Fire management plan

2001 - 2006

Pilliga Nature Reserve

NSW NATIONAL PARKS AND WILDLIFE SERVICE

"The whole country was on fire … The country smoked around us on all sides…"

"All the country beyond the river was in flames, and indeed, from the time of our arrival in these part, the atmosphere has been so obscured by smoke, that I could never obtain a distinct view of the horizon. The smoke darkened the air at night, so as to hide the stars, and thus prevented us from ascertaining our latitude … Fires prevailed fully as extensively, at great distance in the interior, and the sultry air seemed heated by the general conflagration."

Thomas Mitchell, commenting on the fires in the eastern Pilliga, during his first journey to the area in mid December 1831.

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Cover photo: Cycad fronds resprouting two weeks after the 1997 Timmallallee Creek fire which burnt over 140,000 hectares over nature reserve, state forests and private lands. Peter Brookhouse, NSW NPWS

Summary

Planning and consultative process

This fire management plan has been prepared to describe the activities to be conducted and the management guidelines required to control and manage fire in the Pilliga Nature Reserve.

The plan places emphasis on the protection of life and property, the safe suppression of fires and the conservation of reserve's natural and cultural heritage.

A number of stakeholders have been consulted on the actions required to manage bush fire risks, to conserve the reserve's heritage and on the strategies for the safe suppression of fires. Groups consulted were volunteer Rural Fire Brigades, reserve neighbours and the Pilliga Scrub Bush Fire Management Committee.

This fire management plan was developed concurrently with the Pilliga Scrub Fire Management Plan which was prepared by the Pilliga Scrub Bush Fire Management Committee and the Rural Fire Service.

NPWS fire management objectives

In accordance with Sections 63 & 64 of the *Rural Fires Act, 1997* and the *National Parks and Wildlife Act, 1974*, the primary objectives for fire management in the Pilliga Nature Reserve are:

- to prevent the occurrence of human caused unplanned bushfires on the reserve
- to suppress unplanned bushfires on the reserve
- to minimise the potential for the spread of bushfires on, from, or into the reserve
- to protect from bushfires, persons and property on, or immediately adjacent to, the reserve
- to manage bushfire to avoid the extinction of native species known to occur naturally within the reserve
- to protect from damage by bushfires Aboriginal sites, historic places and culturally significant features known to exist within the reserve
- to work co-operatively with neighbours and rural fire brigades in managing fire in and adjacent to the reserve
- to prevent single large fire events greater than 20,000 hectares
- to implement fire suppression strategies which will encourage effective and safe containment of wildfires

Life and property protection by strategic fire management

Life and property protection will be achieved by the maintenance of trails within the reserve, and an extensive prescribed burning program.

All existing fire trails within the reserve will be maintained. Two trails, Punks Trail and Baileys Road will be re-aligned to provide safer access.

Strategic fire management zones will be established along the eastern and southern areas of the reserve, and along the major trails within the reserve. Prescribed burning will be conducted in these areas.

A trail will be constructed along the southern boundary of the Ukerbarley Section of the reserve

Loading ramps will be constructed in a number of locations to allow quick access for earthmoving equipment.

Strategies for heritage management

The strategies for heritage management are:

- preventing single large fire events in the reserve by prescribed burning in strategic fire advantage zones;

- conduct prescribed burning, according to management guidelines, which will produce a mosaic of areas with different intervals since last fire; and

- provide operational guidelines which will reduce impact of fire operations on the heritage attributes of the reserve

Contents

1.0 Introduction

The Pilliga Nature Reserve is part of the large semi-arid forest, woodland and shrub complex known as the Pilliga Scrub. The Scrub has an extensive fire history, with about 400 fires recorded in the last fifty years, 40 of these on the nature reserve.

The Pilliga scrub could be described as 'big fire country', where periodically, a single large fire will affect a major portion of the scrub. The scale of these fires, and their rate of their spread, requires a fire management approach which is of a landscape scale, rather than confined to a certain tenure or a small part of the Pilliga Scrub.

The Pilliga Nature Reserve Fire Management Plan describes the fire management guidelines, programs and activities necessary for the National Parks and Wildlife Service to meet its obligations to conserve the reserve's heritage under the *National Parks and Wildlife Act, 1974* and the *Threatened Species Conservation Act, 1995* and to protect life and property under the *Rural Fires Act, 1997*. The reserve is managed by the Service's Northern Plains Region.

A Plan of Operations for the entire Pilliga Scrub has been jointly prepared by the Service, NSW State Forests, the Rural Fire Service and the NSW Fire Brigades. The Pilliga Nature Reserve Fire Management Plan has been prepared in line with the *Castlereagh Region Pilliga Operations Subplan*.

This fire management plan has been prepared in accordance with the policies and procedures detailed in the National Parks and Wildlife Service's *Fire Management Manual* and the *Draft Pilliga Nature Reserve Plan of Management*. This plan will be reviewed and updated after five years, or after major fire events or the release of research pertinent to the management of the reserve's biodiversity.

This plan is supported by the *Northern Plains Regional Incident Procedures,* which details the procedures and contact lists by which the Service will respond to fires and other incidents. This is revised annually.

The Service is a prescribed fire authority under the Section 52 of the *Rural Fires Act, 1997*. It is responsible for the suppression of fires and the implementation of fuel management on all lands under its care, control and management. The Service may also, under the Act, suppress or assist in the control and suppression of fires within eight kilometres of any land it manages.

The Pilliga Nature Reserve is situated in the local government areas of Coonabarabran, Gunnedah and Narrabri. Each shire has a Bush Fire Management Committee, of which the Service is an active member. The committees were formed under Section 46 of the *Rural Fires Act 1997*, and are required to prepare plans of operations and bush fire risk management plans. The Pilliga Nature Reserve Fire Management Plan has been prepared in consultation with these committees. The fire management guidelines and strategies contained in this plan will be incorporated into these co-operative plans.

The Fire Control Officers for the Coonabarabran, Gunnedah and Narrabri Rural Fire Districts will be required, under Section 38 of the *Rural Fires Act,* to refer and comply with the management guidelines and strategy considerations set out in the plan when a fire occurs on Pilliga Nature Reserve.

This plan document is also supported by maps, documents and computer databases that are maintained at the offices of the Northern Plains Region at Narrabri and Coonabarabran.

1.1 Scope and purpose of the plan

This fire management plan has been prepared to provide guidelines for the protection of life and property through fire suppression and fuel management activities, and for the ecological application of fire in the Pilliga Nature Reserve.

The plan covers the reserve area with consideration to adjacent areas with contiguous natural vegetation (see Map 1). This coverage assists in achieving a co-ordinated approach by the Service and other land management and fire authorities to protect life and property, and to protect habitats for threatened species.

The management of fire outside the nature reserve remains the responsibility of the other land management authorities, landholders and Bush Fire Brigade Captains, unless specified otherwise in plans prepared by the Bush Fire Management Committees.

Fire management zones and areas have been prepared for the planning coverage. These zones recognise the various fire management requirements for heritage management in the reserve and the protection of assets, both on the reserve and on adjoining tenures.

The plan's coverage has been determined by the identification of the assets at risk and by consultation with neighbours, local Bush Fire Brigades and the Coonabarabran, Gunnedah and Narrabri Bush Fire Management Committees.

The guidelines for the management of natural and cultural heritage have been based on current scientific understanding of the relationships between biodiversity and fire regimes, and the threat of fire and fire operations to cultural sites. The guidelines describe appropriate fire management regimes to promote biodiversity and to protect threatened species and cultural sites.

1.2 The planning environment

1.2.1 Management objectives of the Pilliga Nature Reserve

The management of the Pilliga Nature Reserve is prescribed by objectives stated in the *National Parks and Wildlife Act, 1974* and the *Draft Pilliga Nature Reserve Plan of Management*. It is a requirement under the Act that no operations or actions are to be undertaken that are contrary to the plan of management.

The general objectives for the management of national parks and nature reserves in New South Wales are:

- the protection and preservation of natural and special features
- the conservation of biodiversity

- the maintenance of natural processes as far as possible

- the preservation of Aboriginal sites and historic features

- the encouragement of scientific and educational research into environmental features and processes, prehistoric and historic features and park use patterns.

The policies contained in *Draft Pilliga Nature Reserve Plan of Management* for fire management are:

- fire management in the reserve shall be part of a landscape approach for the whole Pilliga, including the reserve, adjacent forestry areas, private land and vacant Crown land; and

- the fire management objectives of the NPWS in the reserve are:

  - to prevent the occurrence of human caused unplanned bushfires on the reserve;

  - to suppress unplanned bushfires on the reserve;

  - to minimise the potential for the spread of bushfires on, from, or into the reserve;

  - to protect from bushfires, persons and property on, or immediately adjacent to, the reserve;

  - to manage bushfires to avoid the extinction of native species known to occur naturally within the reserve;

  - to protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features known to exist within the reserve;

  - to work co-operatively with neighbours and rural fire brigades in managing fire in and adjacent to the reserve;

  - to prevent single large fire events greater than 20,000 hectares; and

  - to implement fire suppression strategies which will encourage effective and safe containment of wildfires.

The strategies contained in *Draft Pilliga Nature Reserve Plan of Management* for fire management are:

- keep wildfires under 20,000 hectares;

- establish strategic fire management zones along the southern and eastern boundaries, Newell Highway and key fire management trails which will assist in containing and limiting the spread of fire, and from which prescribed burning will be conducted to assist the control of wildfires;

- develop and implement guidelines for fire suppression strategies which differentiate between broad fuel types, and seasonal and weather conditions;

- develop guidelines which allow for:
    - early withdrawal to predetermined control lines when the fire is rapidly spreading and severe fire weather is forecast;
    - extending the fire area by tying into recently burnt areas and adjacent control lines if the appropriate time since the last fire has lapsed, and moderate weather conditions are forecast; and
    - minimising the fire area if the time since last fire is below an acceptable period;
- conduct prescribed burning which is responsive to weather conditions, and which will reduce the potential for excessive burn areas;
- encourage further research into the relationships and interactions between fire, flora, fauna and the broader landscape;
- maintain all currently designated fire trails, closing some fire management trails from time to time when weather conditions make them impassable and potentially hazardous;
- encourage research into fuel accumulation and fire ecology;
- consult neighbours and local bushfire captains prior to hazard reduction activities, and where possible, when undertaking fire suppression activities in the reserve; and
- contact and consult apiarists regarding sites in the reserve which may be impacted by prescribed burning activities and, where possible, when undertaking fire suppression activities in the reserve

1.2.2 Fire management policies of the National Parks and Wildlife Service

The fire management policies of the Service include the following:

- the Service regards fire as a natural phenomenon and one of the continuing physical factors of the Australian environment.
- the Service recognises the evolutionary adaptation of many native species of plants and animals to fire regimes.
- the Service accepts that fire can be a useful management tool.
- fire is and will be used as a fuel reducing agent where this does not conflict with management objectives.
- where life and property are directly threatened by fuel conditions, all steps will be taken to minimise risks, with other management needs regarded as secondary considerations.

- all fire prevention and suppression works will, where possible, be pre-planned and coordinated with neighbours and other agencies likely to be affected by Service activities.

- the Service will undertake fire prevention programs, through public education and through local supervision and enforcement of the Acts and regulations applying to fires.

- the Service supports the principle of co-operative approach to fire suppression to most effectively use fire-fighting resources within the community, providing that fire management operations will take into account the protection of natural resources.

- the Service will collect information on the biology of native plants in relation to fire.

- databases on the conservation requirements of species in relation to fire will be established and reviewed as new information is acquired.

- research will be undertaken to provide data that will assist in making management decisions.

1.3 Principles of biodiversity conservation in fire management

The *NSW Biodiversity Strategy (1999)* was prepared by the New South Wales Government as a policy for the conservation of biodiversity in the State. The strategy requires that the results of applied fire research and the principles for biodiversity conservation be incorporated into fire management plans.

Biodiversity conservation aims to prevent the extinction of species, particularly extinctions induced by the action of humans. This can be assisted by identifying the fire management regimes that promote the recovery and survival of native flora and fauna.

The conservation objective of this plan is to manage fire to retain (avoid extinction of) species known to occur naturally within the Pilliga Nature Reserve.

The elements of a fire regime, which affect the survival of a species, are fire intensity, fire frequency, season and size of the fire.

Contemporary ecological research in fire-prone ecosystems has established some general principles about the fire regimes needed to avoid the extinction of species. These principles are:

- many plants and animals share similar adaptations to fire, and have similar responses to fire, eg epicormic shoots on eucalypts

  fire regimes can be specified for groups of species according to their responses to fire

- many species with different responses to fire occur in the one plant and animal community

  a fire regime prescribed for a community should include a number of variations in

each element of the fire regime over the range of that community

fire regimes for a community may include different fire frequencies, including fire exclusion

- fire events need to be recorded and evaluated for their impacts so that fire regimes prescribed for a community are adjusted to ensure the survival of all species

1.4 Plan performance indicators

The Service has established performance indicators to measure the success of fire management plans. These performance indicators are listed below against the broad objectives of the Service's fire management.

Objective	Performance indicators
To prevent the occurrence of human caused unplanned fires on the reserve	On reserves, with a history of unplanned fire, ignitions caused by humans, are progressively reduced over the planning period On reserves, with no history of unplanned fire, there is no increase in ignitions caused by humans over the planning period.
To suppress unplanned fires occurring on the reserve	Fires occurring on the reserve are suppressed within appropriate control lines on the reserve, safely, with minimum environmental damage and cost during the planning period.
To minimise the potential for spread of wildfires on, from or into the reserve.	Wildfires starting in the reserve are suppressed within the reserve and fires starting outside of the reserve are prevented from entering the reserve, safely, with minimum environmental damage and cost during the planning period.
To protect from bushfires occurring on the reserve, persons and property on, or immediately adjacent to, the reserve.	No death or injury to persons, or destruction of property, caused by on park bushfires in the planning period.
To manage bushfires to avoid the extinction of species known to occur naturally within the reserve	Fire regimes are maintained within the specified ecological thresholds across more than 50% of the area of each plant community on the reserve. No significant decline of species populations (common or threatened) due to inappropriate fire regimes, suppression operations or other fire management works, occurs during the planning period.
To protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features which are known to exist within the reserve.	No damage caused to known Aboriginal sites, historic places and culturally significant features as a result of bushfires during the planning period.

