Department of National Parks,
Recreation, Sport and Racing

Planned Burn Guidelines

New England Tableland Bioregion of Queensland

Queensland Government

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Disclaimer

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Front cover photograph: Sundown National Park, Brett Roberts, QPWS (2004).

Bp2006

Foreword

The New England Tableland bioregion contains significant regional ecosystems and species that can be seriously impacted by inappropriate fire regimes. Over the last 40 years, severe wildfires have occurred too frequently in this landscape, impacting on its unique biodiversity. This guideline will assist rangers and other land managers to reduce the impact of such events and maximise conditions that will allow plants and animals to survive and flourish in their response to fire. Improved conservation outcomes such as these, in this distinctive and fragmented landscape will come from improved fire management practices.

Through consultation, the best available knowledge at the time has been used to develop this guideline. It is expected that as new information becomes available regarding the requirements of individual species and ecosystems this will be reviewed and added. In a fragmented landscape the best use of fire will ensure ongoing conservation outcomes.

Brett Roberts
Senior Ranger
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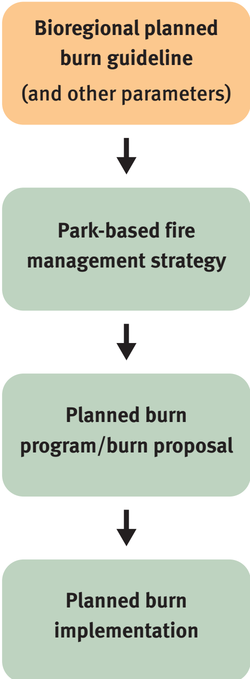
Purpose of this guideline

This guideline was developed as part of the Department of National Parks, Recreation, Sport and Racing's (NPRSR) Queensland Parks and Wildlife Service (QPWS) Fire Management System to support the formation of fire strategies, burn proposals and on-ground planned burn implementation (supported by the Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go). They assist rangers and other land managers to:

- protect life and property
- maintain healthy ecosystems
- promote awareness of fire management issues in the field
- identify clear fire management objectives to address those issues; and how to assess objectives to assist in adaptive management
- identify suitable fire behaviour, burn tactics and weather conditions to achieve objectives
- provide information and tools to assist in implementing planned burns.

Please note that this planned burn guideline uses 'fire vegetation groups' provided in ParkInfo that assist their integration into maps and fire strategies. A fire vegetation group is a group of related ecosystems that share common fire management requirements.



How the planned burn guideline fits into the QPWS Fire Management System.

Scope

- This guideline applies to the New England Tableland bioregion (refer to Figure 1) and covers the following fire vegetation groups: grassy open forests, shrubby open forests, open forest with limited ground fuel, sedgelands, rock pavement communities, riparian/fringing communities and vine thickets (refer to Appendix 1 for regional ecosystems contained in each fire vegetation group).
- It covers the most common fire management issues arising in the New England Tableland. In some cases there will be a need to include issues in fire strategies or burn proposals beyond the scope of this guideline (e.g. highly specific species management issues).
- This guideline recognises and respects Traditional Owner traditional ecological knowledge and the importance of collaborative fire management. Consultation and involvement should be sought from local Traditional Owners in the preparation and implementation of planned burns and specific guidelines incorporated into fire strategies where relevant.
- Development of the guideline has been by literature review and a knowledge-capturing exercise, using both scientific and practical sources. It will be reviewed as new information becomes available.

Peter Haselgrove, QPWS, Sundown National Park (2009).

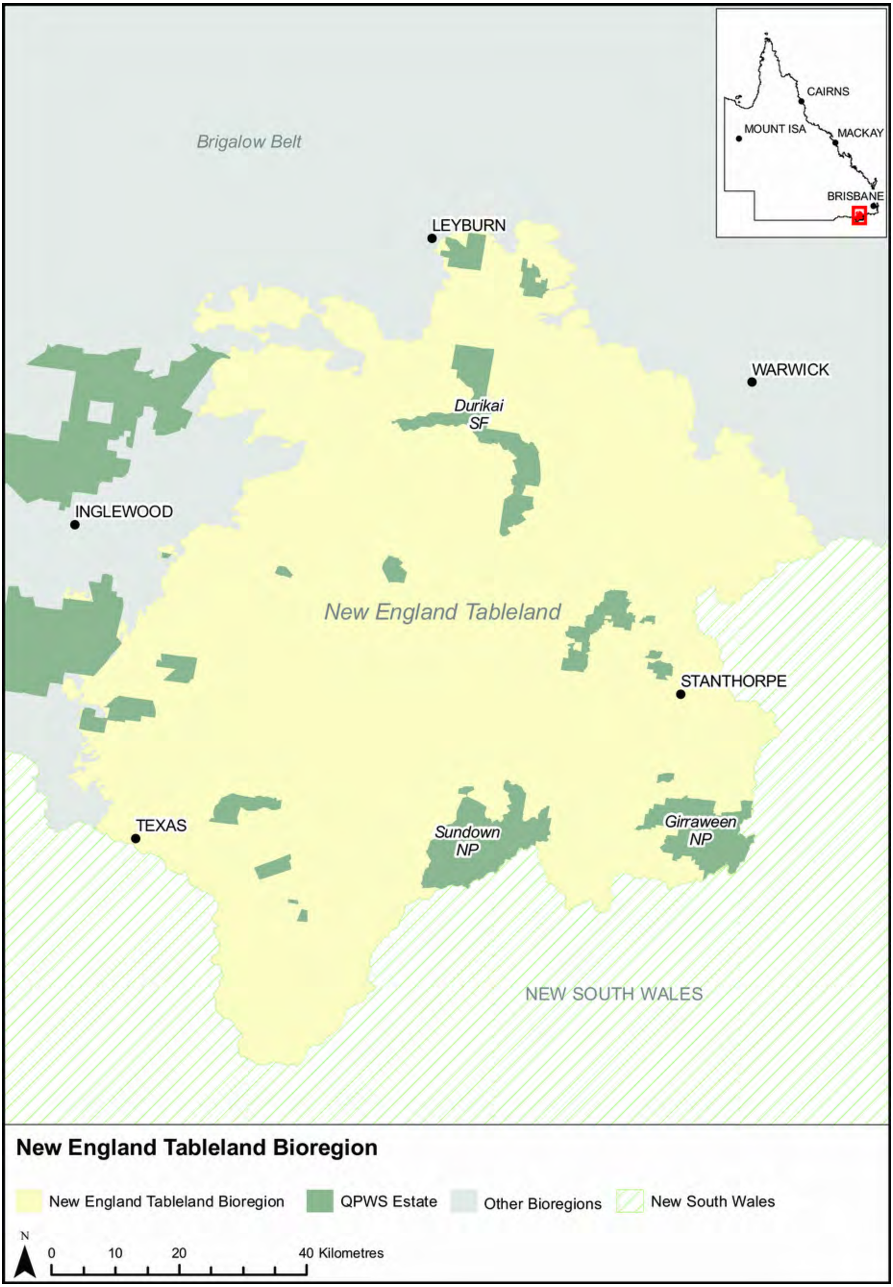


Figure 1: Map of the New England Tableland bioregion of Queensland.

Fire and climate in the New England Tableland bioregion

The New England Tableland bioregion has a climate that is generally cooler than the rest of Queensland with frosts experienced from mid-autumn to mid-spring. This can restrict the hours available for planned burns but also provide another tactic for containment. The majority of rainfall occurs during summer, either as heavy thunderstorms or from tropical rain depressions. However, it is highly variable across the bioregion with eastern parts (e.g. Girraween National Park) receiving higher rainfall than western parts.

The fire season is defined as the months in which more severe wildfires generally occur. Winters are typically dry and if little rain is received, can lead to a period of high fire danger going into spring when dry strong westerly winds often occur. In general the fire season starts in September, peaking in October, and continues into December.

Further information can be found in the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go and on the Bureau of Meteorology website at www.bom.gov.au.

Sundown National Park, Brett Roberts, QPWS (2004).

How to use this guideline

Step 1: Know your local fire strategy. This planned burn guideline works with and supports your local fire strategy. While the guideline should address the majority of issues in your area, it is essential you also review your fire strategy before completing your planned burn proposal to ensure all ecological issues are considered (e.g. zoning plan, threatened species, fire histories, *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and other legislative requirements).

Step 2: Observe the country. It is essential to regularly observe the country that you manage (and the surrounding landscape). Familiarise yourself with this guideline so it becomes part of your observation of the environment as you go about your work. To assist you in observing the environment, undertake this simple exercise:

1. If a **canopy** is present (e.g. for open forests and woodlands) observe the following:
   a) Is tree branch foliage dying? Is there epicormic regrowth on branches? Are there any dead trees?
   b) Are there habitat trees (e.g. trees with hollows)?
   c) Are there rainforest, scrub or riparian ecosystems nearby?
2. For fire vegetation groups with a **mid-layer** (trees above the height of shrubs and grasses but not yet in the canopy) observe the following:
   a) What are the mid-layer trees (young canopy trees, wattles, casuarinas or rainforest species)? How open or dense is the mid-layer?
   b) Is there evidence of fire? What is the prevalence and height of blackened bark?
3. For fire vegetation groups with a **ground-layer** of grasses, sedges or shrubs, observe where relevant:
   a) The presence of grasses and grass clumps. Do the grasses look healthy and vigorous? Are there well-formed grass clumps?
   b) Is there a build-up of dead and decaying matter associated with grasses, shrubs, ferns or sedges?
   c) Are shrubs looking healthy and vigorous? Are there dying crowns on the shrubs?
   d) Does the ground-layer have a diversity of species or is it dominated by one or a few juvenile tree species? Are weeds dominating the understorey?

Step 3: Read the relevant chapters of this guideline and decide which issues apply to the area you are observing. It is common for burn proposals to address more than one issue—do not necessarily limit yourself to one issue per burn proposal.

Step 4: Consider your fire management priorities. Each chapter offers guidance for determining fire management priorities. The statements about priorities are based on a standard QPWS planned burn proposal prioritisation framework intended to guide both land managers and approval bodies.

Step 5: Choose measurable objectives. Each chapter of this guideline provides measurable objectives to include in your burn proposals (be guided also by the objectives in your fire strategy). Choose one or more objectives whilst observing the land. Do you need to adjust the objectives so they apply to your situation? Do you need to develop objectives not already included in these guidelines? If you find it difficult to identify your objectives, contact your natural resource management ranger or equivalent.

Step 6: Write a burn proposal. The **measurable objectives, fire behaviour, tactics** and **weather conditions** sections of each chapter can be copied directly into your burn proposals. Copy (ctrl+c) statements from a PDF version of this guideline and paste them (ctrl+v) into the burn proposal. Note that you may have to adjust the wording.

Step 7: Is your burn ready to go? Refer to the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go. Becoming familiar with the tools in this guideline will enable you to predict fire behaviour and achieve your burn proposal objectives.

Step 8: Review the measurable objectives in your burn proposal. After a fire, undertake the post-fire assessment recommended by this guideline (as defined in your burn proposal). This will indicate if you have achieved your planned burn objectives. This guideline provides information on how to report the results in your fire report.

Step 9: Review your fire management issue (re-apply this guideline to the burn area starting from Step 1). Return to the burn area after one year and then a few years after the original burn—once again applying this guideline. Many issues (such as weed control) are not resolved with a single burn and it is important to keep observing the land. If the results of fire management are unexpected or difficult to understand please seek further advice. If this process identifies shortfalls in your fire strategy, consider reviewing it. Step 9 can be implemented as part of a structured photo-monitoring process at various locations within the estate. Instructions can be obtained from the QPWS Fire Management System.

Chapter 1: Grassy open forest

This fire vegetation group contains a range of open eucalypt forest and woodland communities, commonly found on drier hill slopes, alluvial flats and along creek lines. Cypress, bull oak and acacia or a combination of these trees may be common in the mid to upper stratum. The understorey is predominantly grassy, though may be sparse, and interspersed with scattered shrubs, sedges and/or herbs. This group also includes treeless grassy flats historically cleared for grazing in Girraween and Sundown national parks.

Some of these grassy woodlands have a very restricted distribution such as New England peppermint *Eucalyptus nova-anglica* grassy woodlands (recently declared critically endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*). Significantly, most of the ecosystems in this group have a biodiversity status of **endangered** or **of concern** (Queensland Herbarium 2011a).

Fire management issues

A grassy open forest structure can be threatened by overabundant saplings or shrubs, eventually leading to loss of grass species and diversity. On the New England Tableland saplings of cypress, bull oak and some acacias may frequently become overabundant in the mid-stratum. Common shrubs such as dogwood, hop bush and dead finish can also become dominant in the understorey with the absence of fire. The presence of invasive exotic grasses may unexpectedly increase the severity of fires, impacting on the health of ecosystems. Fire can also promote exotic grasses as they regenerate faster than native grasses post-fire.

Issues:

1. Maintain healthy grassy open forest
2. Reduce overabundant saplings or shrubs
3. Manage invasive grasses.

Extent within bioregion: 192 949 hectares (ha), 25 per cent; **Regional ecosystems:** 13.3.1; 13.3.2; 13.3.3; 13.3.4; 13.3.5; 13.3.7; 13.11.3; 13.11.4; 13.11.6; 13.11.8; 13.12.4; 13.12.8; 13.12.9; 13.12.10.

Examples of this FVG: Durikai State Forest, 10 480 ha; Sundown National Park, 6 657 ha; Girraween National Park, 4 625 ha; Arcot State Forest, 2 475 ha; Leyburn State Forest, 2 470 ha; Texas State Forest 1, 1 796 ha; Yelarbon State Forest, 1 509 ha; Talgai State Forest, 1 394 ha; Bringalily State Forest, 1,299 ha; Sundown Resources Reserve, 1 264 ha; Gunyan State Forest, 1 036 ha; Macintyre State Forest, 951 ha; Texas State Forest 2 450 ha; Greenup State Forest, 417 ha; Claremont State Forest, 273 ha; Terrica State Forest, 267 ha; Broadwater State Forest, 231 ha; Bracker Creek (Warroo Environmental Reserve), 132 ha.

Issue 1: Maintain healthy grassy open forest

Healthy grassy open forest or woodland should be maintained with mosaic burning.

Awareness of the environment

Key indicators of a healthy open forest or woodland with a grassy understorey (refer to the photos below):

- The open forest and woodland ground-layer is dominated by grasses and/ or sedges with occasional shrubs, bracken, herbs or any mix of these. A few young canopy species are present in the mid and lower-stratums (enough to eventually replace the canopy).
- Scattered trees of various heights and ages are present (refer to the discussion points below).
- Habitat trees and fallen logs are present.
- The forest is easy to walk through or see through.

Spotted gum/ ironbark open forest with a sparse but healthy grass understorey and trees of various ages.

Jenise Blaik, QPWS, Greenup State Forest (2010).

Grass clumps appear well-formed and healthy on the slopes of this rocky woodland.
Jenise Blaik, QPWS, Sundown National Park (2010).

This immature river red gum community is slightly overstocked with canopy trees however the structure of the sedge understorey is healthy.
Jenise Blaik, QPWS, Leyburn State Forest (2010).

Eucalypt woodland with a healthy grass and sedge understorey and presence of fallen logs.
Jenise Blaik, QPWS, Girraween National Park (2010).

