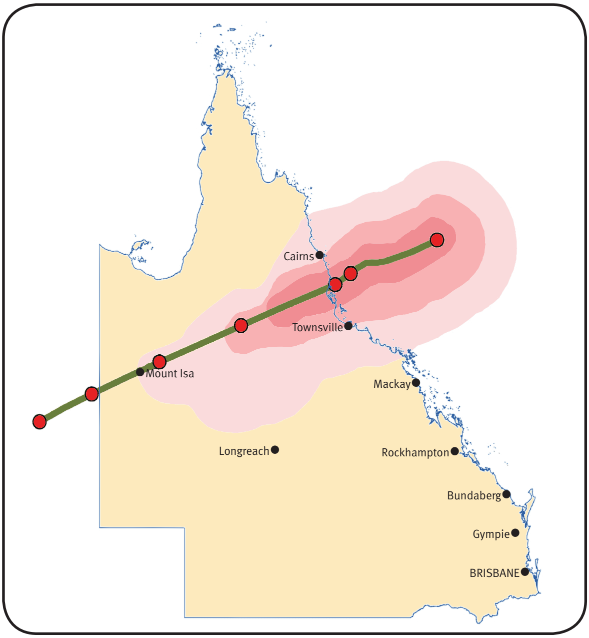
Issue 7: Post cyclone planned burning

In the event of a severe tropical cyclone (category three or higher) the canopy of trees and shrubs may be stripped, accumulating upon or suspended above the ground as leaves, fine leaf shred and branches. Snapped limbs can be left hanging in the canopy creating ladder fuel. In the event of a category four or higher cyclone, understorey vegetation is also damaged further increasing elevated fuels. A high level of fallen tree damage can also be expected, increasing heavy-fuel loads and impeding fireline access.

Once dry, the changed fuel conditions may lead to:

- the potential for extensive or high severity wildfires
- an increased fuel hazard near to assets and infrastructure
- altered fire behaviour during planned burning operations in the two years following a cyclone
- fire-sensitive communities becoming vulnerable to fire encroachment during certain dry periods
- an opportunity to re-introduce fire into areas that have been transitioning to closed forest.

Strategic planned burning with high soil moisture and avoiding dry conditions; encouraging landholders to mechanically reduce fuel; avoiding ignition sources during risk periods; and reviewing scheduled planned burns to make use of moister seasonal conditions are strategies to compensate for changed fuel conditions.



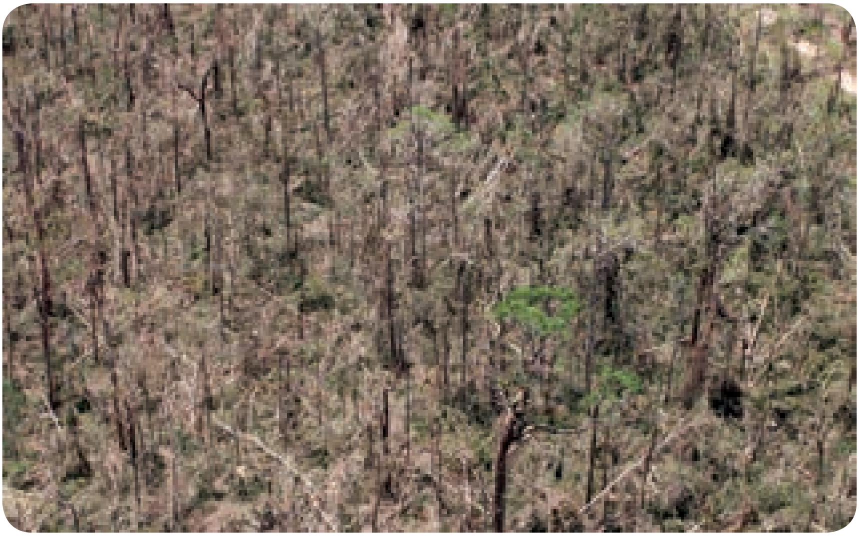
Illustrating the extensive region of wind damage caused by Cyclone Yasi which devastated the Cassowary Coast in February 2011.

David Clark, QPWS (2011).

Awareness of the environment

Indicators of increased fuel hazard due to a severe tropical cyclone:

- There has been at least a **category three severe tropical cyclone** (165–224 km/hr, very destructive winds).
- Vegetation and branches are stripped from open forest trees.
- Leaf, leaf shred, branches and limbs are accumulated on the ground as significant fuel loads.
- Branches and fine fuels are elevated above ground where they can easily aerate and become an elevated fuel hazard.
- The reduction in native vegetation cover has allowed the establishment of high biomass invasive grasses (refer to Issue 6 of this chapter).
- Rainforest or other fire-sensitive community has been extensively stripped of canopy foliage creating an open structure, with fuel accumulation on the ground or suspended; the open structure creating conditions where forest floor fuels become flammable under dry conditions.
- There has been at least a **category four severe tropical cyclone** (225–279 km/hr, very destructive winds).
- In this case, understorey vegetation may also be severely damaged creating excessive vertical and ladder fuels leading to an increased fuel hazard.
- Although cyclone categories have been used to indicate wind damage, be aware that the pattern of damage can be quite variable. For example, a forest might be stripped of canopy vegetation, however have no accumulated fuel, as the fuel was blown elsewhere. Similarly a forest that did not sustain wind damage (e.g. the protected side of a ridge) may have received the blown fuel. Therefore post cyclone assessments on the ground and/or by air are essential. Monitoring fuel conditions in the years following a cyclone is important as fuel matures and breaks down at different rates in different locations.



Strewn fuel and fallen branches will create a high fuel hazard when dry. Dead or fallen trees will allow fires to smoulder for some time, creating re-ignition risk.
Audrey Reilly, QPWS, Cyclone Yasi, Murray Falls (2011).

Category 5 cyclonic winds can cause build-up of fine and elevated fuels over substantial areas. Suspended fuel is aerated which decreases drying time and increases combustibility.
Richard Lindeman, QPWS, Cyclone Yasi, Stephens Island, Barnard Island Group National Park (2011).