1.5 Definitions of fire management terms

Aerial detection	The discovering, locating and reporting of fires from aircraft
Aerial ignition	The igniting of fine fuels for prescribed purposes by dropping incendiary devices or materials from aircraft.
Aspect	The direction towards which the slope faces.
Available fuel	The portion of the total fuel that would actually burn under various specified conditions
Backburning	A fire started intentionally along the inner edge of a fireline to consume the fuel in the path of a wildfire.
Biodiversity	The variety of life forms, the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity.
Bush fire	A general term used to describe a fire in vegetation.
Bush Fire Management Committees	A committee formed in a local government area, under *S.46* of the *Rural Fires Act 1997* to prepare bush fire management plans to facilitate co-ordinated fire operations and fuel management.
Bush Fire Management Unit (FMU)	Management areas of a variable size that define containment blocks in the event of a wildfire. Alternatively they have also been designated as areas of specific ecosystem types defined by management authorities in order to monitor the long term effects of fire upon those areas.
Bush Fire Management Zone (BFMZ)	Management areas (usually sub-sets of fire management units) where a specified fire management operational objective, strategy and performance indicator has been developed to mitigate against the threat of a wildfire
Control line	A natural or constructed barrier, or treated fire edge, used in fire suppression and prescribed burning to limit the spread of fire.
Drought index	A numerical value reflecting the dryness of soils, deep forest litter, logs and living vegetation.
Fire behaviour	The manner in which a fire reacts to the variables of fuel, weather and topography.
Fire break	Any natural or constructed discontinuity in a fuel bed used to segregate, stop and control the spread of a wildfire, or to provide a control line from which to suppress a fire.
Fire intensity	The rate of energy release per unit of fire front. It can be expressed in the terms of flame height and the forward rate of spread of the fire front.
Fire management plan	The document outlining the actions and guidelines which will assist in controlling fire, mitigate the impacts of fire and protect elements of the natural and cultural heritage.
Fire regime	The history of fire in a particular vegetation type or area including

	frequency, intensity and season of burning. It may also include proposals for the use of fire in a given area.
Fire retardant	A chemical generally mixed with water, designed to retard combustion. It is applied as a slurry from the ground or the air.
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.
Fuel management	Modification of fuels by prescribed burning, or other means.
Lightning fire	A fire caused by lightning
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.
Reserve	Pilliga Nature Reserve
Service	The National Parks and Wildlife Service.
Suppression advantages	A natural or constructed feature, vegetation type or burnt area that may used in fire suppression as a control line.
Thresholds	The limits of tolerance of species and communities, expressed in the terms of the variables which constitute a fire regime (frequency, intensity and season), beyond which extinctions of species may occur.

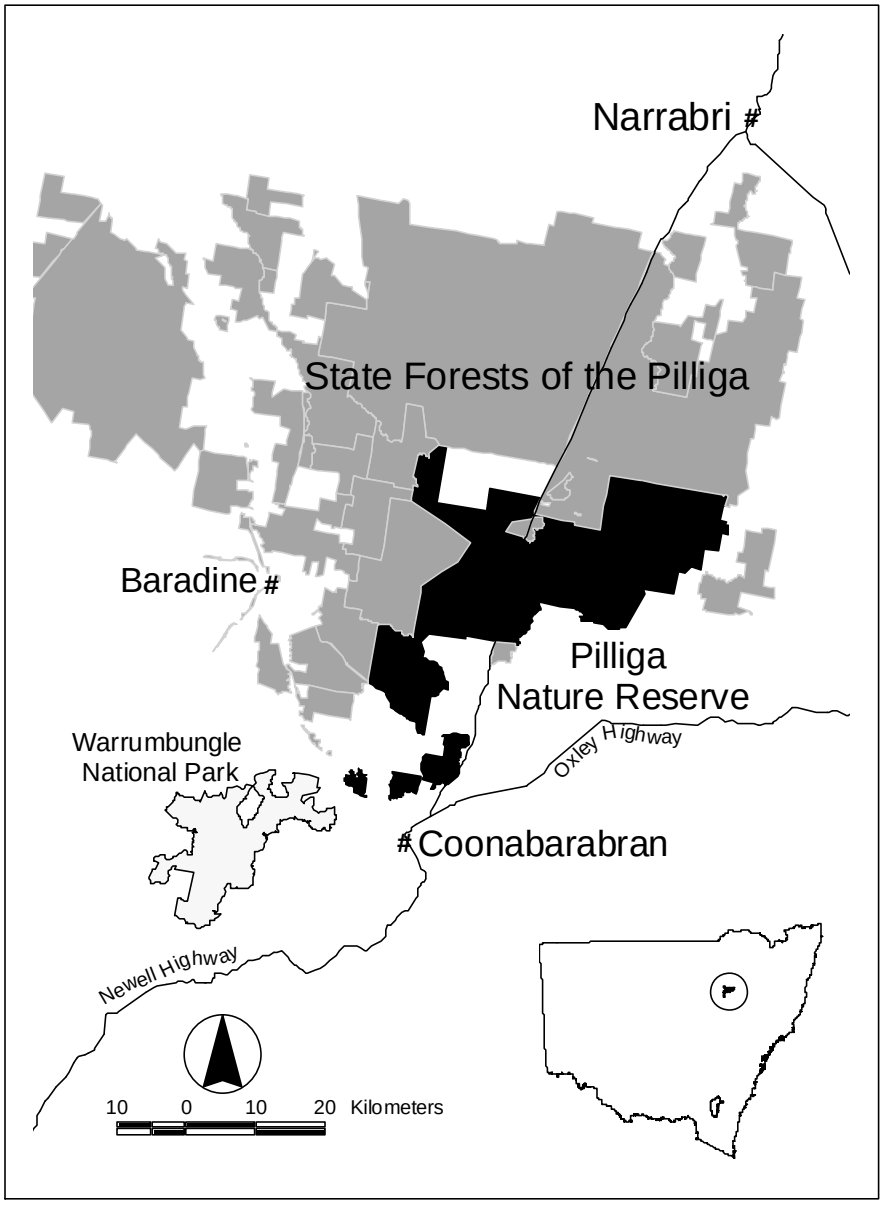
2.0 Description of the reserve

2.1 Location

Pilliga Nature Reserve is about 84,000 hectares in area, and is located on the North-west Slopes of New South Wales. The reserve occurs in four disjunct areas, with the most southerly section ten kilometres north of Coonabarabran (see Map 2.1). The reserve is part of the 'Pilliga Scrub' which has an approximate area of over 450,000 hectares.

The Pilliga State Forests adjoins the reserve on its northern and western boundaries. Large grazing properties adjoin the reserve to the east, and smaller rural properties adjoin the southern sections of the reserve**.**

Map 2.1 Locality of the Pilliga Nature Reserve



2.2 Terrain

The Pilliga is dominated by sandstone, colluvial and alluvial landforms that are derived by the erosion of the Jurassic Pilliga sandstones and previously overlying lithologies. The region also has a number of small exposed volcanic intrusions and extrusions. These are related to the volcanic activity which formed the Warrumbungle and Nandewar Volcanos which were active between 20 and 13 million years ago (Packham, 1969).

The Pilliga landscape dips down from the south to the north, from about 600 metres ASL near the Warrumbungle Range, to about 250 metres ASL near the Namoi River floodplain. The altitudinal range in the reserve is between 300 and 600 metres.

The reserve is situated in the central part of the Pilliga landscape. Southern sections of reserve are characterised by dissected sandstone plateaux and sandstone ridges. Northern and eastern sections of the reserve are characterised by sandstone ridges and broad colluvial and alluvial valleys. The three broad land units of the Pilliga are listed in Table 2.2.

The gradients in the reserve are generally below 5 degrees. Steep slopes are limited to the gorges of the dissected plateaux country in the south-west of the reserve, and occasional sandstone outcrops in the east of the reserve.

Table 2.2 Broad land units of the Pilliga Area

Unit	Description	Location
Escarpment country	Sandstone plateaux dissected formed low escarpments and very steep terrain	Dandry Creek valley and Ukerbarley, located west of the Newell Highway to a distance 40 kms north of Coonabarabran
Undulating sandstone	Low sandstone ridges which separated by broad or narrow low valleys	The entire northern and eastern area of the reserve , covers the majority of the Pilliga Scrub east of Rocky Road and County Line Road, and the majority of the areas in the southern Pilliga
Pilliga Plains	Flat country broken by creek lines	The northern and western areas of the Pilliga, and generally located outside the reserve

2.3 Biodiversity

2.3.1 Vegetation

The reserve's vegetation is dominated by *Eucalyptus, Angophora* and *Callitris* open forests and woodlands. A number of different vegetation types occur within the reserve, and their distribution is characteristic of the landforms resulting from lithologies, and erosional and depositional events.

Two broad vegetation types have been described in the reserve. Their distribution and fire ecology are listed in Table 2.3 and illustrated by Map 2.4.

The reserve contains over 500 species. Five species are listed as rare or threatened under the ROTAP system. Many species are endemic, either to the reserve or the Pilliga landsystems. Two of the ROTAP species potentially occurring in the reserve are also listed under Schedules in the *Threatened Species Conservation Act 1995*. These species are listed in Appendix 1, with a description of their fire ecology.

The reserve is within the North-west Slopes botanical sub-division of New South Wales. The vegetation types and species present in the reserve are typical of the communities that occur on Pilliga land-systems elsewhere in the botanical sub-division.

The botanical significance of the reserve can be summarised as follows:

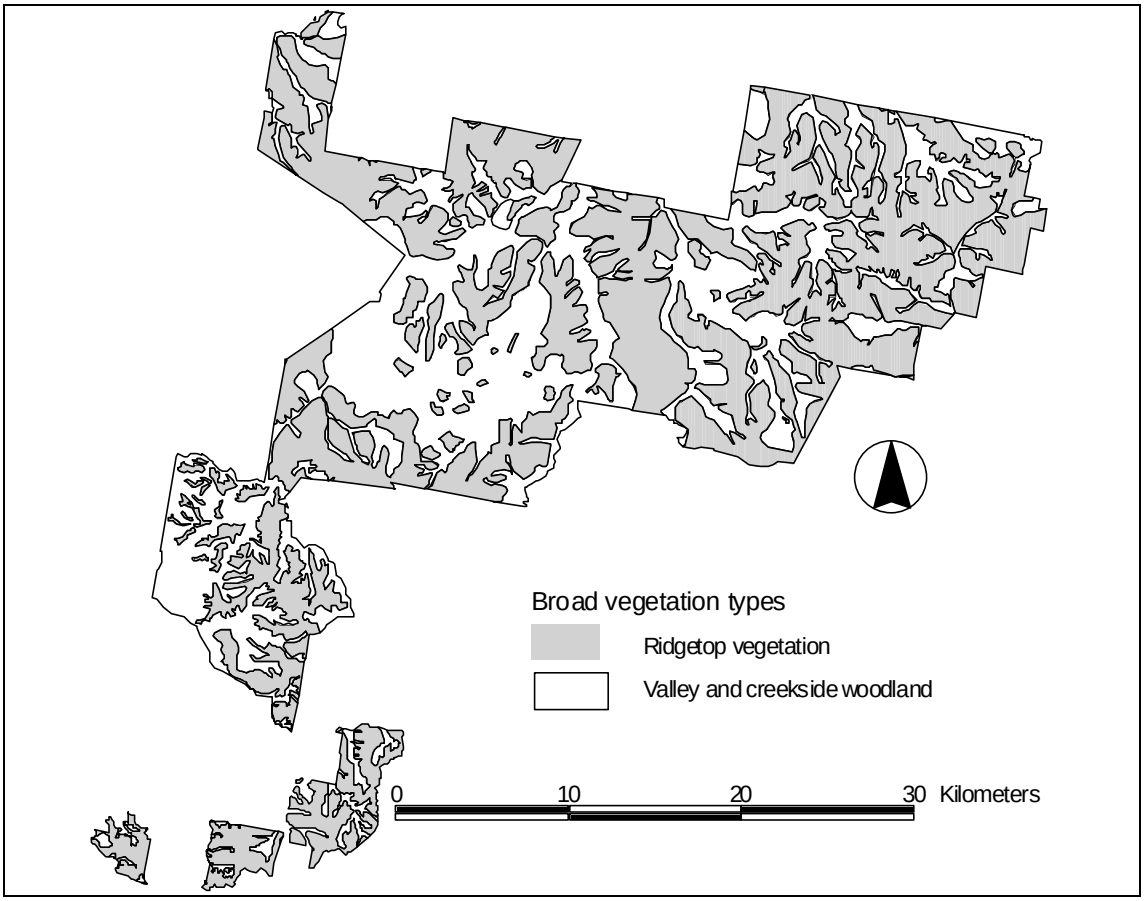
- a sample of the largest native forest, woodland and shrubland complex in western New South Wales

- the eastern and western range of distribution for a number of species is located within the reserve

Table 2.3 Vegetation types and fire ecology in the Pilliga Nature Reserve.

Broad vegetation type	Area (ha)	% area	Fire ecology
Ridgetop Eucalypt forest, woodlands and shrublands • E. rossii / Corymbia trachyphloia / E. macroryncha / E. crebra / E. fibrosa/Callitris endlicheri • E.dwyeri / Allocasuarina spp.	49,214	59	A decline in species may occur if: • two consecutive fires are less than 15 years apart • consecutive fires are low intensity • a fire-free interval of 30 years is exceeded A long-term change in the structure of the canopy vegetation may occur if two large high intensity fire events occur within same area, in a period less than 30 years
Valley and creek-side Woodlands • E. blakelyi / E. melliodora / E. crebra / Angophora floribunda / Callitris glaucophylla / Allocasuarina luemanii • E. chlorclada X camaldulensis / Angophora floribunda • Angophora leiocarpa	34,306	41	A decline in species may occur if: • two consecutive fires are less than 10 years apart • consecutive fires are low intensity • a fire-free interval of 20 years is exceeded A long-term change in the structure of the canopy vegetation may occur if two large high intensity fire events occur within same area, in a period less than 30 years

Map 2.4 Broad vegetation types, Pilliga Nature Reserve



2.3.2 Fauna

The reserve has a diverse fauna which is representative of the transition area between the Bassian and Eyrean zoographical regions. The total number of species recorded, to date, are 10 amphibian species, 144 bird species, 27 reptile species and 31 mammal species.

Eighteen species occurring in the reserve have been listed under Schedules in the *Threatened Species Conservation Act 1995*. These species, along with other species of special interest, and their fire threats are listed in Appendix 1.

A dramatic change in the Pilliga's fauna occurred within the last century. A number of species became extinct, possibly encouraged by the introduction of different land use practices by settlers, changing vegetation and the introduction of feral animals (Rolls, 1981). The Mallee-fowl may be very close to extinction in the Pilliga, with the last verified observation was 20 years ago. Species with a tenuous status in the Pilliga are Black-striped Wallaby, Spotted-tailed Quoll and Rufous Bettong.

The Pilliga landsystems have endemic mammal species. The Pilliga Mouse was described in 1979, and has a wide distribution within the area. An undescribed Dunnart has been captured, with a potentially second undescribed species captured in 1998 (D. Paull, pers. comm.).

Unsuccessful surveys have been conducted for Hopping Mice (*Notomys*), a species opportunistically observed by researchers.

The Pilliga is an important area for insectivorous bats, with 15 - 25 species occurring (Parnaby & Hoye,1997). These animals are dependant upon woodland and forest canopies for foraging (Date & Paull, 1996). Parnaby and Hoye (1997) recorded a reduced diversity of species in recently burnt areas and in areas with a long period of fire absence. Large fire events may have a significant impact on food resources for a period up to 10 years.

The faunal significance of the reserve and adjoining areas can be summarised as follows:

- endemic species are associated with the Pilliga landsystems
- presence or likely presence of relict populations for some species
- a highly diverse bat fauna
- a high number of threatened species recorded
- a high number of species occurring on the limits of their distribution.

