GUIDELINES

for

Low Intensity Bush Fire Hazard Reduction Burning

(for private landholders)

- Determine fuel load and structure
- Effects on the environment
- Fire breaks and control lines
- Weather conditions
- Lighting patterns
- Test burns
- Safety
- Mopping up
- Reporting

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NSW RURAL FIRE SERVICE

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Introduction

These Guidelines are intended for use by private landholders who have been issued with a Bush Fire Hazard Reduction Certificate by the NSW Rural Fire Service (RFS). They detail the key considerations and general principles for undertaking low intensity bush fire hazard reduction burning. While primarily relating to dry open Eucalypt forest fuel types, these Guidelines can be applied to any bush fire hazard reduction burning after careful assessment of fuel loads, fuel availability and weather conditions.

Burning of vegetation can potentially be quite hazardous. You should be confident that you are capable and experienced enough to undertake a bush fire hazard reduction burning activity. In some cases it may be safer to conduct a pile burn where it is practical to rake up the material to be hazard reduced into a pile. Contact your local RFS Fire Control Centre if further information is required to implement these Guidelines.

The existing requirement to obtain a Fire Permit, which may be issued with a Bush Fire Hazard Reduction Certificate, still applies. If you are unsure about the regulations relating to the lighting of fires consult the fact sheet *Before You Light that Fire* from your local RFS.

Ultimately you are responsible for any fire you light - if it escapes you may be liable for the damage it causes.

Bush Fire Hazard Reduction Burning in Asset Protection Zones and Strategic Fire Advantage Zones

Bush fire hazard reduction burning is a means of using low intensity fire to reduce excess fuel for a predetermined area under specific conditions. The characteristics of a low intensity burn include:

- Low flame heights averaging approximately one metre. Flame heights may be higher in patches of heavy or elevated fuels.
- Scorch height should be less than five metres. Scorch height is the height at which tree leaves are killed from the heat of the fire.
- Slow rate of spread (a slow walking pace).

The objective of bush fire hazard reduction burning carried out under a Bush Fire Hazard Reduction Certificate in Asset Protection Zones (APZ) and Strategic Fire Advantage Zones (SFAZ) is to reduce bush fire hazards to protect life property and the environment. Compliance with the conditions on your Certificate and these Guidelines will ensure that any environmental and cultural heritage values identified are also protected.

Zones in which bush fire hazard reduction can be used for community and asset protection are identified in Bush Fire Risk Management Plans prepared by local Bush Fire Management Committees. Bush Fire Risk Management Plans can be viewed at your local RFS or your local council.

These plans identify:

- **Asset Protection Zones:**
  These are zones adjacent to built assets (such as homes, and other structures) and are generally 20 to 50 metres wide. Fuels are intensively managed in these zones to provide a buffer of very low fuel levels between an asset and a bush fire hazard (e.g. bushland). The low fuel levels in APZ provide fire crews and home/land owners greater opportunities to safely defend their home/asset during a bushfire. APZs should reduce the chance of ground fires, radiant heat and embers damaging an asset.

  In many cases an APZ will be created and maintained using mechanical methods. In some cases, for example where the terrain is very rough or steep, fire may be used to reduce these fuels. Extreme care must be taken to ensure that the fire is always under control as the burning will be very close to assets.

Strategic Fire Advantage Zones:
These are larger bush fire hazard reduced areas where fuels are managed to slow a bush fire and reduce its intensity. They are often located adjacent to an APZ to enhance the effectiveness of the APZ. SFAZs can be established in strategic locations, such as adjacent to fire trails in high ignition areas or firepaths. They can enhance fire control options and provide opportunities to contain fires before they threaten communities or assets.
Generally fuel loads in these areas are reduced using prescribed burning techniques.

Setting Objectives For Bush Fire Hazard Reduction

The broad objective of bush fire hazard reduction work is to reduce the fine fuel load and alter the fuel structure to a level that provides a safe 'defendable space' around an asset while limiting adverse environmental effects of the burn.