Recently logged forests will have less variety in height and age of eucalypts but may still have a healthy grass understorey.
Jenise Blaik, QPWS, Talgai State Forest (2010).

This woodland is recovering after a history of ring-barking and sheep grazing but retains a healthy grass understorey. Low-severity mosaic burns will allow the survival and recruitment of eucalypts (enough to eventually replace canopy).
Jenise Blaik, QPWS, Sundown National Park (2010).

Several open grassy areas historically cleared for grazing are found in Sundown and Girraween national parks and if healthy should be mosaic burnt in association with surrounding grassy open forests.
Jenise Blaik, QPWS, Sundown National Park (2010).

The following may indicate that fire is required to maintain a grassy open forest or woodland (refer to the photos below):

- Grasses appear sparse or clumps are poorly formed. An accumulation of dead material exists around the base of the grass or sedge.
- Bracken or blady grass is dominant in the understorey (more than 50 per cent) indicating previous fire(s) have occurred during dry conditions, favouring these species.
- Acacia, bull oak or cypress is becoming abundant in the ground and/or mid-layers.
- Shrub species such as hops, dead finish, dogwood or peach bush are becoming abundant (i.e. comprises more than 25 per cent of the understorey).
- Where present, trunks of mature acacias (e.g. pechey wattle *Acacia neriifolia*) are covered in orange lichen.
- Where present, grass trees are beginning to form dense brown skirts.

Grass clumps that are dying-off and accumulating leaf litter (despite recent rains) may indicate the absence of fire. Consider if these changes are due to seasonal effects or drought.

Jenise Blaik, QPWS, Talgai and Greenup State Forests (2010).

This understorey is dominated by bracken and blady grass indicating previous fires may have occurred during dry conditions. Low-severity patchy burns with good soil moisture may help to re-establish other native grasses where seed stock is still available.
Jenise Blaik, QPWS, Passchendaele State Forest (2010).

Cypress saplings in the understorey of this ironbark woodland are starting to appear abundant and grasses have become sparse.
Jenise Blaik, QPWS, Texas No.2 State Forest (2010).

Shrubs such as dogwood have become abundant and grasses have become sparse—both indicators that fire is required to maintain grass health and reduce the dominance of shrubs.

Jenise Blaik, QPWS, Girraween National Park (2010).

Photos above show indicators that fire has been absent for too long.

Left: The upper branches of mature acacia (foreground) have died and grasses are becoming sparse. **Right:** The brown skirts on grass trees provide habitat for invertebrates and skinks. However, as the skirts build-up (this one has built-up so much that it indicates a long absence of fire) they indicate the need for fire management to maintain a forest with an open structure. In the absence of fire, these open forest habitat features would eventually perish. With planned burn conditions unburnt patches remain, providing areas of refuge in contrast to wildfires which tend to burn extensive areas.

Jenise Blaik, QPWS, Talgai State Forest (2010).

Grass is healthy due to recent rain but accumulated fuels and orange lichen covering the trunk of a mature acacia are indicators of a long-unburnt area.
Jenise Blaik, QPWS, Sundown National Park (2010).

Discussion

- Some protected areas contain heavily disturbed or immature systems due to previous logging and grazing practices. In these systems, the canopy may be understocked, overstocked or contain a more even-aged population. As long as the structure of the understorey appears healthy, implementing this guideline should help to re-establish a more varied and mature system over time.
- Be aware that signs of poor health can also be the result of drought and should be assessed in conjunction with known fire history. Implementing fire during drought conditions is not recommended as this could compound health problems.
- Low nutrient soils are common in the New England Tableland (e.g. ironbark communities in Durikai State Forest) and grasses may always appear less vigorous or sparse).
- Grazing may contribute to grass sparseness and impact on fire behaviour or the ability to carry a fire.
- Impacts from periodic high-severity wildfires which occur in this region will need to be considered when developing the planned burn program.

Grazing may significantly reduce the ability to carry a fire in grassy open forest (right side of fence).

Peter Cavendish, QPWS, Glen Rock State Forest (2007).

Impacts from a high-severity wildfire will affect future planned burn programs.

QPWS, Girraween National Park (2002).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of special conservation significance.
High	Planned burn to maintain ecosystem in areas where ecosystem health is good.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
40–80 % mosaic of burnt patches within grassy open forest	Choose one of these options: Visual estimation of percentage of vegetation burnt—from one or more vantage points or from the air. Map the boundaries of burnt areas with GPS, plot on ParkInfo and thereby determine the percentage of area burnt. In three locations (that take account of the variability of landform and ecosystems within burn area) walk 300 or more metres through planned burn area estimating per cent of ground burnt within visual field.	**Achieved:** 40–80 % burnt. **Partially achieved:** between 30–40 % **Or** 80–90 % burnt. **Not achieved:** < 30 % consider follow-up planned burn. **Or** > 90 % burnt—need to assess impacts on ecosystem.

> 90 % of clumping grass bases remain as stubble.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire severity) and count the grass clumps in a radius of at least five metres.	**Achieved:** > 90 % bases remain. **Partially achieved:** 75–90 % bases remain. **Not achieved:** < 75 % bases remain.
> 95 % of standing dead trees and standing live hollow-bearing trees (habitat trees) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	**Achieved:** > 95 % retained. **Partially achieved:** 80–95 % retained. **Not achieved:** < 80 % retained.
> 75 % fallen logs (with a diameter ≥ 20 cm) retained.	Before and after fire, select three or more sites of 20 metre radius' (taking into account the variability of landform and likely fire severity) and estimate percentage of fallen logs retained after fire.	**Achieved:** > 75 % retained. **Partially achieved:** 60–75 % retained. **Not achieved:** < 60 % retained.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Where possible, creating a mosaic of burnt and unburnt areas provides refuge for wildlife and creates a wider diversity of habitat. Note also the retention of some fallen logs.
Peter Leeson QPWS (2007).

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	< 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Nearly all habitat trees, fallen logs, and grass stubble retained. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (i.e. recently burnt through to the maximum time frame). Consider a broad fire interval range of between three to eight years.
- Longer intervals should be used in drier western areas where fuel accumulation is slower and low-nutrient soils exist or where the understorey contains mixed grassy and shrubby elements.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 40–80 per cent burnt within the target communities.

Landscape mosaic

- In general, do not burn more than 20 per cent of open forests with a grassy understorey within the management area, in the same year. During particularly good seasons, it may be beneficial to burn more than 20 per cent and during very poor seasons it may be necessary to minimise the amount of planned burning.

Other considerations

- Grassy flats surrounding waterholes in Sundown National Park are currently burnt more frequently (two to three years) to promote habitat for the near-threatened turquoise parrot.
- Consider introducing variation in season and interval as much as possible.
- Avoid moderate-severity fires in late autumn as this is when the growing period ceases, and soils may remain susceptible to erosion for prolonged periods during winter.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided. Drought conditions may also lead to poor results and/or wildfires.

Season: April to August

FFDI: < 11

DI (KBDI): < 100. If > 100, good results are still possible if burns are conducted following rainfall events and fire weather is not forecast for the following week.

Wind speed: < 15 km/hr

Soil moisture: Good moisture conditions are necessary to protect grass bases, hollow-bearing trees and fallen logs. Consider days since rain when planning fires.

Other considerations:

- During winter, the effective burn period is reduced to a maximum of two to four hours (between 11 am and 3 pm). This is due to low temperatures and moisture from frost and dew.
- Angophora/spotted gum communities burn easily and planned burns can be conducted early in the season.
- Ironbark/cypress communities require drier conditions to burn and are generally burnt later in the season. However, be aware of the high risk of re-ignition if less than 60 per cent is burnt or if the community is interspersed with spotted gum/ironbark communities.
- Be aware that topography can affect wind conditions, often creating localised patterns which may alter fire behaviour.

What burn tactics should I consider?

- Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.
- **Aerial ignition.** Use of aerial incendiaries is essential to cover large or inaccessible burn areas and to maximise efficiency of resources (particularly in winter when the burning times are reduced to two to four hours between 11 am and 3 pm). Lighting patterns will need to be adjusted to achieve the recommended mosaic. Fixed-wing planes are more useful in broader flatter areas (generally in western areas) and helicopters provide greater control in the rugged terrain of Sundown and Girraween national parks. Lighting along ridgelines will allow the fire to trickle down slopes and self-extinguish in moister areas.
- **Spot ignition** applies to aerial and ground ignition and can be used to alter the desired severity of a fire (particularly where there is an accumulation of volatile fuels). Spot ignition that is close together will result in a line of fire that is of greater severity (as spots merge they create high-intensity junction zones). Spot ignition that is further apart will result in a lower-intensity fire. Note that the spacing of the spots will generally vary throughout the planned burn area due to changes in weather conditions, topography and fuel loads. In areas of high fuel hazard and/or with long-unburnt vegetation, broad-spaced, aerial grid-pattern ignition may create runs of fire which can also result in high-severity junction zones. Consider lighting these areas later in the day to limit their intensity.

- Where **fire containment** is an issue, dew-point (particularly in Girraween) can be useful to help contain the planned burn area and create a mosaic.
- Lighting on the leeward (smoky) edge can be a useful way to create a **low-severity backing fire** into the planned burn area, or create a containment edge for a higher-severity fire ignited inside the planned burn area. Lighting down-ridge is an important tactic to create a lower-severity burn.
- **A running fire** may be required where fuel is less continuous or when cooler conditions and higher moisture levels exist.

A low-severity backing fire (lit against the wind) is preferable in drier conditions or when fuel levels are high.

Brett Roberts, QPWS, Lockyer National Park (2005).

Issue 2: Reduce overabundant saplings or shrubs

In an open forest/woodland with a grassy understorey, a broadscale overabundance of saplings or shrubs may reduce the health of grasses through competition and shading. Without the early intervention of fire, the forest can transition from an open to a closed system, in which planned burns become difficult to reintroduce.

Awareness of the environment

Key indicators of where fire management is required (refer to photos below):

- A mass germination of young acacias, cypress, bull oaks or other woody species is emerging above the grasses in the understorey.
- There is an increase in abundance of acacia, cypress or bull oak saplings in the mid-stratum.
- Where present, certain shrubs such as hops, dead finish or dogwood are becoming dominant in the understorey.
- Grasses and herbs are declining in health and abundance or are becoming increasingly sparse.
- Where present, sedges and/or shrubs are declining in health and abundance due to the shading of saplings.
- There is an accumulation of suspended and/or elevated fuels.

A flush of acacia saplings in the understorey has been triggered by a high-severity fire event.

Jenise Blaik, QPWS, Durikai State Forest (2010).

Bull oak saplings are overabundant in the understorey and grasses are becoming sparse.

Jenise Blaik, QPWS, Talgai State Forest (2010).

Too many cypress saplings in the understorey are changing the structure and shading out the grasses.

Jenise Blaik, QPWS, Leyburn State Forest (2010).

The understorey is dominated by a dense cover of the shrub dead finish which is shading out the grasses in the ground layer.

Jenise Blaik, QPWS, Sundown National Park (2010).

Discussion

Why are saplings or shrubs overabundant?

An overabundance of saplings or a single shrub species in the understorey may be triggered in response to any one of the following:

- A high-severity fire event with no subsequent fire to thin the resulting flush of tree or shrub seedlings.
- A prolonged absence of fire leading to a gradual increase in woody species.
- The removal of stock grazing.

Potential impacts of overabundant saplings or shrubs:

- A thickening of trees or shrubs will result in lower understorey diversity due to shading and fuel levels that are too low to carry a burn.
- Saplings and shrubs often burn with higher intensity which promotes the regeneration of woody species rather than grass.
- Once a thicket has developed, it may be difficult to re-introduce a burn into that area if left too long.
- An abundance of saplings in the understorey changes the structure from an open to a closed structure.
- Canopy species in the understorey are required for the eventual replacement of the canopy. However, the potential of these species to shade out the understorey must be considered.

Other considerations

- Some areas of grassy open forest and woodland in the New England Tableland are susceptible to acacia, bull oak or cypress thickening. In the absence of fire, seed stock of these species builds up and may result in a mass germination, often following a high-severity fire event such as wildfire.
- For acacia, cypress and bull oak thickening, it is particularly important to observe post-fire germination and kill rates to ascertain the need for subsequent planned burns.
- It is likely that more than one planned burn will be required to manage issues.
- If the initial burn triggers a flush of new seedlings, a follow-up planned burn may be required when sufficient fuel allows for a **low** to **moderate -** severity burn.
- Once the area has recovered, the recommended regime for a healthy grassy open forest and woodland should be resumed (refer to Issue 1).

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good.**
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Assessing outcomes

Formulating objectives for planned burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Scorch above ground component of > 75 % of saplings or targeted shrubs < 1 m.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings or targeted shrubs (above ground components) scorched.	**Achieved:** > 75 % scorched. **Partially achieved:** 25–75 % scorched. **Not achieved:** < 25 % scorched.
> 50 % of the grass clumps remain as stubble.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and count the grass clumps in a radius of at least five metres.	**Achieved:** > 50 % bases remain. **Not achieved:** < 50 % bases remain.
> 80 % of habitat trees retained.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	**Achieved:** > 80 % retained. **Not achieved:** < 80 % retained.
> 50 % fallen logs (with a diameter ≥ 20 cm) retained.	Before and after fire, select three or more sites of 20 metre radius (taking into account the variability of landform and likely fire intensity) and estimate percentage of fallen logs retained after fire.	**Achieved:** > 50 % retained. **Not achieved:** < 50 % retained.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

These overabundant wattles have been scorched to reduce their density without encouraging a new flush of acacia seedlings.
Mark Cant, QPWS, Durikai State Forest (2011).

Fire parameters

What fire characteristics will help address this issue?

Continuity of fuel

- The key factor for managing this issue is to ensure that sufficient fuel has accumulated to carry the planned burn and scorch the targeted plants.

Fire severity

- Moderate.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Mosaic (area burnt within an individual planned burn)

- Burn as much of the area dominated by saplings (or targeted shrubs) as possible.

Other considerations

- It is possible that more than one planned burn will be required to manage this issue. If the initial planned burn triggers a flush of new seedlings, a follow-up low to moderate-severity burn will be necessary.
- Any follow-up planned burn will need to be hot enough to scorch the shrub layer and applied before a significant seed bank has developed. In this instance, a fire frequency that is shorter than normal may be required for this community.
- Avoid lower-severity burns, as this will exhaust fuel and reduce opportunities for subsequent moderate severity burns.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: The accumulation of fuel and sufficient moisture to favour regeneration of grasses is seasonally dependent. Caution is required if undertaking a moderate-severity burn in late autumn as this is the end of the growing period and will result in slow regeneration and soils being exposed to erosion during winter rains.

