HOTSPOTS FIRE PROJECT

MANAGING FIRE ON YOUR PROPERTY

A booklet for landholders in the Northern Rivers Region

NSW RURAL FIRE SERVICE

Nature Conservation Council The voice for nature in NSW

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The Hotspots Fire Project acknowledges that the preparation and implementation of this guide occurs on the traditional lands of First Nations peoples and that this management has and continues to shape the landscape we see today.

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

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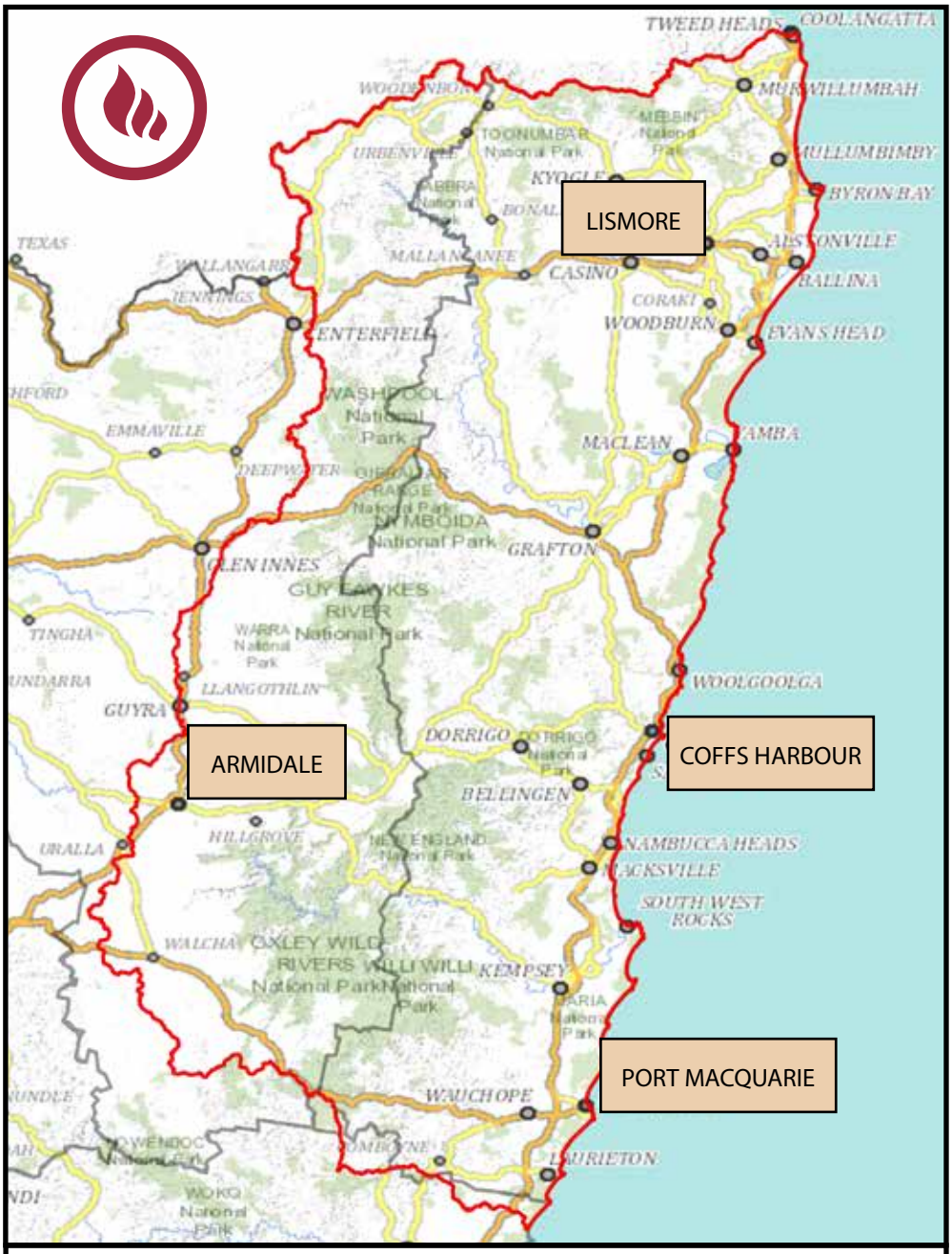

Northern Rivers Region

1 INTRODUCTION TO THE NORTHERN RIVERS REGION

The Northern Rivers Region (the Region) covers approximately 50, 000 km^2 of north-east NSW extending from the Queensland border, south to the Camden Haven River and inland onto the New England Tableland. It includes internationally-significant Gondwana Rainforest of Australia World Heritage Area and nationally significant wilderness and wetland, coast and marine environments. The Region extends seawards three-nautical miles and also includes Lord Howe Island. A defining natural feature of the Region is the large river systems - the Tweed, Brunswick, Richmond, Clarence, Bellinger, Nambucca-Macleay and the Hastings, which flow eastward from the Great Dividing Range.

