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PLANNING FOR BETTER BUSH FIRE PROTECTION

MAY 1988

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CONTENTS

1.0 INTRODUCTION

Bush fires have historically been a part of the Australian environment. On 'blow up days' bush fires continue to exact a terrible toll in terms of life and property as evidenced on 16th February, 1983 (Ash Wednesday) in Victoria and South Australia when 76 lives were lost and 2,463 homes destroyed by fire.

The number of insurance claims ran to 5,300. The House of Representatives Standing Committee on Environment and Conservation report "Bush Fires and the Australian Environment" sets the total property loss at about $500 million.

Without adequate fire prevention and planning, fire damage on the scale experienced during Ash Wednesday could occur in South-Western Australia when severe fire weather conditions are experienced each year.

Bush fire protection in Western Australia is a function of Local Government which administers the day to day running of volunteer brigades and fire prevention works.

The Bush Fires Board provides essential advisory, liaison, training and co-ordinated support functions. The Board also has a responsibility to provide an overview of bush fire protection and the maintenance of the whole organisation to a level commensurate with the fire risk.

Higher density rural developments such as low density residential, rural residential and, hobby farms and special rural subdivisions are of particular concern because these have the potential to introduce new communities unfamiliar with the dangers posed by fire prone environments. At the same time rural fire suppression strategies developed for 'broad acre' farming may no longer be relevant to the protection of these communities. The introduction of such communities into rural and outer urban areas requires special care and the overriding policy is not to locate such development in areas with a very high hazard rating unless appropriate fire management provisions can be introduced to ensure the future safety of land users. In most instances fire management provisions will be available.

The Western Australian bush fire protection strategy relies heavily on fire prevention, recognising that the effect of bush fires can be significantly reduced, and at the same time maximising success in fire suppression, by careful planning and implementation of fire prevention measures even under adverse weather conditions.

In keeping with this philosophy, the Board seeks to reduce the impact of bush fires on rural development through encouragement of proper land use planning, selection of appropriate land for different land use categories, good subdivisional layout and building standards all designed to provide the least possible exposure to damage by fire.

This booklet explains fire protection planning and relates it to land use planning and the preparation of local rural strategies, concept plans, zoning and subdivision plans. It also seeks to assist all those involved in the rural planning process, including Local Government Authorities, their staff, planning consultants and developers.

This booklet should be read in conjunction with the State Planning Commission's Rural Land Use Planning Policy and Guidelines for the Preparation of a Local Rural Strategy or the Commission's Policy on Special Residential Zones.

2.0 ISSUES AFFECTING BUSH FIRE PROTECTION PLANS

There are two major aspects affecting bush fire management:-

- bush fire behaviour and the factors which determine this behaviour; and

- management problems associated with fire protection.

2.1 BUSH FIRE BEHAVIOUR

The way in which fires burn and their performance described is known as fire behaviour.

Fire behaviour is determined by the environment in which the fire is burning and obeys physical laws.

Fire behaviour is the reaction of a fire to the factors which make up the environment - fuel, the air mass or weather and topography.

Fuel factors, including the type of fuel, its moisture content, arrangement and quantity influence the intensity of bush fires, the speed with which they spread and their potential to throw spot fires ahead of the main fire front.

Weather factors, including the wind, air temperature and relative humidity, have an effect on the direction and speed of fire spread as well as the flammability of fuels.

Topographical effects include added rates of fire spread uphill and special gully wind effects on fires in hilly or rough terrain. In general, gully wind effects can lead to increased fire behaviour which may also be erratic and difficult to predict.

(Additional information on fire behaviour is contained in Bush Fires Board papers "Environmental Factors Affecting Fire Behaviour" and "Fire Behaviour Prediction").

2.2 FIRE PROTECTION PROBLEMS

The most common fire protection problems associated with rural subdivisions are as follows:

2.2.1 LOCATION

The most eagerly sought sites tend to be steep, rugged and heavily vegetated providing a maximum of aesthetic attraction and privacy. These locations are difficult to protect from bush fires due to problems with access for fire fighters and appliances, a lack of 'escape' routes

for residents, and steep slopes and heavy vegetation combine to create very intense fires which are very difficult to suppress.

2.2.2 SERVICES

The comparative remoteness from existing services frequently precludes a reticulated water supply and residents may have to rely on rain collection tanks and bores. Similarly, the standard of vehicular access seldom lends itself to fire safety requirements.

2.2.3 BLOCK SIZES

Larger residential blocks provide significant areas of undeveloped land within a subdivision where fires can develop to a considerable size and intensity. Residents find it difficult to maintain these large areas in a well managed 'low fuel' condition.

2.2.4 BUILDING DESIGN

Rustic and open plan building designs present a severe fire risk in these bush fire prone areas where every effort is required to build to proper fire resistant standards.

2.2.5 FIRE MANAGEMENT REQUIREMENTS OF ADJACENT LAND USES

The most difficult management problems usually arise because the fire management regime on adjacent land is not compatible with protection of more densely populated areas. Fire management for nature reserves or tree plantations, for instance, is not usually compatible with fire management for residential or semi-rural land uses and the location of higher density populations in such situations should be avoided unless fire management can be introduced to suit both land uses.

3.0 BUSH FIRE CONTROL ORGANISATION IN WESTERN AUSTRALIA AND PLANNING FOR BUSH FIRE PROTECTION

3.1 BUSH FIRE CONTROL ORGANISATION

Bush fire protection in rural, semi-rural and many townsite and suburban areas is provided by volunteer bush fire brigades which are administered by Local Government.

Support for brigades from the State Government is through the activities of the Bush Fires Board which provides advice, training, and co-ordination services to Local Government and volunteers.

Local Government is an integral and essential part of the Bush Fires Organisation and is responsible for:

- Routine administration of the provisions of the Bush Fires Act.
- Prosecution of offences.
- Publishing a Firebreak Notice and policing compliance with requirements of the notice.
- Attending to fire protection in its area of jurisdiction.
- The appointment of Bush Fire Control Officers and other officers connected with bush fire control.
- Varying the dates of restricted and prohibited burning times to suit the seasonal conditions.
- Issuing orders to provide for hazard reduction on private property.
- The decision to expend funds for the purchase and maintenance of fire protection equipment and for the prevention and control of bush fires.
- Providing insurance cover for fire fighters.