These fallen fuels have dried to a point of ignition within 2 weeks of a cyclone.

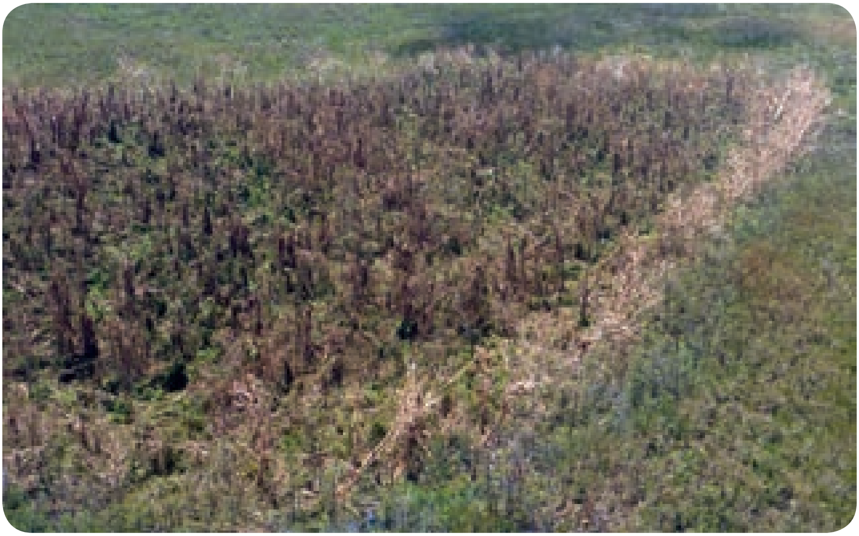
Mark Parsons, QPWS, Cyclone Yasi, Lily Creek (2011).

Be aware of changed fuel conditions next to assets and infrastructure after cyclonic wind impact.

Audrey Reilly, QPWS, Cyclone Yasi, Bingal Bay (2011).

Usually not fire prone, coastal littoral communities can accumulate sufficient fuels to carry fire following a cyclone; if there are aerated fine fuels and fire is pushed by a sea-breeze.

Mark Parsons, QPWS, Cyclone Yasi, Foreshore, Girramay National Park (2011).



A melaleuca wetland severely impacted by cyclonic winds. Be aware that fuel lying upon wetlands may carry fire where it would not usually travel. Also, this wetland now has an enormous amount of ladder fuel which will increase fire severity leading to tree death if burnt inappropriately.

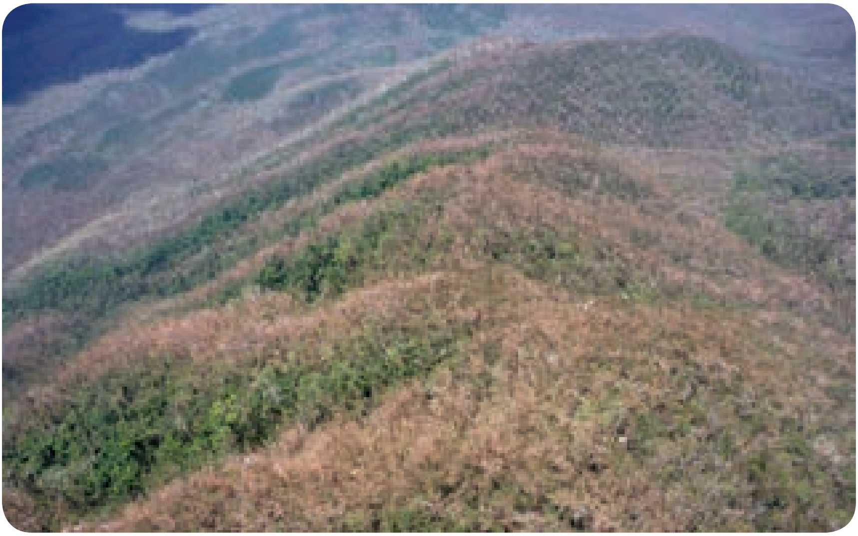
Audrey Reilly, QPWS, Cyclone Yasi, Hull River (2011).

Strewn fuel and trees fallen across fire lines is one of the many issues to consider when planning fires after cyclones.

Audrey Reilly, QPWS, Cyclone Yasi, Murray Falls (2011).

Melaleuca wetland damage by Category 5 cyclonic winds. Notice that most trees have been stripped and many lie on the ground.

Audrey Reilly, QPWS, Cyclone Yasi, Hull River (2011).



Category five cyclonic winds impacted these ridges and peaks, causing a build up of dead and flammable material next to vine forest. Avoid fires in the late dry season as vine forest/ rainforest edges are potentially vulnerable to fire in the two years after a cyclone, if they are upslope of a run of fire.

Audrey Reilly, QPWS, Cyclone Yasi, Cardwell Range (2011).

Discussion

- After a severe tropical cyclone, people will not naturally think about planned burning. However, without a fuel reduction strategy, there is a risk of extensive wildfires in the following dry season and a risk of fires that will impact on already stressed canopy.
- The canopy of trees damaged by severe cyclones is particularly susceptible to further impacts (such as canopy scorch) and may lead to tree death. Until the health of the canopy is restored, fires which may impact them should be avoided.
- The best time to act on post cyclone fuel reduction is soon after rain. Moist and humid conditions create slow moving, trickling fires with good residence time. Such fires have good fuel consumption, a low severity, are easy to control and allow disorientated and distressed fauna to find refuge areas. Also, they are less likely to further stress the canopy. The next best time to utilise moist conditions is the following storm season.
- Where ignition sources can be reliably controlled, consider avoiding fires altogether for a period. Especially where fires are likely to scorch stressed canopy.
- Despite best efforts, after a cyclone that causes extensive damage, it will not be possible to reduce fuel hazard in all the areas where it would be desirable to do so. A prioritised approach is required.
- The best way to protect property and infrastructure is emphasising the landholder's responsibility to mechanically clean up fuel. However, planned burning in moist conditions may form part fuel reduction strategies.
- Expectations of how fire behaves in a normal year must be reconsidered post cyclone (or even after a severe storm). It is likely programmed fire management can continue, but only after re-assessment of planned burn areas. Be aware that increased finer fuels and increased native or high biomass invasive grass cover, suspended and aerated fuel, open canopies and continuous fuel will change the way fire behaves. Fire will be more severe and may carry where it would not normally (e.g. over gullies, over streams, over fire lines, and over wetlands). Site preparation, careful consideration of tactics and a different burning window may be required, using more moist and humid seasonal conditions than normal years in order to compensate for increased fuel.
- If it is not possible to use moister seasonal conditions and yet it is still important to reduce fuel, careful consideration of ignition tactics will be required. Backing fires away from risk areas, down slope and/or against the wind can be considered. Afternoon and evening conditions can also be considered.