Nearly two-thirds (59%) of the Region is private land, and the main productive use is livestock grazing. The major cropping activity is sugar cane farming on the floodplains north from Grafton, potato farming at Dorrigo, and minor areas of soya beans, tea-tree, blueberry, macadamia, stonefruit and other crops generally restricted to the coastal plains. Other major land uses include national parks (22%) and State forests (12%) and the major population centres which are primarily located along the coast.

North-east NSW generally experiences a warm temperate to sub-tropical climate. In summer, easterly to south-easterly winds predominate, resulting in a distinct summer-autumn rainfall maximum and relatively dry springs. In winter, dry westerly to south westerly winds predominate with a general pattern of fine sunny days and cool nights. Rainfall is generally lower the further you move away from the coast.

The significant variation in climate, altitude, geology and soils contributes towards a great diversity of plant and animal communities. Four of the six major areas of rainforest in NSW are located in the Region at Richmond–Tweed, Washpool, Dorrigo and Hastings which contain outstanding examples of subtropical, warm temperate, cool temperate, dry and littoral rainforest. The region includes the NSW component of the Border Ranges, which supports largely intact natural ecosystems.

Sclerophyll forests and woodlands comprise around 85% of the remaining native vegetation in the Region located mainly along the Great Dividing Range and Great Escarpment (Great Eastern Ranges).

The Region's current high population growth, with associated urban and tourist developments particularly along the coastal fringe, is a major cause of continued habitat loss and fragmentation. While 22% of the region is within protected areas (i.e. national parks and nature reserves), not all vegetation communities or habitat types are well represented and for some threatened species, like the koala now listed as Endangered at the state and national level, significant habitat occurs on private lands.

The Region is rich in Aboriginal cultural heritage. It encompasses the traditional lands of several First Nations including parts of the Nganyaywana (southern New England Tablelands), Ngarabal (northern New England Tablelands), Biripi (Hastings Valley) and Bundjalung (Richmond, Tweed, northern Clarence Valley area) and Yaegl Nation (coastal Clarence Valley); and the entire territories of the Dunghutti (Macleay Valley) and Gumbaynggirr groups (Bellinger and southern part of the Clarence Valley). In the region there are many areas and landscape features that have important social, spiritual, historical, and commemorative significance.

2 LIVING WITH FIRE

Fire in the Northern Rivers

Fire is part of life on the land in the Northern Rivers Region of New South Wales. Some landholders use fire as a land management tool for hazard reduction, to encourage green pick for grazing and for cultural or ecological purposes. Others may not use fire as a management tool but are more concerned about the impact of bush fire on their properties, particularly during drought conditions.

Developed specifically for the Northern Rivers, 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 in building healthy land systems. For some landholders, this information will stimulate a new understanding of the role of fire 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.

Currawinya © Hotspots Fire Project

Fire and the Australian continent

Fire has shaped the character and biodiversity of Australian landscapes for millions of years prior to the arrival of people. Many plant and animals species evolved strategies for coping with fire with the ability to survive fire directly and/or taking advantage of the post-fire environment.

Changes to ancient fire regimes were accelerated as Australia drifted north over the last 70 million years which led to the gradual drying of the continent along with fire in the vegetation being ignited from lightning strikes and volcanoes. On a continental scale, this process contributed to the expansion and dominance of fire tolerant and drought resistant species such as Eucalyptus and sclerophyllous vegetation. This in turn led to the contraction of fire sensitive areas such as rainforest to more naturally fire protected and wetter locations[5].

First Nations Australian's have a long history over thousands of years of using fire as a land management tool and cultural practice. These practices helped shape a cultural landscape that left the legacy of Australia's unique biodiversity and ecosystems prior to European colonisation. Fire sensitive vegetation communities such as rainforest were protected from wildfire where possible by carefully burning fire tolerant areas as a firebreak on the perimeter. This ensured the health of these rainforest areas and the plants and animals that people depended on for food and resources. Countless pathways or walking tracks across the region between different areas were often kept open and grassy with cultural burning to allow for better access and to encourage animals to forage on the regrowth.

In more recent times, several First Nations groups have been working to reintroduce cultural burning practices back on to Country in the Northern Rivers region. The most important principle of cultural burning is having the right First Nations people involved for each area being considered. Other common principles of cultural burning include only burning small areas in calm, cooler conditions to create low intensity fires that do not impact the tree canopy and just burn the ground layer. This leaves unburnt patches and promotes habitat and resources for native animals. In some areas where knowledge and cultural practices of fire have been interrupted by colonisation, knowledge is now being renewed through regional collaboration, practicing the principles of cultural burning and observing the change and ecological health of the landscape over time. In turn this supports the strengthening of connection and knowledge between First Nations people and country and the skills and experience to manage these areas for future generations.

