Department of National Parks, Recreation, Sport and Racing

Planned Burn Guidelines

Gulf Plains Bioregion of Queensland

Queensland Government

Prepared by: Queensland Parks and Wildlife Service (QPWS) Enhanced Fire Management Team, Queensland Department of National Parks, Recreation, Sport and Racing (NPRSR).

First published May 2013
Published by the Department of National Parks, Recreation, Sport and Racing

National Library of Australia Cataloguing-in-Publication

Planned Burn Guidelines – Gulf Plains Bioregion of Queensland
First edition
Bibliography
ISBN 978-1-7423-0933
1. Planned Burn – Guideline 2. Fire Management 3. Bioregion – Queensland

Disclaimer

Acknowledgements

The following people made substantial contributions to the intellectual content of these planned burn guidelines based on experience and/or expert knowledge with regard to fire management in the Gulf Plains bioregion. QPWS staff include: Mick Cockburn, Mike Ahmet, Danny Chew, Lana Little, Tony Cockburn, Rob Fishburn, Nick Smith, Keith McDonald, and John Clarkson. Queensland Herbarium staff include: John Thompson, Hans Dillewaard and Gary Wilson. DAFF staff include: Bernie English and Dr Paul Williams (Vegetation Management Science Pty Ltd).

This guideline has been developed and produced by the QPWS Enhanced Fire Management Team: Kerensa McCallie, David Shevill, Wayne Kington, Jenise Blaik, Troy Spinks, Mark Cant and Justine Douglas; supported by David Clark, Caroline Grayson, Ellen Thyer and Tim Killen. Following a successful pilot project (QPWS South East Region Planned Burn Guidelines) initiated and developed by QPWS staff: Wayne Kington, David Kington and Mark Burnham.

Front cover photograph: Boodjamulla (Lawn Hill) Resource Reserve, Lea Ezzy, QPWS (2012).

Bp2013

Foreword

At more than 22 million hectares, the Gulf Plains bioregion covers approximately 12 per cent of Queensland, yet is contained within just two geological basins — the Carpentaria and Karumba. The bioregion is characterised by extensive alluvial plains, but also includes a dynamic coastal strip; and some tablelands, hills and ranges along its margins. Covering more than six degrees of longitude and almost seven degrees of latitude, the bioregion sees highly variable rainfall, and is influenced by coastal effects, but typically has cool, dry winters and hot, wet (monsoonal) summers. Extreme weather events such as droughts, floods and cyclones can affect the whole region, with subsequent influence on the timing and intensity of fires.

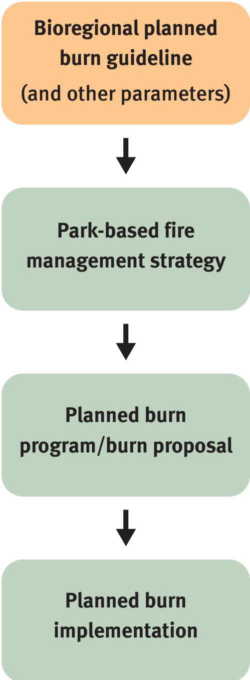
The economy of the region relies heavily on the pastoral industry, as well as fishing and tourism. These activities demand robust native grasslands and savannahs, stable riparian fringes and healthy and productive wetlands. The management of protected areas in the region has similar goals.

Woody thickening and invasion by weeds such as rubber vine, prickly acacia, and mimosa bush pose a serious threat to the biodiversity and production values of the Gulf Plains. Fire plays a key role in an integrated approach to halting and reversing these processes.

Informed use of fire is one of the most cost effective tools available and it is hoped these guidelines will provide a platform from which land managers can shape and hone a kit tailored to the needs of the lands and waters under their custodianship.

Lana Little
Ranger
Northern Region
Queensland Parks and Wildlife Service.

Table of contents



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

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.

Scope

- This guideline applies to the Gulf Plains bioregion (refer to Figure 1) and covers the following fire vegetation groups: eucalypt communities, grasslands and sedgelands, melaleuca communities, acacia communities, springs and dunes, vine thickets, mangrove and saltmarsh communities (refer to Appendix 1 for regional ecosystems contained in each fire vegetation group).
- It covers the most common fire management issues arising in the Gulf Plains bioregion. 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.

Paul Williams, Vegetation Management Science Pty Ltd, Carly's Lagoon, Finucane Island National Park (2010).

Figure 1: Map of the Gulf Plains bioregion of Queensland.

Fire and climate in the Gulf Plains bioregion of Queensland

Cool dry winters and hot wet summers with frequent cyclonic activity and prolonged rainfall characterise this bioregion. During the summer monsoon most of the region's annual rainfall occurs. This sometimes results in severe prolonged flooding (e.g. 2009 floods), that have the potential to cause widespread loss of understory species and native fauna.

While the amount of rainfall varies between years, it generally decreases from north to south and east to west. Meaning there is significant variation in the issues facing land managers and in particular those using fire as a means of managing the landscape.

Planned burning in the Gulf Plains bioregion must remain flexible to allow for variation in the timing and length of wet seasons and the impact of extreme rainfall events. Staff must be vigilant in recognising opportunities to burn and capitalising on these opportunities. It is also important to be aware of conditions prior to and following planned burns.

Fire risk is linked to the occurrence of fire weather days or sequences of days (FDR very high+ / FDI 25+). In the Gulf Plains bioregion these days have an average temperature 35°C, low humidity (18 per cent) and sustained winds > 17 km/hr (refer to Figure 2).

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>.

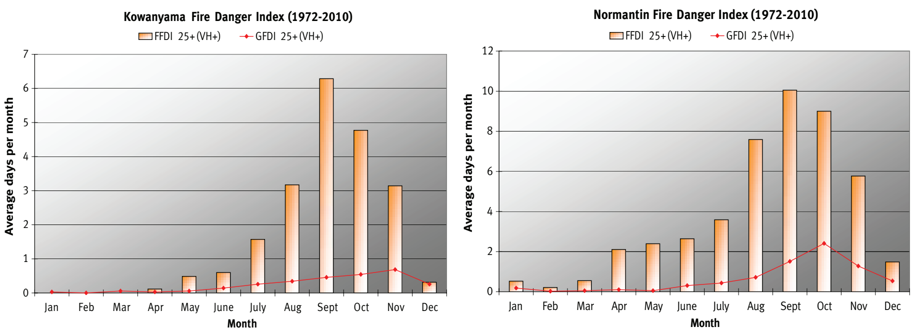


Figure 2: Fire weather risk in the Gulf Plains bioregion.

The likelihood of a fire weather day or sequence of days (FDI 25+) increases significantly from around August and persists for a few months until the start of the wet season. Data (Lucas 2010).

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: Eucalypt communities

This fire vegetation group contains a broad range of open forest and woodland communities. The canopy is typically dominated by a mix of *Eucalyptus* spp. and *Corymbia* spp. with scattered shrubs and small trees, sometimes with associated paperbarks *Melaleuca* spp. The ground layer is dominated by either tussock (various species) or hummock grasses (spinifex) or a mix of the two with rushes and sedges in wetter sites. In some areas a dense shrub layer is present. This fire vegetation group also includes spinifex grasslands and riparian communities supporting eucalypt spp. such as coolibah *Eucalyptus microtheca* with grasses and rushes on alluvial flats and other communities fringing watercourses.

Fire management issues

This fire vegetation group occurs over extensive, often inaccessible areas necessitating a broad-scale approach to fire management, most efficiently achieved through aerial ignition. The key strategy is to commence planned burning early in the dry season as soon as ground fuels are sufficiently cured to carry fire (and when fire self-extinguishes in the early evening). Planned burns should continue into the mid dry season. This approach breaks-up the continuity of fuels across the landscape and mitigates impacts of late-season wildfire. In the absence of proactive planned burning, late-season wildfires can be extensive, frequent and intense, resulting in ecological impacts (such as loss of diversity) and producing an enormous amount of greenhouse gas emissions.

There is a gradient of typical fire frequency experienced across the Gulf Plains, with more frequent fires in the north-east in areas dominated by sorghum, *Sarga* spp. and annual tussock grasses. Fire frequency declines further south as perennials and hummock grasses (e.g. spinifex) dominate.

Loss of open structure through overabundant seedlings/saplings can lead to woody thickening. This process is attributed to a long absence of planned burning and/or fires repeatedly applied too early in the season (when they are not intense enough to control emerging overabundant seedlings/saplings). Thickening is thought to be more prevalent in the drier, southern areas of the bioregion (where fires are less frequent). In the Gulf Plains, thickening is often attributed to overgrazing of stock, allowing woody species to gain a competitive advantage over grasses.

Issues:

1. Maintain healthy tussock grass dominated eucalypt communities.
2. Maintain healthy shrubby or spinifex dominated communities.
3. Reduce overabundant saplings.
4. Reduce woody weeds.
5. Manage high biomass invasive grasses.

Extent within bioregion: 10 007 486 hectares (ha), 45 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Staaten River National Park, 252 114 ha; Rungulla Proposed new National Park, 50 351 ha; Errk Oykangand National Park (Cape York Peninsula Aboriginal Land), 30 030 ha; Gilbert River Proposed new National Park, 20 201 ha; Bulleringa National Park, 16 508 ha; Lawn Hill (Widdallion) Resources Reserve, 8210 ha; Blackbraes National Park, 4966 ha; Porcupine Gorge National Park, 2350 ha; Boodjamulla (Lawn Hill) National Park, 1851 ha; White Mountains National Park, 980 ha; Mutton Hole Wetlands Conservation Park, 429 ha; Lawn Hill (Arthur Creek) Resources Reserve, 355 ha; Lawn Hill (Gorge Mouth) Resources Reserve, 215 ha; Blackbraes Resources Reserve, 192 ha; The Canyon, 186 ha; Finucane Island National Park, 161 ha; Lawn Hill (Creek) Resources Reserve, 135 ha.

Issue 1: Maintain healthy tussock grass dominated eucalypt communities

Use broad-scale mosaic burning to maintain a landscape of healthy eucalypt communities.

Awareness of the environment

Key indicators of healthy tussock grass dominated eucalypt communities:

- Eucalypt communities have a very open canopy of *Eucalyptus* spp. and/or *Corymbia* spp. trees. Some young canopy species are present in the understorey (enough to eventually replace the canopy) but are not extensive enough to produce shading impacts.
- Tussock grasses dominate the understorey and are vigorous and upright.
- A diversity of herbs and forbs are found between the grass tussocks. They are more apparent during the wet season.
- In riparian eucalypt communities, grasses may be interspersed with sedges and rushes.
- *Eucalyptus* spp., *Acacia* spp. and/or *Melaleuca* spp. and in some areas currant bush *Carissa lanceolata*, quinine *Petalostigma* spp., gutta percha *Excoecaria parvifolia* or other species, appear as scattered individuals and are not so frequent that they are beginning to shade out the ground layer.
- Mistletoe is present but not common.