- In some locations cyclones may provide a rare opportunity to reintroduce fire into open forests and woodlands which are in the late stages of transition to closed forest communities through seedling/sapling and rainforest invasion. Species found in eucalypt forest and woodland in particular need abundant light and bare soil to establish. Temporarily reducing the understory through planned burning may allow seedlings of canopy trees such as eucalypts to establish and thus halt or slow the transitioning process.
- After a severe cyclone, there will be a substantial number of fallen trees that may smoulder long after fire (especially after the second year), creating a re-ignition risk if burning in increasing fire hazard periods (mid to late dry season). Planned burning will not normally consume fallen trees, and the problem is likely to persist for years after a cyclone. Burning with moisture and in periods of stable moist conditions, or in declining fire hazard, will minimise the risk.
- During the late dry season in the two years after a cyclone, rainforest edges are vulnerable to upslope runs of fire. Lantana, high biomass grass invasion and severe cyclone events (causing a more open canopy) increases the risk of encroachment.

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 or if visibility is good, look about and average the results. Return to the same location and record counts before and after the burn to support the estimations.

Choose objectives as appropriate:

Measurable objectives	How to be assessed	How to be reported (in fire report)
No canopy scorch.	There are two options: 1. From one or more vantage points, estimate extent of canopy scorched. 2. In three locations (that take account of the variability of landform within burn area), walk 300 or more metres through planned burn area estimating percentage of canopy scorched within visual field.	**Achieved:** No canopy scorch. **Partially Achieved:** 1–20 % of canopy scorched. **Not Achieved:** > 20 % of canopy scorched.
Reduce overall fuel hazard to low **Or** Reduce fuel load to less than five tonnes/ha.	Post fire; use the Overall Fuel Hazard Guide (Hines et al. 2010b), or Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Fuel hazard has been reduced to low; Or fuel load has been reduced to less than five tonnes/ha. **Not Achieved:** Fuel hazard has not been reduced to low Or fuel load is greater than five tonnes/ha.

Fire patchiness of 70–100 % burnt .	There are three options: 1. From one or more vantage points, estimate aerial extent of ground burnt. 2. In three locations (that take account of the variability of landform within burn area), walk 300 or more metres through planned burn area estimating percentage of ground burnt within visual field. 3. Walk into one or more gully heads, and down one or more ridges and estimate percentage of ground burnt within visual field.	**Achieved:** Mosaic or patchiness of > 70 %. **Partially Achieved:** Mosaic or patchiness of 50–70 %, the extent and rate of spread of any subsequent wildfire would still be limited. **Not Achieved:** Mosaic or patchiness of < 50 %. High proportion of patchiness, unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be limited).

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

Monitoring the issue over time

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

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**. Slow moving trickling fires preferred. Be aware that in the two years after a cyclone, burning in dryer months might create higher than anticipated fire severity.

Fire frequency / interval

- After a cyclone, it may be imperative to reduce fine fuels to reduce risk.

Patchiness (mosaic of individual burns)

- Mosaic or patchiness of > 70 % to reduce litter fuels.

Other consideration

- Planned burning in moist conditions is only one of the ways to reduce risk after a cyclone. Mechanical fuel reduction and avoiding ignition sources during risk periods are also important strategies.
- Fires should not scorch the canopy of trees which have been cyclone damaged. Be aware that this may be more difficult following cyclones due to higher fuel loads and considerable care should be taken.

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.

Recent rain: Burn soon after rain events as this increases the controllability of fire where excessive fuels have accumulated. Use the drying tables available in the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to estimate how soon the site will be ready to carry fire after rain (but take account of the fact there are suspended aerated fuels that might dry sooner). Moist conditions will recur in the following storm burning season (November to January).

Humidity: > 50 % humidity will create conditions where fire will trickle. This helps to create a low-severity fire with sufficient residence time to consume fuel.

Wind speed: < 15 km/hr (higher for storm burning).

FFDI: < 11.

Season: Aim for **summer** until **autumn**. Also, storm burns during **December** until **January**.

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). During your burn regularly review and adjust tactics as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Progressive burning** is very useful after a cyclone when combined with careful observations of fire behaviour, as this will indicate when conditions are becoming too dry for easy control of fires.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low intensity backing fire.
- **A low intensity backing fire.** A slow moving, low intensity backing fire will generally result in a better consumption of surface fuel. This tactic ensures the fire has a greater amount of residence time and reduction of available fuels, particularly fine fuels (grasses, leaf litter, twigs etc), while minimising fire severity and rate of spread.
- **Spot ignition.** Can be used to alter the desired intensity of a fire particularly where there is a high accumulation of available and volatile fuels. Increased spacing between spots will result in a lower severity fire. The spacing of the spots should be varied throughout the burn to take into consideration changes in weather conditions, topography, fuel loads etc.
- **Afternoon ignition.** This is particularly useful where suitable conditions are not available during the day. This will assist in promoting a low-severity fire that may trickle along the edge of non-target communities and generally self-extinguish due to milder conditions overnight.
- **Limit fire encroachment into non-target communities.** Where the non-target community is present in low lying areas (e.g. riparian systems), utilise the surrounding topography to create a low-severity backing fire that travels down slope towards the non-target community. If conditions are unsuitable (the non-target community has been damaged by cyclone and is upslope) use appropriate lighting patterns combined with active suppression along the margin of the non-target community to promote a low severity backing fire that burns away from the non-target community (refer to Chapter 10, Issue 6).
- **Strip ignition to draw** fire away from non-target community edge. Using more than one line of ignition can create convective updrafts which draw fires together and away from non-target areas. It is important to have safe refuges when undertaking this type of burning. For example for lighting along a track the person furthest from the track should walk parallel to the track and at least 20 m ahead of the person lighting nearer the track. This reduces the chance of the ‘outer’ person becoming cut off from the refuge area (the track).