The changes to our landscapes since 1788 have been profound and ongoing. We are now faced with fragmented vegetation and the combined impacts of invasive plants and animals as well as extensive and frequent wildfires.

We need to draw on both old and new knowledge about fire in order to protect people, natural and built assets and cultural values, and so manage for healthy and 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.

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[5] Bowman, D. M. J. S. (2000). *Australian rainforests : islands of green in a land of fire*. Cambridge : New York : Cambridge University Press, http://www.loc.gov/catdir/toc/cam025/99024978.html

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 fairly recently 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 can 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.*

In the abscence of fire, *Banksia ericifolia* can competitively exclude other plant species from available space and sunlight. © W. Parker

Obligate Seeders

When obligate seeder species are exposed to a high intensity 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). 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 and intensity 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, others are relatively short-lived.

Obligate seeders may store seed on the plant in woody capsules © W. Parker

Resprouters

Resprouters are able to resprout after fire from woody underground lignotubers or epicormic 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. However, too frequent burning can encourage some of the less desirable grass species for example in the Northern Rivers, the native Blady grass (*Imperata cylindrica*) or the introduced weed species such as Coolati grass (*Hyparrhenia hirta*) or African Lovegrass (*Eragrostis curvula*). 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 about fire season:

Climate and weather will influence fire season more than any other factor. In the Northern Rivers, the bush fire season generally coincides with spring and / or summer. 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 can dry out fuels so that ignition is easier and fire intensity is hotter (low fuel moisture content). In the Northern Rivers, the fire danger period can begin as early as August, especially during periods of drought conditions.

The window of opportunity for planned burns varies across the Region and is usually limited to autumn, late winter or spring. 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. If the burn is to occur within the official fire danger period, the burn can still proceed if the weather conditions are appropriate, however, a permit will be required to be obtained from the NSW Rural Fire Service (NSW RFS).

From an ecological point of view, some variability in the season in which fires occur is likely to be best. 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:

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 should aim to leave unburnt patches, a process called mosaic burning. Creating internal patchiness within the fire area is a key objective of hazard reduction burns.

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. 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.

Fires also burn faster and more intensely when running uphill, as the available fuel is preheated by the flames and ignites more easily.

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.

Acacia resprouting from buds under the bark
© P. Donatiu, QFBC

Generally:

- Fires tend to be more intense when there is more available dry fine fuel. 'Fine fuel' is material less than a pencil width (6 mm).
- High intensity fires are more destructive and will kill more plant and animal species, but they also have an important role 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).

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

Low intensity burn at Jaaningga Nature Reserve © S. Hemer, NPWS

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

Fire regimes: implications for management

In some parts of the landscape bush fire is inevitable due to fuel accumulation, climatic conditions and likely ignition sources such as arson and lightning. Prevailing weather conditions and natural landscape patterns will often influence fire season, intensity and extent. Management planning needs to be flexible enough to accommodate bush fire.

Over many thousands of years, much of the Australian bush has evolved ways to live successfully with fire and to use it for 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

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.

© A. Miehs

PLANT RESPONSES TO FIRE FREQUENCY IN A SHRUBBY VEGETATION TYPE

Fire is important in allowing a diverse mixture of shrubs to keep living together. The following example illustrates the need for variability in both fire frequency and fire extent to cater for plant species with different responses to fire. The two banksia species in this story occur in coastal heath communities on the NSW North Coast.

The Wallum Banksia (*Banksia aemula)* is one of the largest heathland species. This plant can live for a century and survive in frequently burnt heath. This is because adult plants have access to three strategies for surviving fire: They can (1) resprout from lignotubers underground and from (2) epicormic buds under the bark above ground. In the unlikely event that adult plants are killed by fire, a new generation of Wallum Banksias can emerge from (3) seed after fire.

The Heath Banksia (*Banksia ericifolia)* on the other hand, is an obligate seeder. This means the adult plant has only one fire survival strategy - seed release. Most seeds are released from the woody cones only after the parent plant has been killed by fire. It takes 5 to 8 years for this dense shrub to reach maturity, so if the coastal heath in which it occurs is burned at intervals of less than 7 or 8 years, this plant can become locally extinct.

At the same time, intervals which are too long can impact Heath Banksia, as this shrub lives for decades rather than centuries. Once adult plants die, seeds in cones quickly lose viability. Fire while adult plants are still alive triggers seed release, provides a nutritious ash bed for young seedlings, and reduces competition for sunlight, space, and moisture.

By 15 years after fire, Heath Banksias grow very large and thick, shading out smaller plants. They will have also stored massive amounts of seed. If all of the fires are spaced 15-30 years apart, new generations of Heath Banksia will dominate the landscape.