Healthy open woodlands should have a mix of mature canopy trees such as this bastard bloodwood *Corymbia setosa* interspersed with seedlings/saplings and young trees (enough to eventually replace the canopy).

Lana Little, QPWS, Staaten River National Park (2004).

Grassy eucalypt communities should be open and easy to walk through. These areas provide habitat for golden-shouldered parrots and black-throated finches.
Lana Little, QPWS, Staaten River National Park (2004).

A healthy cover of green grasses interspersed with herbs and forbs can be a sign of healthy grassy woodland. This woodland is habitat for the endangered golden-shouldered parrot. Termites are major detritivores, eating decaying plant matter and returning the nutrients to the ecosystem. Their mounds provide nest sites for this parrot species.
Lana Little, QPWS, Staaten River National Park (2004).

In some areas grasses are naturally sparse (such as on top of escarpments).
QPWS, Bulleringa National Park (2010).

Be aware that the abundance of some small tree species is not related to fire management, but is a result of soil and landscape characteristics. Smooth-leaved quinine *Petalostigma banksii* is often naturally abundant in the mid layer.
Mike Ahmet, QPWS, Monitoring site. Bulleringa National Park (2007).

Many herbs and forbs are more common following fire. An absence of these types of plants can be an indicator of the need to apply fire. Their presence will be more obvious during the wet season.

John Thompson, Queensland Herbarium.

The following may indicate that fire is required to maintain eucalypt communities with a tussock grass understory:

- An accumulation of dead material in tussocks, collapsing grass and poorly formed grass clumps are present. Grasses are more or less continuous to allow the passage of fire (in some areas grasses are naturally less continuous).
- There is a build-up of rank or stand-over (grass with significant dead material not consumed in previous burning cycles) grasses.
- Species such as *Eucalyptus* spp., *Acacia* spp., currant bush *Carissa* spp. or other species are becoming more than scattered or are emerging above the ground layer.
- There is a lack of wet season diversity in the ground layer; forbs and herbs are infrequent or absent. These species may be naturally absent in the dry season.
- Mistletoes (Loranthaceae family) and other parasitic plants such as native cherries (Santalaceae family) and dodder-laurel vines *Cassytha* spp. becoming frequent. Mistletoes are present on lower level branches.

Dense stands of rank or stand-over grasses can be a good indicator of the immediate need to apply fire, as shown during this November storm burn. Consider burning an area with heavy fuel loads such as this under mild conditions/or high soil moisture to reduce fire severity and extent.

Lana Little, QPWS, Dunbar Station (2011).

Woody thickening can occur where fires have been absent or infrequent. This Cooktown ironwood *Erythrophleum chlorostachys* has thickened in the mid-stratum and if left unmanaged will shade out grasses.

Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Early stage thickening of eucalypts and Cooktown ironwood is much easier to manage as younger trees are much more susceptible to fire. However fuels need to be sufficient for fires to be effective. Spelling pasture prior to planned burns may be necessary.

Paul Williams, Vegetation Management Science Pty Ltd, Near Normanton (2011).

Sometimes quinine appears to have thickened below the canopy. However, in many locations it naturally occurs this way within the mid stratum/lower tree layer.
Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Darwin stringy bark *Eucalyptus tetrodonta* is thick beneath the canopy in some areas of the northern Gulf Plains; this is a natural phenomenon and more likely a result of soil and landscape characteristics than fire management.
Lana Little, QPWS, Staaten River National Park (2004).

Discussion

- A key strategy to manage the vast expanses of inaccessible eucalypt communities in the Gulf Plains is broad-scale management through aerial ignition. Ideally, this would include at least three different ignition periods on each property, each year.
- Wildfires resulting from dry storms late in the dry season or in the early wet season are frequent (one to two years) and extensive. While fires from lightning strikes are part of the natural system, they have considerable ecological impacts when early season burning has not occurred or has been insufficient to mitigate the run of a hot fire late in the dry season.
- Grasses are generally considered ready to burn when they reach 50–60 per cent cured. The North Australian Grassland Fuel Guide (Johnson 2001) may assist in determining when grasses are ready to burn. However, caution should be used and local knowledge sought as some grass species that still appear too green to burn will burn severely (and vice versa).
- Variation in burn season and short inter-fire intervals promote better habitat for many species of birds in eucalypt communities. Valentine et al. (2007) found that bird abundance dramatically increased in burnt sites soon after fire (12 months), but declined in the longer term (four years), especially for nectivores and granivores.
- Very small patches of scrub with deciduous softwood species may be present within eucalypt communities. They often occur on very low rises with sandy soils. These areas will not burn under most planned burning conditions; however late-season fires may carry into these areas on occasion. Proactive planned burning resulting in an established mosaic in surrounding fire adapted communities will assist in preventing late season wildfire incursion (refer to Chapter 6: Vine thickets).

- Most eucalypt dominated riparian and fringing communities retain fire-sensitive species. In most cases these communities will not burn readily because of a lack of ground layer fuels or humid micro-climates within them. In other areas, where there is a grassy layer present they often burn in association with the surrounding landscape. Where they occur, species such as river red gum *Eucalyptus camaldulensis*, *Melaleuca* spp. *Pandanus*, river she-oak *Casuarina cunninghamiana*, palms (e.g. *Livistona* spp.), figs *Ficus* spp. and some vine thicket species are threatened by too frequent fire. Maintaining a landscape mosaic in the surrounding fire-adapted communities mitigates the impacts of unplanned fire.
- Riparian areas with *Eucalypt* spp., provide habitat for a range of species. High severity or frequent fires may have flow-on effects to wildlife such as the goshawk *Erythrotriorchis radiatus*. The red goshawk is considered Endangered under the Queensland *Nature Conservation Act 1992* and is Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
- A key issue within some tussock grass eucalypt communities is the invasion of buffel grass *Pennisetum* ciliare and weeds such as rubber vine *Cryptostegia grandiflora*. Buffel and other invasive grasses can increase fuel loads and contribute to high severity fires resulting in tree death. Rubber vine smothers vegetation forming impenetrable thickets. If weeds are an issue, refer to Chapter 8 for fire management guidelines.

What is the priority for this issue?

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

Riparian areas are critical habitat for the red goshawk which requires very tall trees for nesting and hunting.

John Augusteyn, QPWS, Violet Vale Station (1998).

Eucalypt spp. are often co-dominant canopy species of riparian communities and provide important habitat for a range of fauna. Care should be taken to minimise the extent, severity and frequency of fires in riparian areas.

B. Douglas, Gilbert River area (2011).

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 at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Progressive burning demonstrated.	Using fire scar remote sensing data, estimate burnt and unburnt country by month, on an annual basis. Note that early burns may not be visible on NAFI, it may be necessary to combine remote sensing with points collected on GPS that mark early ignition locations.	**Achieved:** Remote sensing shows a series of progressive burns through the season. **Partially Achieved:** One to two burns achieved. **Not Achieved:** No burning has occurred.
Proactive planned burning has prevented impact by subsequent wildfire to natural/cultural resources or infrastructure.	Using fire scar remote sensing data (e.g. NAFI), estimate area of planned burns against wildfire on an annual basis.	**Achieved:** Annual area of planned burn prevents impacts of wildfire. **Not Achieved:** Wildfire has a significant impact.
> 75 % of overabundant saplings < 2 m are reduced.	Select several sites or walk several transects, estimate the percentage of overabundant saplings (above ground components) reduced.	**Achieved:** > 75 %. **Partially Achieved:** 25–75 %. **Not Achieved:** < 25 %.

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.

A number of Sav-Mon (savannah monitoring) sites are established across the bioregion and are designed to assess long-term changes in vegetation health. Queensland Herbarium CORVEG sites could be used or established (refer to Neldner et al. 2005).

Mapping and assessment of fire history through fire scars from the North Australian Fire Information (NAFI) system or other means, is useful to guide future fire planning.

Under suitable planned burn conditions, some natural barriers such as creeks, rivers and rocky outcrops are useful barriers to fire movement.

Lana Little, QPWS, Staaten River National Park (2000).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Tussock grass eucalypt communities: Low** to **moderate**, with occasional **high** severity fires.
- **Riparian areas: Low** to **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)	< 100	< 0.5	< 2.0	Some patchiness, most of the surface and near surface fuels have burnt. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	100–500	0.5–1.5	2.0–5.0	All surface and near surface fuels burnt. All or most of mid-storey canopy leaves scorched. Upper canopy leaves may be partly scorched.
High (H)	500–10 000	1.5–4.0	Complete canopy scorch	All ground material affected by fire. All mid storey canopy leaves scorched or charred. All upper storey canopy leaves scorched.

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

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

- 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 one and five years aiming for the lower range of this interval in most areas and the higher end in fire-adapted riparian communities.

Mosaic (area burnt within an individual planned burn)

- Most fires should be patchy; however this will vary with burn location and will need to be assessed on a case by case basis. However, it is not acceptable to completely burn all of an area and conversely it is important to burn sufficient area to impede later burns or wildfires.
- A mosaic is generally achieved with 30–70% burnt within the target area.

Other considerations

- An extensive network of river systems form a key part of mitigating wildfires as they provide areas which can act as natural fire-breaks. These areas can be can be enhanced as breaks by nearby early season proactive burning.
- The exotic plant Hyptis *Hyptis suaveolen* is often present in riparian areas on Bulleringa National Park, and may impede early burning attempts.

An early dry season burn in grassy eucalypt communities is ideal if the desired outcome is a high level of patchiness.

This photo was taken in June 2009. QPWS, Bulleringa National Park (2009).

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:

Grassy eucalypt communities

- **Soon after the wet** season when it is dry enough to carry a fire (just) but the fire will extinguish in the evening. Continue planned burning through until the **mid dry season** until fires carry into the night but not overnight. Do not burn in the late dry season.
- Occasional storm burns may be required where hot fires have been absent for a number of years. Higher severity fires caused by lightning strike are also a natural feature of these systems and are not usually a problem provided that early season burning has been conducted in a way that mitigates the extent and severity of wildfire.
- Repeated early season burns are not recommended where overabundant seedlings/saplings are an issue (refer to Chapter 8, Issue 3 for fire management guidelines).
- In some riparian areas wet season burning can reduce fuels and prevent wildfires later in the season. These areas can be used as barriers to fire movement providing sufficient early season burns have occurred both within riparian areas and surrounding fire-adapted communities.

GFDI: < 18

DI (KBDI): 80–100

Wind speed: < 23 km/hr

Soil moisture: Good soil moisture assists in protecting underground portions of vegetation (allowing quick recovery) and promotes seedling germination post-fire. This helps in restoring ground cover and preventing erosion issues.