FFDI: 5 to 11

DI (KBDI): < 100

Wind speed: < 15 km/hr

What planned burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- While a moderate-severity fire is recommended to address the overabundance of saplings, it is largely dependent on their height (refer to the severity table for scorch heights). Where there is a lack of surface and near-surface fuels (due to shading-out or a well-developed thicket) a **running-fire** of high-severity may be required. In this instance a follow-up planned burn will be required to kill the surviving saplings and any new seedlings that may germinate.
- **Line or strip ignition** is used to create a fire of higher intensity which is useful in reducing overabundant trees (through scorching).
- **Commence lighting on the leeward (smoky) edge.** This can be a useful way to create a containment edge for a high-severity fire ignited inside the burn area.
- **A low-severity backing fire with good residence time** (lit against the wind on the smoky edge or down slope) will generally result in the more complete coverage of an area and a better reduction of available fuels. As the intensity and rate of spread are kept to a minimum, the fire has a greater amount of time to burn fuels in that area. This tactic is also useful in reducing overabundant seedlings and saplings.

Issue 3: Manage invasive grasses

Invasive exotic grasses are capable of out-competing and replacing native grass species to form dominant stands. They tend to occur as a result of disturbance and spread along firelines, utility easements and areas historically cleared for grazing. The main species of concern in the New England Tablelands are coolatai, African lovegrass and whiskey grass. They are generally taller and produce significantly more dry matter than native species; increasing fuel loads, fire intensity, spotting and flame height. This leads to increased fire severity and spread which results in greater tree death and loss of habitat features with flow on effects to species.

Awareness of the environment

Key indicators (refer to photos below):

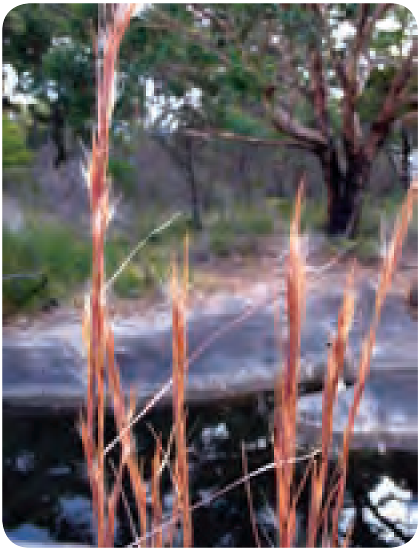
- Invasive exotic grasses are present, usually in dense infestations.
- Exotic grasses generally form single-species dominated stands with a lot of mass and/or dead material.
- Most exotic grasses grow taller than the native species.

Coolatai grass forms a dense stand on the edge of this woodland and has the potential to increase fire severity.

Peter Haselgrove, QPWS, Sundown National Park (2009).

Discussion

- **Coolatai grass** *Hyparrhenia hirta* is an exotic perennial tussock grass, up to 1.5 m tall that is capable of invading endangered grassy woodlands. It can produce seed in the first growth season and is self-fertile enabling new populations to arise from a single plant (Weed CRC 2007).
- **African love grass** *Eragrostis curvula* is also an exotic perennial species that can form dense monocultures up to 1.2 m high. It produces vast quantities of seed which quickly develop into large viable seed banks, making the plant very difficult to eradicate (DEEDI 2009).
- Both Coolatai and African love grass need to be growing actively (late spring to summer) for herbicide to be effective. Fire can be used to remove dead biomass and stimulate regrowth before spraying six to eight weeks later (ideally) before either species flower.
- **Whiskey grass** *Andropogon virginicus* is a tall tussock grass up to one metre with a distinctive erect, columnar habit. It is orange-brown in colour during the warmer months, fading to a straw colour during winter. It invades disturbed areas along tracks and some rock pavement communities and like other exotic grasses can increase the fire hazard.
- During planned burn operations where these grasses are present, the potential to either promote or control them and their effect on fire severity must be considered.
- Management of these species is still experimental so staff should be encouraged to record observations regarding these species' response to fire and map their distribution.
- Be aware of weed hygiene issues when maintaining firelines or planned burning in areas with invasive grasses. Fire vehicles, machinery, equipment, boots and clothing can aid seed spread along firelines and should be cleaned before and after contact. Machinery should work from clean areas back into infested areas to reduce the risk of spreading weed seeds.



Seed head of whiskey grass

Kym Sparshott, QPWS,
Girraween National Park (2006).

Seed head of African love grass

Donovan Sharp, QPWS (2011).

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good.** It is important to be aware of the presence of invasive grasses (particularly where it is a new infestation) so that their negative effects can be managed and the potential of control can be considered.
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Evaluating outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Choose from below as appropriate:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Promote mass germination of invasive grass seeds in preparation for control with herbicide.	Assess the site after the burn (preferably after rain) for germination of invasive grass seeds.	**Achieved:** mass germination of weed seeds. **Partially achieved:** moderate germination of weed seeds (sufficient to warrant follow-up spraying). **Not achieved:** Insufficient germination to warrant follow-up spraying.
Reduce fuel hazard (created by exotic grass) to low to limit impacts of unplanned wildfire on regeneration.	Post-fire, use the Overall Fuel Hazard Guide to visually assess the remaining fuel hazard in three locations.	**Achieved:** Fuel hazard has been reduced to low. **Not achieved:** Fuel hazard has not been reduced to low.
Burn 80–100 % of the exotic grass infestation.	Before and after fire, assess the percentage of exotic grass that has been burnt.	**Achieved:** 80–100 % burnt. **Partially achieved:** 60–80 % burnt. **Not achieved:** < 60 % burnt.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate**

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: winter (Girraween National Park is experimenting with burning whiskey grass during moister conditions)

FFDI: < 11

DI (KBDI): not dependent

Wind speed: < 20 km/hr

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Commence lighting on the leeward (smoky) edge** to create a low-severity backing fire into the burn area, where higher fuel levels (due to exotic grasses) or drier conditions are present.
- **Burn with the wind away from the firelines** to avoid the risk of fire spotting over.
- **As part of an integrated control program** use planned burns to remove dead material and promote the mass germination of invasive grass in preparation for herbicide spraying. Successful treatment will require site monitoring and repeated follow-up of remaining plants and new seedlings.
- **Late afternoon ignition** will help to limit fire severity and increase the chance of the fire self-extinguishing under milder conditions and higher soil moisture.
- **Spot ignition** can be used to alter the desired intensity of a fire particularly where there is an invasive grass infestation. Increased spacing between spots will result in a lower intensity. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.

Planned burn of invasive grasses (whiskey and love grass), showing rapid increase in flame height and rate of spread from spot ignition (top), after one minute (centre) and two minutes (bottom).

John Cowburn, QPWS, Girraween National Park (2010).

Chapter 2: Shrubby open forest

This fire vegetation group contains a range of open eucalypt forest and woodland communities with an understorey dominated by shrubs, heath, ferns or a mixture of these. It also includes the moister tall to very tall open forests of New England ash. Shrubby open forests are found predominantly on the upper slopes, hillsides and higher altitudes of the tablelands on granite or traprock. Other distinctive shrubby communities occur intermittently throughout the traprock country (e.g. Durikai State Forest). The shrubby open forests of this bioregion contain many temperate-adapted plants and animals that do not occur elsewhere in Queensland.

Fire management issues

The climate, topography and shrubby sclerophyllous vegetation combine to produce a high fire risk environment. These communities are susceptible to high-severity spring wildfires which cause severe ecosystem impacts from which recovery is very slow. It is therefore critical to maintain existing healthy shrubby open forest using mosaic burning (refer to Appendix 2).

Overabundant saplings (mainly wattle or hop bush) in the mid-stratum can threaten an open canopy structure and also lead to a loss of diversity in the shrubby understorey.

Issues:

1. Maintain healthy shrubby open forest
2. Minimise loss of diversity from high intensity wildfires
3. Reduce overabundant saplings in the mid-stratum.

Extent within bioregion: 48 972 ha, 6 per cent; **Regional ecosystems:** 13.11.1; 13.11.2; 13.12.1; 13.12.2; 13.12.5.

Examples of this FVG: Girraween National Park, 5 739 ha; Sundown National Park, 5 183 ha; Passchendaele State Forest, 1 685 ha; Sundown Resources Reserve, 1 246 ha; Broadwater State Forest, 684 ha; Girraween (Bill Goebels House), 1 ha; Pozieres State Forest, 1 ha.

Issue 1: Maintain healthy shrubby open forest

Maintain existing healthy shrubby open forest and woodland using mosaic burning.

Awareness of the environment

Key indicators of a healthy shrubby open forest (refer to photos below):

- The understorey is dominated by a diverse shrub layer of varied height. Scattered sedges, grasses and ferns may be present. Some young canopy species are present in the mid and lower stratums (enough to eventually replace the canopy) and the canopy appears healthy.
- In some areas of New England ash forests, even-aged stands of young canopy trees are a natural feature. Recruitment may be of mixed or even-aged stands.
- Hollow-bearing trees and fallen logs are present.
- Mature shrub species with healthy foliage and fruiting bodies in different stages of maturity are present (e.g. hakea, banksia, pea flowers, conesticks, crinkle bush and geebung).

This tall open forest has canopy species of varied ages and a shrubby/ferny understorey.
Jenise Blaik, QPWS, Girraween National Park (2010).

This New England ash open forest has a diverse understorey of shrubs, ferns and sedges. Even-aged stands of young canopy trees can be a natural feature in these communities.
John Williams, DEEDI, base of Bald Rock (1973).

This open ironbark forest has a dense shrubby understorey.
Jenise Blaik, QPWS, Durikai Scientific Area (2010).

A diverse shrub layer with canopy trees of varying sizes.
Jenise Blaik, QPWS, Girraween National Park (2010).

Some shrub species such as banksias retain fruiting bodies on branches which can provide some indication of time since fire. The presence of mature shrub species with healthy foliage and/or flowers also indicates good health (e.g. hop bitter pea, pictured right).
Jenise Blaik, QPWS, Girraween National Park (2011).

Indicators of declining health in shrubby open forest:

- Shrubs look unhealthy or are dying. For example, significant loss of lower level leaves, accumulation of brown leaves, spindly branches or dead crowns (ends of branches) are evident.
- Where they are known to occur, there is a loss or reduction of obligate seeders (e.g. the endangered *Boronia repanda*).
- The diversity of mid/ground stratum species (grasses, herbs, sedges and shrubs) has declined.
- There is a significant build-up of fine fuels such as dead grass material, leaf litter, suspended leaf litter, bark and twigs. There is an accumulation of elevated fuels.
- There is a dominance of bracken in the understorey.

Dead branches are noticeable in the shrub layer indicating the long-term absence of fire.

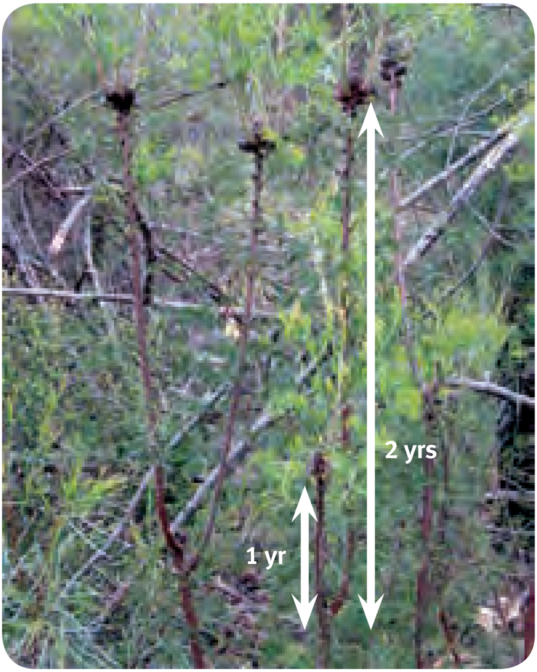
Jenise Blaik, QPWS, Durikai State Forest (2010).

A widespread build-up of ground litter and suspended fuels can provide an indicator that mosaic burning is required to reduce the risk of extensive high-severity wildfire.

Jenise Blaik, QPWS, Girraween National Park (2011).

Significant loss of leaves and dead crowns are indicators of poor health in this shrubby understorey.
David Kington, QPWS (2007).

A dominance of bracken in a shrubby understorey may be an indicator of too-frequent fire without soil moisture.
Jenise Blaik, QPWS, Girraween National Park (2010).



Counting the number of fruiting nodes on the common shrub conesticks *Petrophile canescens* can provide an indicator of time since fire.

Jenise Blaik, QPWS, Girraween National Park (2011).

Some shrubs are killed by fire and rely on soil-stored seed to regenerate (e.g. the endangered *Boronia repanda*). Too-frequent fire can lead to localised extinctions if there is insufficient time for the shrub to mature to viable seed production.

Kym Sparshott, QPWS, Girraween National Park (2004).

Discussion

- Many species present in shrubby open forest, including numerous endangered, vulnerable and near threatened taxa are dependent on fire, but their specific fire requirements are unknown. Mosaic burning ensures that across an area, a variety of habitat conditions is maintained (this maximises species' chances of survival and provides vital habitat particularly for many ground-dwelling fauna species [e.g. lyrebirds]).
- Be aware that many species of obligate-seeder shrubs don't reach maximum seed production for several years after their first fruit production (and their first year may produce insufficient or unviable seed).
- It is important to break the cycle and extent of wildfires by creating landscape mosaics in healthy communities. Aerial ignition will be required to achieve this in large unbroken or inaccessible areas.
- Shrub species that retain fruiting bodies on branches can be used as a guide to indicate time since fire. Examples include the fruiting nodes on the common shrub conesticks and the generations of seed capsules on bottlebrushes, hakeas, banksias and melaleucas.
- It is important to distinguish shrubs from juvenile trees (shrubs are multi-stemmed plants that will remain in the mid to lower stratum). Too many juvenile trees will grow to shade-out understorey plants and without the early intervention of fire, will result in a more closed system that is difficult to burn.
- Be aware that signs of poor health can also be the result of drought. Implementing fire during drought conditions is not recommended as this could compound health problems.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good.**

Assessing outcomes

Formulating objectives for planned burn proposals

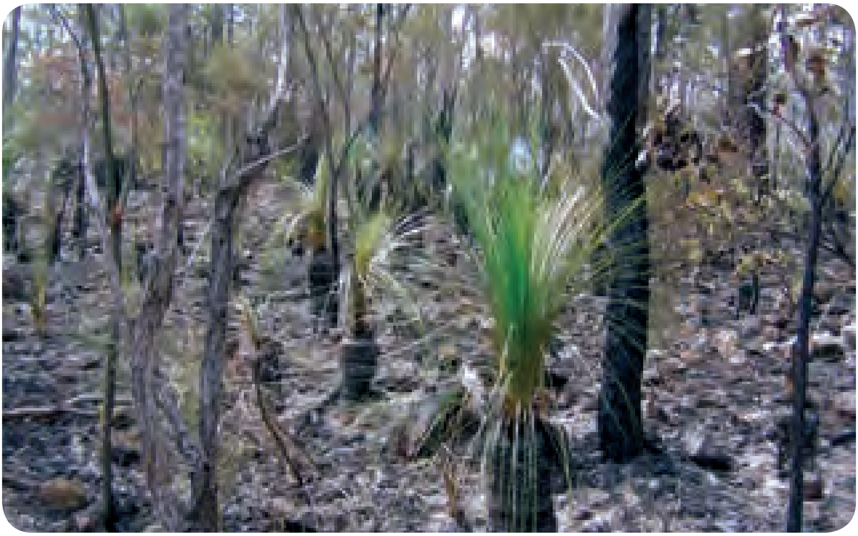
Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
50–80 % mosaic of burnt patches within shrubby open forest.	Choose one of these options: Visual estimation of percentage of vegetation burnt—from one or more vantage points or from the air. Map the boundaries of burnt areas with GPS, plot on ParkInfo and thereby determine the percentage of area burnt. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 or more metres through the planned burn area estimating percentage of ground burnt within the visual field.	**Achieved:** 50–80 % burnt. **Partially achieved:** between 30–50 % burnt. **Not achieved:** < 30 % burnt: consider follow-up planned burn. **Or** > 80 % burnt: need to assess results of other relevant objectives.