Once a Bush Fire Hazard Reduction Certificate is issued it is important to have a clear idea of the burn's desired objectives specific to your location. This will allow selection of the most appropriate techniques for a successful bush fire hazard reduction burn. In planning and implementing a bush fire hazard reduction burn the elements and precautions that you need to consider for your specific burning area are:

1. Fuel load and structure
2. Effects on the environment and community
3. Specific objectives for APZ and SFAZ
4. Adequate fire breaks and control lines
5. Season and weather conditions
6. Topography and fire behaviour
7. Lighting patterns
8. Conducting a test burn
9. Safety considerations
10. Mopping up and patrol
11. Reporting

In some cases (e.g. for a large bush fire hazard reduction burn over many hectares in size) a detailed, written burn plan describing these elements may be required. If in doubt ask the local RFS Fire Control Centre if a plan is required.

Step 1. Determine fuel load and structure

Bush fire fuel is vegetation that will burn during a bush fire. The most hazardous fuel are fine fuels that will burn during the intense initial passage of the firefront. Fine fuels are those fuels less than six millimetres in diameter and includes the dead or dry leaf litter, grass, twigs and bark that gather on the ground or are suspended in the shrub layer of a bush area.

The quantity (usually expressed in tonnes per hectare (t/ha)) and arrangement of fine fuel will impact on the rate of spread and behaviour of a fire. The objective of bush fire hazard reduction is to reduce, but not totally remove, the amount of fine fuel and modify fuel structure to a more horizontal arrangement. Without fine fuels, a fire is difficult to light or sustain, similar to lighting a log fire without small kindling. As a rule of thumb, if the quantity of fuel is doubled then the forward rate of spread of the fire will also double.

Information about fuel assessment techniques can be obtained from your local RFS Fire Control Centre.

Step 2. Consider the effects on the environment and community

In some instances APZs and SFAZs may hold particular environmental values such as stream and riverside (riparian) vegetation, or protect unstable soils or threatened species. Ensure that you comply with the conditions attached to the Bush Fire Hazard Reduction Certificate. The conditions may include measures to protect biodiversity by burning within fire frequency thresholds or excluding fire from specific areas to protect threatened species. Failure to comply with the conditions may result in considerable fines if damage is done to the environment.

Riverside or creek (riparian) vegetation is important for maintaining water quality and fish habitat. Every effort should be made to keep fire out of these areas.

Ensuring that fires are of low intensity will protect tree canopies and any tree dwelling animals such as koalas. Low intensity fires are often also patchy and there is a much lower potential for soil erosion if significant rain falls after the burn.

The smoke produced from bush fire hazard reduction burning has great potential to impact upon the community. Atmospheric conditions may limit smoke dispersal, causing it to linger in the area. It is particularly important to consider if sensitive areas such as schools, hospitals, neighbours with health concerns or nursing homes are nearby. Ensure you discuss your proposals with these facilities, neighbours and occupiers of any properties that may be affected by the burn.

A No Burn Notice, which may prohibit bush fire hazard reduction burning, is issued on days of predicted high air pollution. Your local RFS will advise you of pollution concerns or lighting bans when you notify them 24 hours before your burn. Notification is a requirement of any approval you have and ensures that people who may be affected by smoke or embers are aware of the activity and that people don't mistakenly report the activity as a wild fire.

To minimise the impact of smoke, burning should be restricted to daylight hours whenever possible.

Large fires near roads may produce smoke that could be a traffic hazard. There are some cases where smoke from fires has caused serious accidents. You should consider if traffic management signs are required. In cases where there are major roads it may be necessary to get advice from the police or traffic authorities to determine what is the best way to manage the effects of smoke on traffic.