2.4 Aboriginal heritage

The Pilliga area was part of the Gamilaroi nation. The type and frequency of the sites in the parts of the reserve and adjacent to the reserve indicates permanent occupation, with most sites located along valleys.

The reserve has not been comprehensively surveyed for sites. However, there is a diversity of sites. Scarred trees occur in the southern sections of the reserve along creeklines. Axe grinding grooves also occur along creeklines, and can be expected to occur where water flows over rock shelves and at permanent waterholes. Shelters with deposits and art have been located where rock overhangs occur, particularly in the steeper terrain of the Pilliga area. Open camps have generally been found adjacent to permanent water and shelters.

2.5 Historical heritage

The historical heritage of the Pilliga area is predominately associated with grazing and forestry.

There have been a number of occupancies in the reserve area by small landholders. Leases and permissive occupancies were granted, primarily along alluvial valleys where creeks had permanent waterholes. The remains of dwellings, sheds, fences and yards are evident, particularly in the major valleys.

The extraction of White Cypress, for construction timber, and ironbark, for railway sleepers, was the basis of logging in the reserve area. The obvious remains of this industry are the sleeper dumps, where logs were cut into sleepers and the excess timber left behind.

2.6 Radio Communications

The Service operates a mid-band repeater located on Wanda Trig, about 3 kilometres south-west of Sandstone Caves. This provides coverage for most of the reserve. Another repeater is located on Needle Mountain in the Warrumbungle Range, and provides coverage to the southern areas of the Pilliga.

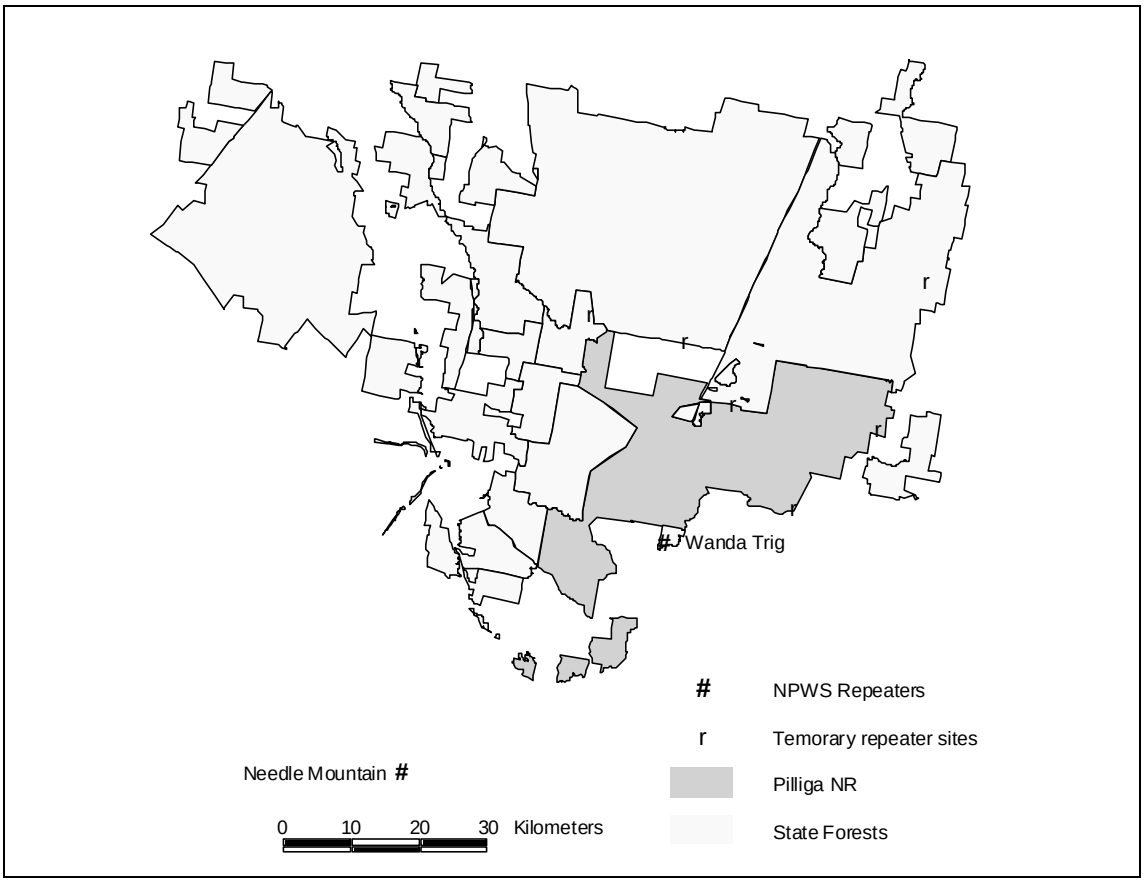
The Rural Fire Service operates an UHF repeater at Wanda Trig.

Mobile phone services, both CDMA and GSM, are available through most areas of the reserve.

Radio communications may need to be augmented during fire operations with the installation of portable repeaters. Radio mast bases have been installed, in some locations of the Pilliga, to facilitate the augmentation of communications.

The location of repeaters and radio mast bases is illustrated by Map 2.5.

Map 2.5 Location of fixed repeaters and radio mast bases for temporary repeaters

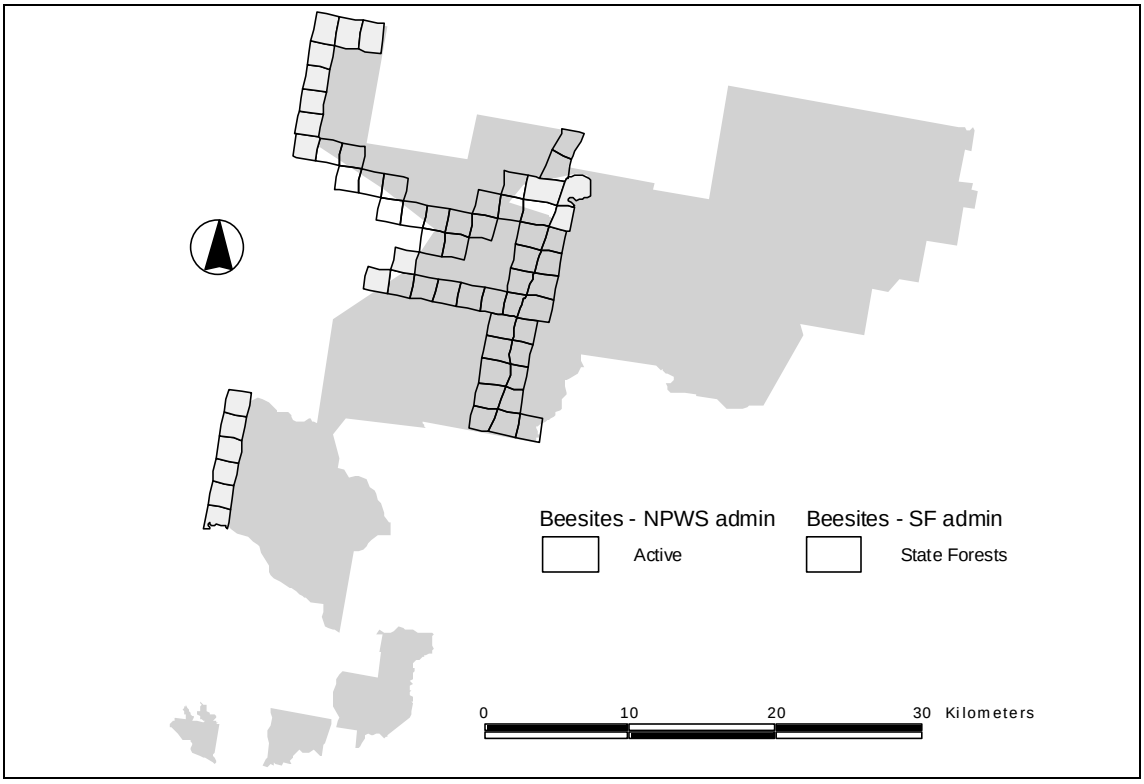


2.7 Beekeeping

There are a number of bee sites located in various areas of the reserve. Most active sites are along the Newell Highway and Number 1 Break Road. These sites are leased under a special arrangement. The location of bee sites is illustrated by Map 2.6.

Hives are present in the reserve when certain species of eucalpyts are flowering.

Map 2.6 Location of bee-sites, Pilliga Nature Reserve



3.0 Bush fire environment

3.1 Fire history

3.1.1 Wildfires

The history of fire in the Pilliga Scrub has been well recorded during the last 50 years by both NSW State Forests and the Service. About 400 fires have been recorded, 40 of these affecting the Pilliga Nature Reserve.

The eastern Pilliga Scrub could be described as 'big fire country', where periodically, a single large fire will affect a major proportion of the scrub. A summary of these major fires is listed in Table 3.1 and most are illustrated by Maps 3.2a - 3.2f.

A number of large fires have crossed the Newell Highway which bisects the Pilliga.

Major fire seasons in the Pilliga have occurred at least once every decade. These have been associated with drought periods when the Southern Oscillation Indices (SOI) were either very low, or declining after ‘good seasons’ with a strong positive value. This is illustrated by Figure 3.3 in which the SOI seasonal values were calculated as an average for the months of September to December.

Table 3.1 Major fires in the eastern Pilliga Scrub

Fire season	Area (ha)	Location	Comments
1951/52	+350,000	The entire eastern half of the Pilliga, extending to the Oxley Highway	Occurred after the wet year of 1950, where record floods were recorded in the Castlereagh River The fire burnt over 2 weeks.
1957/58	65,000	East of the Newell Highway, affecting the south-eastern Pilliga East State Forest and the current Pilliga Nature Reserve	Two separate fires of +30,000 ha. Occurred after the wet year of 1955 when floods occurred in Namoi Valley.
1966/67	+100,000	The current Pilliga Nature Reserve and private property to the Oxley Highway	Commenced on private property as a result of spring burning. previous years were wet.
1974/75	43,000	South-eastern Pilliga East State Forest and part of the Pilliga Nature Reserve	Commenced west of the Newell Highway and was contained along Scratch Road
1977/78	25,000	South-western part of the Pilliga Nature Reserve	
1982/83	120,000	Pilliga East State Forest	Burnt most of the northern Pilliga scrub area. Occurred in a drought year.
1997/98	+140,000	Pilliga East State Forest and the western Pilliga Nature Reserve	Very extensive areas burnt of the western side of the Newell Highway. The season was a moderate drought year with rains preceding the fire.

Maps 3.2 (a - f) Major fires in the eastern Pilliga Scrub, focusing on the Pilliga Nature Reserve

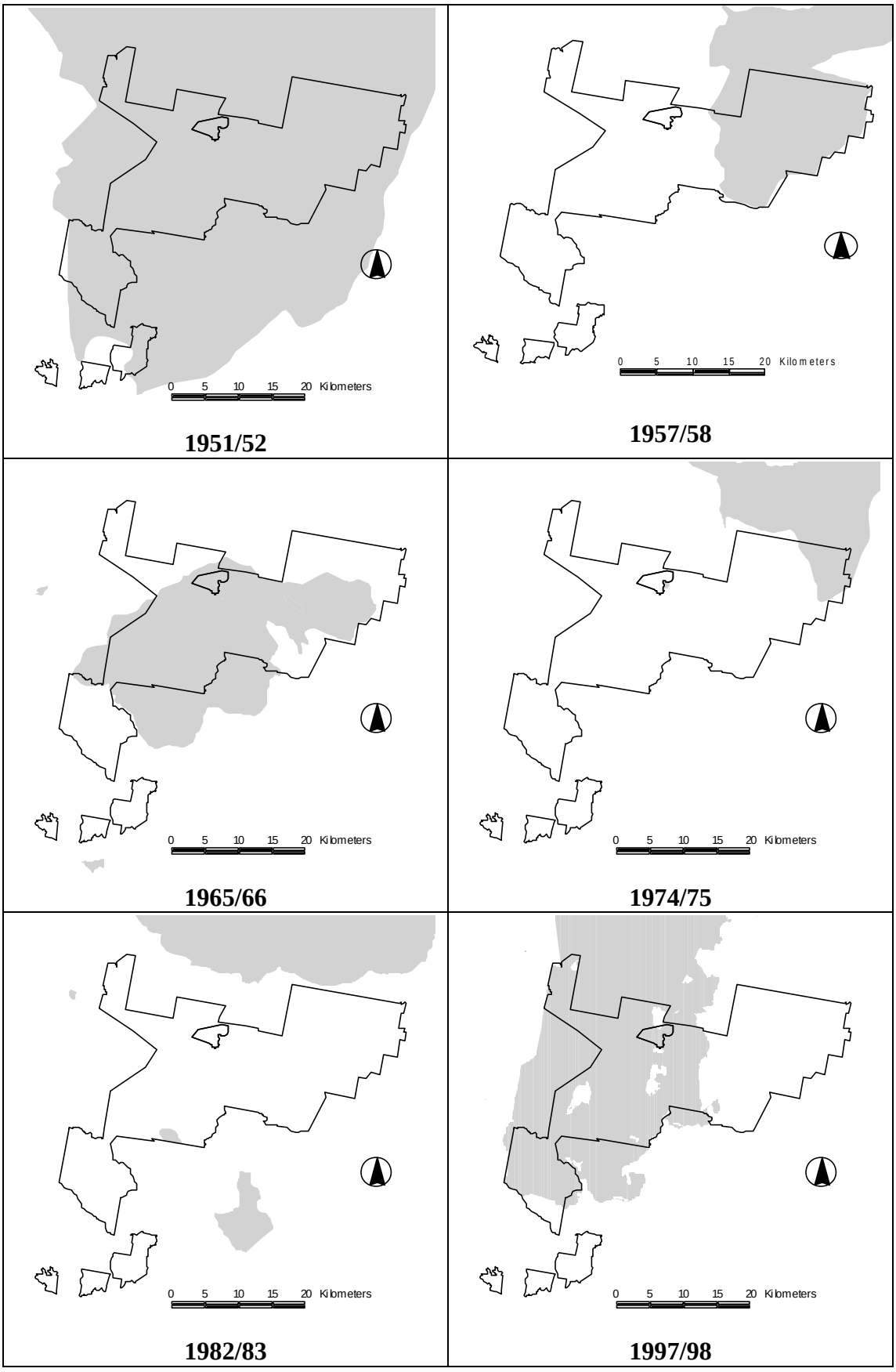
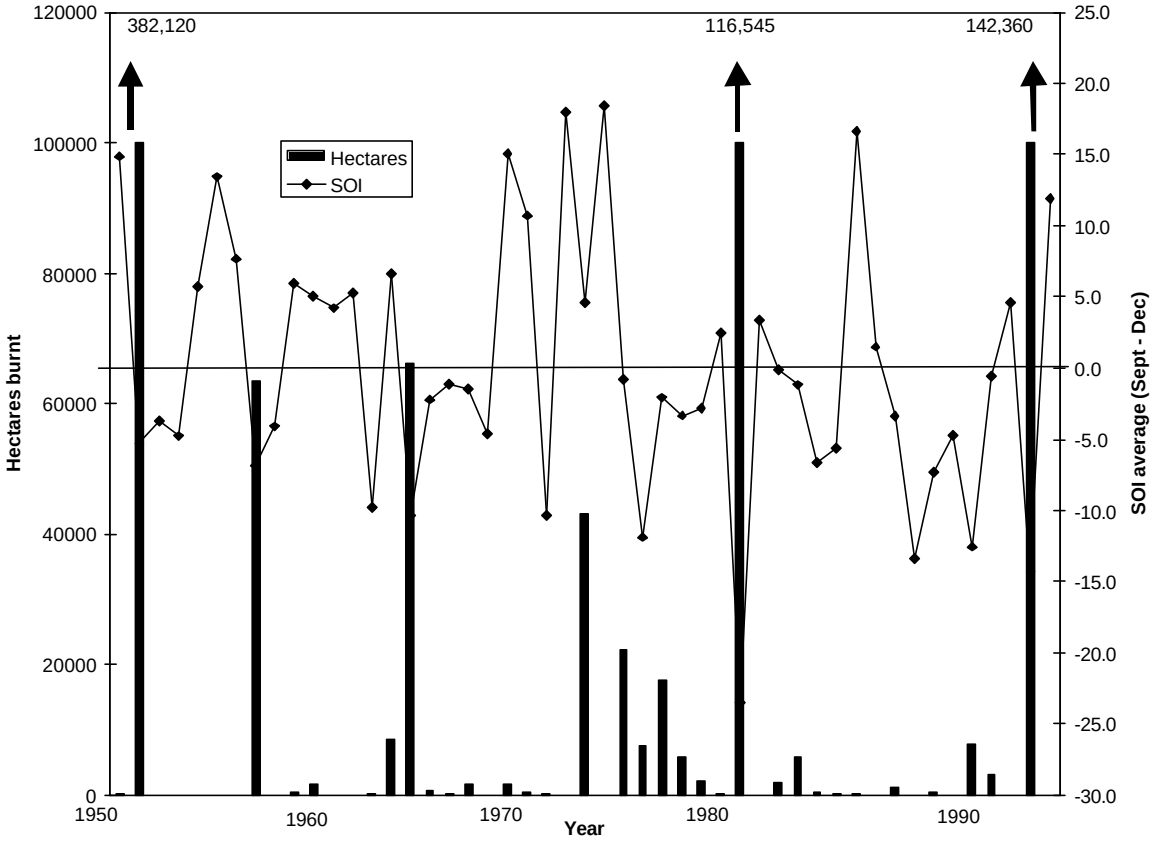