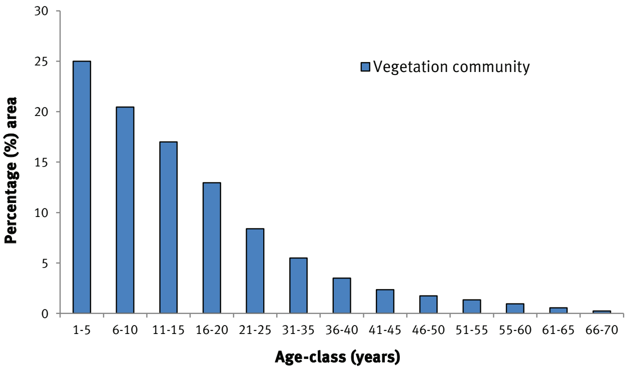
- **Wet lines, blower lines (to clear strewn material) and/or rake-hoe** lines may have to be established along the edge of non-target areas. It is time consuming to establish wet lines, blower lines or rake-hoe lines especially where the boundary is extensive and where there has been considerable fallen timber, so use this tactic only where the prevailing weather conditions or the above tactics are not suitable to limit fire encroachment into non-target areas.

Severe Cyclone Monica (Category three) uprooted entire trees in the northern section of Mungkan Kandju National Park in April 2006.

Mike Ahmet, QPWS (2006).

Glossary of fire terminology

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

<table>
<tr><th>Terminology</th><th>Definition</th></tr>
<tr><td>Aerial ignition</td><td>The lighting of fine fuels for planned burning by dropping incendiary devices or materials from aircraft.</td></tr>
<tr><td>Available fuel</td><td>The portion of the total fuel that would actually burn under current or specified conditions.</td></tr>
<tr><td>Age-class distribution</td><td>The distribution of groups of similar aged vegetation (age-class) of a particular vegetation community after fire. In fire ecology this is used to indicate the success of mosaic burning in achieving varied habitat conditions. This is usually represented as a plot of areas (y-axis) versus age-class (x-axis) (e.g. 25 per cent of a fire vegetation group burnt between one and five years ago) (refer to Figure 1).
Figure 1: Idealised age-class distribution (concept only)

</td></tr>
<tr><td>Burn severity</td><td>Relates to the amount of time necessary to return to pre-fire levels of biomass or ecological function.</td></tr>
<tr><td>Backing-fire</td><td>The part of a fire which is burning back against the wind or down slope, where the flame height and rate of spread is minimal.</td></tr>
</table>

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

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

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

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

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

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

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

Terminology	Definition
Mosaic burn	An approach which aims to create spatial and temporal variation in fire regimes. This can occur within an individual burn and at a landscape level (refer to Appendix 2).
Obligate seeders (obligate seed regenerating species)	Shrubs that are killed by fire and rely on soil-stored seed bank to regenerate. In fire ecology, the time it takes obligate seeders to mature and establish a seed bank often indicates the minimum frequency with which a vegetation community should be burnt in order to avoid the local extinction of these species.
Patchiness	A percentage or proportion of the ground layer vegetation (grasses, herbs and trees/shrubs less than one metre) not affected by fire (i.e. 20 per cent patchiness = 80 per cent burnt).
Perennial plants	Plants that last for more than two growing seasons, either dying back after each season as some herbaceous plants do, or growing continuously like many shrubs.
Planned burn	The controlled application of fire under specified environmental conditions to a pre-determined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. In the context of QPWS operations: a fire that is deliberately and legally lit for the purposes of managing the natural and/or cultural and/or production resources of the area (e.g. reducing fire hazard, ecological manipulation), and protecting life and property.

Terminology	Definition
Progressive burning	Progressive burning is an approach to planned burning where ignition is carried out throughout much of the year as conditions allow. In northern Queensland, ignition can begin early in the year after heavy seasonal rain, with numerous small ignitions creating a fine scale mosaic. These burnt areas can provide opportunistic barriers to fire for burning later in the year. They also provide fauna refuge areas. Progressive burning helps create a rich mosaic of intensities, burnt/ unburnt areas, and seasonal variability. Be aware of how fire behaves differently in different seasons. Depending on local climatic conditions, there can be up to four seasons in the wet tropics (this will vary from moister to drier climatic areas): The **early burn period** following seasonal heavy rain where fire self extinguishes overnight and will not burn through areas burnt the year before. **Secondary burn season** where fires will burn through the night and will extinguish within areas burnt the year before. **Falling leaf season**, where a blanket of leaves often crosses natural water features. This is the dry season and fires will not go out. Fires in dry conditions will often favour woody species over grasses. **Storm burning**, where climatic conditions allow, from December through to January, is a useful way to achieve intense, wind supported fire where rain can be reliably expected to follow; providing good conditions for regeneration (Mick Blackman pers. comm., 10 September 2011).
Rate of spread (ROS)	The forward progress per unit time of the head fire or another specified part of the fire perimeter, defined as metres per hour.
Relative humidity (RH)	The amount of water vapour in a given volume of air, expressed as a percentage of the maximum amount of water vapour the air can hold at that temperature.
Scorch height	Is the height to which former green leaves still suspended on plants are turned brown by the heat of a fire.
Strip burning	Setting fire to a narrow strip of fuel adjacent to a fire-line and then burning successively wider adjacent strips as the preceding strip bums out.
Test fire	A controlled fire of limited extent ignited to evaluate fire behaviour.