Intensification of development in rural areas can place added loads on Local Government to provide for proper bush fire control.

Extra services, which are not necessarily confined to bush fire matters, include advice to new residents, enforcement of Council Notices, By-laws and Regulations and the maintenance of Bush Fire Brigades.

3.2 BUSH FIRE PROTECTION PLANNING

In addition to the above responsibilities, the Bush Fire Board and Local Government are responsible for undertaking and/or monitoring bush fire protection planning associated with the land use planning process.

Bush fire planning includes two primary components:
a) The selection of suitable land for development.
b) The preparation of fire control policies and procedures.

Bush fire planning is undertaken at three stages:
a) District Fire Protection Plans.
b) Fire hazard assessment and selection of suitable areas for intensification and development.
c) Fire management plans.
These are discussed further below.

3.2.1 DISTRICT FIRE PROTECTION PLANS

District Fire Protection Plans are prepared by the Bush Fires Board for areas throughout the State which have similar fire protection problems. Most fire protection plans will involve a number of local government areas.

These are fire suppression and prevention plans for fire risk areas and set out policies and procedures regarding access, fire breaks, fuel reduction schemes, and mutual aid programmes between different local land management and fire authorities.

3.2.2 FIRE HAZARD ASSESSMENT AND MAPPING

Fire hazard assessment is a fire hazard rating system which has been developed to assess the potential fire danger of an area. Fire hazard assessment can be made over land in both its existing state and can account for the fire control procedures required for proposed developments. Fire hazard assessment is used to select areas suitable for more intensive development.

Sections 4.0 and 5.0 describe in full the fire hazard assessment and mapping procedures developed for Western Australian conditions.

3.2.3 FIRE MANAGEMENT PLANS

Fire management plans are prepared for specific areas in a local government area undergoing change and development. They will address issues such as access and strategic fire break systems, water supply, fuel reduction management and the maintenance of a fire fighting force. Such plans also form the "agreement" between different parties on allotted tasks.

Section 6.0 describes in full the issues covered by a fire management plan.

3.3 RELATIONSHIP OF FIRE PROTECTION PLANNING TO STATE PLANNING COMMISSION LAND USE PLANNING REQUIREMENTS

The State Planning Commission policies governing land use planning in rural and semi-rural areas require bush fire protection planning to be incorporated into the land use planning process.[1] The relationship between the bush fire planning procedure and the land use planning procedures is explained in Figure One below.

FIGURE ONE: The relationship between the bush fire planning procedure and the land use planning procedure.

LAND USE PLANNING	FIRE PROTECTION PLANNING
1. Local Rural Strategy	
1a Preliminary Assessment	A very general statement on fire protection planning including reference to existing Bush Fires Board District Fire Protection Plans. Definition of known areas which should be excluded from consideration or intensification on fire safety grounds.
1b Selection of areas suitable for intensification of development	Fire hazard assessment and selection of suitable policy areas. Development of broad fire management policies.
2. Concept and/or subdivision guide plans	Fire management plans specifying fire safety measures in detail and the means by which they will be implemented and maintained.
3. Zoning and Subdivision	Implementation of fire safety measures.

[1] Refer to: State Planning Commission
- Rural Land Use Planning Policy
- Guidelines for the Preparation of a Local Rural Strategy
- Policy P6 Special Residential Zones

4.0 FIRE HAZARD ASSESSMENT AND MAPPING

4.1 INTRODUCTION

A fire hazard mapping method has been adapted by the Bush Fires Board from a technique developed by the Town and Country Planning Board of Victoria in conjunction with the Country Fire Authority and has been modified and tested to suit Western Australian conditions.

It involves a system of rating the fire hazard risk and mapping areas with the same hazard rating. Areas of high, medium or low fire risk can thus be identified.

Areas of high fire hazard can be defined as those areas where fires are most likely to occur and where such fires could create a dangerous situation for both fire fighters and residents.

The identification of those 'danger' areas and the preparation of maps showing areas of high bush fire hazard is a particularly important exercise in municipalities which are undertaking rural planning for development, or are likely to be subject to pressure for more intensive rural development. Such maps can be used for the selection of policy areas suitable for more intensive development.

The hazard rating system can be used to determine the degree of hazard existing at the time of inspection and, by superimposing planned development such as buildings, roads, hazard reduction processes and water supplies, the degree of hazard following development can also be determined.

The methodology used for assessing the degree of fire hazard (in relation to establishing new development) involves the preparation of a medium scale map, a detailed report and area-specific recommendations on future land use.

This mapping method has been specifically developed to enable local fire brigade personnel and others with knowledge of the local fire hazard situation to comprehend and complete the exercise at one session. It relies on pooling and categorizing existing knowledge to establish relative fire hazard ratings. The results are used for broad fire prevention and planning purposes.

4.2 PREPARATION OF A FIRE HAZARD MAP

The preparation of a fire hazard map and accompanying report is usually undertaken by officers of the municipality in consultation with local Bush Fire Control

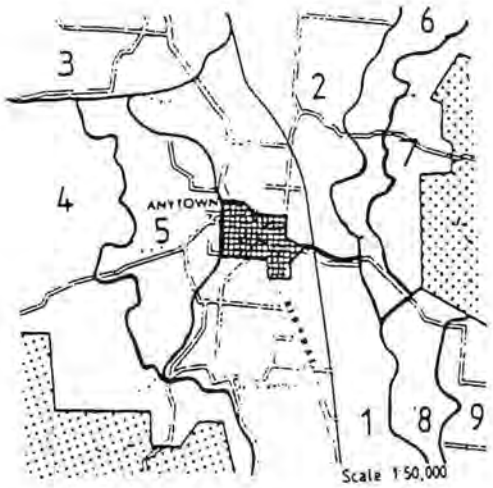
Officers, a Bush Fires Board Liaison Officer and, where forest land and reserves are involved, an officer of the Department of Conservation and Land Management. This group is chosen on the basis of knowledge of the fire history and bush fire conditions in particular areas of the municipality.

The map should first be drawn up during a `round-table' conference although some areas may need to be field-checked. A plan of the municipality to a scale of approximately 1:50,000 is suitable as a base map. It should show topographic information and the significant areas of public land.