Ensuring some fire intervals of 7-10 years, interspersed with some longer intervals, will therefore allow other smaller plant species to grow and build up new generations of seed.

Banksia ericofolia is an obligate seeder
© W. Parker

PLANT RESPONSES TO FIRE FREQUENCY AND EXTENT IN GRASSY VEGETATION

Many of the grassy forests and woodlands in the Region are extensively used for grazing and have a strong historic association with frequent burning. Fire frequency affects 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 tend to increase in numbers. These open grassy forests typically have high biodiversity values and many (now threatened) native fauna species have been lost or are declining because of the loss of such habitats in which fire has a critical role in maintaining.

Plant diversity in grassy forest and woodland is concentrated in the ground layer. Here, tussock-forming grasses such as Kangaroo grass (*Themeda australis*), Barbed Wire grass (*Cymbopogon refractus*) and Native Sorghum (*Sorghum leiocladum*) dominate the ground layer. Smaller grasses and herbs grow in the spaces between these tussocks. Fire burns the dense tussocks back, making space for the smaller species. Many grasses and herbs flower rapidly after fire, producing seeds which germinate while gaps between resprouting grass tussocks are still available.

Kangaroo grass , *Themeda triandra*
© J. Tann

Where fire has been excluded from grassy areas, shrubs - including lantana (an environmental weed) – can increase to the point where grasses and herbs are shaded out. Heavy litter which accumulates as time goes by after a fire may also leave little room for small ground layer species. Research suggests some ground layer grasses and herbs grow best in open patches away from trees and shrubs; these species may be lost if open patches disappear. Varying fire frequency over time and space is important to maintain biodiversity. In grassy woodland and forest understoreys, patchy fires play a vital part in ensuring enough space for all plant species including shrubs, grasses and herbs.

ANIMAL RESPONSES TO FIRE FREQUENCY AND FIRE EXTENT

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 Northern Rivers Region provide significant areas of habitat for national and state listed threatened fauna species

Hollows as Habitat

There are significant areas of mature and old growth eucalypt forest across the 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, providing 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.

Mammals and Birds

Many iconic threatened fauna species are known to use hollows in the Region. The Yellow-bellied Glider, listed as Vulnerable on the *Environment Protection and Biodiversity Act 1999* (EPBC Act) and the *NSW Biodiversity Conversation Act 2016* (BC Act), inhabits fertile and productive forests in the eastern and upper parts of the region. The Greater Glider (*Petauroides volans*) was once common in forests 20 years ago but is now listed as Endangered on the EPBC Act. The Vulnerable Squirrel Glider (*Petaurus norfolcensis*), inhabits drier forests and woodlands in the eastern and central parts of the region. These gliders are favoured prey of the Powerful Owl (*Ninox strenua*), listed as Vulnerable on the BC Act, Australia's largest owl at 60 cm in height.

Sugar Glider © K. Stepnell

Vulnerable Powerful Owl © Dept. Planning and Environment

The Powerful Owl lives in wet and dry forest in coastal regions and on the tablelands and western slopes of northern New South Wales. This bird has a strong association with long-unburnt areas of forest for its nesting and roosting locations. However, it is known to forage in open forest areas. Patchy, frequent fires provide the open, accessible forest areas in which small birds and mice become easy prey.

Other Vulnerable large owls known from the region include the Masked Owl (T*yto novaehollandiae*), and the Barking Owl (*N. connivens*). To ensure the survival of these sensitive species, large hollows must be maintained in the landscape. This will ensure that breeding pairs can successfully maintain their large home range and reproduce.

In frequently burnt areas, there tends to be less shrub cover and more open spaces. Animals that rely on a dense, shrubby environment for their food and shelter are displaced by species adapted to more open habitat. In heath communities, for example, some birds and small mammals, like sugar gliders and eastern pygmy possums, rely on *Banksia ericifolia* thickets for nectar and shelter. By increasing the frequency of fires and removing these thickets across the landscape, there is a risk of losing these animals.

Both open and shrubby patches play a role in conserving the range of animal species found in grassy vegetation. Some creatures thrive in dense shrubs, while others do best in open grassy areas. For example, the Endangered Hastings River Mouse (*Pseudomys oralis*) appears to respond well to moderately frequent burning and low intensity grazing regimes. On the other hand, Bush Rats (*Rattus fuscipes*) and Brown Antechinus (*Antechinus stuartii*) do better in habitats where fire has not occurred for many years. Variable fire intervals will therefore be needed to ensure the survival of the diversity of species in the landscape.

Vulnerable Eastern Pygmy Possum feeds on the nectar of Banksias © K. Stepnell

Invertebrates

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 (e.g. insect, crustacean and mollusc) populations post fire, however they can also be quick to recover.

