HOTSPOTS FIRE PROJECT

MANAGING FIRE ON YOUR PROPERTY

A booklet for landholders in the Border Rivers-Gwydir region

NSW RURAL FIRE SERVICE

Nature Conservation Council The voice for nature in NSW

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Version 1, July 2014

The Hotspots Fire Project is jointly delivered by the
Nature Conservation Council of NSW and NSW Rural Fire Service.

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1 INTRODUCTION TO THE BORDER RIVERS-GWYDIR REGION

The Border Rivers-Gwydir region is comprised of two major catchments: the Border Rivers and Gwydir River. The rivers in the area flow westward with the major rivers being the Gwydir, Barwon, Severn, Macintyre and Dumaresq. Covering an area of approximately 50,000 square kilometres these catchments are part of the upper reaches of the Murray-Darling basin. The region has three distinct landscapes: the Tablelands, the Slopes and the Plains. The population of 65,000 people is concentrated in and around Glen Innes, Tenterfield and Uralla on the Tablelands, Inverell and Bingara on the Slopes, and Moree and Mungindi on the Plains.

The climate ranges from subtropical to temperate with cooler, wetter conditions in the east and hotter, drier conditions in the west. Agriculture is the main industry in the region with the Tablelands supporting grazing for wool, lamb and beef cattle. The Slopes and Plains contain a mix of cropping and grazing with a focus on irrigated crops in the west. The varied geology of the region also allows for mining and energy production including sapphires, tin and coal.

Across the region the significant variation in climate, altitude, geology and soils results in a great diversity of plant and animal communities. A wide variety of vegetation formations occur in the region with woodlands and forests being the most common, but heaths, shrublands, swamps, grasslands and rainforests are all represented. Areas with relatively intact native vegetation cover are found mostly on the land which is least productive, such as steep slopes in hilly and mountainous terrain, areas of sharply-sloping granite and rhyolite, and poor sandy soils on the sandstones of the Warialda (Pilliga) formation.

In the east of the region high altitude areas have extensive patches of forest remaining. Moving west the vegetation gradually changes to more open woodlands, shrublands and grassy plains. Several plant species are unique to this region, including the Myall Creek wattle (*Acacia atrox*) and Bolivia Hill boronia (*Boronia boliviensis*). The region also includes around 40,000 hectares of wetlands with 823 hectares of the Gingham and Gwydir Wetlands protected under the Ramsar Convention on Wetlands.

The Border Rivers-Gwydir area is rich in Aboriginal cultural heritage, with many Aboriginal nations living in the area for over thousands of years (and still living in the area today). Aboriginal nations of the Border Rivers-Gwydir region include the Kamilaroi (Gomeroi), Anawaan, Ngarrabal and Banbai.

The land of the Kamilaroi nation stretches from the western area of the region to the border with the Banbai nation near Guyra in the east of the region. The Anawaan nation's land extends south from the border with the Banbai nation (near Guyra) towards Uralla and northwest towards the Tingha district. The land of the Ngarrabal nation is around the Glen Innes area.

There are a number of Aboriginal cultural heritage sites in the Border Rivers-Gwydir area including: artefact scatters and rock art, burial sites, scarred and carved trees, grinding grooves and middens, and mission and reserve sites.

2 LIVING WITH FIRE

Fire in the Border Rivers-Gwydir

Fire is part of life on the land in the Border Rivers-Gwydir region of New South Wales. Some landholders use fire as a land management tool. Others are concerned about the impact of wildfire on their properties, particularly during drought conditions.

Developed specifically for the Border Rivers-Gwydir, this booklet provides an introduction on how fire can be managed for healthy, productive landscapes and also presents a framework for incorporating fire into property management planning activities.

Knowledge about the nature of fire and its effects on the landscape will help provide greater confidence in managing fire, both for the protection of life and property, and as a land management tool.

For some landholders, this information will stimulate a new understanding of the role of fire in shaping and sustaining local landscapes and the plant and animal species they contain. For those already in the know, this information will add to existing knowledge and hopefully prompt some important new insights into fire management.

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Fire and the Australian continent

Triggered by lightning strikes and traditionally used by Aboriginal Australians, fire has shaped the character of Australian landscapes for millions of years. Many plant and animal species have evolved strategies to deal with fire, and some species have developed ways to take advantage of the opportunities it creates.

Aboriginal Australians actively used fire as a management tool. In some parts of the landscape, we know Aboriginal fire management practices involved smaller and more frequent fires than would have occurred naturally by lightning strike.

There is much debate though, about the nature and extent of Aboriginal burning across the Australian continent.

Even if we knew the whole story about Aboriginal fire management, this knowledge may not give us all the answers we need for the future conservation of native plant and animal communities.

The changes to our landscapes since European colonisation have been profound. In particular we are faced with fragmented vegetation, the spread of introduced species, and changes in the abundance of native plants and animals.

We need to draw on both old and new knowledge about fire in order to protect our bush and so manage for healthy productive landscapes. Much of our new knowledge and our current understanding of how fire might best be managed comes from looking at the way plant and animal species in different communities respond to fire. This topic is the focus of the next section.

> “For me fire is part of a bigger narrative about learning to live like an Australian, as if we intend to stay on this continent forever, for good.” [1]

1 Andrew Campbell - farmer, first national landcare facilitator, and Executive Director of Land and Water Australia speaking at the Australia Burning forum held just after the 2003 fires in Canberra. Quote taken from: Campbell, A. (2003) “Learning to live with fire” pp 243-247 in Cary, G., Lindenmayer, D., and Dovers, S. Australia Burning: Fire Ecology, Policy and Management Issues, CSIRO Publishing, Collingwood, Victoria.

3 MANAGING FIRE FOR BIODIVERSITY CONSERVATION

Science based management

Scientists and land managers have long recognised the relationship between biodiversity (the variety of different plant and animal species) and healthy land systems.

It wasn't until the late 70's that scientists gained a much better understanding of the significant role that fire plays in shaping these land systems and the biodiversity within them. Fire ecology is now an important area of scientific study.

For landholders, the most useful information to come out of this research relates to how different aspects of fire affect vegetation and wildlife, and how different plant and animal species respond to fire.

Plant responses to fire

Many Australian plant species have developed reproductive strategies in close association with fire. Since fire is such a powerful disturbance force, changes in fire patterns can quickly influence which species (and reproductive strategies) will persist in an area and which won't.

Different plant species respond differently to fire: some do not tolerate fire, some do tolerate fire and others rely on it for reproduction. For many Australian plants one or more of their reproduction processes (flowering, seed release or germination) occur exclusively, or most abundantly, in the months or years after a fire.

Scientists describe two broad post-fire regeneration strategies that occur in areas with a long history of fire which are of particular relevance to fire managers: *obligate seeding and resprouting.*

© M. Graham

Obligate Seeders

When *obligate seeder* species are exposed to a fire, all, or almost all, plants are killed. These species can persist, however, by regenerating from seed (they're *obliged* to regenerate from seed if they are to survive in an area). This seed may be stored in the soil, on the plant (e.g. in cones), or brought in from nearby unburnt patches of vegetation by wind, water, birds or other animals.

Land managers implementing fire management strategies need to consider the frequency of burning if they wish to ensure the survival of these obligate seeder species.

Obligate seeders reliant on seed dispersal from other areas may also be threatened by extensive fires. This is because no or few seed supply areas escape being burnt and the likelihood of animals (or other dispersers) bringing in new seed is reduced.

Fire *intensity* can also affect obligate seeders because specific temperatures may be necessary to trigger seed release and/or germination.

Fire frequency needs to take account of the life span of obligate seeders; including the amount of time it takes for these plants to experience their first flowering and to produce seeds. If the interval between two fires is too short, the second fire may wipe out an entire generation of young obligate seeders before they have reached reproductive maturity (i.e. before they have started producing seed).