The first task is to divide the municipality into broadly homogenous areas, for the purpose of fire hazard assessment. Examples of areas which could be considered as having relatively uniform characteristics from the fire hazard viewpoint include an irrigation district, river flood plain, steep hilly terrain, forested areas, coastal dunes, etc. These areas may be further refined as the assessment proceeds. As areas of public land are unlikely to be subject to development, it is not usually necessary to include these as areas to be rated, although their effect on the fire hazard rating in adjoining areas should be kept in mind when preparing the final recommendation and assessment.

FIGURE TWO: Fire Hazard Assessment

HOMOGENOUS AREAS SELECTED



MAP 1 Definition of Areas of Broadly Similar Fire Hazard

A separate fire hazard rating is then calculated for each broadly homogenous area identified.

4.3 THE FACTORS USED FOR ASSESSMENT OF FIRE HAZARD RATINGS

In considering the suitability of particular areas for development, the potential fire hazard rating may be assessed according to the following factors:

* Frequency of fire season
* Length of fire season
* Slope-steepness
* Vegetation - ground cover
* Vegetation - average annual driest state
* Fire history
* Density/type of development or land use
* Access to the area
* Fire fighting services and facilities

Each of these factors is explained in further detail.

Additional criteria may need to be incorporated in particular areas.

4.3.1 FREQUENCY OF FIRE SEASON

A fire season is a period when fire danger is generally high due to the condition of the vegetation on the land when any outbreaks of fire would be particularly difficult to control or suppress. The reasons governing the occurrence of a fire season in any particular area will vary. In the low rainfall areas of the State, for example the Goldfields, a fire season may occur in years of above average rainfall, as the resulting vegetation dries off in the summer and becomes a high fire hazard. In high rainfall areas of the South-West some vegetation becomes a fire hazard only after a severe drought, which may occur every 5 to 10 years. Irrigation areas may never have a bad fire season.

The frequency of a fire season can be measured in terms of the number of years in which such a season occurs, e.g. every year, once every five years, etc. The more frequently a fire season occurs the greater is the potential fire hazard exposure.

4.3.2 LENGTH OF FIRE SEASON

A fire season can vary greatly in length, and relates to the number of months that fuels are in a flammable state and able to support damaging bush fires. Forest and scrub fuels in the South-West for example may support a fire season of around 4 to 6 months, while grass areas on the South Coast may be in a flammable condition for only one to two months each year. The longer the average fire season, the greater is the potential fire hazard.

4.3.3 SLOPE - STEEPNESS

The speed of a fire changes dramatically as the steepness of the slope increases. Steep slopes represent fire control difficulties, as they frequently preclude adequate access for fire fighters. Fuel reduction and firebreak construction will be either expensive or else restricted by possible erosion problems.

4.3.4 VEGETATION COVER

Fire hazard depends on the quantity of fuel (vegetation) which is available for a fire. The fuel quantity and/or flammability is a major contributor to fire intensity. This factor provides for an estimate of how much ground cover normally exists during a fire season.

Fuel reduction techniques which can reduce the impact of this factor are well developed in Western Australia and widely practised. However, there are areas of high conservation value and areas prone to erosion which require management regimes, which may preclude fuel reduction or at least lengthen the periods between prescribed burns.

In general, residential development should be well separated from such areas by wide buffer zones.

4.3.5 VEGETATION - AVERAGE ANNUAL DRIEST STATE

The degree of fire hazard associated with vegetation will range from the high hazard of very dry forest and/or grassland, to the low hazard of completely green (usually irrigated) pastures. As part of the annual life cycle of grasses, they 'cure' or dry out. The relative risk associated with cleared and forested land in the one area may vary, depending on the extent of drying during a fire season.

4.3.6 FIRE HISTORY

The Fire History of an area relates principally to the number of fires which have started there, as well as those

which have passed through. Areas which are known to have been particularly prone to outbreaks of fire from either natural or man-made causes, need to be considered as having a higher degree of hazard than others. For example, it may be known that a particular section of the Darling Escarpment has a history of frequent fires, but the small portion to be occupied by the new development has not suffered fires for many years. The development area should nevertheless be awarded a high rating in accordance with the risk appropriate to the section in which it lies. This factor is difficult to rate empirically, but is usually based on a relative estimate for different areas. Increase in population inevitably increases the number of fires experienced.

4.3.7 DENSITY AND TYPE OF DEVELOPMENT OR LAND USE

The amount and type of development in an area can be evaluated in terms of its effect on potential fire hazard. This relates to the probability of fires being started by people, either living in an area or using recreational facilities there, as well as the problems of property damage and evacuation in the event of a fire.

In general the main problems often exist at the interface of residential and farm land with undeveloped bush or forest. Depending on the land use and degree to which the undeveloped land is managed, a high to very high hazard can exist. For example, State Forest areas subject to a regular fuel reduction programme maintain a maximum loading of 8 tonnes/hectare and represent a lower risk factor than areas with higher fuel loadings.

Property on the interface with areas carrying higher fuel loadings will be exposed to a potentially greater risk, due to the very high fire intensities which can arise from these heavy fuels.

Fires reaching a high intensity cannot be attacked directly by conventional fire appliances.

A high degree of hazard also applies to small communities in isolated areas. In addition, hobby farms, if poorly managed or under-stocked, are generally a greater hazard than commercial farms. Risks can be considerably reduced by proper fuel management and provision of strategic firebreaks and access for fire fighting.

4.3.8 ACCESS TO THE AREA

Access implies access for fire fighters and egress for residents.

The degree of fire hazard that can be associated with access ranges from very high in situations with steep, windy or dead end roads of single vehicle width, which may be unsuitable for conventional vehicles, to low in situations with two or more directions of egress on roads with sufficient width for passing, and suitable for conventional vehicles.

Development should avoid long 'battleaxe' access to blocks, cul-de-sacs and steep grades on access tracks, which could limit the effectiveness of the fire suppression effort.

Access and development must be assessed in relation to the existing situation when assessing for strategy planning. Proposed access and development are to be taken into account when assessing for subdivision.

4.3.9 FIRE FIGHTING SERVICES AND FACILITIES

The standard of fire fighting services and facilities is determined by four main factors:

* The distance and therefore the time of travel by the fire brigade

* The brigade's equipment

* The adequacy of fire access tracks

* The availability of water

4.4 DETERMINATION OF HAZARD RATINGS

The second task is to assess each of the homogenous areas identified against the factors outlined previously by using a fire hazard rating score sheet. (See Appendix 1)

The hazard rating categories under each factor should not be regarded as absolute, but should be used as a guide.

