entering the adjacent Big Desert Wilderness.
- Two 6 000 gallon poly tanks should be installed at the junction of the Kirra north boundary and the Centre Track for suppression purposes.
- A B-zone is designated on the western, northern and southern boundaries of Kirra station. The zone will be a linear strip approximately 500 metres wide burnt when fuel levels within this zone reach high.
- A B-zone is designated either side of the Bordertown-Pinnaroo road from the northern boundary of the block through to the southern boundary of the Heritage Agreement: Section's 8 and 12 of the Hundred of Shaugh. The zone will be a linear strip approximately 500 metres wide burnt on alternate sides of the road when fuel levels within this zone reach high.
- Bounded landscape protection burns may be implemented adjacent access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Refer to Section 8.5 (C zones) for detail on the process to be followed. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the Northern Kirra Station boundary, extending north as fuel levels in the 1999 fire scar build to levels that will again carry a fire. Similarly, areas on the southern boundary of the reserve adjacent to Heritage Agreement scrub will increase in fire risk as fuel levels build.

- Ecological burning is permitted (as outlined in Section 8.5) to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.

Suppression

Quick response with small units (14's) and suitable heavy machinery (A-frame, cross-ribbed roller) to any incident is essential to restrict the size of fires within Mount Shaugh Block. Incident managers are to notify DSE and CFA of any fire within the block and provide information on the likelihood of the fire moving into the Big Desert Wilderness or adjacent farmland. Police should be notified of any threat to public traffic on the Bordertown–Pinnaroo Road as soon as possible to facilitate patrols and road closures.

Suppression efforts should seek to act first on threats to adjacent private property, Kirra Station and Comet Bore Campground. Firefighters should note that the Border Track is open to the Pertendi Hut turnoff in both directions during the fire danger season.

Note: Comet Bore and Dogger's Hut Campgrounds should be checked for visitors at the earliest possible point in an incident.

All suppression activities should use areas of reduced fuels through either natural vegetation breaks or existing buffers. Heavy machinery usage and backburning may still be employed at the discretion of the Incident Controller, but may only be permitted after consultation with DEH. Knowledge regarding service track standards should be sought from DEH staff or local landholders where relevant. Guidelines for heavy machinery usage, aerial suppression and backburning are discussed in Section 7.

10 RESEARCH AND MONITORING

Monitoring and assessing the response of species and communities to fire and fire regimes forms a critical component of this plan. Regardless of tenure or the management activity prescribed, pre- and post-fire monitoring is critical to ensure information is gathered on the impacts (positive and negative) of management actions. Monitoring is a mandatory requirement for any management action involving prescribed fire as burning is a form of vegetation clearance under the *Native Vegetation Act 1991*. Similarly, there is a requirement under the EPBC Act to improve understanding of any identified threatening process for listed flora or fauna. The desired outcome of the program is the protection and enhancement of biodiversity within the plan area, through the provision of an adaptive management framework that guides future fire management.

With respect to baseline data, Ngarkat CP is well resourced given the research projects and the existing monitoring program of Dr. David Paton through the University of Adelaide. These projects have provided data on the following:

- Patterns of post-fire recovery for flora and fauna.
- Status of and trends in population dynamics for a range of species relative to seasonal variability.
- Combined effects of fire regime and climate on basic ecosystem function.
- Threatened species population distributions and status.
- Temporal change in climatic conditions and fire history.

Additionally, extensive information on the response of mallee-heath ecosystems to fire has been ongoing in one form or another within the area since the 1950's. The research of Ray Specht and others has provided a useful knowledge base on a range of aspects of heathland ecology (Gillam, 2004a; b; Pelton and Conran, 2002; Specht, 1979; 1981). Much of this information can be extrapolated for use in fire management actions within the plan area. Many of these sites are in areas that have been frequently burnt, and as such will be useful for measuring changes brought about by fire. There is further potential to utilise the data gathered from this program in conjunction with the Digital Elevation Model developed for Ngarkat CP to develop an ecosystem model for the reserve.

10.1 Research

The baseline data developed from the University of Adelaide's long-term monitoring and research program and other previous research can be further augmented by the continued development of the following projects:

A > Develop a comprehensive mallee-heath fire behaviour model for use in bushfire suppression and prescribed burning.

In a bid to close knowledge gaps with respect to fire behaviour in various types of mallee-heath within Ngarkat CP, DEH has commenced a research project in conjunction with Ensis (CSIRO Canberra) through the Bushfire CRC. The project, entitled: **FuSE** (**F**ire **E**xperiments in **S**crub, with attention to wind '**u**'), will improve understanding of the relationship between fire behaviour and fuel type, load, arrangement and weather conditions. This information will

then be used to formulate a "Mallee Fire Danger Index" that can be used as a tool to aid Incident Management decisions, assess fire related risk and better define burning prescriptions (for prescribed burning and backburning operations) in these vegetation communities.

B > Create a database for plant and animal species response mechanisms to fire for the Ngarkat area.

Detail on species response to fire in Ngarkat CP is not well understood. Measures of pre and post fire species richness and diversity, as well as response mechanisms of individual species are essential baseline information. Within this, the impacts of burning out-of-season (i.e. in the cooler months) on response require assessment to provide informed adaptive management. Detail on threatened flora response should be sought through targeted research projects.

10.2 Monitoring

Monitoring in zones will be ongoing, with measurements made both pre-fire and immediately post-fire, and at intervals following such that the responses of biodiversity to fire can be identified. Opportunistic plots may be established in recently burnt zones if they are deemed to contribute further to the information being collected through the program.

A > What are the impacts of prescribed burning?

Not all fire management blocks within the plan area contain survey plots, and not all of the questions listed above are relevant to all land managers or indeed can be addressed given the resources available. Implementation budgets will include provision for an annual monitoring component (either through DEH for public land or through the Native Vegetation Fund for Heritage Agreements), with the outcomes of the monitoring program to be fed into the review process.