Cooktown ironwood can expand into adjacent open woodlands and grasslands if fire has been long absent or frequently applied too early in the season.

Peter Stanton, Environmental Consultant Pty Ltd, Namarrong (1991).

Storm burning in the early wet season can assist in producing fires of limited extent and severity, as indicated by this burn in December.

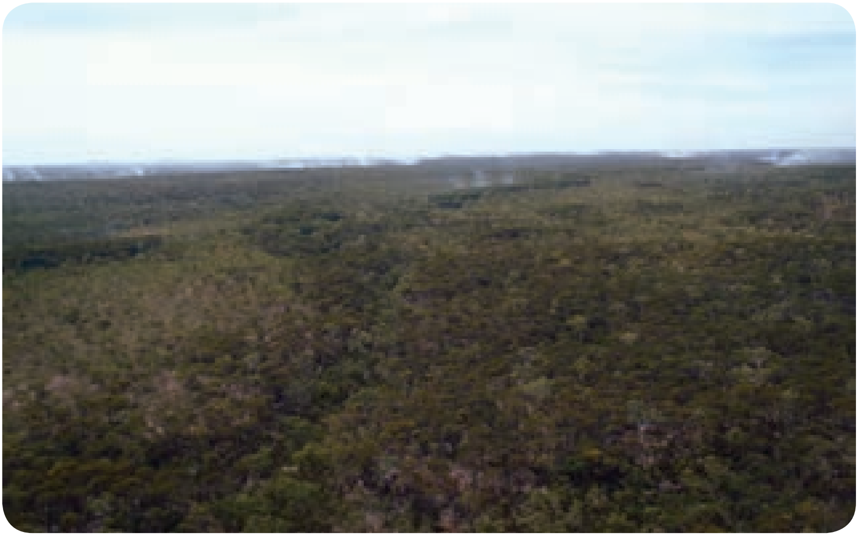
Lana Little, QPWS, Staaten River National Park (2005).

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the planned burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Aerial ignition**. A landscape approach to fire management is necessary due to the size and inaccessibility of eucalypt communities. This is mostly achieved through **aerial ignition**. Early dry-season fires can be lit in either morning or afternoon depending on the desired outcome. Ignition timing would be determined by how far the fire is required to travel before self-extinguishing in evening conditions. A useful tool to determine the rate of spread is the CSIRO Grassland Fire Spread Meter for Northern Australia. Use natural features such as rivers and streams (even if there is no water, there may be sufficient moisture), areas of sparse or uncured fuel or previously burnt areas to contain fires. Also, note that these natural features may prevent fire from carrying as far as intended. Aerial ignition also provides an opportunity to burn away from non-target communities (e.g. springs, vine thickets and acacia communities) creating areas of reduced fuel protecting them from impacts of late dry-season wildfires. It is good practice to plot out an aerial incendiary path using maps, satellite images or aerial photographs and to program the path into a GPS for use in flight.
- **Spot ignition** is used to alter the desired intensity of a fire and create the desired mosaic of burnt and unburnt areas. A number of patterns of lighting can be used. The spacing of the spots affects the resulting intensity and mosaic.
- **Single point ignition** is used to create a fire of limited extent with a limited fire front. Often, this may mean lighting only at a single location for an entire burn (a number of ignition points at the same location may be required) or very widely spaced ignition points creating separate fires. If creation of a patchy fire is the objective then it is better to use successive single point ignitions creating separate fires.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout as much of the year as conditions allow. In the Gulf Plains, ignition can begin soon after the wet season as soon as fuel has cured sufficiently to carry fire, with numerous small ignitions. Progressive burning then continues into the mid dry season. Ideally multiple periods of ignition should occur in each park in each year. These burnt areas can provide opportunistic barriers to fire to support burning later in the year (e.g. storm burning) or to provide barriers to wildfire movement. They also create patchiness and fauna refuges and help create a rich mosaic of severities, burnt/unburnt areas, and seasonal variability to support habitat diversity.

- **Storm burning**. Burns undertaken in the storm season after first storms and when there is a high probability of rain after burning. Containment of storm burns relies on impending rain, natural breaks, or earlier season burning having established areas of lower fuel sufficient to impede the passage of fires.
- Use **periods of declining fire hazard** so that fires are more controllable. Daily patterns can be utilised (e.g. after 2 pm, relative humidity tends to increase and temperature and winds decrease) meaning fires become less severe and will often self-extinguish early in the season but may carry through the night later in the year.
- A **running fire** of a higher intensity, lit with the wind can help reduce overabundant seedlings/sapling. A l**ow intensity backing fire**, which is slow moving and **increases residence time**, is also useful to reduce woody weeds or overabundant seedlings/saplings. The best method is dependent on the amount of fuel available and also on the overabundant species (some species can be killed with lower severity fire with a high residence time; others species must be scorched to their tip—seek advice).
- **Line ignition**. In open woodland communities where soils retain moisture for longer it may be necessary to create a line of fire to carry fire through uncured fuels. But avoid using this approach repeatedly along tracks or roads.



Targeting rank or standover-grasses through broad-scale aerial ignition with widely spaced incendiaries. In the right conditions, techniques such as this will assist in impeding wildfires later in the season and meeting other conservation outcomes.

Nick Smith, QPWS, Bulleringa National Park (2012).

Issue 2: Maintain healthy shrubby or spinifex dominated communities

This issue applies to the management of spinifex *Triodia* spp. dominated grasslands as well as eucalypt communities with a spinifex or shrubby dominated ground layer.

Spinifex is very flammable, but can take a long time to form continuous fuel (when hummocks begin to join-up). Apply fire before the hummocks form continuous fuel over large areas, to create patchy fires and to mitigate extensive and severe wildfires.

Awareness of the environment

Key indicators of healthy spinifex or shrubby communities:

- These areas may have an open canopy of *Eucalyptus* spp. or *Corymbia* spp. Some young canopy trees are present in the understorey (enough to eventually replace the canopy).
- In spinifex grasslands, trees may be absent or present as scattered emergents.
- Spinifex shows a variation in time-since-fire across the landscape. Some more recently burnt areas have spinifex interspersed with occasional tussock grasses and forbs. A mosaic of longer unburnt areas containing spinifex with a build-up of dead and dying material should remain.
- In the first few years after fire there is a diversity of herbs, forbs and annual grasses between spinifex hummocks.
- Shrubby eucalypt communities (which occur in some areas) may have a mid-dense to dense layer of shrubs with sparse spinifex or tussock grasses in the ground stratum. They are generally found on scarps and plateaux.
- Shrubby communities are naturally very diverse, often with a number of *Eucalyptus* spp., *Melaleuca* spp., or *Acacia* spp. dominating and interspersed with a number of species of shrubs such as *Grevillea* spp. or *Jacksonia* spp.

Healthy silver leaf box *Eucalyptus pruinosa* low open woodland with a ground layer of spinifex.

John Neldner, Queensland Herbarium, south-west Nardoo Homestead (1999).

A mixture of hummock (spinifex) and tussock grasses may be present in some communities including those dominated by Darwin stringybark *E. tetrodonta* and quinine tree *Petalostigma banksii*.

Mike Ahmet, QPWS, Bulleringa National Park (2009).

In spinifex areas, herbs and forbs flourish in the year following fire. With time-since-fire, spinifex will once again dominate.
Justine Douglas, QPWS, Boodjamulla (Lawn Hill) National Park (2012).

Ground fuels can be naturally sparse in some spinifex communities.
Gary Wilson, Queensland Herbarium, Near Tallawanta homestead (2006).

A shrubby woodland. In shrubby areas, obligate seeders (fire-killed shrubs) such as yellow flowering *Jacksonia ramosissima* should be allowed to flower and set seed a number of times before the next planned burn (this usually takes more than seven years). Observe the shrubs for evidence of accumulated seeding bodies (such as cones or pods).

Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Some shrubby communities are more open with a more continuous and diverse ground cover.

QPWS, Bulleringa National Park (2009).

The following may indicate that fire is required to maintain eucalypt communities with a spinifex or shrubby understory:

- Spinifex clumps are big enough that some have joined or almost joined so that fires will carry in some areas.
- When spinifex clumps are big enough that it becomes difficult to walk in a straight line, the fuel load has become quite high and care is required when burning.
- Parts of the spinifex hummock are grey and dry.
- Diversity of the ground layer has decreased. Herbs and forbs are absent between spinifex hummocks.
- Evidence of recent seeding such as presence of old seed stalks where seeds are absent (as seeds have dropped to the ground).
- In shrubby dominated areas, the crowns and branches of shrubs are declining in health and high proportions have dead or dying crowns or branches. Lower leaves are browning and there is a build-up of dead leaves.
- Wattles, *Grevillea* spp. and *Jacksonia* spp. which germinated after a previous fire have had several years of seed production, or are beginning to die.
- In shrubby eucalypt communities with a spinifex ground layer, some *Cassytha* spp. may begin to smother shrubs and ground layer plants.

This feathertop spinifex *Triodia bitextura* has seeded a number of times and is ready to be burnt. Ensure hummocks have seeded and are large and mature prior to burning.
Mike Ahmet, QPWS, Bulleringa National Park (2009).

As spinifex ages the hummocks begin to accumulate grey, dry material; an indication of the need to apply fire. Sometimes the hummocks collapse in the centre.
Gary Wilson, Queensland Herbarium, Neumayer Valley Station (2006).

When spinifex hummocks have become so large that they join or almost join it is an indicator of the need to apply fire. Where fuel has become more continuous like this, wet season burning could be used to minimise fire severity and extent.
John Neldner, Queensland Herbarium, South of Normanton (1999).

Although it takes several years for shrubs to mature and set seed, shrub diversity begins to decline after very long fire intervals. The build-up of lower level dead-leaves on shrubs indicates that fire is required.

Mike Ahmet, QPWS, Bulleringa National Park (2009).

Discussion

- Spinifex tends to continue to increase in size and fuel load with time-since-fire. In the years after fire, the distance between hummocks gradually decreases, allowing fire to travel more readily across the landscape. A very wet year (summer rain is better for spinifex growth than winter rain) or succession of wet years can provide a boost to the growth of spinifex (and consequent increase in fuel). This can result in severe, extensive wildfires, usually within the following two years. Fire should be applied before the hummocks join together to create patchy fires.
- Grazing can impact on the health of spinifex communities by reducing their diversity (the cattle prefer soft forbs and spinifex seed heads) and by reducing the continuity of fuels required for fire management.
- After fire some acacias will naturally form dense thickets that will thin out over time. It is not necessary to target these areas for burning in order to reduce this temporary acacia dominance.