The factors and associated hazard ratings are as follows:

FACTOR	HAZARD RATING	HAZARD SCORE
1 Frequency of Fire Season		
Every year or two	VH	5
Two to ten years	M	3
Ten years +	VL	1

2 Length of Annual Fire Season

Five or more months	VH	5
Four months	H	4
Three months	M	3
Two months	VL	2
One month	VL	1

3 Slope Steepness

Very Steep >15^0 (>30%)	VH	10
Steep 11^0 - 15^0 (21% - 30%)	H	8
Moderate (rolling 7^0 - 10^0 (13% - 20%) hills)	M	6
Gentle (undulating/ 3^0 - 6^0 (4% - 12%) sloping)	L	5
Flat 0^0 - 2^0 (0% - 2%)	VL	4

4 Vegetation - Ground Cover

Forest	Karri (Jarrah) (etc.)		Grassland and Scrub/Heath		
Very Heavy>12	>24	TPH[2]	Tall and Dense	VH	5
Heavy 9-12	20-24	TPH	Medium Dense	H	4
Medium 6-8	15-19	TPH	Short Dense	H	3
Sparse 3-5	10-14	TPH	-	L	2
V. Sparse<3	<9	TPH	Sparse	VL	1

[2] TPH - Tonnes Per Hectare

5 Vegetation - Annual Driest State

(Forest)	(Grassland)		
Dry	100% cured	VH	5
Medium	partly cured 50%	M	3
Green	total green fuel	VL	1

6 Fire History

Very frequent outbreaks (several every year)	VH	5
Frequent (every 1 - 2 years)	H	4
Occasional (every 3 - 5 years)	M	3
Rarely (every 5 - 10 years)	L	2
None recorded	VL	1

7 Density and Type of Development or Land Use

High	Homes on interface with bush or heavy grass areas, one home per 0.1 to 1 ha	H	4
Moderate	One home per 2 - 10 ha or intensive recreation site	M	3
Low	One home per 10 -50 ha	L	2

8 Access to the Area

Very poor - One direction road 4 wheel drive	VH	5
Poor - one direction road 2 wheel drive	H	4
Fair - two direction road single width 2 wheel drive	M	3
Good	L	2
Excellent - two direction road double width 2 wheel drive	VL	1

9 Effectiveness of Fire Fighting Services

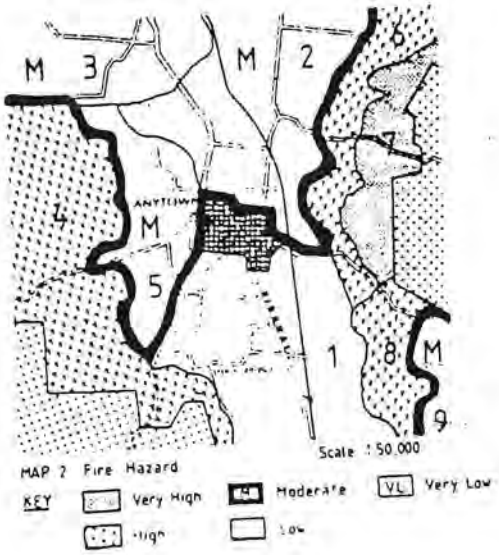
Ineffective, no close fire brigade, no fire access tracks, no water	VH	5
Effective fire brigade but some distance from the area	M	3
Effective well equipped fire brigade, in close proximity, good fire access tracks, water is available	VL	1

4.5 ALLOCATION OF HAZARD RATINGS

The third task is to allocate an overall fire hazard rating for each area. The table below is used to determine this rating from the Points Total, i.e., the sum of the hazard scores. The Fire Hazard Rating is then marked in the appropriate area on the map. (See Figure 3)

POINTS TOTAL	FIRE HAZARD RATING
43 - 50	Very High (VH)
35 - 42	High (H)
26 - 34	Moderate (M)
18 - 25	Low (L)
10 - 17	Very Low (VL)

FIGURE THREE: Completed Map Defining Fire Hazard Rating Areas



4.6 Preparation of a Report

The report accompanying the map should include a description of the method used, the areas identified, the fire hazard rating score sheet and a description of the results of the mapping.

5.0 SELECTION OF AREAS SUITABLE FOR INTENSIFICATION OF DEVELOPMENT

Once fire hazard maps and associated reports have been prepared, they can be used for the selection of land suitable for intensification of development.

Intensification of development in 'Very High' or 'High' hazard areas should be strongly discouraged. Where development is to be permitted, it should be conditional on the incorporation of adequate fire safety measures such as firebreaks, buffer zones, fire access tracks, water supplies and fire suppression arrangements.

Development which is likely to involve large numbers of people (e.g. school or other organisations, camps, etc.) should not be permitted in areas of 'Very High' or 'High' hazard. Special care should be taken if locating such development in areas of 'Moderate' hazard.

The most popular sites tend to be steep, rugged and heavily vegetated, providing a maximum of aesthetic attraction and privacy. These locations are difficult to protect from bush fires.

An answer to the problems of these areas often lies in good fire management, such as avoiding unfavourable terrain, providing fuel reduction programmes and good access for fire attack. However, if any of these measures are not possible for any reason, the suitability of the area for development must be questioned. In all cases, residential development must be avoided adjacent to land carrying heavy fuel loadings.

Attention must be paid to adjacent bush or grass areas which must be managed in a complimentary manner so that high intensity fires cannot sweep into residential areas from outside.

It must be remembered, that forests, parks and reserves should be managed primarily to protect the ecology and, although protection of life and property is awarded high priority, a prime consideration must be the protection of vegetation and fauna.

Management to protect ecological value involves maintenance of fire regimes which permit fuel accumulation to levels far in excess of minimum safety standards for residential areas. In addition roads and tracks may be kept to a minimum to restrict access, to avoid spread of plant disease and for economic reasons.

When subdivisions are created adjacent to such conservation areas, there is considerable pressure on land managers to conform to management standards compatible with residential fire safety and strategies have to be adjusted accordingly. The result may be a down-grading of the conservation value of park or reserve, or added management costs.