As well as the biota focussed monitoring protocol, DEH will also monitor the effectiveness of prescribed works in achieving objectives (e.g. the effectiveness of prescribed burns in halting bushfires, protecting assets (built and environmental) and improving suppression likelihood and firefighter safety). Information required will include the weather conditions experienced when bushfires burn into B-zones, the vegetation type/fuel levels in the area burnt, the age of community burnt and the nature of any breaches across fuel modified areas.

Pre and post fire monitoring of colonies or sub-populations of target species such as the Mallee Emu-wren, Malleefowl and Western Whipbird is critical to measuring the sustainability of prescribed burning practices in Ngarkat CP. Responsibility for the management and implementation of the threatened mallee bird aspects of the program is with the Murraylands Conservation Programs Unit, in consultation with the Regional Fire Management Officer and the Mallee District Ranger.

Recommendation

Monitoring

14. It is recommended that DEH continue to support the existing University of Adelaide monitoring program

11 RECOMMENDATIONS

Implementation of the recommendations and works listed in this plan is subject to available resources as well as regional and state-wide priorities. A schedule of works, including proposed prescribed burns, will be developed annually to meet the recommendations listed in this plan. This schedule will be available from the Regional Fire Management Officer.

Prescribed burning within Heritage Agreements is not included in this schedule (except where there is continuity with public land). Prescribed burning in Heritage Agreements is to be planned by the individual landholder in consultation with the relevant Bush Management Advisor. Individual burn plans will be developed prior to any prescribed burning as detailed in Section 8.5.

11.1 Summary of Recommendations

Heritage Agreements

1. To assist in the implementation of prescribed burning and other pre-suppression works within Heritage Agreements it is recommended that funding be sought through the SAMDB and South East NRM Boards to assist in fire management on private land. These funds should be managed through the Conservation Programs Unit (Murraylands Region).

Fire Emergency Procedures and Response Planning

2. Maintain and expand as necessary the Ngarkat Fire Operations Group to:
   - review and endorse the DEH annual works program as developed considering the objectives of this plan
   - contribute to the review of this plan after 10 yeas of implementation
   - identify operational issues and corrective actions specific to the Ngarkat District
   - identify knowledge and resource deficiencies specific to fire management and make recommendations on how these deficiencies might be addressed
   - report to CFS Regional Operations Planning Officers and Centre for Lessons Learnt of relevant recommendations and outcomes of actions
   - review and implement any recommendations or an action arising out of agency or interagency debriefs.

Aerial Observation

3. It is strongly recommended that Incident Management Teams request aerial observation as early as possible in the incident. An aerial platform should be deployed when smoke is first sighted or in the event of an electrical storm passing through the area during the months September through to March.

Aerial Suppression

4. It is recommended that a CFS approved airstrip be constructed and maintained at Kirra Station for fire emergencies to provide improved aerial suppression capabilities in Mount Shaugh, Ngarkat, Pertendi and McCallum Blocks as well as in western Victoria.

Fire Access Tracks

5. Implement signage across the planning area on public lands and adjacent heritage agreements.
6. Encourage adjacent landowners to adopt that the GAFLC (2005) guidelines.
7. Encourage owners of Heritage Agreements abutting Ngarkat CP to implement and maintain a 20 metre perimeter firebreak on their land.
8. Encourage owners of Heritage Agreements abutting Carcuma CP to implement and maintain a Major Track (seven metre width) on their land.
9. Include areas of unalienated Crown land adjacent to the existing boundary of Ngarkat CP within the rolling firebreak program. These areas shall be rolled to a width of 20 metres until they are gazetted as part of the Conservation Park.

Fire Water

10. All tanks (Pertendi Hut, Comet Bore and Pocock's Mill) within Ngarkat CP must be at carrying capacity at the start of each fire season.
11. Tanks at Pertendi Hut, Comet Bore and Pocock's Mill within Ngarkat CP are protected by Asset Protection zones (A-zones). All tank sites are to have minor access tracks to allow for safe access and egress.
12. Water sources adjacent the planning area are identified, the landholder is consulted and arrangement negotiated for access to the water. This can also involve the provision of tanks and fittings on private property if there is a strategic benefit in having water at that location. Funding for such works will be negotiated between members of the Ngarkat Operations Group and the landholder concerned.

Managing Visitors

13. Interpretive signage, describing evacuation procedures and the aims and strategies of the Ngarkat District Fire Management Plan, should be implemented at relevant Visitor Centres and the DEH Regional and District Offices for each of the Reserves concerned.

Monitoring

14. It is recommended that DEH continue to support the existing University of Adelaide monitoring program

11.2 Table of Recommended Works for Fire Management Blocks

TABLE 4: RECOMMENDED WORKS TO BE UNDERTAKEN WITHIN FIRE MANAGEMENT BLOCKS

	Recommendation
Carcuma Block	Develop & maintain a Major Track on the Carcuma CP boundary to a width of seven metres.
	Recommend that all other Heritage Agreement components have Minor Tracks (four metres) maintained on their perimeter.
	Implement bounded landscape protection burns if required, adjacent to tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
Ashby's Block	Maintain the Box Flat-Jimmy's Well Block Boundary Track to a width of seven metres.
	Recommend that all other Heritage Agreement components have Minor Tracks (four metres) maintained on their perimeter.
	The western and northern boundaries of the Ngarkat CP that are part of the block are to be maintained to a width of 20 metres using cross-ribbed rolling on a four-year cycle.
	Landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
	Habitat protection burns may be implemented to protect remnant vegetation or identified habitat areas for targeted threatened species
	Upgrade Unnamed Track (Eastern Boundary) to at least a Minor Fire Track.
Box Flat Block	Maintain the Box Flat-Jimmy's Well Block Boundary Track to a width of seven metres.
	The western and northern boundaries of Ngarkat CP that are part of the block are to be maintained to a width of 20 metres.
	Recommend that all other Heritage Agreement components have Minor Tracks (four metres) maintained on their perimeter.
	Landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
	Habitat protection burns may be implemented to protect remnant vegetation or identified habitat areas for targeted threatened species.
Jimmy's Well Block	The Box Flat-Jimmy's Well Track, the Mt. Rescue-Jimmy's Well and Jimmy's Well-Ashby's Block Boundary Tracks and the Baan Hill Track are to be maintained at a width of seven metres.
	The western boundary of the block/reserve is to be maintained to a width of 20 metres.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
	Habitat protection burns may be implemented to protect threatened species.

