A GUIDE TO FIRE MANAGEMENT in Queensland

(Incorporating fire management theory and departmental practice)

Queensland Government

Department of Natural Resources

FORWARD

The Department of Natural Resources is charged with the proper administration of sustainable use of land. To fulfil this responsibility, it intends to deliver products and services based on fair and effective processes which recognise the rights and obligations of all who have an interest in land in Queensland.

In accordance with the Land Services Strategic Plan, one of these services is to maintain unallocated State lands and unmanaged Reserves awaiting allocation.

This Manual has been prepared through the joint cooperation of Land Services Operations and the Applied Research Unit of the Department and has received the endorsement of the Queensland Fire Services Division of the Department of Emergency Services.

Its preparation was in response to recommendations made under the Audit of Bushfire Strategies for Queensland, which was initiated by Cabinet direction of 24 January 1994, the subsequent report of which was tabled in Parliament on 9 September 1994.

The strategies identified within the Manual are, subject to the availability of resources, to be implemented immediately to ensure that fire threats emanating from unallocated State lands and unmanaged Reserves throughout Queensland pose a minimal risk to human life and property.

BB Smith
Director-General

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General Manager

Contents

PREFACE

HOW TO READ THIS MANUAL

1. Read the Preface to become familiar with the definitions and acronyms.

2. Read the Executive Summary to be aware of the manual's aims and recommendations.

3. If you are unfamiliar with fire management and require to understand the theory to formulate a fire management plan, read Part A (Theory).

4. If you are responsible for formulating and/or implementing a fire management plan, read Part B (DNR Policy and Practice).

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DEFINITIONS

TERM	MEANING
Fire Break or Fire Line	Is a relatively narrow strip of mainly cleared ground separating bushland from residences, commercial structures, crops, pasture, or other bushland.
Fire Danger	Is a combination of all factors which determine whether fires will start, spread and cause damage, and whether and to what extent they can be controlled and combines: a. Fire hazard (the fuel potentially available for burning, taking into consideration such factors as quantity, arrangement, current or potential flammability), indicating the relative difficulty of suppression should the fuel be ignited; b. Fire risk (the relative chance or probability of a fire starting), which is dependent on a causative agent. As fire cannot burn without fuel, hazard must be studied in conjunction with risk.
Fire Danger Maps	Are concerned with the possible ignition and subsequent spread of a fire and indicate where major fire-prone areas are likely to occur.
Fire Danger Rating	Is a measure of the chances of a fire starting, spreading, causing damage and the difficulty of controlling a fire.
Fire Management	Is the ongoing management of an area, to protect assets and minimise the threat of fire.
Fire Trail	Is a track in bushland to allow access by fire fighters to combat a wildfire (it may fulfil a second role as a fire break if its location is suitable and if it is wide enough).
Floater	Is a wind-borne ember carried above and in front of an advancing fire – it increases the rate of spread of the fire.
Fuel Reduction Buffer	Consists of a fire break, a bordering strip of land that is burnt every 2 to 3 years and a pathway separating the buffer from neighbouring bushland.
Prescribed Burning	(also known as controlled burning or broad-area burning) is the planned application of fire under selected weather and fuel conditions, so that the fire is confined to a predetermined area and burns with the intensity and rate of spread necessary to achieve defined fire management objectives.
Protected Area	Is an area declared for conservation purposes under the Nature Conservation Act (such as National Park or Conservation Park).
Survey Distance	The horizontal (not slope distance) between two points. All distances defined in this manual are survey distances.
Wildfire	Is any unplanned fire.

ACRONYMS

ACRONYM	MEANING
EPA	Environmental Protection Agency
DNR	Department of Natural Resources
DoT	Department of Transport (Q-Rail and Roads)
DPI (APG)	Department of Primary Industries (Agricultural Production Group)
DPI (FS)	Department of Primary Industries (Forest Service)
GIS	Geographic Information System (a computer-based spatial database and query system)
QFS	Queensland Fire Services
USL	Unallocated State Land

REQUIREMENTS

EXECUTIVE SUMMARY

The aims of the DNR Fire Management Manual

1. Maximise discussion of fire management issues within DNR.
2. Provide a knowledge base of fire management within DNR.
3. Formulate DNR fire management policies and procedures.
4. Provide consistency of fire management policy in DNR.
5. Create common report formats for the individual location-specific fire management plans prepared by DNR.
6. Minimise duplication of effort in the creation of fire management plans in DNR.
7. Encourage a multi-agency approach to fire management.

The aims of an integrated fire management plan

1. Decrease the risk of wildfires to life, property and environmental assets.
2. Improve ecological management.
3. Increase cooperation between the relevant authorities in fire management.
4. Create multi-agency fire management of the area concerned, where the actions of the different agencies complement one another to achieve mutually agreed goals.

Scope

The manual has two parts:

1. Part A discusses the theory of fire management;
2. Part B discusses DNR fire management practices (Part B will form the basis for the preparation of individual fire management plans by district offices).

THE REQUIREMENTS FOR A DNR FIRE MANAGEMENT PLAN

Safeguarding lives in a fire emergency

1 (page 6) Safeguard lives in fire emergencies on large areas of USL by:

a. Erecting sign posts pointing the way to common destinations.
b. Erecting easily-seen coded marker posts at standard intervals along tracks and at track intersections to guide fire crews.
c. Creating a map of the area (for use by fire crews), displaying the locations of the coded marker posts, local features, isolated structures, etc.
d. Closing the areas to the public at times of high to extreme fire danger by erecting suitable warning signs on entrances.
e. Locating any public recreational activities, such as picnicking and camping, away from hazardous areas such as dense remote bushland with poor access.

Funding

4 (page 8)
a. Contribute towards the fire fighting operations of other agencies fighting fires on USL.
b. Contribute towards the operations of other agencies conducting prescribed burns (authorised by DNR) on USL.
c. Fund the construction and maintenance of fire breaks and fuel reduction buffers bordering USL.

The calculation of fire danger

5 (page 9) Incorporate the QFS risk mapping methodology in DNR fire management plans when the methodology becomes locally available.

Better regulation and control of development

7 (page 13) Encourage local government to apply fire management considerations to its planning and approval processes.

Community education

8 (page 23) Engage the cooperation of local media to educate and involve the local community in:

a. The nature and behaviour of fire;
b. The appropriate responses to fire emergencies;
c. The aims and effects of any prescribed burning regime.

Prescribed burning and slashing

3 (page 8) Have prescribed burns on USL, carried out by other agencies with the required expertise (such as EPA, DPI(FS), or QFS) and according to DNR procedures.

6 (page 10) Encourage fire fighters and support agencies to carry out prescribed burns on USL (authorised by DNR) as training exercises.

9 (page 43) Authorise prescribed burns on USL (where necessary) to reduce the threat of fire to nearby communities having regard to the best use the land may be allocated to and environmental concern.

10 (page 43) Do not conduct prescribed burning for hazard reduction in:

a. Rainforests;
b. Small isolated areas of remnant bushland, such as urban reserves;
c. Areas remote from human habitation and remote from areas of commercial value;

d. Areas of low fire risk;
e. Areas where life and property are adequately protected by fire breaks;
f. Exposed areas affected by wind;
g. Grass areas where drought has otherwise made fodder scarce.

11 (page 46) Preferably carry out prescribed burns:

a. In May, June, July or August;
b. As late in the day as possible without requiring monitoring after nightfall;
c. With a grassland fire danger rating of less than 20;
d. With a forest fire danger rating of less than 10;
e. With an air temperature of less than 25 degrees Celsius;
f. With a relative humidity between 40% and 60%;
g. Where the lower layer of ground litter is moist and the upper level dry;
h. With a wind speed between 10 kph and 15 kph;
i. With a wind direction carrying smoke away from built up areas.

12 (page 50) Conduct prescribed burns:

a. Against the prevailing breeze from one edge of the block;
b. To prevent the development of very high or extreme fire hazards, without degrading the environment (this usually means a burn cycle of 7 to 9 years and a minimum of 5 years between burns).
c. With a varying block size;
d. With a maximum block size of 500 ha;
e. In a mosaic of burnt blocks and blocks in various stages of recovery from fire.

13 (page 51) In the execution of a prescribed burn:

a. Seek the assistance of agencies who carry out fire management in the area;
b. Use existing tracks and fire breaks or construct new fire breaks to separate the bushland into vegetation blocks;
c. Give advanced warning to the local city/shire council, police and fire brigade;
d. Suitably inform immediate neighbours of the expected time of the burn and the reasons for it;
e. Erect “BURNING OFF” signs on nearby roads;
f. Protect infrastructure, such as fences, signs and structures;
g. Make certain that no burning or smouldering material will start new fires beyond the bounds of the burned blocks;
h. Estimate the severity of the burn and other effects;
i. Monitor regeneration of the bushland.

14 (page 51) Slash regrowth on fire breaks and small areas of mostly-cleared land, such as overgrown town allotments and any picnic / camping / rest areas on USL.

Fire trails, fire breaks and fuel reduction buffers

2 (page 6) Minimise the environmental impacts when constructing fire breaks – particularly in areas where native title may not have been extinguished.

15 (page 52) Consider the fire break as the essential primary tool of fire management.

16 (page 53) Create fire breaks on the boundary with builtup areas, crops or pasture, even if this means constructing the break on private land rather than USL.

17 (page 53) Integrate DNR fire breaks with fire breaks constructed by other agencies to separate <u>all</u> built up areas, crops and pasture from bordering bushland.

18 (page 53) For fire trails:

a. Use (and where necessary upgrade) existing bush tracks;
b. Do not allow a continuous low vegetation canopy to form over a fire trail;

c. Maintain a width of at least 6 metres – preferably 8 metres.

19 (page 54) For fire breaks:

a. Set a width of 20 metres for high fire danger bordering residences or commercial / industrial buildings;
b. Set a width of 15 metres for medium fire danger bordering residences or commercial / industrial buildings or crops or pasture;
c. Set a width of 10 metres in bushland or when a road provides insufficient width, or for low fire danger bordering residences or commercial / industrial buildings or crops or pasture;
d. Slash each fire break by the end of August, each year;
e. Keep fire breaks clear of structures, vehicles, domestic goods, refuse and plantings that either impede access by fire fighting vehicles and slashers or significantly increase the fuel load.

20 (page 55) For fuel reduction buffers:

a. Construct in areas of high fire danger;
b. Set a width of 10 to 15 metres for the fire break, 50 to 100 metres for the sacrificial area and 3 to 6 metres for the curving bounding path;
c. Conduct prescribed burns of the sacrificial areas, every 2 to 3 years.

21 (page 56) Regarding vehicular access on fire breaks:

a. Do not construct road surfaces on fire breaks unless there is no alternative;
b. Add fill to fire breaks in boggy areas to improve vehicle access;
c. Encourage residents of sandy areas to maintain fire breaks outside their fenclines, to firm the sand much more quickly.

22 (page 57)
a. Retain several species of mature, healthy, structurally-sound, long lived, local
b. native trees on fire breaks, for either aesthetic or biodiversity reasons;
c. Space trees along the fire breaks to create a continuous park-like appearance;
d. Space trees across the fire breaks to reduce line-of-sight along the fire break.

23 (page 58) Remove the following classifications of tree from fire breaks:

a. Dead trees;
b. Trees expected to die within 10 years;
c. Trees with hollowed, rotting or insect-riddled trunks;
d. Trees with an excessive lean (say greater than 15 degrees from the vertical);
e. Exotic species and undesirable non-local natives;
f. Trees less than 2.5 metres away from other trees;
g. Trees within 5 metres of the boundary of adjoining private property.

24 (page 63) Preferably use a chipper when constructing fire breaks on the urban-rural interface to minimise smoke generation, return nutrients to the soil and discourage noxious weed growth.

Choice of fire management methods

25 (page 67) When making decisions on the fire management measures to be adopted, consult the decision tree listed in this manual (the decision tree is a guide, not a mandatory procedure).

Contents of each fire management plan

26 (page 71) Create an integrated fire management plan in cooperation with the other agencies with responsibilities in fire management in the area and inviting comment from the local community. The plan will include:

a. Aims, objectives and responsibilities;

b. A description of the area and its fire management needs;
c. The behaviour of previous fires in the area;
d. The problems to be addressed;
e. Prescribed burning;
f. Fire breaks, fire trails and fuel reduction buffers;
g. Slashing of fire breaks and overgrown allotments;
h. Governmental regulation and control;
i. Community education, consultation and liaison.