Conservation areas and plantations cannot be expected to be managed primarily for the protection of adjoining residential development and it may be inappropriate to locate urban or semi-rural development adjacent to areas with such incompatible management requirements.

6.0 THE FIRE MANAGEMENT PLAN

6.1 INTRODUCTION

Once decisions have been made on future land use in an area, fire management plans can be prepared. These plans will usually be prepared in conjunction with concept or subdivision guide plans required by the land use planning process.

Fire management plans introduce fire protection measure such as long term maintenance of access, strategic firebreak systems, water supply, fuel reduction management and maintenance of a fire fighting force.

In addition to identifying responsibility for funding and putting in place various fire protection measures, they deal with long term maintenance of the protective measures.

In circumstances where the protection of the area may depend on a number of agencies working together, the fire management plan will form the 'agreement' between all concerned on their agreed tasks.

The complexity or sophistication of management plans will depend on the degree of fire risk, the severity of the fire protection problem and the degree to which fire protection measures must continue to be provided in the medium to long term.

Plans should address the following topics:

* A brief description of the area.

* A definition of the fire risk and fire problems.

* Specific fire protection measures including:

  - access for fire vehicles and egress for residents;
  - strategic firebreaks and buffer zones;
  - fuel reduction on undeveloped areas within and adjacent to proposed development;
  - water supplies for fire control;
  - provision of fire brigade services;
  - maintenance responsibility for fire protection initiatives and services;
  - public education of residents;
  - local Government requirements for patrol, enforcement and advisory services.

The Bush Fires Board can assist with the preparation of fire management plans.

Plans should be a concise statement defining the fire protection problem, what is to be done to combat the problem, who is responsible for implementation and maintenance.

6.2 FIRE MANAGEMENT GUIDELINES

Fire management plans prepared in conjunction with subdivision guide plans or plans for areas undergoing intensification must include the specification of fire safety measures which must be addressed in detail during 'zoning' and 'subdivision' phases.

The following fire safety measures should be considered.

6.2.1 Proper Access for Fire Suppression Forces to be Established

Access must provide for both fire fighters and residents, particularly if evacuation has to take place.

Access for fire vehicles must be provided between the development and adjacent undeveloped or bush land areas as well as to buildings and improvements.

Egress and escape routes must be planned for residents, preferably separate from those used by fire vehicles.

Access must be of a standard to allow two way traffic flow of fire vehicles, or else have frequent 'passing' places.

Curves and gradients must allow the ready passage of laden fire tankers.

Access for vehicles must allow for safe movement and turning. Gateways should be at least three metres wide. Roadways should have a well-compacted surface with slopes no greater than 1 in 6 and surface water must be properly drained.

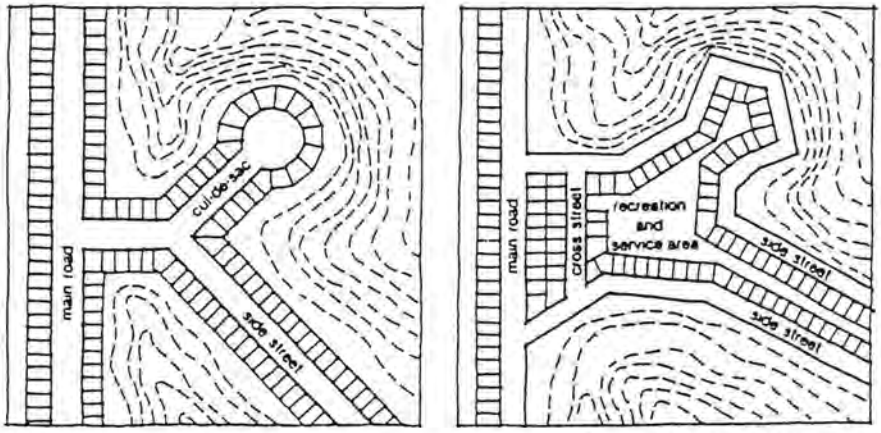
There should be properly constructed crossings over waterways. Turning areas must be wide enough for large vehicles to manoeuvre, ie. a minimum turning circle of 20 metres in diameter.

Narrow, winding, dead-end tracks through steep, rough country and thick vegetation are particularly dangerous as they can be easily blocked by fire or fallen trees.

In high hazard areas, it is safer to provide two clearly sign-posted routes in and out of the site.

Cul-de-sac development and long 'battle-axe' driveways are particularly hazardous in bush fire prone areas and should be avoided.

FIGURE FOUR: Access Problems



BAD Ribbon development along ridge roads with bushland up to the rear fences of housing lots makes it difficult to establish fire breaks and provides poor access to the bush for fire fighters

GOOD A ring-road system of subdivision can provide an outlook into the bush while the road provides a fire break as well as access for fire fighters

6.2.2 STRATEGIC FIREBREAKS AND LOW FUEL ZONES

The major factor determining the intensity of a bush fire is the quantity of fuel available to the fire. Reducing the fuel available will effectively reduce the intensity of a fire.

Reduction of ground fuels can prevent a fire 'crowning' and significantly reduce the occurrence of 'spotting', ie. embers thrown far ahead of the main fire. High intensity fires limit the ability of firefighters to take effective action and have a severe impact on buildings in the path of the fire.