	Recommendation
Mount Rescue Block	The Gosse Hill, Bucks Camp, Mt Rescue-Jimmy's Well Block Boundary and the Baan Hill Tracks are to be maintained at a width of seven metres.
	The southern, eastern and western boundaries of the block/reserve are to be maintained to a width of 20 metres.
	The boundary of Section 11, Hundred of Archibald and Section 1, Hundred of Makin should be maintained as a firebreak to a width of 20 metres given their impending gazettal as part of Ngarkat CP.
	Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (Minor Track) to ensure adequate access for appliances during incidents.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
	Habitat protection burns may be implemented to protect identified habitat areas for the Mallee Emu-wren. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible. Priority should be given to breaking up Section 11, Hundred of Archibald to ensure it is not burnt in a single fire event.
McCallum Block	The McCallum-Ngarkat Block Boundary Track, Emu-wren Track, the Pines Track and the Baan Hill Track are to be maintained at a width of seven metres.
	The southern and eastern boundaries of the block/reserve are to be maintained to a width of 20 metres.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations.
	Habitat protection burns may be implemented to protect identified habitat areas for the Mallee Emu-wren. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.
Ngarkat Block	The Piggery Track and the Baan Hill Track are to be maintained at a width of seven metres.
	A B-zone approximately 500 metres wide is to be maintained to the west of the Bordertown-Pinnaroo Road. The alternate side (Pertendi and Mt Shaugh Blocks) will also be maintained to a width of 500 metres- treated alternately as fuel levels and minimum fire intervals permit.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. Areas adjacent to the Baan Hill Track, the Piggery Track should be given priority for these works.
	Unbounded landscape protection burns less than 2 500 hectares (5% of the block area) may be implemented using aerial ignition through the centre of the block to promote patchiness in fire regimes and aid in preventing bushfires growing rapidly in inaccessible areas of the block. These buffers are to be predominantly linear and run in a north-south direction on flat terrain.
	Habitat protection burns may be implemented to protect identified habitat areas for threatened species. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.
	Ecological burning is permitted to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.
Day Block	The Piggery Track and the Baan Hill Track are to be maintained at a width of seven metres.
	The northern boundary of the block, including the unalienated Crown land adjoining the reserve's northern boundary are to be maintained to a width of 20 metres. Discussions should be held with adjacent Heritage Agreement owners regarding the feasibility (where possible) of extending this firebreak along the boundary of abutting Heritage Agreements.

	Recommendation
	An A-zone is to be maintained to a width of 40 metres around the windmill, tanks and standpipe at Pocock's Mill and at Paton's Hut.
	A B-zone approximately 500 metres wide is to be maintained to the west of the Bordertown-Pinnaroo Road. The alternate side (Pertendi Block) will also be maintained to a width of 500 metres- treated alternately as fuel levels and minimum fire intervals permit.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations Areas adjacent to the Baan Hill Track, the Piggery Track and Heritage Agreements on the northern boundary of Ngarkat CP should be given priority for these works.
	Habitat protection burns may be implemented to protect identified habitat areas for threatened species. These burns shall be restricted to sand plain areas, avoiding dunes wherever possible.
Scorpion Springs Block	The Centre and Border Tracks are to be maintained as a standard fire access track (rolled to a width of seven metres).
	Reserve boundary firebreaks are maintained to a width of 20 metres.
	Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (minor fire access track) to ensure adequate access for appliances during incidents.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the block's northern boundary, extending south to the Pertendi Block boundary as fuel levels in the 1999 fire scar build to levels that will again carry a fire. Similarly, areas on the western boundary of the block adjacent to Heritage Agreement scrub will increase in fire risk as fuel levels build.
	Ecological burning is permitted to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.
Pertendi Block	The Centre and Border Tracks are to be maintained as a standard fire access track.
	Reserve boundary firebreaks are maintained to a width of 20 metres.
	A 40 metre A-zone is designated around the firewater tanks and toilet facilities at Pertendi Hut and Comet Bore Campgrounds.
	A B-zone is designated on the northern boundary of Kirra Station. The zone will be a strip approximately 500 metres wide.
	A B-zone is designated either side of the Bordertown-Pinnaroo Road from the northern boundary of the block through to the southern boundary with Mount Shaugh Block. The zone will be a strip approximately 500 metres wide burnt on alternate sides of the road.
	Bounded landscape protection burns may be implemented adjacent to access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the northern Kirra Station boundary, extending north as fuel levels in the 1999 fire scar build to levels that will again carry a fire.
	Ecological burning to manage populations of Lowan Phebalium (in accordance with recommendations in both the Regional and National Recovery Plan for the species).