- To achieve a patchy burn in spinifex, burns need to occur in the wet season or very soon after to take advantage of fuel and soil moisture. Be aware that spinifex can remain green throughout the year and it should not be assumed that because it is green it is safe to burn. Spinifex, while still green or even still wet from rain, will burn intensively after a few months following the last rains of the wet season (usually around April).
- Several fire-killed shrubs (e.g. wattles) require five years from germination to seed production. Some areas should be left long enough to allow fire-killed shrubs to persist. But leaving large areas unburnt for six years or more (to allow seed production by shrubs) creates a risk of extensive wildfires. Therefore, implementing small patchy burns, in the late wet season to early dry season, is the best way to mitigate against extensive wildfire and at the same time create areas that remain longer unburnt.
- Recently burnt spinifex and shrubby eucalypt communities tend to have a diversity of re-sprouting perennials, annuals and ephemeral forbs soon after fire. The number of species present tends to decline with time-since-fire.
- Fires which are too severe and occur without sufficient soil moisture result in the death of sub-soil grass bases/roots and slow post-fire recovery. Soil moisture also promotes rapid post-fire spinifex seedling establishment. Burning without soil moisture will often kill spinifex hummocks or slow seedling establishment and give a competitive advantage to weeds and woody species.

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance.**
High	Planned burns to **maintain ecosystems** 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 at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Progressive burning demonstrated.	Using fire scar remote sensing data, estimate burnt and unburnt country by month, on an annual basis. Note that early burns may not be visible on NAFI it may be necessary to combine remote sensing with points collected on GPS.	**Achieved:** Remote sensing shows a series of progressive burns through the season. **Partially Achieved:** One to two burns achieved. **Not Achieved:** No burning has occurred.
Proactive planned burning has prevented impact by subsequent wildfire to natural/ cultural resources or infrastructure.	Using fire scar remote sensing data, estimate area of planned burns against wildfire on an annual basis.	**Achieved:** Annual area planned burnt prevents impact by wildfire. **Not Achieved:** Wildfire has had significant impact.

Create a fine-scaled patchy burn in spinifex communities.	Choose one of these options: a. Visual estimation of percentage of vegetation burnt—from one or more vantage points, or from the air, using landmarks as a 'size' guide. b. Map the boundaries of burnt areas with GPS, plot on GIS and thereby determine the range of patch sizes.	**Achieved:** 25–75 % of spinifex hummocks remain unburnt within the burn area. **Not Achieved:** More than 75 % or less than 25 % of spinifex hummocks remain unburnt within the burn area.
Recruitment of obligate seeders (e.g. *Jacksonia* spp., *Acacia* spp.) promoted over the burn area.	6–12 months after the burn, seedlings of fire-killed shrubs can be seen in the ground layer. Within unburnt areas of the burn footprint more mature shrubs remain—visually assess from one or more vantage points or from the air.	**Achieved:** Fire-killed shrubs are present at various heights/ stages of maturity across the burn area. **Not Achieved:** Fire-killed shrubs are all of a single age/height across the burn area.

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.

A number of Sav-Mon (savannah monitoring) sites are established across the bioregion and are designed to assess long-term changes in vegetation health. Queensland Herbarium CORVEG sites could be used or established (refer to Neldner et al. 2005).

Mapping and assessment of fire history through fire scars from NAFI or other means is useful to guide future fire planning.

Very open woodland with a low spinifex ground layer, recently burnt.
Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Patchiness is enhanced by the broken, rocky ground in this eucalypt community on sandstone.
Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** to **moderate**.
- Spinifex communities may naturally burn with a higher severity in some areas.

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)	100–1500	0.5–2.0	2.0–5.0	All surface and near surface fuels burnt. Stubble burnt to blackened remnants.
Moderate (M)	1500–4500	2.0–4.0	Some canopy scorch may occur	Ground burnt completely. Stubble burnt to ash.
High (H)	> 4500	> 4.0	Canopy scorch will be extensive.	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 two to seven years. Leave a mosaic of areas longer, including shrubby dominated areas. Mosaic burning will help retain areas of longer inter-fire interval.

Mosaic (area burnt within an individual planned burn)

- Fires should be as patchy as possible, however this will be difficult to achieve within some long-unburnt country due to contiguous spinifex fuel. A greater level of mosaic can be achieved by ignition of spinifex during, or very soon after the wet season and by using afternoon ignition.

Other considerations:

- Spinifex has high resin content and is extremely volatile. It can burn when wet and is not reliant upon complete curing to carry a fire. Moisture and wind are also factors in determining how effectively a burn will carry across the landscape.

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:

- **Wet season** to **early dry season** for spinifex. Slightly later burns may be acceptable in shrubby areas.
- Avoid burning during **dry conditions**, with humidity less than 30 per cent and high temperatures. These conditions tend to occur just before the start of the storm season.
- **Storm burning**. Burns undertaken in the storm season after the first storms when there is a high probability of follow up rain.

GFDI: < 18

DI (KBDI): 80–120

Wind speed: < 23 km/hr

Patchy fire retains habitat features and promotes diversity in the ground stratum. Early afternoon ignition is one tactic which may assist in achieving a patchy fire, as shown by this June burn.

Paul Williams, Vegetation Management Science Pty Ltd, Bulleringa National Park (2009).

Feathertop spinifex does not seed for two to three years following fire. Avoid repeatedly applying extensive fires before several years of seed production. Note the recovering spinifex and recently burnt spinifex stubble shown in this photo taken in June.

Mike Ahmet, QPWS, Bulleringa National Park (2009).

Shrubby low woodland *Eucalyptus terminalis, Melaleuca minutifolia,* and *Melaleuca stenostachya.*

Peter Stanton, Environmental Consultant Pty Ltd, Near Reid River, Bulleringa Holding Pty Ltd (1991).

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the planned burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Aerial ignition**. Broad-scale fire management using **aerial ignition** is useful in the Gulf Plains due to the size and inaccessibility of some eucalypt communities. Wet-season to early dry-season fires can be lit in the morning or afternoon depending on the desired outcome. Ignition timing will determine how far the fire travels before self-extinguishing under milder evening conditions. Use natural features such as rivers and streams (even if there is no water, there may be sufficient moisture), areas of tussock grasses which are sparse or uncured or previously burnt areas to contain fires. Also note that these natural features may prevent fire from carrying as far as intended. Aerial ignition also provides an opportunity to burn away from non-target communities (e.g. springs, vine thickets and acacia communities) creating areas of reduced fuel protecting them from impacts of late dry-season wildfires. It is good practice to plot out an aerial incendiary path using maps, satellite images or aerial photographs and to program the path into a GPS for use in flight.
- **Spot ignition** is used in spinifex communities with non-continuous hummocks to create patchiness. The spacing of the spots affects the resulting intensity and mosaic. Individual hummocks can be ignited using a drip torch or matches. Well spaced ignition spots can create a greater level of patchiness.
- **Single point ignition** is used to create a fire of limited extent with a limited fire front. Often, this may mean lighting only a single location for an entire burn (a number of ignition points at the same location may be required) or very widely spaced ignition points creating separate fires.
- **Progressive burning**. Planned burning is carried out throughout the year as conditions allow. Ignition can begin in the storm season and continue through the wet season into the early dry season, with numerous small fires creating a landscape mosaic. Ideally multiple periods of ignition should occur in each park in each year. Progressive burning helps to create a mosaic of severities, burnt/unburnt areas, and seasonal variability and reduces the risk of large scale fires late in the dry season.

- **Storm burning**. Burns undertaken in the storm season after the first storms when there is a high probability of follow up rain. Containment of storm burns relies on impending rain, natural breaks, or earlier-season burning which has established areas of lower fuel sufficient to impede the passage of later fires.
- Use **periods of declining fire hazard**, so that fires are more controllable. Daily patterns can be utilised (e.g. after 2 pm, relative humidity tends to increase and temperature and winds decrease) meaning fires become less severe and will often self extinguish early in the season.
- A **running fire** of a higher intensity, lit with the wind can help carry fire through discontinuous fuel.
- **Line ignition**. In spinifex understories line ignition can help fire carry through areas where fuel is discontinuous.

Issue 3: Reduce overabundant saplings

Overabundance of acacias, eucalypts or other native shrubs and trees may lead to woody thickening; reducing the health of the ground layer through competition and shading.

Refer to Chapter 8 (Issue 3), for fire management guidelines.

Issue 4: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora* is presently found throughout the bioregion in moderate to very dense infestations. Rubber vine is fire-sensitive and eradication has been achieved in some areas using fire alone.

Refer to Chapter 8 (Issue 4), for fire management guidelines.

Ghost gum woodlands are considered 'of concern', not because of clearing, but rather the extent of rubber vine infestation. Fire can assist in managing this issue.
Carly Greig, EHP, Finucane Island National Park (2010).

Issue 5: Manage high biomass invasive grasses

High biomass grasses can be promoted by fire, and increase the severity of fire leading to impacts on ecosystems. In some cases, fire can be used as part of control.

Refer to Chapter 8 (Issue 5), for fire management guidelines.

Chapter 2: Grasslands and sedgelands

Grasslands and sedgelands are open and treeless or contain only scattered trees or shrubs. Grasslands vary across the bioregion and dominant grass species are influenced by rainfall and soil type (and other factors). Significant diversity is added by forbs, sedges and annual grasses. Spinifex *Triodia* spp. grasslands are mapped with adjoining Eucalypt communities (refer to Chapter 1 [Issue 2]: Maintain healthy shrubby or spinifex dominated communities).

- On floodplains, drainage lines and loamy plains, common species include Australian wild rice *Oryza australiensis*, Flinders grasses *Iseilema* spp., bluegrass *Dichanthium* spp., silky browntop *Eulalia* aurea, *Astrebla* spp. *Chrysopogon fallax* and *Sarga plumosum*. Also present though rarely dominating are wiregrasses *Aristida* spp. On sandy soils *Schizachyrium* spp. and wiregrasses are present.
- Spike rushes *Eleocharis* spp. and sedges *Cyperus* spp. are present on seasonal or permanent swamps, wetlands and lagoons. Sedgelands may also contain Australian wild rice *Oryza australiensis* and other occasional grasses such as lovegrasses *Eragrostis* spp., *Ectrosia* spp. This fire regime group also includes seasonal and permanent wetlands with sparse vegetation not usually threatened by fire.

Fire management issues

Retaining open grasslands by preventing invasion by trees and shrubs is an issue in some areas. Overabundant seedlings/saplings, leading to woody thickening occurs where fire has been long absent, infrequent or repeatedly applied too early in the season (creating fires of insufficient severity to scorch seedlings/saplings). This issue can be compounded by overgrazing or not spelling a pasture after fire, allowing cattle access to the 'green pick' and thereby giving woody species a competitive advantage.