Figure 3.3 Southern Oscillation Indices (average for September to December) and area burnt in the Pilliga Scrub



The vast majority of ignitions in the Pilliga have been lightning strikes. Other ignition sources have included prescribed or legal burning, camp and billy fires, motor vehicle accidents and deliberate ignitions

Wildfires ignited by lightning generally occur from late November to early February. Wildfires from prescribed or legal burns occur mainly in late autumn or early spring.

The incidence of human-caused ignitions has decreased. This reflects changes in work and travel patterns. A number of earlier fires were caused by ‘billy fires’ located at work camps and the roadside camps of travelers. Thermos flasks and motels may have been major factors in eliminating these causes (Brookhouse and Nicholson, 1999).

As more prescribed burning has been carried out over the years, the incidence of wildfires caused by escaped burns has risen. This may be partly due to an increased frequency of prescribed burning.

The pattern of wildfire ignitions is random. This is due to lightning as the major cause, and the low level of ignition by other causes.

Aggressive parallel attack and indirect strategies have been used in containing wildfires. This has involved the construction of control lines along the flanks of running fires, using earth-moving equipment, and the use of fire trails from which backburns were ignited.

Parallel attack has been very successful in containing most fires. However, it has proven inappropriate in some instances. This has been in ridge top forests, woodlands and shrublands and valley and creekside woodlands, during conditions of extremely low humidities, a rapidly growing fire perimeter and adverse follow-up weather. Under these conditions, narrow control lines have failed to hold fire fronts.

3.1.2 Prescribed burning

It is likely that regular winter burning of perennial grasses in the Pilliga was conducted by Aboriginals before European settlement. Early graziers in the area burnt these same grasses to provide green pick for cattle (Rolls, 1981).

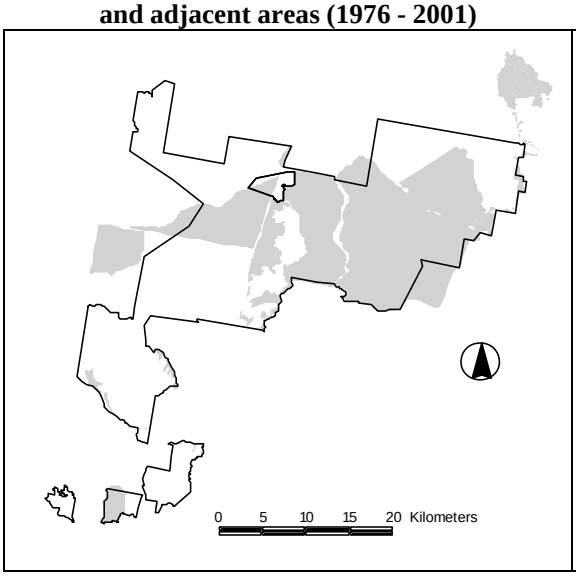
Extensive prescribed burning has been conducted in the reserve, mainly for fuel management. The burn areas vary from 100 hectares to 5,000 hectares. The majority of the burns have been concentrated on the eastern side of the Newell Highway (see Map 3.4). This has been due to the experience that the most severe fire weather will cause fires to run towards the east and south-east.

The value of prescribed burning was demonstrated during the 1997 fire. Burnt areas that were incorporated into control lines successfully held the fire, and other recently burnt areas remained unburnt.

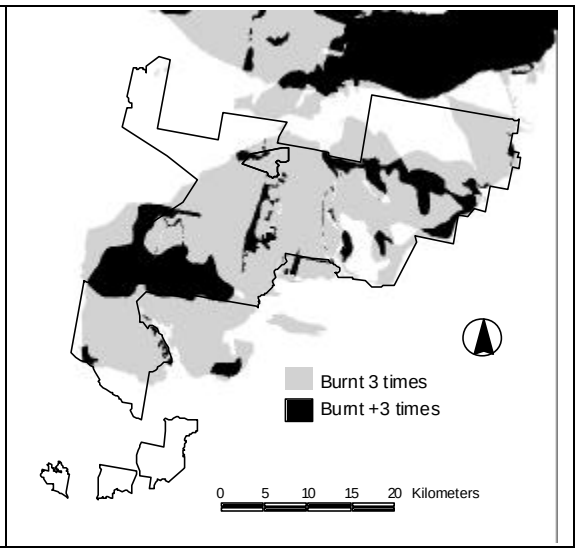
Some recently burnt areas did burn again in 1997. These areas were associated with creeklines which have grass and shrub understoreys.

Vegetation type and season affect the effectiveness of burnt areas, over time, to exclude fires. Valley and creekside vegetation can produce continuous ground fuels within two to three years. This was demonstrated by the three year interval between the 1994 hazard reduction and the 1997 wildfire.

Map 3.4 Prescribed burns in the Pilliga Nature Reserve and adjacent areas (1976 - 2001)



Map 3.5 Fire frequency since 1950



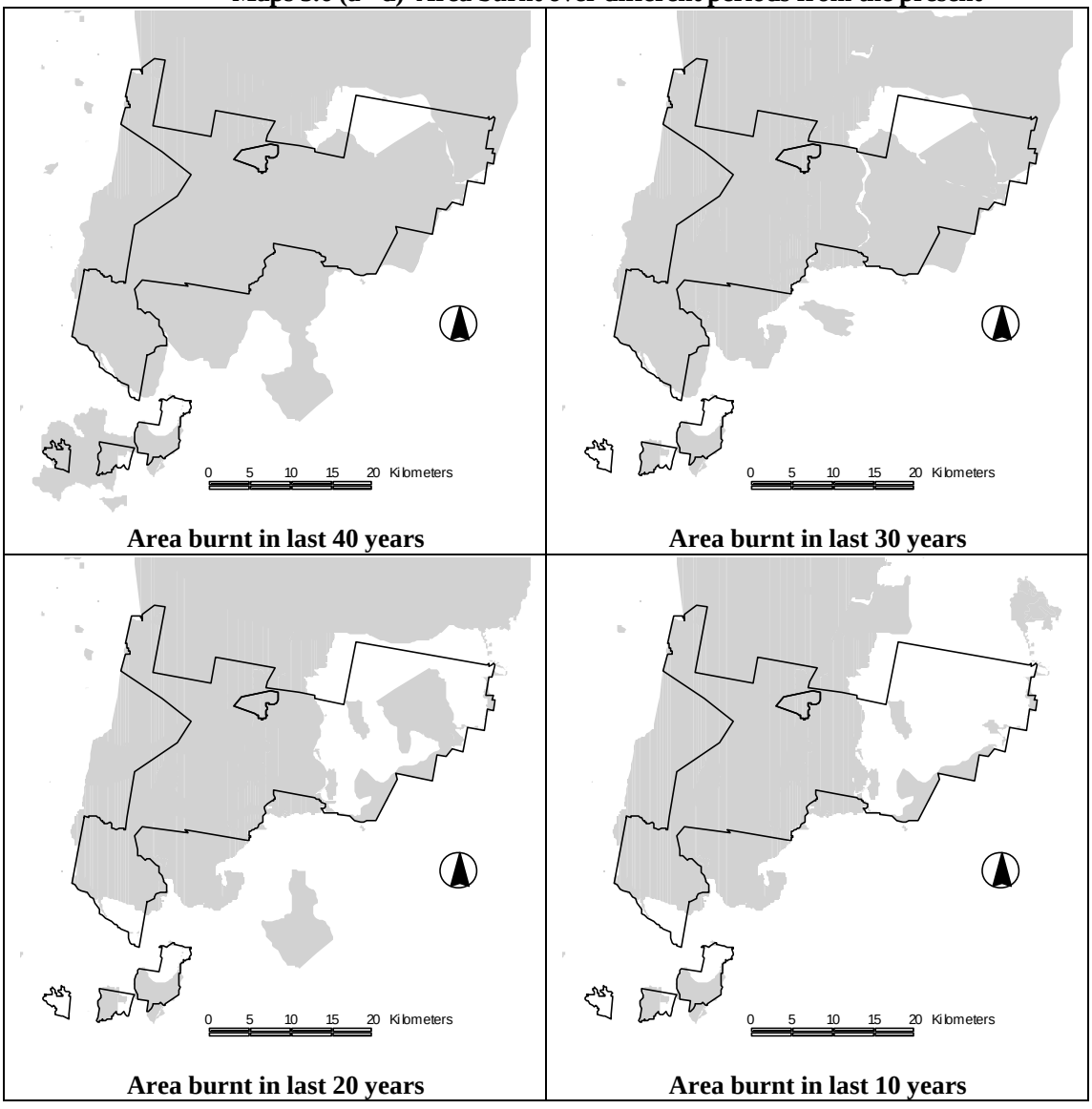
3.1.3 Fire frequency

The frequency of fire occurrence varies considerably through the Pilliga Nature Reserve. Areas of the reserve have been burnt more than three times in the last 50 years (see Map 3.5). This frequency of fires needs to be considered in the terms of biodiversity management and the location of strategic fire management zones to assist with the containing potentially large fires and the achieving of biodiversity objectives.

3.1.4 Time since last fire

Virtually all the western area of the Pilliga Nature Reserve has been burnt within the last 10 years, mainly due to the 1997 fire, see Maps 3.6 (a - d). Only one substantial area remains in the reserve which has remained unburnt since 1957. This area is located west of Galloway Road, and south of Delwood Road. The area with the next longest time since fire is located in the NE corner of the reserve, and was last burnt in 1974. Most of the area east of the Borah Creek remains unburnt for more than 10 years, except for areas burnt for hazard reduction.

Maps 3.6 (a - d) Area burnt over different periods from the present



Area burnt in last 40 years

Area burnt in last 30 years

Area burnt in last 20 years

Area burnt in last 10 years

3.1.5 Fire records

Records of all known wildfires and prescribed burns in and adjacent to the reserve area are maintained in the offices of the Northern Plains Region at Narrabri and Coonabarabran. These records are maintained as documents, maps and computer databases. All known fire boundaries have been recorded in a geographical information system.

3.2 Fire weather

3.2.1 Climate

The rainfall for the reserve is highly variable, and is often characterised by prolonged dry periods and short wet periods. The average annual rainfall at Coonabarabran is 740 mm, with annual records ranging from 321 mm to 1595 mm, and a monthly mean of 61 mm. Monthly averages are illustrated by Figure 3.7.

The highest mean rainfall period is December to February. The warm season rainfall is associated with high pressure systems commencing to track through the central and higher latitudes of the Australian continent. This increases the probability of warm maritime air masses from the northern Australian coast. The preceding season is characterised by high probabilities of dry continental air masses. The transition from the drier to 'moist' seasons is accompanied by higher lightning activity.

The timing of the transition is highly variable. This is indicated by the probability of more than one thunderstorm occurring in a fortnightly period (see Figure 3.8). The transition may occur from October to January.