Wolf Spider © G. Gowing

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. Wolf spiders (Family *Lycosidae*) for example are ground hunters, preferring more open habitats to hunt while jumping spiders (Family *Salticidae*) hunt for food in understory vegetation, trees and logs provided by more complex habitats.

Bush Fire, Mosaics and Variability

Maximisation of biodiversity, creating refuges and allowing breeding cycles are only a few factors that will be improved by mosaic burning. 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 bush fire 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?

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 Department of Planning and Environment (DPE) 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.

The 32,000 square kilometres covered by the Northern Rivers Region includes a wide range of environments, from tablelands to the slopes and down onto the plains. The wide range of elevations in the Region (from 0 to 1500 m above sea level) has a significant impact on the climate, influencing temperature, humidity and rainfall, and thus the diversity of vegetation types across the Region.

Annual rainfall varies from over 1600 mm on parts of the far north coast to 800 - 1200 mm along parts of the tablelands. Summers are relatively hot, with average temperatures ranging from 16 - 18° C along the mountains, to 24 - 26° C north of Grafton. Winters are cool to mild, with temperatures ranging from 4 - 6° C along the mountains, to 14 - 16° C along the far north coast.

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 recognise 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 Northern Rivers are listed on the following pages.

The vegetation types are classified according to a statewide assessment made in 2003 by Dr David Keith. (Keith, D., 2003. *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT.* Department of Environment and Conservation NSW, Hurstvile, NSW.) 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 Northern Rivers

Rainforests

@W. Parker

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 Northern Rivers 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 Northern Rivers 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 bush fire 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 Forests (shrubby subformation)

© P. Redpath

Wet Sclerophyll Forests (shrubby subformation) are tall eucalypt forests with a dense understorey of broad soft-leaved shrubs, ferns and herbs. These forests grow on relatively fertile soils in high rainfall areas. Wet Sclerophyll Forest (shrubby subformation) is often found in the zone between drier eucalypt forest and rainforest, and may revert to rainforest in the absence of fire. 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.

These forests are likely to experience occasional intense bush fires, perhaps every 40 to 100 years, or sometimes even less often. Intense fire may be needed for eucalypts to regenerate. Less intense but more frequent understorey fires may also have a role.

Currently, variable fire intervals in the range 30 - 60 years are recommended for these forests, across the State. However as research into the effects of fire frequency in shrubby Wet Sclerophyll Forests in Northern NSW has been minimal, it is expected these recommendations will be refined as we learn more.

Wet Sclerophyll Forests (grassy subformation)

© P. Watson

Wet Sclerophyll Forest (grassy subformation) is dominated by straight-trunked eucalypts, with a grassy understorey and sparse shrubs, which may have hard or soft leaves. This tall forest type grows on 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.

Appropriate fire frequencies for this forest type are still being debated. Variable fire intervals in the range 15 to 50 years are recommended.

Several northern 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 and small mammals. To provide for the full range, it is probably important to keep some parts of the landscape open with frequent fire, while other places are burnt less often to allow thicker habitat to develop.

Grassy Woodlands

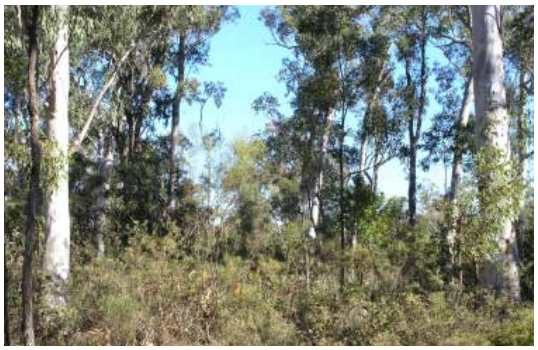
© W. Parker

This vegetation type is open eucalypt woodland with a dry understorey of grasses, herbs and scattered shrubs. In the Northern Rivers, Grassy Woodlands grow on rolling terrain with fertile soils and moderate rainfall.

It has been extensively used, particularly for grazing which is often associated with frequent burning.

Across the State, a variable fire frequency of between 8 and 40 years has been recommended. North Coast Grassy Woodlands are yet to be studied.

Dry Sclerophyll Forests (shrubby subformation)



© M. Graham

This vegetation type includes low forest and woodland dominated by eucalypts, with a hard-leaved shrubby understorey. The term sclerophyll refers to the hard, leathery leaves of many distinctly Australian trees and shrubs.

In the shrubby understorey of these forests, there are many obligate seeders and resprouting shrubs. The cover of grasses and sedges is sparse.

Variable fire intervals mostly in the 10 to 30 year range are recommended state-wide to maintain diversity in this vegetation type.

