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Elevated Fuel Guide

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Contents:

About this guide ...

Shrub, heath and suspended fuels can determine whether or not - and how fast - a fire will spread and the success or failure of fire control.

The purpose of this guide is to assist supervisors of fire control operations or prescribed burns, and personnel who participate in the planning and scheduling of fuel reduction burns, in assessing levels of elevated fuels. Using this guide will help ensure that:

- strategy of wildfire control is more effective (in terms of method of attack, suitability of planned or existing control lines, and adequacy of resources);

- conduct of prescribed burning or back-burning is more effective (in terms of actions to ensure that control lines are not breached);

- safety of fireline personnel is increased;
- protection of assets such as houses in forested areas is increased;
- the protection priorities of fuel reduction burning are identified more consistently.

This Guide describes four levels of elevated fuel. The categories are based on a **Reference First Attack**, which is defined as being: direct attack by a 50 kW bulldozer (D3 class) and a small tanker (400 litre capacity) and crew, within 30 minutes of detection of a single fire burning on level terrain with good access, when the Drought Factor (Luke and McArthur 1978) is 10 and the wind speed (at a height of 10m in the open) is 20 km/h.

What Comprises Elevated Fuel?

Elevated fuel comprises shrub, heath, and suspended material. The level depends on the fuel amount (weight), height, horizontal and vertical continuity, proportion of dead material, thickness of the foliage and twigs, and flammability of the live foliage.

The flammability of the elevated fuel is highest when the foliage, twigs and other fuel particles are very fine (eg maximum width 1-2 mm), the live foliage contains volatile oils, the proportion of dead material is high, and the fuels are arranged with a high level of "density" and horizontal and vertical continuity that promotes the spread of flames.

The vegetation type and the time elapsed since the most recent fire substantially determine the elevated fuel level.

How to Assess Elevated Fuels ...

Compare the elevated fuels throughout the area of interest with the photographs and descriptions in this Guide, to find the level or levels that match best. Isolated patches of a particular elevated fuel type (eg gully vegetation) should be considered only where they are close to actual or potential control lines or to assets such as houses.

Factors Affecting Fire Threat

Three classes of fuel - elevated, bark and litter - each contribute to the *overall fuel rating* for a particular site. The fire *threat* at a particular site will depend on the overall fuel rating and on other factors such as the ignition risk, the assets needing protection, the ground slope, the moisture regime (eg the fuel rating on southern aspects or at higher elevations may be mitigated by moisture in many seasons), the presence of rocks and logs, and the typical weather patterns.

Descriptions and Photos of Fuel Levels

Moderate

Elevated fuels add very little to the flame height or rate of spread of a fire except at exteme levels of fire danger.

The overall fuel of the site depends almost entirely on the bark and litter fuels, except at extreme levels of fire danger.

This level is characterised by vegetation such as:

- sparse understorey vegetation;
- bracken and heath or shrubs that are re-establishing after a fire.

The elevated fuels generally have the following characteristics:

- elevated material is sparse/dispersed or arranged so that it does not sustain flames readily;
- dead material is virtually absent.

Elevated fuels should not limit the success of the Reference First Attack (see page 4) on wildfires up to a Forest Fire Danger Index of 50.

The Photos show a bracken fuel (left) and a sparse understorey (right).

High

Elevated fuels cause some patchy increases in the flame height and/or rate of spread of a fire.

The overall fuel rating of the site is dominated by the bark and surface fuels, but the elevated fuels add to the fire behaviour, especially at Very High and Extreme levels of fire danger.

This level is characterised by vegetation such as:

- bracken which has moderate density and age;
- wiregrass which contains a low proportion of dead material or which is less than 0.5m high;
- grass which is less than about 0.3 m high;
- shrubs with moderate density and moderate flammability of live foliage (eg *Cassinia spp.*, *Goodenia spp.*);
- tall shrubs (eg at least 5m high) with not much fine fuel for the first few metres above the ground (eg *Pomaderris spp.*, *Bedfordia spp.*).
- broombrush (*Melaleuca uncinata*);

The elevated fuels generally have the following characteristics:

- moderately dense;
- the proportion of dead material is 0-20% (by dry weight);
- if tall (eg at least 5m), then there is not much fine fuel for at least the first 2-4m above the ground.

Elevated fuels are likely to cause the Reference First Attack (see page 4) to fail when the Forest Fire Danger Index is in the range 24 to 50.

The photos show a moderately dense understorey fuel (left) and a tall pomaderris understorey fuel (right).

Very High

Elevated fuels dictate the flame height and rate of spread of a fire.

Elevated fuels are a dominant part of the overall fuel rating of the site. Surface fuels are less important: fires may even spread when the surface fuels are wet. The additional presence of *taller* shrubs (eg banksias, hakeas, wattles) may further enhance the hazard.

This level is characterised by vegetation such as:

- heath which contains 20-50% dead material;
- wiregrass of which a substantial proportion is 0.5-1m high and which is dense enough to suspend eucalypt leaves and other fine fuel above the ground;
- bracken which contains 20-50% dead material and which is dense enough to suspend other material such as eucalypt bark;
- shrub understoreys that are dense, contain 20% or more dead mateial, and which are at least 1m high;
- grasses and annuals that are dense, 1m or more high and which are or will be at least 80% cured;
- *Triodia sp.* which is moderately dense.