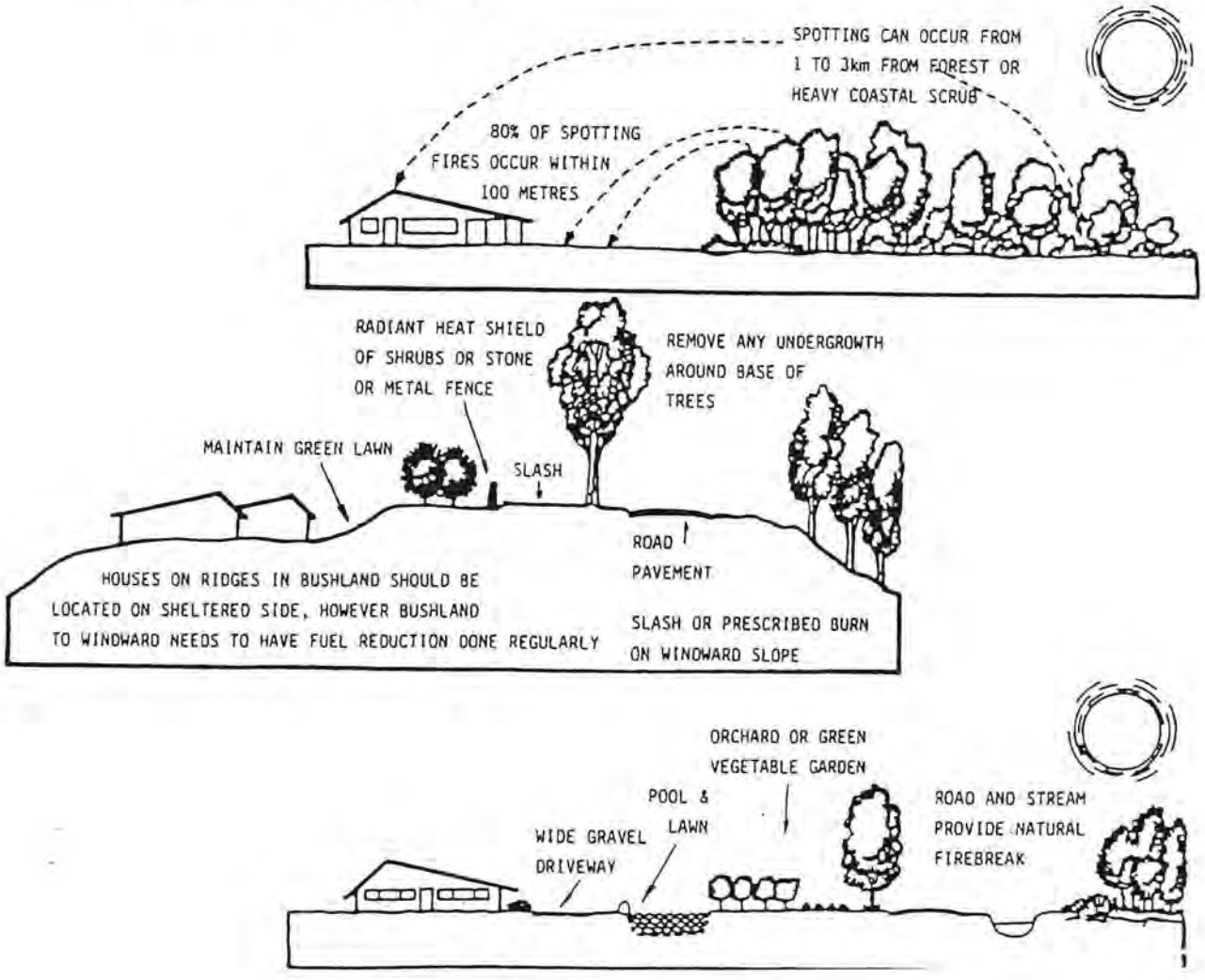
Heavy vegetation cover adjacent to development poses a serious threat to residents in a fire.

Areas with reduced loads, significantly aid fire suppression.

Strategic low fuel areas can be created by locating public open space, park areas, gardens, golf courses, ovals etc. where they will form a barrier against fire reaching residential areas. Irrigated parks areas form ideal barriers.

'Natural' low fuel areas within strategic systems should be linked so as to form continuous buffers.

FIGURE FIVE: Strategic Fire Breaks



6.2.3 WATER SUPPLY AND DISTRIBUTION

The availability of an adequate water supply during a fire is critical as it serves three main functions:

* For use by householders controlling spot fires in and around the house.

* For protecting houses from radiant heat and sparks, using garden and house sprinkler systems.

* Supplies for fire brigades involved in fighting the main fire.

The first is essential for every house; while the need for the second or third will vary, depending on individual situations.

In many situations, however, water supply on individual blocks is not adequate for any of the above purposes.

In a significant number of rural subdivisions for instance, a reticulated water service is not provided. Water supply by individual roof catchment or bore is usually restricted to domestic use and is not sufficient for bush fire protection by either the landowner or bush fire brigades.

Houses in areas which are provided with a reticulated water supply, may find that during a fire there is a severe loss of water pressure, while houses which obtain water supply from tanks or dams and rely on electric pumps to obtain water under pressure, may find that power fails.

In all cases, a supplementary supply of water under pressure needs to be available.

In areas which have a reticulated water supply, this central supply should be made available through fire hydrants, positioned at not less than 200m intervals.

In the absence of a scheme water supply with hydrants, consideration must be given to providing a tank system to supply fire units. An overhead filling device for tank supplies is favoured and should be independent of electrical pumps.

Other sources of water include swimming pools, both private and public.

Hard standing for fire vehicles is required at water filling points.

In areas supplied by mains water, a fire fighting reserve may be held in a tank through which the normal supply is fed, thereby ensuring it is always full. To obtain water under pressure either an elevated storage or a small (eg. 5hp) petrol or diesel pump needs to be provided. Areas which have reticulated supply should also have hydrants positioned at not less than 200m intervals above the main.

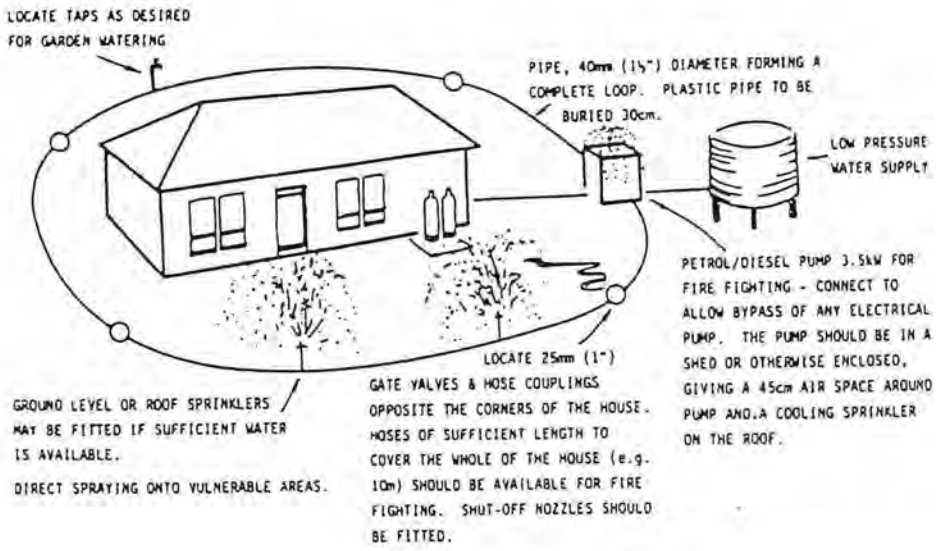
If tank stands are used, they should be protected by a radiant heat shield (eg. corrugated iron) and the area beneath them kept clear of flammable materials.