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Appendix 1: List of regional ecosystems

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

Fire vegetation group	Hectares within the Cape York Peninsula bioregion	Percentage
Eucalypt communities	8 525 969	69.11
Grasslands	439 270	3.56
Heath communities	587 299	4.76
Melaleuca communities	1 701 670	13.79
Sedgelands	100 674	0.82
Acacia communities	2 496	0.02
Dunes and coral cays	57 179	0.46
Rainforest	480 819	3.90
Mangrove and saltmarsh	272 990	2.21
TOTAL	**12 336 713**	**100**

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
1	1	**Eucalypt communities**	Eucalypt communities		3.12.37, 3.12.7, 3.12.8, 3.12.9, 3.10.15a, 3.10.15b, 3.11.12, 3.11.15, 3.11.15a, 3.11.15b, 3.11.17, 3.11.17a, 3.11.17b, 3.11.17x1, 3.11.5, 3.11.6a, 3.11.6b, 3.11.6c, 3.12.17, 3.12.17a, 3.12.17b, 3.12.17x1, 3.12.18, 3.12.19a, 3.12.19b, 3.2.7, 3.2.7a, 3.2.7b, 3.3.17a, 3.3.17b, 3.3.18, 3.3.19, 3.3.20a, 3.3.20b, 3.3.20c, 3.3.21, 3.3.22a, 3.3.22b, 3.3.23, 3.3.28, 3.3.29, 3.3.8, 3.5.21, 3.5.21x1, 3.5.22a, 3.5.22b, 3.5.22c, 3.5.22d, 3.5.22x1, 3.5.22x2, 3.5.25a, 3.5.25b, 3.5.25c, 3.5.26, 3.5.31, 3.5.5a, 3.5.5b, 3.8.3a, 3.8.3b, 3.11.8, 3.11.8x1, 3.11.8x2, 3.11.9, 3.12.10a, 3.12.10b, 3.12.10c, 3.12.10x2, 3.12.11, 3.12.12, 3.12.13, 3.12.14a, 3.12.14b, 3.12.14c, 3.12.23a, 3.12.23b, 3.12.24, 3.12.25, 3.12.38, 3.10.10, 3.10.10a, 3.10.10b, 3.10.11, 3.10.21a, 3.10.21b, 3.10.21c, 3.10.6a, 3.10.6b, 3.10.6c, 3.10.6d, 3.10.6x1a, 3.10.6x1b, 3.10.7a, 3.10.7b, 3.10.8, 3.10.9a, 3.10.9b, 3.10.9c, 3.10.9d, 3.10.9e, 3.11.10a, 3.11.10b, 3.11.11, 3.11.11x1a, 3.11.11x1b, 3.11.11x1c, 3.11.11x1d, 3.11.11x2, 3.11.11x3, 3.11.13, 3.11.14, 3.11.4, 3.11.7, 3.12.15a, 3.12.15b, 3.12.15x1a, 3.12.15x1b, 3.12.15x1c, 3.12.15x2a, 3.12.15x2b, 3.2.10a, 3.2.10b, 3.2.10c, 3.2.5a, 3.2.5b, 3.2.5c, 3.2.8a, 3.2.8b, 3.2.9, 3.3.26, 3.3.27a, 3.3.27b, 3.3.27c, 3.3.31a, 3.3.31b, 3.3.31c, 3.3.70, 3.5.1, 3.5.10, 3.5.10x1, 3.5.11, 3.5.12, 3.5.2, 3.5.23, 3.5.23x1, 3.5.24a, 3.5.24b, 3.5.6, 3.5.7a, 3.5.7b, 3.5.7c, 3.5.7d, 3.5.7e, 3.5.7x1, 3.5.7x2a, 3.5.7x2b, 3.5.7x2c, 3.5.8a, 3.5.8b, 3.5.8c, 3.5.9a, 3.5.9b, 3.5.9d, 3.7.3, 3.7.4, 3.7.5a, 3.7.5b, 3.9.2a, 3.9.2b, 3.9.2x2, 3.9.2x1, 3.9.2x3, 3.9.2x4, 3.9.2x5, 3.9.4, 3.9.4a, 3.9.4b, 3.9.6, 3.3.30.
	1		Floodplain woodlands		3.3.11, 3.3.15, 3.3.16, 3.3.24, 3.3.25a, 3.3.25b, 3.3.25c, 3.3.35, 3.3.36, 3.3.36a, 3.3.36b, 3.3.37a, 3.3.37b, 3.3.40a, 3.3.40b, 3.3.45, 3.3.46, 3.3.69, 3.3.9.
2	1	**Grasslands**	Grasslands		3.3.44, 3.12.29, 3.3.56, 3.3.56a, 3.3.56b, 3.3.56c, 3.12.30, 3.12.31, 3.12.31x1, 3.12.31x1a, 3.12.31x2a, 3.12.31x2b, 3.12.32, 3.3.34, 3.3.57, 3.3.58, 3.3.60a, 3.3.60b, 3.3.61a, 3.3.61b, 3.3.62, 3.5.29, 3.5.30, 3.5.30x1, 3.5.30x3, 3.8.4a, 3.8.4b, 3.9.5, 3.9.7, 3.9.8a, 3.9.8b.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
3	1	**Sedgelands**	Saw sedge or bulkaru sedgelands	Sb	3.10.20, 3.2.33, 3.3.63, 3.3.64, 3.3.64a, 3.3.64b, 3.3.64c, 3.3.65.
	1		Permanent lakes and lagoons	Sl	3.2.27, 3.2.27a, 3.2.27b, 3.3.66a, 3.3.66b, 3.3.66x1a, 3.3.66x1b.
4	1	**Heath communities**	Heath communities		3.12.26a,3.12.26b, 3.12.26c, 3.12.26x1, 3.12.26x2, 3.12.27, 3.12.28, 3.3.53a, 3.3.53b, 3.3.53x1, 3.3.53x2, 3.3.54, 3.3.55, 3.10.12, 3.10.13, 3.10.14, 3.10.17, 3.10.18, 3.10.19a,3.10.19b, 3.11.19, 3.11.19a, 3.11.19b, 3.2.18a,3.2.18b, 3.2.18c, 3.2.19a,3.2.19b, 3.2.20, 3.2.21, 3.2.22, 3.2.23, 3.5.19, 3.5.19x1, 3.5.19x2, 3.5.19x3, 3.5.19x4, 3.5.19x5, 3.5.19x6, 3.5.19x7, 3.5.19x8, 3.5.28.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	Regional ecosystems (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
5	1	Melaleuca communities	Melaleuca swamps	Ms	3.2.4a, 3.2.4b, 3.2.4c, 3.2.4d, 3.2.4e, 3.3.12.
	1		Melaleuca heath	Mh	3.3.51, 3.3.52a, 3.3.52b, 3.3.52c, 3.2.14, 3.3.67, 3.7.6x2.
	1		Melaleuca gallery forest	Mg	3.3.10a, 3.3.10b, 3.3.10c, 3.3.10d. *see note below table
	1		Melaleuca woodland	Mw	3.3.42a, 3.3.42b, 3.3.43, 3.3.43x1, 3.3.47, 3.3.48a, 3.3.48b, 3.3.49x1, 3.3.49a, 3.3.49b, 3.3.50a,3.3.50b, 3.3.50c, 3.10.16a,3.10.16b, 3.10.16c, 3.10.16x1, 3.10.16x2, 3.11.18a,3.11.18b, 3.11.18c, 3.12.16a,3.12.16b, 3.12.16c, 3.2.3, 3.3.13, 3.3.14a, 3.3.14b, 3.3.32, 3.3.41, 3.3.42c, 3.5.13, 3.5.14a,3.5.14b, 3.5.14c, 3.5.15a,3.5.15b, 3.5.16, 3.5.17a,3.5.17b, 3.5.18, 3.5.18x2, 3.5.27, 3.7.6, 3.7.6a,3.7.6b, 3.7.6x1, 3.7.6x3, 3.3.33, 3.2.16. **see note below table