The elevated fuels generally have the following characteristics:

- the density and continuity (vertical and horizontal) are high;
- the proportion of dead material is 20-50%;
- the general height of the vegetation (ie ignoring small amounts at the top) is at least 0.5m and usually at least 1m;

- the fuel particles are mostly less than 1-2 mm thick.

The Reference First Attack on wildfires is likely to fail when the Forest Fire Danger Index (see definition on page 4) is in the range 12 to 24.

The photos (on the next page) show bracken fuel (left), dry heathland fuel (centre left), wiregrass fuel (centre right) and dogwood fuel (right). The flammability of the heathland is very high, making up for the lower density.

Extreme

Elevated fuels almost entirely determine the flame height and rate of spread of a fire.

The overall fuel rating of the site is Extreme irrespective of the bark and surface fuels.

This level is characterized by vegetation such as:

- tea tree, melaleuca or heath that is at least 2-3 m high and where very fine fuels are present from top to bottom of the vegetation;
- wiregrass that is dense and at least 2-3m high.

The elevated fuels generally have the following characteristics:

- vegetation is **tall** (at least 2-3 metres), dense and continuous from top to bottom;
- large amounts of leaves, twigs and other fuel particles with maximum thickness less than 2 mm are distributed from ground level to the top of the vegetation.
- proportion of dead material is greater than 20% (by dry weight);
- flammability of live foliage is high;
- the weight of living and dead elevated fine fuel is high (greater than about 10 t/ha).

The Reference First Attack (see definition on page 4) on wildfires is likely to fail when the Forest Fire Danger Index is in the range 8 to 12.

The photos show a highly developed wiregrass fuel (left) and a very tall and dense wet heathland fuel (right). Note that these photos have necessarily been taken from an edge of the fuels.

CNR Protection Priority Burning Zones

CNR plans strategically for fire protection. An important outcome of the planning process is a map that shows Protection Priority Burning Zones with the following purposes:

Priority 1 zone - to provide the highest level of protection of life, property and public land values and assets.

Priority 2 zone - to provide a strategic corridor of sufficient width and continuity to provide a substantial barrier to the spread of wildfire, reduce fire intensity and damage, and provide a base for fire suppression.

Priority 3 zone - to provide for broad area protection where it is important to reduce severity of wildfire, to prevent destruction of natural and cultural values and to complement works in higher priority zones.

The management of each zone involves keeping fuels below a specified level. The levels are specified in terms of fine fuel quantity; but these levels could be revised to account for fuel type and arrangement by specifiying that the Priority Zones should be maintained with overall fuel ratings at or below the following maximum levels:

- P1 zone - Moderate
- P2 zone - High
- P3 zone - High on 50% of the area.

Overall fuel ratings of Moderate and High are defined on the next page.

Overall Fuel Rating of a Site

The overall fuel rating of a site can be classified as follows:

Hazard	Range of FDI within which the Reference* First Attack will fail
Low	won't fail
Moderate	50+
High	24-50
Very High	12-24
Extreme	8-12

* see definition on page 4.

After determining the elevated fuel level using this Guide, the bark level using the bark guide (Wilson 1992a) and the litter level by measurement, the overall fuel rating for a particular site can be determined by referring to the appropriate combination of elevated, litter and bark fuels in Tables 1 to 3 on the next page.

The overall fuel rating, as summarised from Tables 1 to 3, is Moderate or High when fuels are at or below the following maximum levels:

Moderate
- litter Moderate (8 t/ha);
- bark High (unless litter less than 4 t/ha);
- shrub High

High
- litter High (12 t/ha);
- bark High (unless litter less than 4 t/ha);
- shrub High

Table 1. Bark Level: Low, Moderate or High

Elevated Fuel Level	Litter Level (t/ha) L (0-4)	M (4-8)	H (8-12)	VH (12-18)	E (18+)
L	L	M	H	VH	E
M	L	M	H	VH	E
H	L	M	H	VH	E
VH	VH	VH	VH	VH	E
E	E	E	E	E	E

Table 2. Bark Level: Very High

Elevated Fuel Level	Litter Level (t/ha) L (0-4)	M (4-8)	H (8-12)	VH (12-18)	E (18+)
L	M	VH	VH	VH	E
M	M	VH	VH	VH	E
H	M	VH	VH	VH	E
VH	VH	VH	VH	E	E
E	E	E	E	E	E

Table 3. Bark Level: Extreme

Elevated Fuel Level	Litter Level (t/ha) L (0-4)	M (4-8)	H (8-12)	VH (12-18)	E (18+)
L	M	E	E	E	E
M	M	E	E	E	E
H	M	E	E	E	E
VH	E	E	E	E	E
E	E	E	E	E	E

Further Information

- The CNR fire planning process, including description of the protection Priority Burning Zones, is described by the Department of Conservation, Forests and Lands (1989).
- This classification of elevated fuels is based on the perceptions of experienced fire personnel (see Acknowledgements), as interpreted by the author. It is both subjective and useful, for the reasons discussed by Wilson (1992b). The use of this guide in combination with careful observations of elevated fuels, fire behaviour and the difficulty of fire suppression should provide the basis for the classification to be refined and quantified.

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