Dry Schlerophyll Forests (shrub/grass subformation)

© W. Parker

Dry Sclerophyll Forest (shrub/grass subformation) consists of open eucalypt forest with a sparse hard-leaved shrub layer and continuous grassy groundcover. These forests occur on moderately fertile soils in moderate rainfall areas. Like Grassy Woodland, most of these forests are extensively used for pasture and have an associated frequent burning regime. Across the State, intervals in the 8 to 50 year range have been recommended. The grass component is likely to be best maintained by short intervals, while the shrub component is predicted to increase with longer intervals.

Local research in the Dry Sclerophyll Forests of the escarpment gorges found sites with inter-fire intervals of 10 - 15 years, in particular, supported a diverse range of shrubs. Grass cover was highest where fire was moderately frequent, with at least one very short inter-fire interval.

Heathlands

© P. Redpath

Heathland is dominated by hard-leaved shrubs, many of which are obligate seeders. Heath grows in high rainfall areas, on infertile soils, often in exposed positions. Different types of heath occur in the Northern Rivers, including the heathlands found in coastal areas where the soil may be moist, and those growing in drier rocky inland areas. In coastal heath, fires at a range of intervals between 10 and 30 years, are recommended for maintaining overall biodiversity.

Heathland in rocky inland areas is probably adapted to a range of fire regimes depending on its relationship to the surrounding vegetation. Intervals between 15 and 50 years are suggested.

Freshwater Wetlands

Freshwater Wetlands include swamp heath, floodplain shrublands and sedgeland. These wetlands usually have a dense groundcover of sedges. They occur on peaty soils with reduced drainage and may be either periodically or permanently inundated with fresh water. A fire frequency between 10 and 35 years has been suggested for this vegetation type.

© M. Graham

This community is vulnerable to peat fires when the substrate is dry. Because of this, planned fires are best conducted when the substrate is wet.

Note that Freshwater Wetlands are areas of environmental sensitivity, and need to be treated with care. Fire should be excluded from some classes of Freshwater Wetland. Most coastal wetlands are covered by protective legislation, such as SEPP (Coastal Management) 2018, Biodiversity Conservation Act 2016 (as endangered ecological communities), or Development Control Plans.

Forested Wetlands

© W. Parker

These forests typically feature hard-leaved trees (eucalypts, casuarinas, paperbarks), scattered shrubs and a continuous ground-cover of water-loving sedges and herbs.

They grow in high rainfall areas on coastal dune swales, flood plains and riparian zones, principally along the coast and inland rivers.

Scientists have not yet studied the role of fire in this vegetation type in any detail; however variable intervals between 10 and 35 years are suggested for this vegetation type.

Estuarine and Saline Wetlands

© W. Parker

These communities include the mangroves and salt marshes that occur along the edge of coastal estuaries.

They are not fire-prone communities and excluding fire is appropriate.

Creek-side vegetation

© M. Graham

Creek-side or riparian vegetation includes all vegetation within the riparian zone. The vegetation in the riparian zone protects these environments from erosion and maintains water quality.

Burning riparian vegetation may destroy bank stability, disturb nutrient cycling, increase sedimentation in the creek, and alter light levels and temperature in the creek environment. These communities are generally not prone to fire and excluding fire is appropriate.

Note that rainforests and wetlands are areas of environmental sensitivity, and need to be treated with care. On or near the coast, rainforests and wetlands may be subject to additional protective legislation, such as the State Environmental Planning Policy (SEPP) (Coastal Management) 2018, *Biodiversity Conservation Act 2016* (as endangered ecological communities), or zoning instruments under the *Environmental Planning and Assessment Act, 1979*.

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 ecological needs of the bush.

Many landholders see their assets as being their house and property as well as the productivity of their land. In addition to this, the natural and cultural values of a property are also valuable assets.

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

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, former Aboriginal Heritage Officer, Department of Planning and Environment.

PROTECTING *ALL* YOUR ASSETS

The bush fire risk management planning process applies a zoning approach to fire management planning. Zones are a way of identifying areas in the landscape for planning and risk management purposes. There are five types of zones which have different intents.

- **Asset Protection Zones** (APZs) are fuel reduced areas surrounding a built asset or structure which is managed progressively to minimise fuel loads in order to reduce the potential radiant heat levels, flame contact, ember and smoke attack. Vegetation within these zones should be managed to ensure it does not provide a path for the transfer of fire from unmanaged vegetation to the asset either from the ground level or through the tree canopy. Refer to the NSW RFS Standards for APZs and seek NSW RFS advice to determine the recommended width of your APZ. Environmental approval to undertake vegetation clearance may be required.

- **Strategic Fire Advantage Zones** (SFAZs) are large scale, strategically determined areas which are regularly burnt to reduce fuel loads. These fuel reduced areas are designed to slow a fire, reduce its intensity in the landscape and provide a valuable opportunity for active firefighting during a bush fire. They can be located in areas of known fire paths or adjacent to APZs. These zones are determined by each Bush Fire Management Committee during the development of a Bush Fire Risk Management Plan.