Create age class diversity within shrubby open forest by mosaic burning across the landscape (e.g. mosaic burn approx 30 % every 'x' years).	Choose one of the options from above	**Achieved:** 25–50 % of community burnt. **Partially achieved:** 0–25 % or 50–75% burnt (adjust future planned burn objectives depending on result). **Not Achieved:** > 75 % of community burnt.
Limited canopy scorch.	In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 or more metres through planned burn area estimating percentage of canopy scorch within visual field.	**Achieved:** < 10 % canopy scorch. **Partially achieved:** 10–25 %. **Not achieved:** > 25 %.
80 % of grass tree skirts removed with living shoots emerging.	Select one or more sites or walk one or more transects and estimate the percentage of grass skirts removed after the fire.	**Achieved:** 50–80 %. **Partially achieved:** 30–50 %. **Not achieved:** < 30 %.
> 95 % of standing dead trees and standing live hollow-bearing trees (habitat trees) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	**Achieved:** > 95 % retained. **Partially achieved:** 90–95 % retained. **Not achieved:** < 90 % retained.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.



Dead tree skirts have been removed during this planned burn. Living shoots are emerging.

Peter Cavendish, QPWS (2007).

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate.**

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	≤ 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Bases of grass clumps and fleshy base of sedges and lilies remains and is ‘green’. Shrub trunks and main lateral stems remain although may be charred. Nearly all habitat trees and fallen logs retained. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer retained. Some fleshy sedge bases remain though show charring. General charring of shrubs but some frames remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 50–80 per cent burnt within the target communities.
- Moist areas such as gullies should remain unburnt as they provide significant areas for wildlife refuge and contain fire-sensitive species such as epiphytes and ferns.

Landscape mosaic

- Do not burn more than 30 per cent of these shrubby communities within a management unit, within the same year.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation** and previous fire patchiness and adjusting for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response. Consider a broad fire interval of between seven to twenty-five years.

Other considerations

- Occasional moderate-severity burns help to ensure emerging overabundant trees are managed. Low-severity burns allow some canopy trees to survive and eventually replace the canopy— it is important to strike a balance between tree reduction and canopy tree recruitment.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: March to August (late summer burns may occasionally be considered).

FFDI: < 11 (lower the FDI if there are higher fuel loads)

DI (KBDI): < 100

Wind speed: < 20 km/hr

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Aerial ignition.** Use of aerial incendiaries is essential to cover large or inaccessible burn areas and to maximise efficiency of resources, (particularly in winter when the burning times are reduced to two to four hours between 11 am and 3 pm). Lighting patterns will need to be adjusted to achieve the recommended mosaic. Fixed-wing planes are useful in broad, flat areas (generally in western areas). Helicopters provide greater control in rugged terrain (e.g. Sundown and Girraween national parks). Lighting along ridgelines will allow the fire to trickle down slopes and self-extinguish in moist areas. Ignition on higher slopes will create a slow-moving **backing fire** which generally results in more coverage and helps to minimise fire intensity and rate of spread.

Aerial spot ignition of shrubby open forest along ridgelines.

Brett Roberts, QPWS, Sundown National Park (2004).

- **Spot ignition** applies to aerial and ground ignition and can be used to alter the desired intensity of a fire (particularly where there is an accumulation of volatile fuels). Spots close together will result in a line of fire that is of greater intensity (i.e. as spots merge they create high-severity junction zones). Spots further apart will result in a lower-intensity fire. Note that the spacing of spots will generally vary throughout the burn due to changes in weather conditions, topography throughout the burn due to changes in weather conditions, topography and fuel loads. In the flatter country of northern and western parts of the bioregion spacing is more easily regulated. The rugged or hilly areas require more frequently adjusted intervals.
- **A running-fire** may be required where fuel is less continuous or fire is needed to carry through cooler conditions and/or higher moisture levels.
- A **low-intensity backing fire** is preferred where higher fuel levels or drier conditions are present.
- **Commencing lighting on the leeward (smoky) edge** to create a low-intensity backing fire into the burn area or to create a containment edge for a high-severity fire ignited inside the burn area.

Issue 2: Minimise loss of diversity from high intensity wildfires

Shrubby communities within the New England Tableland bioregion are vulnerable to too-frequent high-intensity spring wildfires which result in ecosystem impacts across extensive areas. Long-term effects include the loss of mature canopy trees, a reduction in plant diversity and loss of fauna habitat features. Shrubby open forests are often slow to recover due to nutrient-poor soils and typically low rainfall in spring when most of the wildfires occur.

Post-wildfire regeneration of even-age understorey vegetation across extensive areas promotes a cycle of high-intensity wildfires due to more consistent increases in fuel loads. Fuel reduction in strategic wildfire corridors (e.g. along ridge-tops) and the mosaic burning of remaining healthy communities is a key strategy to mitigate the impact and extent of unplanned fire.

Awareness of the environment

Key indicators of impacts from high-intensity wildfire:

- There are a significant number of dead or charred branches in the canopy.
- Charring of tree stems exist up to the canopy (particularly stringybarks).
- Fire scars exist on trees.
- Coppicing has occurred, especially from large branches, trunks and bases.
- There is a dominance of wattles in the understorey.
- There is a lack of ground plants or limited diversity in the understorey.
- Ash beds from burnt logs and charcoal exist on the ground.
- Also, refer to fire history records.

Charring of tree stems up to the canopy (left) and blackened trunks and branches of mature dead canopy trees are indicators of previous high-intensity wildfires.
Jenise Blaik, QPWS Girraween National Park (2011).

Discussion

- Wildfire usually occurs under dry or otherwise unsuitable conditions. Combined with the predominantly low-nutrient soils of the tablelands wildfire can result in severe long-term impacts on shrubby communities.
- High-intensity wildfires may also favour domination of one or two species (e.g. wattle) post-fire. Where there is a widespread overabundance of saplings in the understorey refer to Issue 3.
- Where possible, wildfire mitigation zones should be placed along park boundaries to help limit the severity and extent of wildfires entering or leaving the park. This will require liaison and cooperation with park neighbours.
- Wildfires will happen in severe conditions regardless of wildfire mitigation burning. However, planned burning may help to reduce their severity and extent.
- Too frequent and/or severe fire events remove the structurally complex ground and mid-strata layers. This can result in an even-age class that is generally less diverse.

- Post-wildfire, planned burn programs need to strike a balance between allowing time for recovery and mitigating against a continual cycle of wildfires (i.e. in high risk areas, moderate severity burns at the more frequent end of the interval may be preferable to repeated high-severity wildfires in dry conditions that consume extensive areas).
- Under drought or prolonged dry conditions, recovery from wildfire is extremely slow.
- Note that drought conditions may also cause canopy die-back. Charred branches in the canopy will indicate that the die-back has been caused by wildfire not drought.
- Prolonged loss of canopy can result in structural changes to the vegetation community.

What is the priority for mitigating this issue?

Priority	Priority assessment
Very high	Planned burn required to **mitigate hazard** or **simplify vegetation structure,** usually within **wildfire mitigation zones.**

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as the most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Overall fuel hazard has been reduced to low.	Post fire; use the Overall Fuel Hazard Guide (Hines et al. 2010b), or Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Overall fuel hazard has been reduced to low. **Not achieved:** Overall fuel hazard has not been reduced to low.
60–80 % mosaic of burnt patches in wildfire corridors.	There are three options: From one or more vantage points, estimate aerial extent of ground burnt. In three locations (that take account of the variability of landform within burn area), walk 300 or more metres through planned burn area estimating per cent of ground burnt within visual field. Walk into one or more gully heads, and down one or more ridges and estimate per cent of ground burnt within visual field.	**Achieved:** 60–80 % burnt. **Partially achieved:** 50–60 % burnt. **Not achieved:** < 50 % burnt. High proportion of unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be limited).

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate** – aim to scorch the mid-stratum of shrubby fuel

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer retained. Some fleshy sedge bases remain though show charring. General charring of shrubs but some frames remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Mosaic (area burnt within an individual planned burn)

- Good fire coverage with no fuel corridors.

Fire frequency / interval

- In strategic wildfire mitigation areas, use the lower end of the recommended fire frequency (as appropriate for wildfire mitigation zones).

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: March to August

FFDI: 6–11

DI (KBDI): < 120

Wind speed: < 20 km/hr

What planned burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- In wildfire mitigation zones select tactics that will reduce elevated fuel and ensure a good coverage of fire (with no fuel corridors). Consider re-igniting any large unburnt areas.
- **Aerial ignition** (using aerial incendiaries) is a tactic used to cover large or inaccessible burn areas and to maximise the efficiency of resources, (particularly in winter when the burning times are reduced to two–four hours between 11 am and 3 pm). Reduced burning times are an important tactic for creating landscape mosaics in the absence of firelines. Morning frosts and dew (which remain longer in shaded areas) are also useful in creating patchy burns. Lighting patterns will need to be adjusted to achieve greater fire coverage and act as wildfire mitigation zones. Lighting along strategic ridgelines will reduce fuel in wildfire corridors and allow the fire to trickle down slopes and self-extinguish in moister areas.
- **Spot ignition** (aerial and ground ignition) can be used to effectively alter the desired intensity of a fire (particularly where there is an accumulation of volatile fuels). Spots close together will result in a line of fire that is of greater intensity (as spots merge they create high-intensity junction zones). Spots that are further apart will result in a lower-intensity fire. Note that the spacing of the spots will generally vary throughout the burn due to changes in weather conditions, topography and fuel loads. In the flatter country of northern and western parts of the bioregion spacing is easier to regulate. Rugged or hilly areas require regularly adjusted intervals.
- **A low-severity backing fire with good residence time** (lit against the wind on the smoky edge or down slope) will generally result in the more complete coverage of an area and a better reduction of available fuels. As the intensity and rate of spread are kept to a minimum, the fire has a greater amount of time to burn fuels in that area. This tactic is also useful in reducing overabundant seedlings and saplings.

Issue 3: Reduce overabundant saplings in the mid-stratum

Overabundant saplings in the mid-stratum can become a major issue in areas affected by widespread wildfire. Within Girraween National Park mass germination of wattle (particularly in western areas) and hop bush in shrubby open forest commonly results from severe wildfire events.

Awareness of the environment

Key indicators of overabundant saplings:

- The mid-stratum is dominated by young acacias or hop bush.
- The mid-stratum is difficult to see through or walk through.
- Shrub diversity and abundance is declining.
- Shrubs look unhealthy (e.g. they are beginning to lose their lower leaves, spindly branches are present and/or some crowns (the ends of branches) are dying. There is also an accumulation of brown leaves on the shrubs.
- Where they are known to occur, there is a loss or reduction of fire-killed species (obligate seeders e.g. *Boronia repanda*).
- Suspended litter and bark is perched in the shrubs.

The mid-stratum is dominated by acacias in the understorey of this shrubby open forest.
Mark Cant, QPWS, Broadwater State Forest (2009).

Discussion

Why are saplings overabundant?

An overabundance of saplings in the understorey may be triggered in response to the following:

- A high-severity fire event with no subsequent fire to thin the resulting flush of tree seedlings. If a fire triggers a flush of saplings it will be necessary to plan a subsequent burn.
- Overabundant saplings can be a result of repeated low-severity or early season fires.
- In the absence of fire, seed stock can build up. After a wildfire event (usually of high-severity) saplings (e.g. certain wattles) can germinate from this seed bank en masse. It is likely that more than one fire will be required to address the issue. Post-fire observations are essential to monitor the kill-rate and germination of these species in order to ascertain the need for subsequent burns.

Potential impacts of overabundant saplings:

- Thick stands of saplings can result in lower understorey plant diversity (often due to shading) and can lead to the dominance of one or two species.
- Too many saplings in the understorey can change the structure from an open to closed structure.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good.**
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Reduce above ground component of > 75 % of saplings or targeted shrubs < 1 m.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) or targeted shrubs scorched.	**Achieved:** > 75 %. **Partially achieved:** 25–75 %. **Not achieved:** < 25 %.
> 80 % of habitat trees retained.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	**Achieved:** > 80 % retained. **Not achieved:** < 80 % retained.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate**

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer retained. Some fleshy sedge bases remain though show charring. General charring of shrubs but some frames remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Mosaic (area burnt within an individual planned burn)

- Burn as much of the area dominated by saplings or targeted shrubs as possible.

Continuity of fuel

- The key factor for managing this issue is to ensure that sufficient fuel has accumulated to carry the burn and enable scorching of targeted plants.

Other considerations

- It is possible that more than one planned burn will be required to manage this issue. If the initial burn triggers a flush of new seedlings use a low to moderate-severity fire (as the fuel allows).

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: The accumulation of fuel will determine the appropriate season to burn. However, burn during periods of sufficient soil moisture to promote shrub regeneration.

FFDI: 5–11

DI: < 100

Wind speed: < 20 km/hr

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- While a **moderate**-intensity fire is recommended to address this issue, it is largely dependent upon the height of the saplings (refer to the severity table on scorch height). A high-severity **running-fire** may be required initially where there is a lack of surface and near-surface fuels (due to excessively-shaded or well-developed thickets). In this instance a follow-up planned burn will be required to kill the surviving saplings and newly emerged seedlings.

This low-intensity burn was not hot enough to scorch the overabundant wattles in the understorey (so was unsuccessful) but has consumed available ground fuel. A follow-up planned burn will not be possible until sufficient fuels have accumulated.
Mark Cant, QPWS, Durikai State Forest (2011).

- **Line or strip ignition** is used to create a high-severity fire—useful in reducing overabundant trees (through scorching).
- **Commencing lighting on the leeward (smoky) edge** can be a useful way to create a containment edge for a high–severity burn.
- **A backing fire with good residence time.** This slow moving backing fire will generally result in the more complete coverage of an area and a better reduction of available fuels. As the intensity and rate of spread are kept to a minimum the fire has a greater amount of time to burn fuels in that area. Particularly used to reduce fine fuels such as grasses, leaf litter and twigs. This tactic is also useful in reducing overabundant seedlings and saplings.
- **Spot ignition** can be used to alter the desired intensity of a fire particularly where there is an accumulation of volatile fuels. Spot ignition that is close together will result in a line of fire that is of greater intensity (i.e. as spots merge they create high-severity junction zones). Spot ignition that is further apart will result in a lower-intensity fire which is often preferred. Note that the spacing of spots will generally vary throughout the burn due to changes in weather conditions, topography and fuel loads. In the flat country of northern and western parts of the bioregion spacing is easier to regulate. Rugged or hilly areas require aerial incendiaries at shorter intervals.

Chapter 3: Open forest with limited ground fuel

This fire vegetation group contains two communities which naturally have very sparse understoreys—gum-topped box (grey box) and mugga ironbark forests. These forests are found in drier parts of the bioregion and grow on stony infertile soils derived from a hard, dense rock known locally as traprock.