On the other hand, if fire is excluded from an area for too long, a whole generation of obligate seeders may move beyond reproductive age and die off before a fire has had a chance to trigger germination. While some seeds can survive in the soil for very long periods, seeds of some species are relatively short lived.

Obligate seeder pink five-corners (*Styphelia triflora*) © P. Watson, Hotspots Fire Project

Resprouters

Resprouters are able to resprout after fire from woody underground *lignotubers* or from buds protected underneath their bark. Many landholders may be familiar with the behaviour of these plants.

Some resprouters can tolerate frequent fire, and some can live for a long time without fire. However, it is important to note that even resprouter populations may be affected by very frequent fire or by fire exclusion, and may rely on seed to ensure healthy, diverse gene pools.

Not surprisingly, in the absence of fire, those plants which come to dominate the landscape include long lived species and those which are able to regenerate without fire. These plants may competitively exclude other species from available light and space. A fire can help to open up the bush so light can reach ground level triggering resprouting, germination, and plant growth.

Fire regimes

Fire regime is the term used to describe aspects of fire that are important for managing vegetation and wildlife.

A fire regime includes the following factors:

- **Fire Frequency:** the number of fires in a given time
- **Fire Season:** what time of year the fire occurs
- **Fire Extent:** the area covered by the fire
- **Fire Intensity:** how hot the fire is

More on fire frequency:

It is important to consider the sequence of fire events. Long term effects on landscape and biodiversity are generally the result of a pattern of fires over time, rather than of just a single fire. (Although this is not to say that a single fire doesn't have the potential to significantly impact on a given area, like in a rainforest for example).

The amount of time between fires (fire interval) and the frequency with which fires occur in a given area are important in the conservation of our plant and animal species.

Frequent burning tends to reduce shrub cover and increase grassiness in some vegetation types resulting in more open landscapes. Infrequently burnt areas may naturally be shrubbier. These differences in vegetation structure affect the animals and birds that live in the bush. Some animals need shrub cover to shelter and breed, while others need open, grassy areas to find their food.

More on fire season:

Climate and weather will influence fire season more than any other factor. In the Border Rivers-Gwydir, the bush fire season generally runs from October through to March. Some areas around New England may see the bush fire season start as early as August. The fire danger period may extend outside these times, especially during drought conditions. Weather conditions associated with bush fire season include moderate to high daytime temperatures and low relative humidity with winds from the north-west. Dry lightning storms are also common during this period. In some areas, frosts in winter create low fuel moisture contents. November is typically the worst month for larger fires.

Planned burns are, of course, constrained by the bush fire danger period and total fire bans, as well as by weather. The window of opportunity for planned burns is usually limited to autumn or spring. Burns may also occur during winter, but conditions are often marginal. The implementation of any planned burn is dependent on the exact weather conditions on the days leading up to and on the day of the burn.

From an ecological point of view, some variability in the season in which a fire occurs is likely to be the best way to go. While the season appears to affect some individual species,

scientific findings do not point to a particular season being 'better' for a whole community of plant and animal species. Where possible, it is probably better to avoid always burning at the same time of year.

More on fire extent:

The area covered by any particular fire can vary. Some wildfires can be very extensive, for example late in 2009, a number of fires burnt in and around the Torrington area, burning more than 34,000 hectares. These fires, including the Black Creek/Granite Creek Fire, and the Flagstone Creek fire, burnt through almost 70% of the Torrington State Conservation Area. Planned burns may range from small burns of a hectare or less, to large burns of several hundred hectares.

Within a fire perimeter, patches will often remain unburnt. Extensive fires that leave few unburnt patches may limit the ability of animals to find refuge during the fire, and food and shelter after it has passed. Unburnt patches provide a base from which animals can slowly move back into burnt areas as these recover. Those undertaking planned burns aim to leave unburnt patches.

However, small burns may also have a down side. Animals can easily move into small burnt patches from surrounding unburnt country and may place too much grazing pressure on the recovering vegetation in these small patches. This problem may be particularly prevalent where animals such as kangaroos are abundant. If a greater area is burnt, grazing pressure is more likely to be spread, reducing impacts on regenerating vegetation.

Landholders wanting to burn with biodiversity in mind may therefore want to aim for burns of varying size, while still ensuring unburnt bushland patches remain for fauna. Burning a number of different patches at around the same time is another way to spread grazing pressure over a larger area. Previously burnt patches can provide boundaries for later patch burns.

More on fire intensity:

A fire varies in intensity depending on factors such as wind speed, temperature, humidity, slope, fuel load and the structure of the vegetation. The most intense fires tend to occur during times of high temperatures, low humidity and strong winds.

Different vegetation types are adapted to different fire frequencies.

Variability in the interval between fires is important for maintaining species diversity. Repeated fire intervals of similar length are not always good news for plants or animals.

Eucalypt resprouting from base
© M.Graham, Hotspots Fire Project

Generally:

- Fires tend to be more intense when there is more available dry fine fuel. 'Fine fuel' is material less than a pencil width.
- High intensity fires are more destructive and will kill more plant and animal species, but they are also naturally occurring and important in some plant communities.
- After a high intensity fire, lots of seed germination may occur. Areas opened up by a high intensity fire will provide increased areas of sunlight and space for young plants to develop.
- Variation in fire intensity plays a role in keeping a greater number of species in the community (i.e. maintaining biodiversity).

Extensively burnt areas can affect the ability of plants and animals to recover after fire. © M.Graham

Low intensity fire. © W. Parker

Unburnt patches will provide animals with a refuge during and after the fire. © W. Drake

Fire regimes: implications for management

At best, fire management planning is a blunt tool and in some parts of the landscape, unplanned fire is inevitable. Prevailing weather conditions and natural landscape patterns will often influence fire season, intensity and extent. Management planning needs to be flexible enough to accommodate unplanned fire, variability in landscape and weather patterns.

Over thousands of years, much of the Australian bush has evolved ways to live successfully with fire and use it to reproductive advantage. Many vegetation types have also developed an ability to 'bounce back' from different fire regimes. This bouncing back is often termed 'resilience'.

The best approach is to vary your fire management actions over time. Talk to people with knowledge in your region, and try different things based on your own observations of vegetation responses to fire on your property.

Biodiversity is more likely to be sustained when fire management extremes are avoided. Excluding all fire from your property, or burning as soon as vegetation has sufficient fuel to support a fire, will eventually see the loss of species adapted to a more moderate or variable regime.

High intensity fire. © G. Walker, NSW Rural Fire Service

4 FIRE IN THE LANDSCAPE: PUTTING THE SCIENCE INTO CONTEXT

Like many natural processes, the relationship between vegetation and fire regime is complex. However, there are some simple principles that emerge in the following stories about fire in particular plant and animal communities.

FIRE FREQUENCY IN GRASSY WOODLANDS

Grassy Woodlands in the Border Rivers-Gwydir, like other regions, have been extensively cleared for agriculture. Patches of good quality grassy woodland where native species still dominate are therefore very valuable for conservation.

A great diversity of Grassy Woodland communities occupy the Border Rivers-Gwydir, driven by varying annual rainfall and the complex interactions of elevation, fire, topography, geology and soil formation processes. The climatic variation across the east-west gradient in the Border Rivers-Gwydir allows for the existence of four distinct Grassy Woodland classes; Tableland Clay (on the most fertile soils at upper elevations of the New England Tableland), New England, Western Slopes and Floodplain Transition Woodlands on the western alluvial plains.