Mount Shaugh Block	Recommendation
	The Kirra Access Road is to be maintained to a major track standard (Tatiara District Council are responsible for the maintenance of this road).
	The southern boundary of the block/reserve is to be maintained to a width of 20 metres.
	Perimeter tracks in participating Heritage Agreements should be maintained at a minimum width of four metres (minor fire access track) to ensure adequate access for appliances during incidents.
	An emergency airstrip should be constructed in Kirra Station (subject to the landowner's approval) for use in aerial observation, suppression, or ignition operations during bushfires or prescribed burning. This resource would also be available for DSE aircraft in the event of a bushfire approaching or entering the adjacent Big Desert Wilderness.
	Two 6 000 gallon poly tanks should be installed at the junction of the Kirra north boundary and the Centre Track for suppression purposes.
	A B-zone is designated on the western, northern and southern boundaries of Kirra station. The zone will be a linear strip approximately 500 metres wide burnt within the minimum threshold for the listed vegetation community, or at such a time that the fuel levels within this zone reach high.
	A B-zone is designated either side of the Bordertown-Pinnaroo road from the northern boundary of the block through to the southern boundary of the Heritage Agreement: Section's 8 and 12 of the Hundred of Shaugh. The zone will be a linear strip approximately 500 metres wide burnt on alternate sides of the road within the minimum threshold for the listed vegetation community, or at such a time that the fuel levels within this zone reach high.
	Bounded landscape protection burns may be implemented adjacent access tracks in areas where tracks have native vegetation on either side, or in areas that have known threatened or significant species populations. A priority for this strategy (under current fuel conditions and risks) is the Centre Track from the Northern Kirra Station boundary, extending north as fuel levels in the 1999 fire scar build to levels that will again carry a fire. Similarly, areas on the southern boundary of the reserve adjacent to Heritage Agreement scrub will increase in fire risk as fuel levels build.
	Ecological burning is permitted to manage existing populations of Lowan Phebalium in accordance with recommendations outlined in both the Regional and National Recovery Plan for the species.

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13 APPENDICES

Appendix 1: Fire Response of Rated and Significant Flora Species Recorded in the Plan Area

Species	Rating*		Life Form	Occurrence	Fire Response	Fire Management Guidelines	Source
	NPW Act	EPBC Act					
Annual Fern (*Anogramma leptophylla*)	R		Small fern				No data
Cleland's Beard-heath (*Leucopogon clelandii*)	R		Diffuse shrub to 0.3 m.	Widespread record distribution throughout the planning area.			KI/Vic/NSW-other
Eastern Apple-berry (*Billardiera scandens*)	R		Climbing plant to 3 m.		Resprout from the roots		NSW/Vic
Fringed Heath-myrtle (*Micromyrtus ciliata*)	R		Shrub 0.5 – 1 m.	In the east of the planning area, spreading into Big Desert Wilderness	Short-lived seed stored on plant	Fire Intervals > 5 years	NSW/Vic
Kangaroo Island Logania (*Logania insularis*)	V	VU	Small shrub to 0.3 m.	Two records in the southwest of the planning area in Mt. Rescue Block.	Short-lived seed stored on plant	Fire intervals >2 years	KI
Limestone Phebalium (*Leionema microphyllum*)	R		Small shrub to 0.7 m.	Found solely on limestone soils.			No data
Lowan Phebalium (*Phebalium lowanense*)	V	VU	Small shrub to 0.6 m.	Locally common in the east of Ngarkat CP in the 1999 fire scar.	Obligate seeders	Fire intervals between 10 & 30 years are required to maintain viable populations & seedbanks.	(Carter, 2005; Obst, 2005)
Mallee Bitter-pea (*Daviesia benthamii ssp. humilis*)	R		Slender shrub 0.3 – 2 m.				No data
Mallee Wattle (*Acacia montana*)	R		Large Shrub	One record only	Long-lived seed stored on plant & in soil	Require some moderate to high intensity fire	E

*Refer to Appendix 3 for conservation status code definitions

Species	Rating*		Life Form	Occurrence	Fire Response	Fire Management Guidelines	Source
	NPW Act	EPBC Act					
Narrow-leaf Wax-flower (*Eriostemon angustifolius ssp. angustifolius*)	R		Small shrub to 0.6 m.	Records predominantly on the western side of the planning area			No data
Pink Zieria (*Zieria veronicea*)	R		Small shrub to 0.6 m.		Short-lived seed stored on plant	Fire Intervals > 4 years	KI
Scaly Haeckeria (*Haeckeria philodota*)	V		Daisy	One record only		No available information	No data
Short Wallaby-grass (*Danthonia carphoides*)	R		Tufted perennial grass		Resprout from the roots		E
Splendid Bush-pea (*Pultenaea villifera*)	V	VU	Low shrub	One record near Gosse Hill in Mt. Rescue Block.			KI/NSW/Vic-other
Spreading Pennywort (*Hydrocotyle crassiuscula*)	R		Prostrate annual		Short-lived seed stored on plant	Fire Intervals > 2 years	KI
Whittaker's Drosera (*Drosera whittakeri ssp. aberrans*)	R		Prostrate, tuberous herb.	Records predominantly in the west of the planning area in Mt. Rescue & Ashby's Blocks.	Resprout from tubers	Fire intervals >3 years	Vic/KI
Wilson's Honey-myrtle (*Melaleuca wilsonii*)	R		Shrub to 1.5 m.				Vic/NSW-other

*Refer to Appendix 3 for conservation status code definitions

Appendix 2a: Fire Response of Rated and Significant Avifauna Species Recorded in the Plan Area