Figure 3.7 Long Term Average Monthly Rainfall, Coonabarabran

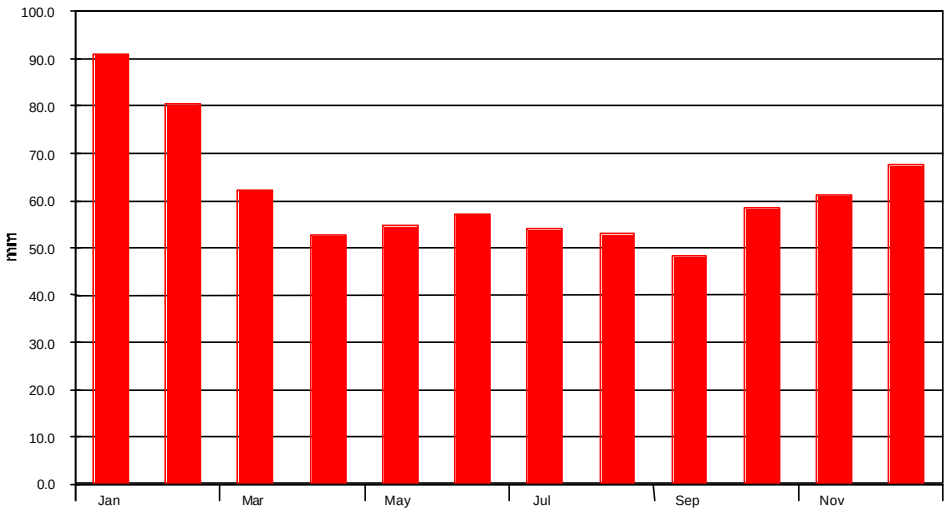


Figure 3.8 Probability of thunderstorms in Coonabarabran over 14 Days

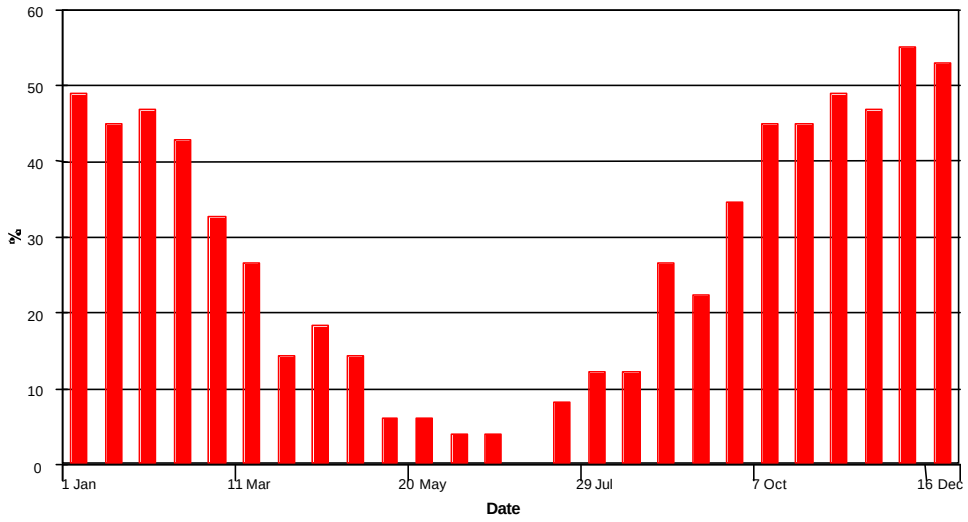
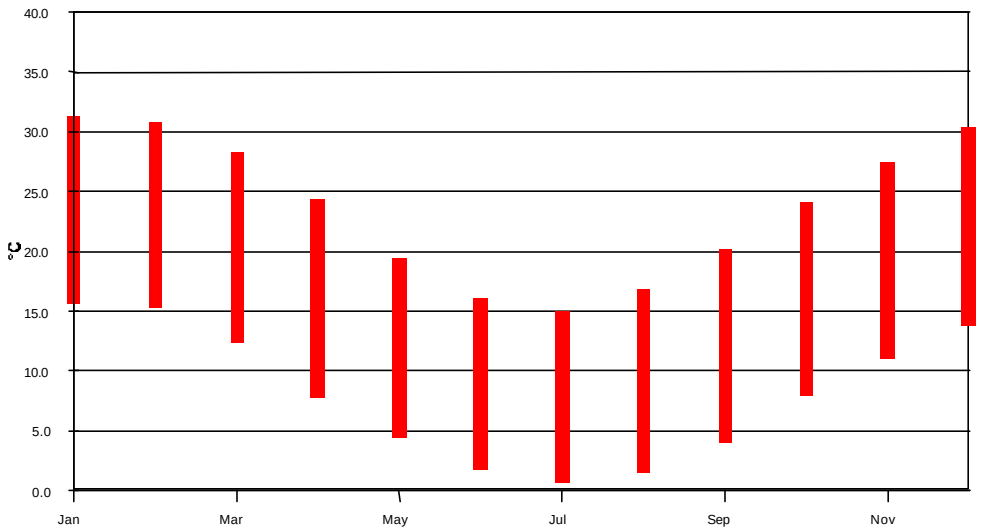


Figure 3.9 Long Term Average Monthly Temperature Range for Coonabarabran



The mean daily maximum temperatures exceed 25^{oC} from October to March, and exceed 30^{oC} from December to February (see Figure 3.9). The diurnal temperature range consistently averages 15^{oC} throughout the year. Mean daily minimum temperatures drop below 10^{oC} from April to October.

3.2.2 Conditions associated with wildfires

Lightning causes most wildfire ignitions in the Pilliga. The weather associated with lightning activity varies. The majority of ignitions are accompanied by rainfall and higher humidities that often limit the spread of fires, allowing rapid suppression to be effective. Some events are immediately followed by dry gusty north-westerly or south-westerly winds which can result in a rapidly spreading fire.

Large fires have been associated with one of the following weather patterns:

- prefrontal systems directing hot and very dry air, with high winds, from the north-west
- slow moving intense troughs, with extremely dry and unstable air

Both weather systems may display daily changes in wind direction, which can cause the fire to run at right angles and even in the opposite direction to the previous day's fire activity.

The weather patterns that propagate a large fire event may last for up to 7 - 10 days.

Any fire ignited, outside a recently burnt area, during hot dry windy weather has the potential to burn >5,000 hectares in the first day.

The greatest potential for large fires is in the period late October to early January. Rapid suppression response is required for all fires during this 'critical fire season'.

The seasonal conditions that can increase the risk of a large fire event are:

- rapidly decreasing Southern Oscillation Index values;
- intense droughts; or
- drying conditions after above average rainfall years

The diurnal variation of temperature, humidity and wind in the Pilliga has a large impact on fire suppression tactics. The night-time conditions will often prevent backburning in most fuel and vegetation types. The opportunity for effective backburning is often limited to the late afternoon and early evening, when the wind drops, but before the humidity rises.

3.2.3 Conditions suitable for prescribed burns

The most favourable periods for prescribed burning in reserve occur when there is:

- dry surface fuels;
- a high level of moisture recovery in fine fuels at night; and
- a low probability of dry north-westerly winds.

The main periods of year where conditions suitable for prescribed burning may occur are autumn and early winter. This allows for open-ended burns to be lit, and for a higher probability for burns to stay within prescribed boundaries.

Prescribed burns may be lit outside these periods where there are secure boundaries, and the area can be burnt out and made safe before the passage of very high to extreme fire weather.

The chief limiting factor for successful prescribed burning is the high probability of rain in late

autumn and early winter. The prevailing lower temperatures and higher humidities prevent adequate drying of surface fuels

The timing of the light-up is very important. Low fuel moisture is essential to get any effective burning, due to the low levels or the discontinuous arrangement of surface fuels.

3.3 Fire behaviour potential

The greatest determinants for fire behaviour potential in the Pilliga Scrub, other than weather, are the vegetation type and the time since fire. Terrain is a minor determinant due to the low gradients for most of the area.

Extreme fire behaviour may occur in Ridgetop forest, woodlands and shrublands, and Valley and Creekside woodlands, once a sufficient time since fire has lapsed.

Fuel and fire behaviour characteristics of vegetation types in the Pilliga Nature Reserve are described in Table 3.9.

Table 3.9. Fuel and fire behaviour characteristics of vegetation communities in the Pilliga Nature Reserve

Broad vegetation type	Fuel characteristics	Fire behaviour characteristics
Ridgetop forests, woodlands and shrublands	• accumulates ground fuel from leaf litter and shrub branches, particularly under Bloodwoods • continuous shrub understorey • continuous fuel ladder from litter to the canopy • standing and ground fuels require a build up period, with 15+ years producing critical fuel levels	• Rapid fire spread with winds and low humidities • High risks of crown fires • Rate of spread can easily reach 4-6 kph • Backburning is difficult without wind, if fuels are low or humidity is >40% • Backburning is very intense with high fuels and low humidities
Valley and Creekside Woodlands	• Grassy and open shrub understoreys • Continuous ground and standing fuel. • Leaf litter rapidly accumulates under Angophoras • Fibrous bark of Angophora carries fire up • Standing fuel can build up quickly after successive good seasons.	• Rapid fire spread with high scorch heights • Will continue to burn at night with favourable humidities • intense short distance spotting • Suitable for night-time backburning when there is no wind

The potential fire behaviour in the eastern Pilliga is illustrated by the following incidents:

- a day time fire run of 30 kilometres (1982 Pilliga East fire)
- increases of fire area greater than 50,000 hectares in one day (1982 Pilliga East fire)
- significant fire runs in different directions over successive days (1966 Southern Pilliga fire and 1997 Timmallallee Creek fire)
- a night time fire run of 9 km in Valley and Creekside woodlands (1997 Timmallallee Creek fire)

3.4 Damage potential

3.4.1 Life and property

The areas where there is a potential threat to life and property are the small and medium sized rural holdings along the Newell Highway, Baradine Road, Yaminbah Valley, Dandry Road, and Narrawa Road. Many of smaller holdings adjoin the southern sections of the reserve.

The properties along the eastern and southern boundaries of the reserve, east of the Newell Highway, are larger grazing properties. Wildfires have generally been successfully contained along the margins of uncleared vegetation near the reserve boundaries.

Coonabarabran township has a potential risk due to almost continuous uncleared vegetation extending from the south-west of the reserve to areas adjoining the township.

The community under greatest threat is in Yaminbah Valley, and known as the Stannix Park estate. There is almost continuous Ridgetop woodlands and shrublands to the estate, and currently inadequate fuel management and fire protection works within the area and adjoining it.

3.4.2 Economic

Large fires within the eastern Pilliga may result in some loss of timber values. The eastern area has low levels of valuable millable timbers. Economically important timber resources are located in the western Pilliga Scrub, and historically have been unaffected by large fire events.

Large fire events and smaller intense fire events have an important effect on the flowering of trees, and consequently honey production.

Fire spreading from the eastern Pilliga could impact on cropping and grazing lands, causing potentially significant economic losses.

3.4.3 Natural heritage

Large fire events may threaten biodiversity through the extensive short-term change of habitats over a wide area. Impacts include the removal of suitable habitat for species, the reduction of available food resources, the possible removal of large portions of individual populations and increased predation by introduced predators. The greatest threat would be to species that require a habitat that develops over a fire free period of at least 10 – 15 years.

The soils of the Pilliga are highly erodible. Large fire events leave extensive areas susceptible to sheet erosion. The mass movement of soil occurs if large fire events are followed by heavy rainfall. Control line construction and other associated earth works also leave areas highly susceptible to erosion.

3.4.4 Cultural heritage

The Aboriginal sites susceptible to damage during fires are ground based sites. The risk comes from the earth works associated with fire operations. The susceptible sites are camp sites and grinding grooves. Constructing control lines away from sites can prevent the damage. Historic sites can be similarly protected.

Fire may destroy scarred trees. These trees should be protected, where possible, by excluding them from fire areas.

4.0 Fire management

4.1 Fire management objectives

The fire management objectives of the Service in the Pilliga Nature Reserve are:

- to prevent the occurrence of human caused unplanned bushfires on the reserve
- to suppress unplanned bushfires on the reserve
- to minimise the potential for the spread of bushfires on, from, or into the reserve
- to protect from bushfires, persons and property on, or immediately adjacent to, the reserve
- to manage bushfires to avoid the extinction of native species known to occur naturally within the reserve
- to protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features known to exist within the reserve
- to work co-operatively with neighbours and rural fire brigades in managing fire in and adjacent to the reserve
- to prevent single large fire events greater than 20,000 hectares
- to implement fire suppression strategies which will encourage effective and safe containment of wildfires

4.2 Fire management units

The area covered by this plan is be divided into fire management zones and fire management areas.

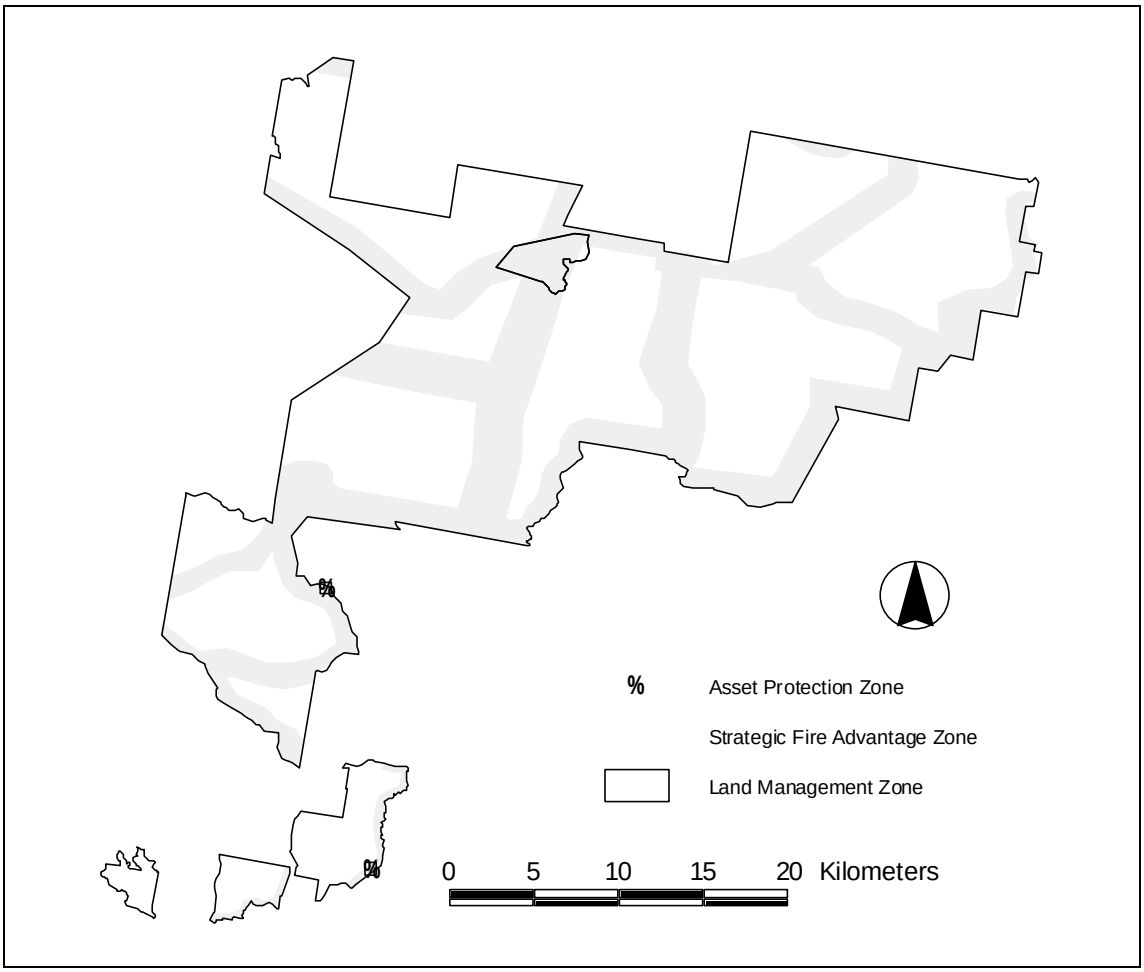
Fire management zones describe the main fire management objectives for the area covered, and are described in Table 4.1 and their locations illustrated in Map 4.2. The terminology for the zones in this plan is consistent with the *Pilliga Operations Sub-plan* prepared, by the *Pilliga Special Joint Committee*, for the entire Pilliga Area, and appended to *Plans of Operation* prepared by the affected Bush Fire Management Committees.

Fire management areas are the fundamental unit of the plan area for which fire management prescriptions will be applied. The areas have been determined by the location of trails, natural fire barriers and negotiable routes, and are illustrated in Map 4.3. Each fire management area and its management prescriptions will be described in a separate document called *Fire Management Area Profiles*.