Remnants with white box (*Eucalyptus albens*), yellow box (*E. melliodora*), and/or Blakely's red gum (*E. blakelyi*) with a grassy understorey are part of the Critically Endangered Ecological Community Box-Gum Grassy Woodland. Another Grassy Woodland that is recognised as an Endangered Ecological Community is Fuzzy Box (*E. conica*) Woodland on alluvial soils. Conservation of these remnants is essential for retaining habitat for many declining native plants and animals.

Within Grassy Woodland communities, fire frequency can affect the balance between woody species and grasses. Frequent burning tends to produce open, grassy landscapes, whereas in places where fire has been excluded or is rare, shrubs and young trees may increase in number.

In Grassy Woodlands, tussock grasses such as kangaroo grass (*Themeda australis)*; snowgrass (*Poa sieberiana*) and wallaby grasses (*Austrodanthonia sp*) dominate the ground layer. Smaller grasses and herbs grow in the spaces between these tussocks. Fire increases diversity by burning the dense tussocks, making space for the smaller species. Many of these grasses and herbs flower rapidly after fire, producing seeds which germinate while gaps between resprouting grass tussocks are still available. Some of the native tussock grasses, particularly kangaroo grass, are also encouraged by fire. Thus fire provides a way for large native grasses, small grasses and herbs to co-exist.

Where fire has been excluded from Grassy Woodlands, shrubs may increase or decrease depending on whether or not they rely on fire for regeneration. Shrubs and trees that are not reliant on fire and can regenerate between fires will likely increase in density in the absence of fire. If environmental conditions are favourable, these species may then progressively come to dominate the landscape shading out the grasses and herbs. Heavy litter which accumulates over time may also leave little room for small ground layer species. However, there are also shrubs that depend on fire to regenerate. These shrubs may appear in large numbers after a fire as seed stored in the soil is stimulated to germinate. These types of shrubs will tend to die off after a long time without fire, producing a more open understorey.

Both ground layer plants and shrubs form part of the rich diversity of Grassy Woodlands in the Border Rivers-Gwydir region and fire plays an important role in regulating these woodlands. The extent of loss, fragmentation and change to Grassy Woodlands, means fire needs to be carefully managed and varying fire over time and space is likely to be important for maintaining diversity.

Grassy Woodland © M. Graham

FIRE AND ANIMAL HABITAT

Variability in fire frequency over time and across the landscape plays an important role in providing the habitat that bushland animals need. Fire alters the structure and density of vegetation layers and can change the species composition of bushland areas. Some birds, mammals and invertebrates may even disappear if fires occur too often or are excluded completely. Landscapes in the Border Rivers-Gwydir provide a significant refuge for several nationally vulnerable fauna species.

Hollows as Habitat

There are significant areas of mature and old growth eucalypt forest across the Great Dividing Range and surrounding ranges of the Border Rivers-Gwydir region. These magnificent forests have numerous hollows and provide habitat for an abundance of fauna. Many fauna species are dependent upon hollows for key parts of their life-cycle. Specifically, hollows provide places for animals to feed, shelter and breed. Hollows can take many centuries to develop or be replaced when lost from a landscape. Fires can burn through significant hollow-bearing trees and cause them to fall. This leads to a loss of valuable habitat and causes increased competition for remaining hollows. Maintenance of hollow-bearing trees and enhancement of these valuable habitats wherever possible, is needed to ensure the survival of many native species.

Hollow-bearing tree © M. Graham

Mammals and Birds

Many threatened fauna species are known to use hollows in the Border Rivers-Gwydir region. The Vulnerable squirrel glider (*Petaurus norfolcensis*) inhabits larger patches of forest and woodland in the eastern parts of the region. This glider lives in small family groups occupying areas of bushland that contain several key habitats that are strongly influenced by fire. Abundant hollows are needed by squirrel gliders for constructing bowl-shaped, leaf lined nests. They prefer mixed species forests and woodlands with a shrubby midstorey. Key food sources include gum producing trees such as Acacia and nectar-producing trees and shrubs such as Banksias.

Although relatively widespread across this region, the squirrel glider has disappeared from many landscapes because of clearance, fragmentation and degradation of forests and woodlands. Viable populations of the squirrel glider require the maintenance of mature and old-growth forest and woodland for hollows and a diversity of native tree and shrub species for food. Areas of habitat also need to be connected, with isolated and fragmented populations of squirel gliders facing long-term decline and potentially local extinction.

Squirrel glider © K. Stepnell
Office of Environment and Heritage

Fire can both promote and destroy squirrel glider habitat. The germination of various wattles (*Acacia spp*) used by the

glider is often triggered by hot fires. Frequent fire can lead to loss of nectar bearing shrubs important for food. Poorly managed fires can destroy hollows or lead to collapse of hollow-bearing trees. Extensive fires can lead to temporary loss of food resources and contribute to population declines and local extinction. Establishing or maintaining a patchy mosaic of forest and woodland in varying stages of post-fire regeneration will assist in maintaining, and potentially enhancing, viable populations of squirrel gliders across the region.

The Border Rivers–Gwydir region provides a nationally significant refuge for several Vulnerable woodland birds. Extensive clearing of woodland vegetation for cropping and grazing across the Western Slopes and Plains of Victoria, NSW and Queensland has caused the ongoing decline of a group of birds collectively termed "declining woodland birds". This group includes threatened species such as the regent honeyeater (*Anthochaera phrygia*), swift parrot (*Lathamus discolour*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), diamond firetail (*Stagonopleura guttata*) and speckled warbler (*Chthonicola sagittata*).

In recent decades the regent honeyeater has declined significantly and there are potentially no more than 500 adult birds spanning a substantial range between far northern Victoria and far southern Queensland. Fertile and productive woodlands between Bundarra and Barraba are renowned as one of the last remaining breeding strongholds of this Critically Endangered species.

Besides broad-scale clearing, woodland birds have declined for a variety of reasons that include: inappropriate fire regimes, particularly too frequent or intense fires; displacement by aggressive native birds; ongoing loss of understorey habitat structure caused by firewood gathering, mechanical clearing and fire; degradation by weeds; and predation by vertebrate pests.

Retention of understorey habitat structure is critical for the survival of many woodland birds. Poorly managed fires can destroy fallen timber and too frequent fires can simplify and reduce understorey vegetation cover. In many woodland areas fire can be a significant contributor to habitat patchiness. Good fire management outcomes have an important role to play in ensuring the survival of populations of many woodland birds in the Border Rivers-Gwydir region.

Regent honeyeater © R. Smith

Invertebrates

Kapatur pink slug © M.J. Murphy

Different fire regimes will also affect invertebrates like ants, beetles and spiders. Numbers of these invertebrates can be reduced immediately post-fire, but can quickly recover. Although overall diversity can be the same between areas, the frequency of fires will affect the features of the habitat and therefore which species live there. Excess nutrients from bush fire debris can reduce aquatic macro-invertebrate populations post fire (e.g. insect, crustacean & mollusc), however they can also be quick to recover. Some plant-eating beetles, flies and spiders can take advantage of recent fires, while ants which feed in the litter layer can be more common in longer unburnt areas.

One of the most striking invertebrates found in Border Rivers-Gwydir region is the Kaputar pink slug (*Triboniophorus aff. graeffei*). This giant slug can be up to 20cm in length and has been found only in a small area of high elevation eucalypt forest and rainforests within Mt Kaputar National Park. Having a very soft and moist skin it is highly sensitive to fire and fire also can remove essential microhabitat for foraging and shelter. Sensitive fire management practices are likely to be needed for ensuring its survival.

Wildfire, Mosaics and Variability

In some places, fire needs to happen often enough to maintain open, grassy forest environments rich in grasses and herbs, where early-successional animal species can thrive. Other places need to support good-sized patches of thicker vegetation where broadleaf shrubs and late-successional fauna can flourish. It is also important to remember some animals need access to both open areas and denser cover and a mosaic of patches can fulfil that requirement.