PART A: THEORY

A.1.0 AIMS, OBJECTIVES, RESPONSIBILITIES, CAPABILITIES

A.1.1 The aims of this manual

1. Maximise discussion of fire management issues within DNR.

2. Provide a knowledge base of fire management with DNR.

3. Formulate DNR fire management procedures.

4. Provide consistent fire management practice in DNR.

5. Create common report formats for the individual location-specific fire management plans prepared by DNR.

6. Minimise duplication of effort in the creation of fire management plans in DNR, by using this manual as a guide and as a theory base.

7. Encourage a multi-agency approach to fire management.

A.1.2 The desirability of integrated fire management

Non consultation between agencies and property owners of fire management plans could result in inconsistent plans being prepared for an area which could prove fatal in a fire emergency.

For example, bushland bordering a built up area might be partly USL, partly reserve and partly leasehold. DNR, the trustee and the lessee would need to create a continuous fire break, to quarantine the built-up area from wildfires in the bushland.

A.1.3 The desirability of integrated land management

The management of (and planning for) large tracts of land with a variety of tenure is an important task, involving the interaction of complex issues, such as fire management, land use allocation and land rehabilitation. For example, land use in an area should be compatible with the fire danger, to avoid generating or exacerbating fire management problems.

Much of the data required in one application is required in other applications and this may justify the creation of a GIS. The database would include:

a. property information (boundaries, tenures, valuations, etc);
b. urban infrastructure (power lines, water main outlets, roads, tracks, etc);
c. land information (contours, drainage, soils, etc);
d. biological data (species numbers, distributions, fire tolerances, etc).

A.1.4 The immediate objectives of integrated fire management

1. Minimise the fire danger to life and property.

2. Where considered desirable, use prescribed burning as a habitat management tool (to retain biodiversity, assist endangered species, etc).

3. Increase the efficiency and effectiveness of fire management:

    a. Maximise cooperation between local fire management agencies.
    b. Create and maintain a common database of relevant information.

c. Have staff trained in fire management responsibilities and current fire management practices and maintain a high level of competence in this area.
d. Keep all participants informed of any changes in any work scheduled under the fire management plan.
e. Share new fire management information obtained (such as new fire modelling algorithms, new papers on fire management, relevant biological data).

4. Increase the resources allocated to fire management:

a. Achieve and retain an adequate level of funds to fulfil fire management responsibilities.
b. Increase the involvement in fire management of agencies and individuals with land management responsibilities.

5. Increase public awareness and understanding of the fire danger in the area.

A.1.5 Desirable longer-term objectives of integrated fire management.

1. Integrate the fire management plan into local land use allocation plans, strategic plans and land rehabilitation plans.

2. Compile comprehensive inventories of the ecosystems, prior to burning.

3. Monitor the recovery of land subjected to wildfires and prescribed burns.

4. Formulate management objectives for specific ecosystems.

5. Use foresters, ecologists, hydrologists, botanists and recreation planners to create a simple expert system, containing local experience in fire fighting, fire behaviour, fire control and fire management.

A.1.6 Future versions of any integrated fire management plan.

A fire management plan is not a static document. It is periodically updated, as:

a. fire incidents, weather conditions and funding affect planning;
b. new research affects the fire management principles of the document;
c. the experience gained from implementing the fire management principles modifies the approaches followed.

A.1.7 Fire management responsibility for land

AGENCY	FIRE MANAGEMENT RESPONSIBILITY ON PUBLIC LANDS
Local Government	Public lands for which the local government is trustee (road reserves, park and recreation reserves, water reserves, etc).
EPA	Protected areas.
DNR	Unallocated State Land and unmanaged Reserves.
DoT	Transport corridors.
DPI(FS)	State Forests and Timber Reserves.
QFS	Urban areas.
Landholders	Freehold land and leasehold land for which they are responsible.

A.1.8 The knowledge and capabilities of the agencies

AGENCY	FIRE MANAGEMENT RESPONSIBILITY ON PUBLIC LANDS
Local Government	Infrastructure knowledge.
EPA	Prescribed burning for conservation purposes.
DNR	The capability to create and maintain a fire management GIS and to create local maps useful in fire management.
DoT	Q-Rail's existing fire management plans and fire fighting capabilities.
DPI(APG)	Agricultural systems research (the ecological effects of fire).

DPI(FS)	Prescribed burning for hazard reduction.
QFS	Fire management planning and practical fire fighting experience.
SES	Practical fire fighting experience, particularly in rural areas.

A.1.9 Safeguarding lives

Requirement 1:

Safeguard lives in fire emergencies on large areas of USL by:

a. Erecting sign posts pointing the way to common destinations.
b. Erecting easily-seen coded marker posts at standard intervals along tracks and at track intersections to guide fire crews;
c. Creating a map of the area (for use by fire crews), displaying the locations of the coded marker posts, local features, isolated structures, etc;
d. Closing the areas to the public at times of high to extreme fire danger by erecting suitable warning signs on entrances;
e. Locating any public recreational activities, such as picnicking and camping, away from hazardous areas such as dense remote bushland with poor access.

A.1.10 Native Title

Given that fire breaks are created for the purpose of protecting the public health and safety, the risk of not proceeding with their creation far outweighs any possibility of extinguishing native title.

Requirement 2:

Minimise the environmental impact when constructing fire breaks – particularly in areas where native title may not have been extinguished.

A.1.11 Fire response plans

A fire management plan must be compatible with any associated fire response plan (which is prepared by the agencies responsible for fighting fires). This manual does not cover the subject of fire response plans. While DNR is responsible for the control of fires on USL, fire fighting is conducted by other agencies.

A fire response plan describes the operational response to a wildfire by listing:

a. The areas of high fire danger in the area covered by the plan;
b. Continually-updated contact names and their telephone numbers, manning lists, maps, equipment maintenance schedules and training programs;
c. Arrangements for the dispatch of fire crews;
d. A cooperative framework for the safe use of crews from other areas;
e. Coordination procedures;
f. Equipment numbers and capabilities;
g. Communications between the command centre and fire fighting crews;
h. Vehicle and personal safety in a fire emergency;
i. Evacuation plans for the community.

A.1.12 Aspects of fire management not being considered by DNR

1. Conducting experiments and monitoring results on experimental plots to:

    a. provide basic data on the effects of the burning regimes on the forest ecosystem (such as the rate of fuel load accumulation);
    b. assess the post fire changes in vegetation and soils;
    c. assess the desirability of such changes;
    d. develop predictive post fire successional models.

2. Developing fire simulation algorithms to predict the behaviour of a fire (for fire management and for fire response). However, it is difficult to gather all the data required for an accurate simulation and the limitations of the algorithms make accurate prediction doubtful.

A.1.13 The capabilities of fire fighting vehicles

Fire pumpers are used by QFS for urban fire fighting. They are 2WD vehicles and usually have a water capacity of about 2000 litres.

Slip-on units (also known as a mop-up units) are used by EPA, DPI(FS) and timber harvesting companies for rural fire fighting. They are 4WD utilities with a crew of two and a water capacity of 400 to 500 litres.

Tankers are used by timber harvesting companies and by DPI(FS) for rural fire fighting. They are 4WD vehicles with a water capacity of 3000 to 5000 litres and are often equipped with a water cannon.

A.2.0 GOVERNMENTAL INITIATIVES AND LEGISLATION

A.2.1 Queensland Bushfire Strategy Report

A Queensland Bushfire Strategy Report was presented to Parliament in September 1994. Some of its findings are applicable to DNR fire management planning.

Page 5, Paragraph 1

"The State, as a land owner, is also responsible for protecting its assets. Large tracts of land are controlled by agencies such as the Q-NPWS, the DPI(FS) and the Department of Natural Resources.

Implication

DNR is responsible for the fire management of USL.

Page 6, Paragraphs 1 and 2

"The Audit team found that the Department of Natural Resources has initiated a program to maintain these areas (USL) until future use is determined. Fire management on USL should be undertaken by the most appropriate Bushfire Management Authority.

The Department of Natural Resources, on the other hand, does not currently contribute to the prevention of, or provide protection from, fire on USL or land not under trusteeship. The Audit team was of the view that the Government through both the DNR and the DoT should provide for fire management on their lands."

Implication

The report does not identify the most appropriate bushfire management authority, or what is meant by fire management.

Requirement 3:

Have prescribed burns on USL carried out by other agencies with the required expertise (such as EPA, DPI(FS), or QFS) and according to DNR procedures.

Requirement 4:

a. Contribute towards the fire fighting operations of other agencies fighting fires on USL.
b. Contribute towards the operations of other agencies conducting prescribed burns (authorised by DNR) on USL.
c. Fund the construction an maintenance of fire breaks and fuel reduction buffers bordering USL.

A.2.2 Queensland Bushfire Audit Review Report

On 24 January 1994, Cabinet commissioned an audit of the effectiveness of existing bushfire strategies in Queensland.

An Audit Report (2) was subsequently presented to Cabinet and its recommendations endorsed. The recommendations can be grouped into the following categories:

a. directly relevant to DNR fire management planning;
b. indirectly relevant to DNR fire management planning (directly addressed to other agencies);
c. relevant to DNR but not to DNR fire management planning;
d. not relevant to DNR.

Only the first two categories are listed here.

Recommendation 3

"QFS develop and apply, in conjunction with the Inter-Departmental Committee, by 1 July 1995, a risk mapping methodology suitable for use in existing and proposed rural-urban interface areas for planning and training purposes."

Implication

DNR has ceased development of its own risk mapping methodology.

Requirement 5:

Incorporate the QFS risk mapping methodology in DNR fire management plans when the methodology becomes locally available.

Recommendation 7

"The fire control and hazard reduction arrangements for individual land owners (either self-help or fire brigade dependant) be detailed in local Fire Management Plans and dissenting land owners be encouraged to undertake appropriate hazard reduction to minimise fire risk."

Implication

DNR fire management plans are to promote hazard reduction practices. The Bushfire Audit recognises the need for additional funding for DNR. While the Bushfire Audit does not define hazard reduction, this document assumes that it includes fire break creation and maintenance, and fuel reduction strategies.

Recommendation 11

"By 1 March 1995, the Directors-General, Department of Natural Resources and Department of Transport and other Government instrumentalities develop fire management policies, practices and plans for all lands under their control on advice from the Director-General, QES."

Implication

All public lands are to be managed appropriately with due consideration given to fire protection of the public and adjoining private land.

DNR is required to develop general fire management policies, practices and plans.

Each region of DNR is required to develop specific management plans (based on the general policies, practices and plans) for the lands under their control.

Recommendation 31

"The Commissioner, QFS and Bushfire Management Authorities ensure hazard reduction burning be utilised as a training medium for fire fighters and support agencies by 1 September 1994 and commence and control exercises be initiated on a regular basis by 1 January 1995."

Requirement 6:

Encourage fire fighters and support agencies to carry out prescribed burns on USL (authorised by DNR) as training exercises.

Recommendation 35

"The Commissioner, QFS

a. provide a model Fire Management Plan by 1 March 1995.
b. Together with Bushfire Management Authorities prepare, by 1 January 1996, a Fire Management Plan for some urban brigades and each rural-urban interface Rural Fire Brigade area, major State Forests and National Parks.

c. Provide for "let burn" areas to be determined in Fire Management Plans where it is considered appropriate to do so. Fire burning under even extreme conditions needs to be considered in this context."

Implication

The format and scope of DNR fire management plans may alter to conform to the format of the QFS model Fire Management Plan.

Attempt to reconcile any difference in policy between DNR fire management plans and the QFS model Fire Management Plan.

Where applicable, incorporate "let burn" areas in DNR fire management plans.

A.2.3 The Fire Service Act 1990

Section 7 (page 148)	State government departments are subject to the provisions of the Act.
Section 53 (pages 162,163)	QFS can demand the assistance of DNR to deal with any fire danger on USL.
Section 67 (page 166)	In the event of wildfire on USL, DNR must take all reasonable steps to extinguish or control the fire (even without a QFS directive ordering the action).
Section 69 (pages 167,168)	QFS can required DNR make or maintain fire breaks and deal with any vegetation on USL, in accordance with directions (hazard reduction burning, or slashing).

A.2.4 DNR funding for fire management and fire response

Projects involving fire prevention strategies, such as:

a. general maintenance (including slashing and removal of fuel loads); and
b. creation and maintenance of fire breaks;

are addressed as "New Initiative Funding" in terms of the Bushfire Audit.