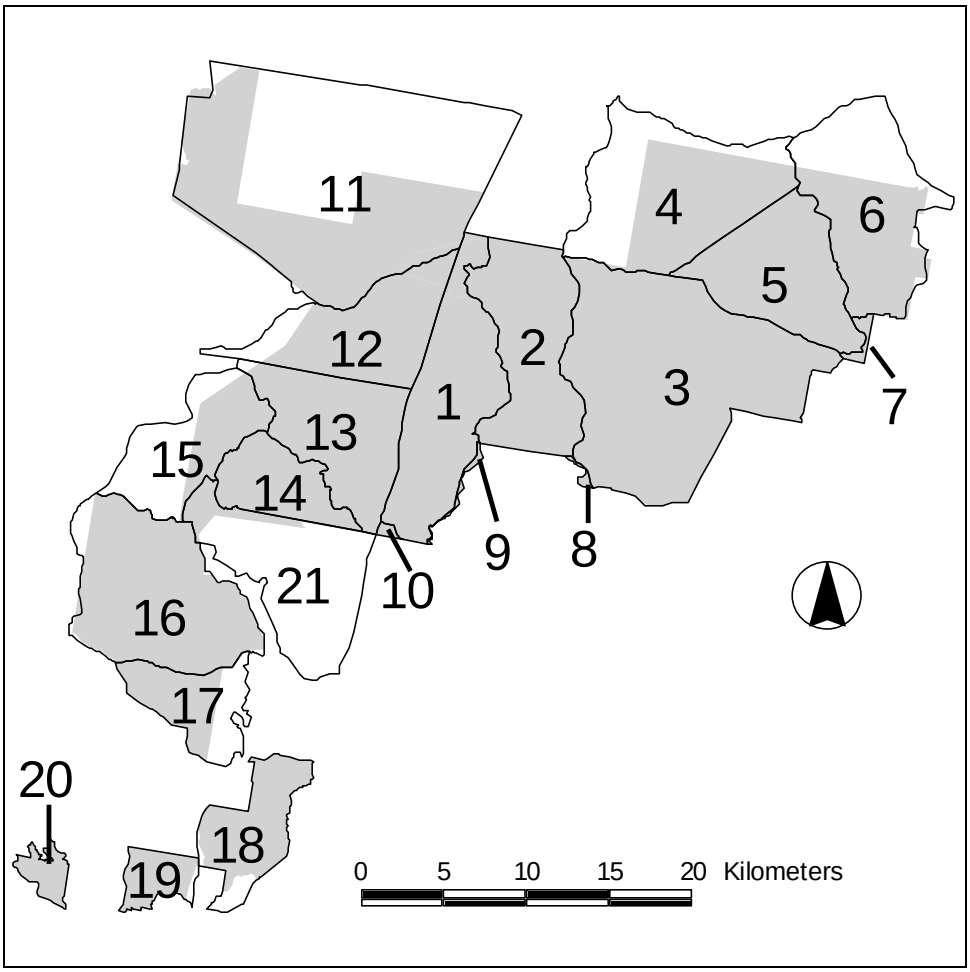
Table 4.1 Fire management zones. Pilliga Nature Reserve

Zone	Purpose	Actions
Asset Protection	• to protect residences and farm infrastructure	• prescribed burning at a frequency to maintain low fuel levels , ensuring that there is not a continuous grass, litter and shurb cover •
Strategic Fire Advantage	• to facilitate protection and conservation in other zones • to manage fuels for the strategic containment of wildfires	• prescribed burning • suppression or containment of unplanned fires
Land Management (HeritageArea)	• to prevent permanent damage or destruction of heritage items by an inappropriate fire regime	• suppress fires inconsistent with the fire management guidelines for vegetation types and threatened species • maintain appropriate fire regimes

Map 4.2 Fire management zones. Pilliga Nature Reserve and adjoining areas



Map 4.3 Fire management areas. Pilliga Nature Reserve and adjacent areas



	Fire management area	ha		Fire management area	ha		Fire management area	ha
1.	Yaminbah West	6,785	8.	Borah Creek	80	15.	Badham	4,550
2.	Yaminbah East	6,270	9.	Yaminbah Creek	115	16.	Coopers	8,530
3.	Borah	14,740	10.	Sandstone Caves	80	17.	Salaks	2,980
4.	Delwood	8,800	11.	Timmallallee North	20,120	18.	Upper Dandry	3,320
5.	Kerringle - Baileys	14,740	12.	Timmallallee Creek	5,480	19.	Ukerbarley	1,280
6.	Willala	7,380	13.	Timmallallee South	5,540	20.	Yearinan	710
7.	Baileys Gate	190	14.	Banksia	2,860	21.	Barkarla	6,560

4.3 Protection of neighbours and facilities

The assets requiring protection from fires burning on and leaving the nature reserve are the adjoining grazing and cropping lands, livestock, bee hives, fences, farm buildings and residences and machinery.

Asset protection will be performed, where possible, by the construction and maintenance of trails along or adjacent to the nature reserve's boundary with private property. In the case of bee hives, early or rapid notification of fires or fire operations will allow beekeepers to take appropriate action.

Sections of the reserve boundary pass through terrain that is steep, and are therefore inappropriate locations to construct and maintain trails. In these cases, the Service will negotiate with the landholder to locate trails where they will be mutually advantageous for fire management and the landholders' requirements.

Two Asset Protection Zones will be established adjacent to two residences bordering on the reserve. These will be located next to Geronimos Hideaway and the Pilliga Pottery.

4.4 Strategic fire management

Strategic fire management involves works, which may assist in the containment of wildfires, and which are performed before the occurrence of wildfires. This is achieved by prescribed burning and, by the construction and maintenance of fire trails.

Strategic fire advantage zones will be established in a number of locations in the reserve. The purpose of these zones will be to maintain areas with lower fuel levels, by the use of prescribed burning, to significantly reduce potential fire behaviour in a wildfire and to provide manageable control lines.

The location of the strategic fire advantage zones is illustrated in Map 4.2. These zones are located along the following roads and trails, of which most are illustrated by Map 5.1:

Scratch Road	Sandstone Caves Road	Punks Trail
Galloways Road	Newell Highway	Coopers Creek Trail
Kerringle Road	Dipper Road	Salaks Road
Borah Road	Timmallallee Creek Road	Dandry Road
Airlands Road	Number One Break Road	Ukerbarley Trail
Redbank Trail	Banksia Trail	
Yaminbah Creek Trail	Badhams Trail	

The fire trails managed and maintained in the reserve are listed in Section 5.

The interval between a previous fire event, and a proposed prescribed burn, may need to be less than the vegetation management guidelines stated in the following section. These instances will arise after very wet seasons when a rapid build-up of fine fuels occurs. Recently burnt areas may need to be burnt again to ensure that Strategic Fire Management Zones will be effective.

The strategic fire advantage zones will form the basis of pre-determined suppression strategies during certain conditions. Under extreme conditions, the zones will be used as control lines once a fire starts running, with resources falling back to roads and trails located in these zones.

4.5 Land Management (Heritage Area) - Heritage Conservation

A Land Management (Heritage Area) Zone will cover the majority of the reserve.

The management requirements for the protection and conservation of the various heritage attributes of the reserve are discussed below.

4.5.1 Biodiversity - vegetation management guidelines

The management guidelines for vegetation communities provide a basis for decision making for the programming of prescribed burns and fire suppression strategies.

The management guidelines for each broad vegetation type are listed in the Table 4.4. These guidelines provide broad parameters of key fire regime components required to achieve biodiversity objectives.

Management guidelines for rare or threatened plants species are listed in Appendix 1. Some of the listed species may be impacted upon by control line construction for fire operations. This list should be referred to as to determine actions to avoid damage to these species.

Table 4.4. Management guidelines for vegetation types in the Pilliga Nature Reserve

Broad vegetation type	Management guidelines
Ridgetop Eucalypt forest, woodlands and shrublands	• an interval between fire events of less than 15 years should be avoided • a high intensity may be permitted after a fire-free interval greater than 30 years • two consecutive low intensity fires should be avoided • avoid two large area high intensity wildfires in a period less than 30 years
Valley and Creek-side Woodlands	• an interval between fire events less than 10 years should be avoided • a high intensity may be permitted after a fire-free interval greater than 30 years • avoid two large area high intensity wildfires in a period less than 30 years

4.5.2 Biodiversity - fauna management guidelines

The greatest threat to the maintaining the fauna diversity of the Pilliga is the size of large fire events and adverse fire regimes over a large area. Large fire events have acute short-term impacts on food resources and shelter for a number of species. Reducing the potential for large fire events is the major management guideline for all fauna in the Pilliga.

Limited studies have indicated that faunal diversity in the Pilliga is reduced with fire intervals less than 10 years and greater than 20 years. Applying this interval in Strategic Fire Management

Zones will allow both fuel management and faunal diversity objectives, for most species, to be achieved.

Some species rely on habitats that only develop with the longer fire-free intervals. Areas will be selected within the Land Management (Heritage Area) Zones where a longer fire free interval will be maintained.

The management requirement for threatened species and species of special interest are listed in Appendix 1. These guidelines will also benefit other native fauna species. These are intended to augment the definitions of desirable fire regimes for vegetation types listed in Table 4.4. As additional sightings of rare and threatened species are recorded, there may be a need to modify these fire management guidelines accordingly.

The guidelines provided for the management of animal species and their habitats within this plan will be subject to the provisions of the *Threatened Species Conservation Act, 1995*. This Act provides the framework to protect and encourage the recovery of threatened species, populations and ecological communities. The development of recovery plans is a requirement under the Act to ensure the appropriate management and planning for the conservation of threatened species. As these recovery plans are developed, there may be a need to adjust the fire management guidelines according to the recommendations of the recovery plans.

4.5.3 Aboriginal heritage

Aboriginal sites in the nature reserve could be at risk by inappropriate fire operations. The risk of damage can be prevented by excluding the use of earth moving equipment in locations identified to contain, or potentially contain, Aboriginal sites or areas. Maps of site location will be held at service offices.

Sites surveys will be conducted along proposed permanent and temporary trail routes to prevent damage to Aboriginal sites.

4.5.4 Historical heritage

The historical heritage of the nature reserve can be protected by excluding sites from burn areas and by the construction of control lines around them. Maps of site location will be held at service offices.

4.5.5 Landscape conservation guidelines

The reserve has extensive rocky ridges and slopes that could suffer long term damage by the use of earth-moving equipment, particularly for long control lines. The risk of damage will be reduced by avoiding the use of earth moving equipment in selected areas, and working adjacent to these areas. Also, the construction of long control lines will be slower in very rocky areas.

The soils within the reserve are highly erodible, particularly where slopes exceed five degrees and along gully and creek lines. Severe erosion can be avoided by:

- minimising the length of trail construction, using earth moving equipment, in steeper country

- considering the construction of short lengths of handtool trails in steep country to link sections of dozer constructed lines
- locating control lines at least 20 – 50 metres from the gully or creekline, if the line is to be constructed along a valley
- avoiding the widening of established fire trails
- stablising and restoring newly constructed control lines as soon as possible after the containment of the fire

4.5.6 Fire operation record-keeping

The future management of the reserve for biodiversity and heritage management will be based on the keeping of thorough records of all fire management operations. Information that is regarded as essential are:

- fire boundaries
- estimations of the fire intensity over areas burnt
- location of earthworks
- location of large scale foam and retardant drops

4.6 Evaluation of fire current regimes

The 1997 wildfire affected over 50% of the reserve, and with another 10% of the reserve affected by wildfires and prescribed burns during the last ten years.

The 1997 fire significantly reduced the range of the areas in classes for time since last fire. These classes are illustrated by Figure 4.5. The classes with the smallest areas are: 6 – 10 years, 11 – 15 years and 31 - 40 years since fire.

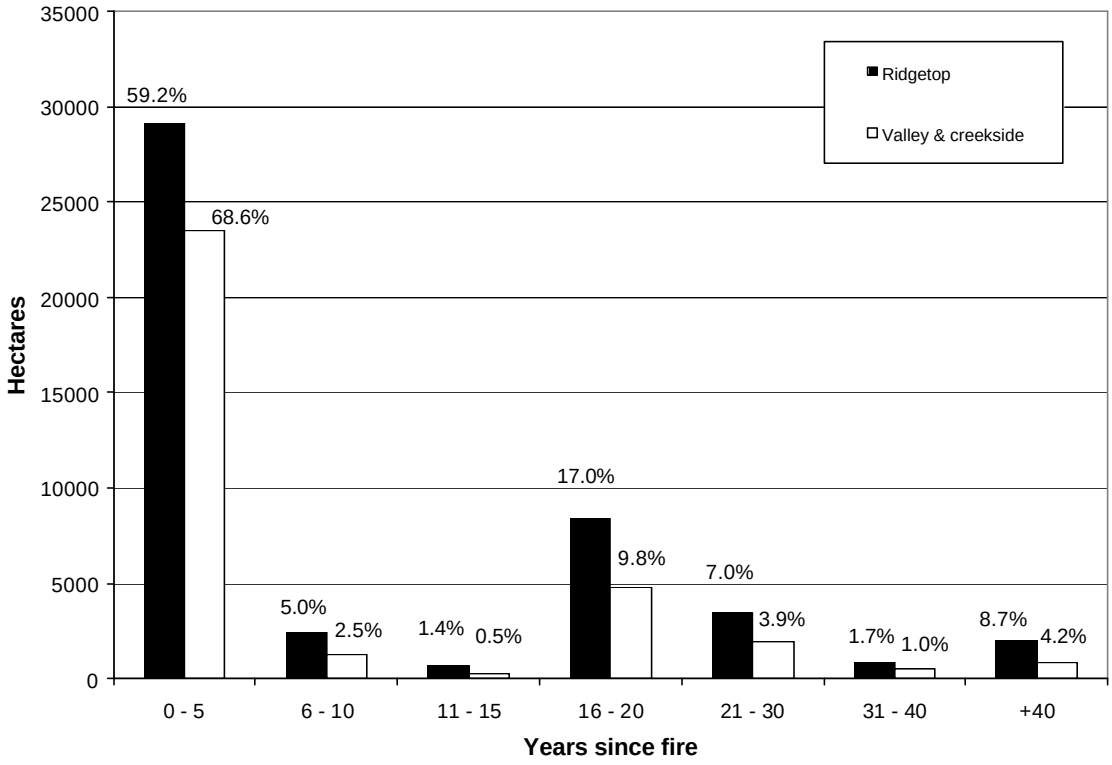
A number of areas have been burnt four and more times in the last 50 years, with the highest frequency occurring on the southern side of Kerringle Road (see Map 3.5 for fire frequency). It will be important to reduce the extent of wildfires in these areas, and exclude prescribed burns during the next five years.

Maintaining areas with a longer fire-free interval will be an important aim for the next fire years. This is to provide habitats for species that require a long fire-free interval. Areas with an interval of greater than twenty years are located in the eastern areas of the reserve. This includes an area that has not burnt since 1951.

The risk of a large fire event in the eastern Pilliga remains high during the next five years. Prescribed burning in Strategic Fire Advantage Zones in the eastern areas will be important to minimise the potential size of wildfires.