Fire management issues

The condition of the understorey in these communities prior to historical clearing, grazing and altered fire regimes is unknown. However, these forests have extremely sparse and slow-growing understorey vegetation. Getting fire to carry during a planned burn in these communities is not feasible due to the limited availability of ground fuel. These communities will only burn with occasional wildfires under dry conditions. Maintaining appropriate mosaic burning in surrounding fire-adapted areas is the best strategy to mitigate the potential impacts of too-frequent and severe wildfire.

Extent within bioregion: 8 474 ha, 1 per cent; **Regional ecosystems:** 13.9.2; 13.11.5.

Examples of this FVG: Texas State Forest 1 237 ha; Texas State Forest 2 545 ha; Greenup State Forest 1 276 ha; Durikai State Forest 1 518 ha.

Gum-topped box (grey box) community with very limited fuel in the ground layer.
Jenise Blaik, QPWS, Devine State Forest (2010).

Mugga ironbark open woodland also has limited fuel present in the ground layer.
Michael Mathieson, Queensland Herbarium, Texas State Forest (2002).

Mugga ironbark woodland with a sparse shrub-layer and limited ground fuel.
Bill McDonald, Queensland Herbarium, Durikai State Forest (2009).

Ironbark/ grey box community with very sparse grass.
Jenise Blaik, QPWS, Leyburn State Forest (2010).

Grass is so sparse that it is often difficult to see unless viewed close-up.
Jenise Blaik, QPWS, Devine State Forest (2010).

Chapter 4: Sedgeland

This fire vegetation group includes wet heath and sedgelands mostly on peaty soils. They are either permanently or periodically waterlogged in broad shallow valleys, gullies and elevated seepage areas of Girraween National Park. Trees are mostly absent or occasionally emergent with the exception of E*ucalyptus camphora* communities where they are a major component. Most have a continuous low heath shrub layer and a ground layer typically dominated by sedges or a grass/sedge mix. The biodiversity status of this group is endangered (Queensland Herbarium 2011a).

Fire management issues

These communities are ideally burnt when water is standing but has receded, exposing available fuel. Although planned burning with standing water is not always possible, it is important to ensure that there is enough moisture to avoid peat fires. Sedgelands have particularly high species diversity and local endemism (i.e. species evolved to that particular location) that will be impacted by poorly timed fire.

Issue:

1. Maintain healthy sedgeland.

Extent within bioregion: 325 ha, < 1 per cent; **Regional ecosystems:** 13.3.6

Examples of this FVG: Girraween National Park, 315 ha.

Issue 1: Maintain healthy sedgeland

Use fire to maintain healthy sedgeland.

Awareness of the environment

Key indicators of health:

- There is a continuous wet heath shrub layer frequently interspersed with sedges.
- There is a mixed grass/sedge layer in the drier areas of the community.
- Standing water or areas of seepage are present.
- Trees are absent; present as scattered emergents; or occasionally frequent (e.g. mountain swamp gum *Eucalyptus camphora*).

Drier areas of Dingo Swamp support a mixed grass/sedge ground-layer.
Jenise Blaik, QPWS, Girraween National Park (2010).

Scattered emergent eucalypts with a continuous heath/sedge ground-layer are present in wetter areas of Dingo Swamp.

Jenise Blaik, QPWS, Girraween National Park (2010).

Mountain swamp gum can occur as a scattered to dense canopy cover with an understorey of sedges.

Note the presence of standing water which will prevent peat fires in this community.

Jenise Blaik, QPWS, Girraween National Park (2011).

Early signs of when a burn may be required:

- There is a build-up of dead material around the bases of sedges. Sedges are no longer erect (are beginning to collapse).
- Low shrubs or other ground-layer plants are beginning to die off.

Discussion

- Low-lying sedgelands gradually accumulate peat (partially decayed, densely--packed vegetation). Due to its porous nature and high carbon content, peat is easily ignited when dry and the resulting fire can severely damage the ecosystem and continue to burn / smoulder for extended periods.
- Peat fires can re-ignite as they continue to burn deep into the peat layer. They are extremely difficult to extinguish and can travel underground beneath firelines and ignite elsewhere.
- If burnt, peat takes many years to reform.
- Limited planned burning has been undertaken in these communities and they have historically burnt during wildfires.

What is the priority for this issue?

Priority	Priority assessment
Highest	**Conservation** burns of the highest priority e.g. **critical areas for endangered ecosystems or species.**

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 90 % of ground layer plants and shrubs recover after fire.	Before and after fire, select three or more sites and estimate cover of shrubs, sedges and other ground plants that recover one to three months after fire.	**Achieved:** > 90 % recover. **Partially achieved:** 70–90 % recovers. **Not achieved:** < 70 % recovers.
The planned burn does not result in a peat fire.	Ongoing visual assessment during and post burn to determine if the fire has carried into peat layer and developed into a peat fire.	**Achieved:** Fire did not carry into peat layer and develop into a peat fire. **Not achieved:** Fire carried into peat layer and developed into a peat fire.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate** (with patches of **high** in open sedgeland)

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	100–1500	0.5–1.5	Complete standing biomass removed	All surface and near surface fuels burnt. Stubble burnt to blackened remnants.
High (H)	1500–5300	1.5–4.0	Complete biomass removed	Ground burnt completely. Stubble burnt to ash.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (i.e. recently burnt through to the maximum time frame). Consider a broad fire interval range of between eight to fifteen years.

Mosaic (area burnt within an individual planned burn)

- Because of the continuous nature of fuel in sedgelands the entire planned burn area tends to burn with no internal patchiness. Mosaics are only possible if planned at a landscape level (by targeting different areas in different years).

Landscape mosaic

- Do not burn more than 20 per cent of sedgelands in any one year, within a management area.

Other considerations

- As sedgelands often adjoin open forest, applying different fire regimes is difficult. Careful consideration of weather conditions, wind direction and ignition strategies will assist.

Planned burns undertaken in adjacent open forest will require careful consideration of soil moisture, wind direction and ignition tactics to prevent fire penetrating this swampy gully too frequently or during dry conditions.

Bill McDonald, Queensland Herbarium, Underground Creek track, Girraween National Park (2009).

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: Late autumn to winter. Avoid drought or dry conditions

FFDI: < 11

DI (KBDI): < 75 (if peat is present, DI > 50 may increase the possibility of peat fire)

Wind speed: < 20 km/hr

Soil moisture: In the absence of standing water, the peat should still be water logged (water can squeeze out of it). If possible burn two to three days after rain.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Line or strip ignition** is used to help carry the fire through very moist fuels.
- **Spot ignition** can be used to alter the desired severity of a fire. Spot ignition that is close together will result in a line of a greater intensity (i.e. as spots merge they create high-intensity junction zones). Spot ignition that is further apart will result in a lower-severity fire. Burn during late afternoons or at night to help reduce intensity.
- **Limit fire encroachment into sedgeland communities.** Use appropriate lighting patterns along the margin of the sedgeland community to promote a low-intensity backing fire that burns away from the non-target community. Where the sedgeland exists in low-lying areas (e.g. drainage lines), utilise the surrounding topography to create a low-intensity backing fire that travels down the slope towards the non-target community.

Chapter 5: Rock pavement communities

This fire vegetation group contains outcrop heaths (known locally as rock gardens), shrublands and open woodlands with a heath understorey (restricted to granite pavements) and *Eucalyptus prava* orange gum shrubland/woodland on exposed ridges and bluffs (located on traprock soils in Sundown National Park). These communities tend to occur at higher altitudes within Girraween and Sundown national parks and are always surrounded by fire-adapted communities.

These regional ecosystems have the biodiversity status **of concern** and provide habitat for a host of rare and threatened plant species.

Fire management issues

Communities that are interspersed by large areas of rock pavement or occur in isolated pockets and generally have limited fuel are mostly self-protecting from too-frequent fire. This fire vegetation group is thought to be adapted to very long fire frequency (Sparshott 2007) and due to its fragmentation there is no planned burning undertaken. Rock pavement communities are susceptible to burning during severe wildfire events that occur in surrounding fire-adapted vegetation.

Issue:

1. Limit fire encroachment into rock pavement communities.

Extent within bioregion: 747 ha, < 1 per cent; **Regional ecosystems:** 13.12.3; 13.12.6; (RE unmapped in Sundown National Park).

Examples of this FVG: Girraween National Park, 723 ha; Sundown National Park, 404 ha.

Issue 1: Limit fire encroachment into rock pavement communities

Mosaic burning in surrounding fire-adapted vegetation creates areas of reduced fuel that limit the extent of wildfires.

Refer to Chapter 8 (Issue 2), for fire management guidelines.

Isolated pockets of rock pavement vegetation are largely self-protecting from too frequent fire.

Jenise Blaik, QPWS, Girraween National Park (2010).

Rock pavement communities often contain obligate seeder shrubs such as *Homoranthus montanus* which only regenerate post-fire from seed and require longer fire-free intervals to mature to seed production.

Peter Haselgrove, QPWS, Sundown National Park (2009).

Chapter 6: Riparian and fringing communities

This fire vegetation group includes riparian shrublands and river she-oak open forests and woodlands occurring along watercourses. They are typically narrow-fringing communities with an understorey dominated by sedges.

Fire management issues

Many of the species in these communities are fire sensitive—it is critical to **avoid burning** this vegetation group. When burning adjacent fire-adapted communities, limit fire encroachment by using suitable conditions and/or by burning away from the edges. Proactive fire management in surrounding fire-adapted areas will help to mitigate the impacts of unplanned fire.

Issue:

1. Limit fire encroachment into riparian and fringing communities.

Extent within bioregion: 4 049 ha, 1 per cent; **Regional ecosystems:** 13.3.1x1; 13.3.5.

Examples of this FVG: Yelarbon State Forest, 7 ha; Bracker Creek (Warroo Environmental Reserve), 118 ha; Sundown National Park, 275 ha.

Issue 1: Limit fire encroachment into riparian and fringing communities

Many riparian and fringing communities contain a high proportion of fire-sensitive shrubs and trees such as river she-oak *Casuarina cunninghamiana,* and/or habitat trees. Too frequent and/or severe fire removes or inhibits the development of structurally-complex ground and mid-strata vegetation, opens up the canopy and increases the risk of weed invasion and soil erosion. This in turn leads to a greater production of fine fuel (mainly grass) and therefore an increase in fire hazard. Aim to minimise the frequency and intensity of fire in riparian communities. This will promote structurally-complex ground and mid-strata vegetation and retain mature habitat trees.

When burning adjacent fire-adapted communities, limit fire encroachment into riparian and fringing communities by burning under suitable conditions and using tactics such as burning away from edges. Using low-intensity burns in surrounding areas such as fringing eucalypt forest during the late wet season to early dry season (March to April) may be useful in reducing fuel loads and mitigating the impacts of wildfire—particularly the loss of habitat trees.

Refer to Chapter 8 (Issue 2), regarding fire management guidelines.

Avoid fire penetrating into most riparian communities. Many of the fringing forest species such as casuarinas and melaleuca shrubs are fire-sensitive.

Peter Haselgrove, QPWS, McAlisters Creek, Sundown National Park (2008).

Implementing planned burns in surrounding fire-adapted communities during the recommended season and using appropriate tactics will limit potential impacts on this community.

Peter Haselgrove, QPWS, Sundown National Park (2005).

After a flood, flammable material may be stacked against trees and if ignited may damage or kill the tree. Avoid ignition and allow it to break down naturally. Because this accumulated fuel is not continuous, it does not usually pose a wildfire hazard.

Peter Leeson, QPWS, Gympie (2011).

Chapter 7: Vine thicket

Vine thickets have a very limited distribution within the New England Tableland bioregion and are restricted to gorges and protected scree slopes in Sundown National Park. They typically contain figs, stinging trees and numerous vines and are often interspersed with riparian woodlands of angophora and river she-oak.

Fire management issues

Due to higher moisture and protection provided by steep-sided rocky gorges or scree slopes these communities do not usually burn. However maintaining surrounding fire-adapted communities with mosaic burning is important to protect vine thickets from severe wildfire events.

Issue:

1. Limit fire encroachment into vine thicket.

Vine thicket in Ooline Gorge. Shading from rock walls and high moisture levels generally protect these communities from wildfires.

Peter Haselgrove, QPWS, Sundown National Park (2009).

Extent within bioregion: 88 ha, < 1 per cent; **Regional ecosystem:** 13.11.7.

Examples of this FVG: Sundown National Park, 16 ha.

Issue 1: Limit fire encroachment into vine thicket

To protect vine thicket edges from wildfire it is beneficial to mosaic burn surrounding fire-adapted communities (refer to relevant fire vegetation groups).

Refer to Chapter 8 (Issue 2), regarding fire management guidelines

Edges of this vine thicket in Red Rock Gorge are well-defined. These areas are generally self-protecting from fire.

Peter Haselgrove, QPWS, Sundown National Park (2009).

Chapter 8: Common issues

In the New England Tableland bioregion there are some issues where the fire management approach is similar, irrespective of the fire vegetation group. Rather than repeating the issues for each fire vegetation group, they are gathered in this chapter and cross referenced where relevant in each fire vegetation group chapter.

Fire management issues

1. Hazard reduction (fuel management) burns
2. Limit fire encroachment into non-target communities
3. Planned burning near sensitive cultural heritage sites.

Issue 1: Hazard reduction (fuel management) burns

In many cases it is important to use fire to reduce fuels. In the QPWS Fire Management System, protection zones aim to create areas of simplified vegetation structure and reduced fuel levels around key infrastructure, property and natural and cultural resources that may be damaged by fire. Protection zones should be maintained in a relatively low fuel hazard state by planned burning as often as fuel levels allow. In wildfire mitigation zones the aim of planned burning is to simplify the structure and reduce the quantity of fuel (within the ecological regime for the community) to mitigate flame height, spread and intensity of subsequent wildfires; and therefore improve their controllability.

Awareness of the environment

Main indicators of where fire management is required

- The combined accumulation of all fuels (surface fuels, near-surface fuels, elevated fuels and bark hazard) exceeds a **low** to **moderate** overall fuel hazard as per the Overall Fuel Hazard Assessment Guide (Hines et al. 2010b). Note that this is the preferred assessment method.

Or

- The combined accumulation of all fuels (surface fuels, near-surface fuels, elevated fuels and bark hazard) exceeds five tonnes per hectare (see Step 5 of the supporting guideline: How to assess if your burn is ready to go, for a fuel load estimation technique).

Descriptive indicators of where fire management is required (Not all of these indicators will apply to every fire vegetation group)

- Containment hazards (e.g. stumps, logs and stags) are present along firelines within protection zones.
- A high bark hazard is present.
- Dead material has accumulated around the base of grasses, sedges and ferns.
- There is an accumulation of continuous surface fuels that will carry a fire.
- Ground layer plants or shrubs are smothered by leaf litter in some areas.
- Shrub branches have significant dead material.
- Ribbon bark, leaf litter and fine branch material is perched in shrub and sapling foliage.
- An accumulation of coarse fuels with a diameter greater than six millimetres is present on the ground or perched in shrubs and trees.
- The mid or lower stratum is difficult to see through or walk through.