Where native vegetation covers large areas it is likely that wildfire will fulfil this prescription. Where remnants have been isolated by clearing and urbanisation, or where fire suppression has been unusually effective, some ecological burning may need to occur. Hot fires have their place, as well as cool winter burns. A further point is the importance of topography in providing refuge areas from which re-colonisation of the post-fire environment can occur. Not only do unburnt areas serve this function, places where fire is less severe also play this role. When thinking about the effects of fire and how best to manage it, it is instructive to consider landscape patterns: how does vegetation change with topography? How does topography affect fire behaviour and how does this enable plant and animal species to survive and thrive together in a fire-prone environment?

THE STORY OF WHITE CYPRESS PINE

White cypress pine (*Callitris glaucophylla*) is a prominent feature of the landscape across central western New South Wales and is a component of many vegetation classes in the Border Rivers-Gwydir. Unlike most trees in Australia, *Callitris* species are not flowering plants; they are conifers and produce seed on the surface of cone scales.

The recruitment of white cypress pine isn't triggered by fire, but rather is an occasional event associated with particularly good rainfall. The density of young pines can be quite high. Unlike eucalypts, pine seedlings can take many decades to reduce in density and thick stands of small spindly trees can remain for many years. Whilst these stands can provide good

habitat for native species including terrestrial orchids and woodland birds, dense regrowth is not suitable habitat for other species. Because of this, changes in habitat structure from open woodlands to dense cypress regrowth can lead to changes in native animal populations.

The last two hundred years have seen many changes in the cypress pine woodlands. Some have been cleared for cropping, while elsewhere the density of pine has increased. The balance between eucalypts and pines, and between large and small trees, has also changed. Early 19th century leases often required landholders to remove eucalypts, shrubs and young pines. Mature pines provided excellent wood. As foresters know, pine regeneration happens readily in 'understocked' stands: where once mature eucalypts and pines left few resources for new plants, logging created gaps for young pines to come in.

The regeneration and thickening of woody native species, such as white cypress pine, in previously cleared or agricultural landscapes is regarded as a problem for agricultural productivity. On the other hand dense regeneration of white cypress pine can provide a more sheltered and cooler microclimate than surrounding open habitats. This is particularly the case during extremely hot summer days when native animals such as the koala take refuge within cooler cypress stands.

Fire regimes have also changed. Historians and scientists who have studied cypress pine forests generally agree that fires started by Aboriginal Australians and lightning probably once helped maintain a mosaic of woodland patches. In many places the understorey was open and grassy under a canopy of eucalypts and mature pines, while in other places shrubs and young cypress grew thickly or in clumps. Although challenging to know for sure, it appears with European settlement, fire became increasingly less common in the slopes and plains of NSW.

White cypress pine is much more sensitive to fire than the eucalypts that grow with it. Not all cypress plants are killed in every fire: even in hot wildfires a proportion are generally tall enough to escape most of the flames. Seedlings, however, are readily killed in a burn. Thus fire has the potential to kill very young regrowth, and to thin dense cypress stands.

Landholders who may wish to limit the density of pine stands may find fire a useful tool for managing white cypress pine seedlings. Fire and other management techniques that encourage the growth of eucalypts, native shrubs and deep-rooted perennial native grasses will in turn produce more ground fuel for fires, may discourage pine regeneration and provide habitat for those native animals that require the nectar, seeds and insects that are available from these native plants.

While fire may open up cypress pine stands, getting fire into them without burning down the neighbourhood can be challenging. The trick will be to find fire regimes that balance all the different needs of plants, animals and us – a job for landholders, people familiar with fire and scientists to tackle together.

White cypress pine © W. Parker

5 MANAGING FIRE FOR DIFFERENT VEGETATION TYPES

If different vegetation types are adapted to different fire frequencies, how do landholders know whether their fire management actions are good for biodiversity?

To help make these decisions, the Office of Environment and Heritage (OEH) has developed fire frequency guidelines for broad vegetation types around NSW. These guidelines are periods of time (in years) bounded by 'thresholds'. Thresholds refer to the upper and lower limitations to survival for species that are particularly sensitive to very short or very long, intervals between fires. The fire frequency guidelines aim to ensure fire intervals are long enough to let vulnerable obligate seeders grow to maturity, while also ensuring fire happens often enough to keep short lived species around.

Hotspots is working with OEH and local ecologists to further support these guidelines to take into account the considerable differences between regions within NSW. The 50,000 square kilometres covered by the Border Rivers-Gwydir region includes a wide range of environments, from tablelands to the slopes and down onto the plains. The Border Rivers area rises in the New England Tablelands from an elevation exceeding 1400 m. The Gwydir River rises in the tablelands between Uralla and Guyra at an elevation of up to 1400 m above sea level.

The Border Rivers-Gwydir region has a diverse climate, ranging from subalpine to temperate and subtropical, with hot and dry conditions prevailing in the west, and cooler, wetter conditions at the edge of the New England Tablelands in the east. Annual rainfall varies from an average greater than 1100 mm in the east to less than 600 mm in the west of the region. Summers are relatively hot, with average maximum January temperatures across the region from 27–34 °C. Winters are cool to mild, with average maximum July temperatures of 14–17 °C.

All these factors affect which plants grow where, and how fast they grow. They also affect the way fire behaves. Fire frequency guidelines aim to reflect these differences.

> The recommended fire frequency intervals are based on what scientists currently know about fire ecology, and will continue to be refined as more information comes to hand. Upper thresholds in particular are currently based on very limited data.

Fire frequency intervals for broad vegetation types found in the Border Rivers-Gwydir are listed on the following pages.

For further information or to find out any recent developments please refer to the NSW Rural Fire Service website at: www.rfs.nsw.gov.au.

The vegetation types are classified according to a statewide assessment made in 2004 by Dr David Keith. The groupings can be recognised by specific combinations of plant species, in some cases, these include plant species found nowhere else. The vegetation types are also based on factors such as the height and spacing of the dominant plants as well as geographic indicators of rainfall and soil type.

Vegetation types of the Border Rivers-Gwydir

Rainforest

Western Vine Thicket, Planchonella Nature Reserve © M. Graham

Rainforests are usually dominated by soft leaved trees with vines, ferns and other soft leaved plants in the understorey, they generally grow on moist sites with fertile soils. In the Border Rivers-Gwydir region, such rainforests are very limited and occur as small pockets of subtropical and warm temperate rainforest in the far east. Dry rainforests and western vine thickets are restricted to the dry hills and flats west of the New England Tableland and western slopes and within ravines along the Nandewar Range. The Border Rivers-Gwydir region contains the best examples of western vine thicket in NSW, although all are small remnants of an extensively cleared vegetation community. These habitats are moister, darker and more sheltered than the surrounding landscape and generally shade out more flammable species that fuel fires, thereby protecting most of the forest from fire events. Weeds such as Coolatai grass (*Hyparrhenia hirta*) may increase the likelihood of fire coming into these areas.

Although a wildfire may occasionally burn through a rainforest and the community may be able to recover slowly, rainforest is very sensitive to recurring fires. Fire should therefore be excluded.

Wet Sclerophyll Forest (shrubby subformation)

North Coast Wet Sclerophyll Forest © W. Parker

The term *sclerophyll* refers to the hard, leathery leaves of many distinctly Australian trees and shrubs.