The area of fire events should be minimised in the areas affected by the 1997 fire. Prescribed burning may be permitted in this area, where there is a rapid build up of fuels in a Strategic Fire Advantage Zone, and the effectiveness of the zone could be reduced.

Figure 4.5 Time since fire, by area, for the broad vegetation types



4.7 Operational guidelines

Operational guidelines describe actions which should be implemented during any fire operation in order to encourage effective and safe fire suppression, and to protect the heritage attributes of the nature reserve. These guidelines were developed from the experience of large fires in the Pilliga Scrub (Brookhouse and Nicholson, 1999).

The guidelines are consistent with the *Pilliga Operations Sub-plan* prepared, by the *Pilliga Special Joint Committee*, for the entire Pilliga Area, and appended to *Plans of Operation* prepared by the affected Bush Fire Management Committees.

The operational guidelines will be supported by the *Suppression Advantages Map* that details the location of tracks, trails, loading ramping and watering points. This map will be held in the NPWS offices at Coonabarabran and Narrabri.

Aerial suppression strategies, for rapid initial attack, are limited both by surface water availability and the deployment time for appropriately adapted bombing aircraft

These guidelines are listed in Tables 4.6, 4.7, 4.8 & 4.9.

Table 4.6 Operational guidelines: General guidelines

Operational area	Guidelines
Aerial bombing	• Fixed wing bombing aircraft must operate out of the closest airfield practicable. • The use of bombing aircraft should support containment operations by aggressively attacking spot-overs. • Broad scale retardant drops are generally impractical due to the potential for very long control lines.
Aerial ignition	• Both fixed wing and helicopters mounted with incendriary machines should be deployed to support large burn-out operations due to the potential length of control lines and the potential areas to be burnt.
Backburning	• Resources required for burning operations should be programmed to take full advantage of the short period suitable for burning operations. • Burning operations, in most cases, requires wind assistance or low humidities, for most vegetation types and fuel conditions • The opportunity for backburning at moderate intensities is very restricted for most vegetation types and fuel conditions • Temperature and humidity trends must be monitored carefully to determine the best times to implement backburns • Thorough briefings must be conducted with Sector Commanders, Crew Leaders on the backburning guidelines • The timing of backburning should be planned and implemented as to prevent a deep high intensity burn between the the western control lines and the active fire.
Construction of control lines	• Plant must be guided at night where there are safety issues arising from cliffs moderate and steep terrain, and steep creek banks in flat terrain • Plant guides should be briefed on the location of the proposed line and heritage items. • Earthmoving equipment constructing control lines, near active fire edges, must be accompanied by a suitable fire tender with radio communications. • Minimise the length of trail construction, using earth moving equipment, in steeper country • Consider the construction of short lengths of handtool trails in steep country to link sections of dozer constructed lines • Locate control lines at least 20 – 50 metres from the gully or creekline, if the line is to be constructed along a valley • Avoid the widening of established fire trails, where possible. • Control lines need not exceed 6 metres.
Containment strategies	• Proposed control lines must be located with consideration of the potential rate of spread under the current weather conditions, *extreme weather has fire runs between 15 and 30 kms* • The use of recently burnt areas as control advantages should be maximised • The *Incident Management Base Maps* should be referred in developing containment strategies • Control lines should be re-inforced through backburning.
Crew shifts during large fires and extreme weather	• Crew deployment should be maximised during the late afternoon and early evening for backburning operations.
Fire runs (fires with convection columns)	• The heads of fire runs will not be directly attacked, except with indirect methods to deepen existing control lines and strategic fire management areas
Parallel attack	• Parallel attack should not attempt to move around the head until the fire stops running. • Distance between control line construction plant operators and burn out crews / fire units must be kept to a minimum. (This is for the safety of the plant operators.)
Reconnaissance	• Aerial reconnaissance must be conducted regularly with large fires or potentially large fires.
Restoration	• Plant crews should be allocated to soil erosion control works and remedial restoration works before standing down from the fire operations

Table 4.7 Operational guidelines: Guidelines for broad vegetation types - Seasons with saturated sub-soils

Broad vegetation type	Guidelines
All vegetation types	**Containment strategy** • Vehicle and earth moving equipment use may be severely limited due to the risk of bogging • The use of vehicles should be avoided in areas known or identified to be prone to surface soil and sub-soil saturation • A broad area containment strategy should be considered using existing roads and trails, creeklines and recently burnt areas.

Table 4.8 Operational guidelines: Guidelines for broad vegetation types - Moderate conditions

Broad vegetation type	Guidelines
Ridgetop forests, woodlands and shrublands	**Containment strategy** *severe or dry unstable weather conditions forecast* • direct and parallel attack with plant and fire units to minimise fire area • secure flank as soon as possible on the next predicted downwind side *moist weather forecast* • maximise fire area in accordance with the requirements for any proposed prescribed burns, to meet long term fire and land management objectives • in steep dissected country, control line construction may only be possible along ridgetops and spurs • in undulating sandstone country, control line construction may be more rapid along or parallel to ridgetops
Valley and Creekside Woodlands	**Containment strategy** *severe or dry unstable weather conditions forecast* • direct and parallel attack with plant and fire units to minimise fire area • secure flank as soon as possible on the next predicted downwind side *moist weather forecast* • maximise fire area in accordance with the requirements for any proposed prescribed burns, to meet long term fire and land management objectives • construct a control line across the woodlands, preventing rapid spread

Table 4.9 Operational guidelines: Guidelines for broad vegetation types - Very High – Extreme conditions

Broad vegetation type	Guidelines
Ridgetop forests, woodlands and shrublands	**Containment strategy** • fallback to existing trails and roads and recently burnt areas when fire runs exceed control line construction rates and/or during weather with very low humidities and shifting winds • 0 - 3 year burn areas may hold head fires, if area is deep enough • 3 - 7 year burn areas will generally reduce the fire intensity, but may not hold head fires • select control lines • secure and deepen control lines on the next predicted downwind side of the fire • burn-out the area between the control and the fire front as soon as possible on the next predicted downwind side, using ground and aerial ignition methods **Backburning** • target backburning operations when humidity rises in late afternoon and early evening • consider restricting backburning operations on downwind control lines when humidity <20% • maximise backburning opportunities with winds, where appropriate • backburns should not be lit to early so that it does not add to the fire front or intensity

Valley and Creekside Woodlands	**Containment strategy** • use existing trails and roads and recently burnt areas when fire runs exceed control line construction rates and/or during weather with very low humidities • consider establishing a temporary control line across the woodlands, preventing rapid evening spread • carefully assess recently burnt areas for their effectiveness to hold fires without hard control lines • 1+ year burn areas may not hold head fires, but reduce intensity • secure and deepen control lines on the next predicted downwind side of the fire • burnout the area between the control and the fire front as soon as possible on the next predicted downwind side **Backburning** • consider restricting backburning operations on downwind control lines when humidity <20% • maximise backburning opportunities during the evening

4.8 Research and monitoring requirements

The research and monitoring requirements associated with fire management and the conservation of the nature reserve include the effects of wildfires and prescribed burns, remote sensing of fuel conditions and the survey of Aboriginal sites.

Specific actions to fulfil these research and monitoring requirements are as follows:

Requirements	Actions
• fuel monitoring	establish fuel monitoring sites, measuring build up of available fuel
• fire effects	establish monitoring sites after wildfire events, and and before prescribed burns, recording species composition and regeneration
• assessing fuel conditions using remote sensing technology	utilise satellite data and fuel field measurements to develop a methodology to monitor fuel buildup
• biodiversity surveys	initiate vegetation and fauna surveys and monitoring programs

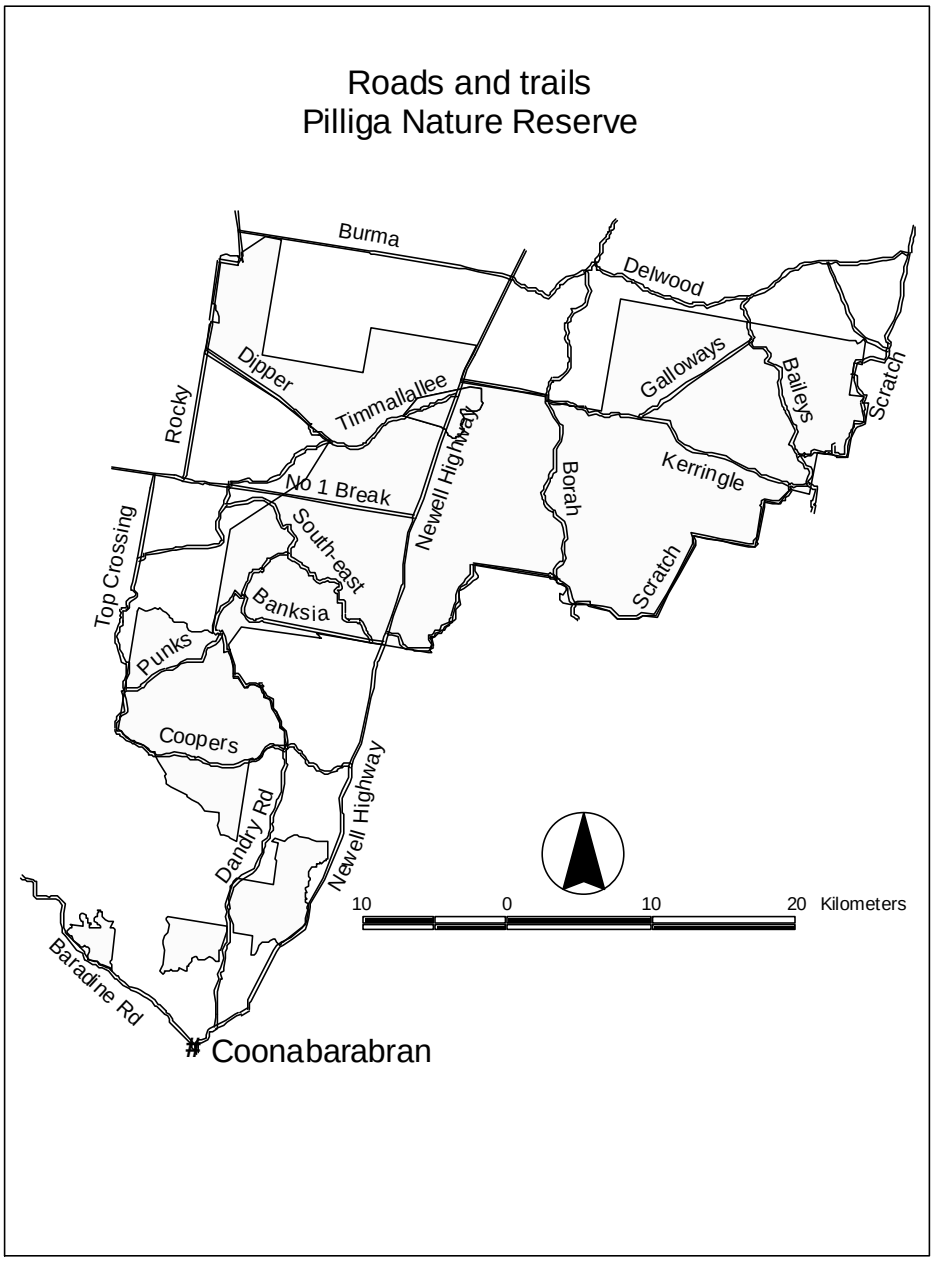
5.0 Fire management assets

5.1 Fire management access

5.1.1 Existing trails and routes

Fire management trails includes all roads, vehicular trails and walking trails that can be used for fire management and fire control operations. The fire management trails in and adjacent to the Pilliga Nature Reserve are illustrated by map 5.1 and listed in Table 5.2.

Map 5.1. Location of trails in the Pilliga Nature Reserve



A detailed trail register is maintained in the offices of the Northern Plains Region, and describes vehicular accessibility, condition and actions required on the trail during fire suppression operations. All trails will be mapped on the *Suppression advantages map*.

Table 5.2 Fire Trails in the Pilliga Nature Reserve

Name	Length	Location
Airlands Road	5.5	east of Newell Highway
Badham Trail	5.0	west of Newell Highway
Baileys Road	14.2	east of Newell Highway
Banksia Trail	16.0	west of Newell Highway
Borah Creek Trail	16.8	east of Newell Highway
Dandry Creek Trail	5.0	south-west part of the reserve
Darkos	4.0	around Dandry Station property
Dipper Road	11.0	west of Newell Highway
Galloway Road	10.0	east of Newell Highway
Geronimos Trail	5.0	Upper Dandry section of the reserve
Kerringle Road	19.0	east of Newell Highway
Number One Break Road	10.0	west of Newell Highway
Punks Road	8.0	south-west part of the reserve
Sandstone Caves Road / Yaminbah Creek Trail / Redbank Trail	16.0	east of Newell Highway
Scratch Road /Baileys Gate	35.0	east of Newell Highway
South-east Trail	14.0	west of Newell Highway
Timmallallee Creek trail	10.0	west of Newell Highway

5.1.2 Proposed trails

There is only one new trail proposed by this plan. This will be located along the southern boundary of the Ukerbarley section of the reserve. This trail would link Dandry Road to Ukerbarley property.

5.1.3 Proposed trail re-alignments

There are two proposed trail re-alignments. These are:

- Baileys Road between Scratch Road and Galloway Road
- Punks Trail

Both trails currently follow along creeklines, and are very susceptible to water logging. There is a very high risk of vehicles bogging when the water table is high. Severe erosion has occurred. Re-aligning sections of these trails will reduce the susceptibility of the these trails to erosion. Sections of abandoned trails will be stabilised and rehabilitated.

5.1.4 Trail signs

Small signs will be constructed and erected at the beginning and the junctions of trails. This will assist all fire fighters during fire operations.

5.2 Fire management utilities

Fire management utilities includes infrastructure that assists in the detection and control of wildfires, and assists in fire management operations. This includes fire towers, dams and maintained watering points, and helipads.

All infrastructure is mapped on the *Pilliga Nature Reserve Incident Management Base Map* held in the NPWS offices at Coonabarabran and Narrabri.

Alilades are used to provide bearings to smoke sightings. These will be maintained at Borah Station, Baileys Look-out and Willala Mountain.

Loading ramps are required for unloading earth-moving machinery used for fire operations. Loading ramps will be constructed and maintained at:

- Airlands Road
- Baileys Gate
- Banksia Trail
- Barkarla
- Borah Station
- Burma Road
- No 1 Break Road
- Salaks Road
- Yaminbah Waterhole

Where the ramps are located on private property, the Service will negotiate with the landholder over the construction and maintenance of the ramp.

6.0 Works schedule

6.1 Bushfire utilities, fire trails and mechanical fuel management

This works schedule specifies the maintenance program for all existing fire management infrastructure and fire trails, the construction timetable for new infrastructure and trails for the period 2001 to 2006. This also includes works for asset protection which involves mechanical treatment for fuels.

The acquisition of specific equipment which will enhance the Service's fire management capability is also listed below.