An accumulation of continuous surface fuels around infrastructure indicates the need for fire management.

Peter Haselgrove, QPWS, Sundown National Park (2008).

Discussion

- To estimate fuel hazard (recommended for use in open forests and woodlands) use the Overall Fuel Hazard Assessment Guide (Hines, et al. 2010b).
- To estimate fuel load, refer to Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go.
- The terms fuel load and fuel hazard are widely used to describe fuels, often interchangeably. While they are related, they do differ significantly (refer to Photos 1a and 1b) and can be defined as:

Fuel hazard – the “condition of the fuel taking into consideration such factors as quantity, arrangement, current or potential flammability and the difficulty of suppression if fuel should be ignited” (Wilson 1992).

Fuel load – “the dry weight of combustible materials per area, usually expressed as tonnes per hectare. A quantification of fuel load does not describe how the fuel is arranged nor its state or structure” (Hines et al. 2010a).

Demonstration of the difference between **fuel load** and **fuel hazard.**

Photo 1a: The two samples above have the **same fuel load** (eighteen pages of newspaper) but a different fuel arrangement.

Troy Spinks, QPWS (2010).

Photo 1b: The fuel arrangement contributes to the difference in **fuel hazard.**

Troy Spinks, QPWS (2010).

- It is important to maintain a simplified vegetation fuel structure in protection zones and wildfire mitigation zones, which means addressing issues such as suspended and elevated fuel and overabundant saplings and seedlings.
- Fire management that favours grasses will assist in achieving an open structure suitable for wildfire management and mitigation. Moist conditions and low-severity burns that retain the bases of grasses will give them a competitive advantage over woody species.
- In wildfire mitigation zones it is essential to maintain ecosystem health. Ensure the use of appropriate conservation objectives for the fire vegetation group in addition to a fuel reduction objective (refer to fuel reduction objectives below).
- When establishing protection zones or wildfire mitigation zones favour fire vegetation groups that support a simplified vegetation fuel structure. Where possible avoid fire vegetation groups containing species that naturally produce high-severity fire during wildfire conditions (e.g. heath).

- It is not always possible to contain planned burns within the protected area due to the location of park boundaries (firelines may not exist along park boundaries as they are often in inaccessible areas and have continuous fuel levels. Cooperative fuel reduction burns with neighbours are often the only way to achieve the objectives of protection and wildfire mitigation zones. Refer to the QPWS Good neighbour policy and Notifying external parties of planned burn operations procedural guide.
- Planned burning often creates a smoke management issue particularly where burns are undertaken close to residential areas or commercial operations (e.g. agriculture, airports, major roads and high voltage power lines). Planning needs to consider factors such as fuel type, fuel hazard, temperature inversion and wind speed and direction all of which can have significant effects on the quantity of smoke generated and how it is distributed.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burn required to **protect life** and/or **property,** usually within **protection zones.**
Medium	Planned burn required to **mitigate hazard** or **simplify vegetation structure,** usually within **wildfire mitigation zones.**

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Reduce overall fuel hazard to low or moderate. **Or** Reduce fuel load to < 5 tonnes/ha.	**Post fire:** use the Overall Fuel Hazard Assessment Guide (Hines et al. 2010b) **Or** Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Fuel hazard has been reduced to low or moderate **Or** fuel load has been reduced to < 5 tonnes/ha. **Not achieved:** Fuel hazard has not been reduced to low or moderate **Or** fuel load is > 5 tonnes/ha.
Burn 90–100 % (for protection zone) 60–80 % (for wildfire mitigation zone).	Choose one of these options: a) Visual estimation of percentage of vegetation burnt – from one or more vantage points, or from the air. b) Map the boundaries of burnt areas with GPS, plot on ParkInfo and thereby determine the percentage of area burnt. c) In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 or more metres through planned burn area estimating the percentage of ground burnt within visual field.	**Protection zone** **Achieved:** > 90 % burnt. **Partially achieved:** 80–90 % burnt, the extent and rate of spread of any subsequent wildfire would still be limited. **Not achieved:** < 80 % burnt. High proportion of unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be sufficiently limited). **Wildfire mitigation zone** **Achieved:** 60–80 % burnt. **Partially achieved:** 50–60 % burnt. **Not achieved:** < 50 % burnt. High proportion of unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be sufficiently limited).

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**. Where there is a high fuel load or elevated fuels (e.g. when first establishing a protection zone) the initial fire may result in a **moderate** to **high** severity. Following this initial burn, aim to reinstate a regime that will promote **low** severity planned burns. Severity should be sufficient to reduce elevated fuels and bark hazard (i.e. allow fire to run up trunks).

Fire frequency / interval (refer to Appendix 2 for a discussion)

- **Protection zones:** Fuel management planned burns within protection zones are carried out as soon as possible after they can carry a fire in order to maintain a relatively low fuel hazard.
- **Wildfire mitigation zones:** Planned burns within wildfire mitigation zones are undertaken within the fire frequency recommended for the fire vegetation group but generally towards the lower end of that range.

Mosaic (area burnt within an individual planned burn)

- **Protection zones:** 90 per cent burnt
- **Wildfire mitigation zones:** 60–80 per cent burnt.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Autumn–winter

FFDI: < 11

DI (KBDI): < 100

Wind speed: < 15 km/hr

Soil moisture: While the aim of hazard reduction burning is to reduce the amount of fuel, good soil moisture is necessary for the following reasons:

- soil moisture reduces scorch height and limits leaf drop post-fire
- the impact upon habitat trees, soils and other environmental values is minimised
- the likelihood of a woody species thicket developing post-fire is reduced
- grasses are favoured over woody species (woody species create undesirable fuel conditions).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Cooperative burning** for protection and wildfire mitigation will require the involvement of neighbours, local councils, Department of Transport and Main Roads, Queensland Fire and Rescue Service and Forestry Plantations Queensland Pty Ltd. Tactics may need to be adjusted accordingly to help achieve the objectives or requirements of these external groups.
- **Aerial ignition** is an important tactic for **mitigation** of wildfire as it is often the only way to access and create large-scale landscape mosaics in strategic areas. During winter on the New England Tableland there is a limited window of burning time (usually 11 am to 3 pm) due to low temperatures, frosts and dew point. Lighting patterns are also dependent on existing weather conditions such as cloud cover and topography. Southerly slopes which are always cool and shaded, need to be burnt in the middle of the day or during the maximum temperature. Aerial ignition lit towards the lower slopes (particularly where there is cypress) to create a run of fire is the most appropriate method on these slopes.

- Fuel reduction in **protection zones** will often require the combination of burning and mechanical methods (e.g. mowing or slashing).
- **Spot ignition** can be used effectively to alter the desired intensity of a fire particularly where there is a high accumulation of available and volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots will result in a lower intensity fire. The spacing of the spots will generally vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low intensity backing fire. Depending on available fuels and the prevailing wind on the day, use either spot or strip lighting or a combination of both.
- **A low intensity backing fire** is usually slow moving, and will generally result in a more complete coverage of an area and a better consumption in continuous fuel. This tactic ensures the fire has a greater amount of residence time and reduction of available fuels, particularly fine fuels (grasses, leaf litter, twigs etc), while minimising fire severity and rate of spread.
- While a low intensity backing fire is recommended, a **running fire** of a higher intensity may be required in discontinuous or elevated fuel. Use with caution and be aware of environmental impacts that may result. To create higher intensity, contain the smoky side first, then **spot light the windward (clear) edge.** If the planned burn area is narrow, use caution when lighting the windward edge as the fire intensity may increase when the fire converges with the previously lit backing fire creating higher- intensity junction zones and the potential of fire escaping through a spot-over.

Issue 2: Limit fire encroachment into non-target communities

Non-target fire vegetation groups may include sedgeland, rock pavement communities, riparian and fringing communities, vine thicket and too-frequently burnt shrubby open forest. These communities are often self-protecting if fire is used under appropriately mild conditions. If suitable conditions are not available, tactics such as burning away from these communities can be used to protect them.

Awareness of the environment

Indicators of fire encroachment risk:

- Standing water or water-logged conditions do not exist.
- Invasive grasses are present in rock pavement or riparian communities or fringing shrubby open forest.
- High fuel hazard corridors exist in adjoining communities.
- The non-target community is upslope of a potential running fire.

Whiskey grass has invaded this isolated rock pavement community potentially increasing the risk of spot-overs during planned burn operations in adjacent communities.
Kym Sparshott, QPWS, Girraween National Park (2006).

Discussion

- Because wildfire often occurs under dry or otherwise unsuitable conditions (e.g. when sedgelands have limited moisture) it has the potential to damage non-target and fire-sensitive fire vegetation groups. Proactive broad-scale management of surrounding fire-adapted areas with mosaic burning is one of the best ways to reduce the impacts of unplanned fire on non-target and fire-sensitive communities.
- Under appropriate planned burn conditions with good soil moisture, non-target communities tend to self-protect and additional protective tactics may not be required. Sometimes where a non-target community occurs at the top of a slope it is necessary to avoid a running fire upslope even in ideal conditions.
- If suitable conditions cannot be achieved specific tactics may be required to protect the non-target fire vegetation group (refer to the tactics at the end of this issue).
- Ensure suitable conditions when burning areas surrounding sedgeland communities to avoid peat fires. If it is necessary to burn adjacent forest in less than ideal conditions, manage the fire carefully to minimise the risk of the fire entering peat areas (e.g. burn away from the sedgeland edges).
- The presence of invasive grasses increases the severity of fire. If invasive grasses are present use fire with caution.

When conducting planned burns in open forest surrounding sedgeland, ensure that peat is waterlogged to minimise the risk of a peat fire.

Kym Sparshott, QPWS, Girraween National Park (2006).

What is the priority for this issue?

Priority	Priority assessment
High	For burn proposals in areas with non-target communities, it is important to avoid encroachment of fire.

Assessing outcomes

Formulating objectives

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select from below as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
No scorch of margin of non-target fire vegetation group.	**After the burn** (immediately or very soon after): visual estimation of the percentage of margins scorched from one or more vantage points, or from the air. **Or** **After the burn** (immediately or very soon after): walk the margin of the non-target community or representative sections (e.g. a 100 metre long section of the margin in three locations) and estimate the percentage of margin scorched.	**Achieved:** no scorch. **Partially achieved:** < 5 % scorched. **Not achieved:** > 5 % scorched.
Fire penetrates no further than one metre into the edge (if there is a well-defined edge).	**After the burn** (immediately or very soon after): visual assessment from one or more vantage points, or from the air. **Or** **After the burn** (immediately or very soon after): walk the margin of the non-target community, or representative sections (e.g. a 100 metre long section of the margin in three locations) and determine whether the fire has penetrated further than one metre into the edge.	**Achieved:** Fire penetrates no further than one metre into the edge. **Not achieved:** Fire penetrates further than one metre into the edge.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Fire parameters

What fire characteristics will help address this issue?

The below characteristics apply to fires in areas **adjacent** to the non-target fire vegetation group.

Fire severity

- A **low-severity** fire in an adjacent fire-adapted community will help to achieve the objective of limited fire encroachment. A backing fire will help to ensure a good coverage of fire (refer to the mosaic section below). If there are overabundant saplings in the area being burnt, a higher-severity fire may be required (in which case, appropriate tactics and moisture conditions will help to limit scorch of the non-target areas).

Mosaic (area burnt within an individual planned burn)

- Consult the recommended mosaic for the fire vegetation group being burnt. Aim for the higher end of the recommended mosaic as this will help mitigate the movement of wildfire into fire-sensitive communities.

Landscape mosaic

- Proactive broad-scale management of surrounding fire-adapted areas using mosaic burning is one of the best ways to reduce impacts of unplanned fire within non-target fire vegetation groups and fire-sensitive communities.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

FDI: Refer to relevant fire vegetation group

DI (KBDI): Refer to the relevant fire vegetation group

Wind speed: < 15 km/hr

Soil moisture: If fuel moisture within a fire-sensitive community is insufficient or the fire-sensitive community is upslope from the planned burn, consider using tactics outlined below.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Test burn** the site to ensure the non-target communities will not be affected.
- **Do not create a running fire.** If it is necessary to burn adjacent sclerophyll forest during drier conditions use a low-intensity perimeter burn from the edge of low lying communities to protect their margins.
- **Commence lighting on the leeward (smoky) edge** to establish the fire and promote a low-intensity backing fire. Depending on available fuels and the prevailing wind on the day, this may require either spot or strip lighting or a combination of both.
- **Afternoon ignition**—planned burning in areas adjacent to non-target communities can be undertaken late in the afternoon. The milder conditions during this period will assist in promoting low-severity fires that trickle along the edge and generally self-extinguish overnight (particularly during winter).
- **Limit fire encroachment into non-target communities.** Where the non-target community is present in low-lying areas (e.g. sedgelands), utilise the surrounding topography to create a low-intensity backing fire that travels down the slope towards the non-target community. If conditions are unsuitable (e.g. the non-target community is too dry to ensure fire will self-extinguish on its boundary or it is upslope of a potential run of fire) use appropriate lighting patterns along the margin of the non-target community. This will promote a low-intensity backing fire that burns away from the non-target community.
- **Use strip ignition to draw** fire away from the non-target community's edge. When more than one line of ignition is used it can create micro-wind conditions that can draw fire away from non-target areas. It is important to have safe refuges when undertaking this type of burning.

Issue 3: Planned burning near sensitive cultural heritage sites

It is important to have knowledge of the location of significant cultural heritage sites, items and places of Indigenous or European heritage when planning fire management. The local fire strategy should identify these locations (it is important to note that some locations will be culturally sensitive and therefore their location will not be specifically identified in text or on maps). Consulting Traditional Owners and the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) Indigenous cultural heritage branch and the Department of Environment and Heritage Protection (EHP) European cultural heritage branch during fire strategy preparation will help to identify these places, items and issues.

Awareness of the environment

Key indicators of European cultural heritage sites:

- The existence of building ruins, corrugated iron shacks, wooden house stumps, old fence posts, old stock yards, tombstones, wells, graves, bottle dumps, old machinery and iron debris.
- Quarries and old mine sites (sometimes deep holes covered with corrugated iron or wood) are present.
- Forestry artefacts including marked trees (shield trees), and old machinery such as winders (timber tramways) and timber jinkers (timber lifting wagon) exist.
- Military artefacts such as old equipment and used ammunition are found.
- Survey and trig points exist.
- The presence of historic fence-lines.

Some historic sites like the ruins of this pastoral hut and yard may require manual fuel management combined with tactics such as backing the fire away from the site to minimise the risk of fire damage.

QPWS, Girraween National Park (1998).

As surrounding vegetation regenerates, these old forestry tent rigs will become more vulnerable to fire and may require manual fuel reduction to prolong their conservation.

QPWS, Durikai State Forest (2004).

The New England Tableland has a rich history of mining activity. Timber structures such as these old mine shafts are highly vulnerable to fire. A landscape proactively managed with mosaic burning will help limit the spread and severity of wildfires, improving protection of cultural heritage artefacts and sites.

QPWS, Talgai State Forest (1998).

QPWS, Sundown National Park (1979).

Raking around and removing loose branches and debris at the start of the fire season and prior to planned burns will help conserve historic mining artefacts such as the cable winder (below) and survey peg (above).