A.3.0 THE ROLE OF LOCAL GOVERNMENT

A.3.1 Fire dangers in rural residential development

1. Poor road access.
2. Inadequate maps.
3. Inadequate local knowledge by fire fighters.
4. Inadequate fire fighting capability.
5. Ignorance of fire dangers and fire management responsibilities by residents.
6. No reticulated water supply.
7. Isolated homes surrounded by bushland.
8. Close proximity to large tracts of bushland.

A.3.2 Options for development control

1. Site park, sport and recreation reserves on the border with bushland.

   These reserves can serve a second purpose as fire breaks.

   If the neighbouring bushland is later residentially developed, the reserves can serve a second purpose as wildlife corridors.

2. Require developers of subdivisions bordering bushland to:

   a. build perimeter roads that serve a second purpose as fire breaks;
   b. avoid complex street patterns and dead-end roads that hinder access.

3. Prohibit development – particularly on heavily forested, steeply sloping land;

4. Resume land otherwise destined for residential development;

5. Restructure allotments and redesign subdivisions to reduce housing density, or improve the siting of buildings or improve access.

A.3.3 Options for the requirements of residents

1. Reduce fuel loads on their properties.
2. Create and maintain fire breaks on their properties.
3. Provide sufficient tank water capacity for fire fighting, where there is no reticulated water supply.
4. Require minimum clearance between structures and bushland.
5. Require building design and construction to optimise resistance to fire.

A.3.4 The importance of well-planned development

Most of the threat to life and property in high-intensity wildfires could be eliminated by the application of fire management principles to the strategic planning and development approval operations of local government.

Requirement 7:

Encourage local government to apply fire management considerations to its planning and approval process.

A.4.0 FIRE BEHAVIOUR

A.4.1 The conditions required for fire

1. Fuel (vegetation and structures (houses) provide the fuel for wildfires).
2. Sufficient heat to cause ignition of the fuel (matches and lighting strikes provide the heat source for wildfires).
3. Heat to maintain combustion (once a wildfire starts, it generates its own heat).
4. Sufficient oxygen to sustain combustion of a fire (the open air provides the oxygen for a wildfire).

A.4.2 The sources of danger to buildings

1. Wind-blown sparks entering buildings through unprotected openings (the main cause of building damage).
2. Radiant heat (rarely causes buildings to catch fire, but it can shatter glass and thus allow sparks and flame to enter buildings).
3. High-intensity fires (can generate high winds which can lift roof coverings or fling debris through windows and so allow sparks to enter buildings).

A.4.3 The effects of fire in forests

The relatively slow rate of decomposition in eucalypt forests, periodic droughts, strong winds and high temperatures result in many wildfires in Australian forests.

Surface fires consume surface litter and low vegetation.

Crown fires:

a. run through the canopies of trees as well as burning surface fuels;
b. can develop only where a surface fire is burning in an area;
c. can travel well in front of the surface fire and throw spot fires before them;
d. can travel at a much higher speed than that achievable by a surface fire;
e. are the most dangerous type of forest fire.

A.4.4 The effects of excluding fire

1. Very heavy fuel loads accumulate.
2. When a fire eventually occurs, the large fuel load makes the fire intense and difficult to control.
3. Species reliant on fires for successful regeneration decline or become locally extinct.
4. It avoids the reduced local biodiversity that results from burning at strict intervals over large areas (where seedlings and saplings continually perish in the fires and thus, as the mature trees age and die, they are not replaced).
5. The growth of pasture and woody vegetation decreases the soil erosion risk.
6. The denser ground cover provides an environment and refuge for smaller animals and birds.

A.4.5 The factors determining the intensity and rate of spread of a wildfire

<u>Fuel load accumulation</u>

The fuel load for a fire includes:

a. dead material – surface litter and dead trees;
b. live material – particularly acacias, banksias, eucalypts and paperbarks.

Different vegetation communities accumulate fuel at different rates to reach different steady state fuel levels. In many vegetation communities, fuel loads can exceed the recommended limit of 8 tonnes per hectare after only 3 to 6 years, while in other communities, this level may be reached only after 10 to 15 years – if at all.

Immediately after a fire, the fuel load level is at a minimum. The level depends on the intensity of the fire. Fuel loads then increase to a peak. The time taken to reach the peak depends on the vegetation communities and weather conditions.

Clearing or burning undergrowth is the best way to reduce fuel loads and thus fire intensity.

Vegetation

Different vegetation communities have different fire tolerances.

Different vegetation types have different heat yields:

1. Forest and scrub fires generate significantly more heat energy than grass fires.
2. Eucalyptus naturally produce very volatile substances and so fires in eucalypt forests are often intense.
3. Wallum country can experience frequent high-intensity fires.
4. Melaleucas are often found in swamp areas, where fires are infrequent.

The amount of canopy cover of different vegetation types determines the influence of winds on a fire:

1. Open heath and swamp have little canopy and so are completely exposed to the wind.
2. Woodland forests of scribbly gum and banksia have a reduced canopy and so wind entry is greater than the average for woodland forests.

Degree of curing

Percent curing of grassland = 100* number of dead stalks / total number of stalks

Grassland fires increase in intensity and rate of spread, with increasing curing of the grasses. Different grasses cure at different rate – barely grass may be fully cured, while kikuyu is still green. Consequently, estimates of curing should be based on the average for the area under consideration.

Topography

Fires burn more quickly and with greater intensity up slopes than they do down slopes or on level ground. The rate of forward spread of a fire will increase by:

a. 33 percent up a 5 degree slope;
b. 100 percent up a 10 degree slope;
c. 300 percent up a 20 degree slope.

The rate of spread will correspondingly decrease on a down slope.

As the slope increases, it also becomes more difficult to fight a fire and more difficult to construct and maintain fire breaks.

Infrastructure at the top of a slope is particularly at risk in the path of a fire.

Water level

Water can be left standing (above surface) or be present below the surface for long periods after rain periods. Plentiful water supplies stimulate growth and thus increase fuel loads. However, standing water inhibits the ignition and spread of bushfires.

Weather conditions

High temperatures, high wind speeds and low humidity's increase the rate of spread of a fire and thus its intensity. As fuels dry out, ignition is easier and the rate of spread of a fire increases. Long term weather conditions influence the drought stress on plants and hence their volatility (days since last rain).

Wind direction

In south-eastern coastal areas, the winds are mainly moist south-easterlies. The worst case for a wildfire would be hot dry north-westerly winds from inland areas. Fire breaks on north-western boundaries should therefore be the widest and most secure.

A.4.6 Major factors that increase fire danger

a. Houses or commercial/industrial buildings close to the bushland.
b. The bush has a steady state fuel load of more than 8 tonnes/hectare.
c. There is an upslope of 10 degrees or more from bushland to bordering private property.
d. Winds from the bushland to bordering private property are often hot, dry and of high velocity in summer.

A.5.0 THE CALCULATION OF FIRE DANGER

A.5.1 Uses

a. Influence the location of fire breaks and the timing of prescribed burns.
b. Be used by local governments to assess any development proposals in these areas, to minimise the risk of fire damage to future property owners.
c. Be used by local governments to restrict development in high-risk areas, by suitable modifications to their strategic plans or development control plans.

A.5.2 The factors determining fire danger

Vegetation / Community

This is the major influence in determining fuel loads and conditions.

VEGETATION / COMMUNITY	DANGER RATING	VEGETATION / COMMUNITY	DANGER RATING
Disturbed (See Land Use)	-	Mulga	2 – 3
Freshwater	0	Heath	3
Mangroves	0	Dry sclerophyll forest (1)	3
Salt marsh	1	Brigalow	2
Closed sedge land	1	Gidgee	2
Beach ridge	1	Ungrazed grasslands	3
Dune fields	1	Improved pasture	3 – 4
Spinifex	1	Pine plantations	3 – 4
Herb fields	1	Cypress pine	3 – 4
Rainforest	1	Wallum	4
Littoral	1	Dry Sclerophyll forest (2)(3)	4
Grazed grasslands	1	Dry Sclerophyll forest (4)	5
Crops	1 - 3	Wet Sclerophyll forest (5)	5

(1) Eucalypt and Cape York fire grasses
(2) Eucalypt and blade grass
(3) Eucalypt and Aristida bothriochloa
(4) Eucalypt and black speargrass
(5) Tall Eucalypt (> 30 metres)

Slope

PERCENTAGE SLOPE	TOPOGRAPHY	DANGER RATING
0 – 3	Gently undulating plains	1
3 – 10	Undulating	2
10 – 20	Rolling hills	3
20 – 30	Steep hills	4
> 30	Mountains	5

Land Use

LAND USE	DANGER RATING
Vegetation (See Vegetation / Community)	1
Open Space / Parkland	2
Urban / Housing	3
Dense / Uncleared	4
Industrial	5

Aspect

This is the direction in which the general area is facing – typically areas facing west suffer more from the drying influences of westerly winds.

ASPECT	DANGER RATING
South, South-East	2
North-East, East, South-West	3
West	4
North, North-West	5

Roads

A road:

a. decreases the fire hazard, because it makes the fire easier to suppress by back burning against the fire;
b. increases the fire risk, because a road is a source of possible accidental or intentional ignition;
c. increases the fire danger (and so is a risk factor and not a hazard factor).

Fire history

FREQUENCY (YEARS)	FREQUENCY (DESCRIPTIVE)	DANGER RATING
> 10 Years	Rare	1
7 – 10 years	Occasional	2
4 – 6 years	Common	3
1 – 3 years	Frequent	4

Some areas are more prone to fire for extraneous reasons, such as frequent lightning strikes on ironstone ridges. However, fire history is often not considered in the calculation of fire danger, either because accurate data are not available, or because it may not be independent of other variables such as vegetation and roads.

The difficulty in suppression outside urban areas

This is measured by the distance further than a standard hose, or combination of hoses, could reach from a fire hydrant. A 2WD fire pumper may not be able to traverse some rural tracks. It may also not carry enough water (at the required pressure and spread) to halt a wildfire.

Area

A fire front is far more likely to develop in large areas of bushland than in small bushland reserves.

Elevation

Elevation is often related to the vegetation type.

Meteorological conditions

Meteorological conditions vary from day to day and so are usually ignored in the calculation of fire danger for fire danger maps.

A.5.3 One model for fire danger mapping

Fire Danger = 100* Vegetation + 30* Slope + 20* Land Use + 10* Aspect + 5*Roads

Each variable has a possible range of O (very low) to 5 (very high) rating, equating to a danger rating range of between 160 and 800.

The final fire danger map may have seven classes of danger (very low, low, medium low, medium, medium high, high, very high).

Any model may need to be modified on the advice of experts with experience of local conditions by:

a. incorporating past ignition sources and points (such as lighting strikes);
b. including the knowledge of people who have coordinated or fought wildfires in the area;
c. obtaining more detailed knowledge of the proximity of homes and businesses to vegetation (thereby allowing for buffer zones and other open space).

A.5.4 Using the model

The risk of ignition depends on the proximity of flammable areas of vegetation or land uses to causative agents such as roads. For example, an industrial area will have a high risk because of the road network and stocks of flammable material.

Once an ignition takes hold, the degree of danger estimates the potential spread of the fire in calm conditions. It provides an overview of the types of issues which need to be addressed in a local fire plan, in the different land use types.

A.5.5 McArthur fire danger meters

Fire danger meters are used to estimate the fire danger at a specific place and time. The metres assume level or gently undulating ground.

At a fire danger rating of 1 or 2, fires will not burn, or burn so slowly that control presents little difficulty. At a fire danger rating of 100, fires will burn so hot and fast that control is virtually impossible.

The grassland meter calculates fire danger as a function of air temperatures, relative humidity, wind speed and degree of curing.

The forest meter calculates fire danger as a function of air temperature, relative humidity, wind speed, amount of last rainfall and the number of days since last rain.

A.6.0 PRESCRIBED BURNING

A.6.1 The controversial nature of prescribed burning

If prescribed burning is not carried out and a high-intensity wildfire results, there is public criticism that inexcusable inaction allowed a dangerous situation to develop.

If prescribed burning is carried out and unexpected changes in the weather conditions cause it to be become uncontrolled, there is public criticism that miscalculated operations created a dangerous situation.

If prescribed burning is regularly carried out, there are public complaints of ruined washing, asthma attacks, habitat destruction and heartless slaughter of bush creatures.