Step 3. Determine Specific Objectives for APZ and SFAZ

Objectives in Asset Protection Zones are different from those in Strategic Fire Advantage Zones. The following are examples of objectives for each zone:

ZONE	OBJECTIVES
Asset Protection Zone (APZ)	• reduce fine fuel load and structure to a level that provides a safe 'defensible space' around or within an asset; • reduce fine fuels by approximately 70-100% within the zone to prevent a ground fire reaching the asset; • reduce vertical structure of the fine fuels by reducing shrub fuels; • reduce the amount of available bark on stringy bark trees.
Strategic Fire Advantage Zone (SFAZ)	• reduce fine fuel load and structure to a level that provides fire fighters with an area in which they have a high probability of success in containing bushfires burning within, or into the area; • reduce fine fuels by approximately 50-80% within area; • reduce vertical structure of the fine fuels by reducing shrub fuels; • reduce the amount of available bark on stringy bark trees.

Step 4. Ensure that there are adequate fire breaks and control lines

When planning your bush fire hazard reduction burn, it is important to consider well-placed control lines and fire breaks. A control line is a planned, defined perimeter used to stop the fire escaping from the designated burn area. Control lines may be a combination of roads, mineral earth breaks (hand or machine constructed),

streams, areas that are already bare of fuels (rock shelves, green crop areas or recently burnt) or cleared land.

You should create a basic map of your proposal, even if it is a sketch. This should include the location of assets, control lines and the proposed burn area. This will help you illustrate your intentions to others who are assisting with the burn.

You must establish if further work is required to make control lines suitable (i.e. they may require cutting back or grading). Alternately you may be required to create a control line. If doing so be sure to take into consideration the environmental impact that may result, particularly soil erosion.

To construct a control line, determine the best place for the line and clear all leaf litter and other fuel for at least one metre width, raking the accumulated litter into the area on the side of the trail that will be burned, and spreading the litter out over a wide area. Clear around the base of trees for approximately one metre and also around any large logs lying along the ground near to the control line. This will prevent the fire travelling up the trees particularly trees with a rough bark surface. It is preferable to leave large logs unburned for environmental reasons

The person responsible for bush fire hazard reduction work is responsible for its control. The law has severe penalties if a fire escapes its control lines, on to your neighbours property or into any environmentally sensitive location.

While undertaking your bush fire hazard reduction burn you must be able to extinguish the fire if it begins to escape and/or put out any re-ignition points if they occur. You need an adequate source of water available. You may also need a pump and hose.

An out of control fire can spread very quickly so reporting or calling for assistance early is of utmost importance. If an emergency should occur ring 000 and report the fire. Failure to do so is a serious offence and may result in a fine or imprisonment.

Step 5. Determine the season and weather conditions for a low intensity bush fire hazard reduction burn

(a) Selecting the season

Selection of the right year and season to carry out bush fire hazard reduction burning is crucial to meet fuel reduction and environmental objectives, and minimise the potential for escape or reignition at a later date.

In southern NSW (generally from the Illawarra south) bush fire hazard reduction burning is typically conducted in autumn. Late spring bush fire hazard reduction burning (after fuels have dried out sufficiently following winter rainfall) is usually avoided due to the potential for reignition in summer when rainfall is lowest and conditions are hot and dry. Spring burning in the south should only be carried out by, or with the assistance of, very experienced burning crews and avoided in years of below average rainfall.

In northern NSW (generally Sydney north, and more particularly north of the Hunter district) bush fire hazard reduction burning is generally conducted in early spring, when fuels have dried out during the usual dry winter. If fuels are sufficiently dry it may also be conducted during autumn and winter. In most years, the onset of typical summer rainfall patterns reduces the potential for reignition during summer. Spring burning in years of below average rainfall should only be carried out by, or with the assistance of, very experienced burning crews.

(b) Selecting the appropriate day and time of the day

Fire behaviour is determined by fuel and weather conditions. Therefore to minimise the risk of escape and to ensure calm fire behaviour, burning should be carried out when the weather conditions are suitable. Importantly, a bush fire hazard reduction burn should be planned to :

- Be flexible enough to adjust the burn day to take advantage of suitable forecast conditions (from Bureau of Meteorology, through local media, press or internet (www.bom.gov.au).