Wet Sclerophyll Forests (shrubby subformation) are tall eucalypt forests with a dense understorey of ferns, herbs, and shrubs with broad soft leaves. These forests grow on relatively fertile soils in high rainfall areas. In the Border Rivers-Gwydir region, this vegetation type is highly restricted, only occurring along the highest slopes of the Great Dividing Range in the far east. Although it is understood that fire is important in these forests, the fire intervals needed to preserve the dominant eucalypts and safeguard other biodiversity values are still unclear. Shrubby subformation Wet Sclerophyll Forests are likely to experience occasional intense wild fires, perhaps every 50 to 100 years. Intense fire may be needed for some eucalypts to regenerate. Less intense but more frequent understorey fires may have a role in maintaining shrubs, ferns and herbs.

Currently, variable fire intervals in the range 25 to 60 years are recommended for shrubby subformation Wet Sclerophyll Forests across the state. However these recommendations may be reviewed and refined as we learn more.

Wet Sclerophyll Forest (grassy subformation)

Northern Tableland Wet Sclerophyll Forest,Torrington
© M. Graham

Grassy subformation Wet Sclerophyll Forests of the Border Rivers-Gwydir region are dominated by straight trunked eucalypts, with a grassy understorey and sparse shrubs which may have hard or soft leaves. These forests grow on relatively fertile soils in high rainfall areas. It is similar to Wet Sclerophyll Forest (shrubby subformation) but has a more open canopy, less shrubs and a greater grassy or herbaceous groundcover. In the Border Rivers-Gwydir region, this vegetation type is limited to the far eastern parts along the Great Dividing Range.

Several NSW studies have found that fire frequency has a profound effect on vegetation structure in wet grassy forests. Frequently burnt areas are open and grassy, with a diverse herbaceous ground layer, while infrequent burning is associated with an increased abundance of shrubs and small trees. Each environment provides habitat for a distinct suite of plants, insects, birds and small mammals. To provide for the full range, it is important to keep some parts of the landscape open with relatively frequent fire, while other places are burnt less often to allow thicker habitat to develop.

Appropriate fire frequencies for this forest type are still being debated. The present state-wide recommendation is for fires every 10 to 50 years although occasional low intensity fire on a more frequent basis may be necessary for the maintenance of understorey diversity.

Dry Sclerophyll Forest (shrubby subformation)

Yetman Dry Sclerhophyll Forest, Yetman © M. Graham

This vegetation type is extensive and covers forests dominated by various eucalypts such as ironbarks, red gums and stringybarks, but may also support white and black cypress pine (*Callitris glaucophylla* and *C. endlicheri*), smooth-barked apple (*Angophora leiocarpa*) and long-fruited bloodwood (*Corymbia dolichocarpa*). The shrubby understories of these forests contain many obligate seeders and resprouting shrubs whose flowers colour the bush in spring. The cover of grasses and sedges is sparse. Shrubby Dry Sclerophyll Forests grow on poor soils in moderate rainfall areas. The shrubby forests of Torrington, Bald Rock, Yetman and the ranges around Mt Kaputar are good examples of shrubby Dry Sclerophyll Forest.

Variable fire intervals between 7 to 30 years are recommended to maintain diversity in this vegetation type.

Dry Sclerophyll Forest (shrub/grass subformation)

New England Dry Sclerophyll Forest, Tingha © M. Graham

Dry sclerophyll (shrub/grass subformation) forests consist of open eucalypt forest with a sparse hard leaved shrub layer and a grassy groundcover. These forests occur on moderately fertile soils in moderate rainfall areas, and are relatively extensive in the Border Rivers-Gwydir region. Examples occur along the Nandewar Range and the ranges to the west of Inverell.

The more grassy open forests may require slightly more frequent fire with an occasional longer interval between fires. The grass component is likely to be best maintained by short intervals, while the shrub component is predicted to increase with longer intervals.

Across the state, intervals in the 5 to 25 year range, with occasional intervals of up to 50 years in some areas, have been recommended for these forests.

Grassy Woodland

Tableland Clay Grassy Woodland, Guyra © M. Graham

This is open eucalypt woodland consisting of trees that are widely spaced with crowns that rarely touch. The understorey is usually quite grassy with herbs and scattered shrubs. Grassy Woodlands grow on rolling terrain with fertile soils and moderate rainfall, and have been extensively cleared and used for grazing and cropping. Good condition remnants of Grassy Woodlands in the wetter and more productive parts of the Border Rivers-Gwydir region are rare, and are found from the high altitudes of the New England Tablelands through to scattered remnant areas across the western slopes. As the slopes give way to the plains the species composition of Grassy Woodlands shifts towards plants that are able to cope with a drier climate.

Across the state, a variable fire frequency of between 5 to 40 years has been recommended. In places where plants grow relatively quickly because of higher rainfall and warmer temperatures, intervals compatible with retaining a diverse, grassy understorey along with some shrubs are likely to lie towards the lower end of this range. On the western slopes where rainfall is moderate or at higher elevations, plants may grow more slowly and somewhat longer fire intervals may be more appropriate.

Grassland

Semi-arid Floodplain Grassland, Moree Plains © M. Graham

Grasslands are notable for their lack of woody plants, although some shrubs and trees can sometimes be found in these communities. A wide variety of herbs grow in the spaces between tussocks of perennial native grasses such as kangaroo grass (*Themeda australis*), common tussock grass (*Poa labillardieri*) and wallaby grasses (e.g. *Austrodanthonia/ Danthonia spp*). Many plants in native Grasslands may be missed; some may not be visible through autumn or winter, but re-emerge to flower in spring. The extent of native Grasslands in the Border Rivers Gwydir region has been highly reduced by agricultural activities. This type of vegetation is now limited to small patches near Guyra and on the black soil (Mitchell grass) plains near Moree. Grazing and pasture improvement have extensively modified the Grasslands, so remnants where native species continue to thrive are places to be cherished.

Across the state, fires at intervals between 2 to 10 years are recommended to keep dominant grasses from overwhelming smaller herbs and to open up gaps for seedlings to germinate and grow. A slightly longer interval might be more appropriate in sites with slower growth (high altitude grasslands). As rainfall decreases, the spaces between grass clumps may also close up more slowly. Knowledge of the fire responses of Grasslands is still developing.

Heathland

Northern Montane Heath, Torrington © M. Graham

Heathland is dominated by hard leaved shrubs, many of which are obligate seeders. Heath grows in moderate to higher rainfall areas, on infertile soils, often in exposed positions. In the Border Rivers-Gwydir, Heathland is usually found in association with rocky outcrops (dry heath) and on rocky ridges and slopes where soils are not deep or fertile enough to support trees, such as the various granite outcrops across the New England Tableland.

Fires at a range of intervals between 7 to 30 years are recommended for maintaining biodiversity in Heathlands. Within this range, variability is important as this creates the space and opportunity for large and small species with a range of responses to fire, to live together.

Forested Wetlands

Eastern Riverine Forest, Upper Horton River © M. Graham

These forests typically feature hard leaved trees (paperbarks, casuarinas, eucalypts), scattered shrubs and patchy groundcover of water loving sedges and herbs. They occur on major floodplains or along riparian (riverbank) zones. River oak (*Casuarina cunninghamiana*) and river red gum (*Eucalyptus camaldulensis*) are the two main trees dominating the riparian forests of the Border Rivers and Gwydir catchments. The dominance of these trees shifts from river oak in the steeper and rockier eastern parts of the catchment to river red gum on the broad open floodplains of the west.

Scientists have not yet studied the role of fire in this vegetation type in any detail; however variable intervals between 7 and 35 years have been suggested.

Freshwater Wetlands

Montane Lake, Mother of Ducks Lagoon Nature Reserve
© M. Graham

Two main types of Freshwater Wetlands are found in the Border Rivers-Gwydir catchments. Those along inland rivers and floodplains in areas that are periodically or permanently flooded with fresh water and the Montane Bogs, Fens, Lakes and Lagoons (such as Mother of Ducks Lagoon) scattered atop the New England Tableland in the east of the catchment. In floodplain areas, forests of river red gums form a mosaic with lignum shrublands and reed-beds. In their natural state these wetlands usually have a dense groundcover of water loving sedges and herbs, and provide wonderful habitat for water birds.