The practitioners of prescribed burning thus need local support, extensive local knowledge of the expected effects of their operations, a high level of expertise in carrying out the work and subsequent monitoring of the results of the work.

Requirement 8:

Engage the cooperation of local media to educate and involve the local community in:

a. the nature and behaviour of fire;
b. the appropriate responses to fire emergencies;
c. the aims and effects of any prescribed burning regime.

A.6.2 The uses of prescribed burning

1. Hazard Reduction

    (a) Reduce the fire intensity of wildfires.
    (b) Prevent crown fires by reducing fuel loads below the level critical for crown fire formation.

2. Ecological modification (habitat management)

    (a) Assist in increasing and maintaining biodiversity within a landscape.
    (b) Promote generation of certain fire-reliant tree species.
    (c) Control regrowth of woody weeds and to clean up fallen timber to favour certain desirable species.
    (d) Provide a direct contact for seeds with the soil.
    (e) Control pests and diseases.

3. Pasture improvement

    (a) Produce ash and so return nutrients to the soil.
    (b) Stimulate growth and increase the palatability and nutritional content of grasses for livestock grazing.
    (c) Attract animals to areas that might be left ungrazed.

A.6.3 Hazard reduction

The principal aim of hazard reduction burns (also called fuel reduction burns) is to protect life and property. It achieves this by burning when the fuel land in the bushland builds to a point where a fire could develop into a serious threat.

The burn consumes surface litter and reduces the levels of fine fuel and thus:

(a) Reduces the intensity and rate of spread of wildfires;
(b) Generally prevents crown fires from developing (even in extreme weather conditions);
(c) Reduces the erratic behaviour of wildfires;
(d) Reduces the threat of fires spreading and spotting.

Conditions are thus made safer for fire fighters attempting to control wildfires.

A.6.4 Habitat management

Prescribed burning for ecological management can be used where the intention is to:

(a) Provide a diversity of age classes of vegetation;
(b) Provide successional stages of vegetation;
(c) Favour species, communities and habitats;
(d) Return areas to pre-European conditions;
(e) Create conditions conducive to the return of locally extinct species.

Successful environmental fire management requires:

(a) adequate knowledge of:

  (i) the effects of fire on native ecosystems;
  (ii) the past history of fires in the area concerned;
  (iii) the distribution and abundance of species, and their reaction to fire;
  (iv) the species behaviour, feeding and breeding habits, etc.

(b) the collection of field information before, during and after fires;
(c) accurate prediction of the weather for specific areas, so that burning prescriptions can be accurately applied;
(d) the capability to speedily extinguish wildfires.

Some species rely on fire for propagation or habitat conservation.

A.6.5 The environmental effects of wildfire and prescribed burns

PRESCRIBED BURN	WILDFIRE
WILDLIFE Advantages Most organisms can escape or hide until the fires pass. Frequent burning favours the larger grazing species, such as kangaroos and wallabies. Eighty-to-ninety percent of insect and other invertebrate fauna in the upper soil and litter may be killed by mild fires, but numbers increase rapidly as the vegetation recovers. Disadvantages Frequent burning is detrimental to smaller more specialised animals, because it reduces the level of forest litter and understorey cover – the habitat of half the animal species.	WILDLIFE Advantages Some animal species require wildfires – opossums may need the hollows of trees killed by intense fires for shelter and may need the shoots of regenerating saplings for food. Disadvantages Only fast-moving animals escape. Only well-buried or protected animals survive unscathed. Animals may later starve to death through loss of habitat or be killed by predators through loss of cover.
SOIL Advantages There is a significant increase in soil nutrients immediately after a burn. There is no marked effect on the erosion processes in a single burn. There is no significant changes in the mineral content of the soil. Disadvantages There may be cumulative erosion losses resulting from frequent low-intensity burns. Many leguminous (nitrogen-fixing) understorey species require fires of moderate intensity before they germinate. Continual low-intensity burns may thus deplete nitrogen levels in the soil, in the longer term.	SOIL Advantages There is a significant increase in soil nutrients immediately after a burn. Disadvantages Frequent exposure increases the risk of erosion or damage. Heavy rain following severe fires can increase ash and soil runoff and so seriously degrade water quality. High-intensity fires tend to sterilise the soil and greatly reduce the populations of micro-organisms which break down litter and recycle nutrients.
BIOMASS AND GREENHOUSE	BIOMASS AND GREENHOUSE

Low-intensity burns only consume fine surface fuels and thus contribute little to greenhouse effects, as forests consume carbon dioxide for plant growth.	The amount of biologically-stored carbon can be greatly reduced, if repeated high-intensity fires transform tall forests to scrub or grassland, or cause peats to burn. The resulting increase in atmospheric carbon dioxide contributes to greenhouse warning.
TREES Advantages Most mature trees are not harmed, although some foliage may be scorched. Trees covered by bark are partly insulated from low-intensity fire. Disadvantages Frequent burns may cause some species to suffer increased fungal attack.	TREES Advantages Wildfires are unlikely to cause long-term ecosystem alteration, or species loss. Disadvantages Trees may be harmed if flames persist for 2 – 3 minutes. Many trees with a bark less than 2 cm thick may perish. Trees growing in sandy soil are the most likely to be killed by a fire, because sand conducts the heat to the roots.
LITTER Low-intensity burns may cause only the top layer to burn, leaving 0.5 to 1.0 cm of litter to protect the soil. Burns of higher intensity may consume all litter.	LITTER All litter is normally incinerated.
GRASS & LOW-GROWING SHRUBS Burnet to varying degrees, depending on the purpose to be achieved. Frequent burns reduce the amount and height of shrub vegetation. Disadvantages Exotic species and weeds may proliferate with regular prescribed burns and create a higher fuel load than the natural vegetation would have.	GRASS AND LOW-GROWING SHRUBS Mostly incinerated – some may survive in crown fires (where fire travels through the canopy) and areas skipped by the fire. .
TREES AND SHRUBS Disadvantages The fire may be of insufficient intensity to stimulate adequate seeding germination, for species with hard seed.	TREES AND SHRUBS

Plants that germinate from soil-stored legume seeds tend to be replaced by species which regenerate from rootstocks and seeds stored on the plants. Plants which regenerate from seeds carried from the mature plant have seeds that lack dormancy and tend not to be stored in the soil. Fires stimulate the release of seed, which later germinate. The seedlings grow to provide the next seed source. If a fire occurs before the seedlings reach maturity and produce new seed, the species disappear from the area.	

This discussion shows that the environment considerations of prescribed burning and wildfires can be very complex. Wildfires cause dramatic and damaging short-term changes. However, repeated prescribed burns can cause dramatic long-term changes, which may (or may not) have been intended.

A.6.6 The time of year for burns

Low-intensity prescribed burning is normally carried out in autumn or winter to minimise damage to the forest. Summer wildfires in fuel-reduced areas are then more controllable and burn at a lower intensity, reducing damage to the forest.

However, species diversity will decline if fires occur at the wrong time of the year and kill the flowers or the seed before they mature. Cool season burning may disrupt the breeding of some species. Spring burning may interfere with the breeding season of some animal species and the flowering and fruiting of some plant species.

A.6.7 The frequency of burns

For hazard reduction purposes only, a block would usually be burnt every 3 to 5 years. For habitation management purposes only, a block may be burnt every 8 to 10 years (if at all). For hazard reduction without significant ecological damage, a block may be burnt every 7 to 9 years.

The number of small mammals falls dramatically in the first year after a burn, mainly from starvation and from predation on the burnt ground, where cover and protection is reduced. Thus, the recovery of animal populations after a fire depends on the pattern of recovery of the plant community. The numbers increase dramatically about 5 to 7 years after the burn, through breeding and recolonisation from unburnt areas.

Some plant species may require a period of 10 years without fire to allow germination and the setting of viable seed. If fires are more frequent than this, the fires will alter the composition of the flora. A fire frequency of one fire every 10 to 15 years would be optimal for maintaining species diversity in this instance. However, the frequency of wildfires is often greater than this.

A.6.8 The burn pattern

A mosaic pattern of burnt and recovering vegetation blocks allows animals to survive by moving ahead of a prescribed burn to neighbouring unburnt blocks.

Many larger reptile species have low population densities and low reproduction rates and their numbers build up only slowly after a fire. The ability of reptiles to recover depends on the amount of unburnt vegetation to serve as a base for recolonisation. A low-intensity fire burning all of an area is more deleterious than an intense fire which leaves some unburnt ground.

A.6.9 The fire intensity of burns

To select suitable weather for achieving a prescribed fire intensity, it is necessary to identify fuel types and quantities within each area to be burned. Fire behaviour tables then predict suitable conditions for lighting.

A.6.10 Multistage burning

Multistage burning is prescribed burning carried out in several stages over a season, to progressively remove fuels as they dry out. This procedure is used in areas of heavy fuel accumulations and varying fuel flammability. Multistage burning is expensive because of its repetitive nature, but avoids destructive high-intensity burns.

A.6.11 A management plan for prescribed burns

The interval between burns on a vegetation block depends on the particular objective(s) to be achieved on that block. A prescribed-burning regime can be designed to meet a large number of specific management objectives.

A fire management plan may include many different regimes of different intensity, frequency and season.

Typical example:

a. In softwood timber plantations, conduct low-intensity burns every 2 years to protect a valuable commercial resource from wildfire (degradation of the understorey is acceptable, as it has little ecological value).

b. In areas of dense scrub near to a town, conduct low-intensity burns every 5 years to maintain low-hazard zones so that wildfires can be contained.

c. In forest areas of a national park:

   (i) conduct moderate-intensity fires every 10 to 15 years to maintain a leguminous understorey for fauna habitat and to preserve forest fertility.
   (ii) Carry out high-intensity fires to regenerate 1- percent of the forest every 10 years.

d. In wetlands, burn 20 percent of swamp vegetation every 20 years to preserve wildlife habitat.

e. On small isolated islands, exclude fire completely to ensure preservation of specific faunal habitats.

A.6.12 Problems

1. Cost

   The cost varies with area and hazard. The cost per hectare for a 1000 ha burn in western grasslands might be $3, while the cost per hectare for a 50 ha burn in dense urban bushland might be $20.

2. Rapid accumulation of fuel load to dangerous levels

   Many vegetation communities achieve a dangerous level of fuel load after only a few years. In these circumstances, hazard reduction burning at a frequency high enough to prevent a dangerous level of fuel load occurring would not only be very expensive, it would also seriously degrade the forest.

   For such vegetation communities:

   i. conduct ecological prescribed burning and accept a dangerous fuel load level for some years of the burn cycle;
   ii. use fire breaks and fuel reduction buffers as the principal protection against wildfire.

3. Paucity of data

Usually far too little is known of the species that make up the ecosystem for confident estimates to be made of the optimal parameters for a prescribed burning regime. Species numbers and distributions, fuel characteristics, fuel accumulation rates and fire tolerances are either unknown or only scantily known.

4. Unachievable work loads

The fire frequency set out in management plans may not be achievable because of limited resources, coordination problems, or long periods of unfavourable weather.

5. Creation of wildfires

Prescribed burns can get out of control and become wildfires, because:

a. the wind may change direction and increase in velocity;
b. the fuel load may be too high and too dry for a safe prescribed burn;
c. circumstances may dictate that a prescribed burn take place in inappropriate conditions (such as in hot dry summer months);
d. the fire crew may lack expertise.

6. Unintended environmental degradation

The timing and effects of the second burn can have a major effect on the future ecology of the area.

A.6.13 The approach taken by other agencies

AGENCY	APPROACH
EPA	EPA conducts controlled burning to: a. reduce accumulated fuel loads in buffer strips and key locations to minimise the hazard of wildfires to human life and property; b. restore the "natural" fire regime by control burning areas which have remained unburnt for too long; c. ensure the survival of fauna by producing a mosaic of vegetation blocks recovering from fire (and so preventing the broad scale habitat depletion caused by wildfires); d. enhance the environment for targeted fauna and flora species; e. control weeds; f. protect infrastructure in camping and picnic grounds in protected areas.
DoT	DoT carries out controlled burns on transport corridors to: a. reduce the fire hazard to bordering land; b. increase the visibility of signs and intersections; c. increase the visibility of animals which could cause accidents. Constraints include: a. the smoke hazard to the travelling public; b. the use of remnant vegetation as fodder and shelter for stock in droughts; c. soil stabilisation and erosion control; d. the role of vegetation in integrating roads into the landscape; e. the conservation of flora and fauna; f. cost. In most cases, Volunteer Rural Fire Brigades will carry out the burn-off when requested by local Fire Wardens. DoT can also issue permits to private land owners to burn off on lands controlled by DoT.
DPI(FS)	DPI(FS) employs underburning in timber plantations to maintain low fuel levels and so limit

	the intensity and spread of wildfire within the plantations.
QFS	QFS is not a property holder and carries out prescribed burning to fight existing fire threats.