- **Ignition Management Zones** (IMZs) are an area in the landscape that is maintained at a reduced fuel level in order to minimise the propagation of ignitions and limit the rapid escalation of fires, often along ridgetops. IMZs are similar to Strategic Fire Advantage Zones but are treated more regularly and thoroughly than a SFAZ.

- **Land Management Zones** (LMZs), the main focus of the Hotspots Fire Project, 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 RFS recommends burning in these zones to maintain a mosaic of areas with varying fuel loads.

- **Fire Exclusion Zones** (FEZs) 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. Planning decisions with respect to these zones should be heavily guided by the NSW RFS.

When planning for a prescribed burn it is important to define your objectives, acknowledging that there is a greater focus on hazard reduction works closer to assets (e.g. APZs and SFAZs) and a better balance between land management objectives (e.g. biodiversity conservation) and fire management in LMZs.

Burning native vegetation on your property requires environmental assessment and consent. Landholders need to apply to the NSW RFS for a Bush Fire Hazard Reduction Certificate (HRC) before planning and implementing a burn. Applications for a HRC are assessed under the Bush Fire Environmental Assessment Code for NSW. Assessments are made on biodiversity, threatened species, cultural heritage, and other potential impacts on waterbodies and soil erosion.

In processing a HRC application to carry out a burn in a SFAZ or LMZ the NSW 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. The SFAZ minimum intervals represent an absolute minimum (i.e. their intent is to minimise environmental harm in areas where fire is managed primarily for fuel reduction). LMZ minimum intervals represent a more

sustainable minimum (considered more appropriate where biodiversity management is the primary goal).

A range of NSW 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 local district offices. 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 and cultural values 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 information can help you prepare a property fire management plan:

Think about how you manage your property, what you want to achieve and how this might affect your fire management goals. Consider: risk, production, conservation and cultural values.

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

- Most properties will benefit from at least one Asset Protection Zones (APZ), based around your main property asset/s. The NSW Rural Fire Service have resources which can assist you in determining the size, placement and management of these.

2. Identify and map the vegetation types on your property as well as any known fire history.

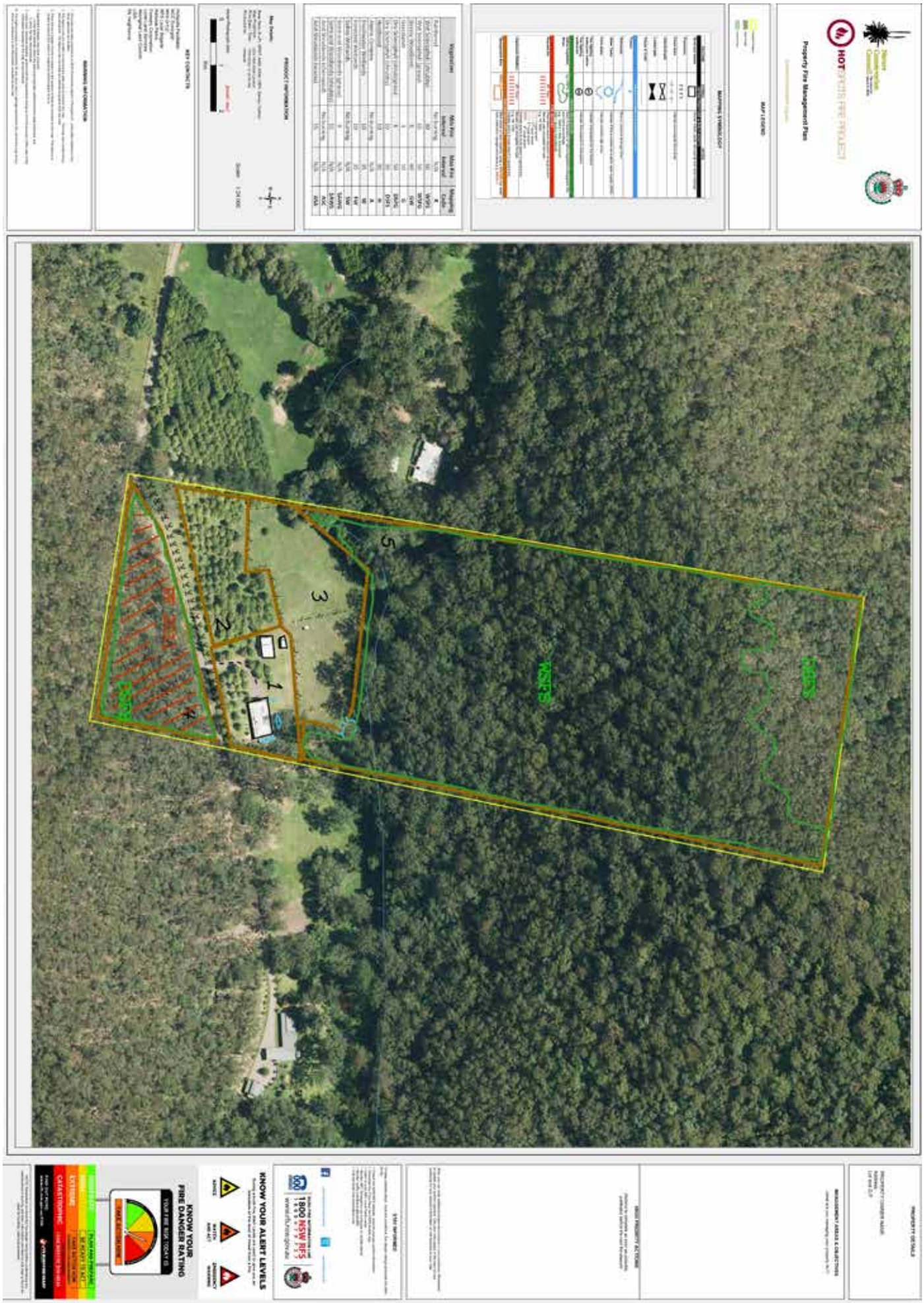
- Make a note of the fire frequency intervals recommended for the vegetation types on your property.
- How often have these vegetation types burned in the past? Note when and where fires have occurred. What is the fuel load?
- Are past fire regimes consistent with recommended regimes? Make a note of 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, as well as to reduce fuel in strategic areas.