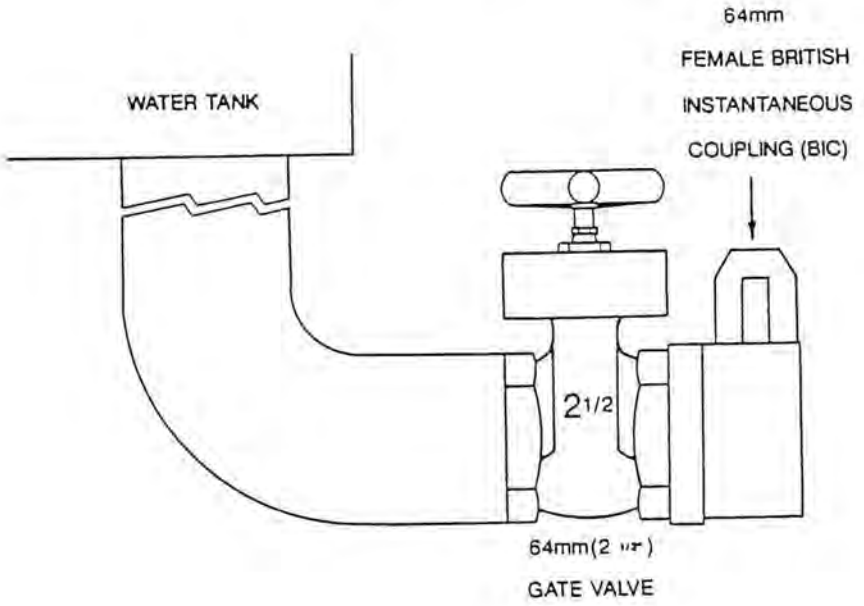
Water supply points should be located to enable a 20 minute turnaround time for light appliances.

Typically static water storage is 25,000 litres per tank with one tank per 50 homes.

6.2.4 WATER DISTRIBUTION FOR FIRE PROTECTION

FIGURE SIX: Water Distribution for Fire Protection





Tanks should be fitted with a 64mm Female British Instantaneous Coupling to enable brigade appliances to couple to them and should be fitted with a gate valve

6.2.5 BUILDING ENVELOPES

Building envelopes should be sited within a road or strategic fire fighting access system.

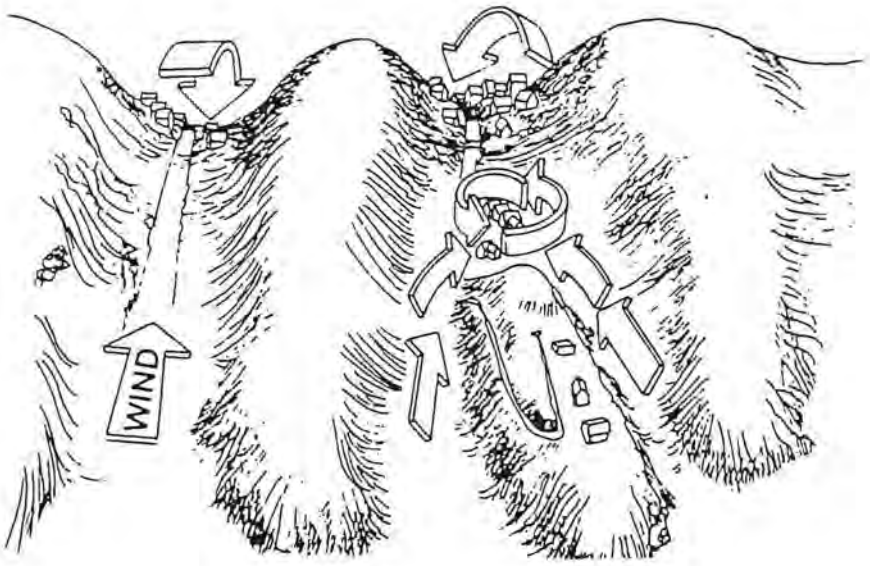
Council tree preservation orders must not preclude proper clearing for fire protection purposes.

Building envelopes should avoid steep, rugged or ridge top situations where fire behaviour is likely to peak.

6.2.6 AVOID STEEP SLOPES/RIDGE TOPS

Account must be taken that fires burn more quickly and with greater intensity up slopes than on the flat or downhill. Ridge tops and steep slopes are therefore the most dangerous sites on which to build. Gullies can substantially modify wind direction, creating turbulence, erratic fire behaviour and increased wind force.

FIGURE SEVEN: Wind Effects In Gully Situations



7.0 ZONING AND SUBDIVISION PLANS

Many of the measures identified in the fire management plan detailed above will be implemented through zoning and subdivision. Detailed fire safety specifications and standards will be incorporated into zoning provisions and subdivision design.