A.7.0 FIRE BREAKS, FIRE TRIALS AND FUEL REDUCTION BUFFERS

A.7.1 Purpose

A fire break or fuel reduction buffer:

a. allows access for fire fighting vehicles to fight a bushfire;
b. provides a line for back burning against a bushfire;
c. reduces the temperature that would otherwise be experienced by nearby buildings in a bushfire;
d. provides refuge and escape for fire fighting crews in bushland.

A fire trail facilitates access to fire-prone areas for fire-suppression operations.

Direct attack on fires is successful only on low-intensity fires, and then only if the response is swift. The usual method of combating bushfires is the use of fire breaks to stop the spread of the fire. A fire break is NOT expected to stop. Unaided, the progress of a high-intensity wildfire. Floaters from a fire front may remain airborne for several kilometres before starting spot fires well beyond even the wildest fire break.

A fire break can act as a primary defence (where it is the only barrier to a wildfire), or as a secondary defence (where it acts as backup to a more substantial barrier). Examples of a fire break as a secondary defence include the following:

a. residences bordered by a fire creak on a narrow strip of USL bushland bounded on the other side by a river or pastures;
b. residences bordered by a fire break on USL, bounded on the other side by a parallel wider fire break on a road reserve.

A.7.2 Agency responsibility

AGENCY	GENERAL LOCATION OF A FIRE BREAK
Local government	Bush-covered Council-controlled reserves (including road reserves), bordering residential and commercial property.
EPA	Protected areas (perimeter and internal).
DNR	Bush-covered USL bordering residential and commercial properties.
DoT	Transport corridors.
DPI(FS)	State Forests and plantations (perimeter and internal).
QFS	None (does not control land).
Private landholder	Private Property.

A.7.3 Problems

1. Maintenance costs:

   Fire breaks must be slashed annually and fire trails must be graded annually.

2. Maintenance of soil stability:

   Exposed soil on steep slopes is prone to erosion and can be churned up by vehicles and eroding fire breaks can silt streams.

   Fire breaks constructed while fighting fires are often poorly constructed and can create later erosion. After a fire, either upgrade these fire breaks to proper standards or close and revegetate them.

3. Control of exotic species:

   The opening up of the canopy and exposure of the soil promotes the invasion of noxious weeds.

   Fire trails can spread noxious weeds and fungal diseases in to the forest.

4. Fire trails increase human access to remote areas and increase the number of accidentally-lit and deliberately-lit fires. In one national park alone, 9 out of 10 fires started at the edge of trails.

5. Fire trails can allow predator birds into the depths of the forest.

6. Nutrients may be removed, particularly when creating the fire breaks.

7. The continual removal of immature plants when maintaining the fire breaks causes species to disappear from the fire breaks – mature trees produce less seed as they age and die.

A.7.4 The appearance of a fire break

Many residents oppose totally cleared strips bordering their properties because:

a. they fear that this will attract thieves or unwanted traffic; or
b. they bought their properties for the bushland setting.

Isolated mature trees on fire breaks do not present a hazard – most fuel is contained in the understorey and ground litter.

Trees should remain in place across the width of the track (allowing for an exclusion zone close to the boundary with private property). This will reduce the likelihood of the fire break being used as a vehicle track and still allow safe access for fire fighting vehicles along the property boundaries even when smoke severely reduces visibility.

Urban fire breaks should thus present a park-like appearance to enhance the appearance of a neighbourhood. This approach will help to discourage the practice of some residents to use fire breaks as a dumping ground for rubbish. This practice produces visual ugliness, increases the spread of weeds along the fire break and into the adjacent bushland, and makes back burning more difficult and dangerous.

A.7.5 The width of a fire break

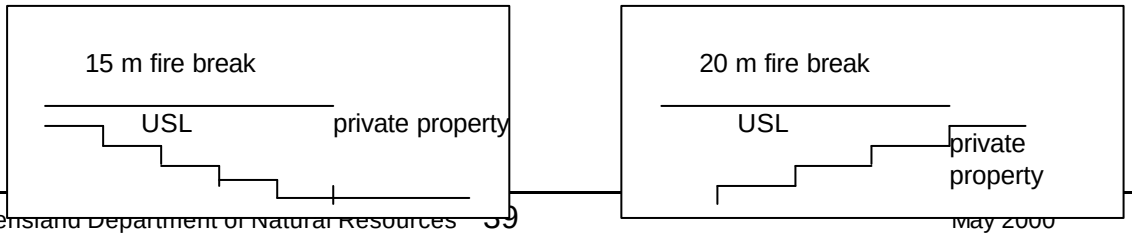
A standard strip fire break must be:

a. wide enough to allow:

   (i) sufficient room for stacking and burning when the fire break is being created;
   (ii) for turning manoeuvres by fire fighting vehicles and slashers;
   (iii) ample access and room for fire fighting and back burning;
   (iv) acceptable temperatures in neighbouring buildings when the bordering bushland is burning.

b. not unnecessarily wide – the added unnecessary cost may reduce the length of fire breaks that could be constructed and maintained.

The widths will be affected by topography. An upslope significantly increases the intensity of a fire, while a down slope significantly reduces the intensity of a fire. Significant up slopes thus require a greater width of fire break.



downslope fire break upslope fire break

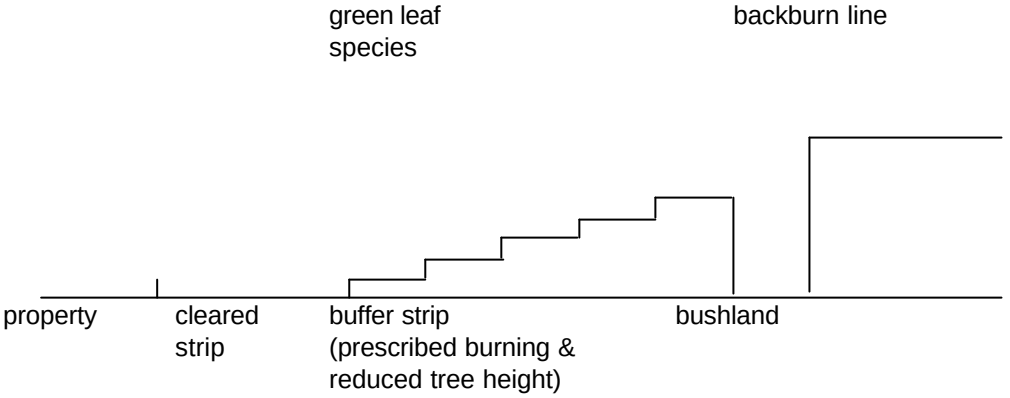
A.7.6 The "perfect" fire break

The "perfect" fire break consist of:

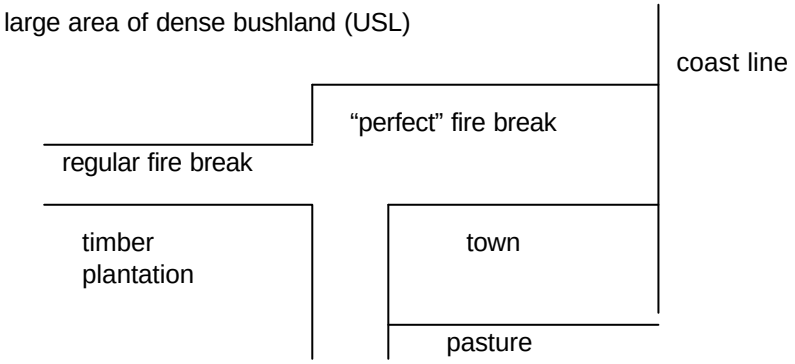
a. a completely cleared strip, at least 20 metres wide, bordering the property;
b. green-leaf species on the bush verge next to the fire break;
c. prescribed burning in a bordering strip of bushland where the strip is:

   (i) 50 to 100 metres wide;
   (ii) bounded on the bushland side by a narrow strip which is used as a back burn line for the prescribed burning;

d. a progressively reduced tree heoght in the bordering strip as one nears the completely cleared strip.

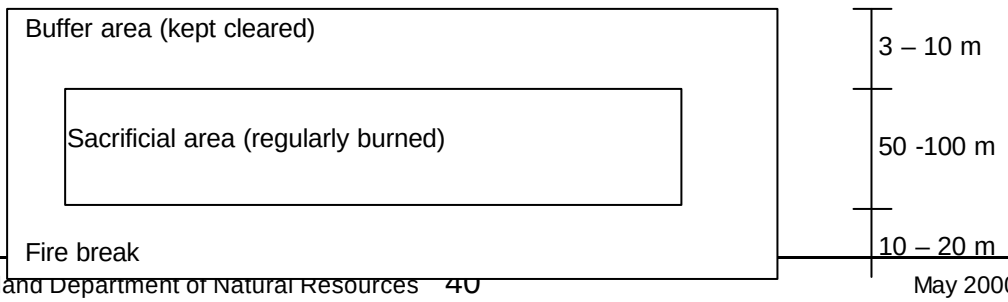


This "perfect" fire break is actually a combination of the standard strip fire break and the fuel reduction buffer. The expense of creating and maintaining "perfect" fire breaks make them uneconomic in large-scale works.



A.7.7 The fuel reduction buffer

Bushland protected area
(burned only for the overall conservation of native species)



Urban area

A fuel reduction buffer is technically superior to a narrower single strip fire break, but has practical disadvantages that limit its use:

a. It is much more expensive to create and to maintain.

b. If this strip adjoins residences, residents may continually complain about burn offs every 2 to 3 years.

c. Frequent burn offs may promote weed invasions.

d. Wide burnt-out sacrificial strips are unsightly and thus may be incompatible with the image that an area may wish to project (even though later rain will stimulate new growth).

Their major use is as an alternative to large-scale prescribed burning of bushland neighbouring private property.

A.7.8 Costs

A contractor can quote for the job as a whole. This has the advantage of certainty as to cost. It has the disadvantage (particularly when a full site inspection is impractical) of contractors padding the quotes to allow for uncertainty as to the magnitude of the work. The alternative is hire on an hourly basis.

***** Costs vary greatly but the following values are considered to be reasonable:

Fire break construction	$8000 / km (dense scrub, no earthwork)
Transport of equipment to site	$100
Chipper and labour	$115 / hour
Drott	$90 / hour
Front end loader	$80 / hour
Bobcat	$60 / hour
Slasher	$50 / hour

*** As at 1 September 1995**

A.7.9 Possible sources of labour to maintain fire breaks

Contractors

Slashing contractors are usually employed for this work.

Local residents

On urban fire breaks, encourage the neighbouring residents and (especially) businesses to maintain the fire break. It is, after all, in their best interests to do so.

Community Services workers

Consider using Community Services to obtain the services of citizens working off their Community Service obligations.

Corrective Services workers

Consider using the Work Program in Corrective Services. However, prison labour is best used in large one-off projects, such as creating a fire break.

Australian Trust for Conservation Volunteers

Consider using ATCV (Australian Trust for Conservation Volunteers). ATCV is a national non-profit agency, which seeks to assist landholders with practical conservation projects. However, ATCV is better suited to more sophisticated labour-intensive work, such as land rehabilitation.

Workers in Government employment schemes

DEET (the federal Department of Employment, Education and Training) operates several schemes to train the unemployed, such as:

a. LEAP (Landcare and Environment Action Program);
b. REEP (Regional Environmental Employment Projects);
c. JobSkills Schemes.

Internal staff of other agencies

Local government, EPA and DPI(FS) often use their day labour to create and maintain fire breaks. DNR may be able to hire these workers at mutually satisfactory rate.

PART B:DNR POLICY AND PRACTICE

B.1.0 PRESCRIBED BURNING AND SLASHING

B.1.1 Rationale

DNR has conflicting requirements in any prescribed burning regime. A burn cycle designed to satisfy hazard reduction criteria will violate ecosystem management criteria and vice-versa.

Prescribed burns on USL will be carried out having regard to the best use to which the land may be allocated. Where USL has known conservation values a burn cycle will be developed so as to minimise the affects on the environment.