Drought, river regulation and grazing have all impacted inland wetlands. Wet-dry cycles play a vital role in maintaining their diversity, and ensuring these continue is the major issue for their survival.

Fire intervals of between 6 to 35 years have been suggested for Freshwater Wetlands and variable fire regimes may play a role in the recruitment of some shrubs in drier healthy wetlands. However, for most other wetland types, fires rarely occur, if at all, and have little ecological function. The use of fire therefore is not considered to be a practical management tool and should be avoided if possible. In some cases, these wetlands can occur on peat and peat fires can have a devastating effect on these systems and should be avoided. Freshwater Wetlands are areas of great environmental sensitivity, and need to be treated with care.

Semi-arid Woodland (grassy subformation)

Riverine Plain Woodland, Moree Plains © M. Graham

Semi-arid Woodlands cover most of the western plains and the drier half of the western slopes of NSW. The woodlands of the semi-arid zone are dominated by sclerophyll trees (eucalyptus, bloodwoods, she-oaks, wattles, cypress pines), contain drought-resistant shrubs and are home to many ephemeral (short-term or transitory) grasses and herbs. Grassy subformation Woodlands occur on the floodplains in areas subject to occasional flooding. These woodlands intergrade with Grasslands and Arid Shrublands. To the east these woodlands become Grassy Woodlands. A great diversity of grassy Semi-arid Woodlands are known from the Border Rivers-Gwydir region including, North-west Floodplain Woodlands, Riverine Plain Woodlands, Brigalow Clay Plain Woodlands and North-west Alluvial Sand Woodlands. Drought plays a major role in shaping the vegetation and also influences fire regimes. In many places fires will only burn when the grasses which flourish after good rains dry off.

The Border Rivers-Gwydir catchment contains most of the remnant Brigalow Clay Plain Woodlands in NSW. These highly significant woodlands, an Endangered Ecological Community, have been mostly cleared and converted to cereal cropping, with most remnants being small and isolated.

Fire frequency guidelines for Semi-arid Woodlands (grassy) are particularly tentative due to lack of data, however intervals between 6 and 40 years have been proposed.

Semi-arid Woodland (shrubby subformation)

Western Peneplain Woodland, Moree Plains © M. Graham

Trees in the Semi-arid shrubby Woodlands subformation are generally shorter in stature than those in the grassy subformation, there is less grass cover but frequently drought-resistant shrubs are dominant. Sclerophyll trees such as eucalypts, wattles, cypress pines and she-oaks dominate these areas with drought-resistant shrubs and grasses making up the understorey. Soils vary from sandy outwash soils to red-brown loams on adjacent floodplains. The sandy soils naturally favour shrubs while the heavier floodplain soils will more likely support higher grass cover.

As with other vegetation classes, disturbance affects the density of trees, shrubs and grasses within Semi-arid Woodlands. Drought plays a major role in shaping the vegetation and influences fire regimes. In some places where shrubby areas have thickened up considerably since European settlement, lack of fire is thought to be one of several factors involved in this change.

Fire frequency guidelines for Semi-arid Woodlands (shrubby) are particularly tentative due to lack of data; however intervals between 10 and 40 years have been proposed.

Arid Shrublands (chenopod subformation)

Riverine Chenopod Shrubland, Moree Plains © M. Graham

Arid Shrublands dominated by chenopods such as saltbush (*Atriplex spp*), roly-poly (*Sclerolaena muricata*) and bluebush (*Maireana spp*) are restricted to the riverine plains in the far west of the Border Rivers-Gwydir catchment. These vegetation communities are part of the chenopod subformation of Arid Shrublands. Chenopod shrublands have low flammability, and are considered extremely fire-sensitive.

Chenopod species are mostly obligate seeders with only local seed dispersal and no effective post-fire seedbank.

Fire should be avoided in chenopod shrublands.

Arid Shrublands (acacia subformation)

North-west Plain Shrublands, Moree Plains/Gingham
© M. Graham

Arid Shrublands (acacia subformation) in the Border River-Gwydir catchment are restricted to very small patches in the far west. Dominated by leopardwood (*Flindersia maculosa*) this vegetation type occurs on more elevated areas of the plains that receive less than 500 mm of rainfall per annum.

Some plants that comprise the Arid Shrublands (acacia subformation) have the capacity to regenerate after the infrequent (30-50 years) unplanned fires that mostly occur following fuel build-up during favourable climatic conditions such as significant La Niña events.

The minimum interval for fire in this vegetation type should be at least 5-6 years, and the maximum approximately 40 years, although there is a recognised lack of knowledge of the best fire regimes for this vegetation subformation.

6 FIRE MANAGEMENT PLANNING

Introduction

If you live in a fire prone landscape, eliminating fire from your property is not a practical solution. Managing fire is an important part of living with fire, both to protect life and property and to respond to the needs of the bush.

Traditionally many landholders see their assets as being their house and property as well as the productivity of their land. In addition to this, a growing number of landholders consider the different plant and animal species on their property to be assets of real value. Aboriginal symbols of cultural importance are also considered to be assets.

If you consider native vegetation and wildlife as assets, effective planning will be essential to meeting the challenges associated with fire in the Border Rivers-Gwydir.

This planning needs to address two goals: (1) protection of life and property and (2) protection of environmental and cultural values.

Each goal requires its own particular management strategies which can be developed and implemented at the property level. However, in particular areas of your property, these two goals may come into conflict. In these instances, the relative advantages and disadvantages need to be weighed up and tradeoffs are often inevitable.

> “Hotspots is a way of returning the community back to the land, with a new range of training programs and education that can provide the community with the skills and knowledge to be in the drivers seat for managing their own land. They can now set their own direction.”
>
> – Claude McDermott, Aboriginal Heritage Officer, Office of Environment and Heritage.

Protecting *all* your assets

The *Rural Fires Act* (1997) recognises ecologically sustainable development and endorses the Bush Fire Risk Management Planning Process which is designed to protect life, property and the environment.

A zoning approach to fire management planning

The Bush Fire Risk Management Planning Process uses a zoning approach to fire management planning.

- **Asset Protection Zones** are fuel reduced areas around assets or groups of assets which are adjacent to bush fire hazards. These areas contain highly modified vegetation to prevent fire from having a pathway to the assets. Asset Protection Zones provide a safe defendable space for fire fighters and home owners to use if there is a fire.

- **Strategic Fire Advantage Zones** are strategic fuel reduced areas designed to slow a fire and reduce its intensity. These areas may need to be maintained using slashing or fuel reduction burning to provide strategically located fuel reduced areas to reduce vulnerability of assets. The NSW Rural Fire Service recommends reducing fuel in these zones by 50-80%.

- **Land Management Zones** are areas that are managed to maintain or enhance land management objectives, including biodiversity. Fire history, vegetation type and fire frequency are important considerations in these areas. The NSW Rural Fire Service recommends burning in these zones to maintain a mosaic of areas with varying fuel loads.

- **Fire Exclusion Zones** are areas where fire is actively excluded. These areas may include rainforest and other fire sensitive vegetation and some cultural or historic heritage sites and production areas.

When planning for a prescribed burn it is important to define your objectives. The fire frequency intervals in a Strategic Fire Advantage Zone (i.e. where your objective is to protect life and property) may be shorter than those needed to protect biodiversity.