Broad-scale planned burning is the key to preventing late season wildfires that can be extensive, frequent and intense. Wildfires can also result in ecological impacts and produce an enormous amount of greenhouse gas. Commence planned burning early in the dry season, to break up the continuity of fuels across the landscape.

Sedgelands in the Gulf Plains are not actively targeted with fire. They are allowed to burn in association with the surrounding landscape but tend to burn far less often due to the presence of moisture. Permanent lakes and lagoons with fringing woodland/sedgelands rarely burn and active fire management is not required.

Be aware of the presence of invasive and high-biomass grasses as they dramatically increase fire severity, and fire can promote them. Buffel grass *Cenchrus ciliaris* is an established problem in some areas. Para grass *Urochloa mutica* and grader grass *Themeda quadrivalvis* are emerging weeds and staff should be alert to new infestations.

Woody weeds such as parkinsonia *Parkinsonia aculeata* and smothering species such as rubber vine *Cryptostegia grandiflora* are widespread in the bioregion. In some cases they are able to be managed with fire. Prickly mimosa *Vachellia farnesiana* is widespread in grasslands in some areas.

Issues:

1. Maintain healthy grasslands and sedgelands.
2. Maintain healthy spinifex grasslands.
3. Reduce overabundant saplings.
4. Reduce woody weeds.
5. Manage high-biomass grasses.

Extent within bioregion: 4 395 268 ha, 20 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Mutton Hole Wetlands Conservation Park, 1614 ha; Finucane Island National Park, 1196 ha; Errk Oykangand National Park (Cape York Peninsula Aboriginal Land), 682 ha; Lawn Hill (Gregory) Resources Reserve, 383 ha; Staaten River National Park, 112 ha; Boodjamulla (Lawn Hill) National Park, 52 ha; Rungulla Proposed new National Park, 12 ha; Lawn Hill (Gregory River Base) Resources Reserve, 5 ha.

Issue 1: Maintain healthy grasslands and sedgelands

Use fire to maintain open grasslands and sedgelands, to promote diversity and prevent extensive wildfires.

Awareness of the environment

Key indicators of healthy fire-adapted grassland:

- A diversity of grasses (including both annuals and perennials) and/or sedges and forbs are present.
- Grasslands and sedgelands are treeless and shrubless or contain only scattered trees or shrubs.

A healthy open grassland community. Note scattered trees along a seasonal watercourse. When shrubs and trees are more than scattered or are emerging above the grass layer, this may indicate fire is needed.

Gary Wilson, Queensland Herbarium, south of Armraynald Homestead (2007).

Forbs, herbs and mixed grasses should be present but perennial grasses should dominate.
Gary Wilson, Queensland Herbarium, east of the Burke Development Road (2006).

Seasonal sedgelands require occasional fires to maintain diversity. Many wetland plants will have been reduced to subsoil bulbs by the middle of the dry season— in which case fire is unlikely to carry (Williams and Greig 2010).
Carly Greig, EHP, Finucane Island National Park (2010).

Sedgelands may surround permanent lagoons and while not actively targeted with fire may burn in association with surrounding communities, during late dry-season fires.
Paul Williams, Vegetation Science Pty Ltd, Carly's Lagoon, Finucane Island (2010).

Healthy sedgelands are generally open communities. However scattered trees and shrubs may be present on their margins. Sedgelands such as this one are prone to invasion of woody weeds such as rubber vine.
Paul Williams, Vegetation Management Science Pty Ltd, Carly's Lagoon, Finucane Island National Park (2010).

The following may indicate that fire is required to maintain fire adapted grasslands or sedgelands:

- An accumulation of dead material in grasses, collapsing grass and poorly formed grass clumps are present. Or grasses have become dense.
- There is a build-up of rank or stand-over (grass with significant dead material not consumed in previous burning cycles) grasses.
- Seed heads of a variety of different grasses and herbs are visible.
- Eucalyptus spp., *Acacia* spp. and/or *Melaleuca* spp. and in some areas currant bush *Carissa lanceolata,* quinine *Petalostigma* spp., gutta percha *Excoecaria parvifolia* or other species are becoming more frequent or emerging above the ground layer.
- Weeds such as parkinsonia, rubber vine or prickly mimosa may have started to become common and saplings are becoming visible above the grasses.
- Sedges have become dry and matted.
- Rubber vine is smothering sedges within sedgelands.

This grassland is still healthy but the density of grasses indicates a fire is required in the near future to maintain grassland diversity, as grasses will outcompete other herbs and forbs in the absence of fire. Fires also reduce fuel loads and ensure shrubs and trees remain scattered.

Justine Douglas, QPWS, Lawn Hill Station (2012).

Bulkaru sedgelands in the dry season.

Mike Ahmet, QPWS, Red Lily Lagoon Lakefield National Park (2009).

Discussion

- The endangered golden-shouldered parrot *Psephotus chrysopterygius* nests in termite mounds in grasslands. Their habitat is declining due to melaleuca woodland invasion that reduces nesting habitat and food sources. *Melaleuca* spp. seedlings and saplings shade-out and eventually replace open grassland communities when high-severity fires are restricted or absent. These parrots are now confined to a single population in the Gulf Plains within the upper reaches of the Staaten River mostly within Staaten River National Park (Garnett and Crowley 2002). If melaleuca thickening in northern Australia continues populations will continue to retreat and become more isolated.
- Fire is a useful method of control of some woody weed and prickly acacia *Vachellia nilotica* seedlings, but is less effective on or may have no impact on larger trees. Seeding occurs between March and June. Fire is a useful method of control of parkinsonia *Parkinsonia aculeata* but is not known to be an effective control method for prickly mimosa *Vachellia farnesiana*. If woody weeds are an issue, refer to Chapter 8 (Issue 4), for fire management guidelines.
- Fires which are too severe and occur without sufficient soil moisture result in the death of sub-soil grass bases/roots resulting in slow post fire recovery. Burning without soil moisture will give a competitive advantage to weeds and woody species.
- The common death adder *Acanthophis antarcticus* is present throughout most of the southern, central and lower-north of the bioregion. This species is currently listed as near threatened under the Queensland *Nature Conservation Act 1992*. Widespread fires with little internal patchiness can impact on this species. Mosaic burning will provide refuge areas and retain important habitat features such as unburnt grass clumps and fallen logs.

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance.**
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.

Left: The grassland habitat of the golden-shouldered parrot continues to decline due to high-severity fires being restricted or absent. Within thickened areas small scale fires late in the year, or fires started by lighting (providing sufficient earlier burning has occurred) may assist.

Above: nest in a termite mound.

Left: QPWS. **Above:** Daryn Storch, QPWS, Cape York.

Mosaic burning assists in the protection of the common death adder.

QPWS.

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 at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
A mosaic of 25–80 % of blackened ground within the boundary of the burn area.	**Before and after fire**, select three or more sites (taking into account the variability of landform and likely fire intensity), and estimate the percentage of burnt areas.	**Achieved:** 25–80 % burnt. **Not Achieved:** Less than 25 % or more than 80 % burnt.
More than 75 % of emerging shrubs or trees pushed back to the ground layer.	**Before and after fire**, select three or more sites (taking into account the variability of landform and likely fire intensity), and count the number of emerging shrubs or trees (above ground components) reduced by fire.	**Achieved:** More than 75 % pushed back to the ground layer. **Partially Achieved:** 50–75 % pushed back to the ground layer. **Not Achieved:** < 50 % pushed back to the ground layer.

More than 80 % of the bases of grass clumps remain in burnt areas.	**After the burn:** select three sites (taking into account the variability of landform and likely fire intensity) and estimate percentage of grass clumps remaining.	**Achieved:** More than 80 % bases remain. **Partially Achieved:** 50–80 % bases remain. **Not Achieved:** Less than 50 % bases remain.

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.

A number of Sav–Mon (savannah monitoring) sites are established across the bioregion and are designed to assess long–term changes in vegetation health. Also Queensland Herbarium CORVEG sites could be used or established (Neldner et al. 2005).

Mapping and assessment of fire history through fire scars from NAFI (North Australian Fire Information) or other means is useful to guide future fire planning.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate** and **high**-severity fire.

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)	50–100	0.3–0.5	≤ 2.5	Some patchiness. Most of the surface and near surface fuels have burnt. Stubble still evident.
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 three to six years for grasslands and sedgelands south of approximately Karumba. In northern areas fires every one to three years are acceptable.
- Be aware that some years will be wetter or drier than normal. Fuel accumulation, vegetation health and the need to mitigate wildfire are the most important factors.

Mosaic (area burnt within an individual planned burn)

- Using appropriate tactics and burning with good soil moisture will assist in creating a mosaic.

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: Early dry season (e.g. March to April possibly June following long wet seasons). Storm burns should occasionally be applied, particularly if overabundant saplings/seedlings or woody weeds are an issue. Timing burns to coincide with follow-up rain will assist in promoting grasses.

GFDI: < 20

DI (KBDI): 80–120 (ideally < 100)

Wind speed: < 23 km/hr—some wind may be required to carry fire between grass clumps.

Soil moisture: Good soil moisture is essential for assisting the protection of the underground portions of vegetation and to promote seedling germination post-fire. This will assist in restoring ground cover and preventing erosion issues.

Burning fire adapted grasslands early in the dry season is a tactic that can be used to create a low fuel buffer adjacent to fire-sensitive communities, protecting them from late dry season wildfires.

Carly Greig, EHP, Finucane Island National (2010).

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). Also, 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**. A landscape approach to fire management is necessary due to the size and inaccessibility of grassland communities. This is mostly achieved through **aerial ignition**. Early dry season fires can be lit in either morning or afternoon depending on the desired outcome. Ignition timing would be determined by how far the fire is required to travel before self-extinguishing in evening conditions. A useful tool to determine the rate of spread is the CSIRO Grassland Fire Spread Meter for Northern Australia. Utilise natural features such as rivers and streams (even if there is no water, there may be sufficient moisture), areas of sparse or uncured fuel or previously burnt areas to contain fires. Also, note that these natural features may prevent fire from carrying as far as intended. Aerial ignition also provides an opportunity to burn away from non-target communities (e.g. springs, vine thickets and acacia communities) creating areas of reduced fuel protecting them from impacts of late dry season wildfires. It is good practice to plot out an aerial incendiary path using maps, satellite images or aerial photographs and to program the path into a GPS for use in flight.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout as much of the year as conditions allow. In the Gulf Plains, ignition can begin soon after the wet season as soon as fuel has cured sufficiently to carry fire, with numerous small ignitions. Ideally multiple periods of ignition should occur in each park in each year. These burnt areas can provide opportunistic barriers to fire to support burning later in the year (e.g. storm burning) or to provide barriers to wildfire movement. They also create patchiness and fauna refuges and help create a rich mosaic of severities, burnt/unburnt areas, and seasonal variability to support habitat diversity.
- **Limit fire encroachment into non-target communities.** In some cases, riparian communities can occur adjacent to grasslands. Use appropriate lighting patterns along the margin to promote a **backing fire** that burns away from the non-target community.
- A **running fire** of a higher intensity, lit with the wind can help reduce overabundant seedlings/sapling. A **low intensity backing fire**, which is slow moving and **increases residence time**, is also useful to reduce woody weeds or overabundant seedlings/saplings. The best method is dependent on the amount of fuel available and also on the overabundant species (some species can be killed with lower severity fire with a high residence time; others species must be scorched to their tip —seek advice).