Requirement 9:

Authorise prescribed burns on USL (when necessary) to reduce the threat of fire to nearby communities having regard to the best use the land may be allocated to and environmental concerns.

Avoid prescribed burning in areas, where:

a. fire is not a natural component of the ecosystem (e.g., rainforest);
b. irreversible ecological damage is inevitable (eg: small urban reserves, which do not have the diversity of species and range of habitats to allow them to withstand continual burning, nor sufficient unburnt areas to provide a base for recolonisation – the result is a decrease in the native shrub layer and an increase in weed species);
c. the return does not warrant the effort;
d. it is too hazardous.

Requirement 10:

Do not conduct prescribed burns for hazard reduction in:

a. rainforests;
b. small isolated areas of remnant bushland, such as urban reserves;
c. areas remote from human habitation and remote from areas of commercial value;
d. areas of low fire risk;
e. areas where life and property are adequately protected by fire breaks;
f. exposed areas affected by wind;
g. grass areas where drought has otherwise made fodder scarce.

B.1.2 Preferred conditions for a prescribed burn

Time of year

May, June, July and August.

Reasons:

a. The weather is cooler and the intensity of the fires consequently lower.
b. Interference with most breeding and flowering periods is less likely.
c. Burning in the simmer growth seasons will generate undesirable amounts of smoke – green fuel (not wet fuel) creates the most smoke.

If a prescribed burn has to be carried out in summer, do so immediately after rain has fallen (when the intensity of a fire will be temporarily reduced).

Time of day

The ideal situation is to end the need for monitoring the burn at nightfall (about 6pm, at the recommended time of year). The time to start is thus nightfall less the time needed to carry out the burn. A prescribed burn for a small area (such as around a single building) may thus start at 5 pm. A prescribed burn for a large areas (over hundreds of hectares) may start at 1 pm. A prescribed burn for a large mountainous area may start at 11 am at the highest elevation and burn slowly down slope.

Reasons:

a. A burn should not continue after nightfall, because:

   (i) a fire is more difficult and dangerous to control at night;
   (ii) in winter, the night dew on the ground may extinguish the fire – the temperature often drops significantly between 4:00pm and 8:00pm;
   (iii) in and near urban areas, night fires worry residents.

b. It is preferable to start as late as possible in the day, because:

   (i) air temperature drops as the fire progresses (this helps to control the fire and makes the exercise less energy-sapping for the fire crew);
   (ii) winds are more predictable and stable late in the day.

Fire danger rating

Less than 10 for forests.
Less than 20 for grasslands.

Reasons:

a. A higher fire danger significantly increases the risk of the prescribed burn becoming a high-intensity wildfire.

b. The fuel load of grassland is less than that of forests and control of a grass fire is thus easier than control of a forest fire.

Temperature

Mild (less than 25 degrees C).

Reason:

High temperatures significantly increase the risk of the prescribed burn becoming a high-intensity wildfire.

Relative humidity

Medium (40% to 60%).

Reasons:

a. High humidity may cause the fire to self-extinguish.

b. Low humidity increases the risk of the burn becoming uncontrolled.

Moisture content of ground litter

When the upper layers are dry and the lower layers are wet (the moisture content is about 17% to 26%).

Reasons:

a. A fire will often self-extinguish when both the upper layers and lower layers are wet;

b. It may become too dangerous to conduct a prescribed burn when both the upper layers and lower layers are dry – particularly if the burn is delayed until September or October.

Windspeed

10 kph to 15 kph.

Reasons:

a. If the wind speed is less than 10 kph:

(i) the direction of movement of the fire is less definite and more changeable;
(ii) there is a build-up of smoke;
(iii) the flames remain upright and cause leaves to drop off the trees and feed the fire.

b. If the wind speed is greater than 10 kph, the flames bow over and the canopy is not scorched.

c. If the wind speed is greater than 15 kph, the fore may become uncontrolled.

Wind direction

Away from built-up areas.

Reason:

The smoke generated by the fire drifts away from populated areas and so does not antagonise residents.

Requirement 11:

Preferably carry out prescribed burns:

a. in May, June, July or August;
b. as late in the day as possible without requiring monitoring after nightfall;
c. with a grassland fire danger rating of less than 20;
d. with a forest fire danger rating of less than 10;
e. with an air temperature of less than 25 degrees Celsius;
f. with a relative humidity between 40% and 60%;
g. where the lower layer of ground litter is moist and the upper level dry;
h. with a wind speed between 10 kph and 15 kph;
i. with a wind direction carrying smoke away from built-up areas.

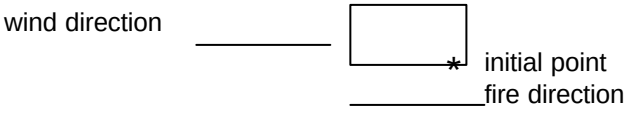
B.1.3 The structure of a prescribed burn

Burn direction when weather conditions are within the burn parameters

Against the prevailing breeze from the downwind edge of the block.

Start spot fires along:

a. the downwind boundary of the block, beginning at one corner;
b. the adjacent boundary, starting at the same corner.



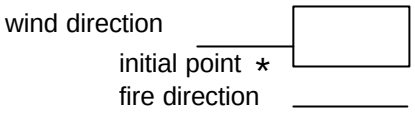
Reasons:

a. The fire advances slowly through the block against the prevailing breeze, allowing fauna to move away from the flames to neighbouring unburnt blocks.
b. If all edges of the block were ignited, animals would be trapped in the centre of the block and many would perish unnecessarily.

Burn direction when conditions are cold and wet and the breeze is light to moderate

With the prevailing breeze from the upwind edge of the block.

This procedure is particularly favoured, when the far boundary ends in a swamp.



Reasons:

a. The usual back burning method (against the prevailing breeze) may not work in cold wet conditions – the fires may quickly self-extinguish.
b. This alternative method allows the breeze to push the fires through the block.

Interval between burns for a vegetation block

Preferably, carry out detailed studies of the area to determine the optimal burn interval. Where prescribed burning is required but the relevant site-specific data does not exist, operate according to the following criteria:

a. On fuel reduction buffers where the USL poses a high fire danger to bordering private property, burn the buffers every 2 to 3 years;

b. On large vegetation blocks, burn to prevent the development of very high or extreme fire hazards, without degrading the environment (this usually means a burn cycle of 7 to 9 years and a minimum of 5 years between burns).

The 5-year interval may be used when abnormal weather has promoted the growth of fuel in vegetation types which accumulate fuel rapidly, even in normal conditions.

Prescribed burning of fuel reduction buffers bordering settlement addresses the hazard reduction concerns of QFS, while the standard burn interval satisfies the ecological management concerns of EPA and DPI(FS).

Block size

To reduce the risk of fire fronts forming, vary block sizes and limit the block size to a maximum areas of 500 ha. The average size of a vegetation block is larger for large areas of USL (and particularly in areas with a relatively low fuel load). Remote areas with few tracks may well not be burnt at all.

The size of actual blocks will vary according to existing boundaries, such as roads, tracks, or water courses. The size of an individual vegetation block must be:

a. large enough, so that an expensive, disfiguring and potentially damaging grid system of fire breaks is not required;
b. small enough to be manageable and allow fauna to escape the flames by retreating into nearby unburnt blocks.

Burn pattern

Create a mosaic of burnt blocks and blocks in various stages of recovery from fire. Adjacent blocks should not be burned in the same year.

Reasons:

a. It helps to prevent a wide fire front developing.

b. It helps to prevent widespread high-intensity fires (even if a block has enough fuel to sustain a high-intensity fire, the neighbouring blocks will not).

c. During prescribed burns, wildlife can flee to neighbouring unburnt blocks.

Example: An area of ecologically-valuable USL has a high steady-state fuel load.
Prevailing summer winds are from the USL to upslope bordering residences. This area is one of extreme fire danger.
A fuel reduction buffer is created and burnt every 3 years. Neighbouring vegetation blocks are burnt every 6 years.

Requirement 12:

Conduct prescribed burns:

a. against the prevailing breeze from one edge of the block;
b. to prevent the development of very high or extreme fire hazards, without degrading the environment (this usually means a burn cycle of 7 to 9 years and a minimum of 5 years between burns).
c. With a varying block size;
d. With a maximum block size of 500 ha;
e. In a mosaic of burnt blocks and blocks in various stages of recovery from fire.

B.1.4 Implementation procedure

a. Create and implement a well-considered education and information plan for the local community to minimise community antipathy to prescribed burns.
b. Seek the assistance of agencies who carry out fire management in the area (Rural Fire Brigades can often be hired at reasonable cost to perform the work as a training exercise).
c. Use existing tracks and fire breaks or construct new fire breaks to separate the bushland into vegetation blocks.
d. Give advanced warning to the local City/Shire Council, police and fire brigade.
e. Suitably inform immediate neighbours of the expected time of the burn and the reasons for it.
f. Erect "BURNING OFF" signs on nearby roads.
g. Protect infrastructure, such as fences, signs and structures.
h. At the conclusion of the burn, confirm that any burning or smouldering material will not start new fires beyond the bounds of the burned blocks.
i. Estimate the severity of the burn (Was the upper canopy badly scorched? What percentage of mature trees perished?).
j. Monitor regeneration of the bushland (How is the fuel load increasing? What species are predominating?).

Requirement 13:

In the execution of a prescribed burn:

a. Seek the assistance of agencies who carry out fire management in the area;
b. Use existing tracks and fire breaks or construct new fire breaks to separate the bushland into vegetation blocks;
c. Give advanced warning to the local city/shire could, police and fire brigade;
d. Suitably inform immediate neighbours of the expected time of the burn and the reasons for it;
e. Erect "BURNING OFF" signs on nearby roads;
f. Protect infrastructure, such as fences, signs and structures;
g. Make certain that no burning or smouldering material will start new fires beyond the bounds of the burned blocks;
h. Estimate the severity of the burn and other effects;
i. Monitor regeneration of the bushland.

B.1.5 Slashing

While slashing does not remove the fuel, it greatly reduces its access to oxygen. The lower layers of slashed material are mostly separated from the open air by the upper layers of slashed material. This sort of material also decomposes quickly. Fires in slashed material thus burn relatively slowly and at a low intensity.

Requirement 14:

Slash regrowth on fire breaks and small areas of mostly-cleared land, such as overgrown town allotments and any picnic/camping/rest areas on USL.

B.2.0 FIRE TRAILS, FIRE BREAKS AND FUEL REDUCTION BUFFERS

B.2.1 General strategy

a. Identify all locations requiring fire breaks, fire trails and fuel reduction buffers, describing their location, function and management responsibilities.

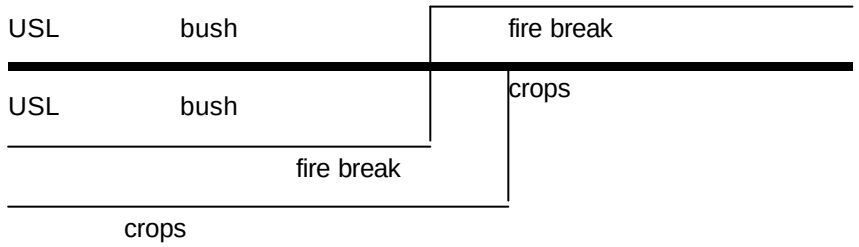
Example:

NO	LOCATION	LOCATED ON	AGENCY TO CREATE	AGENCY TO MAINTAIN	ROLE	STATUS
WO1	Township (north end)	Private property	DNR	Resident	Protect house	created

a. The fire break is the primary fire management tool – prescribed burns require fire breaks to limit the burns, but fire breaks often protect urban areas without any prescribed burn regime.

b. Create fire breaks or buffers on the boundary with built-up areas, crops or pasture, even if they are constructed on private land rather than USL, because:

(i) it is safer for fire fighters not to have bush on both sides;
(ii) property owners are reassured to see the clearing on their boundaries.



c. Integrate DNR fire breaks with other fire breaks constructed by other agencies to separate all built-up areas, crops and pasture from bordering bushland.

Requirement 15:

Consider the fire break as the essential primary tool of fire management.

Requirement 16:

Create fire breaks on the boundary with built-up areas, crops or pasture, even if this means constructing the break on private land rather than USL.

Requirement 17:

Integrate DNR fire breaks with fire breaks constructed by other agencies to separate all built-up areas, crops and pasture from bordering bushland.