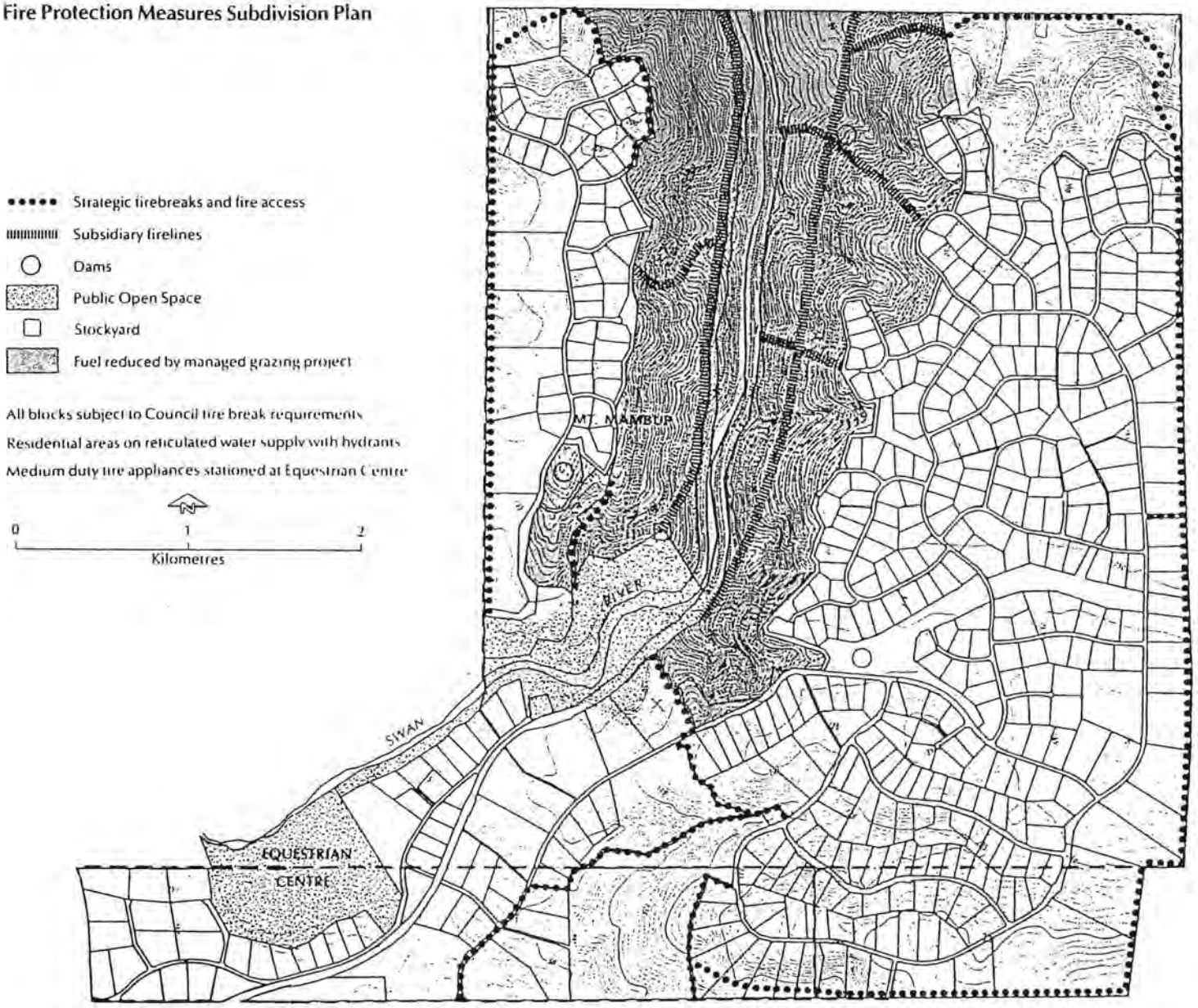
An example of a subdivision planned with due regard to bush fire protection lies north of Perth incorporating parts of the Avon River Valley.

Fire safety provisions include location of building blocks to avoid high fire risk situations, provision of strategic firebreaks and access roads, the avoidance of culs-de-sac and provision of water supplies for fire control. An agreement was also drawn up regarding the responsibility for reducing grass hazard on areas of public open space, the maintenance of all fire protection measures and the acquisition of a suitable fire fighting appliance.

Details of measures taken appear on the subdivision map shown in Figure Eight.

FIGURE EIGHT

Fire Protection Measures Subdivision Plan



APPENDIX 1

SHIRE OF.....AREA.....OFFICER.....DATE.....

FACTOR	HAZARD RATING	HAZARD SCORE	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6	AREA 7
1 Frequency of Fire Season									
Every year or two	VH	5							
Two to ten years	M	3							
Ten years +	VL	1							
2 Length of Fire Season									
Five or more months	VH	5							
Four months	H	4							
Three months	M	3							
Two months	VL	2							
One month	VL	1							
3 Slope Steepness									
Very Steep 15° (30%)	VH	10							
Steep 10° - 15° (20% - 30%)	H	8							
Moderate (rolling hills) 6° - 10° (12% - 20%)	M	6							
Gentle (undulating/ sloping) 2° - 6° (4% - 12%)	L	5							
Flat 0 - 2° (0% - 2%)	VL	4							
4 Vegetation - Ground Cover									
Forest (Jarrah) (etc.) / Karri / Grassland and Scrub/Heath									
Very Heavy >12 TPH >24 TPH Tall and Dense	VH	5							
Heavy 9-12 TPH 20-24 TPH Medium Dense	H	4							
Medium 6- 8 TPH 15-19 TPH Short Dense	M	3							
Sparse 3- 5 TPH 10-14 TPH -	L	2							
V. Sparse <3 TPH <9 Sparse	VL	1							
5 Vegetation Annual Driest State									
(Forest) / (Grassland)									
Dry 100% cured	VH	5							
Medium partly cured 50%	M	3							
Wet total green fuel	VL	1							
6 Fire History									
Very frequent outbreaks (several every year)	VH	5							
Frequent (every 1 - 2 years)	H	4							
Occasional (every 3 - 5 years)	M	3							
Rarely (every 5 - 10 years)	L	2							
None record	VL	1							
7 Density and Type of Development or Land Use (Existing or Proposed - see definition page 6)									
High Homes on interface with bush or heavy grass areas one home per 0.1 to 1 ha.	H	4							
Moderate One home per 2 - 10 ha or intensive recreation site.	M	3							
Low One home per 10 - 50 ha	L	2							
8 Access to the Area (Existing or Proposed - see definition page 6)									
Very poor - One direction road 4 wheel drive	VH	5							
Poor - one direction road 2 wheel drive	H	4							
Fair - two direction road single width 2 wheel drive	M	3							
Good	L	2							
Excellent - two direction road double width 2 wheel drive	VL	1							
9 Effectiveness of Fire Fighting Services									
Ineffective, no close fire brigade, no fire access tracks, no water.	VH	5							
Effective well equipped fire brigade, good fire access tracks, water is available.	VL	1							
POINTS TOTAL									
FIRE HAZARD RATING									

POINTS TOTAL	FIRE HAZARD RATING
43 - 50	Very High
35 - 42	High
26 - 34	Moderate
18 - 25	Low
10 - 17	Very Low