Species	Rating*		Preferred Habitat	Breeding	Extent	Dispersal & Home Range	Fire Response	Fire Management Guidelines	Source
	NPW Act	EPBC Act							
Mallee Emu-wren (*Stipiturus mallee*)	V	VU	*Triodia* and/or *Xanthorrhoea* Mallee or Heath	Pairs, mod. Productivity. Nesting in *Triodia*. Breed: Sept-Dec?	Core. Restricted range.	Max recorded 1.2 km within populations. Likely in order of 10 km? HR: c. 3ha	Recorded 4-42 yrs post-fire in *Triodia*. 44 years in *Xanthorrhoea*. Lost from 20-27 years post-fire *Triodia*.	Reduce the risk of extensive bushfires. Promote patchiness in bushfires in core habitat areas.	(Paton, 2000)
Malleefowl (*Leipoa ocellata*)	V	VU	Mallee & arid to semi-arid shrubland, *Callitris* woodland. Not extensive in Ngarkat CP.	Pairs, high productivity. Nesting in mound that requires high leaf litter. Mound construction: Autumn-Spring. Breed: Sept-Mar	Core of range.	Unknown but 10s of km. HR: 1-2 km^2	Fires likely to cause high mortality. First breeding post-fire 6-17 yrs, younger age rare. Found in vegetation burnt 26-80 yrs ago. Highest densities in sites burnt 60-80 years ago.	Reduce the risk of extensive bushfires. Maintain core areas of long unburnt mallee.	(Benshemesh, 2000; Woinarski, 1989)
Red-lored Whistler (*Pachycephala rufogularis*)	V	VU	Mallee with *Triodia* or dense but patchy understorey	Pairs, low productivity. Breed: in *Triodia*, Aug-Dec	Southern edge of range.	Potential long distance (rarely to 300 km) Low density.	Recorded 6 years post-fire.	Reduce the risk of extensive bushfires.	(Paton, 2000)
Western Whipbird (*Psophodes nigrogularis leucogaster*)	V	VU	Mallee with dense understorey, or heath	Pairs, low productivity. Nesting in dense understorey. Breed: July-Nov.	Southern edge. Restricted range.	Recorded at least 4.5km, likely greater. HR: 10-20 ha.	Preferred vegetation structure generally 10-30 years post-fire. Reduction of understorey density with long fire age may result in decline.	Reduce the risk of extensive bushfires.	(Woinarski, 1989)

*Refer to Appendix 3 for conservation status code definitions

Species	Rating*		Preferred Habitat	Breeding	Extent	Dispersal & Home Range	Fire Response	Fire Management Guidelines	Source
	NPW Act	EPBC Act							
Striated Grasswren (*Amytornis striatus*)	V		Generally *Triodia* with open shrubs and mallee overstorey. Can occur in dense shrub instead of *Triodia*. Limited habitat in Ngarkat CP.	Cooperative breeder. Mod. productivity. Nest frequently in *Triodia*. Breed: Oct-Mar, likely opportunistic with high rainfall events.	Southern edge of range. Isolated in park.	Unknown but likely >10km? HR: recorded 1-5 ha likely larger?	3-5 yrs post fire – Billiatt CP. 7-8 yrs post fire – Ngarkat CP.	Populations likely small, therefore need to locate and protect from catastrophic loss.	(DEH, 2005b)
Slender-billed Thornbill (*Acanthiza iredalei hedleyi*)	V		Heath	Pairs, but likely live in clans. Mod. productivity.	Core, restricted range.	Unknown. HR: unknown.	Highest densities in 1 to12 year old vegetation, with lower density in 22 year old. Site fidelity higher in mature heath. Post-fire colonisation time dependent on distance to unburnt vegetation.	Fine scale mosaic of fire ages. Promote localised patchiness in bushfires in core habitat areas.	(Ward and Paton, 2004)
Australian Bustard (*Ardeotis australis*)	V		NA	NA	Resident population in Ngarkat CP/Big Desert Wilderness.	NA	Opportunistic response to recent burns	NA	(DEH, 2005b)
Blue-winged Parrot (*Neophema chrystoma*)	V		NA	NA	Seasonal visitor?	NA	NA	NA	(DEH, 2005b)
Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*)	V		Desert Banksia heaths (MVS 30) provide an important food source in winter.	NA	Seasonal visitor.	NA	NA	NA	(DEH, 2005b)
Painted Button-quail (*Turnix varia*)	V		Unknown.			Unknown. HR: unknown		Reduce the risk of extensive bushfires.	(DEH, 2005b)

*Refer to Appendix 3 for conservation status code definitions

Species	Rating*		Preferred Habitat	Breeding	Extent	Dispersal & Home Range	Fire Response	Fire Management Guidelines	Source
	NPW Act	EPBC Act							
Chestnut Quail-thrush (*Cinclosoma castanotus*)	R		Mallee with *Triodia* or shrubs. Also likely riparian woodland.	Pairs, productivity unknown. Nests on ground.	Southern edge of range.	Unknown. HR: unknown	Found in vegetation burnt 4-40 yrs ago. Highest densities in sites burnt <10 yrs ago.	Reduce the risk of extensive bushfires. Promote localised patchiness in bushfires in core habitat areas.	(Woinarski, 1989)
Shy Heathwren (*Hylacola cauta cauta*)	R		Mallee with dense understorey. High leaf litter/debris.	Pairs. Mod. productivity. Frequently nests on ground in litter. Breed: July-Dec.	Southern edge of range.	Unknown. HR: unknown.	Post-fire recovery in Ngarkat rapid (1 to 2 years); recorded breeding in areas 3 or more years post-fire. Found in vegetation burnt 4 to 40 yrs ago. Highest densities in sites burnt <10 years ago.	Reduce the risk of extensive bushfires. Promote localised patchiness in bushfires in core habitat areas.	(Paton, 2000; Woinarski, 1989)
Shining Bronze-Cuckoo (*Chrysococcyx lucidus*)	R		Probably mallee, but also associates with habitat of hosts	Parasitic on Fairy-wrens, Mallee Emu-wrens.	Breeding migrant.	Continental movements. HR: unknown (likely large).	Likely driven by host response. Fire can increase parasitism by exposing nests.	Reduce the risk of extensive bushfires.	(Brooker and Rowley, 1991)

*Refer to Appendix 3 for conservation status code definitions

Appendix 2b: Fire Response of Rated and Significant Reptile and Mammal Species Recorded in the Plan Area.