B.2.2 Bush tracks and fire trails

a. Use existing bush tracks as:

(i) fire breaks, allowing a wildfire to be quarantined;
(ii) block boundaries for a prescribed burn mosaic;
(iii) access for fire fighters to control a wildfire.

b. Construct new fire trails if improved access is a necessity. Access may be required for fire management, noxious weed control. Tourism, etc.

c. Close bush tracks that serve no useful purpose and which are little used. Such tracks serve only to aid arsonists.

d. Grade fire trails as required – verges may also warrant slashing.

e. Do not allow a continuous low shrub canopy to form over a fire trail. The dense undergrowth and inadequate overhead clearance would make travel unnecessarily hazardous at times of high fire danger.

f. Maintain a width of at least 6 metres – preferably 8 metres – to allow a vehicles to pass around a stationary vehicle.

Requirement 18:

For fire trails:

a. Use (and where necessary upgrade) existing bush tracks;
b. Do not allow a continuous low vegetation canopy to form over a fire trail;
c. Maintain a width of at least 6 metres – preferably 8 metres.

B.2.3 Fire breaks

a. Construct a fire break by thinning the over storey vegetation, levelling the ground and regularly slashing the understorey to minimise environmental impacts.

b. Do not allow residents to use fire breaks to store goods, dump goods, house animals or to park vehicles.

c. Remove any planting by residents that:

(i) impedes access by fire fighting vehicles or slashers; or
(ii) significantly increases the fuel load on the fire break; or
(iii) threatens contamination of the bordering bushland.

d. Maintain a width of 20 metres where there is a high fire danger near residences or commercial / industrial buildings.

e. Maintain a width of 15 metres where there is a medium fire danger near residences or commercial / industrial buildings or crops or pasture.

f. Maintain a width of 10 metres:

(i) in bushland (eg: separating vegetation blocks);
(ii) where the fire break is a secondary defence behind a wider primary fire break (the fire threat is less on small isolated vegetation blocks);
(iii) next to a narrow road if the road provides insufficient width;
(iv) where there is a low fire danger near residences or commercial / industrial buildings or crops or pasture.

g. Slash each fire break by the end of August (ie: prior to the bushfire and growth season).

Requirement 19:

For fire breaks:

a. Set a width of 20 metres for high fire danger bordering residences or commercial / industrial buildings;
b. Set a width of 15 metres for medium fire danger bordering residences or commercial / industrial buildings or crops or pasture;

c. Set a width of 10 metres in bushland or when a road provides insufficient width, or for low fire danger bordering residences or commercial / industrial buildings or crops or pasture;
d. Slash each fire break by the end of August, each year;
e. Keep fire breaks clear of structures, vehicles, domestic goods, refuse and plantings that either impede access by fire fighting vehicles and slashers or significantly increase the fuel load.

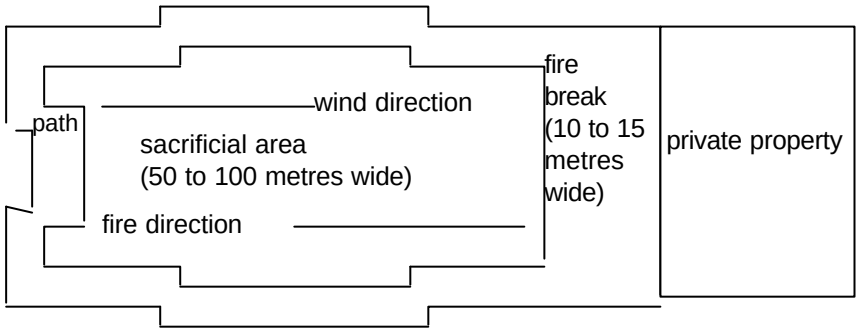
B.2.4 Fuel reduction buffers

a. Construct and maintain fuel reduction buffers, if the fire risk warrants a fuel reduction buffer (rather than a fire break).

b. For the sacrificial area:

   a. Set a 100 metre width when the fire danger is particularly high – high fuel loads in the bushland, a significant upslope from the bushland, high winds from the bushland a common occurrence in summer, buildings close to the boundary with USL.
   b. Set a narrower width when the fire danger is lower, when funding is restricted or the area has high conservation value.

c. For the boundary path, set a width of 3 to 6 metres (sufficient for machine maintenance) and curve the path sufficiently to avoid line-of-sight.



Requirement 20:

Fore fuel reduction buffers:

a. Construct in areas of high fire danger;
b. Set a width of 10 to 15 metres for the fire break, 50 to 100 metres for the sacrificial area and 3 to 6 metres for the curving bounding path;
c. Conduct prescribed burns of the sacrificial areas, every 2 to 3 years.

B.2.5 Vehicular access on fire breaks

Ideally, 2WD fire fighting vehicles should be able to traverse a DNR fire break but this is not always immediately possible. The cost of constructing road surfaces on DNR fire breaks would be prohibitive and many residents would oppose it.

Requirement 21:

Regarding vehicular access on fire breaks:

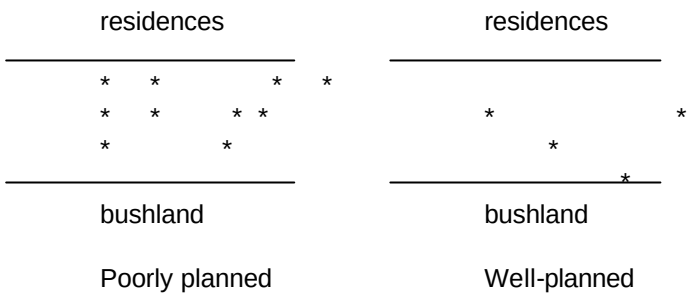
a. Do not construct road surfaces on fire breaks unless there is no alternative;
b. Add fill to fire breaks in boggy areas to improve vehicle access;
c. Encourage residents of sandy areas to maintain fire breaks outside their fencelines to firm the sand much more quickly.

B.2.6 Retaining trees on a fire break

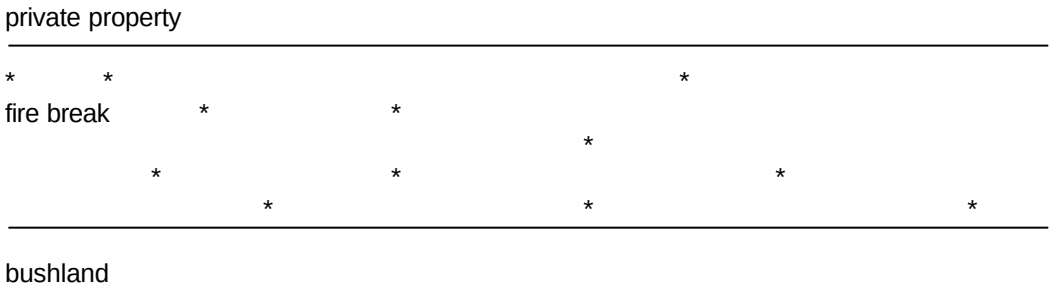
a. Retain mature, aesthetically-pleasing, healthy, structurally-sound, long-lived, local native trees.

b. Where possible, retain several different species for either aesthetic or biodiversity reasons. This may mean the retention of some saplings.

c. Space retained trees so as to allow easy manoeuvring of slashers.



d. Retain trees across the width of the fire break to eliminate line-of-sight along the fire break (except for a 5-metre boundary strip with private property).



Requirement 22:

a. Retain several species of mature, healthy, structurally-sound, long-lived, local native trees on fire breaks for either aesthetic or biodiversity reasons;
b. Space trees along the fire breaks to create a continuous park-like appearance;
c. Space trees across the fire breaks to reduce line-of-sight along the fire break.

B.2.7 Trees to be removed from a fire break

1. Dead trees.

2. Trees expected to die within 10 years (such as trees suffering dieback and short-lived species such as acacias).

3. Structurally unsound trees (such as those with hollowed, rotting or insect-riddled trunks).

4. Trees with an excessive lean (say greater than 15 degrees from the vertical).

5. Exotic species (such as rubber trees) and undesirable non-local natives (such as umbrella trees) to minimise their contaminating spread into surrounding native forest.

6. Leave a gap of at least 2.5 metres between trees and 5 metres between a tree and the boundary with private property, to allow the easy, movement of slashers (with a width of 1.8 to 2.1 metres) and fire fighting vehicles.

Trees within 5 metres of fencelines present problems as their branches often overhang property boundaries. This can result in continuing complaints from the affected residents and continuing expensive branch-lopping operations.

7. Some authorities regard banksias as unacceptable on a fire break as they may catch alight even when several hundred metres beyond a fire front. However, where banksias are the dominant species, some healthy specimens should be retained for aesthetic reasons.

8. A resident may request that a tree contravening these guidelines be preserved. However, residents change their minds as a tree close to the fenceline grows. The resident may leave and a new resident demand that the tree be removed at government expense. It is far cheaper to remove all trees that are to be removed as the fire break is created. It is strongly recommended trees clearly violating these guidelines be removed. (See B.2.8.5)

Requirement 23:

Remove the following classifications of tree from fire breaks:

a. dead trees;
b. trees expected to die within 10 years;
c. trees with hollowed, rotting or insect-riddled trunks;
d. trees with an excessive lean (say greater than 15 degrees from the vertical);
e. exotic species and undesirable non-local natives;
f. trees less than 2.5 metres away from other trees;
g. trees within 5 metres of the boundary of adjoining private property.

(NOTE: Government approved tree clearing guidelines must be observed at all times)

B.2.8 Creating a fire break

The following procedure is recommended but is not mandatory. It is designed to minimise the impact on the land, minimise loss of vegetative material, minimise smoke generation and allow the fire break to be created in one continuous operation.

1. When to create a fire break

   Ironically, the best time to create a fire break is immediately following a fire. The undergrowth has burned, eliminating the need for much of the manual labour. The extent of the work required is also easier to estimate with the greater visibility, but it is often difficult to know if a major tree has survived the fire when choosing the trees to be retained.

   The best time of year is winter when it is easier to acquire a Permit to Burn.

2. Survey the site of the fire break

   a. Note any problems – such as steeply sloping land.
   b. Mark the boundaries – usually with red survey ribbon.
   c. Mark all trees to be retained – usually with white survey ribbon, or with red or yellow spray paint.
   d. If the undergrowth is particularly dense, tree-marking can be partly delayed until the initial clearing work. The delay will allow easier sighting of the trees for tentative identification. It will also be easier to access the trees to mark them and to examine their bases for signs of structural weakness.

3. Engage the contractor

   a. Arrange site visits for contractors.
   b. Fully describe the work required (including the rationale for tree retention, especially for cases where such trees have not yet been specifically identified).
   c. Arrange for quotes.
   d. Engage a contractor to create the fire break – it is the contractor's responsibility to obtain all necessary Permits.

4. Communicate with property owners

Inform all residents and businesses affected of:

a. the intention to create a fire break;
b. the guiding principles of fire break creation;
c. the planned timetable for creating the fire break;
d. the construction procedure;
e. the objection procedure for retention or removal of trees;
f. a request that anyone whose health may be affected by the operation to contact DNR (An objection does not mean that the construction method must be changed, or the construction abandoned. However, the implementation plan may need to be modified. For example, burning stacks may be kept well away from the homes of asthmatics).

5. The objection procedure for the retention or removal of trees

a. Where possible, allow a resident or business operator directly opposite the tree of trees in question a reasonable time (say 5/7 days) to object. The objector may request that a tree marked for retention be removed, or a tree that would otherwise be removed be retained.
b. Inspect the site and inform the objector of the result of the request and the reason(s) for any refusal of the request.
c. A resident may later request the removal from the fire break of a tree. If the tree meets fire break guidelines, either reject the request, or approve it on the proviso that the objector pays for the tree's felling and removal. If the tree no longer meets fire break guidelines, arrange for the tree's felling and removal. ***(Officers are reminded of the obligation to apply natural justice and procedural fairness to all cases of this nature).***

6. Clear an initial path through the undergrowth, **IF** required

a. If the undergrowth is particularly dense, begin the clearing operation by pushing an initial path through the strip – perhaps with a drott.
b. Swing in and out across the strip to avoid creating a line-of-sight along the fire break.
c. Avoid the destruction of mature healthy trees where possible.

7. Chainsaw the undergrowth

a. Use chainsaws to clear the undergrowth and unmarked saplings and fell trees not marked for retention.
b. Cut saplings off about 30-40 cm from the ground. This allows equipment to gain purchase on the exposed stump to rip out the root system.