QPWS, Lee Moon Camp, Sundown National Park (1998).

QPWS, Sundown National Park (1998).

Key indicators of Indigenous cultural heritage sites:

- Arrangements of stones, raised earth patterns or artefacts scattered on the ground (sometimes exposed following a planned burn or wildfire) are present.
- Trees that have been scarred or carved (e.g. a scar in the shape of a canoe) exist.
- Rock shelters with rock paintings, stone tools, artefact bundles, wrapped material or bones inside are located.
- There are engravings on trees or rock faces.

Indigenous markings such as scarred trees (e.g. to make containers, canoes, or temporary shelters) are potentially vulnerable to fire if fuel builds up around their bases.
Main Roads, Leyburn (2000).

Discussion

- **Do not** disturb any cultural heritage site or artefact. Leave all materials in place and treat the location with respect. If you are not sure whether the location or artefacts have been reported, consult the cultural heritage coordination units of DATSIMA (for Indigenous sites) or EHP (for European sites). Also refer to the Duty of Care Guidelines provided in the *Aboriginal Cultural Heritage Act 2003* (Queensland Government 2004).
- When planning burns in and adjacent to sensitive cultural heritage places there is a duty of care to ensure appropriate people are involved. Appropriate people may include Traditional Owners, indigenous rangers, historical societies and cultural heritage experts. If you are unsure who the appropriate people are, refer to the DATSIMA and/or EHP cultural heritage coordination units.
- Be aware of QPWS policy and procedures Management of cultural heritage places on NPRSR estate (DERM 2010a, 2010b) which recommends fire management of a heritage place involve burning only the area surrounding the place that does not contain objects or areas related to the cultural heritage place (e.g. fences or gravestones).
- Large-scale wildfires are known to damage cultural heritage values. A landscape proactively managed with mosaic burning will limit the spread and severity of wildfires giving better protection to cultural heritage artefacts and sites.
- The key risks to cultural heritage sites and artefacts from fire are direct contact with flames, radiant heat and smoke (e.g. radiant heat can exfoliate the surface of rock art sites, flame can crack or burn items and smoke can damage paintings).
- To manage impacts from flame and radiant heat, consider reducing fuel levels though manual, mechanical, or herbicide means or a combination of these. If it is not necessary to reduce fuel it is preferable to leave the site completely undisturbed.
- For larger culturally significant sites it may be necessary to create a secure burnt edge by backing fire away from these locations. Use this tactic prior to broader-scale planned burns.
- For sites that may be impacted by smoke (e.g. rock paintings and rock shelters) use wind to direct smoke away from the site.

What is the priority for this issue?

Priority	Priority assessment
Highest	Fuel management through the implementation of planned burns within **protection zones** to protect life, property, and conservation values.
Very high	Burns protecting **significant cultural heritage sites.**

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
No impact on item or site of cultural heritage significant.	Visual inspection of site or items with supporting photographs before and after fire.	**Achieved:** no impact on site or item. **Not achieved:** there was some impact on site or item.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- Burn within the parameters recommended for the fire vegetation group. **Low**-severity fires will be less likely to impact on cultural heritage sites.

Fire frequency / interval

- Be guided by the fire zoning plan and recommendations for the specific fire vegetation group within the planned burn area.

Landscape mosaic

- A landscape proactively managed with mosaic burning will help reduce fuel hazard, limit the spread and severity of wildfires and better protect cultural heritage artefacts and sites.

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: Favour early season burning and moist conditions.

FFDI: < 11

DI (KBDI): < 100

Wind speed: < 15 km/hr

Wind direction: Closely monitor the wind direction to avoid smoke, flame and/or radiant heat coming into contact with sensitive cultural heritage sites.

Soil moisture: Ensure good soil moisture is present.

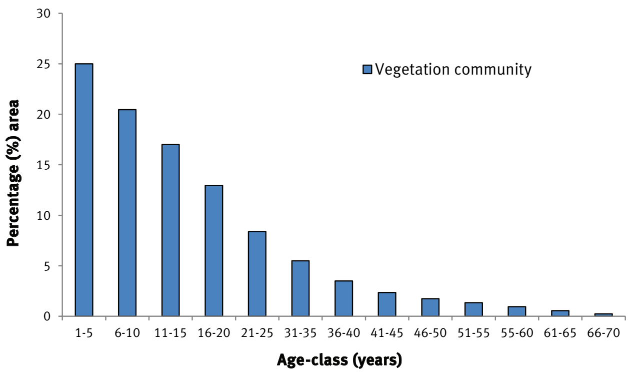
What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). During the burn, tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Manual fuel management** may be required prior to undertaking planned burns near sites of cultural significance (e.g. scar trees and rock art sites). This may include raking, clearing (e.g. creating a rake-hoe line), trimming or leaf blowing the surface fuels away from the site to limit the potential impacts. If it is not necessary to manually reduce the fuel level it is preferable to leave the site completely undisturbed.
- **Spot ignition** can be used to alter the desired intensity of a fire particularly where there is an accumulation of available and volatile fuels next to a site of interest. Widely-spaced spot ignition is preferred around cultural heritage sites as it will promote a slower-moving and more manageable fire.
- **A low-severity backing fire** (usually slow moving) can help ensure fire severity and rate of spread are kept to a minimum.
- Depending on the conditions, **spot light the windward (clear) edge** to direct the active fireline and smoke away from the cultural heritage site. Use a chipped or wet line around the site so the resulting backing fire can be extinguished or self-extinguish at the chipped or wet line.

Glossary of fire terminology

(**Primary source:** Australasian Fire Authorities Council 2012).

Terminology	Definition
Aerial ignition	The lighting of fine fuels for planned burning by dropping incendiary devices or materials from aircraft.
Available fuel	The portion of the total fuel that would actually burn under current or specified conditions.
Age-class distribution	The distribution of groups of similar aged vegetation (age-class) of a particular vegetation community after fire. In fire ecology this is used to indicate the success of mosaic burning in achieving varied habitat conditions. This is usually represented as a plot of areas (y-axis) versus age-class (x-axis) (e.g. 25 per cent of a fire vegetation group burnt between one and five years ago) (refer to Figure 1). **Figure 1: Idealised age-class distribution (concept only)** 
Burn severity	Relates to the amount of time necessary to return to pre-fire levels of biomass or ecological function.
Backing-fire	The part of a fire which is burning back against the wind or down slope, where the flame height and rate of spread is minimal.

Terminology	Definition
Beaufort scale	A system of estimating and reporting wind speeds, invented in the early nineteenth century by Admiral Beaufort of the Royal Navy. It is useful in fire management to indicate wind speed and relies on visual indicators rather than instruments. It equates to: • Beaufort force (or Beaufort number) • wind speed • visible effects upon land objects or seas surface.
BOM	Bureau of Meteorology.
Crown scorch	Browning of the needles or leaves in the crown of a tree or shrub caused by heat from a fire.
Char height	The height to which former green leaves still suspended on plants that are turned black by the flame of the fire. NB: This cannot be measured on the stems of plants as fire 'climbs' the bark.
Dew point temperature	This is a measure of the moisture content of the air and is the temperature to which air must be cooled in order for dew to form. The dew-point is generally derived theoretically from dry and wet-bulb temperatures, with a correction for the site's elevation (BOM).
Drought	A **drought** is defined by the Bureau of Meteorology (BOM) as an 'acute rainfall deficiency'. For the purpose of quantifying the severity of a drought, the BOM describe rainfall deficiency in two categories: '**Serious** rainfall deficiency—rainfall lies above the lowest five per cent of recorded rainfall but below the lowest 10 per cent (decile 1 value) for the period in question, **Severe** rainfall deficiency—rainfall is among the lowest five per cent for the period in question.' For more information, refer to <www.bom.gov.au/climate/glossary/drought.shtml>
Drought index (DI)	A numerical value (e.g. the Byram-Keetch Drought Index), reflecting the dryness of soils, deep forest litter, logs and living vegetation.
Duff layer	Refer to 'humus layer'.

Terminology	Definition
Fire behaviour	The manner in which a fire reacts to variables of fuel, weather and topography.
Fire Danger Index (FDI)/ Fire Danger Rating (FDR)	A relative number and rating denoting an evaluation of rate of spread, or suppression difficulty for specific combinations of fuel moisture and wind speed.
FFDI/FFDR	Forest Fire Danger Index/Danger Rating.
Fire frequency	The frequency of successive fires for a vegetation community in the same point of the landscape (refer to fire interval).
Fire extent	Refer to patchiness.
Fire intensity	The amount of energy released per unit length of fire front, in units of kilowatts per metre of the fireline (also known as the Byram fire-line intensity).
Fire interval	The interval between successive fires for a vegetation community in the same point of the landscape. Often expressed as a range indicating a minimum and maximum number of years that an area should be left between fire events (refer to Appendix 2).
Fireline	Constructed or treated lines/trails (sometimes referred to as fire trails or control lines) or environmental features that can be used in the management of a fire. Permanent firelines should (usually) have a primary purpose other than that of a control line (e.g. access track to a campground). Firelines are **NOT** fire breaks. Although the term 'fireline' is not without its shortcomings it should be used in preference to 'firebreak' to avoid the perception that a fire will stop at a break.

<table>
<tr><th>Terminology</th><th>Definition</th></tr>
<tr><td>Clarification over the terms

‘fire vegetation group’ and ‘fire management zone’.</td><td>The fire management requirements within a conservation fire management zone are based on the fire vegetation groups (FVGs)—groups of related ecosystems that share common fire management requirements. Fire regimes for FVGs are identified in the Bioregional Planned Burn Guidelines and are reflected in fire strategies. Other fire management zones (e.g. protection, wildfire mitigation, special conservation, sustainable production, rehabilitation, exclusion, and reference) will have specific management objectives that override the FVG fire regime requirements. Further, if there are a number of these other zones within a strategy they are identified as fire management subzones (FMSz) (e.g. P1, P2, P3, WM1, WM2, etc) each with specific fire management requirements.

<table>
<tr><th>Fire management zone</th><th>Fire management sub-zone or Fire vegetation group</th></tr>
<tr><td rowspan="2">Conservation</td><td>FVG1</td></tr>
<tr><td>FVG2</td></tr>
<tr><td rowspan="2">Protection</td><td>P1</td></tr>
<tr><td>P2</td></tr>
<tr><td rowspan="2">Wildfire mitigation, etc</td><td>W1</td></tr>
<tr><td>W2</td></tr>
</table></td></tr>
<tr><td>Fire perimeter</td><td>The outer containment boundary in which fire is being applied.</td></tr>
<tr><td>Fire regime</td><td>The recommended use of fire for a particular vegetation type or area including the frequency, intensity, extent, severity, type and season of burning.</td></tr>
<tr><td>Fire regime group (FRG)</td><td>A group of related ecosystems that share a common fire management regime including season, severity, recommended mosaic etc. These are a sub-grouping of the fire vegetation groups to provide more detail about specific fire management requirements. Fire regime groups are provided as a more detailed alternative for use with fire strategies or in mapping.</td></tr>
</table>

Terminology	Definition
Fire season	The period(s) of the year during which fires are likely to occur, spread and cause sufficient damage to warrant organised fire control.
Fire severity	A measure of the effect of fire on vegetation and soil immediately after the fire (e.g. vegetation consumption, vegetation mortality, soil alteration). Can be used to indicate fire intensity.
Fire vegetation group (FVG)	A group of related ecosystems that share common fire management requirements. For the purpose of practical fire management, these ecosystems are treated as a group.
Flame height	The vertical distance between the average tip of the flame and ground level, excluding higher flares.
Fuel	Any material such as grass, leaf litter and live vegetation, which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare.
Fuel hazard	The condition of the fuel and takes into consideration such factors as quantity, arrangement, current or potential flammability and the difficulty of suppression if fuel should be ignited.
Fuel load	The dry weight of combustible materials per area, usually expressed as tonnes per hectare. A quantification of fuel load does not describe how the fuel is arranged, nor its state or structure.
Fuel moisture content	The water content of a fuel particle expressed as a percentage of the oven dry weight of the fuel particle (% ODW).
Grid ignition	A method of lighting prescribed fires where ignition points are set at a predetermined grid-like spacing through an area.
GFDI/GFDR	Grassland Fire Danger Index/Danger Rating.

Terminology	Definition
High biomass grasses	Tend to be exotic species of grasses which can out-compete native species to form dense mono-specific stands. They: • are generally taller than native species • can lead to decreased biodiversity • increase biomass • increase fire severity • increase threat to life and property.
Humus (or duff layer)	The mat of partly decomposed vegetation matter on the forest floor, the original vegetative structures still being recognisable.
Junction zone	An area of greatly increased fire intensity caused by two fire fronts (or flanks) burning towards one another.
Keetch-Byram Drought Index (KBDI)	A numerical value reflecting the dryness of soils, deep forest litter, and heavy fuels and expressed as a scale from 0–203.
Landscape mosaic	A mosaic burn at a landscape level, usually achieved by planning a series of fires across a reserve, a bioregion or broader area.
Lighting pattern	The lighting pattern adopted by fire fighters during planned burning operations, or indirect attack.
Litter	The top layer of the forest floor composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves and needles, little altered in structure by decomposition. (The litter layer of the forest floor).
Mesophyll pioneers	Large-leaved (12.5–20 cm long) rainforest tree species able to establish in neighbouring communities.
Mineral earth	Being completely free of any vegetation or other combustible material.

Terminology	Definition
Mosaic burn	An approach which aims to create spatial and temporal variation in fire regimes. This can occur within an individual burn and at a landscape level (refer to Appendix 2).
Obligate seeders (obligate seed regenerating species)	Shrubs that are killed by fire and rely on soil-stored seed bank to regenerate. In fire ecology, the time it takes obligate seeders to mature and establish a seed bank often indicates the minimum frequency with which a vegetation community should be burnt in order to avoid the local extinction of these species.
Patchiness	A percentage or proportion of the ground layer vegetation (grasses, herbs and trees/shrubs less than one metre) not affected by fire (i.e. 20 per cent patchiness = 80 per cent burnt).
Perennial plants	Plants that last for more than two growing seasons, either dying back after each season as some herbaceous plants do, or growing continuously like many shrubs.
Planned burn	The controlled application of fire under specified environmental conditions to a pre-determined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. In the context of QPWS operations: a fire that is deliberately and legally lit for the purposes of managing the natural and/or cultural and/or production resources of the area (e.g. reducing fire hazard, ecological manipulation), and protecting life and property.
Progressive burning	Progressive burning is an approach to planned burning where ignition is carried out throughout much of the year as conditions allow. In northern Queensland, ignition can begin early in the year after heavy seasonal rain, with numerous small ignitions creating a fine scale mosaic. These burnt areas can provide opportunistic barriers to fire for burning later in the year. They also provide fauna refuge areas. Progressive burning helps create a rich mosaic of intensities, burnt/unburnt areas, and seasonal variability. Be aware of how fire behaves differently in different seasons.
Rate of spread (ROS)	The forward progress per unit time of the head fire or another specified part of the fire perimeter, defined as metres per hour.