Issue 2: Maintain healthy spinifex grasslands

In the Gulf Plains bioregion spinifex *Triodia* spp. grasslands are generally continuous with eucalypt communities with a spinifex dominated understorey.

Refer to Chapter 1 (Issue 2): Maintain healthy shrubby or spinifex dominated communities, for fire management guidelines.

Issue 3: Reduce overabundant saplings

Overabundance of acacias, eucalypts or other trees and shrubs (woody thickening) may reduce the health of the ground layer through competition and shading.

Refer to Chapter 8 (Issue 3), for fire management guidelines.

Issue 4: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora* is presently found throughout the bioregion in moderate to very dense infestations. Rubber vine is fire sensitive and eradication has been achieved in some areas using fire alone. Parkinsonia *Parkinsonia aculeata* and other woody weeds are also found within the bioregion and may be abundant in some areas.

Refer to Chapter 8 (Issue 4), for fire management guidelines.

This sedgeland has become a rubber vine shrubland in the absence of fire. Fire will assist in managing the issue.

Carly Greig, EHP, Finucane Island National Park (2010).

Issue 5: Manage high-biomass grasses

High-biomass grasses can be promoted by fire, and increase the severity of fire leading to impacts on ecosystems. In some cases, fire can be used as part of control.

Refer to Chapter 8 (Issue 5), for fire management guidelines.

Chapter 3: Melaleuca woodlands

This fire vegetation group includes all communities dominated by melaleuca, occasionally with other canopy species present such as *Eucalyptus* spp. or liniment tree *Asteromyrtus symphyocarpa*. In the Gulf Plains bioregion many of these communities occur adjacent to streams and rivers or are periodically inundated. Drier sites have a grassy understory sometimes with sparse shrubs such as smooth-leaved quinine *Petalostigma banksii* and grevillea.

Riparian areas are often dominated by *Melaleuca argentea, Melaleuca fluviatilis*, or *Melaleuca leucadendra*, usually growing amongst river red gum *Eucalyptus camaldulensis, Pandanus* spp., cabbage palm *Livistona rigida*, and with vine thicket species sometimes present. Perennial wetlands or areas which retain water for an extended period often support sedges in the ground stratum while drier areas have grasses, herbs and forbs.

Fire management issues

The main issue for melaleuca communities is maintaining a landscape mosaic (of time-since-fire) through broad-scale fire management, reducing and breaking-up fuel continuity, and therefore limiting the impacts of late-season wildfires.

Establishing and maintaining a landscape mosaic is important to protect the health and persistence of melaleuca communities.

Another issue in some areas is loss of open structure through overabundant seedlings/saplings leading to woody thickening. This process is attributed to a lack of planned burning and/or fires repeatedly applied too early in the season (when they are not intense enough to control emerging overabundant seedlings/saplings). Thickening is thought to be more prevalent in the drier, southern areas of the bioregion, although the spread of melaleuca trees into open grasslands occurs in the north (see Chapter 2: Grasslands and sedgelands). Woody thickening becomes much more severe where stock grazing is combined with repeated early-season burns (or planned burning is avoided in favour of pasture retention). Stock grazing reduces fuel loads preventing fires of sufficient severity to manage thickening and is compounded by cattle concentrating feeding on regrowth grasses in the recently burnt areas, allowing woody species the competitive advantage.

Issues:

1. Maintain healthy melaleuca communities.
2. Reduce woody weeds.
3. Manage high-biomass grasses.

Extent within bioregion: 5 344 469 ha, 24 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Staaten River National Park, 216 495 ha; Errk Oykangand National Park (Cape York Peninsula Aboriginal Land), 6655 ha; Bulleringa National Park, 1507 ha; Rungulla Proposed new National Park, 1136 ha; Gilbert River Proposed new National Park, 352 ha; Mutton Hole Wetlands Conservation Park, 7 ha.

Issue 1: Maintain healthy melaleuca communities

Awareness of the environment

Key indicators of healthy melaleuca communities:

- Melaleuca is the dominant canopy tree. A few saplings of variable size should be present to eventually replace the canopy.
- Healthy melaleuca woodlands have grasses, occasional shrubs or sedges, or any mix of these in the understorey.
- Grasses are upright and vigorous, with well formed bases. A diversity of herbs and forbs are often found between grasses.
- Melaleuca dominated riparian communities may have *Eucalypt* spp., *Pandanus* spp., cabbage palm *Livistona* spp. or vine thicket species present; and grasses interspersed with sedges and rushes.
- In some areas currant bush *Carissa lanceolata*, quinine *Petalostigma* spp., gutta percha *Excoecaria parvifolia* or other species may be scattered, but they are not so frequent that they are beginning to shade out the ground layer.

Healthy open melaleuca woodland.

Paul Williams, Vegetation Management Science Pty Ltd, Staaten River National Park (2004).

Riparian areas with melaleuca lining the banks in Bulleringa National Park. These areas are burnt in association with the surrounding country; however they tend to burn less frequently due to a lack of flammable grasses or because of humid and shaded micro-environments.
Nick Smith, QPWS, Red River (2012).

In melaleuca woodlands, grasses often dominate the ground layer.
QPWS, Staaten River National Park (2009).

The following may indicate that fire is required in melaleuca communities:

- There is a build-up of rank or stand-over (grass with significant dead material not consumed in previous burning cycles) grasses.
- The crowns and branches of shrubs are declining in health and high proportions have dead or dying crowns or branches. Lower leaves are browning and there is a build-up of dead leaves.

Melaleuca communities (appear silver in the photo) are often continuous with eucalypt or other communities and are managed in association with them.

Lana Little, QPWS, Staaten River National Park (2000).

Discussion

- A key strategy to manage the vast expanses of inaccessible melaleuca communities in the Gulf Plains is broad-scale management through aerial ignition. Ideally, this would include at least three different ignition periods on each property, each year.
- In terms of fire management, open melaleuca communities are managed in association with surrounding eucalypt woodlands. Wildfires resulting from dry storms late in the dry season or in the early wet season are frequent (one to two years) and extensive. Whilst, fires from lightning strikes are part of the natural system, they have considerable ecological impacts when early-season burning has not occurred or has been insufficient to mitigate the run of a hot fire late in the dry season.
- Although inappropriate fire management can lead to an overabundance of certain tree species in the understorey, be aware that the abundance of some tree species is not related to fire management, but is a result of soil and landscape characteristics. Knowing the fire history of an area and individual species response to fire is important in determining if thickening is an issue.
- Some melaleuca dominated riparian and fringing communities retain fire-sensitive species and burn less frequently. These are in areas where fire is less likely to penetrate and include braided channels or areas of reduced or silt-coated ground fuels (due to seasonal flooding), or have less flammable grasses and a shaded micro-climate.
- Grazing impacts may lead to further fuel reduction in these areas meaning fires are less frequent and/or severe. Sometimes the role of riparian areas as barriers to fire can be enhanced through proactive early burning in and around them.

- Other rivers within the Gulf Plains are not as self-protecting and are more likely to burn in association with the surrounding landscape. Species such as river red gum *Eucalyptus camaldulensis* or *Melaleuca* spp. dominate but *Pandanus*, river she-oak *Casuarina cunninghamiana*, palms (e.g. *Livistona* spp.) and some vine thicket species such as *Diospyros* spp. or figs *Ficus* spp. may be present. These communities are vulnerable to too frequent and high-severity fire. Managing the surrounding fire adapted communities to mitigate wildfire is important.
- Grasses are generally considered ready to burn when they reach 50–60 per cent cured. The North Australian Grassland Fuel Guide (Johnson 2001) may assist in determining when grasses are ready to burn. However, caution should be used and local knowledge sought as some grass species that still appear too green to burn will burn severely (and vice versa).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance.**
High	Planned burns to **maintain ecosystems** 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 at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Progressive burning demonstrated.	Using fire scar remote sensing data, estimate burnt and unburnt country by month, on an annual basis. Note that early burns may not be visible on NAFI it may be necessary to combine remote sensing with points collected on GPS.	**Achieved:** Remote sensing shows a series of progressive burns through the season. **Partially Achieved:** One to two burns achieved. **Not Achieved:** No burning has occurred.
Proactive planned burning has prevented impact by subsequent wildfire to natural/ cultural resources or infrastructure.	Using fire scar remote sensing data, estimate area of planned burns against wildfire on an annual basis.	**Achieved:** Annual area planned burnt prevents impact by wildfire. **Not Achieved:** Wildfire has had significant impact.
> 75 % of overabundant saplings < 2 m are reduced.	Select several sites or walk several transects, estimate the percentage of overabundant saplings (above ground components) reduced.	**Achieved:** > 75 %. **Partially Achieved:** 25–75 %. **Not Achieved:** < 25 %.

Minimise canopy scorch.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire severity) and observe the number of trees with canopy scorch.	**Achieved:** No canopy scorch has occurred. **Partially Achieved:** Some canopy scorch has occurred. **Not Achieved:** Complete canopy scorch.

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.

A number of Sav-Mon (savannah monitoring) sites are established across the bioregion and are designed to assess long-term changes in vegetation health. Queensland Herbarium CORVEG sites could be used or established (Neldner et al. 2005). Mapping and assessment of fire history through fire scars from NAFI or other means is useful to guide future fire planning.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** to **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 (up to 8 m on melaleuca trees)	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 (up to 20 m on melaleuca trees)	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 one to three years for melaleuca woodlands. Longer fire intervals (e.g. three to five years) are acceptable in the south of the bioregion (e.g. south of about Karumba) and in some riparian areas.

Mosaic (area burnt within an individual planned burn)

- Most fires should be patchy; however this will vary with burn location and will need to be assessed on a case by case basis. However, it is not acceptable to completely burn all of an area and conversely it is important to burn sufficient area to impede extensive late dry-season burns or wildfires.

Other considerations

- Some melaleuca communities will burn later in the season due to soils retaining moisture for longer. The key is to know the country and observe fire behaviour in varying season.
- Do not burn during drought conditions as this can exacerbate drought stress on plants.

Under suitable planned burn conditions, natural barriers such as dry creeks and rocky outcrops are useful barriers to fire movement.
Mick Blackman, Friendly Fire Ecological Contractor Pty Ltd, Mitchell River (2010).