- Decrease the risk of escape or reignition by ensuring there is adequate time for the fire to 'burn out' prior to the onset of unstable weather and/or high winds, such as is commonly associated with the passage of a frontal system.

The four important weather elements for low intensity burning are:

(i) Temperature

Temperature affects the fire behaviour and moisture levels in the fuel. Ideally temperatures should be **less than 25℃** for low intensity burning.
Temperatures are normally at a minimum early in the morning (3-4 am) and at a maximum early to mid afternoon (2-3 pm).

(ii) Relative humidity

Relative humidity affects fire behaviour by altering fuel moisture levels. Relative humidity is usually highest overnight and lowest in the early afternoon. As a general rule, burning should only occur when the relative humidity is 50% and rising. Generally specialist equipment is required to measure relative humidity. Alternatively relative humidity forecasts and observations can be obtained from the Bureau of Meteorology website.

(iii) Wind speed and direction

Wind speed directly influences the rate of spread of the fire, thus increasing or decreasing the intensity of the bush fire hazard reduction burn. Wind speed usually strengthens mid morning and reduces late evening.
Low intensity burns are best carried out in wind conditions **less than 15km/h** as measured in the open. The direction of the wind affects the direction in which the fire develops as well as how fast it progresses.

(iv) Atmospheric stability

To minimise the risk of escape, low intensity burning requires **stable atmospheric conditions**. Stable conditions are usually associated with a high-pressure system dominating the local weather pattern, with clear skies and light winds. Unfortunately a very stable atmosphere usually means that smoke will linger in the air, an important consideration if smoke issues are relevant to the burn. Rapid changes in atmospheric conditions such as unstable weather and high winds associated with the passage of a frontal system can affect the fire's behaviour.

In forest areas with deeply shaded fuels it may not be possible to burn successfully under the above weather prescriptions.

As an alternative you may contact the local RFS to be given the Forest Fire Danger Index (FFDI) score to determine if the conditions are suitable to burn. An FFDI score is calculated from all the weather conditions and gives the best indication of potential fire behaviour. These scores are used for the fire danger signs. Low intensity burning should be performed when the FFDI is less than indicated in the table below.

Table 1 Forest Fire Danger Index limits for low intensity bush fire hazard reduction burning.

Fuel Quantity (t/ha)	Forest Fire Danger Index (FFDI)						
	2	4	6	8	10	15	>15
5	yes	yes	yes	yes	yes	yes	no
10	yes	yes	yes	yes	yes	no	no
15	yes	yes	yes	yes	no	no	no
20	yes	yes	no	no	no	no	no
>25	yes	no	no	no	no	no	no

Step 6. Consider topography and fire behaviour

- Fires burning on level ground will have a different intensity and rate of spread (ROS), than a similar fire under the same weather conditions travelling up a slope or down a slope.
- On an uphill slope an increase of 10 degrees will cause a fire to double the ROS and therefore the speed of the fire. If the angle is increased to 20 degrees then the spread of the fire will be fourfold.
- On a downhill slope, the figures will be reversed which means the fire will travel slower. Generally fires lit for reducing a hazard should be lit at the top of a slope to burn downwards.
- The aspect or direction the fuel faces is of importance, as the fuel may be more moist on some aspects or drier on others. Generally, fuels facing west, northwest or north aspects are exposed to longer periods of sun during the day and will be drier than those on other aspects. The dry fuels will burn more readily increasing the potential for erratic fire behaviour.