Existing trails, high risk season trails and fuel management areas

Infrastructure, trail or area to be treated	Works to be conducted	Scheduled works period
All Class 2 trails	Regrading and slashing	Slashing conducted on biennial program. Grading programmed after annual assessment, based on requirement
All Class 3 trails	Slashing	Slashing conducted on 5 year program
Baileys Road (south)	Closure and stablising route to prevent further erosion Construct new route suitable for future control lines	2001/2002
Punks Road	Construct new route suitable for future control lines Closure and stablising route to prevent further erosion	2001/2002

New trails and infrastructure

Works	Works to be conducted	Scheduled works period
Trail along southern boundary of Ukerbarley Section	route investigation, REF preparation, trail construction	2002/03
Trail signage	purchase and installation	2002/03
Loading ramp construction	construction	2003/04

6.2 Prescribed Burns

The majority of the reserve was burnt during the 1997/1998 fire season. These areas will not be scheduled for prescribed burning during during the 2000 – 2005 planning period.

Areas programmed for prescribed burning during the next five years, and illustrated by Map 6.1, are:

Area	Purpose	Scheduled period
Newell Highway	Strategic Fire Management Zone, fuel reduction	2001
Kerringle Road West	Strategic Fire Management Zone, fuel reduction	2002
Ukerbarley, along Dandry Road	Strategic Fire Management Zone, fuel reduction	2002
Yearinan	Land Management Zone, vegetation management	2003
Scratch Road, between Kerringle Road and Willala Road	Strategic Fire Management Zone, fuel reduction	2004
Scratch Road South	Strategic Fire Management Zone, fuel reduction	2005
Baileys Gate	Strategic Fire Management Zone, fuel reduction	2006
Galloway Road North	Strategic Fire Management Zone, fuel reduction	2006

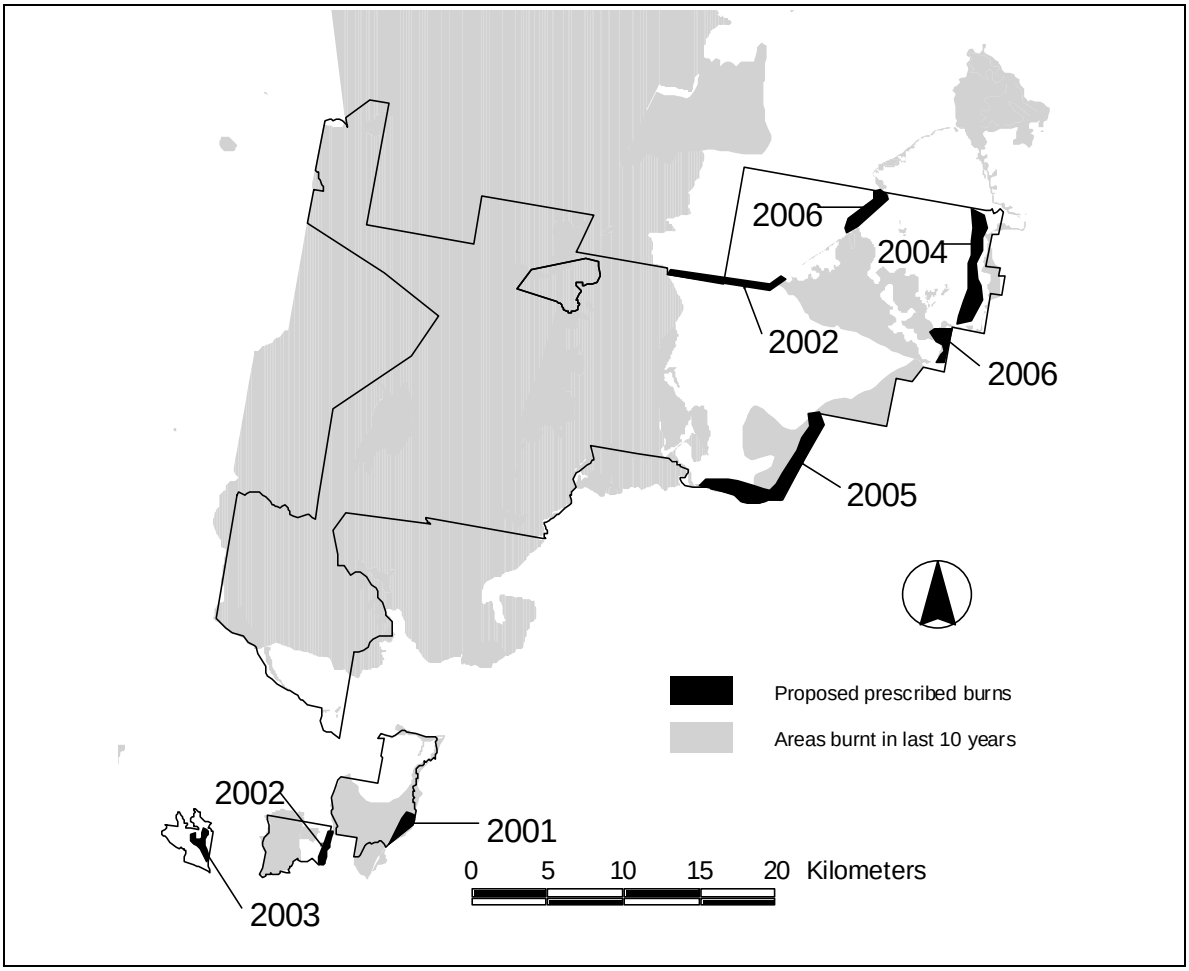
The Service may assist, during the next five years, with adjoining landholders where prescribed burns are proposed for strategic fire management purposes.

6.3 Research

Four research projects have been identified to assist with the fire management of the Pilliga Nature Reserve. The schedule for commencing these projects are listed below.

Research area	Actions	Commencement
• fuel monitoring	• establish fuel monitoring sites, measuring fuel accumulation at each site	2001
• fire effects	• establish monitoring sites after fire events, recording regeneration and species composition	2001
• assessing fuel conditions using remote sensing technology	• utilise satellite data and fuel field measurements to develop a methodology to monitor fuel build	2002
• biodiversity surveys	• Pilliga mouse and small mammals surveys • botanical survey • reptile and bat survey	ongoing 2003 2003

Map 6.1 Proposed prescribed burns for the plan period



7.0 Plan administration

7.1 Management of works

The works programmed for the next five years will be identified in:

- the annual Northern Plains Regional Operations Plan which lists all park management works to be conducted in all conservation reserves in the National Parks and Wildlife Service Northern Plains Region; and

- the Fuel Management Plans prepared by the Coonabarabran, Gunnedah and Narrabri Bush Fire Management Committees.

The performance of the works will be monitored by the Northern Plains Regional Manager. An annual report on the works completed will be submitted to:

- Coonabarabran, Gunnedah and Narrabri Bush Fire Management Committees

- NPWS Fire Management Co-ordinator and Executive Director (Western)

7.2 Monitoring fuel and fire effects

The monitoring of fuel levels and fire effects will be conducted to ensure that the objectives for asset protection and heritage management are achieved. A monitoring program and methodology will be determined.

Currently, no permanent monitoring sites have been established. Temporary monitoring sites may be established in areas where wildfires have occurred, and the fire effects need to be recorded.

7.3 Environmental assessment of scheduled works

The National Parks and Wildlife Service considers that all works listed in the Work Schedule as activities under Section 111 of the *Environmental Planning and Assessment Act 1979*.

Environmental assessments will be conducted according to procedures prepared by the Service, and endorsed by the Department Urban Affairs and Planning. Where a significant impact has been determined for the proposed activity, an environmental impact statement will be prepared.

7.4 Fire management research

The progress of the research will be monitored by the Northern Plains Regional Manager. An annual report on research will be prepared, which will be submitted to:

- Coonabarabran, Gunnedah and Narrabri Bush Fire Management Committees
- NPWS Fire Management Co-ordinator and Executive Director (Western)

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Appendix 1 Rare and threatened species of the Pilliga, their habitat and fire effects, and management guidelines

Species	Common Name	Conservation code	Habitat and fire effects	Management guidelines
Plants				
Eriostemon ericifolius		3RC-	The species has been recorded in the Pilliga East State Forest and the Pilliga Nature Reserve. The species has been observed to regenerate after fire and soil disturbance.	Exclude fires from identified sites for a minimum period of 10 years. Ensure that control line construction avoid plant locations.
Goodenia macbarronii		3VC- Vulnerable	The species may be periodically abundant along water courses and swampy areas after wet seasons. Its distribution is very widespread in the reserve.	No special management requirements.
Lomandra patens		3RCa	Most species of the genus resprout after fire events.	Ensure that control line construction avoids individual plants
Persoonia cuspidifera		2K	The species has been widely observed in and adjacent to the nature reserve. It has been observed resprouting after fire events (P. Brookhouse, pers. comm.)	No special management requirements.
Rulingia procumbens		3V Vulnerable	The species has been observed germinating and re-establishing after fire events in Goonoo State Forest (D. Nicholson, pers. comm.) and the Pilliga Nature Reserve (D. Binns, per. comm.). A periodic burning or soil distirbance may be important for the survival of the species in an area.	A fire-free interval of 30 years should be followed by a moderate to high intensity fire
Reptiles				
Hoplocephalus bitorquatus	Pale-headed Snake	Vulnerable	The habitat is the hollows, cracks and gaps under bark off mature trees (Date & Paull, 1996). Frequent fire may eliminate the species from an area.	Reduce the frequency of fire events, as to prevent the elimination of habitats.
Birds				
Botaurus poiciloptilus	Australasian Bittern	Vulnerable	Vagrant species, visiting watercourses.	No special management requirements.
Calyptorhychus lathami	Glossy Black-cockatoo	Vulnerable	A widespread and commonly sighted species in the Pilliga Scrub. *Allocasuarina* species are a major food resource (Date & Paull, 1996). Have been observed breeding and feeding in *Angophoras* (P. Brookhouse, pers. comm.). Large intense fire events may affect available food resources.	Reduce the incidence of single large fire events which may significantly reduce food resources, particularly stands of *Allocasurina*. Avoid spring burning to prevent disruption of breeding.

Species	Common Name	Conservation code	Habitat and fire effects	Management guidelines
Lathamus discolor	Swift Parrot	Vulnerable	Breeds in southern Australia, and migrates to the north in winter. Large fire events may affect available food resources.	Reduce the incidence of single large fire events which may significantly reduce food resources.
Leipoa ocellata	Malleefowl	Endangered	Mounds and sightings of the species have been recorded in various parts of the reserve. There have been no sightings for about twenty years. Potentially extinct in the reserve and the Pilliga Scrub.	Exclude fire from areas identified to have nest mounds.
Lophocintinia isura	Square-tailed Kite	Vulnerable	Breeding sites recorded in and near the reserve. Pairs will nest in the same location over successive seasons. Spring burning near nesting sites may disrupt breeding.	Prevent burning during the spring breeding season, particularly from nesting areas.
Neophema pulchella	Turquoise Parrot	Vulnerable	The species occurs throughout the reserve. The preferred habitat are Valley and Creekside Woodlands with a grassy understorey. Burning may promote suitable foraging habitat. (Date & Paull, 1996). Spring burning may disrupt breeding.	Prevent burning during the spring breeding season, particularly from nesting areas.
Polytelis swainsonii	Superb Parrot	Vulnerable	A seasonal visitor which does not breed in the Pilliga, migrating to the area during autumn and winter. Large fire events may affect available food resources.	Reduce the incidence of single large fire events which may significantly reduce food resources.
Xanthomyza phrygia	Regent Honey-eater	Endangered	A seasonal visitor which occasionally breeds in the Pilliga. The sightings of the species is associated with stands of Eucalyptus sideroxylon. Fires have been recorded to encourage food sources.(Date & Paull, 1996).	Reduce the incidence of single large fire events which may significantly reduce food resources.
Mammals				
Acrobates pygmaeus	Feathertail Glider		Trapped in the southern Dandry area, near the nature reserve in Ridgetop Woodlands (S. Brookhouse, pers. comm.). Fire events which reduce the number of potential den trees may impact the species. Spring burning may disrupt breeding.	Prevent frequent burning over large areas, at interval less than 15 - 20 years, allowing the regeneration of shrub understories, with a mosaic of times since fire.
Aepypymnus rufescens	Rufous Bettong		Unverified sightings by both researchers and fire fighters. Observations are generally from Valley and Creekside Woodlands.	Reduce the incidence of large fire events, which burn through Valley and Creekside woodlands, allowing for fire intervals greater than 25 years.
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Utilises caves and trees as roosts. Maternity roost has been found in a cave located in the 1997 fire area. Post fire breeding has been successful. A reduction of mature trees may reduce roosting habitat.	Reduce the incidence of large fire events
Chalinolobus pictatus	Little Pied Bat	Vulnerable	Utilises caves and trees as roosts. A reduction of mature trees may reduce roosting habitat.	Reduce the incidence of large fire events

Species	Common Name	Conservation code	Habitat and fire effects	Management guidelines
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Limited sightings in the state forests, potentially in the nature reserve (Paull & Date, 1996). Frequent burning may reduce suitable habitat. Single large fire events may threaten the population.	Reduce the incidence of large fire events
Macropus dorsalis	Black-striped Wallaby	Vulnerable	Limited sightings in the nature reserve and state forests. Preferred habitat is Brigalow. Fires may reduce suitable understorey habitat.	Reduce the incidence of large fire events, which burn through Valley and Creekside woodlands, allowing for fire intervals greater than 25 years.
Miniopterus schreibersii	Common Bent-wing Bat	Vulnerable	Utilises caves and trees as roosts. A reduction of mature trees may reduce roosting habitat.	Reduce the incidence of large fire events
Nyctophilus timoriensis	Greater Long-eared Bat	Vulnerable	Utilises trees as roosts. A reduction of mature trees may reduce roosting habitat.	Reduce the incidence of large fire events
Petaurus norfolcensis	Squirrel Glider	Vulnerable	The species may be potentially common in the southern areas of the Pilliga. Fire events which reduce the number of potential den trees may impact the species. Spring burning may disrupt breeding.	Prevent frequent burning over large areas, at interval less than 15 - 20 years, allowing the regeneration of shrub understories, with a mosaic of times since fire.
Phascolarctos cinereus	Koala	Vulnerable	Occurs along a number of watercourses in the western and southern areas of the reserve. It is more common in the western areas of the Pilliga Scrub. The frequency and size of fires in the eastern areas of the reserve may limit the size of populations.	Prevent high levels of canopy scorch during prescribed burns.
Pseudomys pilligaensis	Pilliga Mouse	Vulnerable	Evidence is suggesting that the species may be more common than expected. The species appears to recover population numbers rapidly after fire events (Paull, pers. comm.).	No special management requirements.
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	Vulnerable	The species feeds above canopies. Its breeding and roosting behaviour in the Pilliga is unknown.	Reduce the incidence of large fire events
Sminthopsis nov. sp.	Undescribed Dunnart		Limited sightings in the state forests and the nature reserve (Lim, 1992; Paull, 1998). The impact of fire on the population is unknown.	Reduce the incidence of large fire events

Plant conservation status codes
2 - geographic range <100 kms 3 - geographic range >100 kms

V - Vulnerable R - Rare K - poorly known C - Reserved a - >1000 plants in conservation reserves - reserved populations not adequately known