Species	Rating*		Preferred Habitat	Breeding	Extent	Fire Response	Fire Management Guidelines	Source/ reliability
	NPW Act	EPBC Act						
Silky Mouse *(Pseudomys apodemoides)*	R		*B. ornata* heath	Do not breed in winter until *B. ornata* is producing moderate number of inflorescences; breeds in summer & winter in mature heaths in average or better seasons	Widespread through heathlands across Ngarkat CP.	Can recolonise in the first few years post-fire but disadvantaged for first 4 to 5 because cannot breed; proximity of mature heath to regenerating heath will influence rate of recolonisation	Provide a fine scale mosaic of different aged *B. ornata* heath. Reduce the risk of extensive bushfires.	D. Paton, unpublished data
Western Pygmy Possum *(Cercatetus concinnus)*			*B. ornata* heath; mallee over heath	Poorly known; breeding limited until *B. ornata* is productive (post-fire & climatic)	Widespread in above average conditions but restricted to small & more productive refugia in droughts.	Proximity of mature heath to regenerating heath, & condition of heath influence recovery post-fire	Provide a fine scale mosaic of different aged *B. ornata* heath. Reduce the risk of extensive bushfires and protect known refugia from bushfire during drought periods	D. Paton, unpublished data
Little Pygmy Possum *(Cercatetus lepidus)*			*B. ornata* heath; mallee over heath	Poorly known; breeding limited until *B. ornata* is productive (post-fire & climatic)	Widespread in above average conditions but restricted to small & more productive refugia in droughts	Proximity of mature heath to regenerating heath, & condition of heath influence recovery post-fire	Provide a fine scale mosaic of different aged *B. ornata* heath. Reduce the risk of extensive bushfires.	D. Paton, unpublished data
Common Dunnart *(Sminthopsis murina)*			Generalist within Ngarkat CP	Poorly known	Widespread in low numbers		Provide a fine scale mosaic of different aged habitat. Reduce the risk of extensive bushfires.	D. Paton, unpublished data
Fat-tailed Dunnart *(Sminthopsis crassicaudata)*			Generalist within Ngarkat	Poorly known	Widespread in low numbers	Occupies regenerating heath (i.e. open habitats) from approx. 2 to approx. 6 years post-fire, but not recorded on mature heaths	Presence of younger post-fire habitat will assist this species	D. Paton, unpublished data

*Refer to Appendix 3 for conservation status code definitions

Species	Rating*		Preferred Habitat	Breeding	Extent	Fire Response	Fire Management Guidelines	Source/ reliability
	NPW Act	EPBC Act						
Mallee Tree-Dragon *(Amphibolurus norrisi)*			Mallee, mallee-heath & Cypress Pine areas	Mate early spring, 3-8 eggs laid in Nov., young hatch after 80 days & take 12 months to mature	Widespread but uncommon	Not present until approx. 5 years post-fire; capture rates highest in mature heath (23 to 27 years old)	Protect remnant areas of Mallee Cypress Pine & mature mallee. Reduce the risk of extensive bushfires in mature remnants.	D. Paton, unpublished data
Mallee Dragon *(Ctenophorus fordi)*			Mallee & heath, dunes ridges & plains, usually with some *Triodia*	Males territorial & mating in spring, multiple clutches of 2 to 3 eggs up to 3 times in a season, eggs hatch after 50-70 days.	Widespread & common across region	Present on regenerating & mature heaths, although capture rates increasing as heath matures, peaking around 11 to15 years	Provide a fine scale mosaic of different aged *B. ornata* heath. Reduce the risk of extensive bushfires.	D. Paton, unpublished data
Painted Dragon *(Ctenophorus pictus)*			Mallee &/or heath	2 to 5 eggs laid in summer, may only breed once or twice in a lifetime	Widespread & common across region	Recolonises regenerating heath & capture rates decline after 8 years post-fire	Provide a fine scale mosaic of different aged recovering *B. ornata* heath. Reduce the risk of extensive bushfires.	D. Paton, unpublished data
Common Scaly-foot *(Pygopus lepidopodus)*			Heath and mallee with *Triodia*	Usually 2 eggs in Oct-Dec, with communal laying recorded, hatch after 70 days in captivity	Widespread, moderately common	Most abundant after 10 years post-fire	Provide a mosaic of mid-successional vegetation communities i.e. 10-30 years.	D. Paton, unpublished data
Sandhill Ctenotus *(Ctenotus brooksi)*			Mallee-heath with *Triodia*	Oviparous, 1-3 eggs laid in summer	Widespread, moderately common	Recolonises within 4 years & capture rates decline after ~23 years post-fire	Provide a mosaic of mid-successional vegetation communities i.e. 10-30 years.	D. Paton, unpublished data
Eastern Spotted Skink *(Ctenotus orientalis)*			Heathland	Oviparous, eggs laid in late spring	Widespread, moderately common	Recolonises within 4 years & remains present at stable abundances to at least 27 years post-fire	Provide a mosaic of mid-successional vegetation communities i.e. 10-30 years.	D. Paton, unpublished data
Eastern Striped Skink *(Ctenotus robustus)*			All habitats occupied	Oviparous, 3-7 eggs laid in late spring, young emerge late Jan to early Feb, sexual maturity within 12 months	Widespread & common	Present in low numbers < 8 years post-fire, more abundant in mature heath (> 23 years)	Provide a mosaic of mid-successional vegetation communities i.e. 10-30 years.	D. Paton, unpublished data