Low severity fire in melaleuca woodlands can assist in protecting nearby creek line vegetation.
QPWS, East Back Creek, Staaten River National Park (2004).

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:

- **Soon after the wet season** when it is dry enough to carry a fire (just) but the fire self-extinguishes in the evening. Continue burns into the dry season until fires carry into the night but not overnight (usually this will be the mid dry season). Do not burn in the late dry season.
- Occasional storm burns may be required where hot fires have been absent for a number of years. Higher severity fires caused by lightning strike are also a natural feature of these systems and are not usually a problem provided that early season burning has been conducted in a way that mitigates the extent and severity of wildfire.
- Repeated early season burns are **not recommended** where overabundant seedlings/saplings are an issue (refer to Chapter 8, Issue 3 for fire management guidelines).
- In some riparian areas **wet-season** burning can reduce fuels and prevent wildfires later in the season. These areas can be used as fire breaks providing sufficient early season burns have occurred both within riparian areas and in surrounding fire-adapted communities.

GFDI: < 18

DI (KBDI): 80–100 but more may be acceptable in some areas

Wind speed: < 23 km/hr

Soil moisture: Good moisture conditions to protect bases of grasses, habitat trees and fallen logs, particularly in riparian areas.

What burn tactics should I consider?

Refer to Chapter 1 (Issue 1), for fire management tactics.

Issue 2: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora* is presently found in a number of locations throughout the bioregion. Rubber vine is fire-sensitive and eradication has been achieved in some areas using fire alone. Parkinsonia *Parkinsonia aculeata* and other woody weeds are also found within the bioregion and may be abundant and widespread in some areas.

Refer to Chapter 8 (Issue 4), for fire management guidelines.

Issue 3: Manage high-biomass grasses

High biomass grasses can be promoted by fire, and increase the severity of fire leading to impacts on ecosystems. In some cases, fire can be used as part of control.

Refer to Chapter 8 (Issue 5), for fire management guidelines.

Chapter 4: Acacia communities

Typically these communities are dominated by a single acacia species such as lancewood *Acacia shirleyi*¸ gidgee *Acacia cambagei* or by shoestring wattle *Acacia stenophylla*. This fire vegetation group includes other communities dominated by corkwood wattles *Vachellia* spp. whitewood *Atalaya hemiglauca*, beefwood *Grevillea striata,* bauhinia *Lysiphyllum cunninghamii* and *Thryptomene oligandra* . The sparse lower layers vary and may include shrubs and a mixture of tussock grasses, spinifex and forbs (Hodgkinson 2002). These communities are found on a variety of landforms including low rises, scarps and stony ledges, plains and depressions on plains, cracking clays, sand ridges and swales.

Fire management issues

Acacia communities are vulnerable to repeated, high severity fire. In most instances, fire should not be applied directly to these areas. Rather, manage surrounding fire-adapted areas to create a landscape mosaic of burnt and unburnt areas that mitigate the frequency, intensity and extent of unplanned fires.

Invasive grasses such as buffel grass *Cenchrus ciliaris* are one of the major threats to acacia communities. These grasses have the ability to draw fires into these areas and increase fire severity.

Issues:

1. Burn adjacent fire-adapted communities to limit fire encroachment into acacia communities.
2. Manage high-biomass grasses.

Extent within bioregion: 1 406 517 ha, 6 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Rungulla Proposed new National Park, 30 629 ha; Gilbert River Proposed new National Park, 14 510 ha; Bulleringa National Park, 11 879 ha.

Issue 1: Burn adjacent fire-adapted communities to limit fire encroachment into acacia communities

Most acacia communities are self protecting due to low or discontinuous fuel loads. Active protection is generally not required in mild conditions. Maintain a varied landscape mosaic of burnt and unburnt patches in adjacent fire-adapted communities to limit the frequency and potential impacts of damaging, unplanned fires in acacia dominated communities.

Refer to Chapter 8 (Issue 6), regarding fire management guidelines.

Many acacia communities are essentially self-protecting due to low fuel loads or their position in the landscape.

Gary Wilson, Queensland Herbarium, west of the Tallawanta homestead (2006).

A healthy lancewood community lies adjacent to open eucalypt woodland with spinifex. Planned burning in the woodlands will assist in protecting fire-sensitive lancewood from impacts of wildfire. Notice the sharp delineation between these communities.

Nick Smith, QPWS, Bulleringa National Park (2012).

Whitewood, while generally not killed by fire, may take many years to regain its pre-fire height.

Gary Wilson, Queensland Herbarium, Neumayer Valley Station (2006).

Fallen trees and branches; these fuels may carry fire into acacia communities on occasion.
Gary Wilson, Queensland Herbarium, north of the Burke and Wills Roadhouse (2005).

Low fuel loads in some gidgee communities afford them protection from fire.
Gary Wilson, Queensland Herbarium, south of the Burketown Development Road (2006).

Discussion

- Fire-killed acacias such as lancewood are reliant on post-fire regeneration from the seed bank for the species to persist locally. These species are hard seeded and require fire to promote germination. Although it is recommended that land managers mitigate wildfire impacts by burning surrounding areas, the occasional (rare) unplanned fire may play a role in the persistence of this community in the landscape. After wildfire it is then critical to exclude further fires until the acacias reach maturity and set several seed crops. This may be at least ten years for lancewood communities.
- Other acacias such as gidgee are long lived, soft seeded, fire killed and have a very limited ability to regenerate from post-fire suckers. Fire plays no role in their germination, which is very occasional and follows high rainfall years. As a mature stand, they may be relatively self-protecting due to low fuel loads.
- Historically, fire within most acacia communities was infrequent, estimated at between ten and fifty years (though this differs where acacias are associated with grasslands). In general fires have occurred following prolonged rainfall which has resulted in substantial grass growth creating sufficient fuel to carry fire (Hodgkinson 2002) or during extensive wildfires. Changes in land use (through clearing and use of pastoral fire) and spread of invasive grasses have resulted in fires of a greater frequency and severity causing undesirable impacts.

Following good seasons it may be necessary to reduce the fuel load on the margins of these communities, to mitigate wildfire impacts.

Gary Wilson, Queensland Herbarium, west of the Neumayer Valley homestead (2006).

Gidgee are soft-seeded, long-lived and may be killed by fire. Fire plays no role in their germination which is very occasional and generally follows high rainfall years.

Gary Wilson, Queensland Herbarium, south of the Nardoo homestead (2006).

Grasses, particularly buffel grass, can carry fire into fire-sensitive gidgee communities. Applying fire early in the season on the margins of these communities may assist in preventing late season wildfire.

Gary Wilson, Queensland Herbarium, north of the Burke and Wills Roadhouse (2005).

Issue 2: Manage high-biomass grasses

It is important to be aware of the presence of invasive grasses as they can dramatically increase fire severity, are often promoted by fire and may result in significant impacts upon vegetation communities. Buffel grass *Cenchrus ciliaris* in particular poses a significant threat to acacia communities by altering fuel characteristics and promoting a cycle of damaging high-severity fires which gradually result in the fragmentation and overall decline in the extent of these areas. Grader grass *Themeda quadrivalvis* may also be an issue in some areas.

Refer to Chapter 8 (Issue 5), for fire management guidelines.

A gidgee dominated woodland with an understorey of buffel grass.
Justine Douglas, QPWS, Moorrinya National Park (2011).

Chapter 5: Springs and dune communities

This fire vegetation group includes fringing communities on perennial springs as well as fire-sensitive dune communities. Springs are found within the south and west of the Gulf Plains bioregion and may not always be visible in regional ecosystem mapping due to their small size. In areas such as Bulleringa National Park they are found in gullies and gorges with dense grasses and some softwood species. Ferns may grow in patches on gorge walls. They are generally surrounded by open eucalypt woodland and are considered 'endangered'. Springs on alluvium, also considered 'endangered', are often dominated by river red gum *Eucalyptus camaldulensis* and/or *Melaleuca leucadendra* and sometimes have peat soils when active. Springs often have significant material and cultural importance to Aboriginal people (DERM 2005). Coastal she-oak *Casuarina equisetifolia* low open woodland is found on dunes adjacent to the estuarine zone and swamp paperbark *Melaleuca quinquenervia* open forest occurs in swales. These are fire-sensitive dune communities.

Fire management issues

The main issue when burning around springs is ensuring there is sufficient moisture to protect the peat layer and fire sensitive soft wood species. If a spring surface has become dry from reduced water flow, there is a risk that fire can spread into the underground peat layer.

Coastal she-oak trees are highly sensitive to fire and fire has a significant impact on these communities. Do not intentionally burn and actively protect them from fire.

Mitigating wildfires is also important to maintaining the health of these ecosystems. Proactive fire management in surrounding fire-adapted areas will assist in mitigating the impacts of unplanned fire.

Issues:

1. Limit fire encroachment into springs and dune communities.
2. Avoid peat fires.

Extent within bioregion: 3 333 ha, < 1 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: None on QPWS estate.

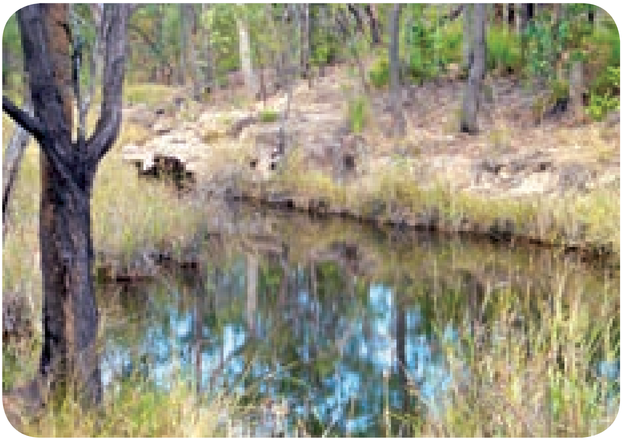
Issue 1: Limit fire encroachment into springs and dune communities

Some plants, such as some softwood species, occur in springs and are particularly fire-sensitive. Care should be taken to ensure they are retained in spring ecosystems. Peat soils may exist in springs on either sandstone or alluvium. Fire should not be applied if peat is dry and if standing water is not visible, the peat should be waterlogged (refer to Issue 2).

Patchy to low-severity burns in surrounding areas in the late wet season to early dry season, that on some occasions trickle into spring communities will be useful to reduce fuel loads and mitigate impacts of wildfire. Early dry-season burns on flood debris and fine fuels on terraces that aim to develop a mosaic of burnt areas may also be necessary to mitigate the impacts of wildfire. These should be lit annually with the aim of burning a number of small patches.

Swamp paperbark open forest may be self-protecting under mild planned burning conditions however high severity fires are potentially a threat. The presence of high biomass grasses and rubber vine may also increase fire severity.