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
6	1	**Acacia communities**	Acacia communities		3.7.2. *** see note below table
7	1	**Dunes and coral cays**	Dunes and coral cays		3.2.1a,3.2.1b, 3.2.11, 3.2.12, 3.2.13, 3.2.15a,3.2.15b, 3.2.15x1, 3.2.17, 3.2.2a,3.2.2b, 3.2.25, 3.2.28, 3.2.29, 3.2.31, 3.2.6a, 3.2.6b.
8	1	**Rainforest**	Rainforest		3.12.1a,3.12.1b, 3.12.22, 3.12.4a,3.12.4b, 3.12.5, 3.12.6, 3.3.5a,3.3.5b, 3.3.5c, 3.10.1, 3.10.1a,3.10.1b, 3.10.1c, 3.10.1d, 3.10.2a,3.10.2b, 3.10.3, 3.10.5a,3.10.5b, 3.11.1x1a, 3.11.1x1b, 3.11.2a,3.11.2b, 3.11.3, 3.11.3x1, 3.12.2, 3.12.20, 3.12.21a,3.12.21b, 3.12.21c, 3.12.3a,3.12.3b, 3.12.3c, 3.12.33a,3.12.33b, 3.12.34a,3.12.34b, 3.12.34c, 3.12.35a,3.12.35b, 3.12.35c, 3.12.35d, 3.12.35e, 3.12.35f, 3.12.36a,3.12.36b, 3.12.36x3, 3.3.1a,3.3.1b, 3.3.1c, 3.3.2a,3.3.2b, 3.3.38, 3.3.38a,3.3.38b, 3.3.39, 3.3.4, 3.3.6, 3.3.68, 3.3.7, 3.5.20, 3.5.3, 3.5.3x1, 3.5.32, 3.5.4, 3.5.4x1, 3.5.4x2, 3.5.4x3, 3.5.4x4, 3.5.4x5, 3.7.1, 3.7.1x1a, 3.7.1x1b, 3.7.1x2, 3.8.1, 3.8.2a,3.8.2b, 3.8.2x1, 3.8.5a, 3.8.5b, 3.8.5c, 3.8.5d, 3.8.5e.
9	1	**Mangrove and saltmarsh**	Mangrove and saltmarsh		3.1.1a, 3.1.1b, 3.1.1c, 3.1.2a,3.1.2b, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.1.7, 3.2.24, 3.2.26, 3.2.30, 3.2.32.

*Melaleuca gallery forests are not well described by the Regional Ecosystem Description Database (REDD), probably because of their remoteness. While only one regional ecosystem is included here there are other communities. Refer to Chapter 4 for further information.

**Melaleuca woodlands are generally well described by the REDD however very tall (+ 30m) woodlands on the margins of swamps and lagoons on deep peat soils have not been identified, probably because they only cover a very small area.

***Acacia dominated communities constitute only a very small proportion of the CYP bioregion. While only one regional ecosystem is included here, others are described in Chapter 6 that are likely not of sufficient size to be mapped for the REDD.

The spatial data is based on version 6.1 of the "Queensland Remnant Vegetation Cover 2006" layer (16 September 2011) and the "Draft Pre-clearing with Regional Ecosystems" layer (20 August 2010) (refer to Figure 1).

Some of the regional ecosystems (RE) listed above are not matched in the spatial data. This may be because the RE is 'not of a mappable size', the RE 'has been moved' (i.e. it has been reclassified into a new RE code), the RE exists only as a sub-dominant RE within the spatial data or the RE has not yet been mapped. In the REDD system, the comments section indicates if the RE is not of a mappable size or if it has been moved.

The RE's listed below do not have any matching records in the spatial data of version 6.1 of the Survey and Mapping of 2006 Remnant Vegetation Communities and Regional Ecosystems of Queensland spatial layer (16 September 2011) and the Draft Pre-clearing Vegetation Communities and Regional Ecosystems layer (20 August 2010).