*Refer to Appendix 3 for conservation status code definitions

Species	Rating*		Preferred Habitat	Breeding	Extent	Fire Response	Fire Management Guidelines	Source/ reliability
	NPW Act	EPBC Act						
Mallee Snake-eye *(Morethia obscura)*			Mallee-heath & heath	Oviparous, 1-5 eggs laid in late spring or early summer	Widespread & common	Present in low numbers < 8 years post-fire before peaking at 11 to15 years before declining to previous levels	Provide a mosaic of mid-successional vegetation communities i.e. 10-30 years.	D. Paton, unpublished data
Marbled Gecko *(Christinis marmoratus)*			All habitats occupied	Recorded as laying 2 eggs, known to use a communal nest site with up to 20 eggs	Widespread but uncommon	Only present on mature heath (> 23 years)	Protect existing mature vegetation. Reduce the risk of large bushfires.	D. Paton, unpublished data
Bougainville's Skink *(Lerista bougainvillii)*			All habitats occupied	Oviparous	Widespread & common	No preference indicated; present in low numbers on regenerating & mature heaths		D. Paton, unpublished data
Grey's Skink *(Menetia greyii)*			All habitats occupied	Oviparous	Widespread & common	Rarely recorded until 11 years post-fire	Provide a mosaic of mature vegetation communities i.e. 10-30 years. Reduce the risk of extensive bushfires in older habitat.	D. Paton, unpublished data
Master's Snake *(Drysdalai mastersii)*			Mallee & heath with *Triodia*	Viviparous with 2 or 3 live young recorded	Widespread? Uncommon	Only recorded on mature heath	Provide a mosaic of mature vegetation communities i.e. 10-30 years. Reduce the risk of extensive bushfires in older habitat.	D. Paton, unpublished data
Mallee Black-headed Snake *(Parasuta spectabilis)*			Mallee-heath with *Triodia*	Viviparous, producing 2-5 live young in late summer	Unknown	Only recorded on >11 year old heath	Provide a mosaic of mature vegetation communities i.e. 10-30 years. Reduce the risk of extensive bushfires in older habitat.	D. Paton, unpublished data

*Refer to Appendix 3 for conservation status code definitions

Appendix 3: EPBC Act and South Australian Conservation Status Codes

SOUTH AUSTRALIAN (SA) CONSERVATION STATUS CODES

E **Endangered:** rare and in danger of becoming extinct in the wild.

V **Vulnerable:** rare and at risk from potential threats or long-term threats which could cause the species to become endangered in the future.

R **Rare:** has a low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.

The list of Endangered, Threatened and Vulnerable flora and fauna species is updated at regular intervals in Schedules 7, 8 and 9 under the *National Parks and Wildlife Act 1972*. To view the most recently gazetted version go to:

Endangered http://www.austlii.edu.au/au/legis/sa/consol_act/npawa1972247/sch7.html

Threatened http://www.austlii.edu.au/au/legis/sa/consol_act/npawa1972247/sch8.html

Vulnerable http://www.austlii.edu.au/au/legis/sa/consol_act/npawa1972247/sch9.html

EPBC ACT CONSERVATION STATUS CODES

The IUCN (1994) devised the following red list categories, with species categorised based on a series of five criteria:

- **Critically Endangered (CR):** A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria A to E.
- **Endangered (EN):** A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria A to E.
- **Vulnerable (VU):** A taxon is Vulnerable when it is neither Critically Endangered nor Endangered, but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria A to E.

14 GLOSSARY OF ACRONYMS AND FIRE MANAGEMENT TERMINOLOGY

Term	Definition
14	A 4WD firefighting appliance, with a capacity of up to 1000 litres of water, fitted with a pump and hose.
24	A 4WD firefighting appliance, with a capacity of up to 2000 litres of water, fitted with a pump and hose.
34	A 4WD firefighting appliance, with a capacity of up to 3000 litres of water, fitted with a pump and hose.
A-frame	Implement (two steel girders welded at the apex) towed behind a tractor used for creating mineral earth breaks.
Backburn(ing)	A fire started intentionally along the inner edge of a control line to consume the fuel in the path of a bushfire.
Bushfire	An unplanned fire. A generic term that includes grass fires, forest fires and scrub fires.
CFS	The South Australian Country Fire Service.
Coarse fuels	Dead woody material, greater than 25mm in diameter, in contact with the soil surface (fallen trees and branches).
Control line	A natural or constructed barrier, or treated fire edge, used in fire suppression and prescribed burning to limit the spread of fire.
Cross-ribbed roller	Adjustable roller towed behind a bulldozer, used for firebreak construction and bushfire response.
DEH	The South Australian Department for Environment & Heritage.
Direct attack	A method of bushfire attack where wet or dry firefighting techniques are used. It involves suppression action right on the fire edge, which becomes the control line.
Discontinuous fuels	Significant gaps between clumps or patches of fuel (DEH, 2006c).
DPBC	District Bushfire Prevention Committee.
DWLBC	The South Australian Department of Water, Land and Biodiversity Conservation.
EAT	DEH Environmental Assessment Table. Completed for all prescribed burns (as part of the Prescribed Burn Plan) and other fire management works where native vegetation is being cleared and is not exempt under the Native Vegetation Act 1991 (DEH, 2004a).
EPBC Act	The commonwealth Environment Protection and Biodiversity Conservation Act 1999.
Extreme fire behaviour	A level of bushfire behaviour characteristics that ordinarily precludes methods of direct suppression action. One or more of the following is usually involved: high rates of spread; prolific crowning and/or spotting; presence of fire whirls and/or a strong convective column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