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

The frequency and intensity of bush fires is projected to increase in many parts of Australia as conditions for fire (such as hot, dry conditions) increase [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 Northern Rivers

The Region's average temperatures, and the number of extremely hot days, have been increasing since 1970. The future climate of the region is likely to continue to be warmer and drier with temperatures increasing by 2 degrees in the far future (2070). Climate change is already affecting the region through increasing temperatures, drought and the impacts of the 2019-20 bush fires[3]. The number of high temperature days is also projected to continue to increase.

Such trends would also increase evaporation, heatwaves, extreme winds and fire weather risk. Despite the trend toward drier conditions particularly in winter, there is also potential for increases in spring and autumn rain and increased intensity of heavy rainfall events, as experienced in 2022. Minimum temperatures are projected to increase resulting in a decrease in frosts in inland areas to the east. These climate projections take into account a broad range of assumptions about future greenhouse gas emissions and differences in various climate models[2].

The Region is expected to experience an increase in the severity and frequency of fire weather conditions in the near future (2030) and the far future (2070). Although these changes in severe fire weather are relatively small in magnitude (up to one additional day every two years) they are projected to occur in prescribed burning periods (spring) and the peak fire risk season (summer) increasing the risk of bush fires. 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.

> “The concept of a ‘normal’ bush fire season is rapidly changing, as bush fires are increasing in number and burn for longer.” [4]

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1. CSIRO (2007a) *Bushfire Weather in South-East Australia: Recent Trends and Projected Climate Change Impacts*. Updated 2013.

2. NSW Office of Environment and Heritage (2014) *Northern Rivers Climate Change snapshot*. Produced by the NSW and ACT Regional Climate Modelling project (NARCLiM).

3. NSW Adapt, (2022) *Climate Change in the North Coast*. NSW Government website www.climatechange.environment.nsw.gov.au/north-coast

4. Hughes, Lesley, (2014) *Be prepared: Climate Change and the NSW Bushfire Threat*. Climate Council of Australia

9 WORKING TOGETHER TO MANAGE FIRE ACROSS THE LANDSCAPE

Cooperation in the Northern Rivers Region

Fire management planning to protect life, property and the environment requires collaboration within communities, between agencies and across tenures. Bush Fire Management Committees are responsible for Bush Fire Risk Management Plans. There are committees for the Far North Coast, Northern Tablelands, Tamworth, Northern Rivers, Mid North Coast, Lower North Coast and Mid Coast.

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.”
>
> – Hotspots workshop participant

Acknowledgements

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, Penny Watson, Grahame Collier and Julie Hinchliffe with assistance from Waminda Parker, Mark Graham, Kevin Taylor, Stefanie Pillora, Kate McShea, John Allen, Richard Geddes and Lucy Tremain 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.

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

The following agencies have resources that 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
www.lls.nsw.gov.au/regions/north-west

Northern Tablelands Local Land Services
www.lls.nsw.gov.au/regions/northern-tablelands

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

Nature Conservation Council of NSW Bushfire Program
www.nature.org.au/bushfire_program

Forestry Corporation of NSW
www.forestrycorporation.com.au

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

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

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Back cover Image © L. Andrews

HOTSPOTS FIRE PROJECT

Nature Conservation Council
The voice for nature in NSW