Unmatched regional ecosystems	3.10.12, 3.10.13, 3.10.17, 3.10.18, 3.10.3, 3.10.8, 3.11.14, 3.3.54, 3.3.7, 3.1.1c, 3.10.20, 3.12.32, 3.3.14b, 3.10.14, 3.10.16x1, 3.10.1b, 3.10.1c, 3.10.1d, 3.11.17a, 3.12.17b, 3.12.19a, 3.12.1a, 3.12.1b, 3.12.26x2, 3.2.18b, 3.3.1c, 3.3.26, 3.3.38b, 3.3.53a, 3.3.53b, 3.5.7b, 3.5.7c, 3.5.7e, 3.7.6a, 3.8.1, 3.8.2x1, 3.11.11x2, 3.11.15b, 3.12.17x1, 3.12.21c, 3.12.22, 3.12.26b, 3.12.34b, 3.2.10b, 3.3.42b, 3.3.45, 3.3.52b, 3.3.60b, 3.3.64c, 3.3.67, 3.5.18x2, 3.5.30x3, 3.5.5b, 3.9.2b.

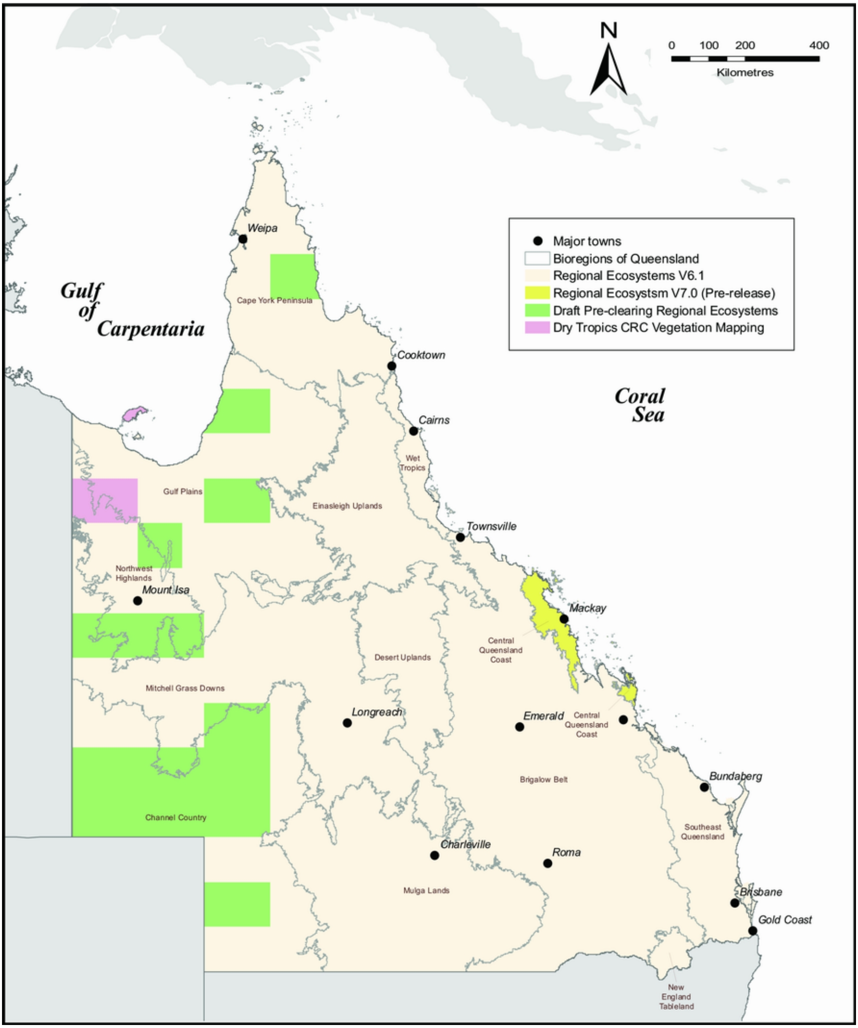

Figure 1: Map of Queensland indicating the different GIS data sources used to produce the spatial fire vegetation group mapping product.

Appendix 2: Mosaic burning

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

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

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

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

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

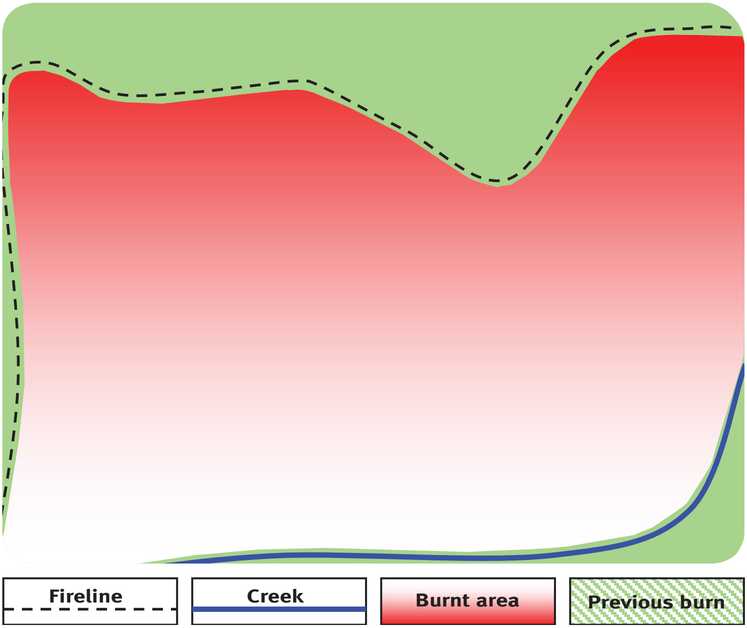

Figure 1: Example area between fireline and creek burnt in a wildfire—year 0. (Recommended fire interval for fire vegetation group is eight–12 years).