8. Chip green undergrowth, saplings and living trees, freshly felled

a. Feed green undergrowth, saplings and trees to the chipper.
b. Either spread the chip along the strip or pile it for later removal and sale. (It is best to spread the chip to inhibit weed infestation and regrowth along the fire break. However, if the cost of creating the fire break can be significantly reduced by the contractor collecting and selling the chip, this may be the preferred option however, the primary importance is to consider future weed infestation).

The use is a chipper:

a. greatly reduces the amount of material to be burned and so greatly reduces the amount of smoke produced;
b. further reduces the amount of smoke produced in the burning operation by consuming the green fuel.

Nearby residents benefit from the reduction in generated smoke.

9. Rip out the base and root systems of felled trees

Rip out the base and root systems of trees – perhaps by using a bobcat with a toothed scoop.

10. Stack and burn

a. Burn:

(i) dead timber (which can damage the chipper blades);
(ii) felled timber that is too large for the chipper;
(iii) tree bases contaminated by soil.

b. Create a minimum clearance of 6 metres between the edge of each stack and other vegetation or property boundaries.

c. Carry out the stacking and burning operation immediately as there is little or no green fuel in the stacks. This is another advantage of the chipper – without it, the contractor would have to return in 2 to 4 week's time for the stacking and burning.

d. Begin burning late enough so as not to disturb residents' sleep, but otherwise as early as possible to have the stack burning through most daylight hours. An 8am start is considered reasonable. Material can be moved from one stack to another to accelerate the burning process. Burning stacks should not be left unattended.

e. If, near nightfall, the stacks are still burning and there is a significant amount of unburnt fuel, consult a QFS fire officer. It is preferable to let the stacks burn out overnight. If overnight burning is approved, inform the affected residents and explain the situation. Alternatively, if the QFS officer refuses to agree to the overnight burning of stacks, dismantle the stacks and bury burning material.

f. Don not push cleared or felled vegetation beyond the bounds of the fire break. Such as build-up of combustible material along edge of the fire break produces visual ugliness and makes the back burning process more difficult and dangerous.

11. Cartage

Remove all non-combustible rubbish from the fire break to the nearest tip.

Cartage of vegetation is not economically feasible because of:

a. the effort required;
b. the number of loads needed; and
c. the council fees at the tip.

12. Smooth the fire break

Smooth the fire break with a levelling blade to simplify maintenance.

Requirement 24:

Preferably use a chipper when constructing fire breaks on the urban-rural interface to minimise smoke generation, return nutrients to the soil and discourage noxious weed growth.

B.3.0 CHOICE OF FIRE MANAGEMENT METHODS

Consider the following decision tree as a guide only. No general reasoning can apply to every situation.

1. IS THE USL RAINFOREST OR SWAMPLAND ?

   YES: If necessary, create/maintain fire breaks with neighbouring land. End
   NO: Go to 2.

2. HAS THE USL LITTLE GROUND COVER (EG: IS IT DESERT OR SEMI-DESERT) ?

   YES: If necessary, create/maintain fire breaks with neighbouring land. End.
   NO: Go to 3.

3. IS THE USL GRASSLAND WITH/WITHOUT SCATTERED TREES ?

   YES: Go to 4.
   NO: Go to 8.

4. IS THE GRASSLAND LESS THAN 2 HA IN SIZE ?

   YES: Slash annually. End.
   NO: Go to 5.

5. IS THE GRASSLAND:

   a. too small to be divided into prescribed burn segments; and
   b. not bordering similar areas providing a wildlife refuge?

   YES: Where necessary, create/maintain fire breaks with neighbouring land. End.
   NO: Go to 6.

6. IS THE GRASSLAND SO LARGE IN AREA THAT PRESCRIBED BURNING:

   a. poses too great a financial burden; or
   b. poses too great a risk of becoming uncontrolled?

   YES: Where necessary, create / maintain fire breaks with neighbouring land. End.
   NO: Go to 7.

7. ARE THERE CLEAR ECOLOGICAL REASONS TO CONDUCT PRESCRIBED BURNS ?

   YES: Conduct prescribed burns. End.
   NO: Where necessary, create/maintain fire breaks with neighbouring land. End.

8. IS THE USL BUSHLAND OR FOREST ?

   YES: Go to 9.
   NO: If it's none of the above, then what is it ? Where necessary, create/maintain fire breaks with neighbouring land. End.

9. IS THE USL REMNANT BUSHLAND ?

   YES: Go to 10.
   NO: Go to 11.

10. IS THE REMNANT BUSHLAND:

    a. too small to be divided into prescribed burn segments; and
    b. not bordering similar areas providing a wildlife refuge?

    YES: Where necessary, create/maintain fire breaks with neighbouring land. End.

NO: Where necessary, create/maintain fire breaks with neighbouring land. Conduct prescribed burns. End.

11. IS THE BUSHLAND MORE THAN 10 KN FROM THE NEARESY PRIVATE PROPERTY ?

YES: The USL does not present an immediate fire threat. There may be ecological considerations.
NO: Go to 12.

12. DOES THE BUSHLAND BORDER PRIVATE PROPERTY ?

YES: Lives, buildings, crops, pasture, etc. must be protected from the threat of fire. Create/maintain a fire break, if there is no present sufficiently-wide break (such as a road). Go to 13.
NO: Go to 15.

13. IS THERE A SIGNIFICANT RISK OF A WILDFIRE JUMPING A FIRE BREAK AND CREATING SIGNIFICANT DAMAGE (EG: USL WITH A HIGH STEADY-STATE FUEL LOAD AND SUMMER WINDS BLOWING FROM THE BUSHLAND TO RESIDENCES) ?

YES: Go to 14.
NO: Go to 15.

14. CAN A HAZARDOUS FUEL LOAD ACCUMULATE WELL BEFORE ECOLOGICAL CONSIDERATIONS WOULD ALLOW A PRESCRIBED BURN?

YES: A simple fire break may not provide sufficient protection. Create / maintain a fuel reduction buffer, or expand an existing fire break into a fuel reduction buffer. Go to 15.
NO: Go to 15.

15. ***Note: Any necessary fire breaks or fuel reduction buffers have been built. Only the question of prescribed bushland burning remains***.

DO TRACKS OR FEATURES EXIST TO CREATE VEGETATION VLOCKS FOR PRESCRIBED BURNING?

YES: Go to 16.
NO: The cost of creating block boundaries may be great. If constructed, the track boundaries may also:

a. be unsightly;
b. promote weed or fungal invasion;
c. create access for predatory birds;
d. increase the probability of wildfires by improving access for arsonists and careless humans.

It is probably best to do nothing. End

16. IS THE BUSHLAND SO LARGE IN AREA THAT PRESCRIBED BURNING:

a. poses too great a financial burden; or
b. poses too great a risk of becoming uncontrolled?

YES: End.
NO: Go to 17.

17. ARE THERE CLEAR ECOLOGICAL REASONS TO CONDUCT PRESCRIBED BURNS ? (eg: high-intensity fires may cause great damage to mature hardwood forests.)

YES: Conduct prescribed burns. End.
NO: The fire hazard to private property has been countered by appropriately located fire breaks or fuel reduction buffers. End.

Requirement 25:

When making decisions on the fire management measures to be adopted, consult the decision tree listed in this manual (the decision tree is a guide, not a mandatory procedure).

B.4.0 THE CONTENTS OF AN INTEGRATED FIRE MANAGEMENT PLAN

B.4.1 Aims, objectives and responsibilities

1. The participants in the fire management plan, their responsibilities and capabilities. This should include all agencies and individuals:

   a. responsible for large tracts of land in the area;
   b. with fire fighting responsibility and capability in the area.

2. The aims (goals) of the fire management plan.

3. The short-term objectives of the fire management plan (the planned implementation of these objectives is described in the fire management plan).

4. The long-term objectives of the fire management plan (objectives that have been identified, but no planning done on their implementation).

B.4.2 The area and its fire management needs

1. A textural description of the area covered by the plan.

2. A cadastral map, showing major built-up areas and roads and tracks significant in fire management.

3. A land tenure / land use map.

4. A map indicating the native title status.

5. A contour and drainage map (including surface water storage, such as dams and weirs).

6. A vegetation map.

7. The current species composition of flora and fauna, their distribution and fire tolerance. (Nature Search 2000, local government atlases and other agencies may provide data. If necessary, conduct a low-cost biological survey using local conservationists, or University volunteers trained in a particular survey method to supplement this information).

8. A map indicating the management zones – plantations, state forests, national parks, pastures/crops, built-up areas, urban/rural interface areas, etc.

9. The fire management objectives for each zone.

B.4.3 The behaviour of fire in the area

1. The effect of prevailing weather conditions in the different seasons (temperature, rainfall, humidity, wind speed and wind direction).

2. The effect of contours and drainage.

3. A map indicating the fire history of the area.

4. The effect of vegetation (including ground litter and flammable material on the trees), considering both the amount of fuel and its flammability.

5. Estimation of the fire hazard.

6. A fire hazard/risk/danger map, indicating fire-prone areas.

B.4.4 The problems to be addressed

1. The vulnerability of life and property, particularly on the urban-rural interface.

2. The environmental impacts of the fire management regimes considered.

3. A map showing the areas where special requirements need to be observed. The special requirements may be protection from fire, multi-stage burning, etc. The reasons may be:

   a. environmental (the conservation of endangered species);
   b. native title;
   c. cultural (such as the conservation of aboriginal scar trees).

4. The intended future use of land

5. (The fire management regime adopted for an area of USL to be developed as an industrial estate may well differ from the regime adopted for an area of USL to be transferred to National Park).

6. Legal responsibilities

   (Minimise risks to life and property on neighbouring land and the subsequent risk of legal liability, by minimising the potential of a fire escaping USL).

B.4.5 Prescribed burning

1. The strategies adopted

   (hazard reduction, habitat management, fire prevention, no prescribed burn, let-burn).

2. The rationale for the regimes adopted

   (The reasons for not conducting prescribed burns in some areas, the reasons for the values given to the prescribed burn parameters in other areas).

3. The areas to be burnt, the areas not to be burnt, the agencies responsible for them (as per the land tenure map).

4. A map of the mosaic of blocks, showing the vegetation type, location of fire breaks and the location of private property.

5. For each block list:

   a. the prescribed burning procedure (if any) that will be applied;
   b. the year it will be burned;
   c. the time interval between burns (this will depend on forest type, rate of fuel accumulation, an assessment of fire risks and an assessment of the environmental impacts).

6. Described any data-gathering exercises (such as field surveys) to be undertaken to improve knowledge for rational and informed decision-making.

7. Define the monitoring procedure for the post-burn recovery stage.

8. Define how success in achieving stated objectives will be measured.

B.4.6 Fire breaks, fire trails and fuel reduction buffers

1. The strategies adopted

   (such as segregate all residences, commercial property, crops and pastures from wildfires in bordering bushland).

2. The rationale for the regimes adopted

(The reasons for the locations of fire breaks, the reasons for the values given to the fire break parameters).

3. The agency responsible for the creation and/or maintenance of each fire break.

4. The physical parameters (width and appearance) of each fire break.

5. Maps of the locations of fire breaks.

6. Procedures for the creation and maintenance of fire breaks.

B.4.7 Slashing of allotments

1. Identify each allotment concerned, the agency responsible for its maintenance and the maintenance schedule.
2. Maps showing the location of the allotments.

B.4.8 Governmental regulation and control

1. The applicability of relevant legislation and by-laws/local laws to fire management.

2. Present and requested requirements of local government planning.

3. Present and requested requirements of developers in fire-prone areas.

4. Present and requested requirements of residents in fire-prone areas.

B.4.9 Community education, consultation and liaison

1. Engage the cooperation of the local media to educate and involved the local community in the aims and effects of the prescribed burning regime.

2. Invite public comment of the released draft and incorporate valid suggestions in the final version of the plan.

Requirement 26:

Create an integrated fire management plan in cooperation with the other agencies with responsibilities in fire management in the area and inviting comment from the local community. The plan will include:

a. aims, objectives and responsibilities;

b. a description of the area and its fire management needs;

c. the behaviour of previous fires in the area;

d. the problems to be addressed;

e. prescribed burning;

f. fire breaks, fire trails and fuel reduction buffers;

g. slashing of fire breaks and overgrown allotments;

h. governmental regulation and control;

i. community education, consultation and liaison.

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