Term	Definition
Extreme fire danger	The highest fire danger classification.
Fine fuels	Grass, leaves, bark and twigs less than 6mm in diameter.
Fire access track	A track constructed and maintained expressly for fire management purposes.
Fire behaviour	The manner in which a fire reacts to the variables of fuel, weather and topography.
Firebreak	An area or strip of land where vegetation has been removed or modified to reduce the risk of fires starting and reduce the intensity and rate of spread of fires that may occur (GAFLC, 2005).
Fire danger	The combination of all factors, which determine whether fires start, spread and do damage, and whether and to what extent they can be controlled.
Fire effects	The physical, biological and ecological impact of fire on the environment.
Fire hazard	Any fuel which if ignited, may be difficult to extinguish.
Fire management	All activities associated with the management of fire-prone land, including the use of fire to meet land management goals and objectives.
Fire regime	The history of fire in a particular vegetation type or area including the fire frequency, interval, intensity, extent and seasonality of burning (Brooks, *et al.*, 2004).
Fire scar	A destructive mark left on a landscape by fire.
Fire season	The period(s) of the year during which fires are likely to occur, spread and do sufficient damage to warrant organised fire control.
Fire suppression	The activities connected with restricting the spread of bushfire following its detection and making it safe.
Fuel	Any material such as grass, leaf litter and live vegetation, which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare.
Fuel arrangement	A general term referring to the spacing and arrangement of fuel in a given area.
Fuel hazard	The Overall Fuel Hazard is defined as the sum of the influences of bark fuel, elevated fuel and surface fine fuel (DEH, 2006c)
Fuel management	Modification of fuels by prescribed burning, or other means.
Fuel reduction burning	The planned application of fire to reduce hazardous fuel quantities, undertaken in prescribed environmental conditions within defined boundaries.
Fuel type	An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause predictable rate of spread or difficulty of control under specified weather conditions.
GAFLC	South Australian Government Agencies Fire Liaison Committee.
IBRA	Interim Biogeographical Regionalisation for Australia.

Term	Definition
Incident Controller (IC)	The individual responsible for the management of all incident operations and IMT.
IMT	Incident Management Team. The group of incident management personnel comprising the Incident Controller and the people he/she appoints to be responsible for the functions of Operations, Planning and Logistics.
Indirect attack	The use of backburning as a method of suppression to confine the fire within a defined area bounded by existing or prepared control lines. Control lines may be a considerable distance ahead of the fire.
Key Fire Response Species	In this fire management plan, these are the species most susceptible to decline due to inappropriate fire regimes: either too frequent or too infrequent fire, low or very high intensity fire, or fire in a particular season.
MVS	Major Vegetation Sub-group.
NHT	National Heritage Trust. Established by the Australian Government in 1997 to help restore and conserve Australia's environment and natural resources (NHT, 2005)
NPW Act	The South Australian *National Parks and Wildlife Act 1972*.
NVC	Native Vegetation Council. Established under the provisions of the *Native Vegetation Act 1991*, responsible for making decisions on a wide range of matters concerning native vegetation in South Australia (DWLBC, 2006)
'Of conservation significance'	In this plan, used to describe important or rated populations or species of flora and fauna as well as vegetation communities. These may be: • Nationally rated, that is, listed as Threatened (with a rating of Extinct, Critically Endangered, Endangered, Vulnerable or Conservation Dependent) under the federal Environment Protection and Biodiversity Conservation (EPBC) Act 1999; • South Australian rated, listed as Threatened (with a rating of Endangered, Vulnerable or Rare) under the National Parks and Wildlife Act 1972, Revised Schedules 7, 8 and 9. • Provisionally listed as Threatened (with a rating of Endangered or Vulnerable) in South Australia, that is, included on the unpublished DEH Provisional List of Threatened Ecosystems of South Australia (DEH, 2005d).
Prescribed burn plan	The plan, which is approved for the conduct of prescribed burning. It contains a map identifying the area to be burnt and incorporates the specifications and conditions under which the operation is to be conducted.
Prescribed burning	The controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. It is undertaken in specified environmental conditions.
Response plan	A plan detailing the response for a risk or an area including the type and number of resources.
Retardant	A chemical generally mixed with water, designed to retard combustion by chemical or physical action. It is usually applied by aircraft but may be applied from tankers at the fire edge.

Term	Definition
Risk assessment	Used in DEH fire planning to assist in evaluating the threat to life, property and environmental assets posed by bushfire and to aid in developing strategies and implementing actions and works for risk mitigation. Considers *Likelihood* and *Consequence* to determine an overall risk rating using a matrix as *Low, Moderate, High, Very High* or *Extreme* (DEH, 2006b)
SAMDB NRM Board	South Australian Murray-Darling Basin Natural Resources Management Board.
Spotting	The ignition of spot fires from sparks or embers.
Total Fire Ban	A ban on lighting and maintaining of a fire in the open, which can be invoked at any time during the year. When invoked, the Total fire Ban is imposed for a period of 24 hours, from midnight to midnight, but may also be imposed for part of a day or days. (Country Fire Service Regulations, 2003)
TPC	The *Threshold of Potential Concern* (TPC) for a vegetation type or community is the level of fire regime element (i.e. fire interval, frequency, intensity or season) where *Key Fire Response Species* are likely to significantly decline if exceeded. Fire regimes beyond that level are likely to lead to local extinction of significant biodiversity. • TPC1 demonstrates the recommended lower limit for fire interval for a particular MVS. That is, vegetation within this MVS will be represented predominantly by early successional species if the inter-fire interval is less than the time specified, and those species that require longer to flower and set seed can disappear from a community. • TPC2 demonstrates the recommended upper limit for fire interval for a particular MVS. That is, populations of some species (e.g. obligate seeders) are likely to reduce within this MVS if fire is absent for more than the time specified.
Weeds CRC	The Cooperative Research Centre for Australian Weed Management.
'Weed of national significance'	20 priority weeds that pose future threats to primary industries, land management, human or animal welfare, biodiversity and conservation values at a national level. These weeds were identified and ranked through the assessment of invasiveness, impacts, potential for spread and socioeconomic and environmental aspects (Australian Weeds Committee, 1999)

Unless otherwise indicated, definitions for fire management terminology were adapted from: Department for Environment & Heritage (DEH) (2006) *Glossary of Fire Management Terms – Draft V00-01*. Government of South Australia, Adelaide.

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