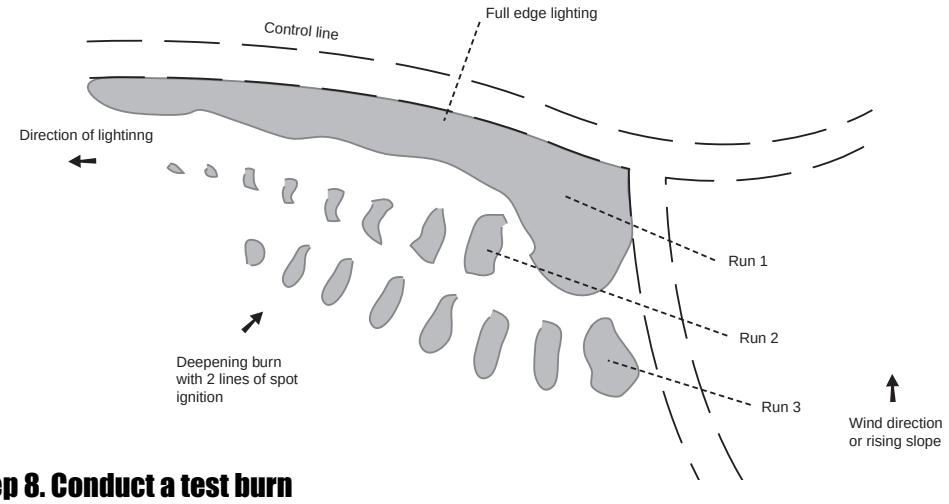
Step 7. Lighting patterns

Lighting patterns strongly influence the proportion of area burned and the flame height generated during a burning operation. Lighting patterns can be used to achieve burn coverage, intensity and environmental prescriptions.
The pattern of lighting a fire can also help to keep fire out of environmentally sensitive areas such as riparian vegetation (vegetation found along river, streams, lakes and wetlands) that is important to maintain water quality.

Lighting patterns to minimise environmental impacts:

- Burn when the higher parts of the topography (ridges) are drier, and the lower parts (valleys and gullies) are moist. To assess the likelihood of gully fuels burning prior to the burning day, collect gully fuel litter in the afternoon and in a cleared area, (such as a the centre of a track) and attempt to burn it. If fuels burn easily then burning should be delayed until rain has fallen.
- Use a downslope lighting pattern, lighting along ridges and allowing the fire to back down the slope to riparian areas.
- Light downwind so that the fire burns into the wind.
- Start ignition at a time such that the burning edge does not reach the riparian vegetation until late in the day when temperature is falling and humidity and fuel moisture are rising.
- To minimise fire burning through stream areas, use a widely spaced spot lighting pattern (10 to 20m between spots) in areas adjacent to the streams, and do not light directly within any riparian vegetation or within 20m of the stream.
- Use spot fires as they burn slower and less intensely than a line of fire.

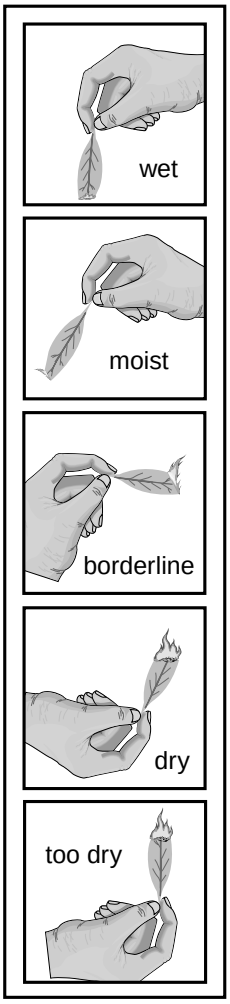
Diagram 7.1: Implementing a spot ignition burning pattern for a low intensity fire



Step 8. Conduct a test burn

(a) Use the burning leaf method to determine the fuel moisture.

A sample leaf should be taken from above and below the surface. Sheltered from any wind, light the end of a dead leaf and, once lit, take the ignition source away. The aim is to discover the angle at which a small flame either goes out or flares up as described in the diagram below. There should also be a difference between the two leaves where the subsurface leaves are moister, otherwise the burn should not proceed.



Leaf burns if held straight down or does not burn at all
All fuels too wet if this leaf is in the area to be burnt.
OK if only in wet area not to be burnt.

Leaf burns if angled downwards
Fine fuels from this leaf's position will only burn if on a slope or in the wind.
OK if the leaf was from the bottom of the litter in the burn area, or from a wet area not to be burnt.