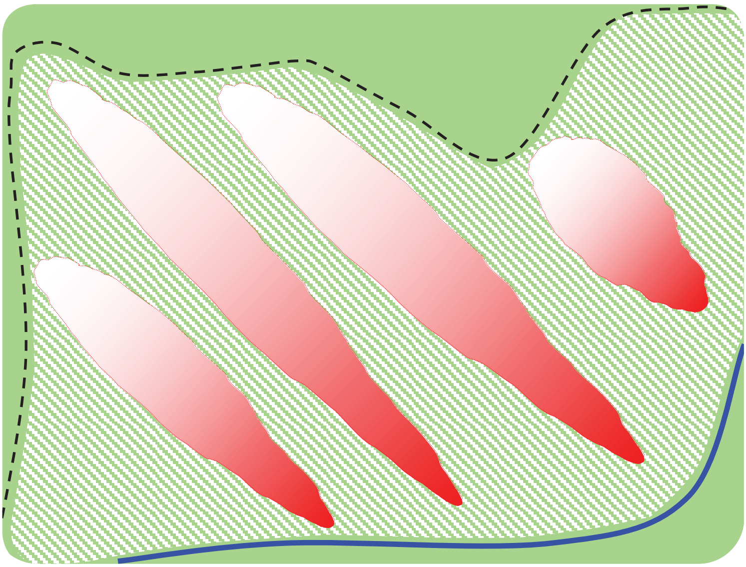

Figure 2: Planned mosaic burn—year 8.

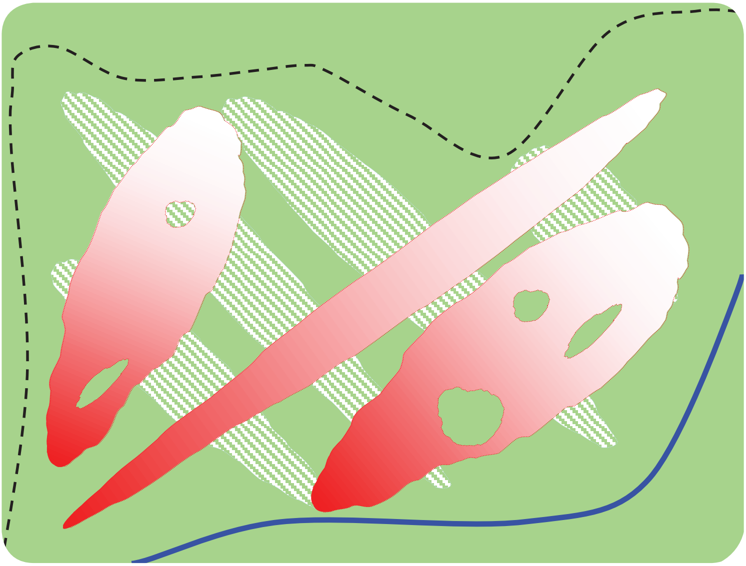

Figure 3: Planned mosaic burn—year 20.

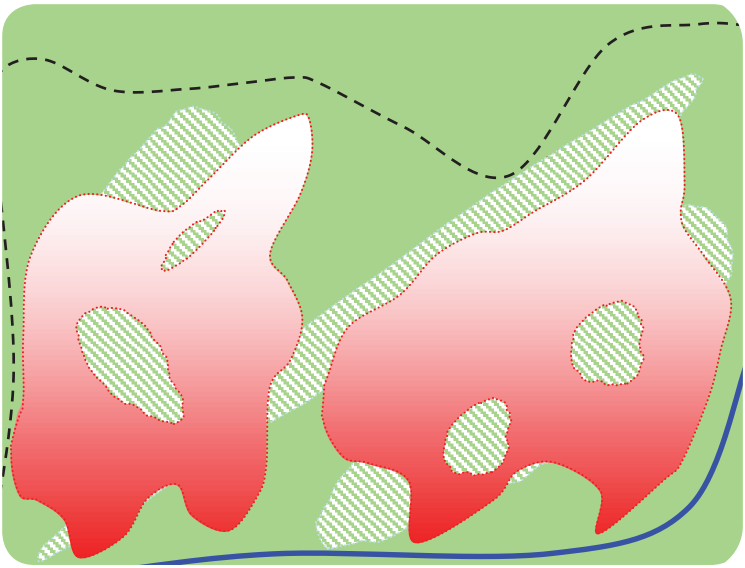

Figure 4: Planned mosaic burn—year 28.

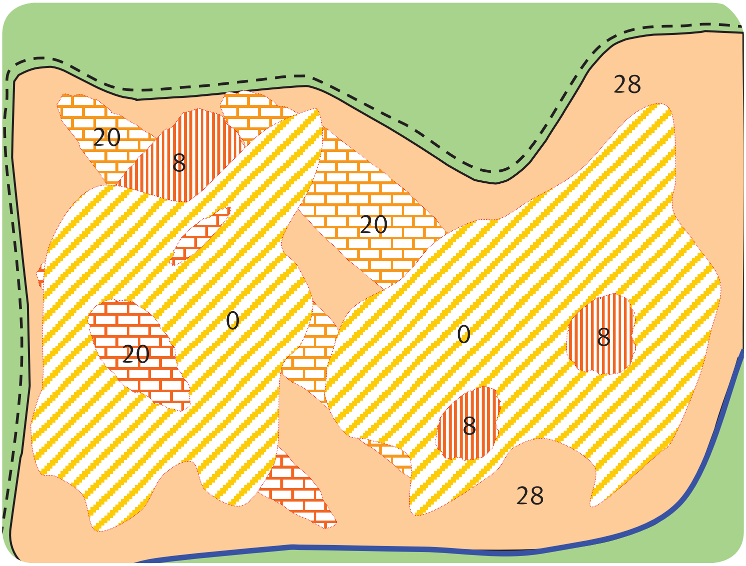

Figure 5: Fire history summary—year 28.
Wildfire and mosaic burn patterns overlaid (with years since last burnt).

Peter Stanton, Environmental Consultant Pty Ltd, Heathlands Resource Reserve (1989).

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