Terminology	Definition
Relative humidity (RH)	The amount of water vapour in a given volume of air, expressed as a percentage of the maximum amount of water vapour the air can hold at that temperature.
Scorch height	Is the height to which former green leaves still suspended on plants are turned brown by the heat of a fire.
Strip burning	Setting fire to a narrow strip of fuel adjacent to a fire-line and then burning successively wider adjacent strips as the preceding strip bums out.
Test fire	A controlled fire of limited extent ignited to evaluate fire behaviour.

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Appendix 1: List of regional ecosystems

A fire vegetation group is a group of related regional ecosystems that share common fire management intent for the purpose of practical fire management.

Fire vegetation group	Hectares within New England Tableland bioregion	Percentage
Grassy open forest	192 949	24.93
Shrubby open forest	48 972	6.33
Open forest with limited ground fuel	8 474	1.09
Sedgeland	325	0.04
Rock pavement communities	747	0.10
Riparian and fringing communities	4 049	0.52
Vine thicket	88	0.01
Other areas	518 361	66.97
TOTAL	**773 965**	**100**

Chapter	**Issues**	**Fire vegetation group**	**Fire regime group**	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).	**Vegetation map units Girraween** (Sparshott 2003) *Sundown* (Grimshaw and Haselgrove 2002)
1	1	**Grassy open forest**	**Grassy open forest**	13.11.3; 3.11.3a; 13.11.3b; 3.11.4; 13.11.6; 13.11.8; 13.11.8a; .12.10; 13.12.4; 13.12.8; 13.12.9; 13.3.1; 13.3.2; 13.3.3; 13.3.4; 13.3.7	4, 5, 7, 8, 12 *3b, 11a, 11c, 11d*
2	1	**Shrubby open forest**	**Shrubby open forest**	13.11.1; 13.11.2; 13.12.5; 13.12.1; 13.12.2	9, 10, 11, 13, 14, 15, 16, 17, 20 *11b, 11e, 11g, 11h, 12a, 12b*
3	1	**Open forest with limited ground fuel**	**Open forest with limited ground fuel**	13.9.2; 13.11.5	Not in Girraween *11f*
4	1	**Sedgeland**	**Sedgeland**	13.3.6	1, 2, 3 *Not in Sundown*
5	1	**Rock pavement communities**	**Rock pavement communities**	13.12.3; 13.12.6	18, 19, 21 *11i, 12c*
6	1	**Riparian and fringing communities**	**Riparian and fringing communities**	13.3.1x1; 13.3.5	6 *3a, 3c*
7	1	**Vine thicket**	**Vine thicket**	13.11.7; 13.11.7a	Not in Girraween *11j, 11k*

The Regional Ecosystems (RE) listed above used records in version 6.1 of the Survey and Mapping of 2006 Remnant Vegetation Communities and Regional Ecosystems of Queensland spatial layer (16 September 2011) (refer to Figure 1).

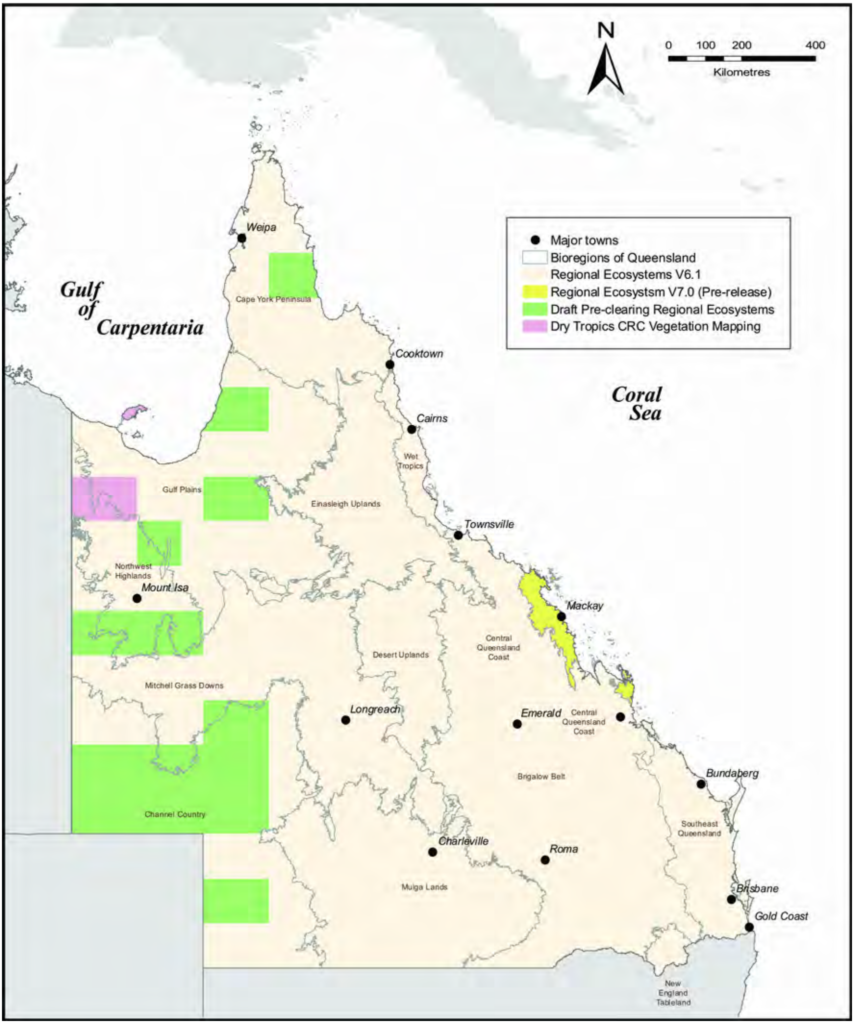

Figure 1: Map of Queensland indicating the different GIS data sources used to produce the spatial fire vegetation group mapping product.

Appendix 2: Mosaic burning

Mosaic burning is an approach to planned burning which aims to maintain and maximise diversity within fire-adapted vegetation communities. At various scales, a mosaic of vegetation in different stages of post-fire response can provide a greater range of habitats for plants and animals including those that prefer open country, those that need dense vegetation or the presence of a particular food source and all ecological requirements in between.

In practice, mosaic burning is achieved through the use of appropriate weather conditions, variation in topography, frequency, intensity, season and ignition patterns to create a patchwork of burnt and unburnt areas. Over time the patches overlay to build a more complex mosaic of vegetation at various stages of response from fire (Figures 1–5 provide a simplified example). This practice can apply to burning at a **landscape scale**—how much of a particular fire vegetation group is targeted within a given year (across a bioregion or management area) or can refer to the area burnt within an individual fire event. Both are important.

The land manager should apply mosaic burning and be guided by the recommended fire frequency. **Note that it is a common mistake to interpret the fire interval as a formula for applying fire.** Consider the following example: A fire strategy might recommend burning with a fire interval of between 8–12 years. In this case the land manager would apply mosaic burning (as often as required) but generally not burning any single patch more frequently than the minimum fire interval (e.g. eight years), or less frequently than the maximum fire interval (e.g. 12 years) (refer to Figures 1–5).

This is relevant because the minimum fire interval represents the amount of time it takes for each species to regenerate sufficiently to tolerate a second fire, and the maximum fire interval represents the amount of time an ecosystem can be left without fire before it begins to decline in health and species might be lost.

As ParkInfo/geographic information systems (GIS) and monitoring tools evolve it will become easier to evaluate if the fire vegetation groups are on track in terms of maintaining an age class distribution and conforming to recommended fire frequencies. Irrespective of monitoring and GIS tools it is important to learn to observe the health of the country and to understand its fire management needs to appropriately apply fire in a way that maintains a healthy ecosystem. This planned burn guideline provides key indicators supported by photographs to help you assess the health of the ecosystems and their fire management needs.

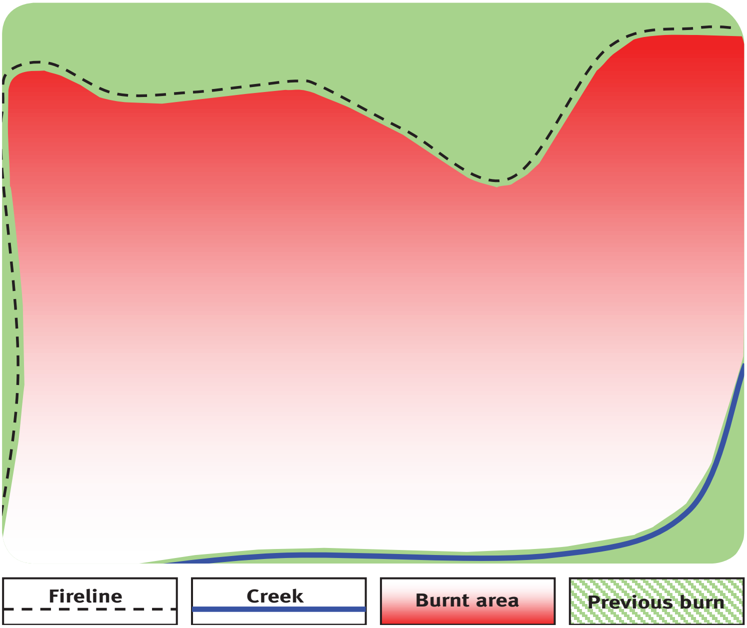

Figure 1: Example area between fireline and creek burnt in a wildfire—year 0. (Recommended fire interval for fire vegetation group is eight–12 years).

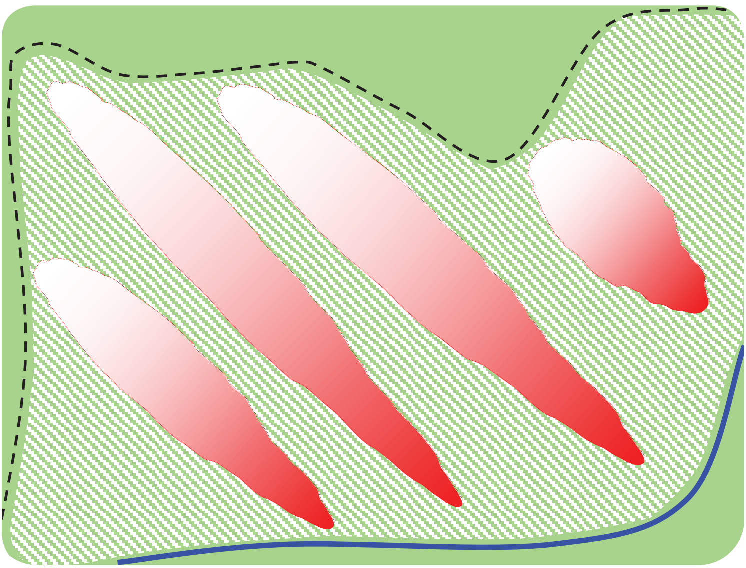

Figure 2: Planned mosaic burn—year 8.

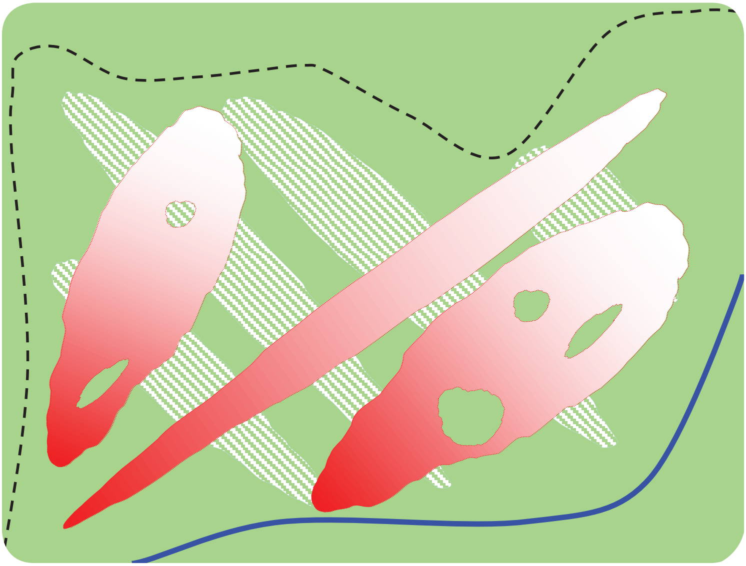

Figure 3: Planned mosaic burn—year 20.

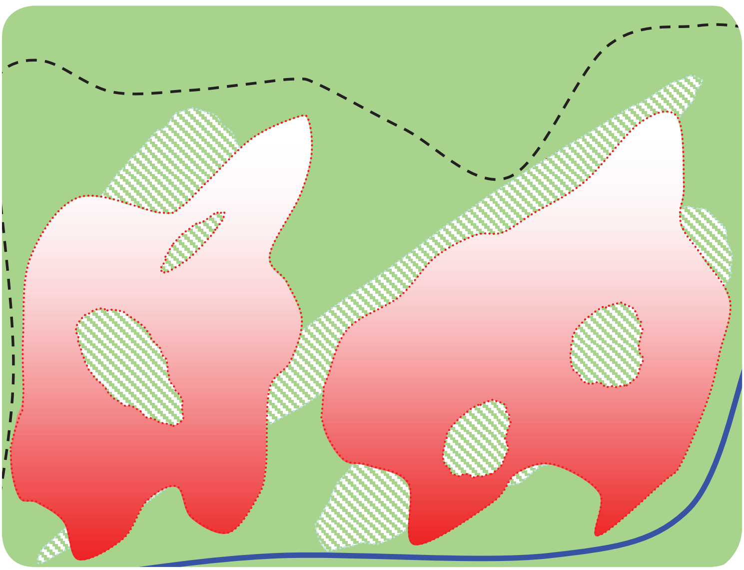

Figure 4: Planned mosaic burn—year 28.

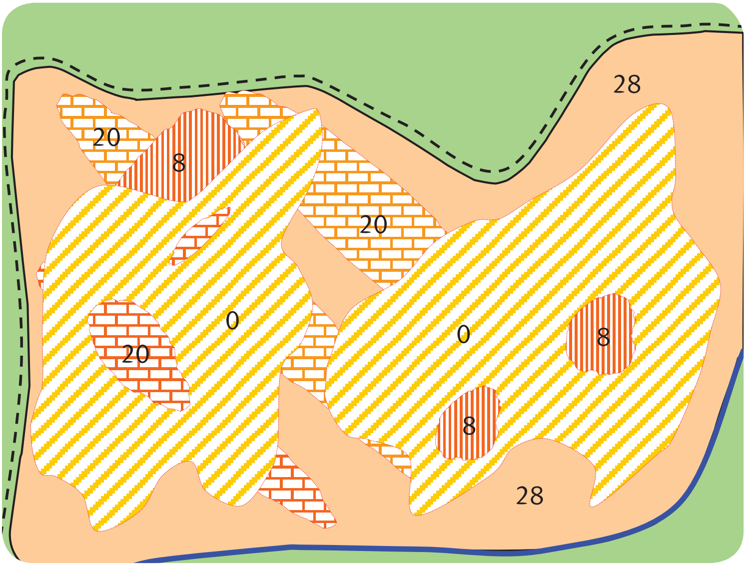

Figure 5: Fire history summary—year 28.
Wildfire and mosaic burn patterns overlaid (with years since last burnt).

Mosaic burn in Sundown National Park.
QPWS, Sundown National Park (2009).

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