Burning native vegetation on your property requires environmental assessment and consent. Landholders need to apply to the NSW Rural Fire Service (RFS) for a *Bush Fire Hazard Reduction Certificate* before planning and implementing a burn. Applications for a Bush Fire Hazard Reduction Certificate are assessed under the Bush Fire Environmental Assessment Code for NSW. In processing an application to carry out a burn in a Strategic Fire Advantage or Land Management Zone, the RFS will consider the vegetation type in which the burn is to be carried out, the fire history and the recommended fire frequency intervals for that vegetation type.

A range of RFS brochures and standards are available that provide detailed information about how to undertake a low intensity burn safely and how to maintain Asset Protection Zones. Most of these are available on the NSW RFS website, or from your local district office. For details on how to safely conduct a low intensity prescribed burn, refer to *Standards for Low Intensity Bush Fire Hazard Reduction Burning*, and for details on how to maintain a suitable Asset Protection Zone, refer to *Standards for Asset Protection Zones*.

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Some key messages in planning for biodiversity conservation

The relationship between fire and biodiversity is complex, and there is still much for scientists and fire managers to learn.

However fire management planning for biodiversity conservation need not be a complex or difficult process. You can take the information in this book away with you, think about it and decide for yourself how you might be able to apply it on your own property.

Based on existing knowledge, and on the information contained in this book, the following key messages provide simple guidelines for fire planning to protect biodiversity on your property.

When making decisions on issues such as fire frequency it helps to be very clear about what your land management objectives are in different areas of your property.

You should anticipate the need for flexibility with regards to your management actions. For many landholders, this forms part of an overall adaptive management approach to biodiversity on their property.

When your objective is biodiversity protection:

1. Think about the key messages listed here; and
2. Use the recommended fire frequency intervals for the different vegetation types on your property as a guide.

THE KEY MESSAGES

Simple principles for management

- Both too frequent and too infrequent fire can trigger negative impacts that throw systems 'out of balance' e.g. loss of species, weed invasion.
- Even within a single vegetation type, different species have different needs in relation to fire. To address this, vary fire frequency over time and space to allow for the full range of species.
- The bush at each stage of growth after fire looks different. Each stage provides different habitat, each has value.
- Don't burn entire vegetation types at once. Patchiness provides refuges for animals and a seed source for plants to recolonise burnt areas.
- Fires occur in a landscape context. It's useful to think about how the different vegetation types in a landscape are related in terms of fire.
- Coordinate fire activities with neighbours to provide a mosaic of vegetation in different stages of post-fire development, as different animals use different stages. Remember that fire management is a shared responsibility.
- When planning how often to burn, think about unplanned as well as planned fire. Unplanned fires may happen often enough to fulfil the needs of the bush.
- Understanding how fire behaves in different vegetation types and the influence of weather and topography will help you to better prepare for fire.

© A. Miller

"Before Hotspots we were an isolated community, we felt we had to fight fire by ourselves, we were alone. But since the training, we feel part of a larger community now that we manage for fire as a community."

– Hotspots workshop participant.

7 PREPARING A PROPERTY FIRE MANAGEMENT PLAN

The following steps can help you prepare a property fire management plan:

1. Identify your property and productivity assets and map them.

- Talk to the NSW Rural Fire Service about setting up and maintaining Asset Protection Zones and Strategic Fire Advantage Zones.

2. Identify and map the vegetation types in your Land Management Zones.

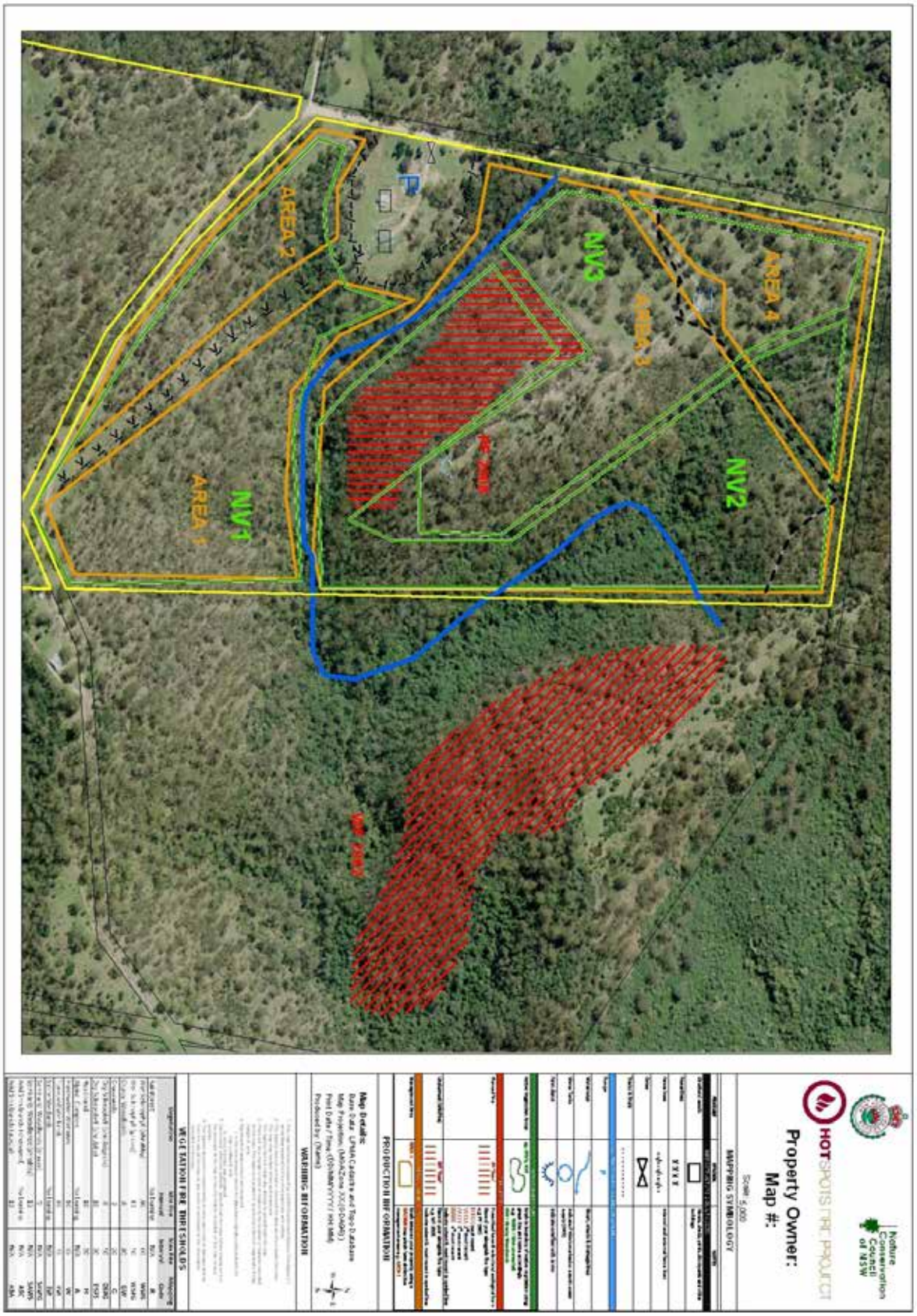
- Make a note of the fire frequency intervals recommended for the vegetation types on your property.
- How often have these vegetation types burned in the past? Note when and where fires have occurred.
- Are past fire regimes consistent with recommended regimes? Make a note of vegetation areas on your property that don't meet recommended fire regimes.
- Think about actions you could take to bring fire frequency into line with the recommendations.

3. Develop and maintain a mosaic of different stages of post-fire development.

- Do you have the resources to maintain parts of your property at different stages of development after fire?
- Could you work with your neighbours to make this happen?

4. Monitor and review.

- Keep a record of when fires occur and what areas they cover.
- Observe what happens to the vegetation, and to different species. Like all land management planning, fire planning is partly a matter of observation and responding to the needs of the land.
- Review your plan as you learn more.