Coastal she-oak open forest contains species highly sensitive to fire and all fires should be excluded. Ensuring fires within adjacent fire-adapted communities mitigate wildfire will assist in their protection. Where practical, a rake-hoe line dragging the blade through she-oak needles can also give added protection.



Wildfires are considered a major threat to springs at Bulleringa—softwood species are potentially vulnerable. Burn in the early dry season or in cool winter months with soil moisture.

QPWS, Donkey Springs, Bulleringa National Park.

Some parts of the spring system are naturally protected from wildfire, while others will need active protection.

QPWS, Donkey Springs, Bulleringa National Park.

Some active springs feed rivers whose banks contain riparian vegetation with different fire requirements to the spring itself. Refer to Chapters 1 and 3 for guidelines for managing riparian areas.

Nick Smith, QPWS, Red River fed by Donkey Springs (2012).

Mangrove, saltmarsh, swamp paperbark and coastal she-oak woodland communities have differing fire responses. Careful planning of fires in adjacent areas is required.
Carly Greig, EHP, Finucane Island National Park (2010).

Coastal she-oak is killed by fire and may require active protection during wildfires or nearby planned burning operations.
Carly Greig, EHP, Finucane Island National Park (2010).

Issue 2: Avoid peat fires

Some spring ecosystems gradually accumulate partially decayed, densely packed vegetation known as peat. In the absence of good soil moisture the peat is easily ignited resulting in a peat fire. Peat fires can burn for months and can have very negative impacts on the whole ecosystem. Peat takes hundreds of years to re-form.

Awareness of the environment

Key indicators of suitable conditions to avoid peat fires:

- Standing water is visible or surface water that covers the bases of sedges and grasses is present.
- In the absence of standing water, the peat should be water logged (it is possible to squeeze water out of it).

While standing water is visible, care should be taken to check all areas containing peat prior to implementing planned burns in or around springs.

Rod Fensham, Queensland Herbarium, Black Spring, Pelham Station (1999).

Discussion

- Due to its porous nature and high carbon content peat is easily ignited when dry, the resulting fire can damage ecosystems and burn / smoulder for an extended period of time, causing re-ignitions.
- Be aware of peat issues when burning in areas adjacent to spring ecosystems. The condition of the peat should be checked to ensure that if fire encroaches, a peat fire will not be ignited. Alternatively indicators such as running water or previous wet season rainfall may provide guidance as to the condition of the peat. If it is necessary to burn adjacent areas in less than ideal conditions, manage the fire carefully to minimise the risk of fire entering peat. Tactics such as burning away from the edges of spring areas may assist in protecting peat.
- The conservation of springs is extremely important as they have considerable environmental values (including unusual endemic flora and fauna) indigenous cultural heritage values.
- Some springs are not threatened by fire as they are not vegetated and do not form peat layers (e.g. mud springs and rocky areas).

The peat layer of this spring community is vulnerable to fire. Ensure peat is water logged or moist when applying fire in adjacent communities.

Rod Fensham, Queensland Herbarium, Black Spring, Pelham Station (1999).

What is the priority for this issue?

Priority	Priority assessment
Very high	Where peat is present, it is important to consider the most appropriate management during burn planning and implementation.

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.

Measurable objectives	How to be assessed	How to be reported (in fire report)
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.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- Low severity fire in the surrounding fire-adapted areas will help to manage fire encroachment.

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

- Fire frequency should be determined by the surrounding fire vegetation community.

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: Early dry season or winter months (cool conditions) when fuel is sufficiently cured to carry fire. Care should be taken following periods of drought as this is when peat is most likely to ignite.

FFDI: < 18

DI (KBDI): 80–120

Wind speed: < 15 km/hr

Soil moisture: Standing water, or water logged peat, is the critical factor that will avoid peat fire.

What burn tactics should I consider?

When burning adjacent fire-adapted areas, where the conditions of standing water or water logged peat can not be achieved, use tactics that will limit encroachment of fire into the spring area. See below.

- **Spot ignition**. Spot ignition can be used effectively to alter the desired severity of a fire. 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 severity fire.
- **Limit fire encroachment into non-target communities.** Use appropriate lighting patterns along the margin of the non-target community to promote a low intensity backing fire that burns away from the non-target community. **Do not create a running fire.**
- In upland areas **target woodlands above the springs** early in the season, to prevent later fires entering the spring proper.

Chapter 6: Vine thickets

Vine thickets occur as low closed forest on mudstone with a sparse shrub layer or as semi-deciduous vine thickets on beach ridges (beach scrub). They are surrounded primarily by grassy open eucalypt or estuarine communities.

Fire management issues

Some of the vine thicket communities in the Gulf Plains have the biodiversity status **'of concern'**. A key conservation issue for this fire vegetation group is the further attrition of some vine thickets due to the increasing number of late dry-season fires.

Sometimes vine thickets are somewhat protected from fire by their position in the landscape or lack of flammable grasses in the ground layer. Although some individual plant species have the capacity to propagate from roots and trunks after minor fire damage, the majority of vine thicket species are generally regarded as fire-sensitive (QPWS 2007). Do not intentionally burn.

Occasionally, fire is used in vine thickets for control of woody weeds such as rubber vine. Fires to manage woody weeds in vine thicket should be of limited extent and severity. Once weed control is achieved it is important to then protect these communities from further fires.

High biomass grasses such as grader grass *Themeda quadrivalvis* exist within and around some vine thickets. High biomass grasses can increase the severity and extent of fires in previously self-protecting vine thickets.

Limit fire encroachment or scorching of vine thickets by undertaking low severity burns in adjacent fire-adapted communities.

Issues:

1. Limit fire encroachment into vine thickets.
2. Reduce woody weeds.
3. Manage high-biomass grasses.

Extent within bioregion: 3969 ha, < 1 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: None on QPWS estate.

Issue 1: Limit fire encroachment into vine thickets

The main strategy is to undertake early dry-season, low-intensity burns in adjacent fire adapted communities. Sometimes it may be necessary to burn away from vine thicket edges.

The beach scrubs of the Gulf of Carpentaria are frequently impacted by wildfires caused by careless campers, fishers and others. These may require active protection from unplanned fire.

Refer to Chapter 8 (Issue 6), regarding fire management guidelines.

Issue 2: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora* is presently found throughout the bioregion in moderate to very dense infestations including within vine thickets. Rubber vine is fire-sensitive and eradication has been achieved in some areas using fire alone. Once control of rubber vine is achieved it is important to then prevent further fires from impacting the vine thicket vegetation.

Refer to Chapter 8 (Issue 4), for fire management guidelines.

Issue 3: Manage high-biomass grasses

Some species of invasive grasses such as grader grass can invade and draw fire into vine thickets. If excluding fire from infested areas adjacent to vine thickets is not possible, a low severity backing fire at intervals not more frequently than every five years could be considered, providing follow-up herbicide treatment of invasive grasses occurs. Mossman River grass can also impact vine thickets and can be managed with fire in some cases.

Refer to Chapter 8 (Issue 5), for fire management guidelines.

Chapter 7: Mangroves and saltmarshes

Mangroves and saltmarshes are found near or within estuarine or brackish water. They are periodically inundated through tidal action and storms. Mangroves occur in stands (along tidal zones), as low trees or shrubs with very little other vegetation present. Saltmarsh is dominated by salt adapted sedges or grasses with other plants sparse.

Fire management issues

Mangroves do not require fire and are somewhat self-protecting under mild burning conditions. Sometimes mangroves can be scorched by nearby planned burning operations or wildfire. Care should be taken to burn away from the edges of mangrove communities or use high tides to assist in their protection (Williams and Greig 2010).

Saltmarsh swamp paperbark open forest is sometimes potentially flammable however it is not actively protected from fire in the Gulf Plains bioregion and probably burns occasionally in association with fires in the surrounding landscape.

Issues:

1. Limit fire encroachment into mangrove and saltmarsh communities.
2. Reduce woody weeds.

Extent within bioregion: 551 315 ha, 2 per cent; Regional ecosystems: Refer to Appendix 1 for complete list.

Examples of this FVG: Finucane Island National Park, 6 071 ha; Mutton Hole Wetlands Conservation Park, 5 315 ha.

Issue 1: Limit fire encroachment into mangrove and saltmarsh communities

Under low to moderate planned burning conditions mangroves are generally not fire-sensitive, however they can be scorched by higher-severity fire. If protection is required the main strategy is to burn at high tide or following recent rain with groundwater seepage. If these conditions cannot be achieved, use tactics such as burning away from the edges of these communities.

Grasses within saltmarsh communities are fire-tolerant and regenerate rapidly after fire, however they are usually interspersed with samphire plants that do not tolerate frequent fire (Williams and Greig 2010). Ensuring fires are not frequent and burning when soils are moist would assist in maintaining the samphire component of this community.

Refer to Chapter 8, Issue 6, for fire management guidelines.

Fire-killed mangroves. Care should be taken to burn away from these trees in planned burning operations which pose a threat of fire incursion.

Carly Greig, EHP, Finucane Island National Park (2010).

Issue 2: Reduce woody weeds

Fire can be an effective tool in the control of rubber vine *Cryptostegia grandiflora*. Rubber vine is fire sensitive and eradication has been achieved in some areas using fire alone. *Calotrope Calotropis procera* is also present but the effect fire on these species is limited due to its soft, spongy nature and ability to resprout from a lignotuber (DEEDI 2011). Some monitoring sites exist on Finucane Island which gauges the effect of fire on these weeds and the recovery of the treated vegetation communities.

Refer to Chapter 8 (Issue 4), for fire management guidelines.

Fires in salt couch/samphire forblands may assist to manage woody weeds such as rubber vine.

Carly Greig, EHP, Finucane Island National Park (2010).

Chapter 8: Common issues

In the Gulf Plains bioregion there are some issues where the fire management approach is similar, irrespective of the fire vegetation group. Rather than repeating these 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

Issues:

1. Hazard reduction (fuel management) burns.
2. Planned burning near sensitive cultural heritage sites.
3. Reduce overabundant saplings and seedlings.
4. Reduce woody weeds.
5. Manage high-biomass grasses.
6. Limit fire encroachment into non-target fire vegetation communities.
7. Cyclones and severe storms.

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.

Frequent, intense late-season fires often cover vast areas. They threaten life and property and have been shown to have significant impact on conservation values and native species. The main strategy for managing these fires is through broad-scale mosaic burning within the fire-adapted landscape (for example see Chapter 1: Eucalypt communities).This hazard reduction guideline (this issue) is for the management of protection and wildfire mitigation zones, and does not cover broad-scale fire management within the broader landscape.

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.

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).

- 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.

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).

- 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
Highest	Planned burn required to **protect life** and/or **property**, usually within **protection zones**.
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.

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.