Leaf burns if level
Fine fuels from this leaf's position will burn, but very slowly unless helped by wind, slope and fuel continuity.

Leaf can be angled upwards and still burns
Fine fuels from this leaf position are dry enough to burn.
OK if this leaf is from the top of the litter, risky if from the bottom.

Leaf burns if held straight up
All fine fuels are very dry and flammable. Fire will spot if windy.
DON'T BURN

(b) Light a small test fire.

Having assessed that weather parameters are within a desirable range, and with suppression equipment close at hand, light a test fire in a prepared area approximately five metres square on flat ground. Observe the test fire flame heights and rate of spread. If the height of flames burning in surface fuels consistently exceeds one metre, then the test fire should be immediately extinguished.

Step 9. Ensure personal safety considerations are implemented

Personal safety while undertaking any bush fire hazard reduction burning is of utmost importance. It is vital to protect yourself and others when conducting a bush fire hazard reduction burn. You should discuss personal safety issues with your local fire service. Adherence to safe working practices is required to ensure a safe burning operation. The following points need to be considered, communicated and understood by all those involved in the burning operation:

- A long sleeved shirt made from thick cotton or wool is ideal to prevent burns to the upper body and arms (eg. Flannelette or cotton drill work shirt).
- Sturdy leather work boots along with a pair of woollen socks.
- A pair of heavy cotton pants will shield your legs from the radiant heat emitted from the fire (eg. Denim jeans or oil free overalls).
- By wearing a wide brimmed hat you can stop embers from dropping onto your head or down the back of your shirt.
- Wear work gloves to protect your hands.
- A good pair of goggles will safeguard your eyes against any embers and debris that may be in the air.
- Cover your nose and mouth with a wet handkerchief, piece of cloth or cloth nappy to prevent inhalation of smoke and embers.
- Drink plenty of water throughout the day to avoid dehydration.
- Ensure that appropriate neighbours, government authority and public notification arrangements have been completed prior to the burn commencing.
- Ensure the area to be treated is clear of personnel before burning begins.
- Ensure that containment lines identified for the burn are in a satisfactory condition to contain the burn in the expected weather conditions.
- Ensure that proper assessment of fuel and weather conditions (current and forecast) has been made before burning commences.

- Ensure that adequate resources are available to conduct the burn in the prevailing and expected conditions, and contain the burn to the planned area.
- Ensure that all people involved in conducting the burn have the appropriate experience, and are dressed in appropriate protective clothing.
- Ensure that all people involved are provided with appropriate information and are aware of safe working procedures for the burn.
- Ensure the burn is monitored at appropriate times until the risk of the fire escaping the planned area, and/or trees falling across roads and trails has passed.
- Working arrangements should ensure that personnel are not working alone or out of sight of others.
- A system of communication is established providing for rapid and reliable communication between personnel working inside the burn perimeter, and the person supervising the burn.
- Safe escape routes and safety zones are identified.
- A lighting pattern is devised, and explained to all personnel, which ensures that fire is not lit downslope of other personnel working in the burn area.
- Any safety hazards are immediately reported to the person supervising the fire.

The highest risk of fire entrapment of personnel conducting a burn exists when people are working within the burn area perimeter. Additional safety precautions need to be planned, briefed and implemented in such circumstances.

Step 10. Mop up and patrol

When you have completed the burn make sure that any logs or trees that are still burning are properly extinguished. In small bush fire hazard reductions all burning material should be extinguished. In large bush fire hazard reductions the perimeter should be extinguished to a depth of at least 10 metres from all fire edges.

You should be regularly patrolling the perimeter to ensure that there is no ignition of unburnt areas outside the perimeter of the area being treated. Under drier conditions, the area may need patrolling for several days following the bush fire hazard reduction work.

Step 11 - Reporting

Ensure that you report on the completion of works by returning the tear off slip from the Bush Fire Hazard Reduction Certificate to the address indicated on the Certificate.