Example Property Fire Management Plan

8 Fire and Climate Change

It is now generally accepted that the world is undergoing a significant change in climate.

The impacts of climate change in Australia are not yet clear although an increase in extreme weather conditions including drought, storms, floods as well as changes in rainfall (increase or decrease in different places) are anticipated.

It is possible that the frequency and intensity of fire may increase as conditions for fire (such as hot, dry conditions) increase. By 2020 in south-east Australia, days of high or extreme fire danger are forecast to increase by 5 to 25 per cent if the effects of climate change are low and by 15 to 65 per cent if they are high[1].

> "A warming of 1.0° C and a 5% decrease in rainfall (a moderate scenario for 2030) would make the climate of Moree similar to the current climate of St. George in southern Queensland." [2]

Climate change in the Border Rivers-Gwydir

The Border Rivers-Gwydir region experiences diverse climatic conditions, with hot and dry conditions prevailing in the west, and cooler and wetter conditions in the New England Tablelands of the east. Since 1950, this region has experienced warming of around 0.8–1.3 °C which is likely to be partly due to human activities. There has been little change in rainfall, with trends in the order of plus or minus 5 mm per decade.[2]

The future climate of the Border Rivers-Gwydir region is likely to be warmer and drier. Average daily minimum and maximum temperatures are likely to increase by between 1 °C and 3 °C in some parts of the region, with the greatest warming during spring and winter. Minimum temperatures are projected to increase on the Tablelands where there is likely to be a decrease in frosts. Maximum temperatures are projected to increase in the west. Rainfall is likely to increase in summer and autumn, and decrease in spring and winter. Evaporation is likely to increase in all seasons due to projected rises in temperature.[3]

These trends would also increase heat waves, extreme winds and fire risk. It is predicted the number of days above 35 °C will increase and the duration of hot spells (number of days with a daily maximum over 35 °C) will increase. Droughts will be more extreme due to an increase in the variability in rainfall from year to year. The risk of fire events may increase due to projected increases in temperature. Despite this trend toward drier conditions, there is also potential for increases in extreme rainfall events. These climate projections take into account a broad

range of assumptions about future greenhouse gas emissions and differences in various climate models.[2, 3]

The impacts of climate change in this area are most likely to be felt through extreme weather events. There will also be long-term consequences for the region from changes in average temperature, rainfall and evaporation.[2]

Changes in the fire regime are likely to impact plants and animals in the region. An increase in fire frequency is likely to alter some ecosystems, affecting species composition and structure. For example if intense, crown-scorching fires increase in frequency in inland areas this is likely to increase mortality rates in mature trees, resulting in younger stands and a reduction in hollow-bearing trees. More frequent fire also enhances recruitment of some weed species. In many eucalypt and casuarina species, fire and drought conditions also reduce seed production, decreasing food for birds such as glossy black cockatoos.

It is not just climate change that will influence future fire regimes and subsequent fire management planning. Human development, settlement patterns and the changing landscape will also play an important role.[2]

> “Altered fire regimes are expected over the coming decades, and may be one of the major ecological challenges for Australia.” [4]

1. CSIRO (2007a) *Bushfire Weather in South-East Australia: Recent Trends and Projected Climate Change Impacts*.

2. CSIRO (2007b) *Climate Change in the Border Rivers-Gwydir Catchment. Prepared for the New South Wales Government by the CSIRO.*

3. Border Rivers Gwydir CMA (2013) *Support Document Border Rivers-Gwydir 2013–2023 Catchment Action Plan*.

4. Morton SR, Hoegh-Guldberg O, Lindenmayer DB, Harriss Olson M, Hughes L, McCulloch MT, McIntyre S, Nix HA, Prober SM, Saunders DA, Anderson AN, Burgman MA, Lefroy EC, Lonsdale WM, Lowe I, McMichael AJ, Parslow JS, Steffen W, Williams JE & Woinarski JCZ (2009*) The big ecological questions inhibiting effective environmental management in Australia*. Austral Ecology 34: 1-9.

9 WORKING TOGETHER TO MANAGE FIRE ACROSS THE LANDSCAPE

Cooperation in the Border Rivers-Gwydir region

Fire management planning to protect life, property and the environment requires collaboration within communities, between agencies and across tenures.

In the Border Rivers-Gwydir, this is already happening. Fire management planning, using a risk management approach, is being undertaken across the wider landscape in national parks, state forests and on public lands.

By working together, individual landholders can be part of a much broader process of fire management, whilst being able to make independent choices about fire management on their own land.

This process has a number of individual and potentially far reaching benefits. Among other things, it encourages landholders to:

- Plan and talk together about assets and how best to protect them;
- Listen to others with knowledge and ask them challenging questions; and
- Protect all of the aspects of the landscape most valued by landholders.

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About the Hotspots Fire Project

Based on best available science and operational knowledge, the Hotspots Fire Project delivers workshops and resources to landholders and land managers to provide them with the skills and knowledge they need to participate in fire management planning.

Hotspots operates on a core belief that well-informed and well-prepared communities complement the roles of land managers and fire agencies and that a shared approach to fire management is critical to any form of planning.

Under the guidance of the nine project partners in the Advisory Committee, Hotspots is delivered through the coordinated efforts of the NSW Rural Fire Service and the Nature Conservation Council of NSW.

> “The workshop really brought the community together to implement not just individual property level planning but also a far reaching and coordinated approach to managing fire risk as well as biodiversity.”
>
> – Hotpspots workshop participant

Partners and collaborators

This booklet has been compiled for the Hotspots Fire Project, with input from and in consultation with a wide range of stakeholders. The information contained herein reflects our understanding at the time of publication. We are learning more about fire and the environment every day and anticipate that some recommendations may change as new information comes to hand.

This booklet was written by Nicole Conroy and Penny Watson, with assistance from Julie Hinchliffe, Christine Pfitzner, Kate McShea, Waminda Parker, Mark Graham and Michelle Rose for the Hotspots Fire Project.

The Hotspots Fire Project is jointly managed by the Nature Conservation Council of NSW and the NSW Rural Fire Service.

Thank you to our project partners for their technical input, photographs and continuing support to the project:

The NSW Office of Environment and Heritage, NSW Local Land Services, NSW Farmers, The Southeast Queensland Fire and Biodiversity Consortium, Forestry Corporation of NSW, Local Government NSW, National Parks and Wildlife Service, and the University of Wollongong's Centre for Environmental Risk Management of Bushfires.

Thank you to Roger Smith and Michael Murphy (NSW National Parks & Wildlife Service) for providing photographs to the booklet.

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Email: hotspots@rfs.nsw.gov.au

The Nature Conservation Council of NSW
(02) 9516 0359 or
Email: info@hotspotsfireproject.org.au

The following agencies have useful websites and may be of assistance:

Hotspots Fire Project
www.hotspotsfireproject.org.au

NSW Rural Fire Service
www.rfs.nsw.gov.au

North West Local Land Services
http://northwest.lls.nsw.gov.au/

Northern Tablelands Local Land Services
http://northerntablelands.lls.nsw.gov.au/

Nature Conservation Council of NSW Bushfire Program
www.nccnsw.org.au/bushfires

Forestry Corporation of NSW
http://www.forestrycorporation.com.au

NSW National Parks & Wildlife Service
www.nationalparks.nsw.gov.au

Southeast Queensland Fire and Biodiversity Consortium
www.fireandbiodiversity.org.au

NSW State Emergency Services
www.ses.nsw.gov.au

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Back cover Image © L. Andrews

HOTSPOTS FIRE PROJECT

Nature Conservation Council
